

Karen Barad Nuclear Hauntings &
Memory Fields, For the
Time-Being(s)

(Keynote for Nuclear Ghosts Workshop, CAPAS,
Heidelberg, Germany, 26 July 2023)

It's early July 2023. I am sitting at my desk reading today's news. I reside on the unceded traditional territory of Huichin, the ancestral homeland of Chochenyo-speaking Lisjan Ohlone people. Lisjan Ohlone Tribal Chair Corrine Gould, has co-founded and co-directs the Sogorea Te' Land Trust—an urban, women-led organization that engages in practices of rematriation, cultural revitalization, and land restoration. Sogorea Te' calls on native and non-native peoples to heal and transform the legacies of colonization, genocide, and patriarchy. The Trust, in partnership with Planting Justice, has been caring for all inhabitants in need in the East Bay by providing food during the pandemic, engaging in a practice for the flourishing of all beings.¹

Within a few miles is the Berkeley campus of the University of California, which oversees the nearby Lawrence Livermore National Laboratory which together with Los Alamos National Laboratory (in New Mexico) has been the United States government's primary institution for nuclear weapons research and development. It is July 5th, not a particularly exceptional day, news-wise; it is simply the day I am making some notes with this talk in mind. Despite the fact that, for the most part, the news has given scarce attention to nuclear issues since the end of the Cold War, nuclear matters have a way of refusing containment and nonetheless leak into things. Indeed, *far from being locatable in space and time, nuclear matters attest to the undoing of spacetime localization and the givenness of such coordinates.*

Today is a week and a half before the anniversary of the first atomic bomb detonation—Trinity Test, which took place on July 16, 1945 at

¹ I begin by situating myself in spacetime only to problematize the possibility of locating oneself or even an event in space and time. What is at issue, rather, is the dynamism of spacetimemattering in its iterative intra-active reconfiguring/re-membering.

5:29 am in Jornada del Muerto desert within the state the colonizers call 'New Mexico'. I'm sipping my morning coffee and looking at the day's headlines on the NPR website (among several I read), and two of the top stories for the day are news items about nuclear issues. One headline—"Ukraine's Zelenskyy warns of possible Russian sabotage at nuclear plant" (Myre 2023)—speaks to a critical point anti-nuclear activists and others have made for decades: it is impossible to draw a line in the sand separating issues of nuclear power from that of nuclear weapons, giving lie to the alleged division between nuclear power and nuclear powers. The possibility of using the Ukrainian Zaporizhzhia Nuclear Power Plant, the largest in Europe, dwarfing Chernobyl, as a weapon has been an active threat, a ticking timebomb, for more than a year now, in the aftermath of Russia's opening move in the invasion of Ukraine—a notable strategic move: to capture the nuclear power plant.²

The other story, "The U.N.'s nuclear watchdog says Japan can release nuclear waste water into the ocean," (Westerman 2023), tells of a plan to pour more than a million tons of radioactive waste water, left over from the Fukushima Power Plant disaster of March 11, 2011, into the Pacific Ocean, with the blessings of the International Atomic Energy Agency which promises oversight of the release over the next 30–40 years. Approval was granted despite the fact that the "plan has drawn significant criticism from the scientific community." Critics also cite the fact that this is a "transboundary issue" that will not only affect Japan. Reading this, I am pleasantly surprised that the article mentions the nearly 70 atomic bombs the US exploded in the Marshall Islands from 1946–58, which turned the small nation state into an open-air and water laboratory, and it actually goes on to make the direct connection: "many across the Pacific say the waste water release plan is a continuation of the Pacific's traumatizing relationship with nuclear technology and harkens to a past when larger powers used their islands—and their people—as collateral damage to further their nuclear ambitions" (Westerman 2023). Nuclearity blows up Newtonian conceptions of space and time. Nuclearity is inherently a haunted matter, where time is out of joint.

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If I am getting ready to speak at length about ghosts, inheritance, and generations, generations of ghosts, which is to say about certain *others* who are not present, nor presently living, either to us, in us, or outside us, it is in the name of *justice*. Of justice where it is not yet, not

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² Both articles are published on [NPR.org](https://www.npr.org) website. NPR stands for National Public Radio.

yet *there* ... It is necessary to speak of *the* ghost, indeed to the ghost and *with* it. ... No justice seems possible or thinkable without the principle of some *responsibility*, beyond all living present ... Without this *non-contemporaneity with itself of the living present*, ... without this responsibility and this respect for justice concerning those who are *not there*, of those who are no longer or who are not yet *present and living*, what sense would it be to ask the question ‘where?’ ‘where tomorrow?’ ‘whither?’—Derrida (1994, xix).

