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The Capitalocene, Part I: on the nature and origins of our ecological crisis

Jason W. Moore

This essay, in two parts, argues for the centrality of historical thinking in coming to grips with capitalism's planetary crises of the twenty-first century. Against the Anthropocene's shallow historicization, I argue for the Capitalocene, understood as a system of power, profit and re/production in the web of life. In Part I, I pursue two arguments. First, I situate the Anthropocene discourse within Green Thought's uneasy relationship to the Human/Nature binary, and its reluctance to consider human organizations – like capitalism – as part of nature. Next, I highlight the Anthropocene's dominant periodization, which meets up with a longstanding environmentalist argument about the Industrial Revolution as the origin of ecological crisis. This ignores early capitalism's environment-making revolution, greater than any watershed since the rise of agriculture and the first cities. While there is no question that environmental change accelerated sharply after 1850, and especially after 1945, it seems equally fruitless to explain these transformations without identifying how they fit into patterns of power, capital and nature established four centuries earlier.

Keywords: Political Economy; Anthropocene; world-ecology; environmental history; political ecology

The creatures, too, must become free.

(Thomas Münzer, 1524)

When and where did humanity's modern relation with the rest of nature begin? The question has gained new prominence with growing concern over accelerating climate change. For the past decade, one answer to this question has captivated scholarly and popular audiences alike: the Anthropocene.

It is, in Paul Voosen's apt phrase, 'an argument wrapped in a word' (2012).

Just what kind of argument is it? As with all fashionable concepts, the Anthropocene has been subject to a wide spectrum of interpretations.¹ But one is dominant. This tells

¹The argument over the periodization of Anthropocene rages on. Some archaeologists now argue for converting most or all of the Holocene into the Anthropocene, either from the mega-fauna extinctions at the dawn of the Holocene, or the origins of agriculture, c. 11,000 BP (summarized in Balter 2013; see Smith, Elliott, and Lyons 2010; Ruddiman 2005, 2013; Gowdy and Krall 2013). Still others argue for an Anthropocene c. 2,000 years BP (e.g., Certini and Scalenghe 2011). Others still argue for a post-1945/1960 periodization (Zalasiewicz et al. 2008).

us that the origins of modern world are to be found in Britain, right around the dawn of the nineteenth century (Crutzen and Stoermer 2000; Crutzen 2002a; Steffen, Crutzen, and McNeill 2007; Steffen et al. 2011a, 2011b; Chakrabarty 2009). 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 is a comforting story with uncomfortable facts. It fits easily within a conventional description – and analytical logic – that separates humanity from the web of life. This makes for a familiar story, one of Humanity doing many terrible things to Nature. It goes something like this. Take one part ‘human’. Then one part ‘environmental consequences’. *Voilà!*, we have a tale of humans ‘overwhelming the great forces of nature’ (Steffen, Crutzen, and McNeill 2007). I call the logic that animates this tale Green Arithmetic. Nature becomes a factor, a variable, a part of the story. This logic runs deep. It is a reflex, a part of our intellectual muscle memory. It shapes our thinking of planetary crisis and its origins, preconceptualizing humanity and nature as separate first, connected second.

The dominant Anthropocene argument also nestles comfortably within a conventional narrative of modernity. The Industrial Revolution is understood as a set of technical, class, and sometimes political relations emerging around coal and steam between 1760 and 1830. This era marks the birth of, well, you name it: industrial society, capitalism, modernity – or so we are told. The Industrial Revolution has served as the lodestar not only of social theory and economic history, but also of Green Thought (Wallerstein 1989; Tilly and Tilly 1971; Moore 2003a, 2015a). In this sense, the ‘transition debate’ is unavoidable – accounts of planetary change and crisis necessarily imply an account of their origins.

The Anthropocene has become something more than a scholarly concept. It has become a wider conversation around humanity’s place in the web of life – a conversation unfolding in the popular press, in activist circles, and across the Two Cultures of the human and natural sciences (e.g. The Economist 2011; The New York Times 2011; Scranton 2015; Purdy 2015; Moore 2016a). There are many positive elements of this conversation – and more than a few problems (see esp. Crist 2016; Malm and Hornborg 2014; Hartley 2016; Haraway 2016; Morrison 2015). In what follows, I explore three entangled moments of that Anthropocene conversation. First is Humanity and Nature as real abstractions – abstractions with operative force in reproducing the world as we know it. These abstractions elide decisive questions of difference amongst humans, and how that difference is constituted through relations within the web of life. Second, I consider historical capitalism as a world-ecology of power, capital and nature, dependent on finding and co-producing Cheap Natures. Finally, I ground these two moments in the history of capitalist origins – which is also the origins of ecological crisis. In successive and overlapping philosophical, politico-economic, and world-historical registers we might begin to identify twenty-first century capitalism’s spaces of vulnerability and contradiction – spaces co-produced through the web of life.

In Part I of this essay, I pursue two major arguments. First, I situate the Anthropocene discourse within Green Thought’s uneasy relationship to the Human/Nature binary, and its reluctance to consider human organizations – like capitalism – part of nature.² Next, I

²Green Thought – an impossibly vast but necessary shorthand (Moore 2015a) – names environmentally oriented research in the humanities and social sciences since the 1970s. It also includes many scholars across the physical sciences, including those pioneering the Anthropocene conversation but also a radical tradition (e.g. Levins and Lewontin 1985).

engage the Anthropocene as a mode of historical thinking. The Anthropocene conversation is in fact several. One is an ongoing debate over ‘golden spikes’ and the stratigraphic record; it is a debate over geological history. My concern in this essay lies elsewhere. I will focus on the dominant periodization, which sees modernity beginning in Great Britain around 1800. Here, the Anthropocene’s periodization meets up with a longstanding environmentalist argument about the Industrial Revolution as *the* turning point in human affairs.

This, however, denies a longer history of capitalism that begins in the era of Columbus. The erasure of capitalism’s early-modern origins, and its extraordinary reshaping of global natures long before the steam engine, is therefore significant in our work to develop an effective radical politics around global warming ... and far more than global warming alone! Ask any historian and she will tell you: how one periodizes history powerfully shapes the interpretation of events, and one’s choice of strategic relations. Start the clock in 1784, with James Watt’s rotary steam engine (Crutzen 2002a), 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 and Dutch agricultural revolutions, with Columbus and the conquest of the Americas, with the first signs of an epochal transition in landscape transformation after 1450.

That transition 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. While there is no question that environmental change accelerated sharply after 1850, and especially after 1945, it seems equally fruitless to explain these transformations without identifying how they fit into patterns of power, capital and nature established some four centuries earlier.

From this standpoint, we may ask, Are we really living in the *Anthropocene* – the ‘age of man’ – with its Eurocentric and techno-determinist vistas? Or are we living in the *Capitalocene* – the ‘age of capital’ – the historical era shaped by the endless accumulation of capital?

How one answers the historical question shapes one’s analysis of – and response to – the crises of the present.

On humanity, human exceptionalism and the Anthropos

Humans *are* distinctive. No one is arguing the point. But *how* do we think through that distinctiveness? How do our conceptualizations lead us to highlight some relations over others, and how do those in/visibilities conform to – and challenge – extant structures of power (Bourdieu and Wacquant 1992; Sohn-Rethel 1978)? The social sciences emerged not only on the premise of fragmentation and the autonomy of spheres (culture, politics, economy, etc.) but also on the ground of human exceptionalism. Seeing human relations as not only distinct from nature, but as effectively independent of the web of life, has shaped social thought for two centuries. (There is a reason why one reads Durkheim but not Darwin in social theory seminars.) In this, human exceptionalism expresses the peculiar idea that humanity ‘alone is not a spatial and temporal web of interspecies dependencies’ (Haraway 2008, 11; also Dunlap and Catton 1979).

The philosophical point is fundamental to the Anthropocene dialogue because, after all, its central concept is the *Anthropos*. In the dominant Anthropocene presentation, the human species becomes a mighty, largely homogeneous, acting unit: the ‘human enterprise’ (Steffen et al. 2011a). (Could a more neoliberal turn of phrase be found?) Inequality,

commodification, imperialism, patriarchy, racism and much more – all have been cleansed from ‘Humanity’, the Anthropocene’s point of departure.

Cleansed of such differences, Humanity appears as a kind of Cartesian virgin birth. Nature appears, in this same imaginary, as ‘out there’, somehow pristine and untouched. (Thus, Humanity and Nature implicate not one, but two, virgin births.) The resulting story of ecological crisis is a kind of Tale of the Fall. Humans do bad things to Nature. Nature becomes a fantasy of the wild, of pristine nature, awaiting our protection, fearing destruction at our hands. In this Tale, the human enterprise now rivals, and presumably is destroying, the ‘great forces of nature’ (Steffen et al. 2011b, 2007). Capitalism and its driving relations have indeed directed horrific violence towards human and extra-human life. I would go so far as to say that an unusual combination of productive and necrotic violence defines capitalism. The Capitalocene, as McBrien reminds us, is also a Necrocene – a system that not only accumulates capital, but drives extinction (2016; also Dawson 2016). At stake is how we think through the relations of Capitalocene and Necrocene – between the creativity of capitalist development and its deep exterminism. That exterminism is not anthropogenic but *capitalogenic*.

Here, then, is an important difference: between an analysis that begins with undifferentiated Humanity and one that sets out from humanity’s patterns of difference, conflict and cooperation. Too often in the Anthropocene narrative, something like the taxonomy of ‘Anthromes’ (Ellis et al. 2010) – ecosystems dominated by humans, and therefore not ‘wild’ – tends to *precede* the interpretation of historical change. Highly linear notions of time and space are substituted for the complex task of historical-geographical interpretation. At the same time, Anthropocene scholars cannot escape the conclusion that humans, too, are a ‘geophysical force’ – the singular is important here – that operates *within* nature (Steffen et al. 2011b, 741).

