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CHAPTER

Land in World-Ecology Perspectives

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Abstract

While theorists of international relations have generally understood land as a strategic resource under the purview of nation-states, a range of theories in the classical Marxist tradition have offered an increasingly sophisticated critique. World-systems theory sought to explain how enclosure turns land from commons into a fungible commodity to which labor and capital are applied across the planet. Through its analysis of the commodity frontier, world-ecology offers a way of thinking about land and the web of life of which it is part that complicates temporal, physical, and politico-legal understandings on which capital and labor operate. This chapter explores how world-ecology helps to deepen an understanding of land by posing questions about how land becomes recognized, and worked on, under capitalism. By drawing attention to the national-state and international complexes that attend the expansion of commodity frontiers, and to the dynamics of material and discursive change through such frontiers, this chapter shows how land itself becomes a site of production about which a richer series of questions might be asked.

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Introduction to World-Ecology

Every political economist needs a theory of action at a distance. Whether land is enclosed and transformed because of supply and demand, by wars among great powers, in the *Sturm und Drang* of imperial terraforming, or simply from the exigencies of "globalization," there is always a story that connects land in one place to decisions made by humans elsewhere. This chapter examines a relatively new theory: world-ecology. Before we situate a world-ecological view of land in a broader context, a word about terms. *World-ecology* needs its hyphen. Without it, unsuspecting readers might imagine that "world ecology" refers to the study of the relationship between species and abiotic habitats, on a planetary scale. While the earth's ecology is certainly grist for scholars of world-ecology, the intellectual lineage that matters most is that in which "ecology" comes to substitute for "system": world-systems theory. For the unfamiliar, world-systems theory isn't just the operating "system of the world" (Stephenson 2005). It is, rather, the tradition that drew on the Annales school of world history, principally through Fernand Braudel's work, which took a particular structural and sociological bent through Immanuel Wallerstein's world-systems theory (Wallerstein 1974; Braudel 1972).

The first volume of Wallerstein's analysis of the modern world-system has a subtitle that provides a helpful point of departure: "Capitalist Agriculture and the Origins of the European World-Economy in the Sixteenth Century." Finding the origins of a world-system in the 1500s, at the dawn of capitalism, fits well with the temporal concerns of the Annales school, and its interest in the backdrop of events within the structures and conjunctures of the longue durée (Braudel 1972, 16; Forster 1978). So, too, does the analysis of the forces

that implicated peasantries and workers in the grand arcs of history. The Annales school had little use for transcripts of diplomatic history between great powers. The full title of the Annales journal—*Annales: Economies, sociétés, civilizations*—signaled the ambition. Far more interesting to this journal's contributors were the temporal cycles of commodities, flows of people and ideas, and long-term ecological shifts that provided the material backdrop for the courtroom dramas with which other historians preoccupied themselves. The same interests are the grist for both world history and world-ecology.

Across the vast canvas of exchanges and transformations that took place in the early modern era, Wallerstein (1979) identified an analytical relationship that could weave those relationships together in a dramatically new way: "the defining characteristic of a social system [is] the existence within it of the division of labour" (5). Centering the question of work allows for a supple reading of history and the present. When the task of analysis is to investigate the geography produced through the division of labor instead of comparing divisions of labor within spatial units defined *a priori*, vital connections emerge across, as Braudel (1972) originally offered, the Mediterranean world. Here, at the heart of world-system analysis, lie the entwined questions: "Who does the work, where are they doing it, and for whom?" (See, similarly, Bernstein 2006.)

Dialectic analysis of the division of labor offers rich rewards. In her overview of world-systems theory, Harriet Friedman helpfully summarizes three linked outcomes that become far easier to see through a world-systems lens. When looking at capitalism's development, the world-system approach foregrounds, first, the development of an international system of prices. Unlike the ancient trade routes, these patterns allow the simultaneous transmission of the same price to producers that might be continents apart. Second, the international division of labor fosters "a larger-than-local pattern of specialized production and interdependence" (Friedman 2000, 501). In the discipline of international relations, this is sometimes understood as the ongoing ledger of "uneven and combined development" (Rioux 2015). Finally, a system of states that recognized each other, and whose practices involved safeguarding and expanding the property rights of its dominant actors, was a third component outcome.

Using world-systems analysis, units of political geography emerge from the processes of capitalist accumulation and crisis. World-systems thinking can be understood as a rejoinder to methodological approaches in liberalism, in which units of comparison such as nation-states are assumed to be natural and independent, operating in the universe of liberal political economy, whose hidden laws of motion might be discerned with sufficiently elegant comparative experiments (Hollis and Smith 1990). Yet this understanding of "globalization" generally fails to account for the processes that produced it. In response, theorists keen to stretch the liberal field have supplemented it with approaches that take the international, not as a given, but as a product of a process of a spatially connected and crisis-ridden expansion of capitalism. As Justin Rosenberg explains, "The significance of 'uneven and combined development' lies in its utility for exactly the opposite exercise: namely, for reintegrating 'the international' within the remit of 'the social.'" (Callinicos and Rosenberg 2008, 86).

Sociologists have been engaged in this project this for some time. World-systems theory encourages a less black-box approach to international relations, asking questions of incorporated comparison (McMichael 1990). So, for instance, instead of asking what the trade in enslaved people did to Martinique, a world-systems approach would locate flows of people, capital, and commodities through Martinique to Europe, the Americas, and beyond, and ask how flows made places, and vice versa, rather than assume the ontological stability of either capital flows or nation-states (Tomich 1990; Ferdinand and Smith 2021).

A world-systems approach also offers the chance to investigate other moments in the division of labor across the world-system before European hegemony. Although Wallerstein was interested in the rise of Europe, that was not the only or the first such system. There is an ongoing project to recuperate the origins of the European world-system in previous world-systems in Africa and Asia (Abu-Lughod 1989).

