

## THREE

# The Rise of Cheap Nature

Jason W. Moore<sup>1</sup>

We live at a crossroads in the history of our species—and of planetary life. What comes next is unknowable with any certainty. But it is not looking good.

Environmentalism theory and research tells us, today, just how bad it is. Mass extinction. Climate change. Ocean acidification. To these planetary shifts, one can add countless regional stories—runaway toxic disasters on land and at sea; cancer clusters; frequent and severe droughts. Our collective sense of “environmental consequences” has never been greater.

But *consequences* of what? Of humanity as a whole? Of population? Of industrial civilization? Of the West? Of capitalism? How we answer the question today will shape the conditions of life on Earth—for millennia to come.

Once we begin to ask this question—What drives today’s disastrous state of affairs?—we move from the consequences of environment-making to its conditions and causes. And once we begin to ask questions about human-initiated environment-making, a new set of connections appears. These are the connections between environment-making and relations of inequality, power, wealth, and work. We begin to ask new questions about the relationship between environmental change and whose work is valued—and whose lives matter. Class, race, gender, sexuality, nation—and much, much more—can be understood in terms of their relationship within the whole of nature, and how that nature has been radically remade over the past five centuries. Such questions unsettle the idea of Nature and Humanity in the uppercase: ecologies without humans, and human relations without ecologies. Far from merely a philosophical difference, the

uppercase Nature and Humanity that dominate Anthropocene stories do something unintentional—but deeply violent. For the story of Humanity and Nature conceals a dirty secret of modern world history. That secret is how capitalism was built on excluding most *humans* from Humanity—indigenous peoples, enslaved Africans, nearly all women, and even many white-skinned men (Slavs, Jews, the Irish). From the perspective of imperial administrators, merchants, planters, and *conquistadores*, these humans were not Human at all. They were regarded as part of Nature, along with trees and soils and rivers—and treated accordingly.

To register the bloody history of this Human/Nature binary is a moral protest. It is also an analytical protest. For capitalism does not thrive on violence and inequality alone. It is a prodigiously creative and productive system too—at least until recently. The symbolic, material, and bodily violence of this audacious separation—Humanity and Nature—performed a special kind of “work” for the modern world. Backed by imperial power and capitalist rationality, it mobilized the unpaid work and energy of humans—especially women, especially the enslaved—in service to transforming landscapes with a singular purpose: the endless accumulation of capital.

Some of us have begun to call this way of thinking *world-ecological* (Moore 2015a).<sup>2</sup> World-ecology does not refer to the “ecology of the world.” Our *ecology* is not the ecology of Nature—with uppercase *N*—but the ecology of the *oikeios*: that creative, generative, and multilayered relation of life-making, of species and environments. Species make environments; environments make species. The philosophical point shapes the historical method: human activity *is* environment-making. And in this observation, nature moves from noun (“the environment”) to verb (environment-making). Human organizations *are* environment-making processes and projects; in turn the web of life shapes human organization. This is the *double internality* of historical change—humanity inside nature, nature inside humanity. (With *humanity* differentiated, not reduced to a formless, abstract homogeneity.) World-ecology is not alone in making the broad philosophical argument. But it is distinctive in arguing for the translation of these philosophical positions into methodological premises, narrative strategies, and theoretical frames. In these frames, specific human organizations—such as capitalism—are revealed as producers and products of the web of life.

Such questions have led us to a set of problems very different from the usual environmentalist critique, with its easy metaphors of Humanity’s

“footprint” upon Nature (e.g., Wackernagel and Rees 1996). Enfolding cause, condition, and consequence in thinking the fate of the planet—and of humans on it—leads us to explore different stories. These are not so simple as Humanity’s fall from Eden, as narratives of catastrophe and collapse would have it (e.g., Diamond 2004). But if they are not so simple, I think we may also find more hopeful stories of how *some* humans have remade the planet, and of how *most* humans might work with other species to co-produce a planet not only more habitable—but more just.

### **Anthropocene Problems, Capitalocene Vistas**

The Anthropocene is one of those ideas—like “globalization” in the 1990s—that worms its way out of academia and captures the popular imagination. It is subject to a bewildering spectrum of arguments, advanced by scholars across the Two Cultures. Geologists, cultural theorists, ecologists, literary analysts, historians, geographers, and anthropologists—everyone wants to get in on the game.

From the outset, then, it is good to be clear about the Anthropocene’s Two Lives. One is the Anthropocene as a broader conversation that transcends the university. In this life, the Anthropocene has opened some measure of public space for dialogue around humanity’s place in the web of life (but see Crist, “On the Poverty of Our Nomenclature” in this volume). This is the Anthropocene as a cultural phenomenon, gracing the cover of the *Economist* (2011a, 2011b) and winning the attention of the *New York Times* editors (2011). This wider conversation has been productive in scholarly circles as well, creating opportunities for scholars across the human and physical sciences to discuss humanity’s role in making planetary natures.

As an analytic, the Anthropocene operates a bit differently. Among earth system scientists, there is an ongoing search for—and debate about—“golden spikes” in the stratigraphic record.<sup>3</sup> Here the method hews closely to a broadly conceived “natural history.” Which golden spike inaugurates the “Age of Man” remains hotly debated.<sup>4</sup>

Here the Anthropocene perspective engages the really big questions of historical change: How do humans make natures, how do natures make humans, and how does that relation shape the long run of human history?

These are questions that the Anthropocene can pose, but cannot answer. Why? Because the perspective retains—even as it seeks to transcend—the binary of Humanity and Nature. It is a binary seemingly inscribed in the intellectual DNA of the Anthropocene project. This

binary animates gripping—but ill-conceived—questions: “Are humans overwhelming the great forces of nature?” (Steffen et al. 2007). More problematic, the Anthropocene’s cultural success sometimes feeds a casual dismissal of conceptual and historical criticisms. For Clive Hamilton, “this discussion [Anthropocene or Capitalocene] is a *diversion*. Will Steffen . . . understands the social roots of this geological epoch. Paul Crutzen, the inventor of this concept, *immediately linked to the burning of fossil fuels and English capitalism*” (Lindgaard 2015, emphasis added). Worse still, Hamilton asks, “Do we really believe a word is so powerful that it has the capacity to change people’s ideas about the causes of climate change? It is not plausible.” These are curious words coming from an advocate of the Anthropocene! Here we see a dangerous closure. That closure is not only a dismissive polemic aimed at closure rather than dialogue—echoed even by the radical magazine *Monthly Review* (e.g., Angus 2015). It reveals a profound, and I am tempted to say willful, misunderstanding of the alternative: the Capitalocene.

For the Capitalocene—“Age of Capital”—is not an argument about replacing one word with another. The Capitalocene argument says three things that the Anthropocene perspective does not—and *cannot*. First, it insists that the history of capitalism is a relation of capital, power, and nature as an organic whole. It is world-ecological (Moore 2015a). It is a multispecies affair. Capitalism is neither a purely economic nor social system, but “a historically situated complex of metabolisms and assemblages” (Haraway et al. 2015, 21). Second, the history of capitalism cannot be reduced to the burning of fossil fuels, in England or anywhere else. It is a history of the relations of power and re/production premised on the cash nexus. Those relations enfolded coal and other energy sources from the sixteenth century; they allowed for successive waves of global conquest and the worldwide appropriations of Cheap Nature. Third, the Capitalocene argument challenges the Eurocentric—and frankly false—view of capitalism as emerging in England during the eighteenth century.

As Hamilton’s riposte to the Capitalocene reveals, the dominant Anthropocene argument assumes a standard narrative. It says that the origins of modern world are to be found in England, right around the dawn of the nineteenth century.<sup>5</sup> The motive force behind this epochal shift? Coal and steam. The driving force behind coal and steam? Not class. Not capital. Not imperialism. Not even culture. But . . . you guessed it, the *Anthropos*: humanity as an undifferentiated whole.

The Anthropocene makes for an easy story. Easy, because it does not challenge the naturalized inequalities, alienation, and violence inscribed in modernity's strategic relations of power and production. It is an easy story to tell because it does not ask us to think about these relations *at all*. It reduces the mosaic of human activity in the web of life to an abstract, homogenous humanity. It removes inequality, commodification, imperialism, patriarchy, and much more from the problem of humanity-in-nature. If sometimes acknowledged, at best these relations exist in the Anthropocene discourse as after-the-fact supplements.

We have noted two major dimensions of the Anthropocene analytic today. One is a strict emphasis on geophysical change and its proximate drivers. The second is an argument about history, and therefore about the present as history. There is frequent slippage between the two. In this latter, the dominant Anthropocene argument goes beyond the domain of earth-system science, reaching into the very heart of historical analysis: the dialectically bound questions of historical agency and periodization.

The Anthropocene argument takes biogeological questions and facts—turning on the presence of variously significant stratigraphic signals (Zalasiewicz et al. 2008, 2011)—as an adequate basis for historical periodization. Two subtle but powerful methodological decisions underpin this approach. In the first instance, empirical focus is narrowed to the consequences of human activity. In this, the Anthropocene argument embodies the *consequentialist bias* of Green Thought across the Two Cultures. It makes the case for humanity's domination of the earth almost entirely through a significant catalogue of biospheric changes. The drivers of such changes are typically reduced to very broad “black box” descriptive categories: industrialization, urbanization, population, and so forth (Steffen et al. 2011a, 2011b). The second methodological choice turns on the construction of humanity as “collective” actor (e.g., Zalasiewicz et al. 2011; Crist, “On the Poverty of Our Nomenclature” in this volume). This choice erases the historical-geographical patterns of differentiation and coherence in the interests of narrative simplicity. This erasure, and the elevation of the *Anthropos* as a collective actor, has encouraged several important mis-recognitions: (1) a neo-Malthusian view of population (see especially Crutzen 2002; Fischer-Kowalski et al. 2014; Ellis et al. 2010), ignoring the modern world-system's actually existing patterns of family formation and population movement (e.g., Seccombe 1992, 1995; Massey et al. 1999); (2) a view of historical change dominated by technology-resource

complexes; (3) a concept of scarcity abstracted from relations of capital, class, and empire; and (4) assigning responsibility for global change to humanity as a whole, rather than to the forces of capital and empire that have given modern world history its coherence (see also Hartley's essay "Anthropocene, Capitalocene, and the Problem of Culture," in this volume).

