ARTS of LIVING

are necessary because of threats to our survival. The livability of the earth is at stake—perhaps not for extremophile bacteria but for the many forms of life that humans and our companion species have learned to love. Mounting crises from chemical contamination, land grabs, and biodiversity loss are prompting interdisciplinary dialogues and urgent calls to action. The sheer magnitude of disruption has pushed scientists, artists, humanists to reconsider relationships between nature and culture, subjects and objects of knowledge, heroes and ghosts of progress. A major challenge is how to think geological, biological, chemical, and cultural activity together, as a network of interactions with shared histories and unstable futures. There is something myth-like about this task: we consider anew the living and the dead; the ability to speak with invisible and cosmic beings; and the possibility of the end of the world.

On a DAMAGED PLANET

monsters and ghosts are figures hiding in plain sight. They point us to forms of noticing that crosscut forms of knowledge, official and vernacular, science and storytelling. They show us co-species practices of living. If monsters are excess, ghosts are absence and invisibility. Monsters are entangled—and contaminated—bodies. Ghosts suffuse landscapes with many kinds of time. Following ghosts and monsters are different ways to know the terrors of the Anthropocene. Ours is a playful invitation for collaborative methods, a call for new creativities for worlds that are possible. It is also an urgent cry against the irreversibility of damage and the extinction of things that are not able to survive.

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Ghosts: Haunted Landscapes of the Anthropocene

Elaine Gan, Nils Bubandt, Anna Tsing, Heather Swanson*

What kinds of human disturbance can life on earth bear?

The winds of the Anthropocene carry ghosts — the vestiges and signs of past ways of life still charged in the present. This book offers stories of those winds, as they blow over haunted landscapes. Our ghosts are the traces of more-than-human histories through which ecologies are made and unmade.

Anthropocene: a time in which Progress and Extinction have become inextricably linked. But that is not all. The history of the Anthropocene is not, and cannot be, a singular story of Man's triumph or decline. We need more-than-human histories, histories of many species as well as of nonliving things. To uncover these histories, we show you landscapes. Landscapes are the sites on which livability is negotiated, not just for humans but for all living beings. Landscapes answer the question: what kinds of human disturbance can life on earth bear? Landscapes show us many kinds of time: the cycles of seasons, generations, communities, human and not human, as well as the changes to species, ecologies, and geologies. To feel the pull of ghosts is to follow such crisscrossing currents of life and death against our habits of only looking forward to a single future. Ghost-bearing winds sweep us into multiple kinds of time. Beyond Progress time — there are ghosts.

Anthropocene: a time in which we hardly know what challenges to livability will be thrown at us. We have destabilized earth systems; we have kicked up virulence. In these times

of uncertainty, shadow biologies and uncanny geologies erupt unexpectedly; it no longer makes sense to hide behind conventional forms of knowledge. Ghosts offer insights once dismissed as archaic, vernacular, and indigenous, but which now seem crucial to collaborative survival.

Ghosts are our companions and guides in this half of the book, in the same way that monsters are if you turn this book over and begin from the other side. The "tête-bêche" format of *Arts of Living on a Damaged Planet*, in which one half is upside-down in relation to the other, allows us to work against the double conceit of modern Man in two different ways. While monsters unsettle the conceit of the individual by pointing to entanglements across and within bodies, ghosts undermine the fable of Progress by guiding us into multiple temporalities that constitute every landscape. In a time of dramatic ecological change, ghosts and monsters allow us — natural scientists, human scientists, artists — to know the world differently. They urge us to notice that the *anthropos*, the figure of the human, neither coalesces nor sits alone. The Anthropocene is a time to notice many kinds of life, and many kinds of time, in their entanglements.

Ghosts and monsters have always pointed to the entanglement of the nonhuman with the human for peasant and indigenous farmers, hunter-gatherers, and pastoralists around the world. Not so much a novel discovery as an act of remembering, then, our arts of noticing entail the cultivation of alliances that modern Man broke apart: between the natural and human sciences, between the arts and sciences, between the worldviews of an imagined West and an imagined Other. We need to relearn arts of noticing, this book argues, if we, and our Earth-bound companions, are to survive the Anthropocene. Ghosts guide us. A haunted wind permeates our reading of the volume's chapters; we show that disconcerting breath through wind-swept dots before each ghost-infested description.

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The Santa Ana winds pour into Los Laureles Canyon along the Tijuana - San Diego border. The wind is hot and dry, and it carries ghosts. *Tires are everywhere in this canyon*, writes Lesley Stern. Garbage dumps, bulldozed mesas, and steel-fenced borders mix with invasive plants and native gardens in weedy shantytowns. Here is the debris of capitalist waste, the unspectacular afterlives of discarded things. Some tires are repurposed as building materials. Others lie around, dumped by careless dealers. Traffic from the U.S. flows southbound into Mexico unchecked; not so for reverse traffic. The canyon remembers *the movement of things,* including unlikely tomatoes growing through toxic sewers and cracked cement. Traces of past, present, and future mix in gardens that sprout from the graves of a violently uneven modernity. Like every landscape, Los Laureles canyon is haunted by its human and nonhuman histories.

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Anthropocene: a time in which the continued viability of many ancient ecologies is put into question. Industrial modernity, which has increased human access to all kinds of goods, has also created landscapes of waste and ecological collapse. The earth has become a dump. The transformation of the formerly biodiverse estuaries and canyons of the U.S.-Mexico border illustrates our situation in its stark discrepancies: condominiums line one side, while waste piles on the other. Ghosts accumulate on both sides of the border from the residues of violence.

Consider extinction. As life-enhancing interspecies entanglements disappear from our landscapes, ghosts take their place. As one commentator argues, “We have driven the rate of biological extinction, the permanent loss of species, up several hundred times beyond its historical levels, and are threatened with the loss of a majority of all species by the end of the

21st century."[1] The term "we" is, of course, a problematic one; it both starts a conversation and cuts it short. *Arts of Living on a Damaged Planet* both joins this conversation and criticizes its closures. Referring to the human *anthropos*, "we" hides global inequalities, colonial histories, and ontological divergence among human practices. Moreover, the notion of a human "we" hides entanglements across species in making bodies and selves (see more in *Monsters*). "Our" entanglement with others matters when it comes to extinctions. Extinction is not just the loss of individual species; mass extinction could ensue from cascading effects. In a co-species world where the bodies of one species are tumbled into the bodies of other species, extinction is not something that happens to a single species. Extinction is a multi-species event. The extinction of a critical number of species would mean the destruction of the coordinations and interdependencies upon which our own ongoing survival also depends.

We — humans and nonhumans alike — live at the cusp of an extinction event comparable in scale and impact to the Cretaceous–Paleogene (K–Pg) extinction event 65 million years ago that killed off the dinosaurs along with some 75 percent of all life forms on the planet.[2] The difference is that the current event, the "sixth extinction" as it is sometimes called, is not coming from outer space in the shape of an asteroid. The extinction event currently taking shape on the horizon of our shared future is the product of our industry. In the end, it may claim us.

How shall we moderns retain the productive horror of our own doings — and yet refuse its inevitability?

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More than 14,000 kilometers lie between the Arctic tundra and the tip of South America. American red knots make that great migration each spring on the belly of the wind... They make a critical stop at Delaware Bay, where they feast on the eggs of horseshoe crabs

that are emerging from the ocean on a single day in synchronized reproduction. Human overharvesting of horseshoe crabs, however, has threatened the food supply of these migrating birds. As a result, a multispecies coordination that has taken place over millions of years is suddenly in danger of extinction. Will they leave only ghosts?, asks biologist Peter Funch.

If red knots survive, it will be because of the resilience of horseshoe crabs. Half a billion years ago, horseshoe crab ancestors were pressed into fossils. Their long history has allowed them many synchronies, including their relation with the red knot bird migration. Modern horseshoe crabs are survivors. But now human harvesters steal their blue blood for the medical industry, using it to test for the presence of bacteria. Alternatives are available; but investors find horseshoe crabs cheap.

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How many kinds of time are wrapped up in these dangerous encounters? Interspecies evolution, intercontinental migration, multispecies reproduction, more-than-human medicine, local beach traffic, and the boom and bust of investment capital: each has its own episodes and rhythms. Minor forms of space and time merge with great ones. An extinction is always a local event as well as a global one. Extinction is a breakdown of coordinations that has unintended and reverberating effects.

Some earth systems scientists describe the Anthropocene as the "Great Acceleration," the sharp rise in the destructive environmental effects of human industry since the second half of the twentieth century.[3] The massive increase in carbon dioxide, methane and nitrate emissions into the atmosphere from industrialized agriculture, mineral extraction, petroleum-driven production, and globalized shipping/transportation networks has outpaced all other rhythms of life. And yet — it is possible to understand the Great Acceleration only through immersion in these many small rhythms. Big stories take their form from seemingly minor

contingencies, asymmetrical encounters, and moments of indeterminacy. Landscapes show us.

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Imagine walking through Mount Pisani in Italy, where pines and abandoned chestnut orchards mingle. Andrew Mathews offers tactics for noticing the *longue durée* of human disturbance as he shows us *form, texture, color*, a process of *constant speculation as to pattern*. Ghosts become tangible through the form of ancient chestnut stools. Centuries of grafting, cultivation, trade, taxation, and disease are inscribed onto their structure and shape. The landscape emerges from ghostly entanglements: the many histories of life and death that have made these trees, this place.

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Extinction leaves traces

To track the histories that make multispecies livability possible, it is not enough to watch lively bodies. Instead, we must wander landscapes, where assemblages of the dead gather together with the living. In their juxtapositions, we see livability anew. Many great animals that roamed the world in the Ice Age, for example, are now extinct. But their traces are still with us. Northern trees that grow back when cut down, such as oaks, may have evolved that ability in times when elephants trampled them. Plants with big seeds, once spread by animals with huge mouths and stomachs, are now more circumscribed in their movements. The ghosts of lost animals haunt these plants, even as the plants live on as our companions in the present.

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The great animals have left us. Giant cave bears, straight-tusked elephants, spotted hyenas: all once made their lives in Europe. The ground sloth, the mastodon, the shrub-ox: these were animals of North America. Unprecedented numbers of megafauna species became

extinct during the late Quarternary period. Their disappearance from Eurasia, Australia, and the Americas is closely linked to the arrival of modern humans to these continents. As biologist Jens-Christian Svenning argues, their loss is almost certainly anthropogenic.

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As humans reshape the landscape, we forget what was there before. Ecologists call this forgetting "the shifting baseline syndrome." Our newly shaped and ruined landscapes quickly become the new reality. Admiring one landscape and its biological entanglements often entails forgetting many others. Forgetting, in itself, remakes landscapes, as we privilege some assemblages over others. Yet ghosts remind us. Ghosts point us back to our forgetting, showing us how living landscapes are imbued with earlier tracks and traces.

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The native American flowers that are now missing from the Great Meadows of the University of California campus in Santa Cruz are ghosts to ecologist Ingrid Parker. Remembering missing flowers alerts her to the amnesia that attends our perception of landscapes. Today, the Great Meadows are places of beauty and leisure, protected by law as natural havens. But the meadows are recent products of human disturbance. They are grasslands of colonially introduced species and almost devoid of the native plants that used to grow there. The flowers and their landscapes, including the human life-worlds of Native Americans that they helped make possible, are specters in these grasslands.

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Hélène Cixous suggests that ghosts are uncanny because they disturb the proper separation between life and death; they mark a "between that is tainted with strangeness."[3] Ghosts introduce strangeness into the landscapes of our times by confusing their temporalities and suggesting the uncanny possibility that other now-dead landscapes dwell within. Death

may not, after all, be the end of life; after death comes the strange life of ghosts. Such strangeness abounds in the Anthropocene, where life persists in the shadow of mass death. Ghosts alert us to this strangeness, to this uncanny nature of nature.

Ghosts remind us that we live in an impossible present — a time of rupture, a world haunted with the threat of extinction. Deep histories tumble in unruly graves that are bulldozed into gardens of Progress. Yet *Arts of Living* is also a book of weeds — the small, partial, and wild stories of more-than-human attempts to stay alive. Ghosts, too, are weeds that whisper tales of the many pasts and yet-to-comes that surround us. Worlds have ended many times before, they say. Endings come with the death of a leaf, the death of a city, the death of a friendship, the death of small things and small stories. The landscapes grown from such endings are our disaster as well as our weedy hope.

Modernist futures have made the Anthropocene

Bad deaths generate their own variety of ghosts. Across mainland Southeast Asia, "green" ghosts arise from deaths in war and in childbirth; these deaths occur before their given time. How much more, then, does the violence of settler colonialism and capitalist expansion give rise to the ghosts of bad death, death out of time? Here is the terrain of what anthropologist Deborah Bird Rose calls "double death," that is, extinction, which extinguishes times to come.

Rose has argued that white Australian settlers brought with them a particular, and peculiar, kind of time.[4] They looked straight ahead to the *future*, a singular path of optimism and salvation informing their dreams and deeds. This *future* is a characteristic feature of commitments to modernity, that complex of symbolic and material projects for separating "nature" and "culture." Moving toward this *future* requires high spirits—and the willingness to participate in great projects of destruction while ignoring extinction as collateral damage. The

settlers looked straight ahead as they destroyed native peoples and ecologies. The terrain carved out by this *future* is suffused with bad death ghosts.

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Alexander Kupny grew up in the hopes of this future, and he is not afraid of ghosts. Kate Brown lets him lead us into the sarcophagus of the destroyed Chernobyl reactor, where he delightedly takes pictures of the wreckage. The ghosts are everywhere. *After forty years in radioactive fields, he said, he can sense decaying atoms.* Everyone has warned him that the radioactivity would kill him, but he paid no heed, even after other friends in his community died. *"The first few times we went below," Kupny said, "I recorded my dose and wrote it down, but then Sergei asked me why I did that. 'What good will it do you to know? The less you know, the better you will sleep.'"*

What better figure for the promises of modernity? The less you know, the better you will sleep. Meanwhile, our safety net of multispecies interdependencies tears and breaks.

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Unintentional consequences hit us with new force

Industrial engineering creates many unplanned effects; what promoters intend is rarely realized. Instead of building toward a single future, many kinds of time swirl through the worlds shaped by the modern anthropos. These are our ghosts.

Sometimes we can see the ghosts of relentless waste and manufactured poverty in the forms of stinking garbage and leaky sewers. But there are also ghosts we cannot see, and those we chose to forget. They don't sit still. They leave traces; they disturb our plans. They crack through pavements. They tell us about both stretches of ancient time and contemporary layerings of time, collapsed together in landscapes.

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In 1945, one technology suddenly changed the whole world: the splitting of an atom. The two atomic bombs that destroyed Hiroshima and Nagasaki, respectively, synchronized the world to radioactivity as winds carried radioisotopes around the world. Physicist and philosopher Karen Barad says these acts of war have scarred bodies and landscapes; every radiated cell is now a ghost of war. Technoscientific war changes what we know as matter, and it calls out for new analytical tools that can move us beyond what is big and small, absent or present, inside or outside. For Barad, ghosts are superpositions of past, present, and future. Radioactivity is eerie, a powerful ghost that resets planetary time. Barad invokes quantum field theory to show us haunted landscapes as *strange topologies*. *Every bit of spacetimemattering is differently constituted, each bit differently entangled inside all others; spacetimemattering is a radical heterogeneity, not a set of static points in a void, but a dynamism of différancing.*

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The synchronizations put into motion by contemporary technology — not just radioactivity but also global pollution, the movements of capital, climate change, and much more — look different when assessed from the perspective of planetary damage. They show us ghosts, the multiple stories of landscape effects. While progress trained us to keep moving forward, to look up to an apex at the end of a horizon, ghosts show us multiple temporalities.

Ladders are not the only kind of time

In Europe, Northern Renaissance thinkers came up with a great scheme linking classical, religious, and emergent modern thinking. They claimed that life had evolved from simple to complex. This was a grand and optimistic view, which placed humans at the top of the Great Chain of Being, the highest rung of a ladder, where God had once resided. Like the Christian

religious thought before it, this scheme assumed we were all in a single time, on a single trajectory.

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The storm of the Anthropocene sweeps us off the ladder into the waves of the more-than-human sea, where biologist Andreas Hejnol shows us tunicates, sponges, and jellies. Terrible and wonderful, we hardly know how to give them names. Take them off the ladder of Progress, Hejnol tells us; let them show us their complex designs. Imagine swimming among them rather than locking them into rungs on a ladder that leads only to ourselves. How many evolutionary gifts do these creatures gather in their beauty and distinction? What kinds of time do they embody?