This analytical depth comes, however, with new sets of problems. If the units of analysis themselves are a product of capitalism's own dialectics, then world-systems theory must answer an additional question that liberal political economy need never confront: How does the world-system change over time? For historians of an older school, the answer obviously lies in the jostling of nation-states and their prosecutions of wars for dominions that ultimately became independent and formed the system of nation-states we find today. For world-systems theorists, nation-states emerge in the flux of relations of power that extend between the core of the world- system, and its peripheries and semi-peripheries. The nation-state is merely an outcome

of a greater and more relevant set of forces operating at the level of the world-system. States, therefore, receive comparatively little analysis in Wallerstein's work (Navarro 1982).

A position of comparative disinterest in states is, at least, sustained by argument. The real engine for change in the world-system is systemic crisis. Every world-system has a beginning and an end, brought about by the impossibility of managing the contradictions internal to it (Wallerstein 1988). Not all contradictions are fatal in the short run—within the modern world-system, the process of resolving contradictions brought about the rearrangement of financial hegemons, with the most important flows of finance shifting from the Netherlands to the United Kingdom to the United States (Arrighi 1994). Crisis can make itself felt across a society, but in the modern world-system, it is precipitated by the consequences of the capitalist division of labor.

The story Wallerstein (1988) offers is that the bourgeoisie

> sporadically accede to some redistribution of surplus value to working strata in order to recreate and expand effective demand, thus permitting renewed expansion. This solves the middle-run problem. However, over the long run, it means a "freeing" of the factors of production, which means a reduction in long-run profit margins. ... As time goes on, oppressed strata are more and more able to rebel, and more and more ready to do so. By the nineteenth century, the level of possibility and will had reached the point that we began to see the emergence of antisystemic movements in their two classical forms (the socialist movements and the nationalist movements). This political development threatened the logic of the system—endless accumulation of capital—in two ways. First, it strengthened the hands of the world's working strata in the constant battle over the division of surplus-value, and therefore threatened long-run profit margins. Secondly, in order to counter the working strata politically, the accumulators of capital have been forced to turn over an ever-greater share of surplus-value to their agents and defenders ... The only thing the accumulators of capital can really do is more of the same. They can treat these rebellions as part of the short-run problems to which there are middle-run solutions, solutions of "cooptation" ... But this "cooptation" is a process that, in the long run, attacks both the economic and the political underpinnings of the system. (586–587)

An analysis that centers a falling rate of profit is certainly helpful in understanding the upheavals of the modern economy (Kliman 2012). It does appear, however, to be a story in which labor and capital matter most centrally, and land appears only as a place of postponement of the central dynamic of crisis. Absent from the dialectical analysis of the division of labor is a discussion of what is transformed by that labor. Particularly in a time where the word *crisis* is increasingly autocompleted as "climate crisis," this agnosticism about the relationships beyond labor and capital seems a particularly profound oversight.

Frontiers in World-Ecology

World-ecology draws both on Marx and a Marxist tradition to enrich the analysis. An important point of departure is the work of British cultural theorist Raymond Williams. In *Keywords*, he observes: "Nature is perhaps the most complex word in the language" (Williams 1976, 219). The division between nature and society, between the thinking and unthinking world, is one that is sometimes attributed to Descartes. World-ecology suggests, however, that Descartes was less a philosopher than a stenographer of already-existing imperatives of capitalist expansion, with precedents had been set long before he was born, and ideas that were coming to him from as far away as New Spain (Dussel 2008).

The transmuting of nature into commodities is a central concern of world-systems theory and world-ecology, and both are concerned with the boundary conditions of the circulation of capital. That boundary is the site of a great deal of analytical work. Rather than see labor being applied at the frontier, as Moore (2015) notes,

> abstract social labor does not *create* frontiers so much as it *is* [original emphasis] a frontier process itself. That frontier is the boundary between commodified and uncommodified life, and capital moves across that boundary through the mapping and quantifying technics of abstract social nature. For all the "self-contained" character of *Capital*, the production of surplus value is not only

> the proletarianization of labor and the accumulation of capital, but the production of global spaces of capitalization and appropriation. (138)

It's hardly surprising that "the frontier" is the focus of many attempts at conceptual clarification (Beckert et al. 2021a, 2021b; Mostern 2021; Berg 2021). Under world-ecology, capitalism is understood to operate through the creation and "cheapening" of, inter alia, food, energy, work, care, money, nature, and lives (Patel and Moore 2017). Thus, as Moore (2014) observes:

> While all civilizations had frontiers of a sort, capitalism was a frontier. The extension of capitalist power to new spaces that were uncommodified became the lifeblood of capitalism. … 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 indeed central. Commodity frontier movements were also, crucially, about the extension of territorial and symbolic forms that appropriated unpaid work in service to commodity production." (288)

Capitalism's boundaries do not mere merely move through a space that capital itself creates and maps. Frontiers endure. Capitalism quickly exhausts the web of life's "free gifts," but the violent smoothing of territory, time, and space that is necessary to engage in appropriation and commodification leaves traces, remains, debris, and detritus (Chari 2013; Stoler 2013). Within the refuse of the first wave of appropriative colonial encounter lie the *matériel* and culture to fix the crises that will inevitably attend cycles of accumulation. Consider, for instance, the fate of an early outpost in the Portuguese empire, Madeira, so called because it was "an island of wood," *ilha da madeira*:

In 1455, the Venetian traveler and slaver Alvise da Ca'da Mosto observed that "there was not a foot of ground [on the island] that was not entirely covered with great trees." He continued, with a developer's eye for improvement:

> It was therefore first of all necessary, when it was desired to people it, to set fire to them, and for a long while this fire swept fiercely over the island. So great was the first conflagration, that [I was told] this Zuanconzales, who was then on the island, was forced, with all the men, women, and children, to flee its fury and to take refuge in the sea, where they remained, up to their necks in water, and without food or drink, for two days and two nights or thereabouts, to escape destruction. By this means they razed a great part of this forest, and cleared the ground for cultivation.
>
> (Cadamosto [1455] 1937, 9)

In an era when raging forest fires augur planetary destruction, it is jarring to read a description in which an uncontrolled inferno heralds not the end of civilization, but its arrival. In Cadamosto's description, the condition of being a climate refugee is temporary. Although the settlers are escaping the flames in the sea, they are secure in their knowledge that after the fire clears, they will be able to cultivate the land and improve it (Li 2007). Astute observers will note the continuity today with Brazilian president Jair Bolsonaro's approval of the Amazon in flames (Hope 2019).

