

# INTERSCALAR VEHICLES FOR AN AFRICAN ANTHROPOCENE: On Waste, Temporality, and Violence

GABRIELLE HECHT  
Stanford University

 <http://orcid.org/0000-0003-1445-0785>

Brightly painted concrete houses, equipped with running water and electricity, arranged in dozens of identical rows: this photograph (Figure 1) depicts the newly built company town of Mounana in eastern Gabon. The road is clean, the children happy. In the late 1970s, this image represented Gabonese “expectations of modernity” (Ferguson 1999) through national and corporate projects. By the end of this essay, I hope you will also see it as an image of the African Anthropocene.

The idea of an African Anthropocene may seem like a paradox. After all, the biggest appeal of the idea of the Anthropocene has been its “planetary” (DeLoughrey 2014). For some geologists, the Anthropocene signals the start of a new epoch, one in which humans permanently mark the stratigraphic record with their “technofossils” (Zalasiewicz et al. 2014). Other earth scientists adopt the notion to signal humanity’s catastrophic effects on the planet’s physical and biochemical systems. During the past decade, the term has become a “charismatic mega-category” (Reddy 2014) across the humanities, arts, and natural and social sciences (Steffen et al. 2011; Ellsworth and Kruse 2012). Inevitably, debates rage about origins and nomenclature. Did the Anthropocene begin with the dawn of human agriculture? Or with the Columbian exchange of the sixteenth and seventeenth centuries? How about the start of European industrialization in the eight-



Figure 1. Mounana, Gabon, late 1970s. Photo courtesy of Cogéma.

teenth century? Some favor July 16, 1945, the date of the first nuclear weapons test at Alamogordo in New Mexico (Lewis and Maslin 2015; Monastersky 2015; Zalasiewicz et al. 2015).

While geologists ponder the stratigraphic signals left by each of these options, humanists and social scientists worry about their political and ethical implications. Early start dates, for example, risk naturalizing the Anthropocene as part of *the* human experience, depoliticizing its causes and exonerating energy-intensive capitalism. Some feel that the very term obscures massive inequalities: attributing the unfolding catastrophes to an undifferentiated humanity elides crucial differences in responsibility and lived experience. Others contest claims that the Anthropocene signals a *new* awareness of ecological harm: the history of nineteenth-century climate science and industrial pollution shows that previous evidence and warnings were politically marginalized (Bonneuil and Fressoz 2016). Still others object that the Anthropocene attributes too much agency to humans, sidelining nonhuman forces. This array of concerns has prompted alternative proposals, such as the Capitalocene (J. Moore 2015). Or the Chthulucene, the monstrous metaphor used by the ever-humorous Donna Haraway (2015, 160) to invoke “myriad temporalities and spatialities and myriad intra-active entities-in-assemblages—including the more-than-human, other-than-human, inhuman, and human-as-humus.”

Wrestling with these counterpoints is invigorating, but alternative nomenclatures seem unlikely to gain much traction in natural-science disciplines or the public sphere. It is hard to imagine the International Commission on Stratigraphy adopting the Capitalocene to designate a new geological epoch. Critics of the Anthropocene concept rightly worry that the idea can be used to revive fantasies about humans' ability to control nature, pointing to *An Ecomodernist Manifesto* (Asafu-Adjaye et al. 2015) as a dangerous example (Collard, Dempsey, and Sundberg 2015; Crist 2015; Hamilton 2015; Latour 2015a; Szerszynski 2015). Still, for many of the Anthropocene's most prominent proponents, the term offers a way of signaling human responsibility, not of asserting control. They use *the Anthropocene* to acknowledge—not deny—the importance of politics, to invite a broad conversation about our earthly condition, to make friends rather than foes (Jonsson 2015; Latour 2015b; Rockström 2015).

How can anthropologists (and their scholarly kin) build on these critiques while retaining the concept's political power, along with its potential to spark new narratives, methodologies, and forms of knowledge? In exploring this question, this essay makes three analytic moves. First and foremost, I argue, we need to understand the Anthropocene and its critiques as scalar projects. This requires treating scale reflexively, as both an analytic category and a political claim, engaging in what E. Summerson Carr and Michael Lempert (2016) call a "pragmatics of scale." The Anthropocene concept holds that our planet has recently experienced a "great acceleration" in the metabolism of its materials, and invites scholars to dramatically expand their spatial and temporal scales of analysis. I maintain that in accepting this invitation, we must also consider the political and ethical work accomplished by scalar choices and claims. To model what such an approach could look like, this essay attempts to hold the analytic and political aspects of scale in productive tension: I unpack the scalar claims of historical actors and projects, *and* use their stories—as well as the materials with which they engage—to move across scalar registers in my own narrative.

My second move is to treat the Anthropocene as the apotheosis of waste.<sup>1</sup> This relates to spatial and temporal scales, of course. Much of what has massively increased is the quantity, extent, and durability of discards: consider the planetary production of particulates, the millennial futures of microplastics and radioactive waste. Furthermore, monitoring discards is a key technique of Anthropocene epistemology: it's *how* we know the geological, atmospheric, and biophysical impact of human activity. Scholarship on waste has come a long way since Mary Douglas (1966, 44) first identified dirt as "matter out of place." Most notably,

scholars have sought to disentangle waste from abjection by focusing on how waste and its management can produce new social relations, cultural forms, and political demands (Hawkins 2006; Gille 2007; Chalfin 2014; Reno 2015; Liboiron 2016; Harvey 2017). My analysis draws inspiration from this emerging field of discard studies. But I stop short of framing the biophysical properties of waste as lively or vibrant (Bennett 2010; Hird 2012; Reno 2014). Metaphors matter. And those particular metaphors enchant: they make materials appear mystical and mysterious. Their joyful connotation can all too easily erase the brutal histories and ontologies that produce new biophysical phenomena, instead indulging in what Zsuzsa Gille (2013, 2) calls “waste fetishism.” It is certainly true that discards never disappear, and that their constituent materials remain active, often in ways that discarders and waste managers did not anticipate and do not track. But that does not mean that the biophysical interactions of wastes with their surroundings are (or were) inherently unpredictable or unknowable. As scholars who study agnotology have shown, ignorance is the obverse of knowledge: its production can be strategic, with the absence of knowledge legitimating the absence of regulatory protection (Proctor and Schiebinger 2008). And even when ignorance is not deliberate, it emerges from social relations. It has power effects.

And so we must never forget that the violence associated with the Anthropocene apotheosis of waste is not merely planetary—it also has particular, differential manifestations. Hence my third move: putting the Anthropocene in place.<sup>2</sup> I gloss this move as the “African Anthropocene,” but my goal is decidedly *not* to propound continental essentialism. I do not aim to identify the characteristics of an “African” Anthropocene in clear distinction to an “Asian” or a “European” one. Rather, I seek a means of holding *the planet* and *a place on the planet* on the same analytic plane. As Judith Irvine (2016) cautions, large scales do not necessarily encompass small ones. Rather than zooming *into* a place in Africa, I am using that place as a point of departure for thinking about the Anthropocene and its multiple forms of violence. Hence my insistence on “an”—rather than “the”—African Anthropocene. There are many possible points of departure, many stories to tell, and many ways of telling them. This essay seeks merely to open the conversation.

For this much is clear: to grapple with the complex interscalar connections posited by the Anthropocene, we need new narratives and analytic modes (Hamilton, Bonneuil, and Gemenne 2015; Thornton and Thornton 2015). Compartmentalization has failed: scholars of the Anthropocene sometimes write as though this were a new revelation (e.g., Chakrabarty 2009), but in fact anthropologists

and science and technology studies scholars have understood this failure for decades, having long challenged the nature/culture binary. Yet challenging binaries is not enough. To understand their violent consequences, we need to refract history through new prisms. We need, as Rob Nixon (2014) argues, to “counter the centripetal force of the dominant Anthropocene species story with centrifugal stories that acknowledge immense inequalities in planet-altering powers.” In experimenting with centrifugal narratives to open new ways of seeing the Anthropocene, this essay pivots around Mounana, Gabon.

### INTERSCALAR VEHICLES

First, though, I need to say more about scale. After all, at its most basic level the Anthropocene asserts scalar enormity. This is readily apparent in the dozens of graphs (generated by natural *and* social scientists) showing exponential increases in the rearrangement of earthly materials and the production of waste, especially as of the 1950s (Steffen et al. 2011). This “great acceleration” is sometimes visualized with a single curve whose only purpose is to invoke scale itself: time forms the x-axis, but the y-axis remains unmarked, denoting pure size.

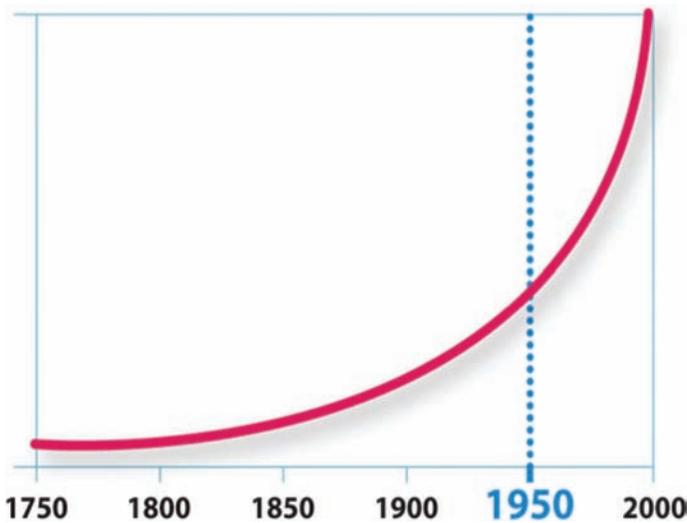


Figure 2. The Great Acceleration, writ large. Image from *Global Change and the Earth System: A Planet Under Pressure*, by Will Steffen et al. (2004).

