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The Value of Everything? Work, Capital, and Historical Nature in the Capitalist World-Ecology

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# *The Value of Everything?*

## Work, Capital, and Historical Nature in the Capitalist World-Ecology

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*Jason W. Moore*

Every civilization must decide what is, and what is not, valuable. The Marxist tradition makes occasional reference to a “law of value.” It is not a phrase that rolls easily off the tongue, apparently. It sounds quaint, curiously out of step with our times. And yet, the tremors of systemic crisis—financial, climate, food, employment—are translating into a new ontological politics that challenge capitalism at its very core: its law of value. Today’s movements for climate justice, food sovereignty, de-growth, the right to the city—and much beyond—underscore a new set of challenges to capitalism’s value system, understood simultaneously in its ethico-political and political-economic dimensions. This new ontological politics has long been implicit in radical politics. But it seems to have reached a new stage today.

By entwining distributional demands—the right to food, housing, a safe environment—with calls for fundamental democratization, justice, and sustainable environment-making, these movements have brought capitalism’s “law of value” into question as never before.

But what is that *law*, and how should we go about re-thinking it? Here we do not have as much help as one would like. Historians of capitalism don’t much care to speak of a law of value, much less put it to work (e.g., Wallerstein 1974; Heller 2011), some also reject it as a kind of metaphysics (Arrighi 1994). But there are hopeful signs that this *lacunae* is being addressed. Recently, value thinking has made a comeback of sorts—some pushing to grasp how value is rooted in historical capitalism’s production of nature (see especially, Parenti 2014; Araghi 2009a, 2009b; Huber 2009, 2011; Yates 2011; Liodakis 2001). Greens, even Marxist Greens, have tended to avoid the Marxist discussion (see Burkett 1999). Among Marxist Greens, the dominant approach remains *Nature and Capitalism*, *Nature plus Capitalism*. In

this, the “exploitation of nature *and* labor” are co-productive of capitalist development (Clark and York 2005: 395; Bunker 1984), a move that confuses, even elides, how capitalism *values* the specific contributions of both (Moore 2014b). Nevertheless, such moves were a necessary and even helpful corrective. For a century, value thinking had been shorn of its circulatory movement with life outside the commodity system. There were always rebels. Rose Luxemburg was one (2003/1913). In the 1970s, feminist scholars grasped the nettle of the problem in a different register: the strange contradictions of domestic labor and the reproduction of labor-power within a system of abstract social labor (Federici 1973; Dalla Costa and James 1972; Vogel 1983; Secombe 1974; Coulson et al. 1975). The renaissance of Red-Green thought by the late 1980s largely forgot the lessons of the domestic labor debate: the law of value (or something like it) was returned to its Social cage. O’Connor’s call for understanding the production of value as an essentially co-productive dialectic—through which humans produced value (abstract labor) but nature (as a whole) produced the conditions of commodity production—fell on deaf ears (1998: esp. ch. 2). Burkett’s classic socio-ecological reconstruction of Marx’s value thinking was celebrated in some circles, even as the very scholars who celebrated it refused its central implications (e.g., Foster 2000b; Clark 2001; e.g., Foster et al. 2010). It appeared that neither Reds nor Greens were prepared for such a synthesis.

Absent synthesis, Marxist Greens chose an arithmetic rather than dialectical solution. What happened was an intellectual override of Marx’s value thinking by a historical materialism largely cleansed of its value relations. Crystallized by the groundbreaking work of John Bellamy Foster and his colleagues, historical materialism was reconfigured as ontological dualism: the “metabolism of nature *and* society” (Foster 2000a: ch. 6). Humans make history, and so does nature. This solved a big problem. It addressed a major lacuna in Marxist thought, putting Nature into the frame. The history of capitalism could now be addressed through an expanded conceptualization: the history of capitalism equals the exploitation of nature and labor. Endless accumulation equals the degradation of nature equals catastrophe. The law of value is sometimes invoked, but as window dressing, not part of the window itself (e.g., Foster et al. 2010; Foster and Holleman 2014).

The difficulty emerges in the lack of explanation of how value is produced, and how the relations of value are reproduced on an extended scale. Historical materialism cleansed of its value relations allows for a certain ease of description: there is a “metabolic rift” between human and natural systems; capitalism is a human system; capitalism does terrible stuff to natural systems. Catastrophe ensues. The problem with all of this is that it doesn’t really explain how these historical processes *work*. This becomes a problem because effective political strategy and policy responses must have a sense of how capitalism has transformed the biosphere, and how the biosphere is transforming capitalism. This is what a value-relational approach can offer.

Working from the curious abstraction that humans are separate from nature—as if the air we breathe, the food we eat, the energy we use have no meaningful analytics—the Green position cannot answer its fundamental questions: How do we view nature, in part or as a whole, as valuable? What are the ethics of a sustainable civilization? How are the valuations of nature practiced in the modern world through markets, states, and ideas?

Such questions can only be addressed by inverting the great biases of Green Thought. *Not*, “How are humans separate from nature?”, but “How do humans “fit” in the web of life?” *Not*, “How are humans destroying nature?”, but “How do humans put nature, human natures included, to work?” These are the questions that might allow for a more nearly adequate analysis of how capitalism works through nature, and how nature works through capitalism. Effective answers will turn on our capacity to see humans as part of nature, to see civilizations as producers and products of particular, *historical* natures, and to see those historical natures at work in the birth and development, not just the “collapse” of civilizations. On offer through a reconstruction of Marx’s value thinking is the possibility of joining the politico-economic and ethico-political dimensions of “laws of value” in successive historical systems. Such a synthesis asks, How does a reading of Marx’s law of value through the *oikeios*—the creative, generative, and multi-layered relation of life-making (Moore 2013a; 2015)—help us to understand the development, crises, and restructuring of capitalism, from its origins to the present?

## VALUE RELATIONS IN THE CAPITALIST WORLD-ECOLOGY: AN OUTLINE

Civilizations are shaped and defined by their priorities: by deciding what things and what relations are valuable. Civilizations make and enforce ontological claims as a condition of their existence. Their rules of reproducing power and wealth turn on these choices of what is and what is not valuable. For capitalism, the choice has been clear, and peculiar. “Value” is determined by labor productivity in commodity production: the average labor-time embedded in the average commodity. This kind of value was unprecedented, and its expressions were spectacular. For feudalism, and tributary civilizations in general, wealth turned on land productivity. Never before had any civilization negotiated the transition from land productivity to labor productivity as the metric of wealth. The difference is between how many bushels of wheat, or rice, or maize can be grown in the average worker’s hour, and how many bushels can be grown on a hectare (or furlong, or *mu*) of land.

Of course, such contrasts are about more than who produces what, and from where and to whom the surplus flows. “Laws” of value speak also to dominant ethico-political judgments about what is and what is not valuable. A capitalist looks at a forest and sees dollar signs, an environmentalist trees and birds and soils, a world-ecologist how humans and other species have co-produced the forest and how that “bundled” forest simultaneously conditions and constrains capital today. It is this ethico-political moment of capitalism’s Cheap Nature strategy that is today in question as never before, as movements for food sovereignty, climate justice, and de-growth challenge valuations of wealth and power premised on capital and its dualist ontology (Moore 2015b).

## VALUE IN THE WEB OF LIFE

First, let us be clear that “law” is a term we get from Marx, who got it from Hegel. *Law*, in this sense, is a not an *iron law* of determination, but rather a law in the “Hegelian sense of the ‘abstract’” (Sweezy 1970: 19). To speak of a *law* of value, then, is not to engage history in a prisonhouse of structural abstraction, but to advance a

working proposition about a durable pattern of power and production that has been obtained over the time and space of historical capitalism. To pick up on one of Marx's favored metaphors, the law of value acts as a kind of gravitational field, shaping broad patterns, yet allowing significant contingency.

Secondly, the law of value as a durable pattern stems from value relations that unify a contradictory relation between and among humans and the rest of nature. This concept of value therefore defies the Cartesian ordering of reality into a Nature/Society binary. In the modern world, value relations forge contradictory unities of capital/labor and paid/unpaid work, including the work of extra-human natures (fossil fuels, animals, etc.). If the substance of value in historical capitalism is abstract social labor, understood as necessary labor-time, the relations that make this possible reach beyond the point of commodity production, and into the reproduction of labor-power and the appropriation of extra-human natures. It is in this sense that we can speak of the law of value as an organizing principle of capitalism as world-ecology, joining the accumulation of capital, the pursuit of power, and the co-production of nature as an organic whole (see esp., Bolthouse 2014; Camba 2014; Cox 2014; Deckard 2014, *forthcoming*; Jakes 2015; Leonardi 2012; Marley 2016; Marley and Fox 2014; Niblett 2012, 2013, 2014; Oloff 2012; Ortiz 2014; Parenti 2014; Weis 2013).

Thirdly, one of the enduring legacies of Cartesian dualism is a privileging of substances over relations in thinking about value. Sometimes that substantialist thinking is about the line between Nature and Society—hidden under the veil of common sense even as the relations on either side of the line are explored. This is true for Marxists as well as Greens. Value, say the Marxists, is abstract social labor; it is determined by socially necessary labor-time, the average labor-time embodied in the average commodity. “But wait!” says the Green thinker, “the average labor-time is just one part of what make that commodity possible” (e.g., Bunker 1984). The Marxist law of value forgets that that Nature—with capital “N”—contributes to the value of all the products that humans use. To which the Marxist, quite properly, says that the whole basis of Marx's political economy is the distinction between “wealth” and “value,” a distinction for which one can trot out innumerable wonderful passages from Marx (e.g., Burkett 1999; Foster 2000a). And there, the discussion seems to have stopped. It replays an older discussion with feminist scholars, who,

like the Greens, rightly challenged the blindness of Marxists to the foundational contributions of another kind of invisible work: the daily and intergenerational reproduction of human life (Vogel 1983; Dalla Costa and James 1972; Federici 1973).

Can we ford this great divide? Between Green and feminist insights into the centrality of unpaid work/energy for capital accumulation, and the Marxist view that labor productivity is the decisive metric of wealth and competitive fitness under capitalism?

