Edited by Simone M. Müller and May-Brith Ohman Nielsen

Toxic Timescapes

Examining Toxicity across Time and Space

SERIES IN ECOLOGY AND HISTORY

Toxic Timescapes

OHIO UNIVERSITY PRESS SERIES IN ECOLOGY AND HISTORY

James L. A. Webb, Jr., Series Editor

Conrad Totman
The Green Archipelago: Forestry in Preindustrial Japan

Timo Myllyntaus and Mikko Saikku, eds.
Encountering the Past in Nature: Essays in Environmental History

James L. A. Webb, Jr.
Tropical Pioneers: Human Agency and Ecological Change in the Highlands of Sri Lanka, 1800–1900

Stephen Dovers, Ruth Edgecombe, and Bill Guest, eds.
South Africa's Environmental History: Cases and Comparisons

David M. Anderson
Eroding the Commons: The Politics of Ecology in Baringo, Kenya, 1890s–1963

William Beinart and JoAnn McGregor, eds.
Social History and African Environments

Michael L. Lewis
Inventing Global Ecology: Tracking the Biodiversity Ideal in India, 1947–1997

Christopher A. Conte
Highland Sanctuary: Environmental History in Tanzania's Usambara Mountains

Kate B. Showers
Imperial Gullies: Soil Erosion and Conservation in Lesotho

Franz-Josef Brüggemeier, Mark Cioc, and Thomas Zeller, eds.
How Green Were the Nazis? Nature, Environment, and Nation in the Third Reich

Peter Thorsheim
Inventing Pollution: Coal, Smoke, and Culture in Britain since 1800

Joseph Morgan Hodge
Triumph of the Expert: Agrarian Doctrines of Development and the Legacies of British Colonialism

Diana K. Davis
Resurrecting the Granary of Rome: Environmental History and French Colonial Expansion in North Africa

Thaddeus Sunseri
Wielding the Ax: State Forestry and Social Conflict in Tanzania, 1820–2000

Mark Cioc
The Game of Conservation: International Treaties to Protect the World's Migratory Animals, 1900–1946

Karen Brown and Daniel Gilfoyle, eds.
Healing the Herds: Disease, Livestock Economies, and the Globalization of Veterinary Medicine

Marco Armiero and Marcus Hall, eds.
Nature and History in Modern Italy

Karen Brown
Mad Dogs and Meerkats: A History of Resurgent Rabies in Southern Africa

Diana K. Davis and Edmund Burke III, eds.
Environmental Imaginaries of the Middle East and North Africa

David Gordon and Shepard Krech III, eds.
Indigenous Knowledge and the Environment in Africa and North America

James C. McCann
The Historical Ecology of Malaria in Ethiopia

Benjamin Reilly
Slavery, Agriculture, and Malaria in the Arabian Peninsula

Stuart McCook
Coffee Is Not Forever: A Global History of the Coffee Leaf Rust

Graeme Wynn, Jane Carruthers, and Nancy J. Jacobs, eds.
Environment, Power, and Justice: Southern African Histories

Simone M. Müller and May-Brith Ohman Nielsen, eds.
Toxic Timescapes: Examining Toxicity across Time and Space

Toxic Timescapes

Examining Toxicity across Time and Space

Edited by

Simone M. Müller and

May-Brith Ohman Nielsen

Ohio University Press

Athens

Ohio University Press, Athens, Ohio 45701

ohioswallow.com

Printed in the United States of America

Ohio University Press books are printed on acid-free paper ∞ ™
31 30 29 28 27 26 25 24 23 22 5 4 3 2 1

Library of Congress Cataloging-in-Publication Data
Names: Müller, Simone M., editor. | Nielsen, May-Brith Ohman, 1962– editor.
Title: Toxic timescapes : examining toxicity across time and space / edited by Simone M. Müller and May-Brith Ohman Nielsen.
Description: Athens : Ohio University Press, [2022] | Series: Ohio University Press series in ecology and history | Includes bibliographical references and index.
Identifiers: LCCN 2022028167 (print) | LCCN 2022028168 (ebook) | ISBN 9780821425046 (paperback) | ISBN 9780821425039 (hardcover) | ISBN 9780821447871 (pdf)
Subjects: LCSH: Pollution—History. | Human ecology. | Toxicology.
Classification: LCC TD174 .T69 2022 (print) | LCC TD174 (ebook) | DDC 577.27—dc23/eng/20221011
LC record available at https://lccn.loc.gov/2022028167
LC ebook record available at https://lccn.loc.gov/2022028168

publication supported by a grant from
The Community Foundation for Greater New Haven
as part of the Urban Haven Project

CONTENTS

ACKNOWLEDGMENTS

Once pressed between two boards, sealed in the orderly form of consecutive chapters, books give an appearance of predetermination and a pathway dependency that neither captures the lively and unruly discussions among contributors nor the myriad loops of irritation and revision that help shape the texts' final form. Standing in line with other pieces of writing on a library shelf, a book also reveals little about the detailed negotiations flying back and forth between editors and press or the institutional and financial backing turning an idea into a readable reality. In this section, we seek to do justice to at least some of these unruly and lively processes that eventually transformed *Toxic Timescapes* from many possible outcomes into the one book that is before you today. Many people and institutions have helped us along this way, and we would like to express our gratitude to all of them.

Toxic Timescapes started off with a workshop at the Rachel Carson Center for Environment and Society at LMU Munich in December 2017. At this lighthouse for environmental humanities with a staff that outdid itself to help us organize this workshop, the desire was born to continue thinking together on how different temporal and spatial frames influence how scholars in the environmental humanities approach and understand life on a polluted planet. Our most heartfelt thanks go out to all the participants of this workshop, who with their papers, their commentaries, or their conference report have breathed life into *Toxic Timescapes* as a tool of analysis. Their enthusiasm and feedback have pushed us to consider *Toxic Timescapes* as an endeavor to support both scholarship and teaching, to better understand the interlocked and overlapping times and spaces that come together in contamination stories. Some of them find themselves as authors in this book. The marvelous poetry reading on *polychronography* by Christopher Cokinos, functioning as the workshop's keynote, gave us the assignment that became the backbone of many writings in *Toxic Timescapes,* namely to think through "temporalities smeared across various stylistics in order to reveal and investigate material flows and networks perceived through the sequential process of writing and reading from an individual point of view."

At a writing retreat at Fevik, Norway, together with Thom Davies and Marco Armiero and in historic company of world-famous writer Roald Dahl, we further refined the meanings of *Toxic Timescapes,* defining the layout of the individual chapters and the overall composition of the edited volume. We could not be more grateful to the generosity of Thom and Marco, two great minds and equally great colleagues. To have the time to think and write in an undisturbed environment is a privilege granted to us by the University of Agder in Kristiansand, Norway, an institution that did not tire to support us in myriad ways throughout the entire production process of *Toxic Timescapes.*

Toxic Timescapes is built around conversation and exchange, most importantly those happening among the authors of the individual sections. Hearing our call on "coherence," they followed our lead into in-depth exchanges between section authors as well as our suggestions on where to draw connections between the different pieces. It has been a great honor to work with these wonderful and gifted scholars, and we have been humbled by their willingness to immediately respond to yet another "small query" in the production process of this book. *Toxic Timescapes* has also been shaped by conversations with scholars beyond the authors in this book. There is the DFG research group Hazardous Travels with Ayushi Dhawan, Maximilian Feichtner, and Jonas Stuck, as well as the Deadly Dreams network with Anne Jorunn Frøyen, Anne-Mette Seines, Victoria Østerberg and Thomas Johnsen. They have not tired to hear and respond to several iterations of this book's theme, and also helped to keep up our morale.

We would like to thank Hannah Roberson for the immaculate language proofreading, Christina Lennartz for shepherding authors and images, and both the University of Agder and the German Research Foundation (DFG) for financially supporting this book endeavor.

Finally, the editors would also like to thank each other—for splendid cooperation and interesting discussion, for their mutual shared strife for depth and editorial ambitions, and for managing to prioritize this book in a maze of scientific and professional commitments and pandemic unpredictability.

INTRODUCTION

Simone M. Müller and May-Brith Ohman Nielsen

"LIKE THE fury of a raging sea, a bubbly ocean of glowing sulphur, hydrogen and oxygen" arranges itself in the massive and luminous molecular nebula Messier 17, declared the European Space Agency, describing the Hubble Telescope image on the cover of this volume.[1] In this bubbly ocean, in one of the richest star fields of the Milky Way, ultraviolet radiation from young massive stars illuminates the gases' wavelike patterns by heating the surfaces of cold hydrogen gas clouds. As a result, the warmed surfaces glow orange and red, making for some of the most spectacular galactic sights. The intense heat and pressure within the nebula cause some material to stream away from the surface, creating the glowing veil of even hotter, green-colored gas that masks background structures.[2] In 1746, French astronomer Philippe de Chéseaux discovered Messier 17, also known as the Omega Nebula. He described it as "quite different from the other [nebulas]," with the "perfect form of a ray or the tail of a comet," giving rise to M17's nickname as the Swan Nebula.[3]

At first sight, the Swan Nebula is an odd example with which to start an interdisciplinary environmental humanities volume on examining toxicity across space and time—and yet, on closer inspection, the image of the radiantly glowing molecular nebula could not be more fitting. Contaminants and environmental poisons work on the human and more-than-human body through the temporal and spatial dissolution of linearity, order, rhythm, location, or containment in a way that is mirrored in the galactic spectacle. Moreover, the Swan Nebula represents a "toxic environment" that fundamentally challenges and even dissolves conservative and predominantly Western notions of space, time, timing, and speed, while inviting similar reflections—as provided in the thirteen contributions in this volume—for life on Earth.

Firstly, the Swan Nebula is located in proximity to planets with genuinely Gaussian temporalities, which—as these planets generate space-time vortices due to general relativity—calls into question all measurements of time and place. Because of the finite speed of light, our vision of the Swan Nebula is a historic snapshot of light that has traveled through space for 5,500 years, allowing us a glimpse of a place that is at such a great distance from our planet that it would take multiple human generations to make the journey there. Multiple generations are also at stake when it comes to toxicity and contamination on our planet, as chemical contaminants exceed human and more-than-human lifespans, disrupt rhythmicities of time as organized into equal compartments, and interfere with the time and timing of cellular growth and the development of multicellular bodies and their offspring.

Secondly, Messier 17 challenges conservative understandings of place, of situatedness, and of material containment. Star formations in process, as captured in the Swan Nebula, allow a glimpse of changes of chemical substances from one aggregate phase to another. Chemical contaminants are hardly ever static. They act in combination, occur in mixtures, and undergo constant changes. Rarely can they be fully contained, either materially or governmentally, as regulations around the world differ and change over time when "pinning down" toxic contaminants as "harmful."[4]

Messier 17, thirdly, is a molecular nebula in space that is as aesthetically pleasing to the human observer as it would be detrimental to the well-being of any multicellular beings, *if they were present.* It is not only the heat or the lack of oxygen but also the radiation that would pose a serious threat to human and more-than-human health. Subatomic particles would tear at high speed through multicellular organisms' DNA molecules, splitting them or damaging their coding for cell reproduction. There is little discussion on the toxicity of outer space for multicellular life, which is precisely the point we want to stress: toxicity is an anthropocentric concept, as societies have commenced examining or governing a particular "toxic" composition of chemical particles in ecosystems only if it—directly or indirectly—concerned "them," human beings. Thinking about toxicity through the absence of human presence pushes scholars to specify what kinds of human and more-than-human body evoke compassion and care and what kinds do not.

Finally, as gases in various colors mix and mingle in our vision of the Swan Nebula, we should not forget that questions of space, time, and embodiment cannot be neatly compartmentalized but must be understood as intersectional. How then, our authors ask, are we to understand toxic environments that not only entail a time regime of their own but also one that extends far beyond the human life span? How do we tell stories that accurately encompass the slow violence exerted by decades of exposure to toxic waste, the genomic mutations shaping the lives of the children and grandchildren of people who once worked in mining, cleaning, or pesticide-intensive greenhouses? What roles do time, space, and embodiment play in scholarly conceptualizations of the phenomena and materialities that we generally describe as "toxic"?

Toxic Timescapes: Examining Toxicity across Space and Time is an interdisciplinary environmental humanities volume whose conceptual and methodological focus seeks to explore human-environment relationships as they have played out—and continue to play out—for life on a permanently polluted planet since the twentieth century. The authors in this volume seek to tackle the methodological challenges that come with the multiplicity and intersection of different scales of time and place and to provide new approaches for the study of contamination and pollution through the concept of *toxic timescapes.* The chapters assembled in this volume offer a multidisciplinary overview of the concept, with authors coming from the disciplines of history, human geography, science and technology studies, philosophy, and political ecology. Chapters span places from Europe, North America, Australia, and the Pacific to Southeast Asia as they observe the intersection of multiple times and spaces at such diverse locations as former war fields in Vietnam, aging nuclear weapon storage facilities in Greenland, and waste deposits in southern Italy, or chemical facilities along the Gulf of Mexico and coral-breeding laboratories all across the world.

Writing on Toxicity in the Age of the Toxic Commons

These days we do not have to look far to find human-environment constellations that illustrate the urgency of this volume's contribution. Our species' excessive and expanding modes of extraction, production, and disposal—necessary to support the perpetual economic growth inherent to the modern, and particularly Western, project—and the excessive use of synthetic chemicals in all sectors of life have fostered toxicity's ubiquity in our air, water, and soil.[5] Every year today, humans emit more than 250 billion metric tons of chemical substances, feeding a toxic avalanche that for centuries has been harming human and more-than-human life everywhere on the planet. At accelerating speed since the mid-eighteenth century, human activity has caused the contamination and pollution of our planet to a degree that François Jarrige and Thomas le Roux see contaminants as "constituent elements of modernity."[6] New synthetic chemicals were applied to control almost all aspects of life, ranging from pesticides to control ecosystems,[7] synthetic drugs to control the (female) human body,[8] and chemical weapons to control military warfare. After World War II, governments around the world started planning for World War III, pouring funds into environmental science in their search for ways to harness natural processes to kill millions of people.[9] The growing amount of waste—with more than 400 million metric tons of hazardous waste generated worldwide today[10]—illustrates another source of the increasing contamination of our planet and of the wasting of relationships of human and more-than-human beings.[11] Be they pesticides, hormone-disrupting chemicals, chemical weapons, dioxins, or nuclear waste, environmental poisons represent a ubiquitous force in the twentieth and twenty-first centuries. And yet, while the poisoning of the planet through human-made chemicals is "probably the largest human impact" to date, according to science writer Julian Cribb, it also is the one "least understood or regulated."[12]

As we live in the age of the *toxic commons,*[13] with toxicity and pollution forcefully ever present in modern daily lives, politicians, juridical systems, media outlets, scholars, and the public alike show great difficulty in detecting, defining, monitoring, or generally coming to terms with them. The struggle, we argue in this volume, is primarily one of making sense of the multiple, overlapping, and intersecting temporal and spatial scales working on the human and more-than-human body, while continuing to pay attention to the important established differentiating concepts of race, class, and gender in order to give space to aspects of (global) environmental justice and social inequality. In the broader field of the environmental humanities, scholars have primarily explored aspects inherent to the pollution of air, water, and land in relation to our modern, industrial way of life.[14] With a primary focus on the late twentieth century, studies disentangle the toxic discourses surrounding the use of pesticides and herbicides or air emission standards, or they focus on the waste from energy or resource extraction processes.[15] Authors have analyzed public and private health issues resulting from toxic exposures and their political, social, psychosomatic, medical, and ethical implications, as well as, finally, their artistic transformations.[16] In this wealth of material, the methodological and theoretical challenges inherent to contamination and pollution, namely that contaminants and environmental poisons, and thus exposure to humans and other living beings, are not static—neither in *time* nor in *space*—have remained little explored conceptually.[17]

Toxic contaminants and their social and cultural framing are never static. The study of both must comply with a multitude of concepts of time and space that simultaneously inscribe themselves in human and more-than-human bodies and narratives while changing over time. Toxicants, such as heavy metals or radioactive molecules, can mark landscapes and their inhabitants for generations or centuries while also imprinting on the dominant framework of industrial clock-time. Stockpiles of corrosive acids, organic chemicals, toxic metals, and other wastes, for instance, pose acute, long-term health and ecological threats, causing groundwater contamination, leaching, and other types of pollution. They do so differently, in different locations across the world, illustrating the existing great economic and social disparities between, for instance, the African continent and rich industrial countries.[18] Atomic energy plants, in turn, while having long played a key role in modern societies' energy policies, to this day pose unresolved questions concerning the future management of their remains.[19]

Additionally, in the same way that toxicants can change their aggregate state from fluid to solid, some of them, such as endocrine disruptors, can also fundamentally alter human and more-than-human bodyscapes, as well as those of yet unborn future generations. The latest technologies of detection and monitoring have revealed not only that synthetic chemicals permeate bodies and ecosystems, but also that they can modify species' reproductive systems.[20] Yet, while researchers know that synthetic chemicals can interfere with the body's hormonal signaling system, legal and medical experts often struggle to establish direct causality between one concrete chemical and distinct health issues among the multitudes of chemicals we are exposed to—in particular since the effects may not show in this generation but in the next. Only decades after exposure, in 1996, did the US Agency of Veterans Affairs acknowledge a connection between Agent Orange exposure and birth defects in the next generation.[21]

Finally, the locality of toxins—whether they are found in the ground, underwater, or in the air—matters tremendously when defining their toxicity, as does the specific social and cultural space they inhabit. Within societies and across nations, the struggle over what—and in what doses and at which life stages—makes a substance toxic and harmful has been ongoing for decades. Tons of the pesticide chlordecone, for instance, ended up as a legal substance in the French Caribbean while it was banned in mainland France. Since the 1970s, the international trade in hazardous waste has greatly benefited from an international disagreement on what substance, dose, or handling constitutes hazardous waste.[22]

As a ubiquitous toxicity in our air, water, and soil becomes an increasingly common reality and both human and more-than-human bodies are increasingly marked by the presence of synthetic chemicals, we see great potential in studies—such as those assembled in this volume—that bring into focus the intersection of time, space, and contamination as these work on the human and more-than-human body. Understanding how a multiplicity of scales—both temporal and spatial—intersects is important when discussing both intergenerational and global environmental justice. It provides a basis for thinking about long-term and future-oriented proposals of toxic cleanup and remediation, as well as for righting past exposures and assembling guidelines around responsibilities.

Toxic Timescapes as a Tool of Analysis

The concept of *toxic timescapes* refers to this intricate intersectionality of time, space, and bodies in relation to toxic exposure. As a tool of analysis, it unpacks linear understandings of time, exploring rhizomatic ways in which harmful substances permeate time and space, producing more-than-human narratives. It equips scholars with new ways of creating data and conceptualizing the historical (past, present, future) presence and possible effects of harmful substances, and provides a theoretical framework for new modes of narration in an uneven world. Thinking through toxic timescapes is an invitation to radically shift our understanding of toxicants in the complex web of life.

Toxic timescapes is a concept with epistemic variation, as the different contributions in this volume illustrate. Since toxicity, pollution, and modes of exposure are never static, their study necessarily complies with a multitude of modes of how time, space, and body relate to toxicants. Dose, timing, velocity, mixture, frequency, and chronology of exposure matter as much as geographic location and the societal position of those exposed. Together, these factors create a specific toxic timescape that lies at the heart of one particular author's narrative, and the individual contributions in this book each look at their specific toxic timescape, ranging from marine environments to Aboriginal ontologies. Epistemically, toxic timescapes are as much personal as they are collective, as they create precedence and enable counternarratives. Moreover, when woven together, the chapters demonstrate the complex reality of toxic existence.

Our studies of the hazardous intersectionality of time, space, and body as toxic timescapes draw from multiple fields of inquiry, foremost that of history, human geography, and sociology, that have already been probing the concepts of time and space. At least since the spatial or landscape turn of the 1970s and 1980s, scholars in the humanities have gained great literacy in and familiarity with multiple and overlapping notions of space.[23] In particular, in the works of Michel Foucault, Henri Lefebvre, Michel de Certeau, and Paul Virilio, the power relations implicit in landscape were newly emphasized. These scholars did so using general headings such as "abstract space" or "symbolic place," which they then interpreted through spatial metaphors such as "panopticism."[24] Within the field of geography, scholars extended this vocabulary into theories on the relationship between power and space, using such terms as "territoriality," "power geometry," or "time-space compression."[25] The newly emerging fields of urban and environmental history put another emphasis on the materiality of distinct places, with environmental historians emphasizing that scholars need to also understand the body as a particular *place* of study. Today, the field has advanced new forms of layered analysis with the influx of digital tools such as GIS. The field of global history, finally, anchors the study of space in extrapolating the myriad relationships between local, national, regional, and global.[26]

In contrast to such a profound familiarity with studying space, scholars have a more limited understanding of the multiple formats of *time.* Although time is at the core of historical inquiries, most historians have spent much more energy on exploring *change over time* than time itself.[27] Studies predominantly follow Newton's linear time model of past, present, and future, while turning a blind eye to circular, rhythmic, or seasonal time models. Fernand Braudel and Reinhart Koselleck are influential exceptions with their concepts of longue durée, and expectation and experience as horizon, respectively.[28] As late as 2012, however, German historian Rüdiger Graf urged that we should not presuppose time, but study it. Most recently, global historians in particular have engaged with the clashes of different social times in an increasingly interconnected world, such as that between industrial and agrarian time in the colonial nineteenth century.[29]

In the late 1980s, inspired by modern means of communication, time studies on the relationships between past, present, and future started to boom in sociology. Niklas Luhmann argued that in modern societies, the future plays a much larger role than the past.[30] In 1998, sociologist Barbara Adam widened the study of time beyond the clashes of different (human) social times by including also the timescapes of nonhuman actors. In her book *Timescapes of Modernity* she engages with the multiple time horizons of socioenvironmental life. These go beyond the temporal dimensions of calendars and clocks and recognize the multiple rhythmicities of nature, ranging from the heartbeat and cycles of activity and rest to seasonality, or the irreversible temporalities of life. According to Adam, these timescapes are in a conflictual relationship with each other and environmental hazards are inescapably tied to the successes of the industrial way of life. New methods of food production, processing, and preservation, for instance, have allowed humans to transcend their dependence on natural rhythmicity and seasonality. With globally sourced foods, industrial societies face an absolute monotony of the same chemically assisted, jet-setting foods that are available everywhere and all the time.[31] Such aseasonality comes at the expense of the health and well-being of citizens, farmers, livestock, and land, as multiple studies of the workings of pesticides illustrate, for instance.[32]

While Adam's work on time and the environment is foundational for understanding the multiple layers of relationships of human and nonhuman time horizons—at least for our conceptualization of toxic timescapes—it has received little recognition in the environmental humanities. Scholars more often cite Rob Nixon's book *Slow Violence* (2011), in which he highlights the violent implications of slowly unfolding environmental catastrophes, such as climate change, toxic drift, deforestation, oil spills, or the environmental aftermaths of war.[33] Focusing on the clash between industrial time and the often much slower processes of cell formation or bioremediation, Nixon speaks of a violence that is dispersed across space and time, a violence that is neither spectacular nor instantaneous, but rather incremental and accretive.

Similarly drawing on the notion of different speeds, those studying disasters are arguing for understanding disasters as fast *and* slow, to not only capture the disaster as an *event* but also as a *process,* since disasters emerge from longue durée interactions between human and ecological systems.[34] Finally, expanding on Nixon while also challenging the notion that slow speed is intricately connected to victimization, most recent studies on pollution, toxicity, and speed have reinscribed power to the subaltern by invoking the notion of *slow observation*—as Thom Davies proposes in this book—or *slow hope,* as Christof Mauch has put forth. The former describes the witnessing of gradual changes of the local environment and its emancipating powers while the latter encompasses the idea that given humanity's vast power to manipulate our earth's ecosystems in destructive ways, we might also be able to imagine a more beneficial impact.[35] Both approaches offer us productive ways of analyzing how people come to live with sustained environmental brutality.

While speed is crucial as an analytical category, it reduces the time relation between humanity and the rest of nature to one of different timescales and limits our frame of analysis to that of linear time. As Adam illustrates in *Timescapes of Modernity,* there are many more different time models, such as seasonality, rhythmicity, or a radioactive isotope's half-life. The notion of toxic timescapes, as proposed in this book, captures the many different possible ways of relating time and toxicity—that is, between (a) past, present, and future, (b) slow and fast, and (c) linear, rhythmic, and seasonal—while situating these different embodied and lived rhythmicities in space. The different contributions in this book do not cover them all in one example; rather, they each highlight different facets of those toxic space-time relationships. Some of the chapters give theoretical and methodological guidance, others source-based examples.

Toxic Timescapes as a Book

This interdisciplinary volume—edited by two environmental historians—brings together renowned and advancing scholars from the disciplines of history, science and technology studies, human geography, political ecology, and philosophy under the umbrella of the environmental humanities to provide a combination of theoretical, methodological, and case-based explorations of the hazardous intersectionality of time, space, and body in the twentieth and twenty-first centuries. Contributions acknowledge the overlapping and intersection of multiple human and more-than-human regimes of time and space in stories of contamination and pollution, calling these *toxic timescapes.* Each chapter has a similar framing as we have asked authors to commence their contributions defining their specific toxic timescape and to end with a recommendation for readers of how to explore further.

The volume is divided into four subsections—(1) Conceptualizing the Long Term, (2) Ontologies of Toxic Space, (3) Expanding upon the Toxic Body, and (4) Conceptualizing Toxic Futures—paying tribute to the main different intersectional constellations of the elements of time, space, and body that we see as integral to the concept of toxic timescapes. The case studies by some of our authors lend themselves more readily to a discussion of the rhythmicities of human, more-than-human, and toxicity's time and timing (Ohman Nielsen, Davies, Borowy), while others are more about how the accumulation or dissolution of toxicity in space brings about a discussion of situatedness and containment (Biggs, Antonova, Wright). Yet another set of case studies clusters around the exploration of the toxic body as a site of violence and emotions as well as resilience and resistance (Iengo and Armiero, J. Peterson, Kirchhof, Ferdinand). In the last cluster, notions of futurity and questions of how to continue living on a contaminated planet are key (Parry, M. Peterson, Laboissière). Each of these four subsections is preceded by a short introduction to the theme of the section, including an overview of the individual chapters and their key arguments.

To end, let us return to the stars. Since prehistoric times, humanity has been not only gazing at the sky and its nightly star formations, but imagining itself among them. These visions, mythologies, and imaginaries have received a new quality in the twentieth century. Since the beginning of crewed space flight in 1961, the small but unique subdiscipline of space toxicology has concerned itself with the study of toxic exposure of humans in space, such as inhalation of reactive mineral dust or exposure to radiation more generally. As we humans are directing our yearning increasingly toward other celestial bodies—potential planets B—the small subdiscipline of space toxicology is growing in importance. It provides the promise of safekeeping humanity as we venture toward new, possibly virgin, pristine, and healthy environments with which we might hopefully fare better than with planet Earth.[36] *Toxic Timescapes* wants to provide an opportunity to return our gaze and our concern back to the one planet that we do have and to inspire inquiries of how we can make sense and come to solutions for—as scholars and concerned citizens—the toxic avalanche that we are facing in our age of the toxic commons.

Notes

1. European Space Agency, NASA, and J. Hester (Arizona State University), "Description of Messier 17, Milky Way Nebula," released April 24, 2003, https://spacetelescope.org/images/heic0305a/.
2. European Space Agency.
3. Nigel Henbest and Heather Couper, *The Guide to the Galaxy* (Cambridge: Cambridge University Press, 1996), 209.
4. An important discussion on containment happened at the 4S Annual Meeting, September 4–7, 2019, in New Orleans, on the theme "Opening Up Containment: Spaces, Trajectories, and Forms of Life."
5. See, for instance, Benjamin Ross and Steven Amter, *The Polluters: The Making of Our Chemically Altered Environment* (New York: Oxford University Press, 2010); Julian Cribb, *Poisoned Planet: How Constant Exposure to Man-Made Chemicals Is Putting Your Life at Risk* (Sydney: Allen & Unwin, 2014).
6. François Jarrige and Thomas le Roux, *The Contamination of the Earth: A History of Pollutions in the Industrial Age,* trans. Janice Egan and Michael Egan (Cambridge, MA: MIT Press, 2021).
7. Michelle Mart, *Pesticides, a Love Story: America's Enduring Embrace of Dangerous Chemicals* (Lawrence: University Press of Kansas, 2015); Frederick Rowe Davis, *Banned: A History of Pesticides and the Science of Toxicology* (New Haven, CT: Yale University Press, 2014). See also Carey Gilliam, *Whitewash: The Story of a Weedkiller, Cancer and the Corruption of Science* (Washington, DC: Island Press, 2017). For an overview of research on pesticides prior to 1962, see José-Ramón Bertomeu-Sánchez, "Introduction. Pesticides: Past and Present," *Journal of History of Science and Technology* 13, no. 1 (2019): 1–27. See also "Chemical Safety: Pesticides," World Health Organization, October 26, 2020, https://www.who.int/topics/pesticides/en/, and "Highly Hazardous Pesticides (HHPs)," UN Environment Programme, accessed June 14, 2022, https://www.unenvironment.org/explore-topics/chemicals-waste/what-we-do/emerging-issues/highly-hazardous-pesticides-hhps.
8. Stacy Alaimo, *Bodily Natures: Science, Environment, and the Material Self* (Bloomington: Indiana University Press, 2010), or Nancy Langston, *Toxic Bodies* (New Haven, CT: Yale University Press, 2011).
9. Jacob Darwin Hamblin, *Arming Mother Nature: The Birth of Catastrophic Environmentalism* (New York: Oxford University Press, 2013); R. Shiloh Krupar, *Hot Spotter's Report: Military Fables of Toxic Waste* (Minneapolis: University of Minnesota Press, 2013).

10. Paul E. Rosenfeld and Lydia G. H. Feng, *Risks of Hazardous Wastes* (Burlington, MA: William Andrew, 2011).
11. Ilenia Iengo and Marco Armiero, chapter 7, this volume.
12. Julian Cribb cited in *SciNews,* "Scientists Categorize Earth as a 'Toxic Planet,'" February 7, 2017, https://phys.org/news/2017-02-scientists-categorize-earth-toxic-planet.html. On the regulation of contaminants, see Ernst Homburg and Elisabeth Vaupel, eds., *Hazardous Chemicals: Agents of Risk and Change, 1800–2000* (New York: Berghahn Books, 2009).
13. Simone Müller, "Toxic Commons: Toxic Global Inequality in the Age of the Anthropocene," *Environmental History* 26, no. 3 (2021): 444–50.
14. For a selection, see David Arnold, *Toxic Histories: Poison and Pollution in Modern India* (Cambridge: Cambridge University Press, 2016); Soraya Boudia and Nathalie Jas, eds., *Powerless Science? Science and Politics in a Toxic World* (New York: Berghahn Books, 2014); Craig E. Colten and Peter N. Skinner, *The Road to Love Canal: Managing Industrial Waste before EPA* (Austin: University of Texas Press, 1996); Pete Daniel, *Toxic Drift: Pesticides and Health in the Post–World War II South* (Baton Rouge: Louisiana State University Press, 2005); David Kinkela, *DDT and the American Century: Global Health, Environmental Politics, and the Pesticide That Changed the World* (Chapel Hill: University of North Carolina Press, 2013); Richard S. Newman, *Love Canal: A Toxic History from Colonial Times to the Present* (New York: Oxford University Press, 2015); James C. Whorton, *The Arsenic Century: How Victorian Britain Was Poisoned at Home, Work, and Play* (Oxford: Oxford University Press, 2011). Much neglected so far is the Scandinavian perspective despite Sweden being such an important player in the internationalization of modern environmentalism. See David Larsson Heidenblad, *Den gröna vändningen* (Lund: Nordic Academic Press, 2021), forthcoming in English as *The Environmental Turn in Postwar Sweden: A New History of Knowledge* (Manchester: Manchester University Press, 2021).
15. Mart, *Pesticides, a Love Story;* Frank Uekotter, *The Age of Smoke: Environmental Policy in Germany and the United States, 1880–1970* (Pittsburgh, PA: University of Pittsburgh Press, 2009); Jacob D. Hamblin, *Poison in the Well: Radioactive Waste in the Oceans at the Dawn of the Nuclear Age* (New Brunswick, NJ: Rutgers University Press, 2008).
16. D. N. Pellow, *Resisting Global Toxics: Transnational Movements for Environmental Justice* (Cambridge, MA: MIT Press, 2007); Julie Sze, *Noxious New York: The Racial Politics of Urban Health and Environmental Justice* (Cambridge, MA: MIT Press, 2010); Oluwafemi Alexander Lapado, "The Contribution of Cartoonists to Environmental Debates in Nigeria: The Koko Waste Dumping Incident," in "Eco-Images: Historical Views and Political Strategies," *RCC Perspectives* no. 1 (2013): 61–71.
17. A great contribution to thinking more generally about the interlocking of human and more-than-human temporalities during the Anthropocene is Bethany Wiggin, Carolyn Fornoff, and Patricia Eunji Kim, eds.,

Timescales: Thinking across Ecological Temporalities (Minneapolis: University of Minnesota Press, 2020).

18. A classic example is the "donation" of obsolete pesticides to African nations from the West, which are now corroding in their containers. Andreas Bernstorff and Kevin Stairs, *POPs in Africa: Hazardous Waste Trade 1980–2000, Obsolete Pesticide Stockpile, A Greenpeace Inventory,* prepared for the fifth intergovernmental negotiating committee for an international legally binding instrument for implementing international action on certain persistent organic pollutants (POPs/NC5), Johannesburg, South Africa, December 4–9, 2000 (Amsterdam: Stichting Greenpeace Council, 2000).
19. Anna Storm, *Hope and Rust: Reinterpreting the Industrial Place in the Late 20th Century* (Stockholm: Royal Institute of Technology, 2008).
20. By the 1990s, researchers had noticed that it was not only wildlife species that were showing difficulties with reproductive health but also increasing numbers of people. Since 1970, boys in the United States have become increasingly likely to develop severe hypospadias, a birth defect of the penis. Testicular cancer has increased in many industrialized countries, such as Denmark, where it has more than tripled since World War II. Men in many industrial nations are showing increases in prostate cancer; a 1999 review found that men in the United States in 1994 had a much greater risk of being diagnosed with prostate cancer than their fathers had. Langston, *Toxic Bodies,* 4.
21. Jesse King and Cecilia Chou, "Agent Orange Birth Defects," *The Embryo Project Encyclopedia,* March 7, 2017, https://embryo.asu.edu/pages/agent-orange-birth-defects; P. H. Schuck, *Agent Orange on Trial: Mass Toxic Disasters in the Courts* (Cambridge, MA: Belknap, 1987).
22. Simone M. Müller, "Hidden Externalities: The Globalization of Hazardous Waste," *Business History Review* 93, no. 1 (2019): 51–74.
23. Jo Guldi, "What Is the Spatial Turn?" Scholars' Lab, University of Virginia, accessed October 26, 2018, http://spatial.scholarslab.org/spatial-turn/.
24. Guldi.
25. Doreen Massey, *Space, Place, and Gender* (Minneapolis: University of Minnesota Press, 1994); David Harvey, *The Condition of Postmodernity: An Enquiry into the Origins of Cultural Change* (Cambridge, MA: Blackwell, 1990).
26. Roland Wenzlhuemer, "Globalization, Communication and the Concept of Space in Global History," *Historical Social Research* 35 (2010): 19–47.
27. This has been critiqued already by Walter Benjamin. See Walter Benjamin, "Geschichtsphilosophische Thesen," in *Zur Kritik der Gewalt und andere Aufsätze* (Frankfurt am Main: Suhrkamp, 1978), 78–94.
28. Fernand Braudel, "Geschichte und Sozialwissenschaften: Die longue durée," in *Schrift und Materie der Geschichte: Vorschläge zur systematischen*

Aneignung historischer Prozesse, ed. Claudia Honegger (Frankfurt am Main: Suhrkamp, 1987), 47–85; Fernand Braudel, *Das Mittelmeer und die mediterrane Welt in der Epoche Philipps II* (Frankfurt am Main: Suhrkamp, 1994); Reinhart Koselleck, "Erfahrungsraum und Erwartungshorizont. Zwei historische Kategorien," in *Vergangene Zukunft: Zur Semantik geschichtlicher Zeiten* (Frankfurt am Main: Suhrkamp, 1989), 349–75.

29. Vanessa Ogle, *The Global Transformation of Time* (Cambridge, MA: Harvard University Press, 2015); Sebastian Conrad, "'Nothing Is the Way It Should Be': Global Transformations of the Time Regime in the Nineteenth Century," *Modern Intellectual History* 15 (2018): 821–48.
30. Niklas Luhmann, "Temporalisierung von Komplexität. Zur Semantik neuzeitlicher Zeitbegriffe," in *Gesellschaftsstruktur und Semantik: Studien zur Wissenssoziologie der modernen Gesellschaft* (Frankfurt am Main: Suhrkamp, 1980), 235–300; Niklas Luhmann, "Die Beschreibung der Zukunft," in *Beobachtungen der Moderne* (Opladen: Westdeutscher Verlag, 1992), 129–47; Niklas Luhmann, "The Future Cannot Begin: Temporal Structures in Modern Society," *Social Research* 43, no. 1 (1976): 130–52.
31. Barbara Adam, *Timescapes of Modernity: The Environment and Invisible Hazards* (London: Routledge, 1998).
32. See Mart, *Pesticides, a Love Story;* Daniel, *Toxic Drift;* May-Brith Ohman Nielsen and Anne Mette Seines, "Poison to the Beasts: Changing Poisons and Poisoning Practices in Campaigns to Kill Norwegian Birds and Mammals, 1845–1967," *Environment and History* 25, no. 3 (2018): 321–64.
33. Rob Nixon, *Slow Violence and the Environmentalism of the Poor* (Cambridge, MA: Harvard University Press, 2011).
34. See, for instance, the six contributions in the special issue "Disasters Fast and Slow," edited by Fiona Williamson and Christ Courtney, *International Review of Environmental History* 4, no. 2 (2018): 2; similarly, see Scott Frickel, "Disasters Fast and Slow: The View from Environmental Studies" (paper presented at the 129th Annual Meeting of the American Historical Association, New York, NY, January 2, 2015).
35. Thom Davies, "Toxic Space and Time: Slow Violence, Necropolitics, and Petrochemical Pollution," *Annals of the American Association of Geographers* 108, no. 6 (2018): 1537–53; Christof Mauch, "Slow Hope: Rethinking Ecologies of Crisis and Fear," *RCC Perspectives: Transformations in Environment and Society* no. 1 (2019).
36. Noreen Khan-Mayberry, John T. James, Rochelle Tyl, and Chiu-wing Lam, "Space Toxicology: Protecting Human Health during Space Operations," *International Journal of Toxicology* 30, no. 1 (2011): 3–18, https://doi.org/10.1177%2F1091581810386389; W. J. Rippstein Jr., "The Role of Toxicology in the Apollo Space Program," in *Biomedical Results of Apollo,* ed. Richard S. Johnston, Lawrence F. Dietlein, and Charles A. Berry (Washington, DC: National Aeronautics and Space Administration, 1975), 151–59.

PART 1

Conceptualizing the Long Term

INTRODUCTION

TOXICITY'S TIME, timing, and duration transgress and challenge many established anthropocentric models of measuring and experiencing time, ranging from the human life span to Western models of linearity and Newton's clock-time. As several chapters in this volume point out, toxicants, such as heavy metals or radioactive molecules, can mark landscapes and their inhabitants, be they human or more-than-human, for generations or centuries, while also imprinting on the dominant framework of industrial clock-time. Pesticides and herbicides inhibit or accelerate natural growth to fit more neatly with industrial time.[1] Toxicity's "long term" also exposes many human time concepts as episodic, with a clear beginning and ending, whereby the process of intoxication is ongoing and hereditary, continuing into many future generations.

Today's predominant understanding of time is a mathematical and linear model of commodity time, an infinite accumulation of equivalent intervals, the buying and selling of which has become the heart of today's clock- and calendar-controlled capitalist social order.[2] Taking the human life span, a year's seasonality, and the rhythm of day and night as starting points, this model has been increasingly refined and has perfected these traditional measurements of everyday life over the past four centuries. The invention of mechanical clocks in the seventeenth century made time countable. The advent of the telegraph and the telephone in the nineteenth century synchronized it, and the breakthrough of Fordist and Taylorist models of production in the twentieth century perfected it.[3] Under the pressure of commodity production, the lived time of everyday life "slid inexorably towards that 'absolute, true, and mathematical time'" that Newton had declared to be the measure of the universe and that not only profoundly influenced the course of industrialization and the development of new production machines but also extended into every sphere of existence. This concept of time also impinges significantly on the way most Western societies and educational systems think about history.[4]

Toxicity illustrates the limitations of such mathematical and linear time models. Environmental poisons disrupt linear rhythmicities of time seen as equal compartments. Pesticides speed up or deter the growth of certain seeds, while endocrine-disrupting chemicals interfere with the time and timing of cellular growth and the development of not only one human or more-than-human body but many more down the line. Slow environmental changes toward deterioration, moreover, highlight the important of reading toxins through notions of speed vis-à-vis the time frames considered. Half-life times of several thousand years, in turn, demonstrate the need to understand toxicity in time frames that expand beyond the singular human experience.

This section, "Conceptualizing the Long Term" (Ohman Nielsen, Davies, Borowy), discusses the theoretical and methodological implications of toxicity's timescapes and their respective imprints on current scholarship as exemplified in scholars' attempts to tackle (a) slow processes of health changes versus the medical and political "necessity" to know about detrimental effects "as soon as possible," (b) the acceleration of cause and effect in a capitalist system versus the slow processes of environmental and health changes in a violent place, and (c) short political election cycles versus half-life times of "the" toxic, and in particular the nuclear.

May-Brith Ohman Nielsen starts off this section with the chapter "Living with Poison: Exploring Generations as Toxic Timescapes," which provides readers with a profound insight into the intricate relationships of toxicity and timing, followed by a discussion of how a historical multigenerational approach could offer new insights into understanding toxic regimes and their long-term effects. While medical and biology scholars struggle to follow timings of exposure in the life of a person, an animal, a fungus, or a plant and link it to following generations due to data security and lack of historic data acquisition, historians can follow a different path. As May-Brith Ohman Nielsen argues, for historians it makes sense to attempt to study the timing of harmful exposure in larger population groups, and to do so in time. The historic generation model her chapter presents provides historians with a tool to study timing and toxic exposure within the life spans of multiple generations.

In his chapter "Slow Observation: Witnessing Long-Term Pollution and Environmental Racism in Cancer Alley," Thom Davies invites readers to engage with toxic timescapes through *slow observation,* an embodied and temporal sense of *knowing* that comes from years of immersion *in* a place and *across* time. As a form of *temporal noticing,* slow observation mirrors the attritional accumulations of pollution spelt out in the terror of what Rob

Nixon called "slow violence,"[5] producing an incremental stratigraphy of knowledge: piecemeal, drip-fed, uncanny, and temporally situated understandings. Slow observation is not just "local knowledge" in a *geographical* sense but is attached to distinct temporalities, assembled and negotiated across years of everyday and embodied encounters with pollution.[6] In addition to Ohman Nielsen's model, Davies's tool of slow observation also provides scholars with a critical means to understand how polluted communities understand the lived reality of persistent environmental threats.[7]

Iris Borowy, finally, provides readers of her chapter, "When Does Safe Mean Safe? Negotiating the Disposal of Radioactive Waste between Months and Millennia," with a historical case study of the ocean dumping of radioactive waste material in the 1960s. Her contribution explores decision-making in the international arena concerning the disposal of long-term toxicants, such as radioactive isotopes. She analyzes the changing visions of radioactive time and marine space that led European governments to first embrace and then abandon ocean dumping and illustrates how concerns over the *here and now* versus over *an indefinite future* defined the controversy over nuclear ocean dumping. This dual, and often conflicting, concern is present in many similar issues of toxicity on different political levels.

Notes

1. On the effect of pesticides on seasonality, see Barbara Adam, *Timescapes of Modernity: The Environment and Invisible Hazards* (London: Routledge, 1998).
2. Scott McQuire, *Visions of Modernity: Representation, Memory, Time and Space in the Age of the Camera* (London: Sage, 1997), 115.
3. Simone M. Müller, *Wiring the World: The Social and Cultural Creation of Global Telegraph Networks* (New York: Columbia University Press, 2015); Vanessa Ogle, *The Global Transformation of Time: 1870–1950* (Cambridge, MA: Harvard University Press, 2015); Sebastian Conrad, "'Nothing Is the Way It Should Be': Global Transformations of the Time Regime in the Nineteenth Century," *Modern Intellectual History* 15, no. 3 (2018): 821–48.
4. McQuire, *Visions of Modernity,* 116.
5. Rob Nixon, *Slow Violence and the Environmentalism of the Poor* (Cambridge, MA: Harvard University Press, 2011).
6. Thom Davies, "Slow Violence and Toxic Geographies: 'Out of Sight' to Whom?," *Environment and Planning C: Politics and Space* 40, no. 2 (2019): 409–27.
7. Thom Davies, "Toxic Space and Time: Slow Violence, Necropolitics, and Petrochemical Pollution," *Annals of the American Association of Geographers* 108, no. 6 (2018): 1537–53.

CHAPTER 1

Living with Poison

Exploring Generations as Toxic Timescapes

May-Brith Ohman Nielsen

BETWEEN DAY twenty and day forty-two after conception, when the vital organs of the human body are formed—brain, spine, heart, lungs, main nerves and blood vessels, limbs, eyes and ears, and most of our internal organs—we are especially vulnerable to harmful exposure, be it from toxicants, starvation, radiation, or other stressors. Harmful exposure on each particular day of this sequence may result in very specific injuries to the organs of the evolving embryo and cause life-threatening harm or life-long health problems. Thus, the timing is the poison. Doses of toxic substances, which may not hurt us at a later stage of life, may do so in earlier life stages, in other combinations or sequences of exposure. Toxic exposure in particularly vulnerable time windows—such as prenatal development, but also puberty—may impinge on the total timescape of the exposed individual, and beyond. Toxic exposure of unborn babies, children, and youth may not only affect their health but also the health of their children, via the impact on their reproductive health.[1]

In this chapter I focus on toxicity and timing expressed through the toxic timescapes of human life, life spans, and generations. I introduce a generational model for historical and for interdisciplinary history and medicine research that could help us understand today's world as infected by a "toxic epidemic," in the words of the UN and the WHO, and produce new types of knowledge resources for protective action. The chapter is organized into four parts. It commences by situating today's world in the context of the "toxic epidemic" before it discusses toxins in time in the second part. In the third part, I reflect on the methodological pitfalls involved in relating toxins to time and timing before I introduce a new methodological approach, my generational model, to inspire new research. Hormone-disrupting chemicals will serve as the main toxic protagonists in this chapter's story.

Life spans, timing, and accumulation are key concepts for unlocking the theoretical premises of this chapter on generations and toxic timescapes. A *toxic timescape* in this chapter is formed through the complex coupling of an animal's life span and various forms of toxic exposure whereby we need to be mindful of both timing and accumulation: the bodies of all living beings are historical bodies. Each body has its own personal timescape, the timescape of an individual's life span. Toxins and the effect of toxic substances upon the living organism are part of this bodily timescape. Exposure to toxic substances, especially those substances that disrupt hormone processes[2] in living bodies, can interfere with complex biological, biochemical, and biophysiological processes in all stages of life span development.[3] This holds true for toxic substances, or combinations thereof, that individuals or groups are exposed to within a short time window, as well as for substances they are exposed to over a longer period of time.

The individual toxic timescape, then, is informed by two important aspects, namely timing and accumulation. A life span is not a homogenous entity; it evolves through life stages. For most animals these are conception, birth, development, maturity, reproduction, and death. Exposure to relatively small doses of harmful chemicals in critical stages of development, when vital organs or bodily functions are formed, could inflict life-long harm and ill health.[4] The *timing* makes the poison.

Additionally, scholarship has shifted from the classic dogma of toxicology that "the dose makes the poison." As this chapter illustrates, this dogma no longer provides the only definition of poison, neither to humans nor to other species. Today we know: Accumulation, over time and lifetimes, also makes the poison. Cocktails, meaning mixes of different chemicals and stressors, also make the poison. Both timing and accumulation matter equally.

The methodological conundrum that this chapter tackles concerns an entryway to understanding both the individual and a societal toxic timescape. For researchers in medicine and biology, it makes sense to examine the timings of exposure in the life of a person, an animal, a fungus, or a plant. For historians, it makes sense to attempt to study the timing of harmful exposure in larger population groups, and to do so in time. The historic generational model I present in this chapter offers both historians and medical researchers a tool with which to collaborate and to study timing and toxic exposure within the life spans of multiple generations. This can help researchers with sufficient context to better account for the impact of long-term trends of exposure, shifting loads of exposure and complexity of exposure within certain age cohorts when assessing the effects of individual exposure, effects of exposure to specific substances, possible generation-specific and generation-crossing effects, or life-long body loads.

The Toxic Epidemic

Right now, environmental poisons and hormone-disrupting chemicals are making history. They are doing so in the most disturbing way by invading the very web of life. Although the precise extent of their effects is still debated, hormone disruptors have the potential to result in far-reaching, long-term environmental degradation, affecting the well-being of humans and other species by impairing their reproductive capacities and through various types of severe disease and disorders.[5] Environmental poisons and hormone-disrupting chemicals are radically different types of historical *agents* than those previously dealt with in the historical sciences. How can they be approached, analyzed, and interpreted as a humanities and social science research issue and as a truly *historical* phenomenon affecting humanity's changing relation with nature? This "toxic epidemic," as the United Nations Environmental Programme (UNEP) and WHO have labeled it in a joint report, is a global epidemic. In many local communities, toxic epidemics may happen very fast and become acute health crises. In other localities, toxic epidemics may appear gradually, over a longer period of time. The global toxic epidemic has been a slowly evolving epidemic.[6] It crosses species and it crosses generations. It is a complex historical process of direct and indirect exposure and of direct and indirect effects of environmental poisons.[7]

The production and release of toxic substances in one locality[8] may, by circulating in nature or through human infrastructure, or both, affect people or plants in an entirely different place. DDT sprayed on agricultural fields in tropical or temperate regions in the 1940s and 1950s ended up in the breastmilk of Inuit mothers in Arctic Greenland. The DDT was washed by rain and rivers, or blown as dust, to the sea. Here it entered the food chain, accumulated in fatty animal tissue, and was consumed by families in the Arctic who obtained most of their diet from the sea, including from fatty animals like seals and whales. Total global exposure is now also the case with PFOS and PFOA. Monitoring environmental pollutants in the Arctic has been especially important in the research effort to uncover the global distributions of persistent organic pollutants and other ecotoxic substances because none of the substances are produced or distributed there originally but rather are brought to the Arctic ecosystems by natural circulations.[9]

Thus, hormone-disrupting and other toxic environmental poisons are ubiquitous. There are no pristine areas of the globe anymore. There are no pristine bodies, neither human nor wildlife. The recognition of these problems, and the understanding of the scope of effects and scenarios, have undergone a paradigmatic change since 2002. Leading scientists maintain that we are just beginning to understand and imagine the possible implications, and authoritative EU review reports lay out extensive and multiple impacts upon present and future generations.[10]

The WHO and UNEP report on the state of the science of endocrine-disrupting chemicals, from 2012, concludes:

> We are starting to understand that a large number of non-communicable diseases have their origin during development and that environmental factors interact with our genetic background to increase susceptibility to a variety of diseases and disorders. It is also clear that one of the important environmental risk factors for endocrine disease is exposure to EDCs [endocrine disruptor chemicals] during development. It is also clear from human studies that we are exposed to perhaps hundreds of chemicals at the time. It is now virtually impossible to examine an unexposed population around the globe. Trends indicate an increasing burden of certain endocrine diseases across the globe in which EDCs are likely playing an important role, and future generations may also be affected.[11]

Since 2012 new authoritative international research-based reports are confirming both the seriousness of the situation and the urgency of acting politically. The Organisation for Economic Co-operation and Development has also agreed upon a more refined and dynamic conceptual apparatus that may serve to move political action on different toxic substances forward, while recognizing that we still need more conclusive research findings on other substances. This challenge was the basis for the establishing of the three categories *proven* endocrine disruptor, *probable* endocrine disruptor, and *possible* endocrine disruptor.[12] This made it possible to put substances on two lists for precautionary considerations, the probable and possible, instead of just waiting for years of conclusive research before taking action to restrict them. An extensive EU report from 2019 concludes that consensus now exists on the definition of hormone disruptors, for the presence of suspected or recognized hormone disruptors in the environment and in humans in the EU, and regarding the understanding that hormone disruptors are "a serious concern for the health of current and future generations and the environment." There is also consensus that "so-called safe thresholds" are inadequate as a regulatory response, because they do not consider life-stage vulnerability, cumulative effects, and combined exposure, among other things.[13]

There are generation-crossing effects of harmful exposure. EDCs pose both acute and long-term threats to ecosystems and human health. These health threats include dysfunction of the male and female reproductive systems;[14] the possibility that parental exposure well before conception may result in damage to progeny;[15] damage to the central nerves and thyroid; deficiencies within the immune system; precocious puberty; impaired cognitive functioning; metabolic diseases; and rises in several forms of cancer, asthma, and allergies.[16] These effects can have a profound impact on the lives, well-being, and identities of exposed people, and more effects are either proven, probable, or possibly generation crossing.[17] In 2012, the WHO argued that "improving fetal and child health, by limiting EDC exposure, will influence the whole life of an individual and reflect the well-being and future of our society."[18] A 2019 EU research review of the status of knowledge with regards to hormone disruptors assessed the health loss in EU countries from population exposures to hormone disruptors and the regulatory framework approach needed to counteract this development. For historians, this confirms that these types of exposure and effects constitute major historical forces and processes, and that historians should engage in studying them with historical perspectives and methods.

Toxins in Time

The harm caused by toxic exposure can show up immediately, or it can develop slowly and appear over time, as Iengo and Armiero, Davis, and Ferdinand illustrate in their chapters in this book. In the latter case, the elapsed time span often serves to blur or mask the causal links between exposure and effects. The exposure and the harm may be identified and recognized as such, or they may be misunderstood or unrecognized. Timescape studies may help to bring out historical contexts and insights that can further recognition and understanding of toxic exposure over time, over generations, and at different life stages, and through this better assess health and environmental implications, and inspire reflection and protective action.

Our life span and life stages may run parallel in time to the lives of many other people and evolve fairly synchronically in historical time. This way, people may be exposed to many similar substances and suffer patterns of exposure that are particular to a historical age group. Human life spans and life stages may also overlap, yet not run parallel, with others born some decades before and after us. Thus, we may be exposed to similar groups of toxicants—for instance, those in plastics, hygiene products, or particular pesticides—yet the exposure may affect us in different ways and harm us to different degrees, according to our life stage at the time of exposure. For historians, this parallelism offers the opportunity to research generations (in the plural) containing many different individuals, instead of one particular family lineage.

Exposure to a specific toxic substance may also affect us differently in combination with other generation-specific accumulated exposure, or the toxic burden of the locality we live in. The effects may also express themselves differently at different life stages, such as infancy, puberty, or old age. Our life span is in a direct transcending hereditary line with other human lives, the life span of our parents and of the children we may have. These life spans are intimately interconnected in a way that may transfer either the chemical body burden or the epigenetic alteration caused by exposure to chemicals, or both. These are complex bodily processes, often developing over a long time and not necessarily confined to one generation. In many cases it is extremely complicated to assess the impact of toxic chemicals upon the health of the individual. In other cases it is less so, and a careful historical examination may make the impact of certain harmful substances appear obvious. Focus on toxic timescapes can serve the purpose of historical examination and produce new types of knowledge resources for protective action.

The toxic timescape of one life stage and the harm inflicted in an earlier life stage may cause health problems that can follow the entire life of an individual and may affect future generations.[19] It is actual living bodies, bodies that carry the burdens of past exposures, exposures *in* time, that provide toxics with human life span temporality and transform them into agents within generational timescapes, into human and environmental history beyond the history of events. Generations and life stages are the human embodiment of toxic timescapes, and both toxics and their effects might cross generations in complex ways we are just beginning to understand. Families, at different times in history, may belong to different timescapes, but their timescapes may also overlap. A child in a family around 1867 may be the mother or the father of a new family in 1897. Thus, the timing of exposure to harmful substances for different family members may have quite different effects and implications for their lifetime and beyond. Family photos, like the photo (figure 1.1) of the family of Eilert Sundt and Conradine Hansen, taken around 1867, may illustrate this, but similar photos of different families or of groups of schoolchildren may help us understand how the people we research were exposed at different stages of life.

By examining a variety of photographic materials from the periods we study—from everyday life, family life, schools, workspaces, or other situations—and through combining these with other sources about the material culture and social practices of the time, we may be able to gain knowledge of the exposome—that is, the measure of all of an individual's exposures in a lifetime, of different age groups at different times and places in history. Thus, we may be able to define and discuss key components of the toxic timescapes people were part of and the implications this may have had for their life and for generations beyond. Eilert Sundt was himself a superb collector of these types of sources of people's everyday life habits and material living conditions. Sundt is

FIGURE 1.1. This family photo shows the family of Eilert Sundt (1817–75) and Nicoline Conradine Hansen (1822–81) around 1867, near Oslo. Oslo Museum / OB.F03445C, CC BY 3.0, https://creativecommons.org/licenses/by/3.0/.

hailed as the pioneer of Norwegian social science, and focused on demography, ethnology, health, cleanliness, sociology, and cultural habits. He traveled extensively and collected a broad variety of data about the living conditions and everyday lives of people in different parts of the country. Historical collections like his may provide insights into sources and forms of historic exposure if we analyze them in new ways and with present-day knowledge of hazards and harm.

The global toxic epidemic and both the health loss and environmental degradation it causes are transformations that entail deep and complex historical processes. Hormone-disrupting chemicals interfere profoundly with these processes of health loss and environmental degradation. These are, on the material side, the results of complex biological, biochemical, and biophysical processes that link past contamination to present and future effects (delayed effects, transgenerational effects), and through which past contamination mixes with current contaminations, continuously transforming our toxic environment and exposure, as well as our epigenetic inheritance.[20] On the social and cultural side, these long-term processes involve historically constructed human mindsets, changing professional and personal thought collectives, concepts, and senses of time.[21] Thus, the long-term challenges posed by environmental degradation cannot be successfully scientifically explored without accounting for the historical dimensions and without accounting for humans as *citizens and historical beings.*[22]

The health problems caused by toxic and hormone-disrupting chemicals are intrinsically historical: exposure to and the body burdens of environmental poisons change over time, in different localities, and for different social groups. The cultural framing of poisons and their political handling are historical phenomena in constant transition. The poisons themselves transform the reality they are part of. The stories we tell about safety and danger, about costs and benefits, means and ends, experts, opponents, and critics are all historical and parts of different timescapes. This could be observed again and again when new pesticides were introduced in the second half of the twentieth century. Many of them were hailed as magic wonders, a blessing to humankind and completely harmless to humans and livestock. When they became contested, the assessments of pros and cons and the reality and ends these referred to changed, among both those who embraced them and those who criticized them, and so did the stories about them after they were banned or put on a list for possible termination of approval.[23] When we analyze these formative histories, we can make more sense of why we have perceived toxicity in changing ways, and we can imagine better alternatives. The fairly recent hypothesis that "the timing makes the poison"[24] stresses the need to provide historical knowledge and, I believe, the research potential of adopting a timescape perspective.

The number of *different* chemicals released in the environment has increased manifold since the problems of environmental poisons and their effects on humans and wildlife were first addressed on a larger scale in the 1960s. Quite a few of the chemicals and the heavy metals considered most harmful have been banned or significantly restricted in many countries successively since the 1970s. The Stockholm Convention, REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals), and other international agreements have been vital to achieve this. These bans have gradually served to lower harmful chemicals' burden in human bodies.[25] However, numerous new and potentially harmful substances have been introduced in the last decades, and at an increasing speed. The average human body in 2013 contained around four hundred different foreign chemicals. These are alien substances produced outside the body, which enter through environmental exposure. So the fifteen-year-olds of 1972 and the fifteen-year-olds of 2017 have grown up and live their lives in quite different toxic timescapes. According to the WHO and UNEP's expert panel of 2012, close to eight hundred chemicals are known or suspected to be capable of interfering with hormone receptors, hormone synthesis, or hormone conversion. The number of both proven and suspected hormone-disrupting chemicals is rapidly growing, and the scientific procedures for testing and defining the hormone-disrupting properties of substances are becoming more and more advanced.[26] "We are at war with ourselves" is a frequently repeated phrase among experts in the field who warn about the serious global consequences of *the toxic epidemic*.[27] How did we come to this? And how come most people and politicians do not recognize our time for what it is—the time of toxics?

The historical paradox and intrinsic human and social challenge, which partly explains the lack of recognition of the fact that we live in a world of ubiquitous toxicity, is this: most of these harmful substances have been introduced into human societies to make life more convenient, safe, and satisfying. Hormone disruptors have been used, and are used, in a multitude of products like pesticides and herbicides, textiles, dyes, detergents, plastic containers and plastics of all sorts, building materials, cosmetics, hygiene products, paint, toys, furniture, household utensils, electronics, outdoor gear, sports equipment, pneumatic tires, drugs, processed food, and much more. Individually and collectively, these items encompass our quality of life and identities, since they determine what we do, how we live, and what we look like.[28] These objects co-construct our conception of normality, of time and space, and of our timescapes.

Researchers within the Deadly Dreams network study human relations to these objects, the mental images, cultural dreams and practices they are part of, and the environmental poisons and hormone-disrupting chemicals they have brought into peoples' lives. Our hypothesis is twofold: That such historical knowledge is absolutely vital if we are to comprehend, interpret, and reflectively approach the challenge of the toxic epidemic. And, moreover, that a historical study of humanity's relation to these chemical substances that slowly change our world, our bodies, and life itself has the capacity to promote understanding, discussion, and social and cultural change. I believe the concept of timescapes can help us conceptualize and cognitively grasp some of this challenge.

I argue that our human experiences with toxic substances are not developed one chemical at the time, one dose at the time, one health injury at the time, but through complex exposure to and experience with cocktails of substances in a variety of social arenas of everyday private and professional life. Knowingly or not, people have experienced them as *cultural cocktails,* too. Like the Industrial Revolution of the nineteenth century, the synthetic revolution of the 1950s and 1960s, and the digital revolution of the 1990s and 2000s.[29] Thus, we must examine the historical and cultural context harmful chemicals appear in and have effects on. This is why broad and transsectorial timescape studies may bring new types of knowledge and insights to the horizons of the past.

The Methodological Challenge for Research, Science, and History

Researchers—from both the natural sciences and the humanities—face many challenges if they wish to understand the effects of toxic exposure across time and generations. Some effects have shown to be more easily accessible to research than others. Birth defects as a result of toxic exposure of the pregnant mother have traditionally been seen as one of the most "easily" timed effects of harmful exposure because it can be linked to the mother's exposure during pregnancy, which today is one of the most easily timed periods in human lives. One of the best-known cases is the thalidomide tragedy of the early 1960s, when babies were born with severe deformities after their mothers were prescribed the drug thalidomide by their physicians to ease morning sickness, and took the drug between day twenty and day forty-two of the pregnancy. The type of deformities the baby suffered affected the central brain, eyes, ears, face, arms, or legs, depending on the exact day or days in this period of early pregnancy the mother took the drug and which organs were forming on that day of human gestation.[30] The time sequence of pregnancy is short and thus makes research into cause and effect of exposure easier than in studies that search for causes and effects over longer time spans, both within and across generations. The pregnant woman has, in many parts of the world, been the object of a lot of health advice and health monitoring.

It is far more complex to examine the impact of environmental factors beyond pregnancy. And *time* is the most complicating factor. Where in time do you start your investigation? Where in time do you stop? How can you, as a researcher, follow the entire life span of an individual, or indeed the life spans of previous or following generations? What if you want to research numerous people, different groups, or different populations located in time and space? If so, you will encounter numerous obstacles in framing your object of study and in making it accessible for analysis. How do you construct the relevant timescape to frame the problems you want to investigate? If the timescape you set out to study is a time section of a human life, all the other exposures, the entire exposome of a day-by-day, year-by-year everyday life, will contaminate and mess up a causal study. This notion of causality is an issue not only for medical researchers but also for historians as they seek to understand the histories of medical discourse and public awareness of certain toxins, and to bring out the relevance of studying certain toxins over others.

An additional complicating factor is that for many environmental poisons and hormone disruptors there are no control groups, because the chemical has spread to an extent where it is present in all living bodies. This is the case with DDT and its metabolites, PFOS and PFOA; with PCBs; and, in some regions and localities, with lead, mercury, and chromium and many more. In other cases, later-life exposure to other harmful substances may alter the exposure load of individuals or groups to such a degree that the initial chemical exposure becomes much less significant as part of their total body burden of environmental poisons. This makes causal-oriented research harder but the toxic load more severe. If the objective of research is to improve health and living conditions for humans and other species, we may be better off investing more research efforts in different ways.

A constructed, yet not far-fetched, example may illustrate the challenge. Let us consider infants whose mothers were exposed to DDT during World War II or the postwar decades. They may have considerable DDT loads in their bodies from their time in utero and from breastfeeding in their first year. These children may then grow up in houses covered with crumbling and flaking white lead paint, or experience mercury pollution in their drinking water and air pollution from traffic and nearby factories. They may be exposed to asbestos, PCBs, and isocyanates in their school buildings. Nevertheless, there may be residues of agrochemicals in their diet and significant doses of herbicides in their playgrounds, schoolyards, parks, and sport arenas. This will not prevent them from taking up tobacco smoking in their teens. They may still start working in welding or tanneries with high chromium exposure in their twenties, or in cleaning or hairdressing, exposed to numerous chemicals in liquids and sprays. Or, they may work in the chemical smog in petrochemical factories, in the dying industrial sector, or in commercial greenhouses, infrastructure maintenance, or e-waste deconstruction; or suffer toxic material exposure in construction work or shipwrecking, as a seasonal farm hand or a waste worker; or hold another occupation with high burden of chemical exposure. Many may even have successive jobs in different industries involving harmful exposure. They may often wear different types of protective clothing soaked with synthetic chemicals to protect them against fire, heat, rain, wind, or frost. Still, they are not protected from suffering exposure to nuclear fallouts or chemical accidents. Nor are they protected from harmful chemical exposures caused by the neglect or ignorance of family, friends, neighbors, and colleagues in their everyday environment, any more than from their own mistakes, calculated risk taking, or previous habits followed by later regrets.

So, in lives like these, plausible human lives, how can you possibly isolate and assess the lifetime impact of the DDT exposure and content in blood and nutrition before and after birth? Or the glyphosate exposure from your food, field, or playground? The same could be said for almost all of the other types of toxic exposure. There is a long-standing tradition where commercial companies producing and distributing harmful chemicals and commodities cling to this exact claim, arguing that it was some other substance, or some other personal life choice, that caused the harm to the individual, the family, the community, or the environment.[31] This is why it is vital not to subscribe to, or confine ourselves to, singular cause-and-effect thinking about toxics and harmful substances,[32] or to get narrowly obsessed with defining the exact harmful effects of one single molecule.[33] In real-world timescapes, this makes little sense, except for assessing and assigning particular responsibility.[34] Historians can not only contribute to the production of knowledge about these broader life circumstances and communities' exposure, but in particular help to provide insights into how the exposome of a place or a community may change over time, in different life stages, and across generations. The human body is a profoundly historical thing, and the chemical burdens carried by all living bodies are both created by history and creators of history.

Moreover, one may argue that historians, with their tradition for handling diverse and complex information, as well as multiple sources and methods, and for organizing and interpreting this information in sequences of time, should have significant advantages when it comes to bringing forth this type of synthesis of knowledge and insights. Thus, might they also have a scientific and social responsibility to make efforts in this direction?

The concept of the *exposome* refers to the measure of all the exposures an individual experiences in a lifetime and how those exposures relate to health. The exposome accounts not only for toxic exposure but also for other types of exposure too—for instance, to bacteria, plants, animals, fungi, or climatic factors like heat, sunlight, or frost. If we are interested in the toxic timescape of individuals and groups, we will pay less attention to their entire exposome but rather focus on the elements of foreign chemical exposure. Some of this toxic load on individuals and groups may be quite local, while other parts may transcend localities. Of the latter, persistent organic pollutants (POPs) and heavy metals are the classic examples.[35]

The consequences of harmful environmental exposure to living beings from environmental toxicants are particularly complex and problematic in the case of exposure to hormone-disrupting chemicals. Exposure to some toxic substances or mixes thereof may, through different bodily processes, also affect the bodies and health of the next generation. It is also known that some exposures cause epigenetic change, and may cause transgenerational effects in third and fourth generations. This is known among other species, and research keeps coming that shows that these effects are probably at work among humans as well.[36]

Thus, toxic exposure is not just a matter of causing harm to the exposed individual or group at a certain point in time. Toxic exposure is also the potential historical exposure of future generations of the originally exposed group. Some types of harmful chemical exposure may even hamper the exposed individual's ability to procreate.[37] This is the case for humans and other living beings in the present, but this was probably also a problem for past generations.

Recent research shows that young boys and girls around puberty are significantly more susceptible to environmental exposure from harmful chemicals than previously known.[38] This means that previous generations' exposure probably affects our health today to a higher degree than we have previously understood. It also means that the toxic timescape of a lifetime in fact extends in time, beyond the individual life, in both directions. And because we do not live alone but are part of different communities, our toxic timescape extends in space as well. For historians this means that harmful environmental poisons and hormone-disrupting chemicals are in effect historical agents. How can we pursue this understanding methodically and transform it into historical generative research?

Researchers from biology and medicine have for some time worked to solve the complex questions of how harmful chemical exposure in one generation, through epigenetic change, shows up in later generations, both as intergenerational and transgenerational effects (see figure 1.2). We now know that when a *pregnant* woman is exposed to toxic chemicals, the germ cells of her son or daughter, and their children as well, are also *directly* exposed. This may result in intergenerational effects, and it is my understanding that this possible epigenetic inheritance, from this original exposure, expressing itself in the third generation, will be a transgenerational effect from the original exposure. Although the individuals in question may belong to completely different generations and live in a very different world than their great grandparents did, the toxic timescape may still be interconnected because the great-grandmother's exposure might have an effect on their health.[39]

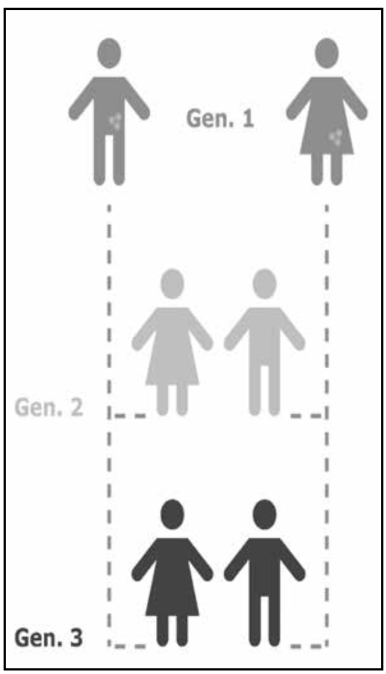


FIGURE 1.2. Three generation model. © Deadly Dreams research network, 2020.

However, if a man or a woman, and their germ cells, were exposed to an environmental poison or stressor, their children are directly exposed to it as well, and the possible transgenerational epigenetic effects may express themselves in the third generation (see figure 1.2). For the topic of toxic timescapes, this means that the generational span of a toxic exposure will vary with the exact life-stage timing of the exposure of the older generation. People whose parents or grandparents were exposed to certain toxics in the years before puberty, before the age of around fifteen, could in some cases be much affected by this exposure, even if their mother did not suffer exposure during pregnancy. It is not only exposure on the part of the pregnant woman that can cause harm to the following generations; harmful exposure on the part of the parents even before pregnancy may harm their children and the next generations as well.[40] Thus, the relevant timescape implications may be somewhat different than we may expect, and we need to pay attention to other toxic exposures than were previously considered, like that of the fifteen-year-old, the girl or the boy going through puberty. I wanted our generational timescape model to reflect this insight (see figure 1.3).

Now, with respect to knowledge about human generations, the research above is at a fairly early stage. Methodically, it is challenging. Transgenerational effects have been easier to prove in lab rodents than in humans because of the shorter generation span of rats and mice.[41] Most other animals also have shorter generations. Many reproduce after only one year. This partly accounts for the susceptibility of some species to harmful exposure and for cases of rapid population decline.[42] However, trans- and intergenerational effects in humans, with their long generation spans, are much harder to study and have mainly been approached in two ways. First, through aftermath studies that follow up on a dramatic historical incident, like accidents or acts of war, and researchers examine the effects on children and grandchildren of the exposed group.[43] These studies expand the relevant timescape of interpretation for the historical impact of the incident to accommodate the second generation, and sometimes they may attempt to accommodate the third generation. Second, researchers have started from a present-day patient group with the same diagnosis, and through interviews they have tried to reconstruct the past exposure of their parents and grandparents.[44] Again this research is expanding the timescape of relevant toxic exposure and burden across generations back in time. However, facing the magnitude of the toxic epidemic, we need research efforts that can help science move beyond the methodological limitations of single strings of individual generational links, and open up the possibility of studying the exposure of larger generational groups, beyond those individuals and families to whom the researchers have clinical access. And that is where historical research can be of great relevance.

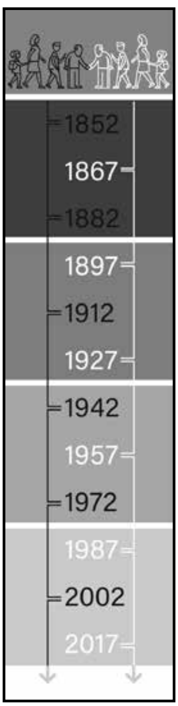
A knowledge gap that historians can bring substantial research findings and insights to is therefore the question of what these past chemical exposures were and how they were part of the everyday life circumstances of previous generations. Instead of medical researchers looking forward with their generational studies, historians could look back in time into archival records to help understand intergenerational exposure. We should discuss and explore how historical research can bring methodological resources to the studies of transgenerational health effects in humans in a way that moves this beyond individuals and their families. The toxic epidemic is a major global health issue,[45] and more research traditions need to contribute with their specific expertise and methodologies. The toxification of the environment and of the life and habitat of other species is also a major global environmental issue.[46] Humans are the producers and distributers of the environmental poisons that produce this crisis. The types, amounts, and patterns of the toxics that they load on global and local ecosystems change over time. Some of these systems are more time sensitive than we think. A timescape generational model may form a useful grid for the analysis of changing environmental burdens and the cultural considerations and practices involved.

I believe that historical studies of generations and of the toxic timescapes of generations can bring conceptual resources from the humanities to the important global effort to counter the toxic epidemic. But I think it has the potential to make sense of people's lives too, if we use it to engage with people's experiences within different communities and different periods. Sometimes I think of it as a grid, sometimes as a fishnet thrown into times past.

The Generational Timescape Model

Timescape perspectives offer analytical tools to handle a historical scenario. Timescape perspectives could be extensive, almost limitless, in both time and space and the inclusion of living bodies. They may encompass past, present, and future. However, without any frames and structures, changing historical objects and processes are hard to study when they are anchored in neither time nor space. Timescape studies should seek to strengthen these connections. For the purpose of my studies into the historical prerequisites for and possible historical implications of the toxic epidemic, I need a grid of smaller timescapes to both embody and structure the wide historical timescape my research group, Deadly Dreams, and I seek to explore. For this I have chosen the timescapes of generations, and of half generations.

This is why: the relevant timescapes for the study of toxic exposure or the chemical body burden of a species cannot, as we have discussed above, be fully accounted for by limiting the study to one particular generation alone. Even as exposed bodies, we are both created by history as well as creators of history. Thus, a toxic timescape model that aspires to contribute knowledge of the toxic epidemic needs to adopt a transgenerational timescape perspective in order to account for the prerequisites for, causes of, and possible impacts of toxic exposure. The concept of timescapes enables more advanced analysis and more sophisticated discussion on the historical significance of toxics. Not only does it allow



us to frame bodily exposure and experience through life stages in different generations, it also allows us to anchor, in the history of living bodies, the most significant historical phenomena relevant to toxic exposure among living species. Among these are different types of chains of producers and distributors of harmful exposure, and the shifting concepts of, knowledge about, and attitudes toward possible harmful substances or combinations thereof, and to values and ideas involved in deliberately or unintentionally exposing humans and other species to toxics.

One of Deadly Dreams' new theoretical and methodological innovations is a particular historical timescape model, consisting of two series of six generations each, combined into a model of twelve half generations covering the period 1852–2017 (see figure 1.3). Historians

FIGURE 1.3. Illustration of timescape and period model. © Deadly Dreams research network, 2020.

usually define a generation as thirty years, and so do we. In addition, my colleagues in the Deadly Dreams network and I have introduced and are experimenting with the novel methodological concept of *half generations,* a fifteen-year period, which serves our research purpose of studying the history of harmful substances in everyday life. New research within our Deadly Dreams cooperation project, RHINESSA, has revealed that boys and girls in puberty, around fifteen years old, are in a particularly vulnerable time window with regard to harmful chemical exposure.[47] Focusing on fifteen-year intervals also gives us at least six, possibly seven, life stages to observe in the life span of long-lived persons: 0—birth, 15—puberty, 30—parent, 45—middle age, 60—older age, 75—high age. We may even be able to study some 90-year-olds.

And in addition, this methodological approach provides us with two different parallel generational sequences and thus a much better chance of detecting significant changes over time. A fifteen-year time span is both wide and narrow enough to catch significant historical changes and developments that affected the lives of the majority of people in a locality in various ways and through different stages of life. It will encompass a generation of children and an educational generation, an average period of childbearing age in the life of a woman, a period of old age, and cycles of historical developments within the economy, migration, politics, social change, material technology, and the exploitation of natural resources. It will also encompass professional generations within different occupations and institutions, cultural frames of thought, scientific discoveries and advancements, and application of scientific insights and thus generations of experts.

Our archival work so far has been based on the archives of the plant protection authorities, the state poison commission, pharmacies' poison protocols, agricultural archives, gardening associations, and organizations of foresters. We also conducted interviews with cleaners and consumers of plastic products[48] and analyzed local newspapers' reporting on pollution and examined how the topic is treated school curricula. We found that, over the last two centuries, fifteen-year periods are often sufficiently long historical intervals for many practices to change, some even in very radical ways. Thus, the toxic timescape of two periods may be entirely different.[49] This is indeed typical in areas and times of acceleration. But fifteen-year time frames also serve to frame, and thus identify, periods and areas of standstill in other fields and the possible contrast between areas of standstill and areas of change. For instance, at certain times a country, region, or local community might experience dramatic changes in demography, in public health, in ecosystems, in science, or in knowledge about health and nature. Yet school curricula, teaching content, textbooks, traditional authorities, environmental legislation, or political planning may appear almost unaffected by the changes. Stagnation, dynamics, or a lack of dynamics can more easily be identified and made a subject for discussion in a grid like this.

I need to emphasize that this is a model for historical generations designed to allow the systematic gathering and combination of historical data, and this is why the model is set within a specific historical referential time. The fifteen-year interval is not random. Our Deadly Dreams timescape intervals are carefully chosen to optimize the match with what we and others have found to be significant turning points in the history of harmful substances (see model in figure 1.3): rather than an exact single year, we focus attention particularly on the years around 1852, 1867, 1882, 1897, 1912, 1927, 1942, 1957, 1972, 1987, 2002, and 2017, respectively.[50] We emphasize that this rhythm is a product of our research experience, and it is not universal. However, the years 1942, 1972, 1987, and 2002—corresponding to the middle of World War II, the dates of the two Stockholm conventions, and the Montreal protocol—are as universal as it gets in this field and might just open the possibility for uncovering more comparable historical sources and circumstances.

Within each of these timescapes, our investigations will focus on the most significant aspects, objects, and habits of everyday life, of communities and knowledge, and of production and consumption that appear to have had an influence on the environmental conditions people experienced and coproduced in their private and professional lives. We will examine those factors that impacted both upon the external environment and upon the nature and well-being of the human body. The relative weight of these different factors could change over time (e.g., petroleum lamps, arsenic rat poison, plastics, PCB windows, or electronic waste), and we intend to keep our research questions open as to what objects, substances, and proportions are most important. The discipline of history has produced lots of knowledge of many aspects of people's lives in past communities that we believe can be reinterpreted for our purpose.

We can never uncover or map the *entire* exposome of an individual, a group, or a generation, and this is even more complicated to do for humans or other living beings in the past. Individuals, groups, and generations are exposed differently, depending, among other things, upon their locality, their social, cultural, and economic life circumstances, and some individual choices, like the choice to smoke or chew tobacco. Further complications and uncertainties await us if we want to understand how the exposome of individuals or groups has changed over time. The best we can do in this respect is to attempt to theorize historical exposomes on the foundation of a complex mosaic of available knowledge. This knowledge is available or obtainable in three ways:

First, some pieces of this knowledge are available through explicit and direct studies that focus on toxic exposure, body burdens, and/or the possible effects of specific toxicants or groups of harmful chemicals within a moment in space and time.[51]

Second, some of this knowledge may be available or obtainable from historical studies that do not have this particular focus but which, nevertheless, can still provide relevant and varied *indirect* knowledge and important context for extracting secondary historical information and that can be reinterpreted for our purpose. These can be studies of everyday life, industrialization, occupations and professions, hygiene, medicine and health care, infrastructure, institutions, legislation and government regulations, local communities, food production, consumption, education, research, and much, much more. Collections of historical big data may also allow for a reanalysis for this purpose.[52]

Third, some of this knowledge may be obtained from carefully designed new research projects that investigate historical sources and circumstances. These can provide either (a) key knowledge of historical exposure, (b) knowledge of the social and cultural aspects of the historical structures that carry the practices of toxic exposure, (c) understandings of key perspectives that open up areas of historical knowledge by uncovering a wider area of the history of toxic exposure, or provide interpretive, conceptual, or theoretical resources for later studies in the field, or (d) the capacity for synthesis and thus the production of new generative historical insights into the history of toxic exposure upon living beings.[53]

It is my belief that we may uncover, map, and identify some main features and key elements of the exposome of humans living at a certain point in historical time and place. It is also reasonable to assume that some of these places may have many or significant similarities, while others may have many differences, even significant ones. Thus, it does make sense to attempt to explore, describe, and assess the main components of the toxic environmental exposure of groups or communities in specific periods of historical time. Deadly Dreams aspires to provide new historical knowledge and analysis that (a) expands the research community's capability to interpret scientific research data on the intergenerational and transgenerational effects of harmful substances and (b) can explain different generations' complex relations with harmful chemicals at different stages in history, and thus provide insights and conceptual means to help reveal and untangle these chemicals, and remove them from our everyday life and our future environment.

The harmful chemicals are omnipresent and have been so for a long time. They are accumulating, biomagnifying, and mixing with other substances into very harmful cocktails that no single research discipline can fully assess. Over time, and over generations, people have become blind to harmful chemicals in their everyday life, because they are part of so many familiar objects, human practices, and patterns of thought that we believe to be truthful, knowledgeable, and rational. We hope that the Deadly Dreams research initiative will provide numerous eye-openers, relevant for politicians, professionals, and communities. We are now in a stage of scientific development where we need to bring together researchers from different disciplines to address this global crisis with new research approaches. We invite researchers to join our initiative to contribute.

If you want to join in and help build up the grid of generational timescapes that can provide complex knowledge of the toxic exposure of different historical generations, at different life stages, and in different places and social settings, this is what you can do: Use the material or case insights from your previous historical studies, from other scholars' work, or from the new investigations you are designing to help gather data about one or more of the half-generation timescapes in our model. Ask the first, and then the second of the following questions:

First, toxic timescapes of exposure and effects: What *types* of harmful chemicals, environmental poisons, and hormone disruptors were present in the personal and professional lives of different groups of people, in different generations, and at different stages throughout modern history? How did they affect people's bodies in proven, possible, or probable ways, at different stages of life? And what types of harmful substances did humans at this time impose upon the environment and other species?

Second, toxic timescapes of knowledge, comprehension, and values: How were the *concepts* of and the *practices* involving harmful chemical substances and environmental poisons constructed at the time and place you study, by different groups, in different arenas, and within different generations? How have concepts and practices changed over time and generations? What were the *implications* with respect to harmful exposure and toxic environmental legacy?

By bringing the two together you may help to open up insights into the history of humans and other beings from a perspective that is critical to the health of future generations and to the future of planetary health.

Notes

1. I refer the readers to the examples and references later in the text.
2. *Hormone disruptor* is the more common term, while *endocrine disruptor* (ED) is the more medical term. In this text I use the more common term for the purpose of interdisciplinary communication.
3. With the term *toxic,* I here mean all substances, or combinations of substances, that cause harm to a living body, either by causing the cells or the body to die, or by causing it to malfunction by disturbing bodily processes in other ways, such as with those substances that are hormone (endocrine) disruptive, called EDs.

   Endocrine disruptor chemicals (EDCs) are substances that disturb hormone production, hormone conversion, or hormone synthesis, which regulate life processes and are vital to homeostasis and healthy development at different life stages. In reference, for a basic definition of EDCs, see C. Molnar and J. Gair, "The Endocrine System," chap. 18 in *Concepts of Biology: 1st Canadian Edition,* https://opentextbc.ca/biology/; Barbara Demeneix and Rémy Slama, *Endocrine Disruptors: From Scientific Evidence to Human Health Protection* (Brussels: European Union, 2019), 17–18.
4. Sarah Vogel, "From 'The Dose Makes the Poison' to 'The Timing Makes the Poison': Conceptualizing Risk in the Synthetic Age," *Environmental History* 13, no. 4 (2008): 667–73; Kortenkamp et al., *State of the Art Assessment*

of Endocrine Disrupters: Final Report (Brussels: European Commission, 2011); Svanes et al., "Father's Environment before Conception and Asthma Risk in His Children: A Multi-generation Analysis of the Respiratory Health in Northern Europe Study," *International Journal of Epidemiology* 46, no. 1 (2017): 235–45; Demeneix and Slama, *Endocrine Disruptors.*

5. Theo Colborn, Dianne Dumanoski, and John Peterson Myers, *Our Stolen Future: Are We Threatening Our Fertility, Intelligence, and Survival? A Scientific Detective Story* (New York: Penguin Books, 1997); European Environment Agency, *The Impact of Endocrine Disruptors on Wildlife, People and Their Environments—The Weybridge+15 (1996–2011) Report* (Luxembourg: Publications Office, 2012); Kortenkamp et al., *State of the Art Assessment of Endocrine Disrupters;* Polyxeni Nicolopoulo-Stamati, Luc Lens, and Vyvyan C. Howard, eds., *Endocrine Disrupters: Environmental Health and Policies* (Dordrecht: Kluwer Academic Publishers, 2001); United Nations Environment Programme, *State of the Science of Endocrine Disputing Chemicals: IPCP-2012,* https://www.unep.org/resources/publication/state-science-endocrine-disputing-chemicals-ipcp-2012; Demeneix and Slama, *Endocrine Disruptors.*
6. Åke Bergman et al., eds., *State of the Science of Endocrine Disrupting Chemicals 2012* (Geneva: World Health Organization, and United Nations Environment Program, 2013).
7. Bergman et al., *State of the Science of Endocrine Disrupting Chemicals 2012.*
8. For articles with a special focus on locality, I refer readers to the section of this book that deals with localities in particular.
9. See, for instance, Pernilla Carlsson et al., "Polyclorinated Biphenyls (PCBs) as Sentinels for the Elucidation of Arctic Environmental Change Processes: A Comprehensive Review Combined with ArcRisk Project Results," *Environmental Science and Pollution Research* 25, no. 23 (2018): 22499–528; Roland Kallenborn, Lars-Otto Reiersen, and Christine Daae Olseng, "Long-Term Atmospheric Monitoring of Persistent Organic Pollutants (POPs) in the Arctic: A Versatile Tool for Regulators and Environmental Science Studies," *Atmospheric Pollution Research* 3, no. 4 (2012): 485–93.
10. Bergman et al., *State of the Science of Endocrine Disrupting Chemicals 2012;* Demeneix and Slama, *Endocrine Disruptors.*
11. Bergman et al., *State of the Science of Endocrine Disrupting Chemicals 2012.* See also the five reports from the Intergovernmental Panel on Climate Change (https://www.ipcc.ch/) and the fifty-nine reports of the Scientific Committee on Problems of the Environment (https://dge.carnegiescience.edu/SCOPE/); United Nations Environment Programme, *State of the Science of Endocrine Disputing Chemicals: IPCP-2012.*
12. The Organisation for Economic Co-operation and Development work on the topic can be reviewed through *OECD Work on Endocrine Disrupting Chemicals* (OECD, 2018), https://www.oecd.org/env/ehs/testing/oecdworkrelatedtoendocrinedisrupters.htm.