When he visited Madeira, Cadamosto reported on the booming trade in wheat that fed the burgeoning archipelago of Portuguese colonial conquests (Serrao 1954). Madeira's wood was initially used for lumber in shipbuilding and construction; that was before entrepreneurs recruited the world's leading hydrological engineers to terraform the island, so that flows of water could be channeled to the soil, where a thirsty sugar-cane crop could reliably be cultivated (Patel and Moore 2017). With the crop environment suitably altered, trees became sources not of construction material, but fuel. Through the frontier, the trees were transformed in their social relations from free gift of construction material to "cheap energy," firewood for a newly refashioned island geared to sugar production (Ghosh 2021; Moore 2009; Greenfield 1977; Vieira 1996a, 2004; Schwartz 2004). The opportunity cost of growing sugar rose so high that it no longer made sense to grow the wheat that had once been the island's principal export. The webs of trade that took cones of sugar off the island were tasked with bringing back food from other outposts of the Portuguese empire. By 1508, it was the Azores that fed Madeira because, as Serrao observed "sugar killed wheat" (Serrao 1954, 339, 40).

The sugar boom had burned through the island by the 1530s, and where no commercially useful trees remained, a crisis ensued, and the frontier was recursively shaped: Madeira became an outpost for ships

carrying enslaved Africans across the Atlantic. Today, the constellation of forces that give Europeans cheap air travel, disposable income, visa-free access to a colonial island in the sun, and political formations that depend on low-wage service work in the Portuguese periphery have enabled savvy entrepreneurs to reconfigure the architecture of Madeira's ghastly past. The plantations where hundreds of enslaved people lived and died harvesting and grinding sugar cane next to the cane mill in Carheta is now a site of thanatourism (Vieira 1996b; Dann and Seaton 2001).

In one of the oldest examples of the permanence of a frontier, Madeira's key commodity has shifted over capitalism's crisis-punctuated arc, from shipbuilding planks, to sugar, to services for traders of enslaved people destined for sugar plantations in Brazil, to services for tourists curious about the conditions of those enslaved people. World-ecology understands a frontier not as a thing but as a dynamic field of power relations operating in the web of life, an always-unstable hegemonic process in which the capitalist imperative to secure profit creates and recreates governing institutions to order humans, and more-than-humans, in ways that will perpetuate cycles of dispossession and exploitation. In Madeira's case, though the commodity has changed, the frontier as a field of power remains. The configurations of local action on the land arise through factors that range from the availability of cheap money—understood as low-interest-rate loans successively borrowed from the fifteenth-century banks in Genoa, the Portuguese tourist board, and the European Union's Regional Development Funds—for commercial development to the existence of affordable air travel and cheap fuel. This constellation of forces involves flows of capital through Brussels, Riyadh, and London, before it reconfigures Funchal.

Capitalism is forever moving through new frontiers. In world-ecology "frontier" is a pivotal concept. As Moore (2015) notes, "New frontiers of appropriation have been central to launching, and sustaining, long waves of accumulation" (88). Early modern capitalism's expansion and success lay in the extent to which the frontiers of commodification outpaced the demand for products drawn from those frontiers. In the measurement and government of those zones of accumulation (and frontiers of disposal, understanding nature as a frontier into which waste is dumped freely), new forms of space, time, and social relations between humans and the web of life have been fashioned and maintained.

Understanding the successive constructions and reconstructions of frontier processes on Madeira is helpful both in illustrating how capitalism might be understood as a frontier, but also in understanding what happens when capitalism transforms the planet. With each successive wave of destruction and reconstruction, Madeira is actively remade. It's not the same Madeira as before, but it's still Madeira. There is a sedimented history (Hall 2005), not just in the vestige of the name "island of trees" for an island without them, but in the biophysical and social relations that attend the conditions of the possibility of change on the island at any given time.

The conditions on Madeira are shaped by, and shape, relations beyond the island. Here, we turn to a kind of crisis that world-ecology explores in ways that world history finds secondary: the metabolic rift. As John Bellamy Foster and Hannah Holleman note (Foster and Holleman 2014), the idea of a metabolic rift comes from Marx's *Grundrisse*:

> It is not the *unity* [orig. emphasis] of living and active humanity with the natural, inorganic conditions of their metabolic exchange with nature, and hence their appropriation of nature, which requires explanation or is the result of a historic process, but rather the *separation* [orig. emphasis] between these [natural,] inorganic conditions of human existence and this active existence, a separation which is completely posited only in the relation of wage labor and capital.
>
> (Marx 1973, 489)

In the first volume of *Capital*, in the discussion of modern industry and agriculture, Marx (1978) makes this a little clearer.

> In modern agriculture, as in urban industry, the increase in the productivity and the mobility of labor is purchased at the cost of laying waste and debilitating labor-power itself. Moreover, all progress in capitalist agriculture is a progress in the art, not only of robbing the worker, but of robbing the soil; all progress in increasing the fertility of the soil for a given time is a progress towards ruining the more long-lasting sources of that fertility. The more a country proceeds from large-scale industry as the background of its development, as in the case of the United States, the more rapid is this process of destruction. Capitalist production, therefore, only develops the

> techniques and the degree of combination of the social process of production by simultaneously undermining the original sources of all wealth—the soil and the worker. (638)

There are two key features to note here. First, the spatial rift between country and city creates an opportunity for capitalist agriculture to degrade the land in one place to feed the people in another. Soil nutrients don't return to country loam from city plates. Under capitalist cycles, nutrients flow from country to city and then out to sea. The physical metabolic process here is, to use the modern word, unsustainable. That tendency to destroy the basis of profit is a central crisis tendency (Foster and Magdoff 2000). It is a source of value that is unseen by world-historical analysis (Salleh 2010), much less the broader world of international relations theory that offers its own take on globalization (Rosenberg 2005).

