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VAMPIRES: SOCIAL CONSTRUCTIVISM, REALISM,
AND OTHER PHILOSOPHICAL UNDEAD (Review Essay)

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The Social Construction of *What?* By Ian Hacking. Cambridge, Mass.: Harvard University Press, 1999. Pp. x, 261.

Social Constructivism and the Philosophy of Science. By Andre Kukla. London: Routledge, 2000. Pp. x, 170.

Ludwig Feuerbach's classic humanist tract, Das Wesen des Christentums, appeared in 1841. Feuerbach argued that religion's claim to worship a transcendent God was not merely an illusion, but a self-deception. Careful examination of religion would show that the actual object of religious practice and understanding was humanity in idealized form. The essence of Christianity was anthropological, not theological. A religious practice that explicitly embraced its anthropological orientation, Feuerbach thought, would be humane and liberating.

Feuerbach was arguably the first social constructivist.¹ Since 1841, Feuerbach's social-anthropological dissolution of God's supposed transcendence has been augmented by arguments for the social construction of human nature, nature in general, and, it seems, everything else. Ian Hacking's book opens with a listing of topics from A to Z whose social construction has been proclaimed in recent book titles (strictly speaking, J and X do not make Hacking's list, but surely Jealousy and X-rays are subsumed under E (Emotions) and F (Facts)).

At various points, triumphant proclamations of contingent social construction have been countered by impassioned defenses of some bastions of recalcitrant, unconstructed reality. Realists may acknowledge the social construction of God, phlogiston, witches, moral depravity, or consumption, but commonly balk at attempts to anthropologize electrons, genes, schizophrenia, or tuberculosis. Reality does transcend human activity and understanding, they insist, and it does impose constraints on us that any open-minded, rational inquirer should recognize.

Realist ripostes have, of course, been countered in turn by constructivists, who argue that apparent encounters with so-called reality in fact mark the "reality effect," which is itself a socially explicable outcome. On this view, "reality" is merely the point at which disputants happen to stop—a negotiated point, not one at which they are compelled to stop. But the dialectic hardly ends here; for realists can ask in turn how genuine conflicts could ever have arisen in the first place without some common, unconstructed reality to disagree about. Eventually, accusations of irrationality and dogmatism (or even accusations of accusations of irrationality²) are exchanged, in familiar but unilluminating challenges to opponents' standing to participate in serious discussions of the matter.

What should we, the interested, bemused, or irritated bystanders, make of such exchanges and the issues they address? The two books under review are thoughtful, often admirable attempts to answer this question. They approach the issues quite differently, however. Andre Kukla reads the many versions of social constructivism as explicit theses in metaphysics and epistemology, and confines his attention primarily to constructivist accounts of natural science. Kukla takes the disagreements between realists and social constructivists to mark a live controversy that needs to be settled openmindedly by drawing careful distinctions and attending critically to the arguments that have been, or could be, mustered on all sides. We must, in short, do some philosophy if we are to untangle these disputes, and Kukla takes on this burden enthusiastically.

Ian Hacking acknowledges that many metaphysical pronouncements have been issued on these topics, but he believes there is no longer a live controversy at this level of abstraction. His post-mortem on social constructivist claims takes their import to be local and performative rather than global and descriptive. Even when social constructivists make sweeping philosophical proclamations about reality in general, we should understand them as instead taking a stance toward something in particular. Hacking's title (*The Social Construction of What?*) is thus intended not simply to express incredulity at some of the answers given to that question, but as a clue to understanding the issue: some particular phenomenon is always implicitly foregrounded by claims of social construction. Moreover, constructivist aims are more often political than theoretical. To claim (for some variable X) that X is socially constructed is to insist upon the possibility and desirability that X be changed. Hacking does not confine his discussion to the natural sciences, because the political and performative appeals to construction are more widespread, and have significance even in fields whose character as social was never in doubt. Thus, where Kukla distinguishes a panoply of constructivist theses (instrumental, reasonable, weak, weak scientific, strong, very strong, etc.), Hacking's taxonomy divides along the two axes of attitude (ironic, reformist, rebellious, revolutionary) and kinds of object (things, ideas, and "elevator words" such as "truth" or "reality"). For Hacking, those who still take the metaphysical issues seriously need therapy rather than philosophy, and what therapy he has to offer mostly concerns how to envision philosophical and political life after the demise of social constructivism as a metaphysical thesis.

For all my considerable admiration of both books, I think neither initial orientation quite captures the current state of scholarly play, or the possibilities for advancing beyond it. I cannot agree with Kukla's presumption that there still remains a live philosophical debate on this topic. Within philosophy of science, the debates between realists and antirealists (with social constructivism assigned to the latter as a marginally respectable *outré* variant³) petered out perhaps a decade ago, at least as controversies that one might genuinely expect to resolve in an illuminating way. About the same time, both the language and substance of 'social construction' was fading away even within its heartland in the sociology of science. The few remaining advocates of good old-fashioned sociology of scientific knowledge now see themselves as an embattled minority even among their former comrades; meanwhile, the work of cultural historians, anthropologists, and feminist theorists of science has taken post-constructivist science studies in important new directions.⁴ By focusing his attention on the debates between realists and constructivists, Kukla mostly suppresses the issues that have driven this new work.

Yet I think there is also something crucially covered over by Hacking's genial post-mortem. Hacking asks that we look beyond the ostensible meaning of social constructivist theses, in order to understand the point of making such claims. I have considerable sympathy for this response, and I think Hacking has identified some important issues underlying the debates over social constructivism. However, what Hacking has not done is to explore the assumptions that allowed these debates to be posed in the problematic terms of realism versus social constructivism. This failure is important, because these terms and the assumptions that drive their use have not entirely gone away, even in Hacking's own discussion. The philosophical arguments may have become tired and tiresome, but we still need a clearer sense of how to get beyond them than Hacking offers.