A pine tree is time, ... and bamboo is time. Mountains are time. Oceans are time. ... If time is annihilated, mountains and oceans are annihilated ... Time itself is being ... and all being is time ... In essence, everything in the entire universe is intimately linked with each other as moments in time, continuous and separate.—Ruth Ozeki (2013,30, reordered).

For Derrida, hauntings are matters of injustices and untimeliness, matters of time out of joint.

Time presses down upon us these days. Its face pressed against ours. Apocalyptic narratives proliferate and weigh on us. If one apocalypse or another, or a conjunction of multiple ones, doesn’t get us, at least not yet, there is nonetheless a sense of impending doom, of a future already squandered. But the very notion of apocalypse, which is always coming, in every epoch it seems, is premised on a future-facing linear construction of time, that serves the workings of racialized capitalism, imperialism, and colonialism, denying past apocalypses and how they live on. There’s a deadly sense of forward-facing directionality and inevitably built-in—an end time—a time that kills time.

And all the while, in these times, there is the constant background hum of ‘uncertain times’ as if time is already set, as in a great clockwork, an invention some deity set in motion at time $t=0$ and watches as history is revealed, bit by bit. It will all unfold, given enough time. It’s just that, at least for now, we don’t yet know what will happen: the future is out in front and uncertain, that is, unknowable, for now. But that in itself is a trap. The future isn’t given, out there, awaiting our arrival. The future—THE future ... wait! This notion of ‘the future’ is in itself already problematic in that it assumes futurity is one ... so I will interrupt this sentence rather than running with it to its presumed inevitable conclusion. What if futurity is understood not as a matter of uncertainty, but rather of indeterminacy? The notion of uncertainty sits happily with the idea of clock-time. Whereas indeterminacy opens up possibilities unthinkable within the structures of clock-time. The political difference is enormously consequential.³

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³ For an in-depth discussion of the differences between epistemological uncertainty and ontological indeterminacy see Karen Barad. 2007. *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning*, Durham: Duke University Press.

Futures are not inevitable, neither are they all out in front. It's important to get the uncertainty trope—this repetitive drumbeat—out of our heads, out of our bodies, and the ways we comport them and think about what they can and can't do, to interrupt this imaginary that, among other things, mutes the polyrhythmic silent cacophony of nothingness, the infinite material possibilities, including re-turning to a past that may yet have been, an infinity of infinity of material wanderings/wonderings that live inside *this very Now*—this Thick-Now—that dances like ripples on an ocean of yearning. That is, the uncertainty drumbeat mutes the play of the virtual which is not only inseparable from materiality but contributes to its very constitution. For time is not the continuous flow of moments that pushes forward without any worldly concerns; rather, time in its materiality is integral to the dynamism of spacetime-mattering, a dynamic field of material possibilities.

To allow for the dynamism of time in its materiality is crucial. This may include the fact that the future is not out in front, and the past, far from being left behind, is alive in the Thick Now of the present moment, and that time doesn't move along in a line, as a succession of moments, but rather entails an infinity of possibilities such as asynchronicity, indeterminacy, superpositions, and entanglements—all manner of interruptions of the ordering of past, present, and future in their presumed presences and sequentiality. Crucially, temporality is not limited to specific matters of the human experience of time. The point here is not merely to call out another instance of human exceptionalism.⁴ But, additionally, to bring to the fore a further assumption that usually goes unacknowledged: that 'humans' (in their differential constitution) are thereby understood to be of a fundamentally different ontological order than time, albeit subject to it. As if 'the human', as its own kind of independent presence, simply shows up on a stage called 'history' or 'the social' at some moment in time. And as if experience is to be understood as a perceptual lens that filters and reorders what *actually* unfolds in time. The point is that this ontological splitting positions the human as its own thing independently of the landtimescape (or so-called 'environment') within which it appears, as if that which matters—the human—is the other to its situatedness along with the notion that there is a reality "out there" that exists independently of human beings who take up positions at given coordinates in space and time.

