
SPRINGS

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Note from the Editors

Welcome to the third issue of [Springs: The Rachel Carson Center Review](#), an open-access online publication surveying the interrelationship between social and environmental changes. Authors and perspectives from Colombia, Ethiopia, Australia, Germany, Sweden, and the US contribute to a global discussion of the environmental crisis, providing fresh insights and food for thought.

This issue includes peer-reviewed essays on heat and hurricanes, an interview on plants in urban environments, reflections on transactional thinking about the environment, and a creative piece that offers five ways to look at a jump in the lake.

Inspired by the meeting between Indigenous representatives and the current Colombian government, Paula Ungar's reflective essay, "[We Have Always Known: On the Trails of People, Plants, and Humboldt](#)," considers Alexander von Humboldt's observations and a more deeply rooted wisdom.

Thomas Princen's "[Weathered History: Galveston and Extreme Events](#)" explores the effects of hurricanes and land subsidence on the region of Galveston, Texas. He takes a long look—from the displacement of First Peoples through the development of the oil industry and the flooding of an exclusive housing subdivision—and questions what an adaptive future would look like.

Does a vegetarian diet balance out flight emissions? In "[I Still Do a Lot of Good](#)," Nina Wormbs reports on reasoning in the face of climate change and reveals the faulty logic of "latent budget thinking" when it comes to the environment.

In "[Roots through Asphalt](#)," landscape historian Sonja Dümpelmann and editor Pauline Kargruber discuss the multifaceted history of plants and trees in urban spaces and their integral roles in human and nonhuman well-being.

Steve Mentz takes the reader with him as he revisits the lake near the Rachel Carson Center's Landhaus in "[Five Ways of Seeing the Steinsee](#)," a creative reflection in poetry and prose.

Melanie Arndt's "[The Heat Is On!](#)" explores the turn of the twentieth-century technologies that created central heating, its societal impacts, and its limits in a world vulnerable to climate change and societies seeking protection from wartime aggression.

Helen Tiffin's opinion essay, "[Human Overpopulation: The Elephant in the Greenhouse](#)," makes the case for inhabitants of the Global North to limit human reproduction, not draconically, but voluntarily, in "a radical reorientation towards life on a shared planet."

In "[The Slow Death of an Ethiopian Lake](#)," Hayal Desta demonstrates the effects of water-grabbing with a focus on the international flower industry as it threatens a precious resource to the local communities—a subtle, invasive dynamic with dire environmental repercussions.

Paul Sutter's "[The Isthmus of Panama and the Knowledge Anthropocene](#)" combines the recovery of environmental history with a "sense of the world as a multiplying series of archives." He establishes the term "Knowledge Anthropocene" to describe an intellectual enterprise that has changed our understanding of earth systems and our role within them.

Springs also brings together writing from other RCC publications. Its [archive](#) curates articles that were published in the open-access online and print journal [RCC Perspectives](#) (2010-2020), in the blog [Seeing the Woods](#) (2012-2021), and in the peer-reviewed online journal [Arcadia: Explorations in Environmental History](#).

Munich,
23 May 2023

"WE HAVE ALWAYS KNOWN": ON THE TRAILS OF PEOPLE, PLANTS,
AND HUMBOLDT

Paula Ungar

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Paula Ungar

I am trying to focus on my writing, I really am. But my phone buzzes again. This time, the message is difficult to ignore. I see a photograph of my beloved friend Adriana, recently appointed for a high position at the Colombian Ministry of Culture, posing with about 30 other people in what seems to be the nightly ending of a day-long meeting. They are standing under a provisional tent roof installed on a worn outdoor basketball court. About half of them are Indigenous representatives from the Consejo Regional Indígena del Cauca (CRIC), a powerful, belligerent Indigenous organization representing more than 84 *resguardos* (Indigenous lands) from the Andean South of Colombia. That is the image that traveled all the way from the southern Colombian Andes to my living room in Bogotá. I can see that some of them are important leaders, as they are holding batons of command. The others are government officers, also wearing their traditional costumes: dark blue waterproof jackets with emblems of different institutions embroidered on the chest. Among them, I recognize the new Minister of the Interior, the most important minister of the Colombian cabinet. They look tired. They are smiling.



Member of the Indigenous Guard in a protest against the Colombian government. © 2019 Carlos Hernando Tapia Caicedo. All rights reserved.

I listen to the voice message Adriana sent me with the photo. She is moved that she is able to attend this "meeting of two governments," as she calls it, which is taking place in Indigenous territories.

Among other stories, she tells me that they discussed whose hymn to sing first at the beginning of the meeting. They agreed to play the Indigenous Guard's hymn before the Colombian one, and to take turns in future meetings. I imagine those loud words resonating around the government officials: "Guard, guard. Strength, strength! Totoroes and Paeces, Yanaconas and Guambianos, Coconucos, Siapidaras,¹ all Colombian Indigenous peoples! Let's go forward, comrades!"

I am interested in examining how boundaries—between ecosystems, organisms, or the researcher and their objects of study—are places where distinct realms merge, where contrasting threads are entangled.

These words make me remember the previous government's brutal repression of the mass demonstrations that took place in 2021. The United Nations Human Rights Office reported 46 deaths, a great majority of them in the same region where this meeting is taking place, allegedly caused by members of the police or the military, and some by civilians protected by the former.² In May, after many days of road blockades by the CRIC, in which they demanded the presence of high-ranking government officials to discuss territorial claims and human rights, the president addressed them on television, stating: "Citizens have suffered a lot because of the blockades. . . . I want to call on the CRIC members to return to their reserves." With these words, the president denied the Indigenous peoples' status as citizens and violently confined them, creating a boundary that separated them from "actual" citizens. The president stayed safely on his side of the boundary, with those that he thought worthy of citizenship.

I force myself not to call Adriana and keep working. I also return to my assignment because, in a way that I have yet to decipher, the image of boundaries between governments being challenged, of the transgression of one domain by a different and willful Other, resonates deeply with what I am doing. I am investigating the dividing lines that constitute the discipline of biology. More specifically, I am interested in examining how boundaries—between ecosystems, organisms, or the researcher and their objects of study—are places where distinct realms merge, where contrasting threads are entangled. As part of this research, I am reading the 1805 *Essay on the Geography of Plants* by Alexander, Baron von Humboldt (1769-1859).

Humboldt's explorations make me see a vegetation that is radically different from the one that I studied in university biology courses, in which my colleagues work today. I feel this difference is related to the fact that Humboldt's science is populated with connections that are lacking in contemporary biology. These are the connections I intend to explore now.

For Humboldt, inspired by Goethe's provocation to transcend the division between subject and object, measuring instruments are extensions of his body, and his body is also a measuring instrument.³ As researchers, we connect with the world we study through our bodies, our imaginations, our fascination, our sensibility.

In the *Essay*, Humboldt dedicates a long paragraph to reflecting on the ways nature affects its observers:

The simple aspect of nature, the sight of fields and woodland, yields a pleasure which is essentially different from the impression received from studying the particular structure of an organized being. In the latter case, it is the detail which interests us and excites our curiosity. . . . What is the moral cause of these sensations? Are they produced by nature, by the size of the arrangements, by the outline of shapes, or by the bearing of the plants? How does this bearing, the more or less wealthy and cheerful nature, influence the habits and particularly the sensitivities of people?⁴

His mentioning of pleasure, curiosity, sensations, and sensitivity brings back a memory of my training as a biologist. When I started my undergraduate studies, an attentive professor heard that I liked to draw and proposed that we make an illustrated guide to the plants of a nature reserve close to Bogotá. I settled in his laboratory with pencils and a stack of white paper and let “the detail” of a pressed, dried, and mounted sample of *Quercus humboldtii* (the Andean oak, named after Alexander von Humboldt) “interest” me and “excite [my] curiosity.” I devoted myself to reproducing the reddish-gray fur that covered the sample of the oak, and that had sheltered the petioles, the buds, the knots, the stems, and the branches of that tree when it was still up there in the high, cold mountains. I committed to recreating the shadows of the subtle and irregular folds of the leathery leaves; the blackened-edged bite impression of a wasp larvae that made me uneasy; the light reflected by the smooth, polished acorn; the scales of the cupule in which the nut fit perfectly seemed to be borrowed from a wounded reptile.



(Left) *Quercus humboldtii* in Alexander von Humboldt and Aimé Bonpland, *Plantes équinoxiales* (Paris: F. Schoell, 1808–09). Public domain. (Right) *Quercus humboldtii* Bonpl. Photo by Jhon Alexander Mantilla Carreño, 2022. CC BY-NC 4.0.

After some days of work, the teacher reviewed the assignment and explained that this drawing, full of peculiarities, did not meet the standards of a scientific illustration. He gave me a set of technical pens, and I started again. I then enjoyed the task of reducing what my eyes could distinguish to lines and dots of different thicknesses, to black and white; I dedicated myself to discarding the singular features of this particular branch of this particular oak tree that traveled from the mist of a forest in the Department of Boyacá and ended up pressed in this office of this university. A laborious mental exercise, in which my memory of the touch of the oak in the cold forest and my imagination of the wasp larvae nibbling the leaf had to take refuge in a plane of my mind different from the one dedicated to my training as a scientist. A dividing line was being drawn.

Humboldt's plants not only have the power to affect the researcher studying them but also influence human interactions around the world. He tells us that social plants "restrict the human population of states, separating neighboring nations and posing obstacles to communication and trade even more serious than do mountains or oceans." For instance, "the combination of *Erica vulgaris*, *Erica tetralix*, the *Lichen icmadophila* and *Haematomma* . . . have held imperial control of the region, sterilizing its soils: human efforts to confront this almost indomitable nature have only succeeded in salvaging small patches of land for agriculture."

For Humboldt, plants are willful, creative, and have the power to intervene in human worlds.

According to Humboldt, plants affect and even instigate human societies. Plant nutrients have an influence "that can be more or less stimulating on the energy and character of passion, navigation history and battles disputing the products of the plant realm." And while cultivated plants accompany humans, arouse their passions, and drive their battles, their wild relatives are fugitives that actively "escaped from human use and regained their original freedom."

For Humboldt, plants are willful, creative, and have the power to intervene in human worlds—how different from the plants that we studied in university courses, where humans were mostly absent. The divide extended to the disciplines: Plants appeared in botany physiology and ecology classes, where there was no place for humans. Humans appeared in the evolution classes, where they wandered, lonely, over the recently formed continents. In conservation biology classes, plants and humans coexisted: We learned that some humans caused the disappearance of some forests, and some other humans saved them. The view of plants as passive, helpless objects seemed to reinforce the boundary separating humans and plants.

Humboldt's *Essay* throws light on the boundaries that divide humans and plants in contemporary biology. It allows me to see our connections through mutual affections. Because they have character, because they can be joyful or imperial or accomplices, plants impact and shape our sensations, our imagination, our distribution on the surface of Earth, and the adventures we embark on.

Thinking with Carla Hustak and Natasha Myers, it could be argued that by denying the possibility of such affections, contemporary biology is "irresponsible." They make the case for an affective ecology that "takes seriously organisms [sic]," one in which "creativity and curiosity characterize the experimental forms of life of all kinds of practitioners." Maybe, in order to "challenge the status quo of ecological irresponsibility," our task consists in defying the training we receive as scientists, which includes camouflaging those fundamental fibers that connect us with plants and make it possible for us to listen to them, to let them affect us.⁵

I return to contemplating Adriana's account of the meeting of two governments. Yes, Humboldt's acknowledgment of plants as powerful, heterogeneous, connected to each other and to us in unfathomable ways seems to resonate with what this government is trying to do. Hopefully, maybe even naively, one might dare to paraphrase Hustak and Myers and say that this government is acting responsibly by taking the diverse worlds that coexist in this country seriously as creative practitioners who manufacture worlds, and by allowing itself to be affected by them.⁶

And only then do I see the contradiction in which I am trapped. Yes, Humboldt was able to see, feel, and transmit the multiple reciprocal connections between him and the living beings he studied, beyond reason and abstraction. But he also wrote in the *Essay* that "fishing, the fruit of palm trees, and some small cultivated lands (if the assemblage of such a small number of plants could be

called cultivation) ... are the sources of nutrition for South American Indians." Ironically, the extraordinary sophistication of Indigenous peoples' connections to their ecosystems, and more particularly their mastery of complex cultivation techniques, seem to be invisible to him.

We need to acknowledge the contradictory, violent exclusion of other humans and their worlds from our understanding of nature.

Although contested,⁷ the affirmations that Humboldt was instrumental to the colonialist understanding of America and the continued European control of it cannot be ignored. Maybe, I think now, if we want to practice a truly responsible ecology, the challenge not only consists of recovering our affective relations with plants, which are part of the roots of our scientific tradition, embodied in Humboldt's observations. Maybe we also need to acknowledge the contradictory, violent exclusion of other humans and their worlds from our understanding of nature, an exclusion that is also part of those same roots.

As I look at the picture again, I realize something that had escaped my eyes before. An Indigenous elder's almond-shaped eyes are looking directly into the camera. He must have heard me say, inspired by Humboldt, that we need to be more responsible, to take plants seriously, to listen to them and let them affect us. I can now see him smiling ironically as he replies, with a voice more powerful and inscrutable than that of the Baron: "We have always known."

Notes

¹ These are the names of six of the eight Indigenous peoples represented by the CRIC.

² "ONU asegura que 28 muertes durante las protestas del paro nacional serían responsabilidad de la fuerza pública," *Infobae*, 15 December 2021, <https://www.infobae.com/america/colombia/2021/12/15/onu-asegura-que-28-muertes-durante-las-protestas-del-paro-nacional-serian-responsabilidad-de-la-fuerza-publica/>.

³ Michael Dettelbach, "The Face of Nature: Precise Measurement, Mapping, and Sensibility in the Work of Alexander von Humboldt," *Studies in History and Philosophy of Science Part C: Studies in History and Philosophy of Biological and Biomedical Sciences* 30, no. 4 (1999): 473–504, [https://doi.org/10.1016/s1369-8486\(99\)00011-4](https://doi.org/10.1016/s1369-8486(99)00011-4).

⁴ The quoted passages from Humboldt's *Essay* appear in a translation by Anne Buttner in "Alexander von Humboldt and Planet Earth's Green Mantle," *Cybergeo: European Journal of Geography*, no. 616 (2012), <https://doi.org/10.4000/cybergeo.25478>.

⁵ Carla Hustak and Natasha Myers, "Involutionary Momentum: Affective Ecologies and the Sciences of Plant/Insect Encounters," *differences* 23, no. 3 (2012): 74–118, p. 106, <https://doi.org/10.1215/10407391-1892907>.

⁶ Hustak and Myers, "Involutionary Momentum," 106.

⁷ Aaron Sachs, "The Ultimate 'Other': Post-Colonialism and Alexander von Humboldt's Ecological Relationship with Nature," *History and Theory* 42, no. 4 (December 2003): 111–35.

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WEATHERED HISTORY: GALVESTON AND EXTREME EVENTS

Thomas Princen

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Thomas Princen

Texas had seen rain before, plenty. It had flooded before, many times. But on 25 August 2017, Hurricane Harvey dumped a volume of water never before contemplated. The storm had become wedged between two weather systems, one trying to push north, the other south. At landfall, it was 450 kilometers in diameter, with 209 kilometer-per-hour winds. Its circulation, extending well out over the Gulf of Mexico, brought a continual flow of moisture. When Harvey stalled out over the Houston-Galveston area for four days, it dropped 60 centimeters of rain in the first 24 hours in certain areas. Due to the region's vast expanses of impermeable roads, parking lots, sidewalks, and rooftops, all built on a flat coastal plain, there was no place for the water to go for days. At the storm's peak, one-third of Houston was underwater, and at least 68 people in Texas died from the direct effects of the storm.



Men working near an overturned house after the Great Storm. © 1900 Henry H. Morris. Courtesy of the Rosenberg Library Galveston, Texas. All rights reserved. This image has been cropped.

A century earlier, on 8 September 1900, another hurricane, called simply "The Great Storm," hit the area, flooding much of the island city of Galveston. This storm killed approximately 6,000 people, by some estimates as many as 12,000. About 3,600 homes were destroyed, along with commercial buildings and infrastructure—all told, one-third of the city. Winds piled up water from north and south, creating a surge of 4.5 meters. In 1900, the highest point on the island was less than 2.7 meters, down from an earlier recorded height of 3.6 meters due to sand mining. The recorded high-water mark of the storm was 4.8 meters. Many houses were simply swept from their foundations. It was, by most measures, the worst natural disaster in US history.



Harvey. © NASA. All rights reserved.

