Remains of the Anthropocene:

A Fragmentary History

Edited by Gregg Mitman, Marco Armiero, and Robert Emmett

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# Preface

Gregg Mitman, Marco Armiero, Robert Emmett

The world is in the midst of a great reawakening, precipitated by a new sensitivity to questions of time: geological, evolutionary, ecological, and human. The cause of this reawakening is an uncertain and urgent future engendered by the dawn of the Anthropocene, a period defined by *Homo sapiens*' influence upon the biophysical systems of the entire planet. The idea of the Anthropocene—a term coined in 2000 by paleoecologist Eugene Stoermer and atmospheric chemist Paul Crutzen—has prompted scientists, artists, humanists, and social scientists to engage creatively with the emerging legacies of our species' geomorphic and biomorphic powers. The advent of this new scientific object, the Anthropocene—whether or not it becomes part of the official stratigraphic record—has altered already how we conceptualize, imagine, and inhabit time, even though we cannot specify when the new era began. The Working Group on the Anthropocene recommended 1950 as the starting date because by then radioactive elements that marked the advent of the atomic bomb were detectable across the globe. Others say it started thousands of years earlier, with the agricultural revolution of the Neolithic period, when the cultivation of crops, domestication of animals, and large-scale human settlements began. The orientation of history is up for grabs—as are the objects that make up history's archive and that bear urgent witness to a looming future, itself a future past. By our objects will we know us.

In the fall of 2014, the Nelson Institute's Center for Culture, History, and Environment at the University of Wisconsin–Madison, in collaboration with the Rachel Carson Center for Environment and Society in Munich and the Environmental Humanities Laboratory at KTH Royal Institute of Technology in Stockholm, brought together artists and anthropologists,

historians and geographers, literary scholars and biologists in the playful, performative space of an "Anthropocene Slam" to shape a cabinet of curiosities for this new age of humans. The responsive, creative spirit of the slam invited freestyle conversation, debate, and reflection on what such a cabinet should be. What objects should it house? Which issues should it speak to? What emotions might it evoke? And what range of meanings and moral tales might it contain?

Above all, in this era of extreme hydrocarbon extraction, extreme weather, and extreme economic disparity, how might certain objects make visible the uneven interplay of economic, material and social forces that shape the relationships among human and nonhuman beings? The Anthropocene is a narrative about space, as well as time, and its sheer scope—e.g., the global scale of warming temperatures, species extinction, ocean acidification—risks obliterating the differences through which its impacts are felt by different beings, occupying different ways of life, in locales across the planet.

Slam performers offered dramatically varied approaches to interrogating and making visible the ways that planetary-scale changes become apparent and leave traces in both space and time. Folding and setting flight to dozens of origami passenger pigeons, a species hunted to extinction within the span of one hundred years, or pouring a slab of concrete, the most widely used material in our increasingly built environment, evokes the sedimentary remains of humanity's impact on Earth.

In contemplating and interrogating a preemptive history of the Anthropocene and its meanings, why bring attention to *objects* when the concept invites planetary-scale thinking across eons? Neil MacGregor, in his best-selling *A History of the World in 100 Objects*, suggests that a history told through objects is a history that speaks "to whole societies and complex processes rather than individual events."[1] Just as paleontologists look to fossil remains to infer

past conditions of life on earth, so might past and present-day objects offer clues to intertwined human and natural histories. The objects gathered in this book resemble more the tarots of a fortuneteller than the archeological finds of an expedition: they speak of the future. A jar of sand from a North Carolina beach, for example, opens our eyes to a multitude of processes shaped by natural and human forces—the ephemerality of barrier islands, changing property regimes, beach nourishment, and heightened storm surges. How vast the time scales, how illuminating the stories contained in just a few layered inches of sand.