Hence, I suggest a different image. Social constructivism and realism are neither live options, nor comfortably dead letters. They are vampires, the philosophical undead that still haunt our concepts and interpretations of nature, culture, and science. I intend this label somewhat seriously. Mario Biagioli has also recently used this image to describe the current place of the Scientific Revolution within the history of science.⁵ While recent work in the history of science shows the incoherence of the concept of “the Scientific Revolution,” Biagioli argues, it nevertheless continues to govern the disciplinary legitimation and curricular structure of the field:

As an “undead” category, the Scientific Revolution ... gives us historians of early modern science a recognizable disciplinary identity and a sustainable academic niche within history departments, without forcing us to believe in the label we use to designate our research field.⁶

Donna Haraway offers a more elaborate interpretation of this image, reminding us that vampires are symbols of cultural pollution and “vectors of category transformation.”⁷ I think the vampire image illuminates realism and social constructivism in both Biagioli’s and Haraway’s senses.⁸ The concepts of nature, culture, and human agency that drive these debates continue to function even when the explicit positions and arguments have become otiose. Moreover, at issue in the use of these concepts are symbolically potent boundaries between nature and culture, human and inhuman, reason and unreason, whose violation too often seems both unavoidable and unacceptable.

I shall consider each book in turn, with an eye not just to their foregrounded arguments, but to where interesting or problematic background assumptions might tellingly emerge.

1. Kukla

Kukla is neither temperamentally nor philosophically inclined toward any but the most limited and banal constructivist theses. He nevertheless seeks to put his own realist and rationalist inclinations in abeyance in order to examine the issues fairly, and within the terms in which he sets the issues, he generally succeeds. As a philosophical exercise in discerning and assessing the different senses in which one might claim that reality, nature, or “the facts” are socially constructed, this is a very good book.

Kukla’s success in these terms will likely be rather more admired by philosophers than historians, however. His conceptual and argumentative clarity is achieved at the cost of abstracting global claims and arguments from the historical or contemporary settings in which they were supposed to do intellectual work. Kukla is well aware of this feature of his discussion; he strikingly concludes his fifth chapter on “the empirical case for constructivism” by dismissing any connection between the arguments that concern him and empirical studies of scientific practice:

The stronger and more exotic claims about the construction of reality are not within the purview of sociology [or, presumably, social or cultural history or anthropology]. This conclusion might have been expected from the start. It shouldn’t come as a surprise that questions about the nature of the world and the status of science can’t be settled just by looking at how people behave. (Kukla, p. 43)

Indeed, Kukla later acknowledges that “the social studies of science conducted by constructivists ... are interesting, informative, and indeed represent something new in the intellectual world,”

despite their “stale philosophical gloss” (Kukla, p. 62). Such claims can cut both ways, however. Kukla’s arguments against constructivists’ “stronger and more exotic claims” may also have few implications for how one ought to study the historically situated practices and achievements of the sciences.

Having said that, something important can be discerned in Kukla’s way of setting the issues. Kukla’s interpretation of social constructivism owes much to earlier philosophical discussions of knowledge that focused on the relations between the inner mind and outer nature.⁹ Participants in these earlier discussions crucially agreed that a knower’s mental states (beliefs, desires, perceptual appearances, etc.) and natural objects are relatively independent components of the world which needed to be connected in order for knowledge to occur. Sense experience came to serve as the required interface between the mind and nature. Without this prior agreement, the discussion cannot start, for the central issue concerned whether we can understand knowledge solely by attending to the mind and its experiential interface (the empiricist view), or whether we also must, as realists believed, take account of natural objects on the other side of that interface.¹⁰

Kukla similarly interprets the social domain as a relatively self-contained component of the world, and identifies social constructivism with the claim that we can understand science without appealing to any features of nature beyond its constructive interface with human social life. Although Kukla does not use the terms ‘component’ and ‘interface’, these distinctions implicitly play an important role in his interpretations and criticisms. Kukla thinks that metaphysical constructivism has gained apparent plausibility from rhetorical shifts (“switcheroos”) between weaker and stronger claims: one argues for constructivism in a weaker sense, then draws the stronger conclusion; in the face of criticism, one retreats to a weaker version as all one ever really intended to claim. Whether this is a fair criticism of the constructivist literature can be set aside for my purposes. The interesting point is that the alleged switcheroos concern the ambiguous status of the supposed interface between the social world and nature. The supposedly weak versions propose that the interface between society and nature is a product of human activity, while the strong versions conclude that what is *beyond* that interface is a product of human activity. Kukla tries to focus attention on the stronger and more striking claims, by acknowledging the plausibility of the weaker claims but minimizing their importance. By identifying these supposedly weaker claims, however, Kukla implicitly highlights what he takes to serve as an interface between society and nature. It is just this way of setting up the issue that I find problematic. By looking more closely at the phenomena that Kukla understands as interfaces between society and nature, I will pose the crucial questions that Kukla does not ask, and cannot ask in his terms: are these phenomena appropriately understood as relatively simple interfaces between society and nature, and are society and nature relatively autonomous components of the world that only interact at such interfaces?

Kukla analyzes the scope of “social construction” and its apparent interface with nature in several ways. He takes social construction always to involve intentional human action.¹¹ Such actions are then divided into material actions and belief-formation. Kukla recognizes that social constructivists have paid considerable attention to the role of material practice in modern science, and acknowledges that traditional philosophy of science has been insufficiently attentive to the importance of laboratory phenomena and materials as products of human artifice.¹² He

nevertheless dismisses constructivist accounts of these phenomena as both limited in scope (“at some point, every material-reconstructive recipe calls for a scoop of unreconstructed nature”), and “not very interesting from a metaphysical point of view” (Kukla, p. 20). His dismissiveness thus identifies the formation of artifacts out of natural materials as one interface between nature and society.

Kukla is similarly dismissive toward claims that concepts and beliefs are socially constructed. It is “obvious *that all our concepts are constructed*,” but “not so easy to devise an equally commonsensical scenario whereby the facts about quarks (not just our concept of a quark) turn out to be socially constructed” (Kukla, p. 3-4). The formation and maintenance of conventions-as-shared-beliefs then serve as Kukla’s paradigm of the social construction of facts: “the fact that there’s a social convention about stopping at red lights is *constituted* by everyone’s believing that there’s a social convention about stopping at red lights.” Acknowledging that real conventions are more complicated than this simple picture suggests, he still insists that “the necessary additions and qualifications are themselves going to be social” (Kukla, p. 22). So Kukla locates a second interface between the social and the natural in the application of conventionally constructed concepts and beliefs to their worldly referents (objects and facts).

