Artwork & Editors

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eds.

II

THE CANCER STAGE

HOW SICK IS OUR SOCIAL DEFENSE SYSTEM?

I

THE NATURE OF OUR ANGER

ON ORGANISING CONSTRUCTIVE RESISTANCE

Jason W. Moore

PUTTING NATURE TO WORK

CHEAP FOOD, CHEAP NATURE AND THE CAPITALOCENE

Suddenly, nature is everywhere. Finance, food, climate, energy, employment – the question of nature is today entwined with "social" contradictions as never before. But how should we think nature? And what kind of thinking do we need in the 21st century, an era marked by unprecedented – and spiralling – biospheric instability? For scholars and activists who take nature seriously, there have been two very different responses to this question. The first response unfolds from the premise that human organi-

zation – a civilization, a world market, an empire – is more or less independent of the web of life. This is the perspective of Humanity and Nature. (Note the uppercase 'H' and 'N'.) In this perspective, modernity's social, technological, and demographic vectors are generating environmental consequences that will soon limit civilization as we know it. There is broad spectrum of interpretive positions here, but one concept stands out about all others: the Anthropocene. It is a concept sufficiently popular and plastic to admit a dizzying array of arguments, extending from The Economist to the great Marxist historian Mike Davis. And if the Anthropocene is not exactly an argument in itself, it asserts the primacy of a well-worn dualism with roots in the rise of capitalism itself: the binary of Humanity and Nature.

The second response to our question – How do we think nature in the 21st century? – agrees with much of the Anthropocene empirical survey. This response concurs: we have entered a new period of unprecedented biospheric instability, and modernity's "business as usual" must change. Nor is there disagreement that modernity's transformation of the biosphere since 1950 has been unprecendented.[1] The difference is in how history works, and how the unfolding biospheric and civilization crisis of the 21st century is unfolding. These scholars and activists insist that the root of the problem is not simply modernity, but modernity in the web of life. I call this the perspective of humanity-in-nature, which is also the perspective of nature-in-humanity. Here again, there is a broad spectrum of positions. While the critique of Humanity / Nature dualism has a long history, a new argument has gathered steam in recent years. This is the argument for seeing modernity as a way of organizing nature – and being organized by the web of life. In this way seeing, the modern world-system is a capitalist world-ecology, joining power, capital, and nature as an entwined whole. From this perspective, the problem is not the "Age of Humans" but the "Age of Capital." Not Anthropocene, but Capitalocene.

Anthropocene, Capitalocene, & the Remaking of Green Thought

The dominant Anthropocene argument poses a question that it cannot answer: How have humans become a "geological force"? (Were we not already a geological force?) I do not mean to suggest that Anthropocene advocates do not respond to the question. They do. But they are responses,

not explanations in any reasonable sense. Most of these responses focus on demography and technology, though additional factors are often recognized – consumerism, trade liberalization, investment flows, and so forth. These imply, but do not, engage questions of power and capital. And what kind of explanation of biospheric crisis in the 21st century abstracts from such questions? Thus, the identification of multiple "trajectories" of the Anthropocene, describes a lot, and explains very little.[2] It identifies the What? But it does not explain the How?

The Anthropocene argument cannot explain how the present crisis is unfolding because it is a captive of the very thought-structures that created the present crisis. At the core of these thought-structures is Cartesian dualism. The term is one of my possible shorthands, and owes its name to René Descartes' famous argument about the separation of mind and body. Cartesian dualism is a mode of thinking the world – ontologically (what is?) and epistemologically (how do we know?) – that took shape between the 15th and 18th centuries. These centuries saw the rise of capitalism – something that most people still think is about "economics," but in fact was about something much more profound. The rise of capitalism was about a new way of organizing the web of life. Fundamental to this process were three entwined historical processes. One was what Marx called primitive accumulation, and this entailed a range of processes that made a growing number of humans dependent on the cash nexus for their survival. Social scientists call this "proletarianization," and it assumed the widest range of forms. It was nearly always partial ("semi-proletarianization"). It is about the transformation of human activity in labour-power, something to be "exchanged" in the commodity system – sometimes called "the labour market." Even if one thinks that human activity is somehow independent of nature, there is no avoiding one fact: proletarianization was rooted in the governance of nature and the replacement of custom and common by the dictatorship of the commodity. Sometimes peasants were forced off the land and found their way to the towns; but sometimes peasants were kept on the land, reduced to cottagers and forced into agricultural wage work to provide what small plots could not. And sometimes proletarians did not look proletarian at all – African slaves in Brazil and the Caribbean sugar plantations were a good example. Like workers in England or Peru, they depended upon the cash nexus to survive.

Proletarianization was never principally economic; it was a product of the new forms of territorial power that emerged after 1450. Here is our second process. The old territorial power – the overlapping jurisdictions and personalized authority of medieval Europe – had crumbled in the long feudal crisis (c. 1315-1453). West-central Europe's ruling classes had tried to restore feudal labour systems – and failed. The most dynamic of the new states owed their dynamism to an alliance with merchant capitalists who were far more than merchants – it was the alliance of the Iberian crowns with Genoese capital that, quite literally, made the space that made capitalism possible. In its early centuries, capitalism was trans-Atlantic or it was nothing. The new empires – but also the internal transformations of the Low Countries and England – were made possible by power of a new type. At its core was the generalization of private property. For a new praxis of modern private property emerged in these centuries. Its "strategic goal" was the separation of the peasantry from non-market access to land: arable and grazing land, forests, wetlands, and all the rest.[3] This was the fundamental condition of proletarianization, and like proletarianization, the enclosures and dispossessions of private property were enormously varied. So too were the states and empires that pursued this strategic goal. Their "central function" was "the internal maintenance and external defence of a private property regime"[4] – and may we add the expanded, globalising, reproduction of that regime?

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

To say praxis is to invoke an ongoing process of capital's self-reflection and capacity for innovation – symbolically and materially. For no civilization has been so adept at overcoming its limits. The new knowledge regime prized dualism, separation, mathematization, the aggregation of units. Its innovations – clustered into scientific revolutions – were at once producers and products of the previous two transformations – of labour (proletarianization) and land (property). At the core of the new thought-structures was a mode of distinction that presumed separation. The most fundamental of these separations was Humanity / Nature. Some people became Humans, who were members of something called Civilization, or Society, or both – as in Adam Smith's "civilised society."[5] From the beginning, most humans were either excluded from Humanity – indigenous Americans, for example – or were designated as only partly Human, as were virtually all European women. As with property, the symbolic boundaries between who was – and who was not – part of Nature (or Society) tended to shift and vary; they were often blurry; and they were flexible. But a boundary there was, and much of the early history of modern race and gender turns on the struggles over that line. (Is it so different today?) That boundary – the Nature / Society divide that the Anthropocene affirms and that many of us now question – was fundamental to the rise of capitalism. For it allowed nature to become Nature – environments without Humans. But note the uppercase 'H': Nature was full of humans treated as Nature. And what did this mean? It meant that the web of life could be reduced to a series of external objects – mapped, explored, surveyed, calculated for what Nature could do for the accumulation of capital. And the substance of that value? Human labour productivity – but not all humanly productive work – measured without regard for its cultural, biophysical, and cooperative dimensions. Human work as abstracted, averaged, deprived of all meaning but for one: value as the average labour-time making the average commodity. For this to occur, not only did new conceptions of nature – as external Nature – take shape, but new conceptions of time and space. For good reason, Mumford tells us that the "key machine" of modernity is not steam engine but the mechanical clock, the physical expression of an earth-shaking idea:

linear time.[6] The clock, Marx underlines, was the "first automatic machine applied to practice purposes."[7] Nor did this early modern revolution of abstraction stop with labour and time. The successive cartographic revolutions, beginning in the 15th century, made possible an extraordinary new apprehension of geography. In the new cartography, geography was cleansed of its troubling particularities and meanings. It became "space as pure quantity."[8] It became abstract space – and therefore, abstract Nature. Here we can begin to see the thought-structures of modernity as more than simply the "superstructures" of material forces. To turn work into labour-power and land into private property was to transform nature into Nature – and to treat Society as something outside of Nature, the better that Society could turn Nature into a set of discrete units, into a repertoire of calculable objects and factors of production. Marx tells us, famously, that the relations of capital and labour "drip with blood and dirt."[9] Does not also the dualism of Society and Nature – understood not as real description but as a signpost of a modernist rationality that can only make sense of relations through the interaction of substances? In highlighting Cartesian dualism as a key source of the problem – unconsciously embraced the Anthropocene argument – we are seeking to make sense of three great thought-procedures that have shaped the modern world: 1) the imposition of "an ontological status upon entities (substance) as opposed to relationships (that is to say energy, matter, people, ideas and so on became things)"; 2) the centrality of "a logic of either/or (rather than both/and)"; and 3) the "idea of a purposive control over nature through applied science."[10]

These thought-procedures dominate Anthropocene thinking in all sorts of ways – not least in their embrace of technical fixes such as geo-engineering. The point I wish to emphasise, however, concerns the fundamentally substantial and arithmetic character of the Anthropocene perspective. Anthropocene thinking remains firmly rooted in a model that "aggregate[s] socio-economic and Earth system trends."[11] The model is descriptively powerful, yielding powerful visual representations of the "Great Acceleration."[12] Descriptively powerful, perhaps – but analytically anemic. The approach aggregates units – Humanity and Nature – that are non-relational and non-independent. Nature and Society are taken as non-problematic; the concepts are confused for actually existing historical processes, in which capitalism is actively shaped by the web of life – and vice-versa. In

sum, the perspective integrates factors but does not synthesize them. Absent is the actual whole of power, capital, and nature entwined in modern world history. More problematic still: the adding up of Nature and Society makes claims for wholeness that undermine efforts to forge a new, post-Cartesian synthesis of humanity-in-nature.

This is the Green Arithmetic model. Society plus Nature equals the Whole. It has deep and honorable roots in the Green Thought – an audacious and simplifying category to be sure. By Green Thought I name that tradition of environmentally-oriented scholarship across the humanities and social sciences, a tradition that always included a few scholars from the physical sciences too. The latter's ranks have swelled dramatically in recent years, as a growing number of scholars recognize the interpenetrating realties of human organization and biospheric change. But the quantitative expansion has not – yet – compelled a fundamental reexamination of the Green Arithmetic model.

From its origins in the 1970s, Green Thought revolutionized our understanding of world history – and of the history of capitalism above all. Absent some reckoning of environmental factors, no account of world-historical process can be regarded today as adequate. These processes include commodity flows and capital accumulation, but extend also into manifold "cultural" realms as well. This is the signal accomplishment of Green Thought since the 1970s: the "blank spots" on the Cartesian mapping of historical change have been progressively filled in. This has been the work of philosophers, literary theorists, environmental historians, ecological economists, political ecologists, and many others. Nature – that inevitable Other to Society – became visible to all (though unevenly) across the humanities and social sciences.