But what if time—spacetime-mattering—has another face, another history, another sense of being? What if time-being is understood—that is, touched into—as a matter of touching, of being in touch, being touched by everything and nothing?⁵ In this sense of mattering, not even

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4 Importantly, 'humans', in all their power-inflected political socialities are deemed exceptional in ways that undergird hierarchies of race, ableism, colonialism, hetero-cis-normativity, and other forms of violence predicated on calculations of lives that matter.

5 I propose a notion of time-being through my work on an agential realist interpretation of quantum field theory independently of Ruth Ozeki, whose notion shares some deep resonances with my own, and which I deeply admire. For example, see Karen Barad. 2017b. "Troubling Time/s and Ecologies of Nothingness: Re-turning, Re-membering, and Facing the Incalculable." *New Formations: A Journal of Culture/Theory/Politics* (92): 56–86.

the great divide—perhaps the ultimate divide—deeper even than the seemingly unbridgeable divides between life and nonlife, organic and inorganic, animate and inanimate—the very divide that undergirds all the other divides—that between existence and nonexistence—can be taken as given? If the nature of existence/nonexistence is not a binary but rather an indeterminacy cut together-apart that undermines ontology in favor of a hauntology, thereby calling into question the belief that there exists some ontological division(s) that can justifiably be assumed from the outset. Which far from being the same thing as a flat ontology, resists any such notion, and instead entails a hauntology that is a dynamism of differentiating-entangling.⁶

In my agential realist reading of quantum field theory, time-being/becoming is an activity of the world in its materiality. Beings do not inhabit or take a place, but rather are of the landtimescape—the spacetime-mattering of the world in its sedimenting enfoldings of iterative intra-activity. Time-beings are excitations of the field of spacetimemattering, and are inseparable from nothingness, from all possible yearnings, imaginings, desirings to be-come.

And relatedly, “memory does not reside in the folds of individual brains; rather, memory is the enfoldings of space-time-matter[ing] written into the universe, or better, the enfolded articulations of the universe in its mattering. Memory is not a record of a fixed past that can be ... erased, written over, or [simply] recovered ... And re-mem-bering is not a replay of a string of moments, but an enlivening and reconfiguring of past and future that is larger than any individual” (Barad 2007, ix). That is, memory is not merely a subjective capacity of the human mind; rather, ‘human’ and ‘mind’ are part of the spacetimemattering of the world. Memory is written into the worlding of the world in all its specificities. Or rather, memory is constituted in and through the world’s iterative re-configurings/ re-mem-berings ... The world ‘holds’ the memory of all configurings and iterative reconfigurings; or rather, the world *is* its memory/re-mem-berings.⁷

This agential realist tale of time-beings and memory is a hauntological matter. Importantly, agential realism is not reducible to quantum physics. It is not even premised on quantum physics (a statement that assumes a given ground that I question). But rather, as part of agential realism I offer an agential realist relational ontology interpretation of quantum physics. This is not an innocent interpretation, but it is a legitimate contender among competing interpretations of quantum physics, where ‘legitimacy’ is traditionally conferred by physicists studying the foundations of quantum mechanics. And that’s important—because it means that it is possible to engage in a practice of doing physics differently. In particular, by

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⁶ Derrida’s notion of spectrality is helpful here. “If it—learning to live—remains to be done, it can happen only between life and death. Neither in life nor in death *alone*. What happens between two, and between all the “two’s” one likes, such as between life and death, can only *maintain itself* with some ghosts, can only *talk with or about* some ghost [*s’entretenir de quelque fantôme*]. So it would be necessary to learn spirits. Even and especially if this, the spectral, is *not*. Even and especially if this, which is neither substance, nor essence, nor existence, *is never present as such*. ... to learn to live *with* ghosts ... To live otherwise, and better. No, not better, but more justly. But *with them*. No *being-with* the other, no *socius* without this with that makes *being-with* in general more enigmatic than ever for us. And this being-with specters would also be, not only but also, a *politics* of memory, of inheritance, and of generations.” (Derrida 1994, xviii–xix). For me, this speaks to the question of ontological indeterminacy in its hauntological sense(ability).