13. Demeneix and Slama, *Endocrine Disruptors.*
14. Helle R. Andersen et al., "Impaired Reproductive Development in Sons of Women Occupationally Exposed to Pesticides during Pregnancy," *Environmental Health Perspectives* 116, no. 4 (2008): 566–72; Christine Wohlfahrt-Veje et al., "Smaller Genitals at School Age in Boys Whose Mothers Were Exposed to Non-persistent Pesticides in Early Pregnancy: Prenatal Pesticide Exposure and Reproductive Health in Boys," *International Journal of Andrology* 35, no. 3 (2012): 265–72.
15. Marianne Lønnebotn et al., "Environmental Impact on Health across Generations: Policy Meets Biology; A Review of Animal and Human Models," *Challenges* 9, no. 2 (2018): 42; Toril Mørkve Knudsen et al., "Transgenerational and Intergenerational Epigenetic Inheritance in Allergic Diseases," *Journal of Allergy and Clinical Immunology* 142, no. 3 (2018): 765–72.
16. Andersen et al., "Impaired Reproductive Development in Sons of Women Occupationally Exposed to Pesticides during Pregnancy"; Kortenkamp et al., *State of the Art Assessment of Endocrine Disrupters;* Philippe Grandjean and Philip J. Landrigan, "Neurobehavioural Effects of Developmental Toxicity," *The Lancet Neurology* 13, no. 3 (2014): 330–38; Martine Bellanger et al., "Neurobehavioral Deficits, Diseases, and Associated Costs of Exposure to Endocrine-Disrupting Chemicals in the European Union," *Journal of Clinical Endocrinology and Metabolism* 100, no. 4 (2015): 1256–66; Leonardo Trasande et al., "Estimating Burden and Disease Costs of Exposure to Endocrine-Disrupting Chemicals in the European Union," *Journal of Clinical Endocrinology and Metabolism* 100, no. 4 (2015): 1245–55; Gretta Goldenman et al., *Study for the Strategy for a Non-toxic Environment of the 7th Environment Action Programme Final Report* (Luxembourg: Publications Office, 2017); Svanes et al., "Father's Environment before Conception and Asthma Risk in His Children"; Louise Dalsager et al., "Associations of Maternal Exposure to Organophosphate and Pyrethroid Insecticides and the Herbicide 2,4-D with Birth Outcomes and Anogenital Distance at 3 Months in the Odense Child Cohort," *Reproductive Toxicology* 76 (2018): 53–62; Mørkve Knudsen et al., "Transgenerational and Intergenerational Epigenetic Inheritance in Allergic Diseases"; Demeneix and Slama, *Endocrine Disruptors.*
17. Demeneix and Slama, *Endocrine Disruptors.*
18. Statement from the work session on chemically induced alterations in sexual development, World Health Organization (2002); Bergman et al., *State of the Science of Endocrine Disrupting Chemicals 2012;* Colborn, Dumanoski, and Myers, *Our Stolen Future;* European Environment Agency, *The Impact of Endocrine Disruptors on Wildlife, People and Their Environments.* The newly adapted strategy to protect EU citizens and the environment against EDCs by the European Commission illustrates a growing awareness among policymakers of the threat that EDCs represent. See European Commission, "Endocrine Disruptors: A Strategy for the

Future that Protects EU Citizens and the Environment," press release, November 7, 2018, https://ec.europa.eu/commission/presscorner/detail/en/IP_18_6287. Demeneix and Slama, *Endocrine Disruptors.*

19. Bergman et al., *State of the Science of Endocrine Disrupting Chemicals 2012.*
20. Miriam L. Diamond et al., "Exploring the Planetary Boundary for Chemical Pollution," *Environment International* 78 (2015): 8–15. Demeneix and Slama, *Endocrine Disruptors.*
21. Ludwig Fleck, *Genesis and Development of a Scientific Fact,* trans. Frederick Bradley and Thaddeus J. Trenn, ed. Thaddeus J. Trenn and Robert K. Merton, with a foreword by Thomas S. Kuhn (Chicago: University of Chicago Press, 1979; originally published in German, 1935).
22. Kristin Asdal, *Politikkens natur: Naturens politick* (Oslo: Universitetsforlaget, 2004); Jean-Paul Gaudillière and Nathalie Jas, "Introduction: la santé environnementale au-delà du risque? Perturbateurs endocriniens, expertise et régulation en France et en Amérique du Nord," *Sciences sociales et santé* 34, no. 3 (2016): 5–18; Sverker Sørlin, "The Contemporaneity of Environmental History: Negotiating Scholarship, Useful History and the New Human Condition," *Journal of Contemporary History* 46, no. 3 (2011): 610–30; May-Brith Ohman Nielsen, *Norvegr–Norges historie bind 3 and 4* (Oslo: Aschehoug Forlag, 2011). May-Brith Ohman Nielsen, *Små paradiser—Hager gjennom et århundre* (Kristiansand: Portal Akademisk, 2015).
23. May-Brith Ohman Nielsen, "Kverk krekene! Strategier for å selge liv og død til norske hageeiere 1945–1975," in *Å selge liv og død,* ed. May-Brith Ohman Nielsen (Joensuu: University Press of Eastern Finland, 2014); Ohman Nielsen, *Små paradiser.* Anne Jorunn Frøyen, "Influencing for Results: Bees, Beekeepers and Norwegian Pesticide Legislation," *Journal of History of Science and Technology* 13, no. 1 (2019): 28–50, https://doi.org/10.2478/host-2019–0002; Michelle Mart, *Pesticides, a Love Story: America's Enduring Embrace of Dangerous Chemicals* (Lawrence: University Press of Kansas, 2015); Frederick Rowe Davis, *Banned: A History of Pesticides and the Science of Toxicology* (New Haven, CT: Yale University Press, 2015).
24. Bergman et al., *State of the Science of Endocrine Disrupting Chemicals 2012.* See also Jody A. Roberts and Nancy Langston, eds., "Toxic Bodies/Toxic Environments: An Interdisciplinary Forum," special issue, *Environmental History* 13, no. 4 (2008), and especially the articles by Linda Nash, "Purity and Danger: Historical Reflections on the Regulation of Environmental Pollutants," *Environmental History* 13, no. 4 (2008): 651–58, and Vogel "From 'The Dose Makes the Poison' to 'The Timing Makes the Poison.'"
25. Therese Haugdahl Nøst et al., "Persistent Organic Pollutants in Norwegian Men from 1979 to 2007: Intraindividual Changes, Age–Period–Cohort Effects, and Model Predictions," *Environmental Health Perspectives* 121 (2013): 1292–98.
26. Demeneix and Slama, *Endocrine Disruptors.*

27. Bergman et al., *State of the Science of Endocrine Disrupting Chemicals 2012.*
28. Ohman Nielsen, *Norvegr–Norges historie bind 3 and 4.*
29. Ohman Nielsen, *Norvegr–Norges historie volume 3 volume 4,* see in particular vol. 4, 164ff.; Ohman Nielsen, "Kverk krekene!"; May-Brith Ohman Nielsen and Anne Mette Seines, "Poison to the Beasts: Changing Poisons and Poisoning Practices in Campaigns to Kill Norwegian Birds and Mammals, 1845–1967," *Environment and History* 25, no. 3 (2019): 321–64.
30. *Thalidomide: The Fifty Year Fight,* directed by Stuart Strickson, aired May 15, 2014, on BBC2. Nancy Langston, *Toxic Bodies* (New Haven, CT: Yale University Press, 2011).
31. Naomi Oreskes and Erik M. Conway, *Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming* (New York: Bloomsbury, 2012); Nathalie Jas and Soraya Bodya, eds., *Powerless Science? Science and Politics in a Toxic World* (New York: Berghahn, 2014).
32. About this dual historicity, see, for instance, May-Brith Ohman Nielsen, "Av jord er du kommet—Av order du kommet. Et utvidet levningsperspektiv," in Carsten Tage Nielsen, Dorthe Gert Simonsen, and Lene Wul, eds., *Mod nye historier: Rapporter til Det 24. Nordiske Historikermøde* 3 (Århus: Jysk selskab for historie, 2001).
33. See, for instance, Malcom Ferdinand's chapter in this book.
34. This is, for instance, necessary in cases of environmental justice and in consumer health injury cases. Examples of this include the cases against the tobacco industry and against Monsanto, the producer of Roundup. On the latter, see Carey Gilliam, *Whitewash: The Story of a Weedkiller, Cancer and the Corruption of Science* (Washington, DC: Island Press, 2017).
35. In this volume, see, for instance, Davis Biggs's chapter on how a multitude of chemicals, not just the mix of herbicides called Agent Orange, accumulated in the area around a military base in Vietnam.
36. In references, Svanes et al., "Father's Environment before Conception and Asthma Risk in His Children," and others.
37. Joseph Pizzorno, "Environmental Toxins and Infertility," *Integrative Medicine* 17, no. 2 (April 2018): 8–11; Mahmoud Mima, David Greenwald, and Samuel Ohlander, "Environmental Toxins and Male Fertility," *Current Urology Reports* 19, no. 7 (2018): 50; Molly S. Estill and Stephen A. Krawetz, "The Epigenetic Consequences of Paternal Exposure to Environmental Contaminants and Reproductive Toxicants," *Current Environmental Health Reports* 3, no. 3 (2016): 202–13; Symielle A. Gaston, Linda S. Birnbaum, and Chandra L. Jackson, "Synthetic Chemicals and Cardiometabolic Health across the Life Course among Vulnerable Populations: A Review of the Literature from 2018 to 2019," *Current Environmental Health Reports* 7, no. 1 (2020): 30–47.
38. Lønnebotn et al., "Environmental Impact on Health across Generations."
39. The figure on this page is revised by Ohman Nielsen and redrawn by Thomas Andersen, University of Agder, based on an original from

Mørkve Knudsen et al., "Transgenerational and Intergenerational Epigenetic Inheritance in Allergic Diseases," under the terms of Creative Commons Attribution License (CC BY 4.0, https://creativecommons.org/licenses/by/4.0/).

40. Simone Accordini et al., "A Three-Generation Study on the Association of Tobacco Smoking with Asthma," *International Journal of Epidemiology* 47, no. 4 (2018): 1106–17; Lønnebotn et al., "Environmental Impact on Health across Generations."
41. Lønnebotn et al., "Environmental Impact on Health across Generations."
42. In references to research on cases of species decline affected by environmental poisons.
43. See, for example, Rebecca C. Painter et al., "Transgenerational Effects of Prenatal Exposure to the Dutch Famine on Neonatal Adiposity and Health in Later Life," *BJOG: An International Journal of Obstetrics and Gynaecology* 115, no. 10 (2008): 1243–49; Committee to Review the Health Effects in Vietnam Veterans of Exposure to Herbicides, Board on the Health of Select Populations, Institute of Medicine, and National Academies of Sciences, Engineering and Medicine, *Veterans and Agent Orange: Update 2014* (Washington, DC: National Academies Press, 2016); P. Ekamper et al., "Independent and Additive Association of Prenatal Famine Exposure and Intermediary Life Conditions with Adult Mortality between Age 18–63 Years," *Social Science and Medicine* 119 (2014): 232–39; Tessa J. Rosenboom et al., "Hungry in the Womb: What Are the Consequences? Lessons from the Dutch Famine," *Maturitas* 70, no. 2 (2011): 141–45; Robert Scholte, Gerard J. van den Berg, and Maarten Lindeboom, "Long-Run Effects of Gestation during the Dutch Hunger Winter Famine on Labor Market and Hospitalization Outcomes," *Journal of Health Economics* 39 (2015): 17–30; Ingrid Eckerman, *The Bhopal Saga: Causes and Consequences of the World's Largest Industrial Disaster* (Hyderabad: Universities Press, 2005); Elizabeth D. Blum, *Love Canal Revisited: Race, Class, and Gender in Environmental Activism* (Lawrence: Kansas University Press, 2008).
44. Nils Oskar Jõgi et al., "Zoonotic Helminth Exposure and Risk of Allergic Diseases: A Study of Two Generations in Norway," *Clinical and Experimental Allergy: Journal of the British Society for Allergy and Clinical Immunology* 48, no. 1 (2018): 66–77.
45. Bergman et al., *State of the Science of Endocrine Disrupting Chemicals 2012;* Demeneix and Slama, *Endocrine Disruptors.*
46. Bergman et al., *State of the Science of Endocrine Disrupting Chemicals 2012;* Demeneix and Slama, *Endocrine Disruptors.*
47. Cecilie Svanes et al., "Exposures during the Prepuberty Period and Future Offspring's Health: Evidence from Human Cohort Studies," *Biology of Reproduction* 105, no. 3 (2021): 667–80.

48. The Toxic Bios project has high relevance for our project and is recommended as a source of methodological inspiration. The project leaders Iengo and Armiero present it in their chapter in this volume.
49. This is one of the experiences the author gained from writing a two-volume, broad-perspective Norwegian history monograph covering the years 1840–2011; a history of Norwegian family and allotment gardening covering the years from the 1980s through the 2010s; and a longitudinal study of poison bait eradication campaigns against Norwegian fauna, 1845–1967, as well as studies of instructions regarding pesticides given to Scandinavian family gardeners. Ohman Nielsen, *Norvegr–Norges historie bind 3 and 4;* Ohman Nielsen, *Små paradiser;* Ohman Nielsen, "Kverk krekene!"; May-Brith Ohman Nielsen, "Syntheticising Scandinavia: The Introduction of Synthetic Pesticides to Scandinavian Gardens 1945–1952," *Journal of the History of Science and Technology* 14 (2020): 113–59; Ohman Nielsen and Seines, "Poison to the Beasts."
50. For instance, 1972 and 2002 were the first and second Stockholm conferences, while the Rio Earth Summit was held in 1987.
51. In this volume you will find these types of studies in the chapters by Davis, Ferdinand, and Iengo and Armiero, but this is also reflected in the chapter by Biggs.
52. For more on historical big data, see Patrick Manning, *Big Data in History* (New York: Palgrave Macmillan, 2013) and also Gunnar Thorvaldsen, *Censuses and Census Takers: A Global History* (London: Routledge, 2017).
53. Readers interested in the concept of generative historical insights may wish to refer to the tradition of Jörn Rüsen: see Jörn Rüsen, *History: Narration, Interpretation, Orientation* (New York: Berghahn Books, 2005). For more on how this can be adapted to the historiography of the history of medicine and health, and epidemics in particular, see May-Brith Ohman Nielsen, *Bugs and Borders: A Historiographical Inquiry into the Theoretical and Methodological Implications of Borders in the Studies of Great Epidemics* (Lewiston, NY: Edwin Mellen, 2015).

CHAPTER 2

Slow Observation

Witnessing Long-Term Pollution and Environmental Racism in Cancer Alley

Thom Davies

IN THIS chapter I suggest that *slow observation* can provide a useful lens with which to understand toxic spaces. But what, exactly, do I mean by "slow observation"?[1] Unlike "slow scholarship,"[2] slow observation does not come from a position of choice or privilege. It is not a rebellion against the status quo or a deliberate act of slowing down. It is, rather, an embodied and temporal sense of *knowing,* something that comes from years of immersion *in* a place and *across* time. It is anchored to the toxic experiences of people and their more-than-human counterparts, to their connection with landscape and its multiple temporalities. Slow observation is predicated on the notion of *being with* a place and time. As a form of *temporal noticing,* slow observation mirrors the attritional accumulations of pollution spelled out in the terror of what Rob Nixon called "slow violence,"[3] producing an incremental stratigraphy of knowledge: piecemeal, drip-fed, uncanny, and temporally situated understandings. Slow observation is not just "local knowledge" in a *geographical* sense but is attached to distinct temporalities, assembled and negotiated across years of everyday and embodied encounters with pollution.[4] Slow observation provides a critical means through which polluted communities understand the lived reality of persistent environmental threats.[5]

For thousands of communities across the globe who are dealing with the longue durée of pollution,[6] slow observation is an ever-present form of temporal witnessing. It is not something "exceptional" to be extracted by outsider-ethnographers but rather a slow knowledge about contamination that is common to many environmental justice communities around the world. From Chernobyl survivors who have learned—over time—which areas of the nuclear exclusion zone are safe to pick mushrooms,[7] to Bhopal-affected communities who are the only witnesses to the gradual demise of their families' health,[8] slow observation is an unavoidable praxis for people who dwell in technologically damaged environments. This slow knowing that inhabitants of toxic geographies experience and share operates counter to the hegemonic time frames of pollution; it is distinct from the industrial time of global markets, extractive industries, or capitalist regimes of accumulation. So, too, does slow observation run counter to formal understandings of pollution, existing separately from the time frames of scientific expertise, with its exposure thresholds, dose-response rates, and toxic half-lives.

If *toxic timescapes* refers to the hazardous intersectionality of time, space, and bodies, then slow observation offers one way of bringing these embodied timescapes alive. This chapter uses the idea of toxic timescapes to explore the lived experience of industrial contamination in a highly polluted region of the United States. By taking seriously the way time is experienced by communities living in a highly toxic geography in Louisiana known as "Cancer Alley," I advance the idea that slow observation is a radical way of understanding pollution at the nexus of time and space. I use "toxic timescapes" in conjunction with "slow observation" to open up a more-than-human narrative, where trees no longer bear fruit, frogs have long disappeared, and birds no longer fly over the Mississippi levee.

Drawing on long-term ethnographic research with communities living in the highly industrialized parish of St. James in Louisiana, in this chapter I examine how time interacts forcefully with the drawn-out experience of pollution. Not only do I discuss the hazardous spaces that people are forced to endure; I also direct attention to the district temporalities that petrochemical pollution creates. For communities such as these, which are surrounded by toxic infrastructure, being able to gradually bear witness to the uncanny, unsettling, and brutal impacts of toxic pollution is an important prism through which to understand, articulate, and potentially resist environmental injustice. By focusing on the lived experience of industrial pollution we can illuminate the myriad ways local communities have learned to *notice* environmental injuries, not over the span of weeks or even years but over decades of slow observation.

In the pages that follow, I will show how toxic timescapes are transcribed into the landscape in multiple ways. The toxic timescapes of Cancer Alley are found not only in the postcolonial histories of this polluted place, where the plantation violence of yesterday has mutated into the toxic racism of today.[9] Neither are they found only in the noxious rhythms of the chemical factories, which—according to local residents—release their toxic loads to coincide with patterns in the weather, or the camouflage of night. In this chapter I argue that toxic timescapes can also be located in the slow observations of people who live alongside pollution, for months, years, or entire lifetimes. By taking seriously these slow observations, we might find new ways of understanding how harmful substances permeate time, space, and bodies.

But before we journey into the heartlands of Cancer Alley, I want first to take a step back and consider the wider role that time and temporality play in the contemporary environmental imagination. In doing so, I reject the bland application of "the Anthropocene" as a catch-all term for these highly unjust, perennially racist, and environmentally uneven times. Simply put, we are not "all in this together." In this rejection I invite other scholars to consider time differently and reimagine how it might be used as a means of resistance.

On Time: Thinking beyond the Anthropocene

Of all the timely concepts, the Anthropocene is this moment's conceptual celebrity. By introducing the simple notion of a geological "age of the human," the Anthropocene has instantly transformed the specter of climate change from a potential future (a possibility) to an inescapable presence (a reality). Such has been the impact of the Anthropocene that other "-oscenes" have sprung up in its wake: the Capitalocene,[10] Wasteocene,[11] Chthulucene,[12] Necrocene,[13] and Plantationocene[14] are just some of the more compelling alternatives to have adopted this geological wordplay. Each one attempts to repackage our contemporary political moment and offer us a different critique of society. Crucially, each one also uses *time* as its conceptual linchpin, to understand what Donna

Haraway described as "the temporality of the thick, fibrous, and lumpy 'now.'"[15] We might dismiss this epoch-defining arms race as another reason to call for "slow scholarship":[16] after all, aren't the numerous publications devoted to the Anthropocene simply a by-product of academia's own "Publish-or-Perish-ocene"?[17] Yet we might also reflect, as we read the pages of this book, Why, at this particular enviro-historical moment, has *time* grabbed hold of our imaginations?

We live in an age when time vies for our attention like never before. Our era of late capitalism has been regularly punctuated by states of "emergency" and declarations of "crisis": time-bound moments that demand urgent responses. With any declaration of an emergency, there is an implicit assumption that the crisis will—in time—come to an end; emergencies are, after all, ostensibly *temporary* ruptures to the status quo. As political theorist Carl Schmitt warned us, states of emergency can be used in pernicious ways by government elites.[18] The "state of exception"—Giorgio Agamben would later write—can be deployed to suspend the rule of law and thus extend the power of the sovereign.[19] But in this moment of acute and global environmental peril, declaring emergencies is no longer the preserve of sovereign authorities. With growing concern about climate breakdown, civil society has also attempted to use the power of the emergency, and the potentiality of *time,* to make political gains. The Extinction Rebellion protests in central London, for example, which began in October 2018 and brought parts of the UK capital to a standstill, not only demanded the government declare a national emergency about climate change; they also used the motif of *time* centrally within their campaign: the symbol for their social movement is a simple hourglass within a circle. As stated on the movement's website, "The circle signifies the planet, while the hourglass inside serves as a warning that *time is rapidly running out*" (emphasis added).[20] By May 1, 2019, with growing pressure from Extinction Rebellion, the UK parliament joined dozens of towns and cities across the country in voting to declare a "climate emergency"—the first nation-state to do so (though with little material effect).[21] If the Anthropocene makes climate change present, then emergencies make it urgent. Yet any "fix" to the global environmental crisis cannot be temporary in nature, when climate chaos is shackled so closely to the workings of racial capitalism itself.

Time, it seems, can be operationalized as a form of resistance. While environmental campaigns have often invoked the interests and rights of future generations to press home their message, until recently it was rare for children themselves to be the main protagonists in environmental disputes.[22] Yet the temporal concept of "intergenerational justice"[23] has recently been mobilized through the School Strike for Climate movement, led by Swedish schoolgirl Greta Thunberg.[24] Having started protesting outside the Swedish Parliament at the age of fifteen, by 2018 Thunberg had taken her solo protest to the UN Climate Summit in Katowice, Poland, telling gathered journalists, "Since our leaders are behaving like children, we will have to take the responsibility they should have taken long ago." Time, or rather *youth,* can be wielded as a political tool.

Like an environmental Pied Piper, Thunberg was able to mobilize vast numbers of children across the world, culminating in March 2019 when 1.4 million students walked out of schools in 2,233 cities across 128 countries, including India, Australia, and the United States. Like the Extinction Rebellion that preceded it, the message of the School Strike was simple: time is running out. Today, children are faced with a growing realization that they stand to inherit a "permanently polluted world."[25] Through the deadly presence of latent contamination and rising greenhouse gases, the hazardous politics of the past have already laid claim to the future.[26]

The Anthropocene, Extinction Rebellion, and the global School Strike are just three examples of ways in which *time* has permeated our environmental imaginations. Each one is an attempt to *use* time—actively, conceptually, and politically—to enact change. What is perhaps missing in this temporal dialogue, however, and something this chapter aims to reveal, is an exploration of the way that time interacts with communities who are on the front lines of the slowly unfurling environmental breakdown: How is time being experienced, mobilized, and observed by environmental justice communities who are living *with* the peculiar terror of pollution? How are toxic timescapes experienced by already-polluted communities, communities for whom environmental damage is not just a future geological threat but a daily and embodied reality?

And here lies the problem. The concept of the Anthropocene *flattens:* it disguises and overlooks the situated embodiments of environmental injustice, replacing it with a myth of planetary "togetherness." But if the environmental justice movement and the study of environmental racism have taught us anything, it is that the consequences of the Anthropocene will never be experienced equally. As Robert Bullard argued in his influential book *Dumping in Dixie,* pollution always follows the path of least resistance.[27] In the words of Marco Armiero—who together with Ilenia Iengo also contributes to this book[28]—we must remain "skeptical of the universal 'we,' which is so central to Anthropocene narratives."[29] The Anthropocene may have enlivened the issue of universal environmental danger, but it has also disguised its unevenness, and—crucially—camouflaged the possibility of acknowledging responsibility. Just as postcolonial writer Gayatri Spivak provocatively asked, "May the subaltern speak?,"[30] in the Anthropocene, with its mounting pollution and uneven industrial discard, perhaps we should be asking, "May the subaltern *breathe?*" As postcolonial scholar Rob Nixon observed, "While some humans are leaving Anthropocene footprints that are indubitably geological, other humans are not geological actors at all."[31] We have not all contributed equally to the "age of the human," and neither will the toxic consequences of global environmental damage be felt in equal measure.[32]

The temporal concept of the Anthropocene stands accused of racial blindness, not only to the historic and contemporary culprits of environmental damage (overwhelmingly: rich White men) but also to the likely victims of the coming climate catastrophe (overwhelmingly: poor people of color). In Kathryn Yusoff's book—*A Billion Black Anthropocenes or None*—she articulates that "the Anthropocene might seem to offer a dystopic future that laments the end of the world, but imperialism and ongoing (settler) colonialisms have been ending worlds for as long as they have been in existence."[33] In this chapter, which is based on ethnographic research in the postcolony of Louisiana, I explore one such dystopia-of-now: a former slave plantation riverscape that today hosts one of the largest clusters of petrochemical facilities in the United States. As this chapter will explore, some residents of Cancer Alley have compared their toxic exposure to a situation of "genocide" or living with a "time bomb." Following Achille Mbembe, we might describe Louisiana's postcolonial petroscape as a "death world."[34] In making this argument, and by joining the dots between slavery (racial capitalism) and pollution (toxic geography), I argue that it is vital to locate the colonial past in our analysis of the toxic present. Indeed, colonialism, slavery, and racial capitalism are essential prerequisites for the contemporary social and ecological (dis)order that the world currently faces.[35] Enlivened by Rob Nixon's idea of slow violence, I will confront how the racist logics of slavery along the lower Mississippi can be mapped onto the toxic geographies of today. The petrochemical landscape presented in this chapter is deeply entwined in settler-colonial logics of extraction, where pollution is not evenly distributed but instead follows the violent contours and toxic geographies of racial capitalism. Yet the story I present is not just one of environmental racism; it is also a story of time and resistance.

This chapter moves away from uncritical Anthropocene thinking, or the timely promise of the "crisis." Instead, I center upon the experiences of those who live *with* pollution. In her essay "Slow Death," Laura Berlant argues that "long-term problems of embodiment within capitalism, in the zoning of the everyday and the work of getting through it, are less successfully addressed in the temporalities of crisis and require other frames for understanding the contexts of doing, being, and thriving."[36] This chapter responds to this call for "other frames" for comprehending long-term problems of embodiment. Frontline communities, such as those discussed in this chapter, are not passive in the face of slow violence. Like other environmental actors mentioned above, they also use *time* to their advantage. In the final act of this chapter, I put forward the notion of "slow observation" as an antidote to the gradually unfolding terror of toxicity. In doing so, I highlight the agency of communities who face toxic discrimination, by invoking their ability to slowly bear witness to the violent timescapes of pollution. Firstly, however, I draw on ethnographic observations in St. James to link this theoretical discussion with the day-to-day realities of inhabiting a distinctly toxic geography.

Time Bombs and Slow Genocide

Geographer Katherine McKittrick astutely observed that across the postcolonial world, the slave plantation has "provided the blueprint for future sites of racial entanglement."[37] In Cancer Alley in southern Louisiana, where thousands of slaves once toiled on sugar plantations, race and toxic pollution have become entangled in a particularly harmful way. An early incarnation of this toxic entanglement occurred in the nineteenth century, when exported sugar from the blood-soaked landscapes of Louisiana literally energized the bodies of coal miners and factory workers in Europe during the Industrial Revolution: a necropolitical energy exchange of sugar for coal that would fuel a global spike in CO_2.

In plantation geographies such as those of southern Louisiana, "slavery weaponized the redistribution of energy around the globe through the flesh of black bodies."[38] By the mid-twentieth century, however, coal had given way to oil as the most profitable fossil fuel, yet the link between race and toxic pollution did not end. Instead, it *mutated, refined,* and *distilled* itself into new, more noxious forms: during the postbellum Jim Crow era, for example, many former slave plantations along the Mississippi were sold directly to petrochemical companies. Nascent oil giants turned these former plantations into chemical processing facilities, as they desired the same frictionless access to the Mississippi River to transport their carbon cargo.[39] While the affluent White landowners were able to sell up and move elsewhere, the descendants of slaves who lived alongside these new chemical factories began to suffer disproportionate exposures to environmental hazards. Residents of Cancer Alley have inherited a toxic timescape that stretches back far beyond living memory, beginning at the dawn of racial capitalism itself, when Indigenous groups—including the Chitimacha, Houma, and Choctaw peoples—were first driven off the land to make way for slavery.[40] Driving along the River Road today, passing former slave plantation museums and oil refineries, you are reminded that in Louisiana, as in other postcolonial geographies, the toxic legacies of slavery have created a racially uneven vulnerability to death.[41]

If you keep driving along the River Road you will eventually arrive at a small and unprepossessing place called St. James, Louisiana. Sandwiched between the west bank of the Mississippi levee on one side, and unbroken sugar and swamp land on the other, this poor, rural community is in the midst of an environmental justice battle. In the Fifth District of St. James Parish, among the old houses, sugarcane fields, and barges that dock in the deep waters of the "Mighty Miss," you will find another spectacle that plagues the lives of its 2,822 inhabitants: a toxic assemblage of *twelve* petrochemical facilities, equating to one petrochemical plant for every 235 residents. As I write this chapter, a new facility—nicknamed "the big one" by the chief executive of Greater New Orleans Inc.—is set to become the thirteenth.

Loretta sat in the local courthouse at a public hearing in St. James. It was her turn to speak. Five minutes only. Leaning forward, adjusting the microphone, she looked up at the Parish Planning Commission. They were familiar faces. These same men (it was always men) had approved the construction of every previous petrochemical facility in the area she could remember, often voting for them unanimously. Within a few miles of her home, the commission had approved Yuhuang Chemical, a Chinese petrochemical plant near the now defunct St. James High School; South Louisiana Methanol, another chemical complex a few miles downstream alongside the Mississippi River; and the expansion of the oil storage facility Ergon Chemical, situated next to Freetown—Louisiana's first settlement founded by former slaves in the wake of the Civil War. These men had also approved the construction of the Bayou Bridge Pipeline, which would pump thousands of gallons of oil to the St. James terminus each day and create an unbroken petrochemical link between the Standing Rock Indian Reservation in North Dakota[42] and Loretta's predominantly African American neighborhood in St. James. The result of these public meetings was always the same. But it was Loretta's turn to talk now, so she cleared her throat and began: "This industry is threatening the health of our communities and the future of our planet," she said, getting straight to the point. Behind her, a group of her neighbors and other local African American residents wore T-shirts with the slogan Rise for Cancer Alley.

The Parish Planning Commission was about to vote on the construction of a major new factory for single-use plastic. If given the go-ahead, this $9.4 billion industrial complex—owned by the Taiwanese petrochemical giant Formosa Plastics—would convert fossil fuels into trillions of plastic pellets each month, which would later become single-use grocery bags, water bottles, and polyester fabrics: material excreta of the Plantationocene that not even deep time would manage to dissolve.[43] Governor John Bel Edwards, at a press conference the previous year, had boasted: "We don't talk numbers like this very often in Louisiana," referring to the 1,200 jobs that Formosa had promised it would bring to the rural parish of St. James. But Loretta had heard it all before. The promise of jobs was, to many residents of St. James, just talk. Instead, interviewees claimed the petrochemical jobs were often given to workers who lived outside the parish, miles away from the toxic fumes and noxious smells. Indeed, like so many polluted landscapes, the small municipality of St. James is economically marginalized and majority African American, with one in five people living below the federal poverty line.[44]

As in other toxic geographies, those benefiting from polluting industry and those being harmed by it fall apart into two very distinct geographies. Toxic materials tend to overflow their formal sites of production and storage, yet the *capital* they accumulate is much more closely guarded, rarely leaking into the surrounding communities. During my time in St. James, participants would comment on the license plates of cars and trucks driven by plant employees, which were often registered in neighboring states, such as Texas, Mississippi, or even Alabama. Others would point out how local motels were doing a fast trade in housing sojourning chemical workers who came from out of state, or how "man camps" were being constructed nearby. Despite the residents of St. James being surrounded by petrochemical real estate worth billions of dollars, very little of the extracted wealth was finding its way into the pockets of those most at risk. Pollution was here, but the paychecks were nowhere to be seen.

For residents such as Loretta, it was not the promise of jobs that had caught her attention but the threat of toxic pollution and chronic illness. If the planning commission approved Formosa's land-use application, the proposed 2,400-acre site, which is situated just half a mile from her home, would emit known human carcinogens, including ethylene oxide and benzene. The sheer material scale of the toxicants that the petrochemical complex planned to release was staggering: according to the fifteen air permits that Formosa Plastics filed in 2019, the proposed construction would discharge the second-highest amount of benzene of any industrial complex in Louisiana and the highest amount of ethylene oxide. Altogether, the fourteen interconnected chemical plants that Formosa Plastics were planning to construct in St. James would emit around 28 million tons of air pollutants every year, including high quantities of volatile organic compounds, nitrogen oxides, and particulates, as well as lesser amounts of harmful substances, including formaldehyde and toluene. On top of this, it would be responsible for a reported 13.6 million tons of carbon dioxide emissions per year.[45] To put that figure into a global context (and context is essential here): according to the Oxford University–based organization Our World in Data, the 2017 carbon dioxide emissions of Ethiopia was 13.4 million tons, while Honduras emitted 10.67 million tons.[46] In other words, the proposed Formosa complex that was being discussed in the St. James courtroom would have a higher chemical footprint than *entire countries.*[47] The Anthropocene may be an epoch-defining "global" phenomenon, but it is places like St. James where its toxic realities come into sharp material focus. In Cancer Alley—which has the highest concentration of petrochemical facilities in the Western Hemisphere—the Anthropocene is not a “coming storm”: it is already here.[48]

Loretta and her neighbors knew that in the years to come, when the wind was blowing in the right direction, some of Formosa’s chemicals would seep into their homes through air ducts, open windows, and cracks in the walls. On some days the chemicals would stink of rotten eggs and sulfur. Other times the chemicals would catch in the back of the throat, make your eyes itch, give you a headache, or bring you out in a rash. Many times, they also knew, the ephemeral chemical geographies would smell of nothing at all but might lead—years later—to cancers or other health problems; the cemetery in St. James, which dates back to the time of slavery, was fast becoming an informal archive of contested environmental exposure. They knew that if they telephoned the Louisiana Department of Environmental Quality to complain about pollution, they would be ignored. Sometimes the person on the other end of the phone would file their complaint incorrectly; other times they would send out an official several days later, only to tell the residents that there was no smell. The residents knew all this because they were already living with the violent consequences of pollution, and they had been for decades. The knowledge they had gradually accrued about the realities of living near industry closely mirrored the slow accumulation of pollution that now surrounded them. The knowledge was epistemologically *slow:* not by choice but through sheer endurance. As I discuss later, this knowledge extended to subtle changes to the environment itself. If the commission approved its construction, Formosa Plastics would be one step closer to becoming the latest in a long line of toxic facilities that dot the Mississippi riverscape between New Orleans and Baton Rouge, facilities that give this region its cancerous epithet.

“If you allow any more harm to our communities,” Loretta continued, looking up at the planning commission, “this is called genocide!” she said, reading slowly and deliberately from a speech that she had carefully prepared earlier. “Genocide means . . .” She paused. “Genocide means the deliberate killing of a large group of people, especially those of a particular ethnic group or nation.” Loretta’s words were an emphatic reminder that pollution is violence. In Cancer Alley, pollution is a form of racial violence, a violence predicated on white supremacy that has never truly left this plantation-scape. Indeed, it was not uncommon for people in St. James to talk about pollution and the presence of industry in terms of actual physical brutality. Some reported feelings of being under siege by sprawling petrochemical infrastructure—being "penned in on all sides" and unable to escape. Others would describe how chemical plants were "killing everything around" and how new infrastructure would "do more damage . . . and do more harm to people." When asked, many participants would reel off a long list of family, friends, and neighbors who had contracted a range of illnesses attributed to this toxic timescape: "There are a lot of people that have cancer. It's just terrible," reported one resident, "a lot of people—everybody gets sick!" Another interviewee joked: "We know we're gonna die, just here you die a little quicker!" Residents would explain how the chemical companies had purchased property off their White neighbors years earlier, leaving African American families to continue living on land that was now contaminated and virtually worthless. The land had been displaced from under them and replaced with the haunting presence of pollution and uncertainty. As one environmental activist explained during an interview, the toxic inheritance from slavery in Louisiana meant communities here were effectively "exchanging one plantation master for another." This is, to quote Robert Bullard, "petrochemical colonialism"[49] writ large.

In the courtroom, Loretta held up a photograph of a sixty-year-old man: "This is a photo of Keith Hunter," she said, showing it to the commission. "Keith died of respiratory problems." Keith was a longtime resident of St. James and an outspoken critic of the oil and gas industry that quite literally surrounded his neighborhood. He first moved to St. James in 1991, and at first, his small wooden house overlooked rolling sugarcane fields that are synonymous with this part of the Deep South. Before long, however, the view from his veranda changed: the fields were replaced with oil storage tanks, along with a railroad terminal where trains would offload their crude cargo. Today, within a one-mile radius of the veranda where Keith used to sit, there are no fewer than 118 oil storage tanks, with more having recently been approved by the planning commission. In an interview conducted before he died, Keith had explained how he could not sleep at night, fearing for the health of his family: "I can't rest peacefully because I live next to a time bomb . . . I'm surrounded. My neighbors are surrounded."[50] Keith died on February 10, 2018, following a respiratory illness.

FIGURE 2.1. Petrochemical storage tanks near a majority African American neighborhood in St. James, Louisiana. Photograph by Thom Davies.

Slowly Witnessing Environmental Injustice

Descriptions of "time bombs" and "genocide" may sound hyperbolic or extraordinary. Yet for people living here—and for many communities around the world who endure the attritional terror of toxic environments—these accounts are not exceptional at all. Invocations of violence—such as descriptions of slow "genocide" or being under siege—both reveal political structures and do political work. Indeed, what *counts* as "violence" is not fixed or static; instead, like other malleable constructs, such as "race,"[51] the meaning of "violence" mutates across time and space.[52] It is not ontologically secure, and what is defined as "violence" becomes a *mirror* to the value system of society: it frames whose deaths matter, and whose lives can (according to those in power) be dumped onto the scrap heap of the Plantationocene. In 2021, Republican senator Bill Cassidy publicly rejected the local nickname "Cancer Alley," describing it as "a slam upon our state." Instead, he blamed illness in Louisiana on individual lifestyle choices. By un-naming violence in this way, and refusing to center the testimonies of environmental damage, he attempted to suspend the truth claims of people who actually live alongside pollution, and flatten their desire for a cleaner future—itself an act of "epistemicide."[53] Well-intentioned calls to decenter accounts of damage from toxic geographies should not be made at the expense of silencing the slow observations of communities who desire cleaner land, air, and water.[54] For many people who inhabit contaminated sites, the language of violence does not compound the harms of polluted places,[55] but instead provides a vital mechanism for liberation, resistance, and repair. In this time of unprecedented and uneven environmental breakdown, it is more important than ever to take seriously testimonies of damage and the political value that counterhegemonic stories of environmental violence can produce,[56] a violence in which *time* plays a vital role.

While in St. James, local residents would take me on guided tours around their gardens. I was shown plant pots and wizened trees, flowerbeds and fruit. Through childhood memories and stories of uncanny alterations to leaves, stems, and shrubs, I would be shown how pollution was affecting the environment. I was shown pecan nuts that were, according to the people who grew them, not as large or as green as they used to be, and flowers that had failed to grow in their usual way. Sometimes plants would fail to germinate altogether, I was told, while other times they would fruit twice in one season: the vegetation was out of kilter with nature and the passing of time. These were not stories of familial death or human suffering (though there are plenty of these accounts too), but something deeper: a more-than-human testament to the attritional impacts of pollution. While on these horticultural "toxic tours,"[57] residents would reminisce about a time before industry arrived, pointing to the rough ground or stumps where fruit trees once stood, before they perished and had to be cut down. "My daddy had orange trees," explained one interviewee who had lived in St. James her whole life. "When I got married I planted some orange trees in the garden. The orange trees died. Plum trees and all that died. Peach trees. Yes, they died. But years ago when we used to have them when I was a little girl, we had those things. They didn't die." Some residents would cast their mind back further, to inherited stories about the important role the land played after slavery ended and during the Jim Crow era. "We been on this land; every generation been on this land, from eighteen-whatever-it-was when they got it," explained one elderly lady, whose house, much like Keith's house, overlooked a field of petrochemical storage tanks. "It was beautiful to live here before they started putting those tanks and things," she reminisced, before explaining how her great-grandfather used to live off the land, selling fresh produce in New Orleans.

FIGURE 2.2. A resident of Cancer Alley holds in her hand a pecan nut that she found in her garden. According to many local residents, long-term chemical pollution has slowly caused vegetation to grow in peculiar ways. Photograph by Thom Davies.

Others blamed "the atmosphere" for the changes they were observing in their local environment: "Like, if you plant butter beans, you might get a handful, you know? It's not plentiful because of the air, the stuff that's polluting everything." The environment had become a barometer for the presence of pollution. These uncanny realizations were not obvious to outsiders such as me. It was true that sometimes I would smell the noxious chemicals from nearby petrochemical facilities while in St. James, or, after a long day of fieldwork I would return home with a headache—but the residents' observations were different. They were slower and, like the pollution itself, had taken years to accumulate. It was not just vegetation that people claimed had slowly changed in the years since industry arrived. One resident recalled how "you used to see toads crawling up the yard," and others would describe how alligators and insects had started being sighted in places they never used to venture. "We don't even see a robin no more," said a local pastor while he addressed his congregation, "but if you go on that end toward Donaldsonville you will see the robins, but they're not coming here because of the environment." The church had become a focal point of environmental activism, and industrial pollution was a frequent talking point: "As simple as a bird," he continued—"a bird that knows where to go and he knows where he can live at, so he knows he can't live here, so he's going that way where he can live." Sitting there, on the wooden pews of the small church, and listening to stories of birds disappearing, I was reminded of Rachel Carson's book *Silent Spring,* which inspired the environmental movement, presenting a dystopian future devoid of bird song. As Carson presciently wrote, "Only within the moment of time represented by the present century has one species—man—acquired significant power to alter the nature of the world."[58] In the twenty-first century in St. James, through the slow observation of local residents, we can see how Carson's prediction was—in some places at least—coming true. As the pastor rhetorically asked, "If it's affecting our trees, our animals, what do you think it's doing to you?"

From witnessing foliage slowly dying or changing color, to birds and frogs no longer appearing in the local environment, to vegetation bearing strange fruit, such slow observation becomes important accumulated knowledge that can help make sense of pollution. In this racialized postcolonial landscape, the uneven distribution of pollution today can be read as an expression of late-modern "necropolitics"[59] and can be traced to the plantation geographies of the past. Within this nature-culture assemblage is the toxic geography of racial capitalism.[60] As such, Cancer Alley is a toxic timescape where layers of structural violence and environmental brutality are slowly revealing themselves to local inhabitants.

In the introduction to her book *Imperial Debris,* Ann Stoler pointedly observes that the dispossessions associated with violent environments "do not always take place in obvious and abrupt acts of assault and seizure, but in more drawn out, less eventful, identifiable ways."[61] Indeed, in the gardens of St. James and the stories of local residents, the environmental assaults were certainly drawn out and slow; it had taken years, for example, for the leaves to appear less green, or for trees to stop bearing fruit. Yet for people who live here, these changes were highly "identifiable" and laced with the everyday events of slow observation. Indeed, this is where I part company with Rob Nixon's description of slow violence as being—as he describes—"out of sight."[62] Instead of highlighting the *invisibility* of pollution, which is so often the focal point of much environmental research, we should turn our attention to how it is being witnessed, embodied, and sensed,[63] and perhaps more importantly, to whose knowledge claims are being ignored. In other words, when we think about slow violence and its potential invisibilities, I suggest we should instead be asking the question "Out of sight to *whom?*"[64] Having researched a range of toxic geographies, from the Chernobyl nuclear exclusion zone in Ukraine[65] to the toxic squalor of refugee camps in France and the Balkans[66] and now—here—in Cancer Alley, it is clear to me that the impacts of pollution are anything but "invisible" to the people they impact.[67] Rachel Carson wrote how "a grim spectre has crept upon us almost unnoticed,"[68] referring to the environmental destruction that technology has wrought. What slow observation does is hold a candle to the word *almost*. For communities who live with pollution, the uncanny silences of spring have been observable for years.

Against Postponement

Subaltern groups confronted by the slow violence of pollution produce alternative narratives about the drawn-out realities of living in a toxic place by slowly observing the changing environment. By suggesting this, I wish to push back against the idea of "postponement" that runs throughout much environmental thinking, which risks hiding the toxic *here and now:* groups for whom exposure is not a future possibility but an *already-happening-moment.* Rob Nixon rightly describes how hazardous substances produce "deferred casualties," implying a "pause" between a toxic event and its manifest consequences.[69] By focusing on the slow observations of environmental justice communities, we can see how this period of deferral is not an empty space that is devoid of human and more-than-human experience. Rather, the slow violence of pollution is a lived reality: a toxic truth that gradually unfolds and refolds in front of frontline communities, in their bodies, environments, and shared narratives. Spaces of slow violence are pregnant with such slow observations and gradual embodiments that coalesce to make toxicants "sensible" for those who live with them.

Like other chapters in this edited volume, I argue that we must take time seriously if we are to understand what it is like to live with pollution. Slow observation offers one way of doing this, with three important qualities. Firstly, slow observation highlights the importance of listening to communities who are actually living alongside pollution. We must incorporate the spatially and temporally situated knowledges that people who inhabit toxic geographies embody, share, and live with. Only then can toxic timescapes be truly reckoned with. Secondly, slow observation is mindful of the long and deep time frames that permeate toxic places, that stretch not only far into the potentially polluted future but also back into the distant reaches of history. Finally, slow observation encourages—or is in fact reliant upon—interdisciplinary knowledge; methodologically, it takes from ethnographical, historical, biographical, and geographical perspectives on space, time, and pollution. In summary, my answer to the question of how to study toxicity and pollution from multiple timed, spaced, and embodied perspectives is simple: speak to people who are already living with pollution. Becoming attuned to the multiple timescapes that communities inhabit is vital if we are to understand our uneven toxic world. This chapter is thus an invitation to other researchers and students to pay closer attention to time, and see how being attentive to slow observation might reanimate their work.

Notes

1. Thom Davies, "Toxic Space and Time: Slow Violence, Necropolitics, and Petrochemical Pollution," *Annals of the American Association of Geographers* 108, no. 6 (2018): 1537–53.
2. Alison Mountz et al., "For Slow Scholarship: A Feminist Politics of Resistance through Collective Action in the Neoliberal University," *ACME: An International E-journal for Critical Geographies* 14, no. 4 (2015): 1235–59.
3. Rob Nixon, *Slow Violence and the Environmentalism of the Poor* (Cambridge, MA: Harvard University Press, 2011).
4. Thom Davies, "Slow Violence and Toxic Geographies: 'Out of Sight' to Whom?," *Environment and Planning C: Politics and Space* 40, no. 2 (2022): 409–27.
5. Davies, "Toxic Space and Time," 1538.
6. For a cartographic overview of environmental injustice across the planet, check out the Global Atlas of Environmental Justice: https://ejatlas.org/.
7. Thom Davies, "Nuclear Borders: Informally Negotiating the Chernobyl Exclusion Zone," in *Informal Economies in Post-Socialist Spaces,* ed. Thom Davies and Abel Polese (London: Palgrave Macmillan, 2015), 225–44; Thom Davies, "Informality and Survival in Ukraine's Nuclear Landscape: Living with the Risks of Chernobyl," *Journal of Eurasian Studies* 6, no. 1 (2015): 34–45.
8. Kim Fortun, "Ethnography in Late Industrialism," *Cultural Anthropology* 27, no. 3 (2012): 446–64.

9. Davies, "Slow Violence and Toxic Geographies." For a related discussion of postcolonial toxic geographies, see Malcom Ferdinand's chapter on French Martinique and Guadeloupe in this volume.
10. Jason W. Moore, "The Capitalocene, Part I: On the Nature and Origins of Our Ecological Crisis," *Journal of Peasant Studies* 44, no. 3 (2017): 594–630.
11. Marco Armiero, *Wasteocene: Stories from the Global Dump* (Cambridge: Cambridge University Press, 2021).
12. Donna J. Haraway, *Staying with the Trouble: Making Kin in the Chthulucene* (Durham, NC: Duke University Press, 2016).
13. Justin McBrien, "Accumulating Extinction: Planetary Catastrophism in the Necrocene," in *Anthropocene Or Capitalocene? Nature, History, and the Crisis of Capitalism,* ed. Jason W. Moore (Oakland, CA: PM Press, 2016), 116–37.
14. Janae Davis et al., "Anthropocene, Capitalocene, . . . Plantationocene? A Manifesto for Ecological Justice in an Age of Global Crises," *Geography Compass* 13, no. 5 (2019): 1–15.
15. Haraway, *Staying with the Trouble,* 206.
16. Mountz et al., "For Slow Scholarship."
17. Marco Armiero, "Sabotaging the Anthropocene; or, In Praise of Mutiny," in *Future Remains: A Cabinet of Curiosities for the Anthropocene,* ed. Gregg Mitman, Marco Armiero, and Robert Emmett (Chicago: University of Chicago Press, 2018), 129.
18. Carl Schmitt, in Giorgio Agamben, *State of Exception,* trans. Kevin Attell (London: University of Chicago Press, 2005), 36.
19. Agamben, *State of Exception.*
20. Accessed via https://www.extinctionsymbol.info/, emphasis added.
21. While the UK parliament's declaration of a "climate crisis" is legally nonbinding, it is nevertheless an important symbolic act that shows how temporality is closely tied to the environmental movement.
22. Joerg Chet Tremmel, ed., *Handbook of Intergenerational Justice* (London: Edward Elgar, 2006).
23. Tracey Skillington, *Climate Change and Intergenerational Justice* (London: Routledge, 2018).
24. For a deeper exploration of how generational timescapes can be important frameworks to understand toxic pollution, see May-Brith Ohman Nielsen's chapter in this volume.
25. Max Liboiron, Manuel Tironi, and Nerea Calvillo, "Toxic Politics: Acting in a Permanently Polluted World," *Social Studies of Science* 48, no. 3 (2018): 331.
26. Thom Davies, "Geography, Time, and Toxic Pollution: Slow Observation in Louisiana," in *A Research Agenda for Geographies of Slow Violence: Making Social and Environmental Injustice Visible,* ed. Shannon O'Lear (Cheltenham, PA: Edward Elgar, 2021), 21–40
27. Robert Bullard, *Dumping in Dixie: Race, Class, and Environmental Quality* (Boulder, CO: Westview, 1990); Thom Davies and Alice Mah, eds., *Toxic*

Truths: Environmental Justice and Citizen Science in a Post Truth Age (London: Manchester University Press, 2020).

28. Check out their discussion of "subaltern time-scapes of contamination" in this volume.
29. Armiero, "Sabotaging the Anthropocene," 129.
30. Gayatri Spivak, "Can the Subaltern Speak?," in *Can the Subaltern Speak? Reflections on the History of an Idea,* ed. Rosalind Morris (New York: Columbia University Press, 1988), 21–78.
31. Rob Nixon, "The Anthropocene: The Promise and Pitfalls of an Epochal Idea," *Edge Effects,* October 12, 2019, https://edgeeffects.net/anthropocene-promise-and-pitfalls/.
32. Laura Pulido, "Racism and the Anthropocene," in *Future Remains: A Cabinet of Curiosities for the Anthropocene,* ed. Gregg Mitman, Marco Armiero, and Robert Emmett (Chicago: University of Chicago Press, 2018), 116–28.
33. Kathryn Yusoff, *A Billion Black Anthropocenes or None* (New York: University of Minnesota Press, 2018).
34. Achille Mbembe, *Necropolitics* (London: Duke University Press, 2019).
35. Leon Sealey-Huggins, "'1.5° C to Stay Alive': Climate Change, Imperialism and Justice for the Caribbean," *Third World Quarterly* 38, no. 11 (2017): 2444–63.
36. Lauren Berlant, *Cruel Optimism* (Durham, NC: Duke University Press), 105.
37. Katherine McKittrick, "On Plantations, Prisons, and a Black Sense of Place," *Social and Cultural Geography* 12, no. 8 (2011): 949.
38. Yusoff, *A Billion Black Anthropocenes or None,* 15.
39. Jessica K. Rapson, "Refining Memory: Sugar, Oil and Plantation Tourism on Louisiana's River Road," *Memory Studies* 3, no. 4 (2020): 752–66.
40. Monique Verdin, "Cancer Alley: Istrouma to the Gulf of Mexico," *Southern Cultures* 26, no. 2 (2020): 80–95. For a vital discussion about pollution and colonial land relations, see Max Liboiron, *Pollution Is Colonialism* (Durham, NC: Duke University Press, 2021).
41. The toxic link between plantation geographies and pollution is also discussed by Malcom Ferdinand in his chapter in this volume.
42. See Kai Bosworth, "'They're Treating Us Like Indians!': Political Ecologies of Property and Race in North American Pipeline Populism," *Antipode* 53, no. 3 (2021): 1–21.
43. Davis et al., "Anthropocene, Capitalocene, . . . Plantationocene?"; Thom Davies, "Photography and Toxic Pollution: Exposing a Chemical Company," *Science as Culture* 27, no. 4 (2018): 543–51.
44. Davies, "Toxic Space and Time."
45. Julie Dermansky, "Louisiana to Hold Hearing for Massive Formosa Plastics Toxic Chemical Complex," *Earth Justice,* July 9, 2019, https://earthjustice.org/news/press/2019/louisiana-to-hold-hearing-for-massive-formosa-plastics-toxic-chemical-complex.

46. "Annual CO_2 Emissions," Our World in Data, accessed June 16, 2022, https://ourworldindata.org/grapher/annual-co2-emissions-per-country.
47. To emphasize this point further, of the fifty-four countries on the continent of Africa, forty-three countries emit *less* CO_2 than this single chemical plant in Louisiana. Data obtained from Global Carbon Atlas, http://www.globalcarbonatlas.org/en/CO2-emissions.
48. See Yusoff, *A Billion Black Anthropocenes or None,* 104.
49. Robert D. Bullard, ed., *Confronting Environmental Racism: Voices from the Grassroots* (Boston, MA: South End, 1993), 13.
50. Julie Dermansky, "A Death in Louisiana's Cancer Alley Reinforces a Small Town's Fears of Industry Impacts," *Truthout,* April 4, 2018, https://truthout.org/articles/a-death-in-louisianas-cancer-alley-reinforces-a-small-towns-fears-of-industry-impacts/.
51. Carl A. Zimring, *Clean and White: A History of Environmental Racism in the United States* (New York: New York University Press, 2017).
52. Davies, "Slow Violence and Toxic Geographies"; James Tyner and Joshua Inwood, "Violence as Fetish: Geography, Marxism, and Dialectics," *Progress in Human Geography* 38, no. 6 (2014): 771–84.
53. Boaventura de Sousa Santos, *Epistemologies of the South: Justice against Epistemicide* (London: Routledge, 2015).
54. Michelle Murphy, "Alterlife and Decolonial Chemical Relations," *Cultural Anthropology* 32, no. 4 (2017): 494–503.
55. For a recent commentary that cautions against including stories of damage within environmental injustice struggles, see Angeliki Balayannis, "Legacies," in *A–Z of Shadow Places Concepts,* ed. Fiona Miller, Donna Houston, and Emily Potter (n.p.: Shadow Places Network, 2020), 1–5, esp. 3, https://www.shadowplaces.net/concepts.
56. For a discussion on the importance of not dismissing nonhegemonic stories of violence, see Thom Davies, Arshad Isakjee, and Jelena Obradovic-Wochnik, "Epistemic Borderwork: Violent Pushbacks, Refugees, and the Politics of Knowledge at the EU Border," *Annals of the American Association of Geographers* (2022): 1–20.
57. Phaedra C. Pezzullo, *Toxic Tourism: Rhetorics of Pollution, Travel, and Environmental Justice* (Tuscaloosa: University of Alabama Press, 2009).
58. Rachel Carson, *Silent Spring* (Boston, MA: Houghton Mifflin Harcourt, 1962), 5.
59. Mbembe, *Necropolitics;* Thom Davies, Arshad Isakjee, and Surindar Dhesi, "Violent Inaction: The Necropolitical Experience of Refugees in Europe," *Antipode* 49, no. 5 (2017): 1263–84.
60. For a fantastic paper linking toxic geography to racial capitalism, see Pavithra Vasudevan and Sara Smith, "The Domestic Geopolitics of Racial Capitalism," *Environment and Planning C: Politics and Space* 38, nos. 7–8 (2020): 1160–79.

61. Ann Laura Stoler, ed., *Imperial Debris: On Ruins and Ruination* (Durham, NC: Duke University Press, 2013).
62. Nixon defines slow violence as "a violence that occurs gradually and out of sight, a violence of delayed destruction that is dispersed across time and space, an attritional violence that is typically not viewed as violence at all." Nixon, *Slow Violence,* 2.
63. Nicholas Shapiro, "Attuning to the Chemosphere: Domestic Formaldehyde, Bodily Reasoning, and the Chemical Sublime," *Cultural Anthropology* 30, no. 3 (2015): 368–93; Vasiliki Touhouliotis, "Weak Seed and a Poisoned Land: Slow Violence and the Toxic Infrastructures of War in South Lebanon," *Environmental Humanities* 10, no. 1 (2018): 86–106.
64. Davies, "Slow Violence and Toxic Geographies."
65. Thom Davies, "A Visual Geography of Chernobyl: Double Exposure," *International Labor and Working-Class History* 84 (2013): 116–39.
66. Surindar Dhesi, Arshad Isakjee, and Thom Davies, "Public Health in the Calais Refugee Camp: Environment, Health and Exclusion," *Critical Public Health* 28, no. 2 (2018): 140–52; Thom Davies and Arshad Isakjee, "Ruins of Empire: Refugees, Race and the Postcolonial Geographies of European Migrant Camps," *Geoforum* 102 (2019): 214–17.
67. Angeliki Balayannis has written brilliantly about invisibility and waste: see Angeliki Balayannis, "Toxic Sights: The Spectacle of Hazardous Waste Removal," *Environment and Planning D* 38, no. 4 (2020): 772–90; Angeliki Balayannis, "Routine Exposures: Reimaging the Visual Politics of Hazardous Sites," *GeoHumanities* 5, no. 2 (2019): 572–90.
68. Carson, *Silent Spring,* 3.
69. Nixon, *Slow Violence and the Environmentalism of the Poor,* 61.

CHAPTER 3

When Does Safe Mean Safe?

Negotiating the Disposal of Radioactive Waste between Months and Millennia

Iris Borowy

FROM 1946 to 1993, thirteen countries used ocean dumping as a disposal method for radioactive waste. During the first two decades of this period, the United States and the United Kingdom were the only Western nations using this method on a broader scale.[1] But in 1967, a collaborative dumping operation was organized by the European Nuclear Energy Agency (ENEA), a suborganization of the Organisation for Economic Cooperation and Development (OECD), renamed the Nuclear Energy Agency (NEA) in 1972. Within this framework, more countries adopted the procedure of discharging radioactive waste material into marine waters. Until 1982, eight participating countries (Belgium, the Netherlands, West Germany, Switzerland, Sweden, France, Italy, and Great Britain) dumped material with a total activity of 37,000 TBq[2] into the Atlantic Ocean at the outer Bay of Biscay to a depth of approximately 4,000 meters.[3]

Disposing of nuclear waste through ocean dumping is noteworthy for several reasons: it marks the only form of disposal, so far, that was given up after having, at one point, been regarded as an acceptable practice; it was the only one that relied, at least partially, on the dispersion and dilution rather than the isolation of radioactive material; and it included a strong element of international collaboration. Abandoning ocean dumping can be read as a success story of global governance. International diplomacy ended ocean dumping, first by regulating it (with the 1972 London Convention on the Prevention of Marine Pollution by Dumping Wastes and Other Matter and with the creation, in 1977, of the OECD Multilateral Consultation and Surveillance Mechanism for Sea Dumping of Radioactive Waste), then by bringing about a voluntary moratorium (in 1983) and, eventually (in 1993), by abolishing it.[4] There can be little doubt that international platforms like international conventions, the negotiations that preceded them, and the cooperation conducted in international organizations on a steady basis were all essential for ending ocean dumping of nuclear waste.

However, less well known, it was also international cooperation under the auspices of an international organization that made ocean dumping standard practice for almost thirty years. Why did a group of European countries begin a concerted action of marine dumping in the 1960s, at a time when the practice was already controversial and one major atomic power, the United States, had already abandoned it? How did they rationalize not only the costs and benefits, financial and otherwise, but also apparent contradictions in reconciling the characteristics of marine environments with those of nuclear material to conclude that ocean dumping was the best available method? This chapter explores decision-making in the international arena concerning long-term toxicants, such as radioactive isotopes. It analyzes the changing visions of radioactive time and marine space that led European governments to first embrace and then abandon ocean dumping and illustrates how concerns over *here and now* versus *an indefinite future* defined the controversy over nuclear ocean dumping.

The actual burden of radioactivity on the oceans deriving from waste disposal is difficult to grasp. For nonexperts (and possibly not only for them) it is difficult to understand what it means for 37,000 TBq of radioactivity to be stored in containers 4,000 meters below sea level for tens of thousands of years. One becquerel (Bq) is defined as the activity involved in the decay of one atomic nucleus per second, and one terabecquerel (Tbq) equals 1,000,000,000,000 Bq. An estimated 370,000 to 630,000 Tbq were discharged in Fukushima, as opposed to approximately 5.2 million Tbq in Chernobyl.[5] Only low-level radioactive waste has ever been disposed of in oceans—that is, material used in the production of nuclear energy or weapons rather than spent fuels. The material dumped into the oceans between 1946 and 1993 contributed less radioactivity to the oceans by far than volcanic eruptions or fallout from atmospheric nuclear weapons tests or accidents at Chernobyl, Sellafield, or others, which, in turn, is only a fraction of the radioactivity that exists naturally in the world's oceans.[6]

Yet, while the measurable level of radioactivity at any one time seems to push radioactive waste off the radar of safety concerns, its temporal dimension places it squarely in the middle of the timescapes in which safety has been discussed, conceptualized, and negotiated.[7] Plutonium, released mainly in nuclear disasters but also contained in some waste, has a half-life of 24,000 years. Uranium-233 and uranium-235, used in nuclear weapons and as fuels in some nuclear reactors, have half-lives of 160 and 7.04 billion years, respectively.[8] This long-term range stands in stark contrast to the short period for which such fuels and weapons are used. As Achim Brunnengräber and Christoph Görg point out, the forty thousand generations of people living during the next one million years will share the globe with nuclear waste created by barely three generations who have employed nuclear energy for military and civil uses.[9] The fact that even among those three generations it has always been a small minority of people who enjoyed the benefits of nuclear energy makes this mismatch of time dimensions even more preposterous. By remaining on the ocean floor quasi-indefinitely, to dissolve into the marine living and nonliving environments in unknown ways, nuclear waste forms the perfect example of what May-Brith Ohman Nielsen, in this volume, refers to as crossing species and generations.

This incongruity is partly a function of political and economic calculations. Partly, it reflects the degree to which human senses and minds are not adapted to geological scales of time and space. Like other animals, humans are good at recognizing risks and opportunities that have in the past been important in their efforts at species survival.[10] An acute awareness of risks many generations away, thousands of meters under sea water, or far away in the future has so far not been among the useful human competences. Human understanding of danger is incommensurate with abstract probabilities and very high numbers, which can be calculated but not imagined. Finally, as Michael Peterson discusses in his chapter, taking responsibility for effects infinitely far in the future is virtually impossible. The discrepancy demonstrates a failure of applying jurisdiction—that is, the human system created to negotiate contradictory claims of responsibility and accountability—to this question. Potential pollution thousands of years from now would not harm people of today, while people living today lack jurisdiction to represent people who will be born thousands of years in the future.[11] The delegates of European governments and international institutions discussing whether or not to dump radioactive material into the Atlantic Ocean in the late 1960s acted accordingly by considering factors within their foreseeable timescale and virtually ignoring those in the far future. All were willing to overlook the possible long-term repercussions of a policy as long as it promised to fulfill their immediate economic needs. Until today, the search for a final disposal site has been politically controversial, technically unsolved, and unsuccessful.[12] Given the incommensurate nature of human and geological timescales, which places the period of risk of nuclear waste far beyond human control, the ultimate disposal of nuclear waste may well be unsolvable in the sense of there being a final arrangement.[13] Instead, the only option may be to find some form of sociotechnical management. For some time, sea dumping was one such form.

Nuclear Waste and the International Arena: The Emerging Context of the 1950s

Historically, using water as a sink for garbage was both frequent and widespread.[14] Dumping garbage into the harbor was an accepted practice in many coastal cities, such as New York, and it extended to military waste as of the end of World War I. Indiscriminately, British, Russian, French, and US forces dumped unused explosives and ammunition in the Baltic Sea, the North Sea, or the Atlantic.[15] In simple continuation of this method, US authorities dumped radioactive waste into the sea for the first time in 1946, the same year US authorities created the Atomic Energy Commission (AEC), the agency formally in charge of organizing US atomic energy concerns. The British government created an analogous agency, the Atomic Energy Research Establishment, also in 1946, and began dumping atomic waste in April 1949. After 1954, the main authority in charge of radioactive waste disposal in Great Britain was the Atomic Energy Authority (AEA).[16] Although the amount of waste was initially small, given the sizable British military and civil atomic program and the scarcity of uninhabited land, the quantities of emerging waste soon seemed too large for disposal on land. By 1953, Britain had dumped 2,027 tons of radioactive waste into the ocean.[17]

The practice of ocean dumping came without long-term planning. In the United States, the AEC had no commission-wide policy on waste, nor an office to oversee waste management. AEC officials had largely left the management of radioactive waste up to their contractors, and contractors left it to their divisions.[18] In hindsight, the carelessness of waste management was impressive and ubiquitous. In the 1940s, scientists in both the US and the Soviet "Plutopias" routinely poured low- and medium-level waste into nearby rivers.[19] This attitude was in line with the treatment of toxic waste in general. At the time, it was perfectly legal and, indeed, normal for industrial plants (as well as for households) to dispose of toxic material in unregulated dumps anywhere, and it was only in the 1970s, in the wake of scandals born of citizens demanding answers in the face of clusters of illnesses, that national authorities and international organizations began taking stock of hazardous waste in any systematic form.[20]

In principle, dumping nuclear waste in water bodies could favor one of two kinds of location, each serving a different concept and strategy. One involved areas with very deep water and little or, ideally, no water currents, to maximize the isolation of the waste-filled containers. The alternative was a region with fast-moving water in order to maximize the dilution of the waste material within a large part of the sea. In either case, ideal places were difficult to find, and skepticism remained even among scientists. Perspectives depended, among other things, on disciplines. While health physicists focused on whether radioactivity was likely to harm humans, oceanographers were interested in the entire ocean ecology within and beyond the reach of humans. Gradually, views in the US, where oceanographers gained an important voice in the debate, and the UK, where health physicists maintained a leading role, diverged.[21] Inherent in these differences were different time dimensions and with them different timescapes: while British health physicists were concerned about health effects in people living at the time, US oceanographers included the potential danger that radioactive isotopes, while thinly diluted today, might over time become concentrated in minerals or algae.[22] One group was more concerned about the now, the other about the future.

In the context of the Cold War and the explosive growth of postwar European economies, European societies increasingly regarded nuclear energy as a political and economic necessity. Institutionalized collaboration seemed essential both to navigate the dangers of nuclear warfare and to feed the voracious energy needs of industries and households in the Global North.[23] Collectively, these goals gave rise to several international organizations. The earliest body was the United Nations AEC, created in 1946 by several Western countries with the goal of limiting the proliferation of nuclear weapons. It ended its work after the explosion of the Soviet atomic bomb in 1949 and was formally disbanded in 1952.[24] One year later, US president Dwight D. Eisenhower's Atoms for Peace speech called for an International Atomic Energy Agency (IAEA). The agency's explicit aim was to provide a collaborative platform for all nuclear powers, including the Soviet Union. After prolonged and complicated negotiations, the agency came into being in 1957. Although it did integrate countries from both sides of the Iron Curtain, it did not create the expected dynamic of goodwill and ended up being a place of friction as much as of cooperation.[25] Almost simultaneously, two other organizations in charge of nuclear energy emerged, both centered on Europe: Euratom, affiliated to the fledgling European Economic Community, and the ENEA, a subcommission of the Organization for European Economic Cooperation (OEEC, which would become the OECD in 1961).[26]

As a part of the OEEC, the ENEA was predominantly an economic body. Its main concern was possible energy shortfalls holding back economic growth in Europe, and its express purpose was to "further the development of the production and uses of nuclear energy."[27] In 1975, it would address waste by establishing a Radioactive Waste Management Committee, but in the 1960s, its focus was on the production of, rather than the waste generated by, nuclear energy. Most of this agency's efforts addressed the creation of a European company for chemical processing of irradiated fuels, an international boiling heavy-water research reactor in Norway, and a high-temperature gas-cooled reactor in the UK.[28] In contrast to the IAEA, membership was limited to Western industrialized countries, excluding the Soviet Union.[29]

International conferences formed another platform where radioactive waste became an international debate. In 1958, the second international conference on atomic energy, attended by 6,300 delegates from sixty-nine countries and specialized UN agencies and drawing over 100,000 visitors, turned the issue into a component of the Cold War.[30] Soviet delegates condemned Western countries for contaminating the oceans by dumping radioactive waste, thereby poisoning the environment of that time. In retrospect, the hypocrisy is remarkable. A report issued by forty-six Russian scientists in 1992 revealed that since World War II the Soviet Union had dumped 2.5 million curies of radioactive waste into the oceans, including entire reactors, amounting to "twice the combined total radioactive waste dumped by twelve other nuclear nations during the entire nuclear era."[31] By another estimate, it was "ten times greater than the amount the Chernobyl accident and Russian nuclear testing together deposited in the Arctic."[32] But these activities were unknown at the time, leaving Western governments with little defense against politically painful attacks.

The US and UK position in favor of nuclear ocean dumping was further weakened by the fact that the practice was being criticized by international oceanographers.[33] In 1959, an IAEA organized conference on waste disposal, cosponsored by UNESCO, highlighted differences between the various camps that harbored different toxic timescapes: American, Italian, and French oceanographers and Soviet delegates on the one hand, who argued for the need for more research, and representatives of the American, British, and French atomic sectors, who argued that there was sufficient knowledge to determine that dumping low-level waste into the sea was safe and justifiable.[34] This disagreement found expression in a compromise stipulation in the 1958 Convention on the High Seas, agreed at the UN-sponsored Conference on the Law of the Sea, stating that every state should "take measures to prevent pollution of the seas from the dumping of radio-active waste, taking into account any standards and regulations which may be formulated by the competent international organizations."[35] Implicitly, the two factions operated on different timescales: one considering the expected immediate (health) effects of the radioactive waste, another imagining possible long-term implications, including the possibility of concentrations up the food chain.

At the time, this controversy was not part of a large antinuclear movement. Such a mass movement would only emerge some years later, with the 1971 protests against the Fessenheim reactor in the Rhineland usually seen as a watershed event.[36] However, there was already sufficient public skepticism and repeated pushback to have an effect. The question tended to be framed in terms of ocean conservation and, often, opposition was local, mounted by people who felt personally affected. For example, when the French Commissariat de l'Énergie Atomique (CEA) planned a dumping operation in the Mediterranean in 1960, numerous mayors and city councils of port cities protested. Their vocal and widely publicized campaign drew the support of Prince Rainier of Monaco and well-known oceanographer Jacques Cousteau, and caused the CEA to suspend its plans indefinitely.[37] Ironically, the limited timescape focused on immediate negative repercussions combined with the virtually timeless principle of conservation. In the US, public opposition to ocean disposal was also a major factor in causing the AEC to impose a moratorium in 1960 on the issuance of new licenses for dumping, in addition to financial considerations since disposal on land was cheaper.[38] After 1962, US ocean-dumping disposals dropped to a trickle and ended completely in 1970.[39]

This left Britain as the—seemingly—only country using this method. This position not only threatened to single the country out for criticism of this policy; the British government also feared that IAEA activities and the Soviet campaign might lead to a ban on sea disposal.[40] However, the British were not alone in facing a problem with atomic waste disposal. France, in particular, had been investing heavily in the development of its nuclear program and was accumulating growing amounts of nuclear waste. Sea dumping appeared a possible option even though the imperfection of the method was undeniable when radioactive waste of British origin repeatedly surfaced in French waters.[41] The same was true for Belgium, which began exporting its nuclear waste to the UK for integration into British dumping expeditions.[42] But no country using nuclear energy could really remain uninterested in potentially promising methods of disposing of the resulting waste material. Thus, for several European governments, sea dumping promised a solution to the long-term problem of what to do with nuclear waste and the short-term problem of how to mitigate international criticism.

Going International: Operation Experimental Disposal of Radioactive Waste into the Atlantic—the 1960s

Ironically, it was a country with little real interest in sea dumping that provoked the internationalization of the practice. In July 1964, the West German delegation to the ENEA explained that its government had decided to conduct an experimental dumping of low-activity waste from the Karlsruhe nuclear research center at a 2,000-meter-deep site in the Atlantic. At the time, West German authorities had actually already decided to use salt formations on land as disposal sites for radioactive waste and were actively looking for suitable sites in Lower Saxony.[43] However, they were interested in conducting a comparison with the safety and costs involved in alternative methods as a way to justify this choice. To make the most of the project, West Germany offered to share the information and/or to shape it into a cooperative event with other interested countries. The British and Norwegian delegates immediately expressed their interest in cooperation.[44]

Subsequently, these questions of the safety and cost efficiency of ocean dumping versus land disposal were also discussed at the ENEA Health and Safety Sub-Committee, which devoted a restricted meeting in late 1963 to two studies dealing, respectively, with oceanographic and biological conditions in the North Sea and with problems regarding radioactive contamination of sea water and marine products.[45]

In January 1965, West German participants turned their vague idea into a tangible proposal, which highlighted practical and financial considerations in addition to scientific knowledge. Since many ENEA member states suffered "unfavorable demographical and geographical conditions for waste disposal into the ground" and safety requirements were costly, a joint operation could help them unburden themselves. Any risk could "safely be excluded by confining the operation to low-level waste and by selecting a suitable and generally accepted area for the discharge."[46] From a British point of view, this initiative seemed like a godsend. Not only did international cooperation seem to offer some protection against a feared ban, but the proposal also generally allowed the British to spread the onus of a controversial practice among more actors. As the British delegate at the ENEA commented in 1965, "Hitherto, the U.K. (and prominent U.K. representatives) have been liable to be pilloried internationally for a practice condemned by many, largely as a result of Russian initiatives. Therefore, any international operations, and particularly one initiated by another country, deserves U.K. encouragement."[47]

The suggestion was particularly valuable in that it had come from a leading Euratom country, it gave the British a leading position, and it allowed them to act upon their "interest that European countries should develop the right ideas."[48] Delighted, the British delegate at the ENEA Health and Safety Committee suggested in June that the study be extended beyond low-level wastes.[49]

By that time, the number of countries interested in participating had grown to include the Netherlands, Italy, Austria, Japan, Denmark, and France. The chances that these countries would develop the "right ideas"—that is, those that would legitimize the ongoing British policy—were looking good. The proposal was positively received, and it gained momentum when the Germans took the initiative in locating a suitable place for the disposal, ideally far enough away from land to offer deep water and geographical isolation but close enough to be easily accessible without great cost. It would also need to have few or no deep-sea currents and no underwater cables.[50] The suggested place was a square 50 kilometers wide in the Atlantic, 450 kilometers west of Cape Finisterre in northwestern Spain.[51]

This initiative began a lengthy process of negotiating different constructions of what constituted toxic risk, safety, or an acceptable degree in between. The problem was that different governments had different expectations, both in terms of what the practice should achieve and in what time spans it should do so. The British government wanted a smooth process, with only a token research element, so that as many countries as possible would participate soon, thus justifying the prior British practice and making possible its continuation. The German government, by contrast, aimed at a process that looked serious and thorough, satisfying its need to demonstrate that it was addressing the issue of nuclear waste disposal scientifically and responsibly. A slow operation or the negative outcome of tests regarding the chosen site was no problem or even positive from a German perspective but absolutely counterproductive from a British point of view. Most other governments, at this stage, were somewhere in between, interested in a possible solution to the waste disposal problem, but with fewer stakes in the method than the British.[52]

Friction was inevitable. During a meeting of delegates from the ENEA, West German authorities, and the British AEA in August 1965, the British were irritated by what they considered "excessive preoccupation with scientific investigations of only indirect relevance to radioactive waste disposal." Such an approach, they feared, might jeopardize the international dumping operation and, thereby, "the achievement of the political objective of an enhanced respectability for sea dumping as a practice."[53] The zeal with which the Germans took the often-invoked need for scientific research seriously risked turning the international operation from one confirming the soundness of British policies to one appearing to expose British irresponsibility.

However, the Germans' approach was strategic more than it was sincere, reacting to disagreements between disciplines in their own country. As the German representative at the ENEA Sub-Committee on Health and

Safety admitted, their problem was that “those with waste to dispose of sometimes found it difficult to convince their colleagues outside atomic energy that sea dumping was respectable and safe.” Since the oceanographers and marine biologists were “in the vanguard of the doubters,” the German side adopted the strategy of neutralizing their arguments.[54] This approach was shared by the French, who were in a similar situation. However, both the German and the French delegates professed to personally believe in the safety of the practice and to regard the investigation as a public relations stunt. Their rationale differed from that of the British, whose delegates felt that “their public had shown virtually no interest in operations so far,” though both sides agreed that “the public must be reassured.”[55] But in the British case, most criticism came from outside of the country, so that international cooperation was, in itself, a way to counter it, without the need for in-depth scientific studies. Thus, while all participants had reason to look for international cooperation, their reasons differed, and the British side felt somewhat piqued that their superior experience in the field was acknowledged but did not result in an unquestioned acceptance of British leadership in the operation.[56]

The countries also differed when it came to the choice of scientific method: while the British embraced a concept of slow dispersal and dilution, the Germans favored long-term isolation and were therefore looking for an area where the water was very, ideally completely, still. Both were problematic positions since the oceanographers in the ENEA committee “agreed that relatively nothing was known about the possible mixing rates and current direction and velocity in this part of the Atlantic” and that it was doubtful whether a precise pronouncement on this topic was even possible. Demonstrating the contradictory timescapes at play, this lack of long-term understanding was framed as a justification for dilution as a short-term solution: “The meeting generally accepted that there will always be some mixing of water wherever waste was dumped and that, in any case, no one could foresee the conditions far enough ahead to be of significance in relation to, for example, plutonium (half-life 24,000 years). It was better that containers should maintain their integrity for a few years to take advantage of decay factors in the shorter-lived materials and then for release and dispersal to occur.”[57]

Although it was not envisaged to include plutonium, this reference to the long half-life of some radioactive material and the inability to control these periods betrayed the disconnect in time dimensions in which the hazard emanating from nuclear wastes, on the one hand, and the management strategies of these wastes, on the other, operated. The calculation was that the waste containers would last at least ten years, the time it would take for material to be transported via water movement from the sea floor to the ocean surface would be another ten years, and by then the process of radioactive decay and the half-life of the material would have substantially reduced radioactivity.[58] However, this time frame depended on decontextualization—what was left out of the picture was that radioactivity could accumulate in ocean fauna when moving up the food chain. This compressing of time and space considerations was not coincidental. By late January 1966, German, Dutch, and French oceanographers admitted that the ongoing scientific investigation by the German *Meteor,* ostensibly designed to provide crucial information for the dumping operation, was, in fact, no longer considered connected. While reserving the right not to authorize additional dumpings later, the head of the Health and Security Committee, as well as the international oceanographers present, agreed that the "waste would be dumped in such small quantities that no danger would arise for the sea around the areas even if the area of investigation should not prove favorable for such dumping."[59] Accordingly, the next meeting of specialists in February 1966 dealt with the technical details of containers. In the process, the French apparently became enthusiastic supporters of the operation, which may have been influenced by the fact that, while other countries had relatively small quantities of waste to dispose of, the French had accumulated about twenty shiploads.[60]

In London, delegates of the AEA, the Foreign Office, and the Ministry of Technology, meeting in March 1966, welcomed this change of attitude by the French but were now faced with the dilemma that they wished to obtain what they considered a rightful position of leadership without jeopardizing the benefits of internationalization: "The United Kingdom had for many years been dumping radioactive waste into the sea and had thus accumulated an unequalled expertise in this field. Sea disposal was, however, a method which had received much criticism in the past, and it would therefore be in the U.K. interest to ensure the success of the international venture, which would establish the validity of sea disposal and vindicate U.K. techniques. It was the A.E.A. view, therefore, that the U.K. should control the whole operation."[61] However, this control should not appear too direct, lest the operation lose its ostensibly international character, which was necessary in order to fulfill British needs, or drive up the cost the British side would be expected to assume.[62]

But this international character was fragile and collaboration limited. By March 1966, the member countries of the ENEA could be grouped into three categories. One, Britain, France, Germany, Belgium, Norway, and the Netherlands were willing to participate in a collaborative operation of dumping radioactive waste into the Atlantic, provided the practical arrangements were approved by their relevant national authorities. Among these, France and the UK could each fill several shiploads but either preferred to join others in mixed shiploads in order to diffuse domestic protests (France) or were willing to adapt to the convenience of other participating countries (UK). Two, Sweden and Italy followed the study with interest, did not wish to contribute this time, but might in a future iteration. And three, Portugal and Spain declined participation and followed the study with acute, potentially critical interest. Each participating country was supposed to be responsible for the collection, packaging in approved containers, storage, inspection, and transportation of its material.[63] But these similar responsibilities obscure the extent to which different countries had different plans, pursuing different purposes. France, clearly under pressure to physically make substantial amounts of material disappear, proposed to contribute by far the most, with 27,000 drums amounting to 5,150 curies. By contrast, Germany, the initiator of the operation, proposed to contribute only 500 to 1,500 drums with a minuscule activity of 10 to 20 curies. Clearly, for Germany this was not about the physical disposal of waste (see table 4.1).

Table 4.1. Disposal Plans May 1966 from the Steering Committee for Nuclear Energy[64]

Country	Volume (number of drums)	Approx. Activity in curies
Belgium	500–600	400–500
France (+ possibly additional material)	27,000 (36,000)	5,150 (200)
Germany	500–1,500	10–20
The Netherlands	500	200
Norway	450	50
Sweden	1,500	10–50
United Kingdom	3,000	100–2,000

But regardless of the amounts of material involved, for all it was a test of policy options, as they agreed that all should pay "special attention to local and national public relations in accordance with the public relations policy developed to govern the conduct of operations."[65]

Doubts and Negotiations: 1966

The entire operation was thrown into jeopardy when the Portuguese voiced serious reservations. In April 1966, the Portuguese delegate at the ENEA Committee on the Experimental Disposal of Radioactive Waste into the Atlantic Ocean explained that, though he was personally satisfied with the existing hazard assessment, he needed to take into account "that powerful non-nuclear interests in Portugal were emotionally involved."[66] His skepticism increased when the ship, which the Germans had sent out to study the prospective dumping area, returned not with the finding of still water on the seabed but with signs of "possibly dangerous movements of water and living organisms," which, they felt, called for further investigations. The British side disagreed and suggested that the German view was "supported by oceanographers who seek an opportunity for additional finances."[67] This accusation was disingenuous; a British expert confirmed that "there were no entirely reliable oceanographic charts for the area but such information as was available indicated possibilities of up-welling in areas to the east and south."[68] Apparently, both sides largely agreed on the physical finding, but the conclusions differed: while the British argued that the site was acceptable because it appeared neither better nor worse than others, the German side considered the findings reason enough to call for further studies. Their views seemed to have an impact on the Portuguese and Dutch attitudes, which alarmed the British. If this site was rejected, the operation might be delayed by one or two years, by which time the Germans might not agree to launch another survey, while the French, the largest partners, might have found an alternative and have opted out of this operation altogether.[69] This concern further narrowed the timescape in which crucial decisions had to be made.

