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Toxic Infrastructures

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Toxic Infrastructures:

An Introduction

Nikolaos Olma and Janine Hauer

For decades infrastructures have been widely seen as the backbone of modernity, a symbol and measure of progress and development and a manifestation of socio-technical imaginaries and futures. Considering the ubiquity and scrutinising the ordinariness of infrastructure, critical social sciences have established a long tradition of "going backstage," providing a vast body of ethnography of infrastructure (Star 1999: 385) that reveals its politics and poetics (Larkin 2013) and continuously challenges its commonly unquestioned promise (Anand, Gupta and Appel 2018). This collection on toxic infrastructures is rooted in that tradition while placing it in the context of "late industrialism" (Fortun 2014: 310), the current historical moment characterised by incidents and disasters that "are everywhere, eminent and normal" (Fortun 2014, 310). In late industrialism, futures are becoming increasingly toxic, as environmental degradation and bodily harm accompany the decay of infrastructural systems and the collapse of certainties.

Our collection critically examines the processes through which infrastructures are rendered toxic. It does so by unravelling the highly complex and multi-scalar social, economic, political and cultural dynamics that inform the toxic relations between technical systems, contaminants, bodies and capital across spaces, temporalities and scales. The theme "toxic infrastructures" points to a paradox (Howe et al. 2016): although one of the main purposes of infrastructures is to mitigate risk, they can also introduce new risks in ways that transform "the[se] materials of modernity" into "instruments of slow violence" (Hecht 2018: 130). They do so not only by domesticating, enabling and mediating toxic flows as part of their regular operating cycles (Dewan and Sibilia 2023), but also by constituting contaminants themselves, as they mobilise elements, molecules and substances, and even contain and consist of toxic materials and heavily treated substances.

A landfill in Sachsen-Anhalt, Germany.
Photo: Philipp Baum, 2023.

We understand infrastructural toxicity to be a dew point of politics of neglect, deferred maintenance, cost-saving measures, political (non)decisions and lack of accountability, among other things. Such politics reshape infrastructures in ways that make possible nuclear disasters, toxic spills and water crises. In 2014, amid a state of financial emergency, the municipal water supply in Flint, Michigan, was switched from the Detroit Water and Sewerage Department—sourced from Lake Huron and the Detroit River—to the Flint River, in an effort to cut delivery costs. But officials failed to apply corrosion inhibitors to the water, resulting in lead from aging pipes leaching into the supply and exposing around one hundred thousand residents to elevated lead levels. Austerity politics here brought together materials that should not have come into contact (Hecht 2017), turning water from a source of life into a hazard, and infrastructural vitalism into lethality. The Flint water crisis was not a random occurrence—it was one of many consequences of capital withdrawing from Flint decades earlier, with the local state following suit (Pulido 2016). The result was yet another city with a majority African-American population

abandoned and left to grow increasingly poor, revealing infrastructural toxicity as a form of "infrastructural violence" (Rodgers and O'Neill 2012) that is disproportionately borne by racialised bodies and marginalised communities in places with long histories of colonialism, exploitation and institutional violence (Liboiron 2021).

The Flint water crisis serves as another reminder that, in late industrialism, disasters emerge from the "tight coupling between natural, technical, political-economic, social, and discursive systems, all of which are aging, often over-wrought, ossified, and politicized" (Fortun 2014: 310). Particularly significant here is that, more than technical systems, toxic infrastructures are deeply political objects intertwined with systemic injustice, as "polluting practices are frequently not only state sanctioned but are often in fact actively *promoted* by states pursuant to their industrial, financial and development goals" (Hall 2014: 130, emphasis in the original). We can therefore think of infrastructural toxicity as a form of systemic and inherent "planned violence" (Boehmer and Davies 2018), as state and capital force infrastructures to turn against themselves and their intended purposes. Yet we remain aware that certain toxicities are revealed only over time, as infrastructures are co-constituted by material properties too complex to oversee and manage in their entirety—particularly in temporal terms. Chemical elements are not as stable as chemistry suggests (Sawyer 2022), and discussions around the construction of complex infrastructures raise fundamental questions about the behaviour of various materials under stress, temperature, pressure and other environmental conditions. These concerns extend to the ways in which materials age or decay, as well as the kinds of residues or systemic metabolic changes their particles may trigger. In other words, there is no way to anticipate all the types of toxicity and "infrastructural harm" (Kallianos, Dunlap and Dalakoglou 2023) that the complex workings of infrastructural systems might unleash.

Grasping toxic infrastructures requires the rethinking of established divisions, scales and contexts (Liboiron, Tironi and Calvillo 2018), as well as attentiveness to the fact that harm inhabits and shapes environments differentially (Hetherington 2019). That does not make infrastructural toxicity any less potent: it is life-threatening as much as it is—quite literally—groundbreaking, as it fosters new ecologies (Dunbar-Hester 2023) and reorients future thinking (Ahmann 2024). The notion of toxic infrastructures helps us keep this tension in sight, offering a powerful tool to think through and navigate the increasingly "toxic commons" (Müller and Balayannis 2025), and to reconsider the politics and ethics of infrastructural pasts, presents and futures. Toxic infrastructures may necessitate costly remediation (e.g., the removal of asbestos from public buildings) or spark intensive debates about the (im)possibilities of relocating waste or decommissioning nuclear plants—debates that may ultimately lead to abandonment and "wastelanding" (Voyles 2015) and the emergence of sacrifice zones (Lerner 2010). For the extended "toxic timescapes" (Müller and Ohman Nielsen 2023) of toxic infrastructures and their legacies obscure and prolong bodily harm "forward into time—after the factory is gone, after the war is over, after the product is no longer on the shelf, after you no longer have a job, and even after any individual life, or any one body" (Murphy 2017: 2).

The contributions to this collection illustrate the politico-economic processes through which infrastructures become toxic, while also highlighting the social, ethical and epistemological challenges they pose for everyday life, health, environments and

social relations. Andrea Bordoli and Laura Goyhenex both locate toxic infrastructures on Indigenous lands in Canada. Bordoli demonstrates the power of images in exposing toxic infrastructures, while also underscoring the challenges of addressing the underlying mechanisms that would ultimately allow for the attribution of accountability. Goyhenex addresses the emergence of portage trails, connecting Indigenous lands to industrial ports later used to transport uranium—ultimately contaminating the surrounding land. Toxic infrastructures here are mobilised to address both the material itself, which remains the focus of ongoing cleanup efforts, and the relationships that enabled its movement in the first place and which shaped the conditions of its current circulation. Fahmi R. Fahroji shows how local farmers in Balangan, Indonesia, are forced to take jobs with the coal-mining corporation that seized their rubber plantations—depriving them of income—and brought them into close contact with toxic waste. He demonstrates in striking terms the mundane ordinariness of living with toxicity while simultaneously adhering to the promises of development (Harvey and Knox 2012). Gulzat Baialieva takes us to Kyzyl-Alma, Kyrgyzstan, where abandoned trichlorosilane fosters both despair and hope among the local population living amid the ruins of a former semiconductor materials plant. She highlights how major restructuring, imposed by Western financial institutions, led to the plant's bankruptcy, leaving no one accountable for the toxic waste and forcing the local community to find ways to endure the near post-apocalyptic aftermath of neoliberal policies and state neglect.

Jorge Afarian examines asbestos contamination in the Buenos Aires metro system. He explores how workers distinguish between acceptable and unacceptable risks, and how they grapple with the consequences of their exposure while pushing for the removal of these hazardous materials in order to safeguard both themselves and passengers. Juliana Ramos Boldrin traces the accumulation of silica in pneumoconiosis patients' lungs across time and space, emphasising the unequal distribution of toxicity in the context of mining operations in Brazil and the entanglement of infrastructures with colonial logics and inequalities. Margaret Tebbe and Fred Ariel Hernandez draw attention to the normalised presence of toxic infrastructures by examining deferred maintenance at Azusa High School in Los Angeles, advocating for ethnography to play an active role in exposing toxicity. Kaitlyn Rabach's account of defective cement in County Donegal, Ireland—where thousands of dwellings are crumbling and homeowners are exposed to toxic mould, yet do not openly acknowledge the problem so as not to devalue their houses and those of their neighbours—further complicates the tense relationship inherent in toxic infrastructures. Finally, Benjamin Steininger attends to the systemic planetary effects enabled by the upscaling of molecular chemical reactions and processes across a globally distributed infrastructure of production, dissemination and consumption, using the example of ammonia synthesis.

Through this collection, we do not mean to essentialise infrastructures or portray them as evil. Rather, given their centrality and ubiquity in everyday life around the globe, we believe that infrastructures afford a unique lens through which to capture the workings and effects of late industrialism across scales and temporalities. After all, we are fully aware that the infrastructures associated with harm are often the very same that provide employment or deliver much-needed resources—just one example of how infrastructures operate on multiple levels concurrently (Larkin 2013: 335). The articles in this issue highlight infrastructures as dynamic systems that not only enable

movement but also shape ecologies and health across diverse contexts. They delve into the lived experiences of late industrialism, offering expanded perspectives on socio-material networks and their broader impacts.

References:

Ahmann, Chloe. 2024. *Futures after Progress: Hope and Doubt in Late Industrial Baltimore.* Chicago, IL: University of Chicago Press.

Anand, Nikhil, Akhil Gupta and Hannah Appel. 2018. *The Promise of Infrastructure.* Durham, NC: Duke University Press.

Boehmer, Elleke and Dominic Davies (eds.). 2018. *Planned Violence: Post/Colonial Urban Infrastructure, Literature and Culture.* Cham: Palgrave Macmillan.

Dewan, Camelia and Elizabeth A. Sibilia. 2023. "Introduction to Special Issue: 'Scaled Ethnographies of Toxic Flows.'" *Environment and Planning C: Politics and Space* 42 (1): 5–12. https://doi.org/10.1177/23996544231218826

Dunbar-Hester, Christina. 2023. *Oil Beach: How Toxic Infrastructure Threatens Life in the Ports of Los Angeles and Beyond.* Chicago, IL: University of Chicago Press.

Fortun, Kim. 2014. "From Latour to Late Industrialism." *HAU: Journal of Ethnographic Theory* 4 (1): 309–29. https://doi.org/10.14318/hau4.1.017

Fortun, Kim. 2012. "Ethnography in Late Industrialism." *Cultural Anthropology* 27 (3): 446–64. https://doi.org/10.1111/j.1548-1360.2012.01153.x

Harvey, Penny and Hannah Knox. 2012. "The Enchantments of Infrastructure." *Mobilities* 7 (4): 521–36. https://doi.org/10.1080/17450101.2012.718935

Hall, Matthew. 2014. "Environmental Harm and Environmental Victims: Scoping Out A 'Green Victimology.'" *International Review of Victimology* 20 (1): 129–43.

Hecht, Gabrielle. 2018. "Interscalar Vehicles for an African Anthropocene: On Waste, Temporality, and Violence." *Cultural Anthropology* 33 (1): 109–41. https://doi.org/10.14506/ca33.1.05

Hecht, Gabrielle. 2017. "Toxic Infrastructures, Nuclear Nightmares, and the African Anthropocene." *Cultures of Energy, the Energy Humanities Podcast*, episode 55, 2 February. www.culturesofenergy.com/ep-55-gabrielle-hecht

Hetherington, Kregg. 2019. *Infrastructure, Environment, and Life in the Anthropocene.* Durham, NC: Duke University Press.

Howe, Cymene, Jessica Lockrem, Hannah Appel, Edward Hackett, Dominic Boyer, Randal Hall, Matthew Schneider-Mayerson, Albert Pope, Akhil Gupta, Elizabeth Rodwell, Andrea Ballestero, Trevor Durbin, Farès el-Dahdah, Elizabeth Long and Cyrus Mody. 2016. "Paradoxical Infrastructures: Ruins, Retrofit, and Risk." *Science, Technology, & Human Values* 41 (3): 547–65.

Kallianos, Yannis, Alexander Dunlap and Dimitris Dalakoglou. 2023. "Introducing Infrastructural Harm: Rethinking Moral Entanglements, Spatio-Temporal Dynamics, and Resistance(S)." *Globalizations* 20 (6): 829–48. https://doi.org/10.1080/14747731.2022.2153493

Larkin, Brian. 2013. "The Politics and Poetics of Infrastructure." *Annual Review of Anthropology* 42 (1): 327–43. https://doi.org/10.1146/annurev-anthro-092412-155522

Lerner, Steve. 2010. *Sacrifice Zones: The Front Lines of Toxic Chemical Exposure in the United States.* Cambridge, MA: MIT Press.

Liboiron, Max. 2021. *Pollution is Colonialism.* Durham, NC: Duke University Press.

Liboiron, Max, Manuel Tironi and Nerea Calvillo. 2018. "Toxic Politics: Acting in a Permanently Polluted World." *Social Studies of Science* 48 (3): 331–49.

Murphy, Michelle. 2017. "What Can't a Body Do?" *Catalyst: Feminism, Theory, Technoscience* 3 (1): 1–15. https://doi.org/10.28968/cftt.v3i1.28791

Müller, Simone M. and Angeliki Balayannis. 2025. "Toxic Commons and the Politics of Ambivalence." In E*cological Ambivalence, Complexity, and Change: Perspectives from the Environmental Humanities,* edited by Simone M. Müller, Matthias Schmidt, and Kirsten Twelbeck, 68–84. London: Routledge.

Müller, Simone M. and May-Brith Ohman Nielsen. 2023. *Toxic Timescapes: Examining Toxicity across Time and Space.* Athens, OH: Ohio University Press.

Pulido, Laura. 2016. "Flint, Environmental Racism, and Racial Capitalism." *Capitalism Nature Socialism* 27 (3): 1–16. https://doi.org/10.1080/10455752.2016.1213013

Rodgers, Dennis, and Bruce O'Neill. 2012. "Infrastructural violence: Introduction to the special issue." *Ethnography* 13 (4): 401–12.

Sawyer, Suzana. 2022. *The Small Matter of Suing Chevron.* Durham, NC: Duke University Press.

Star, Susan Leigh. 1999. "The Ethnography of Infrastructure." *American Behavioral Scientist* 43 (3): 377–91.

Voyles, Traci Brynne. 2015. *Wastelanding: Legacies of Uranium Mining in Navajo Country.* Minneapolis, MN: University of Minnesota Press.

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Breaking Points:

Mediated Contaminations, Infrastructural Toxicity

Andrea Bordoli

Since spring 2022, I have been conducting ethnographic fieldwork in the mining town of Schefferville, Northern Quebec, and the neighboring Innu community of Matimekosh–Lac John (MLJ). Nestled on Quebec's north-eastern border with Newfoundland and Labrador, at the heart of the mineral-rich Labrador Trough, this territory falls within the Nitassinan—the ancestral, unceded yet unrecognized homeland of the Innu. This article focuses on a recent case of water contamination resulting from a containment basin breach at one of the region's mining infrastructures. First, framing the incident as infrastructural violence, it highlights the complex dynamics of making contamination visible beyond local boundaries. Second, by examining one of the state-led, science-based responses to this infrastructural failure, it explores the value of thinking with infrastructural toxicity to address more precisely infrastructural violence in settler-colonial/Indigenous contexts.