⁷ See also Karen Barad. 2010. “Quantum Entanglements and Hauntological Relations of Inheritance: Dis/continuities, SpaceTime Enfoldings, and Justice-to-Come.” *Derrida Today* 3 (2): 240–268.

incorporating and understanding insights derived from theories of justice as integral to the practice of science.

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Matter fell from grace during the twentieth century. What was once labeled ‘inanimate’ became mortal. Very soon after that, it was murdered, exploded at its core, torn to shreds, blown to smithereens. The smallest of smallest bits, the heart of the atom, was broken apart with a violence that made the earth and the heavens quake. In an instant, in a flash of light brighter than a thousand suns, the distance between heaven and earth was obliterated—not merely imaginatively crossed out by Newton’s natural philosophy but physically crossed by a mushroom cloud reaching into the stratosphere.

In order to sense into how agential realism refigures time in terms of *spacetimemattering*, it is important to touch upon how making sense is a matter of touching, sensing, being in touch. Touching is always already about re-turning, re-membling, coming back around again, anew.⁸ For if in telling time—or rather, spacetimemattering becoming a telling of “us”—we take a moment to examine how so many disciplinary and interdisciplinary fields are always already thinking with core concepts in physics, such as space, time, matter, causality, and more, the analysis must entail not simply trading Newtonian ideas for the cool stuff of quantum physics, but also crucially, the tracing of entanglements of the very violences that physics helps produce, as part of bringing forward alternative imaginaries in their materiality. In other words, it is crucial to re-member, to take stock, to re-turn—to turn over and over again the remains of history that get encrusted and unloosen the ghosts that were assumed to be laid to rest and long forgotten. Spacetimemattering is a field of re-memblings.

Nuclearity blows up Newtonian conceptions of time as given, as sequential, as moving forward independently of all happenings. Nuclear bombings are not events in time. They occupy time, colonize it, do violence to it. Nuclear bomb blasts are not a set of independent events situated in space and time. Nuclear time-beings are specific configurings of the field of spacetimemattering: a memory field where ghostliness haunts time itself.

Nuclear time-beings are always already ghostly. Untimeliness is their brand, their very nature. Deep time, both deep histories and deep futures, intergenerational mutations, out-of-time(li)ness itself leeching into bones, ground water, atmospheric particulates of split-seconds raining down, frozen bits of time hardened into glassy residue, shattering histories

⁸ For a more detailed discussion of my agential realist conception of touching see Karen Barad. 2012. “On Touching – The Inhuman That Therefore I Am.” *differences: A Journal of Feminist Cultural Studies*, Special Issue “Feminist Theory Out of Science” 23 (3): 206–223.

and futures measured out as after-lives, half-lives: half of a half of a half ... counting radioactive bits without end.

The very existence of nuclear decay undermines eventfulness, writing a temporality of indefinite ongoingness into the core of radioactive material existence. Nuclear decay is not a singular happening. It pervades time. For example, Pu-242's decay time is 376,000 years meaning that in 376,000 years half of the Pu-242 sample will have decayed, in another 376,000 years, a half of a half will have decayed, and so on. Radioactivity counted out across innumerable generations, left ticking eons beyond time.

Nuclear time-beings are matters of quantum physics. Physicists began working on quantum field theory (QFT) starting in the late 1920s, but quickly ran into difficulties—most seriously, the so-called 'infinities problem', which was not resolved before the war. Histories of physics mark the war effort as specifically interrupting the development of the theory, at least in the West, because the same physicists who were hard at work on QFT were called on to work on and take the lead on the development of new military technologies. This is not a coincidence. Nuclear physics developed alongside and inside QFT, and many of the top physicists around the world were working on both. Skills, techniques, approaches to cracking hard problems, and more, were traded back and forth between military research and the most abstract efforts in theoretical physics. In many ways, for physicists around the globe, the war effort was dis/continuous, with work in 'pure' theoretical physics. It is perhaps no surprise then that at the very core of QFT are traces of militarism, colonialism, and racialized capitalism, together with fundamental questions of the nature of being and time that have the potential to explode the grammar and logics of radioactivity's assumed naturalness.