In such assertions, temporal metrics matter as much as spatial ones. The Anthropocene gains traction over the present by predicting the future, by asking

that we position ourselves as geologists millennia from now, uncovering technofossils in future stratigraphic layers.

Indeed, as recent anthropological writing about scale deftly demonstrates, scale is not just about size or granularity. It is also about categories: what they reveal or hide, the ways in which they do (or do not) nest. And it is about orientation: how we position ourselves, what we position ourselves against, and what comparisons such locations do (or do not) authorize (Helmreich 2009; Carr and Lempert 2016). These insights help us understand the intensity of debates around naming the current epoch. Scholars object not to the claim that humans have wrecked the planet, but rather to the type and coarseness of the scalar units used to make that claim, especially when attributing wreckage to the *anthropos*. A term like *Capitalocene* offers different scales of analysis and comparison, units that are more tractable for humanists and social scientists. In this instance, as in so many others, rescaling serves both to make political claims (by attributing causation and responsibility) and to demarcate disciplinary boundaries.

But scales do not obey fixed ontologies. Geographers argue that scale is emergent, relational, and performative (Marston 2000; Purcell 2003; Sayre 2005, 2009; Neumann 2009; MacKinnon 2011). Instead of caving to the reification reflex, we must treat scales as outcomes of social, cultural, and technopolitical processes. Historians have explored how the construction of scale shapes what can be seen in the Anthropocene (Thomas 2014): climate change can only be apprehended via global models (Edwards 2010), while endocrine disruptions require microscopic attention (Langston 2010). Refracting this contrast back through Judith Irvine's (2016) argument, we see that the latter practice does not nest within the former, but rather represents an entirely different system of observation and value. As anthropologists have shown with studies ranging from the Tongan court system to contemporary fights over Indonesia's rain forests, instances abound in which the production of national, imperial, local, regional, or global scales involved power struggles, replete with winners, losers, and brokers (Tsing 2005, 2012; Philips 2016).

Scales, then, are emergent rather than eternal. But their situatedness and historicity do not detract from their reality. They do work in the world. They are performative. Scale is messy because it is both a category of analysis *and* a category of practice (Brubaker and Cooper 2000; A. Moore 2008; Carr and Lempert 2016). Scholars who seek to understand how actors use scale concepts in practice do not, by virtue of such analysis, escape deploying scalar concepts themselves; nor does such analysis mitigate the real-world effects of scalar prac-

tices. Observing that the Anthropocene is a scalar project should not absolve us from engagement. Rather, it should help us refine our modes of engagement. Scaling is inescapable, but that does not force us into the trap of reification. Scaling is neither inherently evil nor intrinsically virtuous. As E. Summerson Carr and Brooke Fisher (2016, 136) note, scalar practices can both “spawn a sense of intimacy and an ethic of interrelatedness” and “serve projects that discriminate, individuate, and alienate.” So unless we want to leave the Anthropocene to the ecomodernists and the geo-engineers, we need to jump in.

For that, we need interscalar vehicles.

In science-fiction dreams of *interstellar* travel, characters travel distances unbridgeable by conventions of Newtonian mechanics. They arrive at impossible destinations, worlds that teach them new ways of seeing and being. Let’s attempt similarly impossible journeys. What happens when we treat empirical objects as *interscalar* vehicles, as means of connecting stories and scales usually kept apart?

This essay experiments with interscalar vehicles as tools and objects of analysis. The possibilities for such vehicles are endless. Here, I take uranium-bearing rocks as my primary interscalar vehicles, riding them from Gabon to France to Japan, from the 1970s to our planet’s early history to the distant future. In navigating this journey across spatial and temporal scales, I simultaneously observe the interscalar vehicles deployed by historical actors: maps and photographs; compensation claims and warning signs; urban development and cosmological theories; atomic bombs. Interscalar vehicles—theirs and ours—have political, ethical, epistemological, and/or affective dimensions. What makes something an interscalar vehicle is not its essence but its deployment and uptake, its potential to make political claims, craft social relationships, or simply open our imaginations.

I thus use the term *African Anthropocene* not only to signal the significance of African places to our planetary condition but also to frame the analytic challenge at the core of this essay: namely, steering *between* and *within* emic and etic scales. Scales have epistemological, political, and ethical consequences for both informants and scholars. Rather than reject these entanglements, I propose to incorporate them. Moving between scales while simultaneously attending to the history and politics of scale-making, I contend, offers ways of engaging the Anthropocene while highlighting the interscalar complexity of its politics.

Now we can go to Mounana.

## SCALES OF PROSPECTING

The Compagnie Minière d'Uranium de Franceville (COMUF) launched its operations in 1957, just before Gabon gained independence from France. The COMUF began as a joint venture between the French Commissariat à l'Énergie Atomique (CEA) and Mokta, a colonial mining corporation. As the first shipment of uranium left Mounana for France in 1961, the (white, French, male) company managers congratulated themselves on a job well done. Ore reserves seemed ample, and a new training program promised to prepare large numbers of Gabonese men for long-term, salaried mine work. Gabonese uranium was poised to supply French atomic bombs and nuclear power plants for decades to come.

That promise alone represented a victory for the French atomic energy commission. Created at the conclusion of World War II, the CEA's top priority in its early years was finding uranium. Newly valued by the explosions at Hiroshima and Nagasaki, the mineral was initially deemed rare. France had some deposits in its metropole, but would clearly need more to power its reactors, not to mention the bombs some of its engineers longed to build. The CEA launched a massive search throughout France's African territories.

Uranium prospection in the twilight of empire presented scalar dilemmas, both spatial and temporal. Consider this schematic map of the CEA's prospecting activities in 1959. The image appeared in the CEA's annual report in 1960, the year when most French African colonies gained independence. Back then, only Gabonese ore reserves were sufficiently proven to justify a full-blown mining operation. But Niger and the Central African Republic showed considerable promise, and the report announced the CEA's plans to pursue those options. The map simultaneously represented the past and imagined the future, demarcating space according to the expected national lines of 1960, instead of the imperial ones that still obtained in 1959. As [Johannes Fabian \(1983, 146\)](#) might put it, this temporal projection became "a means to occupy space": even as the map acknowledged historical rupture, it made a powerful claim to the temporal continuity of French technopolitical authority. At the cusp of decolonization, the CEA intended to keep treating Francophone Africa as a continuous resource space: its *pré carré*, a zone of privileged access. Dreams of French energy independence relied on African uranium becoming French. They relied, in other words, on the imperial scale disappearing into national scales—on both continents.

While the map ([Figure 3](#)) represented French technopolitical aspirations at a spatial scale of one to thirty-five million (the temporal scale was inherently unquantifiable, gesturing at an indefinite future), this official photograph ([Figure](#)

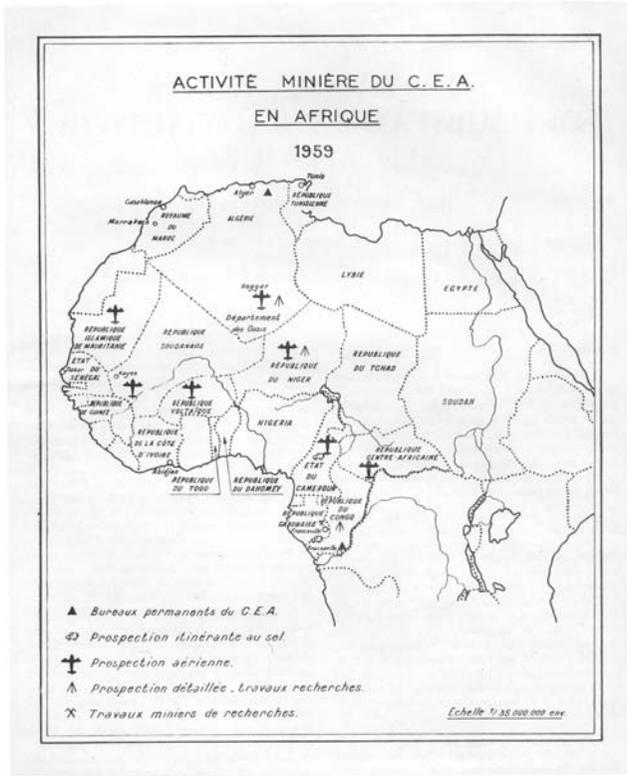


Figure 3. Prospecting for uranium in Africa. Image from the 1960 annual report of the Commissariat à l’Énergie Atomique.

4) depicted power on the ground: a prospecting team trudging through the Gabonese rain forest. The black man in front held a Geiger counter, which cracked in the presence of sufficiently radioactive rocks. His job title was assistant prospector; the CEA trained a cadre of about a dozen such men, selected for their French colonial education and their knowledge of the terrain. The two white men in back were the chief prospectors. Yet the image inadvertently subverted the CEA’s claim to mastery, depicting a classic example of African intermediaries’ key role in the (post)colonial production of knowledge. After all, the so-called assistant was the one guiding the team through the bush and operating the key instrument.

Considered together, these two images exemplify the scalar politics that characterized colonialism and its aftermath. Grand claims, made credible by fine-grained pockets of practice. An interscalar insistence that territorial management resulted in individual uplift, that producing value for France would also produce



**Figure 4.** Prospecting for uranium in Gabon, 1950s. Photo courtesy of Cogéma.

value for Africans. Such promises justified postcolonial collusions between Gabonese state elites and French parastatal corporations, which later critics would identify as the hub of *la Françafrique* (Verschave 1998). (The term designates corrupt relations between the French government and postcolonial African elites. The word can also be heard as *France-à-fric*; *fric* is slang for money.)