Of Black Bears and Red Waters

In spring 2019, an image of a black bear drinking red-tinted water from the shores of a lake near Schefferville appeared in several provincial newspapers. Captured by Conrad André, a member of the Innu community of MLJ located adjacent to the town, this photograph was shared alongside concerns for the environmental impact of mining in the region. When questioned by the media, Tata Steel Minerals Canada (TSMC)—currently the area's only active mining company, despite mining here dating back to the 1950s—dismissed concerns, explaining that the "authorities had been informed" and that the water's coloration was "an innocuous byproduct of mining operations." Furthermore, a TSMC spokesperson urged everyone to remember that "the site in Schefferville is a mine, and not a candy shop."

A black bear drinking red water.
Photo: Conrad André
Spring 2019.

The company's statement, however, stood in stark contrast to the perspective of the MLJ Band Council. Bands are the governing units of Indigenous Nations in Canada, established under the 1876 Indian Act. In a release published shortly afterwards, representatives of the MLJ Band Council reported that regular observations had identified more than twenty contaminated sites near TSMC mining operations. These assessments were conducted jointly by community members and an independent environmental agent hired by the Council to assess the contamination levels. In order to substantiate their claims, the media release included a series of aerial photographs documenting a significant spill of contaminated water from one of TSMC's containment basins in the Goodwood area, located on Newfoundland and Labrador territory. This visual evidence—captured by independent filmmaker Benoît Desjardins, commissioned by the MLJ Band Council to document the spill from a helicopter—established a connection between the red waters as witnessed and a widespread leakage affecting multiple regional waterbodies.

Following these developments, the case received increased attention on the Quebec side of the border, where both Schefferville and MLJ are located. Quebec's Ministry of the Environment described the images as "disturbing" and "worrying," calling for further investigation into the environmental impacts of the spill. Province premier François Legault personally pledged to send specialists to Schefferville for a thorough assessment. Meanwhile, some members of the MLJ community took action and erected

↓Aerial views of the Goodwood basin spill.
Photos: Benoît Desjardins
Spring 2019.

a blockade to halt TSMC's iron ore transportation. Concurrently but independently, Patrice Couture, a professor in ecotoxicology at the Institut National de la Recherche Scientifique in Québec City, launched a research project "MiraNor: Towards Restoration and Protection of Fish Habitats Affected by Mining Activities in Northern Quebec." Focused on assessing freshwater reserves and fish health in northern Quebec's mining regions, the project included a fieldsite in the Schefferville–MLJ area.

Mediated (Remote) Contamination: Infrastructural Violence

At the time my fieldwork began in 2022, the red waters situation was still a pressing concern for the MLJ community. Many were frustrated by TSMC's inaction, as the breach in the Goodwood basin remained unrepaired. This fueled a sense of disillusionment, amplified by the fading media attention since the case was first reported. Some community members particularly lamented the lack of communication regarding the events of spring 2019. By this point, the only concrete measure taken was a fine of 33,373 CAD imposed on TSMC for multiple violations of the Canadian Environmental Protection Act. During an informal conversation, one interlocutor and MLJ community member[1] shared:

> *It has been three years, and we are still waiting for the breach to be repaired… If this had happened down South, they would have addressed it sooner. Here, nobody cares, and we still don't even know if the water is contaminated or not.*

[1] For privacy reasons I anonymize interlocutors, except for those whose names were already made public through media.

This account underscores the critical role of geographic distance and (in)visibility when addressing contamination in remote mining contexts. Scholarship on contamination, pollution and toxicity often highlights their uneven geographical and social distribution (Geissler and Prince 2020). These contexts are shaped by the interplay of slow (Nixon 2011) and infrastructural (Rodgers and O'Neill 2012) forms of violence, both of which emphasize the incremental and often hardly visible nature of contamination and toxicity. Addressing the infrastructural violence of the Goodwood basin breach thus requires engaging with its spatial and visual (media) dimensions across different scales (Dewan and Sibilia 2023). While the effects of the spill were clearly evident to residents, this localized visibility remained largely disregarded, obscured by the region's remoteness (Saxer and Andersson 2019) and by factors limiting the circulation of images documenting the case, such as the lack of independent media on-site and the overall sensitivity towards mining in the region. Broader attention emerged through the production of further visual evidence—a form of community-led "aerial activism" (Moscato 2020) — precipitating extensive media coverage and the subsequent involvement of scientists and public officials.

The challenge, then, lies in translating localized visibility into wider awareness and accountability, particularly among those with the power to enforce concrete change and address the material (infrastructural) origins of contamination. However, sporadic bursts of attention and intermittent, superficial demands for accountability are insufficient. Effective responses require ongoing engagement, decisive intervention, consistent follow-ups and transparent communication—not only to remediate environmental harm and hold the perpetrators accountable, but also to ensure that local communities remain informed and actively involved.

"Bad Land Relations": From Infrastructural Violence to Infrastructural Toxicity?

In the fall of 2022, MiraNor's initiator Prof. Couture shared some of the project's preliminary findings with the MLJ community. He highlighted the challenges of evaluating toxicity in subarctic environments, particularly due to the cold climate and low levels of biodiversity, meaning that any biological samples will necessarily be limited. Furthermore, he explained that specific fish species collected in the region were being analyzed to determine whether contamination in their habitats and bodies exceeded acceptable thresholds. Following Prof. Couture's presentation, a member of the MLJ community asked about the potential risks of contamination for humans, given that many people there regularly eat locally caught fish. Prof. Couture answered:

> *The data collected can't be used to answer such questions with certainty. Our project focuses on evaluating contamination in freshwater and fish health, which is already very challenging in this research setting.*

Mining landscapes around Schefferville.
Photo: Andrea Bordoli
Summer 2022.

During the collective meal closing the event, another community member voiced his views on the matter:

> *How do they measure contamination? How can they separate water from fishes, fishes from humans? And the image of the bear drinking red water? I don't understand. [Why are] we only talking about fish here…?*

By juxtaposing Prof. Couture's preliminary ecotoxicological reports with the reactions of MLJ community members, a disjuncture emerges between infrastructural failure, governmental and scientific responses, and local concerns and perspectives. Contemporary scientific models of evaluation, including the threshold theory of toxicity evoked by Prof. Couture, assume that water and land possess an assimilative capacity able to absorb and retain certain levels of toxic substances. These analyses, by necessity, disentangle species and elements from one another, abstracting them from their relational contexts. Moreover, as Prof. Couture acknowledged, determining threshold levels for individual species is particularly challenging in such contexts.[2]

[2] See Fontaine et al. 2023.

Métis scholar Max Liboiron critiques such perspectives for reproducing "bad land relations," arguing that they "strip away the complexities of Land—including relations to fish, spirits, humans, water, and other entities" (2021: 39–40). Beyond scientific evaluations based on threshold theories, how should toxicity be addressed in this context? How would an understanding of the Goodwood basin failure through the lens of infrastructural toxicity contribute to this analysis? Shifting the focus from (infrastructural) failure and violence to toxicity may help capture the elusive, hard-to-pinpoint nature of the harm at play here. Framing violence by its toxic dimensions offers a more precise way of understanding the "bad land relations" reproduced through standard scientific evaluations of environmental harm. These evaluations are not toxic merely because of their contingent and debatable scientific models and protocols, but because they perpetuate fundamental colonial disruptions to land and those who dwell in it (Voyles 2015; Montoya 2016, 2018; Liboiron 2021). Infrastructural toxicity thus throws into relief the ways in which toxicity is embedded within extractive infrastructures, particularly in contexts shaped by settler governmentalities and Indigenous dispossession. It also highlights how these infrastructures reproduce fundamental colonial disruptions, both materially and conceptually.

References:

Dewan, Camelia and Elizabeth A. Sibilia. 2024. Introduction to special issue: "Scaled ethnographies of toxic flows." *Environment and Planning C: Politics and Space* 42: 5–12. https://doi.org/10.1177/23996544231218826

Fontaine, Anthony, Anne Clifford Martyniuk Mackenzie, Camille Garnier and Patrice Couture. 2023. "Assessing the impacts of mining activities on fish health in Northern Québec." *Canadian Journal of Fisheries and. Aquatic Sciences* 80: 771–94.

Geissler, Paul Wenzel and Ruth Jane Prince. 2020. "'Toxic worldings': introduction to toxic flows." *Anthropology Today* 36: 3–4.

Liboiron, Max. 2021. *Pollution is Colonialism.* Durham, NC: Duke University Press.

Montoya, Teresa. 2018. "Yellow water: rupture and return one year after the Gold King Mine spill." *Anthropology Now* 9: 91–115.

Montoya, Teresa. 2016. "Violence on the Ground, Violence Below the Ground." Hot Spots, *Fieldsights.* https://culanth.org/fieldsights/violence-on-the-ground-violence-below-the-ground

Moscato, Derek. 2020. "Aerial Activism in Old-Growth Rainforest: The Ancient Forest Alliance's Drone Videography as Spatial Communication." *In The Local and the Digital in Environmental Communication, Global Transformations in Media and Communication Research – A Palgrave and IAMCR Series,* edited by Joana Díaz-Pont, Pieter Maeseele, Annika Egan Sjölander, Maitreyee Mishra and Kerrie Foxwell-Norton, 33–48. London: Palgrave Macmillan Cham.

Nixon, Rob, 2011. *Slow Violence and the Environmentalism of the Poor.* Cambridge, MA and London: Harvard University Press.

Rodgers, Dennis and Bruce O'Neill. 2012. "Infrastructural violence: Introduction to the special issue." *Ethnography* 13 (4): 401–12.

Saxer, Martin and Ruben Andersson. 2019. "The return of remoteness: insecurity, isolation and connectivity in the new world disorder." *Social Anthropology/ Anthropologie Sociale* 27 (2): 140–55.

Voyles, Traci Brynne. 2015. *Wastelanding: Legacies of Uranium Mining in Navajo Country.* Minneapolis, MN: University of Minnesota Press.

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Remediating Trails:

Addressing Toxicities from Pitchblende Transportation

Laura Goyhenex

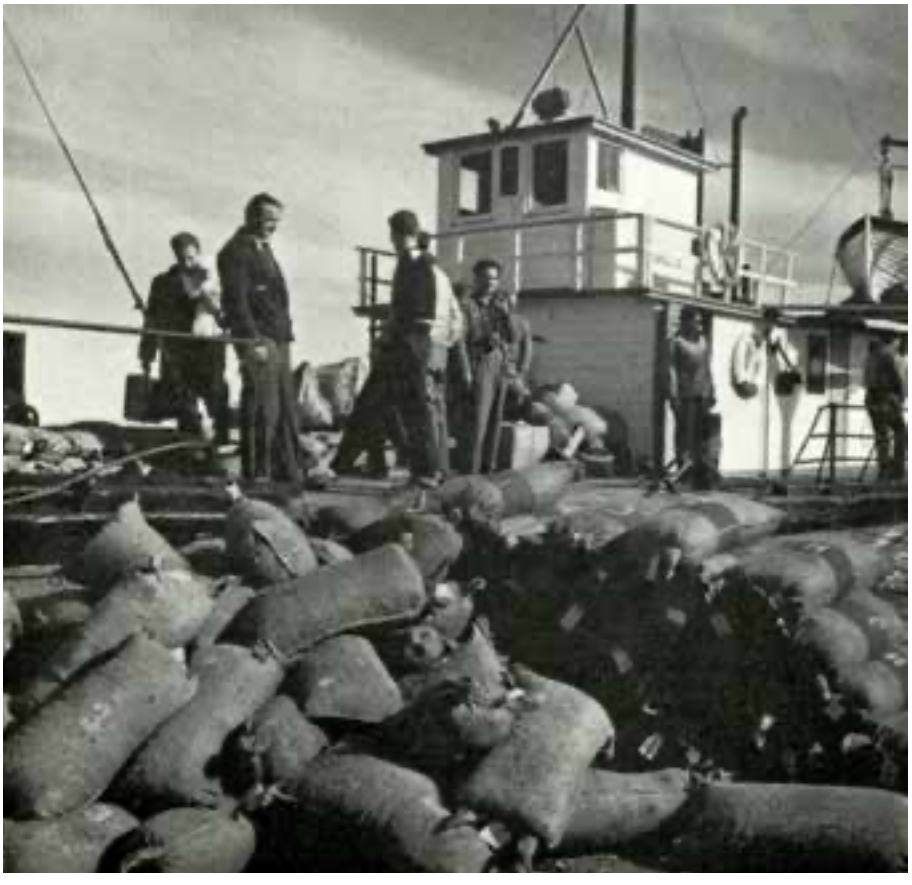
Spring is slowly coming back in the North. Earlier in the evening, the thick layer of ice on the river broke up and was rushed away in a sound of thunder. As the sky is slowly turning pink, people have gathered in the community hall for an open house to discuss the clean-up of historical spilled uranium-ore initiative on the First Nation's reserves.[1] *Open houses such as this are times for the community to be presented information by internal (e.g. Band Office) or external (e.g. consultancy companies) agents, and to discuss and give directions for how projects should be conducted on their land. During the discussion, an Elder calls attention to how spilled uranium-ore exemplifies larger issues of pollution and waste disposal that are adversely affecting his life on the land, pointing out that "We live on poisoned land right now."* (Fieldwork diary, May 2022)

[1] In this article, I mostly use English names for places and people to maintain the anonymity of the First Nations and individuals.

In this article, I look at the toxicities stemming from historical transportation and spillage of uranium-ore on Indigenous lands mentioned in the vignette above. I argue that the pollution and toxicity described as "poison" by the Elder can be understood both as contaminated materials and the colonial relations (Geissler and Prince 2020) embodied by toxic infrastructure.

Transportation of Pitchblende: New Toxicities

Between the 1930s and 1960s, pitchblende, a uranium-rich mineral, was extracted from Great Bear Lake, in the Northwest Territories, the traditional lands of several Indigenous communities. This raw material was then transported along river routes and portage trails to Waterways (Alberta), and then by railroad through Edmonton (Alberta) and finally to Port Hope (Ontario) to be refined—mostly for medical treatments and industrial applications, as well as atomic energy and weaponry. The route from Great Bear Lake to Waterways was known as the Radium Line or Radium Trail, in reference to the material transported and the name of the fleet owned by the transportation company. On that route, gunnysacks containing pitchblende were portaged over land trails around a set of impassable river rapids, on the territory of local Indigenous communities. Very little, if anything at all, was communicated to workers and communities—Indigenous and non-Indigenous—about the dangers of carrying pitchblende. On portage trails,



Gunnysacks containing uranium ore were transported via water routes and overland trails.
Photo: George Hunter (Hunter 1953).

sacks sometimes broke and spilled their contents onto the ground or were stacked in public areas in direct contact with people.

Extraction of uranium in the region ceased in the 1960s. Simultaneously, the portage trails lost their importance following the construction of all-season highways and railroads. The spillage of uranium ore was not addressed until the 1980s, and the first remediation projects—i.e. the cleaning up of materials contaminating the environment—started in the 1990s. As a displaced, radioactive material, pitchblende constitutes a new kind of presence in the land of Indigenous communities, altering the sand and the clay, the moss and the roots, while also changing bodies. Pitchblende itself, however, is not the only thing that makes the portage trails toxic.