In between the Great Storm and Harvey, a much slower event occurred: Brownwood. While there was little drama and it garnered few headlines, it may be the most consequential of the three events, signaling the future of Galveston and other coastal areas more clearly than hurricanes and floods. Brownwood was an upper-class housing subdivision built in 1938 on a peninsula in Galveston Bay, not far from a giant oil refinery in Baytown. Designed and constructed by executives from what became ExxonMobil, it was “isolated from the nearby city with comfortable wooded lots boarding the bay,” according to a local hydrologist.

¹ If the refinery and office buildings were heavy on steel and concrete, Brownwood was natural. Encompassed by water and home to lush vegetation and wildlife, it was an idyllic retreat after a day’s work. Because the subdivision was on a peninsula, all residents were effectively “living on the bay,” a status symbol both then and now. Here, there were nature trails and boat ramps and breezes. It was the perfect sanctuary—that is, until Brownwood began to sink, and flood, repeatedly.

In the early years, Brownwood, with some 500 residences, was roughly 3 meters above sea level. Forty years later, it had subsided to some 2.5 meters. The usual measures were taken—roads elevated, seawalls and bulkheads built, sandbags stacked, homes put on stilts, pumps installed, and, from 1961 to 1983, about two dozen evacuations conducted. Some residents moved further inland or away entirely. Brownwood became the first place eligible for federal flood insurance.²



Brownwood. Courtesy of US Geological Survey, Department of the Interior/USGS. [Public domain](#).

But flooding, while certainly a function of rainfall and storm surge, was largely a product of human-induced subsidence. “Extensive subsidence,” write two geologists, “caused mainly by ground-water pumping but also by oil and gas extraction, has increased the frequency of flooding.” More specifically, “as much as 3 meters of subsidence has shifted the position of the coastline...”³ But eventually the coastline pushes back: rivers, aquifers, and embayments find their natural settling points. And all this without considering climate change.

What, then, is the significance of these three extreme events in a region I call

“Galveston”? What do these events reveal about the past and signal about the future, a future shifting away from fossil fuels and experiencing declining availability of natural resources and waste sinks? “Galveston” is my shorthand for a spatial area in Texas in the United States, currently marked by industrialism and expansionism, and a temporal period that I expect, in the far future, will be seen as ephemeral. Geographically, Galveston begins with Galveston Island at the intersection of land and sea and spreads northward and upstream through Galveston Bay and its freshwater tributaries across the low-lying coastal plain, now dominated by the city of Houston.

But eventually the coastline pushes back: rivers, aquifers, and embayments find their natural settling points. And all this without considering climate change.

My temporal and social lens, though, is larger. It goes back to pre-European native peoples and their ways of living with the land, most notably with water in all its forms—ocean, bay, lagoon, river, and bayous—and all its vicissitudes, whether as storm surge and rain bomb, surface flow and groundwater flow. Through this geographic, social, and long-term temporal lens, Galveston allows for the possibility that, eventually, its peoples will adapt to this watery realm, not adapt defensively against it. They will take their cues not from a black liquid underground, or from money in the bank, but from aboveground rain bombs and storm-water surges, from land that sinks and water sources that salinate, from fish and shrimp and timber that can sustain a population when not abused.

In short, the central question in the twenty-first century is how Harvey in 2017, the Great Storm of Galveston in 1900, and Brownwood through much of the twentieth century all punctuate a long historical pattern and, at the same time, portend a future. One answer is that they seem to have interrupted the grand plans of boosterism, highlighting the geological and meteorological precarity of modern living—especially on a barrier island, but further up the bay too. The three events punctured a dream of conquering nature, a notion that still resonates as the twentieth century, defined by a seeming abundance of resources and perceived endless waste sinks, has come to a begrudging end. Another answer is that they position humans in an ecological pattern, at once migratory and settled.

To research Galveston, I had no choice but to drive, and drive and drive. No place I have been is as car-centric as Houston. I drove to Galveston Island to see the seawall and the port and to try to imagine giant waves and a storm surge engulfing this narrow sandy spit a century ago. I drove to Baytown to see the massive ExxonMobil petrochemical complex and a soggy peninsula where an entire neighborhood, Brownwood, sank into the bay. I drove along the bay and the Houston Ship

Channel, a key piece of infrastructure in Houston's century of rapid growth, along with, of course, lucky strikes in oil fields near and far.⁴ And I toured the ExxonMobil office complex, virtually a city in itself, north of Houston, near the Woodlands—an exclusive housing subdivision built, like Brownwood, by Exxon-affiliated developers—and away from the worst flooding and subsidence. Upon reflection, I had two simultaneous and conflicting sensations: I cannot imagine this place getting on a sustainable path; and, this place cannot last, not like this or anything close to it. But if, or when, it does change, it could well follow paths revealed by its extreme events.

The story of "Galveston" is conventionally told as one of pioneering and industrializing: in short, westward economic growth. As Houston petroleum historian Joseph Pratt puts it, "'opportunity' and 'expansion' early on became the central tenets of Houston's religion of boosterism. Whatever it took to foster economic growth in the region would be done."⁵ "Galveston" has always been a nexus of new frontiers, creating prosperity out of barrier islands and inland bays, underground minerals, powerful technologies, and space flights. From the perspective of natural resource consumption and human ecological adaptation, though, "Galveston" is a story of migration. This story has involved the elimination of the area's earliest inhabitants, or First Peoples, the enslavement of kidnapped African peoples, and the mining of water, sand, oil, and gas, which has resulted in the submerging of coastal lands like Brownwood. And the migration is not yet complete.

This story has involved the elimination of the area's earliest inhabitants, or First Peoples, the enslavement of kidnapped African peoples, and the mining of water, sand, oil, and gas.

First Peoples arrived centuries ago, maybe millennia ago,⁶ followed by a wave of people, mostly of European ancestry, Second Peoples. Upon contact, the two groups traded for a time, but First Peoples' extractive mode became a subordinate strategy to Second Peoples' extractive mode. Hunting, fishing, and gathering according to seasonal availability and conducive weather were replaced by year-round settlement, the clearing of land, the draining of wetlands, the channeling of rivers, and the growing of export crops like cotton and sugar to sell to distant markets. First Peoples return year after year; Second Peoples extract until yields diminish and then move on.

Both modes are adaptive, but only the first can be sustained in place over the long term. In Galveston, that adaptation meant the displacement of First Peoples, where Second Peoples established themselves for maximum wealth generation. For that, Galveston Island was the obvious place to build a port: ideally located at the juncture of sea and land, and yet, being on the bay side of the island, protected from the ocean. Boosterist visions promised boom times ahead. Indeed, Galveston became the most populous city in Texas until nearly the end of the nineteenth century and for a time was the world's largest cotton-shipping port.

Then nature stepped in, shattering this vision. The 1900 Great Storm was a surprise to those whose dreams were based on truly well-protected ports like New York City and London. The Great Storm could have been a day of reckoning. Galveston, a low, sandy barrier island prone to shifting with storms and ocean currents, was no place to build a permanent settlement.



Debris near houses after the Great Storm of 1900. © 1900 Henry H. Morris. Courtesy of the Rosenberg Library Galveston, Texas. All rights reserved.

The lesson of the Great Storm for First Peoples was likely a confirmation of what they had known and passed down for generations—that the island and bay are bounteous places, but they can be deadly as well. Visit, even camp there for short periods, but do not stay, especially in late summer and early fall. The lesson for Second Peoples was different: rebuild for some, migrate further inland for others. The upper bay may not be ideal, but at least it is better protected—with precautions, a permanent year-round settlement is possible. Little could they have known, in the nineteenth century, that this frontier mode could be continued for another century and more with underground extraction. And little could they have known that, like so many migrations, each phase is only temporary, each place, from Galveston Island to the uplands, only a way station until people learn to live in their place, until the economy matures past mere extraction.

And so, Second Peoples settled, as pioneers do. Their resource mode remained extraction. At first, before the Great Storm, they extracted the usual frontier items that could be commodified and sold to markets as far away as New York, even Europe: furs, hides, timber, fish. Then they cleared land and enslaved people to raise commodity crops, especially cotton and sugar. “Both before and after oil,” Pratt writes, “the transportation and processing of raw materials for export constituted the engine of growth” for the “Galveston” area. What is more, the “emphasis [was] on harvesting resources as rapidly as possible with no concern for the long-term depletion of these resources.”⁷ It was a frontier-style extraction that continues to this day.

Pratt poses the essential question: What would have happened “had oil not been discovered near Houston”? Asking this question allows us to use history to imagine a twenty-first-century transition after fossil fuel dependency. If oil had not been found 130 kilometers east of Houston at Spindletop,

that might have been the end of the story. Or, as the editors of *Fortune* magazine put it in 1939, "Without oil Houston would have been just another cotton town."⁸

To extend this imaginative rewrite of history, Second Peoples, situated inland, would have migrated seasonably into the bay all the way to Galveston Island to fish, hunt, and collect vegetation. They would have adapted to "Galveston" much as the First Peoples did. In fact, if the history of fire adaptation in North America is any guide, Second Peoples would have learned such a resource mode from the First Peoples. "The evidence suggests that early European colonists were generally ignorant (or in denial) of wildland fire and of methods to control it," writes fire historian Stephen J. Pyne. "It was from the Indian—into whose fire environment they moved—that the European immigrants learned basic survival skills."⁹

Only now are some people beginning to entertain the idea that they can learn from history and the adaptations of early peoples.

Likewise, the evidence from Galveston suggests that nineteenth-century colonizers were ignorant of the effects of extreme weather on a coastal barrier island. Even after the Great Storm, they retained that ignorance (or denial) right into the twentieth century, buoyed by boosterist calls for greatness and the belief that all could be controlled. Only now are some people beginning to entertain the idea that they can learn from history and the adaptations of early peoples.

How might it have been if settlers had actually aspired to adapt to the environment, not shape it to their desires and ambitions? Things might have been different before and especially after the Great Storm. But this did not happen. Oil transformed the region, as it does wherever it is discovered. Oil is the quintessential environmental signal that says, as positive feedback in the form of power and wealth kicks in, *extract more*. When nearby fields played out, "Galveston" extended its extractive reach, both physical and technological, across the state, the region, and, eventually, proclaimed itself the "Oil Capital of the World," not just for the extracting and refining that took place there, but for the expertise developed that could be applied anywhere in the world.

"Anywhere" became the operative geographic term for "Galveston" in the twentieth century, which was no longer grounded in a particular place. Like so many cosmopolitan centers, it could power its way out of the constrictions of limited port capacity (with dredging and channelization), out of its otherwise backwater location (first with railroads, then with highways and airports), out of seasonably limited freshwater (with reservoirs), out of the heat (with air conditioning). Oil was global. It came out of the ground all over the world and was marketed all over the world. "Energy made in America is not as important as energy simply made wherever it is most economic," said a CEO of ExxonMobil.¹⁰ And if the place does not matter, then the water and the soil, the hurricanes and rain bombs do not matter. New resources can always be procured from some other place; extreme events can always be defended against or endured.

The transformation brought about by oil in twentieth-century Houston is far more than demographic and economic. It is an extension of the frontier. Behaviorally and institutionally, it is the prolongation of the last stage of a boom that, as in all mining operations, eventually turns to bust. Economically, it is the perpetuation of an extractive economy. Politically, it is the grasping for power that empires always do, both in their ascent and in their decline. Ultimately, though, nature bats last. It asserts the placefulness of the denizens of a particular locale, regardless of financial gain, economic, or political power, let alone the physical power of energetically dense fuels.



Texas Oil Refinery. © Art Wager on iStock. All rights reserved.

"Galveston's" oil-and-gas rush consumed the region. It consumed freshwater supplies, causing the land to subside, and, in turn, consumed an oil field and a neighborhood. It consumed land and water with its toxic dumping as well as the climate-stabilizing components of the atmosphere and oceans. Maybe, one day in the not-too-distant future, it will also consume the "pioneering spirit"—what for many peoples has been a colonizing spirit and, for future generations, a depleting spirit.

"Galveston" is only a microcosm of a world addicted to oil. In a world organized as if endless material expansion on a finite planet is possible, it may be a harbinger of what is to come. When the low-cost production runs out, when the amount extracted no longer justifies the energy and capital needed to get it, when the bill for true costs—costs to the land and water locally, and to the climate system globally—comes due, as the story suggests, boom times will be over, and the migration, delayed for a century, will resume.

In a world organized as if endless material expansion on a finite planet is possible, "Galveston" may be a harbinger of what is to come.

What might that resumed migration look like? We can only speculate, but such is the method of a futurist exercise: Many of Houston's occupants will emigrate as an economy grossly propped up by near costless fossil fuels winds down. Just as Galveston Island is propped up physically and economically, "Galveston," the region, the cultural area, the economic engine, is propped up by its own unsustainable physical systems. Those who remain will adapt to a diminished landscape, or move on.

But, in a world full of human activity and impact, moving on cannot preclude adapting, eventually. Significantly, adapting is not installing bigger pumps, better filters, and moving water to suit—what I term defensive adaptation. Rather, adapting is adjusting to the environment, to what nature has given and humans have altered. Here, *adapting to* is the response to a century and more of *domination of*, which surplus-seeking, expansionist societies, especially fossil-fueled societies, have been able to avoid for a couple of centuries.

The twentieth-century modes are no longer tenable, not if living in “Galveston” for the indefinite future is the goal. If, however, the goal is to extract every last bit of wealth, “Galveston” will continue for some time to come. And then it will collapse. If the financial signals are not enough, the natural ones will be, eventually, whether they appear as an even greater Great Storm, another, more severe, rain bomb, an ice storm, a heat wave that exceeds designed tolerances for temperature, or simply the slow sinking of the land compounded by sea-level rise. The alternative, of course, is to adapt in place.

Acknowledgements

This article is adapted from a chapter in Princen’s forthcoming book, *Fire and Flood: Extreme Events and Social Change, Past, Present, Future* (Cambridge, MA: MIT Press).

Notes

¹ J. C. Holzschuh, “Field Trip Guidebook: Land Subsidence in Houston, Texas, USA,” Fourth International Symposium on Land Subsidence, 12–17 May 1991, Houston, Texas.

² Laura Bernal, “Brownwood: Baytown’s Most Historic Neighborhood” (master’s thesis, University of Houston, May 2020), 104.

³ Laura S. Coplin and Devin Galloway, “Houston-Galveston, Texas: Managing Coastal Subsidence,” US Geological Survey, 1999, 35–48, p. 35.

⁴ In fact, the Houston Ship Channel was just a dream of Houston boosters in the nineteenth century. Only in 1909, after the Great Storm of 1900, was a plan developed and, eventually, federal funds procured. Holzschuh, “Land Subsidence in Houston, Texas.”

⁵ Joseph A. Pratt, “A Mixed Blessing: Energy, Economic Growth, and Houston’s Environment,” in *Energy Metropolis: An Environmental History of Houston and the Gulf Coast*, edited by Martin V. Melosi and Joseph A. Pratt (Pittsburgh, PA: University of Pittsburgh Press, 2007), 21–51, p. 24.

⁶ William J. Newcomb, Jr., “Atakapans and Neighboring Groups,” in *Handbook of North American Indians*, ed. William C. Sturtevant, vols. 14–15 (Washington, DC: Smithsonian Institution, 1978–), 659–63.

⁷ Pratt, “A Mixed Blessing,” 25.

⁸ “Texas,” *Fortune*, December 1939, 85–91, 162, cited in Joe R. Feagin, “The Global Context of Metropolitan Growth: Houston and the Oil Industry,” *American Journal of Sociology* 90, no. 6 (1985): 1204–30, p. 1214.

⁹ Stephen J. Pyne, *Fire in America: A Cultural History of Wildland and Rural Fire* (Princeton, NJ: Princeton University Press, 1982), 78.

¹⁰ Rex Tillerson, quoted in Steve Coll, *Private Empire: ExxonMobil and American Power* (New York: Penguin Books, 2012), 239.

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I STILL DO A LOT OF GOOD

Nina Wormbs

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Nina Wormbs

Economic thinking permeates our modern societies. It is so pervasive that we do not reflect on the fact that it rules much of what we do. But we might want to think about the consequences for the transition to a sustainable society. They are not all straightforward.



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In a recent research project, my colleague Maria Wolrath Söderberg and I wanted to know how people argued about their decisions in response to climate change.¹ In a survey circulated through social media in the late spring of 2019, we asked people who considered themselves as having sustainable values, if they had ever acted against their knowledge or intention, and if so, how they had reasoned with themselves to feel better. We know that when we do something that goes against our conviction, we experience what psychologists have called cognitive dissonance, but the struggle to reconcile behaviour and values is also emotional.

To feel better, we need to justify our behaviour to ourselves and our imagined audience. We do this through a process of internal deliberation. In the research project, we studied this experience of cognitive dissonance as it manifested itself in the open-text answers in our survey. We looked for thought structures and patterns using topos theory, first presented by Aristotle. Topoi are modes of reasoning that work in our social context and that can create meaning.