Green Thought's victory was realized at a price, and that price was very high indeed. The valorization of environmental studies was realized through a transformation of the web of life from nature as a whole, into Nature with an uppercase 'N'. Nature became a zone of consequences caused by Humanity (or Society, or Capitalism). Environmental studies became the study of: of industrial civilization, of imperialism, of Economy, Society, and so forth. We began to write environmental histories of, politi-

cal ecologies of, environmental sociologies of. Here was Green Arithmetic: Society + Nature = The Whole. It was a compelling logic; it was institutionally valorized; it was straightforward to operationalize. One needn't rethink political economy, for instance: you could do the "political economy of" the environment. But now – and only now, after the hard-won recognition of environmental studies – we may ask, Does Green Arithmetic add up?

There were always voices that that argued for a more a radical vision. They argued that Green Arithmetic and the dualism of Nature/Society did not go far enough; indeed, some even argued that such dualism could represent a barrier to deepening our understanding of historical change. The arguments were tantalizing, provocative, exciting, unsettling. We can think of David Harvey, Arne Naess, Robert M. Young, Donna Haraway, Raymond Williams, Carolyn Merchant, Neil Smith, and Richard Levins and Richard Lewontin – among many others. Their arguments were all different. And their arguments all said the same thing: everything humans do – including with each other (e.g. making families, making civilizations) – is bundled with the web of life at every turn. Of course, Marx had argued much the same more than century before: human work is a "specifically harnessed natural force"; our species-being is forged through the relation with the rest of nature; the labour process is an activity that simultaneously changes human and extra-human natures – and the relations between them.[13]

For the most part, this argument for a post-Cartesian perspective on historical change remained broadly philosophical. And the philosophical position – humanity-in-nature rather than the Humanity and Nature – enjoyed widespread acceptance. But the analytical implications, the methodological implications, did not. Green Arithmetic dominated – overwhelmingly. We still talked – and still talk – about capitalism and nature. The consequences for our understanding of modernity have been significant: world markets, financialization, geopolitics and imperialism, the theory of capital accumulation, and much, much more – all remain radically underconceptualized because they assume what few of us today consider tenable: that states, empires, markets, commodification are ontologically prior to the web of life. We are – only just now – beginning to cross that Rubicon, to begin to understand the how and the why of capitalism (and all manner of world-historical processes) as not only producers of environmental change but as

products of the web of life. Capitalism, in a word, is a co-produced – not an economic system, not a social system, but a way of organizing nature... and capitalism is a set of relations of human and extra-human natures that are produced not by humans alone, but by and through a complex mosaic of life.

Some of us have begun to call this way of thinking world-ecological.[14] As is probably clear by now, I don't mean the "ecology of the world." Our ecology is not the ecology of Nature – again, the uppercase 'N' – but the ecology of the oikeios*: that creative, generative, and multilayered relation of life-making, of species and environments. Species make environments; environments make species. The philosophical point shapes the historical method: human activity is environment-making. And in this observation, nature moves from noun ("the" environment") to verb (environment-making). Human organizations are environment-making processes and projects; human organizations are shaped by manifold environment-making processes in the web of life. This is the double internality of historical change – humanity inside nature, nature inside humanity. (With humanity differentiated, not reduced to a formless, abstract homogeneity.) World-ecology is not alone in making the broad philosophical argument; but it is distinctive in arguing for the translation of these philosophical positions into methodological premises, narrative strategies, and theoretical frames in which specific forms of human organization – capitalism has been my focus, but it is only of many possibilities – are producers/products of the web of life. From this standpoint, capitalism is a world-ecology, dialectically unifying the accumulation of capital, the pursuit of power, and the co-production of nature. A more complex elabouration is possible, and probably desirable. But this can only come from the ongoing reinvention of environmental studies. The present argument is intended as a series of openings, an invitation to dialogue – not a closed system. The present argument is offered in the spirit of sympoesis, offering boundaries that are porous, fuzzy, shifting, and open to revision.[15]

The Nature of the Historical Problem: Conceptualizing Work / Energy

I want to invert the problem of Nature posed by Green Thought. For environmental studies – and global environmental change scholars in particular – the problem can be stated simply: What does capitalism do to Nature?

Environments are devastated, degraded, plundered, destroyed, pillaged, etc. (Let us note that all these concepts are drastically underconceptualized, often working as slogans rather than explanatory concepts.)

A different question is, however, possible: How has capitalism put nature to work in service to capital accumulation? This question does not rule out the terrible stories of capitalism's terrible acts; it incorporates such questions. (For degradation, whatever that means, shapes the conditions of the work of nature from one historical era to the next.)

How does capitalism put nature to work? Let me clear from the outset, that the "nature" that is put to work includes human natures. The line between Nature and Humanity has been a pivotal struggle in the capitalist world-ecology from its origins. Consider the tightly bound connection between science and gender across the early modern era; the early sixteenth-century debates between Las Casas and Sepúlveda over "natural slaves"; or the colonial designation of indigenous peoples in the later sixteenth-century Andes and elsewhere as naturales.[16]

The concept of work/energy looms large in this argument. It allows us to pierce the Cartesian fog that surrounds the unity of human and extra-human work. Marx's observation that large-scale industry is a mechanism for turning "blood into capital" was no mere polemic. It was a means of highlighting the ways that the capital-relation transforms the work/energy of all natures into a frankly weird crystallization of wealth and power: value. Work/energy helps us to rethink capitalism as a set of relations through which the "capacity to do work" – by human and extra-human natures – is transformed into value, understood as socially necessary labour-time (abstract social labour). "Work/energy" (or potential work/energy) may be capitalized – as in commodified labour-power via the cash nexus – or it may be appropriated via non-economic means, as in the work of a river, waterfall, forest, or some forms of social reproduction. My thinking about work / energy finds inspiration from White's view of energy as the capacity to do work. Work, in turn, is the product of a force acting on a body and the distance the body is moved in the direction of that force. Push a large rock and you are expending energy and doing work; the amount of each depends on how large the rock and how far you push it. The weight and flow

of water produce the energy that allows rivers to do the work of moving rock and soil: the greater the volume of water in the river and the steeper the gradient of its bed, the greater its potential energy.[17]

White's sketch is focused on the geophysical work/energy implied in the historical geography of a river (the Columbia, in this instance) work/energy is also about organic life: from photosynthesis to hunting prey to bearing children. What bears emphasis is how the work/energy of the web of life is incorporated into the relations of power and re/production of wealth, life, and power. Food – in capitalism as for all civilizations – is a crucial nexus of all these. Work/energy allows us to transcend the metabolic fetish of Green materialism, in which flows are narrowly biophysical, can be disrupted, and can be subsequently repaired to some Edenic, pristine state. The work/energy alternative see metabolism through the double internality: flows of power and capital in nature, flows of nature in capital and power. In this, the issue is not "metabolic rift" but metabolic shift.[18]

To this conception of work/energy we may add an outline of labour productivity, as I will use it. Labour productivity is understood in terms of the rate of exploitation and the production of surplus value. The usual Marxist model turns on the relation of machinery and labour-power: more powerful machines allow the average worker to produce more average commodities. Many wrinkles have been added to the model: organizational innovation, labour process rationalization, the impact of transportation, information, and communications technologies, and others.

Within this model, the rate of exploitation (surplus value production) may be expanded when the average worker produces a rising mass of value (often, a rising physical volume of commodities), so long as wages increase more slowly than productivity. Alternatively, exploitation may advance when the worker produces a static mass of value, so long as wages decrease. Thus, accumulation may advance on the basis of rising wages and rapidly advancing productivity, as during Fordism, or on the basis of falling (or static) wages and very slow productivity growth, as during the neoliberal era. Part of this dynamic is captured in the classic distinction between relative and absolute surplus value. In this, a twentieth century auto plant would embody relative surplus value (rising labour productivity per hour)

whereas textile production in the sixteenth century typifies absolute surplus value, in which the production of surplus value was determined by the number of hours worked, not by rising output per hour.

I worry that this distinction between absolute and relative surplus value has too often been hardened into categorical difference. For one, the usual Marxist thinking on the subject presumes early capitalism as static, certainly not a system characterized by the production of relative surplus value. The great advances of the nineteenth century obscured the equally great leap forward in labour productivity after 1450. My point, however, extends beyond the historical observation. The reason both Reds and Greens see "real" capitalism emerging after 1800 turns on a reluctance to look at how capital, science, and empire appropriated nature – including the unpaid work/energy of humans – in service to surplus value production. In metals and mining, shipbuilding, agriculture, textiles, printing, and many other strategic sectors of early capitalism, labour productivity advanced dramatically through new techniques and procedures of harnessing nature's bounty. Early capitalism mobilized technical innovation, systemic violence, and symbolic innovation to lengthen the working day as well as to produce and appropriate Cheap Nature so as to reduce de facto unit labour costs. In such situations – here I think of Norwegian forests or Polish grain or even African slaves – the appropriation of "natural fertility" (Marx) may act like an increase in relative surplus value. Appropriated nature becomes a productive force. If one includes the conquest of the Americas, the direct and indirect implications for labour productivity growth were gigantic. The appropriation of global natures and the accumulation of capital are closely joined through the production of surplus value. From this perspective, we may reasonably ask: Does the ongoing closure of frontiers today signal an exhaustion of capitalism's Cheap Nature strategy, with its prodigious history of appropriating uncommodified nature as a way to advance labour productivity?

The Rise of the Capitalist World-Ecology, Part I: From Technology to Technics

That question cannot be answered persuasively within a dualist frame, and its attachment to the degradation of Nature. For the question of frontiers – frontiers of uncapitalized human and extra-human natures – is a question of putting nature to work, for free of low-cost. This process I will call appropriation, distinct from the exploitation of labour-power in commodity production.

My use of appropriation therefore differs from that of Marx, who deployed the term more or less interchangeably with the exploitation of wage-labour. Appropriation, in what follows, names those extra-economic processes that identify, secure, and channel unpaid work outside the commodity system into the circuit of capital. Scientific, cartographic, and botanical revolutions, broadly conceived, are good examples.[19] Movements of appropriation, in this sense, are distinct from movements of the exploitation of wage-labour, whose tendential generalization is premised on the generalization of appropriative practices. So important is the appropriation of unpaid work that the rising rate of exploitation – the basis of capital accumulation – depends upon the fruits of appropriation derived from Cheap Natures, understood primarily as the "Four Cheaps" of labour-power, food, energy, and raw materials.

