In the Times of Viruses

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Abstract

In the past few years, scientists have discovered ancient viruses trapped in ice that some fear may cause our next global pandemic. The existence of frozen viruses engenders multiple types of relations to the pastness of the virus, including past lives, ecologies, diseases, and ancestors. However, the current great thaw also renders frozen viruses a concern of the future, whereby viruses create relations to future promises of viral pandemics in addition to potential vaccines. That viruses are frozen in glaciers and permafrost complicates our relationship to viruses and time: the ancientness of frozen viruses compares to the possibility of its return to new ecological conditions. By surveying recent scientific and media accounts of these frozen viruses, I propose that frozen ancient viruses are an allochronic assemblage of potentiality that are both fearful and promising, speaking to growing STS attention to microbes, cryopolitics, and the divisions between living, nonliving, and dead.

Keywords: Cryopolitics, Temporality, Microbes, Climate Change, Zombies, Ghosts

Introduction

Arctic ice and permafrost are melting much more quickly than previously predicted and are threatening millions as a result by way of floods, displaced communities, and emergent zoonotic diseases (O'Reilly, 2020; Harvey, 2023). But the great melting of glaciers, ice, and permafrost also contains an additional and unexpected threat, one heretofore hidden within the ice itself: viruses and other microbes long thought dormant may be unleashed upon our contemporary environment. Indeed, in the wake of the Covid-19 viral pandemic, an October 2022 piece in *The Guardian* proclaimed that the "next pandemic may come from melting glaciers," describing a recent scientific study published in the journal *Proceedings of the Royal Society B* (Geddes, 2022). This research describes the risk of viral spillover, wherein a highly pathogenic reservoir population—or a population of organisms that are naturally infected with a specific virus—encounters a new host population through which the virus subsequently spreads. Studies of soil and sediments from Lake Hazen, the high Arctic's largest freshwater lake in Canada, suggest that the potential for frozen ancient viruses to affect new hosts for the first time might be greater the physically closer a potential host is to melting glaciers (Lemieux et al., 2022). Moreover, the reemergence of ancient viruses accompany novel, existing, or mutated viruses that spread through new and existing zoonotic vectors resulting from climate change (Traavik, 2014). Such findings pair with discoveries of frozen ancient viruses since 2003, including a 30,000-year-old giant virus—a virus visible under

a light microscope—and growing concern that ancient viruses will pose a significant threat to animals and humans (Legendre et al., 2014; Zhong et al., 2021).

However, tension lies in the potential thawing of frozen ancient viruses, for while they may give rise to a future pandemic, they may also provide crucial information on viral evolution while also act as a catalyst for future vaccines. This article asks: how long will these ancient viruses, no longer acclimated to our contemporary ecology, stay frozen, and what will happen when they thaw? Furthermore, the article argues that frozen ancient viruses draw attention to the relationality between that which is frozen—the virus—and that which it can potentially infect, humans and nonhumans. This is because viruses must exist in relation to living cells to replicate, and so their frozen status embodies a possibility of infection and replication once melted. That frozen viruses represent the inextricability of infection and replication, in that viruses rely on *living* cells, indexes debates within microbiology as to viruses' living status. While most agree that viruses are nonliving given their inability to self-replicate, attention to their affiliation with living cells, "require[s] us to… embrace a broader understanding of the fundamentally relational nature of biological entities" (Brives, 2021: 247).

As such, this article asks two additional questions, as explored through two unlikely figures: ghosts and zombies. My first question is how does the melting of frozen viruses reconceptualize the temporal relations between viruses, humans, and other nonhuman beings? The fact that frozen viruses originated thousands of years ago signals that any contemporary relations formed with those viruses would also simultaneously entail a relation with the pastness of those viruses. Such pastness, as I will demonstrate, embodies past disease and pestilence alongside past ecologies, past lives, and past ancestors, human and nonhuman alike. I develop the metaphor of viruses haunting the living—viruses as *ghosts*—to index different pasts haunting the present and even potential futures. However, the fact that viruses are frozen, contained within suspended animation to be released in the future (no matter how quickly that future may arrive), means that viruses also instantiate relations to the future—the future assurance that frozen viruses may melt and infect simultaneously haunts the present moment. These are fearful relations to the past and future on the one hand, as the remembrance of disease and the potential for destruction are stitched into the news reports and scientific findings describing these ancient viruses. But on the other hand, they are also promising relations, to the secrets of evolution or to the cures that may work to prevent past and future diseases. This troubles a strict good/bad dichotomy of viruses and thus makes living with viruses far more complicated (Gitzen, 2024), especially when viruses are already part of our bodies and life functions (Sagan, 2014; MacPhail, 2004).

My second question is how does the potential reanimation of frozen viruses challenge the distinctiveness of living, nonliving, and dead categories? Although many microbiologists agree that viruses are biologically nonliving, some microbiologists suggest that the very definition of life needs to be amended to account for entities like viruses (e.g., Kostyrka, 2016; Pennisi, 2013). This is because while viruses may not be able to self-replicate, they are biologically different than other nonliving entities like rocks and metals given their ability to evolve due to natural selection. Increased attention to frozen ancient viruses also pairs with media and scientific attention to so-called 'zombie viruses'—frozen or dormant viruses that are caught within suspended animation and described as 'reawakening' (Yin, 2022). Such invocation of zombie viruses, I suggest, draws much needed social scientific attention to a web that enjoins living, nonliving, and dead together. Frozen viruses demonstrate the tension between these terms, but rather than pose an either/or model of viruses—either living or nonliving or dead—frozen viruses point towards a *both/and* model in which viruses are caught within a web of being simultaneously living, nonliving, and dead.