Full results of the *Meteor* investigation were expected by the end of 1966, and the obvious question was whether preparations for the joint dumping operation should be continued, even though the scientific basis on which it supposedly relied was in doubt, or whether they should be halted, despite the work already invested (and the clear signs that some countries regarded the investigation as a smoke screen anyway). The Portuguese delegate opted for the latter and went on record as wishing "to make his agreement to the proposed program conditional on the final evaluation of the 'Meteor' results proving satisfactory."[70] But he was alone. The ENEA Steering Committee for the Experimental Disposal of Radioactive Waste into the Atlantic Ocean as a whole decided to go ahead with the project and created an Executive Group, consisting of delegates of the actively participating countries, for the "detailed planning" of the dumping operation. Careful control over public image remained at the center of considerations. Thus, the French delegate counseled against informing the public at this stage. Instead, he suggested making "a carefully prepared announcement just before a dumping operation took place."[71]

However, the Executive Group soon realized that it would clearly be difficult to keep an operation secret when it inevitably involved the cooperation of outside groups, notably shipping agencies. Thus, preparations increased the risk of alerting the public, causing "rumours" or "unnecessary anxiety."[72] There was no question of embracing broad, transparent information disclosure. Instead, in keeping with the secrecy, which would feed the distrust of the antinuclear movement years later, the OECD Secretariat prepared a press statement, to be used only in the event of inquiries being made, which highlighted the safety and the experimental character of the project.[73] Belying their alleged lack of concern regarding public opinion, an AEA officer in London urged that the words "dumping operation" be dropped from the text, while a colleague argued that it was important to downplay the research component, lest readers wondered why it was only then that studies regarding a safe disposal method were undertaken while the British had been using this method for many years.[74] The ENEA largely accepted the British suggestions and distributed the text to the public relations departments of the participating governments.[75]

For the time being, British hopes were vindicated: it could internationalize its policies without bearing the expenses. The ENEA Steering Committee agreed that local costs were to be borne by the respective governments, while all other costs should be allocated according to the tonnage of contributions. By January 1967, Norway and Sweden had dropped out of the project, leaving Belgium, France, Germany, the Netherlands, and the UK, who, collectively, planned to dump approximately

11,000 tons of packaged solid waste with an activity of 8,000 curies beta/gamma and of 300 curies alpha. It was the seemingly profane question of insurance that revealed the contradiction between the image of normalcy and control, on the one hand, and the diffuse potential of unknown consequences far in the future, on the other. All participating partners took out an insurance covering possible damage to third parties during loading, transport, and dumping. However, the group found that it "was not possible to obtain acceptable insurance conditions for damages which might be caused by the radioactive waste after dumping. In view of this, the centers have agreed to assume this very hypothetical risk themselves." The mismatch between their own, carefully crafted assessment of "very hypothetical risks" and those based on unscientific but brutally cautious liability was never debated.[76]

Awaiting the final results of the *Meteor* investigation in the spring of 1967, the AEA and ENEA organized a series of meetings designed to make sure that its findings would not derail the dumping operation. In association with the ENEA Secretariat, an AEA official met informally with the German hydrographers and French marine biologists to make sure that their manner of presenting the data would "not inadvertently embarrass the operation or the UK operations."[77] Although the sources do not reveal details of these efforts, they appear to have been successful. In March 1967, H. J. Dunster explained that the authors of the German study, as well as the director of the Centre de Recherches et d'Études Océanographiques, Vsevolod Romanovsky, could be persuaded to provide helpful texts:

> Although the contributions from Kautsky and Feldt both needed substantial editing, there was strong evidence that their approach to the problem had improved considerably since the previous discussions in Paris. Kautsky still has some reservations about the wisdom of sea disposal but has been quite prepared to write a paper showing that this operation is completely safe from the hydrographic point of view. The most effective contribution will almost certainly be that from Romanovsky, who has prepared a detailed and extremely forceful description of the general hydrography of the Iberian Basin. This should go a long way towards convincing the Portuguese that their interests have been thoroughly looked after.[78]

In reality, the scientific findings on the exact makeup of the nuclear timescape in the Atlantic Ocean were far from clear. While the French and, to a lesser degree, the German hydrographers found slow-moving northward currents, the Portuguese and Spanish delegates claimed there was a high probability that currents moved eastward toward the Iberian coast. The British delegate transformed these contradictions into an advantage by simply declaring both findings to be positive, since they suggested that radioactivity would either be isolated or diluted.[79] This logic effectively made any scientific result irrelevant, and it did not convince the Portuguese, especially after news about the impending operation was reported in the English and French press leaving the Portuguese tourist authorities alarmed. Rumors circulated of plans for a Portuguese protest to the OECD.[80]

The British were inclined to ignore these rumors, since any change in plans was bound to create more public attention than a Portuguese protest. In addition, the German and French delegates discredited the Portuguese position as, respectively, "a manifestly irrational attitude by a relatively small member state" or simply emotional.[81] This argument was condescending, coming from governments at a safe distance from the planned dump site. But it was also not so very different from the Portuguese position, which was also not about potential environmental or health risks but about the appearance of such risks—that is, the economic risks to fisheries and tourism resulting from fears and perceived hazards by potential consumers and tourists.[82] The French, at least, were willing to accommodate such concerns by proposing a change of site, which was unacceptable to the Germans (who had invested time, money, and effort in the research of this site) and to the British (who wanted to avoid connecting sea dumping with any type of risk).[83]

The April meeting, attended by forty people from ten counties, IAEA, Euratom, and ENEA, could hardly satisfy the Portuguese.[84] The final report of the research mission of the *Meteor* revealed more details, which, however, did not materially change the impression gained from the more general information about the area. The overall conclusion confirmed that, while the area was not uncontroversial, it was generally well chosen and it would be difficult to identify one that was more appropriate. Besides, while the participating delegates recognized that a change of location might appease public opinion in Portugal and Spain, it seemed scientifically indefensible to shift from a well-researched area with known risks to another that was largely unknown.[85]

Eventually, it did not matter. The actual dumping operation began in late May 1967. The Portuguese were even more alarmed than before when a French press release mentioned the dumping location near the Portuguese coast, which was likely to become known to potential tourists and consumers of fish. But their interventions became increasingly desperate and futile, as they tried to sway British and German authorities when the operation was already underway.[86] In hindsight, their concerns seemed pointless since the event did not result in any public protest.[87] ENEA was satisfied with the outcome and suggested using it for an open—albeit belated—information policy, designed to let the facts speak for themselves:

> References to atomic energy still too often breed public apprehension. The only certain reassurance is provided by time during which it becomes self-evident that the dangers are under proper control. In due course, growing confidence usually leads to acceptance of activities previously feared. Public belief in the necessity for the activities, and even more in the benefits accruing from them, usually overcomes public apprehension. There is therefore a strong case, once the present experimental programme has been completed to make known the fullest details so that the value and necessity of the operation are recognized.[88]

Nobody appeared to be aware of the irony of a call for openness, made retroactively, after months of efforts to the contrary. It was a brief moment, in which allowing the public to have access to information seemed safe, since the apparent experience promised to place the practice of ocean dumping beyond debate. But such seeming transparency was not only deceiving because it came late; it was also patently incorrect, since no amount of practical experience could come close to doing justice to the width of the ocean or the thousands of years of potential radioactivity involved. Relying on experience to build trust in a practice whose effects, by definition, eluded experience, demonstrated the fundamental incongruity of the mental timescapes of radioactive waste disposal and their real-life object. In any event, no such publication seems to have materialized.

The Long-Term Developments after 1967

The success of the European ocean-dumping operation was limited and short lived. It succeeded on a technical level, by showing the feasibility of the cooperative European disposal of low-level radioactive waste. It also succeeded in providing standards and agreed regulations regarding the technicalities of dumping—such as waste containers, handling, et cetera—which was considered a tangible improvement over the preceding, unregulated practice.[89] But the program failed on the scientific, psychological, and political levels, in that it could not create a convincing precedent that demonstrated the safety of the practice, based on firm scientific understanding. The 1970s also saw the rise of a vigorous antinuclear movement in industrialized countries, particularly in France and Germany.[90] In 1986, the Chernobyl disaster further discredited nuclear energy.[91] Generally, environmentalism took hold in industrialized countries.[92] In this climate, sea dumping became increasingly untenable. In 1972, radioactive waste was explicitly included in the list of materials prohibited from being dumped from vessels, aircrafts, and platforms regulated in the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (the London Convention).[93] However, the disposal of radioactive waste in the sea continued until the contracting parties of the Convention agreed on a moratorium in 1983.[94] In 1993, they agreed on a global ban on the sea dumping of radioactive waste, theoretically to be reevaluated after twenty-five years.[95] This agreement put an end to this practice by Western countries, though Soviet/Russian dumping appears to have continued until 1992.[96]

Remarkably, the international organizations that succeeded the ENEA—the NEA and IAEA—did not readily embrace these agreements. Although, as shown in the beginning, they distance themselves from the practice today, for years some of their officials lobbied for restarting the program based on its perceived positive environmental record. In 1977, the NEA set up a Coordinated Research and Environmental Surveillance Programme (CRESP) to monitor its dumping sites. Twelve years later, it had recorded no "excess in the levels of radio-nuclides above those due to nuclear weapons fallout, except on certain occasions where caesium and plutonium were detected at higher levels in samples taken close to packages at the dumping site."[97] By then, an IAEA/NEA Expert Group had developed criteria for determining what types of radiation sources and practices were sufficiently harmless so as to be exempted from regulatory control, including those for sea dumping. In 1989, Dominique Calmet, a staff member in IAEA's Division of Nuclear Fuel Cycle and Waste Management, hoped that new studies regarding the comparative risk of sea dumping and other types of disposal might provide "a more balanced appreciation of the real impact of sea dumping." Given that the deep-sea floor was "one of the most stable and predictable geologic formations on earth," he suggested its consideration for the disposal of high-level radioactive material, whereby packages would contain the wastes for five hundred to one thousand years and long-term containment "for tens of thousands of years, would be provided by the barrier properties of the sediment."[98] Calmet and a colleague made similar calls as late as 1991.[99]

Even in 2007, an NEA paper recorded that its tests "demonstrated that such dumping had no impact on the sea environment—and therefore none on humans."[100] Indeed, a 1995 CRESP report had found no harmful impacts resulting from dumping, so that the monitoring program was discontinued. However, a few years later, scientists were ready to reopen the case. A report by the OSPAR Radioactive Substances Commission pointed out that the London Convention stipulates a review of the practice of dumping, that the real state of the dumped waste containers was "largely unknown and subject to speculation," and that better techniques than those available in the 1990s would provide a more detailed assessment of possible effects.[101] The story of the first cooperative sea-dumping operation in the Atlantic is, therefore, far from over, and the way it has shaped mental and physical timescapes is not yet decided.

A Story of Contradictions

The beginning of collaborative dumping operations of nuclear waste in the Atlantic by European countries in the 1960s is a story of contradictions and of contradicting toxic timescapes. The underlying contradiction forms the very frame of the episode: international cooperation under the auspices of an international organization legitimized, strengthened, and possibly prolonged a practice that had already met opposition and which the United States, the country that pioneered it, had already given up. But it was also international cooperation that ended the practice a few years later, and arguably it was the very example of a collaborative action that established the principle that sea dumping should be subject to international regulation and thereby sowed the seeds of its abolishment through international diplomacy later.

Another form of contradiction applies to the disconnect between the short-term nature of the considerations that informed the decisions of the participating governments and the long-term time dimension in which radioactivity plays out. Although the half-life of the nuclei concerned, and therefore the extent of the disconnect, are unknown, the people involved in the discussions used time concepts ranging from several months, when discussing negotiations with other delegates, to tens of thousands of years, when referring to radioactive material in general. This immense discrepancy was never addressed, as though the participating negotiators and decision makers were unaware of it. This is noteworthy, since the time factor formed an integral component of the different strategies: isolating radioactive waste from the environment presupposed that the containers would act as effective barriers between the contents and the surrounding water for a sufficiently long time as to avoid damage, or for the containers and the depth of roughly 4,000 meters of water to act as barriers between the contaminated material and any organism that could be damaged. Meanwhile, the concept of dilution presupposed that the special distribution would obviate concerns about radioactive half-lives. However, this, in turn, assumed that radioactive material would not interact with its surroundings, being concentrated at specific places through ingestion or adsorption.

Thus, considerations of time could not be separated from those of place, but they were never discussed in detail and rarely even mentioned. Indeed, the timescapes of decision makers were dominated by the strategic considerations of interactions between participants or within the framework of the East-West divide of the Cold War. Place played an obvious role in investigating the location for the dumpsite. The site was chosen and implemented partly for its geographical suitability, which was good but not extraordinary, but also for its relative political isolation, leaving a single country, Portugal, to bear the brunt of resistance. Thus, the story can be read as one where internationalization took the form of the majority bullying a small country into submission. However, this overlooks that the reasons for and against the dumping operations were largely the same, aimed at strengthening the economic development of the countries involved. All countries were interested in—seemingly—cheap energy as a crucial input into the economy. In Portugal this was weakened only because this form of energy was perceived to be in contradiction to other mainstays of the Portuguese economy, fishing and tourism.

Indeed, despite frequent references to safety, the story entails remarkably little concern about safety. Neither those supporting nor those opposing the dumping operation appeared much interested in the safety either of people, who might come into contact with the material, or of other parts of nature. Instead, governments sought an appearance of safety that was designed to project an image of control and responsibility, in dealing both with other governments and with concerned citizens. This goal was the main reason why this cooperation came about at all, as the governments involved hoped to improve how they appeared: Germany by demonstrating thoroughness in searching for a disposal site, Britain by normalizing a controversial disposal method, and others with various combinations in between. The goal was also the reason for the contradictory public relations policy, which highlighted public information but only retroactively, thus seeking an appearance of transparency rather than transparency itself. Ironically, within a few years, this appearance translated into a factual restriction of the spread of toxic material, as international cooperation facilitated an end to ocean dumping (at least by Western countries).

To what extent, however, this decision entails meaningful protection against radioactive contamination or, once more, the appearance of it, is questionable. A report in the year 2000 concluded that at this point in time global fallout was the largest source of anthropogenic radioactivity in marine environments, while dumpsites tended to be of negligible, local impact.[102] Maybe, much like international cooperation acted as a fig leaf to make further sea dumping of radioactive waste possible, international agreement about the end of this practice may act as a fig leaf to obscure ongoing contamination with toxins, radioactive and otherwise.

In contrast to several other chapters in this volume, the toxin in this chapter remains invisible, to readers as well as to the policymakers of the time. Given the complexity of marine systems and our limited knowledge of how radioactivity may or may not interact with various organisms, including possible slow concentration over long periods of time, it is impossible to know today what, if any, effect these events will have on local and global environments. By following an isolated episode within a larger story, this chapter has highlighted the interconnectedness between individual decisions and their position within developments of incalculable global significance. By focusing only on the beginning of a strand of development, it deliberately leaves open an interpretation of this significance. The long-term impact of some environmental developments is relatively clear: without knowing the details, there can be no doubt that climate change will "change everything."[103] Nor can there be any doubt that an atomic bomb is devastating. But the long-term effects of low-level radioactivity are yet unknown and patently unknowable. Its timescapes are simply too vast in every dimension.

Policymakers in the 1960s reacted to this uncertainty by treating the issue as a banality, focusing on the mechanics of dumping and their own immediate interests while effectively ignoring the timescapes at play. Most likely, they were motivated by a perceived lack of alternatives, since atomic energy was considered a necessary component for economic development and military protection, and using atomic energy inevitably created nuclear waste. While vaguely shocking from the vantage point of 2020 (the time of writing), this naïveté and willful ignorance in the face of vastness and uncertainty is not fundamentally different from the routine behavior of many people, including the author and, presumably, many readers of these lines, whose air travels, plastic water bottles, and high-consumption lifestyles contribute to vast timescapes far beyond an easy understanding and whose repercussions remain invisible because decisions are experienced as linked to immediate interests. While policymakers in democratic systems can be faulted for putting their short-term electoral interests above long-term benefits for the societies they serve, voters gave little indication that they would have credited a different attitude: in no country did a party gain a majority on a platform of ending nuclear energy—or for suspending it until a long-term solution for its waste had been found. In many European countries no party ever campaigned on a clear position on nuclear waste, and even in Germany, the country whose Green Party grew out of the antinuclear movement, it would take until 1983 for this party to be voted into parliament and until 1998 for it to become a junior partner in a coalition government. As of mid-2022 there are 436 nuclear power plants in thirty countries around the world.[104] None has a long-term solution for its waste.

In the face of intangible dimensions, it is tempting to retreat to controllable small-scale perspectives, blocking considerations about longer-term dimensions. This can be interpreted as a willful restriction of mental timescapes with different degrees of awareness of the disconnect to the time dimensions relevant to the physical world it supposedly relates to.

In this sense, the small episode of this paper may encapsulate the broad picture of human-nonhuman interaction in the timescapes of big history.

Notes

1. Zdenek Dlouhy, *Disposal of Radioactive Wastes* (Amsterdam: Elsevier, 1982), 226.
2. This paper retains the measurements used in the sources cited. One curie approximately equals 37 billion Bq; 1 Tbq approximately equals 27 curies.
3. Marc-Oliver Aust and Jürgen Herrmann, *Summary of the Situation of Dumped Nuclear Waste in the North-East Atlantic Ocean,* Report on Historic Deep Sea Disposal of Radioactive Waste in Layperson's Language, OSPAR-RSC, 2013, pp. 2, 11, https://www.swr.de/-/id=13132940/property=download/nid=233454/12heab2/index.pdf.
4. "1972 Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention)," Environmental Protection Agency, last updated May 24, 2022, https://www.epa.gov/ocean-dumping/1972-prevention-marine-pollution-dumping-wastes-and-other-matter-london-convention.
5. David Spiegelhalter, "Fear and Numbers in Fukushima," *Significance* 8, no. 3 (2011): 100–103.
6. Lasse Ringius, *Radioactive Waste Disposal at Sea: Public Ideas, Transnational Policy Entrepreneurs, and Environmental Regimes* (Cambridge, MA: MIT Press, 2001), 22–23.
7. For discussions on the concept of risk and safety in social history, see Peter Itzen and Simone Müller, "Risk as a Category of Analysis for a Social History of the Twentieth Century," *Historical Social Research* 41, no. 1 (2016): 7–29.
8. Robert Alvarez, "Managing the Uranium-233 Stockpile of the United States," *Science and Global Security* 21 (2013): 53–69.
9. Achim Brunnengräber and Christoph Görg, "Nuclear Waste in the Anthropocene: Uncertainties and Unforeseeable Timescales in the Disposal of Nuclear Waste," *GAIA—Ecological Perspectives for Science and Society* 26, no. 2 (2017): 96–99.

10. Catrin Rode and X. T. Wang, “Risk-Sensitive Decision Making Examined within an Evolutionary Framework,” *American Behavioral Scientist* 43, no. 6 (2000): 926–39.
11. Jens Kersten, “Eine Million Jahre?,” in *Inwastement: Abfall in Umwelt und Gesellschaft,* (Bielefeld: transcript, 2016), 269–88, esp. 273.
12. Kersten, 270.
13. Patrick Kupper, review of *Die “Achillesferse” der Kernenergie in der Bundesrepublik Deutschland: Zur Kernenergiekontroverse und Geschichte der nuklearen Entsorgung von den Anfängen bis Gorleben 1955 bis 1985,* by Anselm Tiggemann, *Sehepunkte* 6, no. 7/8 (2006), http://www.sehepunkte.de/2006/07/9419.html.
14. Simone Müller and David Stradling, “Water as the Ultimate Sink,” *International Review of Environmental History* 5, no. 1 (2019): 23–41.
15. Robin Nagle, *Picking Up: On the Streets and Behind the Trucks with the Sanitation Workers of New York City* (New York: Farrar, Strauss & Giraux, 2014), 111–21; Simone Müller, “Conflicts: Underneath the Quiet Waves,” in *A Cultural History of the Sea in the Global Age,* ed. Franziska Torma (London: Bloomsbury, 2021).
16. Jacob Hamblin, *Poison in the Well: Radioactive Waste in the Oceans at the Dawn of the Nuclear Age* (New Brunswick, NJ: Rutgers University Press, 2008), 14, 27, 51.
17. Hamblin, 50.
18. Kate Brown, *Plutopia: Nuclear Families, Atomic Cities, and the Great Soviet and American Plutonium Disasters* (Oxford: Oxford University Press, 2013), 171.
19. Brown, 191.
20. Iris Borowy, “Hazardous Waste: The Beginning of International Organizations Addressing a Growing Global Challenge in the 1970s,” *Worldwide Waste: Journal of Interdisciplinary Studies* 2, no. 1 (2019): 1–11.
21. Hamblin, *Poison,* 134–42.
22. Hamblin, 21.
23. Brown, *Plutopia;* John Young and John Kent, *International Relations since 1945* (Oxford: Oxford University Press, 2013), 80–102, 123–30, 142–44; Alfred Crosby, *Children of the Sun* (New York: Norton, 2006), 127–46.
24. Lothar Wedekind, *IAEA Turns 40: Supplement to the IAEA Bulletin,* September 1997, 1–2.
25. David Fischer, *History of the International Atomic Energy Agency: The First Forty Years* (Vienna: IAEA, 1997), 29–50; David Holloway, “The Soviet Union and the Creation of the International Atomic Energy Agency,” *Cold War History* 16, no. 2 (2016): 177–93.
26. Bill Long, *International Environmental Issues and the OECD, 1950–2000: An Historical Perspective* (Paris: OECD, 2000), 28–29.
27. OECD, *NEA 50th Anniversary Historical Review* (2008), 9, https://www.oecd-nea.org/general/reports/nea6365-50th-historical.pdf.
28. OECD, *NEA 50th Anniversary,* 14–18; Fischer, *IAEA,* 62.

29. Hamblin, *Poison,* 204.
30. United Nations, *Yearbook 1959* (New York: UN, 1959), 27–29.
31. Kristin Moody-O'Grady, "Nuclear Waste Dumping in the Oceans: Has the Cold War Taught Us Anything?," *Natural Resources Journal* 35, no. 3 (1995): 697.
32. Jennifer Nyman, "The Dirtiness of the Cold War: Russia's Nuclear Waste in the Arctic," *Environmental Policy and Law* 32, no. 1 (2002): 47.
33. Hamblin, *Poison,* 160–72.
34. Hamblin, 163.
35. *Convention on the High Seas: Done at Geneva on 29 April 1958,* United Nations, https://legal.un.org/ilc/texts/instruments/english/conventions/8_1_1958_high_seas.pdf.
36. Andrew Tompkins, *Better Active Than Radioactive* (Oxford: Oxford University Press, 2016), 13–15; Stephen Milder, "Harnessing the Energy of the Anti-nuclear Activist: How European Federalists Built on Rhine-Valley Protests, 1974–1977," *Perspectives on Global Development and Technology* 9, nos. 1–2 (2010): 119–33.
37. Hamblin, *Poison,* 170–71.
38. Lasse Ringius, *Radioactive Waste Disposal at Sea: Public Ideas, Transnational Policy Entrepreneurs, and Environmental Regimes* (Cambridge, MA: MIT Press, 2001), 28.
39. *Council on Environmental Quality, Ocean Dumping, A National Policy: A Report to the President* (Washington, DC: US Printing Office, 1970), 18.
40. Hamblin, *Poison,* 204.
41. Hamblin, 167–72, 189, 196–98.
42. UK Delegation to OECD, to Wakefield, Foreign Office, April 14, 1965, National Archives London (henceforth: TNA), EG 1–389.
43. Astrid Mignon Kirchhof, "East-West German Transborder Entanglements through the Nuclear Waste Sites in Gorleben and Morsleben," *Journal for the History of Environment and Society* 3 (2018): 145–78.
44. Health and Safety Sub-Committee, Problems Relating to the Disposal of Radioactive Waste into the North Sea, August 20, 1964, SEN/SAN(64)9, OECDA, NUC/167(I).
45. Health and Safety Sub-Committee, Next Meeting, October 2, 1963, SEN/SAN(63)11, Archive of the OECD (henceforth: OECDA), NUC, 169(2).
46. Schulte-Meermann, Chief, International Relations Division, Bundesminister für Wisssenschaftliche Forschung, to Saeland, Director General, ENEA, January 18, 1965, Berlin, Politisches Archiv des Auswärtigen Amtes (henceforth: PAAA), B35.98.
47. Williams to Kelly, Ministry of Technology, March 16, 1966, TNA, EG 1–389.
48. UK Delegation to OECD, to Wakefield, Foreign Office, April 14, 1965, TNA, EG 1–389.

49. ENEA Health and Safety Sub-Committee, Minutes of the 13th Session held on 10th and 11th June 1965, September 10, 1965, NE/SAN(65)1, OECDA, NUC/167(I).
50. ENEA Health and Safety Sub-Committee, July 1965, Experimental Disposal of Radioactive Waste in the Atlantic Ocean, Outline Scheme, attached to Williams, AEA, Health and Safety Branch, to Roper, British Embassy, July 9, 1965, TNA, EG 1–389, 3.
51. Steering Committee for Nuclear Energy, Experimental Disposal of Solid Radioactive Waste into the Atlantic Ocean, Progress Report, June 1967, June 8, 1967, SEN(67)8, TNA, EG 1–390.
52. Steering Committee for Nuclear Energy, Experimental Disposal of Solid Radioactive Waste into the Atlantic Ocean, Progress Report, June 1967, June 8, 1967, SEN(67)8, TNA, EG 1–390.
53. Williams to Roper, August 9, 1965, TNA, EG 1–389.
54. All quotes Richings, ENEA, Sub-Committee on Health and Safety, to AEA, Administrative Division, Authority Health and Safety Branch, November 9, 1965, Experimental Disposal of Radioactive Waste into the Atlantic, 3, TNA, EG 1–389.
55. Richings, ENEA, to AEA, 4.
56. Richings, ENEA, Sub-Committee on Health and Safety, to AEA, Administrative Division, Authority Health and Safety Branch, November 9, 1965, Experimental Disposal of Radioactive Waste into the Atlantic, 3, TNA, EG 1–389.
57. Richings, ENEA, to AEA, 5.
58. ENEA, Steering Committee for Nuclear Energy, Health and Safety Committee, Joint Study of the Possibilities of Radioactive Waste Disposal into the Atlantic Ocean, January 12, 1966, SEN/SAN(66)1, TNA, EG 1–389.
59. Minutes of the meeting of oceanographers at the Deutsches Hydrographisches Institut on January 25–26, 1966, OECDA, NUC 167(1).
60. Minutes of the meeting of oceanographers at the Deutsches Hydrographisches Institut on January 25–26, 1966, OECDA, NUC 167(1).
61. ENEA, Disposal of Radioactive Waste into the Atlantic. Note of a meeting held at Millbank Tower on Wednesday, March 9, 1966, TNA, EG 1–389.
62. Williams to Kelly, Ministry of Technology, March 16, 1966, TNA, EG 1–389.
63. Steering Committee for Nuclear Energy, Radioactive Waste Disposal, Report of the Committee for the Experimental Disposal of Radioactive Waste into the Atlantic Ocean, May 12, 1966, TNA, EG 1–389.
64. Steering Committee for Nuclear Energy, Radioactive Waste Disposal, Report of the Committee for the Experimental Disposal of Radioactive Waste into the Atlantic Ocean, May 12, 1966, TNA, EG 1–389.
65. Report of the Committee on the Experimental Disposal of Radioactive Waste into the Atlantic Ocean. Apparently British draft. Under cover

of: Williams to Authority Health & Safety Branch, April 5, 1966, TNA, EG 1–389.

66. Williams to Authority Health and Safety Branch, April 5, 1966, TNA, EG 1–389.
67. Note of meeting held at Ministry of Technology, June 1 1966, TNA, EG 1–390.
68. Note of meeting held on April 27, 1966, at the Ministry of Agriculture, Fisheries and Food, TNA, EG 1–390.
69. Note of meeting held on April 27, 1966, at the Ministry of Agriculture, Fisheries and Food; Item 9—Waste Disposal Programme NE(66)9, undated, both TNA, EG 1–390.
70. ENEA, Report of the Committee for the Experimental Disposal of Radioactive Waste into the Atlantic Ocean, NE(66)9, June 10, 1966, TNA, EG 1–390.
71. ENEA, Report of the Committee for the Experimental Disposal of Radioactive Waste into the Atlantic Ocean, NE(66)9, June 10, 1966, TNA, EG 1–390.
72. Saeland to Michaels, September 30, 1966, TNA, EG 1–390.
73. Saeland to Michaels, September 30, 1966, TNA, EG 1–390.
74. Clark to Croome, October 5, 1966; Richings to Clark, October 11, 1966, both TNA, EG 1–390.
75. Saeland to Michaels, October 28, 1966, TNA, EG 1–390.
76. ENEA, Steering Committee for Nuclear Energy, Experimental Disposal of Radioactive Waste into the Atlantic Ocean, January 19, 1967, TNA, EG 1–390.
77. Richings to Kelly, March 3, 1967, TNA, EG 1–390.
78. Dunster, meeting in Hamburg to agree the papers to be presented to the ENEA Seminar on the proposed disposal of solid waste to the Atlantic, March 17, 1967, TNA, EG 1–390.
79. Richings, AEA, to Kelly, Ministry of Technology, April 18, 1967, TNA, EG 1–390.
80. "Immediate," undated, unauthored, TNA, EG 1–390.
81. Richings, AEA, to Kelly, Ministry of Technology, April 18, 1967, TNA, EG 1–390.
82. Steering Committee for Nuclear Energy, Experimental Disposal of Solid Radioactive Waste into the Atlantic Ocean, Progress Report, June 1967, June 8, 1967, SEN(67)8, TNA, EG 1–390, 4.
83. Richings to Kelly, April 21, 1967, TNA, EG 1–390.
84. Steering Committee for Nuclear Energy, Experimental Disposal of Solid Radioactive Waste into the Atlantic Ocean, Progress Report, June 1967, June 8, 1967, SEN(67)8, TNA, EG 1–390, 4.
85. ENEA, Evacuation expérimentale de déchets radioactifs solides dans locéan Atlantique, May 9, 1967, TNA, EG 1–390.

86. Ling, Dumping of Radioactive Waste, June 7, 1967, TNA, EG 1–390; Buerstedde, to Bundeministerium für wissenschaftliche Forschung, June 21, 1967, PAAA, B 35.98.
87. Hamblin, *Poison,* 214–18.
88. Steering Committee for Nuclear Energy, Experimental Disposal of Solid Radioactive Waste into the Atlantic Ocean, Progress Report, June 1967, June 8, 1967, SEN(67)8, TNA, EG 1–390, 6.
89. Aust and Herrmann, *Summary,* 2.
90. Tompkins, *Better Active Than Radioactive;* Stephen Milder, *Greening Democracy: The Anti-nuclear Movement and Political Environmentalism in West Germany, 1968–83* (Cambridge: Cambridge University Press, 2017).
91. David Nelson, *Chernobyl: Perspectives on Modern World History* (Farmington Hills, MI: Greenhaven, 2010); Serhii Plokhi, *Chernobyl: The Story of a Nuclear Catastrophe* (New York: Basic Books: 2018).
92. Gary Haw and Alistair Paul, *Environmentalism since 1945* (London: Routledge, 2012).
93. "Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter," International Maritime Organization, https://www.imo.org/en/OurWork/Environment/Pages/London-Convention-Protocol.aspx.
94. Lasse Ringius, *Radioactive Waste Disposal at Sea* (Cambridge, MA: MIT Press, 2001), 5.
95. Aust and Herrmann, *Summary,* 9.
96. Nyman, "Russia's Nuclear Waste," 47.
97. Dominique Calmet, "Ocean Disposal of Radioactive Waste: Status Report," *IAEA Bulletin* 4 (1989): 47.
98. Calmet, 50.
99. Dominique Calment and J. M. Bewers, "Radioactive Waste and Ocean Dumping: The Role of the IAEA," *Marine Policy* 15, no. 6 (1991): 413–30.
100. NEA, Committee on Radiation Protection and Public Health, Summary Report of the 50th Anniversary of the CRPPH, NEA/CRPPH(2007)16, May 31, 2007, p. 7. http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=NEA/CRPPH(2007)16&docLanguage=En.
101. Aust and Herrmann, *Summary,* 2–3.
102. Hugh D. Livingston and Pavel P. Povinec, "Anthropogenic Marine Radioactivity," *Ocean and Coastal Management* 43 (2000): 689–712.
103. Naomi Klein, *This Changes Everything* (New York: Simon & Schuster, 2014).
104. "Number of Operational Reactors in Nuclear Power Plants Worldwide by Country in July 2022," Statista, https://de.statista.com/statistik/daten/studie/152153/umfrage/anzahl-der-sich-in-betrieb-befindenden-atomkraftwerke-weltweit/.

PART 2

Ontologies of Toxic Space

INTRODUCTION

AS MUCH as contaminants and environmental poisons are ubiquitous and uncontainable, they also exist in a defining relationship with *specific* locations, *specific* bodies, and *specific* practices of human-toxicant encounter. This relationship, which we frame as *ontologies of toxic space* and which is explored in the chapters by Biggs, Antonova, and Wright, is key to how societies have understood and conceptualized materials as toxic contaminants. Generally, these practices depend on human zoning practices; on geographical and geological markers—such as the absence or presence of water, wind currents, drifting of smoke or dust, particular rock or soil formations, or local vegetation or fauna; human conceptualizations and governance of space as a category; or practices of encounter, such as inhaling or ingestion.

This ontology of toxic space can be defined from within a very small scale—that is, at a particular point in the human and more-than-human body, or a particular point in a technical process—to within a very big one—that is, by asking in which country toxic material is encountered. Mercury is a prime example that can illustrate how modes of encounter—inhaling or ingestion—have come to matter for societies' framings of harmfulness and how they have changed over time. Mercury is a heavy metal that functions as a neurotoxin and can, if inhaled, cause insomnia, nervousness, and paralysis. Still, it was used as a drug against congestion. Doctors in the nineteenth century advised their patients to drink mercury and only abandoned the practice as it proved difficult to make patients swallow it yet also not breathe for a substantial time. Throughout the twentieth century, mercury was used in amalgam fillings or as a fungicide in agriculture and forestry.[1] Waste incinerators illustrate the importance of location in the context of technical processes, as scientists discovered that dioxins accumulated in fly ash—that is, the ash that amasses in the filters of the chimney of the waste incinerator—rather than in bottom ash at the bottom of the waste incinerator.[2] The international trade in hazardous waste, finally, demonstrates the importance of specific national governance regimes. Even after the turn of the twenty-first century, the very same waste material could be considered hazardous waste in one country and secondary or recycling material in another.[3] The ontology of toxic space, moreover, must in itself be understood in multiplicities. Hardly ever is there just one toxicant contaminating a particular place, albeit one may be dominant, but usually there are many environmental poisons working together on the landscape and the human and more-than-human bodies that inhabit it.

David Biggs starts off this section with his chapter "The Chemical Platoon, the Abandoned Base, and the Village: Human Experiences of Multiple Toxic Timescapes in Vietnam," exploring the human experiences of multiple toxic timescapes overlapping at a particular place in Vietnam, a now abandoned US military base near Huế. Exploring the different chemical missions of the US military chemical platoon, Biggs illustrates how various toxic chemicals, not only Agent Orange, accumulated at the military base. Seeing how *different* toxicants not only accumulate at a particular place but also work together, Biggs argues, should move us away from a narrow focus on "the" single contaminant (e.g., Agent Orange) toward a more holistic view of the totality of toxic releases and exposures happening in different periods of industrial and military time. Accumulation, importantly, happens not only in space but also over time, something that Biggs illustrates as he draws out the chemical history of this particular place prior to and after the American presence.

In "Toxic Flows and Societal Exposures: The Maritime Toxic Timescape, Environmental Degradation, and Social and Political Change on the Bulgarian Black Sea Coast from the 1950s Onward," Anna S. Antonova directs our attention from contaminated *land*-scapes to contaminated *sea*-scapes, with a particular focus on the Black Sea and its Bulgarian coast line. In her chapter, she discusses the peculiarities of maritime space and toxicity. Almost in contrast to the landscape David Biggs describes, where toxins accumulate in place, large bodies of water challenge notions of contamination because toxic particles become dispersed, transformed, or diluted in water, even as they remain in the aquatic ecosystem. Yet, maritime space provides scholars with a perfect metaphor for thinking across time and space, and for attending to toxic flows while retaining a place-based focus, Antonova argues. Considering toxic timescapes from a maritime perspective allows scholars to connect toxic exposure not only to environmental or bodily consequences but also to social and political impacts across shifting political regimes.

Kate Wright closes the section with her chapter “Colonial Occupation as a Toxic Timescape in Anaiwan Country (Australia),” focusing on the suspension of toxic time through space, seen through the lens of Aboriginal ontology. In Aboriginal ontology, place is central, and time cannot exist separately from place. As Wright points out, space is hence the keeper of time. Indeed, it is the keeper of multiple times, as well as the timings of toxicity. Time is held enduring in place—the past, the present, and the future. Wright’s example of Armidale, a regional Australian town, and the Armidale Aboriginal Community Garden project brought to life on an Aboriginal Reserve established on parts of the town’s waste dump illustrates how place not only stores cumulative and iterative exposures to toxicity but also iterative violence. Wright’s approach of thinking toxic timescapes through place unsettles the disjunctive and violent temporal schemes of “progress” that overwrite Indigenous sovereignty and also blind us to the ongoing violence of settler occupation of Indigenous lands.

Notes

1. Fabian Schmidt, “Was macht Quecksilber giftig?,” Deutsche Welle, July 6, 2013, https://www.dw.com/de/was-macht-quecksilber-giftig/a-16514157.
2. Jackie Hamra, “Municipal Incinerator Ash Regulated as Hazardous Waste under RCRA: Costs and Options; City of Chicago v. Environmental Defense Fund,” *Journal of Environmental and Sustainability Law* 3, no. 1 (1994): 33–41.
3. Simone M. Müller, “Hidden Externalities: The Globalization of Hazardous Waste,” *Business History Review* 93, no. 1 (2019): 51–74; on pesticides, see David Weir and Mark Schapiro, *Circle of Poison: Pesticides and People in a Hungry World* (Oakland, CA: Institute for Food and Development Policy, 1981).

CHAPTER 4

The Chemical Platoon, the Abandoned Base, and the Village

Human Experiences of Multiple Toxic Timescapes in Vietnam

David Biggs

SINCE THE development of more toxic explosives and chemical weapons in World War I, war zones and military bases possess unique qualities as *toxic timescapes.* They are subjected to periods of intensive activity when unimaginably large quantities of hazardous, lethal materials are used. Depending on the timespan of a conflict or the lifetime of an active military base, knowledge of toxic exposures in surrounding communities may be severely limited by government secrecy. Partly in response to growing public attention to military toxics and partly in response to the end of the Cold War, a growing subfield of environmental history has emerged with a wide range of approaches to testing grounds, battlefields, military bases, and postwar recovery.[1] With increased declassification of military documents through the Vietnam era to 1975, historians now can produce incredibly detailed, pointillist-like studies of military operations and sites. This chapter takes advantage of this archive of materials on the US war in Vietnam to extrapolate the meaning of toxic timescapes characterized by the overlap of toxic spaces throughout time. The chapter draws on them to compare an almost microscopically focused view of military chemical operations with a contrasting, very murky local understanding of past operations.

Drawing upon archival research, site visits, and interviews, this chapter aims to do two things with respect to understanding the unique temporal and spatial features of toxic exposure in military spaces. First, by considering available military records more comprehensively, it challenges readers to move beyond narratives focused on a single contaminant toward a more holistic view of the totality of toxic releases and exposures happening in different periods of industrial and military time associated with production, logistics, and the use of toxic materials in combat.[2] The first part of this chapter situates one contaminant that has garnered the most attention from the Vietnam War, the tactical herbicide known as Agent Orange, in a broader flow of many different, toxic substances that were key to chemical warfare in Vietnam. Agent Orange and dioxin have drawn global attention to Vietnam as a case study of what some term "ecocide," with several million claims of exposure to the herbicide with degenerative diseases and birth defects in offspring. However, besides this controversial chemical, American troops and combatants in war zones were swimming in a veritable sea of other, toxic chemicals too. Daily life on military bases, and especially for Chemical Corps platoons, involved moving hundreds of drums of solvents, pesticides, explosives, incendiaries, and a powdered form of concentrated, "persistent" tear gas.

Second, after using archival and other sources to reconstruct this more holistic view of a few days in the life of a chemical platoon, this chapter turns to the base area for that platoon, a denuded hilltop near Huế, to illustrate the long-term effects of military occupation and toxic exposures even decades after the end of hostilities. Now almost fifty years since the base was closed (1972) and the war ended (1975), how has this hilltop that was a center for chemical operations over several years figured into local and regional histories of postwar recovery and development? Many former military bases where US chemical troops operated, including this hilltop near Huế, are today disappearing under tree plantations and industrial parks; but local knowledge of these sites and stories of exposure persist (as Antonova also points out in her chapter). The postwar story is complicated. There are scant public meetings or public remediation efforts; and the Vietnamese government still treats cleanups of Agent Orange and dioxin as state secrets. Contrasted with highly public, comprehensive cleanups at Vietnam-era bases in the United States, Okinawa, South Korea, and Europe, in Vietnam there are few visible signs or public records of cleanups. Besides popular, propagandistic stories of nationwide exposures, only oral histories and local field studies provide more granular details describing individual experiences, doses, timing, and spaces of exposure.

Making Chemicals "Tactical" and the Commercial Side of Chemical Warfare

Histories of the herbicide Agent Orange and its use in Vietnam describe one of the most well-known examples of delayed toxic exposures from a war in the twentieth century; however, what few of these works acknowledge is that the same dioxin-containing herbicide in Agent Orange, 2,4,5-T, was by 1965 one of the most popular commercial herbicides in the world.[3] When US Air Force planes began spraying the herbicide over Vietnam in 1963, few questioned the toxicity of Agent Orange, given widespread familiarity with the component herbicides (2,4,5-T and 2,4-D) in agriculture, in landscaping, and even around home gardens. Unlike barrel bombs of napalm or tear gas dropped from helicopters, pesticides did not fit the bill of "chemical weapon." Most were available in commercial formulations at hardware stores. The US Army Chemical Corps designated a formulation for a "tactical" herbicide because American military planners felt the destruction of forest cover in Vietnam was key to "combat support."[4] Even in their "tactical" form, the herbicides in Agent Orange were barely different from commercial formulations available in farm supply stores and landscaping supply sheds. Aerial spraying of commercial herbicides was common in the US and Europe by 1965. What set apart the "tactical" herbicide was more the immense area sprayed and the presence of so many people in the spray path. The intensive use of the herbicide in this way meant that millions of people were exposed, usually by touching residues on leaves or equipment; however, the fact that several times the volume of the herbicide was being consumed globally meant that many more millions of people globally were exposed to Agent Orange's commercial cousins.[5] The same chemical formulation of 2,4,5-trichlorophenoxyacetic acid that killed trees in Vietnam could be found in slightly diluted concentrations in farm supply shops and grounds crew sheds around the industrialized (and industrializing) world, including the Soviet Union.[6] This specific chemical exposure—absorption of dioxin through exposure to 2,4,5-T herbicides—may have been concentrated in the aerial spray paths in Vietnam but it was also happening globally along powerline rights of way, on roadsides, and on golf courses.[7]

This overlap between commercial and militarized pesticides is not unique to Agent Orange but rather had been a central feature of warfare science since World War II. Many herbicides and insecticides, including DDT, had dual fates as tactical chemicals considered vital to war efforts but also as "economic poisons" with commercial applications.[8] After the war was over in 1945, the US, UK, and other governments declassified new chemical formulations to promote their commercialization. With respect to pesticides, in only one well-documented incident did a government weaponize an insecticide specifically to kill people. German officers looking for "more humane" way to commit genocide employed mass quantities of the insecticide hydrocyanic acid (Zyklon B). This popular delousing agent was commercially available from the 1920s. Nazi scientists adapted it to their human-killing gas chambers at Auschwitz and other camps.[9]

The Agent Orange case is similar in one sense to the Nazi use of Zyklon B, namely for the relatively massive quantities of a commercial pesticide that had to be procured for the special mission; for several years, Agent Orange use in Vietnam accounted for almost half of all global production.[10]

However, despite the unprecedented volume of herbicides used in Vietnam, they still made up a small fraction of all US chemical operations in Vietnam. This point is made *not* to diminish the problem of dioxin exposure from herbicides but rather to better understand *past* bodily experiences of *total* chemical exposure in Vietnam. Troops and chemical platoons, especially, spent many days dropping vast supplies of other chemicals, particularly napalm and tear gas, from helicopters. Even if one includes all US Air Force flights dedicated to spraying several million liters of herbicides, the herbicide was just a small part of total chemical activities. Drops of napalm and tear gas dwarfed the herbicide missions in volume by several orders of magnitude. And daily drops of explosive munitions exceeded the tear gas and napalm drops by several more orders of magnitude. This plurality of toxic timescapes meant that humans—both combatants and civilians in the drop zones—were being routinely exposed to multiple toxins representing different pathways of exposure, different spatial and temporal regimes. Especially in war zones, exposure is rarely limited to one chemical.

To many Vietnamese old enough to have witnessed this destruction and to anyone who traveled through the region's ravaged hillsides before their reforestation in the 2000s, this *total exposure* to the war—damage from bombing, incendiaries, tear gas, herbicides, and abandoned industrial operations—was widely apparent. The invisible spread of dioxins and other chemicals was unseen but repeatedly featured in news stories and local campaigns. Vietnamese accounts, especially works translated into English for foreign audiences, related stories of chemical drift, poisoned waters, and higher incidence of stillbirths and birth defects. Other work in the postwar era noted whole communities that formed to manage the salvage of unexploded munitions too.[11] After the war and especially with American veterans returning home, suspicious cancer clusters and incidences of birth defects suggested an invisible culprit; government news outlets repeatedly asserted this was the dioxin in Agent Orange. However, even fifty years later, no studies yet have definitively linked these illnesses to a past exposure to dioxin.[12]

In a series of research presentations for local officials in Huế and one at the US embassy in Hà Nội, I repeatedly showed how historical evidence pointed to a plurality of toxic exposures associated with a wide spectrum of chemical exposures; but both Vietnamese and American officials repeatedly emphasized a singular concern over Agent Orange.[13] In 2011, the United States and Vietnam had just settled on a plan for dioxin cleanups at former American air bases, as well as a plan to share data on bombing missions to locate unexploded ordnance. In my presentations, I suggested from my research that a few dozen American bases exhibited signs of pollution from multiple chemical hazards. Like their counterpart bases in the US, American bases in Vietnam dumped pesticides, solvents, lead paints, and other chemicals in unlined landfills.

Delayed manifestations of illnesses in veterans, offspring, and unwitting settlers around former "hotspots" continue to generate public outrage in Vietnam, but this outrage is repeatedly channeled into a single culprit: Agent Orange. Scholars such as Rob Nixon argue that such decades-delayed illnesses expose "the ultimate cover-up" with respect to governments willingly exposing civilians and their own soldiers to known toxic materials.[14] As I have noted elsewhere, the power and global reputation of this Agent Orange "cover-up" narrative may in itself be useful to state actors for obscuring what was a much broader exposure.[15] Global acceptance of the term *Agent Orange* handily distracts public attention from the more complex spaces of *comprehensive* toxic exposures formed at military bases and in war zones. This apparent willingness to limit research to certain known dioxin reservoirs while ignoring comprehensive cleanups stems, I think, from the fact that other toxic timescapes associated with other contaminants such as hydrocarbons and solvents are now less easily identified with a single polluter such as the US military, since most former base areas have, since the early 2000s, found new life as industrial processing zones.

The Chemical Platoon and Archives of Toxic Exposure in the War Zone

In this unique political climate of hypersensitivity (to research on Agent Orange) and silence (regarding suggestions of multiple, intersecting toxic timescapes), historians can challenge these silences by writing environmental histories that do not reproduce the singular focus on one contaminant at the expense of others. The mostly declassified records of US forces in Vietnam offer a vast trove of public materials providing highly detailed accounts of chemical operations. There is perhaps no better place to begin than in the records of the US Army Chemical Corps, especially its chemical platoons assigned to bases throughout the country.[16] The job of a chemical platoon included both delivering tactical chemicals such as napalm, tear gas, and defoliants outside the base and carrying out "domestic" spraying inside base cantonments with DDT, anti-termite insecticides, and commercial (nontactical) herbicides. Were environmental engineers today to run comprehensive tests of soils at former chemical depot sites on American bases, they might detect a long array of toxic compounds besides dioxin. Storage yards for drummed napalm, Agent Orange, tear gas, and "tactical" chemicals often also housed quantities of commercial pesticides and any especially poisonous chemicals. Pads of concrete or asphalt beyond these drum yards were dispersal zones for chemical platoon soldiers (following guidelines at the time) to rinse drum residues before discarding the steel drums. The day-to-day activities of a chemical platoon and its associated wing of helicopters produced a daily swirl of "tactical" and "nontactical" exposures to fuels and lubricants, paints, solvents, pesticides, tactical herbicides, and thousands of drums of napalm, tear gas, and diesel.[17]

Compared to industrial pollution sites, one of the most unique features of military records on sites in Vietnam is their relative precision. The records of the US Military Assistance Command, Vietnam, and all of its component units operating in Vietnam take up an area of several football fields of collapsing archival shelves containing hundreds of thousands of boxes running floor to ceiling. An army division such as the 101st Airborne, an organization of roughly fifteen thousand persons in Vietnam, operated like a small city in the Vietnam theater with departments for combat, logistics, engineering, intelligence, and planning. In the records for each subsidiary unit, one finds a mix of daily logs, after-action reports, and correspondence. Large encampments like the 101st Airborne's Camp Eagle (located near Huế in central Vietnam, 1968–72) added a Chemical Corps platoon to centrally manage the division's day-to-day tactical and nontactical chemicals.

The photographic records of the Chemical Corps, especially, provide detailed windows on the chemical war in Vietnam, explaining, for example, how the offensive work of a chemical platoon differed from other units, such as military police who used teargas (CS) but in far smaller quantities. The following photograph (figure 4.1) shows a chemical platoon loading drums of "persistent" tear gas (CS2) for a "bulk smoke drop," during which the exploding barrels would cover people and stick to underground walls, asphyxiating anyone inside.

FIGURE 4.1. Troops loading CS. Source: Box 17, Command Historian, Headquarters US Army Vietnam, RG472, NARA2.

This image provides useful clues for understanding the bodily nature of chemical operations and exposures in Vietnam. First, markings on the barrels detail their chemical contents. Companies in the United States manufactured and shipped these barrels following strict government procurement guidelines that required, in the case of persistent CS2, two stripes in the lower third ring of the barrel. All drummed chemicals featured visible cues, such as the orange-colored center ring for drums of Agent Orange, a white center ring for Agent White, and so on. Just visible on the top of the second barrel from right is a fuse protruding from the top. These were the white phosphorus fuses used to ignite the barrels when they hit the ground. Finally, the picture shows how close the bare-backed, enlisted soldiers came to these chemicals on a daily basis.

For every day that the Tenth Chemical Platoon was active in the war zone with the 101st Airborne Division, it recorded its activities in daily situation reports (sitreps) and after-action reports (AARs). These mission records detail not just the type and quantity of chemicals used but also coordinates of the target, purposes of the mission, and other details including pilot observations. The following records selected for one day, March 12, 1970, detail what was a typical day for the platoon:

1000–1115: 20 drums | flame drop—napalm | landing zone clearing
1115–1200: 10 drums | flame drop—napalm | bunkers and caves
1115–1245: UH1 "Huey" helicopter-borne sniffer mission | suspected encampments
1300–1400: UH1 "Huey" tactical CS-410 air-launched grenades | combat
1300–1530: UH1 "Huey" helicopter-borne sniffer missions (3 flights) | encampments
1315–1545: 60 drums | smoke drop—persistent CS—from 7200 feet | suspected base area
1530–1730: 20 drums | flame drop—napalm | cave area[18]

The flight logs for that day did not include a defoliation mission, but the Tenth Chemical almost weekly used a specially rigged Huey helicopter outfitted with a 110-gallon tank and spray rigs to spray Agent Orange or other defoliants (Agent White, Agent Blue) around base perimeters. On March 13, however, the US Air Force squadron responsible for flying fixed-wing defoliation missions sent two planes over the 101st's area of operations to spray 3,000 gallons of Agent Orange along

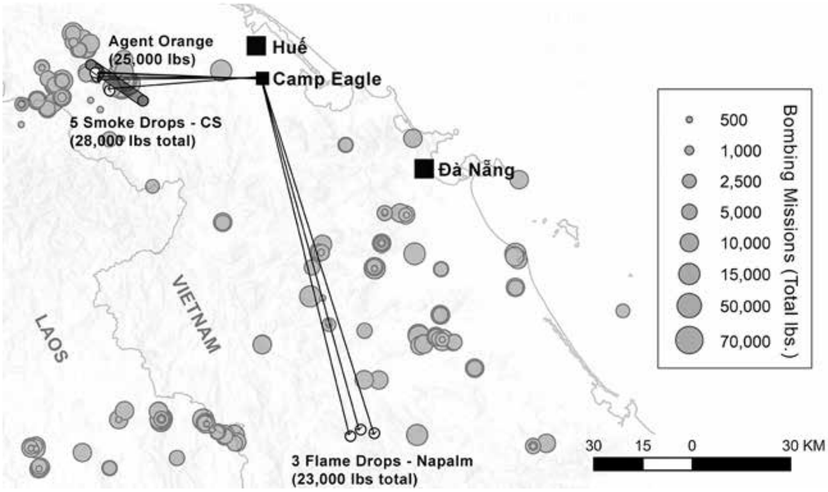


FIGURE 4.2. The Tenth Chemical Platoon's daily missions, March 12, 1970, and all bombing and defoliation, March 12–13, 1970. Figure by author. Map software courtesy of ESRI, Inc.

a path approximately nineteen kilometers long and one kilometer wide (figure 4.2).

This list of missions shows the daily variation in chemical operations and relative scale, but mapping the platoon's activity with all other documented American bombing and defoliation over just two days, March 12–13, 1970, shows a more comprehensive picture of the space of these exposures taking place at just one moment in a war that lasted almost ten years. In just the area of the map (figure 4.2) for these two days, US planes flew 261 missions dropping over 1.3 million pounds of conventional explosives.[19]

The area in the top left of this map shows a particularly concentrated area of bombing. Zooming in to this area (figure 4.3) and adding a terrain and ground cover layer, we can see that the target of this concentrated bombing, defoliation, and CS "smoke drops" was a set of hillsides fringing an upland mountain valley, the A Sầu Valley, that was a major entry point for North Vietnamese troops traveling southward on the Ho Chi Minh Trail. The shaded line denotes the spray path of the two Air Force planes dropping Agent Orange.

The steep terrain and the layering of bombing with chemical drops point to the complexity of this particular landscape with respect to toxic exposures. The map also indicates the surreal degree of precision

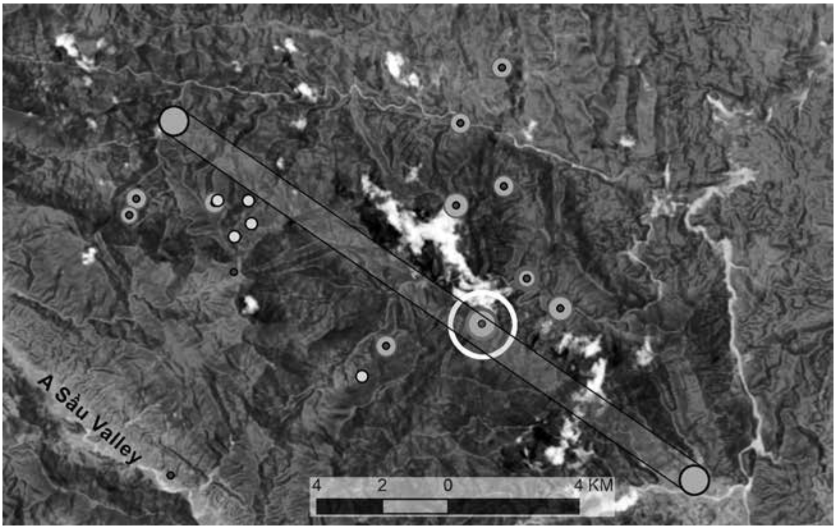


FIGURE 4.3. Chemical missions and bombing, March 12–13, 1970. Figure by author. Map construction courtesy of ESRI, Inc.

with which historians and geographers can, using public data, model particular toxic exposures associated with US military activity to a particular day or two, even particular hours, in a drop zone roughly one to two kilometers in area. However, even this cartographic representation is misleading because often multiple bombing missions with multiple planes dropped on the same target. The circled bomb mission in the map actually represents the following two bombing missions (figure 4.4):

Latitude	Longitude	Date	Num_ Acrft	Aircraft	Load_ Qty	Ordnance	Ord_Class	Category
16.34368	107.28869	3/13/70	3	B-52 D	72	1000 LB GPB M-65 A-1	1000LB MK-65	Gen Purpose
16.34368	107.28869	3/13/70	3	B-52 D	72	750 LB General Purpose Bomb	750LB MK-117	Gen Purpose

FIGURE 4.4. Excerpt from THOR GIS. Figure by author. Map software courtesy of ESRI, Inc.

This figure tells us that on March 13, six B-52 “Superfortress” bombers dropped a total of 126,000 pounds of bombs (57 metric tons) on this site.

Hupy and Koehler have also shown how intensive bombing reconfigured the terrains through which toxic chemicals either dispersed or concentrated in reservoirs. They examine the lines of bomb craters produced from "carpet bombing" with craters more than twenty meters in diameter, noting long-term consequences for the geomorphology of the region.[20] They introduce a new term, *bombturbation,* to describe such intensive, bombing-related alteration of topography. Especially in mountainous regions of Vietnam, bombing radically altered sediment transport, mesotopography, and pathways for revegetation given massive loss of topsoil. Add to this cratering effect the collection of residues of Agent Orange or unexploded drums of CS, and one can develop a more complete picture of specific points in the war zones as multilayered toxic timescapes.

While Vietnamese military documents are mostly not public, military histories of the People's Army nevertheless show that the Americans were not the only ones introducing potential toxicants into this environment. A history of the Trương Sơn Route (Ho Chi Minh Trail) lists the following components of a military command made up of roughly fifty thousand men and women working at "17 military stations" with "22 vehicle battalions, 4 mobile anti-aircraft regiments and eight anti-aircraft battalions," as well as combat units and finally "two regiments of gasoline pipeline troops."[21]

Contrary to popular American depictions of their Vietnamese opponents as shadowy figures hiding in the jungle with only a rifle, the reality of the communist effort, especially by 1970, was more one of a city on the move. Supply lines of troops supplied with Russian and Chinese equipment fanned out in streams along mountain trails and rejoined at designated supply points in Laos. Like the US Army at Camp Eagle, they produced new towns at these key junction points.[22]

In the decades since the war ended in 1975, most Vietnamese records of life in the war zone appear in movies and fiction. Lê Minh Khuê (1997), a veteran of an all-female youth brigade supporting the Trương Sơn Command on the trail, writes terse, Hemingway-like short stories depicting lives shattered amidst images of moonscapes produced by bomb craters. Even today, news clips and television documentaries often visually refer to black-and-white pans across apocalypse-like destruction in the mountains, though generally the aim of these shows is to contrast wartime destruction with today's "regreened" (*phủ xanh*) hillsides now covered in blankets of industrial forests or cash crops such as tea and coffee.[23]

The Village, the Hill, and the Base

After the war's end in 1975, amidst a backdrop of denuded hills and dead trees, stories of Agent Orange continued to circulate while the Vietnamese government strictly limited most overtures of foreign aid to support comprehensive toxicological research. The US trade embargo against Vietnam prevented meaningful exchanges between American and Vietnamese scientists before 1994. Meanwhile in 1991, the US Congress passed the Agent Orange Act to direct the Veterans Administration to treat American veterans.[24] At the same time, the US Environmental Protection Agency included several dozen Vietnam-era bases *inside* United States territory on its National Priority List for comprehensive toxic cleanup.[25] The normalization of US-Vietnam relations led to more public, multinational investigations but solely at the well-known Agent Orange hotspots. In 1996 and 1997, a Canadian-Vietnamese team visited the A Shau Valley to test for dioxin at sites in the mountains. Along the cratered hillsides where planes had sprayed, they found traces of TCDD dioxin comparable to background levels on American golf courses, zero to five parts per trillion. However, at one former base in the valley where the herbicide was stored in drums and presumably released into bomb craters after the base's evacuation, the team found spikes of dioxin contamination and traced it from the ponds to ducks and fish and to human fat tissue, especially breast milk.[26] As US-Vietnam relations improved in the first decade of the twenty-first century, the Ford Foundation's first Vietnam director in Hanoi worked with government representatives and scientists to establish a public "dialogue" aimed at remediating what most agreed were the priority polluted sites, the former airbases that stockpiled herbicides.[27]

While the United States has now committed several hundred million dollars to cleaning up the dioxin hotspots at several former air bases, very little of this international dialogue has ventured beyond Agent Orange and dioxin to include comprehensive cleanups at the dozens of former bases like Camp Eagle. Were the United States to pay for comprehensive remedial investigations and cleanup, the cost at each larger base site might reach one billion US dollars; considering that the United States operated several dozen major base sites, a total cost for comprehensive toxic cleanup might top thirty billion dollars.[28] There are, of course, complicating factors beyond the reluctance of American leaders and the US Congress to spend such a sum. For one, many former base sites are now repurposed as industrial parks; for another, such assistance is inevitably tied up with fast-evolving, new defense arrangements between the United States and Vietnam. Finally, in a country where the average annual income approaches 6,000 US dollars, the scale of such a comprehensive cleanup is so unimaginable it rarely enters public discussion.

And yet, just like the highly detailed accounts of daily chemical and bombing missions, there is a detailed archive describing each individual military base with maps of landfills, chemical depots, maintenance facilities, and the like. There is also photography, even satellite photography, that one can use to detect the footprints of sites like the Tenth Chemical's depot, with its rinse pads and the helicopter pad where Hueys and CH-47s departed on daily missions.

Applied Toxic Timescape Research

Given these high-level political and economic constraints, it is unlikely that either government will carry out remedial investigations at these sites; but there is nevertheless important value in drawing on publicly available sources to, if nothing else, provide information to local stakeholders. It was largely thanks to local government interest in obtaining this information that I was able from 2007 to 2011 to carry out site visits, oral histories, and local research around one military area near Huế in central Vietnam. This area had minimal association with the Agent Orange hotspots, but beginning in 2000, the local government had struggled with periodic discoveries of buried chemicals, especially persistent CS. I set out an applied project to detail, in the manner of comprehensive remedial investigations, the toxic history of these bases. In researching base closure records at the National Archives, I discovered highly detailed air photos, maps, and other records detailing landfills, chemical storage depots, and other facilities. Like many American bases, this one closed abruptly in December 1971 as the US military began drawing down troops. In less than one month, all of the units assigned to the base (including the Tenth Chemical Platoon) returned to the United States. Figure 4.5 shows the ghost town left behind as the South Vietnamese military took possession of the base property.

FIGURE 4.5. MACV Base Turnover Files, Camp Eagle. Source: NARA2, RG472, MACV Construction Directorate, Real Property Disposal Files, Box 3. Map software courtesy of ESRI, Inc.

This almost-domestic scene, a man standing with two dogs in the foreground, also contains evidence of the fate of the emptied drums used by the thousands to deliver fuel and chemicals to Camp Eagle. Troops used them as fire bins for burning organic waste or, more commonly, as makeshift barriers against shrapnel along the walls of barracks. A row of drums is just visible in the background behind the man.

To the world press, US officials noted that as part of the Vietnamization strategy, the bases would soon be filled by thousands of Vietnamese soldiers who would continue to prosecute the war. Privately, however, both US and South Vietnamese officials acknowledged that the base turnover was a hasty, improvised, total abandonment of these spaces. American forces removed perimeter lighting systems, air conditioners, water-treatment systems, fencing, electrical generators, medical equipment, helicopters, guns, communications equipment, and so on. The base they turned over was a defenseless shell. Things they did not remove included several years' worth of industrial waste in the base landfill and years' worth of chemical residues spilled over the hillside. Stocks of containerized napalm and CS presumably found new applications with the South Vietnamese military, but unearthed caches of CS in the area suggest either the Americans or the South Vietnamese buried unused stocks in pits.[29]

Combining text records with historic air photos and satellite imagery permitted me to pinpoint the facilities of the Tenth Chemical Platoon

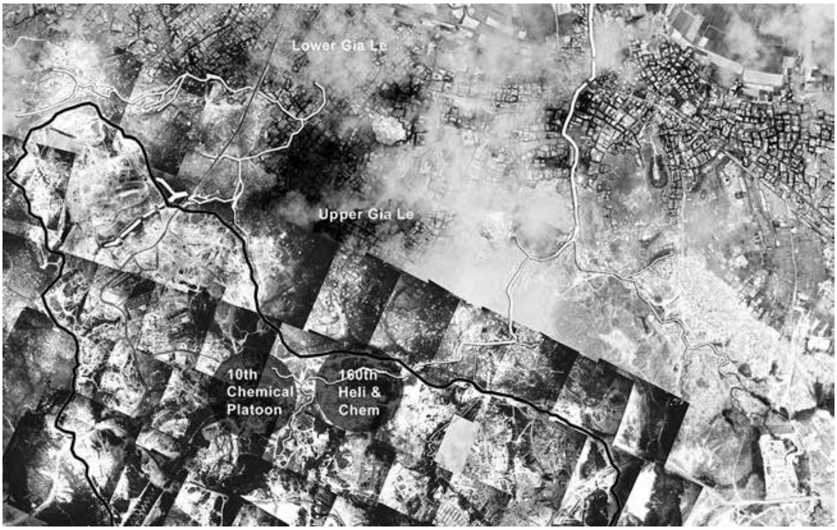


FIGURE 4.6. Photomosaic and satellite imagery, 1972, showing Camp Eagle cantonment with added detail of base boundary (black) and streams (white). Sources: Box 3, Military Assistance Command Vietnam Construction Directorate, Real Property Disposal Files, RG472, NARA2 and CORONA Frame DS1117–2038DF144, courtesy of US Geological Survey, Earth Resources Observation and Science Center. Image by author. Map construction courtesy of ESRI, Inc.

as well as landfills and potential spill sites; showing it in relationship to stream drainage and nearby village lands permitted a more focused view on areas most likely to be impacted by toxic runoff. Figure 4.6 shows the base boundary (black outline) with streams (white lines) running north (downstream) into village fields and homes.

This juxtaposition of chemical operations and hazardous chemical storage along a stream drainage was not accidental. The siting of the Tenth Chemical Platoon with pads for drummed chemicals next to the 160th Helicopter Battalion that carried them reflected a common military and industrial practice of the mid-1960s, using natural drainage pathways to dump waste—fuel runoff, pesticide residues, herbicides, and excess from the steel drums. The disposal protocol of the day was to wash these residues off the asphalt-covered helipad or drum field into the stream below.

For almost thirty years after the base closed, there was little effort to regreen this landscape. As a military property, the base area transferred in 1975 to the conquering People's Army. Suddenly overwhelmed with

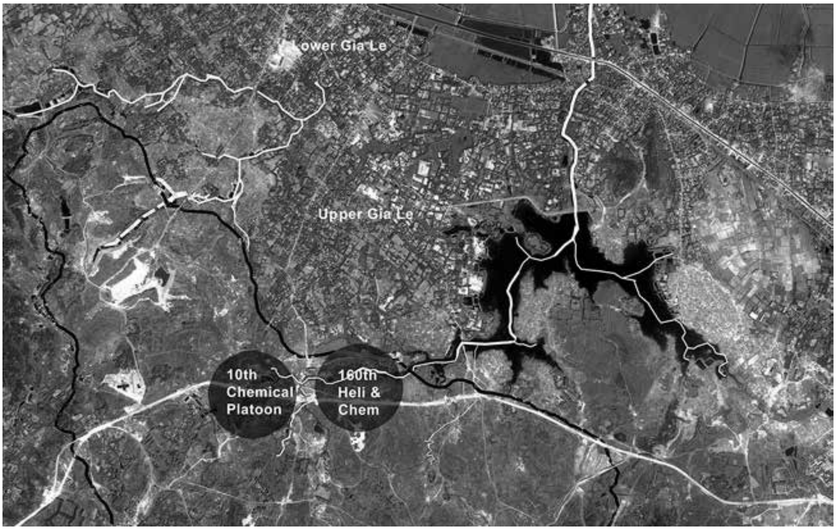


FIGURE 4.7. 2002 IKONOS satellite image with annotations added by author. Source: IKONOS-2 satellite frame, courtesy of GeoEye Foundation. Map software courtesy of ESRI, Inc.

so many inherited base properties, the People's Army made little effort to manage such spaces that, under a reunified government, had little strategic value.

A (multispectral) satellite image taken in 2002 (figure 4.7), adjusted to show an infrared layer, details the still-denuded hilltops and outlines of buildings on the base and a new, potentially complicated addition to the village landscape: a reservoir.

Built to supply village fields with water throughout the dry season, these reservoirs have become focal points for toxic finds. Just as in the A Shau Valley, the muddy silt at the base of reservoirs is often contaminated with heavy metals and other toxic molecules, such as dioxin, that settle into the mud. When local workers periodically clean these shallow lakes, they often discover (sometimes with fatal consequences) waste drums from the base lands above.

As the pace of economic development has accelerated rapidly in Vietnam since the early 2000s, the number of these discoveries has increased. In January 2000, workers at a similar reservoir a few kilometers away excavated about a dozen fifty-five-gallon drums of discarded CS2. Assuming the drums were empty, they punctured them with shovels and then accidentally inhaled the caustic powder. Several later died at the hospital with holes in their lungs and esophagus.[30] These toxic events, rarely attracting much interest from Hanoi or abroad, nevertheless catalyze local and provincial governments to take a more comprehensive approach to the toxic timescapes of the base. Agent Orange research has continued at three still-functioning airbases, but the overwhelming majority of former military landscapes are left for local governments and villages to manage.

In the course of interviews with local experts and village residents, many of whom recounted stories of individuals in their families with unusual birth defects and cancers, I quickly began to realize a number of complexities in attempting to link stories of sickness to the chemical wastes in the hills above.

Mobile People, Mobile Chemicals

Returning to the issue of bodily experiences in these multilayered, complex toxic timescapes, we see that another challenge in identifying the source of a person's exposure stems from the fact that people moved long distances during the war years and especially after, as over a million people left Vietnam as refugees. Many Vietnamese veterans, women and men, left their home villages as youth and traveled hundreds if not thousands of kilometers for military service over several years. One resident, Mr. Minh (born 1925), recounted how he joined the Việt Minh before 1954, traveled to Hà Nội for training, then in the 1960s managed a key ferry crossing on the Ho Chi Minh Trail in Laos. He was sprayed with Agent Orange there; and he blamed his son's severely deformed legs on his exposure to the herbicide.[31] As with so many veterans, he believed this toxic exposure in Laos brought genetic damage in his children. This realization—that one's body carries the chemical imprints of exposures from elsewhere—highlights a major concern for veterans and their offspring who are unsure whether toxic exposures have occurred far away in former battle zones or through daily, small-dose exposure from drinking water in the village.

Returning to a broader theme in this volume, how are we to characterize these bodily dimensions of toxic timescapes when persons such as Mr. Minh, postwar settlers, and refugees were moving such great distances? As Mr. Minh recounted tales of his travels during the war and experiences with the postwar settlers in the "dead" hills above the village, I quickly dissolved my *static* picture of village life derived from so much colonial anthropology and postcolonial, nationalist writing about the countryside.

In this chapter I have focused on the stories that historians can construct about a toxic past. In the case of the chemical platoon and its base in central Vietnam, reconstructing multiple toxic timescapes of the American chemical war challenges a tendency to obfuscate this reality through a singular focus on Agent Orange. The extent and effects of herbicide spraying are highly visible in the media, less so the landscape today; and there remains a deep sense of injustice among millions of Vietnamese who, like Mr. Minh, believe their suffering is directly tied to encounters with this chemical. However, from the perspective of constructing toxic histories, the nationwide if not global association between Vietnam and Agent Orange is troubling. Does it not distract attention from the more complex chemical environments and ecosystems of the war zone? The moral story of Agent Orange is clear, but getting at more complex histories of the herbicide's place in the war zone and the world requires deconstruction of this monotoxic tale. Outside of Vietnam, tens of millions of people traveled through environments treated with the same chemical, and its contaminants, as that in Agent Orange. In the war zone, people moved through environments touched by more than a dozen potentially toxic or lethal chemicals. What makes the Agent Orange story so salient is its boundedness. There are discrete boundaries of spray paths, and records of spray missions with specifics on date, location, and volumes used. The specificity of historical records such as the Tenth Chemical Platoon's daily missions challenges this singular focus with highly detailed mappings of all sorts of chemical activity, a day in the war zone.

My ethnographic and site-based studies also revealed other "blind spots" having less to do with a focus on a specific chemical than my tendency to focus on this site during just one "toxic" war. The lens through which I originally understood this base footprint was almost wholly colored by American records, air photos, and maps. Like so many colonial ethnographers, I read this landscape through this archival framing. This exceptional or colonial bias presents problems for developing more comprehensive understandings of toxic timescapes, as Kate Wright's chapter (this volume) makes clear in her study of Indigenous ontologies of time. The military base in my study, like most of those occupied by Americans in the 1960s, was not "carved out of nature." Ethnographic research gradually shifted my focus from locating toxic exposures within the American period to placing American-era episodes in a more layered history of ecological ruptures and sociopolitical responses to areas described as "dead" land since the early 1800s.[32] The conditions that produced the base and its frequent releases of napalm, CS, fuels, and pesticides were historically and socially situated in "dead land" long separated from other spaces. Taking this "Indigenous ontology" and thinking forward in time, 1960s toxicity has in turn produced ideal conditions for new state and private interests to locate new, potentially toxic ventures here.

My initial blind spot on "American exceptionalism" opened up further questions about how such toxic timescapes fit into longer histories of what Scott terms the grid-based logic of state building.[33] Base expansions were limited to lands described locally as "wasteland" (*đất bỏ hoang*), but in a country where land is scarce, even "dead" or "waste" land has important uses. This dynamic nature of "waste" areas associated with multilayered toxic timescapes deserves greater attention. In ten years of research trips, I watched some sites identified as potentially toxic transform with a new mix of military and industrial enterprises. The grid logic of the abandoned American base with its sewer, water, and electric lines was reborn into an export processing zone.

Ethnographic studies of polluted places expose cracks in one's critical lenses and shortcomings for historians who rely almost solely on archives. Truly aligning one's research with a toxic landscape and timescape may mean abandoning certain moral frameworks in which toxicity is constructed too. A preoccupation with the American military activities of the Tenth Chemical Platoon obscures a longer, more dynamic interplay between military and industrial polluters at the site.

Acknowledging these rich pockets of chemical history as well as critical blind spots, how might this kind of multilayered analysis "do work" for other researchers or at other sites? Situating studies of toxicity in less static, more historically dynamic spaces subject to shifting human experiences and activities may allow for a more rhizomic approach to understanding how toxicity, such as dioxin exposures or persistent CS, travels through nature and through living bodies. Toxic exposures in the war zones of Vietnam and in the villages produced distinctive metabolic and social ruptures. Deforestation and the creation of “wasteland” in the hills produced “openings” for successive industrial occupation too. The value of this multilayered or rhizomic approach is that it does not diminish the importance of fine-grained, individual actions; rather, it places them in a more dynamic context.

Notes

1. Richard Tucker and Edmund Russell’s *Natural Enemy, Natural Ally* (2004) offers a useful early synthesis of early ideas in this trend, particularly examining areas where military research such as in pesticides has general spillover effects in civilian life. Since then, there have been too many works to summarize, but suffice to say that scholars, especially historians, have opened up fascinating comparative studies, such as historian Kate Brown’s *Plutopia: Nuclear Families, Atomic Cities, and the Great Soviet and American Plutonium Disasters* (Oxford: Oxford University Press, 2015), and creative approaches to secret spaces, such as geographer and artist Trevor Paglen’s *Blank Spots on the Map: The Dark Geography of the Pentagon’s Secret World* (New York: New American Library, 2014).
2. A similar point about several contaminants defining toxic spaces versus one singular contaminant dominating the media narrative is made by Iris Borowy in this volume.
3. Recent histories of Agent Orange include Martini’s (2012) and Zierler’s (2011) histories of the development of Agent Orange and its unusual use as a tactical herbicide in Vietnam. Alvin Young (2009), a US Air Force herbicide researcher, has published one of the most comprehensive guides to Department of Defense records. Stellman et al. (2003) have for more than thirty years focused on problems associated with US veterans’ exposure and attributed health problems. Historian Robert Neer (2013) has published one of the first histories of the incendiary napalm, while various researchers including Vatthana Pholsena and Oliver Tappe (2013) have focused studies on regional responses to problems posed by unexploded ordnance.
4. See Alvin Young, *The History, Use, Disposition and Environmental Fate of Agent Orange* (New York: Springer, 2009), 62–63.
5. For estimates of Vietnamese exposures, see Jeanne M. Stellman and Steven D. Stellman, “Agent Orange during the Vietnam War: The Lingering Issue of Its Civilian and Military Health Impact,” *American Journal of Public Health.* 108, no. 6 (2018): 726–28. Their estimates of people exposed, including Vietnamese civilians, Americans, and foreign persons, range from 2.1 to 4.8 million.

6. See John Jake Ryan and Arnold Schecter, "Exposure of Russian Phenoxy Herbicide Producers to Dioxins," *Journal of Occupational and Environmental Medicine* 42, no. 9 (2000): 861–70.
7. There is extensive scientific literature on the history of dioxin exposures in commercial plants producing 2,4,5-T in such places as Nitro, West Virginia, USA (1949); Ludwigshafen, Rhineland-Palatinate, Germany (1953); and Seveso, Lombardy, Italy (1976). For a concise overview, see Roland Weber, Mats Tysklind, and Caroline Gaus, "Dioxin: Contemporary and Future Challenges of Historical Legacies (Editorial, Dedicated to Otto Hutzinger)," *Environmental Science and Pollution Research* 15, no. 2 (2008): 96–100.
8. The term *economic poison* is used in US laws to describe pesticides. Passed in 1947 as many war-era chemicals were coming on the market, the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) described pesticides, including herbicides, as "economic poisons." Synthetic auxin herbicides such as 2,4,5-T and 2,4-D were added to this list in an August 7, 1959 Amendment. See United States Environmental Protection Agency, *Legal Compilation: Statutes and Legislative History, Executive Orders, Regulations, Guidelines and Reports* (Washington, DC: GPO, 1973), 47, 89.
9. Nestar Russell, "The Nazi's Pursuit for a 'Humane' Method of Killing," in *Understanding Willing Participants, Volume 2: Milgram's Obedience Experiments and the Holocaust* (London: Springer, 2019), 241–76.
10. This estimate is based on calculations using US Tariff Commission Reports and the US Department of Agriculture's annual *Pesticide Review.* See also David Biggs, "Following Dioxin's Drift: Agent Orange Stories and the Challenge of Metabolic History," *International Review of Environmental History* 4, no. 1 (2018): 18–20.
11. Examples of English-language accounts include Trần Mai Nam's *The Narrow Strip of Land (The Story of a Journey)* (Hanoi: Foreign Languages Publishing House, 1969). For a discussion of North Vietnamese radio broadcasts and newspaper stories about toxic exposures, see Historical Working Group, "Herbicide Operations in the Republic of Vietnam," Box 8, Historians Background Material Files, MACV Secretary of the Joint Staff (MACJ03), RG472, US National Archives. For her study on postwar salvage, see Christina Schwenkel, "War Debris in Postwar Society: Managing Risk and Uncertainty in the DMZ," in *Interactions with a Violent Past: Reading Post-Conflict Landscapes in Cambodia, Laos and Vietnam,* ed. Vatthana Pholsena and Oliver Tappe (Singapore: National University of Singapore Press, 2013), 135–56.
12. For a comprehensive history of the many legal battles and scientific studies, see Edwin Martini, *Agent Orange: History, Science and the Politics of Uncertainty* (Amherst: University of Massachusetts Press, 2012).
13. Details of that research are described in David Biggs, *Footprints of War: Militarized Landscapes in Vietnam* (Seattle: University of Washington Press, 2018), 189–96.

14. Rob Nixon, *Slow Violence and the Environmentalism of the Poor* (Cambridge, MA: Harvard University Press, 2013), 210–11.
15. Biggs, "Following Dioxin's Drift," 30.
16. The US Army Chemical Corps attached chemical platoons and chemical companies to army combat divisions in Vietnam. Most of these records are contained within the series Chemical Units, United States Army, Vietnam, Records of US Forces in Southeast Asia, Record Group 472. The materials discussed in this chapter focus on one chemical unit, the Tenth Chemical Platoon. Its daily logs are held in two locations: the Chemical Officer Daily Journal, 101st Airborne Division, United States Army Vietnam, RG472, and Tenth Chemical Platoon, Chemical Units, U.S. Army, Vietnam, RG472.
17. These activities are detailed in chemical platoon records as well as in historic aerial photography showing locations of chemical depots on US bases. The air photography is located within base closure records compiled by the Real Property Management Division: see Property Disposal Files, Construction Directorate, Military Assistance Command, Vietnam, RG472. Disposal techniques from that era followed US Department of Defense Disposal Manuals. See, for example, US Department of Defense, *Defense Disposal Manual* (Alexandria, VA: Defense Supply Agency, 1964).
18. See Boxes 2–3, Chemical Officer Daily Journal, 101st Airborne Division, RG472, NARA2.
19. Data on individual US bombing missions were found at the US Air Force Research Institute's THOR: Theater History of Operations Reports at http://afri.au.af.mil/thor/index.asp. This dataset has since been moved to https://data.world/datamil/vietnam-war-thor-data. For an essay describing the dataset, see Sarah Loicano, "Historic Airpower Database Now Online," US Air Force, August 9, 2013, www.af.mil/News/ArticleDisplay/tabid/223/Article/466817/historic-airpower-database-now-online.aspx.
20. Joseph Hupy and Thomas Koehler, "Modern Warfare as a Significant Form of Zoogeomorphic Disturbance upon the Landscape," *Geomorphology* 157 (July 2012): 169–82.
21. Đồng Sĩ Nguyễn, *The Trans-Trường Sơn Route: A Memoir* (Hà Nội: Thế Giới Publishers, 2005), 143.
22. Đồng Sĩ Nguyễn, 143.
23. Lê Minh Khuê, *The Stars, The Earth, The River* (Chicago: Northwestern University Press, 2005). See, for example, her story "A Day on the Road," about the Youth Brigades working to maintain portions of the Ho Chi Minh Trail, pp. 37–54. There is also a sizable literature in Vietnamese memoirs and official histories of this work. See Hội Nhà Văn Việt Nam, *Đường Hồ Chí Minh: Hồi Kỳ của nhiều tắc giả* [Ho Chi Minh Trail: Memoirs by many authors] (Hanoi: Nhà Xuất Bản Tác Phẩm Mới, 1982).
24. See Martini, *Agent Orange,* 190–96.

25. The Comprehensive Environmental Response, Compensation, and Liability Act (1980; also known as the Superfund Act) established a procedure for investigating and cleaning up toxic waste sites. The National Priorities List indicated those sites deemed the most hazardous. More than half of the sites on this list by 1991 were military bases.
26. L. Wayne Dwernychuk et al., "Dioxin Reservoirs in Southern Vietnam—A Legacy of Agent Orange," *Chemosphere* 47 (2002): 121.
27. Le Ke Son and Charles Bailey, *From Enemies to Partners: Vietnam, the U.S. and Agent Orange* (Chicago: G. Anton, 2018).
28. I derive this only as a rough estimate based on figures for major cleanup efforts at former and active US bases in the United States. Jonathan Wargo tallies the cost for a two-decade-long cleanup at the Massachusetts Military Reservation at over 750 million US dollars.
29. "Eagle Turnover," January 16, 1972, Box 3, Real Property Management Division, Property Disposal Files, Military Assistance Command, Vietnam, RG472.
30. This event is described in Province People's Committee Decree 272, January 26, 2000. More recently, the Vietnamese daily *Pháp Luật VN* returned to investigate alleged cancer clusters around the pollution site. See Thủy Nhung, "Nghi vấn thảm họa ung thư từ hầm chứa chất độc CS v. kho trữ thuốc trừ sụ," Pháp Luật VN, August 18, 2016, https://www.baomoi.com/nghi-van-tham-hoa-ung-thu-tu-ham-chua-chat-doc-cs-va-kho-tru-thuoc-tru-sau/c/20119429.epi.
31. Minh, interview by author, January 18, 2012.
32. This more layered approach to militarized landscapes is the subject of my book *Footprints of War: Militarized Landscapes in Vietnam* (Seattle: University of Washington Press, 2018).
33. James Scott, *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed* (New Haven, CT: Yale University Press, 1998), 49–52.

CHAPTER 5

Toxic Flows and Societal Exposures

The Maritime Toxic Timescape, Environmental Degradation, and Social and Political Change on the Bulgarian Black Sea Coast from the 1950s Onward

Anna S. Antonova

WHEN RACHEL Carson wrote of water pollution by pesticides as a problem that must be regarded "as part of the whole to which it belongs—the pollution of the total environment of mankind,"[1] she indicated that polluted spaces can simultaneously offer a material reality of lived experiences and a metaphorical entryway to discussions of broader societal issues. Nowhere is this truer than in maritime contexts, where the liminality of maritime space bridges the material and the metaphorical, the slow and the immediate, and the visible and the invisible. Maritime spaces, such as the Bulgarian Black Sea, which is the focus of this chapter, offer a unique take on *toxic timescapes* as they allow us to think across time and space and to attend to flows and connections while retaining a place-based focus. Toxicity is hard to monitor or trace in the context of large bodies of water, where toxic particles often become dispersed, transformed, or diluted even as they remain in the ecosystem. Considering maritime space, hence, requires scholars of toxicity to think beyond its immediate material consequences on bodies and environments. Adopting a maritime perspective offers a disruptive look at toxicity, demanding that scholars reflect on what toxic exposure could mean for communities in terms of their social relations and politics against a fluid backdrop of uncertainty.

In this chapter, I argue that communities faced with a lack of transparency or certainty about the material consequences of toxic exposure come to experience an internalized, societal exposure—that is, a collective sense of living in toxic surroundings. Unlike the literal, bodily exposure to toxicity, this societal exposure is not something chemically traceable in the body. I argue, however, that it leaves a mark on how societies think about and relate to each other and to their environments. Societal exposure functions alongside its material twin, cutting across time and space to form an equally important part of the toxic timescape.

I base these arguments on my empirical observations from the Bulgarian Black Sea coast, where I conducted fieldwork as part of a larger project on contested social and environmental change on two European shores (the Yorkshire North Sea coast being the other). The Bulgarian Black Sea has been the recipient of heavy agricultural and military waste in the last century. Since at least the 1950s, a series of interconnected problems arising from industrial runoff and the sea's own unique oceanography have rendered it one of the most degraded seas in the world;[2] but the possible lingering effects of these dynamics are not always clear to communities living along its coastlines. Meanwhile, the country of Bulgaria has witnessed a series of political changes—the change from monarchy to socialism in 1944, the transition to democracy in 1989, and the accession to the European Union in 2007. Throughout my research along the Bulgarian Black Sea coast, I collected media, political, literary, and archival texts, and interviewed environmental activists, community members, and government officials, selected as part of a purposive snowball approach.[3]

Reading these varying textual and oral narratives together, I describe a toxic timescape that spans different temporalities and political and economic regimes. Through my analysis, I debate the movement of toxic flows on the Bulgarian stretch of the Black Sea shore in both material and metaphorical ways. A central difficulty that I continue to encounter lies in determining the distinction—or lack thereof—between the *material* consequences of toxic exposure and the *societal* consequences that can be equally acute and possibly even more elusive. I argue that the distinction is particularly elusive for contexts (like the one I debate here) in which invisibility, temporal complexity, and ambiguity complicate communities' experiences of toxic exposure. Although the chapter presents a narrative in which neither time nor the political circumstances remain static, these divergent flows come together in my focus on the Bulgarian Black Sea coast. In this way, my perspective on maritime space complements the temporal flux in Kate Wright's chapter, as well as the spatial and temporal layering of toxicity in David Biggs's, as part of this section of *Toxic Timescapes.* Both temporally and spatially fluctuating, as well as layering over time, the maritime toxic timescape of the Bulgarian Black Sea coast helps highlight how multiple flows might still be colocated at an analytical intersection point.

My chapter proceeds as follows. First, in order to better situate my exploration of the maritime perspective on toxic timescapes, I align theoretical work on maritime space, coasts, and flows with the concept of the toxic timescape. In the second section, "Toxicity Flows: A Maritime Perspective," I define this theoretical perspective and introduce its relevance by briefly visiting the modern history of pollution and toxic flows into the Black Sea. Next, in "Contesting Hazards on the Contemporary Bulgarian Black Sea Coast," I outline some of the discussions and contestations pertaining to toxicity that I witnessed during my fieldwork on the Bulgarian Black Sea coastline. I explain the conditions of uncertainty that prevail in this context and show how participants reacted to these conditions by resorting to specific practices of representation and knowledge production. In section four, "Inherited Toxicity and Metaphorical Exposures," I go back in time to the late socialist period and the postsocialist transition in order to highlight some of the parallels and continuities between the two temporalities and show how being attentive to a longer timeline offers additional explanatory power when it comes to analyzing the contemporary narratives. As with David Biggs's exploration of chemicals in Vietnam in this volume, I demonstrate how in a toxic timescape, problems with toxicity may evolve continuously despite the fluctuation of political regimes over the years. Finally, I link my observations about the Bulgarian Black Sea toxic timescape back to the theoretical discussion on toxic flows, before drawing out the contributions this chapter might offer to the book's reader.

Toxicity Flows: A Maritime Perspective

When Barbara Adam first proposed the timescape as a lens that can "bring into view the in/visible, latent, immanent and implicate dimensions of socio-environmental phenomena and processes,"[4] she may as well have been talking about maritime space. Oceans, seas, and their coasts, as various scholars studying them have highlighted,[5] require a type of thinking that can make connections across time or different planes of space. Christer Westerdahl has observed how maritime culture everywhere is characterized by "a preoccupation with directions, and combinations of time, direction and distance," as well as with the visible and invisible extensions of the natural coastal or marine landscape.[6] Saltwater expanses lead human thought along less habitual temporal or spatial paths, provoking humans living by the coast to understand the invisible threats that concern Rob Nixon in his postulation of slow violence.[7] It is not coincidental that the volume you are currently reading features an oceanic section. Maritime space links places, times, and flows, as well as the visible to the invisible, the imaginative to the political, and the metaphorical to the material.

Maritime space also presents a valuable theoretical lens for the toxic timescape because it helps extend these spatial and temporal connections beyond the individual human experience. Thinking about or with the sea often necessitates awareness of the nonhuman perspective and scale, much as Jesse Peterson illustrates in his chapter on toxic algae in this volume. This is a lesson taught well by strands of Indigenous thought and posthuman scholarship, which frame the fluid and dynamic relations between humans and their environment through the prism of water flows. Astrida Neimanis's *Bodies of Water,* for example, has recently reimagined embodiment as watery, precisely because this enables a rupture of the boundary between individual bodies and the social and material environments they connect to.[8] Her argument owes much to strands of Anishinaabek Indigenous thought, reflected in the works of Deborah McGregor,[9] in which such human-environmental flows form the basis of situated philosophical, legal, spiritual, and social knowledge. Similar concepts emphasizing the watery entanglement between humans and environments and its reach across every aspect of shared lives, from the political to the cultural, appear also in Paulatuuq thinking, as Indigenous feminist scholar Zoe Todd has shown.[10]

Beyond thinking across temporal and spatial scales, thinking with maritime flows helps highlight how human experiences of the environment are simultaneously material and metaphorical. Throughout history, material uses of and phenomena associated with the planetary hydrosphere have often underlined specific societal and cultural perceptions. For example, scholars like Philip Steinberg and Elizabeth DeLoughrey have shown how the material spaces of the oceans and seas have supported a variety of modernity's industrial, geopolitical, and military structures.[11] DeLoughrey, in particular, suggests that the sea can be "humanized" by its absorption of pollution and waste—including also the waste of human lives in the Middle Passage.[12] Through this absorption, DeLoughrey further argues, the oceans enabled capitalist modernity, both physically (by taking its waste) and metaphorically (by carrying the hidden costs of its ideological regimes). In recent scholarship, these points have been taken further by Simone Müller and David Stradling, who have shown that human perceptions of water bodies' liquidity and opacity have made them into "ultimate sinks," and illustrated how these kinds of perceptions shape and define various legal and political regimes.[13] Thinking about waste in watersheds, these authors suggest, must be as much about systems of knowledge and their politics as about the physical waste dumped in the water. Taken together, these insights lead me to two key points. First, maritime space enables a fluidity of thought that cuts across questions of the material, imaginative, and even legal aspects of waste. And second, through this fluidity, maritime space can provide a theoretically robust context for considering how toxicity spans spatial and temporal scales and flows between individual and collective entities.