## THE LAW OF VALUE AS A LAW OF CHEAP NATURE

The way forward looks something like this. The substance of value *is* socially necessary labor-time. The drive to advance labor productivity *is* fundamental to competitive fitness. This means that the exploitation of commodified labor-power is central to capital accumulation, and to the survival of individual capitalists. But this cannot be the end of the story. For the relations necessary to accumulate abstract social labor are *necessarily* more expansive, in scale, scope, speed, and intensity. Capital must not only ceaselessly accumulate and revolutionize commodity production; it must ceaselessly search for, and find ways to produce, Cheap Natures that can deliver a rising stream of low-cost food, labor-power, energy, and raw materials to the factory gates. (Or office doors, or . . . .) These are the Four Cheaps. The law of value in a capitalist society is a law of Cheap Nature (Moore 2012, 2014a, 2015).

What this law says, in effect, is that every great wave of accumulation turns on Cheap Nature, understood as use-values produced with a below average value-composition. In systemic terms, Cheap Nature is produced when the interlocking agencies of capital, science, and empire—blunt categories, yes—succeed in releasing new sources of free or low-cost human and extra-human natures for capital. The Four Cheaps are at the core of such Cheap Natures, reproduced cyclically across the history of capitalism. “Cheap Nature” is punctuated here—with an emphatically upper-case “C” and “N”—because we are focusing on a capitalist way of seeing the world. The bourgeois vision supposes that the web of life can be fragmented, that its moments can be valued through calculations of price and value, and that most work that occurs under capitalism can be unpaid.

Cheap Nature is “cheap” in a historically specific sense, defined by the periodic, and radical, reduction in the socially necessary labor-time of these Big Four inputs: food, labor-power, energy, and raw materials.<sup>1</sup> Cheap Nature, as accumulation strategy, works by reducing the value composition, but increasing the technical composition, of capital as a whole, by opening new opportunities for investment, and, in its qualitative dimension, by allowing technologies and new kinds of nature to transform extant structures of capital accumulation and world power. In all this, *commodity frontiers*, or frontiers of appropriation, are central. This leads to the tightly connective movements of “internal” restructuring and geographical expansion that restore and reconfigure the Four Cheaps. The great expansions of the long nineteenth and twentieth centuries turned on cheap coal and oil, cheap metals, and cheap food, alongside the massive destabilization of peasant societies from eastern Europe to East Asia.

However, the movements of creating the necessary relations and conditions of Cheap Nature cannot be reduced to the immediate process of production, or even commodity production and exchange as a whole. These are crucial and indispensable. But they are not sufficient. Capitalism depends on a repertoire of strategies for *appropriating* the unpaid work/energy of humans and the rest of nature outside of the commodity system. These strategies cannot be reduced to so-called economic relations but are enabled by a mix of science, power, and culture. These are blunt instruments, but they will suffice. The reality is interpenetrated, messy, and complex. Crucially, science, power, and culture operate within value’s gravitational field, *and are co-constitutive of it*.

The implication is explosive: the law of value represents a determination of socially necessary labor-time which occurs simultaneously through organizational and technical innovation *and* through strategies of appropriating the unpaid work/energy of “women, nature, and colonies” (Mies 1986: 77). Without massive streams of unpaid work/energy from the rest of nature—including that delivered by women—the costs of production would rise, and accumulation

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<sup>1</sup> Many colleagues have insisted on a “Fifth” Cheap: Cheap Money. This is undeniably true. *However*, Cheap Money—whose maintenance is the strategic priority of leading capitalist interests today—works only through its capacity to restore Cheap Nature. Cheap Money serves to re/produce Cheap Nature; it is not Cheap Nature as such. Nevertheless, the constitutive relations between money/capital/nature-as-*oikeios* merit sustained investigation and conceptual elaboration.

would slow. Every act of exploitation (of commodified labor-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. As goes the 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. These movements of appropriation produce the necessary conditions for the endless accumulation of capital (value-in-motion).

In other words: Value doesn't work unless most work isn't valued.

The law of value under capitalism is, then, comprised of two moments. One is the endless accumulation of capital as abstract social labor. The other, the ceaseless expansion of the relations of exploitation and appropriation, joined as an organic whole. This perspective stresses the historical and logical *non-identity* between the value-form and its necessarily more expansive value-relations. While Marxist political economy has taken value to be an *economic* phenomenon with systemic implications, the inverse formulation may be more plausible: value-relations are a *systemic* phenomenon with a pivotal economic moment. Far from denying the centrality of socially necessary labor-time to capitalist civilization, such an approach affirms Marx's greatest contribution within a theoretical frame implicit in the dialectical method. Thinking of value as systemic phenomenon with a pivotal economic moment allows us to connect the production and accumulation of surplus value with its necessary conditions of reproduction. It recognizes, moreover, that these conditions extend beyond the circuit of capital: the accumulation of abstract social labor is possible through the appropriation of unpaid work (human and extra-human). The value-form (the commodity) and its substance (abstract social labor) depend upon value-relations that configure wage-labor with its necessarily more expansive conditions of reproduction: unpaid work. Importantly, capital's appropriation of unpaid work transcends the Cartesian divide, encompassing both human and extra-human work as outside, but necessary to, the circuit of capital and the production of value.

## VALUE AS METHOD: CAPITAL, CLASS, AND NATURE

The law of value is not only a law of Cheap Nature but a terrain of class struggle. As argued elsewhere, the rise of capitalism and the formation of a peculiar law of value over the “long” sixteenth century was a process of class struggle; the great frontier expansions, encompassing both the “global Baltic” and the global Atlantic, were in part motivated by the strength of the Western European peasantry in beating back feudal restoration. The law of value emerged only as class struggles in late medieval Europe propelled the expansion of commodity production and exchange overseas. Where and when value-relations reached into the European heartland, the class struggle quickly reached a boiling point, as in the Central European mining and metallurgy boom and the German Peasants’ War of 1525, only the most dramatic of a series of class struggles involving workers and peasants against capital and the state (Moore 2003a, 2003b, 2007, 2010a, 2010b).

Value, then, cannot be regarded as a discrete “economic” process alongside that of class struggle and class formation any more than value-relations can be understood as a social process independent of the web of life. There is no recipe that can deliver us from either abstract structuralism or abstract voluntarism; the most useful guide is to tack back and forth between the logic of capital and the history of capitalism, between the apparently “social” and the seemingly “environmental.”

Marx’s theory of value has long been criticized in Green Thought (e.g., Bunker 1984, 1985; Cronon 1990; Daly and Farley 2004; Hornborg 1998). The argument runs something like this: Marx’s theory of value was a *labor* theory of value. In such a scheme, the only thing that counts as valuable is labor. The theory therefore ignores Nature (not Humans) and thus offers, at best, a partial guide to the history of capitalism and prescriptions for environmental sustainability. A *marxisante* version of this argument appears subtly. Clark and York (2005), for instance, refer to the “exploitation of nature and labor,” even as they deploy the language of a “law of value.”

The critique has been challenged on textual and theoretical grounds (Burkett 1999; Foster and Burkett 2006; Foster 2000a). But the *terms of the critique* have accepted the Green framing. In essence, the critique of Marx pointed to a *lacunae*, if not in Marx’s work, then

certainly in twentieth-century Marxism, the political economy of capitalism has been conceptualized in social reductionist terms. Social relations were all that counted. The Green fix? Nature matters too. The Red-Green fix? Capitalism is social system premised on endless accumulation *and* a “metabolic rift between nature and society,” in which Nature’s cycles and flows are disrupted by humans (e.g., Foster et al. 2010; for a critique see Moore 2011b, 2014b). The Red-Green fix is what I call Green Arithmetic: nature plus capitalism equals the Whole. The essential agreement between Marxist and environmentalist approaches is found in the Cartesian consensus: Relations between Humans go into one “system,” relations between the elements of Nature (not Humans) make another system, the Human system creates prices (exchange-value), the Natural system creates utility (use-value), the two systems interact.

*Voilà!* One plus one equals . . . ? Well, what?

This isn’t clear. Green Arithmetic just doesn’t add up, because adding up violent abstractions—Nature/Society—doesn’t bring us closer to historical specificity. The essential problem with both Red and Green approaches is their acceptance of modernity’s most basic assumption: Humans are separate from Nature (Moore 2015). Marx’s contribution pointed towards a much different line of thinking: Humans are “natural forces” (1973); they are linked to nature internally (2007); capitalism “robs” us of our “vital forces” in *the same way* as it robs the soil of its nutrients (1977); our life-activity simultaneously changes us, our relations within nature, and the “historical natures” around us (1977). Marx’s conception of value relations points towards a methodological directive that has, until now, been widely ignored: the relations of power and re/production amongst humans are constitutively bound to their relations within the web of life. There can be no adequate determination of the specifically social without these relations. The classical categories of Marx’s critique—capital, class, value—are irreducibly socio-ecological. They unfold through the *oikeios*. In this, the production of value as abstract social labor turns on the expanded reproduction of relations with (and *within*) the rest of uncommodified work. Whose work? Among humans, reproductive work, “women’s work,” above all, but also the work/energy of plate tectonics, of rainforests, of rivers. In short, the work of nature.

Marx’s value theory therefore suggests a set of groundbreaking propositions. First, value relations *already* entwine human and extra-

human work and their constitutive internal and external relations. Secondly, the historical specificity of value-relations encompasses not only wage-work but also the mobilization of uncapitalized natures—soils, women's work, and so forth—as fundamental to the rate of exploitation. Thirdly, the contradictions and contingencies of capitalism unfold through developments within and between the zone of exploitation and the zone of appropriation. In this, *exploitation* encompasses labor-power within the commodity system, while appropriation encompasses the transfers of uncapitalized work/energy necessary to accumulation but not actually penetrated by the capital relation. The upshot is that value in capitalism remains peculiar, but historically patterned. It is peculiar because it assigns value not to human work, but only to human work whose reproduction depends on the cash nexus. By assigning value-creation to labor-power within commodity production, this pattern compelled ceaseless geographical expansion and restructuring. This occurred, necessarily, not only to expand the reserve army of labor, but to entrain ever wider spheres of uncapitalized nature in service to advancing labor productivity.

## A PECULIAR WAY OF ORGANIZING NATURE

Modernity's law of value is an exceedingly peculiar way of organizing life in a civilization. Born amidst the rise of capitalism after 1450, the law of value enabled an unprecedented historical transition from land productivity to labor productivity as the metric of wealth and power. It was an ingenious civilizational strategy, for it enabled the deployment of capitalist *technics*—crystallizations of tools and ideas, power and nature—to appropriate the wealth of uncommodified nature (human work included) in service to advancing labor productivity within the zone of commodification. The great leap forward in the scale, scope, and speed of landscape and biological transformations in the three centuries after 1450 may be understood in this light.

