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COMMENTARY

On the Themed Collection, “The Formal and Real Subsumption of Nature”

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The title of our (with Rachel Schurman) original *Society & Natural Resources* article, “Industrial Dynamics and the Problem of Nature” (Boyd, Prudham, and Schurman 2001), signaled our overriding interest at the time in the industrialization of nature. In that article, we developed an analytical framework to investigate the ways in which the biophysical properties and processes of “nonhuman nature” are harnessed and subsumed to different logics of industrial production. We were less interested in exploring processes of commodification and the extension of markets per se, topics that were a focus of scholarly attention at the time and that continue to animate important work on so-called neoliberal natures (see, e.g., Heynen et al. 2007). Rather, we focused on production (the “hidden abode”) and the particular industrial dynamics that emerged out of the ways in which capital takes hold of and circulates through non-human nature.

We recognized then, as we do now, that “every industry is ultimately ‘nature-based’” (Boyd, Prudham, and Schurman 2001, 567), but have never found that truism to be particularly useful as a point of departure for analysis. Instead we posited that there is something specific about those sectors in which firms are involved in a direct and immediate way in the appropriation and transformation of nonhuman nature. And we tried to identify general tendencies at work in those sectors where nature is confronted as a more-or-less given source of raw materials (i.e., formal subsumption) versus those where nature is (re)made to work harder, faster, and better (i.e., real subsumption). We recognize the limits of this framework as the basis for any sort of general theory of socioecological transformation; we never intended it to serve that function. Our objective was to theorize some of the ways in which capital seeks to take hold of nature and subordinate it to the dictates of industrial production.

Our characterization of nature as “obstacle, opportunity, and surprise” in the original article (Boyd, Prudham, and Schurman 2001, 560) was intended to capture the dynamics of this confrontation by avoiding an overemphasis on constraints or obstacles while giving nature a genuine role in the production process. To be sure, our approach was “firm-centric,” and several of the interventions in this special issue have reminded us of the diversity of ways in which nature enables specific strategies of capital accumulation, including in response to regulatory interventions (see, e.g., Cooper in this issue). But we

chose to focus directly on how industrial firms work to harness and subordinate biophysical properties and processes to production.

Revisiting Nature's Subsumption

The articles in this collection provide an opportunity to revisit and further develop some of the ideas we sketched in 2001 regarding the formal and real subsumption of nature. In that article, we drew on Karl Marx's framework for understanding contending logics by which social labor is subordinated (i.e., subsumed) to the imperatives of capitalist production in order to consider the ways in which biophysical processes are appropriated, harnessed, and transformed. We suggested that, over time, firms dependent on the appropriation and transformation of natural resources would be inclined to find ways to target biophysical processes and that these dynamics could be understood, at least in part, by drawing from Marx's conceptualization of the contrast between the formal and real subsumption of labor.¹

In the simplest terms, formal subsumption for Marx refers to labor processes in which the workers retain considerable autonomy in shaping the material character, organization, and management of production. This autonomy includes, for instance, control over the rate of work. "Putting out" or cottage-industry systems of production in which spatially dispersed workers are retained to work in their own homes or artisanal shops, for instance, represent perhaps the foremost examples of formal subsumption and are typical of (though not exclusive to) early capitalist enterprises (Braudel 1988). Crucially, formal subsumption takes the labor process largely as it exists, with capitalist control limited to a combination of the specification of products to be made, the advancement of credit, ownership and provision of raw materials, and so on. As a consequence, the production of surplus value or profit comes strictly from that portion of the working day (or week) that a worker works in excess of the working time required to recoup his or her wages. Increasing the rate of profit can only arise from a combination of extending the working day or week (while keeping the wage fixed) or from increasing the total mass of labor deployed. Formal subsumption is thus based upon an extensive logic.

