Bringing Nature Back Into Sociology's Disciplinary Narrative Through Critical Realism

Article *in* Organization & Environment · December 2005

DOI: 10.1177/1086026605281697

1 author:

Michael S Carolan
Colorado State University
163 PUBLICATIONS **5,519** CITATIONS

Society, Biology, and Ecology : Bringing Nature Back Into Sociology's Disciplinary Narrative Through Critical Realism

Michael S. Carolan

Organization Environment 2005 18: 393
DOI: 10.1177/1086026605281697

SOCIETY, BIOLOGY, AND ECOLOGY

Bringing Nature Back Into Sociology's Disciplinary Narrative Through Critical Realism

MICHAEL S. CAROLAN
Colorado State University

This article represents both a continuance and a reformulation of an ongoing project: a call to sociology proper to "bring nature back in." Moving beyond such earlier heuristics as Demeritt's "conjoined materiality," Freudenburg and colleagues' "conjoint constitution," Norgaard's "coevolution," and Bell's "ecological dialogue," this article uses Bhaskar's work and his writings on critical realism to develop a conceptual framework through which to view nature-society relations. Following a brief overview of Bhaskarian critical realism, a conceptual typology is forwarded whereby reality is collapsed into three fluid categories referred to as (in descending order of ontological depth) "nature," nature, and Nature. Through this, a sketch of reality is presented that allows for critical discussion and analysis concerning the growing interrelationship between the social and the natural realms, while opening the door for debate as to what this dynamic means for sociology's long-term viability.

Keywords: *Bhaskar; critical realism; discourse; epistemic fallacy; ontological stratification*

Sociology has had a long theoretical tradition of claiming epistemological supremacy over processes occurring within the realm of "the social." Sociology, according to Durkheim (1964), is the study of *social* facts through other *social* facts.[1] This is what makes (and what originally made) sociology a distinct and separate discipline from psychology, biology, economics, and physics—or so the argument goes. And as such, it is believed that our disciplinary energies should be directed toward the study of interrelationships among thoroughly social phenomena. Anything else, it is feared, could delegitimize its epistemic claims and ultimately the discipline itself.

Except for the occasional lip service given to multidisciplinary research, the boundaries between the "social" and the "natural" sciences are as strong today as ever (Birke 2000, 2003; Davey, 2003; Scambler & Scambler, 2003). Such intellectual divisions are believed to reflect generalized distinctions of reality (Ingold, 1997); a reality where the social and the natural are of an ontologically distinct kind, sufficiently "closed" to justify the maintenance of today's disciplinary

Author's Note: *I would first like to thank Michael Bell for years of good "dialogue" about societal-ecological relations. I would also like to thank Belinda Backous, Eugene Rosa, and Riley Dunlap for their support and for reading and commenting on earlier manuscripts. Thanks to Arthur Mol and Wageningen University for providing me with a generous fellowship during which time many of the ideas in this article were developed. Finally, I am also grateful to the reviewers and editors for their constructive comments.*

Organization & Environment, Vol. 18 No. 4, December 2005 393-421
DOI: 10.1177/1086026605281697

islands and the epistemic claims they generate (Smith, 2001). This article questions such assumptions, thereby opening them up for investigation.

Indeed, scholars from within sociology have been calling for the bridging of this "great divide" (Goldman & Schurman, 2000) for quite some time, albeit the call has risen in tenor and pitch in recent years. Environmental sociologists in particular have been steadfast in this regard, calling on sociology proper to "bring nature back in" since Catton and Dunlap's (1978a) seminal article (see also, Catton & Dunlap, 1978b, 1980; Dunlap & Catton, 1979).

Yet the call neither begins nor ends with environmental sociologists. Interesting connections between the social and the natural have been made across the discipline of sociology. We see it, for instance, in evolutionary sociology (e.g., Maryanski 1998; Maryanski & Turner, 1992), the sociology of the body (e.g., Bury & Wadsworth, 2003; B. Turner, 2003), medical sociology (e.g., Fox, 2003; Kelleher & Hall, 2003), sociology of emotions (e.g., J. Turner, 2000, 2002), and sociology of religion (e.g., Crippen, 1988; Crippen & Machalek, 1989), as well as by some feminists (e.g., Fausto-Sterling, 2000, 2003).

Nor has the call come exclusively from social scientists. On the other "side" of the divide, a similar call has been made—in a thoughtful, nondeterministic way—by, for instance, neurobiologists Steven Rose (e.g., 1992, 1997) and Henry Plotkin (2001, 2003) and feminist biologist (and activist) Lynda Birke (2000, 2003). Ultimately, the division between the social and the natural realms has been contested from across both sides of this epistemic divide (Haila, 2000). This has had the effect of problematizing traditional disciplinary disarticulations between sociocultural and biophysical phenomena, all of which is given further force in light of recent advances in the life and ecological sciences.

As mentioned, environmental sociologists have perhaps been the most forceful and articulate in their attempts to conceptually sort out the dynamic processes of nature-society interactions, leading to such terms as *conjoined materiality* (Demeritt, 1998), *conjoint constitution* (Freudenburg, Frickel, & Gramling, 1995), *coevolution* (Norgaard, 1994), and *ecological dialogue* (Bell, 2004), just to name a few. Yet these conceptual heuristics remain highly problematic on a number of levels.

First, they fail to account for the ontological asymmetry that exists between the two realms—namely, that although the biophysical can exist without the social, the converse is categorically impossible. Yet if we conceptualize the two realms as being mutually constitutive of each other, how then is this asymmetrical relationship explained?

Second, these heuristics do little to further our understanding of how the social and the natural interact other than highlighting the fact that they do. In doing this, they ultimately succumb to a type of conflationary theorizing, whereby analytic distinction between the two realms is lost. All nature-society relations, thus, become, to borrow a few terms from Latour (1993), equally "impure" heterogeneous "chains of associations" (p. 17). Yet as I detail, not all hybrids are the same—for example, the midwestern corn field, as a sociobiophysical effect, is not the same, quantitatively or qualitatively speaking, as unstable genomes because of hazardous levels of ambient radiation. In short, once we begin to see these two realms as being ontologically inseparable—which, I believe, the above heuristics do (and this in some respects includes the work of Latour)—we lose analytic force to distinguish between different *types* of hybridity. Retaining analytic difference between these realms is also essential if we are to pursue a meaningful ecological

ethic. For ultimately, as Kate Soper (1995) argued, there can be no ecological ethic without some demarcation between humans and the environment:

> Unless human beings are differentiated from other organic and inorganic forms of being, they can be made no more liable for the effects of their occupancy of the ecosystem than can any other species, and it would make no more sense to call upon them to desist from destroying nature than to call upon cats to stop killing birds. (p. 160)

Third, the above heuristics fail to provide the conceptual tools to allow for an examination of this interrelationship temporally—that is, in terms of how it might be coevolving in accordance with broader sociocultural processes (such as with capitalism, globalization, etc.). Instead, they view this relationship—in terms of its "intensity" and "rate"—as fixed. Yet as I argue, the data do not appear to support such a presupposition. Rather, based on recent insights by the life and ecological sciences, this interrelationship appears to be dynamic and increasing in its intensity with the nonlinear unfolding of modernity.

Fourth, the above-mentioned heuristics lack a conceptual foundation on which to differentiate between "natures" that are ascribed to clearly different referents. Nature, for both sociologists and nonsociologists alike, means many different things. Any conceptual project to bring nature in, then, must also be predicated on a parallel project to understand what nature is and how to conceptually differentiate between these various referents made to it—involving phenomena as varied as, for example, "unnatural" versus "natural" sexual acts, to "natural" disasters such as tornados and earthquakes, to the "nature" of old-growth forests, gravity, and ecosystems.

Fifth, underlying these criticisms is that the above heuristics merely presuppose their realist assumptions to be true, a priori, without any philosophical or logical support for such a position. Thus, although they ground themselves within a form of realism, it is a shallow realism at best: what is sometimes referred to in philosophy of science as naïve realism. These heuristics, in other words, arrive at their ontological conclusions through the backdoor—through epistemology. That is to say, they conflate *knowledge* of what is (an epistemological statement) for what *is* (an ontological statement) and, thus, commit what Bhaskar (1978) called an "epistemic fallacy" (p. 36).

Which brings me to the sixth and final critique of the above heuristics that speak to nature-society interactions: Because of their shallow or naïve realism, they lack force to speak of "things" (broadly defined to refer to causal tendencies and objects) that cannot be readily observed. As others and I have argued, many of the sociobiophysical effects of modernity are beyond direct perception, which is to say they are "epistemologically distant" from us (Beck, 1992; Carolan, 2004, in press-a). Given this, environmental sociology needs to be grounded in an explicit realist project, a project that allows for the speaking of things that cannot be directly observed (and are, thus, beyond the level of the empirical [or "actual," to evoke a term defined shortly]), but which are real nevertheless.

The framework developed in this article allows for the making of analytic distinctions between the social and biophysical, while leaving conceptual space for interaction effects. Through a critical realist philosophy of science—specifically, that as developed by Roy Bhaskar—I work to provide conceptual space for the complex relationships that exist between the diverse strata of reality that result in

varied affects and consequences. And in doing this, I illustrate why we need a sociology that is open to social and biophysical variables at both the descriptive and explanatory level.

Toward this end, the article progresses as follows. I begin with a discussion of that which is at the heart of the issue: reality. The historical division between the social and the natural is predicated on assumptions of *what is*. Consequently, I know of no other way to critique this division without first questioning the ontological assumptions on which this division is based. Specifically, this discussion is informed by the postulates of critical realism. According to critical realism, reality is an "open," ontologically stratified whole (Bhaskar, 1978). Following a brief overview of critical realism in general and the postulates of its stratified account of reality in particular, I then develop a conceptual typology whereby I "collapse" this stratified whole into three fluid categories—referred to as "nature," nature, and Nature. This conceptual strategy serves to reduce some of the complexity of reality as a stratified whole, while still allowing a critical realist–informed discussion to take place about it. From here, a critical analysis occurs concerning what appears to be a growing interrelationship between the social and the natural realms. This culminates in a discussion as to what place, if any, there should be for the biophysical in sociology.

CRITICAL REALISM AND ONTOLOGICAL STRATIFICATION

Critical realism emerged largely out of the United Kingdom in the 1970s (e.g., Benton, 1977, 1981; Harré, 1970, 1972; Harré & Madden, 1975; Keat, 1971; Keat & Urry, 1975). From this tradition, it is Bhaskar's (1978, 1989, 1994, 1998) treatment that is considered by many to be the most systematic, complete, and influential today.[2]

Critical realism is a nonfoundationist epistemology, which acknowledges that knowledge-producing actions can make sense only when the assumption of the existence of an independent material reality is granted—hence, its claim to *realism* (Benton, 2001a). Yet in doing this, critical realism does not assume a one-to-one correlation between knowledge claims and reality; one must be careful not to conflate critical realism with mere empiricism (more on this later). Critical realism acknowledges that there is a distinction between the way things are and our knowledge claims about those objects of knowledge. To conflate the two—to reduce ontology to epistemology—is to succumb to Bhaskar's (1978) epistemic fallacy. This allows, and here is the crux of critical realism (and, thus, what makes critical realism *critical*), for the fallibility of knowledge claims; to open knowledge claims to criticism, testing, and further improvement. (Bhaskar's project is, thus, an emancipatory one, in some ways similar to that of Habermas's, 1987.)