We can glimpse the emergence of this peculiar valuation from the earliest moments of the transition to capitalism. From the sixteenth century, the law of value began to take shape out of the global extensions of commodity production and exchange, stretching from the silver mines of Saxony and Potosí, to the sugar plantations of Bra-

zil and Barbados, to the timber frontiers of Scandinavia and the Baltic. This was early capitalism's commodity frontier strategy, and it was central to an epochal shift because it raised labor productivity by treating uncaptialized nature as a substitute for machinery. At every turn, land (forests, silver veins, fertile soils) was organized by empires, planters, seigneurs, yeoman farmers, and many others, as a force of production in servitude to the commodity form, a mechanism for advancing the productivity of labor. Treating the whole of uncaptialized nature as a force of production, early capitalism was able to remake planetary natures in an epochal fashion (Moore 2007, 2010a, 2010b).

Civilizations before capitalism transformed landscapes on a large scale: feudal Europe, the Greek city-states, the Romans, successive Chinese empires, the Sumerians, and many more. In every instance, there were vital clusters of commercial activity and commodity production. What changed after 1450 were the relevant units, and organization, of time and space. Pre-modern civilizations transformed regions over the span of centuries. Capitalism transformed regional landscapes in mere decades. Through the capacities of monetary capital to command, and indeed to produce, space, there emerged a fundamentally globalizing mode of producing wealth, nature, and power centered on the commodity form. As central to its era as railroads or automobiles to others, sugar production moved, in roughly half-century cycles, across the Atlantic world after 1450, from Madeira to São Tomé, enclosing in successive turns Pernambuco, Bahia, Barbados, and thence the wider Caribbean. Silver mining flowered in central Europe, moving restlessly from one site to another. It then relocated through the alchemies of empire and finance to Potosí, half a world away, only to give way in turn to the great silver mines of Zacatecas and Guanajuato in the eighteenth century. Commodity frontiers premised on forest products, on fish, on iron and copper, on cereals and flax, moved with the same socio-spatial rhythm (although as dance, not lockstep), occupying, producing, and exhausting in serialized fashion the ecological formations of the North Atlantic, from the shores of Newfoundland to southern Norway to the banks of the Vistula and the foothills of the Urals (Moore 2010a, 2010b). In contrast to the view of early capitalism as technologically or socially inert, every movement of global occupation and transformation signaled a new phase of social organization, technical deployment, and landscape discipline. Never before had any civilization moved so fast, so far. Something decisive had changed.

To call that “something” Nature/Society would merely restate the very problem we seek to answer. But if we can accept, even provisionally, that Marx’s value theory identifies a “deep structure” of historical capitalism, we have a clue as to how human and extra-human nature work is entwined. This weave of the human and extra-human—a “law” of value—gives priority to labor productivity, and mobilizes uncapitalized natures without regard for its reproduction. Here we have more than a simple restatement of the problem. We have the possibility of understanding capitalism as premised on a fundamental disequilibrium in the value relation of capitalization and appropriation in the web of life. If we, moreover, follow Marx and identify the external vent (the frontier) as central—recall how he moves in successive chapters at the end of *Capital* from the “conquest” of the national “home market” to the “commercial wars . . . which [have] the globe as its battlefield,” to the “growth of the international character of the capitalist regime” and its mounting systemic contradictions (1977: 913, 915, 929)—then we may begin to see the successive resolutions of the disequilibrating tendency as essentially self-limiting. To explore this self-limiting movement, one must move from the logic of capital to the history of capitalism.

This analytic possibility is vitally important because it will help us discern the greatest question of our times: What are the limits to capitalist civilization, and how are these limits constituted by humans and the rest of nature in the web of life? It would be mystifying to say that the limits of capitalism are ultimately determined by the biosphere itself, although in an abstract sense this is true. But this is a view of Nature as an independent system. This is insufficient to understand *how* capitalism reaches limits, *how* capitalism has transcended limits historically, and *how* capitalism has remade successive historical natures in a way that may pose intractable problems for its survival today.

Marx’s conception of value seems to offer a useful way to answer these questions. It allows us to discern not merely the patterns of power, re/production, and accumulation over the *longue durée*, but the logic animating these patterns’ emergence and evolution. I call this method educative because we are locating value as a gravitational field. The patterns that take shape through this field move at once in quasi-linear and contingent fashion. In all this, money is very important, and of course central to capitalist civilization. What money *represents*, however, is not nearly as obvious. Money is so important in

historical capitalism because it is central to three interconnected processes: 1) carving out a part of human activity, paid work, and giving it special value, 2) de-valuing the rest of nature, so as to put these natures to work for free, or low cost, 3) governing the evolving boundary between capitalization and appropriation, between “economy,” its constitutive relations, and the web of life. For monetary accumulation (“into which all commodities dissolve themselves”), at once imprints and registers the material transformation of commodity production (where money “dissolves itself into all commodities”) (Marx 1973: 142). This double movement of dissolution and reconstitution not only reworks our imaginary idea of humans-in-nature and its spatial forms; it navigates and transforms the temporal barriers posed by successive historical natures. Marx’s essential insight on the role of money-capital in negotiating blockages within the circuit of capital applies equally to those operating within the circuits of Cheap Nature: the Four Cheaps.

## VALUE AND THE CENTRALITY OF SOCIALLY NECESSARY UNPAID WORK

Recognizing capital accumulation as both objective process and subjective project, Marx’s value thinking offers a promising way to comprehend the inner connections between accumulation, biophysical change, and modernity as a whole. These inner connections could be glimpsed from the origins of modernity. They underpin the epoch-making transformations of land and labor in early modern capitalism (Moore 2017). These transformations were not however, the straightforward result of capital in its economic expression. This strange metric, value, oriented the whole of West-Central Europe towards an equally strange conquest of space. The geographical movements of commodification and appropriation were mutually determined by a symbolic-material reworking of space through value. It was a strange reworking, what Marx calls the “annihilation of space by time” (1973: 424). Across the “long” sixteenth century we can see a new form of time, abstract time, emerging. While all civilizations are in some sense built to expand across varied topographies, none represented these topographies as externally and progressively abstracted in the ways which dominated early capitalism’s geographical

praxis. The genius of capitalism's Cheap Nature strategy was to represent time as linear, space as flat, and nature as external (Mumford 1934; Merchant 1980; Pickles 2004). It was a civilizational inflection of the "God-trick" (Haraway 1988), with bourgeois knowledge representing its special brand of quantifying and scientific reason as a mirror of the world, the same world being reshaped by early modernity's scientific revolutions in alliance with empires and capitals. The God-trick was producer and product of abstract social nature: the co-production of Nature as something to be mapped, rationalized, quantified, and above all, *controlled* in ways that eased the endless accumulation of capital.

With abstract time, in other words, comes abstract space (Lefebvre, 1991). They were the indispensable corollaries to the weird crystallization of human and extra-human natures in the form of abstract social labor. It is this ascendant law of value—operating as gravitational field rather than mechanism—that underpins the extraordinary landscape and biological revolutions of early modernity. In these centuries we find the origins of capitalism's Cheap Nature strategy, the very strategy that underpins today's biospheric turbulence. This strategy enables advancing labor productivity in great bursts by means of effecting even greater bursts in the production of the Four Cheaps: labor-power, food, energy, and raw materials. The catch is that capital-labor relations are not well-equipped to map, code, survey, quantify, and otherwise identify and facilitate *new* sources of Cheap Nature. This latter has involved all manner of knowledge-practices, closely linked but not reducible to territorial power, in which the expanded reproduction of the capital/*unpaid* work relation has been central. This is the terrain of abstract social *nature* and accumulation by appropriation.

The idea of nature as external has worked so effectively because the condition for capital's so-called self-expansion is the location and production of nature's external to capital. (A palpably co-productive process.) Because these natures are historical and therefore finite, the exhaustion of one historical nature quickly prompts the "discovery" of new natures that deliver qualitatively new and quantitatively larger sources of unpaid work. Thus did the Kew Gardens of British hegemony yield to the International Agricultural Research Centers of American hegemony, which in turn were superseded by the bio-prospecting, rent-seeking, and genomic mapping practices of the neoliberal era (Brockway 1978; Kloppenburg 1988; McAfee 2003). But

the origins of Nature go back to the sixteenth century. Early capitalism's world-praxis, fusing symbolic coding and material inscription, moved forward an audacious fetishization of nature, crystallized in the era's cartographic, scientific, and quantifying revolutions. These were the symbolic moments of primitive accumulation, creating a new intellectual system whose presumption, personified by Descartes, was the separation of humans from the rest of nature.

The origins of Cheap Nature are, of course, more than intellectual and symbolic. The transgression of medieval intellectual frontiers was paired with the transgression of medieval territoriality. While civilizational expansion is in some sense fundamental to all, there emerged in early modern Europe a specific geographical thrust. While all civilizations had frontiers of a sort, capitalism did something very different. Before the sixteenth century, a civilization's frontiers—such as feudal Europe's drive east of the Elbe—were more-or-less an output of the system. With the rise of capitalism, frontier-making was much more fundamental: not merely a safety valve, but a constitutive spatial moment of unlocking the epoch-making potential of endless accumulation. The extension of capitalist power to new, uncommodified spaces became the lifeblood of capitalism. I have elsewhere considered the historical geographies of early capitalism's commodity frontiers (Moore 2000, 2003a, 2003b, 2009, 2010a, 2010b, 2010c, 2010d). For the moment, I wish to highlight two relational axes of these frontiers. First, commodity frontier movements were not merely about the extension of commodity relations, although this was central. They were also, crucially, about the deployment of territorial power and geographical knowledge necessary for the commodity-oriented appropriation of unpaid work/energy. This unpaid work could be delivered by humans—women or slaves, for example—or by extra-human natures, such as forests, soils, or rivers. Secondly, from the very beginning such frontiers were essential to creating the forms of Cheap Nature specific to capitalism: the Four Cheaps.

## FORDING THE CARTESIAN DIVIDE: THE VALUES OF WORK/ENERGY

What are the implications of this line of thought for a post-Cartesian historical method, one that takes the law of value as a co-production of humans bundled with the rest of nature?

For Marx, use-value and exchange-value represent “*on the surface*” the “internal opposition of use-value and value” (Marx 1977: 153, 209). Marx’s discussion in these opening pages of *Capital* are pitched at so high a level of abstraction that the implications of this “internal opposition” have been insufficiently grasped. These implications are explosive. To say that value and use-value are *internally related* is to say that the value relation encompasses the relation value/use-value in a way that necessarily extends beyond the immediate process of production. Here is a connection that allows us to join definite “modes of production” and definite “modes of life” in concrete historical unities (quotations from Marx and Engels 1970: 42).