Taken together, I argue that the viral relationalities embodied within frozen viruses eschew both a binary opposition of life/nonlife and life/death, and a linear temporality that sees viruses as only infecting (and reproducing/replicating), to produce more viruses, to then repeat the process. Instead, these viral relationalities are an

allochronic assemblage of potentiality (Prasse-Freeman, 2025). Indeed, whereas the reproduction/replication narrative of viruses renders the viral pathway and subsequent relationality linear, I argue instead that when frozen viruses are suspended and unable to replicate, they still embody that which they *were* (ancient), that which they *are* (frozen), and that which they *can be* (infectious, instructive, threatening, beneficial). Viruses are more than just their replication/reproduction; they are a relationality that queries the (artificial) divisions between living, nonliving, and dead found within their replication/reproduction.

This article is a theorization of frozen viruses supported through media and discourse analyses of scientific papers, science writing, and news media. While not exhaustive, I focus on materials that address the following areas: 1) the concept of the virus and debates over what constitutes a virus and its living/nonliving status; 2) recent (since 2014) attention to the discovery of frozen ancient viruses, including giant viruses (viruses observable under a light microscope); 3) discussion of zombie viruses, especially as they relate to frozen viruses (directly and indirectly); and 4) comparisons between viruses and ghosts. I also use theoretical arguments from a range of disciplines as my concern is the subject of (frozen and zombie) viruses rather than in contributing to a specific disciplinary argument. My goal in utilizing cross-disciplinary materials—scientific, social scientific, philosophical, historical, and popular media—is to construct an interdisciplinary argument and approach to frozen viruses that extrapolates both viral relationality and the living/nonliving/dead web.

I begin by discussing the historical conceptualization of the virus alongside more recent social scientific and scientific explications of viruses and microbes. I then examine reports on the discovery of ancient viruses found in melting ice and permafrost. To complicate these reports, I interrogate the politics of freezing and melting and how I come to understand frozen ancient viruses as a temporal phenomenon. I transition to two figures used to talk about frozen viruses, ghosts and zombies, and how both metaphors enable novel understandings of frozen viruses as *both* fearful *and* promising. These metaphors also critically challenge the divide between the living, the nonliving, and the dead, and so I use these figures as a point of entry into discussions of life itself.

A 'living process'

To argue for the temporal significance of frozen ancient viruses, it is necessary to first address the biological concept of the virus itself. Since Russian botanist Dimitri Iwanowsky first co-discovered the tabaco mosaic virus in the late 19th century and began the concentrated study of virology, viruses have historically been many things, including infectious agents, diseases, and micro-organisms. Historian of science Scott Podolsky (1996: 83-84) explores three ways that viruses have been mobilized from the late 1920s to the early 1960s: as a metaphor and "conceptual shorthand for a definition of life itself"; as an "operational model, …an independently existing gene, carrying the identical operational connotations…as did its cellularly integrated brethren"; and as taxonomic lineage in the plurality of "viruses." What these three definitions demonstrate is the variability of what the virus has meant in science over the years, and the difficulty biologists have had in defining the virus.

Yet it was Andre Lwoff (1957) who, in his famed essay "The Concept of Virus," laid the foundation for modern virology. One key aspect to the definition of the virus, Lwoff (1957: 242) observes, is infectiousness, for without this key characteristic, "we are no longer [able] to discriminate between virus and the cellular organelles endowed with genetic continuity". He thus proposes the following definition, one which still carries immense weight more than sixty years later:

> viruses are infectious, potentially pathogenic, nucleoproteinic entities possessing only one type of nucleic acid, which are reproduced from their genetic material, are unable to grow and to undergo binary fission, and are devoid of a Lipmann system (Lwoff, 1957: 246).

The key parts of this technical definition are the infectivity of viruses, their pathogenic tendencies, and their inability to individually replicate/reproduce—viruses must rely on living cells to replicate, and in so doing, they may cause disease. When compared to micro-organisms, Lwoff con-

cludes that not only are viruses not alive, but they are more similar to cellular organelles—subunits internal to the cell—than micro-organisms. He favors Nobel Prize winning virologist MacFarlane Burnet's assessment that viruses "could almost be called a stream of biological patterns" (Burnet in Lwoff, 1957: 248), meaning that viruses are not "individual organisms" but a pattern of biological materials.

Lwoff and Burnet's separation of viruses from (micro)organisms, also known as microbes, is predicated on the nonliving status of viruses—microorganisms/microbes are living, viruses are not. Heated debates remain within microbiology as to the status of viruses in the Tree of Life, given their active role in cellular evolution (Bandea, 2009). Some microbiologists suggest moving away from a single tree to a more complex and interwoven network of cellular life and viruses that account for ancient viruses that played a role in the development of cellular life and the more recent viruses humans and non-humans encounter (Forterre and Prangishvili, 2009a). Some argue that viruses predate the separation of the domains of cellular life (Bacteria, Archaea, and Eukarya) and are thus active agents in the creation of cellular life (Bamford, 2003). That said, virology remains a subfield of microbiology, and the social scientific study of viruses is typically included within a broader attention to microbes.

Much of the social scientific attention on viruses has focused on their pathogenic quality. Viruses are often interpreted through a biosecurity framework (Lakoff, 2017; Collier and Lakoff, 2021; Porter, 2019), whereby viruses pose a biological threat to the environment, nonhumans, and humans insofar as they infect, replicate, and destroy host cells in the process. The uncertainty over frozen viruses melting heightens the biosecurity threat as their ancientness means they could very well wreak havoc on contemporary ecologies that are wholly different from the ancient ecologies from when they were frozen.