These two interfaces come together, of course, in the application of concepts to artifacts (including kinds of human being into which we make ourselves). Kukla treats these cases as social facts, whose social constructedness is unremarkable:

It’s easy to see how women might turn out to be constructed. ... Those to whom the concept [‘woman’] is applied come to know that the concept is applied to them. This knowledge leads them to behave in ways that are different from how they *would* have behaved if they had not been so categorized. ... The result is the social construction, not just of the concept ‘woman’, but of women. (Kukla, p. 4)

Facts about traffic lights are presumably constructed in analogous ways. The lights themselves do not adjust their behavior to accord with the concept, but people do. What he insists are not constructed are the “scoops of unreconstructed nature” from which artifacts and kinds of human beings are made in the first place.

Kukla in fact thinks that the constructivist literature has almost exclusively identified social construction with the achievement of consensus: “constructivists take the uncontroversial construction of social reality as a model for the construction of scientific reality [and] assume that scientific realities are always based upon self-validating claims” (Kukla, p. 57).¹³ Kukla then readily moves from such emphasis upon construction-by-consensus to an identification of social life with participation in consensus communities. Thus, one of the arguments he takes to be ultimately telling against strong constructivist claims is what he calls “the problem of two societies,” in which different societies each live in their own socially constructed world.¹⁴

The net result of these specifications is that Kukla identifies those aspects of the world that are supposedly under the collective control of human agents (concepts, beliefs, and actions) as its social component, and those that are not (unreconstructed nature and independent facts about it) as its natural component. Kukla then interprets social constructivism as the attempt to subsume the latter within the former, by identifying facts with self-validating beliefs.

This identification is also evident in another argument that Kukla takes as telling against a thorough-going social constructivism. Kukla notes the oft-cited parallel between social

constructivism and the Duhem-Quine thesis that recalcitrant data can always in principle be accommodated by making adjustments elsewhere in an overall web of belief. He then asks how a thoroughgoing social constructivist could ever account for even the apparent recalcitrance of data:

For constructivists, there's also no independent fact of the matter whether an *apparent* disconfirmation has occurred. At least on the face of it, there's no reason why a theory should ever fall on such hard times that it needs to be defended against an apparent disconfirmation. Proponents of the theory can instead deny that the apparent disconfirmation has taken place. (Kukla, p. 84)

This argument seems intended as a *reductio ad absurdum* of social constructivism. Scientists and others do clearly acknowledge conflicts between belief and evidence, and an account of knowledge that renders such conflicts inexplicable is surely a non-starter.

By this point many readers may instead worry that Kukla's arguments are a *reductio ad absurdum* of his interpretation of social constructivism. The claims and arguments he takes up seem seriously disconnected from the forms of social and cultural history that have increasingly displaced traditional internalist histories of science, and even from more theoretically inclined social and cultural studies of science. From the perspective of many philosophical and some scientific readers, on the other hand, the rise of social and cultural history of science, and the prominence of sociological and anthropological studies of science, seem premised upon something like the theoretical assumptions that Kukla attacks, even where these assumptions are not clearly and carefully articulated.

I think there is something right in both views. Kukla's arguments are a useful corrective to some incautious claims within, and even more incautious uses of, the science-studies literature. Yet his discussion only reinforces the sense of disconnection between such claims and the recent work of historians, sociologists, anthropologists, and feminist theorists that has changed the ways in which science is understood within much of the academy. It is instructive that, although Kukla's book was published in 2000, the work Kukla discusses as social constructivist almost entirely dates from the early-to-mid 1980's.¹⁵ No feminist or anthropological science studies, and no historiographically self-conscious work in history of science grace his bibliography. Kukla might reasonably respond that his arguments do not address such work; he is concerned only with claims that nature or natural facts are socially constructed, whenever such claims were made. Yet more recent work has been importantly influenced by constructivist sociology of science, and we can ask what these authors found informative in the constructivist tradition that Kukla does not. The greatest value I find in Kukla's book is the opportunity it offers to understand the roots of these disconnected readings in familiar conceptions of society, nature, language, thought, and human agency.

We have seen that Kukla turns social constructivism into a kind of collective idealism, through a recapitulation of traditionally conceived mind/nature relations in collectivist guise. Underlying that reading, I have been suggesting, is a crucial presumption that nature and society are relatively autonomous components of the world that only interact at well-defined interfaces, in the way that traditional epistemology has taken mind and nature to interact through the interface of body surfaces or perceptual experience. On this presumption, Kukla brushes aside precisely the phenomena most central to empirical work in recent science studies, many of which

first came to prominence in the social constructivist literature: the embodiment of scientific understanding in laboratories and material practice, in non-verbal images and models, and in the textual materiality of language.

These phenomena have become important, I would argue, precisely because they resist treatment as well-defined interfaces between immanent social life and transcendent nature. The more radical (post-constructivist?) thesis that emerges from recent science studies is *the denial that nature and society or culture are self-contained components of the world that interact at localizable interfaces of human artifacts, bodies, and scientific language-or-concepts*. Scientific understanding is not “inside” minds or cultures, but embodied in worldly phenomena, skills, equipment, institutions, and situated discursive exchanges that cut across the traditional bounds of natural objects and social or cultural meanings. In John Haugeland’s terms, what science studies discloses is thus the *intimacy* of material nature and human social life:

The term ‘intimacy’ is meant to suggest more than just necessary interrelation or interdependence but a kind of *commingling* or *integrality* of [nature and human society or culture]—that is, to undermine their very distinctness.¹⁶

If the post-constructivist tradition denies that there is any role for “unreconstructed nature” in our understanding of science, it is not because we are unable to get “outside” of a relatively self-enclosed social world, but because we have never been “inside” one in the first place. The question is not how we ever get from our social world to a transcendent nature, but how meaningful language and other practices are sustained as part of the ongoing reconfiguration of a reliable and meaningful environment. Language is important not as the externalization of thoughts, but as discursive practices that articulate understanding within the material world we inhabit.