Remediating Toxic Infrastructures: The Clean-up Project

For Indigenous communities in the Northwest Territories and Alberta, trails are valued cultural places (Baker 2021; Armstrong et al. 2023), constituting networks between communities of humans and other-than-humans, joining campsites, familial berry patches, hunting grounds and sacred sites. The portage trails on which the pitchblende was transported were cut and maintained by local Indigenous communities, whose knowledge and already existing trails were foundational, commissioned by trading companies to facilitate transportation in the region. The trails themselves were the result of collaboration, establishing division of labour, shared knowledge and mutually reliant communities at both ends of the portage. However, by the 1960s, those collaborative relations partially collapsed with the development of imperial and industrial projects (Tsing et al. 2020), and the pollution of the trails by harmful materials and toxic politics.

To understand the toxicities revolving around the portage trails and their attendant relations, I consider the conceptualization of infrastructures articulated by Cowen (2023). Among other infrastructures, Cowen highlights how settler-colonial infrastructures are anchored in ontologies of supply, ruled by settler-colonial state, feeding colonial violence and extraction. Conversely, Indigenous infrastructures are connected to ontologies of care, ruled by Indigenous legal orders, feeding life and allowing for sustenance. In the context of the transportation routes, this division emphasizes the tensions between two different ontologies and usages of portage trails—even though it is difficult to strictly separate them into distinct categories, as they tend to overlap and entangle. On one hand, the portage trails were and still are supporting vital flows of movement that are so central to life on the land, for both Indigenous and other-than-human communities. Portage trails, as sustaining collective life, can be considered as a critical Indigenous infrastructure (Spice 2018). At the same time, parts of them were also assimilated into and monopolized by imperial and industrial development projects, which led to the displacement and marginalization of communities and pollution of the land. This is a toxicity that permeates both bodies and relations.

Indigenous scholars and activists have pointed out how violence on Indigenous lands is also violence against Indigenous bodies and relations (Shadaan and Murphy 2020), which is sometimes embodied by settler, invasive infrastructures. My understanding is that the once-collaborative portage trails, absorbed and saturated by imperial and

industrial projects, can be described as toxic infrastructures: physically, as land trails and water routes were rendered toxic by radioactive materials; and metaphorically, as the toxic relationships they supported resulted in the extraction, marginalization and dispossession of Indigenous communities and knowledge by industries and governments, reinforcing colonial inequalities. Considering the intrinsic violence of infrastructure of supply (Rodgers and O'Neill 2012), the accidental spillage of uranium ore is an unsurprising failure of such infrastructures (Spice 2018). These toxicities contribute to the cumulative contaminations of development projects, such as the tar sands mines and major river dams upstream, provoking drastic ecological changes which adversely and disproportionally impact inhabitants' lives (Liboiron 2021; Dhillon 2022). These direct encounters manifest very different understandings of toxicities for communities and for bureaucracies.

The remediation project led by the First Nation problematizes these toxicities and their legacies. The initiative centres community knowledge and relations, and people's personal experiences of toxicity.

Restoring Trails and Relations

The First Nation's community-based environmental monitoring is done in parallel to and with the support of Canadian Nuclear Laboratories (CNL) and aims to clean up contaminations caused by the transportation of pitchblende on land trails. The First Nation is supported by CNL, but assessments are done and reviewed independently, with the help of consultants hired by the First Nation.

The clean-up effort consists of finding pitchblende rocks and dust in the ground by conducting gamma-radiation measurements, unearthing contaminated soil and taking it to a designated government-designed nuclear waste disposal site. For the First Nation involved, the remediation project also encompasses ethics of care for the land as kin. Cleaning up is not bounded by thresholds of toxicity as it is for settler-government policies and Western-knowledge-driven agencies, but rather in terms of relations with and care for the land and for generations to come (Gross 2021; Todd 2022), all of which is framed by the community's own legal order. The First Nation's project takes account of local, holistic knowledge, e.g. how medicines and animals are affected by contamination, thus altering community practices. The project therefore encompasses sets of knowledge and relations that are not necessarily considered within settler bureaucratic orders.

Beyond remediation, the First Nation-led initiative advocates for restoration, which is the attempt to return to the ecological conditions that existed before contamination (Keeling et al. 2015). This difference is essential, as simply cleaning up does not necessarily entail the possibility of restoring life as it was pre-contamination. As friends and Elders living in the region explained during discussions or open houses such as that mentioned above, spilled uranium ore affects first and foremost their relations with other-than-humans (for instance berries or moose) and their ability to live on the land. Beyond picking up contaminated soil, what matters most is to centre those relationships for

One end of the portage trails, and the site of the remediation project. Photo: Laura Goyhenex May 2024.

present and future generations. Thus, restoration seeks for collective life to thrive as it did before contamination events. For the community, this has to involve unrestricted access to the land, and the chance to foster relationships with other-than-human communities without the fear of toxicity. By nature, then, these clean-up projects are inscribed in different temporalities: while remediation is focused on shorter time periods, restoration finds an anchor in the long past to envision potential richer futures.

Within the framework of political ecology and environmental justice, the First Nation's project discussed can be understood as an effort to address the toxicity of infrastructures by attending to the toxic materials in the ground, as well as confronting the toxic relationships that were promulgated and reinforced on the portage trails. Looking at the portage trails as both critical Indigenous infrastructure and toxic industrial infrastructure allows us to place those trails within the larger historical context of imperial-extractive infrastructures that reshaped local relations, resulting in adverse and disproportionate effects on Indigenous communities. Rather than considering restoring relations as an effort to turn back time, this is a proposal to move beyond colonial orders and infrastructures. Remediating both material and relational toxicities is a reclamation of being at home, a way of imagining unrestricted futures on and with the land.

References:

Armstrong, Chelsey Geralda, Anne Spice, Mike Ridsdale and John R. Welch. 2023. "Liberating trails and travel routes in Gitxsan and Wet'suwet'en Territories from the tyrannies of heritage resource management regimes." *American Anthropologist* 125 (2): 361–76. https://doi.org/10.1111/aman.13817

Baker, Janelle Marie. 2021. "Logging company clears Cree Nation ancestral trail without recourse." *The Conversation.* https://theconversation.com/logging-company-clears-cree-nation-ancestral-trail-without-recourse-154921

Cowen, Deborah. 2023. "Settler colonial infrastructures and infrastructure otherwise." Intervention: "Infrastructure, Jurisdiction, Extractivism: Keywords for decolonizing geographies." *Political Geography* 101: 102763. https://www.sciencedirect.com/science/article/pii/S0962629822001779

Dhillon, Jaskiran (ed.). 2022. *Indigenous Resurgence: Decolonialization and Movements for Environmental Justice.* New York: Berghahn Books.

Geissler, P. Wenzel and Ruth J. Prince. 2020. "'Toxic worldings': Introduction to toxic flows." *Anthropology Today* 36 (6): 3–4.

Gross, Lena. 2021. "Fuelling toxic relations: Oil sands and settler colonialism in Canada." *Anthropology Today* 37 (4): 19–22.

Hunter, George. 1953. "Uranium for Atomic Power." *The Beaver* (June): 14–21.

Keeling, Arn and John Sandlos (eds). 2015. *Mining and Communities in Northern Canada: History, Politics, and Memory.* Calgary, Alberta: University of Calgary Press.

Liboiron, Max. 2021. *Pollution is Colonialism.* Durham, NC: Duke University Press.

Rodgers, Dennis and Bruce O'Neill. 2012. "Infrastructural violence: Introduction to the special issue." *Ethnography* 13 (4): 401–12.

Shadaan, Reena and Michelle Murphy. 2020. "Endocrine-Disrupting Chemicals (EDCs) as industrial and settler colonial structures: Towards a decolonial feminist approach." *Catalyst: Feminism, Theory, Technoscience* 6 (1): 1–36. https://doi.org/10.28968/cftt.v6i1.32089

Spice, Anne. 2018. "Fighting Invasive Infrastructures: Indigenous Relations against Pipelines." *Environment and society* 9 (1): 40–56.

Todd, Zoe. 2022. "Fossil Fuels and Fossil Kin: An Environmental Kin Study of Weaponised Fossil Kin and Alberta's So-Called 'Energy Resources Heritage'." *Antipode* (early view): 1-25

Tsing, Anna Lowenhaupt, Jennifer Deger, Alder Keleman Saxena and Feifei Zhou (eds). 2020. *Feral Atlas.* Stanford, CA: Stanford University Press. https://www.feralatlas.org/

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Wounded Landscape:

Ambivalence and Toxic Extractivism in Indonesia

Fahmi R. Fahroji

One night in June 2023, while I attempted to interview people about life in Wonorejo, a rubber-plantation village in Balangan, South Kalimantan, Indonesia, an excavator was actively digging coal out of a nearby open-cast mine managed by the Adaro Indonesia Coal Corporation. The roar of machinery was relentless, not only disrupting our interviews but also making it hard for village elders to sleep. This noise, sadly, was not a newsworthy event but an everyday norm for people living in the areas surrounding extraction sites like Wonorejo. Having a sense of normalcy about such noise is symptomatic of a broader system of dependence, where roads, jobs and other essential services in the town have been shaped by Adaro. This dependence not only normalizes the company's activities, but also obscures the environmental and social costs of coal extraction. The community's taken-for-granted reliance on Adaro is an example of "boring infrastructure" (Star 1999: 379)—a system of dependence that does not come into focus until daily life begins to break down.

However, noise is not the only issue here: Adaro has also been guilty of toxic exposure. In 1996, Indonesia's national newspaper, Kompas, reported that a waste pond had burst and contaminated the Balangan River. While Adaro and the national Environmental Agency immediately responded by constructing a new settling pond, reports of river pollution caused by coal-mining waste continued to emerge over the following decades. Now, only freshwater fish cage farmers continue using the river, while most residents rely on water filters, such as those provided by the Regional Drinking Water Company (PDAM). This indicates that there is another layer of infrastructure which operates beyond our view. It includes networks, installations and groundworks that facilitate coal extraction. The blaring noise of extraction signals a wider, more pervasive toxic landscape.

Meaning 'the teeming forest' in Javanese, Wonorejo was officially established in 1999 as part of the New Order government's transmigration program, which relocated people from densely populated areas like Java to less-populated regions such as Kalimantan to ease population pressure and develop agriculture. In this context, Javanese farmers were resettled in Balangan to cultivate rubber. However, the farmers' prosperity from rubber did not last long. In 2006, Adaro begun to acquire land around the village, which increasingly resulted in subtle evictions, as many transmigrants were left with little option other than to sell their land to the company. In the years that followed, the area became nothing short of a coal disposal and dump site. Adaro maintains that the company has retained its engagement through the negotiation of a corporate social responsibility (CSR) compensation fund for those affected (Adaro 2022). Nonetheless, many former residents of Wonorejo have since relocated to the neighboring village of Sumber Rejeki because they no longer had land to sustain their livelihoods. Others, facing similar challenges, moved away from Balangan altogether or returned to Java. This forced relocation was a double misfortune, since the transmigration program failed to secure the people livelihoods and resettlement. Those who remain—the subjects of this story—find that their bodies are trapped in a capitalist system which holds them captive in a wounded and poisonous landscape of extractivism.

A sign marks Adaro Indonesia's control over the former Wonorejo village, warning against entry or use of the land. Photo: Fahmi Fahroji, 2023.

Dead end: the northern boundary of Wonorejo village which is now a mining waste disposal and acid drainage area. Photo: Fahmi Fahroji, 2023.

To (not) Entangle with Toxicity

This captivity extends beyond physical displacement to an ongoing, often mundane entanglement with the toxic effects of coal extraction—both on residents' bodies and in terms of their sense of place within a changing environment. In addition to the intrusive noise of wheel loaders, people are exposed to air pollution and ground shaking due to the strip-mine blasting which occurs at the pit during the day. While the community regards the ceaseless racket as a critical warning of environmental hazards, Adaro instead blames the residents who have remained in the village. As part of its long-term plans, the company has officially slated Wonorejo for relocation because of its proximity to the existing pit and planned quarry expansion. The company dismisses people's concerns, claiming that CSR initiatives are already in place to address any economic impacts. Many locals, however, view these CSR efforts as inadequate and superficial, merely a token gesture which aims to deflect criticism (Welker 2014).

Almost all of my interlocutors hoped to sell their assets (a standard two hectares of smallholdings, a house plot and yards) to Adaro and relocate to a new place. Tukiman, a former resident of Wonorejo who eventually relocated to Sumber Rejeki to live with his son, was part of one of the first groups of transmigrants from Java. Unlike many of his neighbors who quickly agreed to sell, he initially resisted. Yet, as all his neighbors had gradually moved away, he now had no choice but to sell. However, by the time he agreed to sell his land, Adaro was no longer interested in acquiring it. The company

had moved on, and it seemed like it was playing games with Tukiman in the hope that he would accept a very low price. When I asked why he eventually decided to sell his land despite the original reluctance, he explained:

> *I have nothing else here. I have even experienced insomnia, I can't sleep at night. I can't enjoy my days either. This is because of the noise from heavy equipment and blasting. So, what to do, then, when nothing's left?* (Fieldwork interview, June 2023)

Tukiman's story reveals the ambivalence that shapes his life and that of others in a similar position. His experience is useful for understanding a profoundly melancholic process, which captures the sense of loss and disconnection engendered by landscape transformation in coal-mining areas (Dahlgren 2022). Under such an extractivist regime, villages become uninhabited spaces, while the villagers themselves are entangled in

The toxic pond on the former site of part of Wonorejo village. Photo: Fahmi Fahroji, 2023.


KOBELCO

unsolicited new relations and social practices (Skrzypek 2020). This melancholy is reflected in Tukiman's growing sense of dependency. He left behind rubber production a decade ago and has since been reliant on his son, who works for Adaro. It might be seen as contradictory that Tukiman has become an accessory to the Adaro machinery, especially given that villagers view the company's CSR efforts as mere window-dressing. He sees no future but to endure in a state of dependency: his bodily strength weakens and his rubber-tapping skills decline, meanwhile his anxiety grows. The only option as far as he can tell is to give in to extractivist growth—selling his land and relocating, not out of desire but necessity—or to let his son remain with the company that has brought him to this position.

↑ ***A farmer, barely visible under the fodder for livestock, rides a motorcycle on a road that leads now to the coal mine's settling pond area.*** Photo: Fahmi Fahroji, 2023.

↑ **Wakar *('minewatcher') hut and excavator by the dirt road*** Photo: Fahmi Fahroji, 2023.

In contrast to Tukiman, Sulastri, a fellow transmigrant farmer formerly of Wonorejo, has sustained a livelihood by joining Adaro as a *wakar* ('minewatcher') overseeing the settling pond area which was once part of his village. Wastewater from the disposal area and slag piles is channeled through pipes before being discharged into Balangan River. Standing on the edge of the pond, you can readily smell the gas of chemical liquids in the wastewater. This area also functions as a parking lot for trucks, excavators and the company's amenities. Although Adaro has put up signs nearby telling people not to swim, bathe or fish, I caught sight of villagers fishing. Amidst the poisoned ruins, people continue to seek fortune within misfortune. Strange to say, this extractivist landscape reveals a haunting beauty—a "beauty of wounds" (Kurniawan 2016).