Economic thinking is so pervasive that we do not reflect on the fact that it rules much of what we do.

It was striking that the most common ways of reasoning were economic, a recurring type of transactional thinking where people seem to envision an account; an idea of a budget was also visible.² One example is telling: “I hardly ever eat meat and I do not fly anymore. And I don’t have a car and bike to and from work. I am pretty sustainable. Now I am hungry and want to eat meat.” The aberration of occasionally eating a steak—contrary to the ideal vegetarian or vegan lifestyle—is balanced out by a usually low-carbon diet and the use of sustainable transport. The idea is that it evens out.

This also occurs in typical reasoning to legitimise flying: “[I] am thinking that apart from flying I am relatively smart climate-wise, I am vegetarian and have also cut down on dairy.” The budget thinking in this example is latent. The reasoning presupposes that everyone is granted a certain emission quota, and if you cut back on meat and dairy, you are allowed to fly. The problem with this thinking, however, is the size of emissions. It depends a lot on how much you fly and where, but for frequent flyers (more than two trips a year), it is difficult to balance flying with a vegetarian diet.³

The following quote from the survey captures the idea: “I still do a lot of good, for example, bike to work.” In order for this transaction to function, the currency needs to be imagined as good or bad deeds. We envision that good deeds can balance out the bad ones. This is often true in social relations. But when this type of logic is transferred to climate thinking, the consequences are unexpected. To buy an organic T-shirt might be considered a good deed. However, when you try to be even better, and buy five T-shirts, you have not necessarily been a better citizen. Certainly not if you only need one.

We envision that good deeds can balance out the bad ones. But when this type of logic is transferred to climate thinking, the consequences are unexpected.

Buying items that are organic, fair-trade, or in other ways considered climate-friendly, and thinking that it is a deposit in an imagined climate account, has been termed “the negative footprint illusion.” The mistake is forgetting that almost everything we do emits greenhouse gases, even things that are labelled as fair, like chocolate or coffee. The transactions many of our respondents envisioned were examples of a latent budget thinking, which, however, went astray since they did not know the size and proportions. To compare flying with recycling, as though they were comparable, is problematic.

Etymologically, economy comes from Ancient Greek and means to keep house, in particular if resources are scarce. To think economically ought to be a way forward to saving our planet. But we must not compare apples and pears, nor can we act as though a withdrawal is a deposit. If we employ economic thinking, we need to get the figures right.

Notes

¹ The project was named “Understanding Justification of Climate Change Non-action” and was funded by Riksbankens Jubileumsfond P18-0402:1. The survey was conducted in Swedish. The quotes that appear in the essay come from this survey and have been translated by the authors.

² The results can be found in Maria Wolrath Söderberg and Nina Wormbs, “Internal Deliberation Defending Climate-Harmful Behavior,” *Argumentation: An International Journal on Reasoning* 36 (2022): 203–28, <https://doi.org/10.1007/s10503-021-09562-2>.

³ A round-trip flight from Stockholm to New York creates a climate impact corresponding to 1643 kilograms of CO₂ according to flightemissionmap.org. For Stockholm–Lisbon, the figure is 777 kilograms. At present, the average consumption-based climate impact of a Swedish citizen is ca. 8 tonnes per year. It is possible to reduce emissions with dietary change. Changing from a meat-based to a vegetarian diet can save ca 100–1000 kilograms per year, depending on, for example, how much meat the original diet contained. Elinor

Hallström, Annika Carlsson-Kanyama, and Pål Börjesson, "Environmental Impact of Dietary Change: A Systematic Review," *Journal of Cleaner Production* 91 (2015): 1-11, <http://dx.doi.org/10.1016/j.jclepro.2014.12.008>.

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ROOTS THROUGH ASPHALT: A CONVERSATION WITH
SONJA DÜMPELMANN

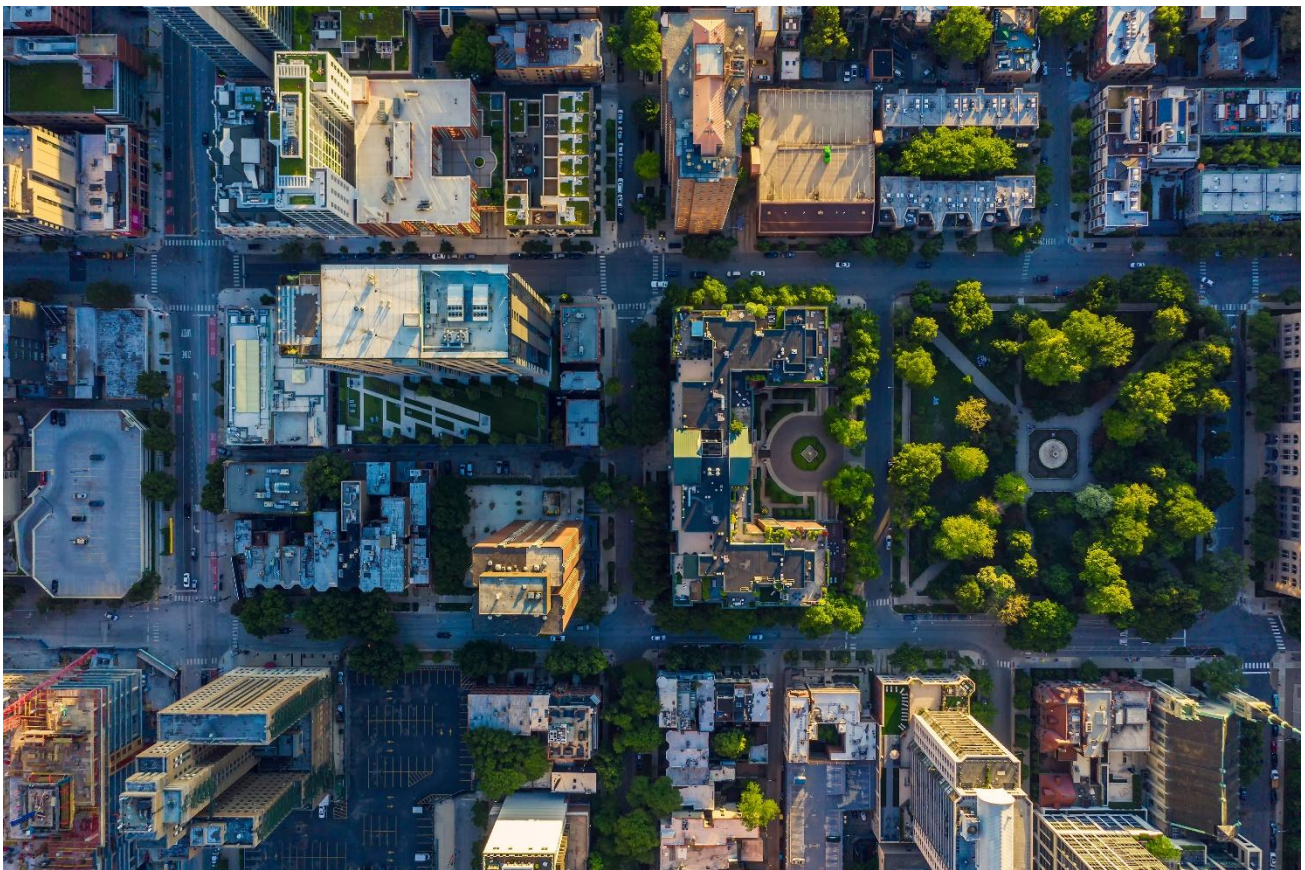
Sonja Dümpelmann and Pauline Kargruber

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Sonja Dümpelmann and Pauline Kargruber

*Sonja Dümpelmann is a landscape historian who is currently working on how grass species have transformed the world, and the history and political implications of window gardening in Philadelphia. During the pandemic, she began growing avocado plants, aspiring to turn her office into a grove. Her most recent publications include an authored monograph, *Seeing Trees: A History of Street Trees in New York City and Berlin* (Yale University Press, 2019), and an edited volume, *Landscapes for Sport: Histories of Physical Exercise, Sport, and Health* (Dumbarton Oaks Research Library and Collection, 2022). Pauline Kargruber is a literary scholar and editor at the Rachel Carson Center. She has a raised garden bed under her kitchen window, where she currently grows radishes, spinach, peas, and marigolds. Below, Sonja and Pauline talk plants in urban environments.*



Aerial view of Chicago's downtown. © marchello74 on iStock. All rights reserved.

PAULINE KARGRUBER: Your book, *Seeing Trees*, narrates what you called “the nature-culture of trees” in a [lecture at Weitzman School of Design](#). When I think of street trees, their roots breaking up the pavement come to mind. Echoing a nineteenth-century argument, cities seem to be a hostile environment for trees and their requirements for a healthy life. And still, as you argue, we need trees in urban areas. But what does it mean for a tree to live in the city?

SONJA DÜMPELMANN: Urban trees need to be able to resist many pressures, be it the lack of space for their roots or for the tree canopy, or the lack of light. Due to stormwater running into urban storm drains rather than infiltrating into soils, and soils often being too compact, trees in cities can lack water. The heat-island effect means that temperatures in cities are generally higher

than in surrounding areas. More than outside of urban environments, trees are therefore threatened by heat and drought as well as air and soil pollution. Furthermore, mechanical injuries by automobiles and bicycles are common, and trees suffer from dog urine. Plants cannot move in the way in which most animals can, so that trees are more dependent on, as well as affected by, the site conditions where they grow.

I like to talk about “plant-friendly urbanism” to elevate the idea that designing cities with and for plants is possible without sacrificing urban density.

PK: You used to work as a landscape designer in Switzerland. How should and can urban planners address the needs of trees in cities?

SD: That’s a long time ago, but I have been educating future landscape architects and other designers for 18 years now. Urban planners can design with trees, and plants more generally, in mind. This means they need to take into account trees’ various needs both above- and belowground, where the root systems can easily conflict with gas, sewer, and water lines, for example. Aboveground as well, trees need space to unfold their canopies, which are vital for the processes of photosynthesis. The provision of pervious surfaces, big enough tree pits, and the selection of appropriate soil substrates are just some of the many things that matter when it comes to accommodating plant life in cities. I like to talk about “plant-friendly urbanism” to elevate the idea that designing cities with and for plants (besides human and nonhuman animals) is possible without sacrificing urban density, which is so important for urban life and culture. In recent years, more attention has been paid to the fact that not only humans inhabit cities, but other organisms do as well. The recognition that plants (and animals) have agency and that we all coproduce our living environment draws attention to the fact that making space for other-than-humans can lead to the creation of a more just and comfortable living environment.

PK: Which tree species are particularly well-suited for a life in the city?

SD: Given that every city is built and structured differently, has different microclimates in different locations, and sits in a specific climate zone with distinct character traits, it is impossible to give a blanket answer when it comes to tree species and cultivars. However, many cities are testing new species and varieties and have been doing so for a while. Their objective is to adapt the species selection to the changing climate. For example, the German Conference of Directors of Parks and Recreation (Gartenamtsleiterkonferenz [GALK] beim Deutschen Städtetag) now recommends planting Montpellier maple (*Acer monspessulanum*) and southern catalpa (*Catalpa bignonioides*), species from northern Persia, southern Europe, and the southeastern United States. These species were not on the first street-tree list established in Germany in 1901, and they were also not suggested in 1975 when GALK founded its urban tree working group in West Germany. However, due to climate change, today these species appear to be increasingly well adapted even in central and northern European urban climates.



(Left) Montpellier maple (*Acer monspessulanum*). Photo by [Uzi Paz](#). CC BY 2.5. (Right) Southern catalpa (*Catalpa bignonioides*). © M. Schuppich on Adobe Stock.

PK: Your work highlights the immaterial value of plants, and trees more specifically—their beauty, the stories they tell, and the psychological effects they can have on humans. What kinds of psychological effects are you referring to?

SD: In the last decades, more and more studies have shown that plants and the spaces they create have a soothing, relaxing effect on humans. As a result, hospital designers, for example, increasingly plan with plants. However, empirical observations and subjective perceptions have long suggested plants' beneficial effects. Recent studies are therefore only confirming what people have intuitively felt, experienced, and "known" for millennia. For example, the Romans claimed that vegetation and its green color had a soothing effect, especially on eyesight. The observation that plants emit oxygen, enabling life on earth, has since the late eighteenth century supported the idea that trees produce healthy air and prevent "bad air" (*mal aria*). Although the latter idea was based upon the miasma theory and proposed that trees formed physical obstacles against the distribution of "bad air" thought to emanate from organic decay, trees in many places did help drain the breeding grounds of mosquitos, the vectors of disease. Trees could therefore contribute to eradicating the parasite that caused malarial fever, even if this occurred in different ways than people knew at the time. Trees filter the air and, through evapotranspiration and shade, often also create pleasant microclimates, especially in hot regions. Given that many trees grow older than humans, they create a sense of permanence despite their own temporality, changeability, and malleability. We humans have long relied on both trees and their wood for shelter.



Clinic for Neurohabilitation and Paraplegiology, Basel, Switzerland. © Katalin Déer. All rights reserved.

PK: In your research, you repeatedly address the intersections of power and plant cultivation. As you write in the edited volume *A Cultural History of Gardens in the Age of Empire* (Bloomsbury, 2013), nineteenth and twentieth-century rulers constructed parks and gardens as symbols of power. What was it about the gardens that impressed and conveyed such power?

SD: Power can be expressed as much by the use of particular plant species as it can through a particular physical design. For example, shortly after the Fascists came to power in Italy, many roadside elm trees were replaced with pine trees. The Fascists declared *Pinus pinea* to be the quintessential Italian tree, although it had only been planted in greater numbers in Rome and its environs beginning in the nineteenth century. Through the practice of planting pines, the Fascists created a visual rhetoric tied to their ideology of “italianness” (*italianità*) and “romanness” (*romanità*), which could also be described as an “invented tradition,” to use Eric Hobsbawm’s term.



Pine trees in Rome, planted to replace other tree species in the 1920s and '30s. © Photo Beto on iStock. All rights reserved.

PK: Which ideological connotations accompany the designs of parks and public gardens today?

SD: The design of our built environment, which includes open spaces of various types, including private gardens, allotment gardens, public parks, plant nurseries, streets, parking lots, and plazas, both reflects and shapes power relationships. This has always been the case and still holds true today. Which ideologies or ideas are guiding depends on time and place, of course, and on the respective political, social, and cultural context. One idea that has been gaining traction in parts of Europe and North America is the recognition of the value of spontaneous vegetation. Concerns about climate change and biodiversity loss, on the one hand, and budget cuts to departments of parks and recreation, which result from the neoliberalization of urban economies, on the other, are rendering the idea of a wilderness aesthetic more popular in some urban areas. Notable examples for designs that have worked with spontaneous plant growth are Berlin's Park am Gleisdreieck and Parc Henri Matisse in Lille.



Design, Parc Henri Matisse, Lille. © Agence Empreinte, Lille. All rights reserved. This image has been cropped.



Parc Henri Matisse, Lille. © Agence Empreinte, Lille. All rights reserved.

PK: When it comes to state ideologies and the values and beliefs that have been manifest in greening projects, we are facing a double-edged sword: in the past, nationalist beliefs were expressed through “natural” gardens that would promote “wild” plants. What do you make of this ideological heritage?

SD: The nationalist “nature,” “home,” “wild,” and “prairie” garden paradigms belong to a particular time and to specific geographies: the late nineteenth and early twentieth centuries in Germany, the Netherlands, Britain, and the United States. The curation of plant associations that appear to be naturally occurring was bolstered by new knowledge gained in plant ecology, and it was used to foster national and nationalist ideologies. It later regained currency and uncritical adaptation during the environmental movement in the 1970s and 1980s. At the time, it was accompanied by a movement of eco-design that condemned all design that did not visually emulate natural systems. In contrast, for many of today’s designers, spontaneous plant growth and carefully curated designs are not mutually exclusive. Many landscape architects take a differentiated point of view that seeks to accommodate natural systems while at the same time addressing questions of human spatial experience, comfort, and culture.

At various moments in time, trees have become a means and method to (re-)claim public space and civil rights.

PK: You are not only interested in the state ideological connotations of urban greenery but also in its correlation with social concerns. Can you expand a little on the convergence of greening cities and social justice? In what ways and to what extent have greening projects been entangled with issues of empowerment and resistance throughout history—up until today?