The one place where Kukla shows some recognition of such a possibility is in considering what he calls “semantic constructivism.” Semantic constructivists do not ask how already-meaningful thoughts could ever reach out to the world, but instead how utterances and other practices could ever acquire or sustain a definite meaning at all. Semantic constructivists argue that no history of past uses of a term (or of conformity to any other social practice) determines its correct application to the next case (and hence it is always indeterminate which concept or other convention is being used).¹⁷ The finite sequence of past uses is consistent with the application of an indefinite number of different concepts, and hence cannot specify any one in particular.¹⁸ For social constructivists, the problem is then to explain how meaning is possible at all. On Kukla’s reading, this argument amounts to a radical form of skepticism, which raises doubts not about the truth of our utterances and thoughts, but about whether they have a determinate meaning.¹⁹

The uses of similar arguments within recent science studies do not incline toward scepticism about meaning, however.²⁰ Instead, they challenge the autonomy of any domain of meaning apart from extensive, “intimate” relations between utterances (including non-verbal representations) and their surroundings. The shift to talk about public language is a turn away from the idea that individuals or communities have direct and incorrigible awareness of the meanings of their thoughts and actions, toward seeing them as meaningful only within an ongoing, extensive (“intimate”) involvement within the material and social world. Language is no longer conceived as an interface between thoughts and things, but as a pervasive aspect of the world in which both thoughts and things acquire significance. Semantic determinacy is not an

all-or-nothing matter, and concepts only acquire more-or-less-definite meaning within larger patterns of discursive practice. Such patterns are not something that speakers make and fully control, but situations in which they find themselves.²¹ Understanding is then not a matter of the translation of determinate meanings into equivalents in a different idiom, but is instead the outcome of mutually transforming discursive exchanges (Bono), “ coordinations of action and belief” (Galison), “ agential intra-action” (Barad), or “ power-sensitive conversations” across the boundaries that define “ us” and “ nature” as material-semiotic actors (Haraway).²² Haugeland nicely captures the result of such claims in his discussion of where scientific intelligence is located:

Apart from its intimate involvement in highly specific complex activities in highly specific complex circumstances, there’s no such thing as scientific intelligence—it doesn’t make any sense. For all its explicitness and abstraction, science is as worldly as agriculture, manufacturing, and government. ... [I]ntelligence abides in the meaningful *world*: not just books and records, but roads and plows, offices, laboratories, communities.²³

The basic model of knowledge operative here is that of active but vulnerable bodies seeking to render their partially shared circumstances more reliable and less threatening, more comprehensible and less alien. Skills, equipment, and language are pervasive constituents of our surroundings, but they also embody our practical-discursive grasp of the world, and they articulate our own possibilities for self-understanding. There is no clear boundary between “ us” and “ not-us.” What has not (yet) been assimilated into our prosthetically embodied grasp of the world is not utterly alien or transcendent, but merely unfamiliar and potentially threatening (not just to our life and well-being, but to the reliability of our practical-discursive grip upon ourselves and our world).

Kukla might well respond that even if such a conception works for our understanding of present surroundings, it cannot possibly make sense of understanding the past. Kukla devotes a chapter to how one could understand the past as socially constructed, and concludes that it cannot be so conceived. But Kukla reaches this conclusion by conceiving of social construction as a self-enclosed web of belief (indeed, he explicitly notes the parallel between “ the problem of two societies” and “ the problem of two eras”), for which present evidence provides an interface with a world outside. But even the remote past, the vast expanses of space, and the otherness of different cultures or species are not on the other side of our understanding of the world, but are incorporated within it. Our world is temporally meaningful because our circumstances are replete with intelligible traces of the past.²⁴ Being a trace, of course, is inseparable from a capacity to trace its history; the expansion of human capacities for tracking and intelligibly articulating the presence of the past expands and further articulates the world we live in. Those capacities were never a self-enclosed conceptual scheme, however, but only a skillful intra-action with what thereby becomes an intelligible world.²⁵

2. Hacking

Hacking comments at the outset of his book that he has never found talk of “ social construction” illuminating. He nevertheless takes up the topic as a matter of intellectual responsibility: the intellectual pathologies of “ science wars” and “ culture wars” (whose militarized labels he gently protests) require a response. He aims neither to refute nor endorse

social constructivist claims, but instead to shift discussion away from their ostensible content. In most cases, he argues, we should ask not what is being said, but what is being done when some phenomenon is said to be socially constructed. The point of such claims typically is to advocate the possibility and desirability of changing some seemingly inevitable aspect of the world or our understanding of it. To say that oral history, women refugees, or Zulu nationalism ('O', 'W' and 'Z' on Hacking's list) are socially constructed is not to expand the ontology of the social world, but to challenge familiar and widely accepted concepts and practices. Once this performative function is grasped, we could dispense with generic talk of social construction, and address the underlying political projects on their particular merits.

Hacking nevertheless discerns three "sticking points," seemingly serious, contestable issues which emerge from discussions of the social construction of nature or natural science. These are not issues newly disclosed by recent scholarship, but perennial and perhaps irresolvable philosophical disputes for which construction-talk serves as fashionable window-dressing. Moreover, for Hacking, the apparent issues in these disputes turn out not to be really at stake; instead, they are matters of intellectual temperament or training, about which we should be tolerant of differences rather than diligent in trying to resolve them. By discerning the range of intelligible views upon these three issues, we would learn something about our intellectual scene and our own places within it, but we should not hope to learn something more definitive about science, nature, or culture.

Hacking's three sticking points are: (1) whether we should regard the most central elements of contemporary science as contingent or inevitable; (2) whether we should regard the structure of scientific categorization as inherent in the world or only as inherent in our forms of representation; (3) whether the best explanations of the stability of much of scientific understanding will incorporate "elements external to the professed content of the science, [e.g.,] social factors, interests, networks, or however they be described" (Hacking, p. 92). Hacking notes that, despite accusations to the contrary, constructivists are rarely sceptics about scientific claims. They are, however, often ironic or irreverent about the cultural authority vested in science, and they see such irreverent unmasking of established authority as ethically and politically progressive. Their opponents, by contrast, passionately insist that not merely scientific truth, but a resolutely scientific attitude, is indispensable to a genuinely progressive politics, and they see constructivist irreverence as not just error, but betrayal. Alan Sokal's hoax was, after all, put forward not to reform the academy, but to launch a struggle for the soul of the political left.

Hacking's discussion of these themes is invariably intelligent and informative. Much of his book also involves extended, historically sensitive discussion of how these issues apply in illuminating cases, which contrasts sharply to Kukla's approach. Where Kukla presents a highly abstract "problem of two societies," for example, Hacking offers an extended and thoughtful response to the interpretive difficulties posed by the initial encounters between Hawaiians and the European ships' crews commanded by Captain Cook. Yet I find in the end that Hacking's discussion sticks on the same point that informs Kukla's conception of social construction. Hacking shares Kukla's interactionist conception of nature and human society as relatively discrete components of the world which interface in bodies and artifacts, concepts and reasons.