Land played a central role in Marx's understanding. Soil fertility through the 1820s and 1830s declined, and this spawned the emergence of modern soil science as a technology for fixing what capitalism had broken in the earth. The boom in the global fertilizer industry, with guano shipped from Peru to the United Kingdom at quantities that rose a hundredfold from 1841 to 1847, serves as a marker for the capitalist recognition of soil fertility (Foster and Magdoff 2000), and for the imperial politics that fixed a problem in domestic soil through imperial conquest (Cushman 2013).

The second key idea in Marx's observations about industrial agriculture lie in the relation of the soil to the worker. Second, Marx is explicit in understanding that the soil and the laborer are separate, but that both are "original sources for all wealth." There are crisis tendencies in what we have come to call both "social" and "natural" metabolic orders: cities chew up and spit out soil nutrients and capitalism does the same to workers. Separating "nature" and "society" is, however, an error of thinking that itself emerges in capitalism, from the world-ordering that happens through frontiers. Luckily, Marx has a method for what good analysis should do here: think dialectically.

In cracking open the question of how, when, and where "work" happens and opening the question about the beings that do it, world-ecology is able to augment world-historical approaches to combined and uneven development (Löwy 2010; Harvey 2001). Crises met with a spatial fix (Harvey 1981) can be ones occasioned not by a crisis of accumulation as traditionally conceived (Foster 1999), but biophysical crises that are *simultaneously* crises occasioned by capitalism's crises of labor-power and profit (Moore 2011b).

Marx's metabolic rift is a theoretical approach that explores how the transformation of matter in one place is related to the operations of capital in another. The rift can span not only the divide between country and city, where the profit motive organizes interventions into the life cycles in the soil to send food to new classes of urban consumers, but can also reach from one corner of the planet to another.[1] McMichael (2012, 146) observes that "the metabolic rift is not only about a material transformation of production, with spatial consequences; it is also about an epistemological break."

Thus, capitalism is only able to understand and meet the climate crisis through the development of markets for ecosystems as a service. Developing this idea further, Schneider and McMichael note, it is hard under capitalism to diagnose a crisis of accumulation as embedded in the biophysical world and its "environmental" crises, precisely because of the enforcement of an "epistemic rift," one that sequesters knowledge about interruptions in flows of capital away from the destruction of the web of life that makes such flows profitable (Schneider and McMichael 2010).

Understanding capitalism's aporias helps return us with a fresh view on what labor might be. Work in world-ecology is differentiated. There is no labor-power without reproductive labor, and that uncounted work is central to the feminist politics of world-ecology, through "the subordination of women, nature and colonies" (Mies 1986, 77; Federici 2014). "Cheap care," "cheap nature," and "cheap work" are, however, different under world-ecology (Patel and Moore 2017; Ivancheva and Keating 2021). Although they share the same characteristics of "free gifts" (Moore 2015), they are appropriated, extracted, commanded, and governed differently. Through hegemonic processes of domination and consent, each is corralled into modern forms of care, space, and time. The "underground of capitalist patriarchy" as Mies puts it (1986, 77), is both a suppressed and vital force for the circulation of capital: the care within the web of life that allows for productive labor is unacknowledged and essential. Pari passu, so are the production of the substance of abstract labor-power and of abstract nature, of *time* and *space,* through which relations of domination can be rendered legible by capitalism (Moore 2018). Capitalism, in other words, produces a ledger of when, where, and with whom it operates. Although reproductive labor and the sustenance of the

web of life require work, capitalism requires that work largely to be free. The operations of power that sustain such legibility are, in turn, grist for analysis.

The ledger is never stable, however, because humans and the more-than-human world buck back. Fixing the meaning of words requires institutional mediation, as Lund (this volume) points out. A central institution in this process of capitalist instruction is the modern police force. Without the threat of state-sanctioned violence to those who traduce private property arrangements, the modern technology of the fence would be meaningless. The meaning of a hedge around enclosed private property comes from the violence that attends its unauthorized crossing by commoners (Blomley 2007). States and their institutions create and attempt to maintain hegemony over time, space, and social relations, productive and reproductive (Cousins, this volume). Standardized work time (Thompson 1967; Martineau 2017) and map-making (Akerman 2017) have, increasingly, become the purview of central government. The processes and projects of the regulation of capitalist space and time are, as McMichael notes (this volume), intrinsic to the development project.

As with all policing, states' policing of time and space involves arts of recognition and diagnosis (Montague 2022). Recognizably foreign bodies—human or more-than-human—are occasion for the state to act. As Sagoff observes in his discussion of invasive species (2009), action by the state always requires a narrative. To police boundaries of species purity with chemicals, the state narrates a time of national purity before the colonial transfer of species, in which natives (not humans, but other beings) didn't have to suffer foreign pests. These hegemonies are socioecological projects in themselves, as well as means of interpolating and governing nature and society (Moore 2011a, 125).

As with any hegemony, the state's attempts to maintain its powers are always resisted. As a range of commentators have noted, the impositions of capitalist time (Rifkin 1987, 2017), space (Williams 2003; Craib 2017), and relationality (Youatt 2017) have all been—and continue to be (Estes 2019)—contested. Through these conflicts, capitalism's frontiers shift. When enslaved human labor ceased to be conscionably cheap—and it is worth observing that human trafficking today occurs at levels comparable to the transatlantic slave trade (International Labour Organization 2017)—capitalists found new sources of cheap *matériel* in order to make profit (Moore 2010a; Patel and Moore 2017).