This means that capitalism can be comprehended through the shifting configuration of the exploitation of labor-power and the appropriation of Cheap Natures. This dialectic of paid and unpaid work demands a disproportionate expansion of the latter (appropriation) in relation to the former (exploitation). The reality is suggested by those widely-cited estimates on the contribution of unpaid work performed by humans (UNDP 1995: #16; Safri and Graham 2010) and the rest of nature (“ecosystem services”) (Costanza et al. 1997, 2014). The quantitative reckonings for unpaid human work—overwhelmingly delivered by women—vary between 70 and 80% of world GDP, for “ecosystem services,” between 70 and 250% of GDP. The relations between these two moments are rarely grasped (but see Perkins 2007); their role in long waves of accumulation, rarely discussed (see O’Hara 1995). Importantly, unpaid work comprises more than ongoing contributions to the daily reproduction of labor-power and the production cycles of agriculture and forestry. It also encompasses the appropriation of *accumulated* unpaid work in the form of children raised to adulthood largely outside the commodity system (e.g., in peasant agriculture) and subsequently pushed or pulled into wage-work, and also in the form of fossil fuels produced through the earth’s bio-geological processes.

The appropriation of unpaid work signifies something beyond the important—but still too partial—notion of environmental costs

and externalities as “missing” from the determination of value (e.g., Patel 2009). For capitalism is not merely a system of unpaid costs (“externalities”), but of unpaid work (“invisibilities”). Here we may borrow a core insight from feminist Marxism: the contribution of unpaid work is not “just there,” but actively produced through complex (yet patterned) relations of power, re/production, and accumulation. I risk pedantry here in saying that the “free gifts” of nature are not “low-hanging fruit” that can simply be picked without much time or effort. Cheap Natures are actively produced by human activity bundled with the rest of nature; human and extra-human natures *both* are replete with creativity and contingency. All life is actively, creatively, incessantly engaged in environment-making, such that, in the modern world, human ingenuity (such as it is) and human activity (such as it has been) must *activate* the work of particular natures in order to appropriate particular streams of unpaid work. Such activation is a co-produced reality, bundling the life-activities of human and extra-human nature in the present, and accumulated over time.

What are the implications for a historically grounded theory of value? On the one hand, capitalism lives and dies on the expanded reproduction of capital: value-in-motion. The substance of value is abstract social labor, or socially necessary labor-time, implicated in the production of surplus value. On the other hand, this production of value is particular—it does not value everything, only labor-power in the circuit of capital—and therefore rests upon a series of devaluations. Plenty of work, the majority of work in the orbit of capitalism, does not register as valuable. Work by humans, especially women, but also “work” performed by extra-human natures. For good reason, Hribal (2003) asks, “Are animals part of the working class?” The question itself illuminates the law of value’s absurd, yet consistent, praxis. Although confusion persists on the matter, it is now clear that Marx understood that extra-human natures perform all sorts of useful (but not specifically *Valuable*) work for capitalist production, and that such useful work was *imminent* to the capital-relation (Burkett 1999). Marx’s reading of value was, in other words, eminently post-Cartesian.

All of these de-valued and un-valued forms of work are, however, outside the value form (the commodity). They do not directly produce value. And yet—and this is a very big *and yet*—value as abstract labor cannot be produced except through unpaid work/energy. This leads me to an unavoidable conclusion: the value *form* and the value *relation* are non-identical. The “commodification of everything” can

only be sustained through the incessant revolutionizing, yes, of the forces of production, but also the *relations of reproduction*. The relations of reproduction cut across the paid/unpaid work and human/extra-human boundaries.

In this, the historical condition for socially necessary labor-time is socially necessary unpaid work. De-valued work is an “immanent . . . antithesis” within the generalization of commodity production and exchange (Marx 1977: 209). In this contradiction, between the expanded reproduction of capital and the reproduction of life, we have “two universes, two ways of life foreign to each other yet whose wholes explain one another” (Braudel 1977: 6). The geographical implication of this enabling and constraining tension between paid and unpaid work? The necessity of frontier-making. Recurrent waves of socio-ecological exhaustion—understood as the inability of a given bundle of human/extra-human natures to deliver more work to capital—implicate recurrent waves of geographical expansion. The commodity frontier strategy has been epoch-making not because of the extension of commodity production and exchange as such, a common misunderstanding of commodity frontier theory (Moore 2000, 2013b, 2013c). Rather, commodity frontiers were so epoch-making because they extended the zone of appropriation *faster* than the zone of commodification. Marx puts his finger on the crucial dialectic when he addresses the contradictions of the working day, the tendency towards manifold “industrial patholog[ies],” and the necessity of incorporating “physically uncorrupted” human natures into the world proletariat (1977: 380).

## VALUE: SYSTEMIC OR “ECONOMIC” RELATION?

It will consequently not suffice to identify the influence of abstract social labor as an “economic” phenomenon, although this remains pivotal. The endless frontier strategy of historical capitalism is premised on a vision of the world as endless: this is the conceit of capital and its theology of endless substitutability.<sup>2</sup> At best, substitutability occurs within definite limits, primarily those of energy flows and the geographical flexibility they offer. The history of capitalism is

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<sup>2</sup> Much of ecological economics can be read as a sustained critique of this theology. A useful introduction is found in Daly and Farley 2004; also Perelman 2007.

one of relentless flexibility rather than endless substitutability. The conditions through which successive world-ecological revolutions have been realized—each yielding a quantum leap in the mass of “physical bodies” and making new streams of unpaid work/energy available for commodity production—may be understood as a succession of one-off affairs. Capitalism has moved from peat and charcoal to coal to oil, from the breadbaskets of the Vistula, southern England, the American Midwest, from labor frontiers in Europe and Africa, Latin America, and South and East Asia. These are not repeatable events. Substitutability does not unfold through infinite time and space.

Abstract social labor, in this reading, is the *economic expression* of the law of value. That law is unworkable historically without strategies of appropriating cheap nature. Why? Because the creation of socially necessary labor-time is constituted through a shifting balance of human and extra-human work; *the co-production of nature*, in other words, is constitutive of socially necessary labor-time. If climate change suppresses agricultural productivity—as it is has been doing for some time now—the value-composition of agricultural production shifts accordingly. Socially necessary labor-time forms and re-forms in and through the web of life.<sup>3</sup> Early capitalism’s landscape transformations, in their epoch-making totality, were unthinkable without new ways of mapping space, controlling time, and cataloguing external nature—and they are inexplicable solely in terms of world-market or class-structural change. The law of value, far from reducible to abstract social labor, finds its necessary conditions of self-expansion through the creation and subsequent appropriation of cheap human and extra-human natures. These movements of appropriation must, if capital is to forestall the rising costs of production, be secured through extra-economic procedures and processes.

By this I mean something more than the recurrent waves of primitive accumulation that we have come to accept as a cyclical phenomenon of capitalism (Angelis 2007). These also remain pivotal. But between our now cherished dialectic of “expanded reproduction” and “accumulation by dispossession” (Harvey 2003) are those knowledges and associated practices committed to the mapping, quantifying, and rationalizing of human and extra-human natures in service to capital

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<sup>3</sup> “[T]he process of reproduction has to be considered from the standpoint of the replacement of the individual components of C’ both in value and in material” (Marx 1978: 469).

accumulation. Thus the trinity: abstract social labor, abstract social nature, primitive accumulation. This is the relational core of capitalist world-praxis. And the work of this unholy trinity? To produce Cheap Natures. Extend the zone of appropriation. In sum, to deliver labor, food, energy, and raw materials—the Four Cheaps—faster than the accumulating mass of surplus capital derived from the exploitation of labor-power. Why? Because the rate of exploitation of labor-power (within the commodity system) tends to exhaust the life-making capacities that enter into the immediate production of value.

Capital asks no questions about the length of life of labor-power. What interests it is purely and simply the maximum of labor-power that can be set in motion in a working day. “It attains this objective by shortening the life of labor-power, *in the same way* as a greedy farmer snatches more produce from the soil by robbing it of its fertility” (Marx 1977: 376, emphasis added).

Exhaustion might take the form of an obvious withering of “vital forces” (Marx 1977: 380). More often, however, exhaustion manifests in the inability of a given production complex to yield a rising stream of unpaid work, performed by human and extra-human natures alike. This latter form of exhaustion typically issues from some combination of class struggle, biophysical change, and the tendentially rising “geographical inertia” of regional built environments (quotation from Harvey 1982: 428–29). In a world treated as boundless, capital as a whole has evinced a cumulative, but cyclically punctuated, tendency to search out and appropriate new, “physically uncorrupted” zones of cheap labor, food, energy, and raw materials. Exhaustion signals a rising value composition of capital, and the inflection point of decline for a given production complex to supply a growing stream of unpaid work to regional accumulation.<sup>4</sup> To the degree that “foreign preserves” can be identified and dominated, the relative “degeneration of the industrial population” matters little (quotations from Cairnes 1862: 110–11 quoted in Marx 1977: 377). Has it been so different for extra-human natures? English agricul-

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<sup>4</sup> This explains something of the recurrent waves of financialization that redounded to the benefit of the declining world hegemon—in their respective *belle époques*, the Dutch, British, and American hegemonies each enjoyed a renewal of accumulation by capitalists in their respective geographical loci by deploying financial means to secure the fruits of agro-industrial expansions, based on new appropriations of cheap nature elsewhere in the world (Arrighi, 1994).

ture, though not necessarily physically exhausted, was certainly exhausted in terms of its capacity to send a rising stream of cheap food to metropolitan capital by the early decades of the nineteenth century (Thomas 1993). Not surprisingly, British capitalism at its mid-century apex would nourish itself on the basis of cheap calories—grain and sugar—supplied from New World frontier zones in North America and the Caribbean (Cronon 1991; Mintz 1985).