From this perspective, Green Thought's love affair with Two Century model of modernity – the Industrial Revolution – appears as a curiously nature-blind and masculinist conception of historical change. (And let me put too fine a point on the matter: this is the historical thinking underpinning the dominant conception of the Anthropocene argument.) The story of capitalism as the story of industrial, technical change reproduces the essential blindspot of both Red and Green thinking over the past half-century. Capitalism's weird system of accounting – privileging and pivoting on the exploitation of labour-power – depends on strategies of appropriating the unpaid work/energy of "women, nature, and colonies."[20] Every act of exploitation requires an even great act of appropriating unpaid work/energy. Absent massive streams of unpaid work/energy from the whole of nature – including that delivered by women – the costs of production would rise, and accumulation would slow. (This is indeed the history of "economic" crises over the past five centuries, moderated to some degree since the 1830s by fossil fuels.) To repeat: every act of exploitation (of commodified labour-power) therefore depends on an even greater act of appropriation (of unpaid work/energy). Wage-workers are exploited; everyone else, human and extra-human, is appropriated. But don't think

I'm being soft of capitalism. To rephrase an old Marxist joke: The only thing worse than being exploited is ... being appropriated. The history of capitalism flows through islands of commodity production, developing within oceans of unpaid work/energy.

Green Thought has – surprisingly in my view – refrained from bringing nature into the core conceptual vocabulary of historical change. Modernity has remained an overwhelmingly technical affair. I am well aware, as I write these words, that Green scholars have made trailblazing contributions to our understanding of culture, politics, resistance movements, and much more. But the core conceptualization of historical change has remained untouched – at best (and it is positive sign) we are now treated to calls for Nature's agency. But this procedure is arithmetic and not synthetic.

The result has been an astonishing blindspot in both Green Thought and World History. The Two Century model of capitalism seemed so reasonable, and fit the historical model so well, that we ignored what was right before our eyes: the remarkable remaking of land and labour beginning in the "long" sixteenth century (1450–1648). (About which, more presently.) Industrialization appears, in the metanarratives of Green Thought, as a deus ex machina dropped onto the world-historical stage by coal and steam power.

There are three questions here. First, is Industrialization the Big Bang of modernity, or is it instead a cyclical phenomenon of capitalism from the long sixteenth century? Second, is Industrialization the most useful concept for explaining large-scale and long-run patterns of wealth, power, and nature in historical capitalism? And third, if we bring nature-as-oikeios into our conceptualization of capitalism, industrial change, and environment-making, what's new?

But is industrialization really the best way to frame the origins and subsequent development of modernity's "ecological" crisis? At its best, industrialization is a shorthand for the tensions between technology and power, between the "forces" and "relations" of production; these are hardly novel historical problems. But these tensions have, almost universally, been framed in dualistic terms, contained within a "social" universe of human

relations ontologically prior to the latter's engagement with web of life. This is the problem of Cartesian dualism, one that bears bitter fruit in the hegemonic narrative of industrialization as acting upon, rather than developing through, nature.

Naming is always fraught with new challenges. In speaking of Cartesian dualism, it is of course true that all blame should not be heaped upon poor Rene. He personified a much broader scientific and especially philosophical movement:

The effect [of Descartes' argument] is to enforce a strict and total division not only between mental and bodily activity, but between mind and nature and between human and animal. As mind becomes pure thought – pure res cogitans or thinking substance, mental, incorporeal, without location, bodiless – body as its dualised other becomes pure matter, pure res extensa, materiality as lack. As mind and nature become substances utterly different in kind and mutually exclusive, the dualist division of realms is accomplished and the possibility of continuity is destroyed from both ends. The intentional, psychological level of description is thus stripped from the body and strictly isolated in a separate mechanism of the mind. The body, deprived of such a level of description and hence of any capacity for agency, becomes an empty mechanism which has no agency or intentionality within itself, but is driven from outside by the mind. The body and nature become the dualised other of the mind.[21]

It is certainly true that humans had long recognized a difference between "first" and "second" natures, and between body and spirit. However, capitalism was the first civilization to organize on this basis. For early modern materialism, the point was not only to interpret the world but to control it: "to make ourselves as it were the masters and possessors of nature."[22] This sensibility was a key organizing principle upon which capitalist civilization organized.

At a time when Cartesian dualism, as philosophical construct, finds itself widely questioned across the spectrum of Green Thought, such dualism retains its hegemony over the methods, theory, and narrative frames of world-historical change. Radical, even Marxist, Greens still tend to think of

capitalism and nature rather than capitalism-in-nature.[23] This is the largely-unacknowledged dissonance at the core of Green Thought today, between the philosophical recognition that humans are a part of nature (humanity-in-nature) and the construction of histories, recent and remote, that proceed as if human relations are ontologically prior to the web of life (humanity and nature).

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

The challenges involved in translating the philosophical premise of humanity-in-nature into historical methods and narrative strategies are considerable. Certainly, a core problem has been the difficulty in forging a conceptual vocabulary that grasps "society" and "nature" as a singular ontological domain, such that all human activity is simultaneously producer and product of the web of life. The problem has been recognized for a long time, and especially since the 1970s. Elsewhere, I have tackled the problem with the concept of the oikeios, signifying the creative, generative, and multi-layered relation of species and environment. The oikeios provides a way to move beyond the narrative trope of "the" environment (as object) in favor

of environment-making (as process), at all turns a co-production of specifically bundled human and extra-human natures. "Nature" and "Society," in world-ecological perspective, are viewed as part of the problem. They are violent abstractions that – by positing discrete ontological domains of humans without nature and nature without humans – dissolve the messy, bundled, and creative co-productions of historical change.[24] The idea of nature as external to human relations is not, however, a magician's trick of smoke-and-mirrors; it is a real historical force. Capitalism, as project, emerges through a world-praxis that creates external natures as objects to be mapped, quantified, and regulated so that they may service capital's insatiable demands for cheap nature. At the same time, as process, capitalism emerges and develops through the web of life; nature is at once internal and external. In this way of seeing, the oikeios is a general abstraction that gains historical traction only insofar as it provides the conditions for recasting the great drivers of world-historical change – foremost among them the perennial darlings of industrialization, imperialism, capitalism, modernity – as co-produced by humans and the rest of nature.

If capitalism as a "way of organizing nature" gets us moving in the right direction, this is a statement more of the "what" of modernity-in-nature than of the "how." To recast the "how" of capitalism as world-ecology – how power, capital, and nature form an organic whole – we might turn to Mumford's notion of technics. Mumford grasped that a new technics emerged in the early modern era – crystallizing tools and knowledge, nature and power, in a new world-praxis, one that reduced both "man" and "nature" to abstractions. For Mumford, power and production in capitalism embodied and reproduced a vast cultural-symbolic repertoire that was cause, condition, and consequence of modernity's specific form of technical advance. This was not, Mumford made plain, a story to be celebrated. It was, rather, one to be recognized, and critiqued, for its peculiarity: "The Chinese, the Arabs, the Greeks, long before the Northern European, had taken most of the first steps toward the machine ... [T]hese peoples plainly had an abundance of technical skill at their command. They had machines; but they did not develop 'the machine'."[25] At the heart of Mumford's argument was the idea that machines, technics, and the alienated violence of capitalist civilization move through the web of life. It was the discovery of nature as a whole [that] was the most important part of that

era of discovery which began for the Western World with the Crusades and the travels of Marco Polo and the southward ventures of the Portuguese. Nature existed to be explored, to be invaded, to be conquered, and finally, to be understood... [A]s soon as the procedure of exploration was definitely outlined in the philosophy and mechanics of the seventeenth century, man himself was excluded from the picture. Technics perhaps temporarily profited by this exclusion; but in the long run the result was to prove unfortunate. In attempting to seize power, man tended to reduce himself to an abstraction, or, what comes to almost the same thing, to dominate every part of himself except that which was bent on seizing power.[26]

In the absence of a world-ecological concept of technics, mainstream and even radical Green Thought conflates the Industrial Revolution with modernity. The question of origins is elided – not resolved – through recourse to a meta-narrative premised on the self-evidently periodizing implications of rising CO2 emissions and other eco-consequential phenomena. The question of the origins of world-ecological crisis is axiomatically reduced to a surficial representation of the drivers and consequences of 19th century industrialization. Of course it all began with coal, says the Anthropocene argument, because the consequences are measurable, and this is, after all, what counts. The consequences of this approach – green thought's consequentialist bias – are more significant than commonly recognized. Kingsnorth, a deeply contradictory figure, puts this well:

My feeling is that the green movement has torpedoed itself with numbers. Its single-minded obsession with climate change, and its insistence on seeing this as an engineering challenge which must be overcome with technological solutions guided by the neutral gaze of Science, has forced it into a ghetto from which it may never escape. Most greens in the mainstream now spend their time arguing about whether they prefer windfarms to wave machines or nuclear power to carbon sequestration. They offer up remarkably confident predictions of what will happen if we do or don't do this or that, all based on mind-numbing numbers cherry-picked from this or that 'study' as if the world were a giant spreadsheet which only needs to be balanced correctly.[27] I would go still further. The fetish of industrialization quickly leads to others. A stylized love affair with machinery leads quickly to a stylized love affair with resources. This is not surprising given

the faint influence of political economy and class analysis in most green interpretations of industrialization. But even for those on the left who favor a class-relational approach, a certain fossil fuel-fetishism appears, as when Malm suggests that we insert fossil fuels as the spark that ignites the engine of capital.[28] "Capital," in these accounts, forms independently of the web of life, and intervenes in "nature" as an exogenous force, variously intruding in, and interrupting, a pre-given "traditional balance between humanity and nature."[29] This view of capitalism as an exogenous rather than endogenous actor in relation to the web of life has the paradoxical effect of reducing nature to a substance that can be variously protected or destroyed.[30] No matter how dialectical the conception of capital, so long as this conception unfolds within a Cartesian frame – humans without nature, nature without humans – the analyst is compelled to engage capital's relation with nature as "tap" and "sink" first, and only later as the field within which modernity unfolds. When push comes to shove, the philosophy of humanity-in-nature gets pushed aside in favor of analytical practicality.[31]

It is always tempting to "think in terms of realities that can be 'touched with the finger'."[32] In this way of thinking – Bourdieu calls it substantialist – substances form prior to, and independently of, events and fields of relations, rather than developing through environments cohered by definite patterns of events.[33] Substantialism, in this sense, is at the heart "human exemptionalist" social theory, which isolates humanity from its extra-human conditions of reproduction.[34] The result is a way of thinking humanity as ontologically independent – a kind of human substance apart from the 'substance' of Earth/Life. Even when the professed goal is holism, substantialist dualism fetters the move towards synthesis. Why? Largely because human exemptionalist social theory – and this is still most social theory – presumes humanity's specificity in the absence of a historical specification of the whole: the natures within which human activity unfolds, and to which human activity actively contributes. The very procedure that might establish humanity's "dialectical historicity" is in the process denied.[35] It turns out that, as with pregnancy, one cannot be a little bit Cartesian. For nature is either abstract and external or historical and immanent to everything that humans do, including those large-scale and long-run patterns of power and production that we call civilizations, world-systems, modes of production, and so forth.