The clocks were arrested in Hiroshima on August 6, 1945 at 8:15 am. Time stopped. Its internal mechanism melted. What happens to time when nuclear forces are harnessed and unleashed on command? Is it not the very fabric of time-being that is being ripped apart, shredded into bits? Vaporized, dispersed, made particulate, whisked away on the breeze? Condensed into raindrops that fall to the ground making puddles on streets and quenching the soil's thirst? Sent up in smoke as the water invades the electrical systems of nuclear plants, Leaked into the groundwater as the nuclear core melts? Time is/was/has been crossed out. Time drawn out like taffy, twisted and swirled in the form of hot metal, cooled, hardened, and splintered. In the twentieth century, time is given a finite lifetime, a decay time, an afterlife. Moments live and die (Barad 2017,103–106).

The Hiroshima bomb continues to go off. In the immediate aftermath of the bombing, those who had survived the blast instinctively made their

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way to ground zero, making the usual kinds of assumptions about the nature of a conventional bomb, which is limited in scope to an event, to look for survivors. But this is no ordinary bomb. And it hadn't finished going off and still hasn't. Many who went to check were further exposed to radiation and they died. Others lived, but their cells tick like little time-bombs that explode into cancers, or they pass mutations on to future generations. Living and nonliving beings become carriers and transmitters of radioactivity, without end.

As a physicist, I take it that is my response-ability, to make evident the forces of violence that exist not only in the applications of science, but inside its very core—in the epistemological, or rather, onto-epistemological workings of the theory itself. And to interrupt the violent storied-materialities physics has been bringing into the world, and bring forth alternative storied-material practices—new-old practices of knowledge-world-making—that include holding the sciences accountable in ways that are integral to the very practice of science. I have argued that what we call physical forces—such as the nuclear force—and what we call social and political forces are not separable, and that objectivity is a matter of tracing the entanglements of various forces in their specificities, and as such, this matter of tracing entanglements is an integral part of the practice of science itself.

When it comes to nuclear landscapes, vaporized bodies and other losses may not be visibly discernible, but they are surely not intangible. There are losses emblazoned on walls: shadows of what once was become eternal... the flash so bright, the heat so hot, nearly every surface becomes a photographic plate. Loss is not absence but a marked presence, or rather a marking that troubles the divide between absence and presence.

These devastated landtimescapes are surely haunted, but not merely in the sense that witness's memories of the dead, of past events, particularly violent ones, linger there. Hauntings are not immaterial. They are an ineliminable feature of existing material conditions.⁹

In "Troubling Time/s and Ecologies of Nothingness: Re-turning, Remembering, and Facing the Incalculable," (2018) I diffractively read quantum field theory—the basis for nuclear physics and the making of an atomic bomb—through a novella *From Trinity to Trinity* by Kyoko Hayashi—a story of re-turning—wherein a survivor of the Nagasaki atomic bomb seeks an embodied way to re-member her 52 classmates who were incinerated and thereby robbed of their own deaths. Her practice of re-membering entails tracing the Pu-bomb that was dropped on Nagasaki back to the Trinity test site, the first place a Pu-bomb was exploded, in the desert of the place the colonizers call 'New Mexico'.

⁹ See photo below.



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Figure 1. Lessons-From-The-Shadows-of-Hiroshima-ft.-Christianus-Iscaiot-You-Tube-2016-08-07-15-22-25.

The body clocks of *hibakusha*—nuclear bomb survivors—have been synchronized to the bomb. Their cells tick with the rhythms of radioactivity: half-lives, indeed. Passed along to future generations through mutations, the bomb continues to go off all these years later while nuclear violences cancel out futures. Individual and collective. Even deep futures. How to ensure the safety of buried radioactive elements? Half of a half of a half ... counting time out by the tens of thousands of years, hundreds of thousands of years, ... possibly beyond human time.

Tracing entanglements is an embodied practice of re-membering—which is not about returning to what was, but rather, about materially reconfiguring spacetime mattering in ways that attempt to do justice to account for the devastation wrought and to produce openings, new possible histories, reconfigurings of spacetime mattering through which time-beings might find a way to endure.

While the dominant American imaginary is that only two atomic bombs have ever been exploded—the devastating blasts that killed more than 175,000 people in Hiroshima and Nagasaki—and that these two isolated incidents ended a war—during the so-called Cold War more than 2,000 nuclear bombs were detonated, the overwhelming majority of them on indigenous lands. A powerful way to get some (albeit limited) sense of the magnitude of the onslaught of nuclear “tests” that disintegrated islands, left massive craters in the ground, and contaminated lands for time immemorial is the video art work entitled *1945–1998* by Isao Hashi-

moto, which in its powerful audiovisual effects gets the point across quite strikingly that the so-called ‘Cold War’ was anything but cold.