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Some kinds of lives stretch beyond our ken, and for us they also offer a ghostly radiance. The lichen that grows on tombstones is one example. Every autumn, mycologist Anne Pringle goes to the Petersham Cemetery near Boston to trace the outline of individual lichen, watching their growth on the gravestones of local residents and dignitaries. They grow slowly, and sometimes some disappear. But some are probably the same individuals as those that first found a place to settle when those dignitaries died centuries ago. For fleeting creatures such as ourselves, lichen are ghosts of the past and the yet-to-come.

Lichen are symbiotic assemblages of species: filamentous fungi and photosynthetic algae or cyanobacteria. Lichen are themselves a kind of landscape, enlivened by their ghosts. Many filamentous fungi are essentially immortal. This does not mean they cannot be killed; yet, unlike humans, they do not die of old age alone. Until cut off by injury, they spread in networks of continually renewed filaments. When we notice their tempo, rather than impose ours, they open us to the possibility of a different kind of livability.

Many kinds of time – of bacteria, fungi, algae, humans, and Western colonialism – meet on the gravestones of Petersham. The ghosts of multispecies landscapes disturb our conventional sense of time, where we can measure and manage one thing leading to another. Lichens will likely be alive when we are gone. Lichens may be ghosts that haunt us from the past but they also peer at us from a future without us. These temporal feats alert us that the time of modernity is not the only kind of time out there. Here common sense can get in our way by telling us that unfamiliar forms of time are irrelevant; we need to cultivate uncommon senses. Unorthodox observers can take us there.

Noticing attunes us to worlds otherwise

When 19th-century Japanese polymath Minakata Kumagusu campaigned to maintain the local shrines that the Meiji government planned to raze, he did so as both a scientist and a participant in local forms of knowledge. Local shrines were sites of remnant old forest, and Minakata hoped to preserve their biodiversity, including that of the slime molds and fungi that were subjects of his research. At the same time, he felt that folk knowledge, including stories of strange beings and eerie shadow biologies, was key to his ability to learn about nature. Rather than dismissing folk knowledge, he incorporated approaches from it into his scientific work. Indeed, while generally unacknowledged, vernacular — and even "spooky" — insights have informed some of the most important science all over the world. This is a reason to learn from ghosts, however unfamiliar their forms. Our experiments combine natural history and vernacular legacies, learning from precedents nourished by other times and places.

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According to the Javanese villagers who befriended anthropologist Nils Bubandt, an ancient spirit-snake lives in the geothermal vent of the mud volcano that recently destroyed

their livelihoods and homes. The spirit being gives them gifts that, while difficult to find and interpret, might change their luck. Villagers scour the mudflat where their homes used to be, hoping to find gifts in stones. Through glimpses of animal forms in the stones, they imagine the possibilities of uncertain futures. Villagers blame the petrochemical industry for the devastating eruption of mud; the eruption followed upon oil drilling in seismically unstable ground. Yet geologists argue over the true and proper cause of the eruption. The mud volcano is caught in undecidability; geologists ask, "Is it *anthropos,* or is it *geos*?" Villagers urge us to see how spirits possess geology as much as village-sought stones. Ghosts haunt such troubled, illegible times.

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In the midst of disaster, stones bring a gift of hope: of fortune, of insight, of the possibility of living-with. The Anthropocene is a moment in which multiple conversations with stones are necessary. After all, the Anthropocene is a geological epoch proposed by geologists, climate-chemists, and stratigraphers - scientists used to studying stones, rocks, sediments, and chemical cycles. In the Anthropocene, they suggest, humans have become a geological force. Human industry is laying down indelible strata in the earth that will remain for some geologist from Mars to detect, even after humans themselves have vanished from the surface of the planet. In this strange, ghostly moment, when humans can extinguish so many pasts and futures, perhaps listening to stones may not be so strange after all.

To learn the stories of stones, geologists might use the insights of ethnographers and poets. In her poem "Marrow," writer Ursula Le Guin urges us to listen to stones without forcing our will on them. Might such listening be necessary to know the Anthropocene?

> There was a word inside a stone.
> I tried to pry it clear,
> mallet and chisel, pick and gad,
> until the stone was dropping blood,

but still I could not hear
the word the stone had said.
I threw it down beside the road
among a thousand stones
and as I turned away it cried
the word aloud within my ear
and the marrow of my bones
heard, and replied.

Shimmer still beckons

Smothered by bad death ghosts, it seems easy to just give in to inevitability, or to climb belligerently up and forward. But there are other ghostly matters shimmering just below our notice. This book argues that collaborative noticing is key to arts of living. To survive, we need to re-learn multiple modes of curiosity. Curiosity stands apart from both fatalism and *a priori* belief; it is an attunement to multispecies entanglement, complexity, and wonder — the shimmer all around us.

"Shimmer" is a gift, too, of the Yolngu people of Australia, as passed to us by Deborah Bird Rose. Shimmer is the seasonal kiss of mutually thrilling encounters among flying foxes and flowering eucalyptus trees, flying fox people, rain, and rainbows. Flying foxes spread eucalyptus pollen and seeds, allowing the trees to reproduce; they are an animal wind in the trees. Rose describes their coordinations through the Yolngu term *bir'yun* — a shimmering into brilliance. *Bir'yun* attends to temporal patterns that emerge from more-than-human shimmerings and dreamings: *pulses of ancestral power, of life riding a wave that is always coming.... Bir'yun shows us that the world is not composed of gears and cogs but of multifaceted, multispecies relations.*

Landscapes shimmer when they gather rhythms shared across varied forms of life. Shimmer describes the coming in and out of focus of multispecies knots, with their cascading effects. Yolngu cosmologies inform us; juxtaposed with the stories made available from many

arts and sciences, vernacular and academic, we learn the liveliness of landscapes. Landscapes are lively actors, enacting many more-than-human dramas, small and large. To follow these dramas, we need new kinds of histories and descriptions, crossing the sciences and humanities.

Postcolonial historian Dipesh Chakrabarty points out that consideration of humanity as a geological force undoes the distinction between natural and human history, forcing us into a new kind of historicity.[5] The deep time of geology, climate, and natural science is collapsing into the historical time of human technology. In the Anthropocene, *anthropos*, the Greek word for human being, has become an overwhelming force that can build and destroy, birth and kill all others on the planet. In the new histories and politics that we must form — and as the contributions to this half of *Arts of Living on a Damaged Planet* demonstrate — we must share space with the ghostly contours of a stone, the radioactivity of a fingerprint, the eggs of a horseshoe crab, a wild bat pollinator, an absent wildflower in a meadow, a lichen on a tombstone, a tomato growing in an abandoned car tire. These are figures for new stories. Here questions about livability cycle anew.

Anthropocene: a time when our survival hinges on a question stirring in the marrow of our bones. What kinds of human disturbances can life on earth bear? By showing us the life's historical entanglement with death in very ruined landscape, ghosts point the way in this half of *Arts of Living on a Damaged Planet*.

Turn the book over and follow monsters.

ENDNOTES

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[1] Peter Raven, "Foreword," in *Atlas of Population and Environment,* eds. Paul Harrison and Fred Pearce (Berkeley: University of California Press, 2000), page x.

[2] Barnosky, A. D., N. Matzke, S. Tomiya, G. O. Wogan, B. Swartz, T. B. Quental, C. Marshall, J. L. McGuire, E. L. Lindsey, K. C. Maguire, B. Mersey, and E. A. Ferrer. 2011. "Has the Earth's sixth mass extinction already arrived?" Nature 471 (7336): 51-7. Mar 3. http://www.ncbi.nlm.nih.gov/pubmed/21368823.

[3] Will Steffen, Wendy Broadgate, Lisa Deutsch, Owen Gaffney, Cornelia Ludwig, "The Trajectory of the Anthropocene: The Great Acceleration." *The Anthropocene Review* 2, no. 1 (2015).

[3] Hélène Cixous, "Fiction and Its Phantoms: A Reading of Freud's *Das Unheimliche* (The "Uncanny"), *New Literary History* 7, no. 3 (1976), page 543.

[4] Deborah Bird Rose, *Reports from a Wild Country: Ethics of Decolonization (*Kensington: University of New South Wales Press, 2004).

[5] Dipesh Chakrabarty, "The Climate of History: Four Theses" *Critical Inquiry* 35, no. 2 (2009).

REFERENCES CITED

Barnosky, A. D., N. Matzke, S. Tomiya, G. O. Wogan, B. Swartz, T. B. Quental, C. Marshall, J. L. McGuire, E. L. Lindsey, K. C. Maguire, B. Mersey, and E. A. Ferrer. 2011. "Has the Earth's sixth mass extinction already arrived?" Nature 471 (7336): 51-7. Mar 3. http://www.ncbi.nlm.nih.gov/pubmed/21368823.

Chakrabarty, Dipesh. "The Climate of History: Four Theses." *Critical Inquiry* 35, no. 2 (2009):197-222.

Cixous, Hélène. "Fiction and Its Phantoms: A Reading of Freud's *Das Unheimliche* (The "Uncanny"). *New Literary History* 7, no. 3 (1976):525-548+619-645, quotation on page 543.

Raven, Peter. "Foreword," in *Atlas of Population and Environment,* eds. Paul Harrison and Fred Pearce. Berkeley: University of California Press, 2000.

Rose, Deborah Bird. *Reports from a Wild Country: Ethics of Decolonization.* Kensington: University of New South Wales Press, 2004.

Steffen, Will, Wendy Broadgate, Lisa Deutsch, Owen Gaffney, and Cornelia Ludwig. "The trajectory of the Anthropocene: The Great Acceleration." *The Anthropocene Review* 2, no. 1 (2015): 81-98.

NEW PAGE

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A Garden or a Grave? The Canyonic Landscape of the Tijuana-San Diego Region

Lesley Stern*

We are in a native garden. It is fall, though this year the summer seems never-ending. The garden is scrubby, typical coastal sage. The air is hot and dry and the foliage is brown, spiky, and brittle. In spring there are many more blooms including a pretty yellow flower, *chrysanthemum coronoria*, an avaricious invasive. Behind me is a small building, the Estuary Visitors Center. I look out westwards, beyond the edges of the garden, to a different terrain: very flat and wet. I am facing westward towards the ocean but my view of the ocean is blocked by a row of condominiums and a straggle of palm trees on the horizon. This is irritating for someone grown accustomed to the views of a city that faces the ocean and turns its back on the desert. I walk westwards on a pathway to the edge of the scrubby native garden. There is a ridge here where the native garden meets the wetland, a dramatic divide. The vegetation is utterly different: fingers of water wind through reeds, dragonflies dart, occasional waterfowl glide, plovers and terns circle and swoop. The sea flows in and out of the tidal channels here.

The Visitors Center is built on the site of a garbage dump. This native garden bordering on a wetland and estuary is a landscape that has been restored, reclaimed as public land—through long and sustained political battles involving many agencies and alliances—and now it is being preserved. Some battles are won, some lost and sometimes the dividing line between victors and vanquished is decidedly indecisive. Take the condominium development: it blocks the view of the ocean and imposes an unnatural edge. But it also prevents the navy who, after the

second world war, owned all of this South West corner of the US and now retain a small area as a helicopter base, from flying directly over this part of the wetlands. Because of the condos they have to fly around the estuary.

Ninety five percent of Californian wetlands have disappeared. This estuary is a small area remaining almost intact, designated one of 25 important wetlands in the US. It is in the Pacific flight path for birds, providing food and shelter. It also protects rare and endangered plant species. Although the boundary of the estuary is clearly demarcated, the urban development along its edges includes myriad non-natives that continue to invade the reserve through permeable borders.

My interest is in canyons. The question I want to begin with is this: can canyons be considered gardens? Or garden-like? Can canyons, in some instances, be considered to share some features with gardens? Particularly in that region where gardens intersect with public space. So why am I here in a landscape very different to canyons? Because this estuary, which has many features of a public garden, is the place where the Tijuana River, via several canyons, empties into the ocean. The most important of these canyons is called, in Mexico, Los *Laureles*, and in the US, Goat Canyon. *Laureles* and the estuary are not only contiguous but also continuous. I cannot see *Laureles* from here, the mountains of Mexico look like small gentle hills. But I am here today to hike, through this public parkland to the point where *Laureles* meets the estuary. There I will encounter an obstruction: the border fence.

If you were to buy a freeway map of this area, or switch on your smart phone, you would have no idea that the San Diego-Tijuana region is built on canyons; indeed you would have no idea that it is one continuous area since maps stop at the border of Mexico. Yet all the time on freeways we drive through or over canyons. The tops and sides of canyons are sliced off, filled

in, bulldozers can be seen creating mesas, cutting across valleys, and building huge retaining walls for the freeway system and housing developments. Thankfully, many canyons remain green because, ironically, the city put infrastructure there: buried, sometimes concretized sewage and power lines.

Oscar Romo, coordinator of the Tijuana Watershed and Director of the Estuary Research Center, has a three dimensional topographical map of the region, of the Tijuana river shed which stretches over a region of approximately 1,750 square miles on either side of the California- Baja California border. His map is about 6 feet square and sits on top of a table. We stand and walk around the table, looking down, like birds, or a navy helicopter hovering. The map is colored and contoured. You see both continuities and divisions that are impossible to discern in the landscape at ground level. What the segueing from green in the north to khaki in the south, for instance, registers is the flow and diversion of water, different kinds of land use and a different distribution of resources. Mexican farmers tend to use water as it flows—a system that is less productive but also more economic in terms of water use. On the US side water is engineered and diverted into the All-American Canal. When water usage is averaged out each person in the US uses 225 gallons of water per day, and in Mexico 25.

I walk around the park on the eastern periphery. There are condos painted in uniform desert colors, and back yards filled with a wonderful array of plants from all over the world, wonderful from my point of view that is, but not from the perspective of those trying to protect the estuary from invasives. As I walk I encounter signs: the navy telling me to keep out and the estuary telling me to keep to the paths. I follow as bidden, resenting such directing and controlling and patrolling of traffic in this quasi-wilderness. Suddenly I am diverted from my path to Mexico and directed towards the ocean. The ribbon of water has widened and forms a

pool perhaps 20 feet wide and the vista opens up, as the wetlands stretch out and the water laces into and disappears into an expansive ocean. I stop, filled with wonder, then turn my back on the ocean, face inland towards a land that is scarified. From here I can see that several canyons—which is to say several creeks and tributaries of the Tijuana River—feed the estuary. *Laureles* is just one. I can, by squinting, clarify the point where *Laureles* is blocked, crossed by the *linea*, *la frontera*, the border fence. I can see a busy road on the Mexico side constructed by landfill across the canyon's valley. Tiny toy cars whizz silently across on their way to Playas, the single seaside neighborhood in Tijuana, a city that has turned its back on the ocean, turned towards the desert. I know that at the bottom of the canyon, in the estuary, trash inexorably accumulates, dramatically exacerbated when it rains. Tires, plastic bottles, mattresses, and more.

Liquids and solids. The solidity of things and the flow of liquid. But it turns out that things are not so solid and liquid does not always flow.

I drive inland, meet up with Oscar Romo, and drive across the border with him in a vehicle more fitted for the terrain we are about to encounter. Here, at the border, is another landscape. Six lanes of traffic in each direction. This is the most populated border crossing in the world. The cars coming into the US seem scarcely to be moving, but we breeze through into Mexico, no need for passports. We drive along next to the new border fence, a shining steel knife, solid, unscalable, slicing through the landscape, through several *colonias* or neighborhoods, through steep canyons, through bands of improvised housing.

We reach *Laureles* and stop at the top of the canyon, in what was a small ranch called *La Cueva*. Everything is different since I was last here, maybe six months ago. The hillside has been shaved, stripped of vegetation, the topsoil scraped away, and the land marked out in chalk into small parcels of land. "For Sale" signs spike the landscape like cactus. The small ranch has been

sold to a developer who will give the new owners a formal certificate of ownership, legally worthless, but prized in this canyon where much of the settlement is informal, where most people are squatting. Despite promises there will be no infrastructure as part of the deal. There will be no sewage or electricity or city garbage disposal. Now that the land has been shaved you can see vividly, with the clarity of a hawk, the sites where trash has been deposited and accumulated in piles on top of the hillside. There are two maquiladoras (factories) out of site, just over the hill, but their presence is registered in two heaps of waste perching on top of the hillside. The third and largest pile is hospital waste from all over the city of Tijuana, much of it the residue of hospital tourism—the large number of people from the US visiting Tijuana for cheap and good medical and dental care. A few houses are already being erected using recycled wood, permeated by poisonous chemicals—railroad ties for instance—sent here from the US. It is illegal to sell this timber in the US and costly, since it has to go into expensively constructed impermeable landfill cells. Sometimes the border is curiously permeable.