The conceptualization of historical natures matters quite a bit to our periodizations of capitalism. For if nature is neither pre-given nor external, we are confronted with the thesis that historical change is a bundled movement of human and extra-human natures. In capitalism, these bundles assume multiple forms, foremost among those of capital, state and imperial territoriality, and class relations. But we may also look the family of "regimes" of food, energy, and raw materials. Capitalism as a whole, I wish to emphasise does not have an ecological regime – it is an ecological regime. But this merely established a new set of questions around how these specific regimes mark specific crystallizations of nature and wealth, tools and power.

On the terrain staked out by the Anthropocene argument, we might consider how the definite relations of early capitalism – co-produced in the web of life – transformed coal from a rock in the ground to a fossil fuel. Let us be clear that the call for the relationality of humanity-in-nature does not deny the materiality of resources.[36] Far from it! The world-ecology alternative argues that resources are relational and therefore historical. Geology is a "basic fact"; it becomes a "historical fact" through the historically co-produced character of resource production, which unfolds through human/extra-human nexus: the oikeios.[37] Geology, in other words, co-produces power and production as it bundles with (equally co-producing) human patterns of power and production – hence the re-bundling of capitalist relations across the later 18th century North Atlantic as the energy regime shifted from charcoal and peat to coal. Specific geological formations, under definite historical circumstances, can become once object of human activity and subject of historical change. This allows us to see civilizations moving through, not around, the rest of nature.

Geology becomes geo-history through definite relations of power and production; these definite relations are geographical, which is to say they are not relations between humans alone. (Any geographical point of view unfolds from the premise that human activity is never ontologically prior to its geographical conditions and consequences.) At the risk of putting too fine a point on the matter, geology does not "directly determine" the organization of production,[38] precisely because the organization of production is not directly determined at all, but rather co-produced. Articulations

of production and reproduction are mediated through the oikeios, especially its dialectic of organic life and inorganic environments.

In the case of coal, we might note the revolution in English coal production began not in the eighteenth century but in the first half of the sixteenth century. If the Anthropocene begins not in 1800 but in the long sixteenth century, we begin to ask much different questions about the drivers of world-ecological crisis in the 21st century. England's coal revolution after 1530 directs our attention to the relations of primitive accumulation and agrarian class structure, to the formation of the modern world market, to new forms of commodity-centered landscape change, to new machineries of state power. This line of argument only appears to return to "social relations" because the legacy of Cartesian thought continues to tell us that state formation, class structure, commodification, and world markets are about relations between humans... which they are not. These too – states, classes, commodity production and exchange – are bundles of human and extra-human nature. They are processes and projects that reconfigure the relations of humanity-in-nature, within large and small geographies alike. From this standpoint, to stick with coal, we can say that geology co-produces energy regimes as historically-specific bundles of relations; geology in this view, is at once subject and object. The view that geo-material specificities determines social organization does not highlight geology's role in historical change; it obscures it. This is so for two reasons, tightly-linked. First, to say that geology determines historical change is to confuse geological facts for historical facts. Second, to conflate geological facts for historical facts is to engage in environmental determinism of a specific kind: the "arithmetic" of Nature plus Society.

But Nature plus Society does not add up. Perhaps most significantly, environmental determinisms, however partial or sophisticated they may be, leave intact the Cartesian order of things, in which society (humans without nature) and nature (environments without humans) interact rather than interpenetrate. The alternative, to see geology co-producing historical change through the oikeios, allows us to see energy regimes – even whole civilizations – moving through, not around, the rest of nature. The definite relations of early capitalism – co-produced in the web of life – transformed coal from a rock in the ground to a fossil fuel. Material flows

and their particularities do matter. But their historical significance is best understood through a relational rather than substantialist view of materiality, one in which the flows of resources, circuits of capital, and the struggles of classes and states form a dialectical whole.

The origins of that dialectical whole – of capitalism as world-ecology rather than capitalism as social system – have rarely been considered.

The Rise of the Capitalist World-Ecology, Part II: The Origins of Cheap Nature

The task is crucial because our understanding of the origins of capitalism as a system of Cheap Nature is fundamental to thinking through the reality – and politics – of the present crisis. Let me be clear that we are dealing with capitalism as world-ecology, as a double internality of humanity-in-nature – not as a closed system that interacts with the rest of nature. The point is important, as even friendly critics of the Capitalocene concept have characterized it in dualist terms.[39] With capitalism we dealing with an emergent pattern of symbolic innovation and material transformation in which the value of labour-power, the rise of world-money, and the endless transformation of the earth form an evolving historical whole.

To speak in these terms is to move our conception of the Capitalocene from the structures of history to the patterns of making history. The Anthropocene perspective begins with a collection of facts – greenhouse gas concentrations, population, etc. – and turns these into historical statements by means of technical, demographic, and metabolic fetishes. The New Scientist illuminated the point with its publication of the now-famous "great acceleration" graphs, running a headline announcing "the facts of overconsumption."[40]

The general thrust of the facts mobilized by earth-system scientists is reasonable. Yes, the biosphere is on the verge of what earth-system scientists called a "state shift." Yes, it will not be pleasant for humans and the rest of life. But the story – often a story of the coming apocalypse – cannot be inferred from these facts. For underpinning the Anthropocene narrative is, as Dan Hartley observes, a "Whig view of history as one endless story of human progress and enlightenment."[41] That Whig view of history is easily

turned inside out, rendered a linear story of the descent into catastrophe. This is true even as earth-system scientists have stressed the non-linearity of biospheric changes.[42] For they have left intact a philosophy of social history – note the dualism – that is essentially linear.

Its key consequence is an overestimation of capitalism's resilience in the face of biospheric instability, and the mounting difficulties that capital faces in securing Cheap Natures: food, energy, raw materials, even labour. Even many radicals share this view. Their overestimation of capitalism's resilience derives from a reluctance to see capitalism's "internal" contradictions of growth, expansion, and restructuring as fundamentally bundled within the web of life. The normal operation of capitalism is somehow exempt from the transformation of nature. Capitalism will continue until the "last tree is cut" – unless and until it is overthrown by political means. Foster captures the sensibility of much of the radical critique in his blunt rejection of James O'Connor: "there is no... [ecological] feedback mechanism – at least for capitalism as a whole."[43] This kind of thinking gives us only one view of capitalism's possible demise: revolution or the apocalypse. It is a millenarian view, to be sure. This disarms the left from pursuing strategies aimed at deepening capitalism's pivotal contradictions – not least the unfolding class struggles over socio-ecological reproduction. All of this is a problem because the non-linearity of biospheric patterns is not linked to the non-linearity of capitalism's internal contradictions. Here I say "internal contradictions" in the sense our double internality, through which capitalism internalizes the contradiction of nature as a whole, while the web of life internalizes capitalism's contradictions. These latter include externalizations, but are much more than just externalizations.

How do we understand the facts of climate change and all the rest? Beyond the obvious – the biosphere is in a very bad state of affairs – this is not clear. Clarity must come from a philosophy of history and a way of seeing historical change that is, as Haraway would say, sympoetic: a way of seeing life and land on Earth as fundamentally entwined. But it must go further. We cannot solve the problems without philosophy. Philosophy cannot solve the problems without analytical methods and a corresponding praxis that allows us to engage the contradictions of the present moment without regard to the violent abstractions of Nature / Society. This is the point of

world-ecology, whose ambition is not to forge a correct line but to advance the most fruitful conversation for our times: not autopoeisis but sympoesis! So let us begin with the obvious, because it is too often forgotten in the midst of chaotic times: Facts in science do not present themselves in a pre-existent shape. Rather it is the experimental or observational protocol that constructs facts out of an undifferentiated nature. And if we do not like what we see, we can rearrange the description of nature to have a more pleasing aspect. So facts make a theory, but it takes a theory to make facts.[44]

There is no need for an abstract theoreticism – the inverse of the abstracted empiricism of Anthropocene analysts. Rather, we are privileging the patterns of history, what Lukács calls "the developing tendencies of history." These "constitute a higher reality than the empirical 'facts'."[45] Indeed, where the Anthropocene perspectives goes wrong – so very, very wrong – is in its reckoning of the present conjuncture as unique. Of course it is unique – but not simply because the data on biospheric change says so. It is unique because we are living in the era of capitalism – an era defined "by the unbroken production and reproduction of the same relation whose elements are converted into empirical facts and incorporated in reified form in the web of rational calculation."[46] Thus does the specifically capitalist rationality at once drive forward the present civilizational crisis and make its facts legible, in the process somehow normalizing the catastrophic reality intimated by this data.

Capitalism began in the long sixteenth century. The signs of this transition are everywhere hidden in plain sight: above all in the landscapes of the early modern Atlantic. Nearly everyone seems to have missed the geography of global environmental transformation as the decisive clue to all the other moments of transition. The environmentalists looked for the modern machine and found it: the steam engine and all the rest. The Marxists looked for the "right" class structure – wage-workers, bourgeois property relations, and all that – and they too found what they were looking for. The economists looked for something that looked like modern markets and institutional mechanisms favoring a "modern economy." All these were very important. And all overlooked something very important: a new pattern of environment-making.

Humans had transformed environments from the very beginning. From the rise of civilization, humans had been making large-scale environmental change. A lot – maybe most – of that environment-making could be characterized negative. Nor did humans require civilization to transform environments on an epochal scale: witness the ecocide of North America's Pleistocene megafauna. Medieval Europe transformed Continental ecology, deforesting vast regions, in the five centuries after 800 C.E. – and the confluence of regional ecology, demographic well-being, and feudal class structure was central to the demise of feudalism as the climate turned wetter and colder after 1250.

These environmental histories played out over hundreds – sometimes thousands – of years. After 1450, human-initiated transformations would be measured in decades. In the centuries between 1450 and 1750, we find a new era of human relations with the rest of nature: the Age of Capital. Its epicenters were those seats of imperial power and centers of financial might. Its tentacles wrapped around ecosystems – humans included! – from the Baltic to Brazil, from Scandinavia to Southeast Asia. The Capitalocene accelerated environmental transformation beyond anything known before – sometimes, as forest clearance, moving at speeds an order of magnitude from the older patterns. There were, to be sure, certain technological shifts that facilitated this landscape revolution – some of which we detail below. And there were certain shifts in technics that were pivotal to the new ecological regime, above all new ways of mapping and calculating the world. Perhaps most fundamental, however, was a shift – scarcely detectable to contemporaries – in what was valued.