Real subsumption, by contrast, involves an intensification of the labor process in which workers surrender more of their autonomy. Marx had in mind the transition from dispersed to concentrated and increasingly centralized deployments of labor featuring cooperative labor processes, a deepening of the technical and social division of labor, and an increase in the role of fixed capital (i.e., capital invested into longer term infrastructure and other relatively enduring forms aimed at speeding up or otherwise improving commodity production and circulation) deployed in production. These transformations of the labor process result in a progressive loss of control and autonomy for workers, as well as deskilling as tasks become more finely differentiated and routinized while machines increasingly dictate the pace of production. Real subsumption also changes the logic of surplus value production since the intensification of the labor process results in workers producing more value per unit of labor time. Real subsumption thus refers to the production of relative surplus value via strategies aimed at making workers work harder, faster, and better. It is based on an intensive logic.

The relationship between the formal and real subsumption of labor is not strictly speaking historical (in the sense of one leading to the other) except inasmuch as real

subsumption presupposes formal subsumption (Murray 2004; Smith 2007). Nor is it the case that a transition to real subsumption is strictly unidirectional. Formal subsumption regimes may develop alongside and even displace real subsumption regimes (e.g., in the outsourcing of customer services, including overseas, by many contemporary firms). Moreover, complex combinations of formal and real subsumption dynamics may coexist, as evidenced, for instance, in contract farming arrangements where, on the one hand, the “laborer” is the owner of the farm, but on the other hand, specification of the technical dimensions of the production process and the provision of considerable fixed capital by a contracting agro-industrial firm suggest real subsumption (Goodman and Redclift 1985).

Much more can be (and has been) said about the significance of Marx’s distinction between the formal and real subsumption of labor, but that is not our goal here, nor was it in the original article. Instead, we sought to take Marx’s framework as a point of departure in considering parallel logics at work in the industrialization of nonhuman biophysical properties and processes. We suggested a contrast between the formal and real subsumption of nature, a contrast that, like its Marxian antecedent, captures a certain historical tendency from the former to the latter, but that also, perhaps more importantly, expresses an analytical distinction between extensive and intensive logics by which biophysical processes are capitalized.

Avenues for Possible Development

The parallel logics at work in the industrialization of nonhuman biophysical properties and processes have several implications and suggest a number of lines of possible further conceptual and empirical development, some of which are expressed in the article in this collection:

The Distinction Between Biological and Nonbiological Industries

First, in our original formulation, we made a strong claim that the logic of cultivation/intensification (i.e., the real subsumption of nature) was possible only in biologically based industries. Although there are various means of advancing real subsumption—through the introduction of exogenous inputs such as fertilizer or feed, improved management practices, or intensive confinement livestock production for example—we emphasized the manipulation of the genetic program through conventional breeding and biotechnology as the principal means or vectors for this process. In retrospect, we recognize that we may have over-stated the distinction between biological and nonbiological industries, as noted by Smith (2007) and as picked up at points in this collection (e.g., Delgado in this issue). It may well be that there are nonbiological, chemical or physical processes that operate according to a logic of cultivation (e.g., growing crystals or other materials; see Delgado in this issue). Exploration and development of the concept of real subsumption in relation to the capitalization of nonbiologically based properties and processes is a welcome and an important line of inquiry that does not, in itself, controvert the essential premise of the formal and real subsumption of nature framework as we suggested it.

That said, we do think the general distinction continues to have relevance and that the logic of intensification as we understood it operates in biologically based industries in ways that merit close examination. The fact that biological processes continue to be targeted as

accumulation strategies in historically and geographically distinct ways provides an important perspective for thinking through the interconnections between capitalist accumulation, environmental change, and social differentiation. For example, as Kloppenburg ([1988] 2004) has argued, until relatively recently, even in industrialized lines of agriculture, plant germplasm was difficult to fully commodify because of the self-reproducing character of nonsterile plants; the absence or weakness of plant patent rights for breeders of novel varieties; and the pervasiveness of free seed sharing twinned with the dominance of publicly sponsored seed improvement research whose results were largely given away to farmers on an open access basis. Yet over time (and initiated largely within the United States), increasing involvement of the private sector in plant breeding has been attended by the extension of private and exclusive property rights over living organisms, the latest phase of which includes patent rights over genes, gene complexes, and genetically modified organisms during the age of commercial biotechnology. The landscape of basic and applied research has been transformed (again, led by the United States), giving rise to a range of integrated and multinational firms increasingly oriented toward the capitalization of life (Boyd 2003).