The Black Sea, an almost fully enclosed sea between southeastern Europe and Asia Minor, illustrates well the value in bringing the maritime perspective to bear on our understanding of the toxic timescape. In this basin, the inflow of toxic and harmful materials is closely entangled with contemporaneous social and political changes. Waste from the region's complex and shifting geopolitics in the twentieth and twenty-first centuries has literally flowed into the Black Sea through the waters of its immense catchment area. Draining the combined watersheds of multiple rivers, including the Danube, Dnieper, and Don (respectively Europe's second, third, and fourth largest), the sea receives the discharge of nineteen countries[14] covering nearly a third of the European continent and parts of Asia. The inflow of so much freshwater contributes to the sea's permanently stratified water column: a very shallow, biologically habitable zone limited to about two hundred meters' depth layered over the world's largest anoxic water mass.[15] Because of how little habitable space there is in its waters, the Black Sea ecosystem is especially vulnerable to pollution and toxicity through the vast size of its catchment.

In turn, this unique materiality has transformed the Black Sea into a mirror for the various industrial and geopolitical shifts along its

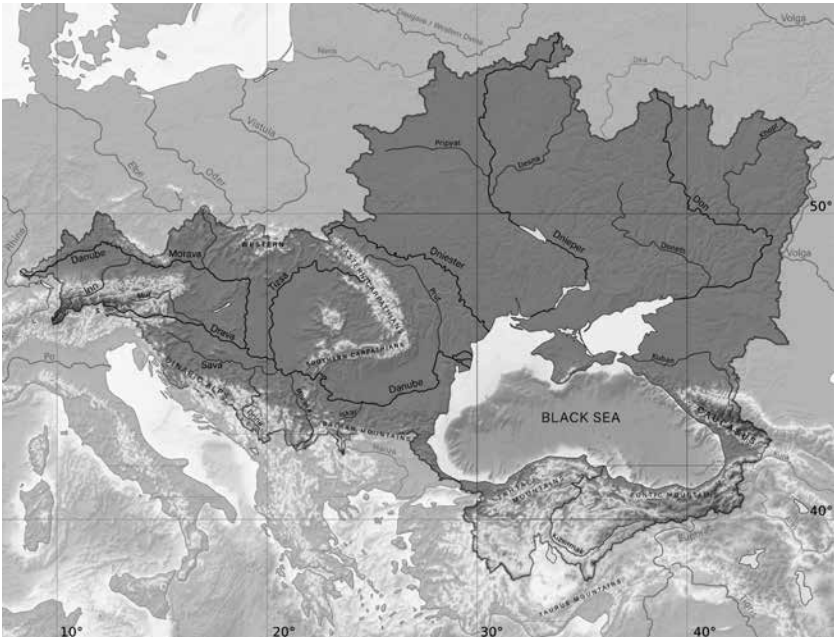


FIGURE 5.1. Black Sea catchment. Tentotwo—Catchment Boundary: CCM River and Catchment Database © European Commission—JRC, 2007, J. V. Vogt et al. (2007): A Pan-European River and Catchment Database, European Commission—JRC, Luxembourg, (EUR 22920 EN) 120 pp., CC BY SA 3.0, https://commons.wikimedia.org/w/index.php?curid=22653494. Map has been altered to provide English place-names.

catchment area. In the apt words of geographer Boian Koulov, the Black Sea's watershed is "certainly not the part [of Europe] that spends the most on environmental protection."[16] In the latter decades of socialism, agricultural runoff rapidly increased the phosphate and nitrate nutrient load flowing into the sea basin, resulting in frequent phytoplankton blooms and eutrophication.[17] Meanwhile, the decline in the sea's top predators throughout the 1950s and 1960s and the introduction through ballast water of the invasive jellyfish *Mnemiopsis leidyi,* factors that contributed to the ecosystem's decimation,[18] reflected global patterns of industrial overfishing and accelerated shipping. The collapse of socialist economies after 1989 brought a temporary decline in nutrient runoff.[19] At the same time, the geopolitical change in relations between the sea's six littoral countries (Bulgaria, Romania, Ukraine, Russia, Georgia, and Turkey) allowed for the creation of the Black Sea Commission and its work on tackling some of the factors affecting the sea's degradation.[20] More recently, however, European Union agricultural subsidies to Bulgaria and Romania since the two countries' accession in 2007 have revived the threat of eutrophication.[21] Meanwhile, strategic considerations over gas and oil transport have subjected the sea to further international pressure and potential pollutants.[22] Reflecting as it does the political and industrial ebbs and flows of its watershed, the Black Sea is still considered today to be one of the most degraded seas in the world.[23] As of 2016 the Black Sea was found to receive pollution at levels sometimes equal to half of those flowing into the Mediterranean, a basin six to seven times its size.[24] In short, there is a long-standing relationship between the political and industrial fortunes of the Black Sea's watershed and the degradation or improvement of the marine environment itself. This relationship highlights the importance of drawing out links between toxic flows, time, and societal change. Yet, apart from scholarship that considers the (admittedly significant) geopolitical challenges in the way of tackling the sea's environmental degradation,[25] the human and societal effects arising from the toxicity flows' movement into and within the Black Sea's basin have been little discussed.

For the rest of my chapter, I focus on the Bulgarian stretch of the Black Sea coast. I describe a maritime toxic timescape that helps bridge the material with the metaphorical, and the societal and political with the environmental, consequences of toxic flows. In the specific place-based context I describe, the permeation of various harmful substances over time is subject to much uncertainty. On the Bulgarian Black Sea coast, the socialist government once obscured environmental data and hid it from the public. Contemporary systems of governance frequently do not have the capacity to monitor pollution extensively, partly due to resources and partly due to the complexity of this maritime space. Taken together, these factors make it difficult for individuals to reflect on the environmental or bodily experiences that hazards might entail for them.

Nevertheless, when conducting fieldwork on this shoreline, and speaking to participants spanning environmental activists, government officials, and local community members, I observed a preoccupation with toxicity that their narratives shared. Across the various materials I examined, toxicity was understood in multiple ways. Spanning different time periods, these narratives debated the idea of a toxic environment both literally and in a range of metaphorical senses. Participants

I interviewed spoke of their concern about visible and invisible violence in ways reminiscent of the entanglement of pollution, politics, and knowledge once exhibited by the socialist regime. Wrangling over contemporary suspicions of industrial shipping pollution or with the uncertainty and underreporting surrounding waste treatment along the coast, participants evoked notions of toxic environments that also spoke to a sense of toxic *society,* a tendency that I traced back to historical and literary narratives emerging from the socialist period. I was intrigued by these cross-temporal connections and by the way the narratives could alternate between the material and metaphorical experiences of toxicity. This chapter, then, emerges from my desire to trace how theoretical insights from studying toxic timescapes can also help scholarship that looks to reconceive socioenvironmental change more broadly.

Contesting Hazards on the Contemporary Bulgarian Black Sea Coast

Focusing on a maritime perspective on toxic timescapes, I contend that the impact of varying hazards spreads beyond the environmental and bodily iterations of toxicity. Instead, I argue that toxicity also carries important political, societal, and even cognitive consequences, especially for communities to whom the material iterations of toxicity are, due to long temporal scales, invisibility, or the politics of knowledge, less clear. On the Bulgarian Black Sea coast, several factors obscure the ability of individual or collective actors to establish their exact circumstances with respect to specific hazards. The complexity of establishing with precision how toxins move or linger in a marine environment is one, as is the insufficient amount of research into the impact of dominant industries like coastal tourism. Equally, however, ambiguity surrounding the shoreline's environmental governance left many participants responding to the visible and invisible threats with sentiments about toxic environments in the metaphorical sense. The uncertainty surrounding different types of environmental hazard on the Bulgarian Black Sea coast—in essence, the illegibility of these hazards to either government or communities—thereby comes to be entangled with societal distrust.

When I spoke to participants on the Bulgarian coastline, I found that they worried about several different types of hazards and toxicity sources. Many spoke of the discharge of wastewater into the sea from overconstructed and seasonally overpopulated coastal towns and resorts. Several told me about solid wastes like construction materials and garbage deposited into the coastal environment. Finally, I also heard about illegal oil dumping inside Bulgaria's exclusive economic zone. Yet the extent, the severity, and often even the existence of all these hazards in the contemporary context was heavily contested between individual narratives.

Depending on their position, participants shared with me contrasting perspectives on toxicity, and perspectives that at times laid claim to diverging timelines. For example, Boryana (a pseudonym, like all other participant names I cite), speaking as a member of a regional institution responsible for environmental oversight, assured me that "there has been a lot improvement in our territory over the last year or two . . . to prevent the runoff of impure water" through new purification plants and increasing the capacity of old ones.[26] On the other hand, however, another participant, Georgi, who was a civic activist in a well-known environmentalist group told me point blank that the institutions were lying to me. It was "an absolute lie" that there was sufficient infrastructure on the coast, he claimed.[27] He recounted for me the example of a purification station in the town of Lozenets, which had been restored in 2016 at the cost of 553,000 leva (about 287,750 dollars) in order to cover seasonal overcapacity.[28] The purification station formed part of what Boryana referred to as good progress in improving water-treatment capacity along the coastline, but, according to Georgi, "in reality [the Lozenets plant] does not purify nitrogen and phosphorus from this water. Because it's old and because it's two-stage. And this runs into the sea, and nobody says this, the Ministry of the Environment conveniently keeps silent, ra ra ra, it's all good, nobody tells the people, this runs into the sea, it presents a wonderful breeding habitat for anything you can think of, and it breeds, and that's why everyone keeps silent."[29]

Each perspective emphasized different aspects of the truth. I found it significant that, in the account I heard from the regional institution's representatives, wastewater was an issue more firmly relegated to the past. While they conceded that several areas around the coastline still lacked the necessary facilities, Boryana and her colleagues emphasized the progress their institution had achieved over time, with Margarita, for instance, pointing to how their institution had "completed purification plants [and] realized deep water runoffs."[30] In their narrative, the only remaining challenge was two remaining small settlements, where they "can't find investment interest to allow new [purification plants] because there's no capacity" and therefore building a purification plant was unjustifiable.[31] By contrast, Georgi situated himself and the activist group to which he belonged as uncovering hazards and toxicities that remain hidden but that he believed were active and of immediate concern in the present. Indeed, in speaking of what he believed ("The Ministry of Environment . . . keeps silent" / "Everyone keeps silent"), Georgi contended that threats had been rendered deliberately invisible, whether through government inaction or through direct corruption. The tension between his account and that of the regional institution reminded me of Barbara Adam's argument that modern societies utilize time as an industrial resource, to be commodified and managed in ways that emphasize visible effects—especially those most legible to economic actors—over the less evident timelines of environmental hazards and degradation.[32] To Boryana and Margarita, the recent progress in treatment capacity and the investment interest in further capacity were the elements of the story that mattered. In Georgi's view, instead, that narrative obscured patterns that were more vital, like the runoff of nitrogen and phosphorus and the possible misuse of knowledge by the Ministry of the Environment. For him, much as Adam might argue, the government's attention to slow timelines serves to erase the immediacy of the hazards that he himself locates in the present.

Speaking to an expert working on environmental monitoring for the ministry, I learned that similar problems of the invisibility or illegibility of threats also persisted at the governance level. The expert, Deyan, told me that it was "very difficult" to establish the effect that, for example, the tourism industry was having on the quality of water, largely because such a study would require volumes of data that the government did not have: "We don't have the capacity, to tell the truth."[33] In his words, the government simply did not have enough people (let alone boats) to collect all the necessary data.[34] Indeed, while scientific data exists to help illustrate tendencies and correlations, creating a study that could present a fully comprehensive picture, particularly in the context of a fluid maritime space, would be difficult.

For instance, there does exist data to substantiate Georgi's concern about unfiltered nitrogen and phosphorus. Together, these nutrients—which encourage phytoplankton growth and exacerbate hypoxia—have been seen as important factors in the Black Sea's eutrophication problems since the 1970s and 1980s.[35] They are still reported by scientists as among the most prominent sources of pollution of the Black Sea basin as a whole.[36] Studies on the Bulgarian coastline's bathing water quality from 2010 and 2016 registered nitrogen, phosphorus, and a range of bacteria associated with wastewater as present but at levels generally compliant with legislation.[37] Yet such studies capture specific points in time and specific locations. The maritime context, by contrast, is fluid, both retaining and circulating, or sometimes transforming or diluting, nutrients and chemicals. Where it comes to more overarching analyses of species or environmental hazards, as Deyan told me, the government "does not have the confidence that [it] has the data with which to interpret the threats facing us."[38] Accounts from local institutions, like the Regional Inspectorate for Environment and Waters (Регионален инспекторат по околната среда и водите, Bulgarian acronym RIOSV) in the district of Burgas, can reflect this difficulty. An inspection on a site along the southern coastline in September 2016 led to the observation that "at a perimeter of 300–400 meters that the sea water is turbid with a specific household-fecal smell."[39] In the summer of 2019, an inspection on a site nearby "found no outflows or discharges of waste" and claimed that the "sea waters are visually pure, with no coloring, opalescence or specific smells observable."[40] These reports could certainly be read in the spirit suggested by Boryana, as an indication of improving water quality resulting from the increased treatment capacity. Spread across time and space, however, and in the absence of definitive monitoring, the reports nevertheless give a fragmented and conflicting picture about the discharge of wastewater and the coastline's water quality as a whole.

In the face of the government's lack of confidence, participants spoke of potential threats by relying on their own observational narratives. Georgi himself was perhaps the best example of this tendency, listing a series of examples to illustrate his points: Coastal towns whose canalization empties directly into the sea—for example, a pipe that "spews, every second it spews some liters per second"; and purification stations at coastal resorts refurbished only to meet already-outdated capacity needs, their incorrect functioning detectable through their smell—"In Tsarevo, everywhere, they smell terribly. Everything smells."[41] Similarly, local environmental NGO employee Andrei speculated that local purification plants were frequently working above capacity, concluding, "There's no way this thing isn't having an impact on the coastal stretch, and when it rotates in this closed off sea, which is so susceptible to eutrophication."[42] Andrei also gave me the example of solid construction waste, which according to him was habitually dumped into one of the coastline's lagoons. Taken together, these comments took on characteristics of what Thom Davies has called "slow observation,"[43] a form of community-based resistance against governments or corporations refusing to see certain hazards.

Thus, in the absence of government certainty, and indeed in the context of distrust toward the government's actions, some participants sought ways to make the threats that concerned them visible. Georgi, for example, recounted to me how he had undertaken to examine the extent of oil pollution inside Bulgaria's coastal waters through conducting independent satellite imagery analysis himself. "I was shocked," he said. "On a single day, in one batch of satellite photos you have, say, ten huge pollutions from ships in the Black Sea . . . in one place there was a trail [of crude] seventy kilometers by one kilometer."[44] He then pointed out to me that his analysis relied on publicly available satellite imagery rather than on the superior imagery the government would have access to. To him, this indicated strongly that the facts were deliberately being held back. His response to this perception was to seek out independent streams of information and take over the means of knowledge production, thereby shaping a narrative that put into focus the hazards he believed were underrepresented.

It was significant that corruption, as much as potential bodily or environmental impacts, featured centrally among these hazards. For both Andrei and Georgi—from their perspective as environmental activists—the persistent hazards remained invisible to the government through mechanisms that, if not deliberate, were at the very least not accidental. Andrei told me, for example, about cases in which environmental impact assessments were missing and where his writing to the local institutions or municipality had produced no results; indeed, he also told me of cases in which his NGO had been pressed to approve of environmental impact assessments before they were written: "They wanted us to support the development plan. I said all right, but will you let us read what it proposes? No, they wouldn't."[45] References to corruption, such as Andrei made, functioned not only as direct signals but also as metaphors for a toxic society. As David Torsello has argued, debating or indeed enacting corruption can enable individuals and communities to “convey general issues of legality and legitimacy,” as well as to restore their political agency.[46] In the cases I have cited here, corruption sits at the core of societal distrust, particularly distrust directed upward from individuals toward the state. Andrei’s and Georgi’s statements reference the presence of corruption in the classic sense, yes, but they also highlight the functioning of corruption as a slow violence in Rob Nixon’s sense.[47] Debating the toxicity of corruption, in turn, enables them to make the invisible, in a way, visible.

More broadly, the uncertainty and distrust surrounding the extent of toxicity were, in and of themselves, types of what I have called above societal and political exposure. Throughout my fieldwork and my analysis of narratives from the Bulgarian Black Sea coast, I frequently witnessed this trajectory: from contesting sources of toxicity, participants moved through their uncertainty about the hazards’ threat level, and finally debated the permeation of social and political degradation as a result. One of the best examples comes from my conversation with local small-scale fisherman Svetoslav, who told me that pollution had contributed toward the decline in fish, particularly turbot, in recent years.[48] But when, at the end of our conversation, I asked him how he would envision a perfect relationship between society and the environment on the Bulgarian coast, he did not speak about fisheries decline, even though that issue had concrete and immediate consequences for him personally. Instead, Svetoslav moved on from toxicity, directing our conversation toward societal relations: “Both in the land, and in the sea, everyone tries to be ahead of the other, everyone tries to outrun the other, everyone tries to lower their net in front of the other, and this is wrong, because there is enough fish for everyone. . . . This is what I wish would change, the jealousy between people.”[49]

Svetoslav’s use of his own livelihood as a metaphor strikes me as an important illustration of the way that toxicity functions metaphorically as well as materially. The causes behind these types of social and political exposure—toxic flows that affect the societal and political consciousness in some way—can be better explained when looking at the Bulgarian Black Sea coast as a timescape. To do so, in the following section I examine narratives that emerged from the 1950s onward. In this way, I bring the sociopolitical and cognitive impacts of toxic exposure over time further to the fore.

Inherited Toxicity and Metaphorical Exposures

To a large extent, the responses to toxicity and uncertainty in the present are rooted in specific experiences in the recent past. In Bulgaria, as elsewhere across the Eastern bloc during the Cold War, the socialist regime left not only a legacy of pollution[50] but also one of tangling knowledge production with state politics. As early as Stalin's *velikie stroiki* ("hero projects," a series of grand plans for modeling and transforming nature across the USSR), socialist countries developed patterns of subjugating the environment—along with society—in the service of the overarching goals for the state and economy.[51] Although the socialist regime had some environmental laws on the books, they were weakly implemented and permanently superseded by the state's industrial targets.[52] For the most part, ecological data was unavailable to the public or, when it was communicated, often proved false; this made it difficult for independent observers or advocates to assess the environmental status of ecosystems.[53] Before glasnost, the regime allowed very little discussion of the ecological consequences of its various industrial undertakings, despite their potential impact on either workers or nearby environments. One prominent example features air pollution from the Kremikovtsi metallurgic plant, opened in 1961 near the capital city Sofia as "the greatest Bulgarian industrial project ever undertaken and . . . the greatest single symbol of socialist construction."[54] Various reports to Radio Free Europe elaborated on the ironic significance of this symbol. From an economic standpoint, the plant was unnecessary and indeed counterproductive due to the poor iron content in local ore deposits and the insufficient quantities of processing materials available in Bulgaria—factors that necessitated expensive imports, earning the plant the nickname "the graveyard of the Bulgarian economy."[55] The pollution and threat to health caused by the plant are hard to ascertain. From the start, laborers considered its working conditions equivalent to those of a concentration camp,[56] but discussions of air pollution were subdued by the government until the late 1980s, when glasnost allowed open debate over some of these issues for the first time.[57] The Kremikovtsi case thus demonstrates aptly how environment, health, and knowledge were all held hostage by the socialist state's industrial targets, even when these targets were unrealistic.

Air pollution is an important tangent here because it helps illustrate how the cross-temporal effects of toxicity acquired a metaphorical and political meaning in the context I discuss. Demands for glasnost around this specific issue resulted in the environment's entanglement in events leading up to the 1989 political transition in Bulgaria. In 1987, high levels of air pollution from a Romanian chlorine factory in the Bulgarian Danube town of Ruse prompted public demonstrations initially led by mothers concerned for their children's health.[58] From that relatively small focus, however, the movement quickly spread across the country. By 1988 and especially 1989, Ecoglasnost had grown into a countrywide public platform for discussions on human rights and political change through the prism of the environment.[59] It covered a variety of regionally important issues, diverging from air pollution toward locally specific concerns; on the southern Bulgarian coastline, for example, it centered around runoff and pollution from Neftochim, a petroleum processing plant near Burgas.[60] Finally, in the autumn of 1989, Ecoglasnost protests in Sofia organized in support of the Helsinki Conference on Environmental Cooperation played a pivotal role in the series of events that triggered the regime's fall.[61]

The short history of the Ecoglasnost movement hints at a vital entanglement between perceptions of environmental degradation, intolerance toward knowledge control, and society building in socialist Bulgaria. A 1988 article in Bulgarian literary newspaper *Literaturen Front,* responding to some of the original Ruse protests, directly connected environmental degradation to morality and societal degradation: "Not only is the environment unhealthy, but also the moral environment suffers, and these unhealthy changes are becoming increasingly serious."[62] Ecoglasnost as a whole similarly utilized the environment as a political and economic critique, targeted equally at material pollution, opaque knowledge production, and societal degradation. The movement's program, as reported by a spokesman to Radio Free Europe in August 1989, included explicit concerns with "the lack of full and up-to-date information about the dangers concealed in all the things we cannot do without—air, water, food, and the soil,"[63] as well as with social and environmental injustice: "Those who make the strategic decisions are not the same people as those who have to face the consequences."[64] These entanglements were strong enough to topple a regime in part because they had existed throughout it. One of the strongest iterations of this entanglement is expressed by dissident writer Georgi Markov as part of his *In Absentia Reports on Bulgaria* (1980).[65] Throughout the *Reports,* Markov's prose frames the environment in Bulgaria alternatively as a site of opposition or as an occupied space, but always as loaded with daily social and political realities. At one point, for example, Markov recounts a conversation in which the participants point out that, though in socialist Bulgaria people have been reduced through distrust to speaking only *to* or *at* one another—as opposed to *with* each other—one can speak *with* the sea.[66] At the end of the *In Absentia Reports,* however, Markov recalls his parting thoughts upon defecting from Bulgaria in 1969 thus: "Later, beyond the Yugoslavian border, I stopped by a patch of grass. I looked back toward Bulgaria and it came to me that precisely the natural beauty sharpened all the more the sense of the intolerability of the ugly life that I personally and many others like me were forced to live. . . . I felt that I could no longer stand the atmosphere in which I lived, the work that I did, the relationships in which I was."[67]

It is significant that Markov grounds his reflection about the "sense of intolerability" and about the atmosphere he can no longer stand to inhabit in the one act of looking back at the material environment inside the Bulgarian border. Markov's evocation of the environment here might be a metaphor, but it is a metaphor with very real and indeed material iterations. I wish to trace this precise link forward in time through the Ecoglasnost movement and further still to the contemporary narratives of participants. There is resonance between the material and metaphorical framings of toxicity during socialism, as expressed in Markov's prose and in the Ecoglasnost movement, and those that participants put forth. There is also direct continuity between these temporalities, enabled by Bulgaria's postsocialist transition, which replicated power imbalances in the country by allowing many of those with political power before the changes to transform it into economic power after 1989.[68] The continuity between these two time frames renders toxic flows difficult to pin down, as their causality must be traced across more than one governance regime, economic system, and set of sources. It is here that the toxic timescape perspective, especially as combined with the fluidity of the maritime context, helps contest a linear conceptualization of time. Viewed through this prism, participants' ways of speaking about their environment in the present acquire a different perspective. The resonance between the two temporalities—that is, the cumulative toxic timescape of the Bulgarian Black Sea coast—exacerbates the feelings of toxic society that communities feel in the face of uncertain and invisible toxicities.

Multitemporal Toxicities and Local Uncertainties

While drawing out some of the links between the socialist period and the contemporary situation, I would like to return to my maritime perspective on toxic flows and its emphasis on the links between time and space, between the visible and the invisible, the material and the metaphorical. At its simplest, this maritime perspective allows me to connect the various sources of hazard I have analyzed above. Ultimately, whatever its source, toxicity comes to form part of the same coastal and marine ecosystem, driven by the same currents and winds along the same coastline, and it is experienced by the same community under the same conditions of uncertainty and inherited distrust. But the maritime perspective on toxic flows also does more than help me connect disparate sources into the "ultimate sink"[69] of the Black Sea. To begin, the Black Sea's maritime materiality itself makes it possible to think about the uncertainty and invisibility that concern this coastline's community across two temporalities. I return here to Westerdahl's point that the maritime landscape calls for thinking along multiple spatial and temporal planes.[70] In the context of the Bulgarian Black Sea coast, the sea brings together historical, cultural, and contemporary forms of toxicity that span the material and the metaphorical. I can meaningfully connect, in this way, Georgi's dual concern about corruption and nitrogen and phosphate runoff to the oceanographic history of eutrophication in the Black Sea and the concerns raised by the Ecoglasnost with the Neftochim plant in Burgas. These seemingly disparate links come together in one chain to provide a multitemporal perspective on scientific uncertainty and the politics of knowledge as vital factors in both the production of material toxic flows and that of metaphorical toxicity in the sense of scientific uncertainty.

The maritime perspective on toxic flows also affords a way of linking environmental humanities scholarship more broadly with societal concerns. For instance, if we were to take DeLoughrey's point about the "humanization" of the sea through waste and pollution,[71] we might draw out an even richer link between, say, Markov's language about talking *with* the sea and Svetoslav's metaphorical use of lowering nets and fish in the sea. Reflecting on these accounts' resonance across temporality from this perspective could suggest to us that the Black Sea is "humanized" not only in the material sense but also through the ways in which its materiality supports the conceptual experiences of societal and political issues. Further, thinking along with Neimanis's watery embodiment—the kind that connects individual bodies with human and nonhuman others[72]—we might better understand how participants can speak about toxicity as a societal experience rather than solely as a material one. My chapter debates, in this way, whether embodiment is limited to the body, if it might not, instead, extend to individual cognitive experiences and societal concerns. To my mind, considering the toxic timescape as a whole—an interlinked, multitemporal, multiscalar context—both enables us to explore this connection and demands that we do so. This is necessary especially where the issues of toxicity are *felt* acutely even if they are not fully factually clear, as in the context of the Bulgarian Black Sea coast.

Throughout this chapter, I have shown that toxicities along the Black Sea coast are both ever present and elusive due to a range of historical, societal, and even environmental factors. The different extents to which the hazards in this context are visible or invisible, both to the state itself and to the community along the coastline, render it hard to establish how various types of toxicity are linked and what their effects might be. Despite this challenge, I have observed and argued that there is a shared societal experience associated with the Bulgarian Black Sea coast toxic timescape, one which unifies these varying types of hazard as well as the uncertainties surrounding them. Significantly, this observation can extend beyond the case I have examined here. I argue that there are political, societal, and cognitive effects of toxicity that can be brought into focus through the prism of the toxic timescape, especially the maritime toxic timescape.

My chapter thus shows the analytical potential of the toxic timescape precisely in contexts where toxicity is invisible or otherwise illegible through the lenses usually employed to define it. The toxic timescape allows for a different type of narration that attends to complex temporal connections and elusive experiences. I have approached this by relying on multiple sources of narrative as a way of accessing different temporal time frames. From this multitemporal perspective on the Bulgarian Black Sea coast's experience with toxicity, spanning the transition between two very different political regimes, we might complicate our thinking of toxicity as a capitalist (or indeed socialist) problem. My chapter helps highlight how toxicity and waste cut across more-than-economic links, and instead evoke entanglements between individual minds, society, and the environment. These entanglements stretch beyond political regimes, with communities coming together across different temporalities in the face of shared uncertainty and the societal consequences derived from it. Here, the toxic timescape exposes a community's mode of both coping with and being shaped by invisible and visible toxicants, in the material as well as the metaphorical sense. Thus, exploring toxic timescapes might well prove a way of examining comprehensive processes that not only impact individual or ecosystem health but also form part of the systematic disruption and dislocation to socioecological relations in communities across the world.

Notes

Research for this chapter has been supported through funding from the European Union's Horizon 2020 research and innovation program under the Marie Skłodowska-Curie grant agreement No 642935.

1. Rachel Carson, "Surface Waters and Underground Seas," in *Silent Spring* (1962; repr., New York: First Mariner Books, 2002), 39.
2. Emma Avoyan, Jan van Tatenhove, and Hilde Toonen, "The Performance of the Black Sea Commission as a Collaborative Governance Regime," *Marine Policy* 81 (April 2017): 285–92.
3. The "snowball" approach comes from H. Russell Bernard, "Nonprobability Sampling and Choosing Informants," in *Research Methods in Anthropology,* 4th ed. (Oxford: Altamira, 2006), 189–91. The original interviews I cite in this chapter were conducted on the Bulgarian Black Sea coast during the fall and winter of 2017–18, but the full range of narrative materials I collected and analyze here ranges from the 1950s to the present.
4. Barbara Adam, *Timescapes of Modernity: The Environment and Invisible Hazards. Global Environmental Change* (London: Routledge, 1998), 10.
5. See John R. Gillis, *The Human Shore: Seacoasts in History* (London: University of Chicago Press, 2012); Philip Steinberg and Kimberley Peters, "Wet Ontologies, Fluid Spaces: Giving Depth to Volume through Oceanic Thinking," *Environment and Planning D: Society and Space* 33, no. 2 (2015): 247–64; Kimberley Peters and Philip E. Steinberg, "The Ocean in Excess: Towards a More-Than-Wet Ontology," *Dialogues in Human Geography* 9, no. 13 (2019): 293–307; David Berg Tuddenham, "Maritime Cultural Landscapes, Maritimity and Quasi Objects," *Journal of Maritime Archaeology* 5, no. 1 (2010): 5–16.

6. Christer Westerdahl, “Fish and Ships: Towards a Theory of Maritime Culture,” *Deutsches Schiffahrtsarchiv* 30 (2007): 203 (emphasis removed), https://nbn-resolving.de/urn:nbn:de:0168-ssoar-55780-7.
7. Rob Nixon, *Slow Violence and the Environmentalism of the Poor* (Cambridge, MA: Harvard University Press, 2011).
8. Astrida Neimanis, *Bodies of Water: Posthuman Feminist Phenomenology* (London: Bloomsbury, 2017), 2.
9. Deborah McGregor, “Indigenous Women, Water Justice and Zaagidowin (Love),” *Canadian Woman Studies* 30, no. 2/3 (2013): 71–78.
10. Zoe Todd, “Fish Pluralities: Human-Animal Relations and Sites of Engagement in Paulatuuq, Arctic Canada,” *Études/Inuit/Studies* 38, nos. 1–2 (2014): 217–38, https://id.erudit.org/iderudit/1028861ar, and Zoe Todd, “An Indigenous Feminist’s Take on the Ontological Turn: ‘Ontology’ Is Just Another Word for Colonialism,” *Journal of Historical Sociology* 29, no. 1 (2016): 4–22.
11. Elizabeth DeLoughrey, “Heavy Waters: Waste and Atlantic Modernity,” *PMLA* 125, no. 3 (2010): 703–12; Philip E. Steinberg, *The Social Construction of the Ocean* (Cambridge: Cambridge University Press, 2001).
12. DeLoughrey, 708.
13. Simone M. Müller and David Stradling, “Water as the Ultimate Sink: Linking Fresh and Saltwater History,” *International Review of Environmental History* 5, no. 1 (2019): 23–42.
14. Avoyan et al., “The Performance of the Black Sea Commission,” 285–92.
15. For more detail on the Black Sea’s oceanography, see Boian Koulov, “Sustainable Environmental Management of Marine Regions: The Black Sea Case Study,” *Geoadria* 17, no. 1 (2012): 3–11; Veselin D. Peychev and Dimitar P. Dimitrov, *Океанология (Oceanology)* (Varna: Онгъл, 2012); or Laurence D. Mee, “The Black Sea in Crisis: A Need for Concerted International Action,” *Ambio* 21, no. 4 (1992): 278–86.
16. Koulov, “Sustainable Environmental Management of Marine Regions,” 6.
17. Mee, “The Black Sea in Crisis,” 278–86.
18. See Georgi M. Daskalov, “Overfishing Drives Atrophic Cascade in the Black Sea,” *Marine Ecology Progress Series* 225 (2002): 53–63; and Georgi M. Daskalov, “Long-Term Changes in Fish Abundance and Environmental Indices in the Black Sea,” *Marine Ecology Progress Series* 255 (2003): 259–70.
19. See Laurence D. Mee, Jana Freiedrich, and Marian T Gomoui, “Restoring the Black Sea in Times of Uncertainty,” *Oceanography* 18, no. 2 (2005): 100–111.
20. Convention on the Protection of the Black Sea Against Pollution (1992). Bucharest, Romania.
21. Tim O’Higgins et al., “Achieving Good Environmental Status in the Black Sea: Scale Mismatches in Environmental Management,” *Ecology and Society* 19, no. 3 (2014): 54–63.

22. Yannis Tsantoulis, "Geopolitics, (Sub)Regionalism, Discourse and a Troubled 'Power Triangle' in the Black Sea," *Southeast European and Black Sea Studies* 9, no. 3 (2009): 243–58, https://www.tandfonline.com/doi/abs/10.1080/14683850902934168; and Liviu Bogdan Vlad, Gheorghe Hurduzeu, and Andrei Josan, "Geopolitical Reconfigurations in the Black Sea Area at the Beginning of the 21st Century," *Romanian Review of Political Geography* 11, no. 1 (2009): 65–76.
23. Avoyan et al., "The Performance of the Black Sea Commission," 285–92.
24. See Hristianna Romanova and Teofan Kuyumdziev, "Анторпогенно замърсяване водите на Българското Черноморие" [Anthropological pollution of the Bulgarian Black Sea coast waters], Варненски Медицински Форум 5, no. 5 (2016): 82.
25. Avoyan et al., "The Performance of the Black Sea Commission," 285–92; Tsantoulis, "Geopolitics," 243–58; and Felix Ciută, "Region? Why Region? Security, Hermeneutics, and the Making of the Black Sea Region," *Geopolitics* 13, no. 1 (2008): 120–47, https://doi.org/10.1080/14650040701783367.
26. Boryana, 2017, personal communication, my translation.
27. Georgi, 2017, personal communication, my translation.
28. Republic of Bulgaria, Public Procurement Agency, Информация за изпълнението на договор за обществена поръчка, БГ-Царево [Information on the completion of a procurement contract], October 31, 2016.
29. Georgi, 2017, personal communication, my translation.
30. Boryana, 2017, personal communication, my translation.
31. Margarita, 2017, personal communication, my translation.
32. Adam, *Timescapes of Modernity,* 11.
33. Deyan, 2017, personal communication, my translation.
34. Deyan, 2017.
35. Mee, "The Black Sea in Crisis," 278–86; Mee et al., "Restoring the Black Sea," 100–111; Georgi M. Daskalov, "Long-Term Changes in Fish Abundance and Environmental Indices in the Black Sea," *Marine Ecology Progress Series* 255 (2003): 259–70; Ahmet E. Kideys, "Ecology: Fall and Rise of the Black Sea Ecosystem," *Science* 297, no. 5586 (2002): 1482–84.
36. Romanova and Kuyumdziev, "Anthropological Pollution," 82.
37. Romanova and Kuyumdziev, 82; see also A. K. Simeonova, R. Z. Chuturkova, and V. B. Bojilova, "Bathing Water Quality Monitoring of Varna Black Sea Coastal Zone, Bulgaria," *Water Resources* 37, no. 4 (2010): 520–27.
38. Deyan, 2017, personal communication, my translation.
39. Republic of Bulgaria, Regional Inspectorate for Environment and Water, Проверен е сигнал за замърсяване на морските води в района Ахтопол [Inspected signal for pollution to the sea waters in the Ahtopol region], September 1, 2017.

40. Republic of Bulgaria, Regional Inspectorate for Environment and Water, 2017; Басейнова дирекция и РИОСВ-Бургас провериха устието на река Караагач [Basin Directorate and RIOSV-Burgas Inspected the Mouth of Karaagach River], July 19, 2019.
41. Georgi, 2017, personal communication, my translation.
42. Andrei, 2017, personal communication, my translation.
43. Thom Davies, "Slow Observation: Witnessing Long-Term Pollution and Environmental Racism in Cancer Alley," in *Toxic TimeScapes,* ed. Simone M. Müller and May-Brith Ohman Nielsen (in this volume).
44. Georgi, 2017, personal communication, my translation.
45. Andrei, 2017, personal communication, my translation.
46. Davide Torsello, *The Ethnography of Corruption: Research Themes in Political Anthropology,* QoG Working Paper Series 11:2 (University of Gothenburg, 2011), 9, https://www.gu.se/sites/default/files/2020-05/2011_2_torsello.pdf.
47. Nixon, *Slow Violence.*
48. Svetoslav, personal communication, 2018, my translation.
49. Svetoslav, personal communication.
50. See Bernd Baumgartl, "Environmental Protest as a Vehicle for Transition: The Case of Ekoglasnost in Bulgaria," in *Environment and Democratic Transition,* ed. Anna Vari and Pal Tamas (Dordrecht: Kluwer Academic Publishers, 1993), 157–75; and D. J. Peterson, *Troubled Lands: The Legacy of Soviet Environmental Destruction* (Boulder, CO: Westview, 1993).
51. Doubravka Olŝáková, ed., *In the Name of the Great Work: Stalin's Plan for the Transformation of Nature and Its Impact in Eastern Europe* (New York: Berghahn Books, 2016), 1–3.
52. Baumgartl, "Environmental Protest," 157–75; see also James Friedberg and Branimir Zaimov, "Politics, Environment and the Rule of Law in Bulgaria," in *Bulgaria in Transition: Environmental Consequences of Political and Economic Transformation,* ed. Philip Shapira et al. (Aldershot, UK: Ashgate, 1998), 83–104.
53. Baumgartl, "Environmental Protest," 157–75.
54. Radio Free Europe, 1961, Situation Report: Bulgaria, Records of Radio Free Europe, Munich, Germany: November 20, 1961, Open Society Archives at Central European University, Budapest: HU OSA 300-8-47-14-74.
55. Radio Free Europe, 1967, Situation Report: Bulgaria, Records of Radio Free Europe, Munich, Germany: November 9, 1967, Open Society Archives at Central European University, Budapest: HU OSA 300-8-47-22-70: p. 1–2.
56. Radio Free Europe, 1961.
57. S. Ashley and R. Nikolaev, 1987, Situation Report: Bulgaria, Records of Radio Free Europe, Munich, Germany: November 4, 1987, Open

Society Archives at Central European University, Budapest: HU OSA 300-8-47-43-10: p. 9.

58. Vesislava Antonova, "Бунтът срещу отровния въздух на соца" [The rebellion against the poisoned air of socialism], *Capital Newspaper,* March 30, 2019, https://www.capital.bg/specialni_izdaniia/kapital_gradove/2019/03/30/3409501_buntut_sreshtu_otrovniia_vuzduh_na_soca/; Baumgartl, "Environmental Protest," 157–75.
59. Liliana Botcheva, "Focus and Effectiveness of Environmental Activism in Eastern Europe: A Comparative Study of Environmental Movements in Bulgaria, Hungary, Slovakia, and Romania," *Journal of Environment and Development* 5, no. 3 (1996): 292–308, https://doi.org/10.1177%2F107049659600500303; Barbara Jancar-Webster, "Environmental Movement and Social Change in the Transition Countries," *Environmental Politics* 7, no. 1 (1998): 69–90, https://doi.org/10.1080/09644019808414373.
60. Boian Koulov, "Post-Communist Change in Ecopolitics and Environmental Management: A Case Study in Bulgaria's Burgas Region," in *Bulgaria in Transition: Environmental Consequences of Political and Economic Transformation,* ed. Philip Shapira et al. (Aldershot, UK: Ashgate, 1998), 201–28.
61. Baumgartl, "Environmental Protest," 157–75; and Jancar-Webster, "Environmental Movement and Social Change," 72.
62. Cited and translated by Baumgartl, "Environmental Protest," 157–75.
63. S. Ashley, 1989, Situation Report: Bulgaria, Records of Radio Free Europe, Munich, Germany: August 7, 1989, Open Society Archives at Central European University, Budapest: HU OSA 300-8-47-45-7: p. 16.
64. Ashley, 1989.
65. Georgi Markov was a Bulgarian novelist, playwright, and journalist who defected in 1969. He went on to air the *In Absentia Reports on Bulgaria* as a series of 137 broadcasts on Radio Free Europe between 1975 and 1978. After Markov's murder in 1978, made internationally famous as the "umbrella assassination," the broadcasts were collected and published in written form in 1980.
66. Georgi Markov, Задочни репортажи за България [In absentia reports on Bulgaria], vol. 2 (1980; Sofia: Ciela, 2008), 175.
67. Markov, 513, my translation.
68. Venelin I. Ganev, *Preying on the State: The Transformation of Bulgaria after 1989* (Ithaca, NY: Cornell University Press, 2007); Christian Giordano and Dobrinka Kostova, "The Social Production of Mistrust," in *Postsocialism: Ideals, Ideologies and Practices in Eurasia,* ed. Chris M. Hann (London: Routledge, 2002), 74–91.
69. Müller and Stradling, "Water as the Ultimate Sink," 23–42.
70. Westerdahl, "Fish and Ships," 203.
71. DeLoughrey, "Heavy Waters," 703–12.
72. Neimanis, *Bodies of Water,* 2.

CHAPTER 6

Colonial Occupation as a Toxic Timescape in Anaiwan Country (Australia)

Kate Wright

AT TWILIGHT the community garden takes on a luminous glow. Smoke from the firepit curls up around three Anaiwan Elders silhouetted against the crimson sky. They are laughing and joking with one another while learning their ancestral language. *Daŋgana ndaga? Nyaŋa ndaga waŋan? Uyidiga lanabura.* Beneath the deep clicks and rolls of their tongues, burning wood hisses. Carbon, once captured and condensed into living forests, is rapidly escaping its cellulose confines. A grammar of branches crackling in the intensities of flame punctuates the human language vibrating above, each wooden pop and bang a wild, loose comma accentuating the rhythms of speech.

In this hour of the evening, before the crow-black night has stripped the world of color, the coming dusk obscures detail but intensifies form. I gaze west across a local high school's playing fields—past the flat, mowed-down, sprinkler-watered grass—and see the sun sinking into the horizon. Painted in the intense hues of the darkening day, the scene seems to mirror the Aboriginal flag—a horizontal block of black on top of a horizontal block of red to declare the immutable connection of Indigenous custodians to the continent's red earth, with a yellow disk in the center to symbolize the life-sustaining sun.

Since the First Sunrise

In 2011, when Uncle Steve Widders, an Anaiwan Elder, invited me to join him in creating a community garden on the eastern fringe of Armidale—a regional Australian town of twenty thousand people situated on unceded Anaiwan country—he was motivated by a desire to reinvigorate a connection to land in Aboriginal cosmologies that he saw reflected in the Aboriginal flag. Speaking at a public event, Widders explained that the community garden is "not just about growing food";[1] rather, it is about reclaiming an emplaced relational metaphysic that may be fundamental for earthly survival:

> Aboriginal values begin with the land, that's what our flag says. . . . Aboriginal people were the first land managers, and the first water managers, environmentalists. . . . They looked after the land, the environment, the animals, the birds, they knew they had to, because everything around them was part of them. . . . Aboriginal people lasted here for tens of thousands of years, under their own governance. . . . I think we all have to really acknowledge that the culture that is regarded as the oldest culture in the world is not being taken seriously.[2]

In this chapter, I position *toxic timescapes* within an Aboriginal ontology of time and place. In contrast to Newtonian linear temporality and its attendant ideologies of modernity and "progress," in which the past seems to disappear with the tide of history, in Aboriginal cosmology, "presence can be held in place, enduring."[3] Toxicity is primarily discussed through the lens of half-lives or generation models. By anchoring toxicity in an ontology of place, this chapter aims to draw the heterogeneous and multiple temporal folds of toxic timescapes into dialogue not only with deep futures (such as the persistence of pollutants) but also with a deep Indigenous ancestral past. This chapter theorizes toxic timescapes in relation to a decolonial understanding of the immutability of Indigenous ancestral presence in the living world, arguing that because ancestral labors are embodied in place, the occupation of Aboriginal lands is also an occupation of ancestral time. Occupation then becomes a primary lens through which to understand toxic timescapes in a settler-colonial context, revealing that toxicity can emerge from an assault on environmentally embodied time itself.

This analysis has grown from a collaborative public environmental humanities research project that I developed through the community garden I helped to cultivate with Uncle Steve Widders in Armidale—the town where I was raised for the first eighteen years of my life. The Armidale Aboriginal Community Garden is sited next to land that was designated as the East Armidale Aboriginal Reserve in 1958, while simultaneously serving as the municipal garbage depot. In the mid-twentieth century this Reserve was home to over one hundred Aboriginal people, who were forced to endure high levels of toxic exposure, as well as extreme levels of government control and neglect, leading directly to community deaths, including the deaths of children.

Bringing a decolonial ontology to bear on an Aboriginal community's lived experience of toxicity is an attempt to resist the cognitive imperialism[4] of the West that works to exclude Indigenous philosophies and subaltern histories from academic knowledges. While there are over five hundred Aboriginal nations in the continent that is now called Australia, and apparent diversity in cultures, languages, and philosophies, the epistemological and ontological centrality of place is a grounding pan-Indigenous principle. So strong is the emphasis on place in Aboriginal worldviews that Kombumerri philosopher Mary Graham has proposed that place be included as a category in any Indigenous method of inquiry because place is "an ontological compass"[5] that centers Indigenous being.

One of the primary goals of the activist research taking place through the Armidale Aboriginal Community Garden is to illuminate histories that have been suppressed by the empty homogenous time of the nation-state[6] and, through a deeply collaborative research and writing process committed to decolonizing methodologies, attend to stories omitted from conventional archives but embedded in bodies, places, and communities. Digging into the soils of the community garden has involved unearthing what Ilenia Iengo and Marco Armiero have, in this volume, termed "subaltern timescapes of contamination."[7] Over the past six years, our community garden team has had to contend with degraded and potentially toxic soils, settler-colonial property relations, and ongoing climate-change-induced drought. These material traces of dispossession, environmental racism, and the toxicity produced by settler-colonial occupation of Indigenous lands subvert the amnesiac erasures of White Australian society, and are augmented by the survivor testimony of Elders and community members who remember living in the 1960s and 1970s on the East Armidale Aboriginal Reserve, or, as it was more commonly and less euphemistically known by the community—the Dump.

Stefania Barca observes that ongoing environmental injustice is enabled by "narrative violence"[8]—that toxicity emerges not only from contamination but also from the stories we tell and fail to tell about the world we live in. I attended a small primary school located less than eight hundred meters from the old Reserve site, yet I learned nothing about the East Armidale Aboriginal Reserve throughout my school years. It was not until I conducted interviews with Aboriginal Elders as part of my PhD research, at the age of twenty-five, that I heard anything about an Aboriginal Reserve that was located on my hometown's rubbish dump.

In my youth I spent many hours traversing the thirty-five-acre block of uncleared bushland that my parents had bought in 1982. My understanding of how my family—descendants of English, Scottish, and Danish migrants—came to be in this pocket of the world was dominated by romantic aesthetics of exploration I was taught through history books and films, my mind populated by sailing ships, ancient maps, and White men in military regalia. As a child I looked in gravel pits for stone tools and searched for the carved shape of shields in eucalypt trees. While I was seeking out traces of Aboriginal culture in my homeplace, I did not know the name of the Anaiwan people who are inalienably connected to the lands I was raised on (let alone the distinct language groups—the Yaniwan, Anēwan, Rādhūn, Inawan, Ambēyang).[9] I had no ancestral stories from the places that nourished me, nor any awareness of ongoing colonial violence and its impact on Aboriginal people in my community. All I was armed with (and it feels increasingly like a weapon) was a romantic image of the ancient Indigene, and a myth of peaceful and rightful conquest.[10] These sanitized historical narratives blinded me to my own position of environmental privilege and its constitutive relationship to the toxic timescapes produced by ongoing settler-colonial occupation of Aboriginal country.

Armidale is located in an area of northeastern Australia known as the "New England Tablelands," a name that articulates the erasures and disjunctions at the heart of the colonial "new world"-making project. The New England tableland region overlays Anaiwan, Dunghutti, Gamilaroi, Gumbaynggirr, and Ngarabal lands, and Australia is mapped by cartographies of place and time that have displaced these sovereign Aboriginal nations. To understand the ongoing violence of settler colonialism, it is necessary to think time and place together. The toxic timescapes that emerge from the settler-colonial occupation of Indigenous country are produced, in part, by the mobilization of time itself to justify Aboriginal dispossession. Linear temporal modes inscribed with a discourse of progress posit the conquest and disappearance of cultures as inevitable outcomes of the tide of history. Aboriginal sovereignty is then discursively thrust into another time—the precolonial—a historical period that is deemed to have ended. As colonial modes of time work to invalidate Indigenous people's prior relationships with land, Aboriginal "law and life ways . . . are buried alive by a dominant colonising culture."[11]

Interconnected temporal and spatial processes of occupation and dispossession produce racialized toxic timescapes. As Aboriginal peoples were dispossessed from their countries, intricate coevolutionary entanglements between cultural practices and ecologies, formed through 65,000–80,000 years of Aboriginal inhabitation of the continent, became disfigured. In the grid-based logic of state building,[12] time and place are carved up into a colonial checkerboard of sites of progress and primitivism, development and waste. Through a range of material and discursive violences, Aboriginal populations became confined to the geographic, social, and economic fringes of White society—the town dump, for example—while Indigenous lands were turned into sacrificial sites of exploitation and extraction.

That the East Armidale Aboriginal Reserve was located on a landfill clearly points to the connections between environmental injustice, racism, colonial extractivism, and toxicity. But within the settler-colonial context an equally compelling case can be made for the toxic ramifications of the ongoing violation of ancestral law—the reckless disregard for abiding Indigenous time held enduring in place and the prevention of Aboriginal people fulfilling custodial obligations to country. In his analysis of multiple toxic timescapes in this volume, David Biggs moves beyond narratives of toxicity that are focused on single contaminants to interrogate layered regimes of toxicity through accumulative toxic exposures that build up in bodies and places. Situating toxic timescapes within an ontology of time embedded in place reveals toxicity emerging from intersecting regimes of settler colonialism that not only produce accumulative contaminants but unravel accumulative ancestral labors that maintain ecological health. This uncovers a previously hidden relationship between Indigenous dispossession, settler-colonial occupation, and toxicity.

In our precarious ecological and political moment, scholars and activists are focused on responsibilities for present and future injustices—to questions of international and intergenerational equity. In his seminal work *Slow Violence and the Environmentalism of the Poor,* Rob Nixon observed that the "environmentally embodied violence"[13] of toxicity means that "the past of slow violence is never past."[14] An emplaced model of toxic timescapes that attends to enduring ancestral time affirms this assertion while recognizing that "to fail the future is also to fail the past."[15] Deborah Bird Rose explains that within Aboriginal ontology: "Human beings . . . are the footprints of the ancestors who died and who still nurture the country and their descendants. Failure works back into time, as well as forward. To kill off chunks of species and connectivities that form the matrix known as country is to start a process that works to erode the traces of the life that preceded us."[16]

One of the most crucial dimensions to understanding a toxic timescape in relation to emplaced ancestral time is a need to rethink the relationship between time, place, change, and endurance. We typically understand time as something that is in motion, and place as something that is static, but looking at places as though they are fixed and stable is like trying to take still photographs of a current in a river. As quantum physicist Carlo Rovelli explains, "The world is not so much made of stones as of fleeting sounds, or of waves moving through the sea."[17] Place is dynamic, it is an *event* taking place.[18] Each ecological formation is a "happening, a moment that will again be dispersed."[19] This view of place, and of time, reconfigures the relationship between toxic flows and environments. Understanding that what endures on this entropic planet is the result of the repetition of patterns and rhythms rather than any fixed or unchanging property challenges the assumption that an environment is something still and pristine that can become infected and contaminated, and instead posits environmental toxicity (and conversely, environmental health) as events in motion, patterns of relationship, participatory moments in time. In her chapter in this volume, Anna S. Antonova notes that maritime space offers generative metaphors for thinking through the relationship between places and flows, and their visible and invisible dimensions.[20] Following Antonova's example we might say that embedded and embodied Indigenous ancestral presence rises and falls like an ocean tide, the connections of the past mysteriously becoming beneath and around us, conditioning the present and the future.

Stephen Muecke ventures a generalization that Aboriginal philosophies "are all about keeping things alive *in their place.*"[21] Within an Aboriginal ontology, layers of time fold over and into one another through the endurance of place and the ongoing responsibilities of Indigenous custodians to follow and care for the immutable laws of the land. Tanganekald scholar Irene Watson explains that the laws for how to live well in country "come from a time the old one's call Kaldowinyeri—the dreaming, the place of lawfulness, *a time before, a time now, and a time we are always coming to.* A time when the first songs were sung, as they sung the law. Laws were birthed as were the ancestors—out of the land and the songs and stories recording our beginnings and birth connections to homelands and territories now known as Australia."[22]

Aboriginal people often say that their ancestors have walked this land "since the first sunrise." Both the image of the sun in the center of the Aboriginal flag, and the wonderfully eloquent turn of phrase—"since the first sunrise"—reflect diurnal patterns of life on earth. In place of flattened geometric renderings of temporality, these expressions of abiding connection to country evoke embodied, embedded, and situated qualities of time. Instead of preceding generations fading into a distant past, or future generations alternatively fading into an unknown nuclear future, as Michael Peterson describes in his chapter in this volume,[23] the first sunrise marks ancestral being as an ongoing present in the living world through the rhythmic oscillation of day and night. And beneath the turning of the sun and moon, and the wheeling cosmogenic stars, land is alive with culture and lore. Yolngu Elder Laklak Barrarwanga explains, "Everywhere you dig in Australia, you'll find some charcoal from the fires of Indigenous people."[24] These markers of Indigenous presence demonstrate that "Indigenous people lived there, that we are from [of] this place. There are layers and layers of it too . . . just like our knowledge. . . . It's significant knowledge that goes down deep. It's from our ancestors. It's knowledge that's embedded in the land and that has been part of the lives of Aboriginal people for generations, forever."[25]

The era of the Anthropocene reads the presence of the human in the geological strata of the planet through what Ilenia Iengo and Marco Armiero describe as "a technostratigraphy of wasted matter—such as carbon sediments, radionuclides and microplastics."[26] Subterranean traces of charcoal from ancestral Indigenous fires are poetic, material reminders of an alternative, counter-stratigraphy of intricate human-environment relationships that are fundamental for ecological flourishing.

Australia is a country that has been shaped by tens of thousands of years of Aboriginal custodianship, where Indigenous land management, particularly fire-stick farming,[27] has transformed even the reproductive mechanisms of the forests. In contrast to myths of pristine, untouched wilderness, precolonial ecologies were intensely managed landscapes. An emplaced model of toxic timescapes is a means of attending to ancestral presence that can be read not only in the geological record but also in the genetic makeup of plants and animals, in the organic layers of our forests, in the living and lively stratigraphy of our entire ecosystem.

Because subaltern experiences of contamination are often hidden and suppressed by those in power, many scholars and activists are undertaking work to make toxicity in marginalized communities visible. A decolonial approach to toxic timescapes addresses another socioenvironmental injustice that underlays toxic timescapes in contexts of Indigenous dispossession: the narrative erasure of Indigenous ancestral labors that are fundamental to ecological health. In settler-colonial contexts where Indigenous claims to land are continually disavowed, recognition of presettlement ecological agency is a counternarrative that centers Aboriginal sovereignty, self-determination, and cultural continuity. To say that Aboriginal knowledges are embedded in place is not to confine Aboriginal agency to a subterranean, primitive, or Stone Age past. On the contrary, it is to foreground the vital importance of Indigenous futures in maintaining the ecological and social well-being of the country.

Places are not static environments but ongoing relationships, meaning that dispossession is not an event, but a structure.[28] The colonial occupation of Indigenous land is a process of socioenvironmental domination that circulates through the metabolism of living ecologies. Franz Fanon observed that "there is not occupation of territory, on the one hand, and independence of persons on the other. It is the country as a whole, its history, its daily pulsation, that are contested, disfigured."[29] In the following pages, I analyze two toxic timescapes that have been produced by the settler-colonial occupation of Indigenous lands that embody ancestral labors, disfiguring history and changing the way the past shapes the present and the future: the East Armidale Aboriginal Reserve, sited on the municipal garbage depot, and the bushfires that incinerated the east coast of the Australian continent in the summer of 2019–20. I then return to some of the environmental and social legacies of colonial violence unearthed through the Armidale Aboriginal Community Garden project to explore possibilities for settler-descendants to become part of a decolonial reoccupation of time and place.

Dispossession and the Dump

That Aboriginal people were exposed to the toxic environs of the Armidale municipal garbage depot is a direct result of dispossession and the settler-colonial occupation of Aboriginal lands. Ambēyan language revivalist Callum Clayton-Dixon observes that colonization of the New England tableland region began in the 1830s and was "especially rapid and intense, the first few decades of upheaval (1830s–1860s) having absolutely catastrophic ramifications for the autochthonous population, thoroughly devastating all aspects of Aboriginal society."[30] By the end of the 1860s, the number of colonizers in the Tableland vastly outnumbered the Indigenous inhabitants, and colonial livestock, mining, cropping, and ringbarking had devastated native ecosystems. Homelands were divided into pastoral stations, where most Aboriginal people now lived, "co-opted into serving the colonial economy, but relegated to the margins of the society they were forced to depend on for survival."[31] Those who did not live on stations were often left "scratching out a meagre existence in fringe camps."[32]

Aboriginal people began settling on the municipal garbage depot in Armidale in the 1950s because ongoing dispossession and the spatial management of colonization—the bulldozing of Aboriginal dwellings, the banning of Aboriginal people from "White" areas, extreme economic disadvantage, and racism that made the purchase or rental of houses impossible[33]—meant that many Aboriginal people had no option but to settle in fringe camps. Camping on the Dump was a means of survival because the rubbish contained material that could be gleaned to create shelter from Armidale's bitterly cold winters. By 1956 about one hundred dispossessed Aboriginal people were "living in poverty in hessian and corrugated iron humpies[34] on the old superseded municipal dump."[35]

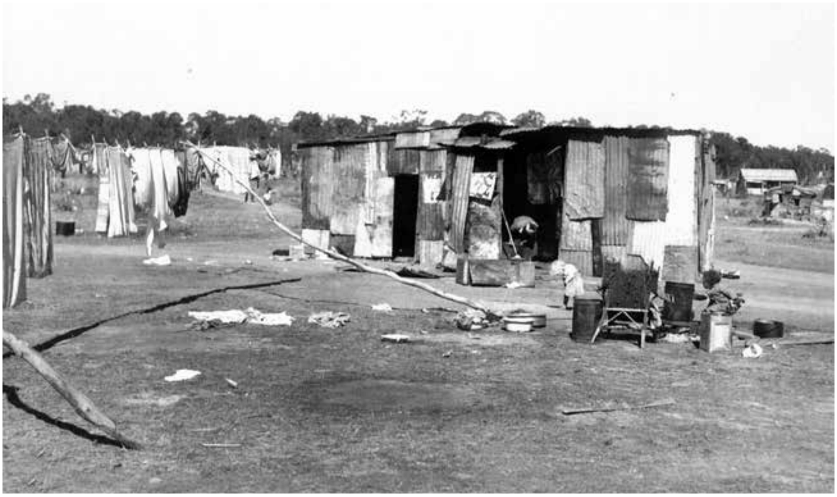


FIGURE 6.1. Woman and child in front of a tin humpy made from material gleaned from Armidale's rubbish dump. Source: Richard Vale. Reproduced with permission.

For colonists to take possession of Aboriginal lands, it was necessary to invalidate Aboriginal sovereignty over those lands. The legal fiction of terra nullius declared that the continent now known as Australia did not belong to anybody prior to White settlement, despite Indigenous inhabitation going back 65,000–80,000 years. This doctrine was not overturned until 1992, and Australian property titles remain founded on its basic assumptions,[36] illustrating the interpenetration of historical and structural dispossession.

Legal scholar Sarah Keenan has interrogated the Torrens title land registration and land transfer system under which most property in Australia is currently managed. Keenan argues that the Torrens system is predicated on invalidating prior Indigenous claims to what has become White property, as "Aboriginal people are demarcated as inhabiting a historical period that has now ended . . . and treated as waste to be contained and removed from the land."[37] In other words, the wasting of Indigenous communities and lifeworlds is a constitutive requirement of colonial occupation and neocolonial capitalist development of Aboriginal lands.

In their chapter in this volume, Ilenia Iengo and Marco Armiero observe that "waste is not only 'a thing' polluting the environment, but a (wasting) relationship that changes the lives of human and more-than-human beings."[38] Looking at the Armidale dump and East Armidale

Aboriginal Reserve as a patterning of place and social relationships reveals the rubbish encircling this vulnerable community of dispossessed people in the mid-twentieth century to be a manifestation of Indigenous-settler power relations in the colony. In the face of "increasingly intensive exploitation of Aboriginal lands and lives,"[39] Aboriginal communities across the country became dependent on the colonial market economy and were forced into situations of poverty and colonial control. At the Armidale dump, this wasting relationship materialized as a community literally creating shelter within the toxic waste of settler-colonial modernity.

Prior to colonial invasion, Aboriginal people did not produce any contaminating waste. Over tens of thousands of years, extensive piles of discarded shells, fish bones, and stone tools—known as middens—were created on the foreshores of lakes, rivers, and beach dunes, but these did not have any polluting impact on the environment. Toxic rubbish dumps and landfills were a distinctly colonial introduction. Armidale's municipal garbage depot was an open landfill for the entire community's waste, including hazardous industrial waste. It was insufficiently isolated, with no drainage or seepage system to prevent contamination of groundwater or the surrounding soil, and no barriers to prevent people, including children, from accessing the waste site. Anaiwan Elder Aunty Pat Cohen moved onto the Dump when she was sixteen years old. She remembers, "There were about thirty or forty little shacks all around. It wasn't a Reserve in those days, it was just a rubbish dump where the rubbish was laying around, and the blackfellers, well they made their camp, their huts out of the bits and pieces that were laying around."[40]

In November 1958, with over one hundred people living in tents and shacks on top of the contaminated soils of the town dump, with one unreliable tap to service everyone, no electricity, and no sewerage, the area was declared the East Armidale Aboriginal Reserve, bringing it under the control of the Aborigines Welfare Board. Under the jurisdiction of the board, Reserves functioned as segregated paternalistic prisons, and the board held extreme power over Aboriginal people's lives. Despite the Aborigines Welfare Board now having the responsibility to maintain the Reserve, the area remained a neglected fringe camp, and much needed and promised basic services, including sewerage, more taps, and electricity, were not provided. The Armidale City Council Garbage Depot was revoked in the same year the area was designated as a Reserve. No environmental remediation work was undertaken, however, and the depot was relocated to an area in very close proximity to the Reserve. Anaiwan Elder Uncle Colin Ahoy, who grew up on the East Armidale Reserve and still lives in that same part of town, recalls, "In the early days when I was only a young kid it used to be called the Dump then because we lived on an old rubbish dump. . . . And straight up the back from where we are today, they moved the rubbish dump from here straight up the hill, which didn't make it any safer for us because when it rained, the seepage from the rubbish came down the hill, through the mission. So it didn't make too much difference."[41]

In her analysis of uranium mining in Navajo country, Traci Brynne Voyles develops the concept of a "wasteland"—"a racial and spatial signifier that renders an environment and the bodies that inhabit it pollutable."[42] A wasteland is a toxic timescape that is demarcated by material and ideological forces as "wasteland discourses collect and sediment to give shape to power relations between peoples and geographies, creating a highly spatialized set of power relations that invoke place as well as race."[43] The people who were living on the Armidale Dump in the 1950s and 1960s were known as Armidale's "fringe dwellers." Fringe dwellers mark the borders of society, the neglected Others or excess in geopolitical renderings of state sovereignty. The entanglement of the discursive and material processes of wastelanding create a toxic feedback loop between people and place, as fringe dwellers who are confined to the rubbish dump of White modernity become discursively associated, in the White imagination, with rubbish and toxicity. Rubbishing, or wastelanding, creates emplaced and discursive toxic timescapes that both produce and normalize incremental and accretive slow violence.[44]

Aunty Hazel Vale, a Gumbaynggirr and Anaiwan woman who spent her childhood on the Reserve, remembers, "When we were growing up, people would call us 'The Dump People,' because it was the old dump, so we got stereotyped because we were the lower class of people."[45] Part of this stereotyping is a violent mobilization of linear time and the discourse of progress and the primitive—a toxic narrative that silences and normalizes toxic exposure,[46] with life-and-death implications. An Armidale general medical practitioner who treated many residents of the Reserve, Dr. Ellen Kent-Hughes, wrote a letter to the *Sydney Morning Herald* published on January 10, 1957, mobilizing a racist wasteland discourse to contest a proposal to improve living conditions by building houses on the East Armidale Aboriginal Reserve.

> I have had practically daily contact with [Aboriginal] people for 35 years, and claim to know something about them. . . . The big problem is how to deal with the drifters. They camp on the outskirts of town and move continually. They are not capable of doing steady work, neither have they the slightest desire to exert themselves. They live on casual work (very casual), charity and the dole. . . . The children run wild, rarely attend school, and are infected with most diseases connected with lack of sanitation. (Recently I had a child in hospital with scabies, head lice, and four types of intestinal worms). . . . You cannot assimilate these coloured people until they are educated, disciplined, and trained; even the adults have the mentality of a neglected slum child. Building a few houses is no answer to the problem; it is the character of the people which needs building up, and that takes a long, long time.[47]

Respected Gumbaynggirr Elder Frank Archibald, who resided on the dump with many extended family members at this time, wrote a retaliatory response outlining the environmental racism his community was subject to, and pleading for houses to improve conditions:

> I am an Aboriginal living on the outskirts of Armidale with some of my children and grandchildren, and I am very annoyed at the letter of Ellen Kent-Hughes which you printed on January 10. . . . This is wild talk and cannot be said of us. We do move around following work but we want to settle down in a house. We want work but all we can get is casual work. . . . This is all the work we can get. When there is no work we take the dole and charity or starve. . . . If Ellen Kent-Hughes lived on the dump she would have scabies, head-lice and worms too. We had only one water tap all the year, and now that does not work. . . . Ellen Kent-Hughes says building a few houses is no answer to the problem. It is the first step for us. Now we can live decently as we always wanted to. We can cook good meals and wash properly. Now our children can go to school clean, without shame, as we always wanted them to. Our characters are all right. I reared 12 children of my own and adopted 17 others.[48]

In early 1960, following two deaths on the Reserve, and the occurrence of serious gastric illness in four or more children, a health officer—Mr. Esdaile—was requested to assess the conditions of the site. On February 21, 1960, Mr. Esdaile reported that the Reserve had "the most appalling sanitary conditions one could imagine."[49] Esdaile identified toxicity emerging from combined violences of dispossession, exposure, and neglect. A lack of sewerage services caused an infestation of flies and maggots, while a lack of flowing water caused ongoing sanitary issues as "the only water for all camps comes from a single tap at the extreme southern end of the ground. Many of the inhabitants need to carry all water for domestic needs up to 500 yards."[50] In a damning indictment of settler-colonial neglect of this confined and controlled community, Esdaile writes: "It is quite apparent that the Aborigines Welfare Board is not managing or regulating the use of the Reserve, as they are statuatorially bound to do, vide Aborigines Protection Act, 1909. Absolutely no facilities are provided on the area by the Board, or any body other than the solitary water tap apparently supplied by The City Council."[51]

Despite the health report recommending urgent action because there was "no doubt that any infectious disease occurring on the Reserve would be transmitted rapidly by the ubiquitous flies and would thrive readily on the conditions prevalent throughout the area,"[52] no changes were made, and seven months later, in September and October 1960, an outbreak of disease spread through the Reserve, killing at least four children and hospitalizing thirteen in under three weeks. The children ranged from six months to three years of age.[53] Following the deaths, Mr. Esdaile stated that it was possible that the children had eaten contaminated food from the dump. This theory was corroborated by Newcastle health officer Dr. T. I. Dunn, who claimed that "children from the aboriginal Reserve regularly raided the city dump in search of food. Older children could have taken the scraps back and given them to younger brothers and sisters."[54]

The toxic timescape of the East Armidale Aboriginal Reserve emerged from a murderous combination of contamination, dispossession, racism, extractivism, neglect, control, and poverty that nested in the bodies of children. In his analysis of a postcolonial toxic timescape in this volume, Malcom Ferdinand observes that it is more than one molecule, contaminant, or source of toxicity that produces toxic timescapes; rather, colonized people are subject to landscapes of exposure that can also be understood as landscapes of injustice.[55] The very fact that consumer waste

FIGURE 6.2. A family in front of a tin humpy at the Armidale dump. Source: Richard Vale. Reproduced with permission.

was collected and conglomerated in such a way as to produce a rubbish dump, and that Aboriginal people were forced, by ongoing dispossession, to live on that rubbish dump, indicates the way contamination functions as part of a colonial network of power, control, and exploitation that is first and foremost about taking possession of land and resources.

Marco Armiero and Massimo De Angelis have coined the term *Wasteocene* to refer to the way waste and contamination are embodied in subaltern communities and subjects, illuminating "the stratification, or the embodying, of the Anthropocene's violence in the organosphere."[56] At the East Armidale Aboriginal Reserve, Aboriginal people were subject to the intersectional toxicity of racialized dispossession and contamination. By sequestering Aboriginal people away on the town rubbish dump, the toxic flows produced by settler-colonial industry and modernity (a product of the extractive pillaging of Aboriginal lands) were consolidated by an apparatus of colonial power.

This granular, situated history has global relevance not only because uneven exposure to toxicity is an experience shared by Indigenous peoples the world over but also because the logic of settler-colonial occupation and extractivism has unleashed a planetary toxic timescape. Ghassan Hage argues that racial and ecological domination is a mode of inhabiting the world that has produced and is intensifying environmental crises. Hage observes that environmental devastation is perpetrated through a logic of occupation where the interests of human colonizers become the primary organizing principles of time and place. At the East Armidale Aboriginal Reserve, we witness the colonial logic of occupation in action, as prior inhabitants, both human and nonhuman, are treated either as waste to be removed or as resources that can be harnessed to the advancement of the colonial project. The petrochemical colonial-capitalist system depends on the extraction of "fuel" from the deep time of the earth—an energy produced by the fossilized bodies of millions upon millions of carboniferous creatures which can also be thought of as humans' coevolutionary, creaturely kin. The capture of these ancient forces produces pollutants with extended ecological futures that concentrate in "the places where the most disenfranchised live and work, accumulating in their bodies, their homes, and in everything alive, sickening their children and threatening to make appearance in their unborn offspring for generations to come."[57] Looking at planetary toxicity through the lens of ancestral place and time positions the geopower that underlies racialized toxic timescapes not as the capture of an amorphous inhuman force but as the perversion of a more-than-human ancestral presence.

Fires and Fences

When I wrote the first draft of this chapter, in January 2020, Australia was in the midst of an unprecedented, catastrophic bushfire season. By the end of the season, the Black Summer fires had burned more than twenty-four million hectares of land, directly causing thirty-three human deaths and forty-five more through smoke inhalation. Over three billion animals were killed or displaced by the flames and smoke that engulfed the country. These devastating fires were the result of disastrous fire conditions caused, in part, by climate change, notably record-breaking temperatures and extended drought.

During the fires, exposure to the toxic bushfire smoke was declared a public health emergency that would soon become fatal.[58] This toxicity was not confined to peripheral "fringe dwellers," who can be easily disregarded and ignored, as bushfire smoke affected the air quality for millions of people, including those living in some of Australia's largest cities—Sydney, Canberra, and Melbourne. As well as leading directly to death, the smoke inhalation also increased rates of respiratory illness, particularly asthma and pneumonia, with unpredictable and lasting impacts for public health.[59]

The extreme and unprecedented level of toxic exposure that blanketed the east coast of the continent in late 2019 and early 2020 is a striking illustration of the vast and emplaced temporal depths that constitute toxic timescapes. Fire historian Stephen Pyne has observed that our climate-changing world is facing a threatening entanglement between two fire realms: "One is overt—the fires that burn living landscapes, the bush. The other fire is covert, because it burns lithic landscapes. These are the once living, now fossilised biomasses such as coal and gas that we combust to power our industrial economies."[60] Through the lens of abiding ancestral time that endures through place, one can add a third fire realm to Stephen Pyne's diagnosis, though this one is defined by its absence—the removal of Indigenous cultural burning. As settler-colonial occupiers of Indigenous lands have extracted and burned the deep geologically embodied ancestral forces of the country they have also actively prevented Aboriginal peoples from engaging in the "fire-stick farming"[61] that would have mitigated fire risk. Rhys Jones, an Australian archaeologist who coined the term *fire-stick farming* to describe the fine-scale mosaic ecologies produced by Indigenous peoples' skillful use of fire to make plant and animal foods more abundant, explains that while fire was an important factor in Australian ecologies for millions of years, human use of fire radically increased fire frequency. Through cultural burning, Aboriginal peoples produced and maintained ecological disequilibriums, and extended the range of pyrophytic plants—plants that encourage and require fire for their reproduction.[62] Because the land was shaped by Aboriginal practices, and Aboriginal practices were also shaped by the land, the continuance of Aboriginal practices on country is vital for the flourishing of human and more-than-human ecologies.

In *The Fire Knows No Boundaries,* Gomeroi poet Rob Waters, one of the founding members of the Armidale Aboriginal Community Garden, writes of the deadly fire season of 2020 as the angry cry of a country that has lost her custodians.

> The fences catch the kangaroos, cage koalas, trap echidnas, goanna and the emu too, but not the fire.
>
> For the fire knows no boundaries.
>
> Those fences were originally laid as a point of demarcation between them and the rest, to claim ownership over land, and claim ownership over those that know what's best;
>
> To claim ownership over a land that has always, longed for fire.

> This land taught our old ones how to belong here; how to live, how to love, and how to treat her with respect, but now that fire grows . . .
>
> And as the fires rage above, she still sits below the fences that they laid;
>
> Angry, waiting.
>
> The fires rage and the poor kangaroo gets caught up in those stupid points of difference.
>
> But the fire knows no boundaries.
>
> Houses fall and people die, the animals run and run until they can't run no more until those fences burn just enough to stop them in its path.
>
> It may not seem this way but she cries for you and your hurting too, but she longs for you to listen.
>
> Let her teach you how to belong;
>
> How to live
>
> How to love
>
> How to treat her with respect.
>
> Because the fire knows no boundaries . . .

Lamenting the suffering produced at the intersection of fires and fences, Waters points to the danger of failing to respond to deep ancestral connections obscured by the smoke and mirrors of Australian property law. Fences are demarcations of White belonging that territorialize the Australian continent. A nationwide crisscross grid of pastoral properties cuts up not only place but time, obscuring deep Indigenous narrative lines[63] patterned across the country.

Failing to attend to the complex interconnections between people, their practices, and place formed over millennia of coevolution, the settler-colonial state has produced an entangled and disturbing toxic timescape revealing that assaults on the environment can also be considered assaults on environmentally embodied histories and deep ancestral pasts. This is vital to understanding the unique coordinators of toxic timescapes in a climate-changing world as attacks on Indigenous knowledges, practices, and laws are threatening the livability of ecologies across the globe.

Zoe Todd and Heather Davis argue that colonialism is a global force that has "compressed space and time in terrifying and unpredictable ways."[64] In describing the violent upheavals wrought by colonial invasion of Indigenous worlds, Davis and Todd evoke the image of a "seismic shock" that "worked to compact and speed up time, laying waste to legal orders, languages, place-story in quick succession." For Davis and Todd, the global environmental devastations of the Anthropocene are reverberations of the seismic shockwave of colonialism "that is now hitting those nations, legal systems and structures" that introduced the colonial, capitalist processes that have devastated Indigenous lifeways and lifeworlds in the last half millennium.[65]

The toxicity unleashed by the settler-colonial erosion of Aboriginal lifeworlds has created disturbing toxic feedback loops that are intensifying death and destruction. Extreme bushfires can produce their own weather patterns through pyrocumulus clouds that unleash dry lightning bolts which spark new fires. The fires that blazed across Australia in late 2019 and early 2020 released 715 million tons of carbon dioxide into the atmosphere, further fueling the climate change that is responsible for unusually combustive fires. The mass mortality of kangaroo, koala, and other large animals produced more carcasses than scavengers could consume, and this is predicted to have long-lasting ecological impacts, having poisoned soil and plant communities. As time and place are compressed in protracted moments of colonial devastation, death no longer turns back into life through transformative regenerative ecological processes; instead, death produces only more death.[66]

John Berger lamented that the dehumanization of society by capitalism has led the living to think of the dead as *eliminated,* with disastrous consequences.[67] As we witness the violent extraction of the subterranean powers of the dead—the fossilized sunshine captured by trillions upon trillions of lives lived upon the earth—and incinerated in our high-speed, endlessly consumptive neoliberal present, we see the reduction of ancestral gifts of life to the toxic fuel of petrocapitalist colonialism. Waanyi author and Boisbouvier Chair in Australian Literature, Alexis Wright, writes,

> In this country there are sacred places holding enormous powers throughout this continent and reaching far out in the seas. But most non-Aboriginal people do not understand the powerful nature of this country and the forces of nature, or how the ancient law stories associated with each of these

> sacred places contain vital knowledge . . . for caring for the stories and powers of the ancestors. These narratives of great and old wisdom are the true constitution for this country, and urgently need to be upfront in the national narrative in understanding how to care for it.[68]

Through the lens of abiding ancestral time that endures in place, we are drawn into alternative studies of toxicity that respond not only to the present and the future but to the ethical demands of the ancestral past. This is incredibly important because life preserves the past and binds time through various modes of reproduction. Life itself is a "watery membrane-bounded encapsulation of space-time,"[69] and endurance on an entropic planet is the product of repetition and rhythm, of patterns and responsive change.

The environmental philosopher and cyberneticist Gregory Bateson once noted that it is much easier to understand sickness than it is to understand health.[70] There is a tendency to notice when things are malfunctioning, when things break. But to understand the unique dynamics of the toxic ecologies we are now immersed in it is vital to also consider the nature of health, of flourishing. Through viewing the places we inhabit not as static landscapes but as events composed of an accumulation of previous moments, a consigning of ancestral presence woven into the strata of our very earth, we can witness the kinds of human participation that have sustained living and dynamic ecologies—an array of ancestral gifts that have created our world.

Keep the Fire Burning

In Aboriginal activist circles there is a saying, "keep the fire burning," that evokes a staunch determination to resist colonial annihilation, to reclaim stolen land and suppressed languages, and to honor ancestors and country. In a continent that cries out for fire—for spiritual and material rejuvenation through careful and responsive cultural burning—this refrain speaks to ancient and abiding connections between people and place formed over millennia. At the opening of this chapter, I relayed a scene of three Anaiwan Elders learning their ancestral language by the glowing embers of the firepit in our community garden. Just as oxygen feeds flame, the speaking of autochthonous languages breathes life back into the country. The Nēwara Aboriginal Corporation, a grassroots language and culture revival organization that now manages the Armidale Aboriginal Community Garden, laments that their ancestral languages and practices were decimated by colonial invasion and occupation, but they refuse to concede its extinction. It has been asleep, they say, but it is waiting to be awoken. Beneath the layers of colonial toxicity that occupy Indigenous bodies and lands are ancestral lifeways.

As a non-Aboriginal occupier of Anaiwan country I am acutely aware of my complicity with the toxic timescape of colonialism. From my own ancestors I have inherited colonial spoils that have blessed my life with gifts born of suffering. It is not possible to return many of these gifts (a childhood spent free from environmental toxicity on Anaiwan lands, for example), just as it is not possible to return to a precolonial past. It is possible, however, to work to create the conditions for the resurgence of a decolonial future, even from within colonial ecologies.

In 2014, I spent many sleepless nights worrying that our planned and much anticipated community garden would not be possible. The toxic timescape of settler colonialism had so poisoned the earth, it threatened to make the recuperation of a more hopeful future impossible. Because the community garden was on land that was directly adjacent to the old municipal garbage depot (which was also the site of the East Armidale Aboriginal Reserve) and because illegal dumping had continued on the area for decades, we needed to test the soil for a range of pollutants: lead, asbestos, copper, arsenic, mercury—a whole litany of pollutants that threatened to make the community garden's development untenable as we did not have the funds to rehabilitate toxic soil.

In November 2014, environmental engineering firm Ferber Environment and Waste analyzed the soils of the community garden site and determined that they did not pose a risk to environmental or human health but that the soil was of very poor quality, with "poor soil structure and low organic matter content."[71] Healthy soil is a multiplicity of the living and the dead, coalescing with mineral fragments. It is made of intra-actions.[72] Maria Puig de la Bellacasa explains: "Soil is not just a habitat or medium for plants and organisms, nor is it just decomposed material, the organic and mineral end-product of organism activity. Organisms *are* soil. A lively soil can only exist with and through a multispecies community of biota that *makes* it."[73]

The soil of the community garden was of extremely poor quality because of dispossession and ecocide—because it had been cleared of the living beings that would transform it into nourishing terrain,[74] including humans who are part of soil communities, and because the toxicity of racialized capitalism had seeped into the earth, poisoning the symbiotic relational systems that create living worlds. While we were safe to continue with developing the community garden, we had to begin to rehabilitate the degraded soil, and the distressed soil has remained an ongoing material reminder that our decolonizing project is immersed in the mineralogical ground of violent colonial power relations.

The community garden's soil carries biomineral and geosocial records of "the past that is not past."[75] Yet material traces of colonial invasion, dispossession, racial capitalism, and ongoing settler occupation are only the latest stratigraphic layer in an archive that maps vast expanses of protean life on earth. The environmental report from Ferber Environment and Waste noted that the soil of the community garden site is "composed of tholeiitic and alkaline basalts, minor trachyte and dolerite deposited during the Tertiary Period of the Cainozoic epoch [66 million–2.6 million years ago]. The site may be further underlain by conglomerate, greybilly, sandstone and claystone deposited during the Tertiary Period. The conglomerate may be further underlain by greywacke, argillite, chert, jasper, and basic volcanics associated with the Sandon Beds. The deposition of the Sandon Beds occurred during the Carboniferous Period of the Palaeozoic Epoch [544 million–245 million years ago]."[76]

Maria Puig de le Bellacasa explains "the time of soil is not 'one.'" Rather, it is a living multiplicity "where multifarious speeds of growth become ecologically significant to each other."[77] In other words, soil is a polyrhythmic, multitemporal patchwork of relations. Laboring in the community garden has taught me that the past is not a veridical record of historical occurrences but a dynamic presence in the living world. Instead of thinking of history as a series of completed events, the embodiment of the past in the community garden's soils reflect history's virtuality: what that past is capable of becoming in relation to the present. Because the past never truly disappears but endures in place, material engagements with place can change how violent colonial histories move through and affect communities, places, and bodies.

Ilenia Iengo and Marco Armiero observe that while stratigraphy is a feature of toxic timescapes, "the historicity of toxic timescapes is not embedded in a static archaeology of layers but . . . in the wasting relationships that create toxic timescapes."[78] They then propose "commoning and caring" as methods of developing less toxic socioecological relations.[79] Similarly, the Armidale Aboriginal Community Garden can be understood as a more-than-human commons created to materialize an environmentally embodied counternarrative to the settler-colonial occupation of Indigenous lands.

Over twenty-five species of plants native to the region are now growing in the community garden. Each of these plants embodies cultural knowledge most clearly articulated through their ethnobotanical uses as native foods, medicines, and materials such as lomandra grasses (*Lomandra longifolia*) for weaving, or flax lily (*Dianella*) for dye. Digging into soils shattered by the colonial world-making process to plant native plants is an act of recuperation that can alter what soil scientists are calling *soil memory*[80] by reshaping the microbial memories circulating through the rhizomatic networks of living creatures that are connected to those soils. In the entangled complexity of the living world, our environmentally embodied past can also be reshaped through the resurgence of culture, meaning that reviving ancestral languages, traditional dancing, weaving, painting, cooking, cultural burning, and sharing stories by a firepit, all become part of a relational reclamation of time and place.

Just as thinking through new modes of space and time can radically reconfigure our understanding of toxicity, thinking through toxicity can radically reconfigure our understanding of space and time. The toxic timescapes of settler colonialism that I have interrogated in this chapter reveal that time is not a passive milieu in which we are arbitrarily situated but a real, tangible force that we actively create and influence with others. Toxicity can emerge from particular mobilizations of temporality and it can also attack time itself—time understood as an emplaced quality of life. It is therefore imperative for anyone striving to produce more just and livable worlds to consider how time is occupied by dominating powers. It is my hope that at the community garden the reoccupation of time through the reclamation of place might allow for the resurgence of life-sustaining ancient rhythms. These ancestral forces have never disappeared, but have been sleeping, in a state of powerful rest, since the first sunrise.

Notes

1. Steve Widders, public conversation at Cultural Immersion Day, Armidale Aboriginal Community Garden, September 11, 2015.
2. Widders, 2015.
3. Stephen Muecke, *Ancient and Modern: Time, Culture and Indigenous Philosophy* (Sydney: University of New South Wales Press, 2004), 16.
4. Marie Battiste, "Maintaining Aboriginal Identity, Language and Culture in Modern Society," in *Reclaiming Indigenous Voice and Vision,* ed. M. Battiste (Vancouver: University of British Columbia Press, 2000), 192.
5. Mary Graham, "Understanding Human Agency in Terms of Place: A Proposed Aboriginal Research Methodology," *PAN: Philosophy, Activism, Nature* 3 (2009): 75.
6. Walter Benjamin, *Illuminations: Essays and Reflections,* ed. Hannah Arendt, trans. Henry Zohn (New York: Schocken Books, 1969).
7. Ilenia Iengo and Marco Armiero, "Toxic Bios: Traversing Toxic Timescapes through Corporeal Storytelling," this volume.
8. Stefania Barca, "Telling the Right Story: Environmental Violence and Liberation Narratives," *Environment and History* 20, no. 4 (2014): 542.
9. Ambēyang language revivalist Callum Clayton-Dixon has undertaken extensive archival research to identify the five language groups that belong to the Anaiwan language community in the southern half of the New England tableland region. This information is taken from Clayton-Dixon's book, *Surviving New England: A History of Aboriginal Resistance and Resilience through the First Forty Years of the Colonial Apocalypse* (Armidale: Anaiwan Language Revival Program, 2019), 17.
10. As Ilenia Iengo and Marco Armiero (in this volume) observe, "Subaltern timescapes remain hidden under the mainstream narratives, which foster a linear understanding of progress and an uncontroversial notion of the common good."
11. Irene Watson, "Buried Alive," *Law and Critique* 13 (2002): 253.
12. James Scott, *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed* (New Haven, CT: Yale University Press, 1998), 49–51.
13. Rob Nixon, *Slow Violence and the Environmentalism of the Poor* (Cambridge, MA: Harvard University Press, 2011), 7.
14. Nixon, 8.
15. Deborah Bird Rose, *Reports from a Wild Country: Ethics for Decolonisation* (Sydney: University of New South Wales Press), 175.
16. Rose, 175.
17. Carlo Rovelli, *The Order of Time* (London: Penguin Books, 2018), 88.
18. Doreen Massey, "Landscape as a Provocation: Reflections on Moving Mountains," *Journal of Material Culture* 11 (2006): 46.
19. Massey, 46.