Objects have the power to bridge different spaces and times. They can summon all at once the past, present, and future, blending the global and local—and thus they can disrupt linear narratives, including those about the Anthropocene. A mid-twentieth century audio recording of a now-deceased Māori man mimicking songs of the huia, an extinct bird species once endemic to New Zealand, connects disparate places and temporalities in looping echoes of memory and extinction. Yet another object in this collection, the painting "Davies Creek Road," simultaneously transports the viewer across the dream time of the Wiradjuri people, the deep time of anthropogenic extinction, and the imagined futures of a valley being transformed by rapacious demands for water in a warming world. All objects have the potential to contain a multitude of stories, if we use them as a way to consider multiple scales of space and time. Such generative stories of objects can serve as models as we seek to resist the narrowing of our collective possibilities. There does not need to be only one future, determined entirely by global climate change.[2]

Objects, too, can disrupt a sense of human exceptionalism that has at times distinguished the human from nature and foretold a future where geo-engineering might solve the planetary mess we are in. But such exceptionalist positions are not sustainable. The human species is

becoming ever more implicated and entangled in the life worlds of other beings on this planet; we depend on each other for our mutual survival. Consider the feathered remains of a Canadian goose, scraped off the fuselage of an Airbus 320-214 bound from New York City's LaGuardia Airport to Charlotte, North Carolina. The lives of the 155 human passengers on board hung in the balance after bird collided with plane. While they survived, the remains—snarge is its technical term—invite us to reflect on the casualties caused directly and indirectly by accelerated lifestyles and to contemplate the possibility of transportation infrastructures that can acknowledge that diverse forms of life move through this world at different speeds and through different kinds of spaces. Objects are material instantiations of discursive relationships. To see objects, not just through the lens of human agency, but through the lives of nonhuman beings that both shape and are shaped by these materializations, is to invite stories—in fossilized bones, decaying tissues, and living flesh. Such stories bear witness to planetary-scale changes in which all species have been active participants.

Objects can also engage many publics. They can evoke inquiry, spark curiosity, and elicit tales not bound by any one discipline, language, or culture—and in so doing they can give voice to the human and even the nonhuman. Such is the case with the objects here. The voices of anthropologists and biologists, literary critics and geographers, historians and sociologists, and artists and writers are all gathered here. But the voices and objects here do largely reflect perspectives from the global North. As this collection circulates around the globe, what additional objects, what other tales might it stimulate?

Collectively, the objects in this book constitute a kind of Cabinet of Curiosities for the Anthropocene. Popular in the late sixteenth and seventeenth centuries, *Wunderkammern* blurred boundaries, displaying the artificial and the natural side by side.[3] The marvels in them were

meant to inspire a range of emotions: wonder, envy, pleasure, and fear. The Anthropocene, by also troubling boundaries between artifice and nature, can provoke similar feelings, and a wide range of expressions. It has provoked utmost hubris, as in Stewart Brand's widely circulated remark: "we are as gods and have to get good at it."[4] And it has inspired more meditative, humble reflections in the face of widespread accelerated extinctions, reflected in Thom van Dooren's question: "What obligations do we have to hold open space in the world for other living beings?"[5] Technocratic optimism and ecological declension exist side by side in future imaginaries. To collect objects *of* the Anthropocene is to register diverse emotional responses—loss, grief, hubris, humility, anger, and pain, among others—evoked in a climate of change and uncertainty.

If there is one emotional register that unites these essays, it is curiosity—one intimately tied to care. Indeed, "Caring," Donna Haraway suggests, "means becoming subject to the unsettling obligation of curiosity, which requires knowing more at the end of the day than at the beginning."[6] By drawing us outside ourselves, curiosity can shake up our place in the world. We would argue, like Vladimir Nabokov, that curiosity is insubordination in its purest form.[7] Hence, reader beware: curiosity matters more than the cabinet.

Such insubordination is necessary to temper the alluring quality of things that have the potential to reify a familiar world. Objects, as Pier Paolo Pasolini wrote, are "containers in which is stored a universe I can extract and look at," teaching us about our place in the world. But we need also to be cautious, Pasolini warns, of the "authoritarian and repressive" character of things that can transform a limited world into a "cosmically absolute" universe. Familiar things have the potential to make other objects "extraneous, anomalous, disquieting and devoid of truth."[8] Objects, then, can just as easily silence other voices as open up other worlds. The

challenge is to ask not only what objects reveal but also what they hide. We need to take notice of less familiar things, such as the goanna in "Davies Creek Road," that invite us to entertain the possibility of other beings, other relations in the world, and other cosmologies not easily subsumed within the dominant tropes of Western science that drive the Anthropocene's overarching narrative.

Tim Flach's photographs of the objects found in our Cabinet of Curiosities for the Anthropocene are also driven by a sense of intrigue and curiosity, inviting the viewer to imagine and explore the past, present, and potentially future meanings of these fossils. Flach's images also suggest each thing's characteristic trait: the brutality of concrete, the forensic nature of a feather, the extinct form of a Blackberry. A London-based photographer whose animal images circulate around the world and provoke questions of what it means to be human, Flach brings to this project an aesthetic sensibility, keen understanding, and technical brilliance in creating wondrous images in the spirit of a cabinet of curiosities.