And this doesn’t even begin to count the colonizing forces of slow (and not so slow) nuclear violence that are an integral part of the nuclear fuel chain—including uranium mining, uranium processing, and nuclear waste storage—which disproportionately affects Indigenous Peoples. For example, the U.S. Environmental Protection Agency and the Navajo Nation have identified more than 523 abandoned uranium mines scattered throughout Arizona and New Mexico, including dozens located dangerously close to homes or water sources.¹⁰

Diné environmental activist Leona Morgan points out that the uranium fuel cycle is a matter of ecocide and resource colonization. For example, the world’s largest uranium spill occurred at the Church Rock Uranium Mill on private land in New Mexico, where a dam broke pouring 100 miles of liquid uranium waste onto Diné lands. Despite the fact that this was the largest release of radioactive materials in the U.S., and occurred just three months after the accident at Three Mile Island, few people have heard about it. And because of the vast uranium deposits on Diné lands, fracking can bring up uranium as well as radon. Furthermore, during the pandemic, Diné people faced the highest rates of COVID-19 in the United States. Environmental injustices are never just one.

Apocalypse upon and apocalypse after apocalypse. And, even so, or maybe just so, Diné poet Jake Skeets, speaks of a decolonial sense of hope in terms of deep time pushing up from the ground, moving vertically, breaking through the encrusted soil of colonialism with its structures of horizontal linear time, the narrative of time as progression, the universalizing time of colonialism and disaster capitalism (Skeets 2020).

Physics has a history of being the helpmate of militarism, colonialism, imperialism, capitalism, racism, and other forces of violence. But physics is not a totality. And so, it is worth asking: If for all its multiple forms of complicity, are there are nonetheless openings that exist within physics that trouble its hegemony, its authority, its unapologetic epistemological imperialism that claims to cover all of space, time, and matter? Is it possible that inside the material practices of physics we might find radical political imaginaries that are resources for the flourishing of all beings, rather than destruction; for justice, rather than the perpetuation of violence? Facing the particular violences of nuclear colonialism, for example, which disproportionately affects indigenous peoples, we might ask: Is it possible to refigure the theory behind nuclear physics—quantum field theory—in such a way that it is response-able to insights from indigenous ontoepistemologies focused on relationality, reciprocity, and responsibility?

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¹⁰ I am grateful to Diné anti-nuclear activist Leona Morgan for lending me some of the images and statistics that I included in my talk.

Jake Skeets writes poetically, powerfully, and compellingly about the role of what he calls “radical remembering” in pushing “forward into a new realm of thinking about memory, time, and land.” For Skeets, “memory is a touchy thing, in that you can touch it.” It is not at all something ephemeral, but a physicality tied to land. He even talks about memory as being “literally scarred into” his body. The materiality of memory is crucial to his politics and his poetics. Skeets (2020) writes:

Memory is a physical construction. While memory is normally associated with the cognitive functions of the brain, I argue that memory’s connection to time imposes its existence onto physical space as much as it does onto cognitive space. I am always fascinated by the idea that the starlight we see today is in fact old light cast out from a time existing simultaneously in the past, present, and future. The star’s light began in its present, a past to us when we see it in our present, which is the star’s future. ...[B]ecause sunlight takes 8 minutes and 20 seconds to reach the earth, the things we see are in some way a part of the past. Pasts, presents, and futures exist simultaneously.

At this point, I want to acknowledge a kind of weaving that is already patterned into this talk, in the braiding/diffracting of three sources of illumination in the night sky, as it were—into a constellation. The three are: my agential realist reading of QFT (already a diffractive storied-materiality threaded through with insights from theories of injustices), my diffractive reading of Kyoko Hayashi’s novella, *From Trinity to Trinity*, on re-membering the entanglements of Nagasaki and Trinity, and the material-poetics of Jake Skeets on the physicality of memory, the matrix of time, memory, and land—placing them in constellation with one another—making a weave, hinting at a diffractive reading of each through the other. Diffraction refuses the logics of analogy and parallelism, and the temporality of the new. What I am proposing is not a matter of weaving together allegedly independent threads now, for the first time, as it were; it is not a matter of my putting them in conversation with one another for the first time, since they are already materially entangled. These storied-materialities are each their own unique weavings—threaded through with differentiated-entanglements—while each is ultimately (differentially-)entangled with the others. Constellations in their patterning-together are made up of the twinklings of different yet entangled histories. So it is with respect for their deep differences, but in acknowledgment that they are already materially in conversation with one another, already intra-dependent and co-constitutively entangled, that I make this small offering.¹¹