Even as most farmers remained trapped in hardship, Sulastri's patronage by the company transformed what was once purely toxic into a source of wealth. He did not mind working as company security despite having to deal with the toxicity of coal blasting and the pungent odor of chlorine from the settling pond, as long as he got paid and had a place to live. Sulastri's connection to Adaro soon deepened, as both his sons were able to secure jobs with the company too. In this context, people can view toxicity as an acceptable risk, a paradoxical balance between the reality of a harsh environment and the hopes of job security for themselves or their children.

A Paradoxical Relationship

Claims regarding pollution have gained political weight, as the Regent of Balangan has argued that the region should receive 75 percent of Adaro's net profits due to its role as the primary coal asset holder (Fahroji 2023). This ambitious request aligns with the coal deposits that Adaro controls in its concession, estimated at 3.3 billion tons across a 34,000-hectare coalfield as of 2022. Such an interpretation also aligns with the idea that the longer Adaro remains, the more potential there is for continued environmental degradation and increased toxicity. Adaro, on the other hand, claims to be fulfilling its responsibility through CSR guarantees, from which some villages—like Sumber Rejeki—benefit in terms of financial support.

This paradoxical relationship is deeply embedded in the ambivalence that characterizes the community's ties to Adaro. The dependencies binding people and the local government to the company cultivate a harmful reliance, which in turn fosters a tendency to turn a blind eye to ongoing issues, such as the persistent pollution of the Balangan River.

This pollution, which has continued for almost three decades, often goes unnoticed or ignored. Today, Adaro's infrastructures are an inseparable part of local people's everyday life. Both Tukiman and Sulastri's experiences encapsulate the ambivalence embedded in the toxic infrastructure of coal extraction in Wonorejo. Their bodies are captive; they are anxious, melancholic and uncomfortable, they rely on Adaro but are somehow still fueled by a sense of hope.

References:

Adaro. 2022. "Annual Report 2021: Shaping a Sustainable Future through Diversification." Jakarta: PT Adaro Energy Indonesia TBK.

Dahlgren, Kari. 2022. "The Final Voids: The Ambiguity of Emptiness in Australian Coal Mine Rehabilitation." *Journal of the Royal Anthropological Institute* 28 (2): 537–55. https://doi.org/10.1111/1467-9655.13707

Fahroji, Fahmi Rizki. 2023. "Uncertain Futures of the Underground in the Ruins of a Borneo Coal Mine." MRes Thesis, University of Glasgow.

Kurniawan, Eka. 2016. *Beauty is a Wound.* London: Pushkin Press.

Skrzypek, Emilia E. 2020. "Extractive Entanglements and Regimes of Accountability at an Undeveloped Mining Project." *Resources Policy* 69: 101815.

Star, Susan Leigh. 1999. "The Ethnography of Infrastructure." *American Behavioral Scientist* 43 (3): 377–91.

Welker, Marina. 2014. Enacting the Corporation: *An American Mining Firm in Post-Authoritarian Indonesia.* Berkeley, CA: University of California press.

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Seeking Environmental Justice Amid Post-Industrial Ruins

Gulzat Baialieva

Kyzyl-Alma: Toxic Legacy of Industrial Decline

Kyzyl-Alma, a village in southern Kyrgyzstan, stands as a stark reminder of post-industrial decay. Once home to the Kristall semiconductor material plant, which produced monosilicon wafers and chips, the village suffered after the plant's privatization and eventual bankruptcy in 2010. Despite its closure, eighty tonnes of highly reactive trichlorosilane remain stored in deteriorating warehouses on the site. This toxic substance reacts violently with moisture, releasing flammable gases and corroding infrastructure. Exposure causes severe health issues, from chemical burns to respiratory distress.

Kyzyl-Alma's decline mirrors a broader pattern across Kyrgyzstan. Once-thriving industrial towns like Tash-Kömür, Mailuu-Suu and Min-Kush collapsed, leaving behind toxic waste and economic hardship. Tash-Kömür, once a coal-production hub, faced mass unemployment as industries shut down. Mailuu-Suu remains contaminated by radioactive waste, and Min-Kush saw its population shrink from twenty thousand to fewer than three thousand due to the decline of the uranium industry. Other towns so affected—including Ak-Tuz, Kok-Jangak, Suluktu and Kadji-Sai—face similar struggles.

An abandoned plant in Mailuu-Suu, Kyrgyzstan. Photo: Nikolaos Olma, 2021.

Despite its hazardous materials, Kyzyl-Alma receives little attention compared to uranium-contaminated areas benefiting from international remediation efforts. Governance failures, lack of institutional trust and weak national coordination in environmental remediation efforts contribute to these disparities. Addressing them requires political commitment and equitable resource distribution.

Slow Violence and Daily Struggles

Kyzyl-Alma's 2,500 residents endure what Nixon (2011) calls "slow violence"—harm that unfolds gradually, remaining invisible and unrecognized. Isolated and politically marginalized, they experience poverty and environmental degradation. Abandoned houses, crumbling infrastructure and dried-up vegetation illustrate the extent of the neglect. The post-Soviet neoliberal restructuring displaced many people, while those who stayed continue to suffer the plant's toxic legacy. Survival here relies on remittances from labor migrants in Russia, while elderly family members care for grandchildren. Some engage in small-scale farming or work in local schools and kindergartens. Others commute to nearby towns for hydropower jobs or sustain themselves through small trade. However, poor road connectivity makes commuting costly and difficult. Many remain simply because they own property that they cannot afford to replace elsewhere—fostering a deep, if reluctant, attachment to their home.

Voices from the Ruins: Memories and Resistance

In summer 2011, I visited my aunt Arzykan Eje, who lives in Kyzyl-Alma. That year, her son, who had migrated to Russia to work at a construction site, tragically died. Arzykan Eje blamed herself for not being able to care for him. Widowed and left without a job after the closure of the Kristall plant, she made ends meet by taking on any work she could find—scrubbing school floors, sewing clothes for home orders, and doing small jobs wherever needed. Alone and in deep despair, she had aged noticeably and her health had deteriorated. Pointing to her chintz summer dress, she explained that she could no longer wear such open clothes because of severe dermatological problems. White patches resembling psoriasis had appeared on her skin, which she attributed to the radiation emitted by the ruined plant. Initially, she suggested we stay the night but quickly changed her mind, perhaps out of concern for me and my child's safety: "You better not spend the night here, especially with a small child. I'd rather come to see you tomorrow in Shamaldy-Sai. We have strong radiation and 'heavy air' (Kg. *aba oor*) here. We are used to it; your aunt is an iron woman (Kg. *temir katyn*)", she said with a laugh[1]. "When a group of tourists from Japan came to our region, their special sensor devices showed high radioactivity. They had to rush back quickly," she added, laughing again.

[1] *Temir katyn* describes a resilient woman. The image became popular following the release of the 1990 film *Temir Xotin*, which features a character who works tirelessly around the clock.

The story about the Japanese visitors and their radiation sensors is one I heard repeatedly from various local residents. Despite its widespread circulation, I was never able to trace the original source or verify the precise details behind this anecdote. People from Kyzyl-Alma, Tash-Kumyr and Shamaldy-Sai often bring up the tale when discussing air quality and radiation concerns in the region.

Just like Arzykan Eje, local residents frequently discuss air quality, referring to radiation as "heavy air." The existence of radiation remains a contested issue, not least because locals sense exposure by means of their bodily feelings, perceiving it mainly through the lens of persistent headaches, which in turn are attributed to poor sleep caused by radiation. This belief is reinforced by the supposedly radioactive reddish hills which

are locally known as Crocodile Mountain (Rus. *Krokodilovaya Gora*), considered part of the natural environment surrounding the abandoned industrial zone.

The strategic importance of the Kristall plant made it one of several secret enterprises operating in southern Kyrgyzstan during the Soviet era. The levels of secrecy were such that, according to Arzykan Eje, speaking about the plant's internal operations was strictly forbidden. Nonetheless, locals and newcomers eagerly sought jobs there, and in the late 1980s it was considered the rising star of the Tash-Kumyr industrial zone. Many of the plant's nearly one thousand employees took pride in their association with this formally secret facility. However, the same secrecy that fuelled their sense of prestige also concealed the extent of their exposure to toxic substances. Allegedly, the high concentrations of chemicals in the workshops caused severe health issues, prompting management to provide workers with regular doses of vodka and fermented kefir, supposedly to detoxify their bodies. "Pure vodka was given to cleanse us from the inside," said Arzykan Eje, joking that despite this she managed to avoid alcoholism. Her husband died a year after being hired as a construction worker at the plant—a death she suspects was linked to the facility's toxicity. Despite years of legal battles, former workers who fell ill while working at the plant have yet to see their occupational health claims acknowledged. With deep sighs and resigned shrugs, they continue their daily lives just a few kilometres away from the source of their suffering, caught in a cycle of hardship and unfulfilled justice.

Enduring Hope Amidst Uncertainty

The plant's closure in 2010 not only stripped hundreds of workers of their income, forcing many to migrate, but also disrupted essential infrastructure services. Sewage, heating and garbage disposal were the plant's responsibility, but its bankruptcy meant these services could no longer be provided to the local community. As a result, the settlement first lost its heating, followed by its hot water supply. A year later, the sewage pipes began to corrode, causing filthy water to flow along the roads and seep near people's houses and the local school. To this day, running water is provided only two hours a day. Frequent power cuts further exacerbate the situation, with locals expressing frustration that, despite their village's proximity to Kyrgyzstan's largest water reservoir and several hydropower stations, consistent water and electricity supplies remain elusive.

In summer 2018, ninety-one residents of Kyzyl-Alma sent the following letter to President Sooronbai Jeenbekov:

> *Before the presidential election, you visited our town and promised to help us. We voted for you, hoping that you would improve life not only in big cities but also in the provinces and small towns like ours… Water, waste management, electricity cuts and economic stagnation [remain significant problems]. Water is not disinfected; it is supplied directly from the river, leading to intestinal diseases and hepatitis, especially in the autumn.* (Original in Kyrgyz, translation by the author)

The letter continues, highlighting the severe environmental and economic challenges, including unemployment, that Kyzyl-Alma faces. Residents express their aspirations for the future through calls for new infrastructure projects and convey their active hopes that the Kristall plant will be reopened. However, they also seek justice for the unresolved social and environmental issues caused by the plant, both during its operation and after its closure. The plant's bankruptcy means that there is no clear entity responsible for addressing these concerns, no one to hold accountable. Some locals view the bankruptcy as suspicious, interpreting it as a strategic move by management to evade responsibility for cleaning up environmental toxicity and maintaining infrastructure in the town. As one resident told me in 2020: "No plant, no responsibility; no one to blame and no one to make demands on."

The residents of Kyzyl-Alma and the former workers at the Kristall plant have been striving for many years to hold the plant owners and the authorities accountable. Since they first demanded state intervention to address their ruined post-industrial lives in a literally toxic environment, the government in the capital Bishkek has changed four times. Those who lack the means to leave the area, contaminated by toxic reservoirs which they fear may rupture one day, live in an environment marked by uncertainty. They hold onto hopes for social and environmental justice, believing that at some point their appeals will be heard. In the meantime, they search for ways to survive amid environmental and infrastructural challenges. Effectively abandoned and left to fend for themselves, they refuse to be passive, continuing to protest in their own ways.

References:

Nixon, Rob. 2011. *Slow Violence and the Environmentalism of the Poor.* Cambridge, MA: Harvard University Press.

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Toxic Struggles:

Asbestos in Argentina's Subway

Jorge Afarian

In 2018, the Argentinian Trade Union Association of Subway Workers (AGTSyP) became aware of the presence of asbestos in the Madrid Metro in Spain, specifically in CAF 5000 model trains. Due to the extreme toxicity of this material, which can cause diseases such as lung cancer or pleural mesothelioma, a Madrid subway worker was experiencing serious health difficulties. This same model of train had been acquired through direct purchase by the City of Buenos Aires (36 wagons) from the Government of Madrid in 2011. Asbestos has been banned in Argentina since 2001, meaning that this acquisition was conducted illegally.

The AGTSyP began to demand the removal and disposal of asbestos throughout the transport network, placing it on the daily agenda, especially as asbestos contamination was confirmed from most of the lines, across trains, tunnels and repair workshops. Some work has been carried out by companies specialized in asbestos removal, mostly in the Rancagua workshop of Line B, but these efforts have only been partial. Beyond asbestos, subway transport is inherently harmful to the health of workers, as it can lead to vision and hearing problems, disruption of the heart's circadian rhythm, and exposure to toxins that affect the human metabolism, among others (Rubio 2024). However, these other conditions have not had the same impact on workers' perceptions, especially in terms of their lethality and severity, as they are considered "occupationally acceptable" (Douglas 1986).

Asbestos-contaminated material ready for removal, Buenos Aires. Photo: Jorge Afarian, 2019.

The concept of toxic infrastructures is useful for rethinking categories such as health hazards and the acceptability of risk, especially when examining the dichotomy between what is acceptable or unacceptable in a form of transport that is seen as a symbol of modernity and progress (Zunino 2013). At the same time, though, workers experience this symbolism of progress in the context of the ban on asbestos in the country, the diseases it may cause in the future and the potential to affect passengers, who are ultimately the recipients of that 'modernity'.

"A little less lung..."

A recurring theme with the workers I interviewed is the greater danger posed by asbestos compared to other typical workplace-related ailments. Working in the subway has long served as a form of "infrastructural violence" (Rodgers and O'Neill 2012) toward workers, but asbestos contamination has added new dimensions and actors to this violence, creating "disposable lives" (Fassin 2018) in favor of capital accumulation. The disposable lives in question are those of the workers, but also those of their families and the passengers of the transport system, although only a small fraction of the latter perceive it.

In 2019, during my fieldwork, I talked to Pablo, paint-booth worker and union delegate:

> *We know we go deaf here because there are older colleagues who struggle to hear. Many young colleagues might have been affected faster. Vision too—when we go outside in the summer, your eyes hurt, and you notice it. The thing is, when we fought against unhealthy conditions* [1]*, it was about whether you had a bit more hearing or a bit more or less vision. But this asbestos issue, it's not about whether you have a little more lung capacity or less.*

[1] The "unhealthy conditions" refer to a conflict from 2002-2004 between workers and the subway companies that focused on the high decibel levels affecting hearing.

Pablo's comments reveal a certain hierarchy in health problems—between what is expected or acceptable in an environment known to be unhealthy, such as hearing impairment or vision loss, and what should never be, like asbestos contamination. It is worth emphasizing the lethality of asbestos for the body: while one can live with reduced hearing or vision, damage to the lungs is inherently life threatening. This view is reinforced by José, an electro-mechanical worker and union delegate:

> *While they were sending us for routine tests, it's within the scope of what we do. You think about the risks insurer and how they might compensate you in a lawsuit for hearing and vision loss, an injury from a metal piece that fell and broke your foot, the accepted workplace risks [in this industry]. But when they give you a scan because of asbestos, they're looking for lung cancer.*

José highlights that diseases from asbestos exposure do not fall under what is considered to be an acceptable risk. Subway work causes illnesses that reduce workers' quality of life, but it is expected within this particular working environment. In contrast, asbestos implies the risk of cancer, which is not accepted.