SD: One aspect discussed increasingly in the United States in these last years is the threat of green gentrification as well as the uneven distribution of access to parks and urban nature in US cities. The latter is the result of discriminatory practices that denied ethnic minorities and their neighborhoods various services, including mortgages, a practice that in the 1930s was formalized by the federal government as “redlining.” However, the uneven distribution of street trees, for example, is not unique to the United States. Despite urban planning ideals in the late nineteenth and early twentieth centuries, which included equal access to urban nature, this is rarely the case anywhere. Take the city of Berlin, for example. Along with a difference in street-tree density between East and West Berlin during the Cold War, there were also differences between the various districts in West Berlin. Neukölln and Kreuzberg had fewer trees per street kilometer than the wealthier districts of Wilmersdorf and Charlottenburg. Given these inequalities, people have founded

grassroots movements to plant more trees in cities, to protect trees, and they have organized around tree care. At various moments in time, trees have become a means and method to (re-)claim public space and civil rights. A notable example are the grassroots tree-planting initiatives by African American citizens during the civil rights movement in the United States.

PK: What about the role of women?

SD: Women have played an important role in all aspects related to plants. For example, they instigated Philadelphia's grassroots window-gardening campaigns that I am currently researching and writing about. I show how plants and by extension plant care, on the one hand, forged social ties and contact across color lines, while on the other, they further promoted residential segregation and white supremacist planning policies.¹ Women were also instrumental in the first street-tree planting campaigns in US cities. In German cities during the First World War, they took over from men. Now women were not only lobbying for trees, but they were also planting them. Trees were a material and method to transgress the separation between the private and public spheres.



(Left) Community gardens, Philadelphia, 2004. (Right) Window boxes, Philadelphia. © Sonja Dümpelmann. All rights reserved.

PK: Last year, I attended a [lecture by Dr. Diego Molina](#), who works on urban nature in tropical cities. Someone in the audience asked about his impression of Munich's urban nature—a city that is often considered to be very green in comparison to other German urban environments. He replied that Munich is a desert compared to Colombian cities when it comes to the number of plants and the diversity of species it is home to. What can we learn from urban planning in the Global South?

SD: The American continents have a greater diversity of naturally occurring tree species. The tropical and subtropical climate zones also produce a different plant aesthetic, which appears very lush and rich. Ideas of diversifying the urban tree canopy in European and US cities go back to the late nineteenth century. Aesthetic concerns and the threat of losing all trees of one species to disease led some city foresters to argue against monotonous "corridor planting" along streets. They experimented with alternating tree species along streets, an idea that some landscape architects have taken up again in more recent times (without realizing there is a history of this!). Cities in Germany and other European countries are aware that they need to diversify their tree canopy, and lists, like the ones mentioned above, today include many species formerly not widely planted in central European cities. Looking at the ways of planting, incorporating, and accommodating spontaneous plant growth in different cities across the world draws attention to the importance of understanding the respective site conditions, be they environmental, cultural, social, or political.



Medellin, Colombia, Poblado Avenue, a green corridor in the city. © camaralucida1 on Adobe Stock. All rights reserved.

PK: The inevitable and somewhat provocative question: would you say there is a value hierarchy between plants and animals with respect to their worthiness of moral consideration?

SD: There would be no life on earth without plants, and yet they are mostly taken for granted, neglected, and often unrecognized. In 2001, scholars of education Elisabeth E. Schussler and James H. Wandersee called attention to “plant blindness” in large parts of Western society. They described it as “the inability to recognize the importance of plants in the biosphere, and in human affairs”; “the inability to appreciate [plants’] aesthetic and unique biological features”; and “the misguided, anthropocentric ranking of plants as inferior to animals.”² In the past, humankind in the West has acted upon a clear value hierarchy with humans at the top, followed by nonhuman animals, and then by plants. However, recently, scientists and philosophers have argued for the sentient life of plants and for plant intelligence. The analogies drawn between animal and plant intelligence and behavior have helped to re-center plants in many scholarly discussions. This also helps to see the “unseen,” the “other,” the marginalized, whether this be plants, lichen, bacteria, fungi, or humans. Seeing plants can promote more nuanced and pluralistic points of view, countering any form of hegemony.

The analogies drawn between animal and plant intelligence and behavior have helped to see the marginalized, whether this be plants, lichen, bacteria, fungi, or humans.

PK: Parts of your research focus on human-plant relationships in urban spaces in the nineteenth and twentieth centuries. The intersections of plants with human culture is what the up-and-coming interdisciplinary field plant humanities engages with. Where would you position yourself within this field? And which potential areas for future research are you most excited about?

SD: I'm very interested in centering plants in my own research³ and am doing this in a number of projects. I recently wrote some articles (another one is forthcoming) on the role of plants in the design of our built environment, and the difficult and politically charged relationship that even a profession like landscape architecture,⁴ whose primary building material is plants, has with these organisms. One of the things that I hope to bring to the field of plant humanities is not only new stories about the relationship between plants and people, but how these stories play out in space and time.

Notes

¹ Sonja recently presented an invited lecture on "Planting Inside-Out: Window Gardening and Civil Rights in Twentieth-Century Philadelphia" (University of Copenhagen, 21 April 2023).

² James H. Wandersee and Elisabeth E. Schussler, "Toward a Theory of Plant Blindness," *Plant Science Bulletin* 47, no. 1 (2001): 2-9.

³ See, for example, "Green Is Hope, and Grass the Future," *Places Journal*, April 2021, <https://placesjournal.org/article/in-berlin-green-is-hope-and-grass-the-future/>.

⁴ See, for example, "It's Not Easy Bein' Green," *LA+ Interdisciplinary Journal of Landscape Architecture*, no. 15 (Spring 2022): 36-45, <https://laplusjournal.com/15-GREEN>; "Plants," in *The Landscape Project*, ed. Richard Weller and Tatum Hands (Pennsylvania: Weitzman School of Design, 2022), 52-68, <https://appliedresearchanddesign.com/product/the-landscape-project>; and the forthcoming "Plant(s) Matter: On the Dichotomy and Duplicity of Green Walls and Grass Pavements," in *Bio/Matter/Technics/Synthetics: Design Futures for the More Than Human*, eds. Franca Trubiano, Susan Kolber, Marta Llor, María José Fuente, and Amber Farrow (Barcelona: Actar).

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FIVE WAYS OF SEEING THE STEINSEE

Steve Mentz

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Steve Mentz

The true eye of the earth is water.

Gaston Bachelard



Lili Wood. *Après le plongeon*. Pigment-inks print, 21 x 29.7 cm. Courtesy of the artist and La Slow Galerie. All rights reserved. This image has been cropped from its original dimensions.

I. The Last Shortest Day

On my last day as a Landhaus fellow at the Rachel Carson Center, with thin December light not quite thawing the snow, I abandoned packing to hike out to the Steinsee. A small Alpine lake near the town of Moosach about a half dozen kilometers away from the fellows' house on the ecofarm in Herrmannsdorf, Germany, the Steinsee contains, on its southeastern corner, a small swimming area, Moosacher Bad. That was my final destination on the shortest afternoon of the year. The trudge across roads and fields, past the Sonnenhausen hotel, and through the woods wasn't my most frequent hiking route in the surrounding country—that would be my daily sunrise circle around the Herrmannsdorf farm, along the Philosophy Walk to the Labyrinth, past the Blue Flower and faux-Stonehenge, which I would often wander in the company of horses. But Alpine lakes are the eye of the world, to paraphrase Bachelard. I wanted to look into that eye one more time.

There wasn't enough light to make it there and back before the looming sunset, which came at 16:22 on that solstice day. The walk to the lake, which I'd done many times during my three-month fellowship, is just far enough that you forget exactly how far it is. One hour? Three? As I crunched

the snow underfoot on the long hill after I passed the Sonnenhausen, I realized, accurately, that I would stomp the last few kilometers back in the dark.

I came to the water's edge in silver-grey twilight, the sun long since hidden by hills. The swimming spot was pockmarked with boot prints. Clearly some local enthusiasts weren't deterred by a little snow. I walked to the edge and saw a rough-hewn rectangle broken out of the ice. There was just enough space for a body to step, dunk, and flee.

The ice framed a brittle gateway. What will you find? What would it feel like?

I stared at the water and at the ice around it. I thought about that door all the way back home.

What do the places we don't reach teach us?

II. An Open Eye



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III. Water as Invitation

It asks us to enter. What if we only go partway? We terrestrial mammals can only go partway into water.

My eco-thinking during this still-young century obsesses over watery forms. I spend my days writing, talking, and teaching about what we learn from immersion and watery proximity. The Landhaus, landlocked on the edge of the Bavarian Alps, was an odd home for my blue-humanities project. I got into a few swimming holes, mostly on excursions to France, Portugal, and Norway, plus I made

the occasional trip to a small, child-filled pool in the nearby town of Glonn. But the Steinsee was my eye at the RCC, my focalizer, and my portal. It's the place I think of most often, now that I'm back home, looking at the snow on a frozen beach in Connecticut.

I remember my first swim at the Steinsee, on a sunny afternoon in early October, luxuriating in the warmth of sunlight absorbed by the top layer of still water. Not many days later, I returned to find the swimming area in the shade. The underwater thermometer, which I'd not checked before, now read 11 degrees. I'm not an ice swimmer or Wim Hof devotee. Mostly I take single digits as an uncrossable Rubicon, so 11 degrees meant: swim now. You won't want to later. A temperature of 11 seemed a just-ajar door, a passage to enter.

Striking out from shore, accepting the lake's invitation, means—as swimming always means—entering into partial alienation. I'm not as strong a swimmer as I used to be, and I wasn't in especially great shape during my fellowship, but I fell into my habitual crawl stroke. The lake opened cold and smooth. My chest slid forward, carving a V-shaped wake behind me. At each sideways breath, I angled my torso slightly so that my ribcage formed, by alternation on each side, a functional, temporary keel. A human swimmer's body cannot be a fully seaworthy vessel, and in the front crawl most of the body, except the arms and crown of the head, remains underwater. But the form kept me up and moving, for a time.

On the warmest day that I remember swimming there, I was with another fellow, and we almost managed to cross the lake. A manicured lawn on the far side, part of a then-closed summer bathing club, beckoned to us as it sloped up from shore. Instead of focusing on the green lawn, I stared down through my goggles into the clear, fresh darkness below. Even in the bright sunshine, the light could not penetrate very far. The water felt thin and transparent, so unlike the silty green-brown ocean, teeming with seaweed and the occasional jellyfish, back home in Long Island Sound. What could I almost see in the Steinsee?

Despite my now 400+ days of thumb-typing with Duolingo, I'm not a proficient speaker of German—but since I'm an eco-theorist and poet who believes that rhymes comprise the hidden structures of language, my Anglophone ears can't help hearing, in the German word *See*, which means lake, an insistent pun on the English *see*, as well as its English homophone *sea*. What can I see in the *See*?

A series of words flitted beneath my attention as I swam out and back. I recorded them on the Notes app on my phone that day, but I'm only returning to them now. These are some things that water does with human minds and bodies.

See. Reflect. Distort. Chill. Connect.

IV. The Steinsee

To see, to see—

As if reflection were the source of vision
And immersion the chill bite of a reality
Too vast for eyes.

Water reflects—

Because all light bounces itself forward into fragments
And distortion, because each mirrored
Inversion changes what we see.

Water distorts—

As the enveloping garment of environment
Wraps its chill around blood-fueled flesh,
So that swimming changes nothing.

Water chills—

Except one's position in the water-world,
Since what is connection except experience
Of and in and through a particular place?

Water connects—

Self to system to splashing in-going,
So that immersion's distorting chill
Reflects and connects self into not-self.

Water binds us as it hides us.
Water guides as it knows.
Water holds.

V. Another Future

It's just barely imaginable that I might go back. Perhaps, as the days stretch toward the languor of the summer solstice, I could go without telling anyone. I could hide myself inside the systemic anonymity of Ubers, airports, planes, stations, the S-Bahn, the Grafing train station, the 440 bus. What if finally, maybe twenty or thirty hours after I sneak away from home, I were to get off at the bus stop in Zinneberg, but instead of turning east toward the Almcafé to walk across the fields back to the farm, I would steer my sleepless body west and north through the woods to Moosacher Bad? The swimming spot would be crowded on the summer solstice. The water would be warm. The eye of the Steinsee would open fully. Would anyone recognize me?

There's a line in Walt Whitman's "Song of Myself" in which the poet looks at the Atlantic and asserts that the ocean will "refuse to go back without feeling of me." In this imaginary other future, I'm in already, cleaving clear water, darting quickly out past the shore bathers toward the middle of the lake. I tread water and look below my feet. The dark, light-craving pupil that is the center of the lake, the center of the eye, buoys me up.

I might not really get back there. But I like what I would see.

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THE HEAT IS ON!

Melanie Arndt

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It was an unusually hot day in Dresden in July 1903. The glinting Elbe was drifting past Bruehl's Terrace, famous throughout the world as the "Balcony of Europe." A steamboat horn heralded the start of the next riverboat cruise and the modern era, or *die Neuzeit*, as German contemporaries proudly called it. A little further along the river, an inconspicuous door opened at the eastern end of Bruehl's Terrace, and out poured a lively crowd of well-dressed men and women. They had just been given an exclusive tour of Dresden's latest attraction, the *Königliche Fernheiz- und Elektrizitätsheizwerk* (Royal District Heating and Electricity Plant). In a winding tunnel below the terrace, the party marveled at the plant: an entire kilometer of pipes and cables that had supplied heat and light to twenty-three public buildings since its 1900 inaugural. The tunnel was entirely pleasant, neither narrow, dark, nor dirty. The visitors' shoes were still shiny and polished by the end of the tour. Inside, the space was a comfortable two meters by two meters and was fully equipped with electric lighting. In an emergency, help could be summoned using a recently installed telephone.¹



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The imposing building at the far end of this tunnel revealed nothing of its subterranean pipelines—and even less of its purpose. From today's perspective, this sounds unspectacular, but back then, it was a sensation. The Royal District Heating and Electricity Plant was one of a kind in Europe.² Its sandstone façade, built between 1899 and 1900 in ornamental neo-Renaissance style, blended nicely with the much-admired Dresden skyline. The sixty-meter-high and over three-meter-wide chimney, disguised as a tower with an observation platform, arguably enhanced the city's horizon. The recently founded tourism association, which had previously complained that the "thousands of

chimneys ... are so terribly insulting to this foreigners' paradise, pensioners' idyll, and dignified royal seat,"³ were sure to have been pleased.



Postcard showing Dresden's Theaterplatz (Theatre Square) with the Royal District Heating and Electricity Plant on the right, 1908. All rights reserved.

The tour group seemed satisfied too. These were not ordinary visitors after all, but rather international delegates of the *Versammlung von Heizungs- und Lüftungsfachmännern* (Assembly of Heating and Ventilation Professionals), which convened in Dresden for that year's conference. At these conferences, which were held every two years starting in 1896, several hundred participants enjoyed enlivening, educational excursions, on which they were shown the latest achievements in technology and industry. Talks and discussions were held on the best methods of supplying heat in times of rapid industrialization and urbanization—the “best methods” being the most modern, healthy, and cost-effective ones—to public buildings such as hospitals and schools, as well as theatres, churches, and even the homes of ordinary workers. Around this time, toward the end of the nineteenth century, revolutionary centralized heating infrastructure began to directly impact collective ideas about warmth, shaping the world in which people in Europe and large parts of North America live today.

Infrastructures such as those championed by the Assembly of Heating and Ventilation Professionals are typically quite long-lasting and, at the same time, inconspicuous once installed.⁴ Often similarly inconspicuous, the history of heating, the study of the modern world's complex supply of warmth, reveals the permeability of the seemingly rigid boundaries between technology, the environment, and society. The technologies used for heating—as pipes and other material remnants, some of which still exist today, buried beneath our very feet—and the history of this technology's development are intricately entwined with humanity's historical relationship to the nonhuman world. Our environments, both individually and socially, including the ecosystems within our bodies, are inseparable from how heat is created, consumed, and perceived. Warmth is a basic need for humans

(and many other living organisms); one cannot imagine the “intimate connections between external nature and the inner nature”⁵ of humans without it. Nevertheless, public and scientific discourse on heating in recent years has often resembled lukewarm floor panels: present, but never in the foreground.⁶

Toward the end of the nineteenth century, revolutionary centralized heating infrastructure began to directly impact collective ideas about warmth.

For the first time in recent European history, Russia’s war against Ukraine has seriously threatened heating supplies to large parts of the western European population. Different heating systems, energy-saving options, comfortable room temperatures, structural energy import dependency, an increase in coal production,⁷ and economically and socially acceptable redistribution are all subjects of intense public debate. The worst case has not yet happened, at least not for most people in western and central Europe; whether they will be spared this scenario next winter remains to be determined. But forms of social inequality have been exposed, such as those known in the 1970s as “fuel poverty,” particularly in the United Kingdom, where people unable to pay for heat have been forced to weather it out in cold, damp apartments, often falling ill.⁸ The war has also clearly shown that the noble goal of late nineteenth-century engineers, health professionals, hygienists, and even politicians—to provide buildings and rooms with heating—inadvertently introduced new risks by making populations more susceptible to energy loss during times of conflict.