In January the rains will come. All the waste and silt will sweep down the 6 miles of the canyon into the estuary and it will be far too much for the sediment basins to catch. Sediment basins were built 10 years ago. In 2003 they were destroyed by the El Nino storm, which also devastated the salt marsh, now completely gone. The topography only needs to change one inch for the ecosystem to be unviable. El Nino brought three feet in. They have been rebuilt, but if made any bigger they will destroy the wild life.

We climb back into the truck and start to head down into the already settled part of the canyon, into a *colonia* called San Bernardo. From here a shanty town, comprising 85,000 people, spreads all the way down to the southern tip of Mexico. Tijuana has been a magnet of immigration for people from poorer states in Mexico and from other parts of Latin America. The

majority of the people are here as illegal immigrants. Most are squatters (on land owned by the Mexican federal government—20 meters on each side of the creek is government land) though some—through shady dealings by developers—hold land titles. Others have acquired title, though usually not formalized, through the Mexican *hejido* laws whereby squatters, after a certain amount of time, do have certain rights to ownership. What typically happens in these situations is that after a period of political jostling, infrastructure is developed, if haphazardly and unevenly: paving of the roads, electricity, and sewage lines.

Water has been brought into the top of San Bernardo, but it is too expensive for most people to access directly. There are no sewer lines. Many of the houses are built perilously close to the creek that runs through the canyon and most are built on the steep sides of the canyon. Where there is little vegetation the wind blows, erosion happens and pollutants are carried in the air. Trash is chucked into the creek and dogs and children play there. When the rains come floods happen very quickly, great channels erupt in the dirt roads. It is impossible for people living here to get out of the canyon.

This community is poor, but like many *colonias* in Tijuana the vernacular housing that has developed unhindered by zoning laws and in an ad hoc manner, using recycled materials, is inventive and crazy. It happens from the bottom up, first you build one room or one story, but with a flat roof bordered by a row of rebars projecting into the sky. Then when possible you build a second story, maybe expand sideways. You incorporate found, foraged, and salvaged materials: garage doors and bits of discarded housing materials from San Diego, tiles, bottles, tires for retaining walls. Maybe there will be a shop or workshop on the ground floor and housing above. Teddy Cruz, an architect and guerrilla urbanist, points to these approaches to mixed-use developments when he urges us to learn from Tijuana. He calls it trickle-up or time-

based building.[i] Mike Davis writes, "In the Do-It-Yourself City, bricolage supplants master planning, and urban design becomes a kind of art brut, generated by populist building practices. If only by default, the masses become the city's true auteurs, and architecture is not so much transcended as retranslated through its dynamic vernacular context."[ii]

The old neighborhood near the border and the airport—Colonia Libertad—shows how an informal community can eventually grow into a formalized settlement, through the development of vernacular building practices along with juridical interventions and the eventual supply of infrastructure. But this community in *Laureles*, because of the creek that runs through the canyon and into the estuary, is both more crucially situated more precarious.

The landscape of this canyon bears little relation to either the kind of arid landscape I experience freeway driving across canyons in San Diego or to one of the green canyons that are being restored. It seems like a vicious circle, an example of where the destruction of the natural environment—in this case a canyon and estuary—is unstoppable, only escalating. Yet this landscape is not separate from the freeways and green canyons. They are all part of one system, part of the larger network of canyons. The "green fingers" about which Appleyard and Lynch were so hopeful in their largely unrealized 1974 planning document, *Temporary Paradise?* (following in the footsteps of John Nolen's 1908 report), sometimes turn out to be grey and cemented, or macadamized, or brown and dusty.[iii] Or churned up by mud and torrents of water.

I am curious about what this man, Oscar Romo, so fierce in his protection of the estuary, so virulent in his guarding against invasives, is doing in the heart of San Bernardo, in what could be considered enemy territory as it were, in the place that causes so many problems for the estuary. What he is doing is building a soccer stadium and community center, planting thousands of trees, negotiating with the Mexican federal government to secure an easement, which would

create a nature reserve running on both sides of the creek for the length of the canyon. Just as importantly he is gathering evidence for US judiciary bodies: evidence that the trash that ends up in the estuary comes originally from the US. Ingeniously he has planted microchips in plastic bottles so that the circuit of trash can be traced. Other small devices, planted like baby trees in the canyons, contain sensors, which register and communicate the movement of solids. This is basically the same technology that Border Patrol will deploy when we join *la linea*, and drive back into the US. But Romo and the scientists he works with on this sensing project are more interested in sensing the movement of things than people, in using the evidence "sensed" as political ammunition, to persuade both US and Mexican judiciary bodies that if *Laureles* is the "problem" for the Estuary, it is also the solution.

The movement of things. Things like tires. Let's take tires. Trees and tires and tomatoes all matter here, all contribute to a shaping of the landscape. But it is to tires and tomatoes that I will now turn. Tires are everywhere in this canyon. Tomatoes are not so much in evidence but on this visit I find two small tomato plants. It is in the commingling of tires and tomatoes that I begin to find some of the answers to the question of canyons and gardens.

Take a tire, any tire. It is a big ugly stinky almost solid thing, a tire. In all probability manufactured in Mexico. As part of a motor vehicle you (or I, anyway) tend not to notice tires. It makes your journey softer, groovier. On the freeway you see cars whizz by and the movement of the tires is just a whirr, a blur. But then you hit a particularly vicious and malevolent nail, lying in wait just for you, and you skid and careen, and then suddenly everything stops. It's just as old man Heidegger predicted: when the tool breaks you notice its thingness.[iv] Though the tire in Heideggerian terms is not a thing, lovingly hand crafted; it is a mass produced and ugly object. Probably not musing muchly upon Heidegger, you take your redundant tire to the shop in order

to trade it in for a new one. Turns out it costs money to get rid of a tire. There are fees. So maybe you will just dump it somewhere. Or maybe you pay the fees, and that's that, your new tire looks exactly like the old one. Your car is intact, tires and all, a solid thing, a piece of property, an asset that can potentially be converted into liquid capital, used as collateral for a loan, to get a mortgage, say, or go on an overseas trip.

But now the dealer has to pay all the fees and go to the bother and expense of getting rid of the redundant tires. Before they are tossed into the landfill, tires—because they sway—have to be cut up, and because of all the toxic properties they contain they have to be properly retired, and the costs of this are derived in part from the taxes we pay. It is much easier for the dealers sometimes to simply schlep the tires across the border and dump or sell them there where they will be patched up and reused, or incorporated into buildings, or just dumped. Massive amounts of tires are dumped.

The lawyers representing various recycling agencies are reluctant to intervene in the circuit of tires. They say this: Once a US tire enters Mexico it is a Mexican tire. And what, I wonder, of the tires that ferry us today between San Diego and Tijuana and back to San Diego?

You can see, in the soccer stadium, that Romo has been learning from Tijuana. The seating and the stage area are built from tires. When he began, with the community, clearing this site it was filled with trash and tires. So rather than engaging in more schlepping, they used the tires just as people have habitually done, to build walls, particularly retaining walls. In the floods however the retaining walls in *Laureles* are in danger of being swept away. Romo brought his engineering skills to bear on the materials at hand—primarily silt and tires, along with permeable pavers made on site—to construct the stadium as both a seating arena and a water filtration system. It is at once very solid, immoveable in fact, and permeable, amenable to liquids. Run off

from the dirt road above the stadium rather than trickling or rushing down into the estuary, will seep into the ground through the permeable pavers and then through layers of silt banked in tires and plastic bottles.

The tires are layered in such a way as to present a scalloped edge, in which hundreds of natives were planted. A politician, in a random and rare act of civil cooperation, came in to clean the area up and yanked all the natives out, believing them to be weeds. Gradual replanting is happening.

Solids and liquids. Obstructions and flows. Steel edges and permeable borders.

There are some—like Hernando De Soto, in *The Mystery of Capital: Why Capitalism Triumphs in the West and Fails Everywhere Else*—who argue that the answer lies in a transformation of the system of property rights.[v] An example of this argument in action was made by Lula, the ex-President of Brazil, in his attempt to give property rights to some of Brazil's poorest people where the *favelas* of Rio de Janeiro, as in Tijuana, crawl dramatically up hillsides. The hope was that this, along with systemic support—financial, social, legal—would provide the means for turning property into a liquid form, into credit, and thus would empower the dispossessed. But insofar as such a proposal remains within the circuit of capital it does not address the environmental factors that occur in a situation such as that of *Laureles* where urban development, albeit of an informal type, collides with what we call "nature" in a potentially explosive manner. It also has the danger of letting the state, and all its local judiciary bodies, off the hook.

Solids and flows. Edible and inedible.

If there are microclimates existing and produced in this canyon there are too micro landscapes. These are rather different to the vistas that we might see at the top of a canyon or

even in a valley looking up and out. These landscapes are small, so small that sometimes you have to lie on your belly in the dust, or crouch down and peer under the "legitimate" landscape in order to discern the features that delineate the scene. Of course the distinction between microclimates and micro landscapes is not always clear cut.

In *Laureles* on this visit I am apprehended by two landscapes so distinctive that I might imagine myself in different worlds. There is a center of attraction in each, and it is the same "thing" that appears, looms up out of the earth, and pulls my gaze downwards. In each case I am exhorted by an invisible force to kneel down, to reach out and touch the round green fruit that grows so fantastically in this unlikely and inhospitable terrain. It is a tomato, a cluster in fact of green tomatoes. We have seen no other tomatoes in *Laureles*. The first tomato plant grows out of a crack in the concrete; the second grows a short distance away in a trickle of water beside the dusty unpaved road. As we kneel down to scrutinize more closely the plant growing in water a stink rises up, assaults the senses. This trickle of water is an open sewer. But since we are already down on our knees we stay there and peer more closely at the verdant green plant life that straggles the edge of the road here. There are a variety of juicy weeds, something that looks temptingly like watercress and a sole celery plant, the leaves of which when crushed release an aroma so much stronger and more enticing than the anemic celery on offer in the supermarkets. In both cases the small bunch of tomatoes have that translucent jade glow that distinguishes tomatoes at the end of the season, tomatoes that—because they will never ripen into redness—revere their greenness. Peering into this micro landscape I feel shrunken, insect-like, as though I have left the canyon and entered into a jungle of gigantic edible delights. It doesn't take long to return to reality. In reality this micro landscape is not such an aberration; on the contrary, it is an ecology that in miniature represents the larger landscape of the canyon. The unfiltered sewage

provides rich nutrients that enable the trees to grow so strongly. And the trees change the larger ecology, purifying the air, filtering water, reducing temperatures, preventing erosion. But the pathogens and toxicity in that trickle of water are concentrated in the tomatoes and celery. The people who live here are endangered, just as the estuary is.

What about the other tomato plant: how does it emerge out of a barren landscape of concrete? It grows in the patio of the NGO Alter Terra run by Oscar Romo, which functions as a scientific field station and is also where he has a nursery of thousands of trees grown from seed and raised to be planted throughout the canyon. However, there are no vegetables here. No one planted a tomato seed, perhaps some salsa fell from a taco, fell between the cracks. Perhaps a seed migrated from elsewhere in the subsoil, and pushed its way up, feeding on the nutrients and filtered water. The concrete here is made of permeable matter, under which is silt. Gradually, bit-by-bit, the nutrients (at the present time from waste water) will work with the filtration to create a new layer of microbially and nutriently rich topsoil. If I lift my head I see stacks of these permeable pavers that are destined to be used in projects around the canyon and also to be sold to bring income back into the canyon.

Here in *Laureles* people garden sparsely in cans, in tires; succulents, roses, cacti, bougainvillea dot the landscape. Trees are being planted, not necessarily the trees that would once have grown here, but trees that hold the earth and clean the air and soil and provide an infrastructure for the urban development. Vegetables, though, given the toxicity of the soil, are a more tricky proposition. I would never have thought that paved roads might be the key to tomatoes. But so long as the boundary between the road and the vegetable patch is permeable the potential of yet another landscape unfolds, one in which vegetables and people and non-native

trees cohabit in a reshaped ecology, one in which continuity between the canyon and the estuary is preserved, and tomatoes might serve to protect the endangered species in the wetlands.

We make our way down through *Laureles* but before reaching the bottom we get into a low gear and climb up to the mesa directly above *Laureles*, and drive through an affluent *colonia* called, for reasons we will soon see, *El Mirador*. Oscar parks the truck and we walk out to the edge of the cliff. We are standing above the very point where *Laureles* opens out into the estuary. Looking West and out to sea we have a magnificent view. But if you drop your eyes there is another landscape, one terraced by obstructions. The canyon settlement ends at a huge culvert over which cars and buses and trucks whizz past, the toy cars I could see in the distance when I began this voyage. They are on a road built in Mexico transversing (just as in San Diego) the canyons. Just beyond this road there are two walls and another road slicing across the landscape: the old rusty dilapidated border fence and the new shiny modernist fence, and in between a wide beautifully paved road built by Homeland Security after 9/11. To build this road they appropriated a 150 foot wide band of land parallel to the fence, demolished a mesa right on the border at the estuary and moved the earth to cut across the open valley. We look back into the US at this southernmost tip and see bulldozers at work creating huge craters. These are new sediment basins. The ones they built when they constructed the new wall and road were insufficient to contain the pollution from the 2003 El Nino storm. Since then there have been slow political negotiations, Homeland Security brought into dialogue with other bodies and urged to pay less attention and less funds to the wall, and more to the estuary and to the shanty town in *Laureles*. These new sediment basins will hopefully offer greater protection when the rains come this January.

Standing here, looking back at the US at its most southern tip, my tomato optimism dissipates, seeps away into all these chiseled cracks and gouges in the landscape. But as we stand eating delicious tacos in lively Tijuana before joining, with our passports, the slow dense mass of cars at the border crossing, it dawns on me that Romo hardly ever uses the word "border." This is perhaps because, imaginatively and strategically and in quotidian practice, he conceives of the boundary not as one between nations but as one that delineates an environmental zone, the Tijuana river water shed. This is the zone in which a whole network of canyons, the green fingers, feel their way, more often than not in urban spaces.

It is like this: a slow and Sisyphean project, a slow changing of the landscape. You plant natives and a politician rips them out, you negotiate with the council to develop infrastructure in a part of San Bernardo and a developer razes the land at the top of the canyon. You clear tons and tons and tons of trash at the mouth of the estuary and Homeland Security rearranges the valley. All of these developments have immense consequences for already endangered species: birds, plants and people. So what do you do? You negotiate with the politicians, the developers, Homeland security, the communities living in the canyon, judiciaries, environmental groups, water authorities and more. You emphasize edges and boundaries that are permeable, you imagine the canyon not as a threat but as a protector. Through small but incremental gestures you begin to shape a way to see the landscape differently.

To see it as mutable: Solids and liquids. Obstructions and flows. Steel edges and permeable borders.

Endnotes

* Writing in the interstices between cultural studies, memoir, and environmental history, **Lesley Stern** expands the ways we see multispecies worlds. Stern will read from her genre-bending book-in-process, in which a natural/social landscape on the southern California-Mexico border comes to life as both cosmos and microcosm. Her dream-like work *The Smoking Book (*1999) has been described as "an innovative, hybrid form of writing…at once intensely personal and kaleidoscopically international."

[i] "How Architectural Innovations Migrate Across Borders," YouTube video, 13:14, Teddy Cruz TEDGlobal talk filmed June 2013, posted by "TED," February 5, 2014, https://www.youtube.com/watch?v=aG-ZeDqG8Zk.

[ii] Mike Davis, "Learning from Tijuana," *Grand Street* 56 (Spring 1996): 35.

[iii] Donald Appleyard and Kevin Lynch, *Temporary Paradise?: A Look at the Special Landscape of the San Diego Region: A Report to the City of San Diego* (Cambridge, MA: Dept. of Urban Studies and Planning, Massachusetts Institute of Technology, 1974); John Nolen, *San Diego, A Comprehensive Plan for its Improvement* (Boston, MA: G. H. Ellis Co., 1908).

[iv] Martin Heidegger, *What is a Thing?* trans. W.B. Barton Jr. and Vera Deutsch, with an analysis by Eugene T. Gendlin (Chicago, IL: H. Regnery Co., 1967).

[v] Hernando de Soto, *The Mystery of Capital: Why Capitalism Triumphs in the West and Fails Everywhere Else* (New York, NY: Basic Books, 2000).

Bibliography

Appleyard, Donald and Kevin Lynch. *Temporary Paradise?: A Look at the Special Landscape of the San Diego Region: A Report to the City of San Diego.* Cambridge, MA: Dept. of Urban Studies and Planning, Massachusetts Institute of Technology, 1974.

Davis, Mike. "Learning from Tijuana." *Grand Street* 56, (Spring, 1996): 33-36.

Heidegger, Martin. *What is a Thing?* Translated by W.B. Barton Jr. and Vera Deutsch, with an analysis by Eugene T. Gendlin. Chicago, IL: H. Regnery Co., 1967.