However, viruses, like microbes, are more than pathogenic, especially as greater attention to the microbiome in scientific and social scientific research has moved away from strictly biosecurity framings (Cañada et al., 2025). Both viruses and microbes "have come to be differently apprehended, no longer now as primarily frightening but also as newly appealing; microbes are also differently comprehended, no longer now only as individual strains but also, increasingly, as communities, as entities that matter within diverse *ecosystems*" (Paxson and Helmreich, 2014: 168). The "newly appealing" quality of microbes and even viruses lie in their potentially "probiotic" capacity to "use life to manage life" as a method to "deliver forms of human, environmental, and even planetary health" (Lorimer, 2020: 2). Fermentation, for instance, is an instance of cultivating microbes to produce healthy food and drink, such as sake, a fermented alcoholic beverage (Hey, 2025). Vaccines are created by exposing live cells to strands of a virus, thereby impelling an immune system response that is then synthesized into a drug. In addition, more attention is being paid to phages, viruses that infect bacteria, as a way to address antibacterial resistance. The point is that microbes and viruses are not solely frightening and threatening entities; they have the potential to be beneficial and probiotic for the sake of not only human health, but nonhuman, environmental, and even planetary health.

Some social scientists suggest that dividing the threatening from the beneficial—the antibiotic from the probiotic—installs a false dualism. Huttunen, Oinas, and Sariola (2021) make this exact point, thereby favoring a *spectrum* of human-microbe relations. At one end humans coexist with microbes, while at the other humans wage war with them, because microbes are something to fear. For Huttunen, Oinas, and Sariola (2021: 127), "controlled engagement" exists somewhere in between, where one "tr[ies] to control the permeable contours of one's body." This is an imperfect heuristic, as the authors themselves recognize, though it allows for a multiplicity of possibilities to emerge from human-microbe relations.

A spectrum, however, still posits that microbes are one thing: the dial may move across the spectrum, but it can only ever rest upon one category. Frozen viruses, however, draw attention to the ability for viruses and microbes to be multiple categories *simultaneously*, both threatening and promising. Such a *both/and* model enables a multiplicity of viral relations that span

not only the threatening and the promising, but time as well, given that frozen viruses embody a simultaneity of past, present, and future by virtue of their frozen status (a point I shall return to below). This temporal simultaneity is similar to Gilles Deleuze's notion of 'pure becoming', or as he writes, an

> infinite identity of both directions or senses at the same time—of future and past, of the day before and the day after, of more and less, of too much and not enough, of active and passive, and of cause and effect (Deleuze, 1990: 2).

Charlotte Brives (2021: 249) calls this type of becoming *pluribiosis*, whereby the multiple relata of viruses, humans, and nonhumans are

> forever in the process of becoming, constantly shaped and transformed by their interactions with other living things, and by the context in which they occur (Brives 2021: 249).

My point in invoking Deleuze and Brives is to draw attention to the ability for viruses to *move* in multiple directions at once, toward the threat and the promise, the past and the future, while not being beholden to any one direction. This is because becoming implies an ever-unfolding movement and mutual relationality, not a static state of being. To illustrate this further, allow me a brief foray into virology.

In their paper entitled "The Great billion-year War between Ribsosome- and Capsid-encoding Organisms (Cells and Viruses) as the Major Source of Evolutionary Novelties," microbiologists Patrick Forterre and David Prangishvili write that

> the tendency for scientists to be repulsed by the images of war, explains why they have underestimated until now the role played by the war between viruses and cells during the evolution of life on our planet (Forterre and Prangishvili, 2009b: 65).

For these two, the so-called "war" between cells and viruses, raging for millennia, is a chief engine in not only evolution par excellence, but innovation, novelty, and creativity. Virologist Michael Cordingley (2017: 14) notes that this "arms race" is often described as "Red Queen dynamics between prey and predator, the host and its invader." For Cordingley and his invocation of *Alice in Wonderland*, the

> allusion to Lewis Carroll's Red Queen is particularly apt, as she tells Alice, 'Here, you see, it takes all the running you can do, to keep in the same place' (Cordingley, 2017: 14).

Evolutionary Biologist Leigh Van Valen (1973) first explained this dynamic by using Carroll's Red Queen as a metaphor for understanding this aspect of evolution. The hypothesis states that as one species evolves, others will adapt and evolve to "catch up" with the evolution of the corresponding species. Cordingley continues, explaining that

> both the virus and host must constantly evolve; each time a new variant of one partner emerges to become more successful to the detriment of the other, the other partner must equal the balance through selection of a countermeasure: punch and counterpunch (Cordingley, 2017: 14).

The focus on the Red Queen, however, elides a cultural dynamic that is embedded in the work of these microbiologists and virologists, even stitched into the very concepts of the virus-cell arms race and Red Queen Hypothesis. This dynamic, I argue, is that viruses are temporal phenomena that emerge in concert with some scientific accounts of the virus as not a particle but an assemblage of potential, a machine that creates any number of processes. Forterre (2016) argues that there is a difference between the virus and the virion. He notes how historically the conflation between the virus particle, also known as a virion, with the virus led to narrow understandings of the virus, entities that "have no specific form in the intracellular phase, with their components being dispersed among those of the infected cells" (Forterre, 2016: 101). In other words, the viral particle or virion disperses within the cell and thus has no specific form or shape once it infiltrates the cell. Virions can be "isolated and purified, allowing their biochemical analysis and their observation" (Forterre, 2016: 101)—the typical image of a virus is actually an image of a virion.

