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Accumulating Extinction
Planetary Catastrophism in the Necrocene

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Capital was born from extinction, and from capital, extinction has flowed.

Capital does not just rob the soil and worker, as Marx observes, it necrotizes the entire planet. Here is a "metabolic rift" (Foster 2000)—between earth and labor—driven by the contradictions of endless accumulation. That accumulation is not only productive; it is necrotic, unfolding a slow violence, occupying and producing overlapping historical, biological, and geological temporalities. Capital is the Sixth Extinction personified: it feasts on the dead, and in doing so, devours all life. The deep time of past cataclysm becomes the deep time of future catastrophe; the residue of life in hydrocarbons becomes the residue of capital in petrochemical plastics.[1] Capitalism leaves in its wake the disappearance of species, languages, cultures, and peoples. It seeks the planned obsolescence of all life. Extinction lies at the heart of capitalist accumulation.

Today's debate about planetary crisis has yielded the concepts of the Anthropocene and the Capitalocene. Both recognize extinction but have yet to grasp its ontological significance—for humanity or for capitalism. What I wish to propose is that we recognize the Necrocene—or "New Death"—as a fundamental biogeological moment of our era: the Capitalocene. The Necrocene reframes the history of capitalism's expansion through the process of *becoming extinction*.

The accumulation of capital is the accumulation potential extinction—a potential increasingly activated in recent decades. This *becoming extinction* is not simply the biological process of species extinction. It is also the extinguishing of cultures and languages, either through force or assimilation; it is the extermination of peoples, either through labor or deliberate murder; it is the extinction of the earth in the depletion fossil fuels, rare earth minerals, even the chemical element helium; it is ocean acidification and eutrophication, deforestation and desertification, melting ice sheets and rising sea levels; the great Pacific garbage patch and nuclear waste entombment; McDonalds and Monsanto.

Here the process of *Necrosis* is central. Unlike apoptosis, the process of programmed cell death beneficial to the organism, Necrosis is born of traumatic injury. Necrosis proceeds by autolysis, a form of self-digestion in which a cell destroys itself through its own enzymes action. Capitalism is the reciprocal transmutation of life into death and death into capital. Necrosis is capital's mode of apoptosis, reproducing the means of production by its destruction. It is both saprophytic and parasitic: it feeds on live and dead nature the same; it seeks to render them indistinguishable. From the standpoint of the Necrocene, capital appears as a *species*, an opportunistic detritus feeder producing mass extinction in the present through the exploitation of past extinctions. The more capitalism exerts its planetary power through the intensification of surplus extraction from Cheap Natures (Moore 2015a),[2] the more it necrotizes the world-ecology it has created.

The Necrocene is the Capitalocene's shadow double, the future past of its necromancy, its monstrous sublime and uncanny paradox. Extinction is the both the immediate success and ultimate failure of the real subsumption of the earth by capital; the ecology of capital is constructed through attempted erasure of existing ecologies—ecologies that include humans. Nothing embodies the reciprocal conditioning between the Capitalocene and the Necrocene more than fossil fuels. Even if the Cheap Natures of charcoal fueled capital's monstrous appetite long before fossil fuels became a general form of energy use, early modern deforestation quickly induced a shift from "shallow" to "deep" time. By the nineteenth century, world accumulation came to depend upon fossil fuels—the appropriation of the deep-time decay of life. Here the Necrocene, but an embryonic omen at the start of the Capitalocene, becomes actualized in capital's novel conscription of deep time.

The argument for the Necrocene flows from a view of capitalism as world-ecology, in which capital accumulation is understood as fundamentally embedded in, and shaped by, the web of life (see Moore 2015a; also Parenti and Hartley's essays in this volume). The Necrocene highlights the relation between capital accumulation and negative-value. That latter encompasses those forms of nature that are directly hostile to capital accumulation, and which cannot be overcome through capital's productivist logic. Questions of waste and toxicity loom large in Moore's account, including of course the rising concentration of greenhouse gases in the atmosphere. But waste and toxification are only part of the reality suggested by the "rise of negative-value" (Moore 2015b). Extinction must be conceptualized in relation to the *longue durée* of capitalism.

We have, it seems, reached a historical tipping point of negative-value accumulation. The nonlinear reproduction of negative-value has clearly become an urgent problem—for capital as well as for planetary life. The "entwinement" of climate change and capital has produced a new contradiction in negative-value: "processes of extracting nature's 'free gifts' (including human labor) and toxifying the biosphere (including humans) have now reached a breaking point." While negative-value accumulation might become more apparent with capital's increasingly frantic efforts to appropriate surplus value and restore Cheap Nature, its history is rooted in the origins of capitalism (Moore 2015b, 5). The Necrocene, coterminous with the Capitalocene, is the slow emergence of the crisis of negative-value accumulation.

The Necrocene concept traces the relation between the material unfolding of extinction through capital and the history of its scientific inquiry. That is why extinction must be examined through exhumation of dead matter: as an object of knowledge, the fossils that led to the discovery of extinction and the concept of catastrophism, and the decayed biomass of hydrocarbons whose use precipitates actual ecological catastrophe. Dead matter is our link to the seeming oblivion of deep time. Through its inspection, we can learn something about our own future catastrophes. The earth is wracked by punctuated cataclysms—subterranean, extraterrestrial, and biological—a press-pulse of species extirpations and radiations (Arens and West 2008). Today we look for analogies for our present epoch in strange hyphenated names: the contemporary mass extinction found in the Permian-Triassic "Great Dying"; the explosive rise of CO_2 ppm in the Paleocene-Eocene Thermal Maximum; life's geological agency in the Great Oxygenation Event of 2.5 billion years ago, when cyanobacterial photosynthesis triggered perhaps life's first "climate catastrophe."[3]