Hacking's commitment to social/natural interactionism shows up most clearly in the third sticking point. Here, the professed content of a science is conceived as an interface between

human society and the natural world, and the question is whether what happens at that interface is best explained by the science's rational transduction of information from outside, or as only a reflection of "factors" internal to human societies.²⁶ The problematic notion in such a conception is that of "content." The intuitive idea is familiar: the content of a science is what its theoretical commitments and methodological prescriptions say, the meaning of sentences, equations, diagrams, or models. Yet this idea only makes sense if meanings can be discerned without drawing upon a background of practical skills, equipment, visual images, material surroundings, institutional networks, and discursive patterns. Is the content of a science its verbal representation of the world, or the reconfiguration of the world itself through practical engagement with things, people, and prior patterns of talk? The more radical post-constructivist claim is not that the content of a science can be explained by social rather than material or rational "factors," but that the only coherent notions of content or meaning incorporate the social, material, and discursive setting of a science. This integrated setting cannot be factored into relatively discrete or autonomous components.

Hacking's interactionist commitment also shows up in the second sticking point, the split between nominalism (which claims that scientific categories are a function of our forms of representation, not of the way the world is), and "inherent-structurism" (which asserts that good scientific categories map onto the inherent structure of the world).²⁷ Both sides of the dispute as Hacking conceives it take meaning to be autonomous. The nominalist obviously believes that our particular representations derive from the system of representation in which we work, and the inherent-structurist "hopes [or, more optimistically, believes] that the world may, of its own nature be structured in the ways in which we describe it" (Hacking, p. 83). The possibility ruled out in advance by both positions and Hacking's account of them is that language is only meaningful in the midst of extensive practical dealings with particular surroundings (often carefully arranged in laboratories, or the extension of laboratory practices into other settings), which thereby also acquire intelligible structure. Meaning would then be found neither in language by itself, nor in the world apart from language, but only within a-world-that-pervasively-incorporates-discursive-practices-and-norms.

Hacking recognizes that the first sticking point, whether the most central elements of our current best science are contingent or inevitable, is difficult even to formulate in a non-trivial way. All science is contingent in an obvious but unhelpful sense: poverty, war, laziness, stupidity, or asteroid impacts might have prevented the achievement of any articulated conception of nature. But what formulation would be more helpful?

[Is the claim] that if other people were to use our equipment, with our assumptions, and had acquired all the tacit knowledge needed to use our equipment, they would get our answer? Not even that. For if they got another answer, we would surely rule that they had made a mistake. So is the claim that if they used our techniques and made no mistakes, they would get our answers? We are close to an empty platitude, a tautology. (Hacking, p. 164)

Part of the problem is that good science is simply difficult; one has to allow for the possibility that people of good sense and good will might still fail to arrive at our results (and vice versa!). But in what I consider the most interesting chapter in the book ("Weapons Research"), Hacking raises a deeper question about this sticking point. Even if the answers to our scientific questions

were inevitable for any society that seriously and tenaciously asked them, it is less obvious that these questions must arise as the right ones to ask.

The best feature of the chapter on weapons research is that Hacking shifts the question of contingency away from the mug's game of counterfactual history toward a prospective inquiry into our current scientific possibilities. The specific focus of Hacking's concern is to understand how the military priorities that have governed so much of research funding since World War II might have affected the kind of science we now do. Hacking recognizes that the role of the military in directing research is not entirely crude and heavy-handed. He is more interested in how the instruments, materials, and style and scale of research might have changed what could count as an interesting question. In fact, there has been much good work on this topic since Hacking's chapter was originally published as an essay in 1986. Paul Edwards' brilliant book on military involvement in the development of computation and cognitive psychology is exemplary of a post-constructivist account that refuses to compartmentalize nature and culture, and which looks not at military "influence" upon science or vice versa, but at the intertwined development of military and scientific priorities and possibilities.²⁸ Peter Galison has argued (expanding substantially upon an earlier article that Hacking cites) that the primary influence of war research on postwar physics was in the material basis and organizational style of research, both of which changed scientists' sense of what was possible and what was interesting and important.²⁹

Yet Hacking still struggles to articulate the notion of scientific *possibility*. His principal trope is an adaptation of the traditional notions of form and content. Military orientation, he suggests, has determined not the content of postwar science, but its form: when "the form of a branch of knowledge has changed, a new space of possibilities has emerged, together with new criteria for questions to ask and ways to answer them" (Hacking, p. 172). This question of how to understand conceptual and practical possibilities has been a long-standing concern of Hacking's. In a previously published article, he strikingly characterized the ways in which the possibilities for human self-understanding change:

"Absolute, unthinkable and undecipherable nothingness" is a great phrase. That is exactly what being a multiple personality, or being a garçon de cafe was to Raymond [VI]'s vassal. Many of you could, in truth, be neither a Parisian waiter nor a split, but both are thinkable, decipherable somethingnesses.³⁰

In the book under review he attempts to make more precise the notions of form and possibility, drawing upon Foucault's early archaeologies, and his own related distinction between sentences that are intelligibly true-or-false, and those that are not:

By a *form* of a branch of scientific knowledge I mean a structured set of declarative sentences that stand for possibilities, that is, sentences that can be true or false, together with techniques for finding out which ones are true and which ones are false. (Hacking, p. 170)³¹

The difficulty with this formulation is that, if one takes seriously the material, institutional, and discursive embodiment of scientific understanding, scientific research runs ahead of what it can already clearly articulate. Hacking thus conflates scientific possibilities (the directions in which researchers are tentatively moving ahead) with the possible actualities that one can already articulate. Hans-Jörg Rheinberger has recently offered a more illuminating formulation of scientific possibilities, which better takes account of the materialization of scientific

understanding in experimental arrangements and skills, and in discursive practices whose inferential relations outrun the sentences one can already confidently formulate and assess:

Experimental systems grow slowly into a kind of scientific hardware within which the more fragile software of epistemic things—this amalgam of halfway-concepts, no-longer-techniques, and not-yet-values-and-standards—is articulated, connected, disconnected, placed, and displaced.³²

Hacking's misconception of the futural temporality of scientific understanding complements Kukla's misunderstanding of its past. Kukla fails to grasp how the world we inhabit incorporates traces of the past in the present, and not merely present sentences that refer to an inaccessible past. Hacking fails to see how the present configuration of material and discursive practice includes not merely already-articulated claims, but more inchoate possibilities eventually recognizable as "a trace of something to which it has given rise."³³