All civilizations have laws of value – broadly patterned priorities for what is valuable and what is not. The decisive shift between the Black Death (1347–53) and the conquest of the Americas was precisely this: value shifted from land productivity under conditions of seigneurial power to labour productivity under the hegemony of the modern world market: "the very basis and living atmosphere of the capitalist mode of production."[47] What difference could this make to our understanding of biospheric crisis in the 21st century? Quite a big one. For the shift from land to labour productivity as the decisive metric of wealth implied an entirely novel approach to relation between human activity and the web of life. For the first

time, the forces of nature were deployed to advance the productivity of human work – but only some human work. Human work within a porous sphere of commodity production and exchange – sometimes (misleadingly) called "the economy" – was to be valued. All other activity was de-valued, and appropriated in service to advancing labour productivity in this, ridiculously narrow, zone of commodification. Thus: the birth of Nature, which implied and necessitated the birth of Society, both dripping with blood and dirt, the necessary ontological counterpoint to the separation of the producers from the means of production.

The condition of the rise of capitalism, in other words, was the creation of Cheap Nature. But Cheap is not free. Cheap is here understood as work/energy and biophysical utility produced with minimal labour-power, and directly implicated in commodity production and exchange.

That labour-power was partly the segment of the population who worked for wages, rapidly growing after 1500. But proletarianization assumes manifold forms. Viewed from the standpoint of reproduction – that is, to the degree that social reproduction depends upon the cash nexus – the proletarian relation reached much farther, even in this long sixteenth century. It included that wider layer of the population within capitalism that depended on capital flows – directly or indirectly – for daily life and intergenerational reproduction. This layer included the fast-growing urban population of western Europe and Latin America – expanding much faster in the period 1550–1700 than in 1700–1850. It included the slave population of the Americas, whose modest demographic weight in 1700 – around 300,000 souls – belied its centrality to capital accumulation through the sugar frontier. And towards the end of the 17th century, it reached deep into the countrysides of the western Europe through proto-industrialization, centering on textiles and taking advantage of women's work and the seasonal agricultural cycle, in turn propelling (semi) proletarian population growth.

The first accomplishment of this new law of value – which was in fact a law of Cheap Nature – was therefore to create Cheap Labour. The number of slaves disembarked each decade in the Americas – mostly to grow sugar, modernity's original cash crop – increased a staggering 1,065 percent be-

tween 1560 and 1710.[48] Slave prices still tended to rise, a tribute to capitalism's devastation of human nature, but from a base much lower than the wage bill for European proletarians. Meanwhile, most Europeans were not doing so great, either:

In Languedoc, ... a 'grain wage' lost half its value between 1480 [and] 1600. In Lyon, ... the buying power of a 'wheat wage' dropped to half its original value between 1500 and 1597. A Modena 'bread wage' was devalued 50 percent between 1530 and 1590, while a Florence wage slumped 60 percent between 1520 and 1600. In Vienna, wage 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 wage decline 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 in 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.[49]

This Cheap Labour was hardly created out of thin air. It was of course an expression of the class struggle. But a class struggle over what? Over the terms of what would be – and what would not be – valued. And over the terms of what counted – and what did not count – as nature. (Or Nature.) Labour-power mattered little without a productivity revolution. Of course, we are told by the Anthropocene advocates – and not a few Marxists – that early capitalism was not really modern, and not really capitalist. Why? Because early capitalism was technologically inert, and unable to sustain the long-run advance of labour productivity. This was, we are told, the era of merchant capitalism – a pre-industrial era.

Was early capitalism really pre-industrial? The proposition is hard to sustain. Labour productivity surged in one key commodity sector after another. In printing, labour productivity advanced 200-fold in the century 1450, with 20 million printed books in circulation by 1500. In the sugar colonies, new mill technology successive boosted productivity across the early mod-

ern centuries; meanwhile sugar refineries in European cities such as Amsterdam were the only industrial establishments comparable to nineteenth century factories. In iron-making, large blast furnaces allowed output per worker to increase five-fold between 1450 and 1650, clearing and transforming forests at every step. In shipping, led by the Dutch Republic, productivity increased fourfold. Meanwhile, a new shipbuilding regime, led by the Dutch, combined Smithian specialization (simplified tasks), the standardization of parts, organizational innovation (integrated supply systems), and technical change (sawmills to displace costly skilled labour) to triple labour productivity. Everywhere, but especially in northwestern Europe, the use of iron tools in agriculture expanded. In the Central European copper-silver metals complex, the saigerprozess revolutionized mining and metallurgy after 1450; the new rod-engines, allowing for effective drainage, allowed for a second great wave of European mining after 1540. In the New World, the mercury-amalgamation process boosted silver production rapidly after the 1560s, especially in Peru. In textiles, the quick diffusion of the "Saxony Wheel" in textile manufacturing, trebling labour productivity, accompanied by the diffusion of fulling and napping mills, advancing productivity still further in fifteenth and sixteenth centuries. Across Europe, but especially in the west, the number of water mills doubled in the three centuries after 1450, and tripling of aggregate horsepower ...

What do these transformations suggest? Any adequate explanation must recognize that there was a transition from control of land as a direct relation of surplus appropriation to control of land as a condition for rising labour productivity within commodity production. This transition was of tremendously uneven and messy. (Aren't they always?) Hence, where peasant cultivation persisted across early modern Europe, there was no dramatic rupture with the medieval rhythm of landscape transformation – except where, as in seventeenth century Poland, peasants were directly pushed towards sylvan zones by cash-crop cultivation. Wherever primary commodity production penetrated, however, the tempo of landscape transformation accelerated. Why should this be? Although the pace of technical change did indeed quicken – and the diffusion of techniques even more so – in the "first" sixteenth century (1450–1557), I do not think this was enough to compel such an epochal shift in landscape transformation. In my view, this shift has a lot to do with the inversion of the labour-land relation

and the ascendance of labour productivity as metric of wealth, unfolding on the basis of appropriating Cheap Natures.

For Cheap Labour and productive labour required one thing if profitability was to be advanced, and the accumulation of capital was to quicken: Cheap energy, food, and raw materials. Cheap thermal energy to smelt the metals, process the sugarcane, and make glass, beer, bricks, and everything else demanded by the world market. Cheap food to keep the price of labour-power from rising, or at least rising too fast. And Cheap raw materials – timber for shipbuilding, potash for dyeing textiles, iron for everything – to maintain a virtuous circle of expanding commodity production. In sum, the whole of nature had to be put to work – in a radically alienating and dynamic way – for capitalism to survive.

This entrained a landscape revolution unprecedented in human history. Its first condition was the conquest of the Atlantic. Between 1535 and 1680, the capitalist world-ecology more than doubled in size, conquering some four million square kilometers between 1535 and 1680.[50] On this basis, Dussel calls the appropriation of the New World "the fundamental structure of the first modernity." This conquest incorporated not only vast expanses of potentially Cheap Nature, but also the labour-power to activate it. By 1500, Spain alone had "colonized more than 2 million square kilometers (an area greater than the whole of Europe of the center) and more than 25 million (a low figure) indigenous peoples, many of whom are integrated into a system of work that produces value (in Marx's strict sense) for the Europe of the center (in the encomienda, mita, haciendas, etc.).[51]

The impressive figures were complemented by capital's new thirst for cheap labour, food, energy, and raw materials within Europe.[52] In the Low Countries, an agricultural revolution allowed three-quarters of Holland's labour force to work outside of agriculture. In Central Europe, a mining and metallurgical revolution thoroughly transformed the political ecology of forests across the region. On Madeira, the first signs of the modern sugar-slave nexus emerged, quickly rising and falling as the island's modest forest were cleared between the 1450s and the 1520s. Madeira's crisis was followed quickly by the sugar's advance to São Tomé (1540s-1590s) and the first modern, large-scale plantation system, which allowed one-third of

the island to be deforested by 1600 and encouraged large-scale slave revolts. Northeastern Brazil had, in any event, already displaced São Tomé at the commanding heights of the world sugar economy by 1570, from which issued the first great wave of clearing Brazil's Atlantic rainforest, unfolding at an unprecedented pace. Potosí emerged as world's leading silver producer after 1545, and then again with its epochal restructuring after 1571, on the heels of the exhaustion of Saxon and Bohemian silver mining, itself conditioned by deforestation, declining ore quality, and labour unrest. The exhaustion of central European mining and metallurgy also afflicted iron and copper production by 1550, which favored English iron output (to 1620), and above all, the rise of Swedish iron and copper. American silver depended on European timber, and so Potosi's efflorescence was accompanied by the shift in the forest products frontier from Poland-Lithuania towards southern Norway in the 1570s, followed by renewed movements into the hinterlands of Danzig (again) by the 1620s, and thence towards Königsberg, Riga and Viborg in successive turns. Meanwhile, the rise of the Vistula breadbasket in the 1550s, exporting cheap grain to the maritime Low Countries, was followed by the agro-ecological exhaustion of Polish market-oriented agriculture in the 1630s.

Shortfalls from the Polish agro-ecological downturn were quickly made good by the English agricultural revolution, which made England the breadbasket of Europe by 1700, albeit on agro-ecological basis that showed signs of exhaustion after the 1760s as productivity stagnated. English forests were rapidly appropriated during the 17th century expansion, such that pig iron output in 1620 would not be exceeded until 1740 even with rising demand, met by imports. These imports were sources from across the North Sea, where iron devoured the forests with such speed that even Sweden's sylvan abundance yielded before the onslaught of the iron commodity frontier. The stagnation of English iron output after 1620 also stimulated an iron commodity frontier movement into Ireland, which, along with the manufacture of staves for export, quickly reduced the Emerald Isle's forest cover from 12.5 percent to just two percent, such that little iron would be produced by the mid-17th century.

The Dutch energy regime, centered on the extraction of domestic peat as cheap fuel, reached its highpoint in the 17th century, but the easily-tapped

zones were quickly exhausted, and peat output declined sharply after 1750. In southeast Asia, the Dutch imposed a new colonial regime between the 1650s and 1670s, securing a monopoly over the clove trade during the 1650s through the large-scale removal of "unauthorized" clove trees, the large-scale relocation of indigenous populations from the interior into new colonial administrative units suitable for labour drafts, and the establishment of new shipyards outside the Batavian core. From the early 17th century, wetlands across the Atlantic world were reclaimed, often by Dutch engineers, from England to Pernambuco and Suriname, Rome to Göteborg. The great burst of Iberian and Italian expansion during the "first" sixteenth century (c. 1450–1557) produced a relative, but widespread, exhaustion of Mediterranean forests – beginning earlier for the Italians and Portuguese, somewhat later for Spain – and especially their capacity to supply quality shipbuilding timber, by the early the 17th century. This resulted in the relocation of Spanish shipbuilding to Cuba, where one-third of the fleet was built by 1700, and the more modest yet significant expansion of Portuguese shipbuilding in Salvador da Bahia and Goa. The Iberian relocation was followed in the 18th century by the emergence of major shipbuilding centers and significant frontiers for timber and naval stores in North America. The relentless geographical expansion of forest product and shipbuilding frontiers was bound up, in no small measure, with the increasingly vast fleets of herring, cod, and whaling vessels that searched and devoured the North Atlantic's sources of maritime protein.