Frontiers aren't linear progressions from one kind of extraction to another, generating and responding to a network of crises, on the same bit of land. Tourism is, after all, just the latest in a series of fixes to capitalist crises (Fletcher 2011). A set of geographical coordinates can, however, contemporaneously host multiple frontiers, and resistances to capitalist expansion. Tourism need never feature. As Cons and Eilenberg (2018) observe, frontiers can be seen as assemblages, spaces that are simultaneously economic boundary activity, lawlessness, wilderness. Within that field of possibility—Deleuze and Guattari (1983) call it a "hodgepodge" (7)—the process of capitalist recognition of value, articulated by metabolic crisis and active resistance by those from whom work is conscripted, can happen on the same piece of land simultaneously. With the crafting of new kinds of property relations, as well as the deployment of national narratives and police, land can become a quizzical thing, and subject to richer analysis. To see this, consider the commodity that came to define "the frontier," at least in large parts of the Americas: gold.

Three Vignettes from Yanomami Territory

Gold

Gold was mined in Brazil almost from the first moment of colonialism. An early wave of mining ran from 1553 to 1597 (Pérez-Aguilar et al. 2013), though the most significant colonial boom and bust ran through the long eighteenth century, 1690 to 1750 (Russell-Wood 1984), with particularly fierce bursts of extractive activity in Minas Gerais and Mato Grosso. The gold boom involved its own circuits of ecological destruction. Mercury was an essential part of the gold refining process, combined and processed with the ore to produce a gold-mercury amalgam that continues to pollute the waterways of the original gold rush (Costa 2011). Those toxic remains are the modern trace of nineteenth-century Portuguese trade patterns.

The Portuguese Empire's commercial and military decline was postponed and then fixed with Brazilian exports and concessions to British capital in Brazil (Inikori 2020). Gold flowed out of Brazil to the British to pay for keeping the Spanish at bay. To do that, capitalist orders pushed families of slavers and enslaved

people through the *cerrado* in Minas Gerais, bringing with them regimes to discipline household, race, and class divisions. Always, with the arrival of oppression, capitalism's least willing participants created spaces of fugitivity and subversion (Higgins 1999; Harmey and Moten 2013). Indeed, farther north in Maranhão and Pará, communities of fugitive formerly enslaved people, quilombos, exploited the divisions between domestic and international bourgeois interests, and funded their autonomy through their knowledge of the geography and geology of the Gurupí River (Abreu 2018). Quilombo communities sold gold to stay free (Cleary 1990, 29–31). Capitalist demands for *specie*, money in coin rather than paper (Maurer 2006), in Europe made possible the existence of autonomous groups in Brazil.

The gold rush has returned, and it is sometimes forgotten that the twentieth-century Brazilian gold rush outproduced those on the more famous frontiers of California and the Klondike (Cleary 1990). Gold remains a billion-dollar annual business, though the zones of exploitation have since moved. Today, one of the most ruthlessly exploited areas is in Yanomami territory (Figure 1).

Figure 1.

Yanomami Territory straddles the border of what is currently northern Brazil and southern Venezuela. cc-by-sa-3.0 Javierfv1212.

Indigenous people came to govern their own land through broader geopolitical forces: the Brazilian military in the 1940s was concerned to occupy the sparsely inhabited northern Amazonian region lest it fall to incursions by foreigners. In the process, infrastructure and matériel needed to be built and placed, and Indigenous communities, contained (Schwartzman 1996). Brazil followed the containment strategies developed in the nineteenth century by the US government to manage its own Indigenous populations, which were subsequently used by settler governments worldwide (Marya and Patel 2021). In 1967, the Brazilian government created the Fundação Nacional do Índio (FUNAI; National Indian Foundation), a successor agency to the Serviço de Proteção ao Índio (Indian Protection Service) founded in 1910. FUNAI is management agency with the authority to govern Indigenous people and to parcel and delimit private property in and around Indigenous territory.

Yanomami territory itself has largely been observed in the breech. Indigenous territory is akin to a semiporous membrane. Indigenous claims outside it are proscribed, but settler incursions inside are open to judicial confusion, ambiguity, and lengthy legal processes that allow a de facto redrawing of boundaries while the de jure discussions plod on for decades. Indeed, as Holston has suggested, the history of Brazilian land law is not one of deficit but, rather, of overwhelming surfeit. In the strategic ambiguities and confusions that emerge from this overdetermination of property, the landed elite's access to the best lawyers allows them to prevail while preserving the appearance of rule of law (Holston 2008, chap. 4). Through such tactics, the Brazilian government had long encouraged incursions into Indigenous territory. Before its recent status as a gold frontier, Yanomami territory was a site of cassiterite tin ore, opened by the Brazilian government of the 1980s and 1990s (Gibbons 1991).

Today, Yanomami territory is pockmarked with artisanal gold-mining operations. A recent investigation by the Associated Press found that in the state of Roraima, which is partially covered by Yanomami territory, and where all gold mining is illegal, the state has been implicated in providing cheap fuel for light aircraft supply lines to service the estimated 20,000 miners in the territory (Cowie and Biller 2022). For ten grams of gold, a pilot and jet fuel can be purchased to take food to and return gold from Indigenous land.