This conclusion, recognizing humans as part of nature whilst separating Humanity from Nature, troubles Anthropocene thinking at every turn. On the one hand, humans become Humanity, a singular *human enterprise*. They act upon – or are subject to – the ‘great forces of nature’. On the other hand, Humanity – the upper case is deliberate – remains a *geophysical force*. This is the ‘One System/Two Systems’ problem faced by environmentally oriented scholars across the Two Cultures (Moore 2015a). In this view, humans are recognized as one species within the web of life (One System). But the recognition proceeds by abstracting – rather than synthesizing – the biological from human sociality. Established methodological frames, analytical strategies and narrative structures are scarcely touched. Practically speaking, Society is independent from Nature (Two Systems). For the earth-system scientists behind the Anthropocene, Social Factors – again, decidedly in the upper case – are added; for scholars in the humanities and social sciences, Nature is added. There are ‘human constructions’ and ‘natural’ constructions (Zalasiewicz et al. 2011b, 837). This is Green Arithmetic: Nature plus Society equals the Whole.

Green Thought, humanity and the problem of dualism

But is this Human/Nature binary the most effective way to distinguish humans in the web of life?

The elevation of the *Anthropos* as a collective actor encourages several important misrecognitions. One is a neo-Malthusian view of population lurking below the surface of these analyses (e.g. Crutzen 2002b; Fischer-Kowalski, Krausmann, and Pallua 2014; Steffen,

Crutzen, and McNeill 2007, 618; Ellis et al. 2013).³ These are neo-Malthusian not because they emphasize population, but because they make population dynamics independent of capitalism's historical patterns of family formation and population movement (see Secombe 1992, 1995). Secondly, Humanity's agency is realized principally through technology-resource complexes rather than interpenetrated relations of power, technology and capital (e.g. Steffen, Crutzen, and McNeill 2007; contrast with Mumford 1934). Thirdly, scarcity tends to be removed from those relations – of power and re/production – and deposited into Nature, abstracted from those relations. And finally, as we have seen, such approaches tend to view humanity (or 'human societies' in the abstract) as responsible for the transgression of planetary thresholds (Steffen et al. 2015b).

Such views evidently rest upon Human/Nature dualism and its cognates. This dualism obscures our vistas of power, production and profit in the web of life. It prevents us from seeing the accumulation of capital as a powerful web of interspecies dependencies; it prevents us from seeing how those interdependencies are not only shaped by capital, but also shape it; and it prevents us from seeing how the terms of that producer/product relation change over time. For instance, it is clear that capitalogenic climate change is undermining crucial relations of capitalism's Cheap Food regime in the twenty-first century – Cheap Nature increasingly confronts forms of nature that cannot be controlled by capitalist technology or rationality (Moore 2015b; Altvater 2016).

Human/Nature dualisms presume what needs to be explained: How have we reached the point where we assume a separation that so clearly does not exist? Such dualisms confuse modernity's historical movements (e.g. alienation) for philosophical abstractions ('separation from nature'). They elide the deep, profound and intimate porosity and permeability of human sociality, whose forms are specific, uneven and distinctive. Nature/Society dualisms cannot discern the flows of human and extra-human life as they bond and bundle with each other; they prevent us from asking questions about the connective tissues of human sociality. Green Arithmetic, in other words, offers a Human/Nature binary that can proceed only by converting the living, multi-species connections of humanity-in-nature and the web of life into dead abstractions – abstractions that connect to each other as cascades of consequences rather than constitutive relations.

The Anthropocene's appeal is not clarity but its opposite. Like globalization in the 1990s, it has come to mean all things to all people. That is sometimes bad and sometimes good. I want to focus on the Anthropocene as a way of thinking about history, about modernity's crises and limits, and as a means of bridging the Two Cultures. It would be impossible – and uncharitable – to ignore the Anthropocene's most important contribution: as a public and scholarly dialogue that has put artists, cultural critics, political economists, historians, geographers, biologists and many others into conversation. This dialogue suggests something of the zeitgeist: the intuition that Nature/Society dualism cannot serve us in an era of accelerating climate change and mass extinction. At the same time, the responsibility of the radical is to name the system and identify how the Anthropocene is implicated in capitalist power, symbolically and materially. That the Anthropocene, at its core, is a fundamentally bourgeois concept should surprise no one. After all, it tells us that behind the

³Strictly speaking, Ellis and his colleagues follow a Boserupian model in which rising population leads to innovation and 'intensification' (2013). This model turns Malthus on his head, positing population growth as opportunity rather constraint. The problem is that the whole history of capitalism, certainly from 1450–1850, was one of *declining* person-to-land ratios on a systemic basis; indeed the whole thrust of capitalism's geographical expansion produced recurrent downward revisions in the labor-to-land ratio.

current, disastrous state of world affairs is the *Anthropos*. It's a trick as old as modernity – the rich and powerful create problems for all of us, then tell us we're all to blame.

But are we? And just who, in any case, is 'we'?

The answer is not so obvious. Neither abstract humanism nor abstract naturalism can suffice. Humans, and human organizations, are obviously distinct from the environments in which they evolve; they are also products of those environments. This is why I've underscored the concept of environment-making as central to rethinking history (Moore 2015a): we make environments and the environments make us (Lewontin and Levins 1997). The web of life is obviously larger than any one species. It operates – if that is the right word – relatively independently of humans. (Just as capitalism operates relatively independently of any firm or empire or even class.) By the same measure, planetary life is a web of interdependencies, all the way up and down. Species form and differentiate through a web of life. That web of life is historical, and not only over geological time. Capitalism's revolutionary character can scarcely be understood absent the extraordinary scientific revolutions behind successive great leaps forward in labor productivity and capital accumulation. Consider how every era of capitalist development turns on agricultural revolutions that comprise not only class, production and power, but also new agronomic and botanical knowledges (see esp. Cañizares-Esguerra 2004; Kloppenburg 1988; Brockway 1979; Perkins 1997). Capitalism revolutionizes the co-production of historical natures as no previously existing civilization could. The implication? Any historical conception of human activity and relations that abstracts geography and biospheric relations is irreducibly partial. Geography in its widest and best sense is an ontological condition.

Human specificities form through, not in spite of, the web of life. From this point of view, we may do away with a powerful dualist shibboleth. In its most naked expression (e.g. Foster 2016), the claim runs like this: seeing human organizations as a part of nature leads to an undifferentiated monism in which no human specificity – and no 'natural' specificity – can be discerned. This in turn undercuts the possibility for Red-Green politics.

Nothing could be further from the truth! Seeing human organizations as part of nature leads us to explore manifold socio-ecological connections that make us specifically human – just not 'exceptional'. These are connections of agro-ecology, of disease, of climate, of hydrology, of the micro-biome, of non-human animals. Can we really discern what makes us human, for instance, abstracted from our relations with dogs, pigs, fish, and cows? For that matter, is there any reasonable way to think through capitalism abstracted from its relationship with non-human animals (e.g. Weis 2013; Hribal 2003; Wilde 2000)? At stake is *how* we understand capitalism in the web of life – which in turn shapes emancipatory strategies. Philosophy will of course not solve the problem of capitalism's unfolding crisis and the contemporary, horrific, dangers to life. But it will be hard to develop a politics of emancipation for all life without a philosophical commitment to precisely that: emancipating *all* life. And an authentically multi-species politics of emancipation will require – and will need to nurture – ways of thinking that connect first, and separate later.

Green Thought has always pointed beyond the dualism of Nature and Society (e.g. Harvey 1974; Naess 1973; Williams 1972; Merchant 1980; Haraway 1991; Plumwood 1993). Just as often, it has been captive to the binary it challenges. Green Thought has been vexed by a thorny reality that has never fit comfortably within dualist models. To their credit, environmentally oriented scholars have stayed with the trouble, to paraphrase Haraway (2016). That reality is one in which humans, quite obviously, work and live and play through our relations with bodies (some human, many not) and landscapes, themselves

often made by bodies. There is no ‘separation’ from nature in our lived experience, even if the natures we inhabit are often filled with concrete structures, traffic jams and cell phone towers.

Capitalocene vistas

Our reality is one in which humans live in peculiar kind of civilization, capitalism. Capitalism is absurd in all sorts of ways. In the terms of this discussion, one absurdity is especially powerful: capitalism is premised on the separation of Humanity and Nature. The whole thrust of capitalist civilization develops the premise that we inhabit something called Society, and act upon something called Nature. This is the problem of alienation, shaping everything from the structures of work to the structures of feeling (e.g. Marx 1977; Braverman 1974; Williams 1977). Society and Nature are, in this sense, not only expressions of alienation but instruments of it.

The violence inscribed in Nature/Humanity was there from the beginning. One moment was the expulsion of many humans from their homes during the rise of capitalism (and many times thereafter). This provided a material condition for seeing nature as external (as Nature). Another was the expulsion of many humans – probably the majority within the orbit of early capitalist power – from Humanity. Most women, most peoples of color, and virtually all Amerindian peoples were excluded from full, often even partial, membership in Humanity. These exclusions were deeply and continuously contested – here Fraser’s thinking around ‘boundary struggles’ is profoundly relevant (2014).

This era of primitive accumulation gave rise not only to the ‘accumulation of capital’ and the ‘accumulation of men’ (Foucault 1977, 221), but also a new world-praxis: Cheap Nature. This praxis was one of accumulating and organizing not only human bodies, but of assigning their value through the Humanity/Nature binary. That so many humans could be reassigned to the domain of the not-human (or not-quite human) allowed capitals and empires to treat them cheaply – even as this cheapening was fiercely resisted.

This Cheapening is twofold. One is a price moment: to reduce the costs of working for capital, directly and indirectly. Another is ethico-political: to cheapen in the English-language sense of the word, to treat as unworthy of dignity and respect. These moments of Cheapening work together, rendering the work of many humans – but also of animals, soils, forests and all manner of extra-human nature – invisible or nearly so. These movements of Cheapening register practically in low- and non-wage labor and dramatic forms of violence and oppression. Thus, relations of accumulating ‘men’ and ‘capital’ – to paraphrase Foucault – are thinkable only through the web of life and a new ontology of Society and Nature that assigns value to some work, and some lives, while excluding the vast majority.