I think this failing is closely connected with Hacking's insistence upon sharply distinguishing social life from nature, and human understanding from things merely understood. In two thoughtful and telling chapters on madness and child abuse, Hacking considers the human body as the supposed interface between these components of the world. How should we understand the relations between concepts of mental illness and neurochemical processes, or between concepts of cruelty or abuse and physical impacts on children's bodies? Hacking is concerned with the looping effects through which conceptual change transforms what has been conceived. Yet he finds it necessary to distinguish "bio-looping," whereby "changes in our ideas may change our physiological states" (Hacking, p. 109), from "classificatory looping" in which classifications "known by people or by those around them, and put to work in institutions, change the ways in which individuals experience themselves" (Hacking, p. 104). Hacking offers a telling qualification, however. In talking about classificatory effects on children diagnosed as hyperactive, he notes that

The interaction occurs in the larger matrix of institutions and practices surrounding this classification. There was a time when children described as hyperactive were placed in "stim-free" classrooms: classrooms in which stimuli were minimized, so that the children would have no occasion for excess activity. Desks were far apart. The walls had no decoration. The windows were curtained. ... The walls were designed for minimum noise reflection.... [The classification] interacted with those who were so described in institutions and practices that were predicated upon classifying children as hyperactive. (Hacking, p. 103)

Classifications only acquire significance within specific material settings, and their "meaning" is as much in the reconfiguration of bodies and their surroundings as in shifting patterns of talk.³⁴ Hacking is not wrong to insist that "there is a big difference between quarks and children." He is wrong only in the conception of knowledge or understanding that underwrites the distinction for him. Meaning and understanding are in the world, not in the head or in an immaterially abstract society or culture; moreover, nature is not something apart from or "beyond" this meaningfully-configured world.

The culmination of Hacking's conciliatory post-mortem on social constructivist controversies is found, however, in his penultimate chapter on "rocks," the classic exemplar of Kukla's "scoops of unreconstructed nature." Hacking writes about particular sciences with

clarity and grace. Here he engagingly explores recent developments in the controversial history of dolomite, the widespread ancient geological strata of magnesium carbonate whose porosity suggests their origins in the substitution of less-voluminous magnesium for the calcium in limestone. He then urges tolerance and civility in lieu of a science-war by suggesting that a wide range of competing philosophical and sociological programs, from Carnap and Popper to Bloor and Latour, have something useful to tell us about this controversy. I suggest a different moral. Hacking's programmatic interpretations seem all too bland and unilluminating next to the lively historical narrative with which he opens the chapter, even to this philosophical reader. Should we then endorse many historians' likely reaction to Kukla's arguments, namely the repudiation of philosophical disputes as a distraction from serious history? No. The problem is not with philosophy, but with the particular philosophical assumptions that drive the debates over social construction, as they have previously driven arguments over mind and world or culture and nature.

Historians, after all, must wrestle with precisely the difficulties of understanding concepts in their circumstances, and circumstances without glaringly anachronistic conceptualizations. Foucault, who like Hacking is more subtle on these topics than most writers, still took up disciplines of the body and confessional technologies of the soul in different books that are more often conjoined than integrated by his readers. The pervasive problems confronting histories of scientific practice and of medicine and disease make these concerns especially acute. Historians of science and medicine must make sense of the intimate intra-action between conceptual, institutional, and cultural developments on the one hand, and the causal significance of disease, experimentation, and other phenomena involved in scientific and medical practices on the other. Comparable difficulties arise on a grander scale in the need to integrate ecological histories of human cultures with more traditional histories.³⁵ Many phenomena traditionally characterized with the resources of social, cultural, or political history, such as the establishment of cities and their expansion into empires, or the European colonization of some but not all areas of the Americas, Africa, and Australia, have been interpreted by ecological historians as biological phenomena, best explained by symbiotic relations between human societies and microbes or the plants and animals that are amenable to domestication. The challenge is to understand the ecological and cultural/political stories not as competitors, but as indispensably conjoined aspects of any adequate historical understanding.

The conceptual underpinnings of recent post-constructivist work in science studies may then have something important to contribute here. Even those who insist that language and culture must always "interact" with their material surroundings still start from the pervasive and problematic conception of distinct components of the world that interact rather than a complex field of material-discursive practice. Such conceptions are deeply entrenched in familiar patterns of talk and thought, periodically emerging to vex even those who aspire to surpass them. But histories of human bodies and ecologies share with post-structuralist histories of discursive formations, feminist work on the embodiment of vision and knowledge, and recent work on the material culture of science, a common opponent in such disembodied treatments of thought, language, and culture, which then perforce place nature on the outside. Perhaps we can begin to learn from the still undead debates over social constructivism how to drive a stake through the heart of such assumptions once and for all.

NOTES

1. Strictly speaking, in the ways in which “social construction” is often understood, Feuerbach was not a social constructivist, since Feuerbach did not divide the human world into social and natural components. In citing Feuerbach as a precursor of social constructivism, I emphasize his thorough-going humanism, and his efforts to identify “God” with what is immanent within human practices and conceptualizations. A thoroughgoing social constructivism similarly rejects any conception of nature as transcendent to human practices and conceptualizations, which are now perforce identified as *social* practices.

2. Bruno Latour, Science in Action: How to Follow Scientists and Engineers Through Society, Cambridge: Harvard University Press, 1987, ch. 5, and Pandora’s Hope: Essays on the Reality of Science Studies, Cambridge: Harvard University Press, 1999, ch. 9 both address critically the role of accusations of irrationality.

3. Hacking himself aligns constructivists with Nelson Goodman’s irrealism, which he sharply distinguishes from antirealism. Kukla, by contrast, specifically treats both Goodman and social constructivists about the sciences as exemplary antirealists.