Prospectors have been implicated in a series of massacres of Indigenous people, most horrifically in 1993 (Weiss and Weiss 1993). The Federal Police and FUNAI dissembled around that event, and though some of

the perpetrators have been caught, justice remains elusive. Recently, artisanal miners protested their treatment by some of the Brazilian federal forces, who have made a few efforts to stop the illegal mining. Despite the illegality of all gold prospecting by *garimpeiros* (small-scale miners) in the state, there is an Association of Independent Prospectors of Roraima, whose members at a recent protest wore shirts proclaiming their status as legitimate workers "Garimpeiro, Trabaljador!" Given the license traditionally afforded such incursions into Indigenous territory, the workers may quite reasonably feel the sting of betrayal. As the Associated Press reported:

> "We are the founders of the state," said Isa Carine Farias, the association's president, and who told the AP she previously worked with illegal mining. "They take an Indigenous person to the United Nations (climate summit); why not take a miner, too?"
>
> (Cowie and Biller 2022)

Garimpeiros have a notion that the land, and the gold beneath it, is part of the patrimony of Brazilian citizenship. They identify as the source of labor in the trinity of land, labor, and capital. The state guarantees their access to land, so that their labor can participate in flows of capital from the gold reclaimed from the subterranean world and out into the markets of Boa Vista, and thence to the trading desks London, Shanghai, and New York. This happens *because* the apparatus of the state has vouchsafed this activity as a quintessentially Brazilian one, as workers turn debt, personal and national, into foreign exchange as part of a great national mission. This is the petit bourgeois national dream, gold-plated.

The Brazilian national story isn't the only one about Yanomami territory. Although the state guards its borders, compassing it in latitude, longitude, depth, and airspace, there are other ways to see and narrate the land (Scott 1998). As Rosset observes, there's a tension between the idea of land, understood as that fungible and contested national patrimony demanded by movements for agrarian reform, and the notion that every individual place is unique, narrated into relations of reciprocity that predate the nation-state (2013). The difference between fungible parcels of land, and anchored Indigenous territory, is a difference of narrative regime. While many stories of gold lead to riches under capitalism, Yanomami traditions offer different narratives both about how humans are bound to particular georgraphies, and even around the relations between humans and gold. Ramos (2010) observes that there is a legend among the Sanumá communities in the Auaris River valley that the gold is guarded by a spirit who commands, "Take only a little or I'll kill your children!" (127).

Land is the complex of territory understood as falling within the jurisdiction of the state, and the complex of territory understood as that nonfungible commodity belonging to Yanomami traditions of place and identity. In either case, the narrative is central to the constitution of the frontier. The Brazilian constitution doesn't come by its name accidentally (Chamber of Deputies Directing Board 2010). It is that nexus of laws that comes to constitute the land in particular ways, licensing it as a frontier for new capitalist enterprise. It is not possible, in other words, to stabilize the "land" part of "land, labor, and capital" without the nation-state, in which the term "nation" is a central feature.

The narratives by and about the Brazilian nation, on the one hand, and the Yanomami one, on the other, are contested terrains of knowledge, produced through processes of colonial capitalism (Long and Long 1992). In this, social scientists are far from innocent. Colonial academic knowledge of Yanomami ethnohistory is part of the problem (Coello de la Rosa 2018). Anthropological representations of Yanomami communities have cast them as citizens in waiting, whose congenital violence disqualifies them from current membership of the polity (Chagnon 1997)—though such conservative tendencies have had countervailing forces within anthropology (Turner 1993). Indeed, that ineradicable cultural propensity for violence licenses not just the state's use of force, but that of the prospectors, who continue to kill Indigenous people under cover of national destiny. It is through academic representations of Yanomami people that "Indigenous" becomes a synonym for "violent," allowing "Brazilian" to mean "civilized."

If narration is central to the rendering of land as a legible frontier, into which capital may safely flow, it is important to recognize the importance of the ways that material transformations can, in turn, affect narratives, which, in turn, inflect flows of capital. Global warming is not just a discursive phenomenon—it is a material one (Fox and Alldred 2020). The political discourses that constitute political responses to this zenith of capitalist crisis are shaped by capital itself, and reflect the different interests of capitalists at given moments of hegemony. Capitalists are interested in creating new stabilities to encourage investment in land; those investments are also strategic interventions in the normalizing of understandings about what

land is, and what it might be. Frontier land can always be a site of competing interests between different kinds of capitalists and those who resist incorporation into the capitalist world-ecology, like the Yanomami. The next section discusses how Yanomami territory has come to be in the sights of "green finance."

Green Carbon Capital

There is no reason why the same land cannot be a site of multiple flows of capital from within different members of a given hegemonic bloc. Indeed, hegemonic blocs form and reform precisely through shifts in the primacy of forms of capital. Arrighi (1994) observes, for instance, the shift in hegemonic predominance from manufacturing toward finance capital over the long twentieth century. In the subterranean land of Yanomami territory, one can observe two frontiers supervenient upon each another, with the power of extractive capital constituting and possibly ceding to that of financial capital.

Land is already an asset class. That is, it can be a frontier for physical extraction and also a fungible part of a portfolio in which it is, to use Fairbairn's exquisite phrase, "like gold with yield" (Fairbairn 2014, 2020). America's largest farmland owner, Bill Gates, with his fellow investors in farmland, enjoys the security of an asset that is fairly liquid, appreciates steadily in value, and also offers revenue from the rent paid on it by rentier farmers (O'Keefe 2021). Gates abets and profits from the power shift within the dominant hegemonic bloc from productive capital to financial capital.

Financial capital is never, itself, a stable category. It, too, is constantly in the process of reinvention, in search of new frontiers. The climate crisis offers an opportunity to create another stream of financial benefit from any given area of land, for example, through the REDD Reducing Emissions from Deforestation and Forest Degradation (REDD) effort and the issuing of carbon credits where the sequestering of carbon is provided as a service (Sullivan 2009; Beymer-Farris and Bassett 2012; Tni 2016). REDD revenue streams have in some cases been created the expense of small-scale agricultural producers (Kansanga and Luginaah 2019). Increasingly, it is becoming clear that the greatest repository of carbon in terrestrial forest systems lies not in the trees, but in the soil, where most terrestrial carbon is locked. Soil is capable of sequestering a great deal of carbon, and it is already being reviewed as a possible addition to REDD+ (Strey et al. 2017).