If we boil down the Anthropocene's historical perspective, we can identify two principal narrative strategies. First, consequences determine periodization. Second, the *Anthropos* drives these consequences. The two frames stem from a philosophical position that we may call Cartesian dualism (Moore 2015a). As with Descartes, the separation of humans from the rest of nature—"Are humans overwhelming the great forces of nature?" (Steffen et al. 2007)—appears as a self-evident reality. In its simplest form, this philosophy locates human activity in one box, the rest of nature in another. To be sure, these two acting units interact and influence each other. But the differences between and within each acting unit are not mutually constitutive, such that changes in one imply changes in the other—although such relations are empirically acknowledged from time to time (Steffen et al. 2011a 845–46). This dualism leads Anthropocene advocates to construct the historical period since 1800 on an arithmetic basis: "human activity plus significant biospheric change = the Anthropocene."

This perspective obscures the actually existing *relations* through which women and men make history within the web of life. To be sure, some radicals have sought to recuperate the Anthropocene argument as crystallizing "capitalism WITH nature" (Swyngedouw 2013, 16). But I find it difficult to square such recuperations with the Anthropocene's fundamentally bourgeois character: above all, its erasure of capitalism's historical specificity and the attendant implication that capitalism's socio-ecological contradictions are the responsibility of all humans.

### **Anthropocene Questions, Capitalocene Answers**

The dominant Anthropocene argument therefore poses a question that it cannot answer: *How* have humans become a "geological force"? (Were we not *already* a geological force?) Anthropocene advocates do of course respond to the question. But they are responses, not explanations in any reasonable sense. Most of these responses focus on demography and technology, though additional factors are often recognized—consumerism, trade liberalization, investment flows, and so forth. These imply, but do not engage directly, questions of power, work, and capital. The

identification of multiple “trajectories” of the Anthropocene describes a lot but explains very little.

The Anthropocene argument cannot explain *how* the present crisis is unfolding for a basic reason: it is captive to the very thought-structures that created the present crisis. At the core of these thought-structures is Cartesian dualism. The term is one of my possible shorthands. This dualism owes its name to René Descartes’s famous argument about the separation of mind and body. Descartes surely does not deserve all blame. He personified a much broader scientific and especially philosophical movement that encouraged

a strict and total division not only between mental and bodily activity, but between mind and nature and between human and animal. As mind becomes pure thought—pure *res cogitans* or thinking substance, mental, incorporeal, without location, bodiless—body as its dualised other becomes pure matter, pure *res extensa*, materiality as lack. As mind and nature become substances utterly different in kind and mutually exclusive, the dualist division of realms is accomplished and the possibility of continuity is destroyed from both ends. The intentional, psychological level of description is thus stripped from the body and strictly isolated in a separate mechanism of the mind. The body, deprived of such a level of description and hence of any capacity for agency, becomes an empty mechanism which has no agency or intentionality within itself, but is driven from outside by the mind. The body and nature become the dualised other of the mind. (Plumwood 1993, 115)

To be sure, humans had long recognized a difference between “first” and “second” natures, and between body and spirit (Cicero 1933). *However*, capitalism was the first civilization to organize itself on this basis. For early modern materialism, the point was not only to interpret the world but to control it: “to make ourselves as it were the masters and possessors of nature” (Descartes 2006, 51). This sensibility was a key organizing principle for an emergent capitalist civilization.

Thus Cartesian dualism is a problem not merely because it is philosophically problematic, but because it is *practically* bound up with a way of thinking the world—ontologically (what is?) and epistemologically (how do we know?)—that took shape between the fifteenth and eighteenth centuries.

These centuries saw the rise of capitalism. Most people—and most scholars—still think about capitalism as matter of “economics.” Markets, prices, money, and all that—not necessarily the most exciting thing to think about. What if, instead of thinking capitalism = economics, we asked if “capitalism” was about something much more profound? One alternative is to think about the rise of capitalism as a new way of organizing nature, and therefore a new way of organizing the relations between work, reproduction, and the conditions of life. Markets, prices, and money are still important in this frame. But the alternative allows us to start looking at how every market, every price, and every movement and accumulation of money was bundled with extra-human nature—and human work too, much of it unpaid.

Instead of capitalism as world-economy, then, we would start to look at capitalism as *world-ecology*. From this angle of vision, three entwined historical processes were fundamental. One was what Marx called primitive accumulation (1977, Part VIII). This entailed a range of processes that made humans dependent on the cash nexus for their survival. Social scientists call this “proletarianization,” and it assumed the widest range of forms. It was nearly always partial (“semi-proletarianization”). It is about the transformation of human activity into labor-power, something to be “exchanged” in the commodity system—sometimes called “the labor market.” Even if one thinks that human activity is somehow independent of nature, there is no avoiding one fact: proletarianization was rooted in the governance of nature and the replacement of custom and common by the dictatorship of the commodity. Sometimes peasants who were forced off the land found their way to the towns. Sometimes they were dispossessed and kept on the land, reduced to cottagers and forced into agricultural wage work—or neoserfdom as in Poland—to acquire what their small plots could not provide. And sometimes proletarians did not look *proletarian* at all—African slaves in Brazilian and Caribbean sugar plantations were a good example (Mintz 1978). Like wage-workers in seventeenth-century England or Peru, slaves also depended upon the cash nexus to survive.

Proletarianization was never principally *economic*; it was a product of new forms of territorial power that emerged after 1450. Here is our second process. The old territorial power—the overlapping jurisdictions and personalized authority of medieval Europe—had crumbled in the long feudal crisis (ca. 1315–1453). West-central Europe’s ruling classes had tried to restore feudal labor systems—and failed. The most dynamic of the new



states owed their dynamism to an alliance with merchant capitalists who were far more than merchants. It was the alliance of the Iberian crowns with Genoese capitalists that, quite literally, made the space that made capitalism possible. In its early centuries, capitalism was trans-Atlantic or it was nothing (Moore 2003a, 2003b, 2007). The new empires—but also the internal transformations of the Low Countries and England—were made possible by power of a new type. At its core was the generalization of private property. For a new *praxis* of modern private property emerged in these centuries. Its “strategic goal” was the separation of the peasantry from nonmarket access to land: arable and grazing land, forests, wetlands, and all the rest (Sevilla-Buitrago 2015). This was the fundamental condition of proletarianization, and like proletarianization, these enclosures and dispossessions were enormously varied. So too were the states and empires that pursued this strategic goal. Their “central function” was “the internal maintenance and external defence of a private property regime” (Teschke 2006, 51; see also Parenti’s essay “Environment-Making in the Capitalocene,” in this volume). And may we add that these states and empires were equally central to the *expanded, globalizing, reproduction of that property regime?*

Our third great historical process turned on new ways of knowing the world. These were purely symbolic, but they were far more than symbolic. The ongoing condition of turning human activity into labor-power, and land into property, was a symbolic-knowledge regime premised on separation—*on alienation*. Let us think of the new knowledge regime as a series of “scientific revolutions” in the broadest sense of the term. This regime made it possible to launch and sustain a process that threatens us all today: putting the whole of nature to work for capital. The job of “science” was to make nature legible to capital accumulation—transforming it into units of Nature and counterpoised to the forces of capital and empire. The job of “the economy” was to channel this alienation through the cash nexus. The job of “the state” was to enforce that cash nexus. To be sure, that “separation from nature” was illusory: humans could never escape nature. But the terms of the relation *did* change. And those changing terms of Humanity/Nature—a complex and protracted process—bundled the symbolic and material. It was a *world-praxis* of remaking the world in the image of capital.

To say *praxis* invokes an ongoing process of capital’s self-reflection and capacity for innovation—symbolically and materially. For no

civilization has been so adept at overcoming its limits. The new knowledge regime prized dualism, separation, mathematization, the aggregation of units. Its innovations, clustered into scientific revolutions, were at once producers and products of the previous two transformations—of labor (proletarianization) and land (property). At the core of the new thought-structures was a mode of distinction that presumed separation. The most fundamental of these separations was Humanity/Nature. Some people became Humans, who were members of something called Civilization, or Society, or both—as in Adam Smith’s “civilised society” ([1776] 1937, 14). From the beginning of capitalism, however, most humans were either excluded from Humanity—indigenous Americans, for example—or were designated as *only partly* Human, as were virtually all European women. As with property, the symbolic boundaries between who was—and who was not—part of Nature (or Society) tended to shift and vary; they were often blurry; and they were flexible. But a boundary there was, and much of the early history of modern race and gender turns on the struggles over that line. (Is it so different today?)

That boundary—the Nature/Society divide that the Anthropocene affirms and that many of us now question—was fundamental to the rise of capitalism. For it allowed nature to become Nature—environments without Humans. But note the uppercase *H*: Nature was full of humans treated as Nature. And what did this mean? It meant that the web of life could be reduced to a series of external objects—mapped, explored, surveyed, calculated for what Nature could do for the accumulation of capital. And the substance of that value? Human labor productivity—but not all *humanly productive work*—measured without regard for its cultural, biophysical, and cooperative dimensions. This was human work as abstracted, averaged, deprived of all meaning but for one: value as the average labor-time making the average commodity.

For this to occur, not only did new conceptions of nature—as external Nature—take shape, but new conceptions of time and space. For good reason, Mumford tells us that the “key machine” of modernity is not the steam engine but the mechanical clock, the physical expression of an earth-shaking idea: linear time (1934, 14). The clock, Marx underlines, was the “first automatic machine applied to practical purposes” (1979, 68). Nor did this early modern revolution of abstraction stop with labor and time. Successive cartographic revolutions, beginning in the fifteenth century, made possible an extraordinary new apprehension of geography. In the

new cartography, geography was cleansed of its troubling particularities and meanings. It became “space as pure quantity” (Biggs 1999, 377). It became abstract space—and therefore, abstract Nature.