Bhaskarian critical realism emerged as an immanent critique of Humean empiricism in general and his theory of causation in particular. The arguments to come out of this debate cannot be examined in any depth here (see Carolan, 2005b, for a more detailed overview of this framework). For the purposes of this article, we can simply say that Bhaskar (1978) developed a form of "transcendental realism" (with clear affinities to Kant, while nevertheless going beyond his "transcendental idealism")[3], which sets out to critique the ontological and epistemological assumptions of Hume's empiricism. From this, Bhaskar arrived at the postulate of *ontological stratification*.

Bhaskar sustained his account of critical realism through the elaboration of an account of what the world *must* be like for science to be possible (what he called the "intransitive dimension").[4] In doing this, he detailed

> how the intelligibility of experiments presupposes that reality is constituted not only by experiences and the course of actual events, but also by structures, powers, mechanisms and tendencies—by aspects of reality that underpin, generate or facilitate the actual phenomena that we may (or may not) experience, but are typically out of phase with them. (Bhaskar & Lawson, 1998, p. 5)

Toward this end, Bhaskar arrived at a stratified account of reality, which he detailed as follows: (a) the "empirical," consisting of experiences/observed events; (b) the "actual," involving the flow of events produced either under controlled conditions of experimentation or as uncontrolled "conjunctures;" and (c) the "real" world of causal powers/tendencies and deep structures.[5]

Empiricism, depending on rigidity of application, recognizes only Level 1 (strict empiricism) and/or Level 2 (moderate empiricism) phenomena. Critical realism, on the other hand, seeks to give conceptual space to the independent reality of Level 3 phenomena, for these intransitive forces are what make scientific investigation both meaningful and necessary. Indeed, if such underlying causal powers were not present, knowledge would merely be a matter of observing and summarizing (Benton & Craib, 2001). Bhaskar (1978) justified this stratified account of reality as follows:

> It is not necessary that science occurs. But given that it does, it is necessary that the world is a certain way. It is contingent that the world is such that science is possible. And, given that it is possible, it is contingent upon the satisfaction of certain social conditions that science in fact occurs. But given that science does or could occur, the world *must* be a certain way. Thus, the transcendental realist asserts, that the world is structured and differentiated can be established by philosophical argument; though the particular structures it contains and the ways in which it is differentiated are matters for substantive scientific investigation. (p. 29)[6]

Bhaskar (1978) gave further shape to this account of reality through his discussion of *rootedness* and *emergence*. As the terms suggest, "higher" level phenomena are rooted in, and emergent from, more "basic" phenomena. This allows for the coexistence of both *being* and *becoming*. Rootedness and emergence represent conceptual linchpins for Bhaskar because they close the door to reductionistic accounts of reality. That is, the dynamic tendencies between strata do not (indeed they cannot) equal determinism. Rather, causal tendencies are multidirectional, going both "upward" and "downward."

For instance, the emergence of higher level phenomena from "lower" level strata does not preclude those higher levels from exerting influence onto those lower levels within which they are rooted. A stressful social situation, for example, can affect one's nervous, endocrine, and digestive systems, all of which, in turn, results in the altering of chemical reactions, hormonal secretions, blood flow, and protein synthesis—that is to say, one's very physiology (Nowak, 2002; Rose, 1997). I present numerous examples of nonreductionist relationships in the following section. For now, I simply want to make clear that the acknowledgement of rootedness—particularly of sociocultural phenomena—need not send us headlong

into the thralls of biological reductionism, as long as that rootedness is predicated on a reality that is stratified, emergent, and open to dynamic tendencies from both "above" and "below." Strata are not ontological islands onto themselves, independent and closed from the tendencies that surround (but do not interpenetrate) their spheres of existence. To take such a position is to effectively close the methodological door to a world of complex and meaningful interactions and reduce explanation to a highly bound, tightly circumscribed view of causality and potentiality; a view of reality, as I detail below, that is becoming increasingly problematic in light of recent advances in the ecological and life sciences.

"Strong" and "Weak" Critical Realism

According to Bhaskar, social reality, like the biophysical below it, is itself real and stratified. In doing this, he pushed his emergentist argument to *within* society itself, which led to his development of a sociological realism—that is, a position that argues that within society exist ontologically distinct and real levels; this position is fully articulated in what Bhaskar (1994) called his transformational model of social activity.[7] Bhaskarian collectivist emergentism, however, does not concern us here. As I argue, Bhaskar's philosophy of science need not be viewed as necessarily bound to his sociological realism. Thus, whether one accepts or rejects Bhaskar's transformational model of social activity is irrelevant to the question at hand. In other words, the rejection of Bhaskar's sociological realism need not lead to the wholesale rejection of critical realism per se; a move that therefore shields the arguments made here from the chorus of critics who view Bhaskar's sociological realism as highly problematic. Arguments critical of Bhaskar's collectivist emergentism (e.g., Harding, 2003; Kemp, 2005; Kivinen & Phroinen, 2004; Sawyer 2001) seek only to repudiate his claim that emergentism occurs within society. In doing this, however, they say nothing as to society's rootedness to lower (e.g., biophysical) substrata or to the multidirectional causal links potentially therein contained. One can, therefore, be a methodological individualist, in the sociological sense, and still be a critical realist.

To aid this discussion, I, thus, present the following heuristic of strong and weak critical realism. Strong critical realism encompasses Bhaskarian critical realism in toto, which includes his arguments regarding collectivist emergentism, sociological realism, and his transformational model of social activity. Weak critical realism, on the other hand, stops short of sociological realism, while accepting Bhaskar's broader philosophy of science that social phenomena remain a component of a larger stratified, emergent, and rooted whole. Thus, henceforth, when I speak of critical realism, I am speaking of the latter weak variety (unless indicated otherwise). In making this distinction, I hope to reinvigorate the debate surrounding critical realism by illustrating that Bhaskar's insights as to the ontological stratification *between* the social and the biophysical cannot be discarded by way of the same arguments that are used to refute his broader sociological realist claims.[8]

This move also allows for a concentrated discussion of issues related to "depth," momentarily sidestepping those of "breadth" that have preoccupied sociology for decades. One of the most pronounced and popular devices within sociology for theoretical demarcation and categorization has been, for lack of a better term, the "micro/macro yardstick"; a point one can quickly verify by reaching for the nearest Introduction to Sociology textbook. Even among professional sociologists, such a device remains perhaps the most prevalent metatheoretical approach for organizing theoretical perspectives (e.g., Ritzer, 2000). Yet with all this attention to the

"agency/structure debate" (which addresses issues of breadth) within sociology, far less energy has been devoted to the equally important "sociocultural/biophysical debate" (which addresses issues of depth). By focusing specifically on the weak variant of critical realism, this property of depth, which has for far too long been ignored in sociotheoretical debates (save for a notable few mentioned earlier), is placed at the forefront of discussion. For, in the end, it is this variant of critical realism that is most useful to environmental sociology as a pragmatic guide to more fully explore the diverse causal interactions that make up social life.

WHAT IS NATURE (AND WHY DO WE WANT IT IN SOCIOLOGY)?

Because of space considerations, unfortunately, the finer philosophical details of critical realism cannot be debated here (for a more thorough discussion, see, e.g., Archer, Bhaskar, Collier, Lawson, & Norrie, 1998; Collier, 1994; Cruickshank, 2002, 2003; Fleetwood, 2005; Kemp, 2005; Scoot-Baumann, 2003). The task, rather, is to develop a conceptual account of nature-society relations with an aim toward moving beyond such earlier heuristics as Demeritt's (1998) "conjoined materiality," Freudenburg and colleagues' (1995) "conjoint constitution," Norgaard's (1994) "coevolution," and Bell's (2004) "ecological dialogue." Guided by the critical realist postulates of emergence, rootedness, and ontological stratification, let us now move toward such a framework.

To begin, I collapse the complex and dynamic reality postulated by critical realism into the following three open, embedded, and emergent strata (in descending order): "nature," nature, and Nature. This collapsed view of reality, as I soon illustrate, allows for both dynamism and temporality to enter into our understanding of societal-biophysical interaction; something environmental sociologists have been admirably—yet largely unsatisfactorily—attempting to do now for more than two decades. Let us, therefore, begin this conceptual project with the question, What is nature?

Nature is a terribly imprecise concept. Raymond Williams (1976), in fact, went so far as to call it "perhaps the most complex word in the language" (p. 184). In sociology, as well as within everyday discourse, the term *nature* is used to speak of any number of things: from the "not natural," involving certain acts of sexuality, the production of pollution, and the urban landscape; to the nature of mountain ranges, old-growth forests, and unspoiled wilderness areas; to the forces of nature, such as gravity and natural selection; to the nature of the universe, of dark matter, quarks, and galaxies; and finally, lest we forget, to the always contentious debate surrounding human nature (Or is it human natures [e.g., Ehrlich, 2002]?). Is there any hope of unsnarling this terminological quagmire, or will sociology be forced to abandon the concept entirely in its quest for conceptual and analytic specificity? It is clear that in everyday discourse, we casually use the term *nature* to speak of widely different referents—such a practice is unavoidable and to an extent acceptable. Within the discourse of sociology, however, more precise terminology is needed.

In doing this, I build not only from the path-breaking works of Bhaskar (e.g., 1978, 1989, 1994, 1998) but also from Soper (1995). Building off of the work of Bhaskar, Soper developed a useful distinction between two aspects of a complex and ontologically stratified whole: (a) a "realist" concept of nature, to reference those "deep structures" of physicality and causality; and (b) a "surface" concept, to reference the empirically observable nature that is in continual flux and transformation. The contrast for Soper, then, is between

> the "nature" that is presupposed as a permanent ground of all ecological activity and environmental change, and its historically changing surface effects, whether these be naturally precipitated (the earthquake or volcanic eruption) or humanly engineered (the ancient barrow or nuclear bunker). (p. 157)

According to Soper, nature exists in both a realist sense, thereby making room for very real biophysical limits, and in a sociocultural sense, so as to provide conceptual space for social critique and the ever-important analysis of power.

This depiction of reality is not, however, without its problems. Indeed, I question just how closely it follows the conceptual postulates originally laid out by Bhaskar. In the end, I find two fundamental problems with Soper's (1995) framework. First, what of those uses of *nature* to reference phenomena deemed as either unnatural or natural—from food preservatives, to sexuality, to agricultural fertilizers? Do such nature claims have no place within Soper's framework? Some have described such nature referents as discursive (Darier, 1999). Others, such as Latour (1993), would claim that such referents, like all nature referents, represent "impure" sociomaterial hybrids. Regardless, the realm of discourse—"pure" or impure—is given little conceptual space within Soper's depiction of reality. Yet discourse is very much part of the world in which we live and as such, must be acknowledged in any depictions of it.

My second criticism of Soper's (1995) treatment of nature(s) is in her somewhat simplistic dichotomization between a permanent, "deep," biophysical nature and a fluid, "shallow," sociobiophysical nature. This seems to be simplifying matters too much, not to mention that it is at odds with most philosophers of biology (a point I elaborate on in a moment). Yes, some aspects of reality do seem to be more mutable than others—one can bend a small twig back onto itself with much more ease than one can space-time. But the either/or dichotomy that Soper proposed overly simplifies that very dynamism imparted by a critical realist epistemology.