We can now connect the dots between the rise of capitalism and the emergence of the law of value. Value relations incorporate a double movement to exploitation and appropriation. Within the commodity system, the exploitation of labor-power reigns supreme, but this supremacy is only possible, given its tendency toward self-exhaustion, to the degree that the appropriation of uncommodified natures counteracts this tendency. This has been difficult to discern because value *relations* are necessarily much broader than the immediate production of the value *form* (the commodity). The generalization of commodity production has proceeded through an expansionary web of value relations whose scope and scale extends well beyond production. The problem of capitalist development is one of the uneven globalization of wage-work *dialectically joined* to the “generalization of its conditions of reproduction” (McMichael 1991: 343). The centrality of wage-work in certain Marxist perspectives is not wrong but partial, given the unsustainability of the circuit of capital as closed system. The difficulty in pursuing this alternative analysis has been rooted in the dualisms immanent to modern thought; for to construct capitalism in this fashion is to transcend the man/woman, nature/society boundaries upon which the whole edifice of modernist thought depends (Plumwood 1993: 41–68; Waring 1988). For not only do we need to unify the distinctive but mutually formative dialectics of human work under capitalism through the nexus of paid/unpaid work, or “productive” and “reproductive” work. We also need to recognize that capitalism’s dynamism has owed everything to appropriating and co-producing ever more creative configurations of human and extra-human work across the *longue durée*.

If we take the nexus of paid/unpaid work as our premise, the implications are significant. Capitalism and value relations cannot be reduced to a relation between the owners of capital and the possessors of labor-power: *the historical condition of socially necessary labor-time is socially necessary unpaid work*. This observation opens a vista on capitalism as a contradictory unity of production and reproduction that

crosses the Cartesian boundary. The meaningful distinction is between the zone of paid work (the exploitation of commodified labor-power) and the zone of unpaid work (the reproduction of life). This contradictory unity works by creating a relatively narrow sphere of commodity production within which labor-power can be said to yield either rising or falling productivity, which can be represented (imperfectly) through input-output calculations. This narrow sphere, premised on the exploitation of labor-power within commodity production, operates in relation to a much more expansive sphere of appropriation, through which the diversity of nature's "free gifts"—including the reproduction of life from the family to the biosphere—may be taken up into commodity production, but not fully capitalized. Why not fully capitalized? Because the capitalization of reproduction is subject to the exhaustive tendencies we have just discussed, which imply a rising value composition of capital and signal a situation in which capital must bear a greater share of its own costs.

## CHEAP NATURE: FROM PLUNDER TO PRODUCTIVITY

This new law of value, turning on socially necessary labor-time within commodity production, required an expansive (*and expanding*) domain of appropriating Cheap Natures. This was in fact what early capitalism was best at doing: developing technologies and knowledges unusually well-suited to identifying, coding, and rationalizing cheap natures. Here the new way of seeing the world—inaugurated by the emergence of the Renaissance perspective—decisively conditioned a new organizing *technics* for the capitalist world-ecology, manifesting in the cartographic-shipbuilding revolution of early modernity, from the Portolan maps and caravels to Mercator globes and galleons, and much more.

Appropriating cheap natures was and is a far more creative act than the *dependencia* language of plunder allows (e.g., Clark and Foster 2009). "Appropriation" represents a productive activity every bit as much as "exploitation." The outright seizure of basic wealth, clearly no invention of the sixteenth century, could not provide a durable basis for the endless accumulation of capital. But the new praxis of Cheap Nature, with accumulation by appropriation at its center, did. Here was a set of appropriative practices combined with the world market and technological innovations oriented towards global

expansion. These practices comprised quite conscious colonial strategies to reorganize indigenous populations into strategic hamlets that functioned as labor reserves: the *reducciones* in the Andes and the *aldeias* in Brazil during the sixteenth century (Gade and Escobar 1982; Schwartz 1978). The practices enabled a rising rate of surplus value by treating the land, *simultaneously*, as a force of production and a “free gift.” It did not matter that horrific levels of mortality accompanied this rising labor productivity so long as the costs of appropriation—through indigenous and African slave trades—were sufficiently low (Schwartz 1985; Moore 2007).

This speaks to a problem not only of economic historiography but also of Marxist political economy. We are, in the conventional reading of Marx, offered two categories for the production of surplus value: absolute (more hours worked) and relative (more commodities produced in the same number of hours). Marx focused on the basic tendencies at play in the rise of large-scale industry, and this focus has been reproduced ever since. But Marx also points towards a theory of the rate of exploitation that is grounded in the dialectic of human and extra-human natures. In this, soil fertility may “act like an increase of fixed capital” (1977: 238, 636–38; 1973: 748). We can take this reference to soil fertility as a stand-in for the life-making capacities of human and extra-human natures. Even where extraordinary soil fertility was in some sense “given,” it was equally co-produced: as in the fertility of seventeenth-century Bahia or the nineteenth-century American Midwest and Great Plains. Absent the cartographic-shipbuilding revolution of the “long” sixteenth century, or the railroad revolution and the rationalization of American territory in the long nineteenth century, the bounty of these frontiers was no more than *potential*. These “hard” and “soft” technologies of production advanced labor productivity by harnessing the capacities of these natures to work for free. But it took work to get these natures to work for free. This was the innovation of early capitalist technical advance. Sugar and wheat frontiers remade the world only through extraordinary movements of capital, knowledge, and humans, each movement a mighty expenditure of energy aimed at transforming nature’s *work* into the bourgeoisie’s *value*. Yes, coal and oil are dramatic examples of this process of appropriating unpaid work, understood in such a relational framework. But this observation—namely, that fossil fuels have been central to rising labor productivity—is turned into a fetish when the same processes are not applied to early capitalism.

The consequence is a massive blindspot in radical thought: the great labor productivity revolution of early capitalism is almost universally ignored (see Moore 2017, *forthcoming*, a).<sup>5</sup> Why so ignored? Because our metrics and narrative frames have been largely unable to bring unpaid work into value-relations. The challenge is to internalize, in our narrative frames and analytical strategies, the ways that configurations of paid and unpaid work stabilize, and are cyclically restructured, through successive productivity regimes. Returning to our early modern frame, we might ask: How do we internalize, analytically, the fertility windfalls of *massapé* soils in seventeenth-century Brazil? Of the contributions of the families of the *mitayos* (forced wage-workers) traveling to the Potosi mines? Of Norwegian and Baltic forests to the shipbuilding centers of the Dutch Republic? Of peasant cultivation to the off-season iron-making work of Swedish peasants, whose labor costs were correspondingly much lower than English competitors? And perhaps most spectacularly—I am again transgressing the Cartesian boundary—of African families whose sons and daughters were impressed into slavery?

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<sup>5</sup> Examples of this early modern labor productivity revolution include: the printing press, perhaps the earliest “great leap forward” in labor productivity with a 200-fold increase after 1450, such that 20 *million* printed books were produced by 1500 (Febvre and Martin 1976: 186; Maddison 2005: 18); the sugar mill in the colonies, successively boosting labor productivity, and the sugar refinery in the metropolises (Daniels and Daniels 1988; van der Woude 2003; Moore 2007); very large blast furnaces in iron-making (Braudel 1981: 378–79); new ships, such as the Dutch *fluyt*, leading to a fourfold increase in labor productivity in shipping and likely a comparable advance in shipbuilding (Unger 1975; Luccassen and Unger 2011); a new shipbuilding regime, led by the Dutch, which combined Smithian specialization (simplified tasks), the standardization of parts, organizational innovation (integrated supply systems), and technical change (sawmills to displace costly skilled labor) combined to triple labor productivity (Wilson 1973; van Bochove 2008: 196; de Vries 1993; Noordegraaf 1993: 5); the rapid expansion of iron implements in agriculture (Bairoch 1973); the mercury-amalgamation process in New World silver production (Bakewell 1987); the elaboration and diffusion of screw-presses (Kellenbenz 1974); the *saigerprozess* in the Central European copper-silver metals complex, and after 1540, the rod-engine for effective drainage, which reached Sweden by 1590 (Blanchard 1995; Hollister-Short 1994); the quick diffusion of the “Saxony Wheel” in textile manufacturing, trebling labor productivity, accompanied by the diffusion of fulling and napping mills, advancing productivity still further (Munro 2002: 264); the doubling of the number of water mills, already widely deployed in the medieval era, doubled in the three centuries after 1450, and tripling of aggregate horsepower (Debeir, et al. 1991: 90–91, 76); the extraordinary multiplication of spring-driven clocks (Landes 1983) . . . nor does this exhaust the list.

This early modern labor productivity revolution turned not only on Smithian specialization, technological change, and organizational innovation, but also on the new *technics* of value through which Cheap Natures were mapped, organized, and appropriated. The “fertility” of cheap natures was the pedestal for productivity advance within the commodity zone. Perhaps inadvertently, Clark offers an illuminating contrast about labor productivity informed by a caloric metric. In a passage that would resonate with any energy-centered critic of industrial agriculture, Clark notes that the average “worker-hour” in English agriculture around 1800 yielded about 2,600 calories, premised on wheat, milk, and wheat staples (2007: 67–68). In contrast, the average “worker-hour” in swidden agriculture in early nineteenth-century Brazil, cultivating manioc, maize, and sweet potatoes, yielded anywhere between 7,000 and 17,600 calories (2000: 67–68).

What does this tell us? Most of all, it tells us that one of the key reasons why capitalism was able to consolidate across the early modern era was its ability to appropriate the astounding realities, and realize the extraordinary potentialities, of uncommodified natures worldwide. If sixteenth-century Europe was exceptional in any technological sense, it was this. Food works well as an example, because the metrics are easy, but one could multiply the appropriations of worker-hour windfalls to all sectors of early capitalism. How would work-hour productivity in timber vary between, say, coppiced English forests and the relatively unmanaged Norwegian forests of the late sixteenth century? Or between long-exploited Central European silver mines and Potosí’s Cerro Rico around 1550? In a narrow sense, these differences were not “produced” in any straightforward, linear sense. But neither were these bountiful frontiers simply there for the taking. *They were co-produced.*

There was necessarily a mix of serendipity and strategy at play in early capitalism’s productivity revolution: serendipity insofar as New World crops such as maize, potatoes, and manioc were high-yielding, and strategy insofar as the new commodity frontiers (sugar and silver especially) actively constructed their production systems around such high-yielding crops. But even where Old World crops were introduced—the Spaniards in colonial Peru loved wheat bread—the initial yields were extraordinarily high (an order of magnitude greater than Europe’s average) and remained so for the first long wave of colonial domination (c. 1545–1640) (Super 1988; Moore 2010d). The point can scarcely be overstated: the introduction of Cheap

Food, as civilizational strategy, “acts like an increase in fixed capital.” The declining price (value composition) of food is advancing labor productivity is the rising rate of exploitation.