In what follows, we make sense of the Necrocene in four stages. I begin with the "Columbian exchange" that accompanied the conquest of the Americas after 1492 (Crosby 1972). Pangea was restored through the intercontinental and transoceanic exchanges of crops, humans, animals—and commodities. The decimation of indigenous populations made for another "discovery": the idea of extinction. Extinction became a problem of knowledge. Second, the reorganization of capital through scientific management and fossil fuel extraction made extinction an apparent problem: one that needed "stewardship." Capitalism's dialectic of accumulation and extinction coevolved with a conceptualization of knowledge of "risk" and "environment." Capitalism did not ignore environmental risk; it made it the central problem of its survival. Third, the post-World War II "Great Acceleration" witnessed the convergence of financial, actuarial, military strategic, and environmental risk around biosecurity. These emerged primarily from the problems of nuclear warfare and the environmental consequences of nuclear testing. Finally, biosecurity disappeared into catastrophic nihilism and the embrace of necrosis; the "survival economy" of neoliberalism as the Donner Party. The belief in our alienation from nature became embodied in the perspective of the human being as the monstrous all-powerful offspring *of nature*. The problem of extinction was rendered intrinsic to human nature rather than to capital.[4] The history of environmentalism is the history of capitalism realizing its own principle of *becoming extinction* through the conceptual system of planetary catastrophism. *This in turn produced a being toward extinction as a permanent characteristic.*

The "Anthropocene" displaces the origins of the contemporary crisis onto the human being *as species* rather than *as capital*. It reinforces what capital wants to believe of itself: that human "nature," not capital, has precipitated today's planetary instability. The Anthropocene says "humanity" put the earth under its power, that it could either save or destroy it—yet it also says the unintended consequences of this power only accelerate our powerlessness over earth's inevitable revenge. We have mistaken who "we" are (as some kind of undifferentiated human mass) from what "we" perform through capital. We have mistaken a historical condition of our economic organization for an innate aspect of the human being. Planetary Catastrophism has become the ideology of capitalism, and in this catastrophism begets catastrophe. The more capital attempts the real subsumption of the earth, the more the earth subsumes it. In the Necrocene, capitalism's farce runs concurrent with its tragedy.

We have finally inverted Benjamin's "Angel of History" (2006). No longer do we blindly fly along, face turned toward the past in horror as the wreckage builds and builds; now we hurl forward, ignorant of the past, eyes fixed on catastrophe upon catastrophe piling up ahead.

Birth and Burial of Catastrophe

Capital might think itself a pioneer species, but the best term for it would be a *disaster taxon*, a species that does not merely fill vacant niches after ecological catastrophes, but creates catastrophes in order to do so.[5] Its history begins with the "unification of the globe by disease" (Ladurie 1981). The demographic collapse of the Amerindians was hardly accidental—this was not simply a "virgin soil epidemic" (e.g., Crosby 1986). To be sure, the infectious diseases Europeans brought with them outran the pace of conquest. But the duration of the demographic collapse attests to capitalism's reorganization of nature: diseases such as tuberculosis and malaria plagued indigenous peoples due to malnutrition, lack of sanitation, overcrowded labor settlements, and lethal exploitation in mines and plantations (Packard 2011; Arnold 1996).

The capitalist reorganization of New World natures boomeranged death upon Eurasia. The Little Ice Age peaked in the seventeenth century (Parker 2013), due partially to the Amerindian demographic collapse. The Americas' population decline allowed for forest regeneration. Reforestation of the Americas combined with strong El Niños and low sunspot activity (the maunder minimum) to precipitate socio-ecological disasters across Eurasia. By 1610, a "CO_2 minima" had been reached; carbon dioxide levels were among the lowest ever recorded in human history (Lewis and Maslin 2015; Nevle and Bird 2008).

Exploiting the demographic catastrophe, capitalism created a novel "tropical" ecology in the slave plantation. Tropical zones—as much created as discovered—became a homogenized equatorial region whose native diversity was destroyed and replaced by a few staple crops such as sugar, tobacco, and coffee. This climatic-geographic differentiation allowed for the ecological othering of colonial subjects, justifying capitalist expansion by creating zones of law and exclusion (Benton 2010). This geographical othering was a self-fulfilling prophecy: the more the plantation system grew, the more the ecological transformations it wrought allowed for malaria and yellow fever to thrive to new epidemic proportions, the more Europeans viewed these places as unsuitable for "civilization," and inhospitable to settlement by "civilized" peoples. The myth that the demand for West African slaves was due to their immunity to the Caribbean disease environment is backward. *First*, indigenous populations collapsed, propelled by the imperial reorganization of natures. *Then*, African slaves were imported well before the flourishing of malaria and yellow fever, which had not existed in the New World prior to the European invasion (Packard 2011; Webb 2009).

By the eighteenth century, thousands of fossils were pouring into the imperial epicenters of knowledge production. Colonial expansion had facilitated an unprecedented cooperation between the natural sciences and the state. Amateur biologists and botanists took advantage of colonial projects to pursue basic research, and at the same time to gather information for the sake of resource exploitation (Cushman 2013; Ax et al. 2011; Beinart and Middleton 2004; Worster 1994; Grove 1995). Strange, unidentifiable fossils flowed in from the peripheries of the French and British empires, hinting at the prospect of species disappearance. These cryptic specimens, such as the woolly mammoth, haunted the salons of the Enlightenment for nearly a century. The mammoth, whose bones were discovered across North America, presented a sort of anatomical Sphinx's riddle.