It is even more astounding that heating has received so little attention of late considering its adverse environmental impact. Heating alone has been responsible for two-thirds of the carbon-dioxide emissions from European households in recent decades. Private households in western and eastern Europe have used a steady amount (about 90 percent) of their total energy for spatial heating (up to 75 percent) and hot water heating (up to 15 percent).⁹

Together with emissions and the number of rooms that require heating, the temperature has also risen over the years, both inside and out. In the early nineteenth century, people relied more on their bodies, their muscular strength, and their wardrobes than on machines for warmth. At that time, a temperature of 15 degrees Celsius was considered high enough to feel pleasantly warm. By the middle of the nineteenth century, that figure had risen by around 3 degrees. By the end of the century, it had climbed to 19 or 20 degrees, especially for living rooms, which were being used more frequently. Nowadays, as Mogens Rüdiger writes, in western societies, or so-called “21-degree cultures,” an average room temperature of 21 to 22 degrees is considered comfortable.¹⁰

But before the invention of central heating, physical movement and woolen clothing alone were barely sufficient to protect people against the cold. Living close together and cuddling up was the order of the day. Mealtimes were held in small, heated rooms, and at night, when our predecessors often shared a place to sleep, they relied on social warmth. This not only had to do with lack of space but also with “social thermoregulation,” as it is called in psychological jargon—that is, the (mutual) use of body heat.¹¹ This is how many species, including nonhuman mammals, birds, and reptiles, maintain the body temperatures necessary for survival. Additionally, it enables them to save up to 53 percent of their energy.¹²



(Left) Sleeping mice. © Susie3Ford on iStock. All rights reserved. (Right) Hermann Götz, *Die Familie in der guten Stube*, oil on canvas, 67.8 x 85.5 cm, 1873. [Wikimedia Commons](#). [Public domain](#).

Medieval historian Annette Kehnel recently advised people to manage the current energy crisis by grouping in cozy, warm communities—around a campfire, in the kitchen while cooking, or in the sauna—thus lowering heating costs.¹³ In fact, a strong correlation between thermal energy and social warmth is hardwired into our brains. Certain areas of the human brain are associated with both social behavior and temperature regulation. As studies by Hans IJzerman and others have strikingly shown, temperature directly affects our social behavior and vice versa.¹⁴ The “cuddle hormone” oxytocin and the “feel-good” hormone serotonin are also active components of thermoregulation.

The pipelines that began to transport thermal energy at the end of the nineteenth century also transported social practices and values, which now too belong to the history of heating supply. With the introduction of district heating, hopes and wishes for a new, modern life materialized at the beginning of the twentieth century. Anthropologist Brian Larkin has described these emotional and symbolic impacts as the “poetics of infrastructure.”¹⁵ This new infrastructure led to an increased spatial separation of domestic activities and generations, an ever-growing delegation of work to infrastructures and equipment, an upward trend toward small-family and double-income households, and ultimately a lifestyle that was increasingly enjoyed indoors.

The pipelines that began to transport thermal energy at the end of the nineteenth century also transported social practices and values, which now too belong to the history of heating supply.

The technology of district-heating pioneers was viewed as “in service of the general public”; it belonged to public health care and popular welfare.¹⁶ At least in discourse, health and convenience often came before economic profits. Healthy temperatures in buildings were supposed to contribute to residents’ well-being, and experts set an overarching goal of “contributing to the convalescence of our ever-growing big cities.”¹⁷ Included in this equation was the “elimination of smoke and soot pollution.”¹⁸ In this respect, Dresden at the turn of the century was progressive. From 1887 on, a police decree required that smoke “containing soot in visible quantities” be avoided. Those who did not comply were liable for fines.¹⁹ However, the decree’s wording was so vague that the Smoke and Soot Control Office’s cash registers were unlikely to have rung very often. Since the Royal District Heating and Electricity Plant replaced a large number of household stoves and used three times less fuel, the “black cloud” did, in fact, recede somewhat.²⁰ But even in the “model industrial state”²¹ of Saxony, the administration preferred to build more chimneys rather than find proper, comprehensive solutions.²² Under such conditions, heating specialists remained cautious in their forecasts. “It will probably take a long time and some ingenious work by engineers before the black

cloud over our cities and factory sites disappears,” said a representative at the end of the Dresden Assembly in 1903.²³

The new heating technology toward the end of the nineteenth century can also be understood in the context of the rise of modern science. It began a conversation about new technological and environmental knowledge—about air composition, heat circulation, reactions of human skin (and wood) to heat, and emissions and their harmfulness. This information, in turn, led to new critiques of these technologies and the ways they were being used.²⁴ Many of the speakers at the congresses made impassioned pleas for their subject to be recognized as a science. The Technische Universität (TU) Berlin took the first step toward this goal with the creation of the world’s first university professorship for ventilation and heating in 1885. The first chair, Hermann Rietschel, a rising star in the field of heating, was just 38 years old and did not hold a doctorate. Two years later, he had built a test station for heating and ventilation systems (Versuchsstation für Heizungs- und Lüftungseinrichtungen) from scratch. Today, TU Berlin honors his legacy with the Hermann Rietschel Institute for Energy, Comfort, and Health in Buildings.



(Left) The Fernwärme Wien, a modern, operational example of the type of fully functional, yet also aesthetically incorporated, district power plant championed by Rietschel and the Assembly of Heating and Ventilation Professionals. © travelview on iStock. All rights reserved. (Right) The Fernwärme Wien central office. © TasfotoNL on iStock. All rights reserved.

It almost appears that the preoccupation with warmth made these gentlemen experts extremely conciliatory. As heated as discussions often were, Rietschel and his associates promoted the idea that their profession was a vocation based on empathy, cooperation, and moderation in competition. They were not just concerned with technology. Time and again, they emphasized the “intellectual work of the engineer,” which was far more important than “pecuniary competition.”²⁵ An obsession with innovation, the “blind imitation of new phenomena, which currently often deteriorates to the

level of an utter epidemic," as Rietschel lamented, had to be countered by an orientation to needs.²⁶ They certainly perceived warmth as a paramount concern of their time: "We city dwellers are in particular need of warmth—that warmth of empathy, of sympathy for the harm and suffering of our fellow citizens, as well as warm feelings toward the happiness of our fellow citizens."²⁷ In this way, heat infrastructures reflect the cumulative ideas and input of diverse members of society: heating and ventilation specialists, company heads, engineers, pipe installers and boiler builders, coal miners, chimney sweeps (often children), plumbers, doctors, public health workers, politicians, economists, advertisers, and, of course, consumers.

Most of these protagonists were men. Although women took part in the heating and ventilation congresses, not only in the field trips but also in lectures, gender roles remained clearly segregated: men were responsible for facility management, and women were responsible for making a cozy home.²⁸ Heating and ventilation specialists, who were otherwise oriented toward modernity, thought little of the emancipation of women. And this too had something to do with warmth: they feared losing the social warmth that enveloped them in the evenings when they arrived home from work: "the friendly reception, a loving caress of a compassionate woman's hand across the worried head of her husband . . . a mouth offered in a kiss." The "modern woman," on the other hand, in "hobble and trouser skirts" gave the impression of "being hostile to men."²⁹ The reinforcement of gender roles in the heating sector is seen not only in the countless disrobed female bodies in the advertisements from the decades that followed but also in the enduring quip that the best heating system is "the one you hear the least, like a good housewife."³⁰ In fact, almost a hundred years after Rietschel cracked this joke for the first time, it was still used to advertise wall, floor, and ceiling heating systems.³¹



"May I present? Our boiler . . . fully customized, completely automatic, hyperefficient!" Mr. Wagner boisterously presents the best part of the house. . . . which impresses his friends and arouses a little admiration." Extracted from Kristian Klaas, *...natürlich Zentralheizung: Wärme und warmes Wasser rund um die Uhr* (Hamburg: Gütersloher Verlagshaus, 1971), 66. Quote translated by Brady Fauth.

The relationship between heating and emancipation is certainly as ambivalent as the one between household electrification and emancipation.³² On the one hand, gender roles became entrenched, with societies increasingly divided into public (supposedly male) and private (supposedly female) spheres. On the other, district heating made it easier for women to live more independently because the time-consuming, exhausting job of keeping homes warm was no longer their responsibility. These new forms of heating facilitated practices of separation and individualization.³³ Not long after the turn of the century, heating and ventilation specialists were hard at work planning bathing facilities—with amenities like wave machines—for “all the nervous and overworked people (in our restlessly hurrying age), office officials suffering from constipation, and people trying to maintain slim physiques out of professional consideration or vanity.”³⁴ Soon thereafter, ads for ovens that heated water for individual bathtubs at home increased, the implication being that people preferred to bathe alone. Heating soon became a commodity to be experienced individually. Warmth was increasingly perceived as something that could be taken for granted, or even as a right, especially since people had become accustomed to uniform, readily available municipal and state-heated spaces.

After their tour through the tunnels of the Royal District Heating and Electricity Plant, other attractions awaited the participants of the Dresden Congress in 1903. Visitors were shown the heating and ventilation systems of two hospitals and a civic school and received a guided tour of the Erste Deutsche Städteausstellung (First German City Exhibition), which presented smoke- and soot-preventing combustion systems as well as the latest, decorated radiator models. Finally, elegant Landau carriages chauffeured the specialists and their wives through the city to the “Balcony of Dresden”—the Luisenhof restaurant on the slopes of the upper Elbe in Loschwitz. From there, they could not only enjoy the fresh air but also the view of the towers and chimneys of the city in the distance.³⁵ According to eyewitness accounts, they may have only “seldom and at most for a period lasting a half to a whole minute” seen “a slight cloud of smoke” emitted from the heating plant.

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Notes

¹ R. Trautmann, “Königliches Fernheiz- und Elektrizitätsheizwerk zu Dresden,” *Glaser's Annalen für Gewerbe und Bauwesen* 52–53, no. 626 (1903): 25–33; Frank Uekötter, *Von der Rauchplage zur ökologischen Revolution: Eine Geschichte der Luftverschmutzung in Deutschland und den USA 1880–1970* (Essen: Klartext Verlag, 2003), 48.

² Dresden followed the example of Lockport, New York. In 1908, there were already 57 district heating systems in the US, two-thirds of which were based on combined heat and power generation. Klaus W. Usemann, *Entwicklung von Heizungs- und Lüftungstechnik zur Wissenschaft. Hermann Rietschel. Leben und Werk* (Munich: Oldenbourg Wissenschaftsverlag, 1993), 360.

³ Eugen Kalkschmidt, “Die Großstadt von 1871 bis zur Jahrhundertwende,” in *Das alte Dresden: Bilder u. Dokumente aus 2 Jh.*, eds. Erich Hänel and Eugen Kalkschmidt (Munich: Franz Hanfstaengl, 1925), 294–300, 295–96. Unless otherwise noted, all translations are by Lucy Jones.

⁴ As an example of the extensive literature on the new history of infrastructure, see Elizabeth Shove and Frank Trentmann, *Infrastructures in Practice: The Dynamics of Demand in Networked Societies* (New York: Routledge, 2019); Dirk van Laak, *Alles im Fluss: Die Lebensadern unserer Gesellschaft—Geschichte und Zukunft der Infrastruktur* (Frankfurt am Main: S. Fischer Verlag, 2018); Stephen Graham and Colin McFarlane, eds., *Infrastructural Lives: Urban Infrastructure in Context* (New York: Routledge, 2015); Nikhil Anand, Akhil Gupta, and Hannah Appel, eds., *The Promise of Infrastructure* (Durham: Duke University Press, 2018); Matthew Gandy, *The Fabric of Space: Water, Modernity, and the Urban Imagination* (Cambridge, MA: MIT Press, 2014); Per Högselius, Arne Kaijser, and Erik van der Vleuten, *Europe's Infrastructure Transition: Economy, War, Nature* (London: Palgrave Macmillan, 2015); Jens Ivo Engels and Alfred

Nordmann, eds., *Was heißt Kritikalität? Zu einem Schlüsselbegriff der Debatte um Kritische Infrastrukturen* (Bielefeld: transcript Verlag, 2019).

⁵ Joachim Radkau, *Natur und Macht: Eine Weltgeschichte der Umwelt* (Munich: Grin Verlag, 2002), 16.

⁶ Exceptions to the nineteenth-century heat supply: Sean Patrick Adams, *Home Fires: How Americans Kept Warm in the Nineteenth Century* (Baltimore: Johns Hopkins University Press, 2014). On the change toward comfort, see also: Ruth Oldenziel and Mikael Hård, eds., *Consumers, Tinkerers, Rebels: The People Who Shaped Europe* (London: Palgrave Macmillan UK, 2013); Elizabeth Shove, *Comfort, Cleanliness and Convenience: The Social Organization of Normality* (Oxford: Berg Publishers, 2004). On central heating and district heating, see the articles by Anna Carlsson-Hyslop and Charlotte Johnson in Elizabeth Shove and Frank Trentmann, eds., *Infrastructures in Practice: The Dynamics of Demand in Networked Societies* (New York: Routledge, 2019); Mogens Rüdiger, "The Breakthrough of the 21 Degrees Culture in Denmark: Undoing and Doing Gender in Dansk Home Making after 1945," *Journal of Energy History/Revue d'Histoire de l'Énergie*, no. 6 (2021): 6, energyhistory.eu/en/node/270; Lenneke Kuijer and Matt Watson, "That's When We Started Using the Living Room: Lessons from a Local History of Domestic Heating in the United Kingdom," *Energy Research & Social Science* 28 (June 2017): 77–85, <https://doi.org/10.1016/j.erss.2017.04.010>.

⁷ Vera Eckert and Tom Sims, "Energy Crisis Fuels Coal Comeback in Germany," *Reuters*, 16 December, 2022, <https://www.reuters.com/markets/commodities/energy-crisis-fuels-coal-comeback-germany-2022-12-16/>.

⁸ Sociological and political science studies to date primarily focus on the phenomenon of fuel poverty. Damiana Salm is currently researching this area from a historical perspective at the University of Freiburg. See also Frank Trentmann and Anna Carlsson-Hyslop, "The Evolution of Energy Demand in Britain: Politics, Daily Life, and Public Housing, 1920s–70s," *The Historical Journal* 61, no. 3 (2018): 807–39, <https://doi.org/10.1017/S0018246X17000255>.

⁹ See, for example, statistics from Eurostat, "Energy Use in Households in 2020," 17 June 2022, <https://ec.europa.eu/eurostat/statistics-explained/index.php?oldid=534412>.

¹⁰ Rüdiger, "The Breakthrough of the 21 Degrees Culture in Denmark." This data is, of course, only an indication and not all apartments reach these temperatures. The temperature perceived as pleasant also depends on gender, age, clothing, and state of health. Irene Pallua, "A Healthy Climate for Swiss Homes: The Medicalisation of Indoor Climate in the Late 19th C.," *Journal of Energy History/Revue d'Histoire de l'Énergie*, no. 7 (2022), 1–21, p. 9, energyhistory.eu/en/node/295; Executive Committee, ed., *Bericht über die vom 3. bis 5. Juli 1905 in Hamburg abgehaltene 5. Versammlung von Heizungs- und Lüftungsfachmännern* (Munich: R. Oldenbourg, 1906), 18; Roger Fouquet, *Heat, Power and Light: Revolutions in Energy Services* (Cheltenham: Edward Elger, 2008), 70, 81; Hermann Recknagel, Eberhard Sprenger, and Ernst-Rudolf Schramek, *Taschenbuch für Heizung und Klimatechnik. Einschließlich Warmwasser- und Kältetechnik* (Munich: Oldenbourg Wissenschaftsverlag, 1999), 51.

¹¹ Hans Rocha IJzerman, *Heartwarming: How Our Inner Thermostat Made Us Human* (New York: W. W. Norton, 2021).

¹² IJzerman, *Heartwarming*, 53. It can get really hot in a crowded Antarctic penguin colony: at the center, temperatures of up to 37.5 degrees Celsius can be reached. *Ibid.*, 39.

¹³ Annette Kehnel, "Heizen, Kleidung, Rituale: Was wir vom Mittelalter lernen können," *Der Spiegel*, 27 December 2022, <https://www.spiegel.de/psychologie/annette-kehnel-uebers-energiesparen-was-wir-vom-mittelalter-lernen-koennen-a-bf571533-2ea2-4f11-9dea-e7b0313206a4>.

¹⁴ IJzerman, *Heartwarming*.

¹⁵ Brian Larkin, "The Politics and Poetics of Infrastructure," *Annual Review of Anthropology* 42 (2013): 327–43, <https://doi.org/10.1146/annurev-anthro-092412-155522>.

¹⁶ Congressional Committee, eds., *XI. Kongress für Heizung und Lüftung, 17.–20. September 1924 in Berlin* (Munich and Berlin: R. Oldenbourg, 1925), 14.