In other words, where is the openness in Soper's (1995) conceptual representation of nature(s)? Ecologists inform us that our present steady-yet-dynamic state could be tipped into a very different direction for reasons so poorly understood that only complexity theory can be used to comprehend them (Gunderson & Holling, 2002; Holling, 2001). Meteorologists use the butterfly wing–flapping metaphor to illustrate the sequence of inconspicuous changes that eventually produce a visible weather event. The opening of deep nature to forces from above is important because it was precisely by assuming nature as constant that sociocultural reductionists justified neglecting and bracketing nature in the first place. Ultimately, Soper's conceptual schema, although a step in the right direction, leaves us with a representation of reality that does not mesh well with our knowledge of the world around us, particularly in view of recent advances in the life and ecological sciences. In short, more work is needed.

Figure 1 illustrates this project of refinement. Like Soper (1995), and Bhaskar, I too conceptualize a reality with ontological depth, but I do not stop there. In short, although Soper left us conceptual space for two terminological categories of nature (deep nature and surface nature), space for three open and dynamic natures can be constructed with further refinement, denoted here as (a) "nature," (b) nature, and (c) Nature.[9] A brief look at each of these three natures will aid in elucidating the conceptual processes described in Figure 1.[10]

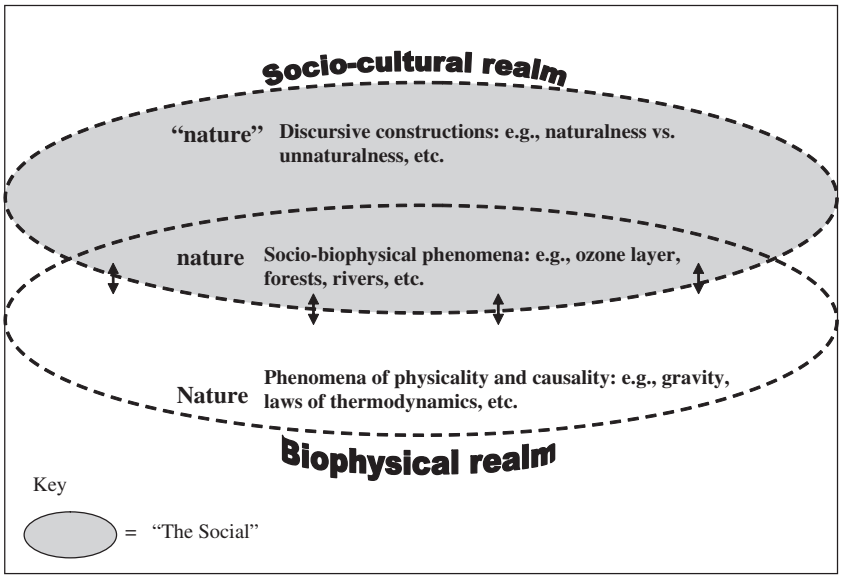

FIGURE 1: The Interpenetrating Sociocultural and Biophysical Realms That Constitute a Causally Dynamic Ecological Whole

Nature as "nature"

To speak of "nature" is to speak of a sociodiscursive concept. This is the "nature" of discourse, power/knowledge, cultural violence, and discursive subjugation. Of course, the discursive relations of power also have their place in understanding the other two natures (nature and Nature) that follow. In "nature," however, discourse takes on a more central role. This is not to suggest that "nature" is devoid of any attachment to the material world around us either—that it is, in short, a pure overloaded signifier. Such linkages, however, are not as immediate as in the two natures to follow. What I am describing, then, is a bounded Latourian hybrid. On one hand, contrary to Latour (and other actor network theorists), I do not see the hybridity of "nature" to be equal to the hybridity of either nature or Nature. Otherwise, one could not analytically differentiate between such different nature referents as nature-as-discursive-subjugation and nature-as-gravity, for they both, according to Latour (1993), equally represent inescapably impure "heterogeneous networks." Indeed, all three natures—"nature," nature, and Nature—represent bounded hybrids. In each, sociobiophysical interactions occur, but to various degrees, thereby underlying the need to conceptually stratify reality so as to better understand how those strata interact and the bounded hybrids that result.

Yet as biophysical phenomena are concomitantly social, so too are social phenomena concomitantly biophysical; as sociologists, we sometimes exalt the former proclamation at the expense of the latter. As Latour (1993) went to great lengths to point out, however, both positions are equally true. There is no pure social or biophysical. "Purity"—like ahistorical Truth—is an illusion of modernity. This is particularly important when speaking of "nature." "Nature" is not a pure sociodiscursive phenomenon—of discourse on more discourse "all the way down"—but a bounded hybrid. To think otherwise is to turn a blind eye toward sub-

jugating, symbolically violent practices that follow processes of naturalization—"Because it is just discourse, right?"—all the while very real social and ecological injustices may be occurring. Let us now turn toward an examination of this "nature" and the naturalization processes therein contained.

The society-nature distinction—at an (impure) sociodiscursive level—like any other distinction in social life, is built on power relations; a process known to Foucault (2000) as a "dividing practice" (p. 326). This distinction is discursively constituted through "games of truth" and "relations of power," which are themselves linked through what Foucault called "power/knowledge." What, then, does this suggest about "nature" as an (impure) sociodiscursive phenomenon? For Foucault, anything that attempts to stand apart from the flow of history—and from power/knowledge itself—is profoundly suspicious. Yet this is what "nature" does. "Nature" is that which is not social. "Nature" is the other. It is free from the discursive disciplinary mechanisms of society and, thus, removed from the "always already there" relations of power (Foucault, 1981, p. 141). Yet in separating "nature" from society, we make it absolute. "Nature" is Truth. "Nature" is right. And frequently, "nature" is good.

Semiologist Roland Barthes (1973), for example, discussed the significant role society plays in our interpretations of "nature," which can lead to what he has termed, "the 'nature' myth." Barthes argued that we should be especially sensitive to myths because myths frequently act as mechanisms through which social injustices become entrenched. Barthes, thus, argued,

> This myth of the "human condition" rests on a very old mystification, which always consists in placing Nature at the bottom of History. Any classical humanism postulates that in scratching the history of men [*sic*] a little, the relativity of their institutions or the superficial diversity of their skins . . . one very quickly reaches the solid rock of a universal human nature. Progressive humanism, on the contrary, must always remember to reverse the terms of this very old imposture, constantly to scour nature, its "laws" and its "limits" in order to discover History there, and at last to establish Nature itself as historical. (p. 108)

Here, Barthes (1973) highlighted the dangers that can occur when we naturalize "nature." Placing something within the realm of the natural relinquishes our ability to critique it. It is then, by definition, outside of us and, thus, beyond criticism: "That's just the way it is, it's not my fault, 'nature' made it that way." In categorizing something as part of "nature," it, thus, becomes beyond reproach and enters the realm of the absolute (R. Williams, 1980).

This cultural politics of "nature" was well captured by Dollimore (1991), who wrote,

> If, in the process of "recovering" nature, Marxism or any other political movement ignores the violence and ideological complexity of nature as a cultural concept, it will only recover a nature imbued with those ideologies which have helped provoke recent crisis. (p. 114)

We can find examples of "nature" being used toward such ends throughout history: to justify practices of Western colonization (Harcourt, 1994; Kleymeyer, 1994), slavery (Butchart, 1998), the displacement of millions in lesser developed countries in the name of "development" (DeChiro, 1998; Diegues, 1998), patriarchy (Bartky, 1997; Downey & Dumit, 1997), population control (Sandilands, 1999;

illustrating what Foucault, 1980, termed "bio-power"), agricultural standards (Carolan, in press-c; DeLind, 2000), and "speciesism" (or the domination of nonhuman animals; Stibbe, 2001).

We are, thus, on our way to constructing the aforementioned tripartite model of "nature"/nature/Nature. Let us now turn attention to the second of the three: nature.

Nature as nature

This is the nature that has been of particular interest to environmental sociologists. It is this nature that Soper (1995) referred to when she spoke of surface nature: the observable sociomaterial nature that is the basis for conceptions that are socially constructed. This is the nature of fields and forests, wind and sun, organisms and watersheds, and landfills and DDT. This is the nature with ubiquitous (and obvious) overlap between the sociocultural and biophysical realms.

Yet this nature also represents a conceptual space of unease for some sociologists, particularly once we start inching closer to those feared deep features of Nature (which whispers for many, "biodeterminism"). Granted, an air of caution is certainly warranted—particularly following such unscrupulous analyses as that provided by William Graham Sumner (1914/1971): "The millionaires are a product of natural selection. . . . They may fairly be regarded as the naturally selected agents of society for certain work" (pp. 156-157). But we must take care not to let this caution unnecessarily develop into feelings of aversion and disgust. For, as I soon illustrate, such emotional responses are misguided at best and may ultimately detract from sociology's future viability at worst. The question therefore becomes, in the words of Benton and Redclift (1994), "How do we open up to investigation the relationship between humans and the rest of nature, without letting in the 'Trojan horse' of biological determinism" (p. 4)?

There is clear justification for concern toward making hasty references to the natural world (such as for fear of legitimating ideologically driven biological determinism). But what concerns me most is that this apprehension is asymmetrical. For with all of our care not to slip down the slope of biological determinism, we remain largely oblivious to the very real risk of ensnaring ourselves in the equally dangerous cage of cultural determinism (see also, Dunlap, 2002, p. 335). In our rush to condemn the fixed-biological, we often overly prescribe mutability and fluidity to the sociocultural realm. We must, thus, remain vigilant to all forms of determinism, biological and otherwise—including sociocultural.

The problem with an intellectual aversion toward the biophysical is that such a view leaves us in a precarious position. Because if Latour (1993) is correct (which I believe he is) in saying that there are no pure social facts out there, only hybrids, what then does this mean to those who still choose to ascribe to a pure social fact epistemology—those who treat the biophysical as epiphenomenal and analytically detached from the causal tendencies said to emanate from the social and the social alone? For as the life and ecological sciences are beginning to inform us, the footprint of humanity now covers the globe. From the water that we drink to the air that we breathe; from the top of Mount Everest to the deepest depths of the ocean; from the cancer in our bodies to the ozone layer miles above our heads, the effects of humanity (and modernity) can increasingly and assuredly be found (Adam, 1998; Budiansky, 1995; McKibben, 1989). So if there are no pure biophysical or sociocultural forms left—if, indeed, there ever were—why then do many still cling to an epistemological position that claims there are? Perhaps a few specific examples of such sociobiophysical forms would help elucidate this point.

Let us begin with the effects of heavy metal neurotoxicity on human behavior. Epidemiological research links some cases of attention deficit disorder and attention deficit/hyperactivity disorder to exposure to such metals as lead and manganese (Needleman & Gatsonis, 1991; Needleman, Shell, Bellinger, Lenton, & Allred, 1990; Walker, 1998) because of lead's ability to downregulate dopamine and glutamate and the capacity of manganese to downregulate serotonin (such exposure has also been linked to aggressive behavior; see Masters, 2001, 2002; Masters, Hone, & Doshi, 1998; Pihl & Ervin, 1990; Stretesky & Lynch, 2004). Of course, although this does not suggest that all cases of attention deficit disorder or attention deficit/hyperactivity disorder can ultimately be traced to heavy metal exposure, examples can be cited where lead removal effectively replaced drug treatment for certain cases (Walker, 1998). Couple this with the fact that the effects of acute lead exposure are overwhelmingly borne by those of lower socioeconomic ranking (Millstone, 1997), and one would think we have the makings of a topic with sociological significance. Such has yet to be the case, however.