Historical capitalism is not only a social formation but an ontological one.⁴ Capitalism’s ontological praxis – Cheap Nature – is decisive to capital’s expanded reproduction, working

⁴The concept of ontological formation derives from Paul James’ groundbreaking work (see e.g. Nairn and James 2005; James 2015). For James, ontological formations are provisionally stabilized – but uneven – practices and conceptions of time, space and identity. Formulated in his studies of nationalism, James emphasizes the multi-layered character of, for instance, modern nationalism, which instantiates ‘customary, traditional, modern and postmodern’ spatio-temporal and social dynamics (2015, 34). Importantly, ontological formations are emergent, ‘as unevenly layered across each other, rather than as epochal replacements of prior formations’ (James 2006, 373). Modernity as ontological formation is one increasingly dominated by a ‘Western mode of organization’ which nevertheless entwines with pre-modern and post-modern relations and tendencies (Nairn and James

through the ceaseless transformation of Earth systems at every scale. There is a rift at the heart of capitalist development. Rather than metabolic separation (Moore *forthcoming*), however, it is likely more useful to chart the recompositions of industrial, urban, imperial, agricultural and other metabolisms – metabolic *shifts*. Capitalism *does*, however, advance an epistemic rift: a rift in our understanding about how human organizations are embedded in nature. The heart of the problem is that Nature/Society dualism not only poses analytical barriers but reproduces ‘real world’ systems of domination, exploitation and appropriation.

This ontological rift is the symbolic expression of the separation of the direct producers from the means of production. Together, these moments constituted the origins of capitalism not only as world-system but as ontological formation: as a world-ecology. Humanity/Nature is a doubly ‘violent’ abstraction: violent in its analytical removal of strategic relations of historical change (Sayer 1987), but also practically violent in enabling capitalism’s world-historical *praxis* – a praxis of cheapening the lives and work of many humans and most non-human natures. This is a praxis of domination and alienation operative simultaneously through the structures of capital, knowledge and feeling. Humanity/Nature is consequently not only violently but *practically* abstract. These are *real abstractions*: abstractions that work in the world because we see and act if Humanity/Nature are given conditions of reality rather than historically constructed (Toscano 2008).

This means that capitalism works through a double register: as *project* and *process*. The One System/Two Systems dissonance in Green Thought more or less corresponds to this double register. Capitalism ‘operationalizes’ through this ontological rift of Nature/Society – central to how capitalism simultaneously advances labor productivity and re-creates Cheap Natures. Capitalism’s governing conceit is that it may do with Nature as it pleases, that Nature is external and may be fragmented, quantified and rationalized to serve economic growth, social development or some other higher good. This is capitalism *as a project*. (Which means that capital’s imagination is vigorously constructivist.⁵) This is also how students of global environmental change have operationalized their research: Nature as external, as tap and sink.⁶ This is the Anthropocene approach, one shared by radicals, too (e.g. Foster, Clark, and York 2010).

As historical *process*, however, capitalism confronts a reality that it cannot change as it pleases. In the dualist ontology of the capitalist project, those limits to remaking reality are narrated as ‘natural limits’ or ‘nature’s agency’. The reality, however, is messier, more nuanced – and more hopeful. While capitalists and empires are busy making Nature with a capital ‘N’ – external, controllable, reducible – the web of life is busy shuffling about the biological and geological conditions of capitalism’s process. Agency, limits and crises – *but also ‘golden ages’* – are co-produced by human organizations with and

2005, 9). My formulation, focusing on capitalism as a way of organizing nature, speaks to a praxis, a set of practices, and rules of reproduction that pivot on James’ ‘deepest’ ontological layer: those ‘principles relevant to nature-place, temporality and embodied life-mortality’ (Nairn and James 2005, 118).

⁵This has led some critics to argue that world-ecology is constructivist and focuses purely on capital’s impress on the earth (e.g. Foster 2016). This misreads insofar as one strand of my work has pursued an immanent critique of capital along the lines of Marx’s *Capital* (1977), in which I have argued that one must ‘see like capital’ in order to transcend the illusions of capital (e.g. Moore 2015a, 91–165). Even within this exposition, however, the analytical goal of such an immanent critique is to discern the contradictions that can be transcended – and those that cannot. Hence the significance of ‘negative-value’ – the emergence of forms of nature, such as climate change, that cannot be fixed by capital’s technoproductivist logic (Moore 2015a, 2015b).

⁶Students of regional change, in political ecology and environmental history, have responded differently.

within nature. That nature is *nature* with an emphatically lower-case *n*. This is nature as us, as inside us, as around us. It is nature – and capitalism-*in*-nature – as a flow of flows. This co-productive – contingent yet also deeply patterned – history is one in which both moments of project and process are unthinkable without each other. What Green Thought has often done – and there have been important, indeed courageous, exceptions – is to sever the constitutive relation between the two, such that philosophy and high theory may (correctly) assert that humans are a part of nature, and ‘empirical’ studies may (correctly) assert that capitalism reworks and degrades Nature. Both are true. But their partiality, confined within Humanity/Nature dualism, limits our capacity to understand the origins of capitalism’s conjoined crises – and to understand how the ‘economic’ and ‘environmental’ problems of the present conjuncture are constitutively joined.

Anthropocene, Capitalocene and the problem of history

The Anthropocene is many arguments. Permit me to simplify. Four kinds of conversations may be detected in the broader Anthropocene dialogue. One is an argument about geological periodization. This turns on biogeological questions and facts. This is the dialogue over ‘golden spikes’, or stratigraphic signals (Zalasiewicz et al. 2008, 2011a). These discussions are also closely connected to arguments about the world-system’s ‘Great Acceleration’, and to how ‘planetary thresholds’ – such as biodiversity and the climate system – are now being crossed (e.g. Rockström et al. 2009; Barnosky et al. 2012; Steffen et al. 2011a, 2015b). Another, distinct thread is a popular conversation around planetary crisis and broader questions of environmental sustainability. The Anthropocene concept has graced the cover of *The Economist* magazine and received the blessing of *The New York Times*’ editorial board – for the very sound reason that anthropogenic arguments obscure capitalogenic realities. A third conversation mirrors the popular one, but within the world’s university system. This conversation has allowed for much-needed dialogue across the Two Cultures.

The latter two conversations turn on an argument about modern world history, and about the origins of ecological crisis today. This is the fourth conversation – and the least developed. For the power of the Anthropocene argument derives, in part, from its revival of an older historiography on the centrality of the Industrial Revolution, understood as the origins of the modern world.

Anthropocenic slippages: geological and world histories

One strand of the Anthropocene argument takes biogeological questions and facts – turning on the presence of variously significant stratigraphic signals (Zalasiewicz et al. 2008, 2011a) – as its central problematic. From the beginning, however (e.g., Crutzen 2002a), there was slippage with the historical question: When do we find the origins of modern ecological crisis? The answer to this question has, in general, been 1800 – give or take a few decades. Two subtle but powerful methodological decisions underpin this periodization. The first, as we have seen, is the elevation of Humanity as the driver of biospheric ‘perturbations’ (Steffen et al. 2015b). The second decision narrows the empirical focus to the environmental consequences of ‘human societies’ (ibid). In this, the Anthropocene argument embodies Green Thought’s *consequentialist bias*. This bias narrates humanity’s domination of the earth almost entirely by cataloguing biospheric changes. Their drivers are typically reduced to very broad black-box descriptive categories: industrialization, urbanization, population and so forth (Steffen et al. 2011a, 2011b, 2015a).

The two principal framing devices – consequences determine periodization; the *Anthropos* as the driver of these consequences – stem from a philosophical position that we may call Cartesian dualism. As with Descartes, the separation of humans from the rest of nature appears as self-evident reality. In its simplest form, this philosophy locates human activity in one box, and the rest of nature in another. To be sure, these two units interact and influence each other. But the differences between and within each acting unit are not mutually constitutive – even if such relations are empirically acknowledged from time to time (Steffen et al. 2011a: 845–846). This dualism leads Anthropocene advocates to construct the period since 1800 arithmetically: ‘human activity plus significant biospheric change = the Anthropocene’. In this, too, the Anthropocene perspective incorporates the common sense of Green Arithmetic: ‘Society plus Nature equals Environmental Studies’.

It all makes wonderful sense, up to a point. But there’s a problem. The parts do not add up. Not only does human activity produce biospheric change, but relations *between* humans are themselves produced in and through the web of life. Nature operates not only outside and inside our bodies (from global climate to the micro-biome) but also *through* our bodies, including our embodied minds. Humans produce intra-species differentiations which are *ontologically* fundamental to our species-being: inequalities of class especially, inflected by all manner of gendered and racialized cosmologies.

From this vantage point, we may reasonably ask, Does the Anthropocene’s *historical* argument obscure more than it illuminates?

Capitalism, real abstractions and the rise of Cheap Nature

For the dominant Anthropocene argument, the origins of ecological crisis are found in British-led industrialization: *the* Industrial Revolution. The Anthropocene argument, however, is not well equipped to offer compelling historical interpretations. It is, after all, an argument about environmental consequences. In itself, that’s not such a bad thing. The problem arises because scholars, activists and publics – quite reasonably – tend to read a particular narrative into the account of consequences. Clive Hamilton expresses this tendency precisely. Paul Crutzen, says Hamilton, ‘immediately linked [the origins of the Anthropocene] to the burning of fossil fuels and English capitalism’ (quoted in Lindgaard 2015). Here is the Anthropocenic syllogism: ‘fossil fuels = capitalism = more fossil fuels = climate catastrophe’.

Such syllogisms – far too commonplace in critical as well as mainstream thought – reflect a poverty of historical thinking. A radical alternative must unfold – and enfold – two arguments simultaneously: about history, and about the thought-structures of modernity. I will start with the latter, because how we deal with the problem of dualism shapes our historical vistas: what is important, and what is not, as environmental historians have long emphasized (e.g. Cronon 1991; Merchant 1980, 1989; Worster 1990). Needed, in other words, is a mode of analysis at once deeply historical and deeply reflexive, one that recognizes how our guiding concepts contest and correspond with capitalism’s governing abstractions (Bourdieu and Wacquant 1992). Such reflexivity, for instance, is at the core of Mitchell’s persuasive account of ‘the economy’ as a real abstraction fundamental to colonial and bourgeois rule in the long twentieth century (2002, 2011).⁷

⁷It is of course true that ‘the economy’ was prefigured by the rise of political economy in the eighteenth century (e.g. Smith 1937).