Subway worker wearing a protective mask, Buenos Aires.
Photo: Jorge Afarian, 2019.

Although there are some protective measures that can be taken to safeguard against asbestos exposure, such as wearing a mask, these tools are not provided to the workers (let alone the passengers) by the companies that manage the subway service and were only used by the specialized firms that carried out the asbestos removal. This serves as a reminder of the neglect that workers face from both the state and the companies involved (Emova and SBASE), while also exemplifying the invisible and "slow violence" (Nixon 2011) inflicted on the bodies of workers and passengers.

Latency and Slow Violence

The long latency period of diseases related to asbestos means that illnesses may manifest several years or even decades after the last exposure. Workers identify this as a form of uncertainty about the possibility of becoming ill, highlighting the inescapability of a future diagnosis, a matter that has been analyzed with regard to other toxic substances (Welcome 2021; Graeter 2022; Kopf 2024).

This characteristic aligns with what is known as slow violence, as latency is invisible; there is no set date when disease might appear, but the danger very much remains, never disappearing (Hecht 2018). Moreover, the perpetrators of infrastructural violence and slow violence here are the state and the companies involved in the maintenance and operation of the transport service, because they were who introduced this toxin

into the environment. This adds another dimension to the fundamental conflict between capital and labor and the power disparity between these two forces, as there is not only a struggle for wages and working conditions but also a fight for the environment and for public health.

José describes it this way:

> *So we're constantly waiting for terrible events to unfold, because there will be people getting sick. The disease has a latency period of thirty to forty years, and usually, the effects are detected after that time.*

Worker wearing a skeleton suit at a trade union protest against asbestos, Buenos Aires. Photo: Ramón Acuña, 2021.

Ernesto, another electro-mechanical worker on the subway who is already affected by pleural plaques caused by asbestos, describes his predicament:

> *So far, eleven affected colleagues have pleural plaques—I am one of them—which is the first sign of the fiber's impact on the body. The situation could stay like this for thirty or forty years, right up until the day I die from other causes, or it could just as easily lead to asbestosis or to lung cancer, or pleural mesothelioma, which is fatal.*

Latency thus appears in the form of personal uncertainty, with doubts about when illness could emerge. Although the disease might not be there physically, it is ever present in the workers' minds, as they constantly ponder a possible negative outcome. In many cases, workers have handled asbestos-contaminated material for over twenty years without being informed or protected by the state or companies.

Public Health

Asbestos does not differentiate between passengers and workers; its fibers can enter the bodies of passengers using public transport and even brief exposure can lead to disease in the future. This is another characteristic that sets asbestos contamination apart from other workplace-related conditions, which only affect subway workers. Roberto, a repair-shop employee, emphasizes this aspect:

> *There's an issue about the public health and passenger safety, because anyone who travels on the subway is at risk. They're riding on trains that are spreading contamination, moving back and forth through tunnels, dispersing microfibers. It's clearly a health issue for both workers and passengers.*

Pedro, another shop worker, also comments on the matter:

> *The public still thinks asbestos is only a worker issue because we handle the asbestos. The thing is, obviously, we're in there for six hours. But the people riding the subway are also exposed because the bituminous paint, which contains blue asbestos, covers the entire interior of the subway.*

This is why the AGTSyP has carried out numerous actions to raise public awareness of the asbestos issue. While there was little communication with passengers at the beginning, interest grew as the actions progressed. While this mode of transport aims to enhance passenger comfort, reduce risks and avoid traffic congestion, it also introduces new hazards (Howe et al. 2016). This case proves that modernity does not always align with improved health.

Conclusion

Subway transport has introduced numerous risks since its construction. Alongside the many possible ailments typical of an unhealthy working environment, asbestos adds a new level of risk, with the potential to cause cancer not only for the workers but also in passengers. However, these conditions, far from intimidating those affected, have generated forms of union resistance, which seek improvements and emphasize the prohibition, lethality, public health and environmental impact of asbestos. The experience of subway workers shows us that the best way to protect health and the environment is through collective care, ensuring a sustainable future for all.

References:

Douglas, Mary. 1986. *Risk Acceptability According to Social Sciences.* London: Taylor and Francis.

Fassin, Didier. 2018. *Por una repolitización del mundo: Las vidas descartables como desafío del siglo XXI.* Buenos Aires: Siglo XXI.

Graeter, Stefanie. 2022. "Logics of Metal Containment." *Roadsides* 7: 75–82. https://doi.org/10.26034/roadsides-202200711

Hecht, Gabrielle. 2018. "Interscalar Vehicles for an African Anthropocene: On Waste, Temporality, and Violence." *Cultural Anthropology* 33 (1): 109–41.

Howe, Cymene, Jessica Lockrem, Hannah Appel, Edward Hackett, Dominic Boyer, Randal Hall, Matthew Schneider-Mayerson, Albert Pope, Akhil Gupta, Elizabeth Rodwell, Andrea Ballestero, Trevor Durbin, Farès el-Dahdah, Elizabeth Long and Cyrus Mody. 2016. "Paradoxical Infrastructures: Ruins, Retrofit, and Risk." *Science, Technology, & Human Values* 41 (3): 547–65.

Kopf, Charline. 2024. "Anxious Atmospheres: Living in the Shadows of Coal." *Roadsides* 12: 16–23. https://doi.org/10.26034/roadsides-202401203

Nixon, Rob. 2011. *Slow Violence and the Environmentalism of the Poor.* Cambridge, MA/London: Harvard University Press.

Rodgers, Dennis and Bruce O'Neill. 2012. "Infrastructural Violence: Introduction to the Special Issue." *Ethnography* 13 (4): 401–12.

Rubio, Hernán. 2024. Asbesto. *Un asesino al acecho en los túneles de Buenos Aires.* Buenos Aires: TEL.

Welcome, Nicholas. 2021. "The Smell of Petroleum: Sensing Toxic Infrastructures." *Roadsides* 6: 54–61. https://doi.org/10.26034/roadsides-202100608

Zunino Singh, Dhan. 2013. "El subte como artefacto cultural (Buenos Aires, 1886–1944). La historia cultural como aporte a los estudios de las movilidades urbanas." *Transporte y Territorio* 9: 173–200.

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Silica Trails:

Turned Soils, Dusty Lungs

Juliana Ramos Boldrin

Dr Carlos, a pulmonologist who worked at a public teaching hospital located in a medium-sized Brazilian city,[1] told me that diagnosing pneumoconiosis can be quite challenging. Pneumoconiosis is a chronic and incurable lung disease caused by inhalation of harmful substances in the workplace, such as coal dust, phosphate rock particles, lead, asbestos, beryllium, cobalt, mercury or silica. To a large extent, the challenge mentioned by Dr Carlos relates to the fact that the symptoms of this disease – cough, decreased respiratory capacity, shortness of breath and fatigue, among others – often manifest years or even decades after initial exposure to these toxic substances. For this reason, investigating the patient's past becomes an indispensable diagnostic tool. It is necessary to carefully recall the various professional occupations that the patient has held in order to identify where and which toxic substance was inhaled. Taking as a starting point these slow and chronic respiratory illnesses caused by exposure to harmful substances in the workplaces, in this article I focus on the production and circulation of silica – a mineral widely used in numerous industrial applications which causes silicosis, the prevalent type of pneumoconiosis in Brazil (Capitani 2006). My aim is to make visible how this process of illness articulates different temporalities as a direct and predictable effect of the industrial infrastructures that shape modern

[1] The hospital is part of the Unified Health System (SUS), a public health model that provides free and universal healthcare.

life. Arguing that these industrial projects are founded on structural violence that turn poor workers' bodies into toxic storage (Graeter 2020; Graeter 2022; Welcome 2021; Kopf 2024), I explore the central and specific place that silica occupies in the construction, maintenance and operation of infrastructures. This line of enquiry reveals that the production of toxicities, far from being limited to the undesirable byproducts generated through industrial processes (Brown 1997; Taylor 2014; Landa 2016; Reno 2016), also involves the materials used to build the infrastructures themselves and the raw materials employed to manufacture their products (Howe et al. 2016; Murphy 2017; Álvarez et al. 2024).

Silica dust.
Photo: Tuaindeed / Getty Images.

Silica is utilized in metallurgy, steelmaking, foundries, the chemical industry, and in the production of ceramics and glass, among various other segments of industry. The applications of this mineral are quite multifaceted. Silica can, for instance, be a raw material in the manufacture of chips that make up our electronic devices, but it can also be a component added to other materials mobilized in the construction of infrastructures, such as in cement and rubber. Thus, from small chips to enormous concrete structures, silica occupies a central place in the materialization and operationalization of the techno-industrial complex, emerging as a component that supports infrastructures themselves.

Making up sixty percent of the Earth's crust, silica is the world's most abundant mineral. Thus, when soils are turned over, exploded, fractured, ground, crushed and sifted in the extraction processes of various minerals, dust containing minute particles of silica is released into the air–this also occurs during other activities, such as concrete manufacturing, steelmaking, civil construction and sandblasting. Due to their small size, these particles remain suspended in the air and are inhaled by miners, bricklayers and other workers involved in these activities. It is no coincidence that silicosis is also known as asma dos mineiros, or 'miner's asthma' (Heloani 2005) in Brazil, one of the world's leading producers and the largest exporter of so-called metallurgical silica. In addition to generating ruined landscapes and its countless environmental and social impacts, mining is the activity that bears the greatest responsibility for workers falling ill with this disease in the country (Souza and Monteiro 2019).

Over time, this particulate matter inhaled daily and invisibly by workers accumulates in their lungs and, as Dr Carlos pointed out, symptoms often do not begin to manifest until years later. In many cases, regulations and inspections to control exposure to the dust are not sufficiently rigorous and even though workers undergo regular check-ups, as Magdalena Górska (2016) shows, the disease's gradual, insidious development means that pneumoconiosis is frequently only identified when the person is already having difficulty breathing.

These silica-saturated lungs bring to light the permeability of bodies and the ways in which toxicities persist across different times and spaces (Müller and Ohman Nielsen 2022), operating as mechanisms of "slow violence" (Nixon 2011) through an act so mundane and so vital as breathing. Silently and routinely, workers' lungs are converted into toxic storage and their lives are gradually and irreversibly altered by lack of air. Following the trails of silica—from turned soils to damaged and dusty lungs—reveals the "asthmatic quality" that characterizes the air of late industrialism (Ahmann and Kenner 2020: 418). As Ahmann and Kenner (2020) contend, airborne toxicity is not an unforeseen or accidental side-effect of industrial activity. On the contrary, as the case of silica makes plain, toxicity is a constitutive dimension of industrial extraction infrastructures that transform exposure into a condition of employment. Moreover, silica elucidates the fact that toxicity is to be found not only in otherwise undesirable byproducts of industrial processes.

As several authors have shown, although toxicity has become a constitutive condition of our modern world, it is not equally distributed (Fortun 2012; Braun 2014; Chance 2018; Sharpe 2016; Garnett 2020; Mbembe 2021). Apropos silicosis, this issue becomes especially evident when we pay attention to the fact that, in Brazil, this disease primarily affects male, poor and racialized bodies performing poorly regulated, precarious, low-paid and physically demanding labor. In short, it is poor workers who are exposed to the risk of illness and whose futures are compromised by shortness of breath. This profoundly unequal distribution of risks demonstrates that race, gender and class are fundamental to understanding the slow and chronic dimensions of "infrastructural violence" (Rodgers and O'Neill 2012). In fact, inequalities seem to be an "economic convenience" (Miguel, Taddei and Figueiredo 2021: 4).

In a country like Brazil, deeply marked by social inequalities inherited from colonialism, this infrastructural violence is inseparable from the geopolitics of power. One example of this is that metallurgical silica produced in Brazil is exported and undergoes purification processes carried out by countries in the Global North to obtain silicon, a semiconductor material that, as mentioned above, is used in the manufacture of chips that make up electronic devices. In other words, the silica particles that accumulate in workers' lungs are entangled with this dynamic of production and circulation of raw materials, showing that infrastructural violence cannot be thought of separately from the "unequal geographies of racial capitalism and colonial extraction" (Ahmann and Kenner 2020: 1). Countries in the Global South so often pay the environmental, social and respiratory costs of the extraction enterprises that nurture the comforts and privileges of the Global North. At the same time, it is noteworthy that the poorest segment of the population also has little access to the benefits generated by infrastructure, which is often precarious or even absent, especially when we think about access to electricity, potable water, public transport and so on. Hence, when we look at the impacts of infrastructure from the point of view of the Global South, it is evident that neither the risks nor the benefits are equally distributed (Simone 2004; Miguel, Taddei and Figueiredo 2021).

In so effectively crossing time and space, silica makes visible how toxicity connects different scales through production chains that entangle the poor breathing conditions and colonial geopolitics which mark our world. Considering how the production and circulation of silica is permeated by dynamics of exploitation that, among other things, culminate in irreversible disease, infrastructures appear as material arrangements that are not only based on entrenched inequalities and colonial logic but also actively contribute to their proliferation and intensification through processes that convert workers' bodies into the matter and energy of capitalist enterprises (Mbembe 2021).

Conclusion

Silica provides a powerful lens through which to capture the toxicity involved in the raw materials used to build infrastructures and maintain their operation. I have sought to highlight how such toxicity shapes and reconfigures bodies, underlining the unequal distribution of risks and benefits while also being a problem inseparable from inequalities and colonial logics that underlie industrial projects. More specifically, slow and chronic infrastructural violences unfold from an act as vital and mundane as breathing, rendering it a mechanism for producing asphyxiation that operates through everyday, lethal exposure. This turns lungs into deposits of toxic particles, compromising vitality and longevity.

In a time marked by the collapse of infrastructures and also by the need to modernize them (Ahmann and Kenner 2020), silica-saturated lungs make it clear that breathing is an unequally shared right (Mbembe 2020), despite being a vital necessity. In this sense, the elemental trails of silica allow us to perceive that developing infrastructures capable of addressing the challenges of today and creating breathable futures requires taking into account the dynamics of exploitation which ensure the comforts and benefits of some at the expense of the illness and precariousness of others.

References:

Ahmann, Chloe and Allison Kenner. 2020. "Breathing Late Industrialism." *Engaging Science, Technology, and Society* 6: 416–38. https://doi.org/10.17351/ests2020.673

Álvarez, Belén, José Silvestre, Antonio García-Martínez and Benito Montañés. 2024. "A comparative approach to evaluate the toxicity of building materials through life cycle assessment." *Science of the Total Environment* 912: 1–12. https://doi.org/10.1016/j.scitotenv.2023.168897

Braun, Lundy. 2014. *Breathing Race into the Machine: The Surprising Career of the Spirometer from Plantation to Genetics.* Minneapolis: University of Minnesota Press.

Brown, Phil and Edwin Mikkelson. 1997. *No Safe Place: Toxic Waste, Leukemia, and Community Action.* Berkeley: University of California Press.

Capitani, Eduardo. 2006. "A silicose (ainda) entre nós." *Jornal Brasileiro de Pneumologia* 32 (6): 1–2. https://doi.org/10.1590/S1806-37132006000600003

Chance, Kerry. 2018. *Living Politics in South Africa's Urban Shacklands.* Chicago: University of Chicago Press.