In 1796, Georges Cuvier proposed a radical solution to this riddle. He argued that the mammoth and the modern Indian elephant were not the same species. While his conclusion was based on anatomical comparison, the planetary reach of colonial "exploration" provided evidence to support his hypothesis. It seemed impossible, Cuvier argued, "that men who have collected and described the smallest insects in the least accessible climates would not have yet seen such substantial animals" if they were still existent (quoted in Rudwick 2005, 359). Cuvier believed he had discovered "the existence of a world previous to ours, destroyed by some kind of catastrophe. . . . What revolution was able to wipe it out to the point of leaving no trace of it except some half-decomposed bones?" (quoted in Rudwick 2005, 363). In 1804, Thomas Jefferson, haunted by the implications of Cuvier's hypothesis, sent Meriwether Lewis and William Clark to search—among other objectives—for mammoths that "should" have been roaming the American West during their expedition (Rudwick 2005, 414).

Of course Lewis and Clark did not find mammoths west of the Mississippi River. Cuvier had found a rupture in the chain of being, and advanced a revolutionary concept: extinction. Cuvier had proposed a theory of "catastrophism": disruptions in ecological homeostasis, driven by exogenous natural catastrophes such as floods and earthquakes, could cause the extinction of previously robust, well-adapted species.

The original theorists of geological deep time, James Hutton and Charles Lyell, as well as the early evolutionists Geoffroy St. Hilaire and Jean-Baptiste Lamarck refused to believe that mass extinction was possible. Catastrophism, in their view, was a relic of the Judeo-Christian mythology. A crucial vulnerability in Cuvier's theory was his denial of evolution. The discovery of deep time rendered Cuvier's time frame much too shallow for geologists, who had come to believe that only gradual, cumulative change across deep time affected species.

Lyell's uniformitarianism—which implied that biological change worked as a constant, rather than punctuated, rhythm—seemed to have triumphed with the publication of *On the Origin of Species* (1859). Darwin's conception of evolution consisted of tiny, accumulative changes occurring at a fairly constant speed through deep time. This appeared to strike a decisive blow against Cuvier's catastrophism. Nevertheless, uniformitarianism remained ill-equipped to explain major gaps in the fossil record; the strange, radiative qualities of species clustered in some strata and absent from others suggested variable speeds of evolutionary change. That pure uniformitarianism triumphed—for the moment—owed much to the *mentalité* of nineteenth-century Anglo-American laissez-faire empiricism. Its ontology assumed that species were autonomous units, in charge of their individual destinies, and whose extinctions were endogenously caused by their lack of adaptive robustness. Species were a sort of biological Horatio Alger. Marx quipped that Darwin had rediscovered nineteenth-century England in the world of the "beasts and plants" (quoted in Foster 2000, 198). Catastrophism was buried, but in a shallow grave, waiting for some tectonic spasm to awaken it.

Uniformitarianism may have pushed catastrophism to the margins of scientific thought, but reminders of past catastrophes were increasingly dredged up, now in the heartlands of capitalism. Quarrying, mining, and railroad construction came upon the bizarre relics of animals, plants, and other hominids that spoke of ancient and unknown disasters. Industrial capitalism increasingly exhumed extinct life: coal and oil. Capitalism had been reared by the "free gifts" of energy in charcoal, peat, water, solar, and wind, but the Cheap Nature of living energy was increasingly inadequate by the mid-nineteenth century. The transition from a biomass to hydrocarbon regime marked the moment when capital, having exhausted contemporary nature, tapped into deep time: the decayed, dead world now harnessed for sake of capital's world-ecology.

From 1492, early capitalism was premised on rapid forest clearance—for fuel especially (Williams 2003). Across Europe and the Americas, the forests retreated, or their ecologies were fundamentally altered. While today it is fashionable to see fossil fuels as fundamental to capitalist development, American capitalism made the switch to coal fairly late in the game. The United States found no need to use anthracite coke until the mid-nineteenth century—and coal did not become the leading energy source until after the Civil War (Pursell 2007, 61). Even with vast forest resources, it became clear by the 1860s that some form of "rational" forest management was necessary.

In 1867, George Perkins Marsh published *Man and Nature*. Marsh conceived "Man" as both parasite and prime mover. Having witnessed New England's deforestation, he believed humans lived in a perpetual imbalance with nature. Man, Marsh argued, had to find ways to address that imbalance—we had to maintain an "intelligent will" that could see beyond contemporary pressures (1965, 41). Nature could not afford the interest rate of our destruction. If the Enlightenment's "economy of nature" meant a balanced budget, then Marsh thought humans were running a great deficit. Marsh articulated the two main strains of environmentalist thought and practice. On the one hand, Marsh advanced a technocratic ethic of conservation that could control nature. On the other hand, he advocated a preservationist ethic that saw "man" as "everywhere a disturbing agent . . . [who] unsparingly persecutes, even to extirpation" all life around him (Marsh 1965, 43). These two tributaries of the "gospel of conservation" followed parallel, and often antagonistic, paths until the turn of the century (Hays 1959).

This antagonism crystallized in the dispute between Gifford Pinchot and John Muir. Arguing over the construction of Hetch Hetchy dam in Yosemite (California) during the 1910s, the dispute prefigured a century of conflicts between conservationism and preservationism. San Francisco's demand for water would ultimately triumph over the natural sublime of the valley. Conservation was tied to state building. In the United States, it was a response to the environmental problems of western expansion driven by homesteading, mining, forestry, and agriculture (Hays 1959; Worster 1985). Preservation was tied to an aesthetic-transcendentalist lexicon of Eden, and the protection of Nature (with an uppercase N) threatened by civilization. For the preservationist Muir, Pinchot's conservationism represented a plan "for the destruction of the first Garden" (Muir 2008, 111). For Muir, a pristine "Eden" was at stake—and it was threatened with extinction. Purged from Muir's vision were the Native Americans who had been expelled from their lands to establish his cherished Yosemite. Nor did Muir confront capitalism's rapacious appetite for Cheap Nature that made it necessary to "preserve nature" in parks such as Yosemite. "Beauty hunger" seemed more important than actually existing hunger and disease. Viewed in a wider context, the very terms of this debate—between preservationists and conservationists—separated questions of resource depletion and toxification. The first became a problem of a pristine Nature, existing "out there," beyond Society; the second became a non-natural problem of urban environments, excluded from environmental politics altogether.