The distinction here is telling, in part because that which is observable—the virion—may be mistaken as the virus, but it is not the virus. Viruses, in philosophers of science John Dupré and Stephan Guttinger's (2016) estimation, are a 'living process,' where their formlessness in the intracellular phase have led to the omission of this stage in scientific configurations of the virus. While the virus may rely on the cell for replication, the virus as a machine of virion particle creation engenders a relation between the pre-virion existence of the cell and its genetic material with the completed virion. For Dupré and Guttinger 'the virus' is simply the process of engaging with a cell, but by attending to its virtual form—what it can become in potential—we can understand it in more capacious terms

Extrapolated from specific instantiations of the virus as a 'living process,' viruses can be understood as allochronic assemblages, something which is evinced by the human genome's relationship to viruses. Microbiologists Karin Moelling and Felix Broecker (2019: 7) note that at least 45% of the human genome is "composed of sequences related to retroviruses." Retroviruses are viruses that use RNA (ribonucleic acid) rather than DNA (deoxyribonucleic acid) as their genetic materials. This includes nearly 8% of the human genome being comprised of endogenous retroviruses (EVRs), a case of ancient retroviruses becoming trapped in the host genome when a retrovirus' RNA genome infects the host's genome, thus impacting the DNA sequence:

> this means that significant portions of the DNA in eukaryotic organisms [which include mammals] originally entered its cell-line by way of a virus (Dupré and Guttinger 2016, 111).

EVRs are also partially responsible for the development of placenta—a temporary organ in the uterus that provides offspring with nutrients and oxygen—in mammals given that they provided syncytin genes, a protein used in placental development, to the host (Moelling and Broecker, 2019: 7-8).

As such, I value the characterization of viruses as a spatiotemporal assemblage of potential processes given that it indexes the multiplicity of viral relations—viruses are not one thing or one set of relations—while also complicating the binary oppositions of living/nonliving and living/dead by necessitating viral relations as that which animates the *doing* and the *acting* of viruses. In other words, viruses maneuver through space and time, malleable in their purpose, for while they infect and attempt to replicate, the effects of such actions are not always wholly pathogenic; in a dialectical fashion, viruses that destroy human and nonhuman *lives* (qua temporally-bound individual existences) may benefit human and nonhuman *evolution* (qua existence of species). Frozen viruses emphasize this dynamic given their temporal suspension, as attention is drawn to both the process of viral replication/reproduction that enjoins viruses, humans, and nonhumans together, as well as to the fact that this process remains, at least for now, unrealized—only *in potentia*. Moreover, frozen viruses also provide us with a look back into a variety of pasts—past ecological conditions, past lives of humans and non-humans, past diseases, and even an ancestral past of how (some) humans and nonhumans once lived—alongside a glimpse to potential futures, when scientists perfect a vaccine, when the next pandemic hits, or when something else happens that we cannot predict. How, might we ask, can viral pasts help us glimpse viral futures?

The frozen menace

Returning to Lake Hazen and similar cases of frozen ancient viruses can begin the work of understanding the spatiotemporal processes of these viruses and the implication of both their frozen presents and their thawed futures. The potential viral spillover of Lake Hazen is one of the latest cases of ancient viruses—viruses that are between 10,000-50,000 years old—being discovered in melting glaciers and permafrost. Scientists may not be entirely fearful, but they are concerned. Microbiologist Jean-Michel Claverie told the BBC that the exposure of ice layers with these ancient viruses could be "a recipe for disaster" (Geddes, 2022). Lauren Leffer (2022) writing for *Gizmodo* similarly notes that this viral spillover "is an opportunity for a virus to become more dangerous." In an October 2022 *Newsweek* piece about the same

concern and study, Claverie was more precise, stating that

> the public health risk is coming from the accelerated release of previously frozen viruses combined with increased human exposure, since global warming is also making Arctic areas much more accessible to industrial development (Dewan, 2022).

As Leffer concludes,

> through the burning of fossil fuels, we're altering everything about our world, down to the interactions between life and viruses at the bottom of a glacial lake (Leffer, 2022).

Anthropogenic climate change is the cause of both the melting of ice and permafrost and what leads to increased contact with previously uninhabited areas.

The "recipe for disaster" that Claverie pronounces taps into a broader fear that media promulgate in their reporting of these ancient viruses. Both *The Guardian* piece (Geddes, 2022) and a *Newsweek* piece (Dewan, 2022) reporting on the same study of Lake Hazen make mention of a 2016 anthrax outbreak that killed a young boy and hospitalized 72 nomadic herders in the town of Salekhard in Siberia. All were exposed to anthrax, which also led to the death of more than 2300 reindeer (Luhn, 2016; Liskova et al., 2021). The anthrax outbreak is believed to have been tied to the thawing of permafrost—a result of climate change and record temperature highs that year—and human exposure to anthrax-riddled reindeer carcasses. Further, as permafrost melts, diseases that infect the remains of humans and animals can seep into the groundwater that people drink. The boy died from an intestinal form of the disease, thus pointing towards this very process. In response, the Russian government deployed a special emergency task force unit, along with 30 tons of "biologically active agents," to Salekhard in order to decontaminate the area (Nilsen, 2016). The people of Salekhard had encountered anthrax before, locally called the 'Siberian plague,' in 1941 to much less (if any) attention and government intervention, whose importance will be discussed below.