Can we not also say something similar about the Nature/Society binary since the sixteenth century? Let us take the emergence of the word society ‘in its general sense’ (Williams 1983, 292). For Williams, this occurs in the middle of the sixteenth century. The timing is significant. Following the defeat of Kett’s Rebellion (1549) – in fact a ‘national rebellion’ – the tide of agrarian class struggle turned in favor of the gentry (Wood 2007; Dimmock 2014; Brenner 1976). England’s non-agricultural and urban population grew nearly twice as fast – 117 percent to 64 percent – as the agricultural population (calculated from Allen 2000, 8). By 1700, England’s landlords held two-thirds of arable land (Thompson 1966). Meanwhile, by the 1530s, coal’s rapid growth had begun (Nef 1966).

But all was not England. These class struggles were complemented by Henry VIII’s 1541 move to deepen colonial rule in Ireland (Ohlmeyer 2016). In a telling letter, one of Henry’s advisors, the Earl of Northampton, urged colonial administrators to ‘draw all the *wild* Irish that dwell now dispersed in woods’, and to resettle them into English-style towns (quoted in Rai 1993, 31, emphasis in original) – a move that prefigured Spanish colonial policy in Peru during the 1570s and Dutch rule in southeast Asia after 1620 (Moore 2010b). Just as the Castilians called indigenous Peruvians *naturales* (Stavig 2000), the English viewed the Irish as savages (Montaño 2014). Through all this, the Irish, indigenous peoples, most women, Africans and many others were expelled from Humanity/Society in whole or in part. When Patterson characterizes modern slavery as ‘social death’ (1982), he implicates a world-historical movement of racial formation in which Africans were effectively treated as part of Nature and not Society – the better they could be treated cheaply. So too with early capitalism’s complex reinvention of gendered domination. King evocatively describes the new gendered order as a modern form of ‘human sacrifice’, dispossessing women of ‘culture’ and treating the domain of women’s activity as ‘natural’, the better to be treated cheaply (1989, 129; also Merchant 1980).⁸ Time and again, most humans were characterized as part of Nature, often as ‘savages’ of one sort of another – in a long era where ‘savagery’ and ‘civility’ stood in for Nature/Society, justifying all manner of bloody expropriations (Leerssen 1995; Kuklick 1991; Kolia forthcoming).

The point is straightforward: Nature and Society, in their upper-case forms, are not merely analytical problems, but *real abstractions* (Sohn-Rethel 1978; Toscano 2008; Moore 2016b). Treated as real by capitalists and empires, they are implicated in modernity’s violence, and in planetary crisis today. That’s not an argument for purity – we all use these concepts. It’s an argument for awareness. It’s an argument for ongoing reflexivity.

Anthropocene thinking shows little of this awareness. This limits its effectiveness to 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 their core, these structures find their taproot in Cartesian dualism, a mode of thought taking shape in early modern Europe. This dualism presupposed:

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,

⁸There is always a danger in reducing such questions to the dynamics of capital accumulation. The issues raised here clearly indicate an expansive array of issues that reach far beyond capital.

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)

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). Modernity’s thought-structures are therefore something more than ‘superstructures’. Systems of thought, to paraphrase Marx, become ‘material forces’ when seized by empires and bourgeoisies (1970, 137). Capitalism’s first great remaking of planetary life – explored in the next section – was scarcely possible without a revolution in ways of thinking and seeing the world. The capitalist revolution, far from a narrowly economic process, was an epochal shift in the ways of earth-moving (mining, farming), state-making, mechanization and symbolic praxis. Not for nothing, the first thing every great European empire set about doing was not merely ‘exploring’, *but mapping and cataloguing* the globe as a potential storehouse of wealth. In this, neither modern mapping nor even the idea of the globe can be taken for granted (e.g. Brotton 1997; Pickles 2004; Ingold 1993).

The capitalist revolution, in other words, turned on a Cartesian revolution – one of several key moments of the long transition. That Cartesian revolution delivered four basic propositions. First, it imposed ‘an ontological status upon entities (substances) as opposed to relationships (that is to say energy, matter, people, ideas and so on became things)’ (Watts 2005, 150–151). Secondly, it encouraged either/or rather than both/and logics – Nature *and* Society rather than societies-*in-nature*. Thirdly, it favored the ‘idea of a purposive control over nature through applied science’, giving rise to a rationality of world conquest and domination (Glacken 1967, 427; Altvater 2016). Finally, as I explore more fully in Part II, this revolution was powerfully ‘ocularcentric’, privileging the visual as the principal means of knowing the world (Jay 1993; Cosgrove 2008):

Cartesian rationalism was predicated on the distinction between the inner reality of the mind and the outer reality of objects; the latter could only be brought into the former ... through a neutral, disembodied gaze situated above space and time. Such a perspective presumes that each person is an undivided, autonomous, rational subject with clear boundaries between ‘inside’ and ‘outside’, i.e., between self and other, body and mind. With Descartes’s *cogito*, vision and thought became funneled into a spectator’s view of the world, one that rendered the emerging surfaces of modernity visible and measurable and rendered the viewer body-less and placeless. Medieval, multiple vantage points in art or literature were displaced by a single disembodied, omniscient, and panopticonic eye. (Warf 2008, 53)

As Political Marxists have long maintained, the conditions of capitalist development can be reduced neither to the world market nor to brute force as such – though both are clearly implicated. Those conditions turn on new forms of private property which compel producers to ‘sell to survive’ (Brenner 1976, 1985, 2001). The rise of private property was at once material, political and symbolic. The cadastral survey and state-backed forms of bourgeois property relations were fundamental moments of class struggle (Harvey 1993; Kain and Baigent 1992). For the English in sixteenth-century Ireland, ‘surveying was to prove another component in the triumph of civility over savagery’ (Montaño 2014, 157). Was not planetary mapping and the colonial coding of human populations along a Nature/Society divide also central? Transforming peasant and indigenous work into direct and veiled forms of labor-power and unpaid work was, at every point, entangled with the transformation of land into private property – in colonies no less than cores.

Such transformations worked through direct violence, class exploitation and the manifold expressions of the Cartesian revolution. These combined movements turned the web of life into the ‘closed totalities’ of Society and Nature under conditions of colonial domination (Quijano 2007) – the latter conveniently removed from the Anthropocene narrative (Morrison 2015). The full story of these movements must go beyond functional consequences – but these consequences were immense. They served to create a Nature that could be decomposed into discrete units, so as to deliver nature’s work/energy to capital as cheaply as possible. That logic of isolation, fragmentation and simplification shaped not only the monocultural landscapes of early capitalism – such as the sugar plantation. It also shaped the lives of humans expelled from Humanity, as colonial populations were forcibly resettled into the era’s ‘strategic hamlets’ – from Ireland to Peru to the Spice Islands. Thus, the problem of Cartesian dualism goes well beyond philosophy. It is not only philosophically but practically violent. It is central to a way of organizing nature – ontologically (what is?) and epistemologically (how do we know?) – that took shape between the fifteenth and eighteenth centuries: the origins of the Capitalocene.

The rise of capitalism cannot be reduced to economics. Capitalocene names capitalism as a system of power, profit, and re/production in the web of life. It thinks capitalism as if human relations form through the geographies of life. Far from refusing the problem of political economy, however, it highlights capitalism as a history in which islands of commodity production and exchange operate within oceans of Cheap – or potentially Cheap – Natures. Vigorous accumulation depends on the existence – and the active production – of human and extra-human natures whose costs of reproduction are kept ‘off the books’. This is, as ecological economists have long emphasized, a process of externalization (e.g. Kapp 1950).

It is also a process of ‘putting Nature to work’. Capitalism does not work because it does terrible things to humans and the rest of nature. It works by organizing production and markets through the cash nexus, itself a decisive mediation of humanity-in-nature (accumulation by capitalization). It also works – and this is less widely understood – by elaborating forms of power, re/production and rationality that mobilize work in service to capital, but outside profit/loss accounting (accumulation by appropriation). This latter is the necessary but not sufficient condition of renewed capital accumulation, a process afflicted by rising costs at every turn. Rising costs are offset in many ways, but chiefly through new combinations of empire and science that secure new and expanded supplies of food, labor, energy and raw materials (the Four Cheaps). These are Cheap to the degree that their reproduction costs can be largely kept ‘off the books’ or – in the case of mineral deposits – extracted at well below prevailing extraction costs (Moore 2015a).

This elaborates Marx’s important but rarely discussed ‘general law’ of underproduction. For Marx, the tendency towards mechanization (a rising share of fixed constant capital) finds its counter-tendency in rising raw material costs (a rising share of circulating constant capital). Simply put, ‘the rate of profit is inversely proportional to the value of the raw materials’ (1967, III, 111). The revival of world accumulation in this sense depends on renewed primitive accumulation. The focus – quite properly – has been on movements of commodification and privatization (e.g. Luxemburg 2003; Harvey 2003; de Angelis 2007). To these I would add the extra-economic movements of empire, science and culture that seek to control and dominate – but not commodify directly or wholly – relations of human and extra-human work (Moore 2015a). These combined and uneven movements reduce the value composition of capitalist production, and in so doing revive the rate of profit on a world scale (Moore 2011). Just as Marx observes that declining soil fertility

may increase the value composition of flax (in his example), so too may high soil fertility act ‘like an increase of fixed capital’ (Marx 1967, I, 67, 1973, 748, 1977, 238).⁹

As the zone of capital-centered relations expands, so too must the domain of appropriating Cheap Natures. This is so because the capital system cannot tolerate ‘expensive’ Natures – although trade-offs are possible – which increase the value composition of capitalist production, and depress the rate of profit. The Anglo-American neoliberal offensive is one example: the value composition of the Four Cheaps was either reduced or stabilized by 1983, whereupon world accumulation revived, albeit less vigorously than in the *trente glorieuses* (Moore 2015a). This provisional model is only thinkable through a perspective that foregrounds capitalism as a way of organizing nature, and relies on the unpaid work/energy of ‘women, nature, and colonies’ (Mies 1986, 77).