In these strange and uncertain times, the curious juxtapositions of *Wunderkammern*, as Libby Robin argues here, invite a salutary reconsideration of the Enlightenment notion of a humanity set apart from Nature that has held sway even as it has become apparent that we live in a post-natural world. The objects in this cabinet join that long-term work of uniting art and science, natural and unnatural histories, and enlivening new makers and publics to respond to the planetary impact of human activities. This volume is less a catalog than as a series of reflective essays organized around fifteen exemplary objects that offer a fragmentary history of the Anthropocene. Its curated selection of "remains" calls for readers to browse, dip in, and explore. Instead of providing a single overarching narrative—whether of a negative universal history of humanity's ecological destruction or a triumphal prediction of a bright and perfectly engineered

future—these remains interrogate the limits of the idea of Anthropocene, and make us wonder anew about what human history is made of.

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[1] Neil MacGregor, A History of the World in 100 Objects (New York: Viking, 2010), xv.

[2]Mike Hulme, "Reducing the Future to Climate: A Story of Climate Determinism and Reductionism," Osiris 26, no. 1 (2011): 245.

[3]Lorraine Daston and Katharine Park, Wonders and the Order of Nature, 1150-1750 (New York: MIT Press, 1998).

[4]Stewart Brand, Whole Earth Discipline (New York: Penguin Books, 2010), 20.

[5] Thom Van Dooren, Flight Ways: Life and Loss at the Edge of Extinction (New York, Columbia University Press, 2014), 5.

[6] Donna Haraway, When Species Meet (Minneapolis: University of Minnesota Press, 2007), 36.

[7] Daniel Gade, Curiosity, Inquiry, and the Geographical Imagination (Bern: Peter Lang, 2011), 14.

[8] Pier Paolo Pasolini, Lutheran Letters. Translated by Stuart Hood (New York: Carcanet, 1987), 29-30.

# Hubris or Humility?

## Genealogies of the Anthropocene

Gregg Mitman

Hubris and humility. They are perhaps the two most common emotional responses to the Anthropocene. The first charts an environmental future of the "good Anthropocene," where technoscience provides the innovative tools for fixing a warming planet. The second propels us to a more dystopic environmental future, or at least a future filled with uncertainty, loss, and mourning in the face of accelerating species extinction and a world increasingly divided by those who have the means to survive and those who do not.

Hubris and humility, I suggest, are deeply rooted in the genealogies of scientific knowlege that have given birth to the Anthropocene, which may well be on its way to becoming a scientific object, given tangible material form in the strata of earth's history.

But why now? Why has the Anthropocene suddenly become the subject of scientific meetings, academic conferences, museum exhibits, journals, and popular articles? Surely, ever since Bill McKibben sounded a popular alarm in *The End of Nature* that global warming had marked a threshold in which nature was no longer, in his words, "an independent force," and that "[b]y changing the weather, we make every spot of earth man-made and artificial," the idea of humans as a force of planetary change is hardly news.[1] Nor has it been for some time. But McKibben's emphasis on a threshold crossed, published the same year as the fall of the Berlin wall, is suggestive of how the Anthropocene, and particularly the knowledge disciplines that sustain it, has its origins in the Cold War and its ensuing collapse. That same year, Francis Fukuyama would publish in *The National Interest*, his similarly famous essay, "The End of

History." "What we may be witnessing," Fukuyama wrote, "is not just the end of the Cold War, or the passing of a particular period of post-war history, but the end of history as such: that is, the end point of mankind's ideological evolution and the universalization of Western liberal democracy as the final form of human government."[2]