¹⁷ Executive Committee, eds., *Bericht über den vom 25. bis 28. Juni 1913 in Cöln am Rhein abgehaltenen IX. Kongress für Heizung und Lüftung* (Munich and Berlin: R. Oldenbourg, 1913), 85.

¹⁸ Trautmann, "Königliches," 25.

¹⁹ Finkelnburg, Göttisheim, August Hirsch, Hobrecht, A. W. v. Hofmann, M. v. Pettenkofer, M. Pistor, Roth, A. Spiess, and v. Winter, eds., *Deutsche Vierteljahrsschrift Für Öffentliche Gesundheitspflege* (Braunschweig: Friedrich Vieweg und Sohn, 1888), 177.

- ²⁰ Konrad Hartmann, Dr. Renk, and Hermann Rietschel, eds., *Bericht über die vom 23.-25. Juli 1903 in Dresden abgehaltene IV. Versammlung von Heizungs- und Lüftungsfachmännern* (Munich and Berlin: R. Oldenbourg, 1903), 105.
- ²¹ Hartmann, Renk, and Rietschel, *IV. Versammlung von Heizungs- und Lüftungsfachmännern*. The Kingdom of Saxony (1806-1918) was one of the pioneers of German industrialization, particularly due to its textile production.
- ²² See Uekötter, *Von der Rauchplage zur ökologischen Revolution*, 116-17.
- ²³ Hartmann, Renk, and Rietschel, *IV. Versammlung von Heizungs- und Lüftungsfachmännern*, 71.
- ²⁴ See Pritchard, *Toward*, 238.
- ²⁵ Usemann, *Entwicklung*, 387.
- ²⁶ Hartmann, Renk, and Rietschel, *IV. Versammlung von Heizungs- und Lüftungsfachmännern*, 58; Executive Committee, *5. Versammlung von Heizungs- und Lüftungsfachmännern*, 38.
- ²⁷ Executive Committee, *IX. Kongress für Heizung und Lüftung*, 185.
- ²⁸ See Ursula Offenberger and Julia C. Nentwich, "Home Heating and the Co-construction of Gender, Technology and Sustainability," *Kvinder, Køn & Forskning*, no. 3-4 (2009): 83-89, <https://doi.org/10.7146/kkf.v0i3-4.27976>.
- ²⁹ Executive Committee, ed., *Bericht über den vom 12. bis 14. Juni 1911 in Dresden abgehaltenen Kongress für Heizung und Lüftung: VIII. Versammlung von Heizungs- und Lüftungsfachmännern* (Munich and Berlin: R. Oldenbourg), 112, 113.
- ³⁰ Executive Committee, *5. Versammlung von Heizungs- und Lüftungsfachmännern*.
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- ³² See Abigail Harrison Moore and Ruth Sandwell, eds., "Women and Energy," *RCC Perspectives: Transformations in Environment and Society* 2020, no. 1, <https://doi.org/10.5282/rcc/9049>; Abigail Harrison Moore and R. W. Sandwell, eds., *In a New Light: Histories of Women and Energy* (Montreal: McGill-Queen's University Press, 2021).
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THE SLOW DEATH OF AN ETHIOPIAN LAKE

Hayal Desta

Springs

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Hayal Desta

I first had the opportunity to visit Lake Ziway when I studied biology as an undergraduate at Addis Ababa University, Ethiopia, in the mid-1990s. Locals fished the lake, and it served as a source of water for the residents of the nearby town, Batu, formerly known as Ziway. Back then, no investment projects had begun in the lake area. The waterfront was covered in acacia vegetation, making it nearly impossible to see from a distance.



Fig. 1. © Hayal Desta. All rights reserved.

When I returned to the area in 2012, the vegetation around the lake had disappeared. The Meki River, which feeds into Lake Ziway, had experienced a drastically reduced flow and occasionally ran dry. The lake had receded from where it was in the 1990s, and the retreated area had been turned into farmland. Fifteen years after my first visit, Ziway was ringed by flower farms, resort hotels, and irrigated land.

Located in the Great East African Rift Valley (also known as the Afro-Arabian rift) region, 160 kilometers south of Addis Ababa and 1636 meters above sea level, Lake Ziway covers an area of 434 square kilometers. Its shoreline is 137 kilometers long within a watershed of 7300 square kilometers. The lake has two feeder rivers—Katar River from the southeastern and Meki from the northwestern direction—and one outlet, the Bulbula River. The five islands in the lake are Tulu Gudo, Tsedecha, Gelila, Funduro, and Debre Sina. On each of them are monasteries of the Ethiopian Orthodox Church. Except for Debre Sina, all are inhabited by the Zay people, believed to have

populated the islands of Lake Ziway between the early fourteenth and the middle of the seventeenth century.¹ The marshes around the lake are also home to several intra-African species of waders as well as cormorants, ducks, herons, cranes, and geese.² In total, the region encompasses about 50 percent of the country's bird species and diverse aquatic species.

The lake benefits the livelihoods of many of the poor local communities—some extremely impoverished households could not survive without Ziway.

The many ecological resources Lake Ziway offers to the local population propel socio-economic development in the region. In 2012-13 and 2014-15, I conducted surveys among heads of households in the communities of Batu and Meki towns. In the 2014-15 survey, all 635 interviewees stated that the lake benefits the livelihoods of many of the poor local communities—some extremely impoverished households could not survive without Ziway. Moreover, some local communities depend on the lake for animal husbandry, grass and reed gathering such as typha and papyrus for mattress making, house thatching, collecting wetland plants for handicraft-making, or small-scale trading of cooked fish and other resources extracted from this body of water.



Fig. 2 and 3: Some of the provisioning services of Lake Ziway to the local communities. © Hayal Desta. All rights reserved.

Other sources of income for the local communities are full-time jobs in the fishing industry and on flower, irrigated crop, or vegetable farms.³ Lake Ziway is one of the main sources of fish supply to the major market centers in the country, Addis Ababa and Adama.⁴ A large number of fishers organized into cooperatives, including women and children, engage in fish processing and marketing in the lake area. The lake also provides a source of water for open and closed farm irrigation in the region. Vegetables, the main local products—tomatoes, peppers, cabbage, and onions—are cultivated and shipped to different parts of the country.

Additionally, Lake Ziway supports various cultural ecosystem services, including aesthetic and spiritual practices as well as educational, recreational, and tourist activities, such as visiting the monasteries on the islands and bird watching. Among the spiritual rituals that local communities perform on the shores of this lake are the annual festival of Epiphany, which is observed on 19 January by Orthodox Church followers, and Irreecha, a thanksgiving holiday celebrated by the Oromo people in September, when the Ethiopian New Year begins. In the local Irreecha tradition, it is customary to scatter freshly cut green grass and flowers in a lake or river and sprinkle them with the lake's water.



Fig. 4: Priests carrying the Ark of the Covenant to celebrate the religious Epiphany ceremony at the shore of Lake Ziway. © Authority for Research and Conservation of Cultural Heritage (ARCCH), Ethiopia, 2018, with the permission of UNESCO.

Importantly, the lake is a major source of water for profit-driven private companies, especially the flower industry, which started to set up businesses in Ethiopia in the late 1990s. Since that time, foreign investment, mainly from the Netherlands, the United Kingdom, and India, has been growing and currently controls ownership of most of the more than 100 flower companies in the country. The remainder of the industry is financed by domestic and joint investors. Ethiopia has now become one of the main exporters of cut flowers—the second largest in Africa and the sixth in the world. Because of the Rift Valley region’s favorable agroclimatic conditions, vast fertile land, and its freshwater resources, the sector is rapidly developing.

Among the various flower companies in the region, one of the largest rose growers in the world and the biggest supplier to Europe, Sher Ethiopia PLC, was established here in June 2005. The company owns 700 hectares of land on the shores of Lake Ziway. It mainly produces roses and covers 65 percent of the total exports in the sector, especially to the European markets. Besides generating foreign exchange, the flower industry has created employment for more than 12,500 workers, most of whom are women.



Fig. 5: Worker at Sher Ethiopia PLC. © Adriano Marzi. All rights reserved.

Although the growth of the cut-flower sector provides numerous employment opportunities and demonstrates the lake's overall value to the local economy, this benefit comes with a cost: one of the major environmental concerns of the cut-flower industry is its enormous consumption of water from Lake Ziway and the corresponding deterioration of the water quality. The industry extracts 115,517 liters of water per day from the lake using electric pumps.⁵ Compared to an average daily per capita water consumption of 40 liters in Addis Ababa,⁶ this amount could cover the water needs of 2,888 individuals.

Ethiopia is one of the most land- and water-grabbed countries in the world, with more than one million hectares of land seized underhandedly (2.13 percent of the global grabbed land and 0.91 percent of the country's area) and 15.74 billion cubic meters of water grabbed, mainly by foreign investment.⁷ Flower companies are a major contributor to this problem.



Fig. 6: Employee transporting freshly cut roses to processing room at AQ Roses PLC farm near Ziway, Ethiopia. Photo by Apollo Habtamu/IWMI, 2015. [CC BY-NC-ND 2.0](#).

Agrarian practices are expanding significantly in the area due to infrastructure improvements, an increase in population, and an investment policy that encourages foreign capital outlay in agriculture through incentives such as exemptions from customs duty and income tax.⁸ All of this means the number of water users of the lake is increasing. The commercial flower farms, various agricultural cooperatives, the drinks industry, and fishermen's associations are all located 10 to 300 meters from the lakeshore—among them, Sher Ethiopia PLC, Ziway Rose, BGI Ethiopia (Castel Winery/Ziway), a subsidiary company of BGI (Brasseries et Glaciers Internationals), and Batu Fishery Research Center. Due to the lack of regulation efforts to control and monitor water extraction, all of them excessively use the water of the lake and its feeder rivers for irrigation.

In all probability, such uncontrolled water extraction will continue to increase in the years to come. If such excessive water extraction and usage persist, it is estimated that the water level of Lake Ziway may be used up within seven decades.⁹ The lake's disappearance would have major repercussions for the local residents. In my 2012-13 survey, members of the local communities stated that the human pressure on Lake Ziway was higher than on any other lake in the Ethiopian Central Rift Valley.¹⁰

If the excessive water extraction and usage persist, it is estimated that the water level of Lake Ziway may be used up within seven decades.

As a result of reduced rainfall and rising temperatures, the lake's watershed is already one of the areas in the country most vulnerable to climate change. The impact of global warming further leads

to declining fish catches, which are again propelled by uncontrolled and excessive fishing practices and water-quality degradation.¹¹ As is the case with water extraction, there is no control of overfishing. In my interviews, local fishermen said that the number of fish in the lake is steadily decreasing, and fish farming is no longer a reliable source of income, prompting the local population to look at other sources of livelihood to compensate for the loss.

Compared to other Ethiopian lakes, human-caused pollution is disproportionately high in Lake Ziway. When studying the ecosystem of the lake in 2013, I was an eyewitness to the effects of the flower industry, which drew freshwater from the lake and discharged untreated wastewater directly back into it (Figure 8). The agrochemical runoff from flower farms all around the watershed is one of the main causes of water-quality deterioration in the lake.¹² The presence of water hyacinth infestation along the western shoreline indicates eutrophication, which occurs when agricultural development activities increase surrounding a lake.¹³



Fig. 7 and 8: Electric pumps to remove water from the lake and wastewater discharge to Lake Ziway from floriculture industries. © Hayal Desta. All rights reserved.

Until quite recently, Lake Ziway was the only source of water for Batu residents. In 2018, when the Batu municipality realized that the water quality was deteriorating,¹⁴ they stopped supplying water from the lake to the residents. This has created a scarcity of water in the town, with the municipality spending more to supply water from remote areas. Yet everyone in the area—companies and individuals—still has free and unlimited access to the lake and its water for various economic activities.

Besides other causes, the deterioration of the lake also comes from a lack of awareness of sustainable resource utilization and protection. In my interviews, a small percentage of the local residents expressed their fear of the lake running dry. The great majority did not seem to realize the consequences of uncontrolled water extraction on the lake's sustainability; 20 percent did not fully understand, and 47 percent could not make any predictions about the future of the lake.¹⁵ The local population is not hostile to the lake, but their livelihood-based activities have an impact. There is a need to raise awareness among these communities so that they can better understand the problems the lake is facing, and then work to create community-based solutions that would alleviate the unwanted action imposed on Ziway and its vital natural resources.



Fig. 9: Lake Ziway, Ethiopia. © Hayal Desta. All rights reserved.

Overexploitation, pollution in the lake, population growth, urbanization, and increased water extraction threaten Ziway's existence.¹⁶ Recognizing the problems, the Batu city municipality conducted a study in 2014 through a consulting firm with funding from the Horn of Africa Regional Environment Centre and Network.¹⁷ The study advised the municipality to implement a buffer zone on the eastern side of the lake, which suffers from high human activity, but nothing has come to fruition so far.

Governmental bodies should play a meaningful role, and they should attempt to involve all stakeholders in implementing the principles of lake sustainability.

To prevent further degradation and to promote the sustainable use of the lake within the framework of environmental justice, it is necessary to allow local actors to participate in the shared responsibilities. Governmental bodies should play a meaningful role, and they should attempt to involve all stakeholders—most importantly, profit-based private companies, and the local communities who use the lake's resources to meet the demands of their livelihoods, as well as farmers cooperatives, non-governmental organizations, and key informants—in implementing the principles of lake sustainability.¹⁸ As stated in Principles 1 and 6 of the *World Lakes Vision* by the International Lake Environment Committee Foundation and the United Nations Environment Programme, "a harmonious relationship between humans and nature is essential for the sustainable use of lakes,"

and “citizens and other stakeholders should be encouraged to participate meaningfully in identifying and resolving critical lake problems.”¹⁹ Regarding the future use and management of Lake Ziway, it is first necessary to identify the impact of investment projects around the lake on its ecological balance. All parties, especially for-profit investment companies, should adhere to water-use standards. Those who make short-term profits by using the lake’s resources should consider the long-term environmental costs. Otherwise, Lake Ziway will soon be history.

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HUMAN OVERPOPULATION: THE ELEPHANT IN THE GREENHOUSE

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Helen Tiffin

Unlike plagues of the dark ages or contemporary diseases we do not yet understand, the modern plague of overpopulation is soluble by means we have discovered and with resources we possess. What is lacking is not sufficient knowledge of the solution but universal consciousness of the gravity of the problem and education of the billions who are its victims.¹

Martin Luther King, Jr.

When it comes to the environmental crisis, human overpopulation remains a topic discreetly avoided in public debate. But, as Reverend Martin Luther King, Jr., Jane Goodall, and Sir David Attenborough have stated, unchecked human population growth and its planetary consequences will have increasingly dire repercussions. Why, then, has the subject of human population not been more urgently discussed? Why have many of those involved in climate-change discussions—including the World Climate Summit conventions—neglected the topic of human overpopulation?



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Human overpopulation has been repeatedly dismissed as a fundamental cause of climate change in favour of other issues, particularly overconsumption in the Global North, leading to land, water, and air pollution, biodiversity loss, and accelerated extinctions of other species. Population growth has been ignored in favour of blaming the pursuit of prosperity: the acquisition of wealth and goods, the myth of unending resources, the shibboleths of “development” and “progress,” technology-driven accumulation, and the capitalist orthodoxy of relentless economic “improvement.” Rampant

individualism and the increased privatisation of local or national “commons” continue to catalyse overconsumption, which is, of course, also a major driver of climate change.

Population growth has been ignored in favour of blaming the pursuit of prosperity.

No longer solely confined to the Northern Hemisphere, overconsumption also affects the Global South, which increasingly aspires to, and where possible, participates in, capitalist consumption. Modi’s India, South and Central America, and an expansionist China, as well as regions of the African continent, pursue consumerist aspirations, inducted into what David Brooks terms “saturation capitalism.”²

But consumption depends on consumers. The world population has increased from 2.5 billion in 1950 to a staggering 8 billion in November 2022. As David Attenborough has stated, “all environmental problems become easier to solve with fewer people, and harder and ultimately impossible to solve with ever more people.”³ Radical differences exist between population numbers and growth rates in rich and poor nations. Nevertheless, the latest United Nations report estimates that by 2050 the world population will reach 9.7 billion.⁴ And as *Population Matters* notes: “In the UK, each one of us is responsible for nearly 8.34 tonnes of CO₂ per year . . . : a growing population counteracts the benefits of other crucial climate actions, and choosing smaller families is vital if we are to ensure that the changes we make are effective and lasting.”⁵

Of course, not all people have reproductive choice. In the Global North, those who do have the luxury to choose should be insisting on a frank and open discussion of the connections between reproductive and global health, and move, individually and communally, towards setting the example of having one child, or at most, two children.