This is the world-ecology perspective’s point of departure (Moore 2003b, 2011, 2015a, 2016a; Altvater 2016; Bolthouse 2014; Camba 2015; Cox 2015; Deckard 2015; Dixon 2015; El Khoury 2015; Frame 2016; Gill 2016; Hartley 2016; Jakes 2016; Marley 2015; McBrien 2016; Campbell and Niblett 2016; Ortiz 2016; Oloff 2016; Parenti 2015, 2016; Taylor 2015; Weis 2013). This alternative emphasizes the rise of capitalism as a new way of organizing nature, organizing new relations between work, reproduction and the conditions of life. That ‘way’ is a two-way street; capitalism is co-produced by and within the web of life at every turn. Manifold extra-human natures – diseases, soils, ‘new’ crops like maize and the potato, draught animals – were active participants in the new ontological formation. Markets, class struggle, states and empires are still important – *hugely important* – in this frame. The alternative allows us to start looking at how every state, class and colonial project, every revolt and strike, and every movement and accumulation of money has been bundled with extra-human nature.

The rise of capitalism: an environment-making revolution

Three great thought-procedures have shaped our thinking about capitalism’s environmental history. The first is Nature/Society dualism. It frames environmental history as the history of something external to social relations, as one of several key dimensions of world history. In this view, environmental history maps the extra-human consequences of capitalist development. The second is closely related. This is the consequentialist bias we encountered earlier. Privileging consequences, this bias focuses first on environmental consequences, then backtracks to their social origins. The resulting narratives find visual form in the thousands of ‘hockey stick’ charts depicting the Great Acceleration (e.g. New Scientist 2008). These charts offer a strikingly linear view of history, a direct causal line from the steam engine to global warming. The third thought-procedure is a long-held Cartesian principle, privileging substances over relations. At the heart of modern thought is a substantialist bias, persuasively challenged by critical thought since Marx (Bourdieu and Wacquant 1992; Watts 2005). Animals become machines, machines and resources become things abstracted from socio-ecological relations (Marx 1977, 512–513). In this view, the Industrial Revolution – even in some radical interpretations – appears as *the* decisive turning point in human history (e.g. Ponting 1991).

⁹This is a question of differential rent (Marx 1981), but not of rent alone. Cheap Nature also poses questions of power and work that do not easily fit within rent theory.

These procedures have worked against seeing capitalism as a peculiar kind of environment-making civilization, and against a view of the early modern origins of ecological crisis. 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 steampower.

No one denies the significance of the long nineteenth century's two great industrializations. The first, beginning in the late eighteenth century, pivoted on coal, steam engines and cotton. The second, beginning in the later nineteenth century, turned on oil, petrochemicals, electricity and automobiles. These are commonly narrated as the 'first' and 'second' Industrial Revolutions – a convention scarcely affected by a century of counter-arguments emphasizing early capitalism's technical dynamism. Even Amin persists in characterizing early capitalism as 'mercantilist' (1998, 14). The 'prodigious development of productive forces' would have to wait until after 1800 (*ibid.*). For Pomeranz too, the real breakthrough occurs after 1800 – but with a key difference. The determining relation is not simply coal, but 'coal *and* colonies' (Pomeranz 2000, 68).

That's an important *and*. Situating coal's epoch-making capacities within class and colonial relations predating steampower's dominance yields an alternative periodization. British-led industrialization unfolded through the linked processes of agricultural revolution at home *and* abroad – providing the labor-power for industry by expelling labor from domestic agriculture and, in the case of the West Indian sugar colonies, channeling capital surpluses into industrial development (Brenner 1976; Blackburn 1998). The possibilities for the 'prodigious development of the productive forces' flowed through the relations of power, capital and nature forged in early capitalism.

These capitalist relations could be forged only through their own, specific, 'prodigious development' – the praxis of turning life into useful work for the accumulation of value. These relations were not *de novo* but evolved across centuries. That hasn't been well understood. The economic interpretation has often fetishized the productive forces – reducing these to machinery rather viewing machinery within system-wide technics of power and knowledge, capital and nature (Mumford 1934). Modern cartography, accounting and surveying were every bit as much a prodigious force of production as the steam engine – as we shall see in Part II of this essay. This allowed for an epochal break between early modern and medieval Europe: Nature became a force of production. Machinery was involved at every turn; but it was not at every turn decisive.

Far from making light of the planetary changes that have occurred since 1850, I take these as several necessary points of departure. The Anthropocene's hockey stick charts point to an inarguable reality: capitalism's environment-making passed a new quantity–quality threshold sometime after 1850, again after 1945, and yet again in recent decades. The Anthropocene's emphasis on geological and planetary thresholds underlines the point. As the Anthropocene has drifted into a wider conversation, however, it has morphed into something different. It has slipped from highlighting the signs of danger to explaining how 'we' have arrived at the moment of planetary crisis. Thinking historically is inescapable; the only question is whether we wish to take historical thinking seriously. If we wish to explain the origins and development of capitalism as world-ecology – crucial to understanding the politics of the twenty-first century – we need a conversation over the ways that relations of power, capital and nature crystallized in the centuries after 1450.

This is the analytical work of the Capitalocene – an ugly word for an ugly system. The concept asks us to unsettle the comfortable narrative of the Anthropocene, to step outside our comfortable conceptual boxes: industrial and pre-industrial; circulation and production; town and country. The Capitalocene argues for situating the rise of capitalism, historically

and geographically, within the web of life. This is capitalism not as economic system but as a situated and multispecies world-ecology of capital, power and re/production (Moore 2016a; Haraway 2016).

A radical shift in the scale, speed and scope of landscape change occurred in the long sixteenth century. Over centuries, feudal Europe had deforested large expanses of western and central Europe (Darby 1956; Moore 2016c). After 1450, however, comparable deforestation occurred in decades, not centuries. One example may suffice. In medieval Picardy (northeastern France), it took 200 years to clear 12,000 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, 12,000 hectares of forest were cleared in a single year. Nor was Brazil exceptional. In the same period, the Vistula Basin was cleared on a scale and at a speed between five and 10 times greater than anything seen in medieval Europe (Moore 2007, 2010b; Williams 2003).

The relations of power and profit that enabled rapid deforestation in the early modern centuries also shaped coal's passage from a rock into a fossil fuel. As resource economists have long recognized, what counts as a resource is not fixed. Resources evolve through historical conditions of power, re/production and geography (Zimmermann 1951). Resources 'become': they are both 'given' and 'constructed'. The trick is to chart the historical geographies of this co-productive dynamic. In this approach, geology is a 'basic fact'; it becomes a 'historical fact' through 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. (Human activity is always ontologically coincident with its geographical conditions and consequences.) In the case of coal, England's coal revolution began not in the eighteenth century but in the first half of the *sixteenth* century. 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 soared, doubling to 2.9 million tons of coal by the 1680s (Weissenbacher 2009; Nef 1966, 19–20, 36, 208). Output increased another 300 percent by 1780 (Davis 2006, 122). If the roots of modern ecological crisis are not in 1800 but in the long sixteenth century, we begin to ask much different questions about world-ecological crisis today. English coal's 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.

The origins of Cheap Nature

Humans transformed environments from the very beginning. Hominin evolution proceeded through a series of biological extroversions – not least fire, reducing energy needed for digestion, and radically expanding human capacities for environment-making (Pyne 1997; Wrangham 2009). Modern humans needed neither agriculture nor cities to revolutionize their environments: consider the disappearance of North American megafauna in a 'geological instant' some 12,000 years ago (Faith and Surovell 2009; also Dawson 2016).¹⁰ The origins

¹⁰The causes of – and the role of humans in – late Pleistocene extinctions remains in question (e.g. Faith and Surovell 2009).

of agriculture and varied forms of civilization unleashed even greater changes in human-initiated (but always co-produced) environment-making.

These environmental histories played out over hundreds – sometimes thousands – of years. After 1450, however, everything moved faster – *a lot faster*. Not everywhere, of course. In many regions peasant life continued much as it had for centuries. But on the commodity frontiers – such as the Madeira and Canary islands, the Erzgebirge Mountains, the Andes, north-eastern Brazil, or the Baltic’s timber-export zones – capitalism radically changed life and land within a generation or two. If this was commercial capitalism, it was no less productivist for being so. For in each of these places, commercial advance depended upon new machines, new economic organization and, frequently, new labor systems. The new scale of production and commerce was both product and producer of a new scale of money and credit. By the 1540s, the Fuggers, creditors to Charles V, enjoyed working capital some 10 times greater than the Medici Bank at its apex (1451) – but with an important difference (Rice 1970, 41; Koenigsberger and Mosse 1968, 50–52). The Fuggers were also industrial capitalists, heavily enmeshed in Central European mining and metallurgy (Vlachovic 1963). The rise of capitalism imposed new temporal dynamics – simultaneously economic, political and ecological – propelled by the drive to reduce ‘socially necessary turnover time’ at the point of production and circulation (Harvey 2001, 327).

Between 1450 and 1750, a new era of human relations in the web of life begins: the Age of Capital. Its epicenters were the seats of imperial power and financial might. Its tentacles wrapped around ecosystems – humans included! – from the Baltic to Brazil, from Scandinavia to Southeast Asia. Alongside new technologies, there was a new *technics* – a new repertoire of science, power and machinery – that aimed at ‘discovering’ and appropriating new Cheap Natures. Chief amongst these were new ways of mapping and calculating the world (Mumford 1934; 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 (Moore 2015a, 51–74). In such value terms, there was an epochal shift between the Black Death (1347) and the conquest of the Americas. Value shifted from land productivity under conditions of seigneurial 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 a novel approach to human activity in 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 – called ‘the economy’ – was to be valued. All other activity was devalued, appropriated in service to advancing labor productivity in a narrow zone of commodification.¹¹ Thus, the birth of Nature

¹¹‘Labor productivity’ is here understood in Marx’s terms of value production and the rate of exploitation. The problem of labor productivity – especially in early modern capitalism – is thorny. One issue is empirical: much of our best evidence is for physical labor productivity, which only indirectly corresponds to the production of surplus value. Another is the sectoral and nationalist bias to labor productivity studies, which do not add up to a system-wide labor productivity estimate. Thus, if one includes the Americas, the direct and indirect implications for labor productivity growth are gigantic. A third difficulty is the study of labor productivity absent the conceptualization of the reproduction of labor-power – largely uncommodified in this period – and the appropriation of uncommodified extra-human natures.

implied and necessitated the birth of Society. Both drip with blood and dirt, the ontological counterpoint to the separation of the producers from the means of production.