The search for fish was complemented by the search for furs, which had only a modest economic weight in world accumulation, but whose steady advance (and serialized exhaustion of fur-bearing animals) across North America (Siberia too), stretching by the 18th century into the expansive Great Lakes region, encouraged significant infrastructure of colonial power. The steady expansion of sugar demand and the exhaustion of Bahia's sugar complex by the mid-17th century favored successive sugar revolutions of the West Indies, from Barbados in the 1640s to Jamaica and St. Domingue in the 18th century, leaving a trail of African graves and denuded landscapes in its wake. The resurgence of Mexican silver production in the 18th century led to the deforestation of already-thin Mexican forests. English coal production rose from 50,000 tons (1530), to 210,000 tons (1560) to 1.5 million tons by 1630. By this point, most of England's important coal-

fields were being exploited. Production continued to surge, doubling to 2.9 million tons of coal by the 1680s. And, perhaps most significantly, the epoch-making "Columbian exchange," as Old World diseases, animals, and crops flowed into the Americas, and New World crops, such as potatoes and maize, flowed into the Old World.

The Making of the Capitalist World-Ecology

These transformations tell us something major, something epochal, was in play. Let me advance two propositions on what this early modern landscape revolution tells us. First, these transformations represented an early modern revolution in labour productivity within commodity production and exchange that was dialectically bound to a revolution in strategies of global appropriation.[53] Crucially, this labour productivity revolution in the zone of commodification was rendered possible by a revolution in the technics of global appropriation – including appropriation within Europe. This was manifested not only in the immediate practices and structures of European imperialism. More fundamentally, the "new" imperialism of early modernity was impossible without a new way of seeing and ordering reality. One could conquer the globe only if one could see it. Here the early forms of external nature, abstract space, and abstract time enabled capitalists and empires to construct global webs of exploitation and appropriation, calculation and credit, property and profit, on an unprecedented scale. The early modern labour productivity revolution turned, in short, on the possibility of opening and appropriating vast frontiers of Cheap Nature, understood simultaneously in land/labour and symbolic registers.

The fact that early capitalism relied on global expansion as the principal means of advancing labour productivity and facilitating world accumulation reveals the remarkable precocity of early capitalism, not its premodern character. This precocity allowed early capitalism to defy the premodern pattern of boom and bust: there would be no systemwide reversal of commodification after 1450, not even during the "crisis" of the 17th century. Why? In sum, because early capitalism's technics – its crystallization of tools and power, knowledge and production – were specifically organized to treat the appropriation of global space as the basis for the accumulation of wealth in its specifically modern form: capital, the substance of which is abstract social labour.

This takes us to a second proposition, which turns on our interpretive frame. The three revolutions we have identified – of landscape transformation, of labour productivity, of the technics of global appropriation – suggest a revision of thinking the law of value in ways both orthodox and revolutionary. Crudely put, I think Marxists have understated the significance of value relations in the modern world-system. First, a vast but weak law of value crystallized during the long 16th century. I would begin with a certain mis-recognition of the law of value. In this, value-relations have been defined as a phenomenon reducible to the "economic" form of abstract social labour. But such an interpretation significantly understates the epoch-making influence of value relations. The law of value – understood as a gravitational field exerting durable influence over the long-run and large-scale patterns of the capitalist world-ecology – is not an economic phenomenon alone, but a systemic process with a pivotal and decisive economic moment (abstract social labour).

Second, the moment of value accumulation (as abstract labour) is historically materialized through the development of scientific and symbolic regimes necessary to identify, quantify, survey, and otherwise enable not only the advance of commodity production but also the ever-more expansive appropriation of cheap natures.

"Cheap nature" in the modern sense encompasses the diversity of human and extra-human activity necessary to capitalist development but not directly valorized ("paid") through the money economy. The decisive historical expression of Cheap Nature in the modern era is the Four Cheaps of labour-power, food, energy, and raw materials. These 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 cheap 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 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. We cannot make sense of value through dualist frame labour and nature. Value relations encompass a contradictory unity of exploitation and appropriation heedless of the Na-

ture/Society divide, only an analysis that proceeds from essential unity of humanity-in-nature can move us forward. The present argument, then, is a brief for such a post-Cartesian – I would call it world-ecological – reading of value. The goal is to focus our attention on the relations of the oikeios that form and re-form capitalism's successive contradictory unities of the exploitation of labour-power (paid work) and the appropriation of a global zone of reproduction (unpaid work) from the family to the biosphere.

This line of thinking and investigation led me to an unexpected argument. I cannot help but see a new law of value in formation in these centuries, expressed by two epoch-making movements.[54] One was the proliferation of knowledges and symbolic regimes that constructed nature as external, space as flat and geometrical, and time as linear (the field of abstract social nature). The other was a new configuration of exploitation (within commodification) and appropriation (outside commodification but in servitude to it). In this latter (the production and accumulation of value), we have the paradox; in the former (abstract social nature) we have clues to how this paradox has been resolved historically. On the one hand, capitalism is a civilization that turns on the zone of commodification and the exploitation of labour-power within it.

On the other hand, strategies of commodification and exploitation can work only to the extent that uncommodified natures are somehow put to work, for free or very low cost. In sum, capitalism must commodify life/work but depends upon the "free ride" of uncommodified life/work to do so. Hence, the centrality of the frontier. Historically, this paradox has been resolved partly through brute force, gunboat diplomacy, shock doctrines, and all the rest. But force is an expensive proposition. However necessary, brute force has been insufficient on its own to unlock and to mobilize the wealth of nature for the long-run accumulation of capital. Beginning with the Iberians clear through to the long 20th century, one of the first things great empires and states do is establish new ways of mapping, categorizing, and surveying the world. These are strategic expressions of the production of abstract social nature and they have been crucial because they allow for the frontier-led appropriations of cheap nature that make possible an otherwise self-consuming strategy: commodification. Coercively-enforced, to be sure, the world-praxis of appropriating cheap natures (humans included) so that some other natures (only some humans included) could be exploited has provided the decisive condition for advancing labour productivity within the commodity system (the field of abstract social labour). I do not think these two movements of abstract social labour and abstract social nature exhaust the possibilities; but I cannot escape the conclusion that they provide at once a minimal and indispensable basis for unpacking the history of capitalism as a way of organizing nature.

Capitalism as Frontier

Capitalism is impossible to understand as a closed system; the endless accumulation of capital is the endless internalization of nature. Capitalism is defined by frontier movement. The conceit of the early modern cartographic revolutions was to conceive of the Earth as abstract space rather than as concrete geographies. The latter, abolished in theory, would continually reassert itself, as geographical particularities (climates, soils, topographies, diseases) entered into dynamic tension with bourgeois fantasies of abstract space. The great advantage of mapping the world as a grid, and nature as an external object, was that one could appropriate the work of nature in a fashion profoundly efficient for capital accumulation. The very dynamism of capitalist production is unthinkable in the absence of frontier appropriations that allowed more and more materials to flow through a given unit of abstract labour-time: value's self-expanding character depends on an exponential rise in the material volume of production, but without a corresponding rise in the abstract labour implied in such production. This incessant reduction of labour-time can occur only to the extent that the Four Cheaps can be secured through appropriation. This requires the continual enlargement of the geographical arenas for such appropriations. Thus are capital and capitalist power joined in the co-production of cheap natures.

For this reason, frontiers are much more central to the expanded reproduction of capital and capitalist power than commonly recognized. When Harvey opines that capitalism, confronting the end of frontiers, might "actively manufacture" such frontiers, he reflects the common sense of the contemporary radical critique this is a profound mis-reading.[55] The processes of privatization and finance-led dispossession, insofar as they operate within the domain of capitalized relations, cannot revive accumulation;

indeed, these processes worked in the neoliberal era because they were bound to the release of minimally commodified labour-power, food, energy, and raw materials into the circuits of capital.

Depeasantization, the reorientation of peasant agriculture towards the world market, the extraction of abundant energy and mineral wealth – these great movements of modern world history have been frontier movements, some more obvious than others. These movements of appropriation have enlarged the reserve army of labour; expanded food supplies to the world proletariat; directed abundant energy flows to, and boosted labour productivity within, commodity production; and channeled gigantic volumes of raw materials into industrial production, driving down the value composition of both fixed and circulating capital, even as the technical composition of capital rose mightily. Put simply, the Great Frontier that opened the capitalist epoch did so by making Nature's free gifts – and human natures' too – more or less cheaply available to those with capital and power.

The Great Frontier was inside as well as outside. Frontier appropriations occur not only on capitalism's outer edges, but also on the "vertical" axis of socio-ecological reproduction within the heartlands of commodification. Not just colonies, then, but also women's unpaid work becomes subject to (partial) commodification. Although the horizontal and vertical moments of these frontier appropriations unfolded in distinct geographical zones with specific socio-ecological inflections, they were unified through their relation to the accumulation process. Commodity frontiers worked in both heartlands and hinterlands by appropriating and transferring unpaid work from zones of appropriation, centering on relations of reproduction, and towards zones of commodification. In the heartlands, the appropriation of women's unpaid work was central to the cheap reproduction of labour-power; in the hinterlands, the appropriation of extra-human natures (forests, soils, mineral veins) was often primary. The secret of the law of value is in this epochal synthesis: of the exploitation of labour-power and the appropriation of the unpaid work/energy. The regime of abstract social labour – premised on socially necessary labour-time – emerged historically, and restructured cumulatively, through the formation of regimes of abstract social nature which made legible new zones of appropriation.

The argument here is that abstract social nature – a systemic family of processes aimed at rationalizing, simplifying, standardizing, and otherwise mapping the world as external object – is directly constitutive of Cheap Nature. In this, abstract social nature is immanent to the law of value; the praxis of external Nature was central to the generalization of commodity production and exchange. From the sixteenth century, the cascading and converging processes of commodification, capital accumulation, and symbolic innovation constituted a virtuous circle of modern world development I do not propose a revision of Marx's law of value in a strict sense: the substance of capital is abstract social labour. I do propose that we take value relations as a methodological premise focused on the trinity of capital/power/nature and the dialectic of capitalization and appropriation.