The *Newsweek* piece in particular notes that

> [p]athogens thought to be extinct, such as smallpox, may also still be lurking beneath the frozen soil, as might ancient viruses to which we have no natural immunity and no effective vaccines or treatments (Dewan, 2022).

Fear emerges in this passage, evident in phrases like "lurking beneath," not only because of the virus but also because the ancient past is significantly different from the present moment or near future. The public may think that these pathogens and viruses are "extinct" when in fact they may be "lurking," like some frozen menace, beneath our feet.

For the *Newsweek* piece, these ancient viruses are considered dormant, asleep even, for as the headline states, "ancient viruses trapped in permafrost for thousands of years are *waking up*" (my emphasis). Being asleep versus being awake is not the same as dead and alive, as waking up assumes that one is already alive. Waking up also implies that viruses are not done yet; they are still in the process of waking up and so fear here lies in that march towards being awake, being fully melted and once again infectious. The metaphor extends to the notion of viruses being "trapped" rather than dead, where their release is not a reanimation of the dead but a reawakening and release of that encased in suspended animation to the contemporary environment.

Frozen viruses engender a liminal state of being (Turner, 1967), betwixt and between the living and dead in what Joanna Radin and Emma Kowal (2017) call 'cryopolitics.' In their conceptualization, cryopolitics "pertains to life that is perpetuated indefinitely such that it becomes difficult to assert with confidence that it is not, in fact, death" (Radin and Kowal, 2017: 8). Reworking Foucault's notion of biopolitics and the axiom of *make live and let die*, Radin and Kowal (2017) consider cryopolitics a way to make live and *not let die*—freezing entails suspending the process of dying to the extent that that which is frozen exists in a sort of cryobiotic state, a "liminal state between life and death" (Lemke, 2022: 70). Radin and Kowal (2017: 8) refer to this liminality as 'latent life,' while Thomas Lemke (2022: 70) favors the notion of 'suspended

life' as it favors "the processual and relational dimensions" of life.

For Radin and Kowal (2017), cryopolitics and latent life refer to the intentional acts of freezing biological materials like microbes and viruses. However, I contend that both concepts capture the nature of frozenness, for the discovery of frozen ancient viruses likely necessitates attempts to keep those viruses frozen, to keep them suspended or latent. Even if frozen viruses are not intentionally kept frozen, their frozen quality still represents the liminality of the virus, caught between what it once was (prior to its frozen status) and what it might become (if it melts). Likewise, the discovery of frozen viruses mirrors the intentional act of freezing viruses and vaccines. Frédéric Keck (2017) offers a helpful case of freezing viruses and vaccines, the former to sequence and study past viruses like the 1918 influenza strand that killed tens of millions of people worldwide, the latter to prevent such a pandemic from happening again. In both cases, the freezing of the virus and the vaccine depends on its eventual thawing (and subsequent usage).

Frozen life induces a temporal fixation on suspension, on the ways life can be both forgotten and neglected as it perpetually exists in a liminal state of neither alive nor dead. As Radin and Kowal espouse,

> this is the most striking temporal dimension of cryopolitics: the abdication of responsibility for action in the present made possible by recourse to the promise of an ever-receding, and technoscientifically enabled, horizon of future salvation (Radin and Kowal, 2017: 9).

For biological materials to be frozen, it is equally prudent to query their potential—perhaps eventual—thawing and melting. In our current climate epoch, humans are responsible for thawing both the entities we intentionally froze and those frozen by nature, especially as the Earth heats and Arctic ice and glaciers melt. While Radin and Kowal (2017) briefly address melting glaciers and sea ice and the risk and endangerment such melting instantiates, I suggest that cryopolitics must account for how freezing exists alongside melting, for even if the "cold optimism" of freezing is the "belief that death…can be postponed indefinitely through practices of preservation" (Radin and Kowal, 2017: 9), there must be a reason for preservation—intentional preservation has a use value that requires that which is frozen to be thawed.

Cryopolitics is ultimately a spatiotemporal relationship between and politics of the living and dead, as is latent life and suspended life (Friedrich and Höhne, 2016; Radin and Kowal, 2017; Lemke, 2022), for with frozen *life*, these scholars posit, we are making claims as to what constitutes the living and the dead. Yet such a conceptualization of frozenness (and melting) erases a third term: the nonliving. Both living and dead assume that what is dead was once living, and that what is living will in the future be dead. But what of viruses, regarded by many scientists as not living and thus not subject to eventual death? How do the freezing and melting practices of viruses complicate both cryopolitics and the implicit division between life and death laden in cryopolitical interpretations? My both/and model proves useful as it accounts for the ways viruses are *both* not living *and* not dead, caught between the living and the dead but being wholly neither. Such a conceptualization of the nonliving mirrors latent and suspended life—frozen life—insofar as such frozen life is similarly trapped within a liminality of neither living nor dead. However, latent and suspended life implies that the frozen organism was at one point alive and will be alive once again. This cannot be said of frozen viruses, whether intentionally frozen or not. Nonliving is not the opposite of living and dead, as I explore below, but part of a triumvirate or web that includes the living and the dead. The nonliving challenges the exclusivity of living and dead while also complicating the relationship between them. While I explore this below, I first stay with the dead and the past to query how viruses may be an avenue for the dead to speak, to haunt the living in the present and in the future.