20. Anna S. Antonova, "Toxic Flows and Societal Exposures: The Maritime Toxic Timescape, Environmental Degradation, and Social and Political Change on the Bulgarian Black Sea Coast from the 1950s Onward," this volume.
21. Stephen Muecke, "The Sacred in History," *Humanities Research* 1 (1999): 34 (emphasis in original).
22. Watson, "Buried Alive," 254 (my emphasis).
23. Michael Peterson, "Decision and Radioactive Principles for the Future: Thinking the Inheritance of Nuclear Waste Repositories with Gramsci and Derrida," this volume.
24. Laklak Burarrwanga et al., *Welcome to My Country* (Melbourne: Allen and Unwin, 2013), 190.
25. Burarrwanga et al., 190.
26. Iengo and Armiero, "Toxic Bios," in this volume.
27. Rhys Jones, "Fire-Stick Farming," *Fire Ecology* 8 (2012): 3–8.
28. Patrick Wolfe, "Settler Colonialism and the Elimination of the Native," *Journal of Genocide Research* 8, no. 4 (2006): 88.
29. Franz Fanon, *A Dying Colonialism* (New York: Grove, 1965), 65.
30. Callum Clayton-Dixon, *Reclaiming Our Story: Resistance, Survival and the New England Linguicide* (master's thesis, University of New England, 2019), 10.
31. Clayton-Dixon, *Surviving New England,* 132.
32. Clayton-Dixon, 132.
33. Two of the earliest Aboriginal people to settle on the town dump were Frank Archibald and Sara Archibald (née Morris). Frank Archibald was descended from the Gumbaynggirr nation and was also initiated as a Dunghutti man. He was born in a shack on the outskirts of Armidale in approximately 1885 to a Scottish father and a Gumbaynggirr mother, Emily. Frank and Sara moved to the fringe-dwelling camp on the dump in Armidale after the local council bulldozed their humpy (just after Christmas, 1954) at Yarra Bay, near La Perouse in Sydney. They were followed by many relations. A survey undertaken in 1961 by the Armidale Association for the Assimilation of Aborigines showed that of a total population of 115, eighty-two were directly related to the Archibalds; Margaret-Ann Franklin, *Assimilation in Action: The Armidale Story* (Armidale, NSW: University of New England Press, 1995), 17.
34. The word *humpy* comes from the Jagera language and refers to a small temporary shelter traditionally made out of branches and bark, but following invasion and colonization it may refer to any temporary building made from available material, including corrugated iron, canvas, metal drums, et cetera.
35. Franklin, *Assimilation in Action,* 16.
36. The silencing of Indigenous rights and sovereignty enabled the myth of settler Australians as "first possessors" to be consummated. The doctrine of terra nullius was overturned in law following the Mabo decision of

1992. In the High Court case of *Mabo and Others v. The State of Queensland,* Indigenous people of the Murray Islands were determined to retain title to their land that had been annexed to the colony of Queensland in 1879. This established native title in common law; see B. David, M. Langton, and I. McNiven, "Re-inventing the Wheel," *PAN: Philosophy, Activism, Nature* 2 (2002): 35. Despite this, overhangs of the terra nullius doctrine persist in Australian society and the denial of Indigenous sovereignty is ongoing.

37. Sarah Keenan, "Smoke, Curtains and Mirrors: The Production of Race through Time and Title Registration," *Law Critique* 28 (2017): 88.
38. Iengo and Armiero, "Toxic Bios," in this volume.
39. Clayton-Dixon, *Surviving New England,* 132.
40. Pat Cohen and Margaret Somerville, *Ingelba and the Five Black Matriarchs* (Sydney: Allen & Unwin, 1990), 98.
41. Colin Ahoy, interview with Barbara Ahoy, Lorina Barker, Laszlo Szabo, Beth O'Loughlin, and Kate Wright, Armidale, May 28, 2018.
42. Traci Brynne Voyles, *Wastelanding: Legacies of Uranium Mining in Navajo Country* (Minneapolis: University of Minnesota Press, 2015), 9.
43. Voyles, 23.
44. Nixon, *Slow Violence,* 2.
45. Hazel Vale, interview with Kate Wright at Armidale Aboriginal Community Garden, April 2019.
46. Iengo and Armiero, "Toxic Bios," in this volume.
47. Ellen Kent-Hughes, "Native Welfare Problems," letter to the editor, *Sydney Morning Herald,* January 10, 1957.
48. Frank Archibald, "Native Welfare Problems: Aboriginal Replies," letter to the editor, *Sydney Morning Herald,* January 1957.
49. R. E. Esdaile, "Health Surveyor's Report of Conditions on the Aborigine Reserve Known as 'The Dump' on Long Swamp Road," February 21, 1960, Archives of the Armidale Association for the Assimilation of Aborigines, Armidale Heritage Centre.
50. Esdaile.
51. Esdaile.
52. Esdaile.
53. "4 Children Die: Fear of Gastro Epidemic," *Sydney Morning Herald,* October 13, 1960; "Appalling Conditions at Armidale Aboriginal Reserve," *Sydney Morning Herald,* October 14, 1960; "Poisoning Theory on Ill Aboriginal Children," *Sydney Morning Herald,* October 14, 1960.
54. "Poisoning Theory," *Sydney Morning Herald.*
55. Malcom Ferdinand, "Toxic Timescapes and the Double Fracture of Modernity: Chlordecone Contamination of Martinique and Guadeloupe," in this volume.
56. Marco Armiero and Massimo De Angelis, "Anthropocene: Victims, Narrators and Revolutionaries," *South Atlantic Quarterly* 116, no. 2 (2017): 347.

57. Barca, "Telling the Right Story," 540–41.
58. Olivia Willis, "Poor Air Quality Caused by Bushfire Smoke Posing Serious Risk for Healthy People Too, Health Experts Warn," *ABC News,* January 7, 2020, https://www.abc.net.au/news/health/2020-01-07/prolonged-bushfire-smoke-creates-new-health-risks/11844934.
59. Alyx Gorman, "Doctors Warn People May Die as a Public Health Impact from Australian Fire Pollution," *The Guardian* (Australia edition), January 3, 2020, https://www.theguardian.com/australia-news/2020/jan/04/doctors-warn-people-may-die-as-public-health-impact-from-australian-fire-pollution-bites.
60. Stephen Pyne, "The Australian Fires are a Harbinger of Things to Come: Don't Ignore Their Warning," *The Guardian,* January 7, 2020, https://www.theguardian.com/commentisfree/2020/jan/07/australia-fires-warning.
61. Jones, "Fire-Stick Farming."
62. Jones, 8.
63. Stephen Muecke, *No Road (Bitumen All the Way)* (Fremantle, AU: Fremantle Arts Centre Press, 1997), 192.
64. Zoe Todd and Heather Davis, "On the Importance of a Date, or, Decolonising the Anthropocene," *ACME: An International Journal for Critical Geographies* 16, no. 4 (2017): 774.
65. Todd and Davis, 774.
66. Deborah Bird Rose coined the term *double death* to describe this kind of cascading destruction that attacks both time and life: "What If the Angel of History Were a Dog?," *Cultural Studies Review* 12, no. 1 (2006): 67–78, https://doi.org/10.5130/csr.v12i1.3414.
67. John Berger, "Twelve Theses on the Economy of the Dead," in *Hold Everything Dear: Dispatches on Survival and Resistance* (New York: Vintage Books, 2007), 3–5.
68. Alexis Wright, "We All Smell the Smoke, We All Feel the Heat: The Environmental Catastrophe Is Global," *The Guardian,* May 17, 2019.
69. Lynn Margulis and Dorion Sagan, *What Is Life?* (Berkeley: University of California Press, 1995), 86.
70. Gregory Bateson, "Lecture on Consciousness and Psychopathology, Part 1," January 1, 1971, Internet Archive, https://archive.org/details/Gregory_Bateson_lecture_on_consciousness_and_psychopathology_part_1_1971_71U030.
71. Ferber Environment and Waste, "Preliminary and Detailed Site Investigation 201 Canambe Road, Armidale" (unpublished environmental report, November 26, 2014), p. 16, in possession of author.
72. Karan Barad, *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning* (Durham, NC: Duke University Press, 2007).
73. Maria Puig de la Bellacasa, "Making Time for Soil: Technoscientific Futurity and the Pace of Care," *Social Studies of Science* 45, no. 5 (2015): 691–716, (emphasis added), https://doi.org/10.1177%2F0306312715599851.

74. Deborah Bird Rose, *Nourishing Terrains: Australian Aboriginal Views of Landscape and Wilderness* (Canberra: Australian Heritage Commission, 1996).
75. Christina Sharpe, *In the Wake: On Blackness and Being* (Durham, NC: Duke University Press, 2016), 13.
76. Ferber Environment and Waste, "Preliminary and Detailed Site Investigation," 5.
77. De la Bellacasa, "Making Time for Soil," 709.
78. Iengo and Armiero, "Toxic Bios," in this volume.
79. Iengo and Armiero, "Toxic Bios," in this volume.
80. Erin R. Lapsanky et al., "Soil Memory as a Potential Mechanism for Encouraging Plant Health and Productivity," *Current Opinion in Biotechnology* 38 (2016): 137–42, https://doi.org/10.1016/j.copbio.2016.01.014.

PART 3

Expanding upon the Toxic Body

INTRODUCTION

ULTIMATELY, HUMAN and more-than-human bodies are sites of contamination too. The fundamental environmental changes of the past, variously resulting in climate catastrophe, resource depletion, or the toxic pandemic, have left their markers not only in the geological strata of this planet but also in the biological and genetic makeup of living bodies. As the chapters in this volume illustrate, environmental poisons *write* their story through their inscription onto living bodies, necessitating a close investigation of the "toxic body" in the first place. On the one hand, the living body is the site of violence, emotions, and trauma; on the other hand, it is the source of resistance and emancipation. On the one hand, the human body "breathes like plants, and lives from water as fish live in water. . . . It, too, can be eroded like the stones and the trees in the acid rain."[1] On the other hand, there is no "solidarity of living things," but rather the continuity of practices that sharpen distinctions between different human bodies and between human and more-than-human bodies in the interchange with contamination. On the one hand, lastly, we speak of contamination as a process during which a toxicant "attacks" the human body. On the other hand, toxicants can be bodies themselves. How do we make sense of these binaries as part of the episteme of the toxic body?

This section, "Expanding upon the Toxic Body," deals with the theoretical, methodological, and narrative-form implications of toxicity's embodiment, using the examples of (a) corporeal storytelling and toxic bios as sources of empowerment and emancipation, (b) more-than-human narratives of toxic exposure from the perspective of algae, (c) fear as a source of emancipation and protest against nuclear siting, and (d) the politics of toxic corporeality in the postcolonial setting of the French Caribbean.

Ilenia Iengo and Marco Armiero start this section with their chapter "Toxic Bios: Traversing Toxic Timescapes through Corporeal Storytelling," bringing power relationships and socioenvironmental injustices into conversation with the concept of toxic timescapes. Their chapter unearths how there are not only the timescapes of corporate powers or governments—marked by the accumulation of profits, a detached instrumentalization of places and people, and blind and often partial faith in technological progress—but also the timescapes of subaltern communities of those who experience the entanglement of toxicity with the time and space of their personal and collective lives. Subaltern timescapes often remain hidden under the mainstream narratives, they argue, which foster a linear understanding of progress and an uncontroversial notion of the common good. To visualize these subaltern timescapes, Iengo and Armiero propose guerrilla narratives as a coresearch practice that aims to explore subaltern timescapes of contamination, toxic exposure, and experiences.

Jesse D. Peterson's chapter, "Storying Toxic Timescape 'Trajectories': Intersections among Algal Toxins and More-Than-Human Bodies," challenges anthropocentric visions of toxicity. Peterson describes how the intersections of algal toxins and algal, animal, and water bodies in different times and places can assist in developing more-than-human narratives about toxins. Mobilizing broad concepts of toxin and body, the chapter addresses the "trajectories" of algal toxins through more-than-human bodies in three sections. The first section looks at algal toxins' relationship to algal bodies, highlighting how these "toxins" benefit algae as well as how these chemicals and bodies often cannot be extricated from each other as a result of ontological indeterminacies. The second section points to the various ways in which algal toxins spread through the bodies of other organisms. Third, algal toxins are considered in relation to the sea to disclose how they permeate the times and spaces of the sea. As a conclusion, the chapter highlights how nonhumans assist in the production of toxic bodies, times, and places. It also reflects on what it means to decenter human interests in toxic narratives, suggesting alternative approaches for dealing with the interrelationship of more-than-human bodies that produce toxicity.

Astrid Kirchhof takes readers into the Republik Freies Wendland (Free Republic of Wendland) in West Germany, where protests against nuclear waste storage took place in the 1970s. This example allows her to bring power relations and experienced socioecological injustices into conversation with the concept of toxic timescapes. In her chapter "Embodying Fear and Toxicity: Environmental Protests against West

Germany's Final Repository for Nuclear Waste in Gorleben, 1977–1980," Kirchhof draws out people's experience of the entanglement of toxicity, fear, and their struggle for a landscape that was chosen as site for a final repository. Using the case of the community of Gorleben, she illustrates how emotional criteria and an embodied perception of a toxic threat were able to become dominant drivers for protest. Emotions like fear were introduced into the public sphere and hotly debated. Feelings were now no longer private, but public, because they were seen as political and part of a social order in which confrontation of the individual with oneself became increasingly important.

Malcom Ferdinand explores the contours and dynamics of a postcolonial toxic timescape with a focus on the Caribbean islands of Guadeloupe and Martinique. His chapter, "Toxic Timescapes and the Double Fracture of Modernity: Chlordecone Contamination of Martinique and Guadeloupe," unearths, similarly to Iengo and Armiero's, the power dynamics within toxic narratives. As Ferdinand illustrates, a number of sociopolitical processes, in dialogue with scientific research, serve to make a toxic timescape visible or invisible. The (in)visibilization of a toxic contamination is the product of a political conflict between competing narratives and actors, each claiming to adequately present the "real" situation. Martinique and Guadeloupe's toxic timescape with respect to the chlordecone contamination is also the site of such an epistemic conflict. Ferdinand uncovers in his chapter two competing main narratives of this contamination that are on either side of what he terms the "double colonial and environmental fracture of modernity," and with it the conceptual and sociopolitical divide that separates environmental issues of the modern world from their underpinnings in colonialism and slavery, and their persistent racism and social inequalities.

Note

1. Ulrich Beck, *Risk Society: Towards a New Modernity* (London: Sage, 1992), 74.

CHAPTER 7

Toxic Bios

Traversing Toxic Timescapes through Corporeal Storytelling

Ilenia Iengo and Marco Armiero

> This is his story, it is the story of an anonymous worker, one among others, one of those workers growing up after the war, living the economic boom on their skin, then experiencing the 1973 oil crisis, and finally dying at the beginning of the new century. . . . This is the story of a man who has begun to work when he was just a kid, entering the factory when he was 14 and never leaving it, because the factory had nested in his cells.
>
> —Alberto Prunetti, *Amianto,* 113

IN THIS chapter, we bring power relationships and socioenvironmental injustices into conversation with the concept of toxic timescapes. For us, the concept of *toxic timescapes* refers to the intricate intersection of time, space, and bodies in relation to toxic exposure. Employing that concept, we will unpack linear understandings of time and explore rhizomatic ways in which harmful substances permeate time and space, producing more-than-human narratives. We will illustrate how, as a tool of analysis, it equips scholars with new ways of creating knowledge, conceptualizing the historical (past, present, and future) presence and possible effects of harmful substances and provides a theoretical framework for new modes of narration in an uneven world. Thinking through toxic timescapes is an invitation to radically shift our understandings of toxicity in the complex web of life.

Our approach is an antidote against any form of naturalization of timescapes. The intricate intersectionality that merges time, space, and bodies is not blind toward class, gender, race, ability, and other forms of hierarchies embedded in the social organization of life. As Malcom Ferdinand and Thom Davies argue in this volume, toxic timescapes are deeply embedded in the colonial history, constituting the foundation of racial capitalism.[1] There are tensions between divergent timescapes. There are those of corporate powers or governments, made of the incremental accumulation of profits, the discounting of future generations, short-term decisions, a detached instrumentalization of places and people, and a blind and often partial faith in technological progress. But there are also the timescapes of subaltern communities who experience the entanglement of toxicity with the time and space of their personal and collective lives, such as those in Algarve, in the south of Portugal, fighting against GMO agriculture, or those on the outskirts of Naples, in Italy, unveiling the contamination imposed on their lives, or, finally, the people in Halkidiki, in the northern province of Greece, rising up against gold mining. Often these subaltern timescapes remain hidden under mainstream narratives, which foster a linear understanding of progress and an uncontroversial notion of the common good. We propose guerrilla narrative as a coresearch practice that aims to explore and make visible subaltern timescapes of contamination. While entering those timescapes through toxic autobiographies, guerrilla narrative transcends the single human story precisely because it makes it possible to access the intricate intersectionality of which timescapes are made.

The chapter is organized in two parts: first, we present our theory and methodology, discussing the concept of the Wasteocene, the age of waste, its embodiment into subaltern bodies, and how a guerrilla narrative approach can offer the key to listen to the bodies' toxic stories. In the second part, we offer an analysis of empirical cases from toxic autobiographies being collected for Toxic Bios, a public environmental humanities project dedicated to eliciting and gathering autobiographical narratives of contamination and resistance by zooming into wasted bodies and landscapes. We will conclude by collating how storytelling from the forefront of environmental contamination uncovers the materially uneven, nonlinear, multiscalar, and more-than-human timescapes of toxicity.

Toxic Lives in the Wasteocene

Perhaps imagining the future is one of the prerogatives of what it means to be human. Often, those imagined futures are dystopic distortions of the present, and, remarkably, waste or toxicity seems to be a prevalent and recurring trope that characterizes these imaginary landscapes. From *Mad Max* to *Blade Runner,* the future looks dirty and unhealthy.

Waste, for instance, best embodies the essence of Cormac McCarthy's dystopian masterpiece, *The Road.*[2] Journeying through a nightmarish landscape with his son, the unnamed protagonist reflects on the decayed world. "Perhaps in the world's destruction," he thinks, "it would be possible at last to see how it was made. Oceans, mountains. The ponderous counter spectacle of things ceasing to be. The sweeping waste, hydroptic and coldly secular. The silence."[3] Although ending with a rather more optimistic tone, the 2008 animated movie *Wall-E* also proposed a waste-based vision of the future, with planet Earth transformed into a gigantic, lifeless landfill.[4] In all these imagined futures, waste is not only "a thing" polluting the environment but a (wasting) relationship that changes the lives of human and more-than-human beings.

The work of science fiction is not that of predicting the future, of course, but rather that of describing and challenging the present through metaphors. As the acclaimed science fiction writer Ursula LeGuin once stated, "The future, in fiction, is a metaphor."[5] Indeed, in the case of the omnipresence and accumulation of material waste, the creative work of science fiction writers may recall the forecasts of the modern seers, experts of any kind entitled to see into the future. From the World Bank experts to the independent worldcounts.com, futurists confirm that the planet is becoming a gigantic toxic dump, perhaps with CO_2 emissions at the top of the worrying list.[6] Earth-system scientists have called this new epoch the Anthropocene, the Age of Humans, an age marked by a technostratigraphy of wasted matter—such as carbon sediments, radionuclides, and microplastics—accumulating upon and inside the earth's surface.[7] However, microparticles of wasted matter have made their way into the living tissues of humans and more-than-human organisms, across the porous boundaries between bodies and ecosystems.[8] As this transcorporeal toxicity is the salient feature of the present condition of humans and more-than-humans, we argue that the Anthropocene should instead be called the Wasteocene, the age of waste. The Wasteocene concept was first launched by Armiero and De Angelis and fully developed in the book *Wasteocene: Stories from the Global Dump,* by Armiero.[9] Intuitively, speaking of the Wasteocene implies the acknowledgment of waste as the epitome of humans' ability to affect the environment to the point of transforming it into a gigantic dump.

However, the Wasteocene is not only a matter of "stuff," of waste in the material sense, but also a matter of relationships. Wasting materially produces wasted people and wasted places, as well as resisting subjects and unexpected communities, as feminist science fiction helps us to imagine and prefigure.[10] Thinking of the Wasteocene as a matter of wasting relationships helps to avoid the techno-fix trap—how to deal with waste—which is rooted in an idea of waste as a side effect of the otherwise successful history of capitalist development. Instead, the Wasteocene implies that wasting relationships—that is, the othering of places and people—is not a side effect of racial capitalism but of its way of functioning. From Martinique to Cancer Alley in Louisiana[11] and all the way to the peripheries of Naples, the toxic timescapes of the Wasteocene are embedded in a history of coloniality and exploitation. As waste is not only a matter of "stuff," so too are toxic timescapes not only about the prolonged effects of toxins through time. Toxic timescapes are the narrative skeleton of modernity embedded into the bodies of human and more-than-human nature. They design the hierarchies of spaces and people; they impose toxic temporalities (development vs. backwardness) and imperial periodization, which erase both alternative conceptions of times and nonconventional and antinormative shifts. In other words, toxic timescapes inform our histories and geographies as much as our human and more-than-human ecologies.

Toxic Bios and Guerrilla Narrative in the Toxic Jungle

Although we do believe that toxic timescapes are embedded in the global texture of modernity, we also find it crucial to explore them in the junctures where they meet with the material flesh and lives of subaltern people. For this reason, in 2016, we launched Toxic Bios, a public environmental humanities project aiming to collect and visibilize toxic autobiographies of people affected by contamination.[12] Through Toxic Bios, we have coproduced a collection of toxic biographies, which are now partially available in an open-access georeferenced archive and kept at the Environmental Humanities Laboratory in Stockholm. The voice of a toxic autobiography belongs to a storyteller whose body—or the body of a loved one—and memories are marked by the materiality of environmental injustice.[13] Toxic Bios aims to provide a new outlook on the history of the dominant socioeconomic model and on the possible alternatives that an embodied understanding of environmental inequalities may generate. Toxic Bios is predicated on the assumption that we live in the age of the Wasteocene. The project itself can be considered a narrative excavation into the new epoch. While the traces of the Anthropocene are looked for in the geological strata, the Wasteocene must be sought within the organosphere—that is, in the living layers of ecosystems. However, the tools of our exploration are not those of medical doctors or of researchers in the labs; Toxic Bios does not put under the microscope the tissues of a sick person or test breast milk.

Toxic Bios has explored the organosphere by supporting the collection and circulation of stories people tell about their bodily experience of environmental contamination.[14] Toxic substances and toxic narratives—that is, the narratives that either silence or normalize injustices—have accumulated in the bodies and imaginaries of humans and more-than-humans, changing the structure and the meaning of individual and collective life. In researching the tensions and interactions between toxic narratives and toxic autobiographies, Toxic Bios aims to provide a new outlook on the history of the dominant development model in two ways: by casting a light on what Rob Nixon has defined as the slow violence[15] of toxicity accumulating in bodies over generations with delayed destruction, and by supporting the possible alternatives that an embodied understanding of environmental inequalities may generate. Those corporeal narratives contribute to a radical critique of the Anthropocene discourse and its organization of spatialities/temporalities.[16] The temporal and spatial complexity of storying a person's bodily encounter with socioenvironmental injustices implies the clash/overlap of multiple narrative timescapes: the biological, the personal, and the collective, including humans and more-than-humans. Telling one's own story always implies a negotiation among those different timescapes. Thereby, Toxic Bios does not end with an exploration of individual toxic stories; instead, we want to make sense of and engage with the articulations of personal and collective timescapes, and we believe it can/must be done through the means of storytelling.[17] The toxic autobiographies we have coproduced through our project are indeed narrative explorations of different timescapes; the biographies of individuals are entangled with the biographies of places, traversed by toxins coming, spatially and temporally, from elsewhere. Working through toxic autobiographies implies placing the body at the center of the human experience of toxic timescapes. It is through the body that toxic timescapes become visible, perceptible. The borders between external and internal nature collapse, following what Stacy Alaimo has called "transcorporeality,"[18] but also the diverse temporalities of toxins, ecologies, communities, and individuals collapse in the body, illustrating the exceptionality of toxic time where past, present, and future seem to coexist.

Toxic Bios explores the embodiment of the Wasteocene within the organosphere; it aims to see how capitalistic violence is inscribed into human and more-than-human bodies. We consider two kinds of toxic embodiment: on the one hand, the deepening of capitalist relations within the fabric of life, in bodies and the environment, producing toxic ecologies in the service of private profits—what Banerjee has called necrocapitalism;[19] on the other hand, the making and maintenance of toxic narratives, which silence injustices while imposing an official truth that becomes embedded into the stories of subaltern people and places.

In order to tackle this twofold toxicity, we have adopted what we have called a guerrilla narrative approach.[20] With this expression, we mean to make explicit Toxic Bios' aims—that is, sabotaging the mainstream toxic narrative of progress, which justifies or invisibilizes injustices,[21] and occupying it with counterhegemonic corporeal storytelling. Guerrilla narrative is rooted in the scholarly traditions of coresearch and action research. It rejects the binary opposition of experts versus the public while actively undisciplining the space of the production and legitimization of knowledge. Methodologically, it is strongly related to the oral history tradition, though with a clearer antagonistic agenda, and a conscious and more extensive use of a plurality of narrative genres, including audiovisual tools, diaries, creative writing, and so on. In comparison to the oral history approach, guerrilla narrative might imply a blurring of the roles of the researcher and the researched; in fact, at least in theory, the Toxic Bios platform supports participation with little to no interface with a researcher being necessary. More concretely, the guerrilla narrative is inspired by similar experiences of research/

storytelling as those realized by the sociologist Stefano Laffi; the project EPiCentro Civitavecchia[22] of the NGO A Sud, which is also one of the hubs of Toxic Bios; and the Italian tradition of storytelling as research.[23]

We purposefully speak about "guerrilla" narrative, referring to the Zapatistas' insurgency of 1994, which perhaps has been among the most powerful liberation experiences the world has witnessed in the last few decades. On January 1, 1994, precisely the same day that the North American Free Trade Agreement was inaugurated, imposing the neoliberal regime across borders, the Zapatista Army of National Liberation occupied seven cities in Chiapas, declaring its intention to march on Mexico City. Although it was indeed an armed insurrection, the Zapatistas immediately showed a very conservative approach to violence, something that distinguished them from other guerrilla experiences in Latin America.[24] Employing our interpretative tools, we may argue that the Zapatistas' insurgency was a crack in the toxic timescapes that had trapped Indigenous and subaltern people since the European invasion.

We like to refer to that experience for two reasons: for its strong engagement with storytelling—the communiqués of the Zapatistas' Army are pieces of literature rather than just political statements[25]—and for its agenda to free areas from the control of the constituted power, aiming to build counterhegemonic communities.[26] Thereby, as a guerrilla narrative project, Toxic Bios also aims to free areas from power control. First, the autonomous areas created by our guerrilla narrative are freed from the toxic narratives that have silenced injustice and oppression. Those are autonomous zones in the sense that subalterns take back control of their stories and of their bodily experiences. Actually, the ultimate free zone of Toxic Bios' guerrilla narrative is the body per se; indeed, the body is reminiscent of the Lacandona Jungle, both intimate and intertwined with the entire world, a battleground between capitalistic appropriation and the liberation of lives. Guerrilla narrative does not only happen in the material toxic jungle of capitalism but it has also a symbolic performative power: it aims to transform that toxic jungle into many Lacandona Jungles—that is, into autonomous spaces where, through the experience of contamination, constituent counterhegemonic powers are in the making. However, this is not a postcapitalist space, because the toxic legacies of capitalism are never "post," in the sense that they produce toxic timescapes that are persistent across time and infectious across space. The legacies of slavery, for instance, produce toxic timescapes that cannot be confined to a specific time or space; on the contrary, they belong to past, present, and future at the same time, embedded in the landscape of Cancer Alley or Martinique as much as in the honorable university temples of Western knowledge production. And that is without forgetting that much of slavery's legacy is embedded in our modern mobile phones, if one would consider the working conditions of so many underage workers in the mines providing rare minerals for that industry.

Therefore, guerrilla narrative cannot only foster a postcapitalist society but it needs to create an antagonistic project, precisely as the Zapatista autonomous zones did. Are they outside, or can they even be outside, global capitalism and its persistent and infectious toxic timescapes? Rather than thinking about inside and outside, we find more fertile the category and practice of autonomous spaces, and *autonomia* in general, meaning the quest to produce lives, communities, and narratives that are autonomous from capitalism.[27] They are immersed in its toxic timescapes but they do not belong to them. It is not a matter of inside/outside but of building autonomous spaces and stories against the totalitarianism of capitalism and its toxic timescapes. As toxic narratives try to impose toxic timescapes as the norm, guerrilla narrative cannot erase them but can reveal the violence of that project and foster a quest for autonomy.

What Is (in) a Body?

According to Karl Marx, nature was the inorganic body of humans; as he wrote in the Paris manuscripts, "Man [indeed, Marx employed a sexist language] lives on nature—means that nature is his body, with which he must remain in continuous interchange if he is not to die. That man's physical and spiritual life is linked to nature means simply that nature is linked to itself, for man is a part of nature." Marx's explanation of the body rotates mainly around the trope of nature—the body is nature as much as nature is the body. However, those lines must be read together with his other well-known statement: "Labor is, first of all, a process between man and nature, a process by which man, through his own actions, mediates, regulates and controls the metabolism between himself and nature." This combination of nature and work is what we see as a body. The toxic body is neither just social/cultural nor purely ecological.

In the body, flows of materials and energy merge with genetic and social history, the external environment infiltrates into the cells. The body is power inscribed into ecology. Epigenetics has actually demonstrated that the stratification of power relations and memories of injustice stay within the body, telling their stories through the genetic narratives of each individual and across generations. In the factory or in the mine, in the slum or in the working-class neighborhood, subaltern bodies merge with an ecology that is never just natural.[28] Capitalism is an ecology of exploitation and contamination that trespasses onto human and more-than-human bodies, but this trespassing is not random; the assumption of Toxic Bios is that it largely interlaces with the fault lines of race, class, and gender.[29] An allergic body in the US, using Gregg Mitman's inspiring *Breathing Space,* is indeed produced in the meeting between the internal ecology of the body and the external ecology of animal, insect, and artificial allergens, but this is only a portion of a story that should also include "the unequal distribution of wealth and health care in American society."[30] Thereby, what is (in) an allergic body is the entire arrangement of a racist, classist, and unjust society as it is crystallized in the external ecology of which that body is a part. Stacy Alaimo has phrased this concept beautifully: "Casting racism as environmental exposes how sociopolitical forces generate landscapes that infiltrate human bodies. Similarly, the 'pancreas under capitalism' and the 'proletarian lung' testify to the penetrating physiological effects of class (and racial) oppression, demonstrating that the biological and the social cannot be considered separate. . . . The proletarian lung illustrates my conception of trans-corporeality, in that the human body is never a rigidly enclosed, protected entity, but is vulnerable to the substances and flows of its environments, which may include industrial environments and their social/economic forces."[31]

Thereby, the proletarian lung is (in) the body as much as the capitalistic dust of extractivism is (in) the air. It has been said that in late modernity the body has become the epitome of identity,[32] which comes together with a strong individualization—no collective identities but only self-identities embodied in the flesh and the bones, inscribed on the skin, shaped by genes, cultures, and choices. Toxic Bios wants to expand and maybe challenge this hyper-individualizing identity project based on the body; as much as it is centered on an embodied storytelling, it also contextualizes bodies in intricate and messy socioecological spatialities.

Telling one's own toxic story is a way to regain self-determination of the body, but it does not obliterate the fact that the body is a battleground, a territory of conquests and defeats, and the frontier of capitalism's expansion. In this sense, oddly enough, an autobiographical project seems to dissolve the obsession with the self, toward bodies enmeshed in socioecological networks, bodies that have the potentiality to reinvent new hybrid identities. As Latin American feminist theorist Natalia De Souza has clearly argued, "This discursive and visual intrusion of the body into the political arena has the potential to open avenues to re-signify our political practices and forms of resistance."[33]

As a genre in US environmental writing, toxic autobiography is a distinct product of marginalized groups denouncing the environmental injustice in which they feel trapped.[34] As such, toxic autobiographies are a prototype of counterhistory, challenging mainstream narratives on progress, the common good, and science. They represent a unique blend of narrative and history, of science and politics, of the personal and the collective. As a literary genre, toxic autobiographies are almost invisible in Europe. Clearly, invisibility does not call into question the existence of such narratives, nor of those experiences, but rather describes their positionality in the hierarchies of the contemporary European cultural industry's relevance. Indeed, a few examples of toxic biographies might be found in the writing of authors who have published with independent or small presses or self-published their texts. In Italy, for instance, there has been a renaissance of working-class narrative in the last few years, thanks to the work of writers such as Alberto Prunetti,[35] Wu Ming 2 and the Metalmente Collective,[36] and Simona Baldanzi.[37] The invisibility of this narrative is connected to the double weakness of environmental justice in Europe, both as a social movement and a scholarly field of study.

Through our Toxic Bios project, we are trying to fill this research gap, coproducing toxic autobiographies, generally deeply connected to place-based environmental justice controversies. We have been directly inspired by the impressive work of the Environmental Justice Atlas;[38] apart from being infinitely smaller than the atlas, the Toxic Bios repository has focused on the personal parts of these environmental controversies, assuming that the personal is always political. Toxic Bios storytellers assemble dates, memories, places, and aspirations in stories that tell something about what has occurred, but in most cases their stories are something different from reports on environmental conflicts. The storytellers are entangled in socioenvironmental assemblages made of bodies, earth, water, fish, plants, mountains, air, and of course, capitalism in the form of property rights, industrial production, contamination, and enclosures. Placing environmental controversies at the center of our toxic storytelling, we assume that toxic autobiographies are subaltern stories of toxic timescapes, voices rising from the contaminated frontiers of global capitalism. From a Portuguese village in the vicinity of a chemical factory to the outskirts of Naples that are filled with illegally dumped toxic waste, we envision those stories as storytelling tools for the (re)generation of alternatives coming from sacrifice zones,[39] areas structurally marginalized in the geography and history of modern progress. While this is, by and large, still true throughout the entire project, it becomes visible that the frontiers of global capitalism, the sacrifice zones ensuring the well-being of the elites, are not only places on a map but also lived experiences of bodies and stories. Some human and more-than-human bodies have become sacrifice zones, toxic dumps, generally rooted into the very geography of subalternity (working-class neighborhoods, economically marginalized and/or racialized communities, etc.) but sometimes going beyond it across winding histories of contamination. Thereby, the storyteller's economic status is not the only thing that matters, since a toxic body is socially and ecologically subaltern to the system built on the (re)production of contamination that has made it a toxic body in the first place.

Bodytelling, or What Do Toxic Autobiographies Talk About?

In what follows, we mobilize some of the toxic autobiographies gathered through our project. These stories will help us to exemplify the main theoretical arguments of this chapter. The stories we have selected are mainly from Portugal and Italy, with a few examples from Greece. Most of our storytellers are women activists in local grassroots organizations fighting against specific instances of environmental injustice in their communities. Our project has met those activists in different moments of their life trajectories. We should never forget that storytellers may tell the same story in radically different ways in different moments of their lives, not only because the functioning of the memory can be tricky but, and maybe especially, because the past is always in a performative relationship with the present and the future. We should also add that it has not been always easy to involve people in this toxic storytelling project. As Stefania Barca has argued, toxicity is not only in the contaminating pollutants altering the ecologies of humans and more-than-humans but also in the narratives silencing or normalizing injustices, shaping the memories of the past and the imaginations of the future.[40] This is why people with a toxic story often believe they have nothing worth telling. And this is why, instead, reappropriating one's own story is a political act, because it requires that the storyteller places themselves in the timescape of history not only as a passive victim but as the one who tells a different story that helps a community to come together and enact a different world.

Novella lives in the midst of the Land of Fires' poisonous landscape between Naples and Caserta in southern Italy, and she has been among the most active participants in the grassroots movements for environmental justice in the region. She has been restlessly denouncing the burning of hazardous waste and was among the organizers of a concert in 2011 to raise awareness about the violence perpetrated on her land. She is convinced that storytelling is a political act of insubordination that allows a different kind of history to be narrated: "Guerrilla narrative helps to look for allies and for 'alternative' documentations to go down in history. These alternative stories are different from what official documents will tell our future generations on the issue of toxic waste dumping in Campania."[41] She believes that narrative justice[42] is of paramount importance, while the most common and strongest weapon used by the hegemonic political and economic system is silencing: "Last time I denounced a toxic fire, some months ago, Carabinieri [one of the Italian police corps] called me back upon arrival at the burning site which was still smoking and they told me: 'Madam, it was nothing to be worried about, it was only dry twigs.' And when I insisted, saying that such a black colored smoke could not be caused by weeds, they summoned me to keep quiet."[43]

Giorgos is a livestock breeder living in Palaiochori village, Greece, and he is a member of SOS Halkidiki, a socioenvironmental justice association rising up against the development of an open-pit gold mine in the forest of Skouries, developed by an international mining corporation. He shares the preoccupation that "the current expansion of mining activities and the enormous environmental burden following them, make it impossible for other productive activities, such as agriculture, livestock, beekeeping etc. to exist in the area." The mining company has been able to exercise violence on the local socioecology in multiple ways. Among the different strategies, the corporation has used narrative violence to erase any other possible scenarios of present and future territorial development. They did so through the institutionalizing of a discourse where exploitation and mining have always been part of the community's history. But Giorgos and the other SOS Haldikiki activists are recovering the stories of a different past, the one that belongs to them: "Our story is forestry, water canalization, and other activities that people do not appreciate anymore. The whole history of the place has been erased and then narrated anew by the company."[44]

The imposition of an official corporate history and the quest for an alternative story that would incorporate the resisting memories of the subalterns are at the very core of a tragic Italian dam disaster, included in the Toxic Bios archive through the voice of Carolina, interviewed by the journalist Lucia Vastano.[45] Carolina is a survivor of the 1963 Vajont disaster, which swept away the entire town of Longarone, killing almost two thousand people, and an activist fighting for justice and dignity for the affected. Like the Vajont valley, Carolina's life has been occupied by the corporation that built the dam. The toxic narrative about progress and modernity that brought the dam there also devalued the local knowledge of people who opposed the project. In the aftermath of the disaster, a new toxic narrative was imposed, one that naturalized the event, erased it from collective memory, and silenced the anger of the survivors. Toxicity almost to perfection. The violence of this toxic narrative is at the core of Carolina's story. She recollects the clash between the judicial truth, which has found the Italian state and the corporation guilty of "multiple negligent homicide with predictability as aggravating factor," and the narrative violence that has framed the disaster as a natural catastrophe rather than as the effect of a profit-driven strategy. "This is the story. Full stop. But still nowadays, after more than fifty years from the massacre of innocents, some try to relieve those responsible from their accountability and to put the blame onto nature." Carolina goes on and says there are some kinds of socially accepted mourning and memories, and others that are silenced; the struggle to politicize the suffering and transform it into collective action has been censured from above: "Institutions have done and do everything is in their power to divide the good survivors from the bad ones. The good ones are those who tell the story of suffering, those who move the listeners to tears, but then stop there. Those are the ones who shut up and leave to the institutions the task of telling the facts and therefore make memory harmless; in this way, memory does not disturb powerful economic interests who still prioritize profit over human lives."

In some stories, the hierarchies at play are explicit, as the storytellers position themselves in antagonistic positions against powerful actors. "We had the strength to say no to the biggest power in the world, the US military," says Concetta.[46] She is actively involved in the NoMuos struggle as a member of a women's group concerned for the health impacts of a terrestrial satellite terminal for telecommunications, in Niscemi, in the south of Sicily.

Similarly, another storyteller from Italy, Silvia, describes the dramatic imbalance of power between activists and their adversaries. Silvia describes herself as a farmer who was forced to become an environmental activist and challenge a powerful energy corporation in order to protect her land from the construction of an overhead power line.[47]

Going back to the Vajont disaster, Carolina also stresses the power gap between powerful actors and the majority of the population: "I want to say that it was a predictable and predicted massacre: institutions gave priority to the profit of the few above the lives of many. The state, which should have defended us, was instead alongside those interests. Even if they knew well that the construction of the dam was highly risky for the local population." Carolina sees the necrocapitalist regime inscribed in the valley: "The Vajont dam is a metaphor for a development which is not concerned about the wealth of the community, but only looks at some extra GDP points. A GDP that grows thanks to death." Here, again, the Vajont story is an effective metaphor for the toxic narratives we consider to be at the roots of any kind of toxicity, because they naturalize toxic timescapes, making them the normal background of our individual and collective lives.

In some cases, the powerful actors responsible for intoxicating the past and future of a community's relationship to a territory are clearly embodied by an international corporate extractivist project. In other contexts, the contamination starts with private investments, continues with state-led development projects, and then erupts through landscape changes culminating in disasters or accumulates in bodies in the form of diseases. Giorgos, the shepherd and activist from SOS Halkidiki, shows the intricate fabric of dependence and absolute power that the mining company exercises not only on workers but on the social and ecological relations between the forest and its inhabitants: "What is most important to understand is that the company operates as a state within a state. It has the absolute power in the region, it has the money and the jobs and determines all the economic therefore social relations influencing the very conscience of the inhabitants." Miriam, an environmental justice activist from Naples, Italy, explains how she became a farmer as an effect of her participation in the struggles against toxic contamination.[48] However, hers should not be understood as the usual individual life project. On the contrary, Miriam's "convivial garden"—this is the name she gave to her agroecology farm—is also a collective space, a prefigurative exercise in experimenting with a joyful coexistence between humans and more-than-humans beings in the face of perpetrated contamination. Since the waste emergency was ongoing in Campania, Miriam talks about resisting such toxic timescapes, saying, "The state is always absent, when not directly colluded with the mafias. . . . Until business will not be transformed into solidarity work among people, it will continue being the pool full of sharks that sees our planet as its personal dumpsite. But we resist. Every single day we start the engine of a massive machine that opposes itself to the collapse of humanity. We slowly move forward, relentlessly."

The marginalized and silenced story of those who bear the costs of economic development, industrial production, and distribution of what capitalism defines as externalities is a story that continuously trespasses on and disrupts the Cartesian dualism of body and mind, nature and society.[49] Therefore, a toxic autobiography is never only an individual story. It crosses the porous boundaries of a person's life; it politicizes the quotidian and builds alliances across places and species. Antonio and Maria, two Portuguese activists from the grassroots environmentalist association ADACE, tell their story by linking it to the fate of more-than-human companions,[50] such as fish dying from arsenic and mercury pollution in the river.[51] When Antonio and Maria say, "And if the fish die, we will die too," the river and the dead fish are not only something out there; they constitute the everyday assemblage of which Antonio and Maria are part and do not feel excluded from, nor impermeable to.[52] At first, we assumed the toxic autobiographies would be human stories, but we were wrong. They are multispecies storytelling.[53] Miriam recollects that "Italian Cancer Charity, which dealt with terminally ill patients and for whom I was volunteering, informed us on the Triangle of Death already in 2008. In the empty room organized for a training course, it seemed terrifying to me that Acerra, Nola and Marigliano—three big towns in the outskirts of

Naples—could be defined the locations of an apocalyptic movie. There, they said, death by cancer had higher rates. Because of waste dumping, the earth was getting sick and us with her."[54] The sense of a shared destiny crossing species and times is also present in a biography from Portugal. Like Miriam, Angela Rosa, an activist fighting against the introduction of GMOs, also decided to become a farmer, going back to her family's land in Algarve, in the south of Portugal. In her story, the trees are companions in a mutually shared history. In the video storytelling, we can see her talking about GMOs and traditional seeds as she walks around the farm; we can hear cicadas singing in the warm sun of Algarve.[55]

Transcorporeality[56] permeates the stories of contamination and resistance, and its conceptualization is key in order to frame the body-environment hybrid substance of storytelling. The toxic stories we have collected always speak of the contamination flows that have somehow transited from a polluting source to one's own body. Once again, the individual story is never just a human nor an individual one. Contaminants, factories, aquifers, and soils are part of those toxic timescapes. The stories of entire communities are told through the story of one single individual. When Antonio from ADACE speaks about nanoparticles emitted by the industrial complex where he works, he says they are to be found everywhere, that they enter the domestic space of homes and bodies.[57] While saying this, Antonio touches his mouth, materially performing the embodiment of toxicity and the transcorporeal relations between his body and what surrounds him.

Similarly, Adriana, an activist from the southern Italian town of Brindisi, describes the subtle ways in which a local coal power plant has been able to pervade every inch of her community and its inhabitants.[58] She claims that both the energy corporation and the very matter of coal as an energy source move from the factory into the community, and by doing so, they shape relations: "We believe that coal has polluted not only air and water but also people's consciousness. Brindisi is enslaved by this company, which financially supports the few cultural events of the city. We say that this is how coal enters our community." Being a livestock breeder, Giorgos, the activist from Palaiochori village, has observed the effects of contamination on plants, animals, and ultimately, humans by the Skouries gold mine: "Check some of the olive trees on your own. If you check the leaves, you will find sand on them. This sand is asbestos. The area is full of asbestos. We know that, we knew that. But the mining operations bring this asbestos up from the ground. And it travels through the air, through the water and the soil. I am a livestock breeder. My animals eat the grass, drink the water. I am afraid of my products. I am not sure if they are safe and healthy. We are even afraid to feed our children."[59] The transcorporeality of toxicity crossing socio-natural bodies can be both an alarming discovery and a recognition of the mutuality embedded in radical actions striving for change, as when Miriam looks back at her experience and sees the fertile crossings of her work on the farm with insects and seeds and the practices of commoning for environmental justice: "We started cultivating people even before the land, so that everyone could understand how much effort there is in producing vegetables following nature's cycles. Today we organize events at the garden in order to discuss about environmental issues, agriculture as commons to rediscover time (because time can never be lost), on solidarity economy in agri-culture."[60]

In Miriam's words, "time can never be lost." Firmly she argues that one's life must be spent for a good cause, such as, in her case, fighting for justice, growing healthy food, and building a common space for nurturing solidarity and a sense of community across species. Miriam's practice of time and space clashes with the concept of toxic timescapes we have employed throughout this chapter. As Miriam's timescapes are those of commoning and caring, so toxic timescapes embody enclosures and wasting. Also in the latter, time is not lost, because toxicity persists and the past stays in the present and projects itself into the future. Toxic spaces are always historical because they exist through time even after the epiphany of contamination. Stratigraphy is the feature of toxic timescapes, but the historicity of toxic timescapes is not embedded in a static archaeology of layers—it is in the wasting relationships that create toxic timescapes. For this reason, against toxic timescapes we need commoning and caring, because what we need is new socioecological relationships.

Space, Time, and Ghosts

In her book *Sick Building Syndrome and the Problem of Uncertainty,* Michelle Murphy explores the ways in which the invisible, yet familiar, wrap of toxicity becomes visible to workers through a process she calls "re-materialization."[61] We argue that this rematerialization may occur also through the very bodies of people; in the Toxic Bios project, the invisible contaminants become symptoms, scars impressed into the body as well as into the stories shaping it. Often the body functions as a sensorial pathway into what we have called the Wasteocene.[62] "You cannot see nor hear the electromagnetic waves of the terrestrial satellite terminal, but they do enter the home silently, they hit you, with no chance of noticing them," says Concetta, the activist from the NoMuos group we met earlier.[63] Miriam also brings the senses to the forefront of understanding and politicizing the experience of contamination by hazardous waste landfills and fires: "Reaching some places between Napoli and Caserta means vomiting and feeling sick: a mephitic smell is like a punch in the stomach. But one day we roused, and some believe it was because of the smells."[64] In his memoirs, Father Maurizio Patriciello, a charismatic leader of the Catholic component of the movement against toxic waste fires in Caivano, in the province of Naples, Italy, employs the stench coming from the toxic fires as a revelatory moment—not a burning bush but a different kind of fire transformed this ordinary priest into a prophet crying in the desert of the Wasteocene. "It was deep night. I woke up suddenly trying to breathe. A disgusting stench had broken in through the window. It had invaded the room and stole all the air. . . . The stench changes your life. It is not Cogito ergo sum. Rather it is Olfacio ergo cogito. Sniff and get angry."[65]

Stories of stench and transformation are rather common. Lucia, a Neapolitan housewife transformed into an environmental activist, describes how the irruption of the smell from a nearby dump into a classroom for adult education revealed the socioenvironmental inequality in which she was immersed, living in one of the most degraded peripheries of Naples. A similar experience happened to Doriana, a veterinarian who became an environmental activist when she moved from the most exclusive neighborhood of Naples to what she thought was an idyllic relic of rurality in the urban space: "It was when we brought our furniture there that we began to feel it. The stench, that terrible, sweetish smell which now I can so easily recognize. Through that smell, we discovered that our new home was less than one kilometer away from the largest landfill in the region."[66]

Doriana's story is illuminating because it truly illustrates how through a sensorial bodily experience she was able to reconnect with the flows of materials invisibly traversing the city and its ecologies; apparently, someone like Doriana, from the upper class, did not have a clue about what was occurring away from her comfort. However, the stink that would have haunted Doriana since then was coming not only from a geography she did not know—a socioecological elsewhere in respect to the city she used to inhabit—but also from a history that was silent for her. The landfill she refers to was the largest and the oldest in the region, opened in the 1950s.

The smell, as an embodied manifestation of toxic stories, has a double spatial and temporal dimension. This twofold dimension is manifest in the Toxic Bios project. Its online platform is organized around a world map, which makes evident the fact that these are stories embedded in places. Indeed, each story is deeply connected to an environment that is intertwined with people. However, toxic stories are rooted but not trapped in places. The map helps to visualize the hybrid blend of bodies and environments, but it may occlude the way that the story knitting them together travels across space and time. This is true not only for the storyteller, who often moves from one place to another, but, perhaps more surprisingly, for the place too. In several toxic stories, places change through time; they are transformed by the arrival of a factory or a waste facility. Contaminants travel through air, water, fluids, and bodies in unexpected and mysterious ways, as the toxic story of Filipe, a choir director from Porto in Portugal, reflects—the way glyphosate has entered his body remains a mystery to him.[67]

The timeline, the turning points, the corruption of life, the quest for reparation are shared by places and people. Storytelling has the power to evoke what/who does not exist anymore and yet, nonetheless, is present and real for those who are telling their stories. As in a weird mix of *Blade Runner*[68] and Macondo,[69] the toxic storytellers seem to cohabit with the ghosts peopling their landscapes and lives: these are the ghosts of invisible threats, of places that are lost forever, of old generations, sometimes enjoying lost paradises but more often passing the marks of terrestrial hells, of future generations, dreamed and feared, had and lost.

Politicizing Toxic Timescapes

Maybe the best metaphor to describe the kind of work Toxic Bios is doing comes from the experimental volume produced by Pulido, Barraclough, and Cheng, *A People's Guide to Los Angeles.*[70] In the introduction, the authors propose the image of the haunted landscape to describe the hybrid blend of invisible presences that people the places we live in: "Los Angeles is filled with ghosts—not only of people, but also of places and buildings and the ordinary and extraordinary events that once filled them."[71] Toxic stories are also haunted by ghosts of substances, human and more-than-human animals, places, dreams, seeds, and nightmares. However, those very toxic stories also haunt places, because, as we all know, what is really haunting a place is not a ghost but the stories that make it visible, even alive. As Carolina powerfully states:

> Do not ask me to recall the survivors' suffering and don't ask me to tell the story of the wound that does not let my husband sleep at night, the wound that heavily influences his existence. . . . The display of pain as an end in itself is not the memory that Vajont needs, or that any other massacre with clear culprits needs. The memory we need is the one that searches for justice and pretends that stories are told to prevent tragedies from happening again. Memory means fighting to preserve truth that will be heritage to future generations. This will help them build a better future, a world where human life counts more that profit.[72]

Pulido, Barraclough, and Cheng have been able to place those ghosts on a map, guiding readers in an exploration of Los Angeles beyond what is visible today. As in an esoteric archaeology, they summon the ghosts of the past through the layers of stories embedded into the texture of the city. Similarly, with Toxic Bios we have attempted to summon the ghosts of the past, present, and future peopling not only places but also bodies. The emancipatory timescapes of resistance to toxicity are expressed by Miriam:

> I understood that to embrace my land, as a farmer and activist, also meant to find my way back home. Losing pieces is natural when growing up. I discovered it among my comrades who are also my family in the struggle. . . . I know every time I look at my daughter's eyes, because I am aware of my responsibility for the world she will live in. I know all that when I rally in the streets, the moment when I trespass

> the border between my personal world and the world one millimeter away from my skin, without feeling any temporal discontinuity anymore. Here, I am free.

With Toxic Bios we have manifested how guerrilla narrative sabotages the toxic narratives that silence or normalize exposure. Through the practice of counterhegemonic storytelling, the multiple layers of toxic timescapes emerge, revealing their entanglement with the power structures inscribed in the socioecological web of life. Those timescapes are personal as much as collective, as appears clear in the Toxic Bios project. They are inscribed into the body, the stories, and the places humans and other beings inhabit. If we do live in the Wasteocene, our task is to make those stratigraphies of toxicity visible. But this work of visibilization must go hand in hand with that of politicization. The stratigraphies of toxicity should not been seen as "natural" features of a mainstream timescape that erases injustice while selling an idea of linear progress. In this chapter, we have argued that guerrilla narrative can perform this combined work of visibilization and politicization; it can be the archaeological excavation into the tissues of life, the magic spell evoking the invisible, bridging personal and collective memoirs, the body, and the ecologies of power and resistance.

Notes

The authors wish to thank the entire team of the Toxic Bios project and the many storytellers who have generously shared their toxic autobiographies with us.

1. Malcom Ferdinand, "Toxic Timescapes and the Double Fracture of Modernity: Chlordecone Contamination of Martinique and Guadeloupe," and Thom Davies, "Slow Observation: Witnessing Long-Term Pollution and Environmental Racism in Cancer Alley," both in this volume.
2. Cormac McCarthy, *The Road* (New York: Alfred A. Knopf, 2006).
3. McCarthy, 231.
4. *Wall-E,* directed by Andrew Stanton (Burbank, CA: Walt Disney Pictures and Pixar Animation Studios, 2008), film.
5. Ursula LeGuin, *The Left Hand of Darkness* (New York: Ace Books, 1976).
6. We are referring here to the World Bank database What a Waste Global Database, https://datacatalog.worldbank.org/dataset/what-waste

-global-database, and to the website The World Counts, https://www.theworldcounts.com/.

7. Paul J. Crutzen, "The 'Anthropocene,'" in *Earth System Science in the Anthropocene,* ed. Eckart Ehlers and Thomas Kraft (Berlin: Springer, 2006), 13–18.
8. Stacy Alaimo, *Bodily Natures: Science, Environment, and the Material Self* (Bloomington: Indiana University Press, 2010).
9. Marco Armiero and Massimo De Angelis, "Anthropocene: Victims, Narrators, and Revolutionaries," *South Atlantic Quarterly* 116, no. 2 (2017): 345–61. For a deep discussion of this intellectual proposal, see Marco Armiero, *Wasteocene: Stories from the Global Dump* (Cambridge: Cambridge University Press, 2021).
10. Adrienne Maree Brown and Walidah Imarisha, eds., *Octavia's Brood: Science Fiction Stories from Social Justice Movements* (Oakland, CA: AK Press, 2015).
11. See Ferdinand and Davies in this volume.
12. Toxic Bios: A Guerrilla Narrative Project, www.toxicbios.eu.
13. Ilenia Iengo, "Endometriosis and Environmental Violence. An Embodied, Situated Ecopolitics from the Land of Fires in Campania, Italy," *Environmental Humanities* 14, no. 2 (2022): 341–60.
14. Giovanna Di Chiro, "Living Environmentalisms: Coalition Politics, Social Reproduction, and Environmental Justice," *Environmental Politics* 17, no. 2 (2008): 276–98.
15. Rob Nixon, *Slow Violence and the Environmentalism of the Poor* (Cambridge, MA: Harvard University Press, 2011).
16. Marco Armiero, "Sabotaging the Anthropocene, on in Praise of Mutiny," in *Future Remains: A Cabinet of Curiosities for the Anthropocene,* ed. Gregg Mitman, Marco Armiero, and Robert Emmett (Chicago: Chicago University Press, 2017), 129–40.
17. Donna Houston, "Environmental Justice Storytelling: Angels and Isotopes at Yucca Mountain, Nevada," *Antipode* 45, no. 2 (2013): 417–35.
18. Alaimo, *Bodily Natures.*
19. Subhabrata Bobby Banerjee, "Necrocapitalism," *Organization Studies* 29, no. 12 (2008): 1541–63.
20. We have elaborated on the concept of guerrilla narrative in the following publications: Ilenia Iengo and Marco Armiero, "The Politicization of Ill Bodies in Campania, Italy," *Journal of Political Ecology* 24 (2017): 44–58; Marco Armiero et al., "Toxic Bios: Toxic Autobiographies—a Public Environmental Humanities Project," *Environmental Justice* 12, no. 1 (2019): 7–11.
21. Stefania Barca, "Telling the Right Story: Environmental Violence and Liberation Narratives," *Environment and History* 20, no. 4 (2014): 535–46.
22. EPiCentro Civitavecchia—Epidemiologia Popolare per la Salute delle Comunità e la Tutela dell'Ambiente was a project run by the Italian NGO A Sud in 2013–14; https://asud.net/epicentro-civitavecchia-epidemiologia-popolare/.

23. Danilo Dolci, *Racconti siciliani* (Turin: Einaudi, 1963).
24. Alex Khasnabish, *Zapatistas: Rebellion from the Grassroots to the Global* (London: Zed Books, 2010).
25. Jeff Conant, *A Poetics of Resistance: The Revolutionary Public Relations of the Zapatista Insurgency* (Oakland, CA: AK Press, 2010).
26. Alvaro Reyes and Mara Kaufman, "Sovereignty, Indigeneity, Territory: Zapatista Autonomy and the New Practices of Decolonization," *South Atlantic Quarterly* 110, no. 2 (2011): 505–25.
27. Patrick Cuninghame, "Autonomism as a Global Social Movement," *Journal of Labor and Society* 13, no. 4 (2010): 451–64.
28. Marco Armiero and Anna Fava, "Of Humans, Sheep, and Dioxin: A History of Contamination and Transformation in Acerra, Italy," *Capitalism Nature Socialism* 27, no. 2 (2016): 67–82.
29. David Naguib Pellow, *Garbage Wars: The Struggle for Environmental Justice in Chicago* (Cambridge, MA: MIT Press, 2002); Julie Sze, *Noxious New York: The Racial Politics of Urban Health and Environmental Justice* (Cambridge, MA: MIT Press, 2006).
30. Gregg Mitman, *Breathing Space: How Allergies Shape Our Lives and Landscapes* (New Haven, CT: Yale University Press, 2008).
31. Alaimo, *Bodily Natures,* 28.
32. Chris Shilling, *The Body and Social Theory* (London: Sage, 2005).
33. Natalia M. F. de Souza, "When the Body Speaks (to) the Political: Feminist Activism in Latin America and the Quest for Alternative Democratic Futures," *Contexto Internacional* 41, no. 1 (2008): 89–112.
34. Richard Newman, "Darker Shades of Green: Love Canal, Toxic Autobiography, and American Environmental Writing," in *Histories of the Dustheap: Waste, Material Cultures, Social Justice,* ed. Stephanie Foote and Elizabeth Mazzolini (Cambridge, MA: MIT Press, 2012), 21–48; Phil Brown, *Toxic Exposures: Contested Illnesses and the Environmental Health Movement* (New York: Columbia University Press, 2007).
35. Alberto Prunetti, *Amianto: Una storia operaia* (Roma: Alegre, 2014).
36. Collettivo Metalmente, Wu Ming 2, and Ivan Brentari, *Meccanoscritto* (Roma: Alegre, 2017).
37. Simona Baldanzi, *Figlia di una vestaglia blu* (Roma: Fazi, 2007).
38. The Environmental Justice Atlas (https://ejatlas.org/) is a large mapping project, which has collected almost 3,700 cases of socioenvironmental conflicts. The project was initiated and is coordinated by the EJAtlas research group in global environmental justice based at the Institute of Environmental Science and Technology at the Universitat Autonoma de Barcelona.
39. Steve Lerner, *Sacrifice Zones: The Front Lines of Toxic Chemical Exposure in the United States* (Cambridge, MA: MIT Press, 2010).
40. Barca, "Telling the Right Story," 535–46.
41. Novella Vitale's autobiography is in the Toxic Bios archive but has not been published yet online.

42. Stefania Barca, *Forces of Reproduction: Notes for a Counter-Hegemonic Anthropocene,* Cambridge Elements in Environmental Humanities (Cambridge: Cambridge University Press, 2020).
43. Novella Vitale's autobiography is in the Toxic Bios archive but has not been published yet online.
44. "Giorgos Vlachos and the 'SOS HALKIDIKI' Anti-Gold Extraction Movement," available at http://toxicbios.eu/#/stories.
45. This interview is in the Toxic Bios archive but has not been published yet online.
46. "My Name Is Concetta," available at http://toxicbios.eu/#/stories.
47. Silvia's autobiography is in the Toxic Bios archive but has not been published yet online.
48. "Miriam Corongiu and Agriculture against the Land of Fires," available at http://toxicbios.eu/#/stories.
49. Jesse D. Peterson elaborates on the more-than-human entanglement of toxic timescapes in his contribution to this volume.
50. Donna Haraway, *When Species Meet* (Minneapolis: University of Minnesota Press, 2008).
51. "António Pinto and Rosa Maria Pratas from ADACE in Aveiro," available at http://toxicbios.eu/#/stories.
52. Linda Nash, *Inescapable Ecologies: A History of Environment, Disease, and Knowledge* (Berkeley: University of California Press, 2006).
53. Donna Haraway, *Staying with the Trouble: Making Kin in the Chthulucene* (Durham, NC: Duke University Press, 2016).
54. "Miriam Corongiu and Agriculture against the Land of Fires," available at http://toxicbios.eu/#/stories.
55. "Angela Rosa, Fighting Oil and Natural Gas Exploration," available at http://toxicbios.eu/#/stories.
56. Alaimo, *Bodily Natures.*
57. "António Pinto and Rosa Maria Pratas from ADACE in Aveiro," available at http://toxicbios.eu/#/stories.
58. "Adriana, Living with a Coal Plant in the City of Brindisi," available at http://toxicbios.eu/#/stories.
59. "Giorgos Vlachos and the 'SOS HALKIDIKI' Anti-Gold Extraction Movement," available at http://toxicbios.eu/#/stories.
60. "Miriam Corongiu and Agriculture against the Land of Fires," available at http://toxicbios.eu/#/stories.
61. Michelle Murphy, *Sick Building Syndrome and the Problem of Uncertainty: Environmental Politics, Technoscience and Women Workers* (Durham, NC: Duke University Press, 2006).
62. Marco Armiero and Salvatore Paolo De Rosa, "Political Effluvia: Smells, Revelations, and the Politicization of Daily Experience in Naples, Italy," in *Methodological Challenges in Nature-Culture and Environmental History Research,*

ed. Jocelyn Thorpe, Stephanie Rutherford, and L. Anders Sandberg (London: Routledge, 2017), 173–86.

63. “My Name Is Concetta,” available at http://toxicbios.eu/#/stories.
64. “Miriam Corongiu and Agriculture against the Land of Fires,” available at http://toxicbios.eu/#/stories.
65. Maurizio Patriciello and Marco Demarco, *Non aspettiamo l’apocalisse: La mia battaglia nella Terra dei Fuochi* (Milan: Rizzoli Editore, 2014), 51–54.
66. D. Sarli, “Da Posillipo a Pianura Solo Andata,” in *Teresa e le altre: Storie di donne nella Terra dei Fuochi,* ed. Marco Armiero (Milano: Jaca Book), 103.
67. “Filipe Veríssimo and the Fight against Glyphosate,” available at http://toxicbios.eu/#/stories.
68. *Blade Runner,* directed by Ridley Scott (USA and Hong Kong: The Ladd Company, 1982), film.
69. Here we refer to the imaginary town of Macondo, created by Gabriel García Márquez in his 1970 novel *One Hundred Years of Solitude.*
70. Laura Pulido, Laura Barraclough, and Wendy Cheng, *A People’s Guide to Los Angeles* (Berkeley: University of California Press, 2012).
71. Pulido, 4.
72. This interview is in the Toxic Bios archive but it has not been yet published online.

CHAPTER 8

Storying Toxic Timescape "Trajectories"

Intersections among Algal Toxins and More-Than-Human Bodies

Jesse D. Peterson

> The free-swimming flagellates of the ocean . . . present us with the paradox, that they can be enormously beneficial to ocean life, as creatures which are half plant, half animal, manufacturing protoplasm as the life-giving substance upon which the myriads of fishes and other sea animals feed; and they can be life-destroyers when, by an excess of breeding, they poison vast numbers of other creatures of the sea.
>
> —Arthur Constance, *The Impenetrable Sea,* 150

When the Baltic Sea warms after winter's frozen grasp, diatoms, dinoflagellates, and cyanobacteria—differing forms of algae—begin to bloom. As Constance notes in the epigraph, as certain algae fructify and spread throughout the sea, they aid primary food production in the seas but can also cause severe consequences for the sea itself, its creatures, and the surrounding lands. As he makes clear, one of the serious threats that algae pose includes the toxins that algae produce. Yet, it is not enough to know that algae produce toxins, but also what kinds, where, and when. Stemming from the impacts of algal toxins on animal bodies, specifically human and domestic livestock, significant efforts have been put in place and many resources have been provided to research and monitor the increase and spread of algal blooms throughout the world. Primarily driven by the desire to safeguard human bodies and other animal bodies that feed humans and provide them with income, these efforts have contributed to an expanded awareness of the intersections between the bodies, times, and places that algal toxins come into contact with and traverse.

Yet, this focus on toxicity from an anthropocentric frame invites us to query what toxicity might look like when other-than-human bodies, times, and places get considered. Hence, prompted by the editors in this volume, this chapter explores these intersections by asking how algal toxins "permeate time and space, producing more-than-human narratives." How might the concept of "timescape" further conceptions and methods related to the study of toxins or toxicants derived from plants or animals responding to environmental changes that are driven by the "geologic" human?[1] In the case of algae, industrial pollution and sewage lead to enriched waters that promote algal growth. This surfeit of algae increases the risk of exposure to algal toxins by other organisms as well as allows for algal bodies to be perceived as toxic vectors, both as producers of and vessels for toxins. That is, pollution can make algal bodies toxic—as in the case of heavy metals and the unknown effects such substances might have on algae and their chemicals—but also establish conditions that are conducive for algae to secrete their own toxins.[2] Literature on algal blooms in the social sciences and humanities has explored certain facets of their ethico-political dimensions and "non-human contributions to agency."[3] This chapter builds on these insights by focusing on how algal toxins might help us think through toxicity using more-than-human narratives.

To look at algal toxins provides an alternative entry point into understanding increasingly toxic spaces around the world, including the seas. Unlike discussions on radioactivity or chemical accumulation, however, algal toxins present a different seasonal and cyclical temporality of toxicity where uncertain recurrence, dynamic flows, and migrating geographies are in play. For instance, in the Baltic Sea, two blooms occur yearly, with usually only the latter blooms being toxic: an early spring bloom consisting mostly of diatoms and a late-summer bloom of cyanobacteria and dinoflagellates, which can extend through the fall. Instead of containment, as in the work of Peter Galison, scientists and politicians engage in monitoring activities to steer algal-human contact.[4] In addition, focusing on algal toxins further illustrates how an "embodied" approach to understanding toxicity can lead to a more-than-human narrative about toxins, questioning and reflecting upon whether toxicity can be extended beyond an anthropocentric understanding of toxicity, toxins, and toxicants.

The dictionary defines a toxin as a poison derived from plants or animals. To try to move beyond anthropocentric toxicity, however, my use of "toxin" in this chapter will be more general, referring to any "impure" substance that may be introduced or absorbed into a *body* (thus "alien") and that contains a potentiality for deforming, critically undermining, or destroying that body. From this definition, there are two kinds of toxins: (1) the theoretical and abstract toxin that could be toxic because it has not yet entered into relation with a recipient body and (2) the physical toxin at work between bodies. My use of the term *body* will also be general. A body is understood to be any spatio-temporal entity with permeable or semipermeable boundaries and which performs working relations and processes that maintain these boundaries over a given length of time. My conception of bodies thus exceeds and extends beyond the organismic, branching into micro and macro scales of bodies, which may include—for the purposes of this chapter—ecosystems and environments, such as the seas. Hence, a toxin not only attacks bodies but is a body itself. In this way, my concept extends Stacy Alaimo's notion of "toxic bodies" beyond the realm of organisms.[5] The study of toxicity using the concept of *toxic timescapes* therefore implies researching toxicity through the relationship between the toxin and other bodies in space and time. To think with toxins as bodies and as being absorbed into bodies provides a map to imagine and story the "trajectories" and intersections of these bodies in time and space. In other words, detailing the trajectory of toxic bodies and where they come into contact implies tracing "the process of change in a phenomenon."[6] Moreover, it articulates some ways in which "toxic embodiment" can be concerned with human and nonhuman bodies that produce toxins and are not just permeated by them.[7] It shows that toxins can be understood only in spatio-temporal relations among multiple bodies.

The aim of this chapter, then, is to produce a more-than-human narrative about algal toxins through a conceptual lens of the body and intersecting it with the timescape concept introduced in this book: to complicate the simplistic appellation for identifying and classifying algae as "toxic" by looking at the relationships between algal toxins and more-than-human bodies. In other words, I attempt to point out the intersections of times, spaces, and bodies of humans and nonhumans with algal toxins and how they might become stressed or transformed by algal toxins, relying upon the representation of algae and their toxins in scientific papers and other supporting materials. To do so, I structure the chapter through an interrogation of algal toxins upon the algal body, animal body, and water body. Each of these sections explores the timings and spatial relationships that establish or destabilize algal "toxins" and contribute to making algal blooms toxic phenomena. A final section explores how an anthropocentric notion of toxicity may be reconsidered by exploring the contexts of nonhuman bodies and algal toxins, which provides opportunities for developing new ways of thinking about, researching, and storying toxicity. Thus, this chapter attempts to articulate and put into relation the general timescapes of algal toxins with different bodies and then reflect upon how this endeavor helps develop a more-than-human narrative by suggesting alternative approaches for studying or contextualizing algal toxicity as well as ecologizing the human and ethicizing the nonhuman.[8]

Algal Body: Toxic Tricksters

In order to begin to describe the timescape of toxic algae, one must begin with understanding the bodies, times, and places of algae themselves and their relationship to these toxins. Concerns usually focus on the effects these toxins have upon other bodies, including their effects upon bodily organs, digestion, and nervous systems. Yet, upon consideration, it becomes obvious that algal toxins are not toxic to the specific algae that produce them. The "toxins" that algae species produce do not harm themselves. For some—especially those species of algae that produce toxins—toxins may be assets, serving algal interests or even their survival. According to Aleicia Holland and Susan Kinnear, algal toxins function as forms of defense against grazers—such as small fish and crustaceans—and other algal competitors. They also benefit algae by helping them maintain homeostasis, generating energy more productively through photosynthesis, or by aiding cellular growth.[9] If these toxins benefit algae, it may be possible that certain toxins could enhance or assist other marine species. These observations point out that toxins may or may not invite us to consider their harmful effects or redress them, depending upon the types of bodies they encounter. Moreover, it also makes clear that not all bodies are "vulnerable bodies" when it comes to toxins. Finally, the algal body invites us to consider that toxicity must be understood within a relational web or matrix of multiple bodies. Algal toxins mean very little in the seas when not released en masse from thousands of individual alga. In other words, toxicity can only be described as an embodied spatio-temporal matrix of more than one agent and more than one body. Toxins can only be described as "toxic" in the specific effects these substances might have upon or within a multitude of bodies whose trajectories cross and come into contact.

Because (algal) bodies are not static, they can also confound or refuse to disclose the relationship between them and their toxins to humans in certain times and places. In the words of Astrid Schrader, they present "ontological indeterminacy."[10] Though algae contain toxins or secrete them, the two might not always come together neatly. For example, some species of algae can be extremely difficult to differentiate. At least five dinoflagellates in the *Alexandrium* genus are morphologically indistinct.[11] Some of these algae are not toxic; some are toxic but have levels of toxicity that will not immediately harm humans and thus are considered nontoxic; and some are highly toxic.[12] During the 1990s in France and the US, two events illustrate how toxins can be difficult to connect to a particular algal body. In the French case, an outbreak of algal growth along the Atlantic coast in Pertuis Breton contributed to the closure of beaches for upward of a month, yet no "toxic" algae or algal toxin could be identified. The toxin itself was unstable and researchers could not figure out its molecular structure (HAN 5, p. 1; HAN 4, p. 3).[13] In the US, in a widely reported incident, the algae *Pfisteria piscicida,* or fish-killer algae, was maligned for causing the death of millions of fish. Nevertheless, several years afterward, it was determined that it may not have been the alga that played a part in the death of these fish but rather amoeba which, at the time, were thought to be part of this alga's life cycle.[14] Since the life cycle of dinoflagellates and cyanobacteria can be complex, this complexity makes it difficult to adequately know if algae are toxic and where or when toxic algae may appear. Such dynamism in algal life cycles points to the tension inherent in attempting to predict algal blooms' toxins where blooms may consist of multiple species at different stages in their life cycles. For example, "forecasting" algal blooms requires finding a "sweet spot" between simplistic and complex representations of algal life in order to make adequate predictions as well as meet current computational and technological capacities to model them.[15] In other words, adequate predictions of algal blooms require the generalization of algal bloom life cycles, which cannot account for the lived realities of algal bodies and which might not be able to account for potential anomalies as a result of this generalization.

In addition, the very bodies of algae combined with their responses to environmental conditions further complexify one's ability to label them as toxic. Not only do toxins emanate at certain stages in the life cycle of algae, these life cycles do not always proceed linearly or "in time." That is, as bodies might be more vulnerable to toxins at one time or another in their life cycle—as May-Brith Ohman Nielsen similarly argues in her chapter on generation models and toxicity in this volume—algae *also produce* toxins during certain times of their life cycles that also must coincide with certain ecological conditions. A typical life cycle for cyanobacteria includes germination, two stages of growth, and then dormancy.[16] However, since algal life cycles are not unidirectional, algae may go dormant or "revert" back to a previous life cycle stage, pointing to irregular and complex rhythms for the release of algal toxins.[17] Because algae can survive extreme colds and desiccation, some algae can even reemerge from ancient times into the present.[18] Often, algae produce toxins only in the warmest months of the year, and several factors must be just right in order for toxins to be emitted. Toxins do not just depend upon the states of the bodies producing them or being poisoned by them but also upon environmental contexts in which the bodies exist.

Additionally, algal bodies may also respond and possibly adapt to other environmental pressures in relatively short time periods. In regards to chemicals/toxins put into water by human activities, some cyanobacteria may be affected by antibiotics polluting their habitat and begin to develop antimicrobial resistance, while others have demonstrated the ability to mutate in the presence of algaecides such as copper sulfate.[19] In addition, the next algal bloom lurking around the corner does not necessarily fit a predictable, linear, and static model but rather a dynamic temporal evolutionary dimension: "The virulence of [harmful algal blooms] is likely to be exalted as humanity's demands on coastal zones intensify, and species which at present are harmless may in the future cause problems."[20] For instance, the increase in potential damage from sargassum in Martinique as a vector for chlordecone, as Malcolm Ferdinand presents in the volume, highlights this last point. Hence, the timescape of an algal bloom inhabits a present stretching into the future where the link between humans and algae shapes one another, possibly pushing one or the other species to become "harmful" to each other as well as other innocent bystanders. The dynamism of algal bodies over time responding to environmental pressures presents serious hurdles in addressing algal toxins.

Not only do algal bodies change over time in response to internal and external stimuli, but the temporality of the toxins they emit is both affected by human industry that creates condition for their increase in frequency and duration as well as scientific understandings of algae as harmful beings. According to Bruno Latour, history gets rewritten, or "retrofitted," as different systems of knowledge provide different interpretations of historical events.[21] In other words, algal blooms became "harmful" only after the fact. They were not poisonous in times past because they and their toxins did not exist for hundreds of years. As Michael Egan demonstrates, Swedish scientists discovered mercury poisoning by actually looking for it; the same could be said about algal toxins.[22] Before the discovery of algae, various other agents potentially caused harm. Where water was concerned, miasma (vapors) or the water itself was often associated with illness. It was not until the late nineteenth century, when *Nodularia spumigena* was identified as a toxic organism, that algae began to be associated with toxicity.[23] By rewriting algal toxicity into the past, algal toxins began to be ubiquitous in space and time.[24] But, in addition, these toxins have become ubiquitous in the bodies of algae as well. That is, algae appear not only as if they have always produced toxins but as if their bodies have always been toxic.

Thus, to speak of an algal body as containing toxins or emitting toxins illustrates the multifaceted character of toxic beings and substances. Bodies and toxins share spatio-temporal dimensions in which the effects of these toxins are variable. Bringing a nonhuman toxin producer into the limelight highlights the need for understanding the range of actors who benefit from toxic release. This is not to justify the production of toxic substances but to more clearly understand the full range of effects (and possibly motivations for producing the toxins) these toxins might have on other creatures and locales. Such investigations would not necessarily be without risk to exposed communities, however. For example, if algal toxins could be identified to assist certain creatures in the aquatic ecosystem, certain groups may use ecological appeals as rationales to not remediate the pollution that promotes algal growth. That is, if excess nutrients flowing into the sea improve algal or some other plant or animal's "well-being" in disproportion to the harms algal toxins cause, one could argue for a greater need to continue polluting substances that benefit algal growth.[25] Hence, to side with algae could be a radical statement that could bridge the line between beneficial or detrimental, with a potential to dovetail environmental philosophies like deep ecology with status quo procedures and politics. The case of algae puts into high relief the point that all toxic bodies are simultaneously threatening, subversive, and troubled.

Animal Body: Toxic Makers

Thinking with animal bodies illustrates the situated aspects of toxic epistemology. Vulnerable animal bodies are those that "make" toxins. They do so by serving as vessels, vectors, and test subjects. When the times and spaces (e.g., bodily rhythms and processes) of an animal body alter as a result of algal toxins, the body can be deduced to be a vulnerable or susceptible body, which leads to it becoming an affected, poisoned, or toxified body. Identifying toxins thus requires knowledge of a general and ideal form of animal body that can then be poisoned, contaminated, or put to death. Paying attention to what is toxic therefore implies caring for some animal bodies but not others. Put another way, algal toxins become toxins by impacting the (particular) space and time of those bodies *that humans monitor and care for.* An algae's toxic body does not matter until humans know about it and when what they care for gets affected by it. Hence, the poisoned bodies' value to humans directly affects the resources expended to monitor and control toxicity. This sort of attention produces certain meanings and benefits valued by people. In regards to algal toxins, there are roughly seventeen different kinds. Some harm humans, some harm fish, and others have no known effects (HAN 59, p. 15).[26] As of 2015, "over 100 . . . products of cyanobacteria are recognised which are toxic to animals, including humans, and to plants."[27] Thus, there is a wide range of bodies that may or may not be assisted or harmed by such chemicals.

In the case of animal bodies, algal toxins may affect other animals' life cycles or may accumulate in their tissues to affect other bodies later on in different places. Algal blooms have been recorded to have affected cultivated and wild semiaquatic and aquatic animals such as trout, salmon, anchovies, oysters, mussels, soft shell clams, shrimp, scallops, lobsters, Dungeness crabs, manatees, corals, milleporonids, gorgonians, penguins, marine birds, and more. They have affected copepod feeding behavior and larval fish recruitment (HAN 3, p. 4).[28] The pathogen *Phromidium corallyticum* causes black band disease on corals. Algal toxins also can intoxicate fish and their larvae. In 1947, a red tide killed "over fifty million fishes, large numbers of which were washed up on the shores in such states of decomposition that they stank disgustingly."[29] Domoic acid has been suggested as a particularly dangerous neurotoxin for sea lions.[30] In addition, when algae and their toxins accrue in the bodies of creatures, they can begin to stockpile in larger amounts through bioaccumulation by moving from body to body as organisms feed on one another. For instance, some species of algae may clog up the gills of fish, suffocating them. Others get caught by filter feeders, like blue mussels and clams, that strain algae out of the water. Certain blooms cause the "blackberry feed" problem, which makes fish largely inedible by making their flesh smell of sulfur (HAN 4, p. 4).[31] In terms of accumulation, one must therefore consider such bodies as toxic carriers or hosts in which the toxin may be activated when it comes into contact with another body.

Algal toxins also escape marine bodies. Swedish officials, for example, point to farm animals and dogs as those most likely to be affected, for they may drink algae-infused water and get sick or die. Humans have also contributed to moving algae about on land. They have used terrestrial animals as an integral part of the process to empirically demonstrate that algae are toxic. In 1878, George Francis "proved" that algae were toxic by administering a wine bottle of "scum" to a sheep who died later that same night.[32] Since then, bioassays predominantly have been the leading method to detect toxins in algae. As of the year 2000, Francis's methods were still deemed "as a necessary part of modern research into cause-and-effect in toxicology," meaning that millions of animals have been put to death globally, primarily, to protect humans from eating toxic algae inside shellfish.[33] Animals that would likely never die as a result of algal toxins get sacrificed in order to save people.[34]

Susceptible to algal bloom toxins, the human animal also experiences a wide range of symptoms. The earliest known record of paralytic shellfish poisoning comes from George Vancouver's account of navigating the Pacific coastlines of North America.[35] Even though algal toxins are not often fatal to humans, many toxic effects are socially, medically, and economically significant, such as paralytic, diarrhetic, and amnesic shellfish poisonings and ciguatera and ichthyotoxin fish poisonings.[36] These toxins have varied effects, functioning as neurotoxins, hepatotoxins, or dermatoxins. For humans to be poisoned, usually the toxins have to enter their digestive tract, but they can also be inhaled. Amnesic shellfish poisoning messes with a person's memory, altering their perceived pasts, while diarrhetic shellfish poisoning speeds up a human body's excremental time. Poisonings happen worldwide, but it is likely that those without properly equipped medical facilities suffer worse.[37] Algal toxins represent threats when emitted from algal blooms but also when chemically synthesized. One of the neurotoxins, saxitoxin, for example, was synthesized and stockpiled by the US military and CIA.[38] At the same time, domoic acid (and kainic acid) has also been suggested to be "well-suited for killing" intestinal parasites within human digestive tracts,[39] highlighting that differing levels of doses of certain toxins are not just innocuous or poisonous but possibly beneficial in certain times or places within a body.

In many respects, the temporality of algal toxins places them between the categories of slow violence and disaster.[40] Certain social times—such as the Swedish exodus during the summer months to the coast for swimming and sailing—run into direct conflict with toxic algal blooms. In response, municipalities clean seaweed off beaches, and water enthusiasts avoid algae as best they can.[41] In addition, many summer homes rely upon groundwater reserves for their water uses; however, due to groundwater shortages and the size of some islands, water can also be drawn from the sea. If algal toxins are present, this poses a risk—not only because toxins may remain in the water long after the algal bloom has disappeared but also because no one knows what harms small doses of algal toxins may do to a person over a long period of time. Thus, algal toxins also may permeate an animal body's time through microexposure. Perhaps as a result of this conflict, certain researchers have suggested controlling the times of the blooms by dumping higher levels of nitrogen fertilizer into the sea in order to spur the growth of the diatomic spring bloom, which hopefully would curtail the growth of the more toxic late-summer blooms.[42] As regards disaster, algal toxins often appear suddenly as if out of nowhere, inflicting serious harms. Recent fish losses off the coasts of southern Chile, contaminated water in Florida (USA) and, most recently, several publicized dog deaths in New York (USA) point to the catastrophic aspects of algal blooms that make them newsworthy.

Water Body: Toxic Neighbors

Algal toxins do not just affect themselves and other plants or animals; they also alter the seas both physically and culturally. When algae secrete their toxins, the toxins may persist in the water column even after a bloom has disappeared. In such a way, algal toxins may modify localized marine conditions. For instance, rheologists have found that algal toxins affect wave caps.[43] Toxins can also affect the taste of water.[44] Nevertheless, the entire consequences of these effects are little understood. More dramatically perhaps, though algal toxins physically affect the water, the primary concerns about toxins arise out of the conflation of bloom with toxin. In other words, algal bodies come to represent or signal toxified water rather than the toxins themselves (see figure 8.1). The toxin and the algae collapse into a hybrid: toxic algae or algal bloom. Hence, concerns about algal toxins are directly linked to the presence of algal blooms, which literally embody the toxic potential of the water. As a result, the seas are tested and monitored for algal blooms, which further upholds the construction of the algal body as a toxic body. In such a way, algal bodies therefore hide the industrial origins—primarily, industrial agriculture and human sewage—of those pollutants that spur their growth.

Research and monitoring have resulted in making society aware of the increase in both space and time of algal blooms. Algal blooms have spread throughout the world's seas and oceans and gotten bigger.[45] As algal blooms enlarge and occupy more space in the seas, their toxins also reach wider distribution, not only in part because the toxins may travel in the water body away from their point of origin.[46] This wider distribution means that algae carry a greater potential to intersect with other lives and livelihoods. In addition, because algal toxins have a wider geographical

FIGURE 8.1. As the lead image on the "Neurotoxin" Wikipedia page, the "scum" on the bottom of the rock and on the surface of the water depict the algae as the equivalent of a toxin. Photograph by Mary Cousins, accessed May 2022, https://commons.wikimedia.org/w/index.php?curid=4091641

reach, algal toxins have a greater capacity to accumulate. Basically, as algae continue to grow and spread, there exists a potential for higher concentrations of algal toxins in the seas. Thus, these toxins permeate space not only in terms of spread and distance but in terms of density.

Over the last several decades, monitoring has shown that algal blooms have increased not just in size and distribution but also in frequency and duration.[47] Algal toxins permeate time through monitoring efforts that attempt to say where they are by saying where they have been. Yet, to overcome this time lag, monitoring efforts seek to improve tools and methods as well as harness social media to "take place" in "real" time in order to analyze data and produce forecasts on the algae situation.[48] It is likely, as Schrader argues, that these efforts conceive time as a "directed (value-laden) sequence" and as "simultaneously atemporal . . . and permanently deferred toward a [teleological] future." That is, technologies and data hide time's passing, naturalizing time as a "static background" by passing over the latencies and disruptions that occur in the processes of producing a “real” or instantaneous time. For Schrader, attempts to monitor algal blooms through this lens serve the values and interests of human economies.[49] Monitoring systems are not set up to prevent toxic blooms but to mitigate their economic impacts, which further points out industry’s unwillingness as well as its (along with the government’s) incapability to track its own (by)products.[50] In this view, these monitoring practices favor technological networks that fabricate immediacy over social and communal awareness about the seas gleaned through, for instance, Thom Davies’s notion of “slow observation.” In addition, Schrader’s critique is somewhat different from others made by those who have argued that Western culture has made *natural* time a static background.[51] Nevertheless, both critiques make speed central to their argument. By conceptualizing the passing of time as too slow or too fast, time becomes indiscernible for a human being and time disappears—objects and environments appear to be unaffected by time’s passing. This industrial speedy time also erases “the other,” as Barbara Adam points out.[52] The speed at which monitoring takes place interrupts one’s understanding of algae and their toxin’s temporalities. Thus, algae blooms harbor a type of toxic timescape when their bevy of interconnected temporalities gets negated through exhaustive monitoring practices. In fact, this suppression of an algal bloom’s temporality further promotes their construction as a societal and environmental risk, especially as “some algal blooms may be contingent on historical events, hence not predictable from even the most profound knowledge of ecological laws.”[53] In the words of Latour, monitoring practices and technologies function as inscription devices that make these toxic timescapes beholden to clock-time and therefore more easily perceived as manageable or controllable.[54]

As Linda Nash points out, in the 1900s, bacteriology helped determine for developed Western societies what needed to get eliminated, particularly a broad category of discrete pathogens—such as bacteria, germs, viruses, insects, feces, dirt and unhygienic practices. Focusing on pathogens allowed for the environment to be “intrinsically healthful” and a healthy body to be a “pure body,” which then allowed governments to institutionalize “the assumption of environmental purity.”[55] Unfortunately, operating with an embedded sense of environmental purity only makes monitoring efforts “continuous with that which they criticize” or, in other words, complicit with perpetuating discourse on “good” or “bad” ways for eliminating the harm.[56] The harm, in this case, is not that algae are toxic; neither is the harm primarily about what spurs algae growth. For instance, the Sweden's National Veterinary Institute's main web page on algal toxins does not mention industrial fertilizer as a primary source for cultural eutrophication at the same time it de-emphasizes the importance of excess nutrients. Instead, it says that *in some cases,* when there are excess nutrients, blooms can become toxic but that this is primarily a result of optimal ecological conditions. Moreover, it emphasizes that excess algae are a sign of ecological "imbalance" rather than a socio-natural phenomenon spurred by the agro-industrial complex, sewage effluent, oil and gas leaks, and more. In sum, the relationship between algal blooms and monitoring efforts tells a story of contamination fears that surface in the forms of toxic temporality, toxic risk, and toxic disgust that algal blooms evoke.