"How Architectural Innovations Migrate Across Borders," YouTube video, 13:14, Teddy Cruz TEDGlobal talk filmed June 2013. Posted by "TED," February 5, 2014. https://www.youtube.com/watch?v=aG-ZeDqG8Zk.

Nolen, John. *San Diego, A Comprehensive Plan for its Improvement*. Boston, MA: G. H. Ellis Co., 1908.

Soto, Hernando de. *The Mystery of Capital: Why Capitalism Triumphs in the West and Fails Everywhere Else*. New York, NY: Basic Books, 2000.

Haunted Geologies:

Spirits, Stones, and the Necropolitics of the Anthropocene

Nils Bubandt*

If you travel south by car from Surabaya, Indonesia's second-largest and sweltering city, towards the cool mountain town of Malang, you will, after about 25 kilometers, come upon a vast elevated landscape of mud. From the road, your view will be blocked by the massive dykes that have been erected to stem the mud. But if you climb to the top of the twenty-meter containment walls you will see a barren and flat landscape of mud, stretching eastwards toward the horizon and the shallow coast line of the Madura Strait. The smell of petrol, emanating from the petroliferous components in the mud, is mixed with a faint but distinctive smell of rotten eggs.[i] If you scan the horizon, you will see, off in the distance to the right, the source of the smell: a plume of steam, pulsating at irregular internals, at the center of the mud flat. The plume, consisting of methane mixed with hydrogen sulfide and sulfur dioxide, comes from the main vent, one of five initial eruption sites of the mud volcano that since May 2006 has spewed out enormous amounts of gas, water and mud. Eleven meters of mud over an area of seven square kilometers bury what used to be 12 villages. The mud has displaced 39,700 people and caused damages estimated to be 30 trillion rupiah (2.2 billion US dollars).[ii] As mud has built up within the containment walls, underground cave-ins have occurred. In one such event, in November 2006, the natural gas pipeline to Surabaya ruptured and exploded, killing thirteen.[iii] Initially projected to continue for centuries, recent estimates suggest that the mud volcano may self-plug within the next two decades.[iv] By this time, however, the weight of the 140 million cubic meters

of mud from the volcano will likely have caused the affected area to subside at least 95 meters.[v] Except for some species of coliform and thermophile bacteria, nothing today lives in the sulfuric and heavy metal-rich mud.

[**Figure G7.1 here**]

The mud volcano, the largest and most controversial of its kind in the world, is a tragic and dystopic, but also illuminating, illustration of the Anthropocene. The Anthropocene is conventionally described as a geological period in which human activity exceeds the forces of nature.[vi] What better example of this excess than if humans cause a disastrous volcanic eruption? The Indonesian mud volcano however also highlights another, equally important and unsettling, feature of the Anthropocene, namely the increasing impossibility of distinguishing human from nonhuman forces, the *anthropos* from the *geos*. For the volcano is simultaneously a national disaster at the center of a continuing political scandal and the object of an ongoing geological dispute about whether its eruption was in fact anthropogenic or natural. An indecidability haunts the mud volcano. Is it an effect of human industry or of tectonic forces? Is it an effect of life or of non-life? It is the indecidability of the mud volcano, and of the Anthropocene, that is the subject of this chapter. For indecidability, I will argue, is simultaneously the signature characteristic, the curse, and the promise of our current moment.

Spirits and the Necropolitics of the Anthropocene

The different names of the mud volcano index its indecidability. Some people refer to the volcano as *Lumpur Lapindo* ("The Lapindo Mud"), after the oil company, PT Lapindo Brantas Incorporation, that drilled for petroleum nearby and which may have caused its eruption.[vii] Lumpur Lapindo names an anthropogenic and political event tainted by industrial greed, mismanagement and corruption. A second, equally used, name for the mud volcano is *Lumpur*

Sidoarjo ("The Sidoarjo Mud") after the sprawling nearby district capital. If the first name highlights the human agency and political liabilities of the mud disaster, *Lumpur Sidoarjo* is a geographical name used to denote where a "natural disaster" happened to strike. But "natural" figures awkwardly here, for not only is this name, as I will show, as political as the previous one, but the name also points directly to the world of spirits. The name *Lumpur Sidoarjo* is thus frequently shortened into the portmanteau "Lusi." Pronounced like the common woman's name Lucy, it names an earth being with a will of its own, and victims of the mud disaster speak its name with as much deference as political acerbity. Lusi is, in other words, equal parts spirit name and political critique. In a play on the name of the Malaysian capital, Kuala Lumpur (literally "The Muddy Estuary"), people in East Java for instance joke that Lusi is their *Kualat Lumpur*, literally their "Cursed Mud." The cursed mud is clearly the inverse image of the shining cosmopolitan dream: a stinking, muddy and failed modern. But more than metaphors are at play here, for "curses" (*kualat*) belong to a very real realm of the world in Indonesia, namely that of occult forces and spirits (*batin*). *Kualat* is a calamity you bring upon yourself by behaving inappropriately. The curse of the mud volcano is in that sense a response to a moral transgression of some sort, an explanation that encapsulates condemnation of industrial mismanagement, critique of political corruption as well as anxieties about cosmological punishment.

Like Fukushima, Bhopal, Chernobyl and other contemporary disasters where the forces of nature and human politics act to exacerbate each other, Lusi is the name for a monstrous geography haunted by the natural as well as the unnatural.[viii] But more so than other recent disasters with an anthropogenic component, the ontologies of the natural and the unnatural (whether human or spiritual kinds of "un-nature") coalesce in Lusi's muddy ferment. On the mud flats of East Java, the realms of geology, politics, industry, divination, lawsuits, spiritual revenge,

and corruption are inextricably entangled in each other. Indeed, the inability to separate one from the other—nature from politics, geothermal activity from industrial activity, human corruption from spiritual revenge—is a constituent part of the volcano's necropolitics.

Achille Mbembe, in his founding article on the term, defined necropolitics as the subjugation of human life to the powers of death in the context of war, terror and weapons of mass destruction.[ix] But in a time of global warming, acidification and mass extinction, I suggest necropolitics has come to cover a much broader and much more stochastic politics of life and death. Humans, animals, plants, fungi and bacteria now live and die under conditions that may have been critically shaped by human activity but that are also increasingly outside of human control. I use the notion of a necropolitics of the Anthropocene to indicate the life and death effects—intended as well as unintended—of this kind of ruination and extinction. Nature may increasingly be human-made. But humans have not only lost control of this nature-making and unmaking. As each new scientific discovery reveals more details of the complex interplay between human worlds and natural worlds, we are also increasingly faced with our inability to tell these worlds apart. In the Anthropocene, necropolitics operates under the sign of metaphysical indeterminacy rather than certainty, unintended consequences rather than control.

As it so happens, spirits exist under the same conditions of uncertainty and possibility. Spirits are never just "there." They are both manifest and disembodied, present and absent. Spirits thrive, as a result, in conditions of doubt rather than belief.[x] "I do not believe in ghosts, but…" is, after all, the conventional start to accounts of experiences with ghosts and spirits. How striking, in light of this, that the Anthropocene is so clearly associated with spirits. Take the figure of Gaia, the self-regulating, sympoetic super-organism of earth's biosphere named after a Greek goddess by climate scientist James Lovelock and biologist Lyn Margulis.[xi] Or take Donna

Haraway's *chthulus*, those earthly "myriad intra-active entities-in-assemblages" that inhabit the Anthropocene.[xii] These tentacular beings of the earth are so named by Haraway to point to the overlap between indigenous spirits—from Pachamama, the Incan goddess of fertility, to A'akuluujjusi, the mother creator of all animals in Inuit thought—and new biological insights into the evolutionary co-becoming of life (see the chapters by Haraway and Gilbert in this volume). In the Anthropocene both climate science and biology seem to bring spirits, once thought to have been killed by secular thought, back to life. This chapter argues that geology in similar ways brings spirits into being. By paying attention to the spirits that abound in and around the Lusi mud volcano, we may yet learn to see, and live with, the ghosts that abound in the necropolitical landscapes of the Anthropocene.

The Story of a Mud Volcano—in Two Parts

The Lusi mud volcano is a geological event with two histories. The volcano is essentially a two-part story. Part one, the "unnatural history" of the volcano as it were, begins in 2006. In the early hours of the morning on 29 May, the mud volcano erupted, shortly after the oil company PT Lapindo Brantas Incorporation had begun exploratory drilling for gas in a late Miocene stratum 2800 meters below the surface of the earth. Studies later showed that the drilling operation fractured a high-pressure aquifer, allowing the rapid influx of formation fluids and gases into the open drill hole, which contrary to standard practice lacked a protective steel casing over a one kilometer stretch.[xiii] The pressurized gas, liquids and mud, mainly from the Pleistocene period, that filled the drill hole eventually caused a series of blowouts 150 meters away from the drilling rig "Banjar Panji-1." It is from these blowout vents that an unstoppable flow of mud has since been burying the surrounding landscape.

This first part of the story is a very recognizable Anthropocene. It is an Anthropocene in which human activity (in this case an oil company) exacerbates the forces of nature, causing what has been called "the first humanly-made volcanic eruption in planetary history."[xiv] The eruption is in this account an anthropogenic perversion of the historical relationship between mud and oil. For oil and gas exploration has always been intimately tied to mud volcanoes. In the nineteenth century, early prospectors discovered that mud volcanism was related to active underground petroleum systems, and they began to use mud volcanoes as indicators for potential oil fields.[xv] Now, it seemed, this historical relationship had been turned on its head. Instead of mud volcanoes being the sign of a petroleum system ready for extraction, fossil carbon extraction was itself perversely creating mud volcanoes.

Industrially produced tectonics have become an increasingly recognized anthropogenic risk, since fracking and high-pressure injection wells have been shown to generate an increase in earth quake activity in the US.[xvi] But Lusi was the first case in which conventional drilling was established as the cause of geothermal activity. As a result, the East Javanese mud volcano quickly became the global icon for a carbon-craving world gone awry, testimony to an oil industry characterized by mismanagement, greed and corruption. Indeed the link between cooperate greed and tectonic disaster seemed embarrassingly obvious. Lapindo Brantas, the oil company linked to the blowout, was controlled by the Bakrie Group, a consortium in which Aburizal Bakrie, then Indonesia's richest man, was a key stakeholder. The fact that Aburizal Bakrie was also Minister for People's Welfare (*Menkosra*) in the coalition government of President Susilo Bambang Yudhoyono, but refused to visit the site or assume any cooperate responsibility for the damages, made the disaster a striking example of the hypocrisy of capitalist carbon extraction. An "unnatural disaster," the magazine *National Geographic* called it.[xvii]

But there is also a second part to the story of Lusi. This part—its "natural history"—paradoxically only adds to Lusi's uncanny nature. This second part of the story begins in the early morning of May 27, 2006, roughly 48 hours before the eruption of Lusi, when a massive earthquake measuring 6.3 on the Richter scale shakes the ground near Yogyakarta, killing 5,749 people and injuring over 38,000. Mud volcanoes, a global phenomenon, are often caused by seismic activity, and some studies therefore argued that the near synchronicity of the earthquake and the volcanic eruption indicated that the two were causally linked.[xviii] The island of Java is traversed by a geological depression along its east-west axis.[xix] The depression, which has been filled with sediments over the last 23 million years, closely follows a subduction zone between the Indian Oceanic and the Eurasian continental plates. This has created one of the world's most seismically active areas, but also the conditions for the presence of rich underground petroleum resources that have been exploited for a hundred years. The same region is home to numerous, naturally occurring, mud volcanoes associated with the presence of petroleum. The Sidoarjo mud volcano, in this scenario, was a "natural" event in an unstable geothermal region: the earthquake near Yogyakarta caused a so-called "strike-slip movement" of the Watukosek fault, one of many tectonic fault lines of this area, triggering the eruption of the mud volcano some 250 kilometers away.[xx]

This second account of the eruption was favored by a number of Indonesian experts, including the senior drilling advisors of the oil company who published their findings in the same prestigious journals as their opponents.[xxi] It was also supported by a number of the Indonesian government's own geological experts, allegedly under the influence of the investors behind the oil company, who were eager to establish the mud volcano as a "natural disaster" in a bid to evade legal responsibility.[xxii] Opponents of this explanation countered that synchronicity

in itself failed to establish a causal link between the earthquake and the mud volcano and that the geographical distance between the two events exceeded other known cases in which mud volcanism had been triggered by seismic activity.[xxiii] The pedigree of those who sought to establish that the mud volcano was a "natural fact" suggested that they were "merchants of doubt," scientists paid by industry to deny the truth of global warming, the harmful effects of smoking or, in this case, the anthropogenic origins of volcanism.[xxiv] Indeed, the theory that Lusi was caused by tectonic activity was haunted by accusations of poor science and corrupt politics.

As a result, the truth of the anthropogenic origin of Lusi seemed secure. Until recently, that is, when independent, computer-based studies showed that the curved underground rock formation in the area could have focused the seismic waves of the Yogyakarta earthquake to produce enough seismic stress on the fault line to trigger the eruption, even if it was more than 200 kilometers away.[xxv] This analysis seriously challenged those who maintain the volcano was triggered by drilling and lent credibility from an unexpected and unbiased source to the industrial merchants of doubt. In its wake, uncertainty rules more than ever.[xxvi] As one geologist concludes, "we may never know what the final trigger was, whether it would have happened anyway, nor even if an early trigger averted a greater disaster, had pressures continued to build up."[xxvii] When it comes to Lusi, geology, one of the most prominent sciences behind the concept of the Anthropocene, is haunted by indecidability. This epistemological indecidability is coupled with high political stakes: the oil company wants the eruption to be a natural disaster to escape liability, while victims want it to be an industrial disaster to enforce payment of compensation. The question essentially is whether Lusi is a political event with a geothermal afterlife or a geothermal event with a political afterlife? At the moment, it is both.[xxviii] I suggest calling this a spectral moment, a time of indecidability but also a time of spirits and ghosts.

The Hope of Stones

On quiet afternoons, you are likely to see people scour the Lusi mud flats. Once in a while, they will stoop to pick up a pebble and inspect it closely before either dropping it again or putting it in a fanny pack around their waists. People say the stones are just trinkets, children's marbles. And yet, they keep collecting them, carefully polishing them smooth with sandpaper in an evident labor of love and dedication in order to bring out the proper contours, the shades of meaning that hide within. Some stones come to assume the shape of a dolphin, others that of a human face. Yet others have organic filaments or veins of quartz that take the shape of a dragon or a lion or the eye of a dead king. Mas Hadi is one of the people collecting stones. He is also a descendant of royalty from the mythical Majapahit empire and a diviner (*waskitó*) with "spirit eyes" that see into the other-world (*mata batin*). Having spirit eyes also enables Mas Hadi to distinguish ordinary stones from unique treasures, a skill in high demand on the mud flats.

One day I sat with Mas Hadi when a *tukang ojek*, a driver of a motorbike taxi, dropped by with an object he had found on the mud flat. It looked like a fossilized shark tooth. The concavity of the labial face, the lack of serration along the edges, and the robustness of the root suggested it was from a mako shark (L: *Isurus oxyrinchus*), probably one who lived and died around 2 million years ago to became part of the Pleistocene stratum from where most of the volcanic mud originates.[xxix] To Mas Hadi, however, it was something else. For along the center of the crown of the tooth there was the outline of something, a pointed object. "This," he declared after some pause, "is special. Do you see the *kris* inside? It comes from the Majapahit empire." What the *ojek* driver had inadvertently stumbled upon was a double *kris*, a dagger associated with royalty and a powerful magical object. "Take it, and keep it safe," Mas Hadi instructed the man, closing the man's palm with his own around the object.

[**Figure G7.2 here**]

Objects such as this tooth-dagger become personal treasures, part of one's arsenal of heirlooms and amulets. Such objects are kept hidden or are fitted and worn in rings for protection. In particular, they are seen to have a magical capacity (*khasiat*) to confer upon the finder good fortune (*rezeki*). The objects are precious because they are full of life, fossilized proof of a spirit life that thrives in an otherwise toxic landscape. The stones are said to come from Lusi's main vent. A giant spirit snake, it is said, dwells within it. Or more accurately, the vent itself *is* a snake, the guardian spirit (*penunggunya*) of the volcano, from whose belly deep underground the stones and objects emerge. The treasures are essentially bezoars from a spirit snake. Traded from Asia to Europe for medicinal purposes since the Renaissance, snake stones (*mustika ular*) and other bezoars are regarded as powerful magical anti-dotes throughout Indonesia.[xxx] The petrified objects that are spewed from the giant snake spirit at the center of the mud volcano are like such bezoars, objects that hold potentially great spiritual power (*kesaktian*).