One thinks in parallel about the dramatic transformation of the global fishing sector since the mid 1980s, driven by the growth of industrial aquaculture. All of the increase in global seafood production in the intervening period is attributable to aquaculture, offsetting and masking stagnation, decline, and even ecological collapse in wild fisheries (DeSombre and Barkin 2011). The expansion of commercial aquaculture also poses a new suite of socioecological questions, including knock-on effects arising from the exploitation of wild-caught fisheries to provide feedstock; land-use changes from the construction of fish ponds; growing antibiotic resistance and antibiotic residues in fish tissues; and changing structures of ownership, industrial organization, property rights, and labor regimes. In sum, an extensive logic of appropriation has given way to a logic of intensification as the biological growth and reproduction of fish have become central to profitability in the industry (motivated, to be sure, by increased regulation of wild fisheries), with far-reaching social and ecological consequences.

Parallels may exist in the capitalization of nonbiological processes and organisms that we either did not attend to or failed to anticipate in 2001. Where nonbiological resource sectors are similarly transformed (e.g., by the commercial development of synthetic diamonds or oil), the contrast between extensive and intensive modes of targeting biophysical processes and entities as avenues for capital accumulation and interfirm competition remains useful. Of particular importance in this respect is the significance (as combinations of obstacle, opportunity, and surprise) of distinct turnover times of capital investment, as well as disjunctures (noted originally by Marx in reference to capitalist agriculture and forestry) between production time and labor time that are features of specific socioecological production processes.

Social Regulation Matters

Second, as developed by Cooper (in this issue) and as noted in the preceding, social regulation (formally, by states, and informally by social movements, ethical and cultural norms, etc.) matters. This is not something we emphasized sufficiently in the original article. The ecological disruptions and environmental externalities generated by the

subsumption of nature can themselves be drivers of subsequent accumulation strategies seeking to subsume biophysical properties and processes. The result may be dynamic and even contradictory logics of subsuming nature unfolding in parallel or in iterative fashion, with important temporal and spatial implications (e.g., in the geographical dispersion, concentration, or relocation of firms based on these accumulation strategies and regulatory influences). In Cooper's case, ruminant biology has become a target of real subsumption in part because of the social regulation of externalities (i.e., methane emissions) generated by previous expansions.

The Dynamic Interplay Between Labor and Nature

Third, if we think of the subsumption of nature and the subsumption of labor in more relational terms, we recognize that they are always combined in specific ways in any particular process of industrial production. Control over and transformation of means of production in general terms is a point of departure for the control, discipline, and exploitation of labor and for the extraction of surplus. This point is central to Marx's analysis of capitalism and to his critique of classical political economy, comprising the general thrust of his account of and emphasis on primitive accumulation (i.e., the conversion of public and communal means of social reproduction to private means of capitalist production) in *Capital*, vol. 1 (De Angelis 2001, 2004). Although we did not emphasize it sufficiently in our original article, that general perspective resonates with recent work emphasizing the resurgence of enclosures within the contemporary global economy (see, e.g., Harvey 2003; 2005; Glassman 2006), as well as the broader scope of capitalist subsumption (see, e.g., Rossi 2013). Elrick (in this issue), in suggesting the subsumption of urban life in part through the visualization of San Francisco's urban metabolism "as a totality of distributions and circulations," is also suggestive in this respect.

More concretely, Carton and Andersson (in this issue), following Smith (2007), demonstrate ways in which processes of subsuming nature (formal or real) via forest carbon offsets may create specific new imperatives for labor. They specifically highlight a need to examine the subordination of petty commodity producers and nominally independent peasant households (i.e., not only wage-laboring processes) as avenues by which the subsumption of nature and the subsumption of labor are conjoined.