Choy, Timothy. 2011. *Ecologies of Comparison: An Ethnography of Endangerment in Hong Kong.* Durham: Duke University Press Books.

Fortun, Kim. 2012. "Ethnography in Late Industrialism." *Cultural Anthropology* 27 (3): 446–64. https://doi.org/10.1111/j.1548-1360.2012.01153.x

Garnett, Emma. 2020. "Breathing Spaces: Modeling Exposure in Air Pollution Science." *Body and Society* 26 (2): 55–78. https://doi.org/10.1177/1357034X20902529

Górska, Magdalena. 2016. *Breathing Matters: Feminist intersectional politics of vulnerability.* Doctoral Thesis, Studies in Arts and Science. Linköping University.

Graeter, Stefanie. 2022. "Logics of Metal Containment." *Roadsides* 7: 75–82. https://doi.org/10.26034/roadsides-202200711

Graeter, Stefanie. 2020. "Infrastructural Incorporations: Toxic Storage, Corporate Indemnity, and Ethical Deferral in Peru's Neoextractive Era." *American Anthropologist* 122 (1): 21–36.

Heloani, Roberto. 2005. "Corpo e trabalho: instrumento ou destino?" *Psicologia Hospitalar* 3 (2): 1–18. http://pepsic.bvsalud.org/scielo.php?script=sci_arttext&pid=S1677-74092005000200003&lng=pt&nrm=iso

Howe, Cymene, Jessica Lockrem, Hannah Appel, Edward Hackett, Dominic Boyer, Randal Hall, Matthew Schneider-Mayerson, Albert Pope, Akhil Gupta, Elizabeth

Rodwell, Andrea Ballestero, Trevor Durbin, Farès el-Dahdah, Elizabeth Long and Cyrus Mody. 2016. "Paradoxical Infrastructures: Ruins, Retrofit, and Risk." *Science, Technology, & Human Values* 41 (3): 547–65.

Kopf, Charline. 2024. "Anxious Atmospheres: Living in the Shadows of Coal." *Roadsides* 12: 16–23. https://doi.org/10.26034/roadsides-202401203

Landa, Mónica Salas. 2016. "Crude Residues: The Workings of Failing Oil Infrastructure in Poza Rica, Veracruz, Mexico." *Environment and Planning A* 48 (4): 718–35.

Mbembe, Achille. 2021. *Brutalismo.* São Paulo: n-1 edições.

Mbembe, Achille. 2020. *O direito universal à respiração.* São Paulo: n-1 edições.

Miguel, Jean Carlos, Renzo Taddei and Felipe Figueiredo. 2021. "Coronavirus, infrastructures and the sociotechnical (dis)entanglements in Brazil." *Social Sciences & Humanities Open* 4 (1): 1–5. https://doi.org/10.1016/j.ssaho.2021.100146

Müller, Simone and May-Brith Ohman Nielsen. 2022. *Toxic Timescapes: Examining Toxicity across Time and Space.* Athens, OH: Ohio University Press.

Murphy, Michelle. 2017. "Alterlife and Decolonial Chemical Relations." *Cultural Anthropology* 32 (4): 494–503. https://doi.org/10.14506/ca32.4.02

Nixon, Rob. 2011. *Slow Violence and the Environmentalism of the Poor.* Cambridge, MA and London: Harvard University Press.

Reno, Joshua O. 2016. *Waste Away: Working and Living with a North American Landfill.* Berkeley, CA: University of California Press.

Rodgers, Dennis and Bruce O'Neill. 2012. "Infrastructural Violence: Introduction to the Special Issue." *Ethnography* 13 (4): 401–12.

Simone, AbdouMaliq. 2004. *For the City Yet to Come: Changing African Life in Four Cities.* Minneapolis, MN: University of Minnesota Press.

Sharpe, Christina. 2016. *In the Wake: On Blackness and Being.* Durham, NC: Duke University Press.

Souza, Tamires and Inês Monteiro. 2019. "Produção mineral no Brasil: Ensaio teórico sobre a epidemiologia da silicose." *Revista CIATEC-UPF* 11 (1): 70–77. https://doi.org/10.5335/ciatec.v11i1.9295.

Taylor, Dorceta. 2014. *Toxic Communities: Environmental Racism, Industrial Pollution, and Residential Mobility.* New York: New York University Press.

Welcome, Nicholas. 2021. “The Smell of Petroleum: Sensing Toxic Infrastructures.” *Roadsides* 6: 54–61. https://doi.org/10.26034/roadsides-202100608

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Repairing Toxic:
Deferred Maintenance in Schools

Margaret Tebbe and Fred Ariel Hernandez

Schools, in the era of late industrialism (Fortun 2012), have become sites of infrastructural decay. Comprehensive data on their condition in the United States are sparse. Most studies estimate that around half of the one hundred thousand public schools nationwide have at least one major infrastructural problem (Eitland et al. 2017; U.S. Government Accountability Office 2020; Filardo 2021). These toxicities take many forms: lead pipes, broken air-circulation systems, buildings that cannot withstand extreme weather and toxic, heat-absorbing landscapes. Moreover, the buildings are precariously maintained via piecemeal repairs.

The toxic exposure produced by this decay represents a gap in understanding for both educators and environmental justice movements. In this article, we highlight how late industrial ethnography can make visible some of the toxic hazards in school buildings that produce, are embedded within, and are formed by late industrial management and repair. Both of the authors came to this work through ethnographic research in primary and secondary schools that was not initially focused on the environment but led us to recognize the importance of schools in environmental governance. Part of late industrial ethnography is studying the world not just as it is, but as it should be—

hence, we draw on ethnographic observation and interviews, along with our experiences teaching students of all ages, to uncover and address environmental injustice. All of these experiences were designed to operate as ethnographic encounters that "challenge and change existing order, [and provoke] new orderings of subjectivity, society, and culture" (Fortun 2012: 450).

Student interns at Azusa High School compare a satellite map of the school campus and their hand-drawn maps. Photo: Fred Ariel Hernandez, 2022.

Our primary site is Azusa High School (AHS), a predominantly Latino and low-income school located about twenty miles east of downtown Los Angeles. AHS was built in the late 1950s, shortly before the Interstate-210 freeway was constructed directly adjacent.

Azusa High School borders a freeway that carries hundreds of thousands of vehicles per day, producing massive quantities of toxic air pollution. Photo: Margaret Tebbe, 2024.

One of the authors (Hernandez) is an AHS alumnus and began to engage in environmental work after becoming an extracurricular sports coach in 2003, the same year that California became the first state to prohibit building schools within five hundred feet of major roads.

Cross-country markers on the edge of the Azusa High School campus, less than fifty feet from the freeway.
Photo: Fred Ariel Hernandez, 2022.

We also draw on seventy interviews conducted with undergraduate students at University of California, Irvine between 2022 and 2025. These interviews were carried out with students in Anthropology 25A: Environmental Injustice, a large undergraduate course at UC Irvine taught by Kim Fortun, one of the authors (Tebbe) and others (Fortun et al. 2023). The course itself is an experiment in late industrial ethnography, and highlights students' experiences within contemporary school infrastructures. Here, we describe two forms of toxic infrastructure—water sources and turf fields—before returning to the value of late industrial ethnography for witnessing and understanding toxic infrastructures.

Water Infrastructure

Water fountains, potent symbols of segregation in the United States, now illustrate the uncertainties of late industrial toxicity. "Do not drink" signs—along with narratives about how you should not drink tap water (Balazs 2011)—are everywhere in older schools. One student from the San Joaquin Valley, a heavily agricultural region of California, shared her memories of such signs:

> *The only exposure I had to the danger of pesticides would be in our bathrooms. The sinks would have a sign that said "Do not use for formula for babies," "Do not drink water," or "External use only." That's something I distinctly remember was in my high school. But also, it was like the pipes that were next to it were like the water fountain. So, which one is which?*

Aging concrete water fountain near the sports fields at AHS. Plant matter collects in the center. Two spigots function, one is missing, another rusted.
Photo: Fred Ariel Hernandez, 2022.

A handwashing basin at Azusa High School with a sign above it warning users not to drink the water.
Photo: Fred Ariel Hernandez, 2022.

A newly installed filtered water bottle-filling and handwashing station at Azusa High School.
Photo: Fred Ariel Hernandez, 2023.

At AHS, the sole water fountain available to Junior Varsity American football, soccer and track athletes is an aging concrete relic. There is no sign or message indicating whether the water is potable, but it works just fine when the handle is pressed. Across the AHS campus, some fountains are neglected and others have been updated. Some have visible filters and some warn of non-potable water, but none share detailed information to explain why students and staff should not drink the water.

When some water fountains are updated and others not, or when only a portion get "non-potable" warnings, it produces distrust and toxic uncertainty (Auyero and Swistun 2009). At the school, repair requests are relayed up the 'chain of command' by coaches, teachers and cafeteria staff, while principals and administrators send decisions down. Students are almost entirely excluded from this process. This echoes the "disassembled" context of late industrialism, where "various parts never come together" (Fortun 2012: 454). Even maintenance staff, who are most responsible for day-to-day fixes and upgrades on campus, are not privy to district-wide replacement plans. Given the piecemeal repairs and intermittent institutional communication, decisions about which fountains are safe or unsafe are often based only on the fixture's appearance.

Artificial Turf

Across the United States, schools are 'upgrading' their fields to artificial turf. Often touted as a water-saving measure, especially in drought-prone regions like Southern California, Los Angeles includes artificial turf in its definition of green space. This turf also eliminates the costs associated with watering, tending and manicuring living

Close up of AHS's turf field. Pellets are visible in between the blades of artificial grass. Photo: Fred Ariel Hernandez, 2023.

grass. AHS installed its turf field and track partially in the hope that it would help attract new students and enrich existing students' experiences, combating sharply declining enrollment. Almost without fail, everyone saw artificial turf as an exciting new investment compared to the old dirt track and pothole-riddled grass field

Late industrialism is not just about aging infrastructure. It is also about 'new' technologies, still dependent on fossil fuels and toxic chemicals, upon which "consumers [come to] love and depend" (Fortun 2014: 311)—like artificial turf. Students, especially athletes, know that turf can be harmful. When the ambient air temperature is 95°F/35°C, turf can reach as much as 160°F/72°C—hot enough to feel it through shoes and cleats (Aubrey 2008; Knox 2022; Munoz and Manthey 2022). One student who played high school football in Texas described his strategies to cope with the heat:

> *A foot above the turf field … you could see the air waving. And it was definitely talked about, we would purposefully spill water on the turf to cool it down and stuff. And then we would try our best to not lay on it until we put our wet shoes on the turf.*

Despite this knowledge, turf is "just something we deal with"—the heat is part of the price of having a field that symbolizes modernity and care for the school.

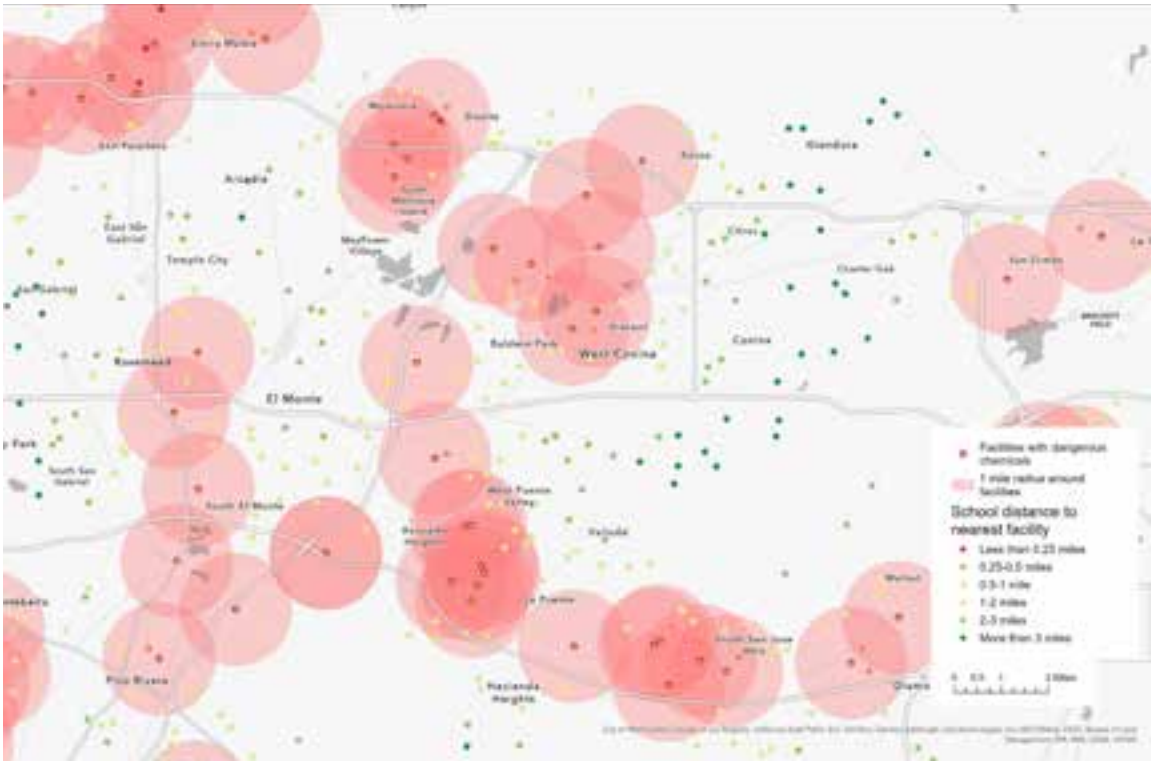
Pellets being tracked off the field at Azusa High School. These pellets can travel across campus and even to students' homes. Photo: Fred Ariel Hernandez, 2023.

Turf has also been linked to carcinogens and other toxins, but these concerns are much less well known (Llompart et al. 2013; Duque-Villaverde et al. 2024). Turf fields contain rubber pellets that help the plastic grass stay upright. When students discussed the problems these pellets presented, they focused on the "mess" that they made—not how they break down and release chemicals on contact, a toxic feature that the students are not necessarily aware of.

Conclusion: Ethnographic Attention and School Infrastructures

Thus far, we have focused on our ethnographic observations of inattention and uncertainty around toxic exposures in and from school infrastructure. This toxicity comes from many sources: aging infrastructure, piecemeal repairs and new technological fixes. Our awareness is diverted away from all of these by the appearance of modernity: a fancy new water fountain or a turf field. Late industrial ethnography, however, promises more than a diagnosis of what is—it also speaks to what should be. The design of our research should support our interlocutors' ability to address both of these arenas. A key task for ethnographers, then, is to build educational programs—for K-12 students, undergraduates, and adults—that support such modes of inquiry.