I Am Become Death, the Savior of Worlds

> "We knew the world would not be the same. A few people laughed, a few people cried. Most people were silent. I remembered the line from the Hindu scripture, the Bhagavad-Gita; Vishnu is trying to persuade the Prince that he should do his duty, and to impress him, takes on his multi-armed form and says, 'Now I am become Death, the destroyer of worlds.' I suppose we all thought that, one way or another."
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> —Robert Oppenheimer, 1965, reflecting on the first atomic bomb test

The return of catastrophism did not come from the upheavals of the Great Depression but from the system of total war that matured across the two world wars. Military-industrial production began to entrench itself in civilian life. It was led by chemical firms finding justification for the continued production of poison gas by transposing its surplus for use in a "war on insects" (Russell 2001). Here an eradication mentality, structured by metaphors of parasites and pests, sustained a new phase of the Necrocene. In the military-industrial production regime, capitalism attempted to save itself from destruction through the absolute intensification of destruction. The apotheosis of this process would be Hiroshima and Nagasaki. Capitalism found in the Atom Bomb the dark watery reflection of its own image. It realized that its logic could only lead to one thing: total extinction. It realized it had become the Necrocene.

Catastrophism's reemergence owes much to the Bomb and its unanticipated side effect in global fallout. Climate science came of age in the

Cold War "techno-politics" of altitude (Edwards 2010, 215). A complex web of satellites, numerical weather models, and weather modification now drove a growing global network of data capture that aimed at planetary surveillance. This atmospheric techno-politics was a reaction to—and catalyst of—the rapid expansion in the spatial and temporal scales of ecological risk. Experts studying the Bomb's environmental effects came to see humanity as a planetary actor in a fragile, finely tuned system—one that postwar humanity threatened to annihilate (Hamblin 2013; Edwards 2012).

Prometheanism, the view that humans could and indeed should control nature, went hand-in-hand with a new catastrophism. At its center of was a new cult of expertise. American world power justified expert political authority through the necessity of managing the hazards set in motion by its permanent war economy. But these experts' authority derived from more than a promise to mitigate catastrophic risks; it also owed much to their proclamations that such risks were *unavoidable*—and outside of political deliberation.[6] This was the birth of the biosecurity state. Vannevar Bush's *Science: The Endless Frontier* (1945) justified this cult of the expert in his reappropriation of Turner's frontier thesis (1898). Bush proposed a new, macho, techno-utopian ideology. The scientist was became a gunslinger in a sidereal wild west, an imperialist fantasy that would overcome the contradictions of capitalist surplus extraction. The *Endless Frontier* as scientific exploration was really the *Endless Frontier* as commodity expansion: apocalyptic fears of extinction would be vanquished by utopian fantasies of techno-omniscience. The scientized discourse of environmental risk obfuscated the close relationship between economic and environmental inequality. This excused the system of production that threatened environmental catastrophe by framing humanity as an undifferentiated mass that had become a "planetary agent."

Weather control was this planetary agent's first major goal. This required solving the problem of modeling and anticipating turbulence. The prospect of enlisting the computational power of the new "Electric Brains"—computers—seemed to make this possible. John von Neumann, mathematician and inventor of ENIAC computer (as well as the Mutually Assured Destruction nuclear strategy), initiated the Numerical Weather Prediction Project at the Institute for Advanced Studies at Princeton in 1946 for this purpose. Von Neumann had corresponded with Norbert Wiener, a pioneer in the analysis of complex nonlinear systems, born of his work designing antiaircraft targeting during World War II. Wiener had popularized systems theory in his 1948 *Cybernetics: Or Control and Communication in the Animal and the Machine*. For Wiener, complex systems were primarily structures governed by the "command and control" of information flows. Chaotic flows of information become entrained in recursive loops of positive and negative feedback, producing an emergent order from "noise." In this scheme, information regulation was a universal framework for all natural and social processes.[7] His conclusions made him skeptical of meteorologists' ability to control the weather due to the "amplification of small differences" leading to unpredictable outcomes (Weart 2008, 58). Edward Lorenz, running weather models in the late 1950s, confirmed Wiener's assertion. He discovered that very similar initial numerical conditions would quickly diverge in their trajectories—this would later become Lorenz's famous "butterfly theory." The weather displayed a chaotic character sensitive to fine-grained differences.

Atmospheric nuclear testing made the need for weather models practical—and urgent. When testing began in earnest in the 1950s, so too did the greatest experiment upon the earth: global radioactive fallout. Strontium-90 did not exist before a hot July day in 1945. As warlike Athena sprung from Zeus's head, strontium-90 burst forth from "the gadget's" plume, flying upward into the stratosphere. From there it dispersed and rained down upon the planet, a toxic blanket of human design and a moment of no return. The earth, capital, and body were now joined through the deep time of radioactive mutation. The notion of the atmosphere and the oceans as a bottomless sink was now put to the test.

Project Sunshine, a secret study initiated by the Atomic Energy Commission in the early 1950s, sought to trace this new twist in capitalism's planetary metabolism. It was an unprecedented effort to understand the global biosphere by tracing the radionuclides throughout the biosphere's trophic levels. The project began in 1949 under the apocalyptic title Project Gabriel. A health physicist at Oak Ridge, Nicholas Smith, calculated the limit point of how many nuclear bombs could be detonated before all life on earth was killed off (Hacker 1994, 181–82). He determined strontium-90 was the worst of a variety of nasty fission products, owing to its ability to mimic calcium, which allowed it to settle in the bone. Once in the bones, strontium-90 needed to knock just one electron from a nearby calcium molecule to begin a metastasized chain reaction (RAND Co. 1953, 2).