Pushing this line further, we can begin to consider the production (and realization) of value and surplus value in capitalist production processes in and through the social metabolism of resource extraction, transformation, and management, respectively. To be clear, the framework we developed in our original article was not intended in any way to diminish the social character of surplus value creation and extraction. Yet clearly the capitalization of nature comprises part of the material conditions for the (differential) production of capitalist value (on this point, see e.g., Burkett 1999). Extensive logics of appropriation (i.e., the formal subsumption of nature) may encourage labor regimes that emphasize formal subsumption (e.g., piece rate labor regimes in reforestation operations featuring planting by hand) or may lead to labor regimes tending toward real subsumption (e.g., highly capital intensive mining regimes), depending on the specific historical and geographical circumstances. Alternatively, intensive logics of appropriation (i.e., the real subsumption of nature) may also encourage (or indeed be encouraged by) logics of formal and real subsumption of labor. Smith (2007, 28) connects the real subsumption of nature to the real subsumption

of labor along these lines by invoking the former as part of the “multidimensional web of capitalist technology and social organization.” Marx, for his part, seems to have suggested as much:

In one respect the transformation of the production process from the simple labour process into a scientific process, which subjugates the forces of nature and compels them to work in the service of human needs, appears as a quality of fixed capital in contrast to living labour; while individual labour as such has ceased to appear as productive, is productive, rather, only in these common labours which subordinate the forces of nature to themselves. (Marx 1858/1973, 700)

None of these threads are ones we took up in the original article. That said, each of us, working independently, has examined in detail ways in which distinctive labor regimes have emerged in relation to efforts to take hold of the biology of tree growth and fiber production in the forest products industries (Prudham 2003; Boyd 2015). Most recently, one of us has explored the relationship between transformations of nature and fixed capital in the context of socioecological “fixes” arising in response to crises of capitalist overaccumulation (e.g., investment in energy infrastructure; see Ekers and Prudham *in press-a*; *in press-b*).

Dynamics of Financialization

Fourth, we note the potential conceptual and empirical development of our framework for thinking systematically about dynamics of financialization. As we observed in our original article, “an overemphasis on constraints tends to downplay the ways in which one firm’s obstacle may become another’s competitive advantage or opportunity. In this context, firms are not only limited by natural processes and inputs, but can carve out a niche for themselves as they successfully confront and even ‘improve upon’ these processes” (Boyd, Prudham, and Schurman 2001, 561). This obstacle/opportunity dialectic was powerfully developed by Henderson (1998) in his examination of the role of agricultural credit programs in the industrialization of California agriculture. His analysis, though historical, resonates with contemporary scholarship exploring processes of financialization in agriculture (see, e.g., Clapp 2014; Isakson 2014), while also pointing to the ways in which nature’s subsumption may be expressed through the financial sector. This includes examination of the relationship between material transformations of nature and the virtual abstraction of nature in the form of financial instruments.

The Role of Ideology and Discourse

Fifth, and very much related to thinking about financialization in relation to nature’s subsumption, the articles by Elrick (in this issue) and Jönsson (in this issue) rightly take us to task for downplaying in our original article the role of ideology and discourse more generally in formal and real subsumption processes. Guilty as charged! While we wanted to prioritize the concreteness and specificity of the material aspects of production in our original article, we insufficiently emphasized that the consequential “reality” of particular biophysical processes and inputs must include their various representations and abstractions.

We thank the editors of the special issue for inviting us to contribute, and the authors of the articles for their valuable contributions. It is an honor to have our work taken seriously and engaged with substantively. We have learned from the contributions here and have taken the opportunity to reflect on and extend our original framework. We hope that this collection, together with our original 2001 article, will both stimulate and provide intellectual resources for others concerned with confronting the current socioecological trajectory.

Note

1. See Marx and Engels ([1867] 1984), *Capital*, volume 1, Parts 3–5, and particularly chapter 16. Murray (2004) also provides an excellent for discussion of the significance of Marx's contrast between formal and real subsumption.

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