In part, apparent statistical anomalies have stymied the discussion of overpopulation, with declines in birth rates often interpreted as declines in absolute population. Furthermore, on average, birth rates in the Global North have declined faster than in the Global South, and activists have largely avoided stepping onto the thin ice of a discussion of global population reduction. But while fertility rates and births have fallen in some Western countries, absolute population continues to grow, albeit at a slower pace than in other parts of the globe. The reluctance to discuss population, or for individuals to choose to limit their numbers of descendants, continues to inhibit viable solutions.

Seeking to reduce future population numbers does not diminish the sanctity of human lives and rights as set out in the United Nations Charter.

The perception that curbing the human population threatens human rights stems from a misunderstanding of what reducing a future population might involve. Controlling birth rates raises the spectres of eugenics and genocide, anathema to the ideals of human rights. Population stability or reduction may also seem to devalue, or even threaten, the lives of those already here. However, does asking people to consider reducing the number of children they produce violate their human rights? Seeking to reduce future population numbers does not diminish the sanctity of human lives and rights as set out in the United Nations Charter. If an individual is not subject to state- or group-controlled imposition or compulsion, their personal decision to have one or, at most, two children should be seen as a sensible, environmental choice, not a violation of human rights.

Furthermore, taking account of human rights should not sideline the rights of other living beings on our planet. Human existence and well-being are interwoven with other organisms and ecosystems of the world. Our anthropocentric attitudes not only drastically harm nonhumans but ultimately damage humans through the degradation and disappearance of nonhuman ecologies.

One widely held theory asserts that the education of women will necessarily lead to a decline in population, but in many parts of the Global South, women's education and liberation from patriarchal regimes and cultures remain long-term aspirations. Even in the Global North, apparently unrelated cultural, religious, political, and economic agendas threaten women's reproductive rights as demonstrated in the overturning of *Roe v. Wade* by the US Supreme Court in 2022. In sum, the impact of overpopulation, and its influence on women's lives, needs to be addressed on a global scale.



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Discussions of human overpopulation have a long and controversial history. Thomas Malthus's *An Essay on the Principle of Population*, published in 1798, generally regarded as the first modern text to address the issue, has been interpreted, misinterpreted, and sometimes employed in contradictory ways. Certainly, the mention of Malthus's name immediately conjures associations with human population numbers, whether positive or negative. As Robert J. Mayhew in his introduction to Malthus's *Essay* (2015) points out, the economist's "historical power and importance rests precisely in the fact that people don't have to read him to invoke his name" and his reputation as a "prophet, variously false or visionary."⁶

The mention of Malthus's name immediately conjures associations with human population numbers, whether positive or negative.

Responding to William Godwin's claim that as civilisation advanced, sexual desire would wither, Malthus argued that desire would not decline and that human beings needed food to survive. Population, when unchecked, increases in a geometrical ratio while food production increases only in an arithmetical ratio. The difficulty arises in balancing population and food resources. In his own time, Christians, and later many Romantic poets subjected Malthus's *Essay* to intense criticism, arguing against what they saw as a ("Malthusian") materialism where food, clothing, and housing appeared the only necessities for "the perfectibility of mankind." Yet nineteenth-century materialists like Marx and Engels, though indebted to Malthus's ideas, particularly the boom and bust cycles inherent in capitalist ideology, rejected his tendency to regard these as "natural." Instead, they argued that "the harmonious society" that would come with the arrival of communism in Europe "would be able to regulate the production of human beings."⁷

However, the Christian and Communist hostility to Malthus did not end with Marx and Engels, but became embedded in state socialisms as well as capitalist ideologies.⁸ For example, in the case of China, Mao in 1949 dismissed the idea that food cannot keep up with increases in population as the "absurd argument of a bourgeois Westerner."⁹ The subsequent Chinese famine of the 1950s, during which millions starved to death, radically changed this position, leading eventually to China's one-child policy. More recently, Mao's original idea of uninhibited population growth seems to have resurfaced, perhaps (ironically), through China's state and private global capitalist expansionism,

guaranteeing the country access to world food supplies and other (supposedly) essential commodities in the future.

Despite many nineteenth-century detractors, Malthus also had supporters amongst many economists. And as Alfred Russel Wallace writes, he and Charles Darwin, in “formulating one of the most important nineteenth-century revolutions in human thought, had been inspired by beetle-collecting, travel, and a shared encounter with Malthus.” The latter was “the spark that lit the fire,” and Darwin directly references Malthus in *On the Origin of Species* (1859).¹⁰



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More recent detractors of Malthus have concentrated on the argument that Malthus's prognoses have still not really come to pass. Human reasoning and technological skill have averted food crises and the consequences Malthus predicted. But as the British philosopher John Gray suggests, “Malthus explains the future of global warfare in the twenty-first century far more effectively than the discussions of the clash of political or religious ideals, while Niall Ferguson has told us in the context of both rising food prices and increased price volatility not to count Malthus out too soon.” Even more “sober economists” such as Nobel laureates Paul Krugman and Joseph Stiglitz have acknowledged that “whereas they could dismiss Malthusian fears about the balance between population and resources over the previous three decades, present statistical data leaves them much less confident.”¹¹

When Paul and Anne Ehrlich published *The Population Bomb* in 1968, they also experienced some of the unfounded prejudices levelled against Malthus's writing and energised new concerns, again sparking both global support and outrage. Along with warning against the potential effects of an exponential increase in global population, their suggestions for ameliorating the coming crisis seemed to many both draconian and racist. While issues of class had dogged the reception of Malthus's essay, some of the Ehrlichs' proposals, such as cutting aid to countries of the Global

South—already facing the challenge of balancing food supply with rapidly increasing populations—were regarded as unfair. The Ehrlichs thus joined Malthus as both prophets and “fascists.” The unfortunate hijacking of their text to advance racist, eugenicist, and other toxic agendas further stifled discussion of the role of population growth in the attempt to address climate change, species extinction, and planetary impoverishment.

Some governments have tried to stem population growth, but failed—India, for instance, and China in particular. The deleterious consequences of the one-child policy instituted as a response to the great famine, failed for a very different reason—the cultural preference for male over female children. The resulting infanticide and a disturbing gender imbalance led to the abandonment of the policy after a small, short-term decline in population.



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Having failed to curb its population growth, China’s current imperial expansionism, including massive acquisition of the world’s land and food resources, serves as a rearguard action in response to this domestic failure, designed to shore up a future for China in a world of human overpopulation, where the scarcity of land, food, and general resource commodities lead to international scarcity and ultimately war. The failures of the one-child policy support arguments against governmentally imposed population control, and as *Population Matters* highlights, future top-down attempts of this nature are not likely to be viable anyway.¹²

In Japan, where the birth rate (but not the overall population) is indeed declining, maintaining a capitalist economy remains the main concern, an always rising population regarded as necessary to the overweening economic interest. Because of the low level of migration to Japan, the feared population deficit raises the spectre of GDP downgrade. Japan’s apparent population decline is often (erroneously) cited as a disturbing harbinger for capitalist economies worldwide.

In some European states, political regimes have begun to employ nationalist and racist strategies. Fears of depopulation have led to the “remedy” of encouraging large families, specifically linked with anti-migration policies by right-wing populist governments. In Hungary, for example, Victor Orbán has promised a lifetime tax exemption for families with four or more children; however, his much vaunted “family-friendly” Hungary extends from his government’s anti-migration policies. In his 2019 State of the Nation address, Orbán said of the more migrant-friendly European nations: “They want as many migrants to enter as there are missing kids, so that the numbers will add up. We Hungarians have a different way of thinking. Instead of just numbers, we want Hungarian children. Migration for us is surrender.”¹³

Overpopulation cannot be addressed through nationalist or racist agendas but must be tackled on a global scale.

In both Russia and Poland, state-sponsorship measures have also been instituted to encourage large (non-migrant) families. As Putin puts it, “Russia’s fate and its historic prospects depend on how many of us there are . . . It depends on how many children are born in Russian families.” Italy and Greece have also introduced baby bonuses, and Australia, under Tony Abbott’s mercifully short leadership, did likewise. In 2017, the UN estimated that by 2100, the population of West Africa will grow from 372 million to 1.6 billion.¹⁴ This generally unwarranted spectre of national depopulation

now drives prejudice against African and Asian migrants, displaced by wars and climate change, arguably themselves products of world overpopulation.

Overpopulation, a global problem, cannot be addressed through nationalist or racist agendas, but must be tackled on a global scale as the displacement and movements of peoples, whether through war, climate crises, hunger, or lifestyle aspirations, have begun to render overpopulation a potentially lethal force. The victims of overpopulation not only include *Homo sapiens* but also the myriad of other beings on which our ultimate survival depends.

While measures such as education and the availability of contraception will ameliorate overpopulation, a long-term solution will only happen if the public addresses the fundamental human cause of the global environmental crises. Government education campaigns focussing on the threats overpopulation poses might offer a way forward, as long as they stay absolutely clear of nationalist arguments and racist sentiment, as in the rhetoric of Putin and Orbán. Open discussion must first take place, an acknowledgment of our fatal anthropocentrism and a radical reorientation towards life on a shared planet. As Jane Goodall says, "We can't go on like this—we can't push human population growth under the carpet."¹⁵

Notes

¹ Martin Luther King, Jr., "Family Planning—A Special and Urgent Concern," speech for the Planned Parenthood Federation Award, 5 May 1966, <https://www.plannedparenthood.org/planned-parenthood-gulf-coast/mlk-acceptance-speech>.

² David Brooks, *Animal Dreams* (Sydney University Press, 2021), 53.

³ *David Attenborough: A Life on Our Planet*, directed by Jonnie Hughes (Bristol and Gland: Silverback Films and World Wildlife Fund [WWF], 2020).

⁴ "World Population to Reach 8 Billion This Year, as Growth Rate Slows," *UN News*, 11 July 2022, <https://news.un.org/en/story/2022/07/1122272>.

⁵ "Big Baby Calls for Small Families to Cut CO₂," *Population Matters*, Spring 2020, 9, <https://populationmatters.org/resources/population-matters-magazine-spring-2020/>.

⁶ Robert J. Mayhew, introduction to *An Essay on the Principle of Population and Other Writings*, by Thomas Malthus, ix–xxviii (London: Penguin Classics, 2015), vii. I am heavily indebted to Mayhew's introduction for present and historical receptions of Malthus's Essay.

⁷ *Ibid.*, xxix, xiii, xxx.

⁸ *Ibid.*, xxix.

⁹ *Ibid.*, xxix, xxx.

¹⁰ *Ibid.*, xxxi.

¹¹ *Ibid.*, viii.

¹² Robin Maynard, "From the Director: Tackling the Trickiest Subjects," *Population Matters*, Spring 2020, 3, <https://populationmatters.org/resources/population-matters-magazine-spring-2020/>.

¹³ Shaun Walker, "Baby Machines: Eastern Europe's Answer to Depopulation," *The Guardian*, 4 March 2020, <https://www.theguardian.com/world/2020/mar/04/baby-bonuses-fit-the-nationalist-agenda-but-do-they-work>.

¹⁴ Walker, "Baby Machines."

¹⁵ Jane Goodall, *Population Matters*, Spring 2020, 11, <https://populationmatters.org/resources/population-matters-magazine-spring-2020/>.

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THE ISTHMUS OF PANAMA AND THE KNOWLEDGE ANTHROPOCENE

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In the final chapter of *Man and Nature*, his landmark 1864 study of an earth transformed by human action, George Perkins Marsh looked ahead to a series of “projected or possible geographic changes by man,” including the “cutting of marine isthmuses.” He had in mind efforts like the Suez Canal, then under construction, which he celebrated as “the greatest and most truly cosmopolite physical improvement ever undertaken by man.” While Marsh was an early critic of the human capacity to upset nature’s harmonies, and the founder of a modern conservation movement aimed at blunting human improvidence, he could be surprisingly sanguine about such megaprojects. As his biographer David Lowenthal noted, Marsh “was an absorbed observer—now admiring, now alarmed—of huge engineering works.” Indeed, *Man and Nature*, though a cautionary book, often praised humanity’s escape from the determinist powers of nature. As Marsh put it in an 1860 letter to Spencer Baird, while many leading geographers of the era taught “that the earth made man”—that human history and culture were deeply shaped by environmental forces and circumstances—his book would show that “man in fact made the earth”—that humans finally had become, as he put it in *Man and Nature*, “truly a geographical agency.”¹



Open-pit coal mine, Hambach, Germany. © Bernhard Lang. All rights reserved.

But geographical agency came with responsibility. After touting the revolutionary nature of massive canal projects, Marsh turned to the “alarming uncertainty as to the effects of joining together waters which nature has put asunder.”² His concerns focused on a proposed interoceanic canal across the Isthmus of Darién, then the Central American route favored by explorers, the US government, and the private capitalists most likely to undertake the project. Marsh wrote *Man and*

Nature at a pivotal moment in the history of the Darién scheme. A decade earlier, in 1854, the highly publicized US Darién Expedition went in search of a prophesied low route across the region. But the commander, Isaac Strain, and his party became hopelessly lost, wandering aimlessly for seven weeks in the rugged forests of the Darién. Six of his men starved to death, and the rest emerged from the jungle in dire shape. Still, the disastrous Strain expedition did not quell enthusiasm for the Darién route, as Marsh's discussion suggested. Not until the early 1870s, when Commander Thomas O. Selfridge Jr. led another US Navy expedition to the region and made it clear that such an easy route was a chimera, would the proposed Darién canal fade from history.³



Return of Commander Selfridge and his Reconnaissance Party from an Expedition in the Interior of Darién. © 1870 Timothy H. O'Sullivan. Gilman Collection, Museum Purchase, 2005. [Public domain](#).

I first encountered Marsh's thoughts on the cutting of marine isthmuses, and on the Darién route in particular, while researching the history of the Panama Canal. One of the central themes of my work is how US officials and other observers boasted about the completed canal as an imperial engineering achievement that overcame a hostile tropical environment.⁴ I was curious to see what Marsh might have to say about the tropics and the capacity for human geographical agency within the region. But Marsh's concerns about the Darién canal had nothing to do with the tropics. Instead, he wrote of the threat such a canal would pose to the workings of a global climate system just coming into scientific view. Although his concerns initially struck me as outlandish, I soon realized they were rooted in a series of discoveries about the earth and its history that would make our modern concept of the Anthropocene possible. This is a story about those discoveries, told through George Perkins Marsh's musings about an unrealized canal.