Here we can begin to see the thought-structures of modernity as more than “superstructures.” To turn work into labor-power and land into private property was to transform nature into Nature. In equal measure, this transformation produced Society as something outside of Nature, the better that Society could turn Nature into a set of discrete units, into a repertoire of calculable objects and factors of production. Marx tells us, famously, that the relations of capital and labor “drip with blood and dirt” (1977, 926). Does not also the dualism of Society and Nature? We do well to grasp Society and Nature not merely as false, but also as *real* abstractions with real force in the world. In highlighting Cartesian dualism as a key source of the problem—unconsciously embraced by the Anthropocene argument—we are seeking to make sense of three great thought-procedures that have shaped the modern world: (1) the imposition of “an ontological status upon entities (substances) as opposed to relationships (that is to say energy, matter, people, ideas and so on became things)”; (2) the centrality of “a logic of either/or (rather than both/and)”; and (3) the “idea of a purposive control over nature through applied science” (Watts 2005, 150–51; Glacken 1967, 427).

These thought-procedures dominate Anthropocene thinking in all sorts of ways—not least in their embrace of technical fixes such as geoen지니어ing (see Altvater’s essay in this volume). The point I wish to emphasize, however, concerns the fundamentally substantialist and arithmetic character of the Anthropocene perspective. Anthropocene thinking remains firmly rooted in a model that “*aggregate[s]* socio-economic and Earth system trends” (Steffen et al. 2015, 8). The model is descriptively powerful, yielding powerful visual representations of the “Great Acceleration” (*New Scientist* 2008). Descriptively powerful, perhaps—but analytically anemic. Nature and Society are taken as unproblematic; the concepts are confused for actually existing historical processes, in which capitalism is actively shaped by the web of life—and vice versa. In sum, the perspective *integrates* factors without synthesizing them. Absent is the actual whole of power, capital, and nature entwined in modern world history. More problematic still: the adding up of Nature and Society makes claims for wholeness that undermine efforts to forge a new, post-Cartesian synthesis of humanity-in-nature.

### **Challenging the Industrial Revolution Myth: From “Work” And “Energy” to Work/Energy**

The Industrial Revolution is the lodestar of Green Thought. No narrative in modern social thought is so powerful as the idea that *It*—capitalism, industrial civilization, and all the rest—all began with coal and steam. Marxist Greens have scarcely altered the story—even if they prefer to speak of capitalism rather than industry. Enzensberger crystallized the Green perspective in his landmark 1974 essay: “the industrial societies of this earth are producing ecological contradictions, which must in the foreseeable future lead to their collapse” (1974, 4). The Marxist position is more nuanced and historical: fossil fuels enabled the “generalization” of capitalist relations and forces of production (Huber 2009; Malm 2013). Both perspectives are grounded in a substantialist rather than relational view of capitalism and nature. In this narrative, fossil fuels become the spark that ignites the circuit of capital and unleashes the dynamism of modern economic growth. From this naturally follows “the destruction of nature on a planetary scale” (Deléage 1989).

What does this narrative get wrong? Quite a lot, it turns out. Even if we take a conventional approach to environmental history, the fossil capital narrative ignores the epochal revolution in landscape change that occurred between 1450 and 1750. But if we go further—and given the pressing realities of biospheric change today, we need to go further—we can see that the rise of capitalism in the long sixteenth century was premised a fundamentally new law of environment-making. Capitalism’s “law of value” was, it turns out, a law of Cheap Nature. It was “cheap” in a specific sense, deploying the capacities of capital, empire, and science to appropriate the unpaid work/energy of global natures within reach of capitalist power.

The concept of work/energy looms large in this argument (Moore 2015a). It allows us to pierce the Cartesian fog that surrounds the unity of human and extra-human work. Marx’s observation that large-scale industry is a mechanism for turning “blood into capital” was no mere polemic. It was a means of highlighting the ways that the capital relation transforms the work/energy of *all* natures into a frankly weird crystallization of wealth and power: value. Work/energy helps us to rethink capitalism as a set of relations through which the “capacity to do work”—by human and extra-human natures—is transformed into value, understood as socially necessary labor-time (abstract social labor). “Work/energy” (or *potential* work/energy) may be capitalized—as in commodified labor-power via the

cash nexus—or it may be appropriated via noneconomic means, as in the work of a river, waterfall, forest, or some forms of social reproduction. My thinking about work/energy finds inspiration from White’s view of

energy as the capacity to do work. Work, in turn, is the product of a force acting on a body and the distance the body is moved in the direction of that force. Push a large rock and you are expending energy and doing work; the amount of each depends on how large the rock and how far you push it. The weight and flow of water produce the energy that allows rivers to do the work of moving rock and soil: the greater the volume of water in the river and the steeper the gradient of its bed, the greater its potential energy. (1995, 6)

White’s sketch is focused on the geophysical work/energy implied in the historical geography of a river (the Columbia, in this instance). Work/energy is also about organic life: from photosynthesis to hunting prey to bearing children. What bears emphasis is *how* capitalism incorporates work/energy into its re/production of wealth, life, and power. The work/energy alternative sees metabolism through the double internality: flows of power and capital in nature, flows of nature in capital and power. Metabolism, in this perspective, is nearly always better understood as a matter of shifts rather than rifts (Moore 2015a, 75–90).

Capitalism’s metabolism of work/energy is crucial because it sharpens our focus on how human work unfolds through the *oikeios*: the pulsing, renewing, and sometimes-exhaustible relation of planetary life. The genius of capitalism—and a morbid genius at that—has been to find ways, through culture, science, and the state, to appropriate streams of work/energy for free or low cost. We find—has it not been right in front of our eyes all along?—that great “economic” revolutions, propelling labor productivity within the commodity system, are always accompanied by “new” imperialisms, “new” sciences, “new” forms of state power. Capitalism has always flourished as archipelagos of commodified relations within oceans of uncommodified life-activity, living and (in the case of fossil fuels) dead.

Let’s begin with the gist of the Industrial Revolution story. This story tells us that capitalism—or Humanity, in the Anthropocene narrative—begins its journey to “overwhelm” planetary nature sometime around 1800. This narrative is shaped by a peculiar kind of past/present binary: the whole of history, at least since the Neolithic Revolution, is cast into the dustbin of the “preindustrial.” Most scholars are well aware that

civilizations transformed environments in significant ways well before the nineteenth century. But, or so the story goes, the really significant changes occurred after this point.

This conventional story misses something significant. In the three centuries after 1450, there occurred the greatest landscape revolution in human history. “Greatest” in three senses: speed, scale, and scope. This revolution was centered in the Atlantic world, itself a creation of early capitalism. For the first time in human history, a durable transoceanic division of labor underpinned the accumulation of wealth. Because that wealth was *capital*, it was premised on a kind of wealth very different from medieval Europe’s. Early capitalism’s defining innovation was its inversion of the age-old primacy of land productivity. Increasingly, labor productivity within a very narrow zone—the production and exchange of commodities—dominated. At first, that dominance was uneven and tentative—but it was nonetheless decisive. It posited a rule of civilizational reproduction—labor productivity within commodity production—that allowed territorial and capitalist agencies to do something quite novel. They put the whole of nature—at least, those human and extra-human natures within their grasp—in service to advancing labor productivity. Long before economists coined the term, nature became a factor of production: Nature.

Let’s be clear on the nature/Nature distinction: most humans were part of Nature, and this designation worked through the new divisions of labor. An African slave was not part of Society in the new capitalist order, but part of Nature—giving a post-Cartesian twist to Patterson’s characterization of slavery as “social death” (1982). Most *human* work was not labor-power and therefore most humans within capital’s gravitational pull were not, or not really, Humans. This meant that the realm of Nature—as ontological formation and world-praxis—encompassed virtually all peoples of color, most women, and most people with white skin living in semicolonial regions (e.g., Ireland, Poland, etc.)

To put most humans into the category of Nature rather than Humanity was to enable an audacious act of global bookkeeping. On the one hand, the decisive thing was work reproduced—directly or indirectly—through the cash nexus. This included a great deal more people in early modern capitalism than scholars usually acknowledge, a point to which we return later in the essay. On the other hand, the volume of work reproduced through the cash nexus depended upon a much greater volume of work outside that nexus—but within reach of capitalist power. Hence, the appropriation of

“women, nature, and colonies” is the fundamental condition of the exploitation of labor-power in the commodity system (Mies 1986, 77). This is the disproportionality at the heart of capitalism between “paid work,” reproduced through the cash nexus, and “unpaid work,” reproduced outside the circuit of capital but indispensable to its expanded reproduction. Every act of producing surplus value, then, depends upon a disproportionately greater act of appropriating the unpaid work of human and extra-human natures.

Once we recognize this disproportionality—between work reproduced inside and outside the cash nexus—the question of work becomes central to our thinking about nature. Because capitalism is a system driven by competition in the productive sphere—which implies rising labor productivity, and more throughput per hour of necessary labor time—it must appropriate ever-larger spheres of uncaptured nature. The whole system works, as ecological economists have long underscored, because capital pays for only one set of costs, and works strenuously to keep all other costs off the books. Centrally, these are the costs of reproducing labor-power, food, energy, and raw materials.