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¹¹ At this point in my presentation I displayed, for inspiration, a work of art, “Dancing on Mars,” by Linape citizen of Delaware Tribe of Indians, scholar-artist Joanne Barker. Many thanks to Joanne for her kind permission.

From Trinity to Trinity is not a Western time-travel novel, but a time-hopping chronicle of one particular infinite moment of time, a time-diffraction/time-superposition tale, an embodied pilgrimage committed to tracing the material entanglements: a risky journey of placing one's body in touch with the materiality of specific colonizing histories—an embodied partial accounting of all possible histories, an iterative circling back around—touching the infinite alterity that constitutes a point, a moment. What is the structure of the infinity of a moment labeled (on some calendars as) August 9? Re-turning to a moment to face the incalculable (Barad 2017b).

For Skeets, memory is material, a physical feature of the world:

Memory is woven in a unique matrix with land, language, and time. Native people have already mastered time travel: they are able to conjure the deepest parts of humankind through the act of memory. Radical remembering, then, has the potential to teach a way of being that isn't tied to a capitalist future but is instead reliant on the self's engagement with the natural world. I don't mean that we should return to precontact Native life, but we should push forward into a new realm of thinking about memory, time, and land.

Standing before a photograph of an aerial view of Nagasaki after the bombing on August 9, 1945, in the National Atomic Museum in New Mexico, Hayashi's unnamed protagonist jumps in time but continues the thought, asking herself: What is the story of this very land that the museum stands on—why here? What is the connection of this land to the obliterated Japanese city shown in the photograph? On her way to Trinity Site, New Mexico, Hayashi traces the entanglements of histories of violence all co-existing in this Now: including those of European colonial conquest of Native American peoples and lands, entangled with the testing of the plutonium bomb on indigenous land in the desert of what the colonizers call 'New Mexico', entangled with the same kind of bomb being dropped a month later on Nagasaki, entangled with uranium mining and nuclear-waste buried on indigenous lands in the American Southwest, entangled with the Fukushima disaster, entangled with existing and future cancers of all the atom bomb survivors and their offspring, including the (human and nonhuman) 'no-bodies' who were downwind from the Trinity test site (Barad 2017b).

"Memory," Skeets (2020) explains:

exists as a kind of spatiotemporal entity, because time, memory, and land are woven together. One cannot look at the Grand Canyon without conjuring the deep time needed to create it. ... I grow weary of the word 'spatial,' because I am more interested in the idea of a terrestrial-temporal matrix. I call this terra-temporal matrix the 'memory field' because of memory's unique engagement with time and land. Time is terrestrial and feeds our cognitive development and relationship to the universe itself. The word 'terrestrial' also grows heavy; it has similarities with words like 'sublunary,' which place the terrestrial opposite a religious or spiritual space. The word 'temporal' isn't adequate either. The memory field is a matrix of time, memory, and land. Land's connection to time feeds our development as human beings, and understanding this connection strengthens our relationship to the universe itself.

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In my agential realist reading of quantum physics: Spacetime-matter-ing is a dynamic ongoing reconfiguring of a field of relationalities among 'moments', 'places', and 'bodies' (in their inseparability) ... Memory is written into the very fabric of the universe. Time-beings/becomings are excitations and condensations of a mattering-fielding of time-being, a topologically complex and dynamically differentiating, iteratively reconfiguring materialization of here-there's-now-then's-being-becomings, an infinity of possibilities condensed into Now—every now, *this* thick-Now bursting with radical possibilities for re-membling, re-bodying the world otherwise. These are ghostly matters. "Hauntings ... are not mere subjective rememberings of a past (assumed to be) left behind (in actuality), but rather, hauntings are the ontological re-memblings, a dynamism of ontological indeterminacy of time-being in its materiality" (Barad 2019, 539).