Viral specters

Reports of frozen ancient viruses present a fearful potential of the future—that frozen viruses will "wake up" to infect and torment—as frozen ancient viruses also haunt the living, both the present living and future living, with their past existence. In a piece on *Science Alert*, the author

declares that "the melt has also created some concerns about ancient viruses coming back to haunt us" (Koumoundouros, 2022). Haunting indexes a fearful activity, but one again reliant on the thawing of frozen viruses, for as microbiologist Zhi-Ping Zhong explains, "melting will not only lead to the loss of those ancient, archived microbes and viruses, but also release them to the environments in the future" (Koumoundouros, 2022). Loss here implies that some ancient microbes and viruses may wither away in our contemporary (or future) ecological landscape, but some would survive to penetrate the environment and infect it. The fear of such viral specters is made explicit in other pieces, such as a 2024 *Down to Earth* headline proclaiming, "Ghosts of the past: Global warming fears resurface as 41,000 years old viruses discovered in Tibetan glacier" (DTE Staff, 2024). Here we see a direct connection between the pastness of an ancient virus and the future possibility of its release into the environment.

Nils Bubandt's (2017: 125) notion of the necropolitics of the Anthropocene—a necropolitics marked by haunted geologies—accentuates this point as it "operates under the sign of metaphysical indeterminacy rather than certainty, unintended consequences rather than control." Contrasting with Foucault's notion of biopolitics, or power to promote life, necropolitics describes a politics of deathmaking, which in its original usage accounts for citizen exposure to death and debility at the hands of weapons and war (Mbembe, 2019). For Bubandt (2017: 124), necropolitics now includes the deathly dangers of human-led climate change to not only other humans, but to the environment and nonhumans. Anthropogenic climate change gives rise to melting glaciers, and yet the consequence of such melting is the potential release of ancient viruses into the future environment; the past is coming back to haunt the future given that viruses, like geology, can "bring spirits into being" (Bubandt, 2017: 125). These spirits represent both the pasts of the frozen ancient viruses—past ecologies and past infections—and the futures of melting and infection that now haunt contemporary ecologies, humans, and nonhumans as potential vectors of infection.

A turn to Derrida (1993) and his notion of hauntology proves useful. As Astrid Schrader explains, hauntology

> describes the paradoxical existence of a specter as neither being nor non-being, neither present nor absent, neither of the 'past' nor of the 'future,' but which affirms an indeterminate relationship between being and becoming and between 'past' and 'future' (Schrader, 2010: 278).

Alan Klima (2019: 20) makes an analogous observation of Derrida, noting that "being-with spectres is *not only* a politics of memory, inheritance, and generation and cannot be reduced to that." Such "being-with spectres" is thus not an either/or model but rather a "not only but also" conception (Derrida, 1993: xviii; Klima, 2019: 20), a both/and model that mirrors my interpretation of frozen viruses as simultaneously past, present, and future (along with being both creative and destructive). Hauntology encapsulates this simultaneity as it is "the idea that there is something from the past which is always present in the present; and, also that this something is waiting for its return to a future to come…the spectre is thus both past and future" (Hughes in Kosmina, 2020: 907).

However, the simultaneous (both/and) pastness and futureness of the ghost-as-virus also renders viruses a haunting force that draws attention to the effects of anthropogenic climate change. Frozen ancient viruses embody a potential necropolitics of the Anthropocene, to invoke Bubandt (2017), given that human-led global warming is causing glaciers and permafrost to melt and "awaken" the sleeping viral specters. Frozen ancient viruses haunt in both instances as they impel both present human bodies to prepare for the second coming of frozen viruses as they attempt to prevent glaciers and permafrost from melting, even as they haunt future humans and nonhumans who may be infected if/once viruses thaw.

Viral specters also index the 2016 anthrax outbreak, for the buried reindeer and even human bodies that contain the anthrax bacterium are part of a past existence of Salekhard residents. It may very well be ancestors and ancestors' reindeers that were thawing and infecting the town and its reindeers, whereby ancestors "haunt"

the present through microbes. Viruses are the specters, the ghosts and the ways we channel ancestral ghosts—be these ancestors humans or nonhumans (e.g., reindeer). This case also illustrates that viral specters do not haunt humans and nonhumans equally; the relations that viruses, and microbes more broadly, have with human and nonhuman bodies differs cross-culturally but also across the power divides between the Global North and Global South (Benezra, 2023; Wrigley, 2023; Gitzen, 2024).

Such haunting pairs with another *Science Alert* piece entitled "melting glaciers are revealing dead bodies and ancient diseases" (Einbinder, 2019). The piece details that frozen bodies of those that attempted to climb Mount Everest are being discovered because of melting glaciers. Yet the discovery of frozen bodies pairs also with the discovery of ancient viruses frozen in the ice whereby "the retreating ice has exposed both mystery…and outright horror: dead bodies and ancient diseases" (Einbinder, 2019). The past, in other words, is haunting the present through frozen bodies and viruses, frightfully so. What makes this article fascinating is that it is framed through these dead bodies. It begins and ends with those bodies discovered in the melting ice and the cost to recover these bodies from the mountain. Yet, it includes, as a seeming aside, a mention of ancient viruses and the potential "rise of deadly, archaic illness." Both are to occupy the same conceptual category in our minds: a horror story that lives in the immediate future.

The haunting of dead bodies and viruses also requires a return into the past. The *Science Alert* piece provides data that details how "the number of glaciers at Glacier National Park, home to around 150 glaciers when created by President Taft in 1910, has been diminished to less than 30" (Einbinder, 2019). The invocation of the recent past of Taft and the founding of Glacier National Park compares to the present existence—150 glaciers versus 30—but doing so manifests a relation between that recent past, the present moment of the "freakishly early" melt of glaciers, and the future promise of even fewer glaciers.