For a concept and potentially a scientific object that is meant to include humans as a geological force on a planetary scale, recognizable in the strata of deep time, the Anthropocene is remarkably resistant to considerations of history. Like the 1989 writings of McKibben and Fukuyama, the Anthropocene trades in talk of rupture—it is an alleged rupture in scale, spatially and temporally, of the impact of the human species on earth. It reinforces a sense of novelty of the human species as a geological agent, either reveling in this newfound power of the human species in changing the face of the earth, or crying out in an elegiac mode of loss and despair. In their essay, "Was the Anthropocene anticipated?," published in *The Anthropocene Review*, Clive Hamilton and Jacques Grinevald dispense of any talk of historical precursors. "The Anthropocene," they insist, "represents a radical rupture with all evolutionary ideas in human and Earth history."[3] Hamilton and Grinevald reject any attempts to locate the Anthropocene concept in previous eras, whether it be the idea of the "biosphere" put forth by the Russian biogeochemist Vladimir Vernadsky in the 1920s or the notion of the "noosphere" advanced by the Jesuit priest and paleontologist Pierre Tielhard de Chardin in the early 20th century. The difficulty, Hamilton and Grinevald argue, is that in such versions, "civilized Man emerges as a geological force *incrementally* over deep time." But such views of incremental human impact, they argue, obscure "the suddenness, severity, duration and irreversibility of the Anthropocene leading to a serious underestimation and mischaracterization of the kind of human response necessary to slow its onset and ameliorate its impacts."[4]

Ruptures allow little place for history; their power lies in unprecedented events. But the discourse of rupture is itself historically contingent. Ruptures surfaced in two critical historical moments in the genealogy of the Anthropocene: the dropping of the atomic bomb, and the end of the Cold War. Both were transformative in reconstituting the disciplinary spaces of environmental knowledge, whereby the geosciences would competitively displace ecology in the scramble for who claimed "the environment" as its subject. Hamilton argues similarly that a "gulf separates Earth system science from classical ecology, one that requires a leap from 'ecological thinking—the science of the relationship between organisms and their local environments—to Earth system thinking, the science of the whole Earth as a complex system beyond the sum of its parts." But we strongly disagree that the Anthropocene represents such a radical break from the past that history doesn't matter.

History matters a great deal. The very structure of knowledge that gave birth to the Anthropocene, built upon models of rupture and planetary crisis, has a specific geography and history in its production. For the Anthropocene is an object constituted through the Cold War nuclear arms race, which yielded unprecedented funding for the earth sciences, and enabled, as Joe Masco argues, "new public fears and visions of planetary threat." Rupture and apocalypse, in addition to the hubris of geoengineering, were built into the scientific apparatus of the national security state. Remarkable continuities—in scientific personnel, computing, and future imaginaries—persisted as global warming replaced communism as the new planetary threat in the aftermath of the Cold War. Such Cold War histories are embedded in the *Plowshares* film, pesticide pump, and marine satellite tags, among other objects on display in the cabinet catalog contained in the pages herein.

But where sits ecology in the Anthropocene? A literature review of the top ten ecological journals based on impact factor suggests that the ecological sciences have been slow to take up the term and continue to shy away from critical engagement with the Anthropocene. This, too, is a contingency of history. In the rapid ascendance of planetary earth science, and the subsequent displacement of ecology as the sine qua non of the environmental sciences, we risk losing sight of life, in all its diverse forms, both human and non-human, that have shaped the planet. We concern ourselves with the Great Acceleration, failing to acknowledge that we are not the only species that have transformed the biogeochemistry of the Earth. Cyanobacteria claim precedent by almost 2.5 billion years. Their sedimentary remains in stromatolites provide evidence of the Great Oxygenation Event, when their photosynthetic capacities transformed the atmosphere of the Earth leading to widespread geological and biological change. It is hubris to suggest that we are the only species that has reshaped life on earth.

So let us step back in time for a moment, not into deep time, but into our more recent past, when ecologists willingly challenged the anthropocentric bias of their geological brethren.

In the search to locate historical precursors of the Anthropocene, it is rather odd that the name Thomas Chamberlin has yet to appear on the list of scientific forerunners in the late 19$^{th}$ and early 20$^{th}$ century. Chamberlin was a luminary in geology and unlike other candidates, such as Vernadsky and Tielhard de Chardin, his postulation of the Psychozoic, suggesting the age of man as a stratigraphic era, *did* make its way into diagrams of past geological ages in a number of geology textbooks in the early 20$^{th}$ century. Chamberlin was, as he liked to say, born on a moraine. The anecdote spoke to the long-lasting impact of his geological work on Pleistocene glaciations, which earned him the first directorship of the U.S. Geological Survey's Pleistocene