Anthropocene scholars note that industrial capitalism has long relied on “cheap nature” (J. Moore 2015, 17)—the assumption that earthly materials are there for the taking. This certainly describes uranium mining in Gabon, where—at least initially—extraction costs were predictable and limited: equipment, transport, wages, and food. Building materials also relied on cheap nature: rock for gravel and concrete, trees for timbering the mineshafts. Value, at all scales, came from turning earthly materials into “raw materials.”

### VALUING SLOW VIOLENCE (PART ONE)

But uranium did not merely produce value for employees. It also produced violence. Boring holes, blasting rocks, digging tunnels: these were dangerous activities. Many locals refused to work in the tunnels because they feared the evil spirits that lurked underground. Working conditions did not dispel those fears. In 1965, a huge slab of rock came crashing down on a team of workers, killing two and injuring others. In 1970, a flood trapped five miners in an underground

cul-de-sac; the image of their bloated bodies, retrieved after six days of searching, remained seared in memories for decades.

Other forms of violence unfolded more slowly (Nixon 2011). Blasting rock left dense clouds of dust, which took longer to disperse than the fifteen-minute waiting period specified by workplace regulations. “After the blast, there’s a lot of dust,” said Marcel Lekonagua, who had been in charge of blasting for several years. “It’s the dust that wasted us . . . you swallow it, you breathe it.” Protective gear did not help: “Those little masks, they didn’t hold up well. They’re made of paper . . . if it gets a little wet—*pa!*” The masks would dissolve, over and over, leaving him with a lifetime of respiratory ailments.

And then there was the radiation. Invisible, odorless, and easy to forget, it came in several varieties. Gamma rays, emitted during the radioactive decay of uranium, could be tracked by individually worn dosimeters. At the end of each month, workers rendered their dosimeters, which went to France for processing. In underground shafts, however, other forms of radiation proved more insidious. Natural uranium atoms decay into radon, which decays into other elements that, when inhaled, lodge in the lungs and bombard soft tissue with radioactive alpha particles. Over time, this changes cellular structures and can lead to lung cancer. But not in everyone: the process is stochastic (another way of saying that scientists do not fully understand the synergy of its causal mechanisms). In any case, portable alpha dosimeters did not exist until the late 1980s. Radon varied unpredictably throughout the shafts, in some places reaching levels twelve times international regulatory limits. For workers, such radiation exposure was the slowest violence of all: cancers could take decades to manifest (Hecht 2012).

Workers did protest. They refused to return to work for days after fatal accidents, shocked that management did not allow time for them to mourn their comrades. News traveled, making it difficult for the COMUF to recruit new labor after major accidents. When the company doctor rejected links between lung disease, dust, and radiation, some workers refused to hand over their dosimeters for the monthly check. Lekonagua held on to his dosimeter because he hoped to find other experts to interpret the results and attest to his exposure levels.

None of this, however, interrupted mining operations for very long. The COMUF counted on jobs, training, housing, and medical care to keep protest in check. It managed the social effects of workplace accidents by placing a monetary value on their violence, offering hazard premiums for underground and other dangerous work. In these and other ways, the company deployed the classic tactics

of industrial development: valuing modernity above life, manufacturing consent. Hardly a unique story.

And then, for a brief time, nature stopped being cheap. This is the moment when our story veers from standard accounts of capitalist/colonial exploitation and plunges into the scalar drama of Anthropocenic imaginations. To understand how, we need to get back into our interscalar vehicle and ride the rocks to the atomic scale. As befits Anthropocene tales, this means delving into the physics and chemistry of uranium.

### FOSSILIZED REACTORS

Natural uranium is primarily composed of uranium-238, an isotope whose nucleus contains 92 protons and 146 neutrons. But other uranium isotopes are also present, notably uranium-235 (still 92 protons—that's what makes it uranium—but only 143 neutrons to glue the nucleus together). The 235 isotope only comprises 0.72 percent of natural uranium. But it holds greater interest for engineers, because its nucleus is unstable enough to split by bombarding it with neutrons. Known as fission, this splitting releases energy and liberates more neutrons, which go on to split other nuclei. For this sequence to become a self-sustaining chain reaction, however, the ratio of  $U_{235}$  atoms must be increased: natural uranium must be enriched. If you want to make an atomic bomb, you need 90 percent  $U_{235}$ . If you want to fuel a reactor, you can settle for 3.5 percent enrichment. The same plant churns out bomb and reactor fuel—the difference lies in how long the uranium feed stays in the circuit.

Preparing the feed for enrichment plants required many steps. Ore extracted from the Mounana deposits was milled at the COMUF, then shipped to France. There it passed through three different factories for additional preparation, before finally entering the enrichment plant in gas form. Each of these stages produced tailings: unwanted material whose uranium content was not high enough to merit further processing. Waste.

Uranium enrichment plants are huge, complex, delicate, and expensive. France's plant at Pierrelatte was devoted exclusively to making military fuel. It came online in 1967, after seven years of construction. Smooth operation required controlling impurities in the feed. At each stage of preparation, engineers took samples to ensure they met specs. This included checking the feed's isotopic composition, a routine test because—as everyone knew—the proportion of  $U_{235}$  isotope in ore was a constant. 0.7202 percent.

Until it wasn't. One day in May 1972, Pierrelatte engineers discovered a batch of feed with less  $U_{235}$  than normal, clocking in at 0.7171 percent. The discrepancy was big enough to pose both technological and financial problems. Flustered, they ran another sample: 0.7088 percent. Worse (Bouzigues et al. 1975).

At first, engineers suspected the batch had become contaminated with tailings during one of the preparation stages. Such a mistake could have geopolitical consequences. The CEA sent uranium destined for civilian purposes to the USSR for enrichment. Using Soviet enrichment services made France less vulnerable to U.S. technological dominance while it spun up another enrichment plant to make civilian fuel (Hecht 1998). The Soviets would certainly discover the depleted feed. They would be furious if they suspected the French of trickery.

Tracing the chain of custody, however, demonstrated that the depleted uranium came from Gabon. Further investigation revealed that Mounana's Oklo deposit had been delivering depleted ore since it opened in 1970. In one core sample, the  $U_{235}$  proportion sank to an astonishing 0.44 percent (Naudet 1991). To grasp the profound weirdness of this result, listen to radiochemist and Manhattan Project veteran George Cowan (1976, 36), who wrote about it for *Scientific American*:

The isotopic composition of uranium is thought to be *a constant of the solar system* in any one era. . . . Chemical processes can make one region rich in uranium and leave another region poor; that is how the deposit at Oklo was formed. U-235 and U-238, however, are virtually indistinguishable chemically. . . . Indeed, the difficulty of separating the isotopes is attested to by the size and complexity of uranium enrichment plants such as those at Pierrelatte. . . . *There seemed to be no plausible mechanism in nature [to explain] the depleted ore.*

As far as anyone knew, the only sources of depleted uranium *in the entire solar system* were human-made waste: spent reactor fuel or enrichment tailings. What could possibly account for its presence in a Precambrian rock formation in eastern Gabon?

Investigators finally settled on an explanation. The depleted uranium resulted from a series of self-sustaining fission reactions almost two billion years ago. (That's half our planet's lifetime.) Way back then, uranium had a different isotopic ratio. This was because  $U_{235}$  decayed faster than  $U_{238}$ . When the planet first formed, its uranium contained 17 percent  $U_{235}$ . By the time the Oklo deposit

formed, this ratio had dropped to 3 percent, roughly the proportion required by most nuclear power plants. Other aspects of the geologic environment—the presence of water, the thickness and density of the uranium deposit—made conditions propitious for self-sustaining chain reactions. These had taken place in the rock bed, off and on, over a period of two million years. In September 1972, CEA experts announced their stunning conclusions to the Academy of Science in Paris: nature had made nuclear reactors nearly two billion years before humans (Bodu et al. 1972; Neuilly et al. 1972). Fission in these so-called natural reactors had depleted the uranium.

Diplomatic disaster averted. But trouble now loomed on another scale. Seven hundred tons of Oklo ore had already entered the fuel cycle, and there was more to come. Because the depleted ore was not usable in human-made reactors, the COMUF viewed it as waste. But it still had to be removed to reach the rich veins of marketable ore underneath, upon which the company had banked its future. Removing depleted ore cost just as much as extracting valuable ore, threatening the COMUF with bankruptcy (Hecht 2012).

And there was another problem. For geologists, radiochemists, and nuclear physicists, the remaining rock formation housed fossilized reactors. These fossils were *their* interscalar vehicles into the planet's past, and they desperately wanted to keep the formation intact to better study it. Nature was no longer cheap. Scientific value challenged economic value. Atomic action threatened international reaction. Values and scales crashed into each other.

### *LA FRANÇAÏRIQUE IN ACTION*

State-supported capitalism—both French and Gabonese—averted wreckage from the crash. In 1972, the French state (via the CEA) was the COMUF's primary shareholder and its sole customer. But the CEA also conducted France's nuclear research. So while one division wanted to normalize its ore supply, another lobbied for preserving the fossilized reactors. To satisfy both constituencies, the CEA agreed to purchase the depleted ore—at a discounted price—for use as research material. This persuaded the COMUF to leave the Oklo ore body intact for a few more years.

Meanwhile, the CEA sought support for the research from President Albert-Bernard (Omar) Bongo (Naudet 1991). Defying colonial-era corporate claims, the Gabonese leader had begun to advocate postcolonial sovereignty over natural resources. He also demanded that the COMUF honor its promises to bring modernity to eastern Gabon, notably by building better housing for its employees.

So getting Bongo on board was crucial. By 1974, the COMUF had agreed to build the housing development pictured at the start of this essay. It also accepted a capital infusion from the state, in return for giving Gabon 25 percent ownership in the company (Hecht 2012). The arrangement set expectations of modernity for workers, the company, and the state (Ferguson 1999).