Technology, then, works through this disproportionality. It works not only to advance labor productivity but to appropriate a rising physical mass of unpaid work/energy from manifold natures. We see this at work in the long history of capitalist mechanization. Sixteenth-century sugar mills, eighteenth-century steam engines, the Fordist assembly lines—all were premised, at every turn, on the appropriation of Cheap Natures. The plantation system was built on Cheap land and labor; steam engines developed at the pitheads of coal mines; the Fordist assembly lines were worthless without Cheap oil, steel, and coal. The bonanza of Cheap fossil fuels allowed capital to smooth out its greatest problem before 1830—the recurrent “underproduction” of food, energy, and raw materials owing to advancing labor productivity in industrial centers (Marx 1967, III, 111–21; Moore 2015a). But since the 1970s, the possibilities for securing Cheap Natures have narrowed. This progressive closure—of capitalism’s Cheap Nature frontiers—has set in motion a new tendency, widely discussed in terms of neoliberalism, the reassertion of market rule, and sharply rising inequality between rich and poor. Often viewed as a triumph, what we have in fact seen is the exhaustion of a centuries-long model of appropriating unpaid work/energy outside the cash nexus. Now, increasingly, firms must *capitalize* rather than appropriate: think of factory-farmed

animals (CAFOs) or tree plantations or aquaculture since the 1970s. Such capitalization, essentially rationalizing primary production through the cash nexus, brings middle-run benefits (rising labor productivity) but also rising costs of production. Increasingly, the costs of socio-ecological reproduction start to show up “on the books.”

The upshot is that the nonlinearity of the Anthropocene’s “Great Acceleration” cannot be explained through technology or population or even “the economy” as such. The organization of work—inside and outside the cash nexus, in all its gendered, semicolonial, and racialized forms—must be at the center of our explanations, and our politics. The question of work and the question of nature will be intimately joined in the politics of the twenty-first century. Indeed, they already are.

### *The Capitalocene: A Relational View*

If we think about work in these more expansive terms, a different view of history comes into focus. We retain our awareness of “environmental” consequences—nearly always imposed on those creatures, humans included, *doing the work*. But we are no longer captive to a view of history premised on consequences. If indeed capitalism is defined by its commitment to endless accumulation, then our starting point—and point of return—must be work. What Marx understood better than most Marxists is that capitalism “works” because it organizes *work* as a multispecies process (Marx 1977, 238 and *passim*; Moore 2015a; Hribal 2003; Haraway 2008). Far from undermining Marx’s conceptualization of value, however, the post-Cartesian critique reinforces it. Many species—and biological and geological processes—perform work for capital that *cannot* be “valued” in a system that values only paid work. The nonlinearity of the Great Acceleration is the logical outcome of a “law of value” premised on advancing labor productivity within a very narrow zone: paid work. As labor productivity advances, there is a geometric uptake of manifold natures, resulting in abrupt and rapid shifts in environment-making. Such a work-centered perspective roots the historical geography of endless accumulation in systems of power, knowledge, and technology that pursue the infinite expansion of work/energy—human and extra-human, paid and unpaid.

Here then is a line in the sand between Anthropocene and Capitalocene arguments. In taking the centrality of work as central to our thinking about capitalism—ontologically (how it is defined) and epistemologically (how we know it and its history)—we have a relational view



of work, power, and re/production since 1492. From this angle of vision, a very different view of the Anthropocene problem comes into focus: how the origins of a new pattern of environment-making began in the Atlantic world during the “long” sixteenth century.

The difference speaks to divergent historical interpretations—and also to differences in political strategy. To locate modernity’s origins through the steam engine and the coal pit is to prioritize shutting down the steam engines and the coal pits, and their twenty-first century incarnations. To locate the origins of the modern world with the rise of capitalism after 1450, with its audacious strategies of global conquest, endless commodification, and relentless rationalization, is to prioritize a much different politics—one that pursues the fundamental transformation of the relations of power, knowledge, and capital that have made the modern world. Shut down a coal plant, and you can slow global warming for a day; shut down the relations that made the coal plant, and you can stop it for good.

The erasure of capitalism’s early modern origins, and the extraordinary reshaping of global natures long before the steam engine, is therefore of some significance—analytically, and politically. Ask any historian and she will tell you: how one periodizes history decisively shapes the interpretation of events, and one’s choice of decisive relations. Start the clock in 1784, with James Watt’s rotary steam engine (Crutzen 2002), and we have a very different view of history—and a very different view of modernity—than we do if we begin with the English or Dutch agricultural revolutions, with Columbus and the conquest of the Americas, with the first signs of an epochal transition in landscape transformation after 1450. Are we really living in the *Anthropocene*, with its return to a curiously Anglocentric vista of humanity, and its reliance on well-worn notions of resource- and technological-determinism? Or are we living in the *Capitalocene*, the historical era shaped by relations privileging the endless accumulation of capital?

The Capitalocene argument posits capitalism as a situated and multispecies world-ecology of capital, power, and re/production. As such it pushes back—strongly—against the Anthropocene’s love affair with Two Century model of modernity: *industrial* society, *industrial* civilization, *industrial* capitalism. The model has obscured something hidden in plain sight: the remarkable remaking of land and labor beginning in the long sixteenth century, ca. 1450–1640, the subject of an extraordinary postwar historiography.<sup>6</sup> Only occasionally did these historians frame

their analyses in terms of capitalism; but there was no question that the early modern transformations of economies and landscapes were closely bound.<sup>7</sup> Since the 1970s, for all their distinctive geographical emphases and interpretive differences, the view of *early* modernity as *real* modernity has persisted.<sup>8</sup> For some, this ongoing “revolt of the early modernists” (van Zanden 2002) did not go nearly so far enough: the decisive period begins sometime just after the turn of the millennium (van Zanden 2009; Levine 2001; Arrighi 1994; Mielants 2007).<sup>9</sup> Yet Green Thought has been slow—*very* slow—to think outside the Two Century box. Industrialization still often appears as a *deus ex machina* dropped onto the world-historical stage by coal and steam power.

On the terrain staked out by the Anthropocene argument, we might consider how the definite relations of early capitalism—co-produced in the web of life—transformed coal from a rock in the ground into a fossil fuel. Let us be clear that the call for the relationality of humanity-in-nature does not deny the materiality of resources. Far from it! The world-ecology alternative argues that resources are relational and therefore historical. Geology is a “basic fact”; it becomes a “historical fact” through the co-produced character of resource production, unfolding through the human/extra-human nexus: the *oikeios* (quotation from Carr 1962; Moore 2015a, 33–50; Harvey 1974).

Geology, in other words, becomes *geohistory* through definite relations of power and production; these definite relations are geographical, which is to say they are not relations between humans alone. (Any geographical point of view unfolds from the premise that human activity is always ontologically coincident with its geographical conditions and consequences.) In the case of coal, we might note the revolution in English coal production began not in the eighteenth century but in the first half of the *sixteenth* century. English coal production rose from 50,000 tons (1530), to 210,000 tons (1560) to 1.5 million tons by 1630. By this point, most of England’s important coalfields were being exploited. Production continued to surge, doubling to 2.9 million tons of coal by the 1680s. If the Anthropocene begins not in 1800 but in the long sixteenth century, we begin to ask much different questions about the drivers of world-ecological crisis in the twenty-first century. English coal’s rapid ascent after 1530 directs our attention to the relations of primitive accumulation and agrarian class structure, to the formation of the modern world market, to new forms of commodity-centered landscape change, to new machineries of

state power. This line of argument only appears to return to “social relations” because the legacy of Cartesian thought continues to tell us that state formation, class structure, commodification, and world markets are purely about relations between humans . . . *which they are not*. These too—states, classes, commodity production and exchange—are bundles of human and extra-human nature. They are processes and projects that reconfigure the relations of humanity-in-nature, within large and small geographies alike.

### **The Origins of Ecological Crisis: From Geological History to Geohistory**

Capitalism in 1800 was no Athena, bursting forth, fully grown and armed, from the head of a carboniferous Zeus. Civilizations do not form through Big Bang events. They emerge through cascading transformations and bifurcations of human activity in the web of life. This cascade finds its origin in the chaos that followed the epochal crisis of feudal civilization after the Black Death (1347–53), followed by the emergence of a “vast but weak” capitalism in the long sixteenth century (Braudel 1961). If we are to put our finger on a new era of human relations with the rest of nature it was in these centuries, centered geographically in the expansive commodity-centered relations of the early modern Atlantic. At the risk of putting too fine a point on the matter: the rise of capitalism after 1450 marked a turning point in the history of humanity’s relation with the rest of nature. It was greater than any watershed since the rise of agriculture and the first cities. And in relational terms, it was even *greater than the rise of the steam engine*.

The rise of capitalism after 1450 marked an epochal shift in the scale, speed, and scope of landscape transformation across the geographical expanse of early capitalism. The long seventeenth-century forest clearances of the Vistula Basin and Brazil’s Atlantic Rainforest occurred on a scale, and at a speed, between five and ten times greater than anything seen in medieval Europe (Moore 2007, 2010b; Darby 1956; Williams 2003). Feudal Europe had taken centuries to deforest large expanses of western and central Europe. After 1450, however, comparable deforestation occurred in decades, not centuries. To take but one example, in medieval Picardy (northeastern France), it took two hundred years to clear twelve thousand hectares of forest, beginning in the twelfth century (Fossier 1968, 315). Four centuries later, in northeastern Brazil at the height of the sugar boom in the 1650s, twelve thousand hectares of forest would be

cleared in a single year (Moore 2007, chap. 6). These are precious clues to an epochal transition in the relations of power, wealth, and nature that occurred over the course of the long medieval crisis and the epochal shift that commenced after 1450.

Whereas the Anthropocene argument begins with biospheric consequences and moves toward social history, another approach is plausible, even desirable. An unconventional ordering of crises would begin with the relations between (and among) humans and the rest of nature, and thence move toward geological and biophysical change. These consequences, in turn, constitute new conditions for successive eras of capitalist restructuring across the *longue durée*. Relations of power and production, themselves co-produced within nature, enfold and unfold consequences. The modern world-system becomes, in this approach, a *capitalist world-ecology*: a civilization that joins the accumulation of capital, the pursuit of power, and the production of nature as an organic whole. This means that capital and power—and countless other strategic relations—do not act *upon* nature, but develop *through* the web of life. Crises are turning points of world-historical processes—accumulation, imperialism, industrialization, and so forth—that are neither social nor environmental as conventionally understood. Rather, these processes are bundles of human and extra-human natures, materially practiced and symbolically enabled.