The etiology of disease has also changed considerably as global "flows" (from travel, to food, to economic markets) further compress time and space. As urban centers continue to push further into formerly uninhabited areas, an increasing number of people are expected to be exposed to large reservoirs of disease that were previously of concern to only nonhuman animals (Ehrlich, 2002, p. 282). The etiology of HIV, for example, cannot be divorced from such social processes as global markets, international air travel, urban sprawl, economic inequality (at both the international and intranational level), and the pressures placed on chimpanzee populations from excessive hunting (Gao, Bailes, Robertson, Chen, & Rodenburg, 1999). Toward this end, we can look to "the virus" as in many ways representing the archetype of the sociobiophysical hybrid: Its being and becoming are inextricably linked to broader sociocultural patterns. And as (late) modernity further compresses time and space, one must wonder what sociobiophysical viral hybrids we will find ourselves confronting in the future.

Another example comes to us by way of sociologist Peter Dickens (2000, 2001a, 2001b, 2004). Dickens looked toward Marx's theory of subsumption to inform a potential articulation between the biological and social sciences. According to Marx (1970), capitalism inevitably leads to what he described as "real" and "formal" subsumption, in which the latter details the direct subordination of labor to capital and the former expresses the loss of individual autonomy. Yet Dickens (2001a) sought to push this idea further, toward a more radical interpretation, namely, that "capitalism, in conjunction with the various forms of biological predispositions . . . may over the long term have been shaping human biology in its own image" (p. 106).

One area of particular interest to Dickens (2001b, 2004) is human development. Specifically, he pointed to epidemiological work that suggests that the effects of the mother's environment are transmitted to her yet unborn child—which he likened to a type of "weather forecast." Consequently, inadequate prenatal care, which is correlated with lower socioeconomic status, can lead to poorly "adapted" individuals and ultimately, if conditions are not improved, an entire (working) class. The Marxian reading of this being that such a "social(-biophysical) fact" points to yet another "contradiction" of capitalism (the idea that capitalism's very logic produces conditions that will lead to its own inevitable demise)—namely, a vicious circle of ill health, which translates into a poorly adapted working class.

Illustrative examples can also be found in the rich tradition of human ecology (e.g., Freese, 1997a, 1997b; Steiner, 2002). Human ecologists have argued that explanatory accounts of social action cannot be separated from the physical environment within which they occur. McLaughlin (2001), for instance, in laying out what he called an "ecology of social action" (p. 22), sketched the origins of a farmers' movement in Saskatchewan, Canada, by linking it to not only such factors as social structures and the market, which are common sociological variables, but also the "unpredictable physical environment" (p. 22). By doing this, McLaughlin argued that such an "'ecology of social action' can provide a more dynamic, historical and critical organizational ecology, one that addresses the co-evolving nature of cultural understanding, organizational forms, and resource constraint" (p. 24). Or take the work of Stedman (2002, 2003), who employed structural equation modeling in an attempt to measure the extent to which the physical environment shapes our construction of meaning, particularly in terms of our sense of place. Indeed, the role of ecology in shaping social (psychological) patterns is difficult to deny, particularly in the context of geopolitical relations and conflicts.

What affects, for instance, have such physical features as mountain ranges and large bodies of water had in regard to the historical adoption and adaptation of technological, cultural, and political innovations (Diamond, 2005; Ehrlich, 2002)? As we move from a coal- and petroleum-based economy to one based on other "alternative" energy sources—such as, say, wind and solar power—what role will the availability of these resources play in how societies are organized (e.g., as with coal and oil, some physical locations are "richer" in wind and solar energy than others)? As available fresh water—itself a "fixed" resource—becomes the most fought over resource in the 21st century (Shiva, 2002; Ward, 2002), how will this conflict shape patterns of agriculture, food systems, and geopolitical boundaries? And how will the steady encroachment of deserts (e.g., desertification) onto formerly productive farmland (Brown, Larson, & Fishchlowitz-Roberts, 2002) shape, for example, global market structures, the direction of biotechnical innovations, food access, and future patterns of water dependency as we turn increasingly toward irrigation (and the large damming projects they require) in our attempts to hold back the sand?

For my last example, take the secondary sex characteristics of strength and muscle mass as further exemplars of sociobiophysical interaction. Overall, genes and endocrine processes create two mutable statistical distributions (for both males and females) between which there is a significant degree of overlap (Birke, 1992). This distribution can be seen, for instance, in such characteristics as strength and muscle mass. For reasons related largely to hormones, females, on average, have a different muscle to fat ratio than men, which, again on average, results in men possessing greater muscle mass and strength than women. Yet because of distinct sociocultural processes, this overlap—particularly in the case of strength and muscle mass—has been artificially reduced (that is to say, these differences have been exaggerated; De Landa, 1997). In the words of Richard Lewontin (1982),

> The division of labor between men and women and the division of early training, activity and attitude cause a very considerable exaggeration of this small difference, so that women become physically weaker than men during their development to an extent far in excess of what can be ascribed to hormones. (p. 109)

Here, then, we find yet another example whereby patterns of social organization shape, and feed back on, something as presumably rooted in biology as muscle

mass and strength, which in turn feeds back on (and reinforces) those very patterns of (patriarchal) social organization.

These various examples reveal interesting interconnections between the social and the biophysical realms. As Latour (1993) noted, the pure nonhybrid is a chimera. Yet as we have also seen, hybrids shift and change with time, in both being and kind. The examples presented above illustrate the potential of (late) modernity to change the intensity and rate at which this hybridization occurs. What we see, then, with the nonlinear unfolding of modernity, is the social extending into and colonizing, if you will, the natural (and vice versa). This has had the effect of expanding the potential realm of sociological inquiry, as well as our epistemic claims to "social facts." All of which places into question the pure epistemic boundaries still clung to by many in the discipline (I revisit this argument shortly).

Nature as Nature

Deep strata Nature is the Nature of physicality, causality, and permanence-with-flux. It is the Nature of gravity, thermodynamics, and ecosystem processes that we have yet to grasp conceptually (except, perhaps, through the use of chaos theory or butterfly wing–flapping metaphors). In many ways, then, Nature has a number of affinities with Soper's (1995) deep nature.

In accordance with the postulates of critical realism, however, not all deep strata are of equal depth. Some phenomena are indeed deeper than others. Gravity and the laws of thermodynamics, one could argue, are deeper than, say, the steady-yet-dynamic state of our ecosystem, which, as earlier described, could be tipped to a very different state for reasons ecologists still poorly understand. Depth, therefore, should not be equated with immutability. Chomsky's (1971, 1975) hypothesis of a universal grammar, for example, posits a structure with ontological depth, which allows for language to develop in an "underdetermined" fashion. But having the neurological capacity to acquire language says nothing to whether one will actually do so. Nor do these deep structures dictate which and how many languages an individual will acquire. Such is ultimately a product of the sociocultural milieu within which the individual is embedded. No determinism here.

This postulate of ontological mutability holds for the deepest of structures. Newton's inverse square law of gravity, for example, has been shown to vary since the beginning of the universe (Davies, 1995). The so-called fine structure constant—or "alpha" (those supposedly unchanging physical properties, such as the speed of light and an electron's charge, that explain how the universe holds together)—has recently been shown to be changing during the course of the past 10 billion years or so: "Light may be slowing down, the electron's charge growing, and atomic nuclei losing mass" (Choi, 2002, p. 7). Even the ironclad "thermodynamic arrow of time" is not immune to this dynamism. It has been described—most convincingly by prominent North American physicist Lawrence Schulman (1997, 1999)—as having the potential to slow down, speed up, and even, as unbelievable as it may seem, run backward. Moreover, as with the shallower strata of reality, those of deep Nature are open to tendencies and forces from both above and below. As noted earlier, the effects of modernity are such that at times, phenomena from deep Nature become "lifted out" and reembedded within the less deep strata of nature. In short, the world of causal powers and deep structures are not exempt to these interpenetrating dynamics.

With that we must be cautious not to view deep structures of Nature as too fixed or permanent but instead, as existing in a state of permanence-with-flux. Sociol-

ogy's avoidance of Nature resides in this belief that Nature is constant, thereby legitimating those justifications for neglecting, or bracketing, nature. As we have seen, however, such assumptions are not only incorrect but also could potentially threaten sociology's long-term longevity and value as the discipline of the social par excellence. We must examine social facts, yes, but not at the exclusion of other salient causal variables, social and otherwise—a point that appears to be only growing in salience as we proceed further down the multiple paths of modernity.

There is also an important epistemological point to be made about these deep structures of Nature: namely, short of taking a "God's eye" position, our knowledge of them will forever be contingent, limited, and changing. This highlights the point made earlier regarding how our knowledge of all levels of reality are socially mediated to various degrees (this point is, thus, not reserved for our knowledge of only "nature"). Thus, the employment of semantic techniques is often required for us to "get at" (for lack of a better term) this realm, such as through use of metaphor, simile, and analogy (Ehrenfeld, 2003). Newtonian mechanics, chaos theory, the Gaia hypothesis, food webs, and self-regulating systems all represent semantic strategies to help draw a "map" of what these deep tendencies (may) look like and how they (may) operate. And these strategies are admittedly limiting in what they allow us to perceive, for while highlighting some aspects of reality they inevitably exclude others (Carolan, in press-b; Forsyth, 2003; Harré, Brockmeir, & Muhlhausler, 1999).

The prominent social theorist Manuel Castells (1996) wrote, "After millennia of a prehistoric battle with Nature, first to survive, then to conquer it, our species has reached the level of knowledge and social organization that will allow us to live in a predominately social world" (p. 478). I question this assessment of modernity and the ramifications for sociology therein implied. I mention this quote because it represents a common conceptual orientation toward the social in sociology today; a conceptual orientation that presents a vulgarly abiophysical orientation, in both being and kind. Indeed, if anything, the social is becoming more coupled to the natural (and vice versa), resulting in novel interrelationships and new horizons of potential for social scientists. If sociology wishes to ensure its future position as the discipline of the social, then it would do well to respond—theoretically, methodologically, epistemologically, and analytically—to these effects of modernity, as opposed to retreating into the hermetically sealed cave of the social fact because of it.

We now have a conceptual foundation on which to differentiate between three open strata of nature: (a) "nature" (as [impure] sociodiscursive phenomena), (b) nature (as sociobiophysical phenomena), and (c) Nature (as deep [but open] phenomena). From this analysis we can conclude that the biophysical not only should but also must be given entry into sociology's disciplinary narrative. To do otherwise would be to greatly restrict sociology's explanatory and descriptive potential over the realm of the social and the social facts over which we claim epistemic primacy.

Sociobiophysical Colonization

Allow me to now briefly return to the issue of colonization. Rather than attempting to view this process through a particular theoretical framework—such as through the lens of Marxism, Habermasian theory, or Weberian rationalism—I prefer to take this discussion to a higher level of abstraction. In short, I view the

above-mentioned sociobiophysical colonization as an effect of the very reductionism that this article speaks against.