Science played a part in performing such expectations: modern states, after all, were supposed to support research. Bongo agreed to help fund a symposium on the so-called Oklo Phenomenon. Cosponsored by the International Atomic Energy Agency (IAEA) and the CEA, the conference took place in June 1975 in Libreville, Gabon's capital. Eager for validation of their bizarre conclusions, CEA scientists had shared Oklo samples with colleagues in the United States, the Soviet Union, and elsewhere. The conference offered an occasion for seventy-four experts from nineteen countries to discuss their initial results.

The conference began with a trip to Mounana to see the phenomenon. Attendees traipsed to the rock face, where COMUF employees outlined the traces of the fossilized reactors. Hardly a spectacular sight, but attendees were happy to see for themselves, and to pick up a souvenir specimen in situ. Plus, who didn't enjoy a little pomp and circumstance? A stage in the middle of the pit, complete with palm fronds, featured speeches by "Gabonese" notables, performing the national scale and reminding visitors whose territory housed the discovery (Cowan 2010).

Scientists then repaired to Libreville to present their findings. Some found the conference setting surprisingly splendid: a luxury hotel, a restaurant supplied by food and wine flown in from France. George Cowan—who by then had become the director of radiochemistry research at Los Alamos, the United States's premier nuclear weapons lab—reported on a lavish reception that Bongo hosted at his residence:

We were serenaded by an orchestra, the all-male musicians dressed semi-formally. Then the dancing began. One of the attractive native female employees from the French Embassy asked me to dance. I couldn't resist a Viennese waltz and did a few turns. The wine and toasting continued until midnight. Suddenly the musicians stripped down to loincloths and began to play wild "jungle" music dominated by percussion. The lovely French Embassy females reappeared wearing only native skirts and gyrating to the new tempo. One of them grabbed my hand and pulled me onto the dance floor. I clumsily tried to hold the deafening beat (Cowan 2010, 107).

This too was *la Françafrique* in action, with Bongo and French officials shamelessly catering to visitors' expectations of exoticism. There is no record of how embassy employees—presumably professionally trained clerical staff—felt about dancing topless with middle-aged white foreigners. Nor do we know how the five female scientists from France responded to the spectacle.

### SCALAR COLLAPSE

When French experts first released their conclusions, they had been greeted with skepticism. The prospect of prehistoric reactors sounded like science fiction. Journalists speculated that ancient aliens accounted for the phenomenon. Many in the international scientific community also expressed doubts. But for the Japanese-born chemist Paul Kazuo Kuroda, the discovery was a vindication.

Kuroda had trained as a nuclear chemist at the Imperial University of Tokyo, joining the faculty there in 1944. Despite a ban on radiochemistry research by the American occupation forces, Kuroda pursued this work after the war. In 1949 he sailed to the United States in search of research collaborations, only to discover that his nationality excluded him from projects with security ramifications. He eventually joined the faculty at the University of Arkansas, where his research led him to predict the existence of natural nuclear reactors in 1956 (Kuroda 1956). He was dismissed as a crackpot. "Scientists were saying that if this idiot is an indication of the program" at Arkansas, he later wrote, "there must be nothing there at all" (Robertson 2011). The Oklo discovery changed everything: Kuroda went from eccentric to prophet overnight.

Kuroda's paper in Libreville used evidence from Oklo to hypothesize about the origins of the earth's elements. He had first begun to speculate about natural nuclear reactors in the earth's early history "one day in August 1945, while standing in the ruins of Hiroshima" (Kuroda 1975, 480). He would invoke this moment repeatedly in later publications, writing that he "became overwhelmed by the power of nuclear energy. . . . The sight before my eyes was just like the end of the world, but I also felt that the beginning of the world may have been just like this. Would it not be possible that nuclear chain reactions occurred on the earth then?" (Kuroda 1982, 2–3). The Oklo find validated his prediction, and Kuroda boldly spun out its cosmological implications. Over the course of time, he speculated, the ancient fission reactions "could've been one of the most important factors in creating mountains and continents thousands of feet below the surface" (Robertson 2011). Indeed, his calculations suggested that the solar system itself was much older than scientists had previously thought.

Kuroda thus collapsed all of terrestrial time into a single, atom-splitting moment. In this ultimate act of nuclear exceptionalism (see [Hecht 2012](#)), the atomic bomb became a synecdoche for all thinkable temporalities, from the solar system's distant past to the planet's apocalyptic future. Japanese scientists might not have designed the atomic bomb, but witnessing its effects firsthand brought unique insight—or so Kuroda's narrative asserted. His scalar collapse claimed intimacy and cosmic significance simultaneously ([Helmreich 2009](#)). Introducing geopolitics, pain, and redemption into texts that were otherwise filled with equations and tables, Kuroda used the bomb itself as an interscalar vehicle. This scalar practice enabled Kuroda to “*feel*, as well as see [himself] as a part of something larger,” as [E. Summerson Carr and Brooke Fisher \(2016, 148\)](#) would argue in a different context. Its repetition in publications spanning decades also suggests an urge to proselytize: to make others feel the intimate cosmological import of his theories.

At the Libreville conference, the bomb as interscalar vehicle traveled through space as well as time—and with no small measure of irony. For Kuroda did not attend the conference personally. Instead, his paper was presented by George Cowan, the Manhattan Project veteran and Los Alamos radiochemist. The two men had probably met over their shared interest in radioactive fallout. Cowan had spent years tracking fallout patterns from U.S. nuclear weapons tests. Kuroda, meanwhile, had studied fallout from China's 1965 atomic test, which he had compared to the probable fallout path of the first-ever atomic explosion at Alamogordo. The bomb that Cowan had worked on. The explosion that preceded Hiroshima. The event that some earth scientists use to mark the official start of the Anthropocene.

Oklo rocks also served as interscalar vehicles into the far future. One of the strangest aspects of the phenomenon: many of the fission products from these ancient chain reactions had moved very little, if at all. This relative immobility sparked a question. Could Oklo serve as a natural analogue for geological storage, shedding light on how buried nuclear waste would behave over the very long term?

Geologists and nuclear power advocates around the world got excited. Waste from weapons manufacturing and power plants was mounting. Activists argued that in the absence of storage solutions, nuclear power development should stop. Some of the waste would remain dangerously radioactive for tens of thousands of years—a time scale far beyond human engineering capacity. Sealing the waste in airtight vessels seemed like an obvious first step, but it was equally

evident that “no man-made container [could] last indefinitely” (Walton and Cowan 1975, 500). What would happen after the canisters cracked? How far would their contents travel? In grappling with such questions, “the most striking fact concerning the Oklo phenomenon is that nature successfully managed to store as much as ten metric tons of fission products in the ground for two billion years” (Walton and Cowan 1975, 500). Many of Oklo’s fission products were also found in human-made nuclear waste. Maybe this remote part of Gabon could help solve the so-called wicked problem of nuclear waste disposal? Several papers in Libreville explored this possibility. *Pace* Jane Bennett (2010) and others, the long-term biophysical interactions between radioactive wastes and their surroundings drove scientific and technical inquiry.

Oklo-as-natural-analogue also entailed strategic scalar collapse. But while Kuroda primarily sought a window onto the deep *past* in order to understand the origins of the solar system, other geologists and chemists saw that past as a window onto the far *future*—a future they began to contemplate decades before the Anthropocene project made its claim on scientific imaginations. For these experts, making that future knowable could legitimate a technopolitical present powered by nuclear energy.

Experts emerged energized from the Libreville conference, ready to plunge into more research. Gabon’s newly appointed minister of scientific research vocally supported the prospect of Gabon becoming a destination for cutting-edge research (Naudet 1975, 633). But scientists had forgotten that their research material was in an active mine. With a heavy heart, the CEA’s Roger Naudet reminded them that the party was over. The COMUF had already sacrificed profits by postponing extraction for three years, but now operations had to resume. Today, his rueful words read like an Anthropocene lament:

The place we saw during the beautiful inaugural ceremony will remain a memory without a future. These extraordinary “fossilized reactors,” the likes of which we will doubtless never find again, and about which we still have so much to learn, will be irremediably destroyed. (Naudet 1975, 631)

The COMUF did destroy the Oklo reactors in the course of mining. But research continued, thanks to the thousands of core samples taken in those early years. De-situated samples became a metonym for de-situated science: the IAEA’s second conference on the subject was held in Paris, not Libreville. Naudet eventually produced a seven-hundred-page textbook on Oklo. Two other fossilized reactor zones were later found, both near Oklo; none have been found outside Gabon

(Janeczek 1999; Jensen and Ewing 2001). Meanwhile, natural analogues became an important tool for research into geological burial of radioactive waste (Miller et al. 2000; Simmons and Stuckless 2010).

Taking the narrative in any of these directions would keep us in the Anthropocene, but make us lose our grounding in Africa. At its most productive, the Anthropocene concept serves as an invitation to probe the deep past and the far future in relation to the (relative) present, the recent past, and the near future—and especially in relation to the people who inhabit these more proximate times. So let's conclude our story by staying in Gabon, and sticking with the rocks themselves as our primary interscalar vehicle.

### VALUING SLOW VIOLENCE (PART TWO)

For local residents, the fossilized reactors sparked different scalar dynamics, in which violence remained central. Consider this remark from Dominique Oyingha, an elected official who had grown up in the area and whose brother worked for the COMUF:

The whole village washed themselves at Okeloleni, drank at Okeloleni. That place where we drank and washed, there was an atomic reactor. . . . [Many people died, and] we knew it wasn't normal. . . . At the time, people accused each other of witchcraft. . . . Only when the COMUF did its mining did we see that we really were in danger-danger.