And so once again, bones from across the global periphery flowed into the new imperial center of the United States. Only this time around, human bodies—not extinct animals—were the prized objects. At Columbia University's Lamont Observatory, the "theochemist" Laurence Kulp avidly embraced the project. Up to this point, the Observatory had been something of a research backwater. The Bomb gave it purpose—and fame. Kulp and his students examined milk, wine, soil, plants, and animals, even accounting for dietary differences across the globe (Higuchi 2010, 306–7).

Most prized, however, were children's bones. This was their Holy Grail. When it came to these bones, the Observatory's scientists were gripped with an almost monomaniacal obsession. Discussions of children's bones seemed to dominate Sunshine meetings.[8] At a 1954 Atomic Energy Commission Project Sunshine conference, Commissioner Willard Libby lamented the tricky grey area that was "the law of body snatching. . . . If anybody knows how to do a good job of body snatching, they will really be serving their country."[9] The AEC hired body snatchers, coerced governments, bribed morticians, and instructed some of the best graduate students in geochemistry to steal samples from the Arctic to Australia to South Africa. Up to one thousand specimens were shipped to the United States from Australia alone, including 284 baby hearts—most without permission of the parents, who they believed should "remain in blissful ignorance" (Roff 2002, 304–5).

Meanwhile the catalyst for a new environmental politics of planetary catastrophe emerged from a different source: a university study of human biomineral specimens. Washington University's Baby Tooth Survey, led by the dentist Louise Reiss, was a citizen effort that collected over three hundred thousands children's "milk teeth" between 1958 and 1962. (Some eighty-five thousand of these teeth still linger in shoeboxes in an ammunition bunker at the university [*St. Louis Post-Dispatch*, 2013].) It was the "citizen science" answer to Project Sunshine. The survey's stated purpose was to provide the public with "objective" scientific knowledge about how radioactive fallout affected human bodies. In this they pioneered scientific data as tool of political protest (Egan, 2007; K. Moore, 2008; Higuchi, 2010). Most of Sunshine's data was already public by the time the project began. It was really the use of juvenile samples that made the Baby Tooth Survey a success. "Milk teeth" put a human face on the abstract, highly technical problem of "permissible dose." This human face was of a suburban white child—the unequal distribution of risks meant that environmental danger only became politically charged when influential groups felt threatened. The fear of bequeathing to our children a ruined planet was now a far more harrowing prospect than the deforestation denounced by Pinchot and his fellow conservationists in the early twentieth-century. Childhood innocence, the *raison d'être* of the era's suburban consumerism, now seemed besieged by unnatural, mutant, alien forces. Here the ancient struggle of monster and child was recapitulated as *Godzilla* v. *Leave it to Beaver*.

When Rachel Carson published *Silent Spring* (1962), the catatrophist synthesis of preservationism and conservationism became the dominant model of how we imagined planetary futures. Carson told the story of fallout through DDT (dichlorodiphenyltrichloroethane)—a seemingly mundane product widely used as an agricultural pesticide. Carson opens *Silent Spring* with Biblical language: "a strange blight crept over everything," bringing with it "mysterious maladies" (1962, 2). A "shadow of death" was cast over all life (ibid.). Something has invaded the Garden; the serpent has arrived. God brings down His wrath upon the inhabitants of the American pastoral, though they know not what they did. Like the first born of Egypt, even children are not spared. They are living, it seems, in a land so toxic they are stricken "suddenly while at play and die within a few hours." A chain reaction of disappearances leaves even that most resilient animal, "man," without succor. Its seems as if an atomic bomb had fallen—the vegetation looked "as if swept by fire, a white granular powder fell "like snow," a metaphor that evoked the horror of "atom dust." Carson extended the relationship between the human body and the radioactive isotope to all industrial chemicals. In so doing, she captured a deepening popular anxiety over the end of humanity through deformity and mutation: an "end" that was fundamentally tied to the practice of modern life, from geopolitics to the backyard. In the inadvertent consequences of our everyday life, a "grim specter has crept upon us almost unnoticed, and this imagined tragedy may easily become the stark reality we all shall know" (Carson 1962, 1–3). In a single sentence, Carson globalized this tragedy as a creeping catastrophe of deep time, not in the flashy mega-explosions of the Bomb, but in the slow violence of its unknown, invisible by-products. "I am Become Death" and "Save the Earth" had become two sides of the same coin.

Carson was not the only scholar who had become aware of deep-time catastrophe. In the 1950s, there were growing popular fears—in Japan, Britain, and America—that nuclear explosions would trigger large-scale climatic changes and extreme weather events (Edwards, 2010; Hamblin, 2013). Most atmospheric experts initially dismissed public concerns. By the early 1960s, once-skeptical scientists began to speculate about the possibilities of melting the polar ice caps with hydrogen bombs to create a "temperate" Arctic. Other scientists feared such an intervention would instead trigger an Ice Age (Wexler 1958). The mystery of the ice ages had been the holy grail of climatological research for nearly a hundred years. In the 1950s, earth scientists generally accepted that there had been four ice ages and interglacial epochs in regular intervals. But evidence remained scant. In the 1930s, the Serbian astronomer Milutan Milankovitch had proposed that orbital cycles based on the long-term elliptical eccentricities of the earth's rotation around the sun were involved. If this was the case, far more than four ice ages had occurred, given that the longest orbital cycle was only one hundred thousand years.