4. Andrew Pickering, ed., Science as Practice and Culture, Chicago: University of Chicago Press, 1991, provides a useful benchmark for sociologists’ shift away from social constructivism and its underlying humanism. Mario Biagioli, ed. The Science Studies Reader, New York: Routledge, 1999, Gary Downey and Joseph Dumit, eds., Cyborgs and Citadels: Anthropological Interventions in Emerging Sciences and Technologies, Santa Fe: School of American Research Press, 1997, Roddey Reid and Sharon Traweek, eds., Doing Science + Culture: How Cultural and Interdisciplinary Studies Are Changing the Way We Look at Science and Medicine, New York:

Routledge, 2000, Evelyn Fox Keller and Helen Longino, eds., Feminism and Science, Oxford: Oxford University Press, 1996, and Lynn Hankinson Nelson and Jack Nelson.eds., Feminism, Science, and the Philosophy of Science, Dordrecht: D. Reidel, 1996, are valuable collections indicating the post-constructivist directions undertaken in science studies generally, or specifically in anthropological and feminist studies of science. Important monographs that exemplify a post-constructivist orientation include Donna Haraway, Primate Visions: Gender, Race and Nature in the World of Modern Science, New York: Routledge, 1989; Donna Haraway, Modest Witness@Second Millenium.FemaleMan^C Meets OncomouseTM, New York: Routledge, 1997; Paul Edwards, The Closed World: Computers and the Politics of Discourse in Cold War America, Cambridge: MIT Press, 1996; James Bono, The Word of God and the Languages of Man: Interpreting Nature in Early Modern Science and Medicine, Volume I, Ficino to Descartes, Madison, University of Wisconsin Press, 1995; Hans-Jörg Rheinberger, Toward a History of Epistemic Things: Synthesizing Proteins in the Test Tube, Stanford: Stanford University Press, 1997; Peter Galison, Image and Logic: A Material Culture of Microphysics, Chicago: University of Chicago Press, 1996; Evelyn Fox Keller, Refiguring Life: Metaphors of Twentieth Century Biology, New York: Columbia University Press, 1995; and Lorraine Daston and Katherine Park, Wonders and the Order of Nature, 1150-1750, New York: Zone Books, 1998.

5. Mario Biagioli, "The Scientific Revolution is Undead," Configurations 6 (1998): 141-47.

6. Biagioli, p. 146.

7. Donna Haraway, Modest Witness@Second Millenium.FemaleMan^C Meets OncomouseTM, New York: Routledge, 1997, pp. 214-17. Haraway introduces the image of the vampire in the

especially potent setting of race and kinship, where the symbolic significance of blood and sex is omnipresent. My use of the image will have no direct analogue to this aspect of Haraway's treatment, although I think that the conceptual boundary work that underlies the debates over social constructivism leads fairly straightforwardly into the concerns Haraway takes up.

8. Strictly speaking, Biagioli's and Haraway's uses of the *image* are somewhat at odds. Should we think of social constructivist and realist assumptions as the undead that still haunt us, or as the rigid maintenance of contrived boundaries that call for vampires to transgress them? The point of applying both images nevertheless converge.

9. The extent to which Kukla has been guided by traditional philosophical conceptions becomes strikingly clear in the parallel he discovers between recent philosophical criticisms of social constructivism, and criticisms raised against Bas van Fraassen's "constructive empiricism" a decade earlier. Playing on van Fraassen's title, The Scientific Image, Kukla suggests that social constructivism offers a "Blurry Image," whose relationship to van Fraassen's view is "akin to that between an out-of-focus photograph and a sharper image that's consistent with all of its blurred features" (Kukla, p. 59). My alternative suggestion is that Kukla produces this Blurry Image by examining social studies of science through the distorting spectacles of the mind/body problem, and the philosophical debates over realism and empiricism. Kukla is not alone in wearing these spectacles, however. Many of the early advocates of the Strong Programme in the sociology of knowledge understood their own work in similar ways (notably, the Edinburgh School of Barry Barnes, David Bloor, David Edge; the Bath School headed by Harry Collins and Trevor Pinch; or the tradition of discourse analysis that began with Michael Mulkay and was taken in different directions by Steve Woolgar and Malcolm Ashmore. The early work of Steven

Shapin and Andrew Pickering also fits here).

10. Van Fraassen cleverly parodied realist arguments by juxtaposing their arguments for knowledge of an external world with earlier arguments for the existence of God. That is another reason Feuerbach is relevant here: like empiricists and the social constructivists as Kukla interprets them, he argues that we can fully understand religious experience and practice without looking beyond its apparent “interface” with any theological dimensions of the world.

11. Kukla recognizes that any adequate account of human social life includes myriad phenomena unintended by anyone, but insists that only the collective outcomes of intentional acts could count as “constructions.”

12. Ian Hacking, Representing and Intervening: Introductory Topics in the Philosophy of Natural Science, Cambridge: Cambridge University Press, 1983, was a prominent early exception to this acknowledged philosophical inattention to material practice, but Hacking’s contemporaries on this theme were otherwise mostly among those prominently thought of as social constructivists. Notable examples include Bruno Latour and Steve Woolgar, Laboratory Life: The Social Construction of a Scientific Fact, Beverly Hills: Sage, 1979; Karin Knorr-Cetina, The Manufacture of Knowledge: An Essay on the Contextual and Constructivist Nature of Science, Oxford: Pergamon Press, 1981; Bruno Latour, “Give Me a Laboratory and I Will Raise the World,” in Karin Knorr-Cetina and Michael Mulkay, ed., Science Observed: Perspectives on the Social Study of Science, London: Sage, 1983, pp. 141-70; Andrew Pickering, Constructing Quarks: A Sociological History of Particle Physics, Chicago: University of Chicago Press, 1984; Steven Shapin and Simon Schaffer, Leviathan and the Air Pump: Hobbes, Boyle, and the Experimental Life, Princeton: Princeton University Press, 1985.

13. Kukla's interpretation of social construction as consensus-formation may be supported by an early methodological focus within the sociology of scientific knowledge upon the opening and closing of scientific controversies as a window into processes of social construction. Yet this interpretation fits less easily with the relentlessly agonistic model employed in actor-network theories. Kukla's own commitment to a fairly sharp and clear distinction between social and natural processes makes it generally harder for him to accommodate views such as Latour's or Pickering's that incorporate "non-human actants" into their accounts of the making of scientific knowledge, and that emphasize not the achievement of collective agreement but instead the establishment of "indispensable passage points" or "interactive stabilizations."

14. One response to the problem of two societies is to adopt epistemological relativism, which Kukla treats separately. Strictly speaking, Kukla treats the problem of two societies as a dilemma: either incompatible facts are both true, or else what is true in one society is determined by what happens in another. What interests me here, of course, is not Kukla's argument, but the conception of a relatively self-enclosed "society" that it draws upon.