Viruses have a history, and each tells a different story (Brives, 2021). A piece on *Impakter* digs deeper into the past to understand these nearly 50,000-year-old ancient viruses found in melting glaciers (Richards, 2022). When invoking the ancientness of the virus, *Impakter* also asks, "what did the world look like 50,000 years ago," before answering the question and detailing that past. Rather than invoking the past with reference to its age (50,000 years old), the piece describes that ancient world as a method for comparing it to our present environment and human existence (as the piece links to a YouTube video entitled "what if you woke up in the stone age"). The piece details how the

> inaugural tools our ancestors designed and built…paved the first steps towards rapid global industrialization that's now melting our glacial ice in the digital age (Einbinder, 2019).

The *Impakter* piece is suggesting that the past is directly responsible for the current and future destruction of the environment and the melting of the glaciers, thus releasing these ancient viruses into our environment.

Frozen ancient viruses teach us of the conditions of the past, including past diseases and pestilence, and thus herald a warning for what may come in the (near) future. Keck's (2017) discussion of using frozen samples of the 1918 flu to study potential disease pathologies of the past alongside preventative measures in the present represents the didactic nature of frozen (ancient) viruses. Such viruses also prove useful in delineating potential evolutionary insights into both the living and nonliving. Bubandt suggests that past ghostly geological objects allow some

> to dream of a different future at the brink of disaster, a future in which livelihood and good fortune do not come at the expense of devastation and death (Bubandt, 2017: 136).

The haunting of viruses, bodies, and ancestors that takes place may thus be one that ushers in good fortune for some, as it may lead to scientific advancement or the development of any given vaccine. However, it is the indeterminacy that opens to the possibility of death within the Anthropocene.

My point in detailing the reporting into these ancient viruses discovered in melting ice is that

the types of viral relations—is the discovery of ancient viruses one to fear or one to herald for future scientific studies? —do not limit the types of relations engendered through the virus. Invocations of dead bodies, reindeer carcasses, hauntings, past environments, and past humans are all different kinds of relations we have to the past, instantiated through frozen viruses. However, frozen viruses also cultivate relations to the future and the uncertainty of what may happen if the ice and permafrost melt and the ancient virus escapes.

The zombie parallax

Viral specters enliven the dead to speak yet again, but frozen viruses may also be invoked with other nomenclature, namely the zombie. The figure of the zombie indexes the polarities of living and dead while also invoking contemplation into the nonliving—neither living nor dead. Simultaneously, the zombie figure invites attention to what viruses do if they are not wholly out to destroy. Not all popular and academic uses of zombie viruses agree with how the phrase is used, but I contend that all usages signal the web of living, nonliving, and dead.

The *Impakter* piece discussed in the previous section (Richards, 2022) refers to frozen ancient viruses as 'zombie viruses' given the fact that, according to the piece, "viruses are not alive" and only once "activated when they come into contact with a living breathing host" are they "triggered [and] able to hijack the host's cellular machinery and energy sources to rapidly make copies of themselves and cause havoc, a.k.a. infection" (Richards, 2022). Here zombie seems to refer to the inertness of the frozen virus—its inability to move and thus infect and replicate within a host—and so while both frozen viruses and non-frozen viruses still require the host to be enlivened (e.g., Forterre, 2016; Dupré and Guttinger, 2016), frozen viruses must first be thawed. Multiple other media reports similarly use the nomenclature of 'zombie virus' to talk about the thawing of frozen viruses (e.g., Walker, 2024; Hunt, 2023) but do little to explicate why they refer to such frozen ancient viruses as such.

A July 2022 *Scientific American* opinion piece about incomplete viral genomes has a kinder take on zombie viruses with the title "How zombies can help prevent the next pandemic" (Yin, 2022). The piece details how "zombie viruses are the crippled byproducts of viral infection that can't reproduce without help." The piece continues:

> but when a zombie viral genome is delivered into a cell that is already infected by a fully functional virus, then—like a zombie—it can spring to life… [and] seems to not make the ongoing viral illness worse (Yin, 2022).

In other words, the zombie paralyzes the advancement of disease, turning active viruses into what we might call, although in a different key, frozen ones. A similar process takes place with phages, viruses that infect bacteria, for as antibiotic resistance grows and bacterial infections spread, phages are considered as a potential option for eradicating bacterial infections. The supposed point of these zombie viruses is thus encapsulated well by professor of chemical and biological engineering John Yin (2022):

> A better understanding of how these zombies work could allow researchers like me to engineer zombies as treatments so that when the next pandemic virus hits, we can give people medicinal zombies to keep them from getting really sick.

"Medicinal zombies" is a phrase that is difficult to ignore. In the popular imagination, to thus think of zombies as beneficial, medicinal even, is as counterintuitive—or, rather, countercultural—as thinking that viruses could also be helpful. Viruses (and zombies) as potentially helpful and hopeful—as a medicinal reservoir of potential vaccine and treatment—complicate the fearful narratives of zombies and viruses, while instantiating a new kind of relationship embodied in the virus: a medicinal kind. Viruses may have played a role in human and nonhuman evolution, but to use viruses as medicine renders these monsters less terrifying and indeed productive of perhaps a more livable hybridized life for some (Haraway, 1999; Gitzen, 2023)—not everyone has equal access to vaccines, after all. Frozen viruses complicate these narratives, for they are even more terrifying given

their ancientness; they are strangers to the contemporary or the future ecological landscape. Yet they simultaneously offer potential scientific discoveries and developments in terms of both the history of Earth—including the history of humans and, more generally, life—and vaccines for not-yet realized or experienced viruses, some perhaps still trapped in the ice.