Primitive accumulation was, then, about more than property, proletarianization and plunder. It marked the origins of Cheap Nature as an accumulation strategy. But Cheap is not free. By Cheap, I underscore how capitalism appropriates work/energy and biophysical utility produced with minimal labor-power, and directly implicated in commodity production and exchange. (Here is Marx's use- and exchange-value mediated through socially necessary labor-time.) Cheap Nature's effect the revival of world accumulation by reducing the value composition of one or more of the Big Four inputs (labor, food, energy, raw materials) below the system-wide average. In so doing, they reduce the costs of production for the system as a whole. Thus, Cheap timber in the seventeenth century – or oil in the twentieth century – reduced not only the value of circulating capital but the whole of commodity in general (Moore 2015a, 91–165).

Because capitalism's law of value privileges labor-power and its productivity as the metric of wealth, a fundamental moment of every great wave of capital accumulation is a paired movement of proletarianization/dispossession and agricultural revolution. Periodic expansions of the reserve army of labor increase competition amongst workers and discourage collective resistance. Successive agricultural revolutions deliver more food with less necessary labor-time, and therefore drive down the reproduction costs of labor-power (Moore 2010d, 2015a, chapter 10). This helps to explain why de-peasantization, proletarianization and agro-ecological change are entwined in every great expansion of the capitalist world-ecology.

The modern proletariat was, therefore, a necessary condition of capitalist development. This proletariat may of course be defined narrowly or expansively. From the latter perspective, we might consider proletarianization as the degree to which social reproduction depends upon the cash nexus; its typical expression is not the 'pure' waged worker but the semi-proletarian household (Wallerstein 1983). Tilly, with some exaggeration, thinks the semi-proletarian share of European population doubled, to 50 percent, between 1500 and 1800 (Tilly 1984). It includes that wider layer of the population within capitalism that depended on capital flows – directly or indirectly – for daily life and intergenerational reproduction. This included the fast-growing urban population of western Europe and Latin America – expanding at a tempo much faster in the period 1550–1700 than in 1700–1850 (de Vries 1984, 39ff.). A massive proletariat that always included a 'sub-proletariat' of female and child labor outside the guild system sustained every European metropolis (Braudel 1983, 133) – including colonial cities such as Potosí. Much of the new proletariat lived, however, not in towns but in the countryside (Tilly 1984; Secombe 1992). These 'proletarian reserves' (Braudel 1972, 30) were necessary to sustain the urban laboring classes, frequently besieged by – in the arid prose of modern social science – 'negative rates of natural increase' (de Vries 1984, 207). That too was the fate of enslaved workers in the Americas. In 1700, just 330,000 African slaves lived in the New World. American slaves' modest demographic weight – some 330,000 souls in 1700 – belied their centrality to capital accumulation through the sugar frontier (Blackburn 1998, 3; Moore 2007; Mintz 1978). Capital surpluses from the West Indies and the Triangular Trade would figure prominently in the British industrialization, providing somewhere between a fifth and a third of 'gross fixed capital formation' by 1770 (Blackburn 1998, 542ff.). Toward the end of the seventeenth century, proletarianization accelerated sharply in agrarian western Europe (Tilly 1984). Historians describe this process as 'protoindustrialization', centering on domestic textile production, and which took advantage of women's work and the seasonal agricultural cycle (Ogilvie and Cerman 1996). This in turn propelled

(semi) proletarian population growth (Seccombe 1992), setting the stage for fossil capitalism. It was precisely at this point, Federici observes, that the ‘definition of women as non-workers ... was nearly completed’ (2004, 92). This multi-faceted proletarianization was, then, not only profoundly racialized but powerfully gendered: the expulsions of women and peoples of color from Society yielded important surpluses to capital.

Cheap Labor was therefore fundamental to capitalism as a system of Cheap Nature. The accomplishment was neither static nor easy. The number of slaves disembarked each decade in the Americas – mostly to grow sugar, modernity’s original cash crop – increased a staggering 1065 percent between 1560 and 1710.¹² Slave prices still tended to rise, a tribute to capitalism’s devastation of *human* nature, but from a base much lower than the European wage bill. Most Europeans, however, benefited not a whit from the new imperialism. van Zanden drily observes a ‘negative link between economic development and ... real wages’ (1999, 187; e.g. Komlos 1989) – a link that, even in Britain, would persist through the 1860s (Rioux 2015). Forced underconsumption was the order of the day:

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; on forced underconsumption, see Araghi 2009)

Labor-power mattered little without a productivity revolution. Labor productivity surged in one major commodity sector after another (Kellenbenz 1974). In printing, labor productivity advanced 200-fold in the century after 1450 (Maddison 2005, 18). By 1500, 20 million printed books were circulating (Febvre and Martin 1976, 186; Maddison 2005, 18). In the sugar colonies, new mill technology recurrently boosted productivity across the early modern centuries (Daniels and Daniels 1988; Moore 2007, ch. 5–6). Within Europe, sugar refineries in cities such as Amsterdam were the only industrial establishments comparable to nineteenth-century factories (van der Woude 2003). 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 (Munro 2002, 264). In iron-making, large blast furnaces allowed output per worker to increase five-fold between 1450 and 1650, clearing and capitalizing forests at every step (Braudel 1981, 378–379). In shipping, led by the Dutch, productivity increased fourfold (Unger 1975; Lucassen and Unger 2011). 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) (Wilson 1973; van Bochove 2008, 196; de Vries 1993; Noordegraaf 1993). Everywhere, but especially in

¹²Calculated from Eltis (2015).

northwestern Europe, the use of iron tools in agriculture expanded (Bairoch 1973). In Central Europe's copper–silver metals complex, the *saigerprozess* smelting technique revolutionized mining and metallurgy after 1450 (Blanchard 1995). New rod-engines, allowing for effective drainage, allowed for a second great wave of European mining after 1540 (Hollister-Short 1994). In the New World, the mercury-amalgamation process boosted silver production after the 1560s, especially in Peru (Bakewell 1987). Across Europe, but especially in the west, the number of water mills doubled in the three centuries after 1450, tripling aggregate horsepower (Debeir, Deleage, and Hemery 1991, 90–91, 76; Davids 2003).

As the forces of production advanced, so too demand for 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. In making such claims, we are naturally dealing with proxies, clues, glimpses of a process that defies easy summary. Among these clues, the doubling of capitalism's geographical reach between 1535 and 1680 is instructive. Four million square kilometers were administered by European states and empires by 1680. Much of this was “formal” more than “real,” but the trend was clear (Chaunu 1959, 148). The conquests of the New World not only marked a vast appropriation of potentially Cheap Nature, but of the labor-power to transform it into capital. For Dussel, this was was ‘the fundamental structure of the first modernity’ (1998, 11).

The conquest of the Americas was spectacular. So too the remaking of Europe. In the Low Countries, an agricultural revolution allowed half the labor force to work outside of agriculture in the sixteenth century. It was a ‘revolution’ because – like the English agricultural revolution that followed – it advanced labor productivity and expelled labor from cultivation (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). It was also a revolution in the *built* environment. Both sides of the town–country division of labor were by this point, committed to an ‘extreme market dependence’ (de Vries and van der Woude 1997, 204). A windmill landscape had taken shape over the previous century, while land reclamation through complex material and organizational systems of water control – *polders* – dominated the century after 1540 (Kaijser 2002; Grigg 1980, 151). Dutch hydraulic engineers soon dispersed across Europe, from Rome to Russia to England, engaged in massive drainage projects (Wilson 1968). Within the Republic, a complex ‘system of dikes, dams, sluices, and drainage canals’ remade the countryside. After 1631, some 658 kilometers of new canals were constructed (TeBrake 2002, 477; de Vries and van der Woude 1997, 35). Dozens of new harbors were built or expanded (32 between 1570 and 1640) – not only in Amsterdam, but across the northern Netherlands (de Vries and van der Woude 1997, 34; ‘t Hart 1995, 63). These early moments of planetary urbanization (Brenner 2014), were cause and consequence of an energy regime premised on domestic peat, ‘the youngest of all fossil fuels’ (Smil 2010, 28). Output peaked in the mid-seventeenth century, by which point the easily tapped zones were exhausted. Production costs increased and peat output declined, sharply after 1750 (van Zanden 2003; de

Zeeuw 1978). Nevertheless, peat output was important to cheapening thermal energy, and urbanization accelerated, along with proletarianization – in the countryside as much as the city. By the mid-sixteenth century, half the workforce received wages (van Bavel 2010). These interlinked transformations of work, land and energy implied expansionary movements within the northern Netherlands and beyond (as we shall see momentarily). By the eighteenth century, inland regions of the eastern Netherlands had become ‘virtually treeless’ (Groenewoudt 2012, 61).

Agricultural revolutions are world-historical events (Moore 2010d). The condition for a labor productivity revolution in one region is the expansion of ‘accumulation by appropriation’ on a much larger scale (Moore 2015a; see Part II of this essay). 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. Baltic imports skyrocketed: 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).

The Dutch agricultural revolution was a necessary – if not sufficient – condition for Dutch world hegemony. Dutch supremacy was realized through mutually reinforcing movements in the deployment of power, the organization of trade and production, and the coercive remaking of land and labor on a planetary scale. Dutch power rested on a thoroughly modern recognition: that world-money, world power and world ecology were dialectically bound. By 1639, the Amsterdam Bourse – the modern world’s first stock exchange – saw 360 different commodities listed. By 1685, there were 550 (Dehing and ‘t Hart 1997, 53). The Bourse, and a growing network of merchant banks, helped to make Amsterdam not only the switchboard of world commerce, but the epicenter of global environmental restructuring. Ready cash would directly cheapen natures wherever possible, and make possible superior military force when necessary. It should come as little surprise, then, that the Dutch Republic had its finger in nearly every significant environmental change in the long seventeenth century (Moore 2010a, 2010b).