### *The Origins of Cheap Nature*

The capitalist world-ecology began in the long sixteenth century. Nearly everyone seems to have missed the geography of global environmental transformation as the decisive clue to all other moments of transition. The environmentalists looked for the modern machine and found it: the steam engine and all the rest. The Marxists looked for the “right” class structure—wage-workers, bourgeois property relations, and all that—and they too found what they were looking for. The economists looked for something that looked like modern markets and institutional mechanisms favoring a “modern economy.” All these were very important. And all overlooked something very important: a new pattern of environment-making.

Humans had transformed environments from the very beginning. From the rise of civilization, humans had been making large-scale environmental change. A lot—maybe most—of that environment-making could be characterized negative. Nor did humans require civilization to transform environments on an epochal scale: witness the ecocide of

North America's Pleistocene megafauna. Medieval Europe transformed Continental ecology, deforesting vast regions, in the five centuries after 800 CE—and the confluence of regional ecology, demography, and feudal class structure was central to the demise of feudalism as the climate turned wetter and colder after 1250.

These environmental histories played out over hundreds—sometimes thousands—of years. After 1450, human-initiated transformations would be measured in decades. In the centuries between 1450 and 1750, we find a new era of human relations with the rest of nature: the Age of Capital. Its epicenters were the seats of imperial power and centers of financial might. Its tentacles wrapped around ecosystems—humans included!—from the Baltic to Brazil, from Scandinavia to Southeast Asia. The Capitalocene accelerated environmental transformation beyond anything known before—sometimes, as with forest clearance, moving at speeds an order of magnitude greater than the medieval pattern. There were, to be sure, certain technological shifts that facilitated this landscape revolution—some of which I detail below. Alongside new technologies, there was a new *technics*—a new repertoire of science, power, and machinery—that aimed a “discovering” and appropriating new Cheap Natures (Mumford 1934; Moore 2015). Above all, there were new ways of mapping and calculating the world (Moore 2015a, 193–220). Perhaps most fundamental, however, was a shift—scarcely detectable to contemporaries—in what was *valued*.

All civilizations have laws of value—broadly patterned priorities for what is valuable and what is not. The decisive shift between the Black Death and the conquest of the Americas was precisely this: value shifted from land productivity under conditions of seigniorial power to labor productivity under the hegemony of the modern world market, “the very basis and living atmosphere of the capitalist mode of production” (Marx 1981, 205). What difference could this make to our understanding of biospheric crisis in the twenty-first century? Quite a big one. The shift from land to labor productivity as the decisive metric of wealth implied an entirely novel approach to the relation between human activity and the web of life. For the first time, the forces of nature were deployed to advance the productivity of human work—but only *some* human work. Human work within a porous sphere of commodity production and exchange—sometimes (misleadingly) called “the economy”—was to be valued. All other activity was devalued, and appropriated in service to advancing labor productivity in a narrow zone of commodification. Thus: the birth

of Nature, which implied and necessitated the birth of Society, both dripping with blood and dirt, the necessary ontological counterpoint to the separation of the producers from the means of production.

The condition of the rise of capitalism, in other words, was the creation of Cheap Nature. But Cheap is not free. Cheap is here understood as work/energy and biophysical utility produced with minimal labor-power, and directly implicated in commodity production and exchange. That labor-power was partly the segment of the population who worked for wages, rapidly growing after 1500. But proletarianization assumes manifold forms. Viewed from the standpoint of reproduction—that is, to the degree that social reproduction depends upon the cash nexus—the proletarian relation reached much farther, even in this long sixteenth century. It included that wider layer of the population within capitalism that depended on capital flows—directly or indirectly—for daily life and intergenerational reproduction. This layer included the fast-growing urban population of western Europe and Latin America—expanding much faster in the period 1550–1700 than in 1700–1850 (de Vries 1984). It included the slave population of the Americas, whose modest demographic weight in 1700—around three hundred thousand souls—belied its centrality to capital accumulation through the sugar frontier (Blackburn 1998, 3; Moore 2007). And toward the end of the seventeenth century, it reached deep into the countrysides of western Europe through proto-industrialization, centering on textiles and taking advantage of women’s work and the seasonal agricultural cycle, in turn propelling (semi) proletarian population growth (Seccombe 1992).

The first accomplishment of this new law of value—a law of Cheap Nature—was therefore to create Cheap Labor. The number of slaves disembarked each decade in the Americas—mostly to grow sugar, modernity’s original cash crop—increased a staggering 1,065 percent between 1560 and 1710.<sup>10</sup> Slave prices still tended to rise, a tribute to capitalism’s devastation of *human* nature, but from a base much lower than the wage bill for European proletarians. Meanwhile, most Europeans were not doing so great, either:

In Languedoc . . . a “grain wage” lost half its value between 1480 [and] 1600. In Lyon, . . . the buying power of a “wheat wage” dropped to half its original value between 1500 and 1597. A Modena “bread wage” was devalued 50 percent between 1530 and 1590, while a Florence

wage slumped 60 percent between 1520 and 1600. In Vienna, wages lost more than half their value against a standard breadbasket of goods between 1510 and 1590; in Valencia, a similar decline occurred between 1500 and 1600. In southern England, a builder's wage fell to half its original value against a bundle of subsistence commodities between 1500–10 and 1610–19. . . . Women's wages declined even further than men's. . . . When one considers . . . that the labouring poor had not been very far above the subsistence floor in 1500, the subsequent decline is awful to contemplate. The underlying cause is readily apparent: a deteriorating ratio of land to labour-power, swelling the ranks of the nearly landless, driving real wages down as the village poor became increasingly dependent on wage income to stay alive. (Seccombe 1992, 161)

This Cheap Labor was hardly created out of thin air. It was an expression of the class struggle. But a class struggle over what? Over the terms of what would be—and what would not be—valued. And over the terms of who and what counted—and who and what did not count—as Nature.

Labor-power mattered little without a productivity revolution. Of course, we are told by the Anthropocene advocates—and not a few Marxists—that early capitalism was not *really* modern, and not really capitalist. Why? Because early capitalism was technologically inert, and unable to sustain the long-run advance of labor productivity. This was, we are told, the era of *merchant* capitalism—a preindustrial era.

Was early capitalism really preindustrial? The proposition is hard to sustain. Labor productivity surged in one key commodity sector after another. In printing, labor productivity advanced two-hundred-fold in the century after 1450, with twenty million printed books in circulation by 1500. In the sugar colonies, new mill technology successively boosted productivity across the early modern centuries; meanwhile sugar refineries in European cities such as Amsterdam were the only industrial establishments comparable to nineteenth-century factories. In iron-making, large blast furnaces allowed output per worker to increase fivefold between 1450 and 1650, clearing and transforming forests at every step. In shipping, led by the firms in the Dutch Republic, productivity increased fourfold. Meanwhile, a new *shipbuilding* regime, also led by the Dutch, tripled labor productivity. It combined Smithian specialization (simplified tasks), the standardization of parts, organizational innovation (integrated supply

systems), and technical change (sawmills to displace costly skilled labor). Everywhere, but especially in northwestern Europe, the use of iron tools in agriculture expanded. In the central European copper-silver metals complex, the *saigerprozess* smelting technique revolutionized mining and metallurgy after 1450. New rod-engines, allowing for effective drainage, allowed for a second great wave of European mining after 1540. In the New World, the mercury-amalgamation process boosted silver production rapidly after the 1560s, especially in Peru. Back in Europe, the quick diffusion of the “Saxony Wheel” in textile manufacturing tripled labor productivity, amplified yet further by the diffusion of fulling and napping mills in the fifteenth and sixteenth centuries. Across Europe, but especially in the west, the number of water mills doubled in the three centuries after 1450, tripling aggregate horsepower.<sup>11</sup>

What do these transformations suggest? Any adequate explanation must recognize that there was a transition from control of land as a direct relation of surplus appropriation to control of land as a condition for rising labor productivity within commodity production. This transition was of course tremendously uneven and messy. Hence, where peasant cultivation persisted across early modern Europe, the rupture with medieval rhythms of landscape transformation was often subtle and gradual—*except where, as in seventeenth-century Poland, peasants were directly pushed toward sylvan zones by cash-crop cultivation* (Moore 2010b).

Wherever primary commodity production penetrated, however, the tempo of landscape transformation accelerated. Why should this be? Part of the answer is the pace of technical change, which did indeed quicken—and the diffusion of techniques even more so—in the “first” sixteenth century (1450–1557). But I do not think this was enough to compel such an epochal shift in landscape transformation. More decisive was the inversion of the labor-land relation and the ascendance of labor productivity as metric of wealth, unfolding on the basis of appropriating Cheap Natures.

For Cheap Labor and productive labor required one thing if profitability was to be advanced, and the accumulation of capital was to quicken: Cheap energy, food, and raw materials. Cheap thermal energy to smelt the metals, process the sugarcane, and make glass, beer, bricks, and everything else demanded by the world market. Cheap food to keep the price of labor-power from rising, or at least from rising too fast. And Cheap raw materials—timber for shipbuilding, potash for dyeing textiles, iron for everything—to maintain a virtuous circle of expanding commodity



production. In sum, the whole of nature had to be put to work—in a radically alienating and dynamic way—for capitalism to survive.

This entrained a landscape revolution unprecedented in human history. Its first condition was the conquest of the Atlantic. Between 1535 and 1680, the capitalist world-ecology more than doubled in size, conquering some four million square kilometers between 1535 and 1680 (Chaunu 1959, 148). This appropriation of the New World was “the fundamental structure of the first modernity” (Dussel 1998, 11). These conquests incorporated not only vast expanses of potentially Cheap Nature, but also the labor-power to activate it. By 1500, Spain alone had “colonized more than 2 million square kilometers (an area greater than the whole of Europe of the center) and more than 25 million (a low figure) indigenous peoples, *many of whom were integrated into a system of work that produces value (in Marx’s strict sense) for the Europe of the center*” (Dussel 1998, 11–12, emphasis added).