The catch? The cheapening of food—along with raw materials and energy—cannot be accomplished by economic and territorial means alone. Cheap Food, and Cheap Nature as capitalist project, could be realized only through the symbolic regimes of abstract social nature. These encompassed the “primitive accumulation of botanical knowledge” organized by Iberian botanical gardens (Cañizares-Esguerra 2004), the emergence of a new “map consciousness” (Pickles 2004), the “death of nature” inaugurated by early modern materialism (Merchant 1980), and much more.

The law of value-in-formation during and since early capitalism unfolded through two simultaneous movements, corresponding to the dialectic of value/not-value (use-value). The latter is “produced” through the zone of appropriation—the condition for *value*—encompassing the unpaid work/energy of human and extra-human natures. Historical capitalism has been able to resolve its recurrent crises because territorialist and capitalist agencies have been able to extend the zone of appropriation faster than the zone of exploitation. This has allowed capitalism to successively overcome seemingly insuperable “natural limits” through the coercively-enforced and scientifically-enabled restoration of the Four Cheaps: labor-power, food, energy, and raw materials. The Four Cheaps are produced by effecting “accumulation by appropriation” faster than “accumulation by capitalization.” This is possible on a planet where capitalization is limited and most life reproduces without the help of capital: the reality of early but not twenty-first century capitalism. Hence, the centrality of the frontier and imperialism in capital accumulation. Significant enlargements in the zone of appropriation resolve capitalism’s crises by simultaneously reducing the value composition of production, expanding physical output, and opening new spheres of capital investment. All of this can proceed so long as capitalization is checked, and appropriation liberated. This is, indeed, the history of capital, empire, and science in the modern world: every new era of capitalism brings with it a new industrialization, a new imperialism, a new science.

## VALUE AND HISTORICAL NATURE

A new industrialization. A new imperialism. A new science . . . a new nature? And if so, what could this mean? This argument about value implies a major shift in how we think of the web of life. If the law of value lends capitalism its patterned coherence—that is, there are identifiable historical-geographical patterns of power and re/production that hold over the long time and large space—the concept of nature works at two levels of abstraction with distinct geographies. The convention, even among radicals, is to see nature as “out there.” This is Nature as a set of resources and extra-human relations to be mobilized and treated sustainably or unsustainably. This is indeed one of the realities we must deal with. It is how capital views nature. It is capital’s civilizational *project* to bring reality into line with this vision. Its geography is the geography of nature-in-capitalism. Nature as contained, controlled, rationally coordinated. At another level of abstract, the web of life works as we all experience it to work: our “environment,” all that surrounds us and flows through us. Here is nature as a whole; we are of it, and “it” shapes all our lives—the lives of civilizations and “big structures” as well. Its geography is the geography of capitalism-in-nature. This is the *process* of historical capitalism. It is messy, cyclical, and full of surprises.

Capitalism’s law of value therefore represents a project that creates a new *historical nature* for the capitalist era and for its successive phases of development. These acts of creation are of course partial, as will be explained momentarily. The linear project becomes subject to a dialectical world-nature. Historical nature, in any given era, is the field upon which historical systems, classes, and capitals operate. It is co-produced, though never in the same fashion from one era to the next, as both human capacities and extra-human natures shift, evolve, and settle upon new patterns. Through these shifts, evolutions, and ruptures, nature as a whole changes, though seldom in direct proportion to the former.

The illusion is to see capitalist agencies developing new “ecological” regimes just as they have developed new trade regimes or geopolitical arrangements. One can productively specify food or resource regimes, of course. But these regimes are neither more nor less “ecological,” only differently configured, than new forms of industrialization or finance or territorial power. All of these moments unfold within the web of life, crystallize distinctive weavings of human and

extra-human nature, and work on and work out different configurations of the *oikeios*. From the standpoint of the capitalist project, value issues a linear directive: remake the natures within reach, reduce them to quantifiable units, mobilize these units in service to commodity-centered labor productivity.

The historical process is of course distinct. The fantasies of value, fantasies with real operative force (“real” abstractions), confront an unruly reality in which everything that humans do with each other is wrapped up in what we do with other natures—and within nature as a whole. The reality defies the extraordinary conflation of “humanity” with the owners of capital, and of “human impacts” on the earth with capital’s exterminism—embodied in value’s surreal compulsion to quantify life and land and ignore everything else.

The co-production of historical natures over the past five centuries is therefore not one of humanity and nature but of specific configurations of human and extra-human nature, differentiated by civilization, class, state, gender, race, and much more. What this means is twofold. First, capitalism does not “produce” nature in a linear fashion, but is an evolving whole that joins the accumulation of capital, the pursuit of power, and the co-production of nature. Secondly, capitalism is not a structurally invariant monolith, Society, acting upon a structurally invariant, external, Nature. Rather, the history of capitalism is one of successive *historical natures* which are both producers *and* products of capitalist development. The point is elementary but underappreciated. At a time when no serious critical scholar would undertake a study of neoliberal capitalism by using “production in general” (Marx 1973: 85), much of Green Thought continues to embrace a notion of “nature in general.” The point may seem far removed from contemporary political questions. I wish to suggest that it is anything but. The concept of “nature in general” as external and essentially static has made it easy for many scholars and activists to embrace the apocalyptic imaginaries of catastrophe and collapse. Absent the specification of historical natures that encompass humanity, nature-in-general has driven Green politics into an “either/or” position: sustainability or collapse (e.g., Costanza et al. 2007).

The alternative? Nature is not just there. We know nature only through our life-activity. Through this life-activity occurs a triple transformation: of ourselves, of external nature, of our relation with other humans and the rest of nature (Marx 1977: 238). This holds,

too, for human organization, the very largest of which are civilizations, understood as patterns of power and production obtained over long-time and large-space. Civilizations co-produce *historical natures* specific to these patterns, and to the developmental phases of these patterns. Crucially, these patterns are not merely about earth-moving, but also about ways of seeing and knowing nature. We call the latter two “symbolic” but they are, in reality, tightly bundled with the material. Ways of earth-moving and ways of knowing form an unbroken, if uneven, circle. To say that humans know only historical natures is not to deny nature in general but to situate our thinking of nature—and the historical practices that unfold from specific ways of knowing nature—within the double internality. In this perspective nature “in general” exists as noumenon, a category of the last instance, without any qualification or characterization. For capitalism, however, nature is an object of labor, a resource, a manifold, an attic, or a cellar, or a boxroom to be ransacked. . . . It is a potential to be actualized by different epochs with different goals, different priorities, different cosmologies, different world views and agendas. The metaphysical basis of reality, of experience, of investigation, changes. Ontologies change, epistemologies change, methodologies change. At a more mundane academic level, there are paradigms, research programs, disciplines, grand theories—all of which are formed and constituted by the contradictions and moving resolution of class forces of different epochs. This is a dynamic, dialectical historical process, born in conflict and struggle (Young 1985).

There are two layers of historical nature specific to capitalism. The first is a historical nature specific to capitalism as a whole. The second is the succession of historical natures co-produced through the law of value: successive phases of capitalism-in-nature. As we have seen, this law of value is a law of Cheap Nature, a dynamic relation compelling the cyclically punctuated realignments of abstract social labor and abstract social nature. The rise of globalizing value relations and the rise of capitalism concurrent with the incessant revolutionizing of time, space, and nature has been central to capitalism from its origins (Harvey 1989; Moore 2007). That these revolutions were fundamentally socio-ecological is easily overlooked. And yet, the universalization of money capital as a storehouse of value is unthinkable except as a part of a world-ecological revolution that enabled European states and capitals to perceive, represent, and act upon a Nature that was cheap and external.

A view of capitalism that proceeds from nature in general tends to flatten not only our understanding of nature as something whose energies are inexorably drawn down, but also our conception of capitalism. Both nature and capitalism become structurally invariant in such a rendering. But the survival of capitalism has turned on its unusual flexibility (Braudel 1982). Where Braudel stressed capital's capacity to move from one sector to another—say, from industry to finance—we might highlight an even more fundamental form of flexibility: the capacity to move from one historical nature to another.

Capitalism has survived the rising capitalization of nature, the incorporation of natures into the circuit of capital, because it revolutionizes the *oikeios* in an entirely novel way. Every phase of capitalism not only makes a quantum leap in its material throughput, but makes that quantum leap through the co-production of a historically-specific nature. The quantitative expansion of capital accumulation occurs through the qualitative reconstruction of historical nature.

Just as the imperialism and great firms of the seventeenth century are not equivalent to the imperialism and great firms of the twenty-first century, neither are we dealing with a structurally invariant nature. There is a quantitative moment that merits careful scrutiny: the exponential growth curves of twentieth-century resource use are a powerful illustration (e.g., McNeill 2000; Costanza et al. 2007). We now have an important literature on energy history for early capitalism, too (Allen 2006; Malanima 2006, 2011). But the qualitative moment that allowed these growth curves cannot be abstracted. Not only has capital sustained itself on the basis on cheap inputs (the quantitative moment); it has also revolutionized the socio-ecological relations of production (the qualitative moment). In this fashion, leading capitalists and imperial states have mobilized a succession of “great leaps forward” in the ecological surplus: the rising share of appropriated unpaid work/energy relative to the mass of accumulated capital. The cumulative moment of geometrically rising throughput is embedded in a cyclical moment of producing new configurations of the *oikeios*. Hence the significance of *historical nature*. Industrial capitalism gave us Darwin and the Kew Gardens, neoliberal capitalism, Gould and biotechnology firms. These cumulative and cyclical movements help us to see how historical nature is created at the outset of an accumulation cycle: (re)launching the Four Cheaps with a high rate and mass of appropriation of unpaid work/energy experiences contradictions that must be resolved through new world-ecological

revolutions. And it is a story of how capitalism's revolutionizing of nature is premised on historical limits of its own making.

### THE *OIKEIOS*, RELATIONAL EXHAUSTION, AND THE LONG WAVE

The normal course of capital accumulation tends to exhaust the establishing relations of re/production that inaugurate a great wave of accumulation. These establishing relations encompass all manner of scientific, botanical and agronomic, cartographic, and technological innovations (see Moore *forthcoming*, a). For now, we will elaborate on a simplified model. The emergence of new major centers of production—with their distinctive patterns of industrial organization and rising labor productivity—is premised on the emergence of more expansive nets of appropriating the unpaid work/energy of human and extra-human natures. These configurations of capitalization (within the circuit of capital) and appropriation (outside that circuit but within reach of capitalist power) allow for long waves of accumulation to unfold. These configurations enable the rate of accumulation to rise at the same time as the costs of production fall.<sup>6</sup> Thus, Cheap Nature, in the specific form of the Four Cheaps (food, labor-power, energy, and raw materials) is the necessary condition for every great wave of accumulation. Over time the value composition of these Big Four inputs begins to rise, the rate of accumulation slows, and capital must find new ways to reconfigure the *oikeios* and restore the Four Cheaps.