Storying Toxic Timescape Trajectories

The intersections of algae, animals, and water have the capacity to alter and warp each other's bodies, times, and spaces. The connections between human-induced pollution, algae, and their interactions with others imply a more-than-human narrative that hopefully depicts toxins as a contested sign that depends upon a whole host of factors and may carry significant consequences. They point to the increasing relevance and importance for understanding toxicity as a more-than-human affair, a key point this chapter has sought to raise. As articulated in the introduction to this chapter, what makes a substance toxic includes dose, timing, velocity, frequency of exposure, place where exposed, societal position, substance exposed to, body types and ages, toxin types and ages, and length of exposure. In the case of algal toxins, all these factors apply. More specifically, it highlights the importance of what or who produces toxins and where and when they might appear. Significantly, it also points to the dynamic ability of nonhumans to also create toxic environments at a global scale. By taking advantage of human-caused pollution, algae produce poisons. Rather than just making environments toxic, pollution creates conditions for environments to become potentially more toxic than they were before. Because toxins are also "contingent on . . . the timing of exposure and effect," the interrelationships between algal blooms and their environment also serve as a clear reminder that water bodies (and, by extension, caves or deserts) are not stable and fixed, but that they are dynamic and interact with myriad nonhuman vitalities.[57] This conclusion signals to us that the effects of pollution and toxic dumping into the environment are also contingent upon when the dumping occurs, how it gets processed or metabolized by natural phenomena, and what temporality in the landscape one is dealing with—in other words, in which bodies do toxins pass and what they do to each other. In this sense, toxicity "occurs" as a result of socioecological relationships among more-than-human bodies in which material effects occur and which effects must then be sensed and interpreted by humans as toxic.

Moreover, increased interest, awareness, and monitoring efforts contribute to the making of toxic times, places, and beings (individually or communally) as much as evolutionary or adaptive strategies undertaken by algae. In other words, algae have become toxic and continue to become more toxic through an increase in knowledge and awareness about them combined with the reification of the algal body as equivalent to its algal toxins. Inasmuch as we know, algal blooms are not intrinsically more harmful than they were millions, even billions, of years ago. However, we do not fully understand what consequences their toxins, the pollutions they absorb, or the other chemicals and poisons in the sea they might interact with will have. In such a way, algal blooms and their toxins begin to articulate a more-than-human narrative about toxic bodies and toxic environments.

Through a consideration of algal toxins, this chapter has essayed to initiate a more-than-human narrative about algal toxins by exploring their "timescape" through a "body" concept that looks at human and other-than-human bodies and their interactions. Doing so aligns with Ilenia Iengo and Marco Armiero's project for creating autonomous spaces for subverting toxic narratives in this volume. For scholars in humanities-based research fields, a more-than-human narrative requires a decentering of the human as main figure in the story, in part, to resolve any potential silences and injustices at work when humans label certain nonhuman bodies and substances toxic. The simple story that algae are toxic and must be monitored forecloses significant interrelationships between humans, algae, other animals, environments, and ecological processes that all contribute to making these differing bodies (more or less) toxic in different times and places. Decentering the human, nevertheless, does not mean that it must be relegated to the sidelines or background for the entire story. It does mean, however, that other bodies' intersections with human bodies—including their nonhuman or posthuman aspect—ought to factor into the story as contributing elements. This means that the more-than-human elements can be treated as entry points to data that may have been there all along but were not deemed important or just have been unobservable. Part of including these elements into one's research implies the researcher remains aware of and reflects upon their times and spaces as well as those of the more-than-human. Doing so could provide a more symbiotic perspective regarding toxic substances, and in the case with algae, one that considers the human species "ongoing mixed natural-cultural-social history with bacteria . . . [that] extends back to [the last universal common ancestor]."[58] Rather than representing a new perilous future of contamination, algal blooms embody a deep history that can be brought to bear upon present issues. To get at this (hi)story, one could interview the algae or understand the ways that algae and their toxins story places.[59] One might describe social interactions among humans and nonhumans through "critical description."[60] These methods invite scholars to make use of the ways in which algal toxins inscribe themselves onto bodies like Sumerian scribes who wrote on tablets of clay. Such work obviously entails relying upon natural scientists' work, meaning that scholars in the humanities would need to develop wider literacy by reading outside their fields or by collaborating with other researchers. Many have been making this call within the environmental humanities; indeed, it has been the primary method by which this chapter has been written.[61] Such can serve as a correlative to the natural sciences understanding of toxicity by helping historicize and contextualize toxins in a relational frame. It may also assist others to take a position on or address toxic substances, especially those who have been or remain to be constructed as vulnerable or toxified bodies.

Notes

1. Dipesh Chakrabarty, "The Climate of History: Four Theses," *Critical Inquiry* 35, no. 2 (2009): 197–222.
2. K. K. I. U. Arunakumara and Xuecheng Zhang, "Heavy Metal Bioaccumulation and Toxicity with Special Reference to Microalgae," *Journal of Ocean University of China* 7, no. 1 (2008): 60–64, https://doi.org/10.1007/s11802-008-0060-y.

3. Michael Paolisso and Erve Chambers, "Culture, Politics, and Toxic Dinoflagellate Blooms: The Anthropology of Pfiesteria," *Human Organization* 60, no. 1 (2001): 1–12; Astrid Schrader, "Responding to *Pfiesteria piscicida* (the Fish Killer): Phantomatic Ontologies, Indeterminacy, and Responsibility in Toxic Microbiology," *Social Studies of Science* 40, no. 2 (2010): 275–306, https://doi.org/10.1177/0306312709344902; Astrid Schrader, "The Time of Slime: Anthropocentrism in Harmful Algal Research," *Environmental Philosophy* 9, no. 1 (2012): 71–93, https://doi.org/10.5840/envirophil2012915; Claire Waterton and Judith Tsouvalis, "On the Political Nature of Cyanobacteria: Intra-Active Collective Politics in Loweswater, the English Lake District," *Environment and Planning D: Society and Space* 33, no. 3 (2015): 477–93, https://doi.org/10.1177/0263775815594305; Claire Waterton, "Indeterminacy and More-Than-Human Bodies: Sites of Experiment for Doing Politics Differently," *Body and Society* 23, no. 3 (2017): 102–29, https://doi.org/10.1177/1357034X17716522.
4. *Containment,* directed by Peter Galison and Robb Moss, produced by Redacted Pictures, 2015, http://www.imdb.com/title/tt4503606/.
5. Stacy Alaimo, *Bodily Natures: Science, Environment, and the Material Self* (Bloomington: Indiana University Press, 2010), 17–22.
6. Doreen B. Massey, *Power-Geometries and the Politics of Space-Time: Hettner-Lecture 1998* (Dept. of Geography, University of Heidelberg, 1999); Doreen B. Massey, *For Space* (London: Sage, 2005), 12.
7. Olga Cielemęcka and Cecilia Åsberg, "Introduction: Toxic Embodiment and Feminist Environmental Humanities," *Environmental Humanities* 11, no. 1 (2019): 101–7, https://doi.org/10.1215/22011919-7349433.
8. Katherine Gibson, Deborah Bird Rose, and Ruth Fincher, eds., *Manifesto for Living in the Anthropocene* (Goleta, CA: Punctum Books, 2015).
9. Aleicia Holland and Susan Kinnear, "Interpreting the Possible Ecological Role(s) of Cyanotoxins: Compounds for Competitive Advantage and/or Physiological Aide?," *Marine Drugs* 11, no. 7 (2013): 2239–58, https://doi.org/10.3390/md11072239.
10. Schrader, "Responding to *Pfiesteria Piscicida* (the Fish Killer)."
11. Kathy Willis and Jennifer McElwain, *The Evolution of Plants* (Oxford: Oxford University Press, 2014), 16. Not only algae but many plants are morphologically difficult to differentiate, including in fossil remains, which has led to "chemosystematics," or the identification of chemicals released from plants to distinguish them from one another.
12. G. M. Hallegraeff et al., *Manual on Harmful Marine Microalgae,* 2nd rev. ed. (UNESCO, 2004), https://www.oceanbestpractices.net/handle/11329/282.
13. ISSHA, "Harmful Algae News: An IOC Newsletter on Toxic Algae and Algal Blooms," 1992, https://issha.org/publications-resources/harmful-algae-news/.

14. Michael T. Peglar et al., "Identification of Amoebae Implicated in the Life Cycle of *Pfiesteria* and *Pfiestena*-Like Dinoflagellates," *Journal of Eukaryotic Microbiology* 51, no. 5 (2004): 542–52, https://doi.org/10.1111/j.1550-7408.2004.tb00290.x.
15. Inga Hense and Aike Beckmann, "The Representation of Cyanobacteria Life Cycle Processes in Aquatic Ecosystem Models," *Ecological Modelling* 221, no. 19 (2010): 2330–38, https://doi.org/10.1016/j.ecolmodel.2010.06.014.
16. Inga Hense and Aike Beckmann, "Towards a Model of Cyanobacteria Life Cycle—Effects of Growing and Resting Stages on Bloom Formation of N2-Fixing Species," *Ecological Modelling* 195, no. 3 (2006): 205–18, https://doi.org/10.1016/j.ecolmodel.2005.11.018; Hense and Beckmann, "The Representation of Cyanobacteria Life Cycle Processes in Aquatic Ecosystem Models."
17. D. M. Anderson and Karin Rengefors, "Community Assembly and Seasonal Succession of Marine Dinoflagellates in a Temperate Estuary: The Importance of Life Cycle Events," *Limnology and Oceanography* 51, no. 2 (2006): 860–73, https://doi.org/10.4319/lo.2006.51.2.0860; Anke Kremp, Timo Tamminen, and Kristian Spilling, "Dinoflagellate Bloom Formation in Natural Assemblages with Diatoms: Nutrient Competition and Growth Strategies in Baltic Spring Phytoplankton," *Aquatic Microbial Ecology* 50 (2008): 181–96, https://doi.org/10.3354/ame01163.
18. Otakar Strunecký, Josef Elster, and Jiří Komárek, "Molecular Clock Evidence for Survival of Antarctic Cyanobacteria (*Oscillatoriales, Phormidium autumnale*) from Paleozoic Times," *FEMS Microbiology Ecology* 82, no. 2 (2012): 482–90, https://doi.org/10.1111/j.1574-6941.2012.01426.x.
19. Gareth Le Page et al., "Integrating Human and Environmental Health in Antibiotic Risk Assessment: A Critical Analysis of Protection Goals, Species Sensitivity and Antimicrobial Resistance," *Environment International* 109 (2017): 155–69, https://doi.org/10.1016/j.envint.2017.09.013; Libertad García-Villada et al., "Occurrence of Copper Resistant Mutants in the Toxic Cyanobacteria *Microcystis aeruginosa:* Characterisation and Future Implications in the Use of Copper Sulphate as Algaecide," *Water Research* 38, no. 8 (2004): 2207–13, https://doi.org/10.1016/j.watres.2004.01.036.
20. ISSHA, "Harmful Algae News," 5.
21. Bruno Latour, "On the Partial Existence of Existing and Non-Existing Objects," in *Biographies of Scientific Objects,* ed. Lorraine Daston (Chicago: University of Chicago Press, 2000), 247–69; Bruno Latour, *Pandora's Hope: Essays on the Reality of Science Studies* (Cambridge, MA: Harvard University Press, 1999).
22. Michael Egan, "Toxic Knowledge: A Mercurial Fugue in Three Parts," Toxic Bodies/Toxic Environments: An Interdisciplinary Forum, ed. Jody

A. Roberts and Nancy Langston, *Environmental History* 13, no. 4 (2008): 629–703, https://doi.org/10.1093/envhis/13.4.629.

23. Anonymous, "The Water in Lake Alexandrina," *South Australian Advertiser,* February 27, 1878; Anonymous, "Two Letters from a Gentleman in the Country, Relating to Mr. Leuwenhoeck's Letter in Transaction," *Philosophical Transactions of the Royal Society of London* 23, no. 288 (1703).
24. Latour, *Pandora's Hope,* 173.
25. Jesse D. Peterson, "Are Dead Zones Dead? Environmental Collapse in Popular Media about Eutrophication in Sea-Based Systems," in *Discourses of Environmental Collapse: Imagining the End,* ed. Alison E. Vogelaar, Brack W. Hale, and Alexandra Peat (London: Routledge, 2018), 32–47.
26. ISSHA, "Harmful Algae News."
27. Geoffrey A. Codd, Hayley Morton, and Peter D. Baker, "George Francis: A Pioneer in the Investigation of the Quality of South Australia's Drinking Water Sources (1878–1883)," *Transactions of the Royal Society of South Australia* 139, no. 2 (2015): 164–70, https://doi.org/10.1080/03721426.2015.1057093.
28. ISSHA, "Harmful Algae News."
29. Arthur Constance, *The Impenetrable Sea* (Charleston, SC: Nabu, 2011), 150.
30. Kenneth R. Weiss, "Sentinels under Attack," *Los Angeles Times,* July 31, 2006, https://www.latimes.com/archives/la-xpm-2006-jul-31-me-ocean31-story.html.
31. ISSHA, "Harmful Algae News." The sulfur smell is likely caused by dimethylsulfide.
32. Anonymous, "The Water in Lake Alexandrina."
33. Codd, Morton, and Baker, "George Francis"; Phillip L. Williams, Robert C. James, and Stephen M. Roberts, eds., *Principles of Toxicology: Environmental and Industrial Applications,* 3rd ed. (Hoboken, NJ: Wiley, 2014). In order to test that shellfish will be safe for human consumption, scientists blend the shellfish into an extract and then inject this extract into mice.
34. Donna Haraway, *When Species Meet,* Posthumanities 3 (Minneapolis: University of Minnesota Press, 2008).
35. D. B. Quayle, *Paralytic Shellfish Poisoning: Safe Shellfish* (Nanaimo, BC: Fisheries Research Board of Canada, 1966).
36. Bruce W. Halstead and E. J. Schantz, *Paralytic Shellfish Poisoning,* WHO Offset Publication, no. 79 (Geneva: World Health Organization, 1984), 7.
37. Pierina Visciano et al., "Marine Biotoxins: Occurrence, Toxicity, Regulatory Limits and Reference Methods," *Frontiers in Microbiology* 7 (2016): 1051, https://doi.org/10.3389/fmicb.2016.01051.
38. *Unauthorized Storage of Toxic Agents, Select Committee to Study Governmental Operations with Respect to Intelligence Activities,* 94th Cong. (1975) (statements of William E. Colby, Sayre Stevens, and Mitchell Rogovin), https://www.aarclibrary.org/publib/church/reports/vol1/html/ChurchV1_0001b.htm.

39. Ole G. Mouritsen, *Seaweeds: Edible, Available, and Sustainable,* trans. Mariela Johansen (Chicago: University of Chicago Press, 2013), 220.
40. Rob Nixon, *Slow Violence and the Environmentalism of the Poor* (Cambridge, MA: Harvard University Press, 2011); Marten Scheffer et al., "Catastrophic Shifts in Ecosystems," *Nature* 413, no. 6856 (2001): 591.
41. Jonas Nilsson, personal interview, June 19, 2019.
42. Anders Stigebrandt and Bo G. Gustafsson, "Improvement of Baltic Proper Water Quality Using Large-Scale Ecological Engineering," *Ambio* 36, no. 2/3 (2007): https://doi.org/10.1579/0044–7447(2007)36[280:iobpwq]2.0.co;2.
43. ISSHA, "Harmful Algae News."
44. George Izaguirre et al., "Geosmin and 2-Methylisoborneol from Cyanobacteria in Three Water Supply Systems," *Applied and Environmental Microbiology* 43, no. 3 (1982): 708.
45. C. S. Reynolds, "Cyanobacterial Water-Blooms," in *Advances in Botanical Research,* vol. 13, ed. J. A. Callow (Cambridge, MA: Academic Press, 1987), 67–143; Brian A. Whitton and Malcolm Potts, eds., *The Ecology of Cyanobacteria: Their Diversity in Time and Space* (New York: Kluwer Academic Publishers, 2002). The main causes for these increases come from industrial agriculture and husbandry along with human sewage. Recent reports indicate that algal blooms may continue to proliferate under changing conditions induced by climate change; on this, see Hans W. Paerl and Jef Huisman, "Climate Change: A Catalyst for Global Expansion of Harmful Cyanobacterial Blooms," *Environmental Microbiology Reports* 1, no. 1 (2009): 27–37.
46. ISSHA, "Harmful Algae News," 7. Causes for algal growth can be complex and speculative, from the presence of wintering fishes to the admixture of new nutrients from deep water, among other possibilities.
47. Rudolph S. S. Wu, "Eutrophication, Water Borne Pathogens and Xenobiotic Compounds: Environmental Risks and Challenges," *Marine Pollution Bulletin* 39, no. 1 (1999): 11–22, https://doi.org/10.1016/S0025-326X(99)00014-4; Robert J. Diaz and Rutger Rosenberg, "Spreading Dead Zones and Consequences for Marine Ecosystems," *Science* 321, no. 5891 (2008): 926–29, https://doi.org/10.1126/science.1156401.
48. The monitoring, modeling, and forecasting network is staggering, and is supported by sea level gauges, HF Radar, an Imaging FlowCytoBot, FerryBox systems, oceanographic buoys, drones, science vessels, monthly cruises (such as the ship *TransPaper*), SeaTrackWeb, and satellites as well as other remote sensing technologies.
49. Schrader, "The Time of Slime," 80, 86–87; Stephen Kern, *The Culture of Time and Space, 1880–1918: With a New Preface* (Cambridge, MA: Harvard University Press, 2003); David Harvey, "Time-Space Compression and the Postmodern Condition," *Modernity: Critical Concepts* 4 (1999): 98–118.

50. Schrader, "The Time of Slime," 85–86; Barbara Adam, *Timescapes of Modernity: The Environment and Invisible Hazards* (London: Routledge, 1998), 10.
51. Bill McKibben, "Worried? Us?," *Granta Magazine,* May 12, 2010, 7–12, https://granta.com/worried-us/.
52. Barbara Adam, "Re-vision: The Centrality of Time for an Ecological Social Science Perspective," in *Risk, Environment and Modernity: Towards a New Ecology,* ed. Scott Lash, Bronislaw Szerszynski, and Brian Wynne (London: Sage, 1996), 90, 93.
53. ISSHA, "Harmful Algae News," 7.
54. Bruno Latour, *Science in Action: How to Follow Scientists and Engineers through Society* (Cambridge, MA: Harvard University Press, 2003).
55. Linda Nash, "Purity and Danger: Historical Reflections on the Regulation of Environmental Pollutants," Toxic Bodies/Toxic Environments: An Interdisciplinary Forum, ed. Jody A. Roberts and Nancy Langston, *Environmental History* 13, no. 4 (2008): 651–52, https://doi.org/10.1093/envhis/13.4.629.
56. Gay Hawkins, "Down the Drain: Shit and the Politics of Disturbance," in *Culture and Waste: The Creation and Destruction of Value,* ed. Gay Hawkins and Stephen Muecke (Lanham, MD: Rowman & Littlefield, 2003), 42.
57. Sarah A. Vogel, "From 'the Dose Makes the Poison' to 'the Timing Makes the Poison': Conceptualizing Risk in the Synthetic Age," Toxic Bodies/Toxic Environments: An Interdisciplinary Forum, ed. Jody A. Roberts and Nancy Langston, *Environmental History* 13, no. 4 (2008): 671–72, https://doi.org/10.1093/envhis/13.4.629; Joseph Grange, *Nature: An Environmental Cosmology* (Albany: State University of New York Press, 1997), 104; Donald Worster, *Dust Bowl: The Southern Plains in the 1930s* (Oxford: Oxford University Press, 2004), 29.
58. Myra J. Hird, *The Origins of Sociable Life: Evolution after Science* (New York: Palgrave Macmillan, 2009), 56–57.
59. John Hartigan, *Care of the Species: Races of Corn and the Science of Plant Biodiversity* (Minneapolis: University of Minnesota Press, 2017); Thom van Dooren and Deborah Bird Rose, "Storied-Places in a Multispecies City," *Humanimalia: A Journal of Human/Animal Interface Studies* 3, no. 2 (2012): 1–27.
60. Anna Tsing, "More-than-Human Sociality: A Call for Critical Description," in *Anthropology and Nature,* ed. Kirsten Hastrup (New York: Routledge, 2014), 27–42.
61. Poul Holm et al., "Humanities for the Environment—a Manifesto for Research and Action," *Humanities* 4, no. 4 (2015): 977–92, https://doi.org/10.3390/h4040977; Cecilia Åsberg, Astrida Neimanis, and Johan Hedrén, "Four Problems, Four Directions for Environmental Humanities: Toward a Critical Posthumanities for the Anthropocene," *Ethics and the Environment* 20, no. 2 (2015): 230–71.

CHAPTER 9

Embodying Fear and Toxicity

Environmental Protests against West Germany's Final Repository for Nuclear Waste in Gorleben, 1977–1980

Astrid Mignon Kirchhof

> Farmland everywhere,
> grassland and grain,
> The cattle is out to pasture
> and soil absorbs the rain.
> Invisible clouds of radiation
> which devastate the land,
> Radioactive death,
> We have to make a stand.[1]

THIS VERSE, from what is known as the "Wendland Song," refers to a thirty-three-day utopia in an area called Wendland, Lower Saxony, when in May 1980 hundreds of people erected a village of huts: they built barracks and toilet blocks, laid water pipes, and set up a radio station and a hospital. The Republik Freies Wendland (Free Republic of Wendland) was born. The "Wendland Song" illustrates the fear, experienced by inhabitants and activists, of invisible radiation and deadly radioactivity, and by building a state within a state the activists demonstrated opposition at the site where geological test drillings for a possible nuclear repository were to be carried out.[2] The fact that radioactive radiation was not perceptible to the senses and seemed to penetrate the human organism unnoticed from outside increased the fear of this qualitatively new threat: atomic radiation. Apocalyptic fears in the 1970s were a decisive driving force behind the West German movement against nuclear power. Fear was also a positively connoted warning signal of toxins that were "invisible, imperceptible, creeping,"[3] invading the body from outside and across time and space. However, this was more of a concern or alarm than a fear clouding reason. In the majority of cases, fear was an attribution by nuclear power proponents to "portray statements by opponents of nuclear power as unobjective and thus be able to deprive them of their legitimacy."[4] Timescapes, as originally conceptualized by sociologist Barbara Adam, importantly link time with space. Adam suggests that the key conceptual tool for overcoming environmental problems is temporality, not spatiality, along with bringing industrial time together with the dynamic processes of nature.[5] Emotions are one embodiment of these dynamic processes of nature, I argue in this chapter, and in line with the efforts of this volume on *toxic timescapes,* I will also include *embodiment* as a nonnegligible variable in the timescape concept.

The relevance of all three variables for a new perspective on the history of the Gorleben protests becomes obvious when we look at the half-life of stored toxins in Gorleben. There are two interim storage facilities in Gorleben. The first is an interim storage facility for low-level radioactive, heat-generating waste from German nuclear waste facilities and from research and industry. The second is an interim storage facility for spent fuel elements and for vitrified, high-level radioactive waste from the French reprocessing plant at La Hague. The radionuclides contained in these wastes decay and release radiation for tens of thousands of years or more. Plutonium-239, for example, has a half-life of almost 25,000 years, while radioactive iodine-129 has a half-life of a good 15 million years.[6] The felt socioecological injustice for the Gorleben community becomes obvious through the timescape lens when farmers explain in an interview their concerns about their land, their home, and possible future radiation that might harm their livelihood: "My family, for example, has lived here for 100 years and I don't think my grandchildren will be able to live here when the WAA is built. . . . If they want to, they can simply take the land away from us when they need it and then we can see where we should still grow. But that's not the worst part. We can pack up completely, because nobody wants to buy our things anymore, with all the radioactive radiation and so on."[7]

Moreover, the timescape concept makes it clear that we have to deal with what has not yet happened, with something that is influenced by current actions but whose effects we cannot know. The Gorleben inhabitants and activists thus pointed out that while we may know our own needs, we cannot know those of future generations—for example, how the storage of fuel rods in salt domes or interim storage facilities will affect the health and environment of future generations, across time and space.[8]

The conflict between citizens of the Gorleben area and politicians shows not only how many time dimensions, which extend beyond one generation, must be considered but also how emotions became a means to validate these enormously long temporal frames. The relevance of feelings is an established object of research in sociological movement research, which "cannot do without strong emotions, without morality and indignation, without compassion and solidarity, without intensification and dramatization."[9] The dispute broke out in 1977 after the state government of Lower Saxony had made a far-reaching decision about storing nuclear waste in the community, without involving the inhabitants. Two years later, on March 28, 1979, a nuclear accident occurred near Harrisburg, the capital city of the US state of Pennsylvania, when the cooling system of the Three Mile Island nuclear reactor malfunctioned and caused a partial meltdown of the reactor core. The loss-of-coolant accident resulted in the release of radioactivity, including radioactive krypton and especially hazardous iodine, into the surrounding environment.[10] On March 25, the so-called Gorleben Trek had been organized, which was directed against the use of nuclear energy generally, but especially against the construction of the nuclear reprocessing plant in Gorleben, and ended with a closing rally on March 31 in Hannover with a hundred thousand participants. Since the accident at the Three Mile Island nuclear power plant happened during the trek, the Harrisburg disaster intensified the protests against the use of nuclear power. The conservative minister-president of Lower Saxony, Ernst Albrecht, temporarily withdrew his plans for the waste management center as it was politically not feasible. The growing criticism from citizens made it clear that they were denying politicians, and in this case Albrecht, the mandate to act on behalf of future generations who have no voting rights in the political systems that make decisions with long-term consequences.[11]

This chapter brings power relations and experienced socioecological injustices into conversation with the concept of toxic timescapes. The people living in the Lüchow-Dannenberg community experienced the entanglement of toxicity, fear, and their struggle for a landscape that was chosen as a site for a final repository in the second half of the 1970s. The fight against the planned nuclear waste management center reveals the spatially and temporally situated knowledges that inhabitants of toxic landscapes have embodied and shared over decades. With their alternative accounts of dangerous contamination, the Gorleben activists have persistently counteracted the toxic mainstream narratives of politics and economy that tried to silence their defense against the assumed exposure.[12] Moreover, the example of the community of Gorleben's response to the issue of a nuclear waste repository can show how emotional criteria and an embodied perception of a toxic threat could become a dominant driver for protest, which was due to a change in society that had taken place in the 1970s. Controversial emotions like fear were introduced into the public sphere and debated.[13] Feelings were now no longer private, but public, and because they were seen as political and part of a social order, they became increasingly important. In this context especially, feelings like fear are considered to be the trigger for mass protests.[14] In the following I will explain the political, social, economic, and geographical conditions that led up to the decision to designate Gorleben as the site for a waste management center. Subsequently, I will analyze the alternative narratives of toxic timescapes that citizens developed by articulating emotions in public and through colorful modes of disobedience. The last subchapter investigates the Free Republic of Wendland as an extreme form of opposition by the people of Gorleben against the planned repository and the associated radiation threat. In doing so, they tried to make it clear to politicians that their responsibility was to understand the spatial and temporal dynamics[15] of interim and final repositories and to make appropriate decisions accordingly.

The Geographical, Social, Economic, and Political Dimensions of Toxic Timescapes

The small community of Gorleben played a crucial role in the public debate about nuclear energy in West Germany. In 1977 the German Society for the Reprocessing of Nuclear Fuel Elements applied to the Ministry of Social Affairs in Lower Saxony for authorization to build and operate a nuclear waste management center in Gorleben. This would have included different facilities like a reprocessing plant, an interim storage facility, a packaging plant for nuclear waste, and an underground final waste repository. The reprocessing plant was the core project of this facility.[16]

In the 1950s, the federal government of Germany had not seen the need to create a final repository, given the small quantity of waste. For instance, high-level waste did not exist because the reactor's fuel elements were returned to the originating countries.[17] Germany considered different ways of storing radioactive waste, such as storage in space; in ice caps similar to Camp Century, where US forces stored nuclear weapons under the surface of the Greenland ice cap, as Jason R. Parry describes in his chapter; or in the sea, as Iris Borowy also analyzes in this volume. All of these ideas were contested and the Federal Republic decided to concentrate on disposal onshore in salt deposits. Because of the existing salt domes in Lower Saxony, the government considered a storage site in this state. Gorleben was not only attractive as a site for a waste storage facility because of its large underground salt dome but also because it was located in one of the most sparsely populated districts in West Germany with an economically underdeveloped regional structure.[18]

In 1976 some forty-nine thousand people lived in Gorleben, and politicians might not have expected much resistance to their plans. Moreover, at 10 percent, the unemployment rate was much higher than in the rest of the Federal Republic, where unemployment was at 3.3 percent in 1980.[19] Politicians argued that building the facility would lead to a considerable regional economic upturn, an opinion that the inhabitants did not share. Rather, they feared that agriculture and tourism, the two most important sources of income in the region, would become economically unviable if a waste management center was built. Lüchow-Dannenberg and the surrounding municipalities were agricultural areas, and more than 20 percent of the inhabitants worked in the agricultural and forestry sector.[20] According to Mr. Helke, managing director of the Kreislandvolkverband (County Farmers Association), there were still about "2,000 agricultural enterprises in the district of Lüchow-Dannenberg [with] a number of full-time farms at around 1,000."[21]

Geography, understood as the space and place of human life and actions, also mattered in a different way. Gorleben formed a tapering salient, protruding far into the German Democratic Republic, and the district of Lüchow-Dannenberg shared 144 kilometers of its border with

East Germany, to the north, south, and east, so that the community was not accessible from these sides. The site's proximity to East Germany was an ongoing concern for West German activists for two reasons. First, in case of an accident at the facility, people living in Gorleben would be trapped. Second, since East Germany was a dictatorship with hardly any possibility for opposition, citizens there could not openly protest against the possible dangers and radiation that might originate from a nearby nuclear facility on the other side of the border.[22] Moreover, an environmental problem in one region may manifest itself differently in another, since airborne toxins often end up being deposited in either water or land forms, and waterborne toxins can evaporate to become airborne contaminants. Toxins can interact with different ecosystems in a variety of ways and generate both moderate and severe effects depending on where and how they travel.[23] Understanding the Gorleben area through toxic timescapes illustrates how disturbed sites are risk materialized, spatialized, and temporalized. The sites clearly present the difficulty of containing the hazards of nuclear facilities, as these hazards do not recognize borders, be they between the two German states or between the final repository and people's homes and properties. If political and economic representatives in Lower Saxony had realized that contaminant containment was uncertain, they would have made a connection between atomic energy, storage underground, and a polluted environment.[24]

Alternative Narratives of Toxic Timescapes, Symbolic Politics, and Gender Dimensions

In February 1977, Albrecht at last announced Gorleben as the site for the final repository and so initiated a fierce conflict between politicians and police on the one side and locals and activists on the other side. The first protest against the planned building of the reprocessing plant came from the farmers: "The main motive [for the protest] is the loss of space associated with the construction of the WAA. The large-scale planned infrastructure measures in particular—i.e., mainly road construction—have driven the farmers up the wall. . . . If the plant is built, the structural change will be drastically intensified—i.e., many farmers will have to give up their business for better or worse."[25]

In the following years, activists used many different strategies to show that slow violence of pollution was their assumed reality: a toxic truth that gradually unfolded in front of them, in their bodies, environments, and shared narratives of protest and fear that seem to go unheard. They publicly expressed emotions in the realm of politics, and fear functioned as a driving force for mass protests. Since radioactive radiation was not perceptible to the senses and seemed to penetrate the human organism unnoticed from outside, the fear of this qualitatively new threat increased. Citizens expressed anxiety about being poisoned with radioactive iodine and about their feelings of helplessness because of it.[26] In an open letter to Minister-President Albrecht, farmer Sigrid Horstmann, from Gartow, a municipality close to Gorleben expressed her fear of dangers that would linger for a long time into the future: "I can already foresee that we, and especially our children and their children, will be treated like lepers, because everyone is afraid of the rays."[27]

The prevalence of a sense of fear can also be seen in books and media reports of the time[28] and in many films, like *China Syndrome,* which was released in 1979, and *Chain Reaction,* which came out a year later, as well as in the doom-laden rhetoric of many of the speakers in the peace and antinuclear movements.[29] But the environmental movement also employed the emotion of fear from its very inception, and haunting symbolism was part of its ideological expression.[30] Politicians, like the Green activist and feminist Petra Kelly, used their personal life histories in order to expand the reach of their politics, a tactic which ensured consistent media interest. In keeping with the motto of the second-wave feminist movement, "the personal is the political," they placed emotions in the public arena and declared their political activism. In Kelly's case it was the death of her sister, which Kelly interpreted as caused by radiation that her sister received to cure her cancer. Kelly used an emotional, symbolic language that was characteristic of her politics. There was scarcely a (media) event at which Kelly would not wear ecological and peace symbols: a printed T-shirt with the dictum "swords into ploughshares," as during her meeting with Honecker in 1983, a small dying fir tree on entering the Bundestag, or a German army helmet with a flower affixed to it at the blockade in Mutlangen.[31] Petra Kelly took up existing feelings of fear of nuclear catastrophe, and in doing so addressed her audience at a fundamental, emotional level.[32] With her life story and her actual and symbolic language, Kelly introduced feelings into the public sphere and into politics.

Empathetic forms of symbolic protest were also organized against the nuclear facilities in Gorleben. For instance, the most important citizens' initiative in the Gorleben area, the Initiative for Environmental Protection in the district of Lüchow-Dannenberg (BI Lüchow-Dannenberg), called for activists from all over the Federal Republic of Germany to come to Gorleben and build "a strong and closed human chain around the Wendland."[33]

The societal discussions of fear, including both the perceived threat and the deliberately chosen political tool, were accompanied by imaginative forms of resistance like arranged treks to Hannover and orchestrated symposiums, and mobilizing forest guards to observe and possibly prevent drillings into salt domes by forming blockades against it. Within five days, the BI Lüchow-Dannenberg raised 800,000 deutsche marks to buy the land wanted by the German Society for the Reprocessing of Nuclear Fuel Elements, but property was sold to the association regardless.[34] As of 1977, activists coordinated several international summer camps.[35] Besides a colorful program with excursions and sports events, the participants also helped local farmers with harvesting and participated in projects about alternative energy. However, the primary goal of the camps was to inform people about the plant, raise awareness, and build up networks.

Camp activists also pointed out the potential toxic timescape of the Gorleben nuclear repository. They explained how a reprocessing plant works technically, clarified the dangers of used nuclear fuel elements, described the risks of radiation, analyzed the geopolitical advantages of building such a plant, indicated the possible benefits for the nuclear industry, and gave background information on the Federal Republic of Germany's nuclear program. Additionally, they named environmental considerations, especially water, soil, and air contamination. They explained how operating the reprocessing facility might affect the water supply, which may then be insufficient to meet the demands of agriculture and forestry in the area. Moreover, chemicals like acids and kerosene could infiltrate into and contaminate ground and surface water, and the emission of toxics into the air would be a thousand times higher in reprocessing plants than in nuclear power plants. They also explained that plants posed an inacceptable risk to people and their homes because of the exposure of humans and animals to radiation and increased rates of cancer or leukemia.[36]

The West German movement against nuclear power was critical of science in its institutional and professional manifestations but nevertheless embraced science as a cognitive system. In their brochures, fliers, and leaflets, they frequently explained the environmental, ecological, and economic risks and consequences of nuclear power in a technocratic tone rather than an emotional writing style, although fear might have been the driving force to write the booklets in the first place. With an unemotional style of writing, the activists aimed at being taken seriously, especially, but not only, by those who doubted the alleged large scale of the environmental and health risks of accidents in nuclear power plants. In order to defend themselves against the accusation of irrationalism, participants also explicitly contradicted the thesis that fear was their motivation for resistance. This move was a reaction to proponents of the technology who systematically denied the objectivity of critics of nuclear energy and rather labeled them emotional in order to devalue their position.[37]

Women were frequently not only at the forefront among critical citizens; they also expressed their fear more clearly and repeatedly related their concerns to a male-connoted technology, capitalism, and patriarchy. Nationally and internationally, women were discussing questions and issues such as "Do doubts regarding nuclear technology also imply fundamental doubts regarding male domination of nature?" and "Are gender differences biological, predisposing women to be more peaceful than men?"[38] Such ecofeminist questions established an essential link between the suppression of women under patriarchy and the subjugation of nature resulting in its damage. A system based on male dominance, so the argument went, had eventually led to the establishment of a model of action in which humans had ceased to be an integral part of the environment. In "The Future Belongs to Benevolence," Petra Kelly argues that "the men in power have brought the world to a point where the livelihoods of all people are threatened."[39] This quotation points at the gender-based concept of care (*Pflege*)—with its precautionary concern for what lies ahead—as a counterpart to the male approach, which used prediction and foresight to project the accumulated knowledge of the past into the future in order to calculate probable, possible, and desired future scenarios that are supposed to guide action in and for the present.[40] In contrast, the care principle implies that we take responsibility not because we can be held liable, but because we relate possible future outcomes at a given time and place to current decisions and actions. In other words, through care, the needs of future generations are related to the needs of the present, with the aim of ensuring that the ability of these future generations to meet their own needs is not compromised.[41]

In August 1979, women from the Lüchow-Dannenberg district met under the motto Women Fight for Life and founded the group known as the Gorleben Women, an activist group consisting of Heike Mahlke, Elisa Mombauer, Marie-Luise Ebeling, Margrit Albers, Edelgard Gräfer, Brita Kärner, Uta-Helene Götz, Irmela Turmann, and others.[42] The women agreed that it was time to offer resistance to Minister-President Albrecht's intention to build a reprocessing plant in Gorleben, and during a visit they handed him a package of uncontaminated honey, as well as eggs that had not yet been irradiated.[43] This symbolic action refers directly to toxic timescapes by making clear to Albrecht that the responsibility for future generations lay in his hands, since nature, the environment, and sustainability are not merely matters of space but fundamentally temporal processes.[44] In the following decades, the Gorleben Women critically and actively countered the plans of the nuclear industry and enriched the opposition with countless actions—creatively, humorously, and resolutely. They wrote innumerable letters to political and church representatives, as well as those of other socially relevant groups, and traveled throughout Germany to establish an international network of women at various nuclear power plant sites.

In 1980, 1,500 to 3,000 women met at the Easter meeting organized by the Gorleben Women and marched with music to the concrete fortress of the drilling rig on Easter night to express their protest against the planned nuclear waste disposal center. They discussed armaments and nuclear power plants, and in a press conference, the Gorleben Women were the first to publicly announce the plans to occupy drilling site 1004.[45] Women's groups in the area but also across Germany inspired each other and protested against a technology that would destroy humankind. For instance, the women's group Diepholz of the Greens in Lower Saxony called for a women's march to Gorleben and stated, "We are afraid and hence now oppose by supporting the women's fight against the atomic program and all misanthropic technologies."[46] The fear expressed here refers to possible radiation damage from malfunctioning nuclear power plants, which often only becomes apparent a very long time after the accident, and this temporal extension brings with it an unavoidable invisibility gap between the incident and the possible impacts.[47] In the end, it was this feeling of desperation and hopelessness that led to the activists' decision to occupy the drilling site and to defend themselves against the planned repository and the associated radiation threat, an action that once again highlights the perceived danger of time and space in the area.

The Free Republic of Wendland: A State within a State as the Ultimate Opposition

The power relation inherent in this example of a toxic timescape and the raising of extreme opposition to nuclear energy was also due to West Germany's political system, which was rather impermeable to input and critique from societal actors.[48] More open political systems usually invited assimilative structures, and antinuclear movement activists found access to established institutions. The opposite was the case in West Germany with its more closed political system. Here, movements tended to be more confrontational and concentrated their action outside established structures, as can be seen in the founding of a state within a state (the Free Republic of Wendland). Social scientists argue that the West German political system offered few opportunities for the opposition to find cooperation partners within the system. For instance, institutions like trade unions were inaccessible to the antinuclear opposition and no party adopted a clear antinuclear stance until the 1980s, when the Greens entered the political arena.[49]

The dominant activist group in Gorleben was the citizen's initiative BI Lüchow-Dannenberg. The founder and chairwoman of the citizen's initiative was Marianne Fritzen, followed by Rebecca Harms and Lilo Wollny. The latter two also became politicians for the newly founded Green Party. For a long time, the BI Lüchow-Dannenberg was opposed to occupying drilling sites, as they were against any illegal actions, and site occupations and blockades clearly broke German law.[50] The decision to seriously reconsider occupying drilling site 1004 came in March 1980, three years after the protests had started. After numerous complaints and legal demonstrations against the construction of the waste facility, and the German state ignoring the protesters' objections and continuing to dig and probe on several test sites in the area, the BI was willing to try some more radical forms of disapproval, as previous attempts had clearly failed. The group made an appeal in the journal *Atom Express* to nonlocal activists and explained that several thousand protesters would be needed for the occupation to be effective.[51]

Marianne Fritzen and other activists wrote a press release in which they explained their decision, which was driven by the timescape threat to their habitat and life if the nuclear center was built: "The construction of the village 1004 is an act of self-defense to counter the menace to our living space and our existence. . . . The nuclear program, with its potential danger, threatens us and future generations to such an incalculable extent that we consider it our duty to counter such a development, while putting our personal situation on the backburner."[52]

To understand why Marianne Fritzen and fellow activists decided to occupy the drilling site after a long period of debating about it, one has to notice how much their mistrust of political authorities, the nuclear industry, and technical-scientific experts had increased. For instance, Martin Mombauer, cofounder of the Green Party of Lower Saxony, and his wife Elisa Mombauer, of the Gorleben Women, originally trusted that the current legal situation would prevent the construction of a nuclear reprocessing center in Gorleben. Their confidence was deeply shaken when the government of Lower Saxony changed the laws that could delay the rapid expansion of nuclear energy. It was experiences such as these that strengthened the activists' doubts "about the legitimacy of the state's institutional structure."[53] Additionally, the police's brutal responses to militant acts and the obvious intention of some politicians to criminalize dissidents only increased skepticism and suspicion of authorities in politics and the economy in West Germany.[54] As research showed, if concerned people have trust in their state or in industry and a transparent information policy is pursued, these concerns can be minimized, as was the case in other European countries.[55] For example, when the Swedish Nuclear Fuel and Waste Management Company was searching for a location to build nuclear waste facilities in the 1990s, it adopted a transparent attitude with local inhabitants instead of a top-down policy, as it realized that local acceptance was a crucial precondition for effective cooperation.[56] In the Gorleben case, and other cases in West Germany, a comparable dialogue was missing, as political elites were fairly intransigent. The BI Lüchow-Dannenberg therefore took over the task of informing citizens: "As a local citizens' initiative, which is trying to prevent a significant part of the German waste disposal center, we can assure you: We feel personally responsible for ensuring that our members are available to every citizen with information about the disposal center. We must not allow our fellow citizens to be relieved of justified fears through unfounded information."[57] This quotation makes clear that emotions like fear do not oppose understanding and enlightenment,[58] but fear was an important motor for resistance that did not necessarily make people passive or paralyze their spirit of counteraction.

When on May 3, 1980, the occupation of drilling site 1004 began, the initiative was supported by thousands of activists who traveled to Wendland from all over West Germany. In total, around five thousand antinuclear activists took part in this occupation.[59] The protesters had brought food, sleeping bags, and the tools needed to build the village. People who, up until then, "had not even mounted a cupboard on a wall, found themselves erecting whole houses."[60] The spokesperson for the whole camp, Rebecca Harms, became the cofounder of the BI Lüchow-Dannenberg. Lilo Wollny ensured catering for all squatters—supported by Norbert, Martha, Waltraud, and others—and cooked up to a thousand portions per day because "they needed someone to take care of the food. . . . So I became the cooking fairy and made sure that hundreds of people had something to eat every day for over a month."[61]

The Free Republic of Wendland lasted for one month and was cleared by the police and Federal Border Guard on June 4, 1980. A few days later, a few concerned families published a newspaper article under the headline "The Future with Atomic Facilities" that again summarized the interplay of time, place, and apocalyptic fear:

> We consider the following risks to be unacceptable: Constant deterioration of health, threat to life due to nuclear catastrophes that cannot be ruled out, economic ruin due to the proven vulnerability of this technology, social conflicts due to the constant restriction of living space in our overpopulated country and the destruction of recreational areas, in which nuclear plants are preferentially built, security measures that turn our democracy into a police state, thousands of tons of nuclear waste that threatens us because nobody knows where to put it, deformities and miscarriages caused by artificial radioactivity on an unimaginable scale, famines caused by contaminated arable land. . . . We urgently appeal to all parents to inform themselves about the nuclear future and to defend themselves against this long-term murder of their children.[62]

Protests by action groups like the BI Lüchow-Dannenberg against the reprocessing and the conditioning plant have continued ever since. Thus, Gorleben was the only nuclear site in Germany that attracted protests, mainly during the annual transport of dry cask containers from France to Germany. The last transport to the Gorleben interim storage facility took place in 2011, and nine years later, in 2020, the Federal Agency for Radio Active Waste Disposal decided that the salt dome in Gorleben would no longer be suitable for a repository. [63]

The struggle over the planned nuclear waste management center in Gorleben demonstrated the spatially and temporally situated knowledges that inhabitants of toxic geographies supposedly embody and share. With their alternative accounts, they counteracted the toxic mainstream narratives of politics and economy that tried to silence their assumed exposure. Through the practice of counterhegemonic storytelling, the multiple layers of toxic timescapes reveal their entanglement with the power structures inscribed into the socioecological Gorleben community, which refused to consider the exposure as a "natural" feature of linear progress and clean energy. Instead, citizens' initiatives, local people, and other opponents active in the Gorleben protests were frightened of radioactive hazards and worried about chemicals that might infiltrate into the soil or evaporate into the air, but conveyed these feelings in factual language.

The challenged political and economic master narrative of a linear understanding of progress and clean energy was as much influenced by geography and the duration of toxic threats as it was by world politics and people's trust in the state. Moreover, because of West Germany's rather closed political system, movements tended to be more confrontational and concentrated their action outside established structures, as can be seen in the founding of the Free Republic of Wendland. The mistrust in the truthfulness of legislative, executive, and judicial institutions made a power structure obvious and was also reflected in an intransigent communication with the people affected by the feared toxic timescapes most of all.

Where other "scapes"—for instance, landscapes and the Gorleben area—mark the spatial features of past and present activities and interactions of organisms and matter, with timescapes their temporal changes and continuities also matter. Since toxicity, pollution, and modes of exposure are never static, the concept investigated how time, space, body, and toxicity relate to forms of opposition. Thus, a toxic timescape can help to shed light on the prerequisites for, causes of, and possible impacts of fear of toxic exposure as a motor for opposing it. It is true that the Free Republic of Wendland could not stop the planned final repository in Gorleben at that time. However, if we look at the new search for a final repository by the federal government, "the beginning of a revolutionary change in the literal sense of the word"[64] in those years becomes clear. With the energy concept of June 6, 2011, the then federal government had decided to develop a new procedure for the search for a site based on geological criteria. Only one German region is no longer under consideration: Gorleben.[65] This shows that the antinuclear movement and the Free Republic of Wendland have been successful over time and space, and with their new forms of fear articulation, to the extent that at least the repository will not be built in their region.

Notes

1. See Günter Zint, ed., *Republik Freies Wendland: Eine Dokumentation* (Frankfurt am Main: Zweitausenundeins, 1980). Translation by the author.
2. Andreas Pankratz, "Das könnte euch so gefallen: Ob es um Brücken für Eidechsen geht oder um den Erhalt eines Schwimmbads—in Bürgerinitiativen hat die Politik oft einen starken Gegner," *Fluter–Magazin der Bundeszentrale für politische Bildung,* September 20, 2011, https://www.fluter.de/das-koennte-euch-so-gefallen.
3. Frank Biess, *Republik der Angst: Eine andere Geschichte der Bundesrepublik* (Hamburg: Rowohlt, 2019), 369.
4. Christian Götter, "Emotionen als Argument—Die Debatte um die Kernenergie im Biblis der 1970er Jahre," in *Emotionen bei der Realisierung eines Endlagers,* ed. Ulrich Smeddinck (Berlin: Berliner Wissenschaftsverlag, 2018), 36.
5. Elizabeth K. Meyer, "Uncertain Parks: Disturbed Sites, Citizens, and Risk Society," in *Large Parks,* ed. Julia Czerniak and George Hargreaves (New York: Princeton Architectural Press, 2007), 81.
6. Hans-Otto Willax, "Status of the Gorleben Pilot Conditioning Plant," *Nuclear Technology* 121, no. 2 (1998): 128–35; Alexander Glaser, "From Brokdorf to Fukushima: The Long Journey to Nuclear Phase-Out," *Bulletin of the Atomic Scientists* 68, no. 6 (2012): 10–21. Also: Nadja Podbregar,

"Das Problem: Radioaktive Abfälle und ihre Entsorgung," *Scinexx—Das Wissensmagazin,* December 1, 2017, https://www.scinexx.de/dossierartikel/das-problem/.

7. "Interview with Three Farmers," *Atom Express—Zeitung der Initiativen gegen Atomenergie,* no. 13 (April 1979): 17–18, ZS 8528, Archive Grünes Gedächtnis (AGG), Berlin.
8. Barbara Adam, "Sustainability and Gender from a Time-Ecological Perspective," in *Geschlechterverhältnisse und Nachhaltigkeit: Die Kategorie Geschlecht in den Nachhaltigkeitswissenschaften,* ed. Sabine Hofmeister, Chrstine Katz, and Tanja Mölders (Opladen: Verlag Barbara Budrich, 2013), 305, 307.
9. Roland Roth and Dieter Rucht, "Einleitung," in *Die sozialen Bewegungen in Deutschland seit 1945: Ein Handbuch,* ed. Roland Roth and Dieter Rucht (Frankfurt am Main: Campus Verlag, 2008), 24, cited in Bernhard Gotto, "Enttäuschung als Politikressource: Zur Kohäsion der westdeutschen Friedensbewegung in den 1980er Jahr," *VfZ* 62 (2014): 1, 6.
10. *United States Nuclear Regulatory Commission Fact Sheet: Three Mile Island Accident,* n.d., https://www.nrc.gov/docs/ML0825/ML082560250.pdf.
11. Anselm Tiggemann, *Die "Achillesferse" der Kernenergie in der Bundesrepublik Deutschland: Zur Kernenrgiekontroverse und Geschichte der nuklearen Entsorgung von den Anfängen bis Gorleben 1955 bis 1985* (Lauf an der Pegnitz: Europaforum Verlag, 2004), 632. See also Silke Mende, *"Nicht rechts, nicht links, sondern vorn": Eine Geschichte der Gründungsgrünen* (Munich: Oldenbourg, 2011), 332; Adam, "Sustainability and Gender from a Time-Ecological Perspective," 305.
12. Similarly, Iengo and Armiero also tease out alternative or "guerrilla" narratives of toxic embodiment in their chapter in this volume.
13. This text draws on ideas of the history of emotions, especially the discovery of a new German culture of emotional and fear-related expressivity in the 1970s and beyond, in which fear was reinterpreted as a positive and appropriate feeling. See, for example, Frank Biess, "Die Sensibilisierung des Subjekts: Angst und 'Neue Subjektivität' in den 1970er Jahren," *WerkstattGeschichte* 49 (2008): 51–71. Also see the research of the Center for the History of Emotions at the Max Planck Institute for Human Development (Ute Frevert, director), https://www.mpib-berlin.mpg.de/research/research-centers/history-of-emotions.
14. Bernhard Gotto, "Enttäuschung als Politikressource," 1, 8.
15. Benjamin J. Richardson, "Timescapes of Ecological Restoration," in *Ecological Restoration Law: Concepts and Case Studies,* ed. Afshin Akhtar–Khavari and Benjamin J. Richardson (London: Routledge, 2019), 57.
16. Kernforschungszentrum Karlsruhe, *Sammlung der Vorträge anlässlich des 2: Statusberichtes des Projektes Wiederaufarbeitung und Abfallbehandlung, 18.11.1977,* April 1978, https://publikationen.bibliothek.kit.edu/270011965; Christel Blanke, Michael Brandt, and Axel Schröder, "Endlager gesucht,"

Deutschlandfunk, April 23, 2013, http://www.deutschlandfunk.de/endlager-gesucht.724.de.html?dram:article_id=244393.

17. Tiggemann, *Die "Achillesferse" der Kernenergie,* 525.
18. Tiggemann, 126 et seq.; Alexander Glaser, "From Brokdorf to Fukushima: The Long Journey to Nuclear Phase-Out," *Bulletin of the Atomic Scientists* 68, no. 6 (2012): 15.
19. "Arbeitslose und Arbeitslosenquote: In absoluten Zahlen und in Prozent aller zivilen Erwerbspersonen, 1980 bis 2021," Bundeszentrale für politische Bildung, March 26, 2022, http://www.bpb.de/nachschlagen/zahlen-und-fakten/soziale-situation-in-deutschland/61718/arbeitslose-und-arbeitslosenquote. See also *Materialien: Informationsbroschüre zum zweiten internationalen Sommer Camp 1977,* Holding A—Eva Breuer, file no. 37, p. 17, AGG, Berlin; *Die WAA Gorleben und wir: Informationsbroschüre zum ersten internationalen Sommer Camp 1977,* Holding A—Eva Breuer, file no. 37, p. 10, AGG, Berlin.
20. Tiggemann, *Die "Achillesferse" der Kernenergie,* 535 et seq.
21. "Conversation with the Manager of the Kreislandvolk," *Atom Express—Zeitung der Initiativen gegen Atomenergie,* no. 13 (April 1979): 16, ZS 8528, AGG, Berlin.
22. Astrid Mignon Kirchhof, "East–West German Transborder Entanglements through the Nuclear Waste Sites in Gorleben and Morsleben," *Journal for the History of Environment and Society* 3 (2018): 145–73.
23. Hilary Cunningham, "Permeabilities, Ecology and Geopolitical Boundaries," in *A Companion to Border Studies,* ed. Thomas M. Wilson and Hastings Donnan (Chichester, UK: Wiley, 2015), 379.
24. Meyer "Uncertain Parks," 65.
25. "Conversation with the Manager of the Kreislandvolk," *Atom Express—Zeitung der Initiativen gegen Atomenergie,* no. 13. About their infrastructural concerns, see Tiggemann, *Die "Achillesferse" der Kernenergie,* 535 et seq.
26. Dietmar Süß, "Wie Furcht die deutsche Gesellschaft stabilisierte," review of *Republik der Angst,* by Frank Biess, *Deutschlandfunk Kultur,* March 2, 2019, https://www.deutschlandfunkkultur.de/republik-der-angst-von-frank-biess-wie-furcht-die-deutsche.1270.de.html?dram:article_id=442481; Philipp Gassert, "Popularität der Apokalypse: Zur Nuklearangst seit 1945," *Aus Politik und Zeitgeschichte* 61 (2011): 48–54.
27. Karl F. Kassel and Ilona Wagner, eds., *Briefe aus einer belagerten Provinz: Leserbriefe und Beiträge aus der Elbe–Jeetzel–Zeitung vom November 1976 bis September 1979* (Frankfurt am Main: Zweitausenundeins, 1979), 26; Barbara Adam, "Industrial Food for Thought: Timescapes of Risk," *Environmental Values* 8, no. 2 (1999): 221.
28. Klaus Traube, "Harrisburg und die Experten," *Der Spiegel,* no. 16/79 (1979): 58–59; Wolfgang Barthel et al., *Der unsichtbare Tod: Die Angst des Bürgers vorm Atom* (Hamburg: Gruner und Jahr, 1979); Christina Perincioli, *Die*

Frauen von Harrisburg oder "Wir lassen uns die Angst nicht ausreden" (Hamburg: Rowohlt, 1986).

29. Angelika Dörfler-Dierken, "Frieden von unten: Die Friedensbewegung der 1980er Jahre," in *Friedensbildung: Das Hamburger Interdisziplinäre Modell,* ed. Ulrike Borchardt et al. (Göttingen: V&R Unipress, 2014), 19.
30. Silke Mende and Birgit Metzger, "Eco-Pacifism: The Environmental Movement as a Source for the Peace Movement," in *The Nuclear Crisis: The Arms Race, Cold War Anxiety, and the German Peace Movement of the 1980s,* ed. Christoph Becker-Schaum et al. (New York: Berghahn, 2016), 130.
31. Saskia Richter, *Die Aktivistin: Das Leben der Petra Kelly* (Munich: DVA Deutsche Verlags–Anstalt, 2010), 242, 245–47, 252 et seq.
32. Manon Maren-Griesebach, *Philosophie der Grünen* (Munich: Olzog, 1982), 15 et seq.; on the use of emotions in the West German peace movement, see Bernhard Gotto, "Enttäuschung als Politikressource."
33. *Bürgerinitiative Umweltschutz Lüchow—Dannenberg, offener Brief an die Ökologie—und Friedensbewegung,* 1984, Holding A—Eva Breuer, file no. 40, AGG, Berlin.
34. *Chronologie der Gorlebener Atomanlagen und des Widerstandes (1977–1996),* NP/ND, Ringbinder Atommüll Gorleben, Archive Papiertiger.
35. Gorlebener TurmbesetzerInnen, *Leben im Atomstaat: Im atomaren Ausstiegspoker ist unser Widerstand der Joker* (Wendland: Eigenverlag, 1996), 282.
36. Die WAA Gorleben und wir: Informationsbroschüre zum ersten internationalen Sommer Camp 1977, Holding A—Eva Breuer, file no. 37, p. 10, AGG, Berlin; *Sammeleinwendung gegen die WAA Dragahn,* without date [1982], Holding A—Eva Breuer, file no. 40, AGG, Berlin.
37. Götter, "Emotionen als Argument," 39. Also: Dolores Augustine, "Popularization of Science and the Anti-nuclear Power Movement in West and East Germany," presentation at the Berlin-Brandenburger Colloquium für Umweltgeschichte Sommersemester, June 22, 2017; Biess, *Republik der Angst,* 374, 380.
38. Ilse Lenz, ed., *Die Neue Frauenbewegung in Deutschland: Abschied vom kleinen Unterschied. Eine Quellensammlung* (Wiesbaden: VS Verlag für Sozialwissenschaften, 2008), 847–65. See Christina Perincioli, "Nike vor der Küchentür: Raketen im Hunsrück," *Courage* 7, no. 1 (1982): 9.
39. Petra Kelly, "Die Zukunft gehört der Güte," *Gesunde Medizin* (1978): 58–59.
40. This concept goes back to the American psychologist and feminist ethicist Carol Gilligan. See Carol Gilligan, *In a Different Voice: Psychological Theory and Women's Development* (Cambridge, MA: Harvard University Press, 1982); Karin Flaake, "Carol Gilligan: Die andere Stimme," in *Schlüsselwerke der Geschlechterforschung,* ed. Martina Löw and Bettina Mathes (Wiesbaden: VS Verlag für Sozialwissenschaften, 2005), 158–75; Astrid Mignon Kirchhof, "Finding Common Ground in the Transnational Peace Movements," *Australian Journal of Politics and History* 61, no. 3 (2015):

432–49; Adam, "Sustainability and Gender from a Time-Ecological Perspective," 307.

41. Adam, "Sustainability and Gender from a Time-Ecological Perspective," 307.
42. Wolfgang Ehmke, ed., *Zwischenschritte: Die Anti–Atomkraft–Bewegung zwischen Gorleben und Wackersdorf* (Cologne: Kölner Volksblatt Verlag, 1987), 67.
43. Birgit Huneke, "Frauenkampf für Lebenslust: Frauen–Kette gegen Kern–Spaltung," *Das feministische Archiv,* https://www.das-feministische-archiv.de/wir-haben-sie-noch-alle/frauenkampf-fuer-lebenslust-frauen-kette-gegen-kern-spaltung.
44. Barbara Adam quoted in Meyer, "Uncertain Parks," 80.
45. See Christa Müller, "'Schade, dass Beton nicht brennt': Ostertreffen in Gorleben," *Courage* 5, no. 5 (1980): 4–6. Also: Ehmke, *Zwischenschritte,* 65.
46. *Women Fight for Life,* poster by the women's group Diepholz of the Greens in Lower Saxony, Easter 1980, PL–05430, AGG, Berlin.
47. Adam, "Sustainability and Gender from a Time-Ecological Perspective," 309.
48. Herbert P. Kitschelt, "Political Opportunity Structures and Political Protest: Anti-nuclear Movements in Four Democracies," *British Journal of Political Science* 16, no. 1 (1986): 66.
49. Kitschelt, 70.
50. Michael L. Hughes, "Civil Disobedience in Transnational Perspective: American and West German Anti-nuclear-Power Protesters, 1975–1982," *Historical Social Research* 39, no. 4 (2014): 238.
51. Rebecca Harms, "Rangeleien um die zweite Tiefbohrstelle," *Atom Express—Zeitung der Initiativen gegen Atomenergie,* no. 18 (March 1980): 19, ZS 8528, AGG, Berlin.
52. Zint, *Republik Freies Wendland,* 99.
53. Mende, *Nicht rechts, nicht links, sondern vorn,* 334.
54. Michael Schüring, *Bekennen gegen den Atomstaat: Die evangelischen Kirchen in der Bundesrepublik Deutschland und die Konflikte um die Atomenergie 1970–1990* (Göttingen: Wallstein, 2015), 89 et seq.
55. M. V. Ramana, "Nuclear Power and the Public," *Bulletin of the Atomic Scientists* 67, no. 4 (2011): 43–51; Helen Caldicott, *Nuclear Power Is Not the Answer to Global Warming or Anything Else* (Melbourne: New Press, 2006), xvii; Martin Brian, "Opposing Nuclear Power: Past and Present," *Social Alternatives* 26, no. 2 (2007): 43–47.
56. Arne Kaijser, "The Referendum That Preserved Nuclear Power and Five Other Critical Events in the History of Nuclear Power in Sweden," in *Pathways into and out of Nuclear Power in Western Europe: Austria, Denmark, Federal Republic of Germany, Italy, and Sweden,* ed. Astrid Mignon Kirchhof (Münster: Deutsches Museum Verlag, 2020), 238–93.
57. Kassel and Wagner, *Briefe aus einer belagerten Provinz,* 22–23.

58. Biess, *Republik der Angst,* 368.
59. TurmbesetzerInnen, *Leben im Atomstaat,* 81. See also Zint, *Republik Freies Wendland,* 11.
60. Zint, *Republik Freies Wendland,* 20.
61. Reimar Paul, "Die Mutter des Widerstandes," *TAZ,* November 3, 2019, https://taz.de/Nachruf-auf-Lilo-Wollny/!5635160/. Also: Zint, *Republik Freies Wendland,* 104–10.
62. Zint, *Republik Freies Wendland,* 305.
63. Willax, "Status of the Gorleben Pilot Conditioning Plant," 128–35; Glaser, "From Brokdorf to Fukushima," 10–21.
64. Anselm Doering-Manteuffel, "Langfristige Ursprünge und dauerhafte Auswirkungen: Zur historischen Einordnung der siebziger Jahre," in *Das Ende der Zuversicht? Die siebziger Jahre als Geschichte,* ed. Konrad Jarausch (Göttingen 2008), 326.
65. Matthias Jauch, "Gorleben ist raus und alle sind auf einmal hellwach," *Tagesspiegel,* February 5, 2021, https://www.tagesspiegel.de/wirtschaft/der-ton-in-der-endlagersuche-wird-schaerfer-gorleben-ist-raus-und-alle-sind-auf-einmal-hellwach/26885248.html.

CHAPTER 10

Toxic Timescapes and the Double Fracture of Modernity

Chlordecone Contamination of Martinique and Guadeloupe

Malcom Ferdinand

FIGURE 10.1. A banana plantation in Martinique, 2017. © Malcom Ferdinand

MARTINIQUE AND Guadeloupe are two small islands located in the middle of the Lesser Antilles. These two former French colonies and now overseas departments of France harbor an ethnically diverse population with African, Asian, and European ancestries. Known for their famous thinkers and writers, such as Aimé Césaire, Frantz Fanon, Maryse Condé, and Edouard Glissant, these islands have also been a destination for Europeans and North Americans in search of a respite from their daily lives. Yet, beneath the vision of a touristic paradise, characterized by lush vegetation, sand, sun, and sea, the eight hundred thousand local inhabitants endure the slow violence of a postcolonial toxic timescape.[1] From 1972 to 1993, an organochlorine named "chlordecone" (CLD) was used as a pesticide on the banana plantations of Martinique and Guadeloupe, resulting in the long-lasting and harmful contamination of these islands. In exploring this toxic timescape, this chapter is concerned with the following questions: What constitutes, forms, or defines a toxic timescape, and in this case a postcolonial toxic timescape? How does one experience a toxic timescape? How do inhabitants, civil societies, and governments respond to it?

The fields of science and technology studies, pragmatic sociology, and environmental humanities have shown that toxic timescapes are never self-evident.[2] A number of sociopolitical processes in dialogue with scientific research contribute to making a toxic timescape visible or keeping it invisible.[3] The (in)visibilization of toxic contamination is the product of a political conflict between competing narratives and actors, each claiming to adequately present the "real" situation. The toxic timescape of Martinique and Guadeloupe with respect to the CLD contamination is also the site of such a conflict. One can find two main narratives of this contamination that are on either side of what I have termed the "double colonial and environmental fracture of modernity."[4] This double fracture refers to the conceptual and sociopolitical divide that separates environmental issues of the modern world from their underpinnings in colonialism and slavery, their persistent racism and social inequalities.

On the one hand, the French government and state officials have defined, characterized, and responded to the CLD contamination with a narrow-minded technical perspective. In presenting this perspective, the first part of this chapter shows the significant and ultimately failed effort by the French government not to draw any links to the history of French colonialism and slavery on these islands. On the other hand, a number of local NGOs, artists, and activist collectives have pointed out the persistence of what Anibal Quijano calls the "coloniality of power" and Ann Laura Stoler terms "the duress of empire": that is, the long-lasting effects of colonization on sociopolitical relations *and* on the way the earth is inhabited.[5] The second part of this chapter points to the postcolonial stance adopted by many inhabitants and activists, particularly those concerned with the important question of environmental justice. Drawing upon numerous fieldwork studies on both islands since 2011, as well as official reports and policies, these first two parts tell two different tales of a postcolonial toxic timescape. The third and final part of this chapter examines how the very existence of this sustained conflict has worked in favor of a more scrutinized and more comprehensive response by the French authorities, while also making invisible important dimensions of this toxic timescape. In particular, issues pertaining to social justice, gender equality, or nonhumans are seemingly absent from this conflict. In short, this chapter seeks to provide an understanding of toxic timescape that moves beyond this double fracture. The term *postcolonial toxic timescape* does not designate a toxic timescape that just happens to be located in a postcolonial setting but rather the double line of inquiry followed here: how the postcolonial condition affects the very constitution of, experiences of, and responses to a toxic timescape, and how the toxic timescape informs one's understanding of the postcolonial condition.

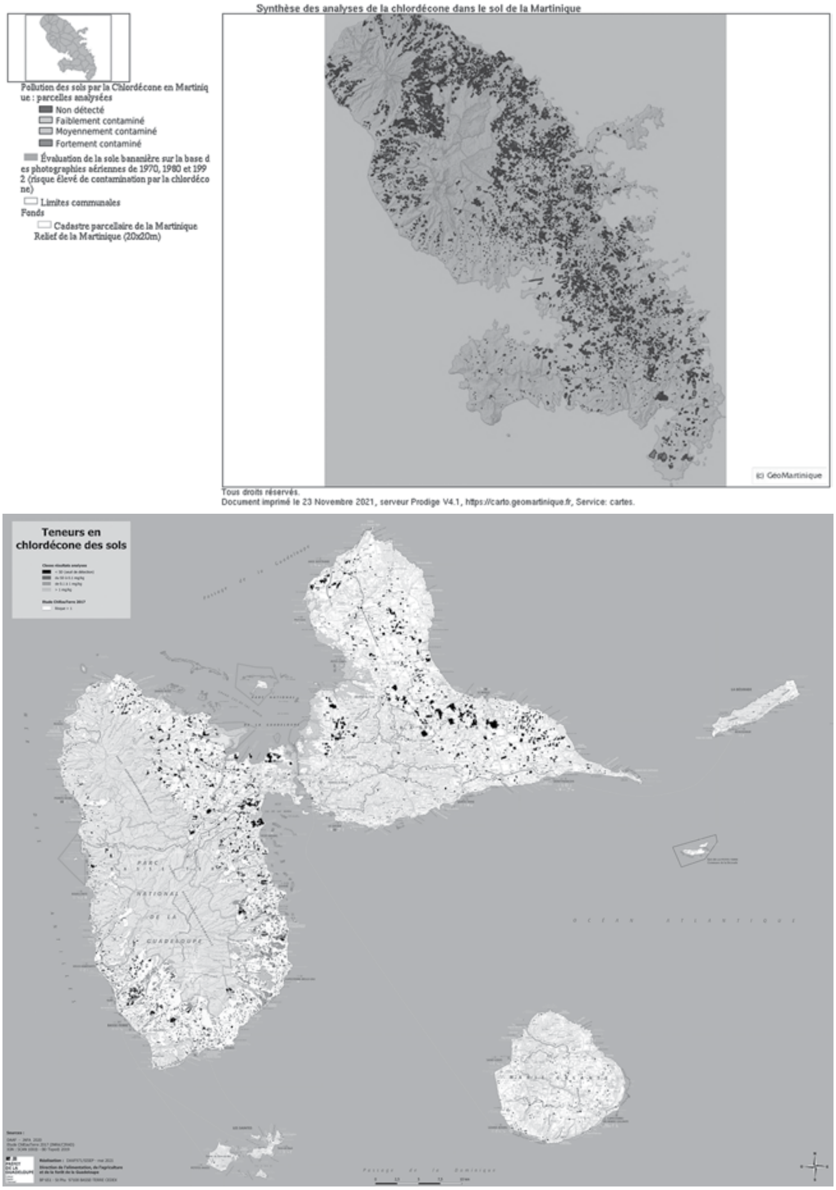
Before continuing, I must also acknowledge my position as a Martinican researcher. I was born and raised in Martinique at the time when CLD was still in use, and I still have family and friends living on the island today. Besides my academic research, working on this subject means walking the uneasy path of recognizing the contamination of my own body, and the bodies of my family and my friends. The comforting positivist illusion of a curtain that completely separates scientists from the object of their research quickly falls away. Moreover, because of my academic work, I have recently become one of the many actors in this affair. Since 2019, I have been asked to do a number of well-circulated televised and written interviews in mainland France and the Antilles. I have also been called upon to testify in the latest parliamentary investigation of the chlordecone contamination in September 2019 and I am now part of a group of scientists tasked with formulating research propositions that can help the French state to deal with this contamination. As a result, this chapter is also informed by my own experience.

The Governmental Perspective: An "Environmental Accident"

Since the beginning of the contamination in 1972, the French state has adopted a very technical and depoliticized definition of the CLD toxic timescape in Martinique and Guadeloupe. It can be found both in the different comments, responses, and policies adopted by the French government with respect to this contamination, and in the first two parliamentary reports of 2005 and 2009.[6] In this perspective, the toxic timescape is simply defined as the "accidental," long-lasting presence of one single molecule (the chlordecone), which happens to be toxic. This is the conclusion of the 2009 parliamentary report: "There has been an environmental accident in the Antilles, because the molecule used until 1990 remains trapped in the soil. There is no need to blacken the picture."[7]

Prior to 1975, CLD was first imported from the United States under the commercial name Kepone. Then, following the banning of this substance in the United States in 1975, it was manufactured in France under the name Curlone and solely used in the French Antilles until 1993. This pesticide took the form of a white powder that was spread around banana plants by agricultural workers to prevent a particular banana weevil (*Cosmopolites sordidus*) from damaging the root of the plant and, eventually, reducing the yield. Because bananas have been the largest agricultural export product of the Antilles since the 1960s, CLD was portrayed by local producers as essential to the economy of the islands. In a little over twenty years, one-sixth of CLD produced globally was sprayed on twenty thousand hectares of arable land on two densely populated islands, Guadeloupe and Martinique.[8] This led to a long-lasting, generalized, and harmful contamination (see figures 10.2a and 10.2b). Environmental models predict that, depending on the nature of the soil, the CLD contamination on Guadeloupe and Martinique may last from many decades to few centuries.[9]

This contamination has also spread from the banana plantations to the entirety of these islands' ecosystems, transcending both time and geographical boundaries. As a result, to this day, CLD is found in inland and coastal waters, in vegetable and animal foods, and of course, in human bodies. A 2018 study estimates that 92 percent and 95 percent of inhabitants are impregnated with chlordecone in Martinique and Guadeloupe, respectively, with an average concentration of 0.14µg/L and 0.13µg/L.[10] This contamination is also harmful. CLD is a toxic agent, an



FIGURES 10.2A AND 10.2B: Maps of the soil contamination with chlordecone in Martinique and Guadeloupe, respectively (2020). The shaded parts indicate the plots of land and regions where most of the contamination has been found. Because these maps evolve with additional testing, the white spaces simply indicate an absence of measurements at this point.[11]

endocrine disruptor, and a carcinogenic agent. The dangerous health impacts of acute exposure to CLD became infamous during the Kepone scandal in the US city of Hopewell, Virginia, in 1975. The workers at the producing factory had a number of health problems known as “Kepone syndrome,” including tremors of the limbs, weight loss, and reduced sperm quality.[12] Contamination led to a fishing ban in the James River and Chesapeake Bay, as well as the banning of the substance from the American market. So far, chronic exposure to CLD in Martinique and Guadeloupe has been proven to reduce the length of gestation, delay the cognitive development of infants, and increase the chance of prostate cancer and its recurrence.[13] It is important to bear in mind that, in 2018, Guadeloupe and Martinique had, respectively, the highest and second-highest rates of prostate cancer in the world.[14]

Framing this toxic timescape solely as an “environmental accident” serves at least three purposes for the French government. First, it allows the government to sustain a discourse on this contamination that confines it to the “environment” as opposed to humans, and thus minimizes the health risks. Such a stance in turn legitimates a delayed, slow, and low-level response. Despite the abundant research and the numerous alarms raised on the toxicity and persistence of CLD in Martinique and Guadeloupe by the Toxic Committee (1969),[15] by agricultural workers (1974), by those who implemented the US ban (1975), by French scientists (1977 and 1980), and by the International Agency for Research on Cancer (1979), the French state failed to respond, maintaining ignorance and giving the illusion of a completely safe situation.[16] Indeed, the French Ministry of Agriculture knowingly authorized a dangerous and persistent molecule in 1972 and kept it on the market even after it was banned in 1975 in the US. Not only did CLD remain authorized until 1993, but the first concrete measure to mitigate the health impacts on citizens from CLD occurred only in 2000. The French state implemented active charcoal filters in water catchments that would prevent inhabitants from Martinique and Guadeloupe from drinking CLD in their tap water. It had taken twenty-eight years of exposure for these first measures to be taken. In 2003, a new policy was introduced, requiring that soil be tested for chlordecone before the cultivation of certain root vegetables, such as yams and sweet potatoes, was allowed, as they are more prone to contain traces of CLD. Since 2007, inland rivers and part of the coastal waters have been closed to fishing. Since 2008, three interministerial plans have been implemented to define the health consequences of the contamination, characterize the pollution, and find depollution solutions. Programs have been put in place to help fishermen either to get early retirement or to find other professional activities, and to support local inhabitants whose family garden was contaminated to find ways to continue to cultivate their land. A fourth plan has been in place since 2021. Why did the French state take so long to protect the health of Martinicans and Guadeloupeans? The 2004 parliamentary report wrongly claims that there was insufficient scientific research done on the lasting toxic effects of CLD and that the general concern about the health consequences of pesticides was lower than it is today.[17] It concludes in short that there was nothing specific to the overseas French citizens in this affair.

Framing this contamination as an “environmental accident” and not a “health scandal” allows the government to minimize health risks and to instill doubt in the scientific research that established the danger of chlordecone. The political production of scientific doubt by the government has focused on the health issue that has garnered most attention: prostate cancer. In 2007, the cancerologist Dominique Belpomme attracted national attention by putting forth publicly the hypothesis of a relation between CLD and prostate cancer in Martinique and Guadeloupe. Belpomme and his organization Association pour la Recherche Thérapeutique Anti-Cancéreuse was contacted by the Martinican ecologist organization Pour Une Martinique Autrement to conduct a study on the health effects of pesticide exposure.[18] The response by governments and medical scientists was swift. Belpomme was summoned to a parliamentary hearing where an incendiary panel pointed to the poor scientific quality of his study and, indeed, the lack of sufficient scientific evidence to sustain his assertions on prostate cancers.[19] However, legitimate scientific doubt served a political purpose: to quiet down legitimate concerns by the population regarding their exposure to pesticides and the associated health risks. Despite the criticism of Belpomme, this event did help publicize the CLD contamination at a national level.[20] Furthermore, three years later, a scientific study conducted in Guadeloupe called Karuprostate established, with a stronger scientific basis, the very same link between CLD and prostate cancer.[21]

While this first study followed due process and the results were published in possibly the best scientific journal on the subject (*Journal of Clinical Oncology*), the first response in 2010 of the government was to request another study on Martinique (Madiprostate). It seems as if after this long history, the government still needed another nearly identical study on the other island before acknowledging the CLD cancer risks. While provisions and funding were found for such a study (the feasibility phase was well underway by 2012–13), the then head of the National Cancer Institute who requested this study, Agnès Buzyn, single-handedly decided to cancel the funding without first consulting with the group of experts in charge of evaluating the feasibility study.[22] Buzyn defended her decision by casting scientific doubt on the study. Since this study was using the same method as the previous one in Guadeloupe, she indirectly cast doubt on that previous research as well. Yet no public explanation of the scientific reason not to fund this research has been given to this day. Ultimately, it seems that the political objective of the government, that of minimizing the public perception of health risks posed by CLD, was used to judge the scientific methods of the epidemiological research.

Again, on October 20, 2018, following four days of the first international conference on CLD organized in Martinique and Guadeloupe, the major newspaper of Guadeloupe, *France-Antilles-Guadeloupe,* printed on its front page "the best specialists of chlordecone assured that no relation was established between the molecule (CLD) and any pathology." Blatantly dismissing the research done, this headline referred to the interview with Jerome Salomon, the head of the French health agency. Although CLD had been associated with an increased risk of prostate cancer, he insisted on the fact that CLD has not yet proven to be the *cause* of prostate cancer. The scientific difference between "association" and "causation" was publicized as being reason enough to cast political doubt on the danger of CLD.

Another instance occurred in February 2019, in the midst of the yellow vest movement in France. Emmanuel Macron, the president of France, convened a meeting with mayors and representatives of the Outre-mer (the overseas French territories). This meeting was part of the "great debate" tour he embarked on to quell the national social unrest. Infamously, when the subject of CLD came up, with the Ministry of Health's Agnès Buzyn at his side (the very same person that removed the funding for the research in Martinique), Macron declared, "We should not say that CLD is carcinogenic. It is established that this product is bad. There are some incidences that have been established scientifically. . . . But, I think we should not go as far as to say it is carcinogenic, because we both say something that is not true, and we fuel fears."[23]

Although the presidential team later claimed it was a simple misunderstanding, this statement participated in the political production of scientific doubt.[24] The doubt introduced regarding epidemiological research relies on the politically astute idea that if, somehow, the link between CLD and prostate cancer could be undermined, then the political protests would die down.[25] This in turns seeks to "normalize" the situation, reducing the issue of the rate of prostate cancer to the genetic composition of the population and possible other environmental factors, factors which so happened not to touch on the faults of the French state.[26] Certainly, as epidemiologists argue themselves, CLD alone is not responsible for prostate cancer, and men with West African ancestry in the United States and elsewhere have shown higher incidence of prostate cancers.[27] However, the issue here is not the discussion of the science of the relation between Black people and prostate cancer. The problem is the political use by the French government of what stands today as only an assumption, since it has not been scientifically established in Martinique or Guadeloupe, that minimizes the danger of a long-lasting pollution which state officials are known to have played an ill-advised part in bringing about in the first place. Not only does this attitude on the part of the French government politically dismiss a scientific epidemiologic study which has shown in Guadeloupe that exposure to CLD does increase the chance of prostate cancer, but it overlooks the other ways that exposure to this molecule has been shown to be harmful—in particular, its effects on the cognitive development of infants and the length of pregnancies.

Cornered by public protests and forced to recognize the health aspects of this toxic timescape, the government's second approach consists of keeping the number of people affected to a minimum. In September 2018, while in Martinique, President Macron declared that the French state "should take its *share* of responsibility in this situation" (emphasis added). The important word here is "share." Indeed, shortly after, the French government announced a plan to recognize CLD as a professional "pathology" for agricultural workers, leaving open the possibility of paying reparations *only to these workers.* While, indeed, agricultural workers are certainly those who have been exposed with the greatest intensity, having used CLD with their bare hands officially from 1972 to 1993, this tactic is insidious for two reasons. One, the government is well aware of the time that has passed between the period of 1972–93 and today, naturally reducing the number of people who can make a viable claim to these possible reparations. Two, it appears incoherent to pay reparations only for agricultural workers when more than 90 percent of inhabitants are contaminated by CLD.

Finally, framing the contamination as an "environmental accident" is also a way to remove any economic or political contentions. The 2004 parliamentary report starts with a statement on the issue of equal citizenship between the inhabitants of the overseas territories of France and those of mainland France following the official decolonization of 1946: "Very often overseas citizens have the feeling that the specificities of their socio-economical situations, their particular set of problems are not well understood, known or taken into account. Such assertation has no place [in this commission]."[28]

Perhaps the most important step taken to produce a narrative that does not look at social or political issues is by ensuring a marginal space for social science and humanities scholars in the decision-making process of the government. As a result, most of the scientific research and expertise that informs the policies of state and government has come from natural and medical scientists. The criticism here is not directed at the much-needed research conducted by microbiologists, agronomists, epidemiologists, and chemists, but at the dominant position of their research, as it used by state officials in designing their responses, mitigation programs, and policies. Out of the approximately 100 million euros allocated by the three interministerial CLD plans from 2008 to 2020, nothing so far has been allocated for the realization of comprehensive research within the fields of the social sciences and humanities. While funds have been allocated for long-lasting research on the medical effects and methods of depollution, only three or four articles have been written explicitly within the frame of the interministerial plan.[29]

This bias induces two damaging misconceptions. One, it establishes the idea that the natural and medical sciences on their own can outright tell the *whole* story of this postcolonial toxic timescape (definition, experience, and responses). This is an idea that is shared both by state officials and by some researchers. Two, it gives the impression that state officials on their own can adequately grasp the experiences and sociopolitical demands of the population. The result is the inclination of the state and government to enact policies that circumvent proper democratic principles with the argument that it is for "scientific reasons." For instance, the decision in 2003 to allow daily ingestion of CLD in local food via the maximum residue level was, at no point, debated publicly.[30] This bias is so ingrained that even the evaluations of the successive plans have been conducted without any social science and humanities scholars. The first major conference on chlordecone in Martinique and Guadeloupe was jointly organized in October 2018 by scholars in agronomy, epidemiology, and medicine on the one hand, and state officials from the ministries of agriculture, the environment, and health on the other hand. Not a single scholar in the humanities and social sciences had been invited to speak at the conference. This decided absence closes a loop where perspectives from the natural and medical sciences help define policies and, in return, help evaluate them, shielding the state from any criticism from the social sciences.

This bias is being challenged today. On the one hand, since 2017 state officials have been confronted with the failure of their policies; the growing anger of Martinican and Guadeloupean inhabitants via a number of demonstrations, petitions, renewed actions for justice; and media attention. The exclusion of inhabitants from the decision-making process vis-à-vis the policies is damning. On the other hand, well-intentioned scholars in the natural and medical sciences are growing frustrated at seeing how their results are being distorted and misinterpreted both by state officials and local inhabitants. Not only do they overlook the way scientific knowledge is being more and more questioned (particularly so if scientists are confused with state officials in the case of wrongful contamination), but they also neglect what Natalie Jas and Soraya Boudia termed the "powerlessness of science," the fact that the production of scientific knowledge alone is not sufficient to enact policies that promote public health and preserve the environment.[31] Because of this challenge, both state officials and scientists now recognize the need to "include" more social scientists and promote more participation from civil society. Some efforts have been made. For instance, as a social science scholar, I was invited to be part of Groupe d'Orientation et de Suivi Scientifique (GOSS), a scientific consortium which suggests and monitors the publicly funded research on the matter. Calls for research on depollution methods now include a line on the societal impacts of their proposed technical method.

However, the willingness to include social sciences and humanities scholars has not led to a reflexive deconstruction of this bias toward the natural and medical sciences, thus maintaining a presumably evident hierarchy. Paradoxically, the inclusion of social scientists is seen as a means to reinvigorate this bias. Inside the GOSS, so far, I am the only one. Far from representing a change, social sciences are seen as magical tools that could unlock the situation. Social sciences should help local inhabitants "accept" policies by state officials that are perceived to be good in themselves, and help natural and medical scientists "adequately" communicate their scientific results and knowledge. From this perspective, social sciences are supposed to help reform a civil society that is perceived to be ill-intentioned or somehow not intelligent enough to deal with science. On the one hand, justice and the democratic demands of society are not seen as legitimate parts of the political life of democracies and as practices of citizenship but as pathologies to be therapeutically dealt with. On the other hand, the idea that social science research on its own (and not only as a sidekick to the "real" science) should be carried out and brought to the discussion table has yet to be fully accepted.

One instance of this approach occurred on October 29, 2019. I was interviewed that day by two representatives of the General Inspection of Social Affairs—a lawyer and an environmental scientist who were in charge of conducting the evaluation of the third CLD plan. Their first and well-intentioned question was "How do we include the population in this plan?" I expressed my surprise at a government agency seeking answers from social scientists on their plan, when they have not yet financed any long-term social sciences research on the subject. I doubt one would have asked an epidemiologist to advise on a policy plan with no research data on which to base their advice. They seemed quite taken aback by my response: "Fund more social sciences research." Hopefully this message would be passed along.[32]

To sum up, five major absences are noteworthy in this "environmentalist" perspective. First, the definition of the problem is only concerned with one single molecule in an environment where many different toxic molecules have been used. The toxic timescape is defined as that of chlordecone, and chlordecone alone. Second, the suffering and anguish caused within different groups of inhabitants associated with the physiological consequences of this toxic molecule and the psychological consequences of knowingly being exposed to this contaminant are not taken into account. While present at the 2018 international conference on CLD in Martinique and Guadeloupe, I repeatedly made the comment that the difference between 22 and 18 μg/l in blood (the authorized limit being 20 μg/l) tells us nothing of the meaning and suffering associated with the pollution for the person whose blood was being tested. Third, the socioeconomic consequences induced by this contamination—such as the loss of economic activities by fishermen and local farmers—have not been studied nor measured so far. Fourth, and furthermore, the nature and structure of the banana economy has never been questioned. On the contrary, the 2009 CLD parliamentary report reaffirms the importance of this sector of the economy for the islands, lauding the efforts of producers in reducing their pesticide use and calling for the development of biotechnology capable of sustaining this production.[33] In other words, a parliamentary report that investigated the consequences of a long-lasting and toxic pollution, which reflects the prioritization of the economic importance of banana production over the health consequences of CLD use, concludes by defending the very same production for its very economic importance. Finally, the postcolonial and postslavery context in which this contamination takes places is carefully silenced.