Searching for spirit shapes in the stones on the mud flats is one amongst a panoply of means through which you may acquire good fortune through magical means in Java. Good fortune or *rezeki* can take many forms, not all of which are financial. *Rezeki* may be to acquire a spouse, a child, a job, recognition, success, or money. It is about leading the good life, about being fulfilled, calm and happy. *Rezeki* is about destiny. It is existential and social rather than merely financial. The pursuit of *rezeki* by magical means is called *pesugihan,* and can be acquired from a veritable multispecies salon of spirits. On the sacred mountain of Kawi you may, for instance, acquire good fortune if you observe a leaf of the *dewandaru* tree (L. *Eugenia uniflora*) fall to the ground. Or you may take up relations with the black boar spirit called *babi ngepet*. The spirit will enable you to turn into a black boar that inconspicuously can steal from

other people. Trees, boars, and snakes may all provide good fortune, but they also require compensation, a reciprocal payment (*tumbalan*), to be pacified. The black boar is said to ask for a human baby in return for its riches. Mas Hadi claimed that the children's graves vandalized in a Sidoarjo cemetery in 2012 had been emptied of human remains by people in search of such compensation gifts.

Spiritual anxiety has been the constant companion of dreams of good fortune at Lusi since its eruption in 2006. While engineers from global mining consultancies have dropped hundreds of cement balls and iron chains into the vent in an unsuccessful attempt to plug it, people throughout Indonesia worry that human heads—procured by government headhunters—have also been surreptitiously thrown into the vent as reciprocal payment (*tumbalan*) to its spirit guardian.[xxxi] For like most volcanoes in Indonesia, the Lusi mud volcano is a spiritual as well as a geothermal entity—a vengeful and angry geo-spirit.[xxxii] Calming the spirit of such a massive disaster requires magic of a special kind. A hundred mystics from all over Java thus participated in a locally organized event in 2006 that attempted to use "paranormal" powers, reciprocal payments and soothing ritual offerings (*sesajen*) in an effort to stop the mudflow.

The Politics of Mud

The pursuit of good fortune through magical means is only one of many strategies that people pursue in order to offset the disastrous effects of the mudflow on their lives. Mas Hadi is 51 years old and makes a meager living as a self-appointed parking guard at a local school. He spends his afternoons on the mud flats, and when he does not divine stones, he is one of a few dozen men, all displaced by the mud, who sell pirated DVDs about Lusi's eruption and offer paid motorbike rides to the mainly Indonesian disaster tourists who come to see the mud flats. Mas Hadi is married for the second time. His first wife died, "of stress" as he puts it, when social

obligations forced the family to share with distant relatives the money they had received as the first installment of compensation payment from the oil company. The money gone, the family had been unable to build a new house, and Mas Hadi's wife had died of grief.

Mas Hadi's story is a common one. The victims' struggle to receive compensation for their lost livelihood has been long and frustrated. In response to the mudflow, a presidential decree from 2007 (Perpres 14/2007) divided the disaster area into two. The decree required the Lapindo oil company to pay 3,8 trillion (338 million dollars) in compensation to people who used to live inside the so-called "affected area map." Meanwhile, the state accepted to pay almost twice as much (6 trillion rupiah or 534 million dollars) from the state budget to villagers living outside of the "affected area." The decision was widely considered part of a politically brokered deal between the government of Susilo Bambang Yudhoyono (SBY) and its coalition partner, Golkar. Aburizal Bakrie was thus not only co-owner of Lapindo but also a key figure of Golkar.[xxxiii] The suspicion was that SBY protected the Bakrie conglomerate from full liability, asking the Bakrie Group to pay only a tenth of the overall estimated cost of the disaster in exchange for Golkar's support for SBY's shaky government.[xxxiv] Deals such as these are standard in Indonesia politics, and the basis for widespread accusations of corruption.[xxxv]

[**Figure G7.3 here**]

Despite the generous political deal, Lapindo sought through a variety of political, legal, and strong-arm tactics to defer payment of the government-ordered compensation to the victims. The company set up a subsidiary, PT Minarak Lapindo Jaya, to handle the compensation, but locals feel that the company's main purpose has been to infiltrate the victims' protest groups and divide them internally by paying full compensation to the most vocal victims in return for political loyalty. For the people looking for stones on the mud flats, their informal motorcycle

taxi association, which takes tourists around the site, doubles as political organization. It is the only remaining victims' group, so they say, that has resisted company pay-offs.

Other stakeholders, including the police and courts, have been less stalwart. In 2009, the regional police in East Java gave up its criminal investigation against Lapindo, a decision that was widely suspected of being made under pressure and the influence of bribes from the oil company.[xxxvi] The Constitutional Court in 2014 upheld the 2007 decree allowing the new parliament, led by President Joko Widodo, to put pressure on Lapindo to pay the remaining 781 billion rupiah (65 million dollars) that the company still owes to the victims.[xxxvii] A victory for democracy, one might claim, but the court's decision maintains the injustice of the initial decree in which the government essentially exonerated the oil company in exchange for political support. Indonesian "politics-as-usual" (*politik seperti biasa*), as one of the victims told me indignantly in a text message.

A Multiplicity of Ghosts

Deprived of adequate compensation, the victims now make a living and seek good fortune on the top of the toxic mud that covers what used to be their villages. In their struggle for compensation, mud has become a frequent symbol of political protest and demonstrators regularly smear their bodies in mud as a sign of protest against a cynical oil company and a corrupt government. But mud is not just a symbol of political corruption, it is also an index of it. The mud at the vent will boil more violently, it is said, when government bureaucrats come to visit. The higher the position and moral liability of the official, the more violently the mud will boil.[xxxviii]

[**Figure G7.4 here**]

Mud is cosmo-political: at once a political symbol and a political agent. The political

agency of mud is deeply entangled with the world of spirits. The popular narrative that the eruption of Lusi was the result of spiritual revenge from a murdered labor activist highlights this cosmo-political agency.

The district of Sidoarjo is a densely populated area of East Java, and the abundance of cheap labor has for decades attracted numerous companies, foreign and domestic. East Java has also always been a political hot spot and it has a long history of labor disputes. One of the twenty-five factories that now lie buried under the mud is PT Catur Putra Surya (CPS), a manufacturer of wristwatches made infamous for being the employer of labor activist, Marsinah, who was kidnapped, raped and killed by unknown assailants in 1993. Although the murder was never solved, it was likely ordered by a New Order network of military, government and employer representatives to silence labor protesters.[xxxix] However, Marsinah's murder galvanized the Indonesian labor movement during the 1990s, and Marsinah herself posthumously became a national celebrity.[xl] Mas Agus, one of the *ojek* drivers and stone prospectors on the mud flats, told me that the mudflow was Marsinah's curse against her murderers. Indeed, Mas Agus claimed that the Chinese owner of the watch company went insane after the mud drowned his factory. In the Lusi mud, environmental disaster, political protest, and the curses of spirits are remolded. The power of geothermal mud to speak through spirits to an unjust political world is legendary; its power is, as the victims put it, "strange but true" (*aneh tapi nyata*). The 2012 movie "The Ghost of the Lapindo Mud" (*Hantu Lumpur Lapindo*) exploits this idea. An example of *film mistik*, a popular movie genre that combines soft eroticism with horror stories featuring the many varieties of spirits and ghosts in the Indonesian mystical universe, *Hantu Lumpur Lapindo* is the story of a striptease dancer who is murdered by a gang of organ thieves after they have removed her heart. The gang dumps her body in the Lapindo mud, but the ghost rises,

smeared in mud, to haunt the gang and kill its members one by one. In the film, mud is the spiritual index of vengeance against capitalist murk, personal greed and social betrayal.

From Necropolitics to Symbiopolitics

Lusi's muddy landscape is haunted. Her "cursed mud" (*kualat lumpur*) is the mark of a necropolis and people see in it an explicit contrast to the metropolis of Kuala Lumpur, a betrayal of people's dream of modernity. In this ruined landscape, destroyed by a heady mix of greedy industry, corrupt politics, tectonic forces and chthonic spirits, body politics fuse with geo-politics: protesters smear their bodies in mud, while a murdered labor unionist turns into a muddy avenging ghost; an employer goes mad when his factory is drowned by mud; the government employs head-hunters whose prize heads are used to plug what the cement balls of international engineers were unable to stop; a snake guardian in a geothermal vent offers gifts of good fortune, while the mud itself is strangely alive and seems to know corrupt politicians from those who are clean.

The strange life of stones and mud speaks to a spectral moment in Indonesia, in which geology is political, politics is corrupt, and corruption is haunted by spirits. But the life of mud and stone is also the sign of a spectrality that characterizes the Anthropocene more generally. The Anthropocene, after all, invites us to imagine a world in which an alien geologist from the future detects in the strata of the ground evidence for the presence of humans long after we have gone extinct.[xli] This science-fiction-like character of the concept of Anthropocene opens up to a retrospective reading of the current moment, a "paleontology of the present" in which humans themselves have become geological sediments or ghosts.[xlii] In the Anthropocene life is already geologic. In this geological ghost vision, the present proceeds from the future, because the possibility of co-species survival depends crucially on what we humans are going to do now in

the midst of an increasingly given fate of ruination and extinction.

Mas Hadi and the other people looking for fossil spirits in a haunted landscape are in that sense not unlike contemporary geologists. Take Jan Zalasiewics, the geologist, who in his book *The Planet in a Pebble* discovers in a single pebble the ingredients for all life on earth.[xliii] Zalasiewics is not any geologist; he is Chair of the Anthropocene Working Group of the International Commission on Stratigraphy, the organization in charge of deciding whether to accept Anthropocene as the scientific name for our time. When he is not busy with this work, Zalasiewics looks at stones. And for him, too, every pebble is full of ghosts.[xliv] Like fossil fuel, the building blocks of every pebble are constituted—in addition to minerals—by a complex of amorphous organic matter, traces of the ancient and strange biology trapped within: acritarchs, chitinozoans, graptolites. Zalasiewics, like Mas Hadi, is interested in the ghostly contours of life in stones not merely because they are telltale remnants of a past but because stones allow him to dream of a different future at the brink of disaster, a future in which livelihood and good fortune do not comes at the expense of devastation and death. Geology here performs the job of *pesugihan*, the magical pursuit of good fortune, in a ruined landscape. In the necropolitics of the Anthropocene, geology is as entangled with politics as it is with ghosts. In the same movement that the Anthropocene is being established as a geological fact, geology itself is becoming political. As geologists have to choose which of the many radioactive, industrial, chemical signals in the ground, in the sea, and in the air that define our time, it is also becoming increasingly apparent that geology can no longer perform the God-trick of remaining outside of what it studies. Like the other sciences of the Anthropocene, geology's diagnosis of our time mires it in the politics of our time.

The question is what kind of politics to choose: the ghostly necropolitics of the current

moment or a politics informed by other kinds of spirits. It seems to me that the spectrality of the Anthropocene is full of ghosts, of many kinds. There are the old ghosts of carbon-based industry, the specters of corrupt politics, and the "god-tricks" of conventional science, to be sure. But there are also the spirits of a different, emergent kind of politics, a symbiopolitics. The Anthropocene presents us with the geological possibility that humans are the graptolites of the future, fossil colonial animals that are engineering our own demise. This shift in perspective is important. If modernity dreamt of the future, the Anthropocene dreams of the present as seen from the future, a perspectival shift that makes our necropolitics apparent to ourselves in the starkest of lights. As the deep time of geology becomes the political history of the present, this also changes what geology, along with other sciences, can and should be.[xlv] We are all inhabitants of the same mud-scape, the same geological sludge, as it were. Anthropocene landscapes of death and extinction are, however, also inhabited by emergent and unexpected constellations life, non-life, and afterlife. Before mud becomes our only future, we need to learn from stones to notice all the forms of life and possibility that exist in the midst of death: that, as I see it, is the message and the magic of the geology of the present. It is also the message of East Javanese people's engagement with spirits, as I read it.

The spirits that reside in the stones and mud of Lusi remind us that the scientific, political and legal inability to differentiate the *anthropos* from the *geos* has its own metaphysics. This metaphysics may be the brainchild of our current troubles and thus the product of a long history of exploitation, colonialism and extermination. But a metaphysic that has lost the ability to distinguish the bios from the geos, the human from the nonhuman, also holds a promise. For the kind of symbiopolitics that this metaphysics makes visible offers the chance for a novel kind of collaboration between science and the politics of the otherwise, a politics that we might learn

from spirits. The indigenous spirits of the Indonesian mud volcano and the secular spirits of the Anthropocene seem to me to form an awkward alliance here. For both indigenous spirits and the spirits of the new geological idea of the Anthropocene ask us to notice the magic of the forces, human and nonhuman, that shape the atmosphere, biosphere and geosphere. The spirits highlight how the inexorable logic of carbon-based business-as-usual that brought us into our current predicament is inherently spectral. But they offer a dissenting voice to this conjuring as well, and here is the basis for a common front between indigenous spirits and the emergent sciences of the Anthropocene, one that grows from a shared recognition of the magic of being-with, the magic of symbiopolitics.

Endnotes

* As an anthropologist, **Nils Bubandt** has learned to be equally at home with witches, protesters, and mud volcanoes. Co-director of Aarhus University Research on the Anthropocene (AURA), with Anna Tsing, Bubandt is Professor of Anthropology at Aarhus University and (with Mark Graham) Editor-in-Chief of the journal *Ethnos*. His most recent book is *The Empty Seashell: Witchcraft and Doubt on an Indonesian Island* (2014).

[i] U.S. Department of Interior, *Preliminary Analytical Results for a Mud Sample Collected from the LUSI Mud Volcano, Sidoarjo, East Java, Indonesia*, by Plumlee, Geoffrey S., et al. Open-File Report 2008-1019 (U.S. Geological Survey: Reston, VA, 2008).

[ii] Hans David Tampubolon, "Mudflow Erupting After 7 Years," *The Jakarta Post*, last modified March 5, 2013, accessed February 7, 2016, http://www.thejakartapost.com/news/2013/03/05/mudflow-erupting-after-7-years.html.

[iii] Jim Schiller, Anton Lucas, and Priyambudi Sulistiyanto, "Learning from the East Java Mudflow: Disaster Politics in Indonesia," *Indonesia* 85 (April 2008), 53.

[iv] Jonathan Amos, "Mud Volcano to Stop 'By Decade's End,'" *BBC News*, last modified December 20, 2013, accessed February 7, 2016, http://www.bbc.com/news/science-environment-25188259.

[v] Richard Davies, et al., "Probabilistic Longevity Estimate for the LUSI Mud Volcano, East Java," *Journal fo the Geological Society* 168 (2011).

[vi] Will Steffen, Paul Crutzen, and John McNeill, "The Anthropocene: Are Humans Now Overwhelming the Great Forces of Nature?" *Ambio* 36, no.8 (2007).

[vii] Italicized words are in Indonesian or Javanese. Latin names are prefaced with the letter "L."

[viii] For analyses of these disasters see Theodore C. Bestor, "Disasters, Natural and Unanatural: Reflections on March 11, 2011, and Its Aftermath," *The Journal of Asian Studies* 72, no. 4 (2013); Kate Brown, *Plutopia: Nuclear Families, Atomic Cities, and the Great Soviet and American Plutonium Disasters* (Oxford: Oxford University Press, 2013); Kim Fortun, *Advocacy after Bhopal: Environmentalism, Disaster, New Global Orders* (Chicago, IL: The University of Chicago Press, 2001); Adriana Petryna, *Life Exposed: Biological Citizens after Chernobyl* (Princeton, NJ: Princeton University Press, 2013).

[ix] Achille Mbembe, "Necropolitics," *Public Culture* 15, no. 1 (2003).

[x] For an extended case study of this from Indonesia see Nils Bubandt, *The Empty Seashell: Witchcraft and Doubt on an Indonesian Island* (Ithaca, NY: Cornell University Press, 2014).

[xi] James Lovelock and Lynn Margulis, "Atmospheric Homeostasis by and for the Biosphere: The Gaia Hypothesis," *Tellus Series A* 26, no. 1-2 (1974).

[xii] Donna Haraway, "Anthropocene, Capitalocene, Plantatiocene, Chthulucene: Making Kin," *Environmental Humanities* 6 (2015), 160.

[xiii] Richard, Davies, et al, "The East Java Mud Volcano (2006 to Present): An Earthquake or Drilling Trigger?" *Earth and Planetary Science Letters* 272 (2008).

[xiv] Steffen, "The Anthropocene: Are Humans Now Overwhelming the Great Forces of Nature?"; Michael Northcott, "Anthropogenic Climate Change and the Truthfullness of Trees," in *Religion and Dangerous Environmental Change: Transdisciplinary Perspectives*, ed. S. Bergmann and D. Gerten (Münster: LIT Verlag, 2010), 103.