From this perspective, value relations are grounded historically in successive configurations of abstract labour and abstract nature. Those configurations are historical natures. Each historical nature, co-produced by the law of value, enables the renewed exploitation of labour-power and the renewed appropriation of life-activity as unpaid work. The appropriation of unpaid work must outstrip the exploitation of labour-power, else the Four Cheaps cannot return, and neither can capitalist prosperity. Abstract social nature names those processes that extend, through new forms of symbolic praxis and knowledge formation, the frontiers of accumulation.

Value is therefore not an economic form with systemic consequences. It is, rather, a systemic relation with a pivotal "economic" expression (abstract social labour). One cannot think about the accumulation of capital without abstract social labour and the struggle to reduce socially necessary labour-time. By the same measure, one cannot think about the accumulation of capital without the symbolic praxis of abstract social nature, allowing for the appropriation of unpaid work on a scale that dwarfs the exploitation of labour-power. Unifying these two moments calls for a mode of inquiry that unifies the circuit of capital and the appropriation of life. This is the work pursued by the world-ecology perspective.

The rise of capitalism launched a new way of organizing nature, mobilizing for the first time a metric of wealth premised on labour productivity rather than land productivity. This was the originary moment of today's fast-

fading Cheap Nature. This strange law of value, taking shape out of the vast frontier appropriations and productive innovations of the sixteenth century, allowed for capitalism's unusual dynamism: appropriating the whole of nature within its grasp to advance the rate of exploitation of labour-power. From the 1450s, there commenced a succession of movements of productivity and plunder. These joined the vast appropriation of nature's free gifts with extraordinary technical innovations in production and transport. At a time when Green Thought still confuses the Industrial Revolution with the origins of ecological crisis, this deeper historicization permits an analysis of the relations that have proven so dynamic for capitalism – and so destructive of planetary life.

This transition from land to labour productivity during the early modern era explains much of the revolutionary pace of early modern landscape transformation. The soils and forests of northeastern Brazil, Scandinavia, and Poland were appropriated (and exhausted) in the long seventeenth century; human nature too was freely appropriated (and exhausted), as New World sugar frontiers and African slaving frontiers moved in tandem. Far from being abolished after the eighteenth century, the great waves of accumulation in the long nineteenth and twentieth centuries were equally dependent on appropriation, this time of vast subterranean coal and oil frontiers.

These frontiers have always been pivotal to the new "tools of empire" and metropolitan productive capacities that destabilized (and appropriated the labour of) peasant formations from South Asia to southern Italy. In light of this history, we may well ask: Is capitalism today capable of appropriating nature's free gifts on a scale sufficient to launch a new phase of accumulation, or are we witnessing the exhaustion of a Cheap Nature strategy that has underwritten capital accumulation since the 16th century?

The question confounds the usual Green critique. Two words crystallize its essence: "environmental degradation." Scholars have used the term a whopping 183,000 times since 1990. The key issue has been, What does humanity – or for radicals, capitalism – do to the environment? The most celebrated Green concepts of our times – the Anthropocene and the ecological footprint – embody this sensibility. Their popularity is often justified – even by radicals – for deepening popular awareness of capitalism's place in the web of life. For Samir Amin, the ecological footprint concept represents the development of a "major strand in radical social thinking about construction of the future."[56] For McKenzie Wark, the Anthropocene may be understood as a "series of metabolic rifts," through which the "soil deplete, the climate alters, the gyre widens."[57] The difficulty emerges when one considers that the Green critique has dozens of ways to talk about what capitalism does to nature, but hardly any way to talk about how nature works for capitalism. But I wish to go further. Whatever the virtues of the Anthropocene and ecological footprint concepts – and whatever their earlier contributions – we have today reached a distinct historical moment. The degradation-focused concepts have evolved: from heuristic, porous, and flexible words to elevator concepts, ideas embedded in the popular – and scholarly – common sense.[58]

These concepts have become tools of the bourgeoisie in its struggles to sustain two irreconcilable objectives: the sustainability of the biosphere and the sustainability of the rate of profit.

A radical and emancipatory alternative does not deny the degradation of nature. Far from it! The counter-argument for the Capitalocene – an ugly word for the ugly timespace of the capitalist world-ecology – understands the degradation of nature as a specific form of environment-making. It will be useful to pause for a moment to reflect on what is hidden in plain sight: Capitalism works because it has put the whole of nature to work, as cheaply as possible. The whole history of industrial, agricultural, scientific, and technological revolutions may be read in this light. I do not mean to suggest that this the whole story – only that the story cannot adequately be told without understanding that capitalism's specific degradation of nature occurs through its specific mobilization of the "forces of nature" as "forces of production." Now, one clarification is immediately necessary, because we are still in the thought-habit of see Nature (environments without humans) whenever one says nature (the web of life). The extraordinary longue duree remaking of global nature as a force of production has been a strategy that regularly assigned the majority of humanity – at least the majority of humans within capitalism's reach – to the status of Nature. There was always contradiction and ambiguity in such assignments, but it

is clear that successive racialized and gendered "social" orders over the past five centuries have relied heavily upon the Nature/Society binary.[59] These have about many things – but not least, they have facilitated the accumulation of capital through manifold gendered and racialized surpluses of unpaid work.

William Kapp, one of the founders of ecological economics, famously characterized the modern economy as a system of "unpaid costs."[60] Today, we know this all too well – heavy metals in children's bloodstreams and Arctic ice, massive garbage patches in the oceans, agro-toxic overload in our soil and water, never mind that small matter of climate change. But capitalism is more than a system of unpaid costs. Perhaps more fundamentally, it is a system of unpaid work. For the genius of capitalism – from the global conquests that commenced in 1492 – has been to treat the work of nature as a "free gift." These conquests have often characterized as act of "plunder" – and there has certainly been plenty in the modern world. But it is hard to sustain a civilization on the basis of plunder. By itself, plunder is too episodic; too violent; and over the long-run, too costly: for a world-ecology premised on labour productivity. The Spaniards discovered this quickly in the sixteenth century – the mines of Potosi, the great silver mountain, would only yield their riches through new systems of colonial control, technology, and work. They also discovered that the great divide of "Nature" and "Society" could be very useful indeed for rendering not only land, but labour, cheap: the Spaniards' referred to Peru's indigenous peoples as naturales. Not all humans were part of Humanity, the better that they could deliver Cheap Nature. From the beginning, Europe's great empires set out deploying science in its widest sense – mapping the world, collecting and organizing biogeographical knowledge, establishing new administrative technologies – to make the whole of nature work on the cheap.

That long history has been reproduced over the past four decades: the earth is now ringed by over 2,000 satellites enabling the unprecedented surveillance and mapping of planetary space; the human genome was mapped; biopiracy and biotechnology has proceeded. But today is different, for two reasons that are closely related. First, the potential sources of cheap work/energy are fewer than ever before. The non-revolution in agricultural biotechnology shows this well. For all the claims that biotech will

somehow feed the world, there has been revolution in agricultural productivity – indeed, agricultural productivity growth has slowed steadily since the mid-1980s. So too the non-revolution in energy. After the opening of modest oil frontiers in the 1970s – in Alaska, the Gulf of Mexico, West Africa, the North Sea – no major sources of cheap energy have appeared. Indeed, the world energy history of the past decade has been marked by the opening of frontiers that are the very opposite of those which have sustained capitalism. These are not low-cost frontiers of production, but very high-cost frontiers, especially in North America's "unconventional" oil sector. Nor does cheap labour seem to be here to stay. The rise of China as the workshop of the world in the 1990s and 2000s occurred, in part, because of massive cheap labour flowing into the cities from the countryside. But this – like all Cheap Nature frontiers – was a one-shot deal. Even in China, wages are rising in the cities – rapidly – and the countryside no longer offers an easy reservoir of cheap labour-power.

From the beginning, modernity's Cheap Nature strategy has been premised on a trinity of specific projects: 1. through the deployment of juridical, cartographic, and quantitative procedures to map, secure, and code Nature with a capital 'N'; 2. the imposition of control projects, such as monoculture, to "simplify" nature within the sphere of production; 3. the extraction of as much work/energy as fast as possible, for the lowest possible capital expenditure.

Taken together, these interwoven projects – creating "economies" of rationalization, control, and speed – have combined to do something more than facilitate high-profit primary production complexes. They have worked to reduce the costs of production for capital as a whole. The lynchpin of the whole strategy was capital's capacity to expand its appropriation of unpaid work/energy faster than the capitalization of global nature.

This brings us to the second contradiction of our times. This is negative-value, which names those emergent forms of nature today that are directly hostile to capital accumulation, and which cannot be resolved through the Cheap Nature strategy. Its chief expression is climate change, but it also includes spiraling antibiotic resistance and the rise of "superweeds" in the heartlands of industrial agriculture.[61]

The rise of negative-value – whose accumulation has been latent for much of capitalist history – therefore suggests a significant and rapid erosion of opportunities for appropriating Cheap Natures. As such, these new limits are qualitatively different from the nutrient- and resource-depletion of earlier, developmental crises in capitalist history. Depletion remains, overlaps, and reinforces negative-value – and vice-versa! – a signal that we are facing an epochal crisis that cannot be resolved within the Cheap Nature model.

Together, world agriculture and forestry (including land clearance) contributes between one-quarter and one-third of greenhouse gas emissions – rivaling or exceeding industry or energy. On the one hand, climate change is reinforcing tendencies – such as the depletion of aquifers – already in motion before the 1990s. On the other hand, climate change is creating new problems: suppressing the yield of the "big four" cereals (rice, wheat, maize, and soy), changing precipitation patterns, and suppressing labour productivity during the increasingly hot summer months when most planting and harvesting occurs. In some cases, rising CO2 concentrations may favor certain crops – wheat or rice for instance. But such productivity gains are strictly hypothetical: they will be offset by rising temperatures over the middle-run of 20 years, and over the short-run, the advance of invasive weeds whose geographical range and fertility will nullify potential gains from carbon fertilization. Lobell and his colleagues find that "global maize and wheat production declined by 3.8% and 5.5%, respectively, compared to a counterfactual without climate trends."[62] By 2035, agriculture will bear one-third, and by 2060 two-thirds, of the global economic costs issuing from climate change.

Here is the accumulation of negative-value at work: the production of direct barriers to the accumulation of capital as a whole, mediated through the climate-mediated erosion of agricultural productivity.

The genius of capitalism, through its manifold Cheap Nature strategies, was to outrun the rising costs of production, by locating, creating, mapping, and quantifying natures external to capitalism but within reach of its power. Today, there is nowhere to run. Much of what we have seen global capitalism over the past decade has been a shifting of costs – from one

capitalist to another, and especially from capital to the vast majority. And there has been another vector of cost-shifting, which has been accelerating in recent years: from the present to the future. This is true, as widely recognized, for future generations. But it is also true for the accumulation of capital, which has always represented a series of bets on future incomes. The real basis of that future income has always been Cheap Nature. Hence: financialization and the polarization of income and wealth – the 1 percent and the 99 percent – are the direct results of the exhaustion of capitalism's Cheap Nature strategy. The end of Cheap Nature may not bring liberation, but it cannot sustain capitalism. Popular strategies for liberation will succeed or fail on our capacity to forge a different ontology of nature, humanity, and justice – one that asks not merely how to redistribute wealth, but how to remake our place in nature in a way that promises emancipation for all life.