Local Activists' Perspective: A "Colonial Discrimination"

Alongside the technical perspective of the toxic timescape of the French government, local inhabitants, local NGOs, and activist collectives in Martinique and Guadeloupe offer a different conceptualization. First, regarding the definition of the situation: in the discourse of inhabitants, the contamination of CLD is not focused on one single molecule but has often been articulated with concern about other toxicants. The first public protest that mentioned chlordecone occurred in Martinique in 1974 during an agricultural workers' strike. Amidst demands for higher wages, better working conditions, regular hours, regular pay, and boots and gloves to work in, they also requested "the total suppression of toxic products (Mocap, Nemacur, Kepone, Hexafor and other organochlorines)."[34] Having experienced the toxicity in their very flesh, CLD is but one of all of the different toxic molecules that constituted their toxic timescape. During the 1980s and 1990s, many environmental NGOs in Martinique, including Assaupamar, made repeated demands to have full transparency on the pesticides used and their possible presence in the water. In 2007, Louis Boutrin and Raphaël Confiant published a book that denounced the CLD contamination in Martinique and Guadeloupe *together with* other molecules such as mirex, lindane, HCH, and most disturbingly, paraquat, which was still being used at the time.[35] In 2003, at a time when many European countries were banning paraquat, France had agreed to continue the use of paraquat particularly in the overseas departments, exhibiting a similar disregard for public health.[36] During the demonstrations against the use of aerial spraying in Martinique and Guadeloupe that took place from 2012 to 2014, CLD also featured in concert with other pesticides.[37] A 2018 study found that, at least until 2015, banana workers were still being exposed to fourteen potentially carcinogenic molecules.[38] Furthermore, activists against CLD pointed out, also in 2018, the use of another type of carcinogenic pesticide in sugar cane, namely asulox.[39] This situation echoes that of Vietnam, presented by David Biggs, in this volume, where the political focus on one single toxicant (Agent Orange) hides numerous others.[40] In the French Antilles, even if CLD occupies the center stage, the postcolonial toxic timescape is not solely defined by one single molecule but encompasses different pesticides that sustained and still sustain a plantation economy.

More recently, this toxic timescape has expanded to substances other than pesticides. In the last decade, Martinique and Guadeloupe have been subjected to the arrival of large quantities of sargassum. These algae land on the Atlantic side of the islands. As they decompose, they emit a very noxious gas called hydrogen sulfide. Inhabitants of the Martinican towns of François and Vauclin, full of banana plantations, are exposed to pesticides such as CLD and to this gas. Furthermore, attempts to collect and reuse this sargassum for fertilization purposes are hampered by the contamination of the coastal waters by CLD. As a result, this also accumulates in the sargassum. The possibility of recycling this alga as a fertilizer runs the risk of bringing CLD back onto the land. Here again, the toxic timescape is wider than just one molecule or one source of toxicity. CLD is part of a "landscape of exposure," perceived as a landscape of injustices.[41]

Second, the definition of the toxic timescape is inextricably associated with the political history of CLD's authorized use, how this came to an end, and the elapsed time before mitigation measures were taken. For most inhabitants of Martinique and Guadeloupe, one thing is certain: the prolonged use of CLD and the ensuing contamination are no accident. The CLD affair is deeply embedded in the numerous state failures to protect the health of local inhabitants, repeatedly choosing to give credence to the financial aspirations of a few banana companies. The first demand to authorize the use of CLD in Martinique and Guadeloupe occurred in 1968. The Toxic Committee refused to grant this authorization because of concern for CLD's toxicity and long persistence in the soil. Yet, in 1972, under the guidance of former president Jacques Chirac, then minister of agriculture, CLD was authorized. The incrimination of the banana companies and state agencies goes a step further after 1976. That year, the United States, the sole producers of Kepone, banned its production because of the environmental and public health risks associated with it.[42] Far from also banning the use of this molecule in Martinique and Guadeloupe, the French state and the Antillean banana companies actively organized the continuation of its use. A local Martinican company, Vincent de Lagarigue, bought out the patent from Allied Chemicals and organized for CLD to be produced domestically *in France* and sold under the commercial name Curlone. The Ministry of Agriculture was quick, for its part, to authorize this new French-made product. As result, the use of CLD continued until 1993.

The way CLD use came to an end also occupies a very important part in the definition of this toxic timescape. Following a European review of policies regarding pesticides, CLD was finally banned in France in 1990. However, the law allowed an additional two years of use to "empty out" the stock. Although legal, this two-year period was deemed illegitimate. Furthermore, after these two years, from 1992 to 1993, the Ministry of Agriculture also gave two more extensions to the banana producers, clearly prioritizing the profit of banana plantations and forsaking once again the concern for public health and ecosystems. These illegal authorizations form the basis of a lawsuit initiated on both islands in 2006 and 2007 for the crime of poisoning, and which is still ongoing today. Adding insult to injury, in 2018, a journalist from *Le Monde,* who obtained classified information from the justice action in process, revealed that, far from emptying out their stock, the banana company that produced CLD domestically used this extension time to produce and stockpile even more CLD.[43] The French state is again deemed to be at fault with respect to the time taken to adopt the first mitigation measures once the toxicity of this product was known. Besides the agricultural workers' protest in 1974 and the end of US production in 1975, two scientific reports pointed out the CLD pollution in Martinique and Guadeloupe in

1977 and 1980, respectively.[44] Yet, the French state waited until 2000 to initiate the first mitigation measures to protect the islands' inhabitants. A willful ignorance was maintained by not testing the water for CLD during regular controls. Fishing in rivers and parts of the coastal waters was closed only in 2008, more than thirty years later. Inhabitants do not understand why, once the pollution was known about, the state took so long to act.

Finally, a number of actions have been taken to specifically criticize the manner in which the state is handling this long-lasting contamination, which is also perceived as an injustice. The choice by the state to allow a certain level of daily intake of CLD, the lack of integration of other pollutants, and the relative opacity of the process are denounced. For many inhabitants, if a molecule is toxic, then any quantity of that molecule authorized in food residues is too much. That is the meaning of the "zero" in the name of the Martinican collective called Zero Chlordecone Zero Poison. The consequence of the normalization of this postcolonial timescape by the French state is the production of an "other" body, a postcolonial body whose excessive exposure to toxicity is also deemed normal.

Third, beneath this layer of injustice caused by the failure of the French state agencies—failures that happen all around the world, including in mainland France, as was the case for asbestos[45]—this CLD contamination is associated with a deeper sense of injustice related to the France's history of colonialism and slavery. Here, the political history and political economy of this contamination are of utmost importance. On the one hand, these repeated failures of the French state take place in the midst of a long history of mistrust of the state on the part of Martinicans and Guadeloupeans. In 1946, the departmentalization law defended by Aimé Césaire, which transformed Martinique and Guadeloupe from "colonies of France" to "overseas departments of France," was predicated upon the promise of equal citizenship and equal social rights.[46] Yet, since the late 1960s a disillusionment has taken hold, as people have realized that this republican promise would in fact not be fulfilled.[47] The overseas territories of France rank the lowest in many social and infrastructure categories, including employment rates. Many political parties that call for independence were created based on the belief that the islands' inhabitants would never be treated equally as long as they remained nonsovereign territories. If the demand for independence has lessened since the late 1970s, the demand for "true equality" is still very strong.[48] From this perspective, CLD is also perceived to be a sign of these everlasting inequalities between the overseas territories of France and mainland France—that is, the remains of a colonial bias in the French government. In 2013, the president of the local Martinican doctors' organization, Dr. Josiane Pelage, expressed this view given the French government's policies regarding pesticides uses in Martinique and Guadeloupe: "Between the life of the banana plant, and the human life, the state clearly chose the banana plant, expressing its cynical attitude toward demands for public health from its inhabitants and particularly those of the overseas territories. Shall we see, like others, the remains of this old colonial mindset which, built on the shameful assertion of the inferiority of the Indigenous person, considers his or her life as an insignificant value."[49]

On the other hand, the CLD pollution was created by specific economic actors, the banana producers, who mostly belong to one specific ethnic group called "Béké," the White Creoles. Not only did this group used to boast about an endogamous policy in order to preserve the "White race," but they also identified themselves as the descendants of the first colonists and slave owners of Martinique and Guadeloupe. CLD brings to the fore a racial opposition between a part of a White minority who have contaminated islands that are inhabited by predominantly Black people and reenact oppositions between masters and slaves. As a result, CLD is also understood as one of the marks of this slavery history and its plantations, as one reminder of this crime against humanity for which, to this day, no justice has been done. Metaphorically, CLD is seen as a sign of the control of the former masters over land, via banana plantations, and over the former slaves—a control which can unilaterally decide what molecule goes into everyone's body and into the rest of the ecosystem. In short, from this perspective, this toxic timescape exceeds the mere confine of environmental pollution. CLD becomes in itself a colonial mark to be removed from one's own body.

Framing CLD as a postcolonial and postslavery injustice has yielded various protests that call for environmental justice.[50] Three interrelated themes are found in these protests. First, they call for a juridical outcome to the situation where the persons or groups responsible for the contamination are recognized and punished for their crime. In 2006 and 2007, local NGOs in Martinique (Assaupamar, Ecologie Urbaine) and Guadeloupe (SOS environnement, Union Régionale des Consommateurs, Agriculture-Santé-Société-Environnement, and the Union des Producteurs Agricoles de Guadeloupe) and one medical doctor (Dr. Denivet) took part in justice actions to denounce willful poisoning by the state. These organizations encountered many difficulties in their action. Fourteen years later, the case is still ongoing. Although not exceptional, the long duration of this justice action is perceived by the claimants to be a strategy to avoid enacting justice for the citizens of Martinique and Guadeloupe.[51]

Following a decision by ANSES (the national agency for food, environmental, and occupational health and safety) that de facto increased the acceptable level of CLD in meat products, a 2017 petition by two agricultural students gained traction with the sign "I am chlordeconed," mimicking the sign "I am Charlie" that was well publicized after the January 2015 Paris terrorist attacks. At that time, a member of the regional health agency, Eric Godard, called out his own administration regarding its reluctance to share crucial toxicity information with the general public. Public demonstrations explicitly directed at the chlordecone scandal also took place in April 2018 in Martinique organized by the Zero Chlordecone collective. This collective brings together numerous local NGOs, political parties, and personalities. In March and April 2018, they organized a social forum formulating fifty-two demands to be met by the government. New justice actions were initiated. In Guadeloupe, the NGO ENVIE-Santé launched a legal action against the state for the continued exposure to CLD.[52] During the 2018 and 2019 demonstrations led by the Zero Chlordecone collective, workshops were held to encourage activists to register and file an official complaint against the French state. More than two thousand juridical complaints have been filed and are awaiting a response from the administrative tribunal. Again, in 2019, a new justice action was taken by two NGOs, one in Guadeloupe (Vivre) and one in mainland France (CRAN), calling attention to the moral prejudice endured by inhabitants of Martinique and Guadeloupe and calling for the state to pay reparations.[53]

These political critiques have also gained visibility through a growing number of artistic critiques. Beside the numerous designs and paintings on the signs and banners used in demonstrations since 2013, including the use of fake Chernobyl-like masks, a number of writers (Yves Marie Seraline, Veronique Kanor), artists (Gerald Marie-nelly, Jean-François

Boclé, Fwaiz photographie, Stéphanie Melyon-Reinette), painters (Patricia Donatien), and singers (Bobi, Ivan Ras, Luch'ko and Sistah Naya, Manu Rosemond, Wozan Monza, Neg Lyrical, and Volkan Berhane Sélassié) have produced pieces that reflect strong views on this contamination—denouncing a genocide, exposing the suffering of people who have become ill because of CLD, condemning the continuation of a master's mentality toward Black people—and carry very disparaging words toward the government. Most notably, in 2018, a few activists decided to subvert the publicity panels along the side of the main highways in Martinique and install instead a particularly powerful ad. The image portrayed a Black woman sitting on a chair wearing a red, white, and blue toga symbolizing the French nation, while her right breast has been amputated because of breast cancer. She is receiving a "blood" transfusion from a banana plant, while holding a book by Frantz Fanon in her right arm. The title reads "the Comédie-Française presents 'impure blood,'" a nod to the controversial chorus of the French national anthem. Different texts accompany this ad, sarcastically depicting the contamination situation as the latest "must-have novel" or an absurd "theater play."

Following the intensification of protest and at the demand of the opposition to the Macron government (La France Insoumise), a parliamentary investigation was opened in 2019 into the chlordecone contamination, headed by the deputies Serge Letchimy and Justine Benin, from Martinique and Guadeloupe, respectively. Contrary to the parliamentary "information mission" in 2004 and the parliamentary report in 2009, this "investigation" has more power, including to summon anyone to come and testify, and has the possibility to initiate a justice action. From July to December 2019, a number of different actors from civil society, government, and state agencies, as well as researchers (including myself), were publicly heard by this commission. The final report is extremely damning, publicly putting the responsibility for this debacle onto the French state and, to a lesser extent, the banana companies.[54] During these hearings, the commission also revealed very disturbing actions taken by authorities regarding CLD: CLD was still commercialized illegally on the islands after the controversial delayed ban in 1993;[55] leftover piles of CLD had been buried beneath a high school playground in Guadeloupe; archives regarding the authorization of this molecule had mysteriously disappeared; officials from the regional health agencies of Martinique and Guadeloupe were informed by a laboratory of the presence of CLD in tap water as early as 1991 but decided not to act and told the laboratory not to conduct further testing and research.[56] Everywhere you look, the use of CLD contravened the law, raising suspicion of corruption and bribery. Yet, to this day, not a single person has been tried or indicted. This absence of justice appears particularly damning with respect to the juridical proceedings of the case of CLD in the United Stated. Less than three years after the production of CLD was halted in Hopewell in 1975, Allied Chemicals and the city of Hopewell were taken to court—the responsible parties had been designated, fines were handed out, and the people of Hopewell could move on with the mitigation and depollution process.[57] More than forty-seven years after the use of CLD in the French Antilles, no single party has been designated in court.

Since October 2019—following the revelations of the 2019 parliamentary commission in Martinique—the protests have taken a more radical turn. On November 24, 2019, and January 12, 2020, two public protests against chlordecone were organized in the street of Paris, bringing together many Martinicans and Guadeloupeans living in the region, shouting their anger at the situation.[58] Angry demonstrations were held in front of the local health agency of Martinique (the same institution that turned a blind eye to the contamination). Similarly, every weekend, activists block the entrances of different supermarkets, some owned by members of the Béké socioethnic group, leading to violent clashes with the national police. On November 13, 2019, seven Martinican activists were arrested for their blockade. Their trial was meant to take place in Fort-de-France (Martinique) on January 13, 2020. Anger was heightened in the face of such a discriminatory enactment of justice. On the one hand, local banana companies and some state officials had polluted the islands, possibly for many centuries, and yet, in forty-three years, not a single individual among the banana producers or government has been arrested or tried in court. On the other hand, local activists denouncing the wrongful exposure of the population to CLD have been swiftly arrested and taken to court within two months. The morning of January 13, a hundred or so activists gathered outside of the court in support of their comrades with signs that read "Who are the real criminals?" They had the support of Martinicans and Guadeloupeans in mainland France who, the day before, had also demonstrated in the streets of Paris in support of these activists with signs reading "slavery and chlordecone: the same disdain by the state."[59] That morning in Martinique, local police prevented them from entering the court, and violent clashes ensued. The police fired flash-balls, causing many injuries among younger and older activists. Bleeding mouths, muscle tears, bruised arms and skulls, burning trash cans, and tear gas created the impression of a combat zone in Fort-de-France all throughout the day and well into the night. The lawyers refused to proceed in such conditions and the trial was postponed to June. Thus, the toxic timescape became the scene of a battle for the dignity of the inhabitants of Martinique and Guadeloupe.

In sum, civil society's response points to both sides of the toxic timescape. In other words, the presence of toxics did not start with the use of chlordecone but goes back much farther. Because of the history of the numerous failures of French state agencies to care for the health of the inhabitants of Martinique and Guadeloupe, and the contamination's embeddedness in slavery and the colonial foundation of France, the CLD contamination is more than the presence of a toxic pollutant in their ecosystems and bodies. In addition to the slow violence, to the years of life deprived of good health, to the anxiety regarding the possible consequences of knowingly living on contaminated land, CLD's presence in these islands also becomes the trace of a long-lasting injustice that has yet to be addressed and recognized by the authorities.

Beyond the Toxic Timescape, the Struggle for a Decolonial Ecology

In this conflict, an opposition exists between civil society and the government regarding the definition of, experience of, and adequate response to this contamination. Far from being solely a question of the science of the toxic timescape, this opposition is in itself a political conflict—a conflict that is bound up with a long and legitimate defiance on the part of the postcolonial citizens of Martinique and Guadeloupe toward the French state. On the one hand, remaining on the "environmental" side of the double fracture of modernity by reducing the scope of the contamination to a minimum allows the French state to remove itself from most of the ongoing postcolonial critique. On the other hand, for most of the local activists, if this contamination is indeed particular in its duration and health impacts, it is seen first and foremost as another example of a continued colonial attitude toward Martinicans and Guadeloupeans, and their islands. Such opposition regarding the toxicity and carcinogenicity of the pollution echoes the work of Gabriel Hecht on nuclear power. The same process in the former colonizer's country would be considered nuclear, whereas in the formerly colonized countries it is deemed safe.[60] However, unlike in the case of a sole agent who would single-handedly decide the level of toxicity, the very existence of this conflict in Martinique and Guadeloupe has in turn had significant consequences on the perception of this toxic timescape and the actions of the French state. In any case, three consequences of this conflict are worth mentioning here.

First, if the claim by activists that the CLD contamination is a case of colonial discrimination has been publicly dismissed by the government, this claim still haunts their actions. Taking a cosmopolitical outlook on the chlordecone contamination highlights this fact. First manufactured in the United States, CLD has been used in more than twenty countries in the world, including in Latin America, Africa, and Europe. If the intensity of the exposure of Martinicans and Guadeloupeans is particularly extreme (one-sixth of global production on two small and densely populated islands), chronic exposure to chlordecone is not specific to Martinique and Guadeloupe. For instance, CLD has been found in rivers and fish in Lower Saxony in Germany.[61] Yet, so far, this environmental contamination has not given rise to similar attention elsewhere. What is even more absurd and indicative of this difference is the fact that the German newspaper *Welt* published a story on Martinique and Guadeloupe in November 2018 insisting on the very grave situations there while remaining completely silent on the fact that the very same molecule was present in German soil.[62] A significant part of the CLD produced in the US was sent to Germany.[63] Why, then, did the CLD contamination become such an important public issue in France? Besides the political requirements of a rule of law (it is more difficult to raise such question under politically unstable regimes in South America or Africa, where governments are prone to a different level of violence against their own citizens), I hypothesize that it is the very existence of the political claim of colonial discrimination, the recognition of various links with France's history of colonialism and slavery, that has compelled the government to take far more action than other countries. Thus, the success of activists in sustaining this political conflict, and in framing this contamination as a challenge that goes to the very heart of the postcolonial relationship between France and its overseas territories, has pushed the French state to take some actions—although still not enough, according to activists.

Second, the prominence of the (post)colonial dimension of the conflict has meant other key aspects of this toxic timescape have been relegated to the background. In all of the public discourse, actions, meetings, demonstrations, and even artistic critiques, one cannot but notice the conspicuous absence of agricultural workers. Those who have perhaps most intensely endured the consequences of these molecules are rarely heard. Their absence is a sign of the invisiblization of the social question at the heart of the CLD contamination. In the past two years, however, a Martinican agricultural workers collective, Le Collectif des Ouvriers Agricoles Empoisonnés par les Pesticides, has entered the public debate on CLD, bringing to the fore the experiences and demands of agricultural workers on this matter.[64] Furthermore, in this conflict, the toxic timescape is rendered genderless. Little attention is paid to the female body's experience of this contamination. The main health issue publicized is that of prostate cancer, a male pathology. Other than their reproductive functions (length of gestation), what place do women hold in the understanding of this situation? Finally, on both sides of the conflict, the issue of the well-being of the ecosystem has been left out. Most of the political and juridical attention has been devoted to the way this contamination affects humans. Nothing has been done with respect to the consequences for nonhumans, the land, and the ecosystem. While local activists go as far as making claims of genocide,[65] very few put forth the claim of ecocide: that is, the recognition that this contamination was *also* an offense against the very land they inhabit.

Third, beyond the sole conflict of *defining* this toxic timescape lies an opposition regarding the societal project each party envisions. On the French government's part, its definition of the toxic timescape reflects a capitalist and neoliberal perspective on the way people should live together and inhabit the land. As a result, at no point in their discourse was the question of the profits made by the banana companies on the back of this dire pollution mentioned, nor the poor state of subsistence farming. In other words, beyond preserving the French state's honor or the desire to save public funds, the attitude of the French government serves the purpose of maintaining a capitalist norm in these postcolonial societies. On the part of the activists, defining this contamination as a postcolonial toxic timescape allows not only for criticism of the French state's actions but, more importantly, for the proposition of different normative ideas of one's own body and of society. Aspects of this project are portrayed, for instance, in the 2018 social forum but also in the recommendations of the 2019 parliamentary commission on chlordecone.[66] These include balancing export agriculture with the development of a proper subsistence-farming economy, preserving the environment from further dangerous pollution, equality among citizens, and the right to justice.

Besides the criticism of the state and the pursuit of environmental justice, many local activists have attempted to put in place concrete solutions to promote a different relation to the land. One of the most remarkable examples is that of a Martinican collective called Chlordetox. Mainly run by women, this collective put in place an experimental protocol to remove CLD from one's own body. First a person tests his or her blood for CLD. Provided no further exposure to CLD is encountered, then after four years, most of the CLD would be eliminated. As a result, they have successfully petitioned the government to have the expensive CLD test be paid for (currently it costs 80 to 140 euros) while developing organic farming practices with local farmers to ensure no more CLD exposure occurs. In December 2019, the French parliament sided in favor of a CLD test free of charge. Through their actions and sustained efforts, activists are calling for a political and ecological transformation in Martinique and Guadeloupe in the way people inhabit these islands, are treated by the French state, and relate to their ecosystems and body. Interviewing many activists over the past nine years, I have referred to these envisioned changes as a *decolonial ecology.*

To conclude, the case of the chlordecone contamination in Martinique and Guadeloupe attests to the struggle of local inhabitants with the French state to make visible the multiple dimensions of this postcolonial toxic timescape. Beyond the issues of environmental impacts and mitigation, and the debate over the extent of the associated health risks and reparation, lies a struggle both to assert the dignity of the citizens of these postcolonial islands and, beyond this contamination, to lay the ground for a livable world.

Notes

1. Rob Nixon, *Slow Violence and the Environmentalism of the Poor* (Cambridge, MA: Harvard University Press, 2011).
2. Michelle Murphy, *Sick Building Syndrome and the Problem of Uncertainty: Environmental Politics, Technoscience, and Women Workers* (Durham, NC: Duke University Press, 2006); Madeleine Akrich, Yannick Barthe, and Catherine Rémy, eds., *Sur la piste environnementale: Menaces sanitaires et mobilisations profanes* (Paris: ParisTech-Presses des Mines, 2010); Gregg Mitman, Michelle Murphy, and Christopher Sellers, eds., *Landscapes of Exposure: Knowledge and Illness in Modern Environments,* Osiris 19 (Chicago: University of Chicago Press, 2004).
3. Joseph Gusfield, *The Culture of Public Problems: Drinking-Driving and the Symbolic Order* (Chicago: University of Chicago Press, 1984).
4. Malcom Ferdinand, *Decolonial Ecology: Thinking from the Caribbean World,* trans. Anthony P. Smith (Cambridge, UK: Polity, 2022).
5. Walter Mignolo and Arturo Escobar, eds., *Globalization and the Decolonial Option* (London: Routledge, 2010); Ann Laura Stoler, *Imperial Durabilities in Our Times* (Durham, NC: Duke University Press, 2014); Dorceyta Taylor, *Toxic Communities: Environmental Racism, Industrial Pollution, and Residential Mobility* (New York: New York University Press, 2014).
6. J. Beaugendre and P. Edmond-Mariette, *Rapport d'information sur l'utilisation du chlordécone et des autres pesticides dans l'agriculture martiniquaise et guadeloupéenne* (Paris: Assemblée nationale, commission des Affaires économiques, de l'Environnement et du Territoire, 2005); J. Le Déaut J. and C. Procaccia, *Rapport sur les impacts de l'utilisation de la chlordécone et des pesticides aux Antilles: Bilan et perspectives d'évolution* (Paris: Office parlementaire d'évaluation des choix scientifiques et technologiques, 2009).
7. Le Déaut and Procaccia, *Rapport sur les impacts de l'utilisation de la chlordécone,* 43.
8. Malcom Ferdinand, "De l'usage du Chlordécone aux Antilles: L'égalité en question," *Revue française des affaires sociales: Enjeux environnementaux, protection sociale et inégalités sociales* 1, nos. 1–2 (2015): 163–83.
9. Y.-M. Cabidoche et al., "Long-Term Pollution by Chlordecone of Tropical Volcanic Soils in the French West Indies: A Simple Leaching Model Accounts for Current Residue," *Environmental Pollution* 157 (June 2009): 1697–705.
10. Santé Publique France and ANSES, *Martinique/Guadeloupe. Évaluation des expositions à la chlordécone et aux autres pesticides. Surveillance du cancer de la prostate. Les résultats des études récentes de Santé publique France et de l'Anses* (Saint-Maurice: Santé publique France, 2018).
11. "Surveillance des contaminations au chlordécone," Plan Chlordécone, last modified June 11, 2018, https://www.chlordecone-infos.fr/content/surveillance-des-contaminations-au-chlordécone.

12. Environmental Protection Agency (EPA), *Toxicological Review of Chlordecone (Kepone): In Support of Summary on the Integrated Risk Information System (IRIS)* (Washington, DC: EPA, 2009).
13. Philippe Kadhel et al., "Chlordecone Exposure, Length of Gestation, and Risk of Preterm Birth," *American Journal of Epidemiology* 179, no. 5 (2014): 536–44, https://doi.org/10.1093/aje/kwt313; Renée Dallaire et al., "Cognitive, Visual, and Motor Development of 7-Month-Old Guadeloupean Infants Exposed to Chlordecone," *Environmental Research* 118 (2012): 79–85, https://doi.org/10.1016/j.envres.2012.07.006; Luc Multigner et al., "Chlordecone Exposure and Risk of Prostate Cancer," *Journal of Clinical Oncology* 28, no. 21 (2010): 3457–62, https://doi.org/10.1200/jco.2009.27.2153; Laurent Brureau, "Endocrine Disrupting-Chemicals and Biochemical Recurrence of Prostate Cancer after Prostatectomy: A Cohort Study in Guadeloupe (French West Indies)," *International Journal of Cancer* 146, no. 3 (2020): 657–63, https://doi.org/10.1002/ijc.32287.
14. Freddie Bray et al., "Global Cancer Statistics 2018: GLOBOCAN Estimates of Incidence and Mortality Worldwide for 36 Cancers in 185 Countries," *CA Cancer Journal for Clinicians* 68, no. 6 (2018): 394–424, https://doi.org/10.3322/caac.21492.
15. This is the state committee in charge of authorizing the use of pesticides.
16. Scott Frickel, "Absences: Methodological Note about Nothing, in Particular," *Social Epistemology* 28, no. 1 (2014): 86–95; Robert N. Proctor, *Golden Holocaust: Origins of the Cigarette Catastrophe and the Case for Abolition* (Berkeley: University of California Press, 2011).
17. Beaugendre and Edmond-Mariette, *Rapport d'information sur l'utilisation du chlordécone,* 21.
18. Dominique Belpomme et al., *Rapport d'expertise et d'audit externe concernant la pollution par les pesticides en Martinique: Conséquences agrobiologiques, alimentaires et sanitaires et proposition d'un plan de sauvegarde en cinq points,* Association pour la recherche thérapeutique anti-cancéreuse (Paris: ARTAC, 2007).
19. LeDeaut and Procaccia, *Rapport sur les impacts de l'utilisation de la chlordécone,* 185–88.
20. Didier Torny, "Le chlordecone aux Antilles: De la découverte de la pollution à la construction de la crise sanitaire," in *Impact sanitaire de l'utilisation de la chlordécone aux Antilles françaises, recommandations pour les recherches et actions de santé publique* (Saint-Maurice: INSERM et INVS, 2009), 5–16.
21. Multigner et al., "Chlordecone Exposure."
22. Hearing of Luc Multigner by the parliamentary commission of 2019, led by Serge Letchimy and Justine Benin. See Serge Letchimy and Justine Benin, *Rapport au nom de la commission d'enquête parlementaire sur l'impact économique, sanitaire et environnemental de l'utilisation du chlordécone et du paraquat Tome II compte rendu des auditions* (Paris: Assemblée nationale, 2019), 25–40.

23. Faustine Vincent, "Chlordécone: L'Elysée plaide le 'malentendu' après la déclaration polémique de Macron," *Le Monde,* February 4, 2019, https://www.lemonde.fr/politique/article/2019/02/04/chlordecone-l-elysee-plaide-le-malentendu-apres-la-declaration-polemique-de-macron_5419206_823448.html.
24. For similar instances of production of scientific doubt by the tobacco industry, see Erik M. Conway and Naomi Oreskes, *Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming* (London: Bloomsbury, 2010); Proctor, *Golden Holocaust.*
25. Malcom Ferdinand and Luc Multigner, "Chlordécone et cancer: à qui profite le doute?," *The Conversation,* November 25, 2019, http://theconversation.com/chlordecone-et-cancer-a-qui-profite-le-doute-113334.
26. Akrich, Barthe, and Rémy, *Sur la piste environnementale,* 7–52.
27. William E. Grizzle et al., "Self-Identified African Americans and Prostate Cancer Risk: West African Genetic Ancestry Is Associated with Prostate Cancer Diagnosis and with Higher Gleason Sum on Biopsy," *Cancer Medicine* 8, no. 16 (2019): 6915–22, https://doi.org/10.1002/cam4.2434.
28. Beaugendre and Edmond-Mariette, *Rapport d'information sur l'utilisation du chlordécone,* 9.
29. Pierre-Benoit Joly, *La saga du chlordécone aux Antilles françaises: Reconstruction chronologique 1968–2008* (Paris: INRA et sciences en société, 2010); Mathieu Fintz, *Éléments historiques sur l'arrivée du chlordécone en France entre 1968 et 1981* (Paris: AFSSET, 2009); Didier Torny, "Gérer une pollution durable, le cas du chlordécone aux Antilles françaises," *Courrier de l'environnement de l'INRA,* no. 59 (2010).
30. Martin Hirsh, *Avis de l'Agence français de sécurité sanitaire des aliments relatifs à l'évaluation des risques liés à la consommation de denrée alimentaires contaminées par la chlordécone en Martinique et en Guadeloupe,* ANSES, December 10, 2003.
31. Soraya Boudia and Natalie Jas, *Powerless Science? Science and Politics in a Toxic World* (New York: Berghahn Books, 2014).
32. To that end, I organized the first workshop on chlordecone from a social sciences perspective, which took place November 6–7, 2019, in Paris. The report and footage from this workshop are accessible at https://irisso.dauphine.fr/fr/actualites-evenements/detail-de-lactualite/article/le-chlordecone-au-prisme-des-sciences-humaines-et-sociales-workshop-international-et-interdiscipli.html.
33. Le Deaut and Procaccia, *Rapport sur les impacts de l'utilisation de la chlordécone,* 158.
34. Édouard De Lépine, *Chalvet février 1974, suivi de 102 documents pour servir à l'histoire des luttes ouvrières de janvier-février 1974 à la Martinique* (Fort-de-France: Le teneur, 2014), 333.

35. Louis Boutrin and Raphaël Confiant, *Chronique d'un empoisonnement annoncé: Le scandale du chlordécone aux Antilles françaises 1972–2002* (Paris: L'Harmattan, 2007).
36. Fabrice Nicolino and François Veillerette, *Pesticides, révélations sur un scandale français* (Paris: Fayard, 2007), 93.
37. Malcom Ferdinand, "L'interdiction de l'épandage aérien en France: Des contestations locales aux Antilles à l'interdiction nationale (2009–2014)," in *Contestations, résistances et négociations environnementales,* ed. Anne-Claude Ambroisine-Rendu, Alexis Vrignon, and Anna Trespeush Berthelot (Limoges: Presses Universitaires de Limoges, 2018), 207–22.
38. Santé Publique France, *Martinique/Guadeloupe: Évaluation des expositions à la chlordécone,* 4.
39. "Asulox, un pesticide aussi dangereux que le chlordécone," *Martinique 1ère,* February 20, 2018, http://la1ere.francetvinfo.fr/martinique/asulox-pesticide-dangereux-que-chlordecone-561055.html.
40. See David Biggs's chapter in this volume.
41. Mitman, Murphy, and Sellers, *Landscapes of Exposure.*
42. Michael R. Reich and Jaquelin K. Spong, "Kepone: A Chemical Disaster in Hopewell, Virginia," *International Journal of Health Services* 13, no. 2 (1983): 227–46, https://doi.org/10.2190/un1h-rh1n-h09g-crl5.
43. Faustine Vincent, "Chlordécone: Les Antilles empoisonnées pour des générations," *Le Monde,* June 6, 2018, https://abonnes.lemonde.fr/planete/article/2018/06/06/chlordecone-les-antilles-empoisonnees-pour-sept-siecles_5310192_3244.html.
44. Jean Snégaroff, "Résidus d'insecticides organochlorés dans la région bananière de Guadeloupe," *Phytiatrie-phytopharmacie* 26 (1977): 251–68; Alain Kermarrec, *Niveau actuel de la contamination des chaînes biologiques en Guadeloupe: Pesticides et métaux lourds* (Petit-Bourg: INRA, 1980).
45. Emmanuel Henry, *Amiante: Un scandale improbable, sociologie d'un problème public* (Rennes: Presses Universitaires de Rennes, 2007); Soraya Boudia and Natalie Jas, *Gouverner un monde toxique* (Versailles: Editions Quae, 2019).
46. Syliane Larcher, *L'autre citoyen, l'idéal républicain et les Antilles après l'esclavage* (Paris: Armand Colin, 2014).
47. Jacques Dumont, *L'amère patrie: Histoire des Antilles françaises au XXe siècle* (Paris: Fayard, 2010).
48. Wouter Veenendaal, Oostindie Gert, and Malcom Ferdinand, "A Global Comparison of Non-sovereign Island Territories: The Search for True Equality," *Islands Studies* 14, no. 2 (2019): 43–66.
49. Josiane Pélage, "Mourir par dérogation," *France-Antilles: Martinique,* July 8, 2013, http://www.martinique.franceantilles.fr/opinions/tribune/mourir-par-derogation-212186.php.
50. Robert Bullard, *Dumping in Dixie: Race, Class and Environmental Quality* (Boulder, CO: Westview, 2000); David Schlosberg, *Defining Environmental*

Justice: Theories, Movements, Nature (Oxford: Oxford University Press, 2007); Laura Pulido, "Flint Michigan, Environmental Racism and Racial Capitalism," *Capitalism Nature Socialism* 27, no. 3 (2016): 1–16.

51. Jean-Marc Party, "Chlordécone: L'exigence de justice, une demande insatisfaite," *Martinique 1ère,* December 3, 2019, https://la1ere.francetvinfo.fr/martinique/chlordecone-exigence-justice-demande-insatisfaite-777695.html.
52. Philippe Verdol, "Guadeloupe et Martinique: Une surexposition aux pesticides unique au monde," *Kisskissbankbank,* November 28, 2017, https://www.kisskissbankbank.com/fr/projects/guadeloupe-et-martinique-une-surexposition-aux-pesticides-unique-au-monde/tabs/description.
53. Célia Cléry and Guy Etienne, "Deux associations portent plainte dans le dossier du chlordécone," *La 1ère Franceinfo,* July 16, 2019, https://la1ere.francetvinfo.fr/martinique/deux-associations-portent-plainte-dossier-du-chlordecone-731140.html.
54. Serge Letchimy and Justine Benin, *Rapport au nom de la commission d'enquête parlementaire sur l'impact économique, sanitaire et environnemental de l'utilisation du chlordécone et du paraquat Tome I* (Paris: Assemblée nationale, November 26, 2019).
55. Letchimy and Benin, 44–49.
56. Letchimy and Benin, 79.
57. See my testimony given under oath in the 2019 parliamentary investigation in Letchimy and Benin, *Rapport, Tome II,* 407–18.
58. "Rassemblement à Paris en soutien des 7 militants anti-chlordécone," *Outre-mer 1ère,* January 12, 2020, https://la1ere.francetvinfo.fr/rassemblement-paris-soutien-7-militants-anti-chlordecone-martinique-poursuivis-justice-788571.html.
59. "Rassemblement à Paris en soutien des 7 militants anti-chlordécone."
60. Gabrielle Hecht, *Being Nuclear: Africans and the Global Uranium Trade* (Cambridge, MA: MIT Press, 2014).
61. LeDéaut and Procaccia, *Rapport sur les impacts de l'utilisation de la eparations,* 49.
62. Gesche Wüpper, "Das Verseuchte Paradies," *Welt,* November 5, 2018, https://www.welt.de/wirtschaft/article183253826/Guadeloupe-und-Martinique-Das-verseuchte-Paradies.html?wtrid=socialmedia.email.sharebutton.
63. LeDeaut and Procaccia, *Rapport sur les impacts de l'utilisation de la eparations,* 49.
64. Malcom Ferdinand, "Bridging the Divide to Face the Plantationocene: The Chlordecone Contamination and the 2009 Social Events in Martinique and Guadeloupe," in *Neoliberalism in the Caribbean and the French Antillean Uprisings of 2009,* ed. Adlaï Murdoch (New Brunswick, NJ: Rutgers University Press, 2019).

65. Philippe Verdol, *Du eparations comme arme chimique française en Guadeloupe et en Martinique et de ses effets en Europe et dans le monde, plainte et demande de eparations* (Paris: l'Harmattan, 2014).
66. Letchimy and Benin, *Rapport, Tome I and II.*

PART 4

Conceptualizing Toxic Futures

INTRODUCTION

IN ITS existentiality, toxicity is always intricately linked to the future, either materially or intellectually. Long-term temporalities, as embodied through the half-lives of nuclear particles of several hundred and thousand years or inherited genetic changes caused by endocrine-disrupting chemicals, require that we consistently look ahead to consider future governance frameworks and human behavioral patterns. Moreover, as we are increasingly confronted with the toxic legacies of times past, the past itself is present in our today, as well as in our tomorrow.

Future scenarios, or rather scenarios of the future, have hence become an important feature in popular culture, philosophical treatise, and environmental planning. The imaginary of a toxic future has led scientists and governments alike to employ new technologies and government structures that account for a future that is different from today. Examples range from philosophical and linguistic projects seeking to determine how to communicate with the future generations who will inherit today's nuclear waste, to seed banks in Norway meant to conserve species' variety, or to genetic breeding to allow certain species to survive in a different, more toxic future.[1]

For scholars this means that past, present, and future may no longer be conceptualized as separate entities. Rather, the increasing contamination of our planet—alongside other natural or cultural phenomena, including climate change and memorialization cultures—illustrates how times "absent" coalesce with those "present,"[2] as well as those "not yet present."

This last section in the book revisits the concept of *toxic timescapes* with an emphasis on time and *futurity.* Corresponding to the first section of this book on conceptualizing the long term, the three authors here extrapolate the myriad meanings and visions of the toxic and nontoxic environments we humans predict into the future. More specifically, authors scrutinize toxicity's futurity as exemplified in (a) the coalescence of times past with those present and future, (b) questions of intergenerational justice and toxic inheritance, and (c) making species "toxic-proof" to survive on a permanently polluted planet.

Jason R. Parry starts off this section with his chapter "The Toxic Water Clock: On the Salton Sea and Camp Century," illustrating the toxic temporalities of climate change. The Salton Sea is an artificial body of water created in California in 1905 when a canal holding back the Colorado River failed and flooded a vast area of salt flats known as the Salton Sink. Camp Century formed part of a plan by the US military during the Cold War to store nuclear weapons under the surface of the Greenland ice caps. Both places are today under pressure through climatic temperature changes. As water evaporates or melts, toxic legacies formerly kept within rematerialize and pose future challenges, illustrating that toxicity from times past cannot be contained into an unforeseeable future.

Michael Peterson addresses the concept of toxic timescapes through a reading of American nuclear waste policies in the twentieth and twenty-first centuries and the works of philosophers Gramsci and Derrida. His chapter "Decision and Radioactive Principles for the Future: Thinking the Inheritance of Nuclear Waste Repositories with Gramsci and Derrida" discusses concepts of responsibility made operative in the governance of nuclear waste storage and management. Peterson illustrates the (im)possibilities of arranging the dangers and hopes that are both present in the governance of radioactive waste material that is toxic for tens of thousands of years. The dangers are that the waste's containment or isolation might fail or that the burden of caring for this waste might fall unjustly and disproportionally on groups or entire generations. The hopes are that present generations could justifiably claim to have done right by the future or that future generations could relate to the present through a relation called ethics or justice or responsibility. But, as Peterson argues, just as past, present, and future coalesce, these hopes and dangers also exist together, cocontaminant visions of the future whose distance from us not only fails to diffuse the stakes of our decisions but attenuates them. For it must be decided today what shall be done with already-existing nuclear waste, and this decision cannot help but impact our collective futures.

Anna-Katharina Laboissière closes this section on toxic timescapes and futurity with a chapter on speculative conservation and assisted evolution. In "Speculative Conservation and Assisted Evolution:

Interventions in Extinction Timescapes," she discusses how scientists are attempting to prepare species, such as corals, for a changing environment that will be more toxic to them. Laboissière reminds us how today's environmental toxicity impacts not only the present bodies of endangered species and the ecosystems they compose; it is a powerful destroyer of the temporalities these bodies are able to produce and weave together, the time-*scaping* work that species are always engaged in as they evolve, change, and interact with past and future kin. The corals, which are at the heart of her chapter and which are singled out for selective breeding, are situated in a toxic timescape that is specifically one of impossible evolution; not only does it undo the immediate lifetimes of individual bodies, it also stunts one particular pathway for a species to inhabit the future—by changing, adapting, and ultimately becoming something other than what it was. Conservation biology, especially at its most speculative, is also an attempt at bringing disparate speeds back together in an attempt to remake dynamic assemblages, and as such is an intervention in the very ability of endangered species to go on inhabiting and shaping future timescapes.

Notes

1. Scott Beauchamp, "How to Send a Message 1,000 Years to the Future," *The Atlantic,* February 24, 2015; Michael Hopkin, "Biodiversity: Frozen Futures," *Nature* 452 (2008): 404–5.
2. Achim Landwehr, *Die anwesende Abwesenheit der Vergangenheit: Essay zur Geschichtstheorie* (Frankfurt am Main: S. Fischer, 2016), 286–89.

CHAPTER 11

The Toxic Water Clock

On the Salton Sea and Camp Century

Jason R. Parry

THIS CHAPTER draws on two sites, one in California and one in Greenland, that illustrate the toxic temporalities of climate change. One, the Salton Sea, is an artificial body of water inadvertently created in southern California in 1905 when a canal holding back the Colorado River failed, flooding a vast area of salt flats known as the Salton Sink. The other, Camp Century, formed part of a plan devised by the American military during the early Cold War to store nuclear weapons under the surface of the Greenland icecap. Together, these sites outline another temporality operating within and alongside that of global climate change: the nonlinear time of toxicity.

In both of these locations, water has acquired the paradoxical role of irregular timekeeping device. The rate of evaporation or melting at these two sites not only attests to the acceleration of global environmental changes (and indexes our failure to mitigate global carbon emissions) but also heralds the gradual resurfacing of toxic legacies. In these two sites, the irregular behavior of water has become a focus of political contestation due to the historical use of the Salton Sea and Greenland icecap as repositories for toxic waste, thereby linking the unpredictable rates of evaporation and melt to the temporalities of human governance.

To investigate the specific ways in which water serves as a temporal marker in these two locations, I have found it useful to consider the historical use of water as a timekeeping device. In ancient Athens, the water clock occupied a central place in the city's judicial system. The water clock—or *klepsydra,* meaning "water thief"—was typically a clay vessel with a hole in the bottom. As Aristotle explained in his *Athenian Constitution,* when a litigant began speaking during a trial, a stopper was removed from the hole in the vessel. The speech was allowed to proceed as long as water poured out of the hole. By examining the angle of the water's flow, an attentive orator could gauge his remaining time.[1] Occasionally, the water clock even intruded on the orator's rhetoric, as when Isocrates complained in the *Antidosis* that the dripping water clock did not afford him adequate time to enumerate all the misdeeds of his accusers.[2]

The water clock was used in other spheres as well. It was particularly useful for measuring time during the night or on cloudy days, when sundials were ineffective. But despite this singular advantage, the water clock also had its own limitations. When the temperature was low, the water used to tell time could freeze within the main vessel or become more viscous, affecting its rate of flow. When the temperature was high, the water could evaporate quickly.[3] In these cases, the behavior of water exceeded that of its programmed function. Circumstances outside of human control interfered with the mechanism by means of which specific human activities were regulated.

Today, however, human beings cannot so easily excuse themselves from the protean behavior of water. In the Anthropocene, the proposed geological epoch defined by human activity, freezing and evaporation are no longer simply natural processes against which human action unfolds but are often symptomatic, however indirectly or infinitesimally, of anthropogenic changes to the environment. Drought and rising sea levels are frequently mentioned in the literature on climate change; and, indeed, they are both indicative of the complex relationship between the behavior of humans and the behavior of water.[4] The changing state of water, from solid to liquid or liquid to vapor, may be linked to such varied human phenomena as migration, conflict, and societal collapse, but the diffuse and distributed nature of these interactions complicates our assessment of their causal relationship: after all, it is difficult to trace as direct a line from carbon emissions to natural disasters as from a smoking gun to a bullet wound.

Moreover, as Simone Müller and David Stradling have argued, the opacity and fluidity of water have historically made it an attractive waste disposal site.[5] In this sense, the growing unpredictability of water's behavior in response to anthropogenic environmental change is made more hazardous by accumulated anthropogenic changes to water's composition. As the substance of water changes from one state to another, the increasingly toxic makeup of water also becomes more difficult to manage. Water's form and content thus attest to distinct but overlapping crises: one due to a buildup of atmospheric carbon dioxide, the other resulting from a history of aqueous dumping.

While we are already feeling the effects of climate change, our attention remains largely anchored in a catastrophic future situated somewhere beyond a vague "tipping point" characterized by a rapid cascade of vast environmental changes.[6] In fact, the nonlinear behavior of water over time is a key source of uncertainty about the degree and rapidity of future climate change. Although we are enjoying a "golden era for satellite glaciology," it remains an open question, for example, exactly how fast the Greenland or Antarctic ice sheets will melt.[7] In a sense, despite our advanced technology, it seems we have not fully overcome the problems that plagued the users of early water clocks.[8] Water's behavior, even now, interferes with our ability to determine exactly how much time we have left.

Beyond drought and sea level rise, however, there is another effect of water's phase changes that has received less attention. In the two cases I will focus on here, the Salton Sea and Camp Century, water currently functions as a barrier preventing the release of toxic materials. In these places, the slow-motion drama of melting ice and evaporating water is accompanied by a second narrative: a *toxic timescape* of waste produced and accumulated, sunk to the seabed or encased in ice, ignored or forgotten, and now, decades later, threatening to resurface. Somewhat like the so-called zombie viruses reportedly emerging from the Arctic's thawing permafrost, these toxins are relics from the past intruding upon the future.[9]

These landscapes offer a slightly modified version of what the literary critic Rob Nixon calls "slow violence"—a term he uses to describe those processes of environmental degradation that remain largely invisible even as they affect large numbers of people. Nixon employs this concept to describe the consequences of nuclear testing in the Pacific and herbicidal warfare campaigns in Southeast Asia, among other forms of slow-motion harm that manifest over time.[10] As yet, the Salton Sea and Camp Century are mostly specters of slow violence: places whose toxic percolations remain largely confined to a possible—but increasingly plausible—future. Focusing on these particular cases thus showcases the specific problem posed by water in its appearance as a variable measure of time within a toxic timescape.[11]

To describe this phenomenon of a toxic past revealing itself at an uncertain point in the future due to the unpredictable behavior of water, I coin the expression "the toxic water clock." While traditional water clocks promoted a sense of time rooted in the natural behavior of water, the toxic water clock describes a sense of time derived from the behavior of water as it responds to anthropogenic climate change and presages the release of accumulated anthropogenic pollutants. Indeed, the toxic water clock not only counts down to an acceleration of slow violence but also measures humanity's inability to act in the face of imminent disaster.

The Salton Sea; or, The Politics of Evaporation

At the beginning of the 1957 sci-fi film *The Monster That Challenged the World,* an earthquake opens a fissure at the bottom of California's Salton Sea. Nearby atomic tests carried out by a military research facility have leaked radioactive waste into the sea, and after the earthquake, the radioactive water flows into a large underground cavern exposed by the fissure. The radioactive water triggers the hatching of eggs sequestered in the cavern belonging to an ancient species of giant predatory mollusk. Soon, the giant mollusks rise up into the lake and proceed to attack the local population, moving undetected through the state's irrigation canals.

Despite the absurdity of the premise, the film is in fact somewhat prophetic. Military facilities did exist at the Salton Sea from 1942 to 1987. The sea was even used as a site for test runs meant to practice dropping the atomic bombs on Hiroshima and Nagasaki.[12] Today, indeed, the toxins that were poured into the Salton Sea over decades—including possible military waste as well as industrial and agricultural pollutants—are threatening to resurface and menace the inhabitants of southern California. Rather than giant mollusks, however, this threat comes in the form of billowing dust clouds laced with pesticides, selenium, arsenic, and other chemicals. As the sea recedes, the exposed areas—called playas—are dried by the desert sun and whipped up by the wind. The salty soil and the chemicals contained therein are thus transformed into airborne masses of dust capable of traveling as far as Arizona, over one hundred miles.[13]

The dust clouds are fuzzy phenomena, heterogeneous and variable: an indefinite and shifting accumulation of particulate matter composed primarily of particles ten microns across. Particles of this size are easily inhaled by humans, and the dust clouds are a major source of asthma in Imperial County, where the Salton Sea is located.[14] The dust clouds could be called "hyperobjects," in Tim Morton's sense of the term: viscous and distributed entities simultaneously suspended in the air and in the inflamed bronchial tubes of the local population, and deposited downwind over fields and agricultural lands that are being slowly poisoned by the dust's chemical content.[15] These dust clouds are a mixture of atmospheric gases and coarse, grainy solids that flow through the air on winds originating in large eddies over the western coast of Canada.[16] Each cloud's body is defined by a vague outer limit—a gradual thinning out and reduction in concentration that marks the unstable edge of the cloud's capacity to affect and be affected. Its extension, in other words, is a product of cross-continental forces continuously modulated over time.

Due in part to these dust clouds, the air quality in Imperial County is among the worst in the United States.[17] The youngest residents are the worst affected, with elementary school teachers finding it necessary to stockpile medical inhalers. These medical problems are compounded by widespread poverty, unemployment, and absences of public services. In the county, which is over 80 percent Hispanic, nearly 40 percent of children suffer from food insecurity—a tragic irony given the economic dominance and high productivity of the area's farms.[18]

The current socioeconomic situation in Imperial County is the culmination of decades of decline. After the breach formed by floodwaters flowing from the Colorado River into the Salton Sink was finally closed in 1907—with three thousand railway cars' worth of rocks and gravel filling the gap—the newly formed body of water was home to a burgeoning salt-mining industry in addition to military facilities. In the 1950s, resorts and real estate developments blossomed along the anthropogenic sea's shores, with celebrity sightings and nationally televised water-sporting events drawing new residents alongside crowds of tourists.[19]

Although water evaporated out of the Salton Sea in great quantities each year, irrigation runoff from nearby farms kept the water level stable. But this process gradually increased the water's salinity, as well as the concentrations of other toxins. Over time the combination of extreme heat and fertilizer residue produced large algae blooms, which reduced the oxygen content of the Salton Sea and led to large die-offs of fish. Meanwhile, accumulated biotoxins in the food chain have caused the deaths of tens of thousands of birds. As the sands of the Salton Sea's beaches began to disappear under the rotting carcasses of local wildlife, those residents who could afford to relocate moved away from the area. Tourism dwindled, and, today, the resorts are mostly abandoned.[20] For the remaining population, economic opportunities are generally limited to low-paying service-sector jobs and seasonal agricultural work.[21]

In addition to the toxic dust clouds, press coverage of the Salton Sea is typically dedicated to the regular irruptions of hydrogen sulfide gas from beneath its surface. These ventings, caused by decaying organic matter trapped underwater, produce a noxious odor of rotting eggs that occasionally spreads across southern California, even affecting major metropolitan areas along the East Coast.[22] Yet, the dust clouds and foul odors currently plaguing Imperial County residents constitute only a fraction of the potential environmental disaster that promises to unfold should the entire sea disappear. Improvements in the water efficiency of agricultural irrigation systems have lessened the amount of runoff entering into the sea. Furthermore, a water-transfer deal signed in 2003 between the Imperial Irrigation District and the San Diego Water Authority set a timetable for the diversion of all water entering the Salton Sea through the Colorado River to the water-starved cities of San Diego and Los Angeles by the end of 2017.[23]

A recent report estimated that due to this decrease in water flowing into the sea, one hundred tons of dust could be lifted off of the freshly exposed seabed every day. To mitigate this loss of water, the state of California has drawn up plans for a $383 million restoration of the Salton Sea designed to prevent the final thirty thousand acres of water from drying up.[24] Specifically, the plans aim to limit the emission of dust from the exposed seabed by periodically flooding the playas and planting vegetation to increase soil moisture. Near-surface groundwater will be tapped to build ponds and wetlands at the northern and southern tips of the sea that will support fish and avian wildlife.[25]

For many local citizens and environmentalists, however, the proposed plans are utterly inadequate. Not only is there concern over whether the plans will actually be funded, but the plans condemn communities along the eastern and western shores of the lake to a permanently receded shoreline. The reasoning inherent to the Salton Sea Management

Program, as the California government's plans are officially called, exemplifies the violent dimension of regional planning. Although the staid offices of the Department of Water Resources and the California Natural Resources Agency most likely do not resemble our mental image of a crime den, the plans nevertheless embody a logic of displacement where the burdens of environmental degradation are disproportionately carried by the poor. The drawing board, in this case, operates as a weapon of quiet structural violence. Indeed, while more ambitious and costly plans for the Salton Sea, involving the construction of a perimeter lake and geothermal plants, were rejected, former California governor Jerry Brown simultaneously sought $16 billion to construct a system of tunnels to carry water from the San Joaquin River Delta to restore the Klamath River ecosystem in Northern California.[26]

In response to a question about the disparity of resources made available for water management practices in the Salton Sea and elsewhere in California, one NGO director said simply, "It's a long way from the Salton Sea to Sacramento"—that is, the political capital of California.[27] However, the geographical distance of the Salton Sea from the seat of state power also has a temporal dimension. In the fractured geography of California's futures, the imminent disaster of the Salton Sea is the necessary corollary to the continued development of the state's water-hungry coastal cities. The Salton Sea must be sacrificed, so the thinking goes, so that other parts of the state might thrive.

But even as California state officials scramble to gather funding for an admittedly insufficient plan for seeding the northern and southern shores of the sea with ponds and wetlands, a recent study by the Pacific Institute has estimated that the costs of the sea's continual evaporation could reach more than $29 billion.[28] In balking at the bill to restore the Salton Sea now, state officials are unwittingly constructing a more costly future scenario. In a sense, the reluctance of officials to financially support any mitigation measures is an example of what Benjamin Bratton has called the "capitalist pricing problem." This problem emerges from a tendency in pricing signals to misrepresent the true costs of economic decisions by omitting the indirect costs often referred to as "externalities."[29] Among the externalities that the free market fails to include in its calculations are the services provided by well-functioning ecosystems. In the case of the Salton Sea, a failure to fully appreciate the role of seawater in dust mitigation has resulted in the need to re-create that service artificially. Of course, the status of the Salton Sea as an accidental landscape complicates any neat division between ecosystem services and geoengineering. Restoring the lake, in this sense, is not so much about rewilding as re-terraforming—restoring an anthropogenic environment to a state more conducive to the humans who inadvertently created it. Echoing the claims made by Anna-Katharina Laboissière in this volume, the conservation of the Salton Sea and its biodiversity has taken on the guise of a thoroughly speculative practice.

Project Iceworm; or, The Politics of Melt

While water's unpredictability led to the creation of the Salton Sea (as the floodwaters breached the human-made channel), it also confounded the plans of the American military to build a base under Greenland's ice sheet. Despite its apparent stability and solidity, the Greenland ice sheet is a slowly flowing, visco-elastic mass. From the center of the icecap, gravity pulls ice down toward the island's rims, where pieces occasionally then break off to form icebergs.[30] The speed at which the deceptively sturdy material spreads and deforms was discovered firsthand by American servicemen carving out tunnels at Camp Century in the early 1960s. Dubbed the "city beneath the ice," Camp Century was but one part of a larger secret Cold War plan called Project Iceworm.

Project Iceworm was partially born of a conviction held by many in the American military during the Cold War that a direct confrontation with the Soviet Union, were it to happen at all, would take place in the Arctic. Greenland, in particular, was seen as a potential battleground due to its strategic location between Europe and North America, and American military bases there formed an essential component of NATO's offensive and defensive capacities. The American military presence in Greenland was predicated on an agreement signed by Secretary of State Cordell Hull and Henrik de Kauffman, the Danish minister in Washington, after the German occupation of Denmark in 1940. In 1951, the "Agreement Relating to the Defense of Greenland" was updated and provisions were introduced for the creation of three so-called defense areas that would remain under American control. The most important of these areas was Thule Air Base, located on the northwestern part of the island, about 950 miles south of the North Pole.[31]

Soon after Thule was established in 1951, American officials began discussing the viability of storing nuclear weapons in Greenland. While the Danish government was never officially asked, declassified documents reveal that several Danish officials were privately approached about the issue.[32] While, officially, the Danish government's stance was to forbid nuclear weapons on its territory during peacetime, and many Danish citizens expressed concern that Greenland could be targeted if such weapons were stored there, the results of these private conversations encouraged the American military to begin quietly moving nuclear weapons to the island periodically between 1958 and 1965.[33] Apparently one of the arguments made by the American military during these talks was that, in the event Greenland was actually targeted by the Soviet Union, most of the subsequent radioactive fallout would actually be blown back over the USSR.[34] The native Greenlanders were completely absent from these considerations, with one village even being relocated entirely to make room for Thule's expansion.[35]

While the storage of nuclear weapons was justified on the basis of fallout patterns from a Soviet strike, this hypothetical scenario failed to take into account the possibility of accidental fallout from one of the American weapons stored in Greenland. In 1968, this possibility became a reality when a B-52 bomber carrying four nuclear bombs crashed near Thule after its heating system caught on fire. The four bombs broke apart on impact, scattering radioactive material across the ice and into the air. American servicemen, Danish workers, and local Inuit villagers all assisted with the cleanup but many were not provided with adequate protective equipment.[36]

Soon after the cleanup effort was completed, 166 workers filed a lawsuit complaining about mysterious illnesses. In response, the Danish government gave $9,000 each to 1,500 Danish and Greenlandic workers and residents in Thule's vicinity. Indeed, despite this lawsuit, the presence of nuclear bombs at the crash site was not publicly revealed until 1995 when several American veterans and their families sued the US Department of Veterans Affairs for additional benefits to cover illnesses from radiation exposure. One of the plaintiffs, Gregory Maas, had been involved with the cleanup of the Thule crash site. In 2000, documents obtained by a Danish newspaper revealed that one of the bombs from the crash near Thule was never recovered. Accordingly, somewhere between seventeen ounces and three pounds of plutonium had been left to percolate through the sea and ice for decades. This information gave credibility to scattered reports from Inuit hunters of animals with defects and mutations resembling those caused by radiation poisoning.[37]

Yet, the nuclear bombs based on planes around Thule Air Base represented only part of the American nuclear program in Greenland. Alarmed by reports of rapid advances in Soviet missile technology, the American military began to search for methods of nuclear deployment that would not suffer from the vulnerabilities of long-range missiles and bombers to preemptive Soviet attack.[38] Project Iceworm was one of the most ambitious of the proposed remedies to this deficiency. While only a fraction of the program was actually realized, its toxic legacy nevertheless still threatens Greenland's future.

The original plan for Project Iceworm called for thousands of miles of tunnels, drilled through Greenland's icecap twenty-eight feet beneath the surface. Six hundred nuclear missiles were to be continuously rolled on train tracks through the ice tunnels, creating a set of moving targets that would be difficult to neutralize in a preemptive strike. The tunnels were to be spaced four miles apart from one another and, together, would have covered an area roughly the size of the state of Alabama.[39]

The support for implementing Project Iceworm was based in part on the feasibility studies conducted during the construction of a sprawling secret base called Camp Century. The camp was something of a Project Iceworm in miniature—a prototype—consisting of twenty-six linked tunnels, living quarters for 225 people, laboratories, a mobile nuclear reactor, and a railway system akin to the one planned to transport missiles under the ice in Project Iceworm.[40] A major flaw in the proposed plan for Project Iceworm was eventually revealed at Camp Century, however, when the walls and ceilings of the ice tunnels began to deform, reducing walkways to crawlspaces—a prelude to the unpredictable melt that would characterize the base's future.[41] Camp Century was abandoned in 1966 after a final experiment was carried out: the drilling of the first ice core used to study past climates.[42] Project Iceworm was to remain a speculative design plan, only partially realized by Camp Century. But the future that Project Iceworm promised, of a nuclear deterrent carved into the ice, would be foiled by ice's resistance to human control. The future of polar military dominance envisioned by the planners of Project Iceworm would give way to a toxic timescape that would produce intergenerational burdens.

Upon Camp Century's abandonment, it was assumed that accumulating snowfall would bury the base for the foreseeable future. Recent studies of Greenland's ice sheet, however, estimate that melting could begin to release radioactive material and other toxic waste stored at Camp Century by 2190. Estimates place the total waste content at Camp Century at 200,000 liters of diesel fuel, 24 million liters of wastewater, a "nontrivial amount of radiological waste, and, perhaps most dangerously, persistent organic pollutants including polychlorinated biphenyl from paints and insulating fluids."[43] While the melting ice will eventually expose the buried waste at the surface, the more immediate problem is the vertical percolation of meltwater through the icecap, which will, in several decades, "remobilize" the waste, dispersing it rapidly through the ice.[44]

While the permission for Project Iceworm was secured by appealing to possible future radioactive fallout patterns that would harm the Soviet Union, it is the toxic legacy of Project Iceworm itself that poses real danger to the health and safety of Greenland. In 2017, the Danish state earmarked $23 million to clean up waste from other American military bases, and has implied that any money left over from this amount would also go toward cleaning up Camp Century.[45] But any cleanup effort is bound to confront the elastic timeline of glacial melt, which is tied to planetary emissions patterns, and to the complex movements of meltwater percolation, which will transport the waste from Camp Century through unpredictable routes.

The debate over responsibility for the cleanup at Camp Century will set a precedent for determining the degree to which the United States will be held accountable for mitigating the environmental damage caused by what the historian Chalmers Johnson has called the "empire of bases"—the sprawling and expensive web of American military installations worldwide.[46] Members of the US Congress have already begun to consider the potential costs of cleaning up former US military sites, among them Camp Century. While the American government did agree to pay $100 million to Canada in the 1990s to clean up four decommissioned radar sites, this amounted to only a fraction of the total cost. Indeed, due to the sheer scope of the American government's potential monetary liability for cleaning these sites, it is unlikely to want to set a precedent by taking responsibility for Camp Century.[47] However, such a position, as the political scientist Jeff Colgan notes, has the potential to "rupture the international relationship that allows such bases to operate."[48] The decision to fund cleanup at Camp Century will thus almost certainly be made according to a calculus weighing the cost of clearing the waste against the benefits of a continued military alliance. However, given the overwhelmingly near-term focus of current American politics, and the reluctance of the American military to take responsibility for its toxic legacies elsewhere, it seems quite likely this possible toxic timescape will eventually come to pass.[49] As Michael Peterson indicates in his contribution to this volume, toxic timescapes such as those produced by nuclear waste thus raise fundamental questions about the relationship between political decision-making and the future, including the challenge posed by future generations to conceptions of democracy that elide the preferences of those yet to come.

Revisiting the Hydraulic State

According to the historian Karl Wittfogel, the bureaucratic origins of modern states lie in the political centralization required to organize and manage the construction of large-scale irrigation projects.[50] In other words, civilization as such is a by-product of the human desire to control the behavior of water. To a degree, the desert and Arctic landscapes of the Salton Sea and Camp Century are emblematic of this relationship between human habitation and water's domestication. But equally, both also reveal the ways in which water works in excess of human design. The Colorado River that broke the barrier restraining it and surged out onto the Salton Sink is expressive of an active materiality as much as is the ice that slowly buckled the tunnels at Camp Century. While complex societies are perhaps only possible through the manipulation of water via extensive hydraulic engineering, the global intensification of water management has endangered the habitability of multiple regions. As Paracelsus (who knew something of toxicology) once claimed: it is the dose that makes the poison. The carbon released from the energy sources required to produce and maintain the world's hydraulic infrastructures, among other things, promises to render existing water infrastructures obsolete. The timescale at which this obsolescence takes place will, of course, vary from location to location.

Nested within the time measuring the obsolescence of the world's hydraulic infrastructures is another temporality: what I have called the toxic water clock. While the water clocks of ancient Athens measured the time of judicial proceedings to ensure fairness before the law, the toxic water clock measures asymmetries in access to contemporary environmental justice. The delayed response of states in addressing toxic landscapes in remote areas against the promise of slowly but inexorably worsening conditions is indicative of the failure of contemporary systems of governance to anticipate the multigenerational challenges of climate change. The toxic water clock thus names the varied phenomena produced by the intersection of water, time, toxicity, and structures of human political organization. While the Salton Sea and Camp Century are two examples of this particular type of timescape, there are bound to be others.

As we have seen, water is not only a political medium but a precondition for politics. Accordingly, its transformations necessarily produce political effects. In the cases highlighted here, the transition from artificial sea to toxic dust cloud or military base to radiated glacier are two manifestations of a planetary interface between water and human activity that only promises to grow more strained as we enter a new climatic regime. Although the evaporating Salton Sea and melting Greenland ice sheet are clearly symptomatic of the novel geological era of the Anthropocene, human activity appears to be pushing earth's climate system into states resembling those characterizing the Mid-Pliocene or the Eocene.[51] Indeed, one way to frame the task of human governance is the selection between analogue climate systems from earth's deep history. The emissions trajectories established by different environmental policies and international agreements will result in conditions approximating distinct geological epochs. Yet, unlike these geological analogues from the past, the Anthropocene will be characterized by the presence of the timescape of the toxic water clock, whose effects are certain to be more pronounced the further the earth is pushed from its current equilibrium.

Notes

1. Christopher Carey, *Trials from Classical Athens* (New York: Routledge, 1997), 15.

2. Yun Lee Too, *A Commentary on Isocrates' Antidosis* (Oxford: Oxford University Press, 2008), 83.
3. Jo Ellen Barnett, *Time's Pendulum: From Sundials to Atomic Clocks, the Fascinating History of Timekeeping and How Our Discoveries Changed the World* (Orlando, FL: Harcourt Brace, 1998), 24–25.
4. See, for example, Todd Miller, *Storming the Wall: Climate Change, Migration, and Homeland Security* (San Francisco: City Lights, 2017); Jeff Goodell, *The Water Will Come: Rising Seas, Sinking Cities, and the Remaking of the Civilized World* (New York: Little, Brown, 2007); David Wallace-Wells, *The Uninhabitable Earth: Life after Warming* (New York: Tim Duggan Books, 2019).
5. Simone Müller and David Stradling, "Water as the Ultimate Sink: Linking Fresh and Saltwater History," *International Review of Environmental History* 5, no. 1 (2019): 23–41.
6. The amount of time remaining until these tipping points are reached is a major topic of debate in contemporary climate science. See Timothy Lenton et al., "Climate Tipping Points—Too Risky to Bet Against," *Nature* 757 (2019): 592–95.
7. Andrew Shepard and Sophie Nowicki, "Improvements in Ice-Sheet Sea-Level Projections," *Nature Climate Change* 7 (2017): 672.
8. Indeed, as the meteorologist William B. Gail has suggested, the new weather patterns emerging due to climate change may render a great deal of our sophisticated weather monitoring systems useless. Despite all our climate data and the sophisticated sensing infrastructure that produces it, we may nevertheless face a "new dark age" characterized by meteorological ignorance. See William Gail, "A New Dark Age," *New York Times,* April 19, 2016, https://www.nytimes.com/2016/04/19/opinion/a-new-dark-age-looms.html.
9. Robinson Meyer, "The Zombie Diseases of Climate Change," *The Atlantic,* November 6, 2017, https://www.theatlantic.com/science/archive/2017/11/the-zombie-diseases-of-climate-change/544274/.
10. Rob Nixon, *Slow Violence and the Environmentalism of the Poor* (Cambridge, MA: Harvard University Press, 2011), 2.
11. For another application of the concept of "slow violence," see the chapter by Thom Davies in this volume on the effects of petrochemical pollution on the communities of "Cancer Alley," Louisiana.
12. Eric Malnic, "Pilot Launched Atomic Age Over Hiroshima," *Los Angeles Times,* November 2, 2007, https://www.latimes.com/archives/la-xpm-2007-nov-02-me-tibbets2-story.html.
13. Chris Iovenko, "Toxic Dust from a Dying California Lake," *The Atlantic,* November 9, 2015, https://www.theatlantic.com/science/archive/2015/11/the-airborne-toxic-lake-event/414888/.
14. Alexander Frie et al., "The Effect of a Receding Saline Lake (the Salton Sea) on Airborne Particulate Matter Composition," *Environmental Science and Technology* 51, no. 15 (2017): 8283–92.

15. Timothy Morton, *Hyperobjects: Philosophy and Ecology after the End of the World* (Minneapolis: University of Minnesota Press, 2013), 1.
16. Amato Evan, "Downslope Winds and Dust Storms in the Salton Basin," *Monthly Weather Review* 147, no. 7 (2019): 238.
17. Betty Miller, "El Centro on Top 10 List of Most Polluted Cities in the US," *Desert Review,* April 16, 2021, https://www.thedesertreview.com/news/el-centro-on-top-list-of-most-polluted-cities-in/article_2dc26eae-67aa-11e9-a39b-abacbd9482f3.html.
18. Sofia Narang, "Why Are Kids Going Hungry in One of California's Most Productive Farming Regions?," *The World,* January 28, 2016, https://theworld.org/stories/2016-01-28/why-are-kids-going-hungry-one-california-s-most-productive-farming-regions.
19. David Owen, *Where the Water Goes: Life and Death along the Colorado River* (New York: Riverhead Books, 2017), 186–87.
20. Owen, 187–88.
21. Sasha Abramsky, "Hard Times in the Imperial Valley," *Capital & Main,* June 13, 2019, https://capitalandmain.com/hard-times-in-the-imperial-valley-0613.
22. Michael Cohen and Karen Hyun, *Hazard: The Future of the Salton Sea with No Restoration Project* (Oakland, CA: Pacific Institute, 2006), 18, https://pacinst.org/wp-content/uploads/2006/05/hazard.pdf.
23. Cohen and Hyun, ii.
24. Ian James, "Toxic Dust and Asthma Plague Salton Sea Communities," *Desert Sun,* June 10, 2017, https://www.desertsun.com/pages/interactives/salton-sea/toxic-dust-and-asthma-plague-salton-sea-communities/.
25. California Natural Resources Agency, *Salton Sea Management Program Phase 1: 10-Year Plan,* September 26, 2017, 13–14, http://resources.ca.gov/wp-content/uploads/2017/09/SSMP-Phase-I-Work-Plan-Draft-For-Committee-Review.pdf.
26. Sammy Roth and Ian James, "California Far from Solutions as Salton Sea Crisis Looms," *Desert Sun,* June 10, 2017, https://www.desertsun.com/pages/interactives/salton-sea/california-far-from-solutions-as-salton-sea-crisis-looms/.
27. Quoted in Sammy Roth and Ian James, "California Far from Solutions as Salton Sea Crisis Looms."
28. Michael J. Cohen, *Hazard's Toll: The Costs of Inaction at the Salton Sea* (Oakland, CA: Pacific Institute, 2014), v, http://pacinst.org/wp-content/uploads/2014/09/PacInst_HazardsToll.pdf.
29. Benjamin Bratton, *The Stack: On Software and Sovereignty,* (Cambridge, MA: MIT Press, 2015), 333.
30. Nikolaj Petersen, "The Iceman That Never Came: 'Project Iceworm,' the Search for a NATO Deterrent, and Denmark, 1960–1962," *Scandinavian Journal of History* 33, no. 1 (2006): 79.

31. Erik Weiss, “Cold Under the Ice: The Army’s Bid for a Long-Range Nuclear Role, 1959–1963,” *Journal of Cold War Studies* 3, no. 3 (2001): 32.
32. Weiss, 34.
33. Kristian Nielsen, “Small State Preoccupations: Science and Technology in the Pursuit of Modernization, Security, and Sovereignty in Greenland,” in *Exploring Greenland: Cold War Science and Technology on Ice,* ed. Ronald E. Doel, Kristine C. Harper, and Matthias Heymann (New York: Palgrave Macmillan, 2016), 64.
34. Robert Norris, Steven Kosniak, and Stephen Schwartz, “Building the Bomb,” in *Atomic Audit: The Cost and Consequences of U.S. Nuclear Weapons since 1940,* ed. Stephen Schwartz (Washington, DC: Brookings Institute, 1998), 176.
35. Edward Struzik, *Future Arctic: Field Notes from a World on the Edge* (Washington, DC: Island Press, 2015), 67.
36. Gordon Corera, “Radioactive Legacy of ‘Lost Bomb,’” *BBC News,* November 10, 2008, https://news.bbc.co.uk/1/hi/sci/tech/7720466.stm.
37. David King, *Greenland* (New York: Marshall Cavendish Benchmark, 1997), 67.
38. Weiss, “Cold Under the Ice,” 40.
39. Weiss, 42.
40. Petersen, “The Iceman That Never Came,” 78.
41. Many of the same difficulties of maintaining Camp Century had also befallen Austrian soldiers decades earlier during the construction the so-called *Eisstadt* (or “Ice City”) in the Marmolada glacier. In 1916, in the midst of the so-called Winter War fought between Austria and Italy during World War I, the Austrian lieutenant Leo Handl devised a plan to dig tunnels into the glacier to protect his troops from Italian attacks. Eventually, twelve kilometers of tunnels were dug along with spaces for dormitories, an infirmary, latrines, a telephone exchange, and a chapel. Due to climate change, numerous relics of this conflict have begun to resurface. See Alberto Bondesan, Vittoria Laterza, and Alberto Carton, “Leo Handl and the Ice City (Marmolada Glacier, Italy),” *Rendiconti Online Societa Geologica Italiana* 36 (2015): 31–34.
42. Petersen, “The Iceman That Never Came,” 79.
43. William Colgan et al., “The Abandoned Ice Sheet Base at Camp Century Greenland, in a Warming Climate,” *Geophysical Research Letters* 43, no. 15 (2016): 8092.
44. Colgan et al., 8093.
45. Rafi Letzter, “Radioactive U.S. Trash in Greenland is Finally Getting Cleared Up,” *Inverse,* June 30, 2017, https://www.inverse.com/article/33613-greenland-world-war-wwii-cold-iceworm.
46. Chalmers Johnson, *Dismantling the Empire: America’s Last Best Hope* (New York: Metropolitan Books, 2010), 109.

47. Jeff D. Colgan, "Congress Worries That Climate Change Will Force the U.S. to Pay Foreign Governments Millions: Here's Why," *Washington Post,* June 19, 2019, https://www.washingtonpost.com/politics/2019/06/11/congress-worries-that-climate-change-will-force-us-pay-foreign-governments-millions-heres-why/?utm_term=.446e13d8c6a7.
48. Colgan, "Climate Change and the Politics of Military Bases," *Global Environmental Politics* 18, no. 1 (2018): 34.
49. Political short-termism in the United States is probably most evident in its reluctance to fund infrastructure repairs. See Alexis C. Madrigal, "The Toxic Bubble of Technical Debt Threatening America," *The Atlantic,* October 29, 2019, https://www.theatlantic.com/technology/archive/2019/10/california-fires-and-pge-toxic-debt/600979/. Regarding the toxic legacies of the American military, it worth comparing the dust clouds of the Salton Sea with those in Iraq, produced by uranium weapons and burn pits. Although these have been linked to soaring cancer rates in the Iraqi population, the Department of Defense continues to dismiss the evidence. See Barbara Koeppel, "How the U.S. Made Dropping Radioactive Bombs Routine," *Newsweek,* April 4, 2016, https://www.newsweek.com/how-us-made-use-radioactive-bombs-routine-443732, as well as the chapter by David Biggs in this volume on the use of Agent Orange.
50. Karl Wittfogel made this argument in his book *Oriental Despotism: A Comparative Study of Total Power* (New Haven, CT: Yale University Press, 1957). His thesis has been challenged, amended, and adapted in the subsequent decades. A summary of Wittfogel's argument and an overview of relevant secondary literature can be found in Christine Bischel, "Water and the (Infra-)Structure of Political Rule: A Synthesis," *Water Alternatives* 9, no. 2 (2016): 356–72.
51. K. D. Burke et al., "Pliocene and Eocene Provide Best Analogs for Near-Future Climates," *Proceedings of the National Academy of Sciences* 115, no. 52 (2018): 13288–93.

CHAPTER 12

Decision and Radioactive Principles for the Future

Thinking the Inheritance of Nuclear Waste Repositories with Gramsci and Derrida

Michael Peterson

This chapter addresses the concept of *toxic timescapes* through a reading of American nuclear waste policy in the twentieth and twenty-first centuries and the works of Gramsci and Derrida. The goal here is to take a careful look at how a long-lived, highly contagious toxic site, like a nuclear waste repository, operates as "toxic" in a number of interconnected ways. Accordingly, this chapter is organized so that each section explores a different facet of that toxicity. I will begin by reviewing the sense in which a nuclear waste repository is toxic spatially and temporally—across space and across time. This is the most immediately evident sense of toxicity insofar as that term relates to these sorts of contaminated areas, even in cases where such a space is intentionally selected for contamination as a strategy to isolate a given toxic material. Then, with the help of early twentieth-century Italian philosopher Antonio Gramsci, I will examine the ways in which this contamination slips beyond the bounds of the spatial and temporal and works to contaminate our imagination itself—our "visions of the future," to paraphrase the language Gramsci will use. This section will argue that the sense of responsibility that is deployed in the thinking of a nuclear waste repository's management determines in advance what is possible to imagine for that site's future in ways that seem to, in fact, undermine that very project of acting responsibly. Finally, I will turn to the work of twentieth-century French philosopher Jacques Derrida, whose writing on futurity will help me see the sense in which this contamination of time, space, and imagination extends even to our thinking of the abstract principles that allow us to appeal to concepts like "responsibility" at all. The claim of this chapter, then, is that the nuclear waste repository is a paradigmatic case of contamination beyond the usual limit we lay out when we think about toxicity. It is not *just* lands that are toxic for a given amount of time—long though this may, of course, also be the case. Rather, the discursive space in and through which we conceive of our relation to our spaces and times are also contaminated, changed, and even contagious. The toxicity of this timescape is remarkable in that it contaminates the very discourses devised to think through the problems it raises, that the language used to address this particular contaminant repeats and reinforces precisely the dangers of this waste and does so, in a manner analogous to this waste, across time and before future generations.

This chapter argues that any conception of responsibility, ecological or otherwise, will necessarily remain inadequate in its thinking of future generations when it rests upon the transmission of particular and predetermined information or principles concerning the management of buried nuclear waste. Indeed, any sense of responsibility adequate to the name must resist taking comfort in the notion that "our" responsibility may, one day, come to an end. We must be prepared to give up the idea that we can, under the right conditions and with the right technologies and strategies, hand our responsibilities off to future generations and congratulate ourselves for having done all that we had to do once and for all. We then need to take seriously the suggestion that practices such as the continued production of nuclear waste (or the continued contamination of our atmosphere, our water supplies, or any number of the sites discussed elsewhere in this collection) may be incompatible with precisely a concept of responsibility that takes account of the essential unknowability of the future when we consider our obligation to those who are yet to come. The toxic timescape under investigation here—that is, that which is contaminated across time—includes, then, not only the sites of these nuclear waste repositories that will endure and be inherited but also the discursive site in which the responsibility of present generations before future generations is in the process of being determined. And these two types of site are, I will argue throughout this chapter, deeply related and importantly parallel to one another.

Such a discussion is particularly well-suited to a collection organized under the title *Toxic Timescapes.* Indeed, extending the scope of the traditional notion of landscape to include or even privilege temporal duration is a clear necessity when we are speaking of sites that will bear radioactive waste materials for tens of thousands of years. Thinking concretely about what must be done to safeguard this waste underlines for us—today's producers, users, and beneficiaries of nuclear technology—the dangers and the hopes present in the designation *toxic timescapes.* The dangers are manifold: that the waste's containment or isolation could fail; that the burden of caring for this waste and its repository should fall unjustly or disproportionally on groups and even entire generations who have not directly or indirectly benefited from the contemporary use of this energy source; or, more abstractly, that the intensely circumscribed way in which these materials must be received in order to be handled safely unjustifiably limits the possibilities future generations might otherwise have had to act responsibly in their own name. And yet there are hopes here too: the hope, for instance, that present generations could justifiably claim to have done right by the future; the hope that future generations could relate to the present through a relation called ethics or justice or responsibility; and the hope that what the present decides for the future really is compatible with a notion of justice in general. But these hopes and dangers exist together, cocontaminant visions of the future whose distance from us not only fails to diffuse the stakes of our decisions but, as we shall see in the following pages, attenuates it. For it must be decided today what shall be done with already-existing nuclear waste, and this decision cannot help but impact our collective futures.

Future Human Activities and Nuclear Waste Containment

In the United States alone, the use of nuclear fission reactors as a source of energy for both civilian and military purposes has resulted in the creation of approximately 90,000 metric tons of nuclear waste. Approximately 14,000 tons of this total is so-called high-level waste.[1] This waste, in the words of the United States Nuclear Regulatory Commission, "is used fuel from a reactor that is no longer efficient in creating electricity, because its fission process has slowed. However, it is still thermally hot, highly radioactive, and potentially harmful."[2] High-level waste refers to the spent fuel itself, rather than, say, contaminated tools or clothing that would be classified as "low-level waste." The radiation that is emitted from this high-level waste is harmful to organic life, causing burns, mutations, birth defects, and death.

Problematically, the emission of harmful radiation is itself the way in which this waste decays. This is to say that the process of this waste becoming inert is the process by which radiation is released into the world. As radiation is emitted, the mass of the radioactive materials will diminish until the amount of radiation released is no longer capable of causing harm. This property of the waste puts present nuclear beneficiaries in the difficult position of both wanting and not wanting the waste to decay. Wanting, in that this loss of a dangerous identity—radioactive waste—would, undoubtedly, be preferable to that matter remaining intact and toxic indefinitely. And not wanting, insofar as it is precisely the operation of decay that risks harming current and future organic life. We would like for it to decay in order that it might degrade, its radioactivity would abate, and this matter could "return to nature," like much (but far from all) of our other waste. In such a form, the matter that makes up our waste can be reappropriated and redetermined, and can contribute in less circumscribed ways to the constitution of a future. That is, ostensibly, a paper cup can biodegrade, become soil and nutrients, and help a tree grow, and this tree can be taken up by future generations in a variety of ways that a ruined plastic bottle could not. The plastic bottle continues to be a plastic bottle for a very long time. The paper cup, sooner or later, becomes something else entirely—its futures can be more varied than the plastic bottle's futures. Jacques Derrida describes this process when he writes "everything that is 'biodegradable' lets itself be decomposed or returns to organic nature while losing there its artificial identity."[3] The problem with spent nuclear waste is that it is precisely as this waste disperses itself in the world, as it loses its "artificial identity" in the world, that its emissions encounter living beings and inflict harm.

Another important complication is the extraordinarily long time it takes for certain elements of our radioactive waste to decay to "safe" levels. Plutonium-239, for instance, has a half-life of 24,000 years.[4] This means that after 24,000 years, approximately one-half of the initial mass of plutonium will remain. Radioactive abatement, the point at which the material no longer emits significant amounts of radiation, is usually estimated to take about ten half-lives.[5] In the case of Plutonium-239, then, we would expect it to take around 240,000 years before it becomes effectively radioactively inert. Taken together with the apparent fact that "present society is deriving a tangible benefit from nuclear power production," American regulatory bodies have concluded there is indeed a responsibility to contain nuclear waste in a manner that would include the "obligation" to "reduce the likelihood of inadvertent interactions" while at the same time maintaining future generations' ability to, knowingly, make decisions regarding the repository's continued operation.[6] Because radioactive waste will outlive those who have benefited from the nuclear fission that produced it, those "beneficiaries" are thought to have an obligation to prevent future generations from being harmed by the waste's emissions. It is worth mentioning here that current regulations for the construction of long-term disposal of nuclear waste "only" require that isolation be maintained for 10,000 years: a scale of time that is both entirely inadequate given the long-lived nature of the materials in question—240,000 years for Plutonium-239, for instance—and also inconceivable from the perspective of human action.

These considerations led the American Environmental Protection Agency (EPA) to assemble the ominously named Human Interference Task Force who, in 1984, wrote the following: "Future societies with knowledge of the existence and location of the [nuclear waste] repository, its contents, and the risks of interference, bear the full responsibility for any of their actions that can reasonably be expected to adversely affect the performance of the repository."[7]

According to the authors of this claim, this phrase is a "premise," as well as a "ground rule," itself made possible by two other premises.[8] These are (a) no structure or system could resist a "determined, perhaps technically superior, future societal effort to overcome it"; and (b) possible "legitimate" future uses for the contents of the repositories should not be "precluded." Clearly, the Human Interference Task Force is sensitive to the difficulty involved in predicting what the future might bring. A powerful technology, at least potentially capable of penetrating our most secure, isolating structures and systems, could develop. New strategies and uses for those by-products we have determined as harmful, toxic, or useless could arise—or, at least, this should not be ruled out. The insight behind these two premises seems to be the simple fact that the future could *be* anything, and, therefore, could *do* anything with its nuclear inheritance. However, the principle the American EPA's Human Interference Task Force derives from this insight introduces an explicitly epistemological dimension to the problem that is as fascinating as it is difficult. For the very possibility of responsibility is now grounded in the successful transmission of knowledge to the future, and it is only on the condition of such a successful transmission of knowledge that the present generation of nuclear beneficiaries can be said to have met its responsibilities to future generations.

"This society's obligation should be discharged by providing a secure isolation system that would continue to function if left undisturbed, and by transmitting knowledge of the repository to future generations, thus allowing them to plan their activities accordingly," continues the EPA's taskforce.[9] Our present society, the currently living generation(s), informed by this society's scientific understanding, would or should discharge its obligation to future generations on the first condition that today's nuclear society has put in a place a system capable, at least in principle, of isolating our hazardous waste in a supposedly self-regulating or automatic system *and* on the second condition that future generations are sufficiently informed of the repository's contents and its attendant risks. That is, the EPA's taskforce is appealing to the fairly widespread notion that risks can be undertaken if and only if those at risk agree to undergo these risks after becoming sufficiently knowledgeable to provide consent.[10] As such, present nuclear society, which is already itself the heir of a previous nuclear society, meets and hands off its obligation insofar as it devises a system not only capable of containing our nuclear waste for an unimaginable amount of time but also capable of transmitting information sufficient for future generations to make decisions.

Communication scholar Peter C. Van Wyck evocatively describes the promise to future generations as one in which there "must persist the groundless hope that the semiotic decomposition of the sign will take place at a slower rate than the nuclear decomposition of the waste. The sign must outlive the waste; a question of half-lives."[11] It is a question of attempting to construct a warning that could be at least as permanent as the waste. The longevity of the radioactive waste has imposed a structure on our containment strategies. Because nuclear waste will last for hundreds of thousands of years or more, systems of communication must also endure. This is a first moment of "discursive contamination"—that our warning must, in content and material, take on the structure of the waste it is being designed to safeguard. The warning signs today's nuclear societies select to communicate with our inheritors must be capable of a survival at least equal to the life of the waste *because* the understanding of responsibility put forth by the American EPA's taskforce insists that this long-lived toxic site be accompanied by these warnings. It will be argued later that this contamination seeps ever deeper into our thinking about this waste. For now, it is the warning sign that has been contaminated. But this leakage will not stop here.