[xv] Guiseppe Etiope and Alexei Milkov, "A New Estimate of Global Methane Flux from Onshore and Shallow Submarine Mud Volcanoes to the Atmosphere," *Environmental Geology* 46 (2004), 1692.

[xvi] Eric Hand, "Injection Wells Blamed in Oklahoma Earthquakes," *Science* 345, no. 6192 (2014).

[xvii] Andrew Marshall, "Drowning in Mud: An Unnatural Disaster Erupts with No End in Sight," *National Geographic* 213, no.1 (January 2008).

[xviii] More than 1,000 terrestrial and shallow water mud volcanoes have been identified and they occur in virtually every part and climatic zone in the world. Even more mud volcanoes occur in the world's oceans, and as many 100,000 mud volcanoes may exist in deep-water environments. Recent estimates suggest that the annual methane release from terrestrial and shallow-water mud volcanoes is between 6 and 9 megatons (Mt), between 3 and 4.5 percent of the total release of an estimated 200 Mt of methane to the atmosphere from natural sources (Etiope and Milkov, "A New Estimate of Global Methane Flux from Onshore and Shallow Submarine Mud Volcanoes to the Atmosphere"). Some 400 Mt of methane is released annually from anthropogenic sources.

[xix] Awang Harun Satyana and Asnidar, "Mud Diapirs and Mud Volcanoes in Depressions of Java to Madura: Origins, Natures, and Implications to Petroleum System," Proceedings of the Indonesian Petroleum Association, IPA08-G-139, Jakarta (May 2008).

[xx] A. Mazzini, et al., "Strike-Slip Faulting as a Trigger Mechanism for Overpressure Release through Piercement Structure. Implications for the Lusi Mud Volcano, Indonesia," *Marine and Petroleum Geology* 26 (2009).

[xxi] Nurrochmat Sawolo, et al., "The LUSI Mud Volcano Triggering Controversy: Was it Caused by Drilling?" *Marine and Petroleum Geology* 26 (2009).

[xxii] Jim Schiller, Anton Lucas, and Priyambudi Sulistiyanto, "Learning from the East Java Mudflow: Disaster Politics in Indonesia," *Indonesia* 85 (April 2008), 62.

[xxiii] Michael Manga, Maria Brumm, and Maxwell Rudolph, "Earthquake Triggering of Mud Volcanoes," *Marine and Petroleum Geology* 26 (2009).

[xxiv] Naomi Oreskes and Erik Conway, *Merchants of Doubt: How a Handful of Scientists Obscured*

the Truth on Issues from Tobacco Smoke to Global Warming (New York, NY: Bloomesbury Press, 2010).

[xxv] M. Lupi, et al., "Lusi Mud Eruption Triggered by Geometric Focussing of Seismic Waves," *Nature Geoscience* 6 (August 2013).

[xxvi] Indeed, the assertion that the eruption was earthquake-induced has recently been challenged by M. R. P. Tingay, et al., "Initiation of the Lusi Mudflow Disaster," *Nature Geoscience* 8, no. 7 (2015).

[xxvii] Paul Davis, "Natural Hazards: Triggered Mud Eruption?" *Nature Geoscience* 6, no. 8 (2013), 593.

[xxviii] In 2008 the American Association of Petroleum Geologists took the unusual step of voting about the cause of the mudflow. Chaired by a Scottish geologist who was a soccer umpire in his spare time, a majority of 42 at the Cape Town meeting agreed that Lusi was an anthropogenic phenomenon caused by the oil company. Three geologists found that the mud volcano was natural and caused by the Yogyakarta earthquake. But a significant minority of 29 scientists found that the evidence was either "inconclusive" or that a combination of the two causes were to blame (see James Morgan, "Mud Eruption 'Caused by Drilling,'" *BBC News*, last modified November 1, 2008, accesesed February 7, 2016, http://news.bbc.co.uk/2/hi/science/nature/7699672.stm). This inability to distinguish a natural disaster from an anthropogenic one points to a key feature of the Anthropocene: Nature is losing

its epistemological position as "natural fact" and increasingly becoming a contested reality. Much like spirits.

[xxix] I would like to thank Professor Gilles Cuny, expert on fossil sharks from Université Claude Bernard Lyon for his help with the paleontological identification of this tooth.

[xxx] Peter Borschberg, "The Euro-Asian Trade in Bezoar Stones (approx. 1500–1700)," in *Artistic and Cultural Exchanges between Europe and Asia, 1400–1900: Rethinking Markets, Workshops and Collections*, ed. M. North (Surrey: Ashgate, 2010).

[xxxi] Gregory Forth, "Heads under Bridges or in Mud," *Anthropology Today* 25, no. 6 (2009).

[xxxii] Judith Schlehe, "Cultural Politics of Natural Disasters: Discourses on Volcanic Eruptions in Indonesia," in *Culture and Changing Environment. Uncertainty, Cognition and Risk Management in Cross-Cultural Perspective*, ed. M. Casimir (New York, NY: Berghahn, 2008).

[xxxiii] In 2009 Aburizal Bakrie was elected the chairman of Golkar, which he used as a platform for his campaign to become the President of Indonesia in 2014. This campaign in large part failed because of the stigma of the Lapindo disaster that continued to make Bakrie a figure of political power, greed, and corruption.

[xxxiv] (Widhiarto 2014).

[xxxv] See Nils Bubandt, *Democracy, Corruption and the Politics of Spirits in Contemporary Indonesia* (London: Routledge, 2014).

[xxxvi] Bosman Batubara, "Resistance through Memory," *Inside Indonesia* 101 (July-September 2010), accessed February 7, 2016, http://www.insideindonesia.org/resistance-through-memory-2.

[xxxvii] Widhiarto 2014.

[xxxviii] Maksum H. M. Zuber, *Titanic Made by Lapindo* (Jakarta: Lafadl Pustaka, 2009).

[xxxix] Tim Lindsey, "The Criminal State: Premanisme and the New Indonesia," in *Indonesia Today:*

Challenges of History, ed. G. Lloyd and S. Smith (Singapore: Institute of Southeast Asian Studies, 2001), 287.

[xl] Leena Avonius, "From Marsinah to Munir: Grounding Human Rights in Indonesia," in *Human Rights in Asia: A Reassessment of the Asian Values Debate*, ed D. Kingsbury and L. Avonius (Basingstoke: Palgrave MacMillan, 2008).

[xli] See Oreskes, *Merchants of Doubt*; Heather Swanson, Nils Bubandt, and Anna Tsing, "Less than One but More than Many: Anthropocene as Science Fiction and Scholarship-in-the-making," *Environment and Society: Advances in Research* 6 (2015); Jan Zalasiewics, *The Earth After Us: What Legacy Will Humans Leave in the Rocks?* (Oxford: Oxford University Press, 2009).

[xlii] W. J. T. Mitchell, *What Do Pictures Want? The Lives and Loves of Images* (Chicago, IL: The Unversity of Chicago Press, 2005), 124.

[xliii] Jan Zalasiewics, *The Planet in a Pebble: A Journey into Earth's Deep History* (Oxford: Oxford University Press, 2012).

[xliv] *Ibid*, 86.

[xlv] Dipesh Chakrabarty, "The climate of history: Four Theses," *Critical Inquiry* 35, no. 2 (2009).

Bibliography

Amos, Jonathan. "Mud Volcano to Stop 'By Decade's End,'" *BBC News*. Last modified December 20, 2013. Accessed February 7, 2016. http://www.bbc.com/news/science-environment-25188259.

Avonius, Leena. "From Marsinah to Munir: Grounding Human Rights in Indonesia." In *Human Rights in Asia: A Reassessment of the Asian Values Debate*, edited by D. Kingsbury and L. Avonius, 99-119. Basingstoke: Palgrave MacMillan, 2008.

Batubara, Bosman. "Resistance through Memory," *Inside Indonesia* 101 (July-September 2010). Accessed February 7, 2016. http://www.insideindonesia.org/resistance-through-memory-2

Bestor, Theodore C. "Disasters, Natural and Unanatural: Reflections on March 11, 2011, and Its Aftermath." *The Journal of Asian Studies* 72, no. 4 (2013):763-782.

Borschberg, Peter. "The Euro-Asian Trade in Bezoar Stones (approx. 1500–1700)." In *Artistic and Cultural Exchanges between Europe and Asia, 1400–1900: Rethinking Markets, Workshops and Collections*, edited by M. North, 29–43. Surrey: Ashgate, 2010.

Brown, Kate. *Plutopia: Nuclear Families, Atomic Cities, and the Great Soviet and American Plutonium Disasters*. Oxford: Oxford University Press, 2013.

Bubandt, Nils. *The Empty Seashell: Witchcraft and Doubt on an Indonesian Island.* Ithaca, NY: Cornell University Press, 2014.

_____, Nils. *Democracy, Corruption and the Politics of Spirits in Contemporary Indonesia*. London: Routledge, 2014.

Chakrabarty, Dipesh. "The climate of history: Four Theses." *Critical Inquiry* 35, no. 2 (2009):

197-222.

Davies, Richard, et al. “The East Java Mud Volcano (2006 to Present): An Earthquake or Drilling Trigger?” *Earth and Planetary Science Letters* 272 (2008):627-638.

_____, Richard, et al. “Probabilistic Longevity Estimate for the LUSI Mud Volcano, East Java.” *Journal fo the Geological Society* 168 (2011):517-523.

Davis, Paul. “Natural Hazards: Triggered Mud Eruption?” *Nature Geoscience* 6, no. 8 (2013):592-593.

Etiope, Guiseppe, and Alexei Milkov. “A New Estimate of Global Methane Flux from Onshore and Shallow Submarine Mud Volcanoes to the Atmosphere.” *Environmental Geology* 46 (2004):997-1002.

Forth, Gregory. “Heads under Bridges or in Mud.” *Anthropology Today* 25, no. 6 (2009):3-6.

Fortun, Kim. *Advocacy after Bhopal: Environmentalism, Disaster, New Global Orders*. Chicago, IL: The University of Chicago Press, 2001.

Hand, Eric. “Injection Wells Blamed in Oklahoma Earthquakes.” *Science* 345, no. 6192 (2014):13-14.

Haraway, Donna. “Anthropocene, Capitalocene, Plantatiocene, Chthulucene: Making Kin.” *Environmental Humanities* 6 (2015):159-165.

Lindsey, Tim. “The Criminal State: Premanisme and the New Indonesia.” In *Indonesia Today: Challenges of History*, edited by G. Lloyd and S. Smith, 283-297. Singapore: Institute of Southeast Asian Studies, 2001.

Lovelock, James, and Lynn Margulis. “Atmospheric Homeostasis by and for the Biosphere: The Gaia Hypothesis.” *Tellus Series A* 26, no. 1-2 (1974):2-10.

Lupi, M., et al. “Lusi Mud Eruption Triggered by Geometric Focussing of Seismic Waves.”

Nature Geoscience 6 (August 2013):642-646.

Manga, Michael, Maria Brumm, and Maxwell Rudolph. "Earthquake Triggering of Mud Volcanoes." *Marine and Petroleum Geology* 26 (2009):1785-1798.

Marshall, Andrew. "Drowning in Mud: An Unnatural Disaster Erupts with No End in Sight." *National Geographic* 213, no.1 (January 2008):58–63.

Mazzini, A, et al. "Strike-Slip Faulting as a Trigger Mechanism for Overpressure Release through Piercement Structure. Implications for the Lusi Mud Volcano, Indonesia." *Marine and Petroleum Geology* 26 (2009):1751-1765.

Mbembe, Achille. "Necropolitics." *Public Culture* 15, no. 1 (2003):11-40.

Mitchell, W. J. T. *What Do Pictures Want? The Lives and Loves of Images*. Chicago, IL: The Unversity of Chicago Press, 2005.

Morgan, James. "Mud Eruption 'Caused by Drilling,'" *BBC News*. Last modified November 1, 2008. Accesesed February 7, 2016. http://news.bbc.co.uk/2/hi/science/nature/7699672.stm.

Northcott, Michael. "Anthropogenic Climate Change and the Truthfullness of Trees." In *Religion and Dangerous Environmental Change: Transdisciplinary Perspectives*, edited by S. Bergmann and D. Gerten, 103-118. Münster: LIT Verlag, 2010.

Oreskes, Naomi, and Erik Conway. *Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming*. New York, NY: Bloomesbury Press, 2010.

_____, Naomi. *The Collapse of Western Civilization: A View from the Future*. New York, NY: Columbia University Press, 2014.

Petryna, Adriana. *Life Exposed: Biological Citizens after Chernobyl*. Princeton, NJ: Princeton

University Press, 2013.

Satyana, Awang Harun, and Asnidar. "Mud Diapirs and Mud Volcanoes in Depressions of Java to Madura: Origins, Natures, and Implications to Petroleum System." Proceedings of the Indonesian Petroleum Association, IPA08-G-139, Jakarta, May 2008.

Sawolo, Nurrochmat, et al. "The LUSI Mud Volcano Triggering Controversy: Was it Caused by Drilling?" *Marine and Petroleum Geology* 26 (2009):1766-1784.

Schiller, Jim, Anton Lucas, and Priyambudi Sulistiyanto. "Learning from the East Java Mudflow: Disaster Politics in Indonesia." *Indonesia* 85 (April 2008):51-77.

Schlehe, Judith. "Cultural Politics of Natural Disasters: Discourses on Volcanic Eruptions in Indonesia." In *Culture and Changing Environment. Uncertainty, Cognition and Risk Management in Cross-Cultural Perspective*, edited by M. Casimir, 275-299. New York, NY: Berghahn, 2008.

Steffen, Will, Paul Crutzen, and John McNeill. "The Anthropocene: Are Humans Now Overwhelming the Great Forces of Nature?" *Ambio* 36, no.8 (2007):614-621.

Swanson, Heather, Nils Bubandt, and Anna Tsing. "Less than One but More than Many: Anthropocene as Science Fiction and Scholarship-in-the-making." *Environment and Society: Advances in Research* 6 (2015): 149-166.

Tampubolon, Hans David. "Mudflow Erupting After 7 Years," *The Jakarta Post*. Last modified March 5, 2013. Accessed February 7, 2016. http://www.thejakartapost.com/news/2013/03/05/mudflow-erupting-after-7-years.html.

Tingay, M. R. P., Maxwell L. Rudolph, M. Manga, R. J. Davies, and Chi-Yuen Wang. "Initiation of the Lusi Mudflow Disaster." *Nature Geoscience* 8, no. 7 (2015): 493-494.

U.S. Department of Interior. *Preliminary Analytical Results for a Mud Sample Collected from*

the LUSI Mud Volcano, Sidoarjo, East Java, Indonesia, by Plumlee, Geoffrey S., et al. Open-File Report 2008-1019, U.S. Geological Survey. Reston, VA, 2008.

Zalasiewics, Jan. *The Earth After Us: What Legacy Will Humans Leave in the Rocks?* Oxford: Oxford University Press, 2009.

_____, Jan. *The Planet in a Pebble: A Journey into Earth's Deep History*. Oxford: Oxford University Press, 2012.

Zuber, Maksum H. M. *Titanic Made by Lapindo*. Jakarta: Lafadl Pustaka, 2009.

[Insert FIG_Monsters2-1 here:]

Monsters: Bodies Tumbled into Bodies

Heather Swanson, Anna Tsing, Nils Bubandt, Elaine Gan*

What if all organisms, including humans, are tangled up with each other?

Jellyfish are monsters. Soft glass parasols as colorful as flowers, they blossom from watery depths with delicate grace. Yet woe to those tangled in their stinging tentacles. Along beaches in Australia, Florida, and the Philippines, jellies are becoming a greater risk than sharks, sending scores of swimmers to hospitals, some with fatal stings. Off the coast of Japan, 450-pound Nomura jellies have capsized boats that have snared loads of them in their nets. In the Black Sea, comb jellyfish eat ten times their weight in a single day, destroying fish and fisheries. As jellyfish consume the small fish fry, emptying seas of other species, the waters fill up with jellies in fantastical numbers. The richness of earlier marine assemblages is banished. The ocean turns monstrous. Filling the seas with sloshing goo, jellyfish are nightmare creatures of a future in which only monsters can survive.

How did such monstrosity arise? Those Black Sea combs—so inspiring and so terrible—arrived in the ballast water of ships as recently as the 1980s. They took over too-warm seas emptied out by overfishing and polluted by the choking run-off of industrial farming. Under other conditions, jellies are capable of playing well with other species. If jellyfish are monsters it is in their entanglements—with us. Jellies become bullies through modern human shipping, overfishing, pollution, and global warming. In all our heedless entanglements with more-than-human life, we humans too are monsters.