There are several ways to interpret Oyingha's comment. We could conclude that when locals learned that their area had housed fossilized reactors since time immemorial, they transferred their explanations for low fertility and short lifespans from each other to the rocks. That is what company managers concluded, when—under pressure from local officials—they commissioned a study of radiation levels around Mounana in 1986. The study took great pains to establish “background” levels, radiation present before mining began—a dubious exercise at best, given that extraction had begun in 1959.

Unsurprisingly, these levels were high. Defining them as *background*, however, meant they could be dismissed as having *always* been present. Stretching the temporal scale back to the beginning of time meant that nature, not the company, was to blame for abnormal demographic and health patterns. In French regulatory schemes, only exposure over the background level counted toward a person's dose. And there were no Gabonese health data from before mining, no demo-

graphic background against which abnormal outcomes could be formally compared: in short, no control groups.

Another way to read Oyingha's comment would be to focus on the last phrase: *Only when the COMUF did its mining did we see that we really were in danger-danger*. Oyingha himself had long harbored suspicions. His brother Marcel Lekonagua worked at the COMUF; you met him earlier, when he described the dust produced by blasting. In the late 1960s, Oyingha took his brother to the Congo, where another uranium mine had recently shut down. Doctors there confirmed the brothers' sense that dust inhalation accounted for the respiratory trouble, and that uranium exposure presented special health dangers. But when the two men returned to Mounana and confronted the mine doctor, they were met with scorn: "Are you crazy? Who told you that uranium made people sick?" Oyingha laughed as he remembered this response. He respected the doctor, whose hospital offered free medical care to everyone in the region. But he did not really expect acknowledgment of occupational disease. The brothers eventually obtained a leave of absence for Lekonagua to recover a bit—but no etiology, not even a diagnosis, and certainly no compensation.

*Danger-danger* had many sources, as those who lived with the wastes of mining knew all too well. Water from mining and milling flowed into rivers, where women soaked their manioc (a regional staple that requires prolonged immersion to become edible). In 1983, residents filed an official complaint with the provincial government: faced with alarming numbers of dead fish, they worried "that their lives [were] in danger." Monitoring and medical care did not adequately address these problems. Disputing these assertions, management insisted that the real problem was that villagers who did not work for the COMUF—and therefore did not live in the company town—wanted access to the same benefits. In other words, these residents also treated infrastructures as forms of "political address" (Larkin 2013, 333); they too deemed access to basic services as integral to the promise of modernity (von Schnitzler 2016). Managers at COMUF strongly felt that responsibility for potable running water belonged to the state, but they conceded that if the company "made an effort," it would "certainly circumvent many of the complaints" (Magnana 1983), thereby touting short-term modernity to elide the longer-term effects of waste-making. In the Zambian Copperbelt, James Ferguson (1999) has argued, workers experienced the end of development as betrayal. But around Mounana, workers, their families, and their neighbors felt betrayal—manifested as dead fish, burning lungs, and vile water—long before the mine shut down.

So-called “international standard practice” dictated that mine waste should be treated or contained. Increasing scrutiny certainly made it necessary to do *something*. Dreading “heavy maintenance and surveillance obligations if Gabonese regulations eventually came close to those . . . in Europe” (Jug 1986), the company reluctantly built a tailings dam to contain the waste in 1990—three decades after operations began. When I visited eight years later, I saw no warning signs. Both the (French) associate director of the mine and the (Gabonese) operator who toured me around the plant insisted that children “just knew” to stay away from the tailings.

Mining ceased in 1999. With few prospects of salaried employment, COMUF veterans focused on the wasting of their land and their bodies. Many remained convinced that mining accounted for their ill health. But could they prove it? Could they hold the company accountable?

To answer these questions, Mounana residents engaged in their own politics of scale. They refused to be relegated to the local, a scale that worked to dismiss them as ignorant and parochial. They also refused the national scale: the Gabonese state had not served them well in the past. Instead, former mineworkers reached north, beyond national territory, to NGOs in Niger and France that advocated on behalf of sick uranium workers. This move asserted how the bodily absorption of minerals connected miners to places and people, not just outside Gabon but outside the African continent. Joining forces, these groups sent a small group of scientists, doctors, and lawyers to investigate in 2006. The team took independent environmental readings and interviewed nearly five hundred COMUF veterans.

The resulting report testified to toxic contamination—and, at least implicitly, to the ways in which it had been facilitated by scalar politics. Protective gear had not been mandatory. Work clothing got washed at home. As one former worker reported, “we were so unaware of the risks that we smoked and ate at the workplace, and since we never wore protective gloves, we ate and inhaled whatever was on our hands and in the air.” Employees did not receive reports of their radiation exposures. The Gabonese state had performed no inspections. Company clinicians had no training in uranium-related occupational health, no access to dosimetric readings. The report estimated that the COMUF had generated more than seven million tons of waste: some dumped directly into rivers, some buried under a thin layer of dirt, and some piled in the tailings pond (Daoud and Getti 2007).

And some of the waste rock was used to build the well-ordered houses in the photograph that launched this essay—as well as the marketplace, the maternity

clinic, and the school. The problem? Although revalued as construction gravel, the rock was not devoid of uranium. Nor was this uranium inert on the atomic scale. It decayed. Many buildings had radon levels well over internationally recommended limits.

The materials of modernity had become instruments of slow violence. Shelter turned into toxic infrastructure. Behold an African Anthropocene.

### AN AFRICAN ANTHROPOCENE

Toxic infrastructures are hardly unique to Africa. Radioactive houses are not even unique to Gabon. At the very moment that Mounana's houses were going up, one-third of the houses in Grand Junction, Colorado were being slated for demolition or remediation. Built with tailings from the uranium mills that powered that town's growth in the 1950s, they too were bursting with radon. Ninety miles further south, some homes in Uravan had radon levels more than seven hundred times the regulatory limits. In 1975, a survey demanded by the Navajo Tribal Council found radioactive buildings strung out from Shiprock to Tuba City.

Some observers might be tempted to see in this simultaneity another example of how Africa lags behind. That would be wrong. It would deny the very coevalness (Fabian 1983) that allows modernity to thrive in some places at the (dialectical) expense of others. As we saw, COMUF managers *did* know that "international standard practice" precluded disposing of tailings in rivers. Were managers equally aware of "radoned" buildings in Colorado? Sources are mute on this point, but it is hard to believe that they completely missed reports circulating through international conferences, journals, and other media. As historians have argued, pollution *despite* knowledge has been a central dynamic of the Anthropocene (Hecht 2012; Locher and Fressoz 2012; Boudia and Jas 2014; Bonneuil and Fressoz 2016; Malm 2016).

Instead, we might think of international standards as interscalar vehicles that aspire to—but rarely achieve—coevalness. In principle, they perform interscalar work through calibration, offering ways of comparing procedures in distant places ("international") against a benchmark ("standard"). In principle, they deny the legitimacy of displacing harm to spaces inhabited by marginalized people, asserting that all places *should* adhere to the same environmental and labor norms. The scalar promise of the international, in sum, is that all places *should* be in the same physical and typological temporality. If and when these interscalar promises are fulfilled, standards become infrastructural (Star and Ruhleder 1996; Edwards

2003, 2010; Busch 2013). But international standards are not ontologically singular. They are historically and technopolitically produced. They can be devices for seeking remediation, but they can also serve as permits to pollute. And they can be ignored, of course. Interscalar vehicles do not necessarily follow the maps drawn for them.

So the simultaneity should serve instead as a sentinel: an indicator (among others) of the unequal waste/valuation dialectic that underpins the making of modernity's scales. Recycled waste provided free building materials with which the COMUF could address the Gabonese state's developmentalist ambitions, thereby enacting the national scale in Mounana. Providing water services in response to protests about pollution produced a municipal scale, entangled with the national scale. But precisely *because* Gabonese regulations did not match European standards, the mine could avoid the heavy financial burdens imposed by the international scale. Meanwhile, the uranium that it churned out for four decades fueled the motors of metropolitan modernity. Gabonese uranium disappeared into French uranium treatment plants. When Gabon's uranium became nuclear fuel, it switched nationalities, enabling France to assert national energy independence through nuclear power. This movement exemplifies why I place this story under the sign of an African Anthropocene, rather than (say) a Gabonese one. It is not just because the uranium switched nationalities. It is also because invoking the national scale had political stakes for actors such as Gabon's lifetime president or the director of the French atomic energy commission: stakes that I do not share, and claims that I explicitly seek to counter with my narrative.

Were it not for the fossilized reactors, the story might remain confined to the sadly familiar temporal scales produced by the deadly confluence of capitalism and colonialism, nationalism and nuclearity. Oklo, however, serves as synecdoche for the Anthropocene *avant la lettre*. It brings industrial time into dialogue with deep time, bodily temporality into dialogue with planetary temporality. Driving the phenomenon is an utterly nonhuman agency, both geological and atomic, accomplishing something that humans, in their infinite hubris, had believed only they could do. Yet Oklo simultaneously underscores the technopolitical power of human agency to operate at both geological and atomic scales. It encapsulates the terrifying scalar collapses and explosions of which we have become capable. Precambrian rock took two million years to generate the materials that a human-built nuclear reactor can pump out in one. Now there's a scale for Anthropocenic acceleration: two million to one.

The materials that power such acceleration do not disappear—not even when they explode. They change form and scale, but they are still there, some more noxious than ever for our species (and others). Cast as natural analogue, Oklo had value for thinking about that problem, though not for solving it. Studying the path of its fission products made for fascinating science, but the analogy had serious limits: the sites under consideration as waste repositories had very different geological properties. When it came to nuclear waste planning, Oklo offered a research paradigm, but not a solution.