One example of such work is Anthropology 25A: Environmental Injustice. Students often come into the class without the tools to perceive or understand toxic infrastructures in schools or communities, and a central goal of the course is to foster this analytic ability. It centers on students developing group case studies of environmental injustice in and around a California school that they select. Student work is supported by a variety of tools designed to make late industrial hazards visible and to envision futures beyond late industrialism not yet imagined. These tools include digital maps built by one of the authors (Tebbe) that bring together public and private environmental data and analytic exercises called sketches, which provide a 'light structure' for students to explore many different types of data and knowledge without overdetermining what they will find. The course has spawned many offshoots, including a state-sponsored high-school curriculum and several high-school internships, one of which took place at AHS.



Risk Management Plan facilities (in red, with a one-mile radius) and schools near Azusa. RMP facilities use dangerous chemicals, such as hydrofluoric acid. Map: Margaret Tebbe, 2024.

The interviews conducted with Anthropology 25A students can be understood not just as evaluation or ethnographic data gathering, but as a tactic for developing students' reflexivity. During our interviews, students are asked to describe environmental problems in their own communities and schools. The process of articulating their experiences with toxicity—with prompting from the interviewer—combined with their work in the course helps them see things that they would not otherwise have noticed or understood. Late industrial ethnography calls for a move beyond diagnosis to the generation of novel futures, in part using methods like interviews to collaboratively create new insights with interlocutors. In Anthropology 25A and other internships and curricula, the authors have witnessed how this benefits students as they develop confidence that they can use what they have learned in combination with their own skills as engineers, doctors, educators and social scientists to understand toxic infrastructures and challenge toxic futures.

References:

Aubrey, Allison. 2008. "High Temps on Turf Fields Spark Safety Concerns." *NPR,* 7 August. https://www.npr.org/2008/08/07/93364750/high-temps-on-turf-fields-spark-safety-concerns

Auyero, Javier and Débora Alejandra Swistun. 2009. *Flammable: Environmental Suffering in an Argentine Shantytown.* Oxford, New York: Oxford University Press.

Balazs, Carolina Laurie. 2011. *Just Water? Social Disparities and Drinking Water Quality in California's San Joaquin Valley.* PhD thesis, University of California, Berkeley. https://escholarship.org/uc/item/8z17v6gt

Duque-Villaverde Andres, Daniel Armada, Thierry Dagnac and Maria Llompart. 2024. "Recycled tire rubber materials in the spotlight. Determination of hazardous and lethal substances." *Science of The Total Environment* 929: 172674. https://doi.org/10.1016/j.scitotenv.2024.172674

Eitland, Erika, Lacey Klingensmith, Piers MacNaughton, Jose Cedeno Laurent, Jack Spengler, Ari Bernstein and Joseph G. Allen. 2017. "Schools for Health: Foundations for Student Success." Cambridge, MA: Harvard T.H. Chan School of Public Health, Healthy Buildings Program. https://healthybuildings.hsph.harvard.edu/wp-content/uploads/2024/10/Schools_ForHealth_UpdatedJan21.pdf

Filardo, Mary. 2021. "State of Our Schools: America's PK-12 Public School Facilities." Washington, D.C.: 21st Century School Fund. https://files.eric.ed.gov/fulltext/ED581630.pdf

Fortun, Kim. 2014. "From Latour to Late Industrialism." *HAU: Journal of Ethnographic Theory* 4 (1): 309–29. https://doi.org/10.14318/hau4.1.017.

Fortun, Kim. 2012. "Ethnography in Late Industrialism." *Cultural Anthropology* 27 (3): 446–64. https://doi.org/10.1111/j.1548-1360.2012.01153.x

Fortun, Kim, Prerna Srigyan, Nadine Tanio and Margaret Tebbe. 2023. "Teaching with Storylines That Call Students In." *Ten Strands* (blog), 16 February. https://tenstrands.org/teaching-with-storylines-that-call-students-in/

Knox, Pam. 2022. "How Hot Does Pavement Get in Summer?" *Climate and Agriculture in the Southeast* (blog), 12 May. https://site.extension.uga.edu/climate/2022/05/how-hot-does-pavement-get/

Llompart Maria, Lucia Sanchez-Prado, Pablo Lamas, Carmen Garcia-Jares, Enrique Roca and Thierry Dagnac. 2013. "Hazardous organic chemicals in rubber recycled tire playgrounds and pavers." *Chemosphere* 90 (2): 423–31. https://doi.org/10.1016/j.chemosphere.2012.07.053

Munoz, Anabel and Grace Manthey. 2022. "The Push for Greener Schools: How Community Groups Are Fighting Extreme Heat Inequities." *ABC7 Los Angeles*, 2 September. https://abc7.com/extreme-heat-in-southern-california-schools-how-much-is-my-community-impacted-by-inequity-los-angeles-unified-school-district/12191406/.

U.S. Government Accountability Office. 2020. "School Districts Frequently Identified Multiple Building Systems Needing Updates or Replacement." Report to Congressional Addressees GAO-20-494. Washington, D.C. https://www.gao.gov/assets/gao-20-494.pdf

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Toxic Recurrences

Kaitlyn Rabach

Like many in Ireland, Sharon begins her morning with a cup of tea. Living with defective concrete, however, makes her routine a bit unusual. Due to the extreme dampness in her home, only one working electrical outlet remains on the first floor. In the kitchen—the room most affected by mold—she moves swiftly to limit her exposure. Many homes in County Donegal, Ireland are full of cracks and mold, and are turning into dust.[1] Sharon's house is one of more than thirty thousand buildings in Donegal crumbling due to the failures of a self-regulated construction industry. Low estimates for addressing just the housing aspect of this disaster exceed 3.2 billion euros and the current governmental redress scheme is rooted in a politically contaminated system—with regional abandonment, "laughable science" (Rabach 2024) and stalled bureaucracy.

[1] Donegal remains the epicenter of the disaster. Here you can read about other affected counties.

Unlike other examples of late industrialism (Fortun 2014) with environmental pollutants coming into the home, the toxic substances present in Sharon's place are produced by the structure itself. The home itself has become toxic. Based on ethnographic fieldwork in County Donegal from 2022 to 2023, I trace the "toxic flows" (Dewan and Sibilia 2023) in the defective concrete homes crisis to unpack the major roles that repeated abandonment and failed governance have played in both producing and prolonging

these toxic exposures. Following Ali Kenner's (2019) invitation to translate "mold into pharmakon," I argue that the intimate relationship between homeowner, infrastructure and mold has ignited new forms of political resistance and activism in Ireland.

Iron sulfides like pyrite have been identified as the main culprits in Donegal's defective concrete. Due to their presence, many homes are crumbling.
Photo: Angela Tourish, 2024.

Concrete and Contamination

During the Celtic Tiger years (1995–2007) the construction industry in Ireland was self-regulated, which resulted in a system without comprehensive audit or inspection—as new property developments, the majority made of concrete, nearly tripled.[2] Concrete, now seen as synonymous with modernity (Forty 2012), is "dense with contradictions and possibilities" (Woodworth and Chu 2024: 3). In Ireland, the contamination which resulted in the defective concrete crisis happened across many sectors—at the concrete factories, at the level of local and national governance, and finally the polluting of homes and neighborhoods. With demand rising, concrete factories cut corners. At the cement quarries they diluted the mix with aggregate full of iron sulfides, producing poor-quality blocks that have disintegrated over time (Leemann et al. 2023). Donegal

[2] See Ó Broin 2021 on building defects during the Celtic Tiger years.

County Council continued to use these concrete companies for local projects, boosting trust in them. Amid a mounting housing crisis, the Irish national authorities placed concrete industry professionals on some of the most substantial regulatory committees for the construction industry.[3]

[3] For an analysis on the stakeholders of the crisis, see Ireland's Timeline: On the Precipice by Debra MacCoy.

Mary Douglas's (2005 [1966]: 36) early work argues that common pollutants such as dirt/waste are "matter out of place," meaning they are not inherently dirty but that they have an ability to disrupt social order when present in our environment. The crumbling blocks in defective concrete homes were thus out of place and in need of containment/reordering. In the case of defective concrete, the pollution actually "enabled and maintained ways of life" (Liboiron, Tironi and Calvillo 2018: 342) because it allowed the industry to build at a pace that matched the financial boom. By turning

Extreme dampness and mold are some of the symptoms of defective concrete. For many homeowners, navigating mold's toxicity has become an everyday reality.
Photo: Angela Tourish, 2024.

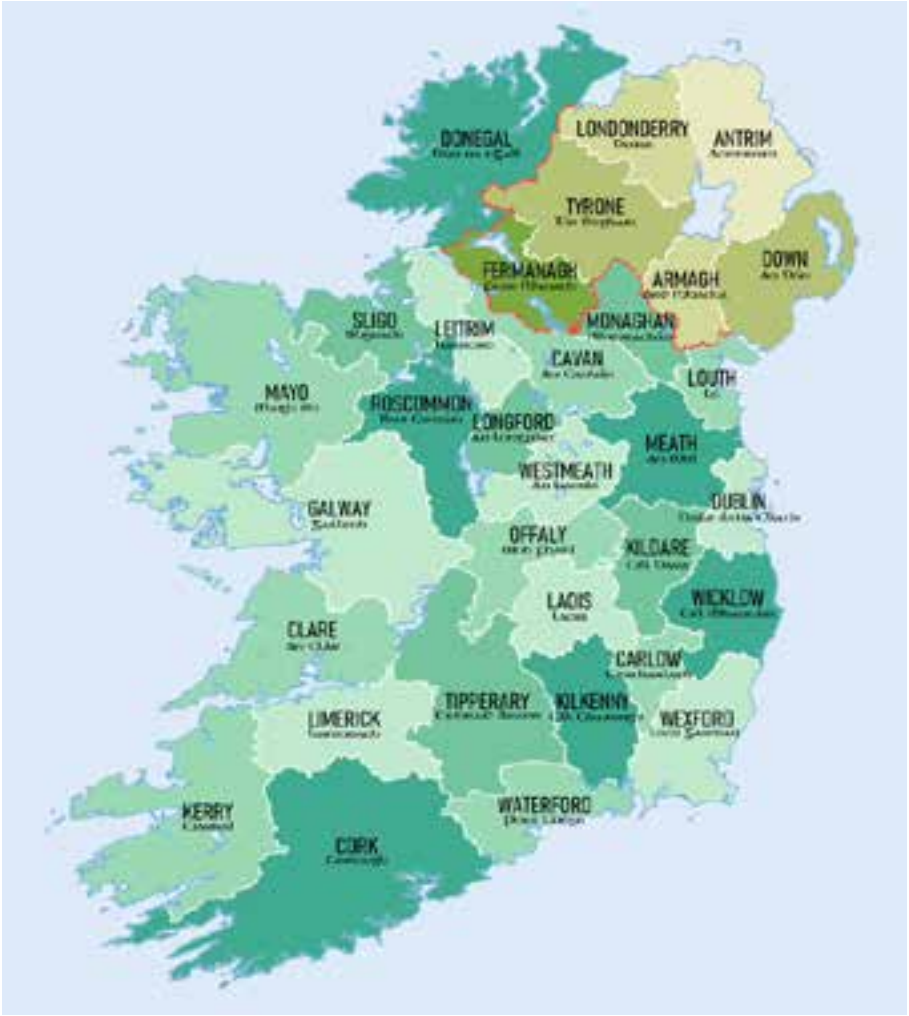
a blind eye to contamination, the government was able to meet the housing demand; meanwhile, social order was disrupted in the homes and neighborhoods themselves. For Douglas, the very definition of home is about bringing a space under control (Douglas

1991), but for these homeowners, mold, cracks and the overall structural stability of their homes were far from controllable.

Latency and Slow Violence

In some places, maintaining the façade of a structurally stable neighborhood, the very integrity of that neighborhood, became the main priority. One homeowner in Letterkenny explained:

> *"No one wanted to be that neighbor. For years no one wanted to admit it. Both to ourselves, but also to others. We kept our heads in the sand because to take our heads out, to say we had it [defective concrete] meant to out our entire [housing] estate. Just by saying it aloud we completely devalued not only our house but the one next door. We all knew we had it, but we couldn't say it out loud."*



Map of Ireland, displaying the island's partition and County Donegal's isolation from the rest of the Republic.
Source: Wikipedia Commons.

By acknowledging the reality of their crumbling homes, homeowners were in danger of polluting the social order. Defective concrete was creating disorder and thus required sorting out. In some instances, threats and insults were targeted at some of the homeowners who were the first to admit that their homes had defective building materials.

Repeated Exposure

When homeowners exposed the situation, they were subject to repeated neglect. Suffering "slow violence" (Nixon 2011), many described the defective concrete disaster as a "slow moving tsunami." The ongoingness of the problems calls us "to delve into the past to exhume the violent structures of social disparity" (Davies 2021: 23–24) that continue to linger in the contemporary landscape. In Donegal, much of this contemporary abandonment dates from the creation of the modern Irish state and the partition that this entailed. Located in the northwestern corner of the Irish mainland, over ninety percent of the county's land border is with Northern Ireland. Donegal suffered several bombings during the Troubles. Nicknamed the "forgotten county," there are still no train lines that link Donegal with the rest of Ireland, nor connections to the national gas network. It was one of the last counties to access high-speed broadband. The physical and political distance from Donegal to Dublin could be a major factor in why defective concrete in the county has not been given serious attention from national lawmakers. Previous iron sulfide disasters have been swiftly remedied in Dublin, but the drawn-out approach for Donegal is yet another example of the county being left behind.

Some of my interlocutors remarked that current remedies by the government are "laughable." After years of denial, the government finally convened an expert panel in 2015. Relying on a desktop study rather than proper examination of the material in question, the panel identified the wrong mineral as the culprit of the crisis, resulting in major delays for those looking to rebuild. While homeowners continue to live in toxic boxes, the government has not prepared plans to arrange temporary housing while their homes are being rebuilt. The few families who have been able to access the convoluted bureaucratic system of redress are facing shortfalls of up to eighty thousand euros. Many homeowners who need to use the scheme are reminded of previous institutional violence by the Irish state and its failed remedies.[4]

[4] See here for an example of another failed Irish redress scheme.

Mold as Pharmakon

With the assistance of local action groups, Sharon and other homeowners had their homes tested for mold (O'Reilly 2023). Results showed elevated fungal spores of Aspergillus and Penicillium, which emit mycotoxins that can cause fever, chills, shortness of breath, headaches, and long-term problems such as liver and kidney damage and immune deficiency (Shurety 2024). Penicillium mold also naturally produces penicillin, the most widely used antibiotic in the world. The mold in Sharon's home, then, is pharmakon—both remedy and poison. In her work on the housing crisis in Philadelphia, Ali Kenner argues that mold can act as a "remedial pharmakon of the Anthropocene," an element which can "expose deeper social values and priorities and perhaps policies" (Kenner 2019). In Donegal, exposing the mold in defective concrete houses became a tipping-point

in homeowners' campaign for a one hundred percent redress or full compensation to rebuild their homes. Images of the problem were released via national news coverage and the public gained awareness of the health impacts of mold exposure.