A decisive early moment was the Dutch subordination of the Baltic. 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). Output was sustained ‘by deviating from the fundamental principles of rotation in tilling the soil’ (Szygielski 1967, 97). If the mechanism of underinvestment was broadly similar to the medieval West, in the early modern East it was re-purposed to sustain Cheap Food for the Dutch. Not surprisingly, Polish agricultural productivity faltered. The physical surplus fell by as much as half between the 1550s and 1700 (Topolski 1962; de Maddalena 1974). It was a ‘catastrophic’ decline (Szygielski 1967, 86). It was also uneven. Declining labor productivity and cereal yields 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 bleaching cloth, 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 suffered the same fate. 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.¹³ Even as the potash frontier moved north and east along the Baltic coast over the next two centuries, the ‘devastation of the forests’ underpinned 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.) We are looking at a deforestation of the Vistula Basin on the order of a million hectares (10,000 square kilometers) – possibly twice as much – between 1500 and 1650.

In Central Europe, a mining and metallurgical revolution supplied an emergent capitalism with a physical basis for money (silver) and manufacturing (iron and copper). Forests – and more importantly, forest commons – were put to work on a huge scale. Central European mining and metallurgical reached its zenith in the half-century after 1470. It was here that early capitalism’s basic raw materials were produced: 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. 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, 8)

As mining boomed and forests retreated, forest enclosures advanced. By 1524, the radical priest Thomas Münzer decried these enclosures, denouncing the logic 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, must become free’ (quoted in Marx 1975, 172). In 1450, forests were abundant, and conflicts between lord and peasant few. By 1525, ‘the situation was entirely changed’ (Blickle 1981, 73). 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.

As Central Europe’s metallurgical boom took flight, a different kind of commodity revolution was unfolding in the Atlantic. This was the rise of King Sugar, modernity’s original cash crop. Combining the ecology of cane and capital, a special lethality defined the sugar plantation system. Sugar not only devoured forests and exhausted soils – it was an apparatus of mass killing in the form of African slavery. On Madeira, located off the western coast of north Africa, the first sugar boom – and the first signs of the modern sugar-slave nexus – took shape. Madeira’s sugar boom began in the 1470s, ousting Mediterranean producers from their privileged position. In the two decades after 1489, sugar production soared – and labor productivity with it. So did deforestation. For sugar was a cash crop that famously devoured nearby forests. As an economic activity it resembled smelter more than 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

¹³The 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 conversion rates of wood to ash and ash to potash (for higher estimates, see Kunas 2007); and on my generous estimate of 200 m³/hectare as the maximal harvestable volume one could extract from a hectare of European forest (Moore 2007, ch. 2).

any sugar would be grown in ensuing centuries (Moore 2009, 2010c). Madeira's crisis was soon followed by sugar's advance to São Tomé (1540s–1590s), home to first large-scale plantation system (Galloway 1989). A third of the island was deforested by 1600, and large-scale slave revolts followed (Peet and Atkinson 1994; Vansina 1996). Northeastern Brazil had, in any event, already knocked São Tomé off its perch atop the world sugar economy by 1570. Brazil's sugar boom drove the first great wave of clearing Brazil's Atlantic rainforest (Dean 1995), unfolding at a furious pace. In an era when agricultural output growth can be measured in fractions of a percentage point, Brazilian sugar output grew 3 percent every year between 1570 and 1640 (Moore 2007, 257; Lucassen and Unger 2011). 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 – this does not count those who died in the Middle Passage – sustaining a population of just over 60,000 slaves by 1650. Brazil's Atlantic rainforest did not fare any better. Sugar's cultivation and fuelwood demands alone required the clearance some 5000 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' – hardly surprising, given the 2.2 million Atlantic slave departures since 1500 – pushing the 'hunt for men' ever deeper into the interior (Godinho 2005, 320; Wolf 1982, 195–231; Austin 2016, 322; Miller 1988). Every great commodity expansion, it seems, requires new streams of Cheap Labor – by market force if possible, bloody coercion if necessary.

Potosí became as 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 deforestation, declining ore quality and escalating labor unrest (Moore 2007, ch. 2–3; Braudel 1982). Potosí's first boom collapsed in the 1560s. On the heels of deepening fiscal crisis, the Spanish Crown moved quickly, inaugurating one of early modernity's most audacious Cheap Nature projects. As ever, the question of work was central. In 1569, the new Viceroy Francisco de Toledo spearheaded a radical recomposition of Andean ecology. A new method of extracting silver, mercury amalgamation, was instituted. Direct forms of labor control replaced arms-length sharecropping. Vast hydraulic infrastructures were built to power the mills that ground ore. Potosí would eventually be surrounded by 32 reservoirs covering 65 square kilometers (Moore 2010a).

Beyond the point of production, 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 *mitayos* were customarily accompanied by family. (Nor does it count the millions of non-human animals engaged in transport and work.) This kept labor costs low in the face of the rising labor demands of pit mining. The *mita* was a system not only of forced wage labor – but also of forcible resettlement. Starting in 1571, some 1.5 million Andeans – a population equal to contemporary Portugal! – were forced into *reducciones*, Spanish-style towns designed to facilitate tractable labor. Crucially, the resettlement strategy was not only about the alienation of labor. That alienation turned on the destruction of the Andean 'vertical archipelago' of diverse, interdependent ecological zones and its replacement with a new ecological model that served the demands of empire, the mines and landowners (Murra 1985; Moore 2010a). Output was

duly restored. Potosí's silver output increased nearly 600 percent between 1575 and 1590 (Bakewell 1987, 242).

The changes upon life and land were immediately apparent to contemporaries. Already in 1603, an anonymous observer wrote:

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. (Anonymous 1603, 114–15, emphasis added)

Back in Europe, shortfalls from Poland's agricultural decline were 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.¹⁴ By midcentury, however, English agriculture stagnated, as nitrogen reserves were depleted (Moore 2015b; Overton 1996). Robust productivity growth after 1600 stalled by 1750 (Broadberry et al. 2011). Exports collapsed (Davis 1962).

The problem was capitalist and world-ecological: a problem of how humans have 'mixed their labor with the earth' (Williams 1972). The exhaustion of England's agricultural revolution after 1760 – revealed in runaway food price inflation and a net per-capita reduction in food consumption – was not a straightforward problem of soil exhaustion, although this was implicated. 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 eroded the labor productivity that had propelled the urban-industrial expansion over the previous century (Moore 2015b).

England's iron consumption spiked in the eighteenth century, but not on the strength of domestic production. It increasingly resorted to the world market to satisfy the rising demand – imports tripled between 1700 and the 1770s (Mitchell 1988, 292). After 1620, English woodlands were unable to sustain rising iron production (Thomas 1993). Pig iron output in 1620 would not be exceeded until 1740 (King 2005). English woodlands retreated, from around nine percent in 1500 to just under five percent at the end of the nineteenth century (Forestry Commission 2013, 7; Smith 2001, 2). Until the 1780s, when coke-firing radically cheapened iron production, rising consumption was sustained by imports, especially from Sweden and later from Russia and even North America. In Sweden, charcoal iron devoured forests so hungrily that even here there was a constant movement, decade by decade, towards more remote – but relatively untouched – woodlands (King 2005; Mathias 1969, 450; Hildebrand 1992). All was not market demand, however – empire mattered, too. The stagnation of English iron output after 1620 stimulated colonial appropriation. Ireland's forest cover declined, from 12.5 percent to just two percent, such that little iron would be produced after the seventeenth century (Kane 1845, 3; Kinahan 1886–87; McCracken 1971, 15, 51 and *passim*).

¹⁴Calculated from Davis (1962, 302).

In southeast Asia, the Dutch imposed a new ecological regime after the founding of the East India Company (VOC) in 1602. Immediately launching a ‘full-scale strategic offensive’ in the Indian Ocean, by 1605 the VOC had wrested control of Ambona, Ternate and Tidore from the Portuguese (Israel 1989, 73). These were the most vital of the so-called Spice Islands – the Maluku Islands between Celebes and New Guinea. Their economic weight was considerable. In the later sixteenth century, Indian Ocean commerce rivaled the Baltic grain trade – although of course one cannot survive by eating spices (Pearson 1988, 42).

By 1619, under Jan Pieterszoon Coen’s leadership, the VOC looked to reorganize spice production – not merely trade. The issue was one of profitability. In contrast to Toledo’s challenge in colonial Peru a half-century prior, the problem was not too little production but too much. It had to be reduced if ‘profit margins were to be maintained’ (Chauvel 1990, 19). Profitability was indeed maintained, at the stratospheric annual rate of 18 percent across the seventeenth century (Lehning 2013, 148) – but only through great violence to human and extra-human life.¹⁵ Across the Spice Islands, control of plants and the imposition of private property were tightly joined in a ‘perfectly destructive ... system’ (Winn 2010; Cooley 1969; quotation from Smith 1937, 601). Clove production, limited to five ‘tiny volcanic islands’ before 1600 (Ternate, Tidore, Motir, Makian and Batjan), was transplanted and concentrated in just two places: the Amboina and Lease Islands (Hall 1992, 209; Davies 1961, 55). This geography was policed by the *hongitochten*. These periodic naval expeditions – manned with conscripted labor – eradicated ‘unauthorized clove plantations’ in support of the Dutch monopoly (Boxer 1965, 111–12). One expedition, to Ceram in 1625, destroyed 65,000 clove trees, a ‘conservative estimate’ (Davies 1961, 55–56). It was far from an isolated incident: the destruction and control of spice trees was a lynchpin of Dutch imperial strategy (Knaap 1992; Ricklefs 2001, 75; Grimes 2006; Loth 1995). That same decade, virtually the entire population of Banda, perhaps 15,000 people, was killed or enslaved. Not surprisingly, the half-century after 1621, when the Dutch colonial strategy began in earnest, was one of sustained population decline (Reid 1990). Banda – and the rest of the Spice Islands – were subordinated to a plantation system, with ‘every aspect of natural and human life tuned to [spice] production’ (Loth 1998, 87).