The Anthropocene contention engages industrial pasts and presents by scaling them against geological time. But its most powerful demand is actually on (or about) the future(s). Oklo thus fit into the full temporal range of Anthropocene claims. Managing temporal excess was—is—a major concern for those seeking a solution for nuclear waste burial. It is not just that ten thousand years (or longer—plutonium's half-life is twenty-four thousand years) exceeds human *design* horizons. That sort of time scale exceeds human *language* horizons. How to make waste repositories legible to humans millennia in the future? How to persuade our descendants that the buried materials are permanent waste, too dangerous to ever be revalued? Such projection into the future does not just require reckoning with geology; it also requires reckoning with language and representation. Attempts to address such questions have involved anthropologists, archaeologists, philosophers, artists, and linguists. Interdisciplinary committees have imagined two- and three-dimensional signage to warn future generations. The most famous is this field of thorns, which aspires to be an interscalar vehicle for language itself.

Inevitably in such discussions, someone invokes the Giza pyramids to demonstrate that taboos against plunder stop working after a while. Of course, memory had some continuity around Giza; locals knew the structures contained treasures. So instead, consider the eight-thousand-year-old geoglyphs recently discovered on the steppes of Kazakhstan. Today, their patterns are only visible from space, in satellite imagery.

Archaeologists assume that nomads made these colossal earthworks, but can only guess at their purpose. Were the geoglyphs a form of media? Did they contain a message? We will never know. The signs—if that is what they are—remain unintelligible.

Scholars and artists tasked with communicating with future generations have the best of intentions. They have to try; they have to hope. What else is there? But let's face it: thorn fields and similar warnings are more reliable as technopolitical signifiers in the present (in this case: *Look! we've figured out how to com-*

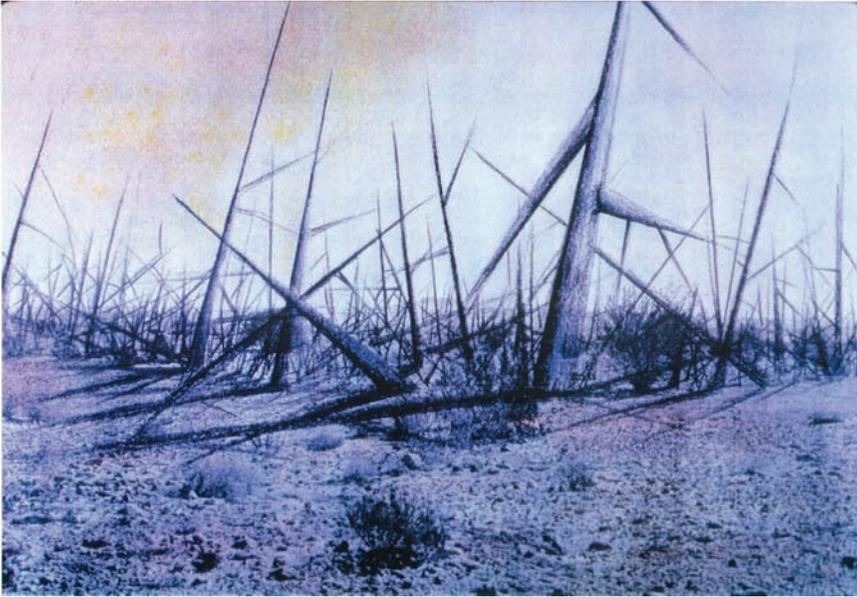


Figure 5. A warning for future generations: landscape of thorns. Image from “Expert Judgments on Markers to Deter Inadvertent Human Intrusion into the Waste Isolation Pilot Plant,” Sandia Report SAND92-1382 (1993). Image courtesy of Safdar Abidi/WIPP.

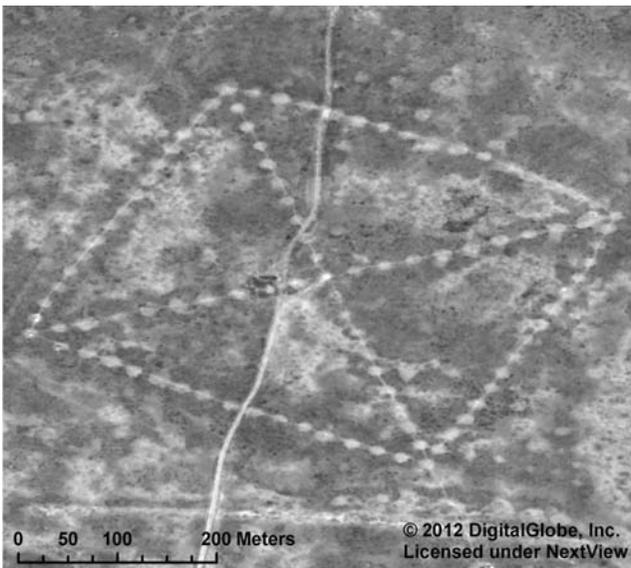


Figure 6. Geoglyphs in Kazakhstan. Image courtesy of Digital Globe.

*municate with our millennial descendants, so it's OK to bury the waste!*) than as effective media for the far future.

Meanwhile, seeing the Anthropocene from Africa forces us to consider signage aimed at present-day humans. A scandal broke out in French and Gabonese media over Mounana's radioactive buildings. In response, Areva (the corporation that took over France's nuclear fuel cycle and power plant construction early this century) reached a deal with the NGOs that commissioned the study. The most heavily contaminated buildings would be demolished, and new dwellings built. And signs would be posted. One, scarcely a meter wide and stuck in the bank of a rivulet, depicted a woman with a basket of manioc on her back, squatting by the water, a red diagonal line crossing the pictogram: *trempage interdit*, soaking forbidden. Others consisted only of spray-painted letters on walls, marking the houses slated for demolition. In contrast to the thorns, these signs—technopolitical signifiers with a different goal—aimed at “de-escalating disaster” (Carr and Fisher 2016). This de-escalation operated in both space and time: the signs proclaimed the local as the appropriate scale of action, and their very flimsiness suggested that the contamination, too, was ephemeral.

Unsurprisingly, the reality of remediation has not matched its promises. Areva certainly claims to have accomplished the mission, calling the COMUF “the first rehabilitated uranium site in central Africa” (Areva n.d.) Production facilities have been dismantled. But further action has lagged. A map of contaminated areas—in Areva's (2015; author's translation) words—“zones with usage restrictions”—was only drafted in late 2015. The construction of replacement dwellings did not begin until 2016, nearly a decade after the alarm was sounded.

As part of its response to the NGOs, Areva established a health observatory in 2010 to monitor former workers. Medical tests would determine whose diseases could be attributed to occupational exposures, and those men would receive treatment and compensation. At this writing, however, no one in Mounana has been deemed to suffer from uranium-related illness. The lack of a cancer registry makes statistical demonstration of disease incidence impossible. (How do you prove that work caused excess illness if you do not know the baseline?) The clinic does not have adequate access to equipment or resources. After a protracted legal battle in France, the families of two former French employees who died of cancer have received compensation. So far, however, not a single Gabonese can say the same.

Fed up, former workers obtained an audience with their prime minister in January 2016 (*Nouveau Gabon* 2016). Their first attempt to rescale their claims

had bypassed the national level because Gabon's government had consistently favored *la Françafrique* over its own citizens. It remains to be seen whether this new rescaling attempt will have a different outcome.<sup>3</sup> We can safely predict, however, that the boom-and-bust cycle of capitalism will make restitution more difficult. Areva recently went bankrupt because of its failure to complete French and Finnish nuclear power plants on time and within budget. The real meaning of flimsy signage: companies are far more ephemeral than the contamination they create—and the structured ephemerality of capitalist institutions is part of what enables contamination.

Extraction (of all kinds) has powered the large-scale rearrangement of substances that materially constitutes the Anthropocene. But to go beyond those who speak of lively waste and vibrant matter, *and* to see beyond grandiose solutions that draw on modernist tropes to assert ever-larger scalar reach, anthropologists and their scholarly kin need to reflexively assemble their own scalar projects, their own interscalar mechanisms for keeping the planet and all of its humans in the same conceptual frame. Thinking with the Anthropocene expands our vision of time and space. Thinking with an *African Anthropocene* reminds us of who pays the price for humanity's planetary footprints, so as to better grasp the kinds of entanglements—and futures—people face in our treacherous times.

### ABSTRACT

*How can we incorporate humanist critiques of the Anthropocene while harnessing the notion's potential for challenging political imagination? Placing the Anthropocene offers one way forward; the notion of an African Anthropocene offers a productive paradox that holds planetary temporality and specific human lives in a single frame. Navigating the Anthropocene from Africa requires attending to scale both as an analytic and an actor category. In order to do so, this essay proposes the notion of interscalar vehicles: objects and modes of analysis that permit scholars and their subjects to move simultaneously through deep time and human time, through geological space and political space. This essay discusses the creation and destruction of value/waste and pasts/futures around a uranium mine in Mounana, Gabon, to unpack the political, ethical, epistemological, and affective dimensions of interscalar vehicles and their violent Anthropocenic implications. [scale; value; waste; Anthropocene; Africa; nuclear; mining]*

### NOTES

*Acknowledgments* Interlocutors at the many venues at which I presented talk versions of this essay offered provocative questions, for which I thank them. An early draft of the written version was completed while on a Mary I. and David D. Hunting Family Fellowship from the University of Michigan's Institute for the Humanities. Special thanks to Paul N.

Edwards, members of Michigan's African History and Anthropology Workshop, and the editors and reviewers of *Cultural Anthropology* for incisive comments that helped sharpen the final version.

1. On the apotheosis of trash as individual human experience, see [Yaeger 2008](#).
2. Some geographers refer to this kind of move as *grounding* the Anthropocene (e.g., [Whitehead 2014](#); [Braun et al. 2015](#)).
3. Things do not look promising. A recent post on the website of the [Gabon Ministry of Mines \(2015\)](#) focuses primarily on prospects for new mines. Its discussion of health and environmental consequences is a nearly perfect echo of Areva's: remediation accomplished, monitoring ongoing, no problems to report.