The impressive figures were complemented by capital’s new thirst for the Cheap Nature within Europe. In the Low Countries, an agricultural revolution allowed three-quarters of Holland’s labor force to work outside of agriculture. It was a “revolution” because—like the English agricultural revolution that followed—it advanced labor productivity and expelled labor from the countryside (van Bavel 2001, 2010). By the end of the sixteenth century, wheat yields peaked, reaching a level not exceeded until the late nineteenth century (Bieleman 2010, 49). The Dutch agricultural revolution was not merely an affair of new techniques and specializations in garden, dairy, and industrial input crops (such as hemp, hops, and madder), but fundamentally a revolution in the *built environment* of the town-country division of labor. The fifteenth century saw the emergence of a windmill landscape, while land reclamation through complex material and organizational systems of water control—*polders*—dominated the century after 1540 (Kaijser 2002; Grigg 1980, 151). A complex “system of dikes, dams, sluices, and drainage canals” remade the countryside, whose maritime regions were committed to an “extreme market dependence” by the sixteenth century (TeBrake 2002, 477; de Vries and van der Woude 1997). Meanwhile, dozens of new harbors were built—not only in Amsterdam, but across the northern Netherlands (de Vries and van der Woude 1997, 34). Urbanization accelerated, and so did proletarianization—in the countryside as much as the city. By the mid-sixteenth century, wage-work occupied as much as half of the economically active population (van Bavel 2010). Meanwhile, this built environment implied expansionary

movements within the northern Netherlands as well as beyond (as we shall see momentarily). By the turn of the eighteenth century, the inland regions of the eastern Netherlands had been transformed into “virtually treeless landscapes” (Groenewoudt 2012, 61).

Agricultural revolutions are world-historical events. The condition for labor productivity revolutions in one region is the expansion of “accumulation by appropriation” on a much larger scale (Moore 2015a). As Dutch farmers retrenched from cereal cultivation into higher-profit lines, grain imports filled the shortfall. These were drawn initially, and always in part, from Flanders, northern France, and the Rhineland. By 1470, however, a line had been crossed. Imports from the Baltic—primarily an expansive Prussian-Polish zone—grew rapidly: fivefold between 1470 and 1500; another fivefold by 1560. This was “enough to feed 15–20 percent of the population of the entire Burgundian Netherlands, and a far greater proportion of the coastal and urban populations” (de Vries and van der Woude 1997, 198).

Poland became an agricultural district of the Dutch Republic. By the early seventeenth century, the Polish Crown was exporting one-third of its net rye production (Slicher van Bath 1977, 88). Such large export shares in low productivity agriculture are fraught with danger. Output was sustained “by deviating from the fundamental principles of rotation in tilling the soil” (Szygielski 1967, 97). Yields fell—sharply. The physical surplus fell by as much as *half* between the 1550s and 1700 (Topolski 1962; de Maddalena 1974; DuPlessis 1997, 82). It was a “catastrophic” decline (Szygielski 1969, 86). It was also uneven. Declining labor productivity and cereal yield could be attenuated, even reversed in some regions, through a large-scale—and *rapid*—movement of forest clearance.

Deforestation was also driven by the rising demands of industrial capital in northwestern Europe. The case of potash, used for cloth bleaching, is breathtaking. In the last quarter of the sixteenth century, English potash imports required the “unpaid work” of 12,000 hectares of (cleared) forest, *every year*. Potash, the most profitable export sector (Zins 1972, 269), encouraged renewed frontier movements through the Baltic. The hinterlands around Königsberg and Riga were subjected to the same dynamic as in Poland. Danzig, at least through the 1630s, remained dominant—the city’s potash exports required the *annual* clearing of 135,000 hectares in that decade alone.<sup>12</sup> Even as the potash commodity frontier moved north and east along the Baltic coast over the next two centuries, the “devastation

of the forests” registered in the Baltic’s declining ash exports (North 1996, 9–14; also Moore 2010b). (Baltic shortfalls would be made good—and then some—by North American suppliers in the eighteenth century [Roberts 1972].) My sense is that we are looking at a deforestation of the Vistula Basin on the order of a million hectares (10,000 square kilometers), and possibly twice as much, between 1500 and 1650.

In central Europe, a mining and metallurgical revolution supplied the emergent capitalist order with a physical basis for money (silver) and manufacturing (iron and copper). Forests—and more importantly, forest commons—were rapidly transformed. Central European mining and metallurgical reached its zenith in the half century after 1470. This region produced the lion’s share of early capitalism’s basic raw materials: copper, lead, and iron. More significantly, new mining and metallurgical techniques—underpinning as prodigious an industrialization as any that came after—allowed for a revolutionary increase in silver production. Here we can glimpse the origins of Cheap Money within Cheap Nature. Production of all metals soared, by fivefold or greater, between the 1450s and 1530s (Nef 1964). Across central Europe, the new metallurgical capitalism scoured the countryside for fuel, effecting widespread pollution and deforestation:

The woods and groves are cut down, for there is need of an endless amount of wood for timbers, machines, and the smelting of metals. And when the woods and groves are felled, then are exterminated the beasts and birds, very many of which furnish a pleasant and agreeable food for man. . . . When the ores are washed, the water which has been used poisons the brooks and streams, and either destroys the fish or drives them away. (Agricola [1556] 1950, 8)

As mining boomed and forests retreated, forest enclosures advanced. By 1524, the radical priest Thomas Müntzer decried these enclosures, through which “every creature should be transformed into property—the fishes in the water, the birds of the air, the plants of the earth: the creatures too should become free” (quoted in Marx 1972, 49). In 1450, “there were still extensive forests, so there were few conflicts between peasants and forest overlords. . . . By 1525 the situation was *entirely changed*” (Blickle 1981, 73, emphasis added). The German Peasant War of 1525—as much a proletarian as a peasant revolt—registered not only a mighty protest against the lords’ enclosure of forests, but the stark realities of rapid changes in land and labor.

Meanwhile, a different kind of agricultural revolution was unfolding in the Atlantic. Here was the rise of the sugar plantation complex. Sugar was modernity's original cash crop. No crop in modern world history was at the root of more misery and devastation than sugar. For sugar not only devoured forests and exhausted soils—it was an apparatus of mass killing in the form of African slavery. On the island of Madeira, located off the western coast of north Africa, the first sugar boom—and the first signs of the modern sugar-slave nexus—emerged. The boom began in the 1470s, quickly ousting Mediterranean producers from their privileged position. In the two decades after 1489, sugar production soared—and labor productivity with it.<sup>13</sup> So did deforestation. As an economic activity, sugar was closer to the iron smelter than the wheat farm. By 1510, 160 square kilometers of forest, nearly one-quarter of the island and over half its accessible forest, had been cleared. Output plummeted; scarcely any sugar would be grown in ensuing centuries (Moore 2009, 2010c). Madeira's crisis was followed quickly by sugar's advance to São Tomé (1540s–1590s) and the first modern, large-scale plantation system, which deforested one-third of the island by 1600 and encouraged large-scale slave revolts.

Northeastern Brazil had, in any event, already displaced São Tomé at the commanding heights of the world sugar economy by 1570. Brazil's sugar boom drove the first great wave of clearing Brazil's Atlantic rainforest, which unfolded at an unprecedented pace. In an era when agricultural output growth can typically be measured in fractions of a percentage point, Brazilian sugar output grew 3 percent every year between 1570 and 1640 (Moore 2007, 257). That it remained profitable owed everything to Cheap Labor and Cheap Energy. The logic of labor management was gruesome: "extract as much labor at as little cost as possible" (Schwartz 1970, 317). It is difficult to convey the sheer lethality of the sugar/slave regime. Nearly 240,000 Africa slaves arrived in northeastern Brazil in the half century after 1600—not counting those who died in the Middle Passage—sustaining a population of just over sixty thousand slaves by 1650 (Moore 2011c). Brazil's Atlantic rainforest did not fare any better. Sugar's cultivation and fuelwood demands *alone* required the clearance some 5,000 square kilometers of forest by 1650 (Dean 1995; Moore 2007, 2009). As if this was not enough, sugar's demographic vortex advanced slaving frontiers within Africa. By 1700, "the human resources of the [Angolan] coast were exhausted," pushing the "hunt for men" ever deeper into the interior (Godinho 2005, 320; Wolf 1982, 195–231). Every great commodity

expansion, it seems, requires new streams of Cheap Labor—by market coercion if possible, by bloody coercion if necessary.

As Brazil's sugar boom unfolded, a different commodity revolution remade Andean life. Potosí emerged as the world's leading silver producer after 1545. The rise of Peruvian silver was a curious brew—imperial conquest, geological good fortune, and declining production in the old central European centers, afflicted by rapid deforestation, declining ore quality, and escalating labor unrest. But the flood of *produced*—rather than simply plundered—silver began to falter in the 1560s. On the heels of deepening fiscal crisis, the Spanish Crown moved quickly, inaugurating one of early modernity's most audacious moments of producing Cheap Nature. As ever, the question of work was central. The arrival of a new Viceroy, Francisco de Toledo, in 1569 was followed by a far-ranging transformation. A new method of extracting silver, mercury amalgamation, was instituted. Labor organization in mining and processing moved from arms-length sharecropping to more direct forms of labor control. A radical process of agrarian restructuring—centering on the *reducciones* (village resettlement) and the *mita* (a labor draft)—was launched to ensure a steady supply of Cheap labor-power for the mines. Three million Andeans would work in the mines before the *mita*'s abolition in 1819—a dramatic undercount when one considers that *mitayo* were customarily accompanied by family. This kept labor costs low in the face of the rising labor demands of pit mining. The *mita* was not only a system of forced wage labor—but of forcible resettlement. Starting in 1571, some 1.5 million Andeans—a population equal to contemporary Portugal!—was forced to settle into *reducciones*, Spanish-style towns designed to facilitate colonial control and steady Cheap Labor. Meanwhile, vast hydraulic infrastructures were built to power the mills that ground ore preparatory to amalgamation. Potosí's "lakes" would eventually contain thirty-two reservoirs covering 65 square kilometers (Moore 2010d). Output was quickly restored. Potosí's silver output increased nearly 600 percent between 1575 and 1590 (Bakewell 1987, 242). Spain's fiscal crisis was—temporarily—resolved; more importantly, it fed the rise of Dutch capitalism.