Nuclear Inheritance and Transmission

Because the possibility of informed decision-making is understood here as the condition for the present's obligations to future generations being met, the EPA's Human Interference Task Force explicitly links the material fact of the waste's long life and continuous interaction with the environment to the semiotic challenge of developing equally long-lived communication practices and systems. Such an understanding of today's society's responsibilities thereby entails a formal analogy between the survival of the waste isolated before the future and the survival of the accompanying message.[12]

Producing such a long-lasting message is an incredible challenge. Efforts to think through a successful strategy and system at this point rely on the redundancy of the message across various mediums, textual and nontextual, in order that, at minimum, the injunction to stay away and avoid drilling remains, in some form, legible to future persons. Suggestions gathered in the EPA's report on markers and strategies include inscribed written messages in the language of each member state of the UN security council, with space to continue translating and inscribing the message in new languages as they emerge; the creation of genetically modified glowing blue cacti, to suggest danger, artifice, and radiation; the installation of massive steel thorns that would rise out of the ground and jut menacingly into the sky; and the creation of an enormous black surface that would reflect the heat of the sun to such a degree that the material survival of naive future archaeologists would become impossible.[13] Less euphemistically, this last plan would involve creating a landscape capable of reaching such intense heat that it would cook any trespassers alive. The landscape itself, then, is required to take on some of the features of our radioactive waste in order to communicate the presence of that waste. The landscape is asked to retain semiotic features, features that allow it to communicate meanings, throughout time—effectively marking the landscape's explicit and intentional re-determination as a timescape.

There are a host of semiotic and technical difficulties involved in these improbable thought experiments.[14] Going forward, however, this chapter will specifically address what is involved in imagining the possibility that everything will, or at least could, go according to plan. There is a future that today's nuclear societies would like to create, a future in which our nuclear waste is left undisturbed or, even better, our waste is understood and so taken up by future generations in their own name. But accomplishing this sort of "handing off" of responsibility for the waste seems to require the survival of precisely that vision of the future wherein today's nuclear waste would remain undisturbed. Were the future to take on an utterly unpredictable shape and so go on to become entirely alien to us, it is difficult to continue to believe that our warning would be legible. And if our warning cannot be inherited and read, our responsibility to future generations, at least according to the formulation cited above, could not be met. Recall that future generations become responsible for the waste they inherit if and only if they are sufficiently informed about it. And so, we might ask ourselves what sort of vision of the future in which our warnings are legible we are capable of articulating at all.

Gramsci, Utopian Thinking, and Principles

When we imagine future societies, their construction, their elaboration, and their organization in order to then imagine what sort of world will inherit our waste and, further, what base-level communicability could be possible, it is helpful to turn to the thinking of utopias as this is taken up in the early work of Antonio Gramsci, specifically his 1917 essay "Three Principles and Three Kinds of Political Order." There, Gramsci writes, "The inherent defect of utopias is this: believing that a vision of the future can be a vision of factual details, whereas it can only be a vision of principles, or of juridical maxims."[15] In the case of long-term nuclear waste disposal, factual details may be understood to refer to such futural projections as the ability of future generations to understand today's nuclear societies' languages, the more or less static interpretive possibilities available for a phenomenological encounter with, for instance, towering thorns or glowing cacti, or even the supposition of an approximately scientific approach to uncovering the meaning of our monuments. The problem, as Gramsci identifies it, is that if our thinking of the future *depends* on such factual details, it will inevitably collapse as a vision of the future as soon as any one of those factual details fails to hold.

Gramsci's understanding of human action complicates the problem of transmitting to future generations a "manual" or "program" for dealing with nuclear waste. Namely, Gramsci insists that the will to act can only be directed at a concrete aim.[16] As such, if we attempt to bring about conditions that would allow for future generations to receive our message about the dangers of nuclear waste material—and, in so doing, meet our obligations to them—we would need to direct our will toward some sort of concrete end. But if these ends are "factual details," such as an encounter with a particular message in a particular place, then, even in our imagining or envisioning of that future, we understand our aims in their contingency—we understand that we might not accomplish what we set out to accomplish. What a "redundant messaging" strategy—that is, a strategy wherein multiple mediums, levels of information, and locations are deployed in order to increase the chance that some form of our warning reach future others—illustrates for us is the attempt to think around the problem of frustrated factual details by multiplying those details. More messages, messages explaining the messages, sites conditioning the reception of the meta-message. This redundancy amounts to the infinite multiplication of particular details. And yet no number of factual details will prove to be enough. Any vision of the future dependent on the prediction of concrete, factual details will always be at risk of failing to come about. If we understand ourselves to *have been* responsible to future generations *on the condition* that a society capable of reading and understanding our warnings emerges, and that they then find themselves doing precisely what we project them doing with our waste, we will have turned out to be irresponsible when (and surely this is a question of "when" and not "if") the future turns out differently than we imagined it. And, indeed, even the comforting notion that overlapping generations will ease the transmission of information from one generation to the next turns on the equally contingent factual detail that such continuity will be preserved. Human history is replete with examples of sites, texts, and remains that have become mysterious or even inscrutable as a result of breaks in continuity that were certainly not anticipated by then-contemporary political or individual actors.

The situation is thus one in which concrete factual details fill the role of "concrete end"—the end toward which our actions are directed in order for that action to be undertaken at all—at the same time that the failure of those factual details to come about is exposed. Gramsci draws the eminently relatable conclusion that, without a concrete end to direct our actions toward, we lose the will to undertake that action at all. Defeatism, we could say, is a by-product of the unfortunate fact that particular ends cannot be guaranteed to result from our actions. Gramsci's conclusion here is fairly intuitive. It is difficult to motivate oneself to undertake a project if we know that this undertaking will fail to accomplish its goal. In the case of nuclear waste isolation, one might begin to question the wisdom of undertaking a project in the name of responsibility when present generations have no control and certainly no guarantee regarding bringing about even the conditions for possible success. Such defeatism led some participants in the American EPA's Human Interference Task Force to recommend a "no-marker" strategy, wherein waste repositories would be wiped from the map, so to speak, following the reasoning that any accompanying information or marker will only encourage unwitting or uninformed intervention with the waste site while failing to set future generations up to successfully deal with that waste.

Gramsci, however, provides an alternative. He argues that rather than grounding our vision of a future on factual details, we ought, instead, to ground it on principles or maxims. If our will to act must be directed toward concrete aims, then, Gramsci reasons, collective will must be directed by a "concrete universal aim."[17] And it seems that Gramsci means here that a concrete universal would be nothing other than a principle in its actualization. A universal aim would be an aim that anyone could take up as their own and so would have to be devoid of any particular reference or content. And making this aim concrete, it would appear, involves thinking through that universal aim in its application or actualization rather than abstractly. This latter point, I think, can be made clearer by way of concretizing it within the problematic of long-term nuclear waste disposal.

The principle at work in the Human Interference Task Force's formulation of our responsibilities states, in its general formulation, that present generations act responsibly when future generations are sufficiently informed that they can act in their own name upon their inheritances. When present generations create conditions whereby future generations *could not* act with sufficient knowledge, the present generation would be said to have acted irresponsibly. As just seen above, such a principle will fail to yield responsible action when we consider that its actualization as a principle requires certain contingent factual details be attained (the legibility of the message being first and foremost among these).

What would be required instead, according to Gramsci's account, is the projection of a universal principle. And if we reexamine the principle suggested by the Human Interference Task Force,[18] we can notice that, on Gramscian grounds, the issue is precisely that this principle or maxim—the transmission of knowledge entails the transmission of responsibility—is itself made possible by factual details, namely, a given set of legible information. The Gramscian response here would be to aim at a principle, such as "maximize the autonomous decision-making of all future generations," and to let concrete practices follow from such a principle. In this way, our principle would be flexible enough to allow for unforeseen circumstances to occur without resulting in our throwing our hands up in desperation at our impotence in the face of the unknowable. This because principles can be applied to any set of circumstances—this is the sense in which these principles are universal. Gramsci calls such a principle the "starting-point for further developments."[19] In this way, action is directed toward or by its aim but without that action being frustrated by the failure of specific concrete details to come to pass. Indeed, even when its stated factual goals fail to occur, such a principle would allow for new actions to be undertaken and new possibilities to be explored that still take that principle as their starting point. The principle is far more flexible than a given set of factual details in that it can be taken up in a variety of contexts and under a variety of conditions. And due to the long half-life of nuclear waste and the material constraints such a bequeathal imposes on our inheritors, we can imagine a principle like "maximize the autonomous decision-making of future generations" first of all prohibiting the continued use of nuclear reactors as an energy source insofar as the waste that we produce today runs up against such a principle *for us today.* There does not seem to be a way to justify the continued use of nuclear energy under present conditions that would maximize rather than limit the decision-making capacities of future generations. Such a principle, then, also accomplishes clear normative work: it would prohibit the expansion of the use of nuclear energy until issues like long-term waste management are resolved. And if these issues are understood to be irresolvable, then a prohibition on the use of nuclear energy would endure.

The Principle and the Program: The Shape of Timescapes to Come

If we understand Gramsci's point that particular factual details cannot constitute a vision of the future that would allow future generations to take responsible action, what is less clear is whether principles themselves also fall prey to such a critique. If concrete details of an imagined future are insufficient to ground action because they are overly contingent and exert too much determinative power over what the future will be, could that same concern be applied to the projection of principles into the future? Would this undermine Gramsci's conclusion that a vision of the future can only be a vision of principles? The question here, more specifically, is whether or not a generalizable principle such as maximizing the autonomous decision-making of future generations might itself overdetermine the future and so undermine such future generations' autonomy. In this way, we can ask whether the articulation of principles for present generations and for future generations might "contaminate" or "infect" that future with remnants of present generations' logics at the same time as and in the same way that these futures are contaminated or infected by the present generations' waste. The overdetermination of the future by the present, in a context where that overdetermination allows for the continued production of hazardous materials and ethical frameworks that would justify this production, is what is meant here by the term *toxicity*. There is, as we shall see, an important logic of contamination at play in attempts to decide in advance just what it would mean for the future to be responsible for the waste of contemporary nuclear societies.

In order to explore this issue in greater detail, we will turn to a set of arguments articulated by Jacques Derrida in his 2003 text *Voyous: deux* *essais sur la raison,* translated as *Rogues: Two Essays on Reason. Rogues* takes as its subject matter the identification "rogue states," the concept of democracy,[20] as well as the right to unilateral action. Democracy remains, Derrida argues throughout the text, to come [*à venir*]. This understanding of the future [*l'avenir*] as to come [*à venir*] is more than a simple play on French homophones. It confronts us with an understanding of the future loaded with expectation ("the future will come"), nonpresence ("the future hasn't come yet"), and a certain necessity ("the future *will* come"). Already it is clear that a substantially different way of thinking of the future is being articulated when compared to the vision articulated above by the Human Interference Task Force. Whereas the Human Interference Task Force allowed its understanding of responsibility to be guided by an imagining of the future determined according to certain parameters—we are responsible if future generations inherit our remains in the way we want them to—Derrida emphasizes precisely the necessary unpredictability of the future alongside that very future's necessary occurrence. There will be a future, Derrida insists, but it is not known to the present.

It is for this reason that Derrida will insist that what defines democracy is not a specific political form that we see in some places around the world and not in others. Rather, democracy is to be thought always as a form that has yet to be instantiated in the world. This "not yet" of democracy is to be thought in terms of a future that is not yet known and so not yet determined. Derrida retains the futural character of democracy without reducing the concept to either a fixed concept that simply has not *yet* been actualized but remains within the realm of the possible, or a concept whose unrealizability would make it out to be a sort of regulative idea that would govern action through a hypothetical imperative, "as if" it were possible.[21] Both of these alternatives would mean deciding in advance what democracy could be, and so fix that concept in a way that strips it of its universality—its ability to be taken up in a wide variety of as-of-yet indeterminate futures. Put differently: Derrida understands democracy as a concept whose legibility depends on our refusing to decide, once and for all, how, where, and when it is to be determined.

The goal of this section will be to see the extent to which Derrida's arguments against the use (or misuse) of the concept of the regulative idea, the fixed principle that determines the trajectory for our actions, can help us think through Gramsci's insistence that the future be envisioned only by means of principles. We will then think through what such an argument can reveal about toxic timescapes in terms of a contagious toxicity that affects an imagining of the future in addition to the state of a place, a time, or a problem. What Derrida is offering here is not so much a critique of thinking using regulative ideas as it is a serious putting into question of the very notion that the relation of the present to the future can be characterized as the present successfully bringing about a specific form of the future or the present accomplishing itself on the condition of just the right sort of future coming about. In the case of nuclear waste, Derrida will allow a critic to investigate the suspicion that making future generations responsible for taking up the waste of the present in predetermined and prescribed ways is inadequate to a thinking of responsibility before these future generations, even or especially when such a strategy is undertaken with the goal of maximizing future generations' autonomy. Derrida's elaboration of futurity, as we shall see, helps us to make the argument that present generations do not "succeed" at being responsible when future generations can take up the present generation's responsibility for them. Rather, present generations seem to be "successful" only at forcing future generations to inherit the present generation's failures and unthoughtful irresponsibility.

In arguing against an understanding of democracy as a regulative idea, Derrida writes the following:

> The responsibility of what remains to be decided or done (in actuality) cannot consist in following, applying, or carrying out a norm or a rule. Wherever I have at my disposal a determinable rule, I know what must be done, and as soon as such knowledge dictates the law, action follows knowledge as a calculable consequence: one *knows* what path to take, one no longer hesitates. The decision then no longer decides anything but is made in advance and is thus in advance annulled. It is simply deployed, without delay, presently, with the automatism attributed to machines. There is no longer any place for justice or responsibility (whether juridical, political, or ethical).[22]

Although the language Derrida uses here can be tricky to wrap our minds around, his claim is relatively straightforward and can be understood in the following way: To be responsible for something could not mean to make a decision according to a rule decided in advance. This is because when a rule is simply followed, no decision as such has been made. Rather, the agent in question is simply carrying out a rule, in the way that a computer does not "decide" what to do when a button on the keyboard is pressed—the computer simply carries out a program. Hence Derrida's point that such a decision "no longer decides anything but is made in advance." Responsibility as such, responding *to* something or being responsible *before* something, will require that the agent in question make a decision in their own name and under their own power. One does not act responsibly when that action has been decided in advance. In the context of the present volume and in terms of modernity's nuclear legacy, this will mean abandoning a conception of responsibility that takes as its condition the guarantee of a certain state of affairs coming to pass.[23]

If the problem Gramsci raised on the level of factual detail was that the vision of the future that would be a condition for action would too easily come apart at the moment a given factual detail fails to materialize, Derrida offers an argument against the determination of the future by way of a rule or, I would add, principle on the grounds that these would predetermine decision-making to the extent that decisions as such become impossible. This is to say that if human action, individual or collective, requires a concrete *aim,* such as the precise reception of a waste repository, maintained, passively or actively, so as to be in the condition that the present generation requires it to be, and for that repository to be received by future generations alongside a message, legible in just the way that the present generation requires it to be, these factual details fail to ground action because they too easily slip away from concreteness. Which is to say that as soon as these exact parameters fail to be met, the future-oriented project for which they are conditions fails. This was Gramsci's argument. On the other hand, and to introduce Derrida's insights to this investigation, universally inheritable rules or principles would fail as a means to maximize autonomy because they would take decision away from action precisely *because* they continue to determine actions in advance across a variety of contexts. Derrida is arguing here that a rule simply being followed renders action *calculable* in such a way that all decisions made in accordance with that rule turn out to have been made in advance. And in a thinking of responsibility for nuclear waste and before future generations, it is already becoming clear that deciding on the conditions of reception for the inheritors of this waste would severely limit—rather than increase—future generations' capacity for being responsible for today's nuclear legacy in the first place.

A complication arises when we try to think through a conception of responsibility that would first of all depend on following a rule or principle, such as "maximize the autonomous decision-making of future generations." If following a rule takes the decision out of decision by determining the character of an action in advance, it is difficult to understand the sense in which the agent or collective making such a decision (or, more accurately now, undertaking an action without having to make a decision) is capable of *responding* and so *being responsible* at all. If nuclear societies today tell future societies how to deal with nuclear waste and nuclear energy—concretely or by way of inheritable principles for action—future societies have no ability to make a decision of their own. Indeed, such a principle would, at the moment of its application, run counter to its stated goal, maximizing autonomy, and would reduce the decision-making of those future generations merely carrying out a program.

Moreover, when we give ourselves such a maxim and insist that this maxim is universal—applicable to all, including future generations—we also allow ourselves to stop making decisions at all insofar as we can, instead, simply follow the program we have laid out. And, further, future generations inheriting this principle would diminish rather than increase their autonomy insofar as following that maxim takes away their autonomous decision-making at the very moment that they take it up, and so this principle's operation undoes its own stated goal. Which is to say that that principle could not apply itself universally—it is not a universal principle. If we use the example of an ostensibly universal principle like "maximize the autonomous decision-making capacity of future generations," we have seen that concretizing this principle seems to require that a given set of inheritances be inherited in the way that the present generation deems necessary for autonomous decision-making (e.g., an intact site, legible instructions), which, in turn, requires that a particular version of our inheritors really does come about (i.e., a version of future generations that will read and use our warnings and our waste just the way that we want them to). In this way, the apparently universal principle that insists that the future generation acts autonomously in practice limits that autonomy so as to exclude any version of the future that would differ from the present generation's image of that future, thereby undermining the universality of that principle in the first place.

It would also be the case in the Human Interference Task Force's conception of a responsibility for nuclear waste that takes nuclear societies' obligations to be met on the condition of the communication of specific knowledge—in this case, knowledge of the location, content, and risks of interfering with the radioactive waste repository. While it may turn out to be the case that adequate knowledge would be necessary for decision-making, the "decision" to accept our knowledge, read it, make it legible, loses its character as a decision at precisely the moment it is projected forward as a condition for responsibility in general. The EPA's Human Interference Task Force insists that future generations *must* inherit our warnings and *must* be able to read them *in order to be responsible at all.* And this series of necessities—what today's nuclear societies' inheritors *must* do—would also be a condition for the present generation's responsibility for the waste to come to an end. What the Human Interference Task Force's formulation of our responsibilities to future generation guarantees, it turns out, is the programmatic repetition of our principles in the name of the possibility of our inheritors becoming fully responsible for themselves while in fact creating conditions that make their *irresponsibility* inevitable. Now it is our principles that must endure as long as the radioactive waste. Principles that apparently must survive variations in context while continuing to extend out into the world. And, in this way, it is the irresponsibility of contemporary nuclear societies that also survives. The present generation has created these problems by thoughtlessly carrying out projects it has inherited from its past and, in the name of responsibility, aspires to guarantee that future generations will do so as well.

This hollowing out of decision-making manifests itself as precisely the moment when epistemological inheritances and bequeathals most perfectly mimic the structure of the waste itself in repeating that waste's brute insistence that it be inherited. These sorts of imaginings of the future appear to us as necessary because of the consequences of the production of nuclear waste. The waste will survive. Our containment of the waste must therefore also survive. And so our warnings must survive. Which means that our vision of the future must survive. And the principles that might make up the vision of that future must survive. All so that our responsibilities can be met at the moment when that vision of what responsibility is in the first place can be inherited by future generations. This, it turns out, is to say that *this* image of responsibility must survive.

Nuclear waste contaminates not only today's landscape and the landscapes of future people but our very decision-making and, thereby, the possibility of future decisions. And it does so irrevocably. Nuclear waste entails—or even necessitates—precisely the sort of attitude which, directly or indirectly, cuts off the possibility of what Derrida called "an essentially interminable questioning, that is, an effective and thus transforming questioning."[24] The continued production of nuclear waste and its contagious logic of programmatics[25] is precisely the sort of practice that would take decision-making, questioning, and revising off the table. Not only for future generations but, indeed, for "us" as well. We might say that the irresponsibility at the origin of the production of the waste—an ignorance of or apathy toward the long-term effects of utilizing nuclear energy—has imposed itself on our thinking of responsibility and inheritance in general. Indeed, this irresponsibility has contaminated the place and the time in which the present and the future find themselves today and tomorrow. The toxicity of this waste can be properly said to reside within a timescape—extended, lived in, and irreducibly temporal. In attempting to hand off our responsibility to future generations, we, in fact, hand off our inability to act responsibly alongside the waste and the institutional and semiotic apparatuses that we have decided accompany these. Although here we should certainly add that *our* decision to engage in this chain of irresponsibility looks less and less like a decision the more we consider it. The material constraints of the waste have, in a sense, forced our hand. It *will* survive.

Derrida is nonetheless clear that there is something that would remain tempting about the regulative idea, the principle that would take itself as only an ideal possibility that would nonetheless ground our decision-making.[26] But, as we have seen, it would have to be a principle that is revisable and insists on its own interminable self-critique. We can imagine a principle being taken up as a decision at each moment of its application. The decision to apply a principle would be a decision insofar as we could also decide not to apply it. Such a principle would not take its applicability as a foregone conclusion. Rather, it would be revisable, interminably. Such an application of a principle would, as an always provisional condition of responsibility, strip our conception of responsibility of any guarantee or any promise of final accomplishment. It would force us to give up the notion that, one day, we will have done enough if we just do the same thing over and over again. And it is entirely possible that such a quasi-regulative principle would be essentially incompatible with the continued production of nuclear waste. The interminable risk such waste poses to present and future generations may insist on certain practices and inheritances being imposed on future generations. But there can be no relief available to present generations that such practices or inheritances could be called "responsible" or that we could be done with our responsibility.

A responsibility that takes itself as *having been accomplished,* once and for all, a responsibility that allows us to walk away from our decisions, our contaminated sites, and our contaminated logics with a clean conscience, would be of the sort that echoes the interminable decay and contamination of our toxic sites throughout time. And to give up this sense of responsibility is to give up a thinking wherein our turn with the waste will come, one day, to an end. Rather, when inheritance is understood as a decision not of whether the waste can be inherited but of *how* it will be inherited each time, our responsibility becomes interminable in a different register. For we continuously determine the contexts from which and out of which this decision of inheritance can be made. We are responsible *first and foremost* at that moment when our inheritors take up our bequeathal as their own.

But this is perhaps too abstract. Too ideal or idealistic. The fact remains that today's nuclear societies' waste is here and will survive and will remain dangerous. There are better or worse ways to contain that nuclear waste, to interact with it, to take it up (or let it lie). It is impossible for the present generation to think responsibility as maintaining a totally open-ended relationship to this toxic substance, even if responsibility now appears to insist on such a refusal to determine in advance. From this impossibility we can perhaps draw two speculative conclusions that might be of interest to those whose interest in these issues led them to this volume initially. For in thinking about toxic timescapes and the danger of that toxicity, this volume seeks to look beyond the strictly empirical delimitation of certain sites as toxic, at the very least because these sites are taken to be spread out in time. And here I have argued that the toxicity of these sites extends to our very discourse, our ways of thinking about seemingly basic categories like, to name only the most determinative in this chapter, responsibility. The first of these conclusions is that, in the name of responsibility to and for the future, the continued use of an energy source that generates waste that, necessarily, determines responsibility in such a way that it becomes impossible is to be opposed. Second, both our responsibility and irresponsibility will, like the toxic timescape called "nuclear waste," survive.

Notes

1. See *Nuclear Waste Benefits and Cost Should Be Better Understood before DOE Commits to a Separate Repository for Defense Waste,* GAO 17–174 (Washington DC: US Government Accountability Office, 2017), https://www.gao.gov/assets/690/682385.pdf.
2. "High-Level Waste," United States Nuclear Regulatory Commission, https://www.nrc.gov/waste/high-level-waste.html, accessed June 29, 2019.
3. Jacques Derrida, "Biodegradables: Seven Diary Fragments," trans. Peggy Kamuf, *Critical Enquiry* 15, no. 4 (1989): 812–73, 828.
4. United States Nuclear Regulatory Commission, *Backgrounder on Radioactive Waste,* April 2015, https://www.nrc.gov/reading-rm/doc-collections/fact-sheets/radwaste.html, accessed October 18, 2017.
5. Peter C. Van Wyck, *Signs of Danger: Waste, Trauma, and Nuclear Threat* (Minneapolis: University of Minnesota Press, 2005), 6.
6. Human Interference Task Force, *Reducing the Likelihood of Future Human Activities That Could Affect Geologic High-level Waste Repositories,* Tech. no. 6799619 (Columbus, OH: Office of Nuclear Waste Isolation, 1984), 8.
7. Human Interference Task Force, 8.
8. Human Interference Task Force, 7.
9. Human Interference Task Force, 9.
10. For an in-depth look at the role informed consent has played in the development and critique of nuclear waste repositories, see Kristin Schrader-Frechette, "Ethical Dilemmas and Radioactive Waste: A Survey of the Issues," *Environmental Ethics* 13 (Winter 1991): 327–43.
11. Van Wyck, *Signs of Danger,* xvi.
12. Worth mentioning here is the Finnish strategy currently in practice at the Onkalo deep waste repository. Reasoning that any markers or systems of communication whatsoever would necessarily increase the likelihood of human interference, engineers at Onkalo would prefer that no exterior marker be left behind at all. A separate EPA task force briefly considered a similar strategy in a 1991 report but concluded that the material existence of the repository itself already constituted a mark and that, therefore, further explanation would be necessary. See Sandra Upson, "Finland's Nuclear Waste Solution," *IEEE Spectrum,* November 30,

2009, https://spectrum.ieee.org/finlands-nuclear-waste-solution, as well as Stephen C. Hora, Detlof von Winterfeldt, and Kathleen M. Trauth, *Expert Judgement on Inadvertent Human Intrusion into the Waste Isolation Pilot Plant,* SAND90–3063 (Albuquerque, NM: Sandia National Laboratories, United States Department of Energy, 1991). For further discussion on site marking strategies, see also Martin J. Pasqualetti, "Landscape Permanence and Nuclear Warnings," *Geographical Review* 87, no. 1 (1997): 73–91.

13. See Hora et al., 1991.
14. Peter C. van Wyck's *Signs of Danger: Waste, Trauma, and Nuclear Threat* remains, to my mind, the single most important contribution to thinking these issues and their psychoanalytic implications through seriously. See also Michael Peterson, "Responsibility and the Non(bio)degradable," in *Eco-Deconstruction: Jacques Derrida and Environmental Philosophy,* ed. Matthias Fritsch, Philippe Lynes, and David Wood, 249–60 (New York: Fordham University Press, 2018).
15. Antonio Gramsci, "Three Principles and Three Kinds of Political Order," *The Pre-Prison Writings,* trans. Virginia Cox (Cambridge: Cambridge University Press, 1994), 20.
16. "It is impossible to conceive of the will being directed at something other than a concrete aim." Gramsci, 20.
17. Gramsci, 20.
18. Quoted above, but repeated here: "Future societies with knowledge of the existence and location of the [nuclear waste] repository, its contents, and the risks of interference, bear the full responsibility for any of their actions that can reasonably be expected to adversely affect the performance of the repository."
19. Gramsci, "Three Principles," 21.
20. For a rigorous reading of Derrida's understanding of democracy as futural and elliptical that links these figures to a relation to future generations, see Matthias Fritsch, "Taking Turns: Democracy to Come and Intergenerational Justice," *Derrida Today* 4, no. 2 (2011): 148–172, as well as Matthias Fritsch, *Taking Turns with the Earth: Phenomenology, Deconstruction, and Intergenerational Justice* (Stanford, CA: Stanford University Press, 2018).
21. That is, a regulative idea that would allow us to say something like "yes, democracy isn't here, now, and perhaps never has been, but we should act *as if* we lived in a democracy so as to get as close as possible to it, or, if we are strict enough or lucky enough, find ourselves in the happy position of instantiating that democracy through our acting *as if* it were already here."
22. Jacques Derrida, *Rogues: Two Essays on Reason* (Stanford, CA: Stanford University Press, 2005), 84–85.
23. And, indeed, this issue is apparent throughout this volume but especially in the contributions of both Anna-Katharina Laboissière (Laboissière,

"Speculative Conservation and Assisted Evolution: Interventions in Extinction Timescapes") and Jason R. Parry (Parry, "The Toxic Water Clock: On the Salton Sea and Camp Century"), in which the massive scientific apparatuses at work in creating predictive models insists on ever tighter control over the present in the name of the repetition of the present (and all of its attendant problematics) into the future.

24. Jacques Derrida, "The Rhetoric of Drugs," *Points . . . Interviews, 1974–1994,* ed. Elisabeth Weber, trans. Peggy Kamuf (Stanford, CA: Stanford University Press, 1995), 239.
25. Here we might consider Jean-Luc Nancy's observation in his book on the Fukushima disaster that, in a world conditioned by inevitable catastrophes which nonetheless appear as mere probabilities, "communication becomes contamination; transmission becomes contagion." See Jean-Luc Nancy, *After Fukushima: The Equivalence of Catastrophe,* trans. Charlotte Mandell. (New York: Fordham University Press, 2015), 34.
26. "Yet the regulative Idea remains, for lack of anything better, if we can say 'lack of anything better' with regard to a regulative Idea, a last resort. Although such a last resort or final recourse risks becoming an alibi, it retains a certain dignity. I cannot swear that I will not one day give in to it." Derrida, *Rogues,* 83.

CHAPTER 13

Speculative Conservation and Assisted Evolution

Interventions in Extinction Timescapes

Anna-Katharina Laboissière

MARINE SCIENTISTS are breeding "super corals" to help bleached reefs recover, as has been reported breathlessly in several news articles on advances in marine conservation.[1] A recently proposed attempt to mitigate the catastrophic effects of increasingly toxifying oceans on reef-forming corals, namely the selective breeding of resistant species—either by mixing genomes within one species or by attempting various hybridizations—marks a decisive break with previous forms of marine conservation, which were generally focused on the in situ preservation of biodiversity and the asexual propagation of local coral stock for replanting. Assisted evolution, as this new approach has been called, is an intervention not only into the distribution but also into the genealogies and futures of coral species. It stands as an intriguing example of what conservation biology becomes when it involves itself in experimental, speculative practices.

In this chapter, I will read the practice of assisted evolution, through the lens of timescapes, as an intervention into temporalities interrupted by capitalist extractivism and climate change. I argue that conservation biology not only *conserves* but also transforms endangered species and, in the case of assisted evolution, does so by animating, manipulating, and participating in the temporal abilities of these species. The selective breeding of species adapted to changing environmental conditions is also timescaping work, reaching into evolutionary pasts to shape alternative futures and potentially denaturalizing the collective labor necessary to survive extinction events.

Matters of extinction and counterextinction can be recast as issues involving discrete events and mitigation attempts as well as broader and more complex timescapes—disturbed ones, in which coevolved intersections of time, place, and bodies are brought lethally out of joint, "fatally confused," in the words of Michelle Bastian.[2] Assisted evolution has been attempted with frogs, who are collectively under threat as a result of a widespread fungal pathogen, as well as with coral species. When the toxicity of ocean water, increasing as a result of carbon dioxide uptake, intersects with accelerating marine heat waves and with the regenerative and evolutionary speeds of coral reefs, the resulting unbearable friction culminates in the catastrophic bleaching events we have witnessed more and more in recent years, amputating or warping these coral reefs' ability to matter as participants in the timescape they were formerly inhabiting. The impacts of environmental toxicity are not limited to the present bodies of endangered species and the ecosystems they compose; they destroy the temporalities these bodies are able to produce and weave together, the time-*scaping* work that species are always engaged in as they evolve, change, and interact with past and future kin. The corals singled out for selective breeding are situated in a *toxic timescape* that is specifically one of impossible evolution; it destroys the lifetimes of individual bodies, but also stunts one particular pathway for a species to inhabit the future—by changing, adapting, and ultimately becoming something other than what it was. Conservation biology, especially at its most speculative, is also an attempt at bringing disparate speeds back together in an attempt to remake dynamic assemblages, and as such an intervention in the very ability of endangered species to go on inhabiting and shaping future timescapes.

Understanding human intervention into nonhuman lives for counterextinction purposes—not just as the irruption of a separate "cultural" or technological regime into "natural" lives but also as one element in a set of interspecies relations spanning coevolutionary history—might bypass common dualisms opposing natural and cultural, wild and artifactualized, which still animate debates in and around conservation biology. These practices do not merely simulate the potentialities contained within abstract and abstracted experimental objects; they have an immediate effect on the agency of the endangered species they are designed to maintain, and it is this agency I propose to excavate by taking into account the futurity and generativity of conservation biology. I will briefly sketch out the historical context in which selective breeding has emerged as a potential conservation tool, as well as the projects in coral assisted evolution currently being trialed in laboratory and field settings. These projects must be read as working not only with bodies but with temporality and temporal agency, in order to lay out precisely where their promise and their danger both lie. I argue that reading assisted evolution as an intervention into timescapes also comes to bear on our understanding of extinction—recasting it as a territory rather than an event, and one that must be crossed by engaging in various forms of interspecies work, making and unmaking present and future timescapes.

The Return of Selective Breeding and the Rise of Assisted Evolution

The issue of adaptation has animated the practice of captive breeding in zoos and botanic gardens at least since the integration of the former into explicit conservation efforts. This shift in zoo-biological strategies can be dated back to the implementation of Species Survival Plans by the American Association of Zoological Parks and Aquaria in the 1980s, and its attendant need for master plans, studbooks, and the coordination of breeding procedures between zoos. Captive breeding comes with a host of conservationist anxieties: the problem of keeping populations as unchanged as possible, the issue of excessive habituation to captivity and human closeness, and the question of how to readapt individuals slated for reintroduction into wild habitats. Species Survival Plans are already ways to "selectively breed individuals in the captive population in order to maximize genetic diversity,"[3] as Carrie Friese points out. And yet, the ex situ conservation of endangered species is also constructed on the premise of breeding them "without compromising the viability of the population or changing its characteristics,"[4] while also negotiating the push and pull of necessary habituation and the desire to keep animals as "untainted" by human sociability as possible.[5] Recent scholarship in animal studies has problematized these assumptions, for instance by critically examining the ex situ breeding of animals so removed from processes of intraspecies transmission and adaptation as to be virtually clueless once released for reintroduction.[6] These discussions all circle around a question sometimes unacknowledged in conservation biology itself, namely the role of ex situ breeding in selecting for certain genes and also for behavior, plasticity, adaptability. Acknowledging this also points toward the need for such a selection to take place in order to have even a chance of mitigating the way captivity severs the coconstituting ebb and flow of predatory, commensal, parasitic, or symbiotic relationships. Conservation biology is an intervention extending into various spatial and temporal dimensions, and it produces maladaptations when it fails to take its own reach and breadth into account. These range from the failed reintroduction of animals bred in captivity and therefore cut off from the possibility of weaving networks of cultural transmission[7] to realizations that ex situ seed collections are not adapted to actual restoration work due to their genetic composition.[8]

While captive breeding met with enthusiasm-dampening criticism by several biologists throughout the 1990s,[9] artificial selection has made a comeback in zoo-biological literature in the context of increased human-induced introductions of pests, environmental toxicants, and pathogens, and destabilization of climates and habitats. "It is time to weigh up the pros and cons of using genetic engineering to rescue species from extinction,"[10] according to a comment article published in *Nature* in 2013. One pathway of artificial selection is genetic rescue: the introduction of new individuals—often called "immigrants"[11]—into a population threatened by genetic bottleneck. One of the most frequently discussed and publicized examples is that of the Florida panther;[12] other adjacent projects were the breeding of blight-resistant American chestnut trees in 2014, and the ongoing restoration of genetic diversity to a group of black-footed ferrets by using samples of unrelated individuals banked at the San Diego Frozen Zoo.[13]

Manipulating immigration flows into existing populations has now paved the way for practicing artificial selection entirely ex situ. One current proposal for selectively breeding resistance into endangered populations is gathering momentum in amphibian conservation. The virulent disease chytridiomycosis, caused by a fungal pathogen (*Batrachochytrium dendrobatidis*) discovered in 1980, has ballooned into a pandemic responsible for significant declines in at least 501 amphibian species. The physiological fragility of amphibian skins combines with capitalist flows of extraction and trade, the tightening of temporal nets across the globe, and the increasingly complex interactions of environmental toxicities, all of which result in a “new Pangaea”[14] for seasoned and resilient travelers such as fungal pathogens; this makes the amphibians first in line for succumbing to new pandemics. But frogs can rally when treated in captivity, and a host of mitigation methods has been tentatively put forward, including selecting for resistance in captive colonies.[15] A first study conducted on captive populations of Panamanian *Atelopus* frogs concludes that “captive populations will be an invaluable asset for breeding resistant frogs that can reduce Bd infections or tolerant frogs that can limit damage caused by infection.”[16] The structure of the chytridiomycosis pandemic is one example of how intersecting spatial changes and toxic emergences make certain futures unlivable, bringing with them both economic expansion and existential contraction; toxic timescapes, here, are those of lethally uncoordinated speeds and movements.

The most advanced experimentations in assisted evolution are currently being carried out by marine scientists. Surfacing from the churning and urgent waters of marine extinction events, a handful of articles have explicitly proposed “speed[ing] up evolution”[17] as an attempt to mitigate the effects of the catastrophic heat waves of 2016 and 2017, which led to a massive bleaching event in the Great Barrier Reef.[18] Coral-reef bleaching—the expulsion of the symbiotic zooxanthellae corals depend on for survival—is due to a variety of stress factors, chief among them the presence of various pollutants, the rise of water temperatures, and increased ocean acidification due to uptake of air pollution. It is the intersection of these factors that makes for a toxifying environment: heat stress undoes symbiotic relationships, and acidification impacts the resilience of reefs unable to properly built skeletons out of calcium carbonate, in a one-two punch that makes bleaching resistance and recovery extraordinarily difficult. In this context of almost hopeless urgency, a number of marine scientists are in the process of making good on a recently published call for “a series of experiments to determine the feasibility of developing coral stocks with enhanced stress tolerance through the acceleration of naturally occurring processes, an approach known as (human)-assisted evolution.”[19] The proposal is at least fourfold, combining different levels of intervention and therefore different types of potential transformations. Their “biological tool box for enhancing coral resilience and stress tolerance” seeks to intervene in several evolutionary processes, such as the modification of microbial communities, the evolution of endosymbionts in the laboratory, epigenetic acclimatization, and the selective breeding of corals. This proposal works on the assumption that coral reefs will have to exist in a future timescape of environmental toxicity, where oceans are and remain more acidic and warmer than they were before; the question here is the inhabitability of such a toxic timescape rather than an attempt at mitigating or reversing its emergence, and of the abilities coral species will need in order to make sense of and engage with this timescape.

According to the authors, the process of selective breeding has received "virtually no attention in coral reef conservation, . . . despite its clear relevance," and it is the main focus, novelty, and strength of their proposal. The authors propose the mixing of gene pools, both within species in order to select for resilient variants, and across different but closely related species in order to create more resistant hybrids. As they point out, "a range of coral species are known to hybridize with other species in the wild"; here, the hybrid is not construed as a threat to established taxonomies and conservation policies whose status must be immediately stabilized or justified but as an interesting opportunity to maximize fitness in dangerously toxic and disturbed environments.

The work to create a coral "bred for the future"[20] is not merely theoretical but already well underway in several laboratories around the world. One such place is the National Sea Simulator, a facility of the Australian Institute of Marine Science (AIMS) located in Townsville, Queensland, where one project in assisted gene flow and one in hybridization are being conducted. The former, helmed by Line Bay, has seen corals flown in from northern Queensland where they survived the 2016 and 2017 heatwaves—the ironies of shipping endangered species by air like so much precious cargo is not confined to attempts at assisted colonization[21]—and tested for increased heat tolerance. The juveniles resulting from cross-fertilization with corals from the middle of the reef have been transplanted to the Great Barrier Reef in July 2019; the survival rates of various crossbreeds are currently being monitored,[22] in an early test of the feasibility of the project on a larger scale.

The latter, under the direction of Madeleine van Oppen, combines several different pairs of coral species in order to monitor the traits inherited by their offspring. To date, van Oppen's team has published the results of the reciprocal crossing of two *Acropora* species pairs—*Acropora tenuis* and *Acropora loripes* on the one hand, and *Acropora sarmentosa* and *Acropora florida* on the other—resulting in eight different offspring groups.[23] In order to do this, corals are grown at the Sea Simulator, kept in several separate tanks, and closely monitored around their spawning time. As soon as they spawn, the sperm and eggs are scooped out of the tanks, taken to the fertilization room, rinsed out and separated, and divided into different cups, there to await crossbreeding with gametes from the species singled out for hybridization.[24] After successful fertilization and colonization of ceramic plugs, the new colonies are distributed into rearing tanks, with one-half grown under ambient conditions and the other in water warmed up by one additional degree, and with increased acidity—a simulation of the toxic timescapes these corals will have to inhabit that is not a merely abstract projection but already a generative existential experiment.[25] Having been given "something that challenges their biology and will translate to them performing better on the reef," in the words of Ruth Gates,[26] they are then monitored for "survival, recruit size, *Symbiodinium* uptake, and photochemical efficiency"[27]—with the observed result that "across all traits measured, hybrids were either equivalent to or more fit than at least one parent, and none of the hybrids performed worse than both parents." While the authors state that hybridization has no observable negative effects, they conclude the study by pointing toward the need for demonstrating "that the risk of this strategy is low by showing that the fitness of later generations remains equal or superior to that of the parental species in the wild" before it can be considered as a viable conservation option.[28] Even so, we see how the increasing toxicity of ocean waters is also a timescape distorting conservationist trajectories and inducing new forms of intervention into evolutionary becomings.

Reassembling Temporal Agency

Environmental scholarship has been turning for some time now toward an exploration of the temporalities of extinction and of the way species end. Michelle Bastian, for instance, has shown how the death of a species can be the result of an increased vulnerability predicated on lethally disrupted rhythms: the leatherback turtles she writes about are dying not *only* because of fishing, not *only* because of climate change, not *only* because of plastic in the oceans, but because all these processes are producing their own disjointed rhythms, and their overlap creates a lethal friction for creatures dependent on their earlier synchronicity or asynchronicity.[29] Bastian points out that conservation work, in this context, can also mean the necessity of disentangling temporalities, of severing rhythms dangerously brought together—as such, it appears as a practice of temporal re- or unweaving as much as one of spatial restitching. The overarching importance of time and its production, the collaborative tending to its textures and rhythms, has also been emphasized by scholars such as Deborah Bird Rose, notably in her characterization of extinction as a double death—the death of death itself, by which she means the time and opportunity to perform death correctly and to weave it into cycles of material and semiotic transmission. "In a few short centuries, the human species has begun unmaking the balance on earth between life and death, enabling death to expand and expand, tilting life toward a catastrophe that is difficult to imagine, difficult to think, and yet morally imperative to consider," she writes in *Wild Dog Dreaming.* "Along with the loss of existing life forms, there is a further, equally critical, loss of new life forms. This means that in our day species being lost are not being replaced. We are seeing the death of evolution in many large classes of life forms."[30] We see here that *time* is of course always of the essence when dealing with or speaking of extinction and counterextinction; but *temporality,* the quality and texture of the relationships a species, a group of researchers, an ecosystem can or cannot have with time, is just as crucial. In the case of bleaching-tolerant corals, the speed of evolution must be brought into some sort of alignment with that of toxification; if ocean acidification and the heat stress it exacerbates create toxic timescapes in which these relationships are cut short and in which, ultimately, no further timescaping will be possible, conservation biology must intervene in the ability to move through time and to collaborate with others in that movement, to oppose new forms of temporal movement to the barren, foreclosed toxic timescape created by mass bleaching events.

The sixth mass extinction event—which the world is in the middle or on the brink of, depending on who is assessing current extinction rates—has to do in part with spatial colonization and in part with the infiltration of matter and bodies by various kinds of toxicants. In this respect, the amphibian conservationists comparing the pathogen circulation affecting frog populations around the world to the re-creation of a functional new Pangaea emphasize how deadly the fungibility of living entities treated as commodities can become in its restitching of geographical relationships and pulling together of distances. This form of spatial colonization comes to bear on humans as well as more-than-human communities (and, arguably, entire ontological worlds),[31] with catastrophic environmental consequences—chief among them climate change, environmental toxicants, and mass extinction. However, this spatial occupation also goes hand in hand with a form of colonization of the future; late capitalism is a formidable machine for reaching down into planetary pasts and using the archived, fossilized remains of former times, such as the carboniferous remains that fueled the Industrial Revolution, to accelerate the present and foreclose the future. As Zoe Todd points out in an essay about the power structures embedded in "euro-western" time and settler colonialism:

> Through the logics of its own science, white supremacy seeks to categorize humans in such a way to stretch its spindly white fingers back through the mammals, the dinosaurs, the marine creatures, the stromatolites, the nucleated-cells, the archeans, the prokaryotes, the very carbon and oxygen and hydrogen and nitrogen and atoms and electrons and quirks and quarks and energy that comprise this existence—they try to stretch that spindly finger back to the very beginning of *being* here on this planet, in the forms we understand being to take. . . . Artifacts are products of a specific and singular march of euro-western time, a march that drills down deep through the current epoch . . . all the way back to the first geologic eon, the Hadean.[32]

Todd makes a compelling case here for analyzing the specifically temporal processes of white supremacy, and the ways in which they empty out racialized bodies, conquered land, nonhuman life, or nonlife by classifying and artifactualizing them. Capitalism, together with the imperialist and racist pillars it rests upon, enacts the reduction of worlds that touch every conceivable spatial, temporal, and relational dimension. The toxicity of this use of earth's past to colonize its future is physical as well as relational: the foreclosed, occupied future timescape prepared by this extractivism makes relationships between agents so poisonous as to become impossible, halting flows of interaction and animacy that are part of timescaping work.

Counterextinction, in this context, must therefore also and necessarily be an attempt at counteracting forms of temporal foreclosure, and this is where I locate the center of gravity of assisted evolution. There has been significant scholarly engagement with forms of suspensive conservation, which seem to arrest time itself and forestall its dangers; Matthew Chrulew, for instance, points out the power relations at play in any technological control of species' lives, reproductive abilities, and temporal agency or suspension, using the example of the Frozen Ark and its attempt to bank as much endangered DNA as possible. "In doing so, cryopower transfigures its object, maintaining it in suspended animation, as life's code or potential but no longer as living, without an experiential relationship to the world, or an autonomous capacity for communal generation. . . . There is an important sense in which cryopower risks becoming an excessive immunization of life, a 'negative [form] of the protection of life.'"[33] While the biopolitical power wielded by suspensive conservation in the name of shielding endangered species from a dangerously disturbed environment can and does result in existential impoverishment, I argue that conservation biology is also simultaneously enrolled in attempts at reanimating the species in its care, in an acknowledgment of the ruins of late capitalism they will have to live in.[34]

Asking how conservation projects enact, counteract, re-create, or invent timescapes, how they are involved in landscaping time as well as space, is to ask about animacy.[35] Saving endangered species is not a matter only of conserving them but of doing so in a way that potentially animates them, putting them in circulation in a way that fosters their ability to link into pasts and futures, and to animate others in their turn. The toxicity of the new timescape forced upon coral reefs undoes this very ability in its atomization of relationships—between endosymbionts and the stressed corals expelling them, and between corals and their evolving offspring. The toxic timescape of coral-reef bleaching is one of animacy brought to a standstill, of the impossibility of turning toward others or toward the future, and while the toxicity itself might not be made good, there is a glimpse of hope for a bypassing of its temporally deadening effects. This particular project of assisted evolution does so by collapsing timescales in order to revive fading temporal agencies; it borrows explicitly from processes occurring in evolutionary time, from a past that can be reactivated as a reservoir for future interventions: "Hybridization is known to occur naturally in some scleractinian corals,"[36] according to one article, which echoes the way that "a range of coral species are known to hybridize with other species in the wild. An interspecific *Acropora* hybrid in the Caribbean, where coral reefs have shown alarming declines, has similar and sometimes higher fitness compared with the parental species."[37] As the writer Judith Schalansky observes in a meditation on death and loss, "Earth itself is famously a heap of past futures, and humanity the motley and fighting community of heirs to a numinous past which must be constantly appropriated and transformed, discarded and destroyed, with the result that, contrary to what we usually assume, it is not the future but the past which is the actual realm of possibilities,"[38] an idea one could potentially apply to evolutionary pasts too, in particular when they are recast as reservoirs for future survival strategies and as justifications for human intervention. And it is not just evolutionary history that is woven into shifting contemporary timescapes: making new hybrids, which might have a chance to inhabit toxic and disturbed futures, also relies on the mediated overlapping of species-specific temporalities (this, essentially, means coordinating the spawning rhythms of the species researchers want to hybridize, set a few hours apart, just long enough to make these interspecies encounters difficult on the reef).

I would, however, go even further. What these experiments in assisted evolution seek to animate goes beyond genetic combinations, the technical difficulties of spawning rhythms, or even the adaptation of one particular novel hybrid. It is *evolvability* itself; the potential to adapt to current conditions and to *keep adapting* past human intervention, and to forge at least one more link—tenuous, perhaps, but existing—to future generations and species. Corals, in this context, emerge as particularly likely candidates due to their kingdom-straddling characteristics:

> Corals possess a range of attributes that promote evolvability, including (i) the common occurrence of asexual reproduction in addition to sexual reproduction—some corals brood larvae asexually and others reproduce asexually through fragmentation or colony fission; (ii) a lack of segregation of the germ cell from the somatic cell line; (iii) the existence of symbiosis with a range of potentially

> fast-evolving microbes; and (iv) naturally occurring high levels of genetic diversity and the occurrence of interspecific hybridization in some taxa. . . . Such characteristics provide not only greater scope for environmentally induced epigenetic changes but also somatic mutations to be passed on from one generation to the next compared with strictly sexually reproducing organisms. . . . Therefore, corals possess a variety of characteristics that make them likely candidate organisms for assisted evolution initiatives.[39]

Of course, the ways in which speculative conservation gives itself the right to animate nonhuman bodies, species, and becomings is not free from the shadow of violence. The first identifiable danger is tied to the immobilizing tendencies of conservation biology I mentioned before. Here we might turn to Todd again: in the essay cited above, she grapples with Kim TallBear's definition of artifacts, "things that no longer have immediate temporal agency—they are merely echoes of past worlds. In following TallBear's thinking, in western ontologies, artifacts are things (no longer a 'who') whose kinship has been severed: their people can no longer speak for or with them."[40] Todd also identifies the transformation of what was previously animated into things by severing that which animates them as the cornerstone of white supremacy and its attendant ills. The natural sciences, developed and expanded in the crucible of colonialism, have always been a part of this process; conservation biology has a high potential for the artifactualization of its material (be it species, bodies, places, or ecosystems, which can all be transformed into objects to be worked upon), and this particular branch of marine science certainly does not seem invested in working with Aboriginal bearers of ecological knowledge, for instance, when it comes to selectively breeding *Acropora* corals from the Great Barrier Reef. Here again, we see the specter of genetic fetishism and of reductive laboratory practices[41] looming ominously above the experimental tanks, overshadowing them with the threat of making lively corals into mere laboratory objects, which can be manipulated at will and are functionally identical.

Let us move now to the other end of the animacy spectrum, where I would also like to emphasize a certain level of kinship between recent transformative conservation proposals and a worryingly neoliberal set of concepts and attitudes: as a magazine article on coral hybridization at the AIMS remarks: "Van Oppen and others are re-engineering corals with techniques as old as the domestication of plants and as new as the latest gene-editing tools. And the researchers are adopting attitudes more common to free-wheeling Silicon Valley startups than the methodical world of conservation science. Just as tech entrepreneurs are urged to 'fail fast, fail often,' scientists are pushing to quickly test ideas and ditch the least promising ones in the hunt for results that can be moved from the lab to the ocean."[42] Here as in other branches of speculative conservation (such as the recent literature dealing with and debating the concept of novel ecosystems), change, flexibility, innovation, and destruction are sometimes couched in dangerously positive techno-utopian terms, with potentially exploitative consequences.[43]

For this reason, one could see endangered species managed in transformative conservation projects as enrolled in a subjectification process[44] not unlike those imposed on humans under late capitalism. The experimental and innovative aims of these projects, fulfilled under the crushing pressure of accelerating ecological urgency, lead to an inevitable *individualization* of the endangered species that are being dragged into the future, and into survival. This is linked to the recent shift in conservation methods: the laboratization of the ex situ repository means that it will no longer be possible to manage the endangered individuals being transformed in view of their salvation as homogenous, standardized populations. Conservationists must attend to the ways in which their practices assign certain existential regimes to the species they are studying and modifying; and, moreover, they are obliged to focus on the individual accidents of mutation, hybridization, and adaptation rather than on the very constants that are so vulnerable to toxicity and climate change in order to carry out their work. These individual traits are, in fact, precisely what is sought out in projects such as assisted evolution; the individually or accidentally exceptional is where hope for the entire species is located.

And so species atomize into individuals, whose differences, specific strengths, resistances, plasticities make them ideal building blocks for what endangered species might yet become. The mandate of transformative conservation is no longer the biopolitical regimenting of manageable, homogeneous, and predictable populations in zoos or botanical gardens for captive breeding, but the maximizing of the potential exhibited by exceptional individuals or populations through the variations in effective adaptation or promised adaptability that might be revealed when they are transplanted into less favorable contexts or juxtaposed with new commensals in novel configurations. Accidents and individualization are sought out, nurtured, and accelerated in the experimental tanks of the Sea Simulator, and this could be read as both an upsurge of nonhuman agency—the imposition of irreducible individual characteristics on the forms of enrollment proposed by scientists and conservationists—and a worrying tendency toward neoliberalizing the work of species-making itself. The exceptional individual seems in danger of being recast as an entrepreneurially minded pioneer, able to make use of unexpected opportunities, but also as a precarious worker lauded for flexibility in the face of a rapidly precarized world in which previous networks of material and existential support have been undone by the atomizing blows of extractive capitalism, making nature fungible and fetishizing every species into a replaceable commodity. In this case, the extraction of value relies on the creativity and self-exploitation of flexible "actors" restabilizing new "niches" opened by creative destruction—just like the new trade routes hoped for, in some quarters, once the Arctic ice has irremediably and completely melted away. This echoes Michael Peterson's work on nuclear inheritance, and on the dangers of unquestioned and accumulated decisions that end up insisting on their own repetition, undoing the possibility of imagining a future not determined by present productive and extractive frameworks.

The question we must ask speculative conservation practices such as assisted migration is not just whether or not temporal agency is being observed and worked on, but what kind of temporal agency exactly, and what sort of timescapes it allows or forecloses—in Michael Peterson's words, how overdetermined the future is by present practices. And while the critical assessments of Western scientific practices and their tendency toward fetishizing or violently managing nonhuman lives and endangered species must always be taken into consideration, there are two other possible definitions of artifact it might be useful to remember here: that which, because it has been made, must also be taken responsibility for;[45] and that which, though created by humans out of inanimate matter, possesses a form of agency, the ability to animate others.[46] I emphasize this here in order to gesture toward the possibility of reading assisted evolution slightly against the grain of frameworks criticizing techno-utopianism or genetic fetishism,[47] and excavating whatever generative or at least intriguing components it might contain.

Proposals for assisted evolution certainly do borrow both their concepts and their tools from commercially oriented agricultural techniques: as Van Oppen et al. note, "Natural mechanisms of adaptation can be harnessed in various ways to produce organisms with characteristics that benefit human populations. Humans have been improving wild animal and plants for thousands of years through selection of superior phenotypes resulting from intra- or interspecific crosses: i.e., selective breeding."[48] However, while it is true that some of their language veers dangerously close to techno-utopian or ecomodernist approaches—probably also for tactical reasons, namely making these proposals legible and palatable to potential funding bodies and research institutions—assisted evolution is also marked by a commitment to more-than-human lives that goes counter to merely transforming them into productive natural resources to be commodified and maximized. As Isabelle Stengers point out in *The Invention of Modern Science,* there are fundamental differences among the demands placed upon the work of technological innovation, experimental sciences, and field sciences. The field is that which cannot be entirely displaced into the laboratory, which cannot be made to exist anywhere but where it is, and field scientists, faced with irreducible incertitude, unlike the reproducibility of proofs and results in the laboratory, must develop what Stengers calls an "aesthetics of contingency."[49] Even at its most speculative and experimental, conservation biology remains wedded to the field, to its irreducible and individualizing characteristics, which make absolute generalizations impossible and demand that researchers remain attuned and responsive to the capabilities and resistances of what they are working with.

The issue when examining any kind of conservation apparatus—but transformative ones especially—is how to guard oneself and that apparatus against neoliberalism's immense ability to co-opt almost every form of resistance into a productive and exploitable resource.[50] This work must go against notions of linear time, of anthropocentric time but also of timelines of progress. The ability to live in future timescapes must not be conceptualized as an *enhancement* but as an *otherwise,*[51] or sideways,[52] or athwart,[53] which acknowledges what might yet be lost in developing that very ability, and how to lose in a way that is generative and meaningful, without ever romanticizing life "in the ruins" of late capitalism. No matter how sensationalizing the headlines sound, this is not a matter of breeding any kind of "super coral" at all, or of proposing that such a heroically augmented being could in any way redeem the ecological catastrophe brought about by the relentless occupation of more-than-human worlds.

Extinction Timescapes

This chapter aims to stand as an individual case study while also presenting the wider conceptual implications of bringing a critical analysis of conservation biology into conversation with timescapes. Here, I take up a philosophical proposal formulated by Joshua Schuster in his investigation of how the issue of extinction complicates any attempt at structuring a robust philosophy of life. Schuster points out the necessity of incorporating a richer and more nuanced understanding of what extinction is and does into any philosophical definition of life—an understanding that takes into account the ways in which extinction both undermines life and makes it possible through ongoing processes of speciation, and the precariousness and changes in species form inherent to life, without diminishing the importance of discrete species or the ecological and existential weight of their loss.[54] I situate my own inquiry within a similar set of concerns; a meaningful and nuanced analysis of counterextinction practices must also work toward questioning and redefining the assumptions about extinction that underpin them. As Schuster puts it, "Futural indifference does not supersede a being's stake in its affairs, but is the co-constitutive condition of care for beings that persist, inhabiting the double bind of difference/indifference. Without loss and extinction, as in philosophies of endless becoming, there is no ecology; but too much loss and extinction, there is also no ecology."[55] I would bring critical analyses of conservation practices to bear on conservation proposals because they are the sites where the question of what extinction is, what its place ought to be in the management of life, and to what extent it must be accepted or worked with is currently being grappled with. Theorizing extinction as a philosophical concept will need enrichment from a variety of concrete case studies; the best concepts are always composted, to take up an idea recently formulated by Jennifer Hamilton and Astrida Neimanis,[56] rather than grown in soil-free suspension, and I propose this case study as one contribution to this ongoing process.

Ultimately, I propose that viewing conservation practices as futural interventions into timescapes is also one possible pathway to thinking about extinction as a *territory* rather than an *event.* Extinction is not a homogeneous process, and it reaches back into the past and forward into the future in a way that disrupts and rearranges individual and collective timescapes in the present. Species can accrue extinction debts, the unraveling of communities begins long before the death of the last individual, and "dead clades" are known to walk long after their fate has already been sealed. If extinction is theorized as something both constitutive of the history of life and the formation of species, and as an existential and temporal terrain that must be crossed rather than a cataclysm that can be waited out in suspensive captivity, transformative conservation might be recontextualized as a fairly recent transmutation of phylogenetic and existential strategies for survival developed in interspecies communities. Current shifts in conservation proposals can then be understood as symptomatic of a dawning realization that one possible response to mass extinction events is to multiply and specialize the pathways, material and temporal, that species can carve through this treacherous terrain.[57] I glimpse in these practices the possibility—distant, perhaps, and never free from the danger of violent power relations—of conceptualizing a relationship to endangered species that includes their past as well as their future, as a territory which can be covered both by human interventions and by more-than-human actors, in their acts of weaving together forms of survival, storing and retrieving their vitality in the bodies of close kin they hybridize with, and provisioning for future transmission.

"How to disrupt patterns of thinking that see the past as finished and the future as not ours or only ours?" is the question asked by Karen Barad in the acknowledgments of *Meeting the Universe Halfway.*[58] It is a question this chapter attempts to find an answer to by working through the speculative and marginal conservation proposals exemplified by recent attempts at assisted evolution. Analyzing conservation biology at its most speculative and transformative is an act of balancing precisely the tensions contained in Barad's question. Reading the interventions enacted by conservation biology as more than mere suspension, the arresting of more-than-human processes, or the pollution and impoverishment of wildness through captivity opens up the possibility of considering the futurity of the multiple practices it is composed of, and in particular of its most transformative elements. I understand futurity, here, as the potential interventions into timescapes contained within transformative proposals, interventions that do not merely shape futures but actively create them. Assisted evolution is one example of practices seeking to maintain the ability not merely to survive current conditions (for which free-floating ex situ conservation would be enough) but to truly *inhabit* another future, even if that future is one transcending human lifetimes and civilizations, or the compatibility of our species with the devastating conditions created by a subset of its population. This inhabitability is predicated on the possibility to rearrange the toxic timescape of inhospitable oceans, a timescape of lethally accelerated speeds cutting through the possibility of slower survival work and kin making. In a sense, this is a multispecies declension of Thom Davies's reminder to incorporate the "long and deep time frames" of toxic places.

This is why I close with the following proposal: adopting an approach that actively denaturalizes both extinction and evolution. I would argue that part of the main thrust of this volume is the idea that timescapes are worth studying precisely because they are *made,* created or caused (intentionally or not), maintained or obscured, but, in all those cases, always the result of some form of work. Conservation practices that understand themselves—or could be read against themselves—as interventions animating the material and temporal agency of endangered species show what shouldering the work that goes into making, maintaining, and transforming a species and its relations could look like, once it is understood that that work, and the future timescapes it opens up, is neither *not ours* nor *only ours.* "Denaturalizing" here means refusing a hyperseparation that would allow technological and scientific interventions to be cast as pure or innocent, as acts that either do not leave their marks in the evolutionary histories of various species, or create entirely abstract laboratory artifacts that can be manipulated without any responsibility toward their relational context. Surviving extinction by evolving has, perhaps, *never been natural;* what is at stake is not to condemn the artificiality of speculative conservation as a violent break in the natural order of things but to characterize more precisely what kind of work it does and how well it collaborates with nonhuman labor and relation making.

I end with yet another quote from Deborah Bird Rose, which lays out the overarching ethical project of her book *Wild Dog Dreaming:* "Jonas's theory, then, is that as our understanding of our relationships with nature changes, so our philosophical ecology changes. . . . Our imperative is to recover or discover connectivity and the radical awareness of being at home that emerges as we embed ourselves ever more complexly into the life of the world."[59] So our philosophical ecology changes: if our stance toward nature, extinction, and remediation can be espoused in a space augmented by at least one dimension—the temporal—who knows what might emerge, and how we might begin to bridge the toxic and lethal suspensions enacted daily in desperate attempts at conserving what is being destroyed?

Notes

1. Damian Carrington, "New Lab-Bred Super Corals Could Help Avert Global Reef Wipeout," *The Guardian,* December 23, 2017.
2. Michelle Bastian, "Fatally Confused: Telling the Time in the Midst of Ecological Crises," *Environmental Philosophy* 9, no. 1 (2012): 23–48.
3. Carrie Friese, *Cloning Wild Life: Zoos, Captivity and the Future of Endangered Animals* (New York: New York University Press, 2013), 31.
4. Torjörn Ebenhard, "Conservation Breeding as a Tool for Saving Animal Species from Extinction," *Trends in Ecology and Evolution* 10, no. 11 (1995): 438–43.
5. "Human-induced changes are often an unexpected, unplanned and detrimental side effect of human activities like captive breeding and hand-feeding wild animals. These changes can affect the success of conservation strategies, and embracing the individual approach by conserving the full range of temperaments is likely to play an important role in animal conservation." McDougall et al., "Wildlife Conservation and Animal Temperament: Causes and Consequences of Evolutionary Change for Captive, Reintroduced, and Wild Populations," *Animal Conservation* 9, no. 1 (2006): 39–48.
6. See, for instance, Matthew Chrulew, "Saving the Golden Lion Tamarin," in *Extinction Studies: Stories of Time, Death, and Generations,* ed. Matthew Chrulew, Deborah Bird Rose, and Thom Van Dooren (New York: Columbia University Press, 2017), 49–87.
7. Chrulew.

8. See, for instance, Edward O. Guerrant, Kayri Havens, and Pati Vitt, "Sampling for Effective Ex Situ Plant Conservation," *International Journal of Plant Sciences* 175, no. 1 (2014): 11–20, and Kayri Havens et al., "Seed Sourcing for Restoration in an Era of Climate Change," *Natural Areas Journal* 35, no. 1 (2015): 122–33.
9. Andrew E. Bowkett, "Recent Captive-Breeding Proposals and the Return of the Ark Concept to Global Species Conservation," *Conservation Biology* 23, no. 3 (2009): 773–76.
10. Michael A. Thomas et al., "Ecology: Gene Tweaking for Conservation," *Nature* 501, no. 7468 (2013): 485–86.
11. David A. Tallmon, Gordon Luikart, and Robin S. Waples, "The Alluring Simplicity and Complex Reality of Genetic Rescue," *Trends in Ecology and Evolution* 19, no. 9 (2004): 489–96.
12. Johnson et al., "Genetic Restoration of the Florida Panther," *Science* 329, no. 5999 (2010): 1641–45.
13. The last extant population of black-footed ferrets was captured in Wyoming in 1987 and has since then been bred in captivity and reintroduced. The use of genetic material held at the San Diego Frozen Zoo has been proposed recently. See Samantha M. Wisely et al., "A Road Map for 21st Century Genetic Restoration: Gene Pool Enrichment of the Black-Footed Ferret," *Journal of Heredity* 106, no. 5 (2015): 581–92.
14. "The unprecedented lethality of a single disease affecting an entire vertebrate class highlights the threat from the spread of pathogens in a globalized world. Global trade has recreated a functional Pangaea for infectious diseases in wildlife, with far-reaching impacts on biodiversity (this study), livestock, and human health." Ben C. Scheele et al., "Amphibian Fungal Panzootic Causes Catastrophic and Ongoing Loss of Biodiversity," *Science* 363, no. 6434 (2019): 1459–63.
15. Matthew D. Venesky et al., "Selecting for Tolerance against Pathogens and Herbivores to Enhance Success of Reintroduction and Translocation," *Conservation Biology* 26, no. 4 (2012): 586–92.
16. Carrie H. R. Lewis et al., "Conserving Panamanian Harlequin Frogs by Integrating Captive-Breeding and Research Programs," *Biological Conservation* 236 (August 2019): 185.
17. A term used by Madeleine van Oppen in several interviews.
18. Higher ocean temperatures are one of the greatest threats to coral reefs worldwide, and back-to-back heatwaves are becoming increasingly frequent. Alexander J. Fordyce et al., "Marine Heatwave Hotspots in Coral Reef Environments: Physical Drivers, Ecophysiological Outcomes, and Impact Upon Structural Complexity," *Frontiers in Marine Science* 6 (2019): 498. "On coral reefs, severe heatwaves trigger episodes of mass bleaching, which occur when the relationship between corals and their photosynthetic symbionts (zooxanthellae, Symbiodinium spp.) breaks

down, turning the coral pale. Bleached corals are physiologically damaged and nutritionally compromised, and they can die if the bleaching is severe and the recovery time of their symbionts is prolonged." Terry P. Hughes et al., "Global Warming Transforms Coral Reef Assemblages," *Nature* 556, no. 7702 (2018): 492–96.

19. Madeleine van Oppen et al., "Building Coral Reef Resilience through Assisted Evolution," *Proceedings of the National Academy of Sciences* 112, no. 8 (2015): 2307–13.
20. "Creating 'Super Coral' to Save Dying Coral Reefs," Associated Press, April 11, 2015, YouTube video, 2:04, https://www.youtube.com/watch?v=DtCDquEYzPE.
21. "Coral Makes Rare Charter Flight," *AIMS,* November 24, 2017; on the translocation, by plane, of endangered avian populations, see Thom Van Dooren, "Moving Birds in Hawai'i: Assisted Colonisation in a Colonised Land," *Cultural Studies Review* 25, no. 1 (2019): 41–64.
22. "Next Generation Corals Undergo First Field Tests on the Great Barrier Reef," *AIMS,* February 7, 2019.
23. Wing Yan Chan et al., "Interspecific Hybridization May Provide Novel Opportunities for Coral Reef Restoration," *Frontiers in Marine Science* 5 (2018): 160.
24. "On this November evening, one of Van Oppen's main experiments is to develop new hybrids. The candidates for this night's matchmaking are pale brown chunks of the small, spiky, and ubiquitous corals *Acropora tenuis* and *A. loripes.* Although those coral live side by side on the Great Barrier and other reefs, *A. loripes* spawns several hours after its cousin, effectively keeping the species separate. But Van Oppen can overcome that in the lab by mixing their spawn by hand." Warren Cornwall, "Researchers Embrace a Radical Idea: Engineering Coral to Cope with Climate Change," *Science,* March 21, 2019.
25. "Settled recruits were randomized and evenly distributed on 24 tailor-made PVC trays to rear under (1) ambient conditions of 27°C, 415 ppm pCO2, or (2) elevated conditions of ambient +1°C, 685 ppm pCO2." Chan et al., "Interspecific Hybridization."
26. "Science Bulletins: Super Corals—Understanding the Science (3 of 3)," American Museum of Natural History, January 14, 2016, YouTube video, 3:13, https://www.youtube.com/watch?v=Yy--l-P4c8A.
27. Chan et al., "Interspecific Hybridization."
28. Chan et al.
29. Michelle Bastian, "Encountering Leatherbacks in Multi-Species Knots of Time," in *Extinction Studies: Stories of Time, Death and Generations,* ed. Deborah Bird Rose, Matthew Chrulew, and Thom Van Dooren (New York: Columbia University Press, 2017), 149–85.
30. Deborah Bird Rose, *Wild Dog Dreaming: Love and Extinction* (Charlottesville: University of Virginia Press, 2011), 61.

31. On that topic, see Arturo Escobar, "Sustaining the Pluriverse: The Political Ontology of Territorial Struggles in Latin America," in *The Anthropology of Sustainability: Beyond Development and Progress,* ed. Mark Brightman and Jerome Lewis (New York: Palgrave Macmillan, 2017), 237–56.
32. Zoe Todd, "On Time," *speculative fish-ctions* (blog), November 7, 2018, https://zoestodd.com/2018/11/07/on-time/.
33. Matthew Chrulew, "Freezing the Ark: The Cryopolitics of Endangered Species Preservation," in *Cryopolitics: Frozen Life in a Melting World,* ed. Joanna Radin and Emma Kowal (Cambridge, MA: MIT Press, 2017), 283–305.
34. Anna Lowenhaupt Tsing, *The Mushroom at the End of the World: On the Possibility of Life in Capitalist Ruins* (Princeton, NJ: Princeton University Press, 2015).
35. I use the term here in a sense inspired by Mel Y. Chen's scholarship. My use of it, however, is only adjacent to Chen's, since my scope here is much more restricted and deals mainly with the ways in which endangered species can avoid the fate of becoming (seemingly) deanimated laboratory objects in conservation biology. I do, however, make a slightly unfaithful use of the idea that "we can then ask not 'who is alive, or dead,' but 'what is animate, or inanimate, or less animate'; relationally, we can ask about the possibilities of the interobjective, above and beyond the intersubjective. . . . For animacy is a category mediated not by whether you are a couch, a piece of lead, a human child, or an animal but by how you interpret the thing of concern and how dynamic you wish it to be." Mel Y. Chen, "Toxic Animacies, Inanimate Affections," *GLQ: A Journal of Lesbian and Gay Studies* 17, nos. 2–3 (2011): 265–86. The question of how dynamic researchers wish the species they are dealing with to be, and how their shifting conservationist assemblages make them more or less animated, is a crucial one.
36. Chan et al., "Interspecific Hybridization."
37. Van Oppen et al., "Building Coral Reef Resilience."
38. Judith Schalansky, *Verzeichnis Einiger Verluste,* trans. Anna-Katharina Laboissière (Berlin: Suhrkamp Verlag, 2018), 19.
39. Van Oppen et al., "Building Coral Reef Resilience."
40. Todd, "On Time."
41. As explored, for instance, by Donna Haraway, *Modest_Witness@Second_Millennium. FemaleMan_Meets_OncoMouse: Feminism and Technoscience* (New York: Routledge, 1997).
42. Cornwall, "Researchers Embrace a Radical Idea."
43. The scientific literature on and the debates around novel ecosystems are particularly rich in this kind of language. "Change, including rapid and disruptive change, is a natural feature of the world we find ourselves in. . . . Ecological novelty is widely perceived as a threat to conservation and restoration, and indeed it can be. However, it also comprises

a reality and, more importantly, an opportunity. If we can understand them better, we can leverage novel ecosystems and other aspects of ecological novelty to advantage in pursuing broad goals in conservation and climate-change adaptation." Stephen T. Jackson, "Perspective: Ecological Novelty Is Not New," in *Novel Ecosystems: Intervening in the New Ecological World Order,* ed. Richard J Hobbs, Eric S. Higgs, and Carol M. Hall (Oxford: Wiley-Blackwell, 2013), 61–65. Another article argues that "restoration ecologists could pave the way for innovative management practices by using novel ecosystems as test beds for new ideas." Michael P. Perring et al., "Incorporating Novelty and Novel Ecosystems into Restoration Planning and Practice in the 21st Century," *Ecological Processes* 2, no. 1 (2013): 18.

44. I understand this in the Foucauldian sense, as a process whereby it is structures of power and techniques of the self that create subjects.
45. I take the idea from an article by Clare Palmer, in which she notes that a climate that has been intentionally altered by humans "can be understood as an 'artifact' for which humans are both causally and morally responsible." Clare Palmer, "Saving Species but Losing Wildness: Should We Genetically Adapt Wild Animal Species to Help Them Respond to Climate Change?," *Midwest Studies in Philosophy* 40, no. 1 (2016): 234–51.
46. Dominique Lestel, for instance, has repeatedly brought the agential, relational sophistication of artifacts such as puppets or religious icons into conversation with questions of nonhuman personhood. Dominique Lestel, *L'animal Singulier* (Paris: Seuil, 2004).
47. The epistemological break in life sciences due to the rise in prominence of DNA and the subsequent shift of scientific attention from organism to code has been analyzed for its political and ontological implications: Eugene Thacker, *The Global Genome: Biotechnology, Politics, and Culture* (Cambridge, MA: MIT Press, 2005); and Haraway, *Modest_Witness@Second_Millennium.* The genomic turn has had profound implications for conservation biology, areas of which seem to have leaned into this "'forgetting' that bodies are nodes in web of integrations, forgetting the tropic quality of all knowledge claims" Donna Haraway traces in her account of genetic technologies. Matthew Chrulew has mapped out the significance of this shift for ex situ cryopreservation projects such as the Frozen Ark, and teased out "the complexity of the remediations" and knowledge production practices performed by suspensive conservation. Chrulew, "Freezing the Ark."
48. Van Oppen et al., "Building Coral Reef Resilience."
49. Isabelle Stengers, *The Invention of Modern Science,* trans. Daniel W. Smith (Minneapolis: University of Minnesota Press, 2000).
50. I read neoliberalism through a Gramscian framework that casts cultural hegemony as reinforcing itself by working with, absorbing, co-opting

and diffusing various forms of resistance. Antonio Gramsci, *The Prison Notebooks,* trans. Joseph Buttigieg (New York: Columbia University Press, 2011), supplemented by Stuart Hall's understanding that "hegemony is a tricky concept and provokes muddled thinking. No project achieves 'hegemony' as a completed project. It is a process, not a state of being. No victories are permanent or final. Hegemony has constantly to be 'worked on', maintained, renewed, revised. Excluded social forces, whose consent has not been won, whose interests have not been taken into account, form the basis of countermovements, resistance, alternative strategies and visions . . . and the struggle over a hegemonic system starts anew." Stuart Hall, "The Neoliberal Revolution," *Cultural Studies* 25, no. 6 (November 1, 2011): 705–28.

51. In a similar vein, the "guerrilla narratives" proposed by Ilenia Iengo and Marco Armiero "contribute to a radical critique of the Anthropocene discourse" and its spatial and temporal organization. The corporeal storytelling they trace is a way of opening up a niche within this dominant narrative and its universalizing claims.
52. Pedro Neves Marques, "Parallel Futures: One or Many Dystopias?," *E-Flux,* April 2019.
53. I borrow the term from Carla Hustak and Natasha Myers, "Involutionary Momentum: Affective Ecologies and the Sciences of Plant/Insect Encounters," *Differences* 23, no. 3 (2012): 74–118.
54. Schuster, "Life after Extinction," *Parrhesia,* no. 27 (2017): 88–115.
55. Schuster, 110.
56. Jennifer Mae Hamilton and Astrida Neimanis, "Composting Feminisms and Environmental Humanities," *Environmental Humanities* 10, no. 2 (2018): 501–27
57. As shown in a previous shift from the conservationist "ark paradigm"—established by Michael Soulé and others in the 1970s, and which casts ex situ conservation as a storage facility awaiting a change in attitudes or a human demographic drop allowing for these species to be restored to a wild future (Michael Soulé et al., "The Millennium Ark: How Long a Voyage, How Many Staterooms, How Many Passengers?," *Zoo Biology* 5, no. 2 [1986]: 101–13)—to an integrated approach of ex situ conservation and restoration initiatives (Edward O. Guerrant et al., *Ex Situ Plant Conservation: Supporting Species Survival in the Wild* [London: Island Press, 2004], 8–9). This shift, in turn, has led to the recent blooming of more speculative proposals, putting the contents of the ark into various forms of circulation, such as assisted migration, which I have engaged with elsewhere (Anna-Katharina Laboissière, "Collect, Save, Adapt: Making and Unmaking Ex Situ Worlds," *Cultural Studies Review* 25, no. 1 [2019]: 65–84), or the use of ex situ plant collections to adapt agriculture to climate change (Hannes Dempewolf et al., "Adapting Agriculture to Climate Change: A Global Initiative to Collect, Conserve, and Use Crop

Wild Relatives," *Agroecology and Sustainable Food Systems* 38, no. 4 [2014]: 369–77).

58. Karen Barad, *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning* (Durham, NC: Duke University Press, 2007), x.
59. Rose, *Wild Dog Dreaming,* 8.

CONTRIBUTORS

Simone M. Müller is project director and principal investigator of the German Research Foundation (DFG) Emmy Noether Research Group project Hazardous Travels: Ghost Acres and the Global Waste Economy at the Rachel Carson Center for Environment and Society at LMU Munich and speaker of the International Graduate Program "Rethinking Environment" between the universities of Augsburg and Munich. She works at the intersection of globalization studies, economic and urban history, and environmental humanities. Her research interests range from the trade in hazardous waste material and the intellectual history of economic ecological thinking, to green city concepts and the study of ocean space. She has received numerous awards and fellowships, among them from the Smithsonian Institution, the Science History Institute, and the University of Pennsylvania. She is a member of the Agder Academy of Science and Letters. In 2017, she was nominated as one of the leading female academics in her field by the DFG and the Bosch Foundation. Her latest book, *The Toxic Ship: The Infamous Voyage of the Khian Sea and the Rise of the Global Hazardous Waste Trade,* will appear within the Weyerhaeuser Environmental Books Series at University of Washington Press (2023).

May-Brith Ohman Nielsen is professor of history at University of Agder and leader of the research group Deadly Dreams: The Cultural History of Poison 1840–2020, which studies the history of environmental poisons across different sections of society. She has published seven monographs on the history of politics and ideology, medical history, epidemics and hygiene, history of gardening, historiography, and history didactics, as well as a two-volume history of Norway, 1840–2011, from an everyday life and environmental perspective. Among her latest publications are "Syntheticising Scandinavia: The Introduction of Synthetic Pesticides to Scandinavian Gardeners, 1945–1952" (2020); "Poison to the Beasts: Changing Poisons and Poison Practices in the Quest to Kill Birds and Mammals in Norwegian Fauna, 1845–1967" (2018); and *A Historiographical*

Inquiry into the Theoretical and Methodological Implications of Borders in the Studies of Great Epidemics: Bugs and Borders (2015). May-Brith has been awarded several academic prices for her work, and she is currently preses of the Agder Academy of Science and Letters.

Marco Armiero is director of the Environmental Humanities Laboratory at the KTH Royal Institute of Technology in Stockholm, Sweden, and research director at the Institute for Studies on the Mediterranean, Italian National Research Council. He is the author of *Wasteocene: Stories from the Global Dumps* (2021, translated into Italian in the same year and forthcoming in Brazil and Bosnia and Herzegovina); *Mussolini's Nature: An Environmental History of Italian Fascism* (2022, with Roberta Biasillo and Wilko Graf von Hardenberg); and *A Rugged Nation: Mountains and the Making of Modern Italy* (2011, translated into Italian in 2013). And he has also coedited several volumes: *A History of Environmentalism: Local Struggles, Global Histories* (2014); *An Environmental History of Mass Migration* (2017); *Future Remains: A Cabinet of Curiosities for the Anthropocene* (2017); and *Nature and History in Modern Italy* (2010). Marco has published articles and edited special issues in *Environment and History, Left History, Radical History Review, Modern Italy,* the *South Atlantic Quarterly, Social Text, Capitalism Nature Socialism, Mobilities,* the *Journal of Historical Geography,* and the *Journal of Political Ecology.* He is senior editor of *Capitalism Nature Socialism.*

Anna S. Antonova works at the intersection between environmental humanities, critical policy studies, and political ecology. Her research broadly examines social and environmental change in the contemporary European context, particularly in coastal landscapes, focusing on the relationship between landscape transformations and blue and green EU governance. Anna is currently director of environmental humanities development at the Rachel Carson Center for Environment and Society at LMU Munich. Before that, she was a Marie Skłodowska-Curie research fellow as part of the ENHANCE network at the University of Leeds, with a dissertation on the conflicting narratives about environment and society emerging from the Yorkshire North Sea and Bulgarian Black Sea coastlines.

David Biggs is a professor of history at the University of California, Riverside. He is the author of the prize-winning 2010 book *Quagmire:*

Nation-Building and Nature in the Mekong Delta and the 2018 book *Footprints of War: Militarized Landscapes in Vietnam,* as well as essays and other works appearing in such publications as the *Journal of Asian Studies,* the *New York Times,* and the *Journal of Environmental History.* His research examines legacies of militarization, histories of cartography, and more recently the social and environmental history of mangroves in the Indo-Pacific.

Iris Borowy is distinguished professor at the University of Shanghai and director of the Center for the History of Global Development. She has taught and done research at various universities in Germany, France, Brazil, Norway, and the United Kingdom. Her research interests include the history of international organizations, of global health, and of global development. Iris has published about fifty academic papers and articles, five (co)edited volumes and three monographs, including *Coming to Terms with World Health: The League of Nations Health Organisation* (2009), *Defining Sustainable Development for Our Common Future: A History of the World Commission on Environment and Development* (2014, Brundtland Commission), and *A History of the Future of Economic Growth* (2017, coedited with Matthias Schmelzer). At present, she is working on a project on the policies of international organizations regarding waste.

Thom Davies is an associate professor in geography at the School of Geography, University of Nottingham. He is interested in the violence of pollution and has researched various toxic geographies including the Chernobyl and Fukushima nuclear exclusion zones, and petrochemical landscapes in the United States. Thom also writes about border violence and the lived experience of refugees in Europe. His work has been published in various high-ranked academic journals, as well in the *Independent* and the *Guardian.* His first coedited book (with Alice Mah), *Toxic Truths: Environmental Justice and Citizen Science in a Post-Truth Age,* was published by Manchester University Press (2020).

Malcom Ferdinand is an environmental engineer from University College London and doctor of political philosophy from Université Paris Diderot. He is now a researcher at the CNRS (IRISSO/University Paris Dauphine). At the crossroad of political philosophy, postcolonial theory, and political ecology, Malcom's research focuses on the Black Atlantic and particularly the Caribbean. He explores the relationships between current ecological crises and the colonial history of modernity. He recently published a book based on his PhD dissertation entitled *Decolonial Ecology: Thinking Ecology from the Caribbean World.*

Ilenia Iengo is a PhD fellow in feminist political ecology at the Barcelona Laboratory for Urban Environmental Justice and Sustainability, Institute of Environmental Science and Technology at the Universitat Autònoma de Barcelona, and early-stage researcher of WEGO (Well-Being, Ecology, Gender, and Community), the European Union's Horizon 2020 research and innovation program under the Marie Skłodowska-Curie grant agreement No. 764908. She has helped coordinate Toxic Bios: A Guerrilla Narrative Project together with Marco Armiero at KTH Environmental Humanities Laboratory. Ilenia's scholar-activist praxis navigates the terrain of embodied environmental and disability justice and transfeminist prefigurative politics in the South of Italy, specifically in and around the city of Naples, where she is a member of Ecologie Politiche del Presente laboratory. She has authored "Endometriosis and Environmental Violence: An Embodied, Situated Ecopolitics from the Land of Fires in Campania, Italy" (2022, *Environmental Humanities*) and coauthored "The Politicization of Ill Bodies in Campania, Italy" (2017, *Journal of Political Ecology*) and "Toxic Bios: Toxic Autobiographies—a Public Environmental Humanities Project" (2019, *Environmental Justice*). She coedited and coauthored the volume *Trame: Pratiche e saperi per un'ecologia politica situata* (2022).

Astrid Mignon Kirchhof is a senior researcher at the Institute for Technology Assessment and Systems Analysis, Karlsruhe. She previously was principal investigator at Humboldt University of Berlin and project director at the Saxon Academy of Science and Humanities in Leipzig. Astrid has received many awards and fellowships, among them from the German Academic Exchange Service, the German Research Foundation, and the VW Stiftung working on numerous interdisciplinary and transnational projects in Australia and the US. Her research covers transnational nineteenth- to twenty-first-century German-German history in its global dimensions at the intersection of social, ecological, economic, technological, and urban history. Examples include histories of nature protection, energy history, political economy, conflict, and social movement as well as philanthropic and gender history. Astrid is a coeditor (together with John McNeill) of *Nature and the Iron Curtain: Environmental Policy and Social Movements in Communist and Capitalist Countries 1945–1990* (2019).

Anna-Katharina Laboissière is a Marie Skłodowska-Curie postdoctoral research fellow at the University of Oslo, where she investigates the resurgence and contemporary uses of fallowing and fallowed land in agricultural policy and scientific research as sites of new bio- and cosmopolitical articulations. Her previous research explores the speculative and neoliberal aspects of conservationist interventions, such as assisted migration, assisted evolution, and crop wild relative breeding. Anna-Katharina's academic and creative work has been published in *Cultural Studies Review, Cultural Anthropology,* and *NebulX.* She received her PhD from the École Normale Supérieure and Curtin University in 2021.

Jason R. Parry is Senior Content R&D at Sapienship. Previously, he was a visiting assistant professor at Purdue University. Recently, his writing has appeared in *Diacritics, Log, SubStance, Theory & Event,* and *Philosophy Today.* Jason is a 2020 Future Architecture Fellow and a recipient of funding from ZEIT Stiftung, the National Science Foundation, and the Max Weber Foundation, among others. He received his PhD in comparative literature from Binghamton University in 2017.

Jesse D. Peterson is a postdoctoral researcher at the Swedish University of Agricultural Sciences in Uppsala, Sweden. He researches how people ascribe value, meaning, and purpose to environmental phenomena. His work discusses marine pollution, conservation, digital technologies, and death, and has appeared in peer-reviewed journals, edited collections, literary magazines, and museum exhibits, such as *Green Letters, The Discourses of Environmental Collapse, Geohumanities, Terrain.org, saltfront,* and more. Jesse completed his PhD with a focus on environmental humanities in 2020 at KTH Royal Institute of Technology, Sweden.

Michael Peterson received his PhD from DePaul University, where he currently teaches as an adjunct professor of philosophy. His research deals with questions of intergenerational responsibility, waste ethics, and twentieth-century French and Italian philosophy. Michael is the author of "Responsibility and the Non(bio)degradable" (2018, *Eco-Deconstruction:*

Derrida and Environmental Philosophy) and is currently working on adapting his dissertation, "Half-Lives of Responsibility: Waste and Inheritance in Environmental Ethics," for publication as his first book.

Kate Wright works at the interface of community-based social and environmental activism and environmental humanities research. She is an affiliated researcher with the Rachel Carson Center for Environment and Society, LMU Munich, and is currently completing her second book—a collaborative and creative history of an Aboriginal community garden that she helped to develop with Anaiwan, Dunghutti, Gumbaynggirr and Gamilaroi people in her hometown of Armidale, NSW, Australia. Kate's first book, *Transdisciplinary Journeys in the Anthropocene: More-Than-Human Encounters,* Routledge Environmental Humanities Series, was published in 2017.

INDEX

Page numbers in italics refer to illustrations.