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* see definition in Jason W. Moore, From Object to Oikeios, Environment-Making in the Capitalist World-Ecology, 2013 http://www.jasonwmoore.com/uploads/Moore__From_Object_to_Oikeios__for_website__May_2013.pdf

Oikeios is a way naming the creative, historical, and dialectical relation between, and also always within, human and extra-human natures. The oikeios is a shorthand: for "oikeios topos", or "favorable place", a term coined by the Greek philosopher-botanist Theophrastus. For Theophrastus, the "oikeios topos" indicated "the relationship between a plant species and the environment". Properly speaking, oikeios is an adjective; but in the long journey towards a vocabulary that transcends the Two Cultures (the physical and human sciences), I ask the reader to excuse a few liberties with the language. Neologisms come a dime a dozen in green thought, and we needn't look far for concepts aiming to fuse or combine the relations of human and extra-human nature. And yet, after decades of vigorous green theorizing and analysis, we still lack an analytical approach that puts the oikeios at the center. Such a perspective would situate the creative and generative relation of species and environment as the ontological pivot of historical change. This reorientation opens up the question of nature – as matrix rather than resource or enabling condition – for historical analysis; it allows the reconstruction of humanity's great movements, from warfare to literature to scientific-technological revolutions, as if nature matters to the whole of the historical process, not merely its context, or its unsavory consequences.

This is the intended contribution of the oikeios. It spotlights the elusive species-environmental relation. It (is) a multi-layered dialectic, comprising flora and fauna, but also our planet's manifold geological and biospheric configurations, cycles, and movements. Through the oikeios form and reform the relations and conditions that create and destroy humanity's mosaic of cooperation and conflict: what is typically called "social" organization. Nature-as-oikeios is, then, not offered as an additional factor, to be placed alongside culture or society or economy. Nature, instead, becomes the matrix within which human activity unfolds, and the field upon which historical agency operates.

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25 Mumford, Technics & Civilization, 4, emphasis added.

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27 Paul Kingsnorth, (2011), "The Quants and the Poets," Dark-Mountain.net, http://dark-mountain.net/blog/the-quants-and-the-poets.

28 Andreas Malm (2013), "The Origins of Fossil Capital," Historical Materialism, 21(1), 15–68.

29 John Bellamy Foster (1994). The Vulnerable Planet. New York: Monthly Review Press, 40.

30 Joan Martinez-Alier (2002). The environmentalism of the poor. Cheltenham, UK: Edward Elgar.

31 Contrast, for instance, David Harvey's impassioned called for a relational ontology of humanity-in-nature, in (1995), Justice, Nature, and the Geography of Difference. Cambridge, UK: Blackwell, with his social reductionism in (2003), The New Imperialism. Oxford: Oxford University Press.

32 Pierre Bourdieu, and Loic J.D. Wacquant (1992), An Invitation to Reflexive Sociology. Chicago: University of Chicago Press, 228.

33 Charles Birch and John B. Cobb (1981), The Liberation of Life. Cambridge: Cambridge University Press, 79–96.

34 Donna J. Haraway (2008). When Species Meet. Minneapolis: University of Minnesota Press.

35 Istvan Mészáros (1970), Marx's Theory of Alienation. London: Merlin Press, 40.

36 Moore, Capitalism in the Web of Life.

37 On basic and historical facts, see E.H. Carr (1962), What is History? New York: Penguin. On the oikeios, see Moore, Capitalism in the Web of Life: Chapter One. (quotation from Carr, 1962; see also Moore, Capitalism in the Web of Life.

38 Stephen G. Bunker and Paul S. Ciccantell (2005), Globalization and the Race for Resources. Baltimore: Johns Hopkins University Press, 25.

39 For example, McKenzie Wark (2015). "Cognitive Mapping," PS: Public Seminar (1 May), http://www.publicseminar.org/2015/05/cogmap/#.VWIULPlVhBc, accessed 3 May, 2015.

40 New Scientist, "Great Acceleration."

41 Daniel Hartley (forthcoming). "Anthropocene, Capitalocene, and the Problem of Culture," in Jason W. Moore, ed., Anthropocene or Capitalocene? Oakland, CA: PM Press.

42 Marten Scheffer, et al. (2001), "Catastrophic Shifts in Ecosystems," Nature, 413, 591-596.

43 John Bellamy Foster (2002). "Capitalism and Ecology: The Nature of the Contradiction," Monthly Review 54(4), online edition, http://monthlyreview.org/2002/09/01/capitalism-and-ecology/. From there Foster adds – intriguingly – that "there is no ecological counterpart to the business cycle." There is, of course, an "ecological countpart" to long waves of accumulation (see Moore, Capitalism in the Web of Life).

44 Richard C. Lewontin (1991), "Facts and the factitious in natural sciences," Critical Inquiry, 18(1), 147.

45 Georg Lukács (1971). History and Class Consciousness. Boston: MIT Press, 181.

46 Lukács, History and Class Consciousness, 182.

47 Karl Marx (1981), Capital. Vol. III. David Fernbach, trans. New York: Penguin, 205.

48 Calculated from David Eltis (2015), "A Brief Overview of the Trans-Atlantic Slave Trade," Voyages: The Trans-Atlantic Slave Trade Database, http://www.slavevoyages.org/tast/assessment/estimates.faces,

Wally Seccombe (1992), A Millenium of Family Change. London: Verso, 161.

49 Pierre Chaunu (1959), Seville et l'Atlantique (1504-1650), VIII (1): Les Structures Geographiques. Paris: S.E.V.P.E.N., 148).

50 Enrique Dussel (1998). "Beyond Eurocentrism," in Frederic Jameson and Masao Miyoshi, eds., The cultures of globalization. Durham, NC: Duke University Press, 11-12, emphasis added.

51 I have omitted detailed references for the next few paragraphs. For references, see Jason W. Moore (forthcoming), "The Capitalocene, Part I: On the Nature and Origins of Our Ecological Crisis," Journal of Peasant Studies.

52 Our conceptual language on this point is still imprecise. "Labour productivity" is here understood in Marx's terms of value composition and the rate of exploitation. Hence, rising labour productivity may involve workers producing more average commodities for the same wages (or even, for a few, rising wages, as during the Fordist "productivity-wages" pact). Alternatively, it may involve workers producing the same number of average commodities for lower wages, a movement expressed in the language of unit labour costs. To some degree, this is captured in Marx's distinction between absolute and relative surplus value. But this distinction is too often hardened into categorical difference.

At a minimum, I would suggest that early capitalism mobilized not technical innovation in production and coercive and symbolic innovation in lengthening the working day, but also pursued ingenious strategies of appropriating cheap natures, at little or no cost, in such a way as to reduce de facto unit labour costs (value composition). In such situations – here I think of Norwegian forests or Polish grain or even African slaves at the end of the sixteenth century – the appropriation of "natural fertility" (Marx) may act like an increase in relative surplus value.

53 Every civilization is cohered by one of another way of configuring human and extra-human relations. We may debate the best language for the relational core that coheres this or that civilization, which I take to be relatively durable pattern of power and production over long-time and large space. My understanding of "law" aligns with Marx's Hegelian reading: law as a general historical tendency that exerts a long-run influence over the historical development of modes of production and reproduction in a given civilization. As with Marx's other "laws," these are broad historical tendencies that operate not in spite of countervailing tendencies, but because of these. (This is what distinguishes a historical-relational method from an ideo-typical one.) For this reason, I have likened capitalism's law of value to a gravitational field, drawing in all manner of external phenomena in contingent fashion.

54 Harvey, The New Imperialism (2003), 131.

55 Jason W. Moore (2007), Ecology and the Rise of Capitalism, PhD Diss., University of California, Berkeley; idem. (2010), "'Amsterdam is Standing on Norway' Part I: The Alchemy of Capital, Empire and Nature in the Diaspora of Silver, 1545–1648," Journal of Agrarian Change 10(1), 35-71; idem. (2010), "'Amsterdam is Standing on Norway' Part II: The Global North Atlantic in the Ecological Revolution of the Long Seventeenth Century," Journal of Agrarian Change 10(2), 188–227.

56 Samir Amin (2009). "Capitalism and the Ecological Footprint," Monthly Review, 61(6), online edition, http://monthlyreview.org/2009/11/01/capitalism-and-the-ecological-footprint/.

57 McKenzie Wark (2015). Molecular Red: Theory for the Anthropocene. London: Verso, 4; drawing on John Bellamy Foster's concept of metabolic rift in Foster, Marx's Ecology. New York: Monthly Review Press. The rift concepts is fundamentally at odds with a relational view of humanity-in-nature: see Jason W. Moore (forthcoming). "Metabolic Rift or Metabolic Shift? From Dualism to Dialectics in the Capitalist World-Ecology," Theory & Society; idem. (2014). "Towards a Singular Metabolism," New Geographies, 6, 108-113. Wark, a relative newcomer to Red-Green thought, had yet to engage the contradiction between the narrow – and quasi-positivist – conception of the metabolic rift, and his own lively and much-need argument for a "labour perspective on the historical tasks of our time," (Wark [2015], "Molecular Red: Theory for the Anthropocene (On Alexander Bogdanov and Kim Stanley Robinson)," e-flux, http://www.e-flux.com/journal/molecular-red-theory-for-the-anthropocene-on-alexander-bogdanov-and-kim-stanley-robinson/.

58 Eileen Crist (2013). "On the Poverty of our Nomenclature," Environmental Humanities, 3, 129–147.

59 See, among many contributions, Plumwood, Mastery of Nature; L.J. Jordanova (1980). "Natural Facts," in Carol P. MacCormack and Marilyn Strathern, eds., Nature, Culture and Gender. Cambridge: Cambridge University Press, 42-69; Peter Wade (1993). " 'Race,' Nature and Culture," Man, 28(1), 17-34; Donald S. Moore, et al., eds. (2003). Race, Nature, and the Politics of Difference (Durham, NC: Duke University Press).

60 K. William Kapp (1950), The Social Costs Of Private Enterprise. New York: Schocken Books, 231.

61 Jason W. Moore (2015). "Cheap Food and Bad Climate: From Surplus Value to Negative Value in the Capitalist World-Ecology," Critical Historical Studies, 2(1), 1–42.

62 David B. Lobell, et al. (2011), "Climate trends and global crop production since 1980," Science, 333, 616.