## REFERENCES

- Areva  
 2015 "Deuxième clis à Mouana en 2015." Press release, November 24.  
 n.d. "COMUF, premier site uranifère réaménagé d'Afrique Centrale." Website.
- Asafu-Adjaye, John, et al.  
 2015 *An Ecomodernist Manifesto*. <http://www.ecomodernism.org>.
- Bennett, Jane  
 2010 *Vibrant Matter: A Political Ecology of Things*. Durham, N.C.: Duke University Press.
- Bodu, R., H. Bouzigues, N. Morin, and J.-P. Pfiffelmann  
 1972 "Sur l'existence d'anomalies isotopiques rencontrées dans l'uranium du Gabon." *Comptes rendus de l'Académie des Sciences, Série D* 275: 1731.
- Bonneuil, Christophe, and Jean-Baptiste Fressoz  
 2016 *The Shock of the Anthropocene: The Earth, History, and Us*. Translated by David Fernbach. New York: Verso.
- Boudia, Soraya, and Nathalie Jas, eds.  
 2014 *Powerless Science? Science and Politics in a Toxic World*. New York: Berghahn.
- Bouzigues, H., R. J. M. Boyer, C. Seyve, and P. Teulieres  
 1975 "Contribution à la solution d'une énigme scientifique." In *The Oklo Phenomenon*, 237–43. Vienna: International Atomic Energy Agency.
- Braun, Bruce, Mat Coleman, Mary Thomas, and Kathryn Yusoff  
 2015 "Grounding the Anthropocene: Sites, Subjects, Struggles in the Bakken Oil Fields." *AntipodeFoundation.org*, November 3. <https://antipodefoundation.org/2015/11/03/grounding-the-anthropocene>.
- Brubaker, Rogers, and Frederick Cooper  
 2000 "Beyond 'Identity.'" *Theory and Society* 29, no. 1: 1–47. <http://www.jstor.org/stable/3108478>.
- Busch, Lawrence  
 2013 *Standards: Recipes for Reality*. Cambridge, Mass.: MIT Press.
- Carr, E. Summerson, and Brooke Fisher  
 2016 "Interscaling Awe, De-Escalating Disaster." In *Scale: Discourse and Dimensions of Social Life*, edited by E. Summerson Carr and Michael Lempert, 133–56. Oakland: University of California Press.
- Carr, E. Summerson, and Michael Lempert  
 2016 "Introduction: Pragmatics of Scale." In *Scale: Discourse and Dimensions of Social Life*, edited by E. Summerson Carr and Michael Lempert, 1–21. Oakland: University of California Press.
- Chakrabarty, Dipesh  
 2009 "The Climate of History: Four Theses." *Critical Inquiry* 35, no. 2: 197–222. <https://doi.org/10.1086/596640>.
- Chalfin, Brenda  
 2014 "Public Things, Excremental Politics, and the Infrastructure of Bare Life in Ghana's City of Tema." *American Ethnologist* 41, no. 1: 92–109. <https://doi.org/10.1111/amet.12062>.

- Collard, Rosemary-Claire, Jessica Dempsey, and Juanita Sundberg  
 2015 “The Moderns’ Amnesia in Two Registers.” *Environmental Humanities* 7, no. 1: 227–32. <https://doi.org/10.1215/22011919-3616425>.
- Cowan, George A.  
 1976 “A Natural Fission Reactor.” *Scientific American*, July: 36–47.  
 2010 *Manhattan Project to the Santa Fe Institute: The Memoirs of George A. Cowan*. Albuquerque: University of New Mexico Press.
- Crist, Eileen  
 2015 “The Reaches of Freedom: A Response to An Ecomodernist Manifesto.” *Environmental Humanities* 7, no. 1: 245–54. <https://doi.org/10.1215/22011919-3616452>.
- Daoud, Samira and Jean-Pierre Getti  
 2007 “Areva au Gabon: Rapport d’enquête sur la situation des travailleurs de la COMUF, filiale gabonaise du groupe Areva-Cogéma.” Report, April 4. Paris: Association Sherpa.
- DeLoughrey, Elizabeth  
 2014 “Satellite Planetaryity and the Ends of the Earth.” *Public Culture* 26, no. 2: 257–80. <https://doi.org/10.1215/08992363-2392057>.
- Douglas, Mary  
 1966 *Purity and Danger: An Analysis of the Concepts of Pollution and Taboo*. New York: Routledge.
- Edwards, Paul N.  
 2003 “Infrastructure and Modernity: Force, Time, and Social Organization in the History of Sociotechnical Systems.” In *Modernity and Technology*, edited by Thomas J. Misa, Philip Brey, and Andrew Feenberg, 185–225. Cambridge, Mass.: MIT Press.  
 2010 *A Vast Machine: Computer Models, Climate Data, and the Politics of Global Warming*. Cambridge, Mass: MIT Press.
- Ellsworth, Elisabeth, and Jamie Kruse, eds.  
 2012 *Making the Geologic Now: Responses to the Material Conditions of Contemporary Life*. Brooklyn, N.Y.: Punctum Books. <https://punctumbooks.com/titles/making-the-geologic-now>.
- Fabian, Johannes  
 1983 *Time and the Other: How Anthropology Makes Its Object*. New York: Columbia University Press.
- Ferguson, James  
 1999 *Expectations of Modernity: Myths and Meanings of Urban Life on the Zambian Copperbelt*. Berkeley: University of California Press.
- Gabon Ministry of Mines  
 2015 “Uranium de Mouana: des indices encourageants pour les activités de la COMUF.” News, October 13. <http://www.mines.gouv.ga/9-actualites/1501-uranium-de-mounana-des-indices-encourageants-pour-les-activites-de-la-comuf->.
- Gille, Zsuzsa  
 2007 *From the Cult of Waste to the Trash Heap of History: The Politics of Waste in Socialist and Postsocialist Hungary*. Bloomington: Indiana University Press.  
 2013 “Is There an Emancipatory Ontology of Matter? A Respond to Myra Hird.” *Social Epistemology Review and Reply Collective* 2, no. 4: 1–6. <https://social-epistemology.com/2013/03/03/is-there-an-emancipatory-ontology-of-matter-a-response-to-myra-hird-zsuzsa-gille>.
- Hamilton, Clive  
 2015 “The Theodicy of the ‘Good Anthropocene’.” *Environmental Humanities* 7, no. 1: 233–38. <https://doi.org/10.1215/22011919-3616434>.
- Hamilton, Clive, Christophe Bonneuil, and François Gemenne, eds.  
 2015 *The Anthropocene and the Global Environmental Crisis: Rethinking Modernity in a New Epoch*. New York: Routledge.

- Haraway, Donna  
 2015 "Anthropocene, Capitalocene, Plantationocene, Chthulucene: Making Kin," *Environmental Humanities* 6, no. 1: 159–65. <https://doi.org/10.1215/22011919-3615934>.
- Harvey, Penelope  
 2017 "Waste Futures: Infrastructures and Political Experimentation in Southern Peru." *Ethnos* 82, no. 4: 672–89. <https://doi.org/10.1080/00141844.2015.1108351>.
- Hawkins, Gay  
 2006 *The Ethics of Waste: How We Relate to Rubbish*. Lanham, Md.: Rowman and Littlefield.
- Hecht, Gabrielle  
 1998 *The Radiance of France: Nuclear Power and National Identity after World War II*. Cambridge, Mass.: MIT Press.  
 2012 *Being Nuclear: Africans and the Global Uranium Trade*. Cambridge, Mass.: MIT Press.
- Helmreich, Stefan  
 2009 *Alien Oceans: Anthropological Voyages in Microbial Seas*. Berkeley: University of California Press.
- Hird, Myra J.  
 2012 "Knowing Waste: Toward an Inhuman Epistemology." *Social Epistemology* 26, nos. 3–4: 453–69. <https://doi.org/10.1080/02691728.2012.727195>.
- Irvine, Judith  
 2016 "Going Upscale: Scales and Scale-Climbing as Ideological Projects." In *Scale: Discourse and Dimensions of Social Life*, edited by E. Summerson Carr and Michael Lempert, 213–31. Oakland: University of California Press.
- Janeczek, Janusz  
 1999 "Mineralogy and Geochemistry of Natural Fission Reactors in Gabon." *Reviews in Mineralogy and Geochemistry* 38, no. 1: 321–92.
- Jensen, Keld Astrup, and Rodney C. Ewing  
 2001 "The Okélobondo Natural Fission Reactor, Southeast Gabon: Geology, Mineralogy, and Retardation of Nuclear-Reaction Products." *GSA Bulletin* 113, no. 1: 32–62.
- Jonsson, Fredrik Albritton  
 2015 "Planetary Politics." *Public Books*, June 15. <http://www.publicbooks.org/nonfiction/planetary-politics>.
- Jug, Victor  
 1986 Letter to J. Moine, May 28. COMUF Archives, Mounana, Gabon.
- Kuroda, Paul Kazuo  
 1956 "On the Nuclear Physical Stability of the Uranium Minerals." *Journal of Chemical Physics* 25, no. 4: 781. <https://doi.org/10.1063/1.1743058>.  
 1975 "Fossil Nuclear Reactor and Plutonium-244 in the Early History of the Solar System." In *The Oklo Phenomenon*, 479–87. Vienna: International Atomic Energy Agency.  
 1982 *The Origins of Chemical Elements and the Oklo Phenomenon*. New York: Springer Verlag.
- Langston, Nancy  
 2010 *Toxic Bodies: Hormone Disruptors and the Legacy of DES*. New Haven, Conn.: Yale University Press.
- Larkin, Brian  
 2013 "The Politics and Poetics of Infrastructure." *Annual Review of Anthropology* 42: 327–43. <https://doi.org/10.1146/annurev-anthro-092412-155522>.
- Latour, Bruno  
 2015a "Fifty Shades of Green." *Environmental Humanities* 7, no. 1: 219–25. <https://doi.org/10.1215/22011919-3616416>.