Geophysicists doubted Milankovitch's hypothesis. To them, it was exceedingly unlikely that slight alterations in solar radiation could cause such huge climatic changes. But the Lamont Observatory's scientists began to think otherwise. They dredged up deep sea core samples suggesting that Milankovitch might be correct. These suggestions implicated something profound: planetary climate could shift rapidly, and do so from even minor perturbations. The geochemist Wallace Broecker, a Lamont Project Sunshine veteran, proposed in 1963 that rapid climatic changes were possible. Milankovitch's theory, Broecker argued, must now be considered as "more than an interesting curiosity" (Weart 2008, 48). The head of the Lamont Observatory, Maurice Ewing, had already coauthored an article in 1956 proposing the possibility that albedo feedback loops might cause ice ages with rapid onset. Cesare Emiliani, studying the chemical markers of ancient foraminifera (tiny snails buried deep in the ocean's crust), proposed many more than four ice ages—and that their occurrence was neither so regular, nor so gradual, as scientists believed (Weart 2008, 45–47). Ice core sampling in the Arctic further confirmed the prospect of climatic instability. Now nuclear and climatic catastrophe merged into one larger complex in the expert mind. Robert Ayres, whose subsequent studies of industrial metabolism influenced sustainable development discourse, wrote a definitive three-volume study for RAND on the environmental effects of nuclear weapons. In it he applied these new theories of ice age instability to argue that nuclear weapons could alter the atmosphere through throwing up huge amounts dust aerosols (Ayres 1965)—what would later be known as a "nuclear winter."

The Cold War "command and control" mentality had pushed scientists to look for a single, overdetermining factor governing the biosphere (Weart, 2008). By the 1960s, that mentality was breaking down. Multidetermination was now favored. It became increasingly clear that the climate operated through sensitive feedback loops at variable speeds. General Circulation Models began to add more and more variables, from ocean currents to volcanic eruptions. By the 1980s, Broecker would even discover that the deep ocean "conveyor" (the thermohaline current), if shut down, could cause rapid and catastrophic climatic changes. It seemed every biospheric process was on a hair trigger, even the ocean.

In the 1950s, scientists assumed that the oceans possessed a nearly infinite capacity to absorb human waste, from radioactive waste to carbon dioxide. The oceanographer Roger Revelle, who had led the first biological study of fallout at Bikini Atoll in 1946, began to undermine even this assumption. In an article coauthored with Hans Suess in 1957, the two men discovered—contrary to their assumptions—that the oceans could not act as an infinite sink for CO_2. "Human beings," they declared, "were carrying out a large-scale geophysical experiment of a kind that could not have happened in the past—and could not be repeated (Revelle and Suess 1957, 19). But CO_2 as "inadvertent weather modification" was still one of several culprits, and not—*yet*—considered the main threat to climate stability. In the 1960s a plethora of anthropogenic atmospheric particulates preoccupied scientists. Walter Orr Roberts realized in 1963 that jet contrails increased cumulus clouds and hence absorbed incoming radiation (Fleagle 1969; Weart 2008), cooling the earth. In the early 1970s NASA scientists Mario Molina and Sherwood Rowland hypothesized that CFCs (from aerosols and refrigerants) were breaking down the ozone layer and could, potentially, warm the earth. Simultaneously, the atmospheric chemist Paul Crutzen found yet another ozone depleting process. This derived from skyrocketing use of artificial fertilizers, which increased nitric oxide in the atmosphere (Weart 2008, 122–23).

Atmospheric scientists remained unsure if the cooling or warming effects of human actions would triumph. One thing, however, was certain: the global atmosphere had been modified by industrial production. The National Science Foundation's 1965 report on the topic echoed George Perkins Marsh a century before, declaring that "man is becoming so numerous and his influences on his environment so profound that he cannot consider himself free to heedlessly or improvidently exploit the air, water, land, and growing things of this earth" (Special Commission on Weather Modification 1965, 1). As scientific studies accumulated, the convergence of chaos theory and catastrophism allowed for a universally shared lingua franca that cut across environmental activism, natural science research, national security strategy, and global development programs.

This discourse was not, of course, centered on the problem of capitalist production. Rather "mankind" as a species was the (catastrophic) agent of change. But even if the discourse of "man" obscured capitalism's primary culpability, the reality of its planetary effects had been clarified empirically—by the very experts who helped to solidify American world power in the 1950s. By the 1970s, it was apparent to many in the natural sciences that the temporal scale of negative-value accumulation had extended far beyond the reach of capital's managerial capacities.

The final variable at work in catastrophism was "population." The engine of environmental degradation seemed to lie with there simply being too many humans. The more people born, the more energy consumed, the more waste produced, the more the earth suffers. Here, it seemed, was a positive feedback loop with only negative consequences. Pollution, perhaps, would not be a problem if there just weren't so many people! Sound management of resources and populations was all that was needed. Global population control could ensure the containment of environmental upheaval. The techno-optimistic cult of expertise seen in many modernization and development programs hid an underlying fear of disaster. The idea of "containing" communism was not simply waged through military and economic means. The maxim *Keep 'Em Fed and They Won't Go Red* was as important as the domino theory to American Cold War strategy.

Hence environmental containment was a primary battleground of the Cold War (White, 2010; Cullather, 2010; Biggs, 2010; Kinkela, 2011). Whereas colonial administrators in 1930s worried about *under*-population stifling economic growth, a different obsession characterized the postwar era: the fear of *over*population (Hodge, 2007; Connelly, 2010; Bashford, 2014). The "population bomb"—the title of Paul Ehrlich's smash bestseller (1968)—transposed the lexicon of nuclear catastrophism into a new ecological threat: overpopulation. Now the very reproduction of "humanity" was a threat to human existence. The discourse of overpopulation resurrected a misanthropic neo-Malthusianism that perceived the greatest threat to the biosecurity of the globe as the growing "hordes" of the Global South (Amrith, 2006). But global capital could perhaps survive the upheavals it had produced via a new concept of ecological securitization. Launched in 1971, UNESCO's Man and the Biosphere Program embodied a new phase in the effort to use global biosecurity to save capitalism from itself. The initiative set aside "biosphere reserves" across the globe, desperately seeking to square the accumulation circle through "sustainable development."