Much has already been written as to how the "hand" of humankind now spans the globe (Beck, 1992, 1997; Giddens, 1991; Merchant, 1980; Moore, 2000), with perhaps the most well-known argument toward this end found in Bill McKibben's (1989) *The End of Nature* (see also, Eckersley, 2005; Gelbspan, 2005; McKibben, 2005; Yearley, 2005). Yet underlying this horizontal *spreading* of humanity across reality (although it is important that as illustrated in the above figure, components of reality remain both external and autonomous to the social) is our vertical *penetration* into it by way of two self-reinforcing orientations: namely, economic and methodological (or epistemic) reductionism.

Economic reductionist arguments are being mobilized throughout the world to support private ownership and market-based management of an ever-increasing number of "commodities" that were previously outside the reach of capitalism's logic (e.g., the patenting of genetic material, carbon "credits," the globalization of "waste"). These arguments, however, are both supported by and support methodological reductionism, which entails the "breaking" of the world down into its constituent parts. And from these self-reinforcing reductionist orientations emerge novel representations of biophysical entities—such as, for instance, "genes"—that present themselves as unitary and fixed objects that can be unproblematically commodified and traded in the global market (Carolan, 2005c; McAfee, 2003).

Yet as others have noted, such reductionist representations are highly problematic, for they rest on a view of the world that is at odds with reality (Fox Keller, 2000; Lewontin, 2000). To speak in metaphorical terms, these representations "see" only the trees of an otherwise dynamic (with upward and downward causal forces), ecologically interconnected forest. In short, these reductionist orientations deny the role of ecology in continually reshaping relationships and effects. Market capitalism must ignore these interconnections, however, for such assemblages are incompatible with neoliberalism and the economic reductionism on which it rests. Such is in recognition that it is much easier to commodify and, thus, claim ownership of, an ontologically independent "object" than a "hybrid-object" that is inseparably connected to its environment (Carolan 2005a, 2005c).

Lewontin (2000) provided the following illustrative example from plant science of some of the problems that can arise when we ascribe to such rigid reductionist frameworks:

> In an attempt to increase the productivity of crops, plant engineers make detailed measurements of microclimate around the plant and then redesign the pattern of leaves to increase the light falling on the photosynthetic surfaces and the available carbon dioxides. But when these redesigned plants, produced by selective breeding, are tested it turns out that the microclimatic conditions for which they were designed have now changed as a consequence of the new design. So the process must be carried out again, and again the redesign changes the conditions. The plant engineers are chasing not only a moving target but a target whose motion is impelled by their own activities. (p. 57)

My point, therefore, is this: Although science and the market seek to continually dissect reality into its constituent parts, creating in its wake a world full of unitary, unproblematic, and ontologically fixed objects, such epistemic maneuvering denies the rooted, emergent, and interconnected qualities those objects have as ecologically embedded entities. All of which, in turn, leads to activities rife with

unintended consequences (see also, Tenner, 1997). The above-mentioned sociobiophysical colonization is, in other words, an unintended effect of manipulating objects that are in reality hybrid-objects: Entities that are ontologically interconnected to other ecologically embedded entities at various "levels" of strata. To speak of sociobiophysical colonization is, thus, to speak of an inevitable "ripple effect" of our actions, accentuated by an unwillingness to see the world in its full complexity because of the epistemic blinders of methodological and economic reductionism (and the discursive and/or cultural reductionism emanating from certain social scientific circles does nothing to improve on this constrained orientation; indeed, it supports it only).[11]

CONCLUSION: NEXT STEPS

Now that most of the conceptual heavy lifting has concluded, let us take a step back and reflect on the framework that lies before us. I would like to begin this process, and in turn conclude this article, discussing a few specific conceptual issues that have yet to be addressed but which are important to further focus this article's argument.

The first point concerns the above-mentioned fluidity of the social: that although the social is unmistakably open, dynamic, and fluid, we must not mistake this as a call for the evaporation of all disciplinary boundaries. Categories serve an important social purpose: They help to provide a little order in a very chaotic world—indeed, without them we could not speak or think about anything. For example, if we did not establish at least some bounded conceptual distinctions between the social and the natural, then everything would be nature—including pollution! Such a relativistic and vulgar postmodern strategy—namely, the deconstruction of all categories—gets us nowhere and we would be worse off because of it. Moreover, it is logically incoherent. To even suggest that categories do not exist presupposes their very existence; otherwise, such statements would not make any sense. Categories give us a language to discuss and debate things—such as environmental pollution, global warming, and environmental racism—that we would not be able to discuss, and take action against, otherwise. The conceptual postulates of critical realism do not lend themselves to such deconstructive claims. Because reality is emergent, rooted, and open, critical realists contend that there must, in fact, be disciplines. Indeed, as Bhaskar (2005) recently argued, critical realism argues for the necessity of a multidisciplinary approach given the nonreducible levels of reality. For ultimately, one could no more reduce all science to one discipline or methodological framework than one could reduce all reality to one level of strata.[12]

Instead of the wholesale evaporation of disciplinary boundaries, perhaps then one would do best calling for, say, a "loosening" of our understanding of the social. This would require setting our sights to vistas beyond the narrowly constructed Durkheimian dictum concerning social facts and toward the horizons of a new precept—a precept that is not fearful of looking toward the biophysical when our search for explanatory and descriptive variables warrants it. For instance, in removing any appeal to the biophysical, we lose grounds for challenging the authority of custom and power that "necessitate" and "naturalize" such cultural practices as genital mutilation and infanticide. Without grounded realist appeals, we could not forcefully question genetically modified organisms, DDT, agricultural chemicals, dioxin, and other pollutants. Nor could we meaningfully critique

nuclear power, the risks associated with endocrine disrupters (or risks in any substantial way for that matter), or the consequences associated with the hole in the ozone layer (Rosa, 1998).

Indeed, during the past few decades there has been a growing push to write out nature entirely by seeing it as an extradiscursive force (see, e.g., Butler 1989, 1994; Foucault 1980, 1981, 2000; Lorber, 1994). Such a conceptual maneuver, however, empties sociology of all critical purchase to oppressive exercises of power—particularly those manifestations involving torture, mutilation, and physical abuse (Sayer, 2000). For if there is no biological substratum lending experiential force to either pleasure or pain, then *pleasure* and *pain* become mere discursive constructions—on further discursive constructions all the way down—whose existence could be reduced through either discursive denial or discursive reconstruction (Carolan, 2005b). All of which leaves sociology radically *uncritical* in character, for it strips it (and us with it) of any authority to "say *what* oppression is bad *for*, or what it does damage *to*" (Sayer, 2000, p. 98).

Allow me to now conclude with a few words regarding the explicit realist program that this article represents. First, why the tripartite model of "nature"/nature/Nature? That is, why 3 levels as opposed to 4, 10, or 100? It is one thing to ask how many strata constitute reality—a question to which not even Bhaskar has sought an answer. It is, however, quite another to ask and decide how many strata are needed in social theorizing (Archer, 1995). The account of reality presented above is meant to stimulate critical debate as to how we should do sociology, particularly given what I and others see as the increasing "hybridization" of reality between human and nonhuman things (e.g., Carolan, 2004, in press-a; Hannerz, 1997; Haraway, 1989, 1997; Latour, 2004; Murdoch, 2003). In other words, it seeks to illustrate by way of a critical realist philosophy of science that opening the door to biophysical variables need not send us headlong into the thralls of biological determinism. Rather, by opening our imaginations to such variables, we better position sociology to study the proliferation of hybridized social facts that are part and parcel of our modern lives. The tripartite model of reality presented above, thus, seeks to give us a language and a framework (not the language or the conceptual framework) from which to begin this discussion. With that said, I do not deny that other levels could be added to this tripartite model (or even levels within levels). Yet for the purposes at hand—namely, to give us a language and conceptual framework to speak of mutable sociobiophysical dynamics by way of references to nature—the three levels serve us well.

Second, critical realism allows us to move beyond the so-called constructivist/realist debate that has been raging in environmental sociological circles for well more than a decade (although the intensity of this debate has diminished considerably during the past few years; see, e.g., Buttel, Hawkins, & Power, 1990; Dunlap & Catton, 1994; Hannigan, 1995; Murphy, 1995, 2001; Yearley, 2002). On one hand, critical realism is hostile to strong forms of constructionism and solipsistic postmodernism (what Bhaskar, 1978, referred to as representing "superidealism") for they do not allow for fallibility. Such epistemological theories posit that all knowledge claims are equally privileged social constructs (what C. W. Mills, 1959, called "democratic theories of knowledge")—which, upfront, appears to be a rather admirable deontological position. Yet on closer inspection, we find such theories incapable of any broader emancipatory critique or project. For although they claim to reject epistemological positions of universality, they do so by paradoxically proscribing their own universal—namely, that all knowledge claims are of

equal validity. In doing this they ensnare the individual in an impenetrable hermeneutic circle. Space for constructive critique thereby vanishes as all validity claims are assigned equal epistemological footing, be they Einstein's or Hitler's. Such positions, to draw from Karl Popper (1963/2002), thus, fail to distinguish clearly enough between "questions of origin" and "questions of validity."

With that said, critical realism does acknowledge the fallibility of knowledge claims—that is, as I have earlier stated, what makes critical realism critical. Yet while rejecting the correspondence theory of truth, critical realism does acknowledge that some knowledge claims—or social constructions—are "better" (or more accurate) than others. Thus, although we may never be able to know reality as it is, we can say that because reality is real, some approximations of it can be better than others. Indeed, if the Green critique is to possess any force we must be able to say this, for without being able to make some reference to an objective reality "out there," such a critique is greatly undermined (Benton, 2001b; Dunlap, 2002; Murphy, 2002). In which case, for example, Union Carbide could claim that the Bhopal gas tragedy of 1984 simply did not happen, and it would be quite difficult to refute such a claim. For without the ability to speak of and point to such things as, for instance, the gas-ravaged bodies, the dead livestock, the soil and water in and around the plant that were contaminated by organochlorines and heavy metals, the birth defects, and the reproductive disorders—which represent convincing evidence that the accident really did occur—issues of validity become reduced effectively to who has the biggest and loudest bullhorn (which often boils down to who has the most money and power).

To argue, therefore, that "the realist 'problematic' implies that there is one correct or best interpretation of the environment" (Yearly, 2002, p. 278) unfairly depicts the position set forth by critical realism. In the above tripartite model of "nature"/nature/Nature, space is made for social constructions (indeed, as noted, knowledge of all three levels is inevitably socially mediated). But we must remember that those social constructions are only a part of a larger stratified whole. Thus, although our knowledge of each strata of reality is mediated to various degrees, this does not take away from the causal efficacy of those biophysical things that social constructions are made in reference to.

In more practical terms, by neglecting biophysical variables we risk undermining our ability—and ultimately our legitimacy in the eyes of the public—to inform public policy. Take the following example concerning the great dust storms in China. In an attempt to dampen these storms, China's State Forest Administration has persuaded the central government to pursue tree planting as the main mitigation strategy. Yet as various ecologists have pointed out, such a strategy may actually be making matters worse because it is the product of a policy that does not fully understand the local biophysical reality of "the problem" (Chen, Cai, & Tang, 2003). Groundwater is now being pumped to places where trees have not grown before, thus, drawing down water sources elsewhere. In the winter and spring, when the dust storms are at their peak (between the months of January and May), the trees also lack a leafy canopy and, thus, do little to actually break the wind. Moreover, the row configuration in which these trees are often planted can actually create a funneling effect that can further intensify wind speeds within these corridors (Dong, Wang, & Liu, 2000; C. Williams, 2005). As we can see from this example, knowledge of biophysical complexities is essential if we are to effectively inform policies in response to the very real (albeit socially and politically mediated) environmental problems of the world today.