Yielding themselves as toxic subjects, "subjects, human and otherwise, that have been produced by harms that are degrading" (Morgan and Fortun 2020: 4), these Donegal homeowners are shifting the politics of activism in rural Ireland. Instead of hiding the pollution, many are opening up their homes to journalists and documentarians, sharing stories of what it means to breathe late industrialism (Ahmann and Kenner 2020). They have refused to support the two traditional center-right parties—Fine Gael and Fianna Fáil—and have harnessed their experiences to become "accidental politicians," using their intimate knowledge of failing infrastructure to create an anti-mainstream political party. This new party—100% Redress—became the third most represented party on Donegal County Council and now has a representative in Dáil Éireann, Ireland's primary legislative body. By bringing in experts to test their domestic spaces for mold, they are pushing against the government's former desktop studies. Using mold as pharmakon, they are refusing to allow their campaign to dwindle.

References:

Ahmann, Chloe and Alison Kenner. 2020. "Breathing Late Industrialism." *Engaging Science, Technology, and Society* 6: 416-38. https://doi.org/10.17351/ests2020.673

Davies, Thom. 2021. "Geography, Time, and Toxic Pollution: Slow Observation in Louisiana." In *A Research Agenda for Geographies of Slow Violence,* edited by Shannon O'Lear, 21–39. Northampton, Massachusetts: Edward Elgar Publishing. https://doi.org/10.4337/9781788978033.00006

Dewan, Camelia and Elizabeth A. Sibilia. 2023. Introduction to special issue: "Scaled ethnographies of toxic flows." *Environment and Planning* 42 (1): 5–12. https://doi.org/10.1177/23996544231218826

Douglas, Mary. 2005 [1966]. *Purity and Danger: An Analysis of Concept of Pollution and Taboo.* London and New York: Routledge.

Douglas, Mary. 1991. "The Idea of a Home: A Kind of Space." *Social Research: An International Quarterly* 58: 287–307.

Fortun, Kim. 2012. "Ethnography in Late Industrialism." *Cultural Anthropology* 27 (3): 446–64. https://doi.org/10.1111/j.1548-1360.2012.01153.x

Forty, Adrian. 2012. *Concrete and Culture: A Material History.* London: Reaktion Books.

Kenner, Ali. 2019. "Mold." *Fieldsights.* https://culanth.org/fieldsights/mold

Leemann, Andreas, Barbara Lothenbach, Beat Münch, Thomas Campbell and Paul Dunlop. 2023. "The 'Mica Crisis' in Donegal, Ireland – A Case of Internal Sulfate Attack?" *Cement and Concrete Research* 168 (June): 107149. https://doi.org/10.1016/j.cemconres.2023.107149

Liboiron, Max, Manuel Tironi and Nerea Calvillo. 2018. "Toxic Politics: Acting in a Permanently Polluted World." *Social Studies of Science* 48 (3): 331–49.

Morgan, Alli and Kim Fortun. 2020. "Toxic Soldiers, Flickering Knowledges, and Enlisted Care: Dispossession and Environmental Injustice." *Catalyst: Feminism, Theory, Technoscience* 6 (1). https://doi.org/10.28968/cftt.v6i1.32808

Nixon, Rob. 2011. *Slow Violence and the Environmentalism of the Poor.* Cambridge, MA and London: Harvard University Press.

Ó Broin, Eoin. 2021. *Defects: Living with the Legacy of the Celtic Tiger.* Dublin: Merrion Press.

O'Reilly, Rita. "Mould and debt add to homeowners' mica and pyrite nightmares." *RTE*, 7 September 2023. https://www.rte.ie/news/primetime/2023/0905/1403578-mould-and-debt-add-to-homeowners-mica-and-pyrite-nightmares/

Rabach, Kaitlyn. 2024. "'Laughable Science': The Irish Government's Response to the Crumbling Homes of Donegal." *Backchannels.* https://4sonline.org/news_manager.php?page=35567

Shurety, Elara. 2024. "Moldy Homes: Toxicity, Race, and the Geographies of Domestic Mold." *Progress in Environmental Geography* 4 (1): 3–23. https://doi.org/10.1177/27539687241307956

Woodworth, Max D. and Cecilia L. Chu. 2024. "Concrete: An Introduction." *Roadsides* 11: 1–6. https://doi.org/10.26034/roadsides-202401101

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Ammonia Synthesis:

Entering a Ubiquitous Chemical Technosphere

Benjamin Steininger

The molecule ammonia (NH_3) is synthesized under high pressure and with the help of catalysts from atmospheric nitrogen (N_2) and from hydrogen (H), which is gained either from water or more commonly from natural gas. The geographer Vaclav Smil (2001) ranked this chemical process—pioneered by Fritz Haber and Carl Bosch in the early years of the last century—above iconic innovations of modernity such as computers, television and space travel. As a core compound of industrial fertilizers, ammonia was central to the 'green revolution' in agriculture and thus to global food production. As a key compound of ammunition, ammonia has also been involved in mass destruction. Finally, as a technological platform, the process of ammonia synthesis gave rise to petrochemistry. In these three ways, this process contributes behind the scenes ('infra') to the fundamental conditions of most of the visible structures integral to the twentieth century and the Anthropocene.

Certain aspects of this story are well known. In Germany, the Haber–Bosch process is one of the landmarks of scientific success. Since 1913 ammonia was produced at Oppau-Ludwigshafen by BASF—just in time to supply ammunition for the First World War. The reputation of Fritz Haber encapsulates the tensions inherent in this: he has been both ostracized as a war criminal for inventing poison gas as a weapon and awarded with a Nobel Prize in 1918 for inventing ammonia synthesis (Szöllösi-Janze 1998). Other aspects of this industry remain invisible. Few would have heard of companies like CF-Industries, Yara, Nutrien, OCI, Qatar Fertilizer Company, Sinofert, Safco—world market leaders in producing substances that end up becoming part of our very own bodies.

This article rethinks the industrial infrastructures of ammonia synthesis and follows some of its associated toxicities. Particular attention is paid to the openness of these infrastructures. High-pressure ammonia plant facilities work as clearly defined environments. But the reactors and tubular structures of an ammonia plant only form the visible core of a technical structure which puts into communication almost all planetary spheres—resources from the atmosphere and lithosphere, with processes in the biosphere and hydrosphere—plus a wide set of economies, politics and further technologies.

Microlandscape on the Haber–Bosch catalyst surface, a high-pressure reactor, World War I battlefield, algal bloom in Baltic Sea, war news on an ammonia pipeline in Ukraine.
Collage: Author, 2024.

Questions of scale are central to the industry of ammonia synthesis. Catalysis chemists themselves describe their understanding of the process as "multiscalar" (Schlögl 2015: 3535). What they deal with stretches over fifteen orders of magnitude between the picoseconds and nanometers of actual molecular interactions, microseconds of "surface transport" on the catalyst materials to the meter and hour ranges of the visible industrial machinery (Ibid.).

Yet where the scales of ammonia production end, the ranges of impact that define its role only begin—in agricultures, economies, histories, ecologies and, as Anthropocene scholarship shows, in actual and future Earth systems—adding further orders of magnitude to the picture. Cultural theory and geography are challenged to interpret those multiscalar processes of ammonia synthesis and their products as a central part of the global "technosphere" (Haff 2014: 126) that defines the actual and future

human condition. For such an endeavor it is not just the quantitative scales that matter, but even more so the qualitative implications of technological interventions that practically and theoretically blur formerly defined frontiers between natural and cultural or historical processes.

Ammonia synthesis is on many levels an almost classic example of techno-science. Even the catalyst that is used to connect nitrogen and hydrogen is not a natural material but was invented around 1910 by BASF (Ertl 2008): it is a solid body composed of iron with chemical additives of potash, calcium, aluminum and oxygen. On an engineering level, the process necessitates high-pressure apparatuses to meet the thermodynamic needs of the reaction: around 200–300 bar pressure and 400–500 degrees Celsius. It also involves production units before and after to create the synthesis gas (a mix of hydrogen and nitrogen), as well as to further process ammonia into marketable products such as fertilizers. Shortly after experimental proofs in 1909, production plants opened in 1913 (Oppau-Ludwigshafen) and 1917 (Merseburg-Leuna). After the First World War, the Allies also started to use the process. Even today, however, it takes the full mobilization of all ranges of physico-chemical infrastructures such as femtosecond lasers (fmsec = 0,000.000.000.000.001 sec), photoemission electron microscopy and digital modelling to—still not fully—grasp what happens during the process on and within the catalyst's surfaces (Ertl 2008; Ertl and Soentgen 2015).

The interpretation of this infrastructure, and its respective forms of toxicity, means interpreting interactions of the technology with very different environments—including biological-material spheres but also spheres of socio-cultural institutions and politics, which enable and maintain this type of techno-science. In this sense, ammonia synthesis belongs both to micro-chemistry and to macro-politics.

With the fixation of nitrogen the vast space of the atmosphere has become a chemical resource of planetary technology. In quantitative terms, the industrial process fixes as much nitrogen as all the natural processes of nitrogen fixation on Earth, such as in bacteria through the help of enzymes like nitrogenase. With the second chemical resource, hydrogen, the precise sites of production plants are also connected to vast areas and economies of extraction, such as the natural gas fields in the lithosphere. A full flowchart of the process before and after the plant could start literally anywhere in the atmosphere and end anywhere in the biosphere, seeing as over the last century large parts of both were affected by intentional fertilizer use and even more by its unintended consequences.

This contrasts the concept of control as a core issue of the whole project of ammonia synthesis—on a molecular level as a high-pressure technology, and as a means to technologically correct the unavoidable loss of fixed nitrogen from soils—identified in the nineteenth century as a distortion of formerly closed nitrogen cycles between plant and animal organisms. The project of planetary correction, the establishment of a controlled 'second nature,' was a failure, giving way to landscapes that can be defined as "third nature" (Böhme 2018), as hybrids of technological planning and unavoidably uncontrollable dynamics. Soils and landscapes affected by ammonia synthesis are paradigmatic third natures. Less than a third of the fertilizer applied to agricultural land reaches the actual arable crop and, thus, food production (Ertl and Soentgen

2015: 14). The rest is washed away, leading to large-scale water problems due to algal blooms. The drastic effects of fertilizers therefore involve both the planned growth of arable crops for world markets and unplanned oceanic dead zones, prominently in the Gulf of Mexico and the Baltic Sea.

This is most salient form of toxicity of ammonia synthesis infrastructures. Yet obviously, toxicity here is not to be considered as an absolute mechanism. It is the specific interactions between chemical products, agricultural systems and aquatic life—and thus a whole set of relationships between different process regimes and infrastructures—that produce the concrete effect. Not only is it infrastructures that need to be scrutinized for their toxicity, but also toxicities should be examined for their infrastructural aspects (Murphy 2017).

What type of toxicity should be addressed at a particular site and in a specific historical scenario depends very much on the location in question. It also depends on epistemological interest. A scholarly perspective on the political and historical environments of this industry can identify forms of toxicity (e.g. connections to war crimes and injustice) that could go unnoticed by chemical toxicologists.

Two types of sites offer good examples with respect to their geographical-historical--political-ecological networks of toxicity. The first type is represented by Oppau-Ludwigshafen and Leuna in Germany, which were the first industrial ammonia plants on the planet. Their most obvious form of toxicity lies in the field of war technology. The violence of the battlefields at Verdun was somehow anticipated in the high-pressure reactors of the hinterland. In the famous explosion of the fertilizer silo in Oppau in 1920—almost an anticipation of the explosion in the port of Beirut in 2020—this destructive power was tangible in peacetime without being debated in terms of ecological explosiveness or toxicity. Following its gaining of "technological momentum" (Hughes 1969), however, from the 1920s onwards ammonia synthesis became central to the development of other high-pressure technologies, in particular in petrochemistry. The political environment of this technological breakthrough involved US partners from the oil industry, such as Standard Oil of New Jersey. It also led to close ties between I.G. Farben (into which BASF was merged in 1926) and the German Nazi regime. I.G. Farben even managed parts of the Auschwitz concentration camp complex and was heavily involved in the Shoah.

Also sites of postwar ammonia production are embedded both in biological and political environments. Whereas the principle of catalytic high-pressure synthesis was retained and simply optimized, the source of hydrogen changed to natural gas. New ecological toxicity is consequently involved on the input side, since natural gas is a highly problematic resource due to methane leakage and extraction by way of shale fracking with its notoriously toxic additives. The world's biggest ammonia factories were built near large natural gas fields from the 1960s onwards in Louisiana, at the "sacrifice zone"—the petrochemical corridor on former plantations that carries not just ecological also but historical-political burdens of enslavement (Lerner 2012; Misrach and Orff 2012; Bullard 2015). In the 1970s, the USSR's biggest plants were constructed on the Volga as part of a large USA–USSR ammonia versus grain deal (Gerlach 2010: 485), involving an ammonia pipeline from Togliatti to Odessa which was in operation

until 2023. Under the conditions of globalization since 1990, large plants were built in China and on the Persian Gulf. Ammonia and thus food production appears more than ever intimately connected to all the manifold ecological and geopolitical pitfalls of petromodernity.

Future fertilizer infrastructures might work with different catalysts, reduced energy consumption or green hydrogen, and may entail less run-off. Nonetheless, as long as the nitrate industry unavoidably connects lithospheric, biospheric, atmospheric and technospheric processes, the need to reflect on its specific planetary ambivalences, contradictions and toxicities will stay.

References:

Böhme, Hartmut. 2018. "Ökologie, Ästhetik und Technik in der dritten Natur." In *Dritte Natur. Technik. Kapital. Umwelt,* edited by Steffen Richter and Andreas Rötzer, 7–22. Berlin: Matthes & Seitz Berlin.

Bullard, Robert D. 2015. "Environmental justice in the 21st century: Race still matters." *Phylon* 52: 72–94.

Ertl, Gerhard. 2008. "Reactions at surfaces: From atoms to complexity" (Nobel lecture). *Angewandte Chemie International Edition* 47 (19): 3524–35.

Ertl, Gerhard and Jens Soentgen (eds). 2015. *N. Stickstoff—ein Element schreibt Weltgeschichte.* Munich: oekom.

Gerlach, Christian. 2010. "Das US-amerikanisch-sowjetische Getreidegeschäft 1972." In *Ökonomie im Kalten Krieg. Studien zum Kalten Krieg* (Band 4), edited by Bernd Greiner, Christian Müller and Claudia Weber, 480–500. Hamburg: Hamburger Edition.

Haff, Peter. 2014. "Humans and Technology in the Anthropocene: Six Rules." *The Anthropocene Review* 1 (2): 126–36.

Hughes, Thomas. 1969. "Technological momentum in history: Hydrogenation in Germany 1898–1933." *Past & Present* 44: 106–32.

Lerner, Steve. 2012. *Sacrifice Zones: The Front Lines of Toxic Chemical Exposure in the United States.* Boston: MIT Press.

Misrach, Richard and Kate Orff. 2012. *Petrochemical America.* New York: Aperture.

Murphy, Michelle. 2017. "Alterlife and Decolonial Chemical Relations." *Cultural Anthropology* 32 (4): 494-503.

Schlögl, Robert. 2015. "Heterogene Katalysatoren – fundamental betrachtet." *Angewandte Chemie* 127 (11): 3531–89.

Smil, Vaclav. 2001. *Enriching the Earth: Fritz Haber, Carl Bosch, and the Transformation of World Food Production.* Cambridge, MA: MIT Press.

Szöllösi-Janze, Margit. 1998. *Fritz Haber.* 1868–1934. *Eine Biographie.* München: Beck.

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