Marsh assumed that the proposed Darién canal would be an “open cut between the two seas,” and he worried that the canal would inevitably be widened and deepened by an erosive ocean current flowing through it. Such a widening of the canal aperture might, in turn, change the course of the Gulf Stream, which delivered warm waters from the tropics to the North Atlantic, moderating Western Europe’s climate. A diminution of the Gulf Stream’s power, or even its wholesale redirection through the canal and into the Pacific, might result, Marsh speculated, in “an immediate depression of the mean temperature of Western Europe to the level of that of Eastern America.” He even suggested that a new “ice period” might be “occasioned by the withdrawal of so important a source of warmth from the northern zones.” The consequences of a sea-level Darién canal, he feared, would be “not inferior in magnitude to any physical revolution which has ever taken place since man appeared upon the earth.”⁵

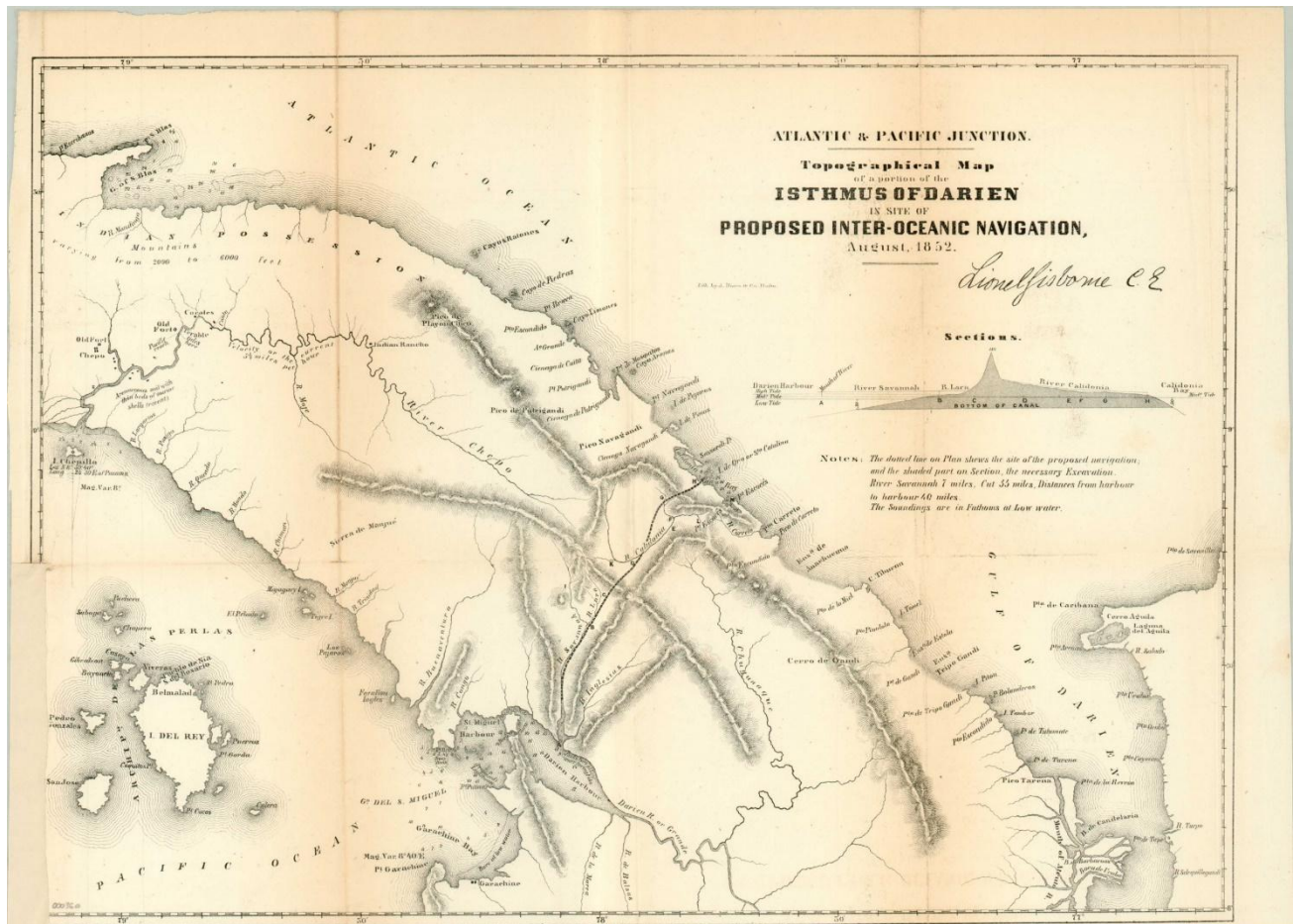
Marsh’s discussion marked a prominent early appreciation of the capacity of human actions to deflect global climate in troubling ways.

It would be easy to dismiss such fears as fabulous. Marsh clearly overestimated the scale of the proposed sea-level canal and its capacity to eat away at the isthmus and divert the Gulf Stream. But his concerns are more significant than they might appear at first blush. For one thing, his discussion, which came decades before the Swedish scientist Svante Arrhenius first suggested that human carbon emissions might warm the climate, marked a prominent early appreciation of the capacity of human actions to deflect global climate in troubling ways. And Marsh was not wrong to raise the alarm about a diminished Gulf Stream. Today we recognize the Gulf Stream, and the larger Atlantic Meridional Overturning Circulation (AMOC) of which it is a part, as critical to the earth’s climate system, a conveyor belt that pulls warm water from the tropics northward. And, as I write, the AMOC may be slowing—not because of a breach in the Panamanian isthmus but because a cold blob of water from the melting Greenland ice cap may be disrupting its flow. For very different reasons, Marsh’s mid-nineteenth-century fears have become ours.⁶

What Marsh knew about the mechanics of all of this is not entirely clear. The only reference he provides for his speculation is a lengthy quote by the German scientist Georg Hartwig and his 1857 book, *Das Leben des Meeres* (The Life of the Sea).⁷ But the Gulf Stream was a well-known phenomenon by the 1860s. Ponce de Léon first noticed the Gulf Stream’s current in 1513, and early European explorers and traders used it to their advantage. By the late 1700s, Benjamin Franklin had popularized the term “Gulf Stream” and, with his cousin Timothy Folger, charted its course as an aid to navigation. The Gulf Stream later received a thorough mapping by the antebellum US oceanographer and proslavery ideologue Matthew Fontaine Maury, who referred to it as a “river in the ocean” and used the sweeping ocean currents as one justification for imagining the Amazon as the next frontier of the American slavocracy. Maury was also among the earliest to recognize the Gulf Stream’s formative role in shaping Europe’s mild climate.⁸ And the whaler and marine scientist William Scoresby had, as early as the 1810s, used his “marine diver” to measure subsurface water temperatures in the far northern Atlantic, establishing the existence of warm water deep below the surface that helped to drive the AMOC’s overturning circulation. The AMOC’s mechanics would not be fully understood until the late twentieth century. Finally, several scientists, including biologist and geologist Louis Agassiz, had pieced together a theory of past ice ages in the decades before Marsh wrote, allowing him to imagine the climatic consequences of the Gulf Stream’s demise.⁹

Marsh likely did not know that what he feared had once been a geographical reality. By the late 1860s, scientists began to theorize that the Isthmus of Panama and the Gulf Stream had not always existed. Early evidence of such geological dynamism would soon be pieced together by the zoologist Albert Günther, and, by the fifth edition of *On the Origin of Species* (1869), Charles Darwin had taken notice of Günther’s work: “Dr. Günther has recently shown that on opposite sides of the isthmus of Panama, about thirty percent of the fishes are the same; and this fact has led naturalists to

believe that the isthmus was formerly open." Today, it is settled science that the geological formation of the Isthmus of Panama occurred several million years ago (though there is still debate about exactly when) and that it redirected tropical ocean currents into the North Atlantic, creating the Gulf Stream. Thus, while Marsh was alarmist in worrying that the Darién canal would alter major ocean currents, he was not entirely wrong about the role that the Isthmus of Panama played in shaping them.¹⁰



Topographical map of a portion of the Isthmus of Darién at the site of the proposed interoceanic navigation. Unknown creator, 1852. Courtesy of Map and Imagery Library, George A. Smathers Libraries, University of Florida. Public domain.

Marsh's speculations about the Darién canal and the Gulf Stream point to what I call a "Knowledge Anthropocene," a transformation in Western understandings of earth history. Marsh fretted about the potential effects of the proposed Darién canal amidst a rapid acceleration in knowledge about the relationship between geology, geography, ocean currents, and climate—knowledge that has become critical to our understanding of the global climate system today. His concerns were prescient in recognizing the human capacity to alter oceanic currents and affect climate; they were also part of a larger intellectual enterprise that changed our understandings of earth systems as rapidly as humans were changing the earth. In the literature on the Anthropocene—the so-called human epoch—Marsh is routinely cited as a foundational figure, one of the first people to recognize the outsized power that humans (or at least certain humans) were coming to exercise over the material environment.¹¹ "Man," as he famously put it, "was everywhere a disturbing agent." But this literature on the materialism of the Anthropocene has not always noticed the deep undercurrent of burgeoning scientific knowledge that has made our contemporary understandings of planetary human impacts possible.¹²

Fundamental to the Knowledge Anthropocene was a revolution of the understanding of deep time that developed among savants across the late eighteenth and nineteenth centuries. Transformative changes in the fields of geology and evolutionary biology led the way. As humans dug deeper into the earth, in some cases to mine and harness the fossil energy of coal, they found stratigraphic and fossil evidence of a planet, and the life upon it, that had evolved over millions, perhaps even billions, of years. This dawning appreciation for earth's deep history is, of course, well known to historians of science, but my interest here is in how this intellectual sea-change reshuffled the relationship between nature and history in Western thinking. Prior to this revolution in deep time, most assumed earth history and human history were roughly coterminous; afterwards, scientists came to understand that the earth had an unfathomably long history before humans arrived on the scene. One result is that human history and earth history were cleaved in two, a development that helped to solidify the idea that there was a nature that existed before, and even outside of, history, one that humans had become capable of dominating and disturbing.¹³

Fundamental to the Knowledge Anthropocene was a revolution of the understanding of deep time that developed among savants across the late eighteenth and nineteenth centuries.

But there was also a countervailing trend. Even as nature came to sit outside of human history, the late-nineteenth-century historian's sensibility—which was only then developing in its modern form among professionalizing historians—intruded upon the scientific study of the environment. Nature became a vast realm for studying change over time, contingency, complexity, and context—all signature features of historical thinking. Again, we see this most obviously in the fields of geology and evolutionary biology, the so-called historical sciences, but it was a broader change than that. Many scientists came to see the more-than-human world not as a product of divine creation or timeless natural laws, but of discrete events playing out over time. They came to understand that “nature is history.” While that phrase might evoke an Anthropocene world of permeating human influence, it has two other important meanings: the more-than-human world has always been a product of history, and “Nature” as a unified realm separate from the human world is an idea whose time has come and gone.¹⁴

The environmental sciences behind the Anthropocene developed not only as sciences with a historical sensibility, but also with a sense of the natural world as a multiplying series of archives. An understanding of earth's deep history developed as chronologists turned away from human sources such as the Bible and toward what we might call environmental archives. For Albert Günther, the comparative anatomies of contemporary fishes were his archive, and they helped him to imagine a past in which the Isthmus of Panama had been permeable. For others, geological strata and their embedded fossil remains told of earth events in the distant past, former regimes of life, the dynamism of species, and the reality of extinction. Historical ecologists and climatologists came to use pollen deposits, packrat middens, tree rings, and other repositories to reconstruct past landscapes and climates, while atmospheric scientists read the air bubbles in ice cores to reconstruct the atmospheres of past ages. More recently, phylogeneticists have found in DNA powerful tools for understanding the histories of species. Even human archives have sometimes become environmental archives. For instance, historians have begun working with geneticists to study the DNA in medieval manuscript parchments made from animal skins, which may allow them to answer questions not only about the manuscripts themselves but also about the history of humans and their livestock during the period. These are just some of the ways in which environmental archives have informed planetary history. The Knowledge Anthropocene has been a fundamentally archival enterprise.¹⁵



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The knowledge revolution that made our modern understandings of the Anthropocene possible has worked, albeit quite slowly, to give us a more-than-human world that is thoroughly the product of history, one that increasingly functions as a series of archival resources with which to reconstruct that history. In the process, the holy duality of Marsh's "man and nature"—the separation of nature and culture that has been so central to modernist traditions of environmental understanding—has been eroding away. We have already seen evidence of how those shifting currents have begun to alter the climate of environmental history and the environmental humanities—in Dipesh Chakrabarty's study of the collapsed distinction between natural and human history and Amitav Ghosh's call for new literary, historical, and political narratives that can imaginatively knit these realms together.¹⁶ We have also seen such evidence in previous scholarship on big history and deep history.¹⁷ My point here is more modest: the Knowledge Anthropocene has helped us to historicize the world, given us the tools for writing new humanist narratives of worldmaking, and suggests that historical habits of mind should play a more central role in global problem-solving. Rather than bringing the insights of science to history, as environmental historians have long done, we need to bring the insights of history to science.

Notes

¹ George Perkins Marsh, *Man and Nature*, ed. David Lowenthal (Seattle: University of Washington Press, 2003), 437–42; David Lowenthal, *George Perkins Marsh: Prophet of Conservation* (Seattle: University of Washington Press, 2000), 267, 279.

² Marsh, *Man and Nature*, 438.

³ Todd Balf, *The Darkest Jungle: The True Story of the Darien Expedition and America's Ill-Fated Race to Connect the Seas* (New York: Crown Publishers, 2003); Thomas Oliver Selfridge, *Reports of the Explorations*

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⁴ Paul S. Sutter, "Nature's Agents or Agents of Empire? Entomological Workers and Environmental Change during the Construction of the Panama Canal," *Isis* 98, no. 4 (December 2007): 724-54; Sutter, "Triumphalism and Unruliness during the Construction of the Panama Canal," in "Unruly Environments," eds., Siddhartha Krishnan, Christopher Pastore, and Sam Temple, *RCC Perspectives: Transformations in Environment and Society*, no. 3 (2015): 19-24.

⁵ Marsh, *Man and Nature*, 441-42.

⁶ Moises Velasquez-Manoff and Jeremy White, "In the Atlantic Ocean, Subtle Shifts Hint at Dramatic Climate Dangers," *New York Times*, 2 March 2021, <https://www.nytimes.com/interactive/2021/03/02/climate/atlantic-ocean-climate-change.html>.

⁷ Marsh, *Man and Nature*, 442-43.

⁸ Stan Ulanski, *Gulf Stream: Tiny Plankton, Giant Bluefin, and the Amazing Story of the Powerful River in the Atlantic* (Chapel Hill: University of North Carolina Press, 2008), x, xii, 14, 31, 47. The Maury quote is from *The Physical Geography of the Sea* (New York: Harper & Brothers, 1855), 25. On Maury's visions for the Amazon, see Gerald Horne, *The Deepest South: The United States, Brazil, and the African Slave Trade* (New York: New York University Press, 2007), 107-27; Walter Johnson, *River of Dark Dreams: Slavery and Empire in the Cotton Kingdom* (Cambridge, MA: The Belknap Press of Harvard University Press, 2013), 280-302.

⁹ On Scoresby, see Gillen D'Arcy Wood, *Tambora: The Eruption that Changed the World* (Princeton, NJ: Princeton University Press, 2014), 135-38. On the ice-age discoveries, see Martin J. S. Rudwick, *Earth's Deep History: How It Was Discovered and Why It Matters* (Chicago: University of Chicago Press, 2014), 174-85.

¹⁰ Albert Günther, "An Account of the Fishes of the States of Central America, Based on the Collections Made by Capt. J. M. Dow, F. Godman, Esq., and O. Salvin, Esq.," *Transactions of the Zoological Society of London* 6 (1868): 377-402. On Günther's influence, see Harilaos A. Lessios, "The First Stage of Speciation as Seen in Organisms Separated by the Isthmus of Panama," in *Endless Forms: Species and Speciation*, eds., Daniel J. Howard and Stewart H. Berlocher (New York: Oxford University Press, 1998), 186-201, p. 187. On the formation of the Isthmus, see Aaron O'Dea, Harilaos A. Lessios, Anthony G. Coates, Roni I. Eytan, Sergio A. Restrepo-Moreno, Alberto L. Cione, Laurel S. Collins et al., "Formation of the Isthmus of Panama," *Science Advances* 2, no. 8 (2016): e1600883. <https://www.science.org/doi/10.1126/sciadv.1600883>; Alex Farnsworth and Emma Stone, "How Events in Panama Created the Modern World (Millions of Years Ago)," *The Conversation*, 20 May 2016, <https://theconversation.com/how-events-in-panama-created-the-modern-world-millions-of-years-ago-58357>.

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¹² Marsh, *Man and Nature*, 36.

¹³ Rudwick, *Earth's Deep History*.

¹⁴ Thomas Andrews and Flannery Burke in "What Does it Mean to Think Historically," *Perspectives on History*, January 2007, <https://www.historians.org/research-and-publications/perspectives-on-history/january-2007/what-does-it-mean-to-think-historically>. On the development of the discipline of history and its marginalization of the nonhuman world, see Dipesh Chakrabarty, "The Climate of History: Four Theses," *Critical Inquiry* 35, no. 2 (Winter 2009): 197-222; Chakrabarty, *The Climate of History in a Planetary Age* (Chicago: University of Chicago Press, 2021). On the idea that "nature is history," see Paul S. Sutter, "The World with Us: The State of American Environmental History," and "Nature Is History," *Journal of American History* 100, 1 (June 2013): 94-119, 145-48.

¹⁵ My thinking here has been influenced by Lorraine Daston, "The Sciences of the Archive," *Osiris* 27, no. 1 (2012): 156-87; and Megan Raby, "Ark and Archive: Making a Place for Long-Term Research on Barro Colorado Island, Panama," *Isis* 106, no. 4 (December 2015): 798-824. On studies of medieval manuscripts, see Sarah Zhang, "The Lab Discovering DNA in Old Books," *The Atlantic*, 19 February 2019, <https://www.theatlantic.com/science/archive/2019/02/dna-books-artifacts/582814/>; Sean P. Doherty, Michelle M. Alexander, Stuart Henderson, Jason Newton, Jonathan Finch, and Matthew J. Collins, "Tracking the British Agricultural Revolution through the Isotopic Analysis of Dated Parchment," *Scientific Reports* 13, no. 61 (2023), <https://doi.org/10.1038/s41598-022-26013-4>.

¹⁶ Chakrabarty, "The Climate of History"; Amitav Ghosh, *The Great Derangement: Climate Change and the Unthinkable* (Chicago: University of Chicago Press, 2016).

¹⁷ David Christian, *Maps of Time: An Introduction to Big History* (Berkeley: University of California Press, 2004); Dan Smail, "In the Grip of Sacred History," *American Historical Review* 110, no. 5 (December 2005): 1337-61; and Smail, *On Deep History and the Brain* (Berkeley: University of California Press, 2008).

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