Coral reefs are monsters. Their polyps rise from reefs of their own making—but not just their own. Like the mythical chimeras of ancient Greece, beasts made up of the head of a lion, the body of a goat, and the tail of a snake, coral reefs are made of mismatched parts—animal, plant, and more—which hang together in fragile coordinations. In contrast to jellies, warming waters do not turn corals into bullies; rather, they drive off symbiotic dinoflagellates, weakening the corals. The necessity of working together makes coral life possible; indeed, symbiosis is essential to life on earth. But symbiosis is also vulnerable. Corals, like jellies, are tied to others in rapidly shifting worlds, but for them, disrupted relations lead not to riotous reproduction, but to decline and death. In all our vulnerable entanglements with more-than-human life, we humans too are monsters.

Monsters are useful figures with which to think the Anthropocene, this time of unintentional but massive human transformation of multispecies life. Monsters are the wonder of symbiosis *and* the threat of ecological disruption. Modern human activities have unleashed new and terrifying threats: from invasive predators such as jellyfish to virulent new pathogens to out-of-control chemical processes. Modern human activities have also revealed the importance of the ancient forms of monstrosity that modernity tried to extinguish: the multispecies entanglements that make life across the earth, as in the coral reef, flourish. The monsters in this book, then, have a double meaning: on the one hand, they help us pay attention to ancient, chimeric entanglements; on the other, they point us to the monstrosities of modern Man. Monsters ask us to consider the wonders and dangers of symbiotic entanglement in the Anthropocene.

In the unknown future of environmental damage, nature is suddenly unfamiliar again. How shall we find our way? Perhaps sensibilities from folklore and science fiction—such as monsters and ghosts—will help. While ghosts (in the other half of this

book) help us read life's enmeshment in landscapes of many kinds of time, monsters point us to life's symbiotic entanglement across bodies. The flip-over, "tête-bêche" format of *Arts of Living on a Damaged Planet* shows ghosts and monsters as two symmetric, mirrored beginnings to stories that challenge the double conceit of modern Man. Against the conceit of Progress, ghosts guide us to landscapes haunted by their pasts. Against the conceit of the individual, monsters highlight life's symbiosis, the folding of bodies within bodies in evolution and in every ecological niche. In symmetrical fashion, ghosts and monsters unsettle the *anthropos* from its presumed center-stage in the Anthropocene by highlighting the webs of histories and bodies in which all life, including human life, is tangled. Rather than imagining phantasms outside of natural history, the monsters and ghosts of this book are observable parts of this world. We learn them through every practice of knowing, from indigenous tradition to science, and draw inspiration from both the arts and sciences to work across genres of observation and storytelling.

We watch for productive crossings

It is unusual for natural scientists and humanists to have more than passing conversations about their work — yet learning about the conditions of livability in these dangerous times must surely be a common task. Consider, then, the excitement of the following exchange:

At our 2014 conference, historian Kate Brown gave a talk about the sufferings of residents of the former plutonium-manufacturing district in Russia, where radioactive traces still course through soil and water. The residents' bodies were suffused with illness and unease. They complained of chronic fatigue, chronic pain, and digestive, circulatory and immune disorders; they showed scars from multiple operations. Yet

doctors could find no clear trace relating their multiple illnesses to radiation from the plutonium plant. The physicians checked for cancers traditionally associated with exposure to radioactivity; they did not find them. The patients' unspecific maladies did not fit standard diagnostic categories, and the doctors turned the residents away without treatment. The residents felt disregarded and betrayed.

Microbiologist Margaret McFall-Ngai listened to Brown's talk with interest: she recognized every symptom Brown listed from her own research, which focuses on how microbes affect the development of organisms, including humans. Rather than diffuse complaints, a product of bad living, as doctors had argued, McFall-Ngai thought all those ailments could easily arise from one cause: mutations in intestinal bacteria. Chronic doses of radiation that might not yet stimulate a human cell cancer could easily have caused bacterial mutations. It seems likely that the plutonium-district residents were suffering from the ills of their microbial companions.

Suffering from the ills of another species: This is the condition of the Anthropocene, for humans and nonhumans alike. This suffering is not just a matter of empathy, but also of material interdependence. We are mixed up with other species; we cannot live without them. Without intestinal bacteria, we cannot digest our food. Without endosymbiotic dinoflagellates, coral polyps lose their vitality. Yet such "monstrous" mixtures have been anathema to the organization of modern industrial progress. Ironically, the denial of the monstrosity of entanglement has turned this life-making trait against us. Industrial campaigns exterminate impurities, undermining the coordinations that make life possible. Plantations grow just one crop, denying intimacies among companion species. Modern dairy and meat farms raise a handful of supercharged breeds. A new kind of monstrosity attacks us: our entanglements, blocked and concealed in these simplifications, return as virulent pathogens and spreading

toxins. Industrial chemicals weave their way through our foodwebs; nuclear byproducts sicken us not just through our human cells but also through our bacteria.

How shall we approach such blowback of the modern? Thinking together, a historian and a microbiologist found a new research problem, a problem both specific and of great import for our times. Their cross-disciplinary curiosity about the microbial worlds of the radiation-affected residents opens up questions about the multispecies mixes that make up our worlds. Brown and McFall-Ngai are both contributors to this book, and their dialogue is at once an example and a parable for the work the book seeks to do. We live on a human-damaged planet, contaminated by industrial pollution and losing more species every year—seemingly without possibilities for cleanup or replacement. Our continued survival demands that we learn something about how best to live and die within the entanglements we have. We need both senses of monstrosity: entanglement as life and as danger.

But who, we must ask, are "we"?

In the 20th century, the natural and human sciences alike imagined the world as composed of individuals – with distinct bodies, genomes, and vested interests. Symbioses, when they were recognized, were considered rare, anomalies in a world characterized by individual autonomy and relentless competition. It turns out, however, that such assumptions were wrong. Recent research on organisms ranging from bacteria to insects to mammals has shown that symbiosis is a near-requirement for life – even for *Homo sapiens*. As developmental biologist Scott Gilbert explains in this volume, our bodies contain more bacterial cells than human ones. Without bacteria, our immune systems do not develop properly. Even reproduction appears to be bacteria-enabled. Life, put simply, is symbioses "all the way down."

As Donna Haraway suggests, recognizing the importance of symbiotic makings ("sympoiesis") is just the beginning of "staying with the trouble." Symbiotic relations must be constantly renewed and negotiated within life's entanglements. When conditions suddenly shift, once life-sustaining relations sometimes turn deadly. The case of low-dose chronic exposure to radioactivity shows us what can happen when symbiotic alliances are broken: essential gut microbes mutate into illness-causing enemies. Symbioses are vulnerable; the fate of one species can change whole ecosystems. As Ingrid Parker reminds us in her essay, the commercial hunting of sea otters off Pacific North America changed kelp forests to sea-urchin barrens; without the otters, urchins took over. Because they were connected by common soil ecologies, whole suites of perennial grasses and wildflowers disappeared in California with the invasion of European annual grasses. This is one of the challenges of our times: entanglement with others makes life possible, but when one relationship goes awry, the repercussions ripple.

What kinds of monsters are we now?

Life has been monstrous almost from its beginnings. In ancient times, prokaryotes (bacteria and archaea) gave birth to monsters in which one organism engulfed others or joined immoderate liaisons, forming nucleated cells and multicellular organisms called eukaryotes. Ever since, we have muddled along in our mixes and messes. All eukaryotic life is monstrous.

Enlightenment Europe, however, tried to banish monsters. Monsters were identified with the irrational and the archaic. Category-crossing beings were abhorrent to Enlightenment ways of ordering the world; sometimes they were classified as things of the devil, the antithesis of godly purity. Martin Luther, the Protestant Reformer,

identified the Catholic Church with monstrosity: in one vivid image, he offered a Papal Ass, a creature with the head of an ass and the breasts and belly of a woman. Luther helped forge what we think of as the modern world through his campaign against category-crossing monsters. But the forms of progress and rationalization that the Enlightenment sparked have proved far scarier than the beasts it sought to banish. For later thinkers, rationalization meant individualization, the creation of distinct and alienated individuals, human and nonhuman. The landscape-making practices that followed from these logics imagined the world as a space filled with autonomous entities and separable kinds, ones that could be easily aligned with capitalist fantasies of endless growth.

Ironically, the monstrosity of monocrops depends on the very multispecies relations that it denies. Anthropologist Marianne Lien provides a striking example of this logic of denial and dependence from Norwegian salmon farms. Commercial aquaculture aims to produce solely salmon, but this has proved impossible. When salmon are kept in close quarters, populations of sea lice – a naturally occurring, but normally spatially scattered fish parasite – explode. Because the lice threaten fish health, farms first turned to chemical baths and medicated feeds, but the lice soon became resistant to the drugs. The situation forced the farms to turn to a multispecies intervention: putting wrasse, a lice-loving 'cleaner fish' into the salmon pens to eat the parasites off the fishes' bodies. But wild wrasse populations were too small for the vast needs of the industry, so they had to begin farming wrasse. The wrasse had their own suite of relations: when young, wrasse require a diet of tiny crustaceans, served live. These copepods, however, proved hard to collect, so now they, too, must be cultivated.

The "simplifications" of industrial farming multiply beyond the original target species. Their multispecies modifications create ever more monsters—exploding

numbers of parasites, drug resistant bacteria, and more virulent diseases – by disrupting and torqueing the monsters that sustain life. The ecological simplifications of the modern world—products of the abhorrence of monsters—have turned monstrosity back against us, conjuring new threats to livability.

We begin with noticing

The seductive simplifications of industrial production threaten to render us blind to monstrosity in all its forms by covering over both lively and destructive connections. They bury once-vibrant rivers under urban concrete and obscure increasing inequalities beneath languages of freedom and personal responsibility. Somehow, in the midst of ruins, we must maintain enough curiosity to notice the strange and wonderful, as well as the terrible and terrifying. Living in a time of planetary catastrophe thus begins with a practice at once humble and difficult: noticing the worlds around us.

Our monsters and ghosts help us notice landscapes of entanglement, bodies with other bodies, time with other times. They aid us in our call for a particular approach to noticing – one that draws inspiration from scientific observation alongside ethnography and critical theory. Ant expert Deborah Gordon embodies the forms of curiosity we hope to cultivate. Rather than be lulled by liberal economic theories, with their focus on individual determination of group outcomes, Gordon begins with questions about "collective behavior" — already in the realm of the monstrous. Gordon has spent more than two decades observing ant interactions in the field with the eye of a natural historian. Based on these observations, she has designed new kinds of experiments that show the flexible interdeterminacies of ant interactions with each other. Where other observers saw only rigid and mechanical "castes," Gordon was able to notice how ants respond to situations of encounter as well as their environment. Mycologist Anne

Pringle similarly enters the monstrous world of lichens, chimeric entanglements of algae and fungi. To study lichen, Pringle must begin by giving up modernist units of individuals and populations.

The modes of noticing we propose are purposefully promiscuous. The rigid segregation of the humanities and natural sciences was an ideology for modern Man's conquest, but it is a poor tool for collaborative survival. Co-species survival requires arts of imagination as much as scientific specifications. But symbiotic scholarship takes time to evolve: many scholars in this book have spent decades in dialogue with others beyond their fields. Perhaps counter-intuitively, slowing down to listen to the world — empirically and imaginatively at the same time — seems our only hope in a moment of crisis and urgency.

Our modes of noticing, however, are themselves monstrous in their connection to Man's conquest. Much of what we know about ecological connection comes from tracking the movement of radiation and other pollutants. Contamination often acts as a "tracer" — a way to see relations. We notice connections in part through their ruination; we see the importance of dinoflagellates to coral reefs only as the corals bleach and die. It is time to start paying attention to more of our companions before we kill them off entirely.

We listen for modes of storytelling

Some kinds of stories help us notice; others get in our way. Modern heroes—the guardians of progress across disciplines—are part of the problem. Thus, for example, McFall-Ngai has suggested that biologist Lynn Margulis, who first imagined symbiosis as the origin of cells, has not been accorded the preeminence she deserves because she is a woman, and thus not eligible for hero status. Male scientists tend to only cite men,

she explained, while women scientists tend to cite male and female scientists equally. Unless we learn to listen broadly, we may miss the biggest story of life on earth: symbiogenesis, the co-making of living things. Practices of storytelling matter.

Several forms of noticing and telling gather in *Arts of Living on a Damaged Planet*. We begin with creative writing, the necessary stimulus to imagining pasts, presents, and the yet to come. Ursula K. LeGuin starts off this half of the volume. She brings us into the craft of writing itself, always already part of other stories: "It's just part of a story, actually a lot of stories… if I'll only listen…" There she teaches us quite properly to fear: "Whiteness crossed the continent, a poison fog where it went, villages were vacant, hearths and ways forsaken." And yet she shows us wonder, as the ocean "holds the whales as lightly as the body holds the soul" even as it mixes the "slow swirl of pelagic polymers" and radioactive waste. Creative writing invites us to imagine the world differently, to listen beyond newspaper headlines to hear those quiet stories about the Anthropocene whispered in small encounters. Imaginative writing draws us into what Donna Haraway, in her chapter, calls "art-science activisms," "sympoietic practices for living on a damaged planet."

To these imaginative frames, we add the sciences of bodies tumbled into bodies, from developmental biology to ecology, and from observation of ants to reflection on extinct elephants and rhinoceroses. They show us lichens, women in childbirth, strange sea creatures, missing wildflowers, and much more. Then, too, we need the environmental humanities and social sciences, which tell us of human and nonhuman histories, cultures and texts; they bring us into assemblages of power and meaning. We follow wolves, tentacular monsters, flying foxes, and stumps of chestnut trees. There are hybrid scholars, too, working across these lines, such as Donna Haraway, both biologist and cultural theorist, Karen Barad, a practicing physicist and feminist critic,

and Andrew Mathews, forester and anthropologist. They show us how to move beyond the exclusions that blocked our attention to cross-species entanglement. We follow kinds of stories that take us beyond the modern individual. Watching and writing: these, too, are arts of living.

Not all stories are equally useful in engaging us with collaborative survival, arts of living on a damaged planet. In her essay, "The carrier bag theory of fiction," Ursula LeGuin quotes a Virginia Woolf glossary in which Woolf defines "heroism" as "botulism." This delightfully unexpected definition can again reframe the problem of livability in the Anthropocene. Woolf's "heroism" might stand in for the enactment of Man's conquest of Nature. This form of heroism has been a dream of modernity—and a cause of contemporary fears for life on earth. Heroic conquests, from big dams to mass relocations, have been dangerous acts, erasing many lives. Botulism is a form of food poisoning most commonly associated with canning; the anaerobic world inside the can may encourage the growth of toxin-producing *Clostridium botulinum* bacteria. These bacteria are common in soil and water, but they only produce toxins under special conditions, such as life inside a can. The aluminum can, a mid-twentieth century invention, is a fitting icon of modern civilization and industrial distribution. The botulism in the can is similarly an icon of the monstrosities of the Anthropocene. Like radioactive contamination and proliferating sea lice, botulism is produced from within the heart of modernity. Heroism—the story line of modern progress—is thus readable, indeed, as botulism. Livability in the Anthropocene is threatened by just those heroic storylines and practices that are thought to have made Man great.

Are there alternatives to heroism/botulism? LeGuin's essay suggests "carrier bags" as another way to tell a story. Collecting offers stories with more complex arcs of

temporality, she argues; instead of a hero single-handedly making the future, there are entanglements and losses of many kinds.

Monsters are bodies tumbled into bodies; the art of telling monstrosity requires stories tumbled into stories. This is what literary critic Carla Freccero shows us through her attention to the jointly material and semiotic worlds of wolf-human relations. As she slips between literary tropes of the "lone wolf" and practices of wolf-killing, forests tumble into fables tumble into politics. Material worlds and the stories we tell about them are bound up with each other. Meanwhile, biologist Andreas Hejnol shows us a dizzying range of body forms, from tapeworms to tunicates, in which each organism inherits the evolutionary solutions of its predecessors; old body plans are always mixed into contemporary ways of life. If we do not let progress "ladders" possess us, we are forced to recognize the monstrous in transformation. Classification systems are monster stories—and ghost stories—too. Nor can the question of monsters stop at the boundaries of life. An anthropogenic mud volcano, the subject of anthropologist Nils Bubandt's essay, is monstrous in just the ways we have been describing: both part of our natural connectedness and a threat to life. Spirits and stones emerge from the mud as our new sympoietic companions: they become part of us, and they urge us, as Haraway puts it, to stay with the trouble.

In this spirit, *Arts of Living on a Damaged Planet* is itself mixed up. The volume seeks to sustain, rather than to simplify or banish, monsters and ghosts. It juxtaposes many genres to show how varied storytelling styles might inform each other both in learning about our challenged planet and in forging strategies for living with others in the yet-to-come.