As Benton (1991) noted well more a decade ago, social phenomena, no matter how much sociologists may wish otherwise, cannot escape the complex web of biological, chemical, and physical interactions. The politics of health and well-being, of gender and sexuality, of food and the environment, of animal rights and welfare, and of the body—these represent just a few of the sites of sociopolitical contention that raise major questions as to the place of the biophysical in social theory. These issues also represent some of the main topics of contention in the 21st century. Moreover, as earlier detailed, that web of interaction between social and biophysical variables is arguably growing in scope—what I have described as sociobiophysical colonization. All of which lends further support, and indeed an air of urgency, to those calls to open sociology up to the potentiality of biophysical variables.

One of the tasks of sociology in the 21st century, then, could be to scale and map the extent of this colonization and prescribe/inform policies to reduce it. Yet such a task can be accomplished only after sociology first rethinks how it conceptualizes the realm of the social. In this article, I have worked to open that concept up to include both social and biophysical variables. It is now up to future empirical research to more fully map the effects of this causally diverse realm of reality.

NOTES

1. The disciplinary foundation on which sociology stood until the early 20th century was quite uncertain. During this period, many questions were directed at where sociology's place should be within the academic world. How is sociology different from history, psychology, or philosophy? What intellectual insights can sociology offer that cannot be provided by an already well-established discipline? Questions such as these made it especially imperative for founders of the discipline to distinguish sociology from other already established disciplines, ultimately culminating in Durkheim's (1964) famous (or infamous) dictum: Causes of social facts must be sought in other social facts. It is important to remember here that early sociological thought was developed, at least in part, as a reaction to social Darwinism. Most notable, it was constructed in partial response to the works of English social philosopher Herbert Spencer (1820-1903) and American sociologist William Graham Sumner (1840-1910). In one essay, for instance, Spencer (1860/2000) compared simple life-forms such as yeast and hydra to primitive societies, whereas when discussing the English form of government, he likened it to the human brain. In another, Spencer (1967) likened the transition from guild- to factory-based production to processes within the human liver.

2. The term *critical realism*, however, was coined decades earlier by Drake (1920).

3. Bhaskar (1978) observed,

> Transcendental realism [also known as critical realism] argues that it is necessary to assume for the intelligibility of science that the order discovered in nature exists independently of men [*sic*], i.e., of human activity in general. Transcendental idealism maintains that this order is actually imposed by men in their cognitive activity. Their differences should thus be clear. According to transcendental realism, if there were no science there would still be a nature, and it is this nature which is investigated by science. Whatever is discovered in nature must be expressed in thought, but the structures and constitutions and causal laws discovered in nature do not depend upon thought. Moreover, the transcendental realist argues, this is not just a dogmatic metaphysical belief; but rather a philosophical position presupposed by key aspects of the social activity of science, whose intelligibility the transcendental idealist cannot thus, anymore than the empiricist, sustain. (p. 27)

4. Bhaskar, thus, produced a philosophical ontology, which allows him to speak of issues of ontology without committing an epistemic fallacy of his own (see Chalmers, 1988, where this criticism was initially brought forth). In other words, Bhaskar produced an account of what the world is *like*, versus a scientific ontology, which speaks to the knowledge of the world produced by science (see Cruickshank, 2004, for a defense of this position).

5. Bhaskar and Lawson (1998) argued that

> explanatory science . . . seeks to account for some phenomenon of interest—typically an experimentally produced event pattern—in terms of a (set) of mechanism(s) most directly responsible. Producing this explanation will involve drawing upon existing cognitive material, and operating under the control of something like a logic of analogy and metaphor, to construct a theory of a mechanism that, if it were to work in the postulated way, could account for the phenomenon in question. The reality of the mechanism so reproduced is subsequently subjected to empirical scrutiny, and the empirical adequacy of the hypothesis maintained compared to that of competing explanations. Following this any explanation that is (tentatively) accepted must itself be explained, and so forth, a move which, in itself, presupposes *a certain stratification of reality* [italics added]. On the transcendental realist view of science, then, its essence lies in the movement at any one level from knowledge of manifest phenomena to knowledge, produced by means of antecedent knowledge, of the structures that generate them. (p. 5)

6. The central mode of inference for critical realism is, thus, neither deduction nor induction but what Lawson (1997) called "retroduction":

> The aim is not to cover a phenomena under a generalisation (this metal expands when heated because all metal do) but to identify a factor responsible for it, that helped to produce, or at least facilitated, it . . . [; t]o posit a mechanism (typically at a different level to the phenomenon being explained) which, if it existed and acted in the postulated manner, could account for the phenomenon singled out for explanation. (p. 213)

7. See, for instance, Harvey (2002) and Scambler and Scambler (2003) for a succinct overview and application of this model.

8. R. Keith Sawyer's (2001; see also, Sawyer 2002a, 2002b) article published in the *American Journal of Sociology* represents one of the most thorough critiques of the emergentist claims of Bhaskarian critical realism. Sawyer's argument hinges on his presupposition of "supervenience," which is the position that if two events are identical with respect to their descriptions at the lower level, then they cannot differ at the higher level; for example, "If a collection *L* of lower-level components with a given set of relations causes higher-level property *H* to emerge at time *t*, then on every other occasion when *L* obtains, *H* will again obtain" (Sawyer 2002b, p. 543). Taking this self-described strong position toward supervenience, Saywer (2002b, p. 555) then proceeded to critique a number of collective emergentist arguments, including that of Bhaskar. But Sawyer spoke only to what I have called strong critical realism, for that is where Bhaskar's collective emergentist arguments are contained. This leads one to wonder at just what level Sawyer's arguments toward emergence are directed—that is, is he speaking of emergence per se or of emergence within *already emergent* higher level properties? Sawyer's concern, rather, appears to be directed toward emergentist arguments that articulate stratification within society, not toward emergence itself. Indeed, in his rejection of what I call strong critical realism, Sawyer provided little that philosophically or theoretically refutes the weaker variant. He spoke at length of various effects that if they hold, would indicate the potential of an emergentist property:

namely, "multiple realizability," "wild disjunction," and William Wimsatt's (1986, 2000) "nonaggregativity" thesis. Yet in evoking these conceptual tools to place into question Bhaskar's sociological realism, one can likewise look toward them to support the emergentist position of weak critical realism (see Carolan, 2005b, for further discussion).

9. I should note that Soper (1995) did provide a third conceptualization of nature: as a metaphysical concept—for example, human nature.

10. This tripartite model is meant to clarify the conceptual and terminological quagmire that surrounds the term *nature*. Thus, although there is some overlap, these three natures are not meant to perfectly reflect Bhaskar's three levels of reality: (a) the empirical, (b) the actual, and (c) the real.

11. With that said, it is important to realize that by highlighting the unintended consequences of science I am not undermining the claims made by critical realism. Simply because science does not result in perfect prediction does not undercut the earlier mentioned transcendental argument made by Bhaskar (1978) concerning his account of what the world must be like for science to be possible. Indeed, if anything, it lends support to his immanent critique of empiricism, for it highlights the causally open nature of reality where observable, predictable regularities are not always obtained (because of the existence of unobservable, yet still real, causal tendencies).

12. There is, however, contention among critical realists as to just how "scientific" various disciplines are. For instance, Rom Harré (1970, 1972; Harré & Madden, 1975) is strongly committed to methodological individualism and has questioned the reality of social structures and, thus, the scientific validity of sociological collectivism. Andrew Collier (1994), because of the impossibility of experimental closure in the social sciences, likewise argued that such sciences cannot be scientific in the fullest sense of the word. Bhaskar (1998), Benton (1981), Lawson (1997), and Archer (1995), on the other hand, have taken the opposite position, making strong arguments as to the scientific potential of the social sciences.

REFERENCES

Adam, B. (1998). *Timescapes of modernity: The environment and invisible hazards*. New York: Routledge.

Archer, M. (1995). *Realist social theory: The morphogentic approach*. Cambridge, UK: Cambridge University Press.

Archer, M., Bhaskar, R., Collier, A., Lawson, T., & Norrie, A. (Eds.). (1998). *Critical realism: Essential readings*. London: Routledge.

Barthes, R. (1973). *Mythologies*. London: Paladin.

Bartky, S. L. (1997). Foucault, femininity, and the modernization of patriarchal power. In K. Conboy, N. Medine, & S. Stanbury (Eds.), *Writing on the body: Female embodiment and feminist theory* (pp. 129-154). New York: Columbia University Press.

Beck, U. (1992). *Risk society: Towards a new modernity.* Newbury Park, CA: Sage.

Beck, U. (1997). Subpolitics: Ecology and the disintegration of institutional power. *Organization & Environment*, *10*(1), 52-65.

Bell, M. M. (2004). *An invitation to environmental sociology* (2nd ed.). Thousand Oaks, CA: Pine Forge Press.

Benton, T. (1977). *The philosophical foundations of the three sociologies*. London: Routledge Kegan Paul.

Benton, T. (1981). Realism and social science. *Radical Philosophy*, *27*, 13-21.

Benton, T. (1991). Biology and social science. *Sociology*, *25*, 1-29.

Benton, T. (2001a). Environmental sociology: Controversy and continuity. *Sosiologisk tidsskrift*, *9*, 5-48.

Benton, T. (2001b). Why are sociologists naturephobes? In J. Lopez & G. Potter (Eds.), *After postmodernism: An introduction to critical realism* (pp. 133-145). New York: Athlone Press.

Benton, T., & Craib, I. (2001). *Philosophy and social science: The philosophical foundations of social thought*. London: Palgrave.

Benton, T., & Redclift, M. (1994). Introduction. In M. Redclift & T. Benton (Eds.), *Social theory and the global environment* (pp. 1-13). London: Routledge.

Bhaskar, R. (1978). *A realist theory of science*. Hassocks, UK: Harvester Press.

Bhaskar, R. (1989). *Reclaiming reality*. London: Verso.

Bhaskar, R. (1994). *Plato etc.: The problems of philosophy and their resolution*. New York: Verso.

Bhaskar, R. (1998). *The possibility of naturalism*. New York: Harvester Wheatsheaf.

Bhaskar, R. (2005, July). *Critical realism and the theory and practice of interdisciplinarity*. Lecture presented at the 37th World Congress of the International Institute of Sociology, Stockholm, Sweden.

Bhaskar, R., & Lawson, T. (1998). Introduction: Basic texts and developments. In M. Archer, R. Bhaskar, C. Andrew, T. Lawson, & A. Norrie (Eds.), *Critical realism: Essential readings* (pp. 3-15). London: Routledge.

Birke, L. (1992). In pursuit of difference: Scientific studies of women and men. In G. Kirkup & L. Smith Keller (Eds.), *Inventing women: Science, technology, and gender* (pp. 81-120). Cambridge, MA: Polity.

Birke, L. (2000). *Feminism and the biological body*. New Brunswick, NJ: Rutgers University Press.

Birke, L. (2003). Shaping biology: Feminism and the idea of "the biological." In S. Williams, L. Birke, & G. A. Bendelow (Eds.), *Debating biology: Sociological reflections on health, medicine and society* (pp. 39-52). London: Routledge.