As I have continued to argue, frozen (ancient) viruses are an allochronic assemblage that symbolizes both the dangers of their thawing—disease and pestilence—but also the potential benefits as symbols of past environments and outbreaks alongside future breakthroughs in evolution and vaccines. While viruses in general carry the both/and quality of being *both* dangerous *and* curative or beneficial, frozen viruses must be understood through their temporal embodiment as they represent what was, what is, and what can be by virtue of being frozen. But Yin's (2022) zombie virus renders viruses as the opposite of threatening. These viruses thus reinterpret the adage that the enemy of my enemy is my friend: viruses, potentially our friends, but most certainly our companions.

Yin's (2022) invocation of the virus "springing to life" like a zombie invokes the division between life and death, mirroring the "reawakening" of ancient viruses discussed above but instead insists that a virus can come back to life. A 2014 BBC headline makes this even more explicit, noting that a "30,000-year-old giant virus 'comes back to life,'" as the piece discusses findings from Claverie's study mentioned above (Morelle, 2014). Describing such a process in those terms also implies that viruses can be both alive and dead, exploding the question of whether viruses are alive or not to instead insist that they are *both/and*. That viruses are "reawakening" or "springing to life" also indexes the process by which this happens. For Yin, the zombie virus must be introduced into a cell already infected by a virus for it to become alive again. If, as discussed above, a virus is a machine producing viral processes, then dead viruses reanimating and becoming alive similarly entangles the pastness of the dead virus (when it was once alive) to the present or future of the live virus (when the dead virus becomes alive).

Yet I argue that if we are to consider the figure of the zombie alongside the virus then we must think not of duality of living and nonliving (Povinelli, 2017), but of a triumvirate: living, nonliving, and dead. I do not solely interpret viruses as damning figures or entities but as destructive, creative, *and* neutral; living, nonliving, *and* dead; past, future, *and* present.

To return to frozen ancient viruses, the division between the living, nonliving, and dead becomes even more tenuous given that frozen viruses are kept in suspended animation, their processes and potentials lying dormant in suspended life (Lemke, 2022), a processual and relational approach to suspended animation. As discussed above, frozen viruses elide the strict distinction between living, dead, and nonliving. This happens because as an assemblage, frozen viruses embody *both* the viral particle (virion) caught in suspended animation, *and* the implied relationship assured in its eventual thawing, a viral relationship between the particle and that which it will infect (be they human, nonhuman, or both). Melted viruses have the potential to infect humans and nonhumans—humans through nonhumans—and thus entwine viruses, humans, and nonhumans together. To be in relation to the frozen and melted virus is thus to be in relation to its history, its living/nonliving/dead embodiment, and its potential and promises, promises that are *both* threatening *and* productive: the virus that kills and the virus that further unlocks evolution and the concept of life.

Conclusion: Heralds of climate change

My goal in this article was to explore the discovery of frozen ancient viruses, their inevitable thawing, and the implications of their discursive construction through the figures of ghosts and zombies. In so doing, I drew attention to the both/and quality of viruses, to *both* the fear surrounding frozen ancient viruses returning to a new ecological setting *and* the potential for said viruses to be the key to both evolutionary explorations and vaccines. I argued that frozen viruses are an allochronic assemblage of potentiality that index both new viral pathways created with their defrosting and the simultaneous pastness/ancientness, present

state, and future promise of the frozen virus. Such an assemblage engenders new kinds of viral relationality that entangle viruses, humans, and nonhumans throughout space and time in ways that come to challenge the thin lines between living, nonliving, and dead. This assemblage thus elides an either/or model of frozen viruses—viruses as either threatening or promising, living or dead or nonliving—in favor of a both/and topology.

The suspension of viruses within ice becomes a herald of climate change, for as the Earth warms and glaciers melt, frozen ancient viruses are exposed to new settings—new humans and nonhumans—and we are not all that sure how these viruses are going to (re)act. This is the fear of such viruses. But as I argued above, frozen viruses are not all that bad in part because not all viruses are bad: Ed Cohen notes that

> the omnipresence of viruses, coupled with their general inoffensiveness and their minuscule scale, make them easy to overlook. They exist almost like genetic background radiation, not very interesting until you begin to focus on it—in which case you might discover that it retains an echo of the Big Bang (Cohen, 2011: 18).

Cohen points out that most viruses we encounter (or, rather, that encounter us) are "inoffensive"; infectious, yes, but not deadly or even noticeable. Dupré and Guttinger go further, noting that

> apart from the very obvious fact that they frequently fail to kill us, there is a general reason for supposing that the vast numbers of viruses or virus-like particles found in the human body are an integral part of the system rather than a reservoir of predators, generally kept sufficiently under control to allow the system to function (Dupré and Guttinger, 2016: 110).

My exploration of frozen ancient viruses draws much needed attention to the intersection between viruses, frozenness and melting, and questions of living/nonliving/dead that are often discussed separately by new materialists, the social study of microbes, and scholars of cryopolitics. Radin and Kowal's (2017) invocation of new temporal interpretations of cryopolitics is a useful marker in this piece because it inserts temporality in my reading of frozen viruses. Rather than static, inanimate nonliving objects stuck in time, frozen viruses embody a temporality that challenges the temporality of life itself: in lieu of a past to present to future telos, frozen viruses are all three simultaneously and thus as entities caught within the web of living/nonliving/dead, frozen viruses represent the promises of what could be at a time when anthropogenic-caused climate change only intensifies.

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