Division. Chief geologist and head of the Wisconsin Geological Survey from 1876 to 1882 at a time when hard rock mining in northern Wisconsin for iron ore was an economic backbone of the state and vital to a growing national steel industry, Chamberlin represented a long tradition in which stratigraphy, or classification of rock formations, was critical to the extraction of coal and minerals that spawned the Industrial Revolution. Indeed, the French comparative zoologist Georges Cuvier created the first geognostic map, detailing the layered structures of the earth around Paris using fossils as distinguishing markers. He did so in partnership with Alexander Brognigart, a mineralogist and director of the state porcelain factory outside of Paris. William Smith, an English mineral surveyor and canal builder, who coined the word stratigraphy, used outcrops of distinct formations and observations of fossils commonly found within them, to create a geognostic map of England and Wales around the same time as Cuvier, leading to bitter rivalry claims. Smith's maps are themselves wonders, even though Smith died penniless, burdened financially by the extravagant costs of producing his enormous maps.

In the early years of stratigraphy in the mid-nineteenth century, national geological surveys paid particular attention to the Carboniferous group, aiming to provide as detailed and accurate information as possible about the outcrops of Coal Measure strata. The growth of stratigraphy was thoroughly entwined in the economy and geopolitics of coal. Yet the intertwined histories of stratigraphy and the dawn of fossil fuel extraction are amazingly absent from discussions of the Anthropocene. Such historical silences seemingly absolve the geological sciences of any responsibility for the unleashing of carbon into the atmosphere at unprecedented rates.

But Chamberlin's interests went well beyond those of economic geology and stratigraphy. Together with his former student and geographer, Rollin D. Salisbury, Chamberlin

advanced the study of physiography, which attempts to explain present-day landforms on the basis of past geologic process such as glaciation, erosion and deposition. In his four-volume survey of the geology of Wisconsin, prepared with the assistance of Salisbury, and published in 1883, Chamberlin introduced the Psychozoic era, representing the geology of the living present. "If the distinguishing of this as a new era is simply a recognition of the superior mental attributes of man," Chamberlin wrote, "the propriety of the classification may be fairly questioned; for, however pre-eminent man's intellectual and moral nature, as compared with the organisms that characterize earlier geological ages—however much man may transcend the Mammals, Reptiles, Fishes, and Invertebrates of the preceding eras, unless that superiority—or man, its working embodiment—is an efficient geologic agent, it does not entitle him to special recognition in a geological classification."[5] Chamberlin believed man had acquired such a status on a strictly geological basis. Cultivation of the soil, along with the excavation and movement of materials, had, Chamberlin argued, altered physiographic processes of erosion and deposition. "The entire land life is being revolutionized through man's agency," wrote Chamberlin. "That he will ultimately modify in a considerable degree marine life," he continued, "scarcely admits of question." Chamberlin argued that the domestication of plants and animals with the beginning of agriculture constituted the first epoch in the Psychozoic era. All previous periods of human existence, he maintained, belonged in the Cenozoic era, for they did not "greatly affect the course of geologic growth."[6]

I draw attention to Chamberlin not to construct an alternative origin for the history of the Anthropocene or tell a great man story in the history of science. Far from it, although his location of a geological "age of man" in the Neolithic agricultural transition is of interest in light of contemporary debates about where exactly to date the Anthropocene, which hinges on a

debate about the nature of change in reconciling earth and human history. It is also worth mentioning that Chamberlin was one of the first, along with Svante Arrhenius, to unite atmospheric chemistry with geology ("the ocean is an atmosphere in storage," wrote Chamberlin) in positing the carbon cycle as a principal driver of global climate oscillations in his search for causal explanations to account for periods of glaciation and retreat. Far more significant, however, were different disciplinary reactions to the Psychozoic era, which marked the culminating chapter in Chamberlin and Salisbury's 1907 textbook, *Geology*, described recently by one geologist as "probably the most influential textbook of geology in the United States prior to World War II."[7] Such reactions are significant because they give us a clue into the ethical relevance and moral tales that the geological and biological sciences have inferred at different moments in time in their reading of earth's history, life's history, and human history.