Given the vigor with which capitalism has deforested the planet, it should surprise no one that some of the land with the most biodiversity and richest soil is land that has managed to resist the incursions of capitalist forces. Indigenous communities are just 5 percent of the world's population, yet occupy 25 percent of its land and live with 80 percent of its biodiversity (Sobrevila 2008, xii). This is not, however, to present some automatically romantic purity of ecological praxis. In *Land's End*, Tania Li offers a rebuke to those who would ascribe to Indigenous communities an unimpeachable subjectivity or imperviousness to capitalism. On the contrary, she notes, the Indigenous highlanders whom she studied in Indonesia, though they were

> imagined by activists of the global indigenous and peasant movements to be securely attached to their land and communities, joined the ranks of people unable to sustain themselves. Surely, if anyone could continue to live in the countryside on the old terms, it should be them. … The process that dislodged them from their land wasn't initiated by land-grabbing corporations or state agencies. There was no "primitive accumulation" of the kind Marx described, "written in the annals of mankind in letters of blood and fire." The process through which they lost control over their collectively owned land was far less dramatic, even mundane. It was the highlanders themselves who took the initiative to plant tree crops, which had the effect of individualizing their land rights and led to the formation of capitalist relations in which their capacity to survive was governed by rules of competition and profit.
>
> (Li 2014, 3–4)

In the state of Acre, in Brazil's northwest, the quantification of ecosystem services has produced a regime that both identifies and rewards labor that will build the soil's carbon stores. It is, as Greenleaf (2020) observes, an ambivalent outcome, allowing peasants and low-income land-workers to supplement their incomes enough to survive, but not enough to enjoy autonomy. Indigenous communities have created REDD projects to benefit from these flows of capital and to defend against logging (Vitel et al. 2013), and are caught in matrices of power that make it particularly important to avoid romanticizing Indigenous communities (Shah 2012).

The carbon sequestered above and beneath the soil is increasingly valuable. In California, for instance, recent attempts to create a pool of new forest growth against which pollution might be traded has been undone by wildfires that have burned through 95 percent of that buffer meant to ensure the permanence of carbon sequestration (Badgley et al. 2022). As the hunt continues in the United States for alternative buffers that will allow the ongoing licensing of pollution, the pool of potential additive projects might be widened by looking internationally. The subterranean carbon in Yanomami territory is a green goldmine that solves the liquidity crisis in carbon credits. The green money, the possibility of microbial carbon sequestration in the Amazon, recapitulates the high colonial mission for silver in South America (Moore 2010b) as part of a hunt for cheap money (Patel and Moore 2017). The analogy holds, with the search for cheap money animated by the potentially deflationary constraints on industrial capital, and the need for profit from finance capital, as Arrighi (1994) observed in the successive waves of financial hegemony in Europe and, eventually, America in the twentieth century. In the twenty-first century, instead of mining specie, the biology of sequestered carbon is rendered tradable through digital distributed ledgers (Woo et al. 2021), blockchains of green gold, from which Indigenous communities may receive a sliver if they're lucky.

It is possible to avoid romanticization and still observe that the land has value for finance capital in large part because Indigenous communities have not reduced the land to a smoldering wreck. As Davi Kopenawa, a Yanomami shaman and educator has pointed out, there is a clear reason why forest carbon has not been commodified. It is, literally unthinkable to do so, because "Since the beginning of time, *Omama* has been the center of what the white people call ecology." (Kopenawa, Albert, and Dundy 2013, 393; emphasis in original). Kopenawa is clear that there are battle lines. "The forest is alive. It can only die if the white people persist in destroying it. If they succeed, the rivers will disappear underground, the soil will crumble, the trees will shrivel up, and the stones will crack in the heat. The dried-up earth will become empty and silent" (2013, vii).

The macrobiome of the Amazon is being commodified to fix the climate crisis. Jair Bolsonaro, the patriarch of national patrimony, understands this well. He points out that the Amazon is "like a virgin that every pervert from the outside lusts for" (Globo G1 2019). In his role as gatekeeper to this sexualized prize, he proclaims himself the pimp in chief.

Feces

There is another crisis in which Yanomami territory is summoned as a fix for a literal human metabolic crisis, prompted by critical approaches to urbanization (Lefebvre 2003; Roy 2016; Brenner and Schmid 2015) and by the need for specificity in understanding the dialectics of frontiers with other zones of capital flow. The metabolic rift points to the processes by which capitalism alienates human social relationships from those of the rest of the web of life (Foster 2000; Moore 2015). Perhaps the maximum *reductio* of this alienation comes from the compounding of capitalist development with the misrecognition of what humans are. Although it serves capital to enumerate and discipline unitary human bodies, humans aren't singular beings. We are holobionts, systems of different species that live within still larger ecosystems (Gilbert, Sapp, and Tauber 2012; Baedke, Fábregas-Tejeda, and Nieves Delgado 2020; Marya and Patel 2021). Humans are and contain multitudes, but many civilizations—not just modern capitalist colonial ones—have disciplined humans into modes of singular and individual recognition. Capitalists have a particular interest in individuation, from the selling of individual humans into slavery to the calculations of units of labor-power to the disciplining of a racialized and gendered workforce (Hall 1980). That process of straightening queer beings is of more than metaphorical concern (Griffiths 2015).

Ignoring the more-than-human beings that allow us to be human has made it easy to kill them. Modern capitalist planetary transformations have resulted in systematic differences between the gut microbiomes of city-dwellers in the global North and those of people living in rural areas in the global South (Conteville, Oliveira-Ferreira, and Vicente 2019). Although there is evidence that capitalism's food system is central to the denuding of the microbiome (Segata 2015), it is not the only cause. There are, for instance differences in skin microbiomes within cities (Kim et al. 2018). Class is also a factor, though not in the way one might presume: in one study, wealth was a proxy for less robust microbiomes, possibly because of higher exposure to household disinfectants (Mello et al. 2016).