While this introduction uses monsters to mix up bodies, challenging the rhetorical reign of the autonomous individual, the introduction to the other half of *Arts*

of Living on a Damaged Planet uses ghosts. Ghosts show the layered temporalities of living and dying that shape our landscapes, tripping up the forward march of progress. Ghosts, like monsters, are creatures of ambivalent entanglement. The landscape assemblages of co-species living are possible because of ghosts; modern Man's singular timelines occlude our vision. Turn this book over and follow ghosts into arts of living.

ENDNOTES

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Remembering in our Amnesia, Seeing in our Blindness

Ingrid M. Parker*

The "Great Meadow" is an iconic place on the campus of the University of California, Santa Cruz (UCSC). Like other California grasslands, it turns golden early in the summer. The thick annual grasses look like fields of grain and contrast beautifully with the dark evergreen trees, huddled in crowds like cross-country runners ready to sprint off the starting line. For many, this landscape with its golden rolling hills is among the most beautiful sights of California. The Great Meadow is protected from campus development to preserve the viewshed for those on the campus, as well as in the city below.

What is not known to many people is that this iconic landscape is almost entirely devoid of what ecologists would call "native plants." In a study of plant biodiversity in the Great Meadow, my colleagues and I quantified the relative abundance of all plant species.[i] We found that 84% were species introduced by Spanish colonists beginning in the 18th century, including familiar European plants like wild oat (*Avena fatua*), ripgut brome (*Bromus diandrus*), wild radish (*Raphanus raphanistrum*), Italian ryegrass (*Lolium multiflorum*), and wild mustards (*Brassica* spp.).[ii] Because many of these introduced species are aggressive competitors, they also dominate the plant cover: in our study, introduced species made up a full 90% of the vegetation growing in the Great Meadow

[**Figure M9.1 here**]

Amnesia

What we consider to be one of our most iconic landscapes would have been unrecognizable to a botanist 300 years ago. But what did the Great Meadow look like before these plants arrived from Europe? We don't really know…an ignorance that is both disturbing and fascinating. A classic hypothesis argues that the coastal grasslands of California were originally dominated by native grasses, such as purple needle grass (*Stipa pulchra*) and creeping wild rye (*Leymus triticoides*).[iii] These species are perennials, some of which can live for hundreds of years. In contrast, the European grasses are annuals, and the golden color of the contemporary California hills in summer reflects that all of the plants are dead. Ecological studies in the past two decades have shown that ecosystem characteristics and functions can differ dramatically between grasslands dominated by European annual grasses and those dominated by native perennials. For example, these systems differ in the availability and timing of soil moisture and vegetation structure, influencing which species can coexist there.[iv]

A captivating idea that has more recently grown to be the dominant theory is that the golden fields of European grasses were once filled not with native grasses, but with wildflowers. In his book *California's Fading Wildflowers*, Richard Minnick draws on a range of historical and ecological evidence to make the argument that at the time of European contact, spring in California was a riot of color.[v] Spectacular fields of shimmering blue lupines and baby blue-eyes, pink owl's clover, prickly yellow fiddlenecks, scarlet paintbrushes, and uncountable poppies like orange dots in a pointillist painting would have stretched from San Diego to San Francisco and beyond. In addition to historical evidence, research on phytoliths (plant micro-fossils) now supports the theory that fields of wildflowers were the original California "grasslands."[vi] Competition from European annual grasses in combination with the introduction of grazing

animals like sheep and cattle wiped out the more vulnerable forbs. Those wildflowers are like ghosts to me. The vision of their exuberance haunts me as I gaze upon the rolling hills around my home.

[Figure M9.2 here]

I believe that to understand the relationship of humans to our landscape today, we have to come to terms with two challenges, which I will call amnesia and blindness. In the case of the wildflowers of California, we don't remember them. Even though the ecological conversion happened in only a few hundred years—less than a blink of an eye in evolutionary terms—we don't even have formal records of their disappearance.

The first human inhabitants of the Great Meadow were the Amah Mutsun. Their role in shaping the landscape was profound, probably most importantly but not exclusively through their use of fire to maintain open meadows and forest edges.[vii] Their mark on the history of UCSC is often forgotten, and the practices themselves are part of cultural knowledge that has been dormant and at risk of being lost.[viii]

Our society's ecological amnesia is profound, and it limits us from understanding our current and past impacts on the species and ecosystems around us. Another example of this is the historical ecology work of Loren McClenachan, who used archived personal photos of recreational fishing expeditions in Key West, Florida to see ecological change in the coral reef ecosystem.[ix] Over a 50-year period, trophy fish shrank almost an order of magnitude, from an average size of 19.9kg to 2.3kg. There were also dramatic changes in fish species in the photos, with large sharks and goliath groupers vanishing over time. What is considered a productive day of sport fishing in Florida today would have been considered a pathetic haul in 1956. This is the concept of the "shifting baseline," and it is recognized as a serious problem in fisheries

management and in conservation generally.[x] We are hampered when we set conservation or restoration goals based on our knowledge of recent times alone, without an understanding of either the structure and composition of plant and animal communities even a hundred years ago, or the practices of the peoples who interacted with the land before European colonization.

Blindness

A second challenge in our relationship to changing ecological assemblages is our limited ability to perceive. Here, I am not even referring to our distractedness, our addiction to electronics and social media, or our children's lack of direct experience of nature.[xi] I am referring to how ecological patterns—the diversity, composition, and overall structure of ecosystems—are often driven by factors that we cannot see. For example, microscopic fungi and bacteria are responsible for much of the fertility of soil and for regulating decomposition and mediating interactions among plants belowground, including symbiotic mycorrhizal fungi and nitrogen-fixing rhizobia.[xii] Other microbes such as pathogenic fungi and oomycetes bring balance to communities and increase biodiversity by causing disease on highly competitive plant species.[xiii]

The history of the scientific field of ecology is one of discovery through learning new ways of seeing. Microbes have become visible to us because we can now "see" their distinctive DNA and RNA in soil and inside of plants and animals.[xiv] This has allowed us to study how the diversity and composition of microbes influence everything from plant productivity to human digestive health. In another revolution in awareness, one of the most important developments in ecological science was the rise of the manipulative experiment as a tool for studying what could not be seen. In 1966, Robert T. Paine published the results of a two-year experiment on food web complexity and biodiversity.[xv] In his experiment on Tatoosh Island, Paine removed ochre sea stars ("starfish," *Pisaster ochraceus*) from a stretch of Pacific Northwest rocky intertidal by

flinging them out to sea. That study, which now has over 2,700 citations, demonstrated a rapid loss of biodiversity as mussels took over in the absence of their predator.[xvi] The effects of the sea stars were entirely invisible until these unobtrusive yet voracious predators were experimentally removed.

The same principle was applied to discover the major driver of kelp forest ecology along the west coast of North America. In a large-scale and brutal hunting "experiment" from 1741-1911, Russian fur traders drove sea otters nearly to extinction.[xvii] By comparing sites with sea otters to areas where otters were missing, marine biologist Jim Estes found that sea otters have a dramatic effect on their ecosystem. The sea otters make it possible for lush and productive kelp forests to grow by eating urchins, keeping the marine herbivores in check.[xviii] Before Estes began his grueling work in the cold waters of Alaska, we were blind to the importance of the sea otter. Now where "urchin barrens" flaunt their bare ground without a scrap of living kelp, the marine ecologist sees the ghost of the otter.

Sometimes it is possible to use our imagination together with our knowledge to take action that leads to the conservation and restoration of species and their ecosystems, to in effect, "bring back a ghost." The conservation nonprofit Island Conservation takes as its mission to prevent extinctions by removing invasive species from islands. Although islands represent only 5% of the world's landmass, they are home to 45% of the world's critically endangered species globally. Most of the animal extinctions on islands are caused by invasive species such as cats and rats. For example, the Pinzón Giant Tortoise (*Chelonoidis nigra* subsp. *duncanensis*) was unable to breed in the wild for 150 years, because invasive rats ate their eggs and hatchlings. While the species struggled on from 1965 in a captive breeding colony, the Pinzón Giant Tortoise went extinct in the wild. In 2012, Island Conservation partnered with Galápagos

National Park and the Charles Darwin Foundation to remove rats from Pinzón. In June of 2013, baby tortoises were seen on Pinzón for the first time in over 150 years.

[**Figure M9.3 here**]

The Pinzón giant tortoise, the sea otter, the wildflowers of California, the goliath grouper… A conservationist must learn how to transcend the amnesia to remember these ghosts, to transcend the blindness to a new kind of sight. In order to accomplish this we need to bring all types of research to the table, from anthropology and archaeology to historical archival research, as well as experimental ecology and molecular ecology. Underlying it all is natural history, that slow art of getting to know a place in space and all of its creatures. Perhaps with a combination of imagination, scientific inquiry, and conservation inspiration, we will see more ghosts come back to life.

Endnotes

* Combining natural history, experiments, and mathematical models, **Ingrid Parker** studies how plants interact with microbes and other organisms in ways that influence their distributions, traits, and ecological dynamics. She is particularly known for her work on the biology of invasive species and on the conservation of rare plant species in California. She is Professor of Ecology and Evolutionary Biology at the University of California, Santa Cruz.

[i] Ingrid M. Parker *et al*., "Phylogenetic Structure and Host Abundance Drive Disease Pressure in Communities," *Nature* 520 (2015).

[ii] Richard Minnich, *California's Fading Wildflowers: Lost Legacy and Biological Invasions* (Berkeley, CA: University of California Press, 2008).

[iii] Frederic E. Clements, "The Relict Method in Dynamic Ecology," Journal of Ecology 22 (1934).

[iv] T.H. Holmes and K.J. Rice, "Patterns of Growth and Soil-Water Utilization in Some Exotic Annuals and Native Perennial Bunchgrasses of California," *Annals of Botany* 78, no. 2 (1996); Nicole A. Molinari and Carla M. D'Antonio, "Structural, Compositional and Trait Differences Between Native- and Non-Native-Dominated Grassland Patches," *Functional Ecology* 28, no. 3 (2014).

[v] Minnick, *California's Fading Wildflowers*.

[vi] Rand R. Evett and James W. Bartolome, "Phytolith Evidence for the Extent and Nature of Prehistoric California Grasslands," *Holocene* 23, no. 11 (2013).

[vii] Jon E. Keeley, "Native American Impacts on Fire Regimes of the California Coastal Ranges," *Journal of Biogeography* 29 (2002); M. Kat Anderson, *Tending the wild: Native American Knowledge and the Management of California's Natural Resources* (Berkeley CA: University of California Press, 2005).

[viii] Rick Flores, "The Amah Mutsun Relearning Program," *UCSC*, accessed February 7, 2016, http://arboretum.ucsc.edu/education/relearning-program/.

[ix] Loren McClenachan, "Documenting Loss of Large Trophy Fish from the Florida Keys with Historical Photographs," *Conservation Biology* 23, no. 3 (2009).

[x] Daniel Pauly, "Anecdotes and the Shifting Baseline Syndrome of Fisheries," *Trends in Ecology and Evolution* 10, no. 10 (1995), 430; S.K. Papworth, J. Rist, L. Coad and E.J. Milner-Gulland, "Evidence for Shifting Baseline Syndrome in Conservation." *Conservation Letters* 2, no. 2 (2008).

[xi] Richard Louv, *Last Child in the Woods: Saving our Children from Nature-Deficit* Disorder (Chapel Hill, NC: Algonquin Books, 2005).

[xii] Yitzhak Hada and Kalliope K. Papadopoulou, "Suppressive Composts: Microbial Ecology Links Between Abiotic Environments and Healthy Plants," *Annual Review of Phytopathology* 50 (2012); Uffe N. Nielsen, Diana H. Wall, and Johan Six, "Soil Biodiversity and the Environment," *Annual Review of Environment and Resources* 40 (2015).

[xiii] James D. Bever, Scott A. Mangan, and Helen M. Alexander, "Maintenance of Species Diversity by Pathogens," *Annual Review of Ecology, Evolution, and Systematics* 46 (2015).

[xiv] Norman R. Pace, "A Molecular View of Microbial Diversity and the Biosphere," *Science* 276 (1997); Erko Stackebrandt, *Molecular Identification, Systematics, and Population Structure of Prokaryotes* (Berlin: Springer, 2006).

[xv] Robert T. Paine, "Food Web Complexity and Species Diversity," *The American Naturalist* 100, no. 910 (1966).

[xvi] *Ibid*.

[xvii] U.S. Department of the Interior, *The Sea Otter (Enhydra lutris): Behavior, Ecology, and Natural History*, by Marianne L. Riedman and James A. Estes, Biological Report 90, no. 14 (Washington, D.C.: U.S. Fish and Wildlife Service, 1990).

[xviii] James A. Estes and John F. Palmisano, "Sea Otters, Their Role in Structuring Nearshore Communities," *Science* 185 (1974).

Bibliography

Anderson, M. Kat. *Tending the Wild: Native American Knowledge and the Management of California's Natural Resources*. Berkeley CA: University of California Press, 2005.

Bever, James D., Scott A. Mangan, and Helen M. Alexander. "Maintenance of Species Diversity by Pathogens." *Annual Review of Ecology, Evolution, and Systematics* 46 (2015): 305-325.

Clements, Frederic E. "The Relict Method in Dynamic Ecology." *Journal of Ecology* 22 (1934): 39-68.

Estes, James A. and John F. Palmisano. "Sea Otters, Their Role in Structuring Nearshore Communities." *Science* 185 (1974):1058-1060.

Evett, Rand R. and James W. Bartolome. "Phytolith Evidence for the Extent and Nature of Prehistoric California Grasslands." *Holocene* 23, no. 11 (2013): 1644-1649.

Flores, Rick. "The Amah Mutsun Relearning Program," *UCSC*. Accessed February 7, 2016. http://arboretum.ucsc.edu/education/relearning-program/.

Hamilton, Jason G. "Changing Perceptions of Pre-European Grasslands in California." *Madroño*

44 (1997): 311-333.

Hada, Yitzhak and Kalliope.K. Papadopoulou. "Suppressive Composts: Microbial Ecology Links Between Abiotic Environments and Healthy Plants." *Annual Review of Phytopathology* 50 (2012): 133-153.

Holmes, T.H. and K.J. Rice. "Patterns of Growth and Soil-Water Utilization in Some Exotic Annuals and Native Perennial Bunchgrasses of California." *Annals of Botany* 78, no. 2 (1996): 233-243.

Keeley, Jon E. "Native American Impacts on Fire Regimes of the California Coastal Ranges." *Journal of Biogeography* 29 (2002): 303-320.

Louv, Richard. *Last Child in the Woods: Saving our Children from Nature-Deficit Disorder*. Chapel Hill, NC: Algonquin Books, 2005.

McClenachan, Loren. "Documenting Loss of Large Trophy Fish from the Florida Keys with Historical Photographs." *Conservation Biology* 23, no. 3 (2009): 636-43.

Minnich, Richard. *California's Fading Wildflowers: Lost Legacy and Biological Invasions*. Berkeley, CA: University of California Press, 2008.

Molinari, Nicole A. and Carla M. D'Antonio. "Structural, Compositional and Trait Differences Between Native- and Non-Native-Dominated Grassland Patches." *Functional Ecology* 28, no. 3 (2014): 745-754.

Nielsen, Uffe N., Diana H. Wall, and Johan Six. "Soil Biodiversity and the Environment." *Annual Review of Environment and Resources* 40 (2015): 63-90.

Pace, Norman R. "A Molecular View of Microbial Diversity and the Biosphere." *Science* 276 (1997): 734–740.

Paine, Robert T. "Food Web Complexity and Species Diversity." *The American Naturalist* 100,

no. 910 (1966): 65–75.

Papworth, S.K., J. Rist, L. Coad and E.J. Milner-Gulland. “Evidence for Shifting Baseline Syndrome in Conservation.” *Conservation Letters* 2, no. 2 (2008): 93-100.

Parker, Ingrid M., Megan Saunders, Megan Bontrager, Andrew P. Weitz, Rebecca Hendricks, Roger Magarey, Karl Suiter, and Gregory S. Gilbert. “Phylogenetic Structure and Host Abundance Drive Disease Pressure in Communities.” *Nature* 520 (2015): 542-544.

Pauly, Daniel. “Anecdotes and the Shifting Baseline Syndrome of Fisheries.” *Trends in Ecology and Evolution* 10, no. 10 (1995): 430.

Stackebrandt, Erko, ed. *Molecular Identification, Systematics, and Population Structure of Prokaryotes*. Berlin: Springer, 2006.

U.S. Department of the Interior. *The Sea Otter (Enhydra lutris): Behavior, Ecology, and Natural History*, by Marianne L. Riedman and James A. Estes, Biological Report 90, no. 14. Washington, D.C.: U.S. Fish and Wildlife Service, 1990.