The rise and fall of the ecological surplus therefore shapes the cyclical and cumulative development of capitalism. To this point, the crucial question has been evaded: How do we periodize, even provisionally, those “long centuries” of development?

Literature concerning the phases of capitalism is impossibly vast and extraordinarily diverse. But its diversity has unfolded within a common, socially reductionist, frame: phases of capitalism are defined by some combination of (geo)political power, technological

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<sup>6</sup> Alternatively, primary commodity prices might remain stable as output rises sharply, as with English coal in the sixteenth and seventeenth centuries (Allen 2006), or copper in the later nineteenth century (Schmitz 1986).

development, class relations, the world market, capitalist organization, and so forth. Within a Cartesian frame, it is possible to render plausible these conceptualizations of capitalism's stadial development. In a world-ecological frame, however, neither the extant conceptualization of the parts (technology, class, etc.) nor the conceptualization of wholes (eras of capitalism), makes sense. All are implicitly world-ecological in the terms that I have laid out. But their explicit reconstruction awaits.

Nevertheless the question of periodization cannot be evaded. Consider, for instance, Arrighi's scheme of successive "long centuries" of capital accumulation as a guiding thread (1994). But I propose to take Arrighi's arguments a step further. The result is a comradely, but fundamentally distinct, synthesis. Arrighi's model of capitalism unfolded from the premise of "input-output" combinations (1994: 5), rather than value as a co-productive relation of capital/nature. The core of his approach was therefore substantialist, a view that confused capitalism with its process, and one that reduced extra-human nature to substances. This led to a historical error with significant theoretical and methodological consequences. For Arrighi did not see that early capitalism was not *real* capitalism. He is hardly alone in this mistake. As we shall see, early capitalism was, *in every major respect*, "real" capitalism, premised above all on the law of value as a law of Cheap Nature: a law that prioritized rising labor productivity in commodity production and exchange. These productivity advances were realized through the unprecedented appropriation of unpaid work/energy. Failing to see the appropriation of Cheap Nature as central to world accumulation, has led to a major mis-recognition of capitalism's laws of motion: namely, that these laws of motion work within the circuit of capital, and socio-ecological relations outside the circuit of capital are not constitutive. This mis-recognition has prevented Marxists and Greens alike from seeing how nature-as-*oikeios* matters. Social reductionism has prevented too many scholars from seeing that frontiers and strategies of appropriating unpaid work/energy have "acted like an increase in fixed capital" in the history of capitalism (Marx 1973: 748). Indeed, the great mechanizations of the past five centuries are dwarfed by contributions of Cheap Nature to world accumulation.

Like Arrighi, I see successive long centuries of capitalist development as central to the story of capitalism: capitalism does not "automatically" restructure (Arrighi and Silver 1999). My periodization—

readers will detect a familial resemblance to Arrighi's model—looks something like this: 1) a Germanic-Iberian cycle (c. 1451–1648), in which the expansionary phase turns to relative decline after the 1557 financial crisis; 2) a Dutch-led cycle (c. 1560s–1740s), in which decline sets in after 1680; 3) a British-led cycle, c. 1680s–1910s), with relative decline after 1873; 4) an American-led cycle (c. 1870s–1980s), with relative decline after 1971; and 5) a neoliberal cycle that commenced in the 1970s. Naming and periodizing is a tricky business, and I make no pretense that these are the best possible; they are simply the most reasonable presently available. This article does not attempt to reconstruct the narrative because we do not yet know how to reconstruct the narrative in a way that recognizes the double internality of capitalism-in-nature/nature-in-capitalism. Such reconstructions are crucial if we are to understand the limits of capitalism today. They will be most effective as they emerge through a sustained conversation among scholars committed to a synthesis in which nature matters. As such, this periodization is a provisional model to allow for reconstructive critique. It is invitation as much as definition.

For Marx, the threat of underproduction was imminent to capitalist development. Marx's general law of underproduction identifies the circuit of capital *as* a socio-ecological relation, albeit one whose substance (value) is necessarily blind to “natural distinctness” (1973: 141). In this model, “the rate of profit is inversely proportional to the value of the raw materials” (Marx 1967, III: 111). The cheaper the raw materials and energy, the higher the rate of profit. Why? Because “constant” capital is comprised of two moments. One is fixed capital, comprising machinery, but also other extra-human forces of production, including animals, that outlast the production cycle.<sup>7</sup> The other is *circulating* capital, not to be confused with the *circulation* (and circuit) of capital. Circulating capital consists of energy and raw materials used up during a production cycle. The dynamism of capitalist production, observes Marx, leads the “portion of constant capital that consists of fixed capital . . . [to] run significantly ahead of the portion consisting of organic raw materials, so that the demand for these raw materials grows more rapidly than their supply” (1967, III: 118–19).

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<sup>7</sup> Hribal (2003) and Haraway (2008: 55) are correct to argue for non-human animals as central to the production of surplus value—but err in assigning animals to the working class. This is not, in any event, how capital views animals, which are either circulating or fixed capital. Indeed, the very condition for variable capital (*human* labor-power) is capital's designation of non-human animals as non-workers.

Here, the “overproduction” of machinery (fixed capital) finds its dialectical antagonism in the “underproduction” of raw materials (circulating capital) (1967, III: 119).

Marx’s theory of underproduction was of course provisional. Capitalism’s productive dynamism is undeniably important here. As capitalist production demands a geometrically-rising throughput, supply crunches are inevitable—even as the severity and duration of such crunches is uneven. But the story of underproduction cannot be told through investment flows and industrial production alone. Simply putting more capital in play does not *necessarily* call forth Cheap Nature, as capitalists in the world energy and metals sectors are discovering today (Kopits 2014; Stevens et al. 2013; Humphreys 2010). The tendency towards underproduction is also a story of how capitalism unfolds through the *oikeios*, and how capitalization exhausts the work/energy streams that open up new opportunities for expanded accumulation. Simply put, the problem of exhaustion is a problem of how capitalism puts nature to work.

Why do the costs of production rise over long waves of accumulation? There are certainly many factors involved, not least those swirling about Marx’s general law of underproduction. In the rush to accumulate capital, and to out-compete other firms, capitalists are not only compelled to invest in more machinery, but to advance labor productivity at every step. Rising labor productivity is rising material throughput per unit of labor-time. (Or more widgets per hour.) Manufacturing is therefore intimately connected with extractive systems in energy, forestry, agriculture, and mining.<sup>8</sup> (*Both, however, are industrial.*) These modes of extraction, however, do not quickly respond to changing industrial and urban demand. There are distinct temporalities in play, which have to do with the different ways that primary and industrial production are bundled, geographically and materially, through the *oikeios*. The most famous of these distinctions—and arguably the most important—is the difference between the production time of agriculture, regulated by the seasons, and its labor-time, such that the continuous flow of manufacture is counterposed to the cyclical flow of cultivation (Marx 1967, II; Mann 1990). If industrial work at the point of production involves the immediate interaction

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<sup>8</sup> This is a preliminary distinction. Agriculture internalizes elements of both categories, and there is a distinction to be made between primarily organic extraction (farming, forestry) and inorganic extraction (coal mining, oil drilling).

of “living” with “dead” labor: workers, machinery, and inputs, extractive work involves these and more: living labor with unpaid (but living) work/energy. Working up the raw materials is easier than getting them out of the ground in the first place; it’s easier to cook a hamburger than it is to butcher a cow. There is, then, a necessarily sticky supply response involved in the delivery of raw materials (circulating capital) to the factory gates. As capitalism developed, that sticky response became more fluid. *But only for a time.* By the end of the twentieth century, the accumulating contradictions of capitalism-in-nature began to reimpose such “stickiness.” Climate change, superweeds, and other signs of extra-human nature’s revolt of began to register as formidable barriers to the old models of accumulation.

## VALUE AND ABSTRACT SOCIAL NATURE

We may now derive a working proposition: the law of value is a way of organizing nature. It is a world-historical project and process of reordering capitalism’s natures, such that one biophysical moment is internalized, as human labor-power (reclassified as “social”), and another is externalized through the progressive subsumption of the rest of nature as a free gift to capital. Value, in other words, is co-produced by human and extra-human natures, not as two blocs but as differentiated bundles of the *oikeios*, and extra-human natures’ relationality is reordered through value as a way of organizing life.

In the English language, value signifies two big things. First, it refers to those objects and relations that are *valuable*. Secondly, it refers to notions of morality, as in the fact/value binary that has loomed so large in modernist thought. Marx’s deployment of the “law of value” was, of course, precisely aimed at identifying the relational core of capitalism, grounded in the expanded reproduction of abstract social labor. And Marxists since Marx have defended, and sometimes elided, the law of value as an economic process that encompasses that first meaning of value: those objects and relations that capitalist civilization deems *valuable*. And so it has been difficult indeed, on this historical experience, to suggest that the operation of the law of value—the expanded reproduction of value-*relations*, enabling the quantitative expansion of abstract labor—may encompass both meanings.

Difficult, yes, but not impossible. Historically speaking, it is hard to deny that new knowledges and symbolic practices—say cartographies and double-entry bookkeeping—were crucial to the formation of capitalism. That this early capitalism might be, in fact, a precocious value regime is often doubted, but it does not reasonably do to dismiss this out of hand: a new world-praxis, by empires and capitals, premised on abstract time and space, money, and nature should give one pause. To introduce such symbolic-cultural affairs into value is, of course, to destabilize the subjective/objective binary presumed by most political economy. The objective world of value has been forged through the subjectivities of “capital’s imagination” (Haiven 2011). The calculative character of value is not a matter of capital using an objective knowledge—premised on dualism and quantification—but a matter of capital deploying its symbolic power to represent the arbitrary character of value relations *as* objective (Bourdieu 1979; Bourdieu and Wacquant 1992). This, I think, is Mitchell’s point in his account of the British economy-making in colonial Egypt (2002), centering on calculability as not merely an objective tool of empire but as a project immanent to imperialism’s bundling of power, class, and nature in the early twentieth century. This line of argument has, alas, centered more on politics than on *political economy*, and thus attention has been lavished on the sphere of power without sufficient attention to the value-relations that determine the decisive stakes of the game. It is not that capital operates independently of power. Rather, systemic rules of reproduction are not determined by power in general, or by territorial power, but by agents unfolding through the law of value-in-nature. This re-framing may help us to clarify the value-relational configuration of paid and unpaid work. For a long time, the “objective” world of economic process was immunized from the moral critique—withstanding a centuries-long countercurrent of moral economy protest and argument (Thompson 1971). But was not this fact/value antinomy itself a strategic way of making rational the essentially arbitrary boundary between paid and unpaid work? That is to say, are not the two common usages of value—as morality and economy—implied in capitalism’s law of value?