The Dutch, drawing on northern Europe’s sylvan frontiers, accomplished what the Iberians could not. The Mediterranean’s forests, never lush, were exhausted by end of the ‘first’ sixteenth century (c. 1450–1557) (Braudel 1972). Ships could be built, but not cheaply, and nowhere in the volumes necessary to sustain shipping and naval dominance. Venetian and Portuguese shipbuilding faced sharply rising shipbuilding costs early in the sixteenth century (Lane 1973; Appuhn 2009). In Portugal, an ‘acute crisis’ of the domestic forest regime set in by 1520 (Devy-Vareta 1985, 67). The costs of building and outfitting ships in the Indian trade doubled over the next century (Pearson 1987, 42). Portugal responded by expanding its shipyards in Goa (India) after 1585, where labor (and presumably timber) costs were just a third of domestic production, and in Salvador da Bahia (Brazil) after 1650 (Wing 2015; Morton 1978). Spain was not long spared the same fate. Its shipbuilding entered a ‘state of crisis’ by the 1560s (Phillips 1986, 22). Just two decades later, Philip II was searching for timber in Poland to build his ill-fated Armada (Braudel 1972, 143). Spain offshored a good share of its shipbuilding to the Caribbean – Havana’s first ships were built in the 1550s. By 1700, perhaps one-third of Spain’s fleet was Cuban-

¹⁵Braudel, however, is skeptical about the VOC’s profits in the seventeenth century (1983, 223–230).

built (Parry 1966, 249; Lynch 1984, 208–209; Funes Monzote 2008; Wing 2015). The silver fleets in the Pacific trade – the famed ‘Manila Galleons’ – were, meanwhile, increasingly built in the Philippines after 1620 (Wing 2015, 154–155). In each location, similar problems materialized – a battle for wood amongst competing economic sectors, relative exhaustion, rising costs and thence the renewed search for Cheap(er) Natures on new frontiers. Nor was this pattern limited to the Iberian world empires. The Iberian relocations were followed in the eighteenth century by the spread of major shipbuilding centers and significant frontiers for timber, potash and naval stores to North America (Perlin 1989).

The relentless geographical expansion of forest products and shipbuilding frontiers was bound up with a ‘Great Hunt’ (Richards 2003). By sea, the imperial powers launched vast fleets of herring, cod and whaling vessels that searched for and devoured the North Atlantic’s sources of maritime protein (Perlin 1989; Poulsen 2008; Richards 2003). By land, they commenced trans-continental hunts 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 (Leitner 2005; Wolf 1982).

Great frontier movements continued across an extended Caribbean in the seventeenth and eighteenth centuries, reshaping food, energy and labor relations. Steadily rising sugar demand and Bahia’s relative exhaustion by the mid-seventeenth century favored successive sugar revolutions in the West Indies (Moore 2007, ch. 6). Sugar refashioned Barbados, Jamaica and St. Domingue (the island of Hispaniola) into agro-export platforms over the next century, leaving a trail of African graves and barren landscapes in its wake. The reshaping of Barbados was expressive. By 1665, after just two decades of sugar planting, ‘all but the most isolated patches of forest’ were gone (Watts 1987, 186; also Dunn 1972, 67, 27). It was a major step towards making the island a ‘virtual biological wasteland’ (Watts 1995, 274) – and a less-than-virtual graveyard, too, one filled with the bodies of 339,000 slaves between 1651 and 1775 (Richards 2003, 424).

Perhaps most significantly, Columbus’s invasion commenced a biogeographical watershed in planetary history: the Columbian Exchange (Crosby 1972). It gave rise to a ‘cobbed-together Columbian supercontinent’, effectively restoring Pangaea after an interlude of 175 million years (Crosby 1989, 667). The Columbian Exchange of New and Old World plants, animals and diseases would have been epoch-making even if the transition to capitalism had been stopped in its tracks. The remarkable productivity of such American crops as maize, potatoes and manioc was enough to considerably enlarge developmental possibilities for any civilization or social formation that cared to adapt them (McCann 2001; Earle 2012). When maize began its rapid diffusion across Europe in the later seventeenth century – the very moment at which proletarianization again accelerated – yields doubled or tripled those of land planted with Old World cereals (Grigg 1982, 84).

The movement of ‘exchange’ in the opposite direction – from Old to New Worlds – was one of heartbreaking misery. Old World diseases reduced the New World’s population by some 90 percent (Cook 1998; Mann 2011). That biogeographical nadir, reached by the early seventeenth century, motivates Lewis and Maslin’s (2015a) Orbis Spike for dating the Anthropocene (1610) – the consequentialist counterpart to the Capitalocene. (Here we see the possibilities of Capitalocene and Anthropocene as complementary rather than competitive optics; see esp. Lewis and Maslin 2015b.) The demographic collapse was hardly a matter of pure biology. Colonial policies, aimed at mobilizing labor directly and indirectly, facilitated the flow of invasive diseases and their murderous toll on indigenous peoples by concentrating indigenous peoples and disrupting long-established

agricultural practices and trade patterns. All reinforced an evolving sensibility in colonial policy, cash-crop agriculture, and surveying and cartographic technologies that viewed external space – in this case the Americas – as *terra nullius*, or ‘nobody’s land’, open to those who could put it to work for the good of Humanity (Seed 1995; Geisler 2015; Kolia forthcoming).

Towards provisional synthesis: the origins of the Capitalocene

World ecology was altered and in a way which, because of the social organization of the emergent European world-economy, would primarily benefit Europe

Wallerstein (1974, 44).

I will close Part I of this essay in two registers. First, briefly, I want to reprise the empirical and explanatory moments of the origins of the Capitalocene. Next, as a prelude to the arguments in Part II, I want to make a plea for more a productive conversation around the origins of ecological crisis and the rise of capitalism.

First, the early modern landscape revolution represented an early modern revolution in labor productivity. This revolution in the zone of commodification was rendered possible by a revolution in the technics of appropriating Cheap Natures, especially the Four Cheaps of food, labor, energy and raw materials. This was realized not only through 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 imagine it (Ingold 1993; Pratt 1992). 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 (Merchant 1980; Lefebvre 1991; Mumford 1934; Crosby 1997; Pickles 2004; Sombart 1915; Chaunu 1959). The early modern labor productivity revolution turned, in short, on the Great Frontier (Webb 1964), understood simultaneously in land/labor and symbolic registers. 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 (Brenner 1976). There would be no system-wide reversal of commodification after 1450, not even during the ‘crisis’ of the seventeenth century. Why? Because early capitalism’s *technics* – its crystallization of tools and power, knowledge and production – were *specifically organized* to treat the appropriation of global space as the basis for the accumulation of wealth in its specifically modern form: capital as abstract social labor.

This takes us to a second proposition, which turns on our interpretive frame. The three revolutions we have identified – of landscape change, of labor productivity, of the *technics* of global appropriation – suggest a way of thinking capitalist crisis world-ecologically. In the terms of this essay, that means putting nature at the center of thinking about work; putting work at the center of our thinking about nature; and setting aside the presumption that human organization of any kind (from family forms to transnational corporations) can be adequately understood abstracted from the web of life.

This entails a conversation over Cheap Nature as a system of domination, appropriation and exploitation that acknowledges the diversity of human and extra-human activity necessary to capitalist development but not directly valorized (‘paid’) through the money economy. The Four Cheaps are the major way that capital prevents the mass of capital

from rising too fast in relation to the mass of appropriated Cheap Nature. When the delivery of such Natures approaches the average value composition of world commodity production, the world-ecological surplus falls and the pace of accumulation slackens. The centrality of Cheap Nature in the endless accumulation of capital can, then, be adequately interpreted only through a post-Cartesian frame that understands value as a way of organizing nature. In this, the law of value is co-produced through the web of life. The law of value is a law of Cheap Nature.

The debate over the rise of capitalism has returned to center stage in world politics – this time in stealth form, this time around the question of nature. Arguments about global crisis under the sign of the Anthropocene have simultaneously embraced a strong narrative on the origins of ecological crisis and evaded the historical work necessary to excavate those origins. That work is one necessary condition for a fruitful debate over the entangled questions of the origins of planetary crisis and the politics of that crisis in the twenty-first century. The Anthropocene is not problematic because it asserts, drawing on a consequentialist and substantialist method, the turning point of the early nineteenth century. It is problematic because it has preconceptualized the problem: it has embraced a longstanding myth that has guided social theory and environmentalist critique. The Industrialization Thesis on ecological crisis is dangerous because it blinds us to the early modern remaking of planetary natures. Ignored by students of the transition to capitalism (but see Wallerstein 1974; Moore 2003a), the question of environmental history is central to understanding the origins of capitalism and the relevant form of crisis today. The issue is so pressing that we would do well to depart the either/or polemics that have long characterized transition and crisis debates.

Recent accounts of the origins of capitalism in the web of life have stressed different periodizations. My argument here and elsewhere has underscored the emergence of new relations of power, profit and re/production from the long sixteenth century. Malm's important study of nineteenth-century 'fossil capital' entails a different periodization (2016). The error is to see these periodizations as mutually exclusive (Altwater 2016). Fossil capital? That is surely a crucial dimension of our reality since the nineteenth century. Capital, power and nature entwine. Just as we live in the era of fossil capital, do we not also live in the era of *agrarian* capitalism – characterized by punctuated revolutions in class struggle, nature, and the productive forces, so necessary to the expanded reproduction of labor power (e.g. Bernstein 2010; McMichael 2013; Moore 2015a, ch. 10)? Are not these different interpretations premised on distinctive angles of vision? Is not the story of fossil capital one amongst several narratives necessary to grasp the history of capitalism and its present crisis? Surely we are dealing with a massive reinvention of capitalism in the nineteenth century. So too – but under very different conditions – after World War II, after 1971, and today. Let us take care – to paraphrase Lenin (1960) – to avoid 'stereotyping' capitalist development into idealized forms.

Different bundles of nature, state, class and the productive forces lead to different visions of capitalism – a banal but necessary observation important to the basic point. None of us has all the pieces of the puzzle; we need to carry forward a fundamental openness to the revision of deeply held frameworks. Our vistas are irreducibly partial – and therefore we must attend simultaneously to their openness and coherence.

Understanding capitalist origins – and the possible trajectories of twenty-first-century crisis – is treacherous work. What I have tried to show is that the spectacular images of the Industrial Revolution transmitted to us by every schoolbook cannot contain the creativity and destructiveness of capitalism. Those images must be complemented by the global transformations of human and extra-human natures – and, as we shall see in Part II – by the emergence of new ways of seeing and organizing the unpaid work of humans and

the rest of nature over the past five centuries. The stakes are too high for formulaic interpretations. We must go deeper.

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