In 1926, Edward Berry, a leading paleobotanist at Johns Hopkins University, wrote a rather scathing, tongue-in-cheek note in *Science* denouncing the Psychozoic era. The objects that garnered Berry's entry into the field of science were fossilized plants, but it was his knowledge of the living, not the dead that made him look quite differently upon a geologic era that singled out humans as the dominant force on earth. As his National Academy of Sciences biographer noted, Berry's "keen appreciation of the meaning of fossil plants led him to see forests and prairies, coastal swamps and steaming jungles, where most geologists saw merely fossil leaves."[8] He was capable of seeing, in other words, the ecological relations of living forms in the distant past. Such engagement with other non-human species, grounded in ecology and botany, led Berry to question the rather anthropocentric-driven narrative of the geological history of the Earth put forth by Chamberlin and Salisbury. "It is probably good philosophy to commence earth history with a hypothetical Archeozoic era, but is it equally good philosophy to

terminate earth history with a Psychozoic era?" asked Berry. "No one would probably gainsay the magnitude and multiferous effects of human activity," Berry argued, "but these are scarcely of geologic magnitude, and I can conceive of many past events as being of much greater importance than the advent of man, if viewed with a certain degree of detachment. Such, for example, as the origin of life itself." "It might," he went on, "be conceivable that the first mammal or the first flowering plant (Angiosperm) was more of an event than the first man."[9] Berry became even more apoplectic. "It seems to me that a Psychozoic era is not only a false assumption, but altogether wrong in principle, and is really nurtured as a surviving atavistic idea from the holocentric philosophy of the Middle Ages,'" he bemoaned. At stake was the centrality of the human species in the long evolutionary history of life on earth. While "there can be no objection to speaking of the present as the Age of Man—or Woman—for that matter," Berry concluded, that was a far cry from establishing a formal geologic era in honor of the human species. Berry insisted that there was no stratigraphic evidence or reason for doing so.

Berry's essays appeared during a period in the history of the life sciences when ecology was in ascendance, and when attention to relationships between organisms and their environments brought forth novel experiments in trying to understand and represent the different life worlds of other beings with whom humans inhabit this earth. It is no coincidence that in the recent turn to multispecies ethnography and to a version of posthumanism informed by animal studies, scholars are resurrecting the work of biologists in the interwar years, such as Jakob von Uexküll or Karl von Frisch, in their efforts to make visible through a diverse array of ethnographic encounters across species divides the existence of parallel universes all around us inhabited by beings living in different perceptual worlds in different scales of time. Whatever its multiple causes—the deadliest war and global pandemic in modern history, which combined,

killed an estimated 60 million people in a few short years; a global economic depression; or the flourishing of ecological and evolutionary science—claims to the superiority of the human species over other forms of life rested on shaky grounds.

And it generated new forms of historical writing in which other species displaced their human companions from center stage. Consider, for example, Hans Zinsser's *Rats, Lice, and History*, published in 1935. A bacteriologist and gifted writer who served on the American Sanitary Commission during the Great War in an effort to combat a typhus epidemic raging on the front lines, which, at its height, resulted in 9,000 new cases arising each day, Zinsser set out to write a world history of the human species, from the perspective, not of man, but of a microbe and an insect. Written as a biography of a disease, *Rats, Lice, and History* introduced an organism—typhus—and its host, the louse—as actants in history long before the emergence of actor-network theory or debates about the agency of nature within environmental history. Harnessing the tools of ecology and evolution, Zinsser set out to tell the "louse's point of view in its relationship to man" in writing "the biography of a protoplasmic continuity like typhus."[10] How vulnerable the human species became, how humble its triumphs looked, when considered from the viewpoints of companion species across the spans of ecological and evolutionary time.

Fast forward three human generations to another pairing of the biological and earth sciences. The year is 2000. Our first author is a Dutch engineer, who got his start in science as a computer specialist at the University of Stockholm's Meteorological Institute, modeling the effects of nitrous oxide on stratospheric ozone. Our second is a paleoecologist who spent his professional career exploring the biology, ecology, and taxonomy of diatoms, those minute aquatic organisms responsible for every fifth breath you take and fixing more carbon than all the world's tropical rainforests. Together Paul Crutzen and Eugene Stoermer, in the pages of the

newsletter of the International Geosphere-Biosphere Program, noted the "major and still growing impacts of human activities on earth and atmosphere" at all scales, including the global.[11] Citing evidence that ranged from a tenfold increase in human population over the last three centuries, to the rapid exhaustion of fossil fuels "generated over several hundred million years," from the substantial increase of nitrous oxide, carbon dioxide, and methane into the atmosphere to the significant depletion of primary production in the world's oceans through human predation, Crutzen and Stoermer proposed using the term "anthropocene" to denote the current geological epoch in which we now live and to emphasize the "central role of mankind in the geology and ecology" of the planet. Crutzen and Stoermer came from two quite different lineages of postwar environmental science, as the objects with which they identified and brought them into their respective fields of geophysics and ecology suggest. The stuff of their science—atmospheric gases and models, diatoms and lake sediments—are also enmeshed in different, but overlapping infrastructures, that have shaped the contours of the Anthropocene, its affective registers, as well as its imagined pasts and futures.