Brown, L., Larson, J., & Fishchlowitz-Roberts, B. (2002). *The earth policy reader*. New York: Norton.

Budiansky, S. (1995). *Nature's keepers: The new science of nature management*. New York: Free Press.

Bury, M., & Wadsworth, M. (2003). The "biological clock"? Aging, health and the body across the lifecourse. In S. Williams, L. Birke, & G. A. Bendelow (Eds.), *Debating biology: Sociological reflections on health, medicine and society* (pp. 109-119). London: Routledge.

Butchart, A. (1998). *The anatomy of power: European construction of the African body*. London: Zed Books.

Butler, J. (1989). *Gender trouble*. London: Routledge.

Butler, J. (1994). Gender as performance: Interview. *Radical Philosophy*, *67*, 32-39.

Buttel, F. H., Hawkins, A. P., & Power, A. G. (1990). From limits to growth to global change. *Global Environmental Change*, *1*, 57-66.

Carolan, M. S. (2004). Ontological politics: Mapping a complex environmental problem. *Environmental Values*, *13*, 497-522.

Carolan, M. S. (2005a). The conspicuous body: Capitalism, consumerism, class, and consumption. *Worldviews: Environment, Culture, Religion*, *9*, 82-111.

Carolan, M. S. (2005b). Realism without reductionism: Toward an ecologically embedded sociology. *Human Ecology Review*, *12*, 1-20.

Carolan, M. S. 2005c). The disciplining of nature: The homogenizing and constraining forces of anti-markets on the food system. *Environmental Values, 14*, 363-387.

Carolan, M. S. (in press-a). Risk, trust and "the beyond" of the environment: A brief look at the recent case of mad cow disease in the United States. *Environmental Values*.

Carolan, M. S. (in press-b). Science, expertise, and the democratization of the decision-making process. *Society and Natural Resources*.

Carolan, M. S. (in press-c). Social change and the adoption and adaptation of knowledge claims: Whose truth do you trust in regard to sustainable agriculture? *Agriculture and Human Values*.

Castells, M. (1996). *The information age, I: The rise of the network society*. Oxford, UK: Basil Blackwell.

Catton, W., & Dunlap, R. (1978a). Environmental sociology: A new paradigm. *American Sociologist*, *13*, 41-49.
Catton, W., & Dunlap, R. (1978b). Paradigms, theories, and the primacy of the HEP-NEP distinction. *The American Sociologist*, *13*, 256-259.
Catton, W., & Dunlap, R. (1980). A new ecological paradigm for post-exuberant sociology. *American Behavioral Scientist*, *24*, 15-47.
Chalmers, A. (1988). Is Bhaskar's realism realistic? *Radical Philosophy*, *49*, 18-23.
Chen, Y. F., Cai, Q. G., & Tang, H. P. (2003). Dust storm as an environmental problem in north China. *Environmental Management*, *32*, 413-417.
Choi, C. (2002, March). And then there were five: A hidden force could be changing the face of the universe. *New Scientist*, *2*(2332), 7.
Chomsky, N. (1971). *Problems of knowledge and freedom*. New York: Pantheon.
Chomsky, N. (1975). *Reflections on language*. New York: Pantheon.
Collier, A. (1994). *Critical realism*. London: Verso.
Crippen, T. (1988). Old and new gods in the modern world: Toward a theory of religious transformation. *Social Forces*, *67*, 316-336.
Crippen, T., & Machalek, R. (1989). The evolutionary foundations of the religious life. *Revue Internationale de Sociologie*, *3*, 61-84.
Cruickshank, J. (2002). *Realism and sociology: Anti-foundationalism, ontology and social research*. London: Routledge.
Cruickshank, J. (Ed.). (2003). *Critical realism: The difference it makes*. London: Routledge.
Cruickshank, J. (2004). A tale of two ontologies: An immanent critique of critical realism. *The Sociological Review*, *52*, 567-585.
Darier, E. (Ed.). (1999). *Discourse of the environment*. Cambridge, MA: Blackwell.
Davey, B. (2003). Evolution and human disease: Bridging the biology/culture gap. In S. Williams, L. Birke, & G. A. Bendelow (Eds.), *Debating biology: Sociological reflections on health, medicine and society* (pp. 15-26). London: Routledge.
Davies, P. C. W. (1995). *About time: Einstein's unfinished revolution*. New York: Simon & Schuster.
DeChiro, G. (1998). Nature as community: The convergence of environment and social justice. In M. Goldman (Ed.), *Privatizing nature: Political struggle for the global commons* (pp. 120-143). New Brunswick, NJ: Rutgers University Press.
De Landa, M. (1997). *A thousand years of non-linear history.* New York: Zone Books.
DeLind, L. (2000). Transforming organic agriculture into industrial organic products: Reconsidering national organic standards. *Human Organization*, *59*, 198-208.
Demeritt, D. (1998). Science, social constructivism and nature. In B. Braun & N. Castree (Eds.), *Remaking reality: Nature at the millennium* (pp. 173-93). New York: Routledge.
Diamond, J. (2005). *Collapse: How societies choose to fail or succeed*. New York: Viking.
Dickens, P. (2000). *Social Darwinism*. Buckingham, UK: Open University Press.
Dickens, P. (2001a). Linking the social and natural sciences: Is capital modifying human biology in its own image? *Sociology*, *35*, 93-110.
Dickens, P. (2001b, July). *Internal and external nature: Exploring the dialectic*. Paper presented at the *New Natures, New Cultures, New Technologies* conference sponsored by Research Committee 24 (Environment and Society) of the International Sociological Association, Cambridge, UK.
Dickens, P. (2004). *Society and nature: Changing our environment, changing ourselves*. Malden, MA: Polity.
Diegues, A. C. (1998). Social movements and the remaking of the commons in the Brazilian Amazon. In M. Goldman (Ed.), *Privatizing nature* (pp. 54-75). New Brunswick, NJ: Rutgers University Press.
Dollimore, J. (1991). *Sexual dissidence: Augustine to Wilde, Freud to Foucault*. Oxford, UK: Clarendon.
Dong, Z. B., Wang, X. M., & Liu, L. Y. (2000). Wind erosion in arid and semiarid China: An overview. *Journal of Soil and Water Conservation*, *55*, 439-444.
Downey, G. L., & Dumit, J. (Eds.). (1997). *Cyborgs and citadels*. Santa Fe, NM: SAR Press.

Drake, D. (1920). *Essays in critical realism: A co-operative study of the problem of knowledge*. London: Macmillan.

Dunlap, R. E. (2002). Paradigms, theories, and environmental sociology. In R. Dunlap, F. H. Buttel, P. Dickens, & A. Gijswijt (Eds.), *Sociological theory and the environment: Classical foundations, contemporary insights* (pp. 329-350). Lanham, MA: Rowman & Littlefield.

Dunlap, R., & Catton, W. (1979). Environmental sociology. *Annual Review of Sociology*, *5*, 243-273.

Dunlap, R., & Catton, W. (1994). Struggling with human exemptionalism: The rise, decline and revitalization of environmental sociology. *The American Sociologist*, *25*, 5-30.

Durkheim, E. (1964). *The rules of sociological method*. New York: Free Press.

Eckersley, R. (2005). Translating science and restoring our sense of wonder: The end of nature as a landmark. *Organization & Environment*, *18*(2), 193-197.

Ehrenfeld, J. (2003). Putting a spotlight on metaphor and analogies in industrial ecology. *Journal of Industrial Ecology*, *7*, 1-4.

Ehrlich, P. R. (2002). *Human natures: Genes, cultures, and the human prospect*. New York: Penguin.

Fausto-Sterling, A. (2000). Beyond difference: Feminism and evolutionary psychology. In H. Rose & S. Rose (Eds.), *Alas, poor Darwin: Arguments against evolutionary psychology* (pp. 209-238). New York: Harmony Books.

Fausto-Sterling, A. (2003). The problem with sex/gender and nature/nurture. In S. Williams, L. Birke, & G. A. Bendelow (Eds.), *Debating biology: Sociological reflections on health, medicine and society* (pp. 123-132). London: Routledge.

Fleetwood, S. (2005). Ontology in organization and management studies: A critical realist perspective. *Organization: The Interdisciplinary Journal of Organization, Theory, and Society*, *12*, 197-222.

Forsyth, T. (2003). *Critical political ecology: The politics of environmental science*. New York: Routledge.

Foucault, M. (1980). *The history of sexuality* (R. Hurley, Trans., Vol. 1). New York: Vintage.

Foucault, M. (1981). *Power/knowledge: Selected interviews and other writings 1972-1977*. New York: Random House.

Foucault, M. (2000). *Power.* New York: New Press.

Fox, R. C. (2003). Through the lenses of biology and sociology: Organ replacement. In S. Williams, L. Birke, & G. A. Bendelow (Eds.), *Debating biology: Sociological reflections on health, medicine and society* (pp. 235-244). London: Routledge.

Fox Keller, E. (2000). *The century of the gene*. Cambridge, MA: Harvard University Press.

Freese, L. (1997a). *Environmental connections*. Greenwich, CT: JAI.

Freese, L. (1997b). *Evolutionary connections*. Greenwich, CT: JAI.

Freudenburg, W. R., Frickel, S., & Gramling, R. (1995). Beyond the nature/society divide: Learning to think about a mountain. *Sociological Forum*, *10*, 361-392.

Gao, F., Bailes, E., Robertson, D. L., Chen, Y., & Rodenburg, C. M. (1999). Origin of the HIV-1 in the chimpanzee *Pan troglodytes troglodytes*. *Nature*, *397*, 436-440.

Gelbspan, R. (2005). Global warming and political power: The end of nature and beyond. *Organization & Environment*, *18*(2), 186-192.

Giddens, A. (1991). *Modernity and self-identity.* Cambridge, UK: Polity.

Goldman, M., & Schurman, R. A. (2000). Closing the "great divide": New social theory on society and nature. *Annual Review of Sociology*, *26*, 563-584.

Gunderson, L. H., & Holling, C. S. (2002). *Panarchy: Understanding transformations in human and natural systems*. Washington, DC: Island Press.

Habermas, J. (1987). *The philosophical discourse of modernity: Twelve lectures*. Cambridge, UK: Polity.

Haila, Y. (2000). Beyond the nature-culture dualism. *Biology and Philosophy*, *15*, 155-175.

Hannerz, U. (1997). Flows, frontiers, hybrids: Key words in transnational anthropology. *Mana*, *3*, 7-39.