- 2015b “Telling Friends from Foes in the Time of the Anthropocene.” In *The Anthropocene and the Global Environmental Crisis: Rethinking Modernity in a New Epoch*, edited by Clive Hamilton, Christophe Bonneuil, and François Gemenne, 145–55. New York: Routledge.
- Lewis, Simon L., and Mark A. Maslin  
 2015 “Defining the Anthropocene.” *Nature* 519: 171–80. <https://doi.org/10.1038/nature14258>.
- Liboiron, Max  
 2016 “Redefining Pollution and Action: The Matter of Plastics.” *Journal of Material Culture* 21, no. 1: 87–110. <https://doi.org/10.1177/1359183515622966>.
- Locher, Fabien and Jean-Baptiste Fressoz  
 2012 “Modernity’s Frail Climate: A Climate History of Environmental Reflexivity.” *Critical Inquiry* 38, no. 3: 579–98. <https://doi.org/10.1086/664552>.
- MacKinnon, Danny  
 2011 “Reconstructing Scale: Toward a New Scalar Politics.” *Progress in Human Geography* 35, no. 1: 21–36. <https://doi.org/10.1177/0309132510367841>.
- Malm, Andreas  
 2016 *Fossil Capital: The Rise of Steam Power and the Roots of Global Warming*. New York: Verso.
- Magnana, Martin  
 1983 Gouverneur de la Province du Haut-Ogooué to Directeur Général de la COMUF, April 11. COMUF Archives, Mounana, Gabon.
- Marston, Sallie A.  
 2000 “The Social Construction of Scale.” *Progress in Human Geography* 24, no. 2: 219–42. <https://doi.org/10.1191/030913200674086272>.
- Miller, William, Russell Alexander, Neil Chapman, Ian McKinley, and John Smellie  
 2000 *Geological Disposal of Radioactive Wastes and Natural Analogues: Lessons from Nature and Archaeology*. New York: Pergamon.
- Monastersky, Richard  
 2015 “Anthropocene: The Human Age.” *Nature* 519: 144–47. <https://doi.org/10.1038/519144a>.
- Moore, Adam  
 2008 “Rethinking Scale as a Geographical Category: From Analysis to Practice.” *Progress in Human Geography* 32, no. 2: 203–225. <https://doi.org/10.1177/0309132507087647>.
- Moore, Jason W.  
 2015 *Capitalism in the Web of Life: Ecology and the Accumulation of Capital*. New York: Verso.
- Naudet, Roger  
 1975 “Table ronde sur l’avenir des recherches.” In *The Oklo Phenomenon*, 631–39. Vienna: International Atomic Energy Agency.  
 1991 *Oklo: Des réacteurs nucléaires fossils. Étude physique*. Paris: Eyrolles.
- Neuilly, M., J. Bussak, C. Prejacques, G. Niej, G. Vendryes, and J. Yvon  
 1972 “Sur l’existence dans un passé reculé d’une réaction en chaîne naturelle de fissions, dans le gisement d’uranium d’Oklo (Gabon).” *Comptes rendus de l’Académie des Sciences, Série D* 275: 1847.
- Neumann, Roderick P.  
 2009 “Political Ecology: Theorizing Scale.” *Progress in Human Geography* 33, no. 3: 398–406. <https://doi.org/10.1177/0309132508096353>.
- Nixon, Rob  
 2011 *Slow Violence and the Environmentalism of the Poor*. Cambridge, Mass.: Harvard University Press.  
 2014 “The Anthropocene: The Promise and Pitfalls of an Epochal Idea.” *Edge Effects*, November 6. <http://edgeeffects.net/anthropocene-promise-and-pitfalls>.

## Nouveau Gabon

- 2016 "Litige contre Areva: les ex-employés de la Comuf sollicitent l'intervention de la primature." <http://www.lenouveaugabon.com/sante/2701-9867-litige-contre-areva-les-ex-employes-de-la-comuf-sollicitent-l-intervention-de-la-primature>.
- Philips, Susan U.  
2016 "Balancing the Scales of Justice in Tonga." In *Scale: Discourse and Dimensions of Social Life*, edited by E. Summerson Carr and Michael Lempert, 112–32. Oakland: University of California Press.
- Proctor, Robert N., and Londa Schiebinger, eds.  
2008 *Agnology: The Making and Unmaking of Ignorance*. Stanford, Calif.: Stanford University Press.
- Purcell, Mark  
2003 "Islands of Practice and the Marston/Brenner Debate: Toward a More Synthetic Critical Human Geography." *Progress in Human Geography* 27, no. 3: 317–32. <https://doi.org/10.1191/0309132503ph436oa>.
- Reddy, Elizabeth  
2014 "What Does It Mean to Do Anthropology in the Anthropocene?" *Platypus*, April 8. <http://blog.castac.org/2014/04/what-does-it-mean-to-do-anthropology-in-the-anthropocene>.
- Reno, Joshua  
2014 "Toward a New Theory of Waste: From 'Matter out of Place' to Signs of Life." *Theory, Culture, and Society* 31, no. 6: 3–27. <https://doi.org/10.1177/0263276413500999>.  
2015 "Waste and Waste Management." *Annual Review of Anthropology* 44: 557–72. <https://doi.org/10.1146/annurev-anthro-102214-014146>.
- Robertson, April M.  
2011 "Paul Kazuo Kuroda (1917–2001)." *Encyclopedia of Arkansas History and Culture*. <http://www.encyclopediaofarkansas.net/encyclopedia/entry-detail.aspx?entryID=6619>.
- Rockström, Johan  
2015 "The Anthropocene, Control, and Responsibility: A Reply to Andy Stirling." *STEPS Centre Blog*, October 29. <http://steps-centre.org/2015/blog/johan-rockstrom-on-the-anthropocene>.
- Sayre, Nathan  
2005 "Ecological and Geographical Scale: Parallels and Potential for Integration." *Progress in Human Geography* 29, no. 3: 276–90. <https://doi.org/10.1191/0309132505ph546oa>.  
2009 "Scale." In *A Companion to Environmental Geography*, edited by Noel Castree, David Demeritt, Diana Liverman, and Bruce Rhoads, 95–108. Malden, Mass.: Blackwell.
- Simmons, Ardyth M., and John S. Stuckless  
2010 "Analogues to Features and Processes of a High-Level Radioactive Waste Repository Proposed for Yucca Mountain, Nevada." Professional Paper 1779. Reston, Va.: U.S. Geological Survey. <https://pubs.usgs.gov/pp/1779>.
- Star, Susan Leigh, and Karen Ruhleder  
1996 "Steps Toward an Ecology of Infrastructure: Design and Access for Large Information Spaces." *Information Systems Research* 7, no. 1: 111–34. <https://doi.org/10.1287/isre.7.1.111>.
- Steffen, Will, Jacques Grinevald, Paul Crutzen, and John McNeill  
2011 "The Anthropocene: Conceptual and Historical Perspectives." *Philosophical Transactions of the Royal Society A* 369: 842–67. <https://doi.org/10.1098/rsta.2010.0327>.

- Szerszynski, Bronislaw  
 2015 "Getting Hitched and Unhitched with the Ecomodernists." *Environmental Humanities* 7, no. 1: 239–44. <https://doi.org/10.1215/22011919-3616443>.
- Thomas, Julia Adeney  
 2014 "History and Biology in the Anthropocene: Problems of Scale, Problems of Value." *American Historical Review* 119, no. 5: 1587–607. <https://doi.org/10.1093/ahr/119.5.1587>.
- Thornton, Thomas F., and Patricia M. Thornton  
 2015 "The Mutable, the Mythical, and the Managerial: Raven Narratives and the Anthropocene." *Environment and Society* 6: 66–86. <https://doi.org/10.3167/ares.2015.060105>.
- Tsing, Anna Lowenhaupt  
 2005 *Friction: An Ethnography of Global Connections*. Princeton, N.J.: Princeton University Press.  
 2012 "On Nonscalability: The Living World is Not Amenable to Precision-Nested Scales." *Common Knowledge* 18, no. 3: 505–524. <https://doi.org/10.1215/0961754X-1630424>.
- Verschave, François-Xavier  
 1998 *La Françafrique: le plus long scandale de la République*. Paris: Stock.
- von Schnitzler, Antina  
 2016 *Democracy's Infrastructure: Techno-Politics and Protest after Apartheid*. Princeton, N.J.: Princeton University Press.
- Walton, Jr., R. D., and G. A. Cowan  
 1975 "Relevance of Nuclide Migration at Oklo to the Problem of Geologic Storage of Radioactive Waste." In *The Oklo Phenomenon*, 499–507. Vienna: International Atomic Energy Agency.
- Whitehead, Mark  
 2014 *Environmental Transformations: A Geography of the Anthropocene*. New York: Routledge.
- Yaeger, Patricia  
 2008 "The Death of Nature and the Apotheosis of Trash; or, Rubbish Ecology." *PMLA* 123, no. 2: 321–39. <https://doi.org/10.1632/pmla.2008.123.2.321>.
- Zalasiewicz, Jan, et al.  
 2015 "When Did the Anthropocene Begin? A Mid-Twentieth Century Boundary Level is Stratigraphically Optimal." *Quaternary International* 383: 196–203. <https://doi.org/10.1016/j.quaint.2014.11.045>.
- Zalasiewicz, Jan, Mark Williams, Colin N. Waters, Anthony D. Barnosky, and Peter Haff  
 2014 "The Technofossil Record of Humans." *Anthropocene Review* 1, no. 1: 34–43. <https://doi.org/10.1177/2053019613514953>.