A glimpse into those differences can be found just two years later, when Crutzen in the pages of *Nature* introduced the concept of the Anthropocene once again, this time without Stoermer. While the essay covered much the same ground as the co-authored IGBP piece, there are notable differences. A number of the biological examples Crutzen and Stoermer had cited as evidence of escalating human impact, including destruction of coastal wetlands and the altering of geochemical cycles of freshwater biotic communities are notably absent. More significant, however, is the concluding paragraph in *Nature*. To "guide society towards environmentally sustainable management in the era of the Anthropocene," Crutzen concluded, "may well involve

internationally accepted, large-scale geoengineering projects, for instance, to optimize climate."[12]

Crutzen has been much more hesitant in recent interviews about "technofixes" to global warming. Indeed, science journalist Christian Schwägerl argues that Crutzen's experiences with chlorofluorocarbons—Crutzen was one of the key scientists to make visible their destructive impact on the ozone layer—"has made him humble in the face of earth's complexity."[13] Whatever Crutzen's individual ethical stance toward engineering the planet may be, the note of technocratic optimism on which he ended his *Nature* article is symptomatic of one strand of futures thinking inherent in the rise to prominence of the geophysical sciences during the Cold War. Harnessing the forces of nature on a global scale in the interest of defense required knowledge about the earth's physical environment: its atmosphere, oceans, and lithosphere. Keeping a thumb on the pulse of the planet arose as a result of both American and Soviet interest in keeping a watchful eye on the bombs going off in each other's territories and radioactive fallout that blanketed the globe. The Cold War produced the scientific infrastructure, data, and research that would ultimately provide, as Paul Edwards and others have argued, the evidence for climate change as well as arguments for the birth of the Anthropocene.

But whose voices have been silenced, whose futures have been displaced, in narratives reliant upon global models that risk ignoring local ecologies: the resilience and vulnerability of different human populations who don't readily aggregate into a universal "we," and the primacy of other nonhuman species critical to the survival of our own? Indeed, it is disconcerting how quickly Stoermer's contribution to the concept of the Anthropocene has been forgotten with his death in 2012. It was the lifeworld of another species—diatoms—that opened Stoermer's eyes, like my own, to ways of being in the world quite distinct from the human-centered one in which

I and my human kin live. Through the shifting distribution and abundance of algal species in the Great Lakes region, revealed through lake sediments, as well as an intimate understanding of their livelihoods and needs, Stoermer was able to tell a story of land-use change in the Great Lakes region, in which humans, plants, and animals all had a part.

The marginalization of ecology in the rise of planetary-scale, geoenvironmental sciences risks turning the Anthropocene into a Promethean narrative of human mastery and control. While work in the ecology and systematics of the microbial world increasingly reveals how we, as humans, are but an entangled bank, a complex assemblage of animal-micro-biome interactions, the Anthropocene strikes back with a vengeance, reasserting the primacy of *homo sapiens* in driving the evolution of life, for good or ill, on the planet. Yet, such a viewpoint ignores how even the human genome is indicative of the interdependence and relationality of living forms that came together as partners in the changing development and evolution of humanity. We need a chorus of voices, from different knowledge disciplines, from people who occupy different places and walks of life on the planet, and from other non-human species to temper the hubris of the anthropos, as Berry recognized long ago in his critique of the Psychozoic era. Objects like snarge, hybrid corals, and the sounds of the Huia bird in this cabinet of curiosities speak powerfully to the way human histories are dependent upon the histories of non-human animals in their tellings.

While stratigraphers will debate and ultimately decide whether the Anthropocene officially marks a new geological epoch in the annals of science, we dare not cede discussion of its meaning and implications to those occupied solely with rocks, sediments, and chemistry. It is, after all, life on the planet—past, present, and future—that bears witness, in fossilized bones and living flesh, to large-scale anthropogenic change. As we think beyond the instantaneous to

longer frames of time, and scale up environmental problems to the global level, we should be cautious to not lose site of the diversity of lives—human and non-human—differentially impacted by planetary change. As Rob Nixon writes in his contribution to this volume, "We may all be in the Anthropocene, but we are not all in it in the same way."

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