Hannigan, J. (1995). *Environmental sociology: A social constructionist perspective*. London: Routledge.
Haraway, D. (1989). *Primate visions: Gender, race, and nature in the world of modern science*. New York: Routledge.
Haraway, D. (1997). *Modest witness at second millennium: Femaleman meets oncomouse*. New York: Routledge.
Harcourt, W. (1994). *Feminist perspectives on sustainable development*. Atlantic Highlands, NJ: Zed.
Harding, S. (2003). Representing reality: The critical realism project. *Feminist Economists*, *9*, 151-159.
Harré, R. (1970). *The principles of scientific thinking*. London: Macmillan.
Harré, R. (1972). *The philosophies of science*. Oxford, UK: Oxford University Press.
Harré, R., Brockmeir, J., & Muhlhausler, P. (1999). *Greenspeak: A study of environmental discourse*. Thousand Oaks, CA: Sage.
Harré, R., & Madden, E. H. (1975). *Causal powers*. Oxford, UK: Basil Blackwell.
Harvey, D. (2002). Agency and community: A critical realist paradigm. *Journal of Theory and Social Behavior*, *32*, 163-194.
Holling, C. S. (2001). Understanding the complexity of economic, ecological, and social systems. *Ecosystems*, *4*, 390-405.
Ingold, T. (1997). Life beyond the edge of nature? Or, the mirage of society. In J. D. Greenwood (Ed.), *The mark of the social: Discovery or invention* (pp. 231-252). New York: Rowman & Littlefield.
Keat, R. (1971). Positivism, naturalism and anti-naturalism in the social sciences. *The Journal for the Theory of Social Behavior*, *1*, 3-17.
Keat, R., & Urry, J. (1975). *Social theory as science*. London: Routledge Kegan Paul.
Kelleher, D., & Hall, B. (2003). Ethnicity and health: Biological and social inheritance. In S. Williams, L. Birke, & G. A. Bendelow (Eds.), *Debating biology: Sociological reflections on health, medicine and society* (pp. 96-108). London: Routledge.
Kemp, S. (2005). Critical realism and the limits of philosophy. *European Journal of Social Theory*, *8*, 171-191.
Kivinen, O., & Phroinen, T. (2004). The relevance of ontological commitments in social sciences: Realist and pragmatist viewpoints. *Journal for the Theory of Social Behavior*, *34*, 231-248.
Kleymeyer, C. D. (1994). *Cultural expression and grassroots development*. Boulder, CO: Lynne Rienner.
Latour, B. (1993). *We have never been modern*. Cambridge, MA: Harvard University Press.
Latour, B. (2004). *Politics of nature: How to bring the sciences into democracy.* Cambridge, MA: Harvard University Press.
Lawson, T. (1997). *Economics and reality.* London: Routledge.
Lewontin, R. (1982). *Human diversity.* New York: Scientific American Books.
Lewontin, R. (2000). *The triple helix: Gene, organism, environment*. Cambridge, MA: Harvard University Press.
Lorber, J. (1994). *The paradoxes of gender.* New Haven, CT: Yale University Press.
Marx, K. (1970). *Capital*. Oxford, UK: Oxford University Press.
Maryanski, A. R. (1998). Evolutionary sociology. *Advances in Human Ecology*, *7*, 1-56.
Maryanski, A. R., & Turner, J. (1992). *The social cage: Human nature and the evolution of society.* Stanford, CA: Stanford University Press.
Masters, R. D. (2001). Biological and politics: Linking nature and nurture. *Annual Review of Political Science*, *4*, 345-369.
Masters, R. D. (2002, November). *Toxins, health, and behavior: The implications of "toxicogenomics" for public policy.* Paper presented at the annual meeting of the American Political Science Association, Boston.
Masters, R. D., Hone, B. T., & Doshi, A. (1998). Environmental pollution, neurotoxicity, and criminal violence. In J. Rose (Ed.), *Environmental toxicology* (pp. 13-48). London: Gordon & Breach.

McAfee, K. (2003). Neoliberalism on the molecular scale: Economic and genetic reductionism in biotechnology battles. *Geoforum*, *34*, 203-219.
McKibben, B. (1989). *The end of nature*. New York: Random House.
McKibben, B. (2005). The emotional core of *The end of nature*. *Organization & Environment*, *18*(2), 182-185.
McLaughlin, P. (2001). Toward an ecology of social action: Merging the ecological and constructivist traditions. *Human Ecology Review*, *8*, 12-28.
Merchant, C. (1980). *The death of nature*. San Francisco: HarperCollins.
Mills, C. W. (1959). *The sociological imagination*. New York: Oxford University Press.
Millstone, E. (1997). *Lead and public health*. London: Taylor & Francis.
Moore, J. W. (2000). Environmental crises and the metabolic rift in world-historical perspective. *Organization & Environment*, *13*(2), 123-157.
Murdoch, J. (2003). Ecologising sociology: Actor-network theory, co-construction and the problem of human exemptionalism. *Sociology*, *35*, 111-133.
Murphy, R. (1995). Sociology as if nature did not matter: An ecological critique. *British Journal of Sociology*, *46*, 688-707.
Murphy, R. (2001). Nature's temporalities and the manufacture of vulnerability: A study of a sudden disaster with implications for creeping ones. *Time and Society*, *10*, 329-348.
Murphy, R. (2002). The internalization of autonomous nature into society. *The Sociological Review*, *50*, 314-333.
Needleman, H. L., & Gatsonis, B. (1991). Metaanalysis of 24 studies of learning disabilities due to lead poisoning. *Journal of the American Medical Association*, *265*, 673-678.
Needleman, H. L., Shell, A., Bellinger, D., Lenton, A., & Allred, R. N. (1990). The long-term effects of exposure to low doses of lead in children. *New England Journal of Medicine*, *322*, 83-88.
Norgaard, R. (1994). *Development betrayed: The end of progress and a coevolutionary revisioning of the future*. New York: Routledge.
Nowak, R. (2002). Men behaving badly: It's not just women who suffer from hormonal ups and downs. *New Scientist*, *2*, 4.
Pihl, R. O., & Ervin, F. (1990). Lead and cadmium levels in violent criminals. *Psychological Report*, *66*, 839-844.
Plotkin, H. (2001). Social constructions and evolution. In C. Heyes & D. Hull (Eds.), *Selection theory and social construction: The evolutionary naturalistic epistemology of Donald T. Campbell* (pp. 119-134). New York: State University of New York Press.
Plotkin, H. (2003). *The imagined world made real: Towards a natural science of culture*. New Brunswick, NJ: Rutgers University Press.
Popper, K. (2002). *Conjectures and refutations*. London: Routledge. (Original work published 1963)
Ritzer, G. (2000). *Sociological theory* (5th ed.). New York: McGraw-Hill.
Rosa, E. A. (1998). Metatheoretical foundations for post-normal risk. *Journal of Risk Research*, *1*, 14-55.
Rose, S. (1992). *The making of memory*. London: Bantam.
Rose, S. (1997). *Lifelines: Biology, freedom, determinism*. New York: Allen Lane.
Sandilands, C. (1999). Sex at the limits. In E. Darier (Ed.), *Discourses of the environment* (pp. 79-94). Oxford, UK: Basil Blackwell.
Sawyer, R. K. (2001). Emergence in sociology: Contemporary philosophy of mind and some implications for sociological theory. *American Journal of Sociology*, *107*, 551-585.
Sawyer, R. K. (2002a). Durkheim's dilemma: Toward a sociology of emergence. *Sociological Theory*, *20*, 227-247.
Sawyer, R. K. (2002b). Nonreductive individualism: Part I—Supervenience and wild disjunction. *Philosophy of the Social Sciences*, *32*, 537-559.
Sayer, A. (2000). *Realism and social science*. London: Sage.
Scambler, G., & Scambler, S. (2003). Realist agendas on biology, health and medicine: Some thoughts and reflections. In S. Williams, L. Birke, & G. A. Bendelow (Eds.),

Debating biology: Sociological reflections on health, medicine and society (pp. 53-65). London: Routledge.
Schulman, L. (1997). *Time's arrow and quantum measurement*. Cambridge, UK: Cambridge University Press.
Schulman, L. (1999). Opposite thermodynamic arrows of time. *Physical Review Letters*, *83*, 5419.
Scott-Baumann, A. (2003). Reconstructive hermeneutical philosophy: Return ticket to the human condition. *Philosophy and Social Criticism*, *29*, 703-727.
Shiva, V. (2002). *Water wars: Privatization, pollution and profit*. Cambridge, MA: South End.
Smith, M. (2001). The face of nature: Environmental ethics and the boundaries of contemporary social theory. *Current Sociology*, *49*, 49-65.
Soper, K. (1995). *What is nature?* Cambridge, MA: Blackwell.
Spencer, H. (1967). *The evolution of society: Selections from Herbert Spencer's principles of sociology*. Chicago: University of Chicago Press.
Spencer, H. (2000). The social organism. In R. J. McGee & R. L. Warms (Eds.), *Anthropological theory* (pp. 11-27). Mountain View, CA: Mayfield. (Original work published 1860)
Stedman, R. C. (2002). Toward a social psychology of place: Predicting behavior from place-based cognitions, attitude, and identity. *Environment and Behavior*, *34*, 405-425.
Stedman, R. C. (2003). Is it really just a social construction? The contribution of the physical environment to sense of place. *Society and Natural Resources*, *16*, 671-685.
Steiner, F. (2002). *Human ecology: Following nature's lead*. Washington, DC: Island Press.
Stibbe, A. (2001). Language, power, and the social construction of animals. *Society and Animals*, *9*, 145-161.
Stretesky, P., & Lynch, M. (2004). The relationship between lead and crime. *Journal of Health and Social Behavior*, *45*, 214-229.
Sumner, W. G. (1971). *The challenge of facts and other essays*. New York: AMS Press. (Original work published 1914)
Tenner, E. (1997). *Why things bite back*. New York: Vintage.
Turner, B. (2003). Biology, vulnerability and politics. In S. Williams, L. Birke, & G. A. Bendelow (Eds.), *Debating biology: Sociological reflections on health, medicine and society* (pp. 271-282). London: Routledge.
Turner, J. H. (2000). *On the origins of human emotions: A sociological inquiry into the evolution of human affect*. Stanford, CA: Stanford University Press.
Turner, J. H. (2002). *Face to face: Toward a sociological theory of interpersonal behavior.* Stanford, CA: Stanford University Press.
Walker, S. (1998). *The hyperactivity hoax: How to stop drugging your child and find real medical help*. New York: St. Martin's.
Ward, D. R. (2002). *Water wars: Drought, flood, folly, and the politics of thirst*. New York: Riverhead Books.
Williams, C. (2005, June 4-10). A land turned to dust. *New Scientist*, *186*, 38-41.
Williams, R. (1976). *Key words: A vocabulary of culture and society*. Glasgow, Scotland: Fontana.
Williams, R. (1980). Ideas of nature. In R. Williams (Ed.), *Problems in materialism and culture* (pp. 67-85). London: Verso.
Wimsatt, W. C. (1986). Forms of aggregativity. In A. Donagan, A. N. Perovich Jr., & M. V. Wedin (Eds.), *Human nature and natural knowledge* (pp. 259-291). Dordrecht, the Netherlands: D. Riedel.
Wimsatt, W. C. (2000). Emergence as non-aggregativity and the biases of reductionisms. *Foundations of Science*, *5*, 269-297.
Yearley, S. (2002). The social construction of environmental problems: A theoretical review and some not-very-Herculean labors. In R. Dunlap, F. H. Buttel, P. Dickens, & A. Gijswijt (Eds.), *Sociological theory and the environment: Classical foundations, contemporary insights* (pp. 274-285). Lanham, MD: Rowman & Littlefield.

Yearley, S. (2005). The "end" or the "humanization" of nature? *Organization & Environment*, *18*(2), 198-201.

Michael S. Carolan is an assistant professor of sociology at Colorado State University. His areas of specialization include environmental sociology, sociology of science and knowledge, sociology of food systems and agriculture, and the sociology of risk. Some of his recent research examines perceptions of risk in the wake of the mad cow scare in the United States, the evolution of epistemic communities within sustainable agriculture, and the sociobiophysical implications ex situ (namely, gene banks) conservation.