The early 1970s marked a new phase of environmental awareness—punctuated in popular consciousness by the first Earth Day in 1970. In this context, *The Limits to Growth* critiqued catastrophism—and reinforced it (Meadows et al. 1972). Donella Meadows and her colleagues used computer simulations to argue that the exponential growth of the global population would outstrip finite resources. Here was Malthus brought into the digital age. *The Limits to Growth*, while criticizing industrial production in the abstract, placed the blame on population rather than production. This seemingly intractable feedback loop of population growth and resource depletion made some scientists to begin to search for the escape hatch to *Spaceship Earth*—before "man" hit the self-destruct button.

In the lean years of the mid-1970s energy crisis and budget cuts, Bush's *Endless Frontier* now became the more modest *High Frontier* (O'Neill 1976). Gerard O'Neill confronted the dilemma of limits to growth and provided a utopian solution. "We can colonize space, and do so without robbing or harming anyone and without polluting anything," he prophesied (O'Neill 1974, 32). Space colonization would be the capitalist's and the environmentalist's dream: habitats would be self-sustaining and cost-neutral, using solar energy, cultivating their own crops, mining minerals on the moon or asteroids. Even endangered species "may find havens for growth in space colonies, where insecticides are unnecessary . . . and industry has unlimited energy for recycling" (O'Neill 1974, 34). O'Neill claimed that the galaxy's effectively inexhaustible resources would sustain population booms and remove limits on economic growth: "if we are so prodigal as to run through the material of the asteroid belt the next 500 years, we can gain another 500 years by using up the moons of the outer planters" (O'Neill, 1974, 39).

Again we see the contradiction of sustainability. O'Neill begins with a description straight out of *The Limits to Growth* but ends by advocating a continuation of capitalism through an endless frontier movement, swallowing up the rest of the solar system's—even the Milky Way's—resources. The L5 Society, a group of space colonization advocates inspired by O'Neill, symbolized the culmination of planetary catastrophism's contradiction of capitalist expansion and environmental protection (Michaud 1986). Their slogan, "Love the Earth: Leave it," might be considered the white flag of Cold War environmentalism: no solution could be found but more of the same in the interstellar beyond.

The environmental imaginary's movement from earth to space also facilitated its inverse: those who studied space began to look back upon the earth. Astrophysicists leapt into planetary climatology. The entry of the astronomers shifted the focus of research in climatic catastrophes back out toward the stars. The astrobiologist Carl Sagan solved the mystery of why Venus, a planet so similar to ours and marginally closer to the sun, could be so much hotter than the earth. It was the work of an amplifying feedback loop: the "Venus Effect" of greenhouse warming. In Venus we saw the hellish reflection of our future. It is no coincidence that NASA's Godard Institute of Space Studies, under the leadership of Jim Hansen, became the central node for climate research in the 1980s. Hansen's testimony before the U.S. Congress in 1988 brought to the public's attention the dire prospect of a rapidly warming atmosphere. He felt confident in his predictions after his team's general circulation models had shown how sulfate aerosols could trigger sufficient albedo feedback to cool the globe. The model, by inverse, also implied how *warming* could occur through the same amplifying feedback process (Weart 2008, 116–18).

Preoccupation with asteroids mirrored a renewed fear of nuclear climate modification, now described as "nuclear winter." Rapid climatic alterations meant that life could be thrown into adaptation crises that led to extinction events, exactly what Cuvier proposed over a century before. Population biologists realized as much. Gould and Eldredge proposed the evolutionary theory of "punctuated equilibrium" (1972), giving a plausible explanation for gaps in the fossil record that had puzzled nineteenth-century naturalists. They posited that periods of rapid species diversification, such as the Cambrian explosion, were followed by long periods of stasis (equilibrium). Eventually another exogenous geological event, such as an asteroid or increased volcanism, disrupted environments too quickly for most species to adapt. From these catastrophes, new species would evolve. The "Alvarez hypothesis" in 1980 would be final icing on the catastrophist cake (Alvarez 1980). Luis and Walter Alvarez argued that the bizarre global strata of the rare element iridium in the geological record suggested an asteroid impact. The extinction of the dinosaurs was most likely caused by such an impact, which sent enough dust aerosols into the atmosphere to cause a cooling feedback loop. Cuvier was vindicated. But where he had seen catastrophe as a product of divine intervention, scientists now saw it in terms of extraterrestrial accidents. Life became *speeds* on a razor's edge of oblivion.

The new catastrophism also made clear that planetary life had experienced multiple mass extinctions. An extinction event is defined as a rapid disappearance of at least three-quarters of all living species, something that occurred five times before the human era (Barnosky et al. 2011, 51). The discovery of mass extinction was certainly disturbing. But in the 1980s, scientists still assumed that such catastrophes occurred only through errant extraterrestrial impacts or nearby supernova bursts, "a somewhat comforting finding" (Ward 2009, 83). It even appeared there was perhaps there was some kind of "natural" periodicity to these events (Raup and Sepowski Jr. 1984). By the 1990s, those comforting findings gave way to something much less comfortable: the idea that life itself could be the catalyst of its own destruction (Ward 2009, 84). The evidence suggested "humanity" as the driver of a new mass extinction event (Leakey and Lewin 1995).

Today, after five centuries of global capitalist expansion, accumulation by extinction has produced a Sixth Extinction (Kolbert 2014). The Sixth Extinction is the material result of the Necrocene's convergence—conceptually, between chaotic systems theory and deep-time biogeological planetary catastrophism; practically, through the actually existing processes of extinction and necrosis under capital. We can analyze the rise of negative-value through the historical geographies of extinction, and the production of knowledge regarding its process. Accumulation by extinction has become dominant. Capital hopes it will invent new corpses upon which to feast.