15. Philosophers of science only slowly became aware of the sociology of scientific knowledge of the 1970's and 1980's. The bulk of the philosophical literature critically addressing this tradition has been written since 1990. An important motivation for Kukla's book is to correct deficiencies he finds in that philosophical literature, i.e., to undertake the important critical task that he thought had not yet been adequately accomplished by earlier philosophical attacks upon social constructivism. This meta-critical task may also help account for Kukla's focus on the early social studies of science which were the target of the more recent philosophical literature.

16. John Haugeland, Having Thought: Essays on the Metaphysics of Mind, Cambridge: Harvard

University Press, 1998, p. 208. Haugeland wrote of the intimacy of “mind, body and world” rather than of natural and social worlds, because his target was interactionist conceptions of mind rather than of society and culture. The two issues are closely connected, however. Kukla’s discussions of social construction are deeply imbued with mentalist talk about beliefs, while post-constructivist science studies have attended to the embodiment of understanding in institutions, experimental systems, non-verbal representations, and discursive practices.

17. The locus classicus in which this sceptical argument about the determinacy of meaning is presented and discussed is Saul Kripke, Wittgenstein on Rules and Private Language, Cambridge: Harvard University Press, 1982. It takes up a chapter in Kukla’s book, both because versions of it have been endorsed by several prominent sociologists of scientific knowledge, notably Barry Barnes, David Bloor, and Harry Collins, and because it provides a novel route to what Kukla regards as the prototypical constructivist claim that nature can play no role in our epistemic decisions.

18. Although Kukla extensively discusses Nelson Goodman, Ways of Worldmaking, Indianapolis: Hackett, 1978 as a philosophical compatriot of social constructivists, he does not note the importance of Goodman’s famous “grue” problem (Nelson Goodman, Fact, Fiction, and Forecast, Cambridge: Harvard University Press, 1954) as a precursor to semantic constructivism. The grue problem was whether the discovery of a green emerald supports the conclusion that all emeralds are green, or that all emeralds are grue (where something is grue if it is first discovered before some future time t and is green, or is first discovered after t and is blue). Many historians, of course, are more likely to have encountered similar lines of argument via Jacques Derrida than through Goodman or Kripke.

19. As Kukla perceptively notes, this argument can be reconstrued as the claim that we are always perpetually in the situation of language-learners rather than users of an already determinate language. Confronted with an apparent counter-instance to what she was previously inclined to say, the language learner has to decide whether to alter her beliefs or the meanings of her words. Kukla's own attitude toward semantic constructivism is ambivalent. He thinks that good arguments can be made for semantic constructivism (indeed, he develops his own version of one), but he also thinks that it entails an unacceptable irrationalism.

20. Kukla may be correct that the arguments endorsed by Barnes, Bloor, or Collins lead, despite themselves, to an all-consuming semantic scepticism, rather than to Barnes' and Bloor's sociological naturalism, or to Collins' "metaphysical socialism" (Kukla's term for Collins' position). More needs to be said to convince me, however.

21. Thus, James Bono, "Science, Discourse, and Literature: The Role/Rule of Metaphor in Science," in Stuart Peterfreund, ed., Literature and Science: Theory and Practice, Boston: Northeastern University Press, 1990, pp. 59-89, argues that we need to understand not the role of metaphor in science, but the rule of metaphor—the inferential and practical relations within and among various discourses that shape the development of scientific understanding in ways only partially controlled by their participants.

22. Bono, "Science, Discourse and Literature"; Peter Galison, Image and Logic: A Material Culture of Microphysics, Chicago: University of Chicago Press, 1997; Karen Barad, "Meeting the Universe Halfway: Realism and Social Constructivism without Contradiction," in L.H. Nelson and J. Nelson, ed., Feminism, Science and the Philosophy of Science, Dordrecht: D. Reidel, 1996, pp. 161-94; Donna Haraway, "Situated Knowledges: The Science Question in

Feminism and the Privilege of Partial Perspective,” in Simians, Cyborgs, and Women: The Reinvention of Nature, New York: Routledge, 1991, pp. 183-202.

23. Haugeland, Having Thought, p. 236.

24. It is instructive that Kukla, by insinuation on pp. 60-62, suggests that he finds Bruno Latour’s use of the concept of a “trace” completely obscure. I am arguing that his prior assumptions obscure the possibility of such a concept.

25. Barad, “Meeting the Universe Halfway,” introduces the term ‘intra-action’ precisely to counter the implication that interaction with the world presupposes the independence of interacting entities, or a well-defined boundary between them.

26. Do not be confused by my shift of the boundaries at issue here. What Hacking calls ‘external’ to the content of science is ‘internal’ to a human society seeking to understand an ‘external’ world. Hacking’s terminology reflects his focus on the boundary between society and its supposed scientific interface with nature: is science a transducer of information from nature, or merely a reflection of what is already contained in the society that produces it? I am focusing attention instead on his underlying conception of society and nature as discrete components with a well-defined interface.

27. Hacking helpfully presents the nominalist not as indifferent to the world as it is apart from our conceptualizations, but as one who

has an even deeper respect for the world [than her opponent]. The world is so autonomous, so much to itself, that it does not even have what we call structure in itself. We make our puny representations of this world, but all the structure of which we can conceive lies within our representations, ... subject to severe constraints, of course.

(Hacking, p. 83)

28. Edwards, The Closed World.

29. Galison, Image and Logic, especially chapters 4, 5, and 8.

30. Ian Hacking, "Making Up People," in T.C. Heller, M. Sosna, and D.E. Wellbury, eds., Reconstructing Individualism: Autonomy, Individuality, and the Self in Western Thought, Stanford: Stanford University Press, 1986, p. 232.

31. Hacking's original formulation of the distinction between sentences that are taken as true (the content of a science), and sentences that are true-or-false (its underlying form), was in "Language, Truth and Reason," in M. Hollis and S. Lukes, ed., Rationality and Relativism, Cambridge: MIT Press, 1982, pp. 48-66. Readers familiar with Foucault will recognize the antecedent distinction between connaissances and savoir articulated in Michel Foucault, L'archaeologie du Savoir, Paris: Gallimard, 1969.

32. Rheinberger, Toward a History of Epistemic Things, p. 36.

33. Rheinberger, Toward a History of Epistemic Things, p. 177, quoting paleontologist Rudolf Daber.

34. The relevant patterns of action and talk crucially incorporate the manifold normative responses to arrangements of things and deployments of terms and judgments as correct or incorrect, appropriate or inappropriate.

35. Prominent examples include Jared Diamond, Guns, Germs and Steel: The Fates