The consequences of denuded microbiomes range from asthma to depression. Conversely, Vunk and Burkholder (2017) note, therapies have already been trialed or are under development for augmenting human microbiomes in order to treat colorectal cancer, obesity, allergies, asthma, anxiety, obsessive-

compulsive disorder, osteoporosis, and *Clostridium difficile* infection. The discovery of such therapies points, Vunk and Berkholder argue, to "the benefits of mining Indigenous microbiota" (94).

"Mining" is the tempting word here because it allows the reification of bacteria in the microbiome into a commodity, like coal or oil. As such, this grammatical action recalls the words of Christopher Columbus (2003) upon seeing the land of the new world, when he observed that there were therapies in this frontier waiting to be brought home:

> I can never tire my eyes in looking at such lovely vegetation, so different from ours. I believe that there are many herbs and many trees that are worth much in Europe for dyes and medicines but I do not know them, and this causes me great sorrow. (123)

The value of the Yanomami microbiome is a new frontier, even if the anxieties it treats about modernity might be a little older (Hobart and Maroney 2019). A small industry exploring the virtues of their microbiome, as evinced through the analysis of feces, has seized the scientific imagination and print space in a range of scientific journals (Clemente et al. 2015; Conteville, Oliveira-Ferreira, and Vicente 2019; Knight 2015). Most of the papers so far restrict themselves to analyses or animal model transplants. As a recent *New York Times* article observes, modern Columbuses have sought El Dorado in Indigenous fecal transplants, administering them to themselves without government approval (Kolata 2021).

This final vignette points not to a problem of commodification but to one of labor. Land is always made valuable by work. The monetizable benefits of Indigenous microbiota comes from their interaction with the microbiomes of humans in the global North. It is hard in modern English to use pronouns other than "it" for microbes, but the difficulty in seeing personhood in these beings is a sign of the nature–society divide (Williams 1976). For those less willing to entertain personhood to read the medical interest in microbiomes as an attempt to put "nature to work," there is another concealed source of labor here. Insofar as the microbiota are the result of sophisticated practices of human ecological interaction, and insofar as those practices involve both cooking and the dissemination of repositories of knowledge around how to live with flora and fauna, and insofar as both these activities are predominantly led by women in Yanomami communities (Ramos 1996), then the theft of Indigenous shit is the appropriation of reproductive labor.

We have written elsewhere about how capitalism needs "cheap care" (Patel and Moore 2017). Every world factory has its mine, its farm, and its household. Every moment of capitalist profit is supported by a necessarily uncounted but valuable hinterland of unpaid and appropriated work. In this way, it is possible to see the thriving microbiome of Yanomami people as the product of women's work, and the work of generations of experiments of being consonant with the sustaining of the Amazonian macrobiome.

Of course, humans' first inoculation with a rich microbiome happens, literally, during reproductive labor: vaginal birth sets humans up with a, hopefully, rich and functional microbiome. It is every capitalist's first free gift (Lokugamage and Pathberiya 2019). For many in the global North, that biome is then denuded by exposure to the dysfunctions of the wider capitalist biome. In Yanomami territory, gut microbial diversity remains through childhood, tended through women's labor in diet and agriculture. This is the labor that is stolen when the night soil on the land is appropriated in the attempt to "re-wild" the denuded microbiome of those in the global North. That history can readily be taken and used to colonize the guts of colonists, in a bitter twist on Nick Estes's (2019) observation that "our history is the future." Such a theft, already reportedly underway (Kolata 2021), falls into old patterns in which the embodied work and knowledge of Indigenous communities is part of a frontier of colonial expansion (Isla 2007; Brockway 1979).

Conclusion

Land is a living palimpsest in which capital's attempts at creating and manifesting certain relations over others become both project and process (McMichael and Weber 2022). World-ecology offers an approach to decoding it that ought, if conducted properly, also offer a key to decolonizing it (Coulthard 2014).

These three vignettes have pointed out that the categories of land, labor, and capital are dynamic material entities, seething with internal dynamics. The stability of land as a factor of production, where labor might be applied and profits drawn, is much better read as the process and product of complex dynamics of crisis and appropriation. World-ecological ideas of "frontier" help to show how vital the idea of land is and the multidimensional palimpsest of projects that might be written upon it historically and simultaneously

through the appropriation of new kinds of work in response to new kinds of crisis. Such an analysis specifically encourages a reconsideration of the agents of labor, the appropriation of their work through capitalism's expanding crises, and the new optics and sciences developed to fix and attend to a series of metabolic rifts. Just as the original metabolic rift spawned a science to amend soil, today's crises in human metabolism have spawned sciences that are scouring the world for new human inoculants, and finding them "free," a product of labor that is ready to be alienated. Whether the narratives that facilitate that alienation are about the march toward national greatness or "for all mankind," the application of state force is an important part of the process by which such new property will be claimed and the crisis policed (Hall et al. 2013).

Ultimately, then, world-ecology points analysts toward the deep narrative questions of "who does the work." It may be that "frontier" is not the right term to describe the process of constituting place, fixing workers, denoting those whose work is to be free, and stabilizing social relationships sufficiently for profit to be extracted from them. When a better analysis comes along, world-ecology will have done its part. For now, though, a world-ecological approach queers the ideas of "land" and "labor" in the "land, labor, capital" trinity to keep scholars busy for a little while yet.

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Note

1 There is a vigorous ontological debate over whether labor and nature can be said to be distinct, or whether terminological transformation is needed to recognize the fact that labor is itself made possible by the web of life. For those curious about the discussion, see Moore (2017); White, Gareau, and Rudy (2017); Foster and Clark (2016); Malm (2018, chap. 6); and Gellert (2019). Participants in this debate, while disagreeing in theory and in precise terminology, appear to agree that in practice, a reasonable response to the climate catastrophe is vigorous resistance from movements of the working class in defense of a livable planet and for ecologically enlightened socialism.