The Future Is Past Forever

The Anthropocene argument explains capital's evils by pointing to human nature. It then calls the suffering born from this evil useful because humanity has brought it upon ourselves, *and only through collapse* can a great rebirth justify this hour of darkness. The Anthropocene argument seems to lead us, again and again, to the idea that only technological cocooning can protect us against life's inherent self-destructive tendencies. "Only engineering will save us now, for 'nature' is simply the facts on the page, staring us in the face" (Ward 2009, 156). This argument seems the very justification for catastrophic capitalism's continuation. If the capitalism's game is Russian roulette, would we not assume that every player is suicidal? The suggestion that we must "save life from itself" through technological manipulation could not be more useful to its ends. Capital now seeks to postpone its demise through planetary geoengineering, intensifying the contradictions of negative-value through "environmental" protection. After thirty years of trying remove sulfur dioxide from the atmosphere, it is now seriously proposed that we inject it back into the stratosphere to save us (National Research Council 2015).

The overwrought sense of "humanity" on the brink of near-term extinction is a pernicious perspective that short-circuits the ability to act (Lilley et al. 2012). Today has born witness to the transformation of "Love the Earth: Leave it" to "Love the Earth: Kill Yourself." The death wish of the deep ecologists and the death drive of capital lies in the same misanthropic fantasy of a world emptied of ourselves—the former in a masochistic longing to erase our sins, the latter in the hope to become pure abstract value unmoored from material entropy and death. Deep ecology and geoengineering schemes are two sides of the same coin. Environmental catastrophism is a politics based upon a thousand Cassandras ringing the death knell of "civilization," a belief that leads either to a fatalist neoprimitivism or a fascistic Darwinian-Malthusian fight for survival.

If we live in the Anthropocene, it is because the Capitalocene wants us to think this way. The "environment" must be discarded as a fiction of capital, and with it "environmentalism." "Green Arithmetic"—adding up Nature and Society (Moore 2015a)—has for too long obfuscated capital's interpenetration of bodies, ecologies, and geological strata. The real subsumption of the earth under capital is impossible: capital will never escape the material world in which it acts. The logic of accumulation is not capable of outrunning extinction because accumulation and extinction are the same process. They cannot be decoupled. But the human being *can* be decoupled from Capital. Capital is extinction. We are not.

Notes

1 A new rock has been proposed: plastiglomerate, made from "the intermingling of melted plastic, beach sediment, basaltic lava fragments, and organic debris" (Corcoran et al. 2014, 4).

2 "The Four Cheaps are central to the resolution of recurrent overaccumulation crises in historical capitalism. Consequently, the cyclical end of the 'Four Cheaps,' in successive accumulation cycles, corresponds to a growing mass of surplus capital with nowhere to go. The exhaustion of commodity frontiers, and the slowed growth of unpaid work, is consequently linked strongly to the peculiar forms of financialization which have emerged since the 1970s" (Moore 2015a, 227).

3 "Photosynthesis triggered one of the world's worst climate disasters, the Paleoproterozoic snowball Earth. Intensive investigation of the time period of the Paleoproterozoic glaciations may reveal whether a novel biological trait is capable of radically altering the world and nearly bringing an end to life on Earth" (Kopp et al. 2005).

4 Lewis and Maslin conclude that "5 centuries of human scientific investigation" had eradicated a belief in humanity's uniqueness in the web of life (2015, 177). Science had transmuted humanity from the top of the chain of being to mere primate to invasive parasite overrunning a fragile biosphere. They called upon their readers to look at the Anthropocene not simply as a stratigraphic classification but as the means for humanity to reassert itself as the central protagonist in the great struggle of life. They seem to have taken a page from Nietzsche, who had observed this decentering brought by science long before. Only, what he said with irony, is repeated now with sincerity. For Nietzsche saw in science a "hard-won *self-contempt* of man as his ultimate and most serious claim to self-respect" (Nietzsche 2000, 592). So too could we say of the Anthropocene: the more we vanquish our uniqueness the more we hold ourselves up as unique. The Anthropocene wants to put us back at the top of the chain of being while banishing us further into what Nietzsche had called "a penetrating sense of our own nothingness" (2000, 591).

5 Disaster taxa typically populate areas after an environmental catastrophe wipes out native species. Mammals, for instance, would not have radiated across the globe in the wake of the K-T extinction event if not for their willingness to be scavengers.

6 The pianist Tom Lehrer summed up this idea in his satirical homage to the V-2 rocket inventor Werner von Braun when he quipped, "Once the rocket goes up, who cares where it comes down? That's not my department, says Werner von Braun" (quoted in Vaver 2006, 175).

7 The Macy Conferences of 1948–1950 included Wiener, Gregory Bateson, Claude Shannon, Talcott Parsons, John von Neumann, and Margaret Mead. These actors led the development of a new "cybernetic" episteme. Talcott Parsons's "grand theory" of social action saw emergent structures of "pattern variables" and "pattern maintenance" as structural evolutionary universals of socialization and the formation of social norms. The engineer Claude Shannon proposed a solution to the problem of "information entropy" at

the 1948 conference. Information entropy was sort of like the game of telephone—a signal's relevant information deteriorates as a function of time due to "noise." Shannon argued that all information is essentially uniform, the content or meaning of the signal itself irrelevant, all analog signals could be compressed to binary code. Life and labor became essentially packets of binary "information."

8 Kulp also seemed to have particular zeal for "sawing up bodies and ashing them"—so many, in fact, that the man "who ran the machine shop bought Larry his own bandsaw because he didn't want him cutting up bodies on his bandsaw in the shop" (Imbrie 1997).

9 AEC Division of Biology and Medicine, January 18, 1955 ("Biophysics Conference") (ACHRE No. NARA-061395-B). In response to Kulp's suggestion that they try the city of Houston because "they don't have all these rules there . . . they have a lot of poverty cases and so on," Libby displayed a rather disquieting joy, exclaiming, "That is wonderful!" (ibid.).