The changes upon life and land were immediately apparent to contemporaries:

Even though today, because of all the work done on the mountain, there is no sign that it had ever had a forest, when it was discovered

it was fully covered with trees they call quínoa, whose wood they used to build the first houses of this settlement. . . . On this mountain, there was also a great amount of hunting of vicuñas, guanacos and viscachas, animals very similar to the rabbits of Spain in their fur and meat, but with a long tail. There were also deer, and today not even weeds grow on the mountain, not even in the most fertile soils where trees could have grown. This is the most frightening, because now the mountain is covered with loose gravel, with little or no fertile land, crossed with sterile mineralized outcroppings. (*Descripción de la Villa y Minas de Potosí* 1603, 114–15)

Returning to Europe, shortfalls from Poland's agricultural decline were quickly made good by the English agricultural revolution. By 1700, England had become Europe's breadbasket. Between 1700 and 1753, England's grain exports increased 511 percent, six times faster than aggregate exports.<sup>14</sup> By midcentury, however, English agriculture stagnated, as nitrogen reserves were depleted (Moore 2015b; Overton 1996). Exports collapsed (Davis 1954). Rapid gains in agricultural productivity after 1600 stalled by 1750 (Broadberry et al. 2011). The problem was capitalist and world-ecological: a problem of how humans have "mixed their labor with the earth" (Williams 1972). The problem of agricultural productivity in late eighteenth-century England—marked by runaway food price inflation and a net per capita reduction in food consumption—was one of the soil mixed with labor. The era's best practices allowed for a revival of agricultural productivity, but only at the cost of faltering labor productivity. On this the English bourgeoisie could not compromise as the manufacturing expansion gathered steam. Pulling labor out of industry would have reversed the very processes of proletarianization that had propelled the urban-industrial expansion over the previous century (Moore 2015b)!

England's iron consumption, which continued growing rapidly in the eighteenth century, increasingly resorted to the world market to satisfy the rising demand. The island's forests had been rapidly appropriated during the seventeenth-century expansion, such that pig iron output in 1620 would not be exceeded until 1740. Imports were sourced from across the North Sea, where iron devoured the forests with such speed that even Sweden's sylvan abundance was threatened (King 2005; Brinley 1993; Fouquet 2008, 59–60; Mathias 1969, 450; Hildebrand 1992). But all was not market demand—empire mattered, too. The stagnation of English iron

output after 1620 also stimulated a colonial movement of appropriation into Ireland. The Emerald Isle's forest cover contracted from 12.5 percent to just 2 percent, such that little iron would be produced after the seventeenth century (Kane 1844, 3; Kinahan 1886–87; McCracken 1971, 15, 51, and *passim*).

British developments were, however, only part of a broader global story. Before Britain became the workshop of the world, the Dutch ruled the roost. The Dutch Republic, the great superpower of the seventeenth century, transformed environments across the globe. The Dutch energy regime, centered on the extraction of domestic peat as cheap fuel, peaked in the seventeenth century. From this point, decline was swift: easily tapped zones were quickly exhausted and costs increased. Peat output declined sharply after 1750 (de Zeeuw 1978). In Southeast Asia, the Dutch imposed a new colonial regime between the 1650s and 1670s. Seeking a monopoly over the clove trade, the Dutch organized the large-scale removal of “unauthorized” clove trees, the large-scale relocation of indigenous populations from the interior into new administrative units suitable for labor drafts, and established new shipyards outside the Batavian core on the island of Java (Boxer 1965, 111–12; Boomgaard 1992a; Peluso 1992, 36–430). From the early seventeenth century, wetlands across the Atlantic world were reclaimed, often by Dutch engineers, from England to Pernambuco and Suriname, Rome to Göteborg.

The great burst of Iberian and Italian expansion during the “first” sixteenth century (ca. 1450–1557) produced a relative, but widespread, exhaustion of Mediterranean forests. This began earlier for the Italians and Portuguese, somewhat later for Spain. For these powers, deforestation weighed heavily on their capacity to supply quality shipbuilding timber, so fundamental to the commercial and military struggles of the time (Wing 2012; Moore 2010b). Spain relocated its shipbuilding to Cuba, where one-third of the fleet was built by 1700 (Parry 1966; Funes Monzote 2008). Portugal expanded its shipyards in Salvador da Bahia (Brazil) and Goa (India) (Morton 1978; Huei 2008). The Iberian relocation was followed in the eighteenth century by the emergence of major shipbuilding centers and significant frontiers for timber, potash, and naval stores in North America.

The relentless geographical expansion of forest products and shipbuilding frontiers was bound up with a “Great Hunt” (Richards 2003). One key moment was the launching of increasingly vast fleets of herring,

cod, and whaling vessels that devoured the North Atlantic's sources of maritime protein (Perlin 1989; Poulsen 2008; Richards 2003). Another was the transcontinental search for furs in Siberia and North America. While fur trading had only a modest economic weight in world accumulation, its steady advance (and serialized exhaustion of fur-bearing animals) across North America encouraged significant infrastructures of colonial power—and the spread of new diseases—by the mid-eighteenth century.

Great frontier movements continued across the Atlantic world in the eighteenth century, reshaping food, energy, and labor relations. Steadily rising sugar demand and the exhaustion of Bahia's sugar complex by the mid-seventeenth century favored successive sugar revolutions in the West Indies. Sugar transformed Barbados, Jamaica, and St. Domingue (the island of Hispaniola) into agro-export platforms over the next century, leaving a trail of African graves and denuded landscapes in its wake. The resurgence of Mexican silver production in the eighteenth century led to the deforestation of already-thin Mexican forests. And, perhaps most significantly, the epoch-making "Columbian exchange," as Old World diseases, animals, and crops flowed into the Americas, and New World crops, such as potatoes and maize, flowed into the Old World (Crosby 1972; Watts 1992; Moore 2015a, 169–92; Studnicki-Gizbert and Schecter 2010; Richards 2003; Wolf 1982).

### **The Making of the Capitalist World-Ecology**

These transformations tell us that something epochal was in play—much earlier than usually supposed. Let me advance two propositions concerning this early modern landscape revolution. First, these transformations represented an early modern revolution in labor productivity. In this new era of Cheap Nature, the advance of commodification was tightly connected to a revolution in strategies of global appropriation. Crucially, this labor productivity revolution in the zone of commodification was made possible by a revolution in the *technics* of global appropriation—including appropriation within Europe. This was manifested not only in the immediate practices and structures of European imperialism. More fundamentally, the "new" imperialism of early modernity was impossible without a new way of seeing and ordering reality. One could conquer the globe only if one could see it. Here the early forms of external nature, abstract space, and abstract time enabled capitalists and empires to construct global webs of exploitation and appropriation, calculation and credit, property and



profit, on an unprecedented scale. The early modern labor productivity revolution turned, in short, on the possibility of opening and appropriating vast frontiers of Cheap Nature (Moore 2015a, 193–219). The fact that early capitalism relied on global expansion as the principal means of advancing labor productivity and facilitating world accumulation reveals the remarkable precocity of early capitalism, not its premodern character. This precocity allowed early capitalism to defy the premodern pattern of boom and bust: there would be no systemwide reversal of commodification after 1450, not even during the “crisis” of the seventeenth century. Why? In sum, because early capitalism’s *technics*—its crystallization of tools and power, knowledge and production—were *specifically organized* to treat the appropriation of global nature in pursuit of the endless accumulation of capital. As long as there were frontiers of Cheap Nature, the problems of capitalism could be fixed with new technologies and new forms of power premised on the Great Frontier.

The rise of capitalism launched a new way of organizing nature. For the first time, a civilization mobilized a metric of wealth premised on labor rather than land productivity. This was the originary moment of today’s fast-fading Cheap Nature. This transition from land to labor productivity during the early modern era explains much of the revolutionary pace of early modern landscape transformation. The soils and forests of northeastern Brazil, Scandinavia, and Poland were appropriated (and exhausted) in the long seventeenth century. Human nature too was freely appropriated (and exhausted), as New World sugar frontiers and African slaving frontiers moved in tandem. Far from being abolished after the eighteenth century, these frontier-led appropriations were amplified by the long fossil boom. Fossil fuels were a new frontier—subterranean “Americas” with seemingly unlimited supplies of Cheap Nature. These frontiers of unpaid work/energy have always been pivotal to the new “tools of empire” and metropolitan productive capacities that destabilized (and appropriated the labor of) peasant formations from South Asia to southern Italy. In light of this history, we may well ask: Is capitalism today capable of appropriating nature’s free gifts on a scale sufficient to launch a new phase of accumulation, or are we witnessing the exhaustion of a Cheap Nature strategy that has underwritten capital accumulation since the sixteenth century?

The question confounds the usual Green critique. Two words crystallize its essence: “environmental degradation.” Scholars have used the

term a whopping 183,000 times since 1990. The key issue has been, What does humanity—or for radicals, capitalism—do *to* the environment? The most celebrated Green concepts of our times—the Anthropocene and the ecological footprint—embody this sensibility. Their popularity is often justified—even by radicals—for enhancing popular awareness of capitalism’s place in the web of life. For Samir Amin, the ecological footprint concept represents the development of a “major strand in radical social thinking about construction of the future” (2009). For McKenzie Wark, the Anthropocene may be understood as a “series of metabolic rifts,” through which the “soil depletes, the climate alters, the gyre widens” (2015, 4). The difficulty emerges when one considers that the Green critique has dozens of ways to talk about what capitalism *does to* nature, but hardly any way to talk about how nature *works for* capitalism.