The climax of Hayashi's novella is the narrator's trip to Trinity Site, the place where the first plutonium bomb was detonated on July 16, 1945, at 5:29 a.m. It is here, at the end of her journey, the very place where it all began, standing in the midst of a desert, inside a fenced area with nothing inside it save a monument to nothingness—to Ground Zero—that the fullness of these embodied tracings of all the various colonizing entanglements comes full circle.

... Trinity is the starting point of my August 9. It is also the final destination of *hibakusha*. From Trinity to Trinity—.

If I make that journey, I can hold August 9 within my life circle. If I can never be free from the event, I should end my relationship by swallowing it (Hayashi 2010, 11).

What does it mean to swallow an event? Perhaps this is an evocation of the ouroboros, the mythical symbol of the serpent biting its tail, representing ‘creation out of destruction, Life out of Death’. Or perhaps it means to ingest the event like radiation: to take it into your gut, to feel it leach into your bones, mutate your innards, and reset your cellular clocks. Perhaps it is about the im/possibility of metabolizing the trauma, transforming the self from victim to survivor. Perhaps it is a way of un/doing the self, of touching oneself through touching all others, taking in multitudes of Others that make up the very matter of one’s being in order to materially transform the self and one’s material sense of self. Perhaps it is about the willingness to put oneself at risk, to place one’s body on this wounded land, to be in touch with it, to have a felt sense of its textures, to come to terms with a shared sense of vulnerability and invisibility, to feel the ways that this land—the colonizer’s “void”, which marks their continuing practices of a-void-ance—always already inhabits the core, the nucleus of your being (Barad 2017b).

Even the smallest bits of space/time/mattering are an enormous multitude. Each ‘individual’—each body of matter you hold in your hand—is made up of entanglements—material relations of response-ability—sedimented histories of intra-actions with ‘itself’ and all ‘others’ across spaces and times. On my agential realist account, there is no such thing as a discrete individual with its own roster of properties. In fact, the ‘other’—the constitutively excluded—is always already with-in: the very notion of the ‘self’ is a troubling of the interior/exterior distinction. Matter in its essence—*and this is precisely what is being called into question*, or rather, is the very question it keeps asking itself—is *an ongoing enactment of the undoing of individuality, self, other, identity, property, and kind*, the very stuff that makes up entanglements of colonialism, capitalism, racism, and other forces of violence. Matter itself is constitutively inhabited by a deconstructive force. Not a destructive force that blows itself apart, but rather an energetics that entails the undoing of notions that have been sedimented into Western philosophy and physics (Barad 2017b).

A decolonizing practice of doing physics cannot entail grabbing hold of Western inventiveness to create something new while leaving the sedimented histories and futures of violence unaddressed. On the contrary, in my agential realist account of QFT, the past is not over, and the future is not what will simply unfold, and practices of knowing and being are not separable, so that objectivity is not about distancing, but on the contrary, it is a matter of being in touch, of being in reciprocal relation, a matter of response-ability. This new-old storied-material scientific account contains within its core not a destructive force to be unleashed, but a seed that

holds within it a material force of justice, and the possibilities for living and dying otherwise.

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Acknowledgements

I would like to thank Jenny Stümer for organizing this wonderful event and inviting me to participate, and for her patient and kind correspondences. I am grateful to Felicitas Loest for her generous, rich, and nuanced introduction. And thanks also to Florian Mussgnug for his thought-provoking response to my talk. And to the Lisjan Ohlone people's continuing care for the land where I am grateful to reside. Some parts of this talk, including my engagement with Diné poet Jake Skeets, were first presented in my keynote "Re-membering Time/s: For the Time-Being," for the Material Life of Time conference in March 2021.

Karen Barad is Distinguished Professor of Feminist Studies, Philosophy, and History of Consciousness at the University of California at Santa Cruz. Barad is the author of *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning* (Duke University Press, 2007) and numerous articles in the fields of physics, philosophy, science studies, poststructuralist theory, and feminist theory. Barad's research has been supported by the National Science Foundation, the Ford Foundation, the Hughes Foundation, the Irvine Foundation, the Mellon Foundation, and the National Endowment for the Humanities. Barad was a founding member of the UCSC Science & Justice Research Center and the Director of the Science & Justice Graduate Training Program.

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