The foregoing suggests that knowledge/culture and value as abstract labor are indeed closely linked. But how? The argument may be stated simply enough. Abstract social nature names a systemic family of processes centered on rationalizing, simplifying, standardizing,

and otherwise mapping and coding the world in service to the quantitative expansion of abstract labor. In this reading, abstract social nature signifies the relation of capital to unpaid work through which spatio-temporal practices identify and facilitate the appropriation of unpaid work. These appropriations do more than supply necessary raw materials; they co-determine “socially” necessary labor-time. In this, abstract social nature can be understood as directly constitutive of value *relations* in creating the conditions for the generalization of commodity production and exchange. This has never been a linear sequence—either with new knowledge in the lead, or as derivative of commodification—but a conjunctural affair, in which cascading processes of commodification, capital accumulation, and symbolic innovation have 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 labor. But the relations that make abstract labor’s growth possible cannot be reduced to the economic sphere; they must be grounded in the *technics* of capitalist power and the conditions for the expanded reproduction of capital on a world-scale. Neither an adequate history of capitalism, nor a sufficiently dynamic theory of capitalist limits, is possible within an economistic reading of the law of value.

Capitalism, as project, seeks to create a world in the image of capital, in which all elements of human and extra-human nature are effectively interchangeable. In the fantasy of neoclassical economics, one “factor” (money, land, resources) can be substituted for another; the elements of production can be moved easily and effortlessly across global space (Perelman 2007). This effort to create a world in the image of capital is what I call capitalism’s *correspondence project*, through which capital seeks to compel the rest of the world to correspond to its desire for a universe of “economic equivalence.” But of course the world as a whole—extra-human natures of all kinds, but also the re/producing classes—does not much want a world of capitalist equivalence. (For that matter, neither do actual existing capitalists, since true correspondence between the logic and reality of capitalism would spell the end of unpaid work.) At some level, all life rebels against the value/monoculture nexus of modernity, from farm to factory. No one, no being, wants to do the same thing, all day, every day. Hence, the struggle over the relation between humans and the rest of nature is necessarily a class struggle. (But not *just* a class struggle.) The struggle over the grip of commodification is, in the first

instance, a contest between contending visions of life and work. Extra-human natures, too, resist the grim compulsions of economic equivalence: superweeds frustrate genetically-modified agriculture; animals resist their assigned roles as objects and forces of production. In this way, capitalism's correspondence *project* meets up with all manner of contending and contentious visions and resistances to create a historical *process* full of contradictions.

Among these contradictions, surely at the top of the list we find those countervailing forces that threaten to slow down the turnover time of capital and to defy the radically simplifying disciplines of capital: working class struggle in the heartlands of industrial production is a good example (Montgomery 1979; Silver 2003). So too is the revolt of extra-human nature in modern agriculture, where a distinctive form of struggle manifests: the "battle with weeds" (a plant in the wrong place) and troublesome pests (Clayton 2003). The pesticide/herbicide treadmill (and its cognates) are bound up with Cheap Nature strategies that hothouse evolutionary adaptation at the point of production and the scale of world accumulation. On the one hand, as the flurry of news reports on the "superweeds" sweeping across the GMO soy zones of the United States revealed in 2010–11, biological natures now appear to be evolving faster than the capacity of capital to control them—resulting in a "Darwinian evolution in fast-forward" (Neuman and Pollack 2010). On the other hand, the revolt of extra-human natures is aided by the revolutionary geography of accumulation itself: from the origins of modernity, "the accumulation of capital . . . is strongly and positively associated with the accumulation of alien invasive species" (Perrings 2010; e.g., Crosby 1972). In sum, capitalism's speed-up and geographical rationalizations suggest a tendency towards rising "geographical inertia" (Harvey 1982: 428–29) that extends well beyond the built environment to encompass *all* environments entrained within value's gravitational pull.

How have these spatio-temporal contradictions, of compressed time and simplified space, been resolved? By and large, it has been through geographical expansion and restructuring—two moments which are geographically distinctive, but unified. Both movements turn on externalizing costs and appropriating unpaid work inwards towards the relations of reproduction (e.g., the shift to the two-income household in the North since the 1970s), and outwards towards minimally-commodified zones of Cheap Food, Labor, Energy, and Raw Materials.

These paired movements of geographical expansion and restructuring are at the core of capitalism's successive spatial fixes, necessary to resolve successive *conjunctures* of overaccumulation. They are constituted through a double movement: 1) the widening and deepening the zone of commodification (value production/abstract social labor), and 2) on an even greater scale, the widening and deepening the zone of appropriation. This latter movement turns on the production of abstract social nature. Abstract social nature is produced through the biopolitical, geographical, and scientific-technical knowledges and practices necessary to secure the conditions for renewing the Four Cheaps. This means that new "frontiers" of *unpaid work* must be identified, and then pressed into the service of capital accumulation.

This reading of the law of value allows us to see the difference between capitalism as historical project and capitalism as historical process. As project, capitalist civilization produces both symbolic forms and material relations that lend Cartesian dualism its kernel of truth; the law of value does indeed reproduce a way of seeing reality that is dualist. Capitalism, as project creates the idea and even a certain reality of "the" environment as an external object. The idea of the environment as external object—rather than as *oikeios*, the creative relation of species and environment-making—is not false, but rather a historical creation of the capitalist world-ecology. The mistake of environmental studies has been to confuse the real historical creation of the *idea* of environment as external object with the *reality*: the reality that environments are always inside and outside of us, material and symbolic *at once*. This is why I emphasize capitalism as a dialectic of project (what the law of value wishes to do, in creating a world that corresponds of value's interchangeability), and process. Capitalism, as world-historical process, is a co-production of humans and the rest of nature. This co-produced historical reality compels the capitalist project to deal with nature (as *oikeios*) no matter the utopian fantasies of value and its universe of economic equivalents. As a process of capital accumulation, capitalism must relentlessly dissolve the boundaries of life in its voracious internalization and reconfiguration of unpaid work—human and extra-human alike (e.g., women's work, beasts of burden, etc.)—in service to the utopian project of endless valorization.

## CONCLUSION

What if one were to say *historical* capitalism implies, *necessitates*, historical nature? And what if one were to say *historical nature*—since the “long” sixteenth century—implies and necessitates historical capitalism? These are the fundamental questions posed by the double internality. This line of questioning encourages, even compels us to go beyond the now-commonplace and rarely specified invocation of Nature as one of several crises facing Humanity today. It asks us to examine how the web of life reshapes human organization—as a force of nature—and how civilizations forge power, production, and reproduction as ways of organizing nature. It asks us to reflect upon our well-worn conceptualizations of capitalism: as economic system, as social system, as commodity system. For if the production of capital has been the strategic pivot of capitalism, to an even greater extent accumulation has unfolded through the appropriation of planetary work/energy. Such appropriation—yes of cheap resources (“taps”) but also of cheap garbage (“sinks”)—does not produce capital as “value,” but it does produce the relations, spaces, and work/energy that make value possible. Capitalism *does* generalize commodity relations, but the actual extent of such generalization depends on an even greater generalization: the appropriation of unpaid work/energy.

This even greater generalization has today reached a boiling point with runaway climate change. The appropriation of Cheap Natures has not only compelled capital to seek out new sources of cheap labor-power, food, energy, and raw materials, but to enclose the atmosphere as a gigantic dumping ground for greenhouse gases. This enclosure—a relation of capital-in-nature—is today generating barriers to capital accumulation that are unprecedented, especially in agriculture. And at the risk of putting too fine a point on matters, this enclosure of the atmosphere is a *class* relation: not only as cause-effect sequence (“the capitalists did it!”) but as a necessary condition of world class relations over the past two centuries.

This way of thinking through the relations of capital-in-nature gives us an alternative to the “nature as external limit” thinking that dominates Red and Green thinking about ecological crises, and about climate change in particular. The problem with such thinking is that it closes down, rather than opening up, the big questions about the geographical flexibility and historical evolution of capitalism as

world-ecology. The limits are real enough. But what is the best way to identify, to narrate, and to explain the emergence of these limits? My response has pointed towards a new conception of value relations that leans heavily on the old, but departs from it in new ways.

Value operates through a dialectic of exploitation and appropriation that illuminates capitalism's peculiar relation with, and within, nature. The relations of exploitation produce abstract social labor. The relations of appropriation, producing abstract social nature, enabled the expanded accumulation of this abstract social labor. On the one hand, the system turns on a weird coding of what is valuable, installing human work within the commodity system (wage-labor) as the decisive metric of wealth. In this domain, the exploitation of labor-power is pivotal, upon which all else turns. On the other hand, the exploitation of wage-labor works only to the degree that its reproduction costs can be checked. The mistake is to see capitalism as defined by wage-labor, any more than it defined by the world market. Rather the crucial question turns on the historical-geographical connections between wage-work and its necessary conditions of expanded reproduction. These conditions depend on massive contributions of unpaid work, outside the commodity system but necessary to its generalization. Sometimes this is called the domain of social reproduction (Bakker and Gill 2003), although it is here that the adjective "social" seems especially unsuitable—where does the "social" moment of raising children end, and the "biological" moment begin? Clearly, we are dealing with a zone of reproduction that transcends any neat and tidy separation of sociality and biology, which are better viewed as internal to each other. Neither is this zone of reproduction—the domain where unpaid work is produced for capital—a narrowly human affair. For unpaid work not only makes possible the production of potential, or the reproduction of actual labor-power as "cheap" labor; it also involves the unpaid work of extra-human natures. In this domain of reproduction, the *appropriation* of unpaid work is central. Such an approach opens up new questions about how capital accumulation, global value-relations, and biospheric change fit together, historically, and in the present rush into the planetary inferno.

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