A radical and emancipatory alternative does not deny the degradation of nature. Far from it! But a politics of nature premised on degradation rather than work renders the radical vision vulnerable to a powerful critique. This says, in effect, that pristine nature has never really existed; that we are living through another of many eras of environmental change that can be resolved through technological innovation (Lynas 2011; Shellenberger and Nordhaus 2011). The counterargument for the Capitalocene—an ugly word for an ugly system—understands the degradation of nature as a specific expression of capitalism’s organization of work. “Work” takes many forms in this conception; it is a multispecies and manifold geo-ecological process. This allows us to think of technology as rooted in the natures co-produced by capitalism. It allows us to see that capitalism has thrived by mobilizing the work of nature as a whole; and to mobilize human work in configurations of “paid” and “unpaid” work by capturing the work/energies of the biosphere.

The long history of industrial, agricultural, scientific, and technological revolutions may be read in this light. I do not mean to suggest that this is the whole story—it isn’t. But I don’t think we can arrive at something approximating an adequate interpretation without seeing how paid and unpaid work—and their cognate processes of accumulation by capitalization and appropriation—have reworked planetary geographies. For this line of thought pinpoints how capitalism’s *specific* degradation of nature occurs through its *specific* mobilization of the “forces of nature” as “forces of production.” Now, one clarification is immediately necessary, because we are still in the thought-habit of seeing Nature (environments

without humans) whenever one says nature (the web of life). The extraordinary *longue durée* remaking of global nature as a force of production has regularly assigned the majority of humanity—at least the majority of humans within capitalism’s reach—to the status of Nature. There was always contradiction and ambiguity in such assignments, but it is clear that successive racialized and gendered “social” orders over the past five centuries have relied heavily upon the Nature/Society binary. These have been about many things—but not least, they have facilitated the accumulation of capital through manifold gendered and racialized surpluses of unpaid work.

William Kapp, one of the founders of ecological economics, famously characterized the modern economy as a system of “unpaid costs” (1950). Today we know this all too well—heavy metals in children’s bloodstreams and Arctic ice, massive garbage patches in the oceans, agro-toxic overload in our soil and water, never mind that small matter of climate change. But capitalism is more than a system of unpaid costs; it is a system of *unpaid work*.

The genius of capitalism—from the global conquests that commenced in 1492—has been to treat the work of nature as a “free gift.” From the beginning, Europe’s great empires set out deploying science in its widest sense—mapping the world, collecting and organizing biogeographical knowledge, establishing new administrative technologies—to make the whole of nature work on the cheap. These were conquests that made plunder “work” for capitalism in a way that went beyond brute force and domination. But it is hard to sustain a civilization on the basis of plunder. By itself, plunder is too episodic; too violent; and over the long run, too costly. The Spaniards discovered this quickly in the sixteenth century—the mines of Potosí, the great silver mountain, would only yield their riches through new systems of colonial control, technology, and work. They also discovered that the great divide of “Nature” and “Society” could be very useful for rendering not only land, but labor, cheap: the Spaniards referred to Peru’s indigenous peoples as *naturales*. Not all humans were part of Humanity, the better that they could deliver Cheap Nature.

That long history has been reproduced over the past four decades: the earth is now ringed by over two thousand satellites enabling the unprecedented surveillance and mapping of planetary space; the human genome was mapped; biopiracy and biotechnology have proceeded. But today is different from the 1970s, for two big, and closely related, reasons. First, the

potential sources of Cheap Nature are fewer than ever before. The non-revolution in agricultural biotechnology shows this well (Moore 2010e). For all the claims that biotech will somehow feed the world, there has been no revolution in agricultural productivity—indeed, agricultural productivity growth has *slowed* steadily since the mid-1980s. So too, the non-revolution in energy. After the opening of modest oil frontiers in the 1970s—in Alaska, the Gulf of Mexico, West Africa, the North Sea—no major sources of *cheap* energy have appeared. Indeed, the world energy history of the past decade has been marked by the opening of frontiers that are the very opposite of those which have sustained capitalism. These are not low-cost frontiers of production, but very *high-cost* frontiers, especially in North America’s “unconventional” oil sector. Nor does Cheap Labor seem to be here to stay. The rise of China as the workshop of the world in the 1990s and 2000s occurred, in part, because of massive Cheap Labor flowing into the cities from the countryside. But this—like all Cheap Nature frontiers—was a one-shot deal. Even in China, wages are rising in the cities—rapidly—and the countryside no longer offers an easy reservoir of Cheap labor-power (Moore 2015a, 221–40).

### **Conclusion**

The origins of capitalism as a system of Cheap Nature are fundamental to thinking through the reality—and politics—of the present crisis. Let me be clear that we are dealing with capitalism as world-ecology, as a double internality of humanity-in-nature—not as a closed system that interacts with the rest of nature. The point is important, as even friendly critics of the Capitalocene concept have characterized it in dualist terms. With capitalism we are dealing with an emergent pattern of symbolic innovation and material transformation in which the value of labor-power, the rise of world-money, and the endless transformation of the earth form an evolving historical whole.

The problem today is the end of the Capitalocene, not the march of the Anthropocene. The reality is not one of humanity “overwhelming the great forces of nature” (Steffen et al. 2007), but rather the exhaustion of its Cheap Nature strategy. (This is the small kernel of truth in the otherwise absurd discourse on ecosystem services.) That process of getting Nature to work for very low expenditures of money and energy is the history of capitalism’s great commodity frontiers, and with it, of capitalism’s long waves of accumulation.

The appropriation of frontier land and labor—Cheap Nature—has been the indispensable condition for great waves of capital accumulation, from Dutch hegemony in the seventeenth century to the rise of neoliberalism in the 1970s and 1980s (Moore 2010b, 2012, 2015). Capitalism has been able to outrun the rising costs of production by co-producing manifold Cheap Nature strategies, locating, creating, mapping, and quantifying natures external to capitalism but within reach of its power. Today there is nowhere to run. Much of what we have seen global capitalism achieve over the past decade has been a shifting of costs—from one capitalist to another, and especially from capital to the vast majority. And there has been another vector of cost-shifting, which has been accelerating in recent years: from the present to the future. This is true, as widely recognized, for future generations. But it is also true for the accumulation of capital, which has always been a series of bets on future income. The real basis of that future income has always been Cheap Nature. Hence: financialization and the polarization of income and wealth—the 1 percent and the 99 percent—are the predictable results of the end of Cheap Nature. That “end” of Cheap Nature may not bring liberation, but it cannot sustain capitalism. Popular strategies for liberation will succeed or fail on our capacity to forge a different ontology of nature, humanity, and justice—one that asks not merely how to redistribute wealth, but how to remake our place in nature in a way that promises emancipation for all life.

## Notes

- 1 Special thanks to Diana C. Gildea, and also to Henry Bernstein, Jay Bolthouse, Holly Jean Buck, Christopher Cox, Sharae Deckard, Joshua Eichen, Ben Marley, Michael Niblett, Roberto José Ortiz, Christian Parenti, Andy Pragacz, Stephen Shapiro, Richard Walker, and Tony Weis for conversations and correspondence on the themes explored in this essay.
- 2 See references in the Introduction.
- 3 “Today, one typically looks for a ‘marker’ level where the strata above and below are recognizably different (usually because they contain different types of fossils) and then selects the place in the world that best shows that level. That point then is chosen to represent, formally, the beginning of a geological time unit. Its title is grand—it is a Global Stratigraphic Section and Point, but more popularly it is known as a ‘golden spike’; it is the standard reference level for a geological time boundary” (Zalasiewicz et al. 2010, 2229, emphasis added).
- 4 The argument over the periodization of the Anthropocene rages on. Some archaeologists now argue for converting most or all of the Holocene into the Anthropocene, either from the megafauna extinctions at the dawn of the Holocene, or the origins of agriculture, ca. 11,000 BP (summarized in

- Balter 2013; see Smith et al. 2010; Ruddiman 2005, 2013; Gowdy and Krall 2013). Still others argue for an Anthropocene ca. 2,000 years BP (e.g., Certini and Scalenghe 2011). While other still argue for a post-1945/1960 periodization (Zalasiewicz et al. 2008). Recently, Lewis and Maslin (2015) proposed a different date with a different kind of spike: an *orbis* spike (“global” spike). The result is a date strikingly close to what I am proposing: 1610.
- 5 See Crutzen and Stoermer 2000; Crutzen 2002; Steffen, Crutzen, and McNeill 2007; Steffen et al. 2011a, 2011b, 2015; Chakrabarty 2009; *The Economist*, 2011a, 2011b.
  - 6 See my critique and reconstruction (Moore 2003a, 2003b). The field of economic history—prior to the cliometric revolution of the 1970s—was the most consistently environmentally aware field of world social science in the first three-quarters of the twentieth century.
  - 7 See, for example, Braudel 1972; Galeano 1973; Kellenbenz 1974, 1976; Kriedte 1983; Nef 1964; Malowist 2009; Prado 1967; Wallerstein 1974; Brenner 1976; Sella 1974; de Vries 1974, 1976; Cipolla 1976.
  - 8 For example, de Vries and van der Woude 1997; de Vries 2001; Brenner 2001; Crosby 1997; DuPlessis 1997; Jones 1987; Landes 1998; Seccombe 1992; Mokyr 1990, 57–80; Moore 2007, 2010a, 2010b; Nef 1964; Prak 2001; van Zanden 1993.
  - 9 Much of this literature is often extraordinarily Eurocentric—Landes, Jones, and van Zanden especially.
  - 10 Calculated from Eltis, 2015.
  - 11 This paragraph draws on a vast historiography. For references, see Moore (2015a).
  - 12 The calculations for this account draw, respectively, on Zins (1972, 268) for English imports; on North’s (1996) estimate of potash weight to timber volume, biased in favor of very high conversation rates of wood to ash and ash to potash (for much higher estimates, see Kunnas 2007); and on my generous estimate of 200m<sup>3</sup>/hectare as the maximal harvestable volume one could extract from a hectare of European forest (Moore 2007, ch. 2).
  - 13 Output grew 4.42 percent annually, and labor productivity 2.18 percent annually, between 1489 and 1509 (calculated from Moore 2010d, 12).
  - 14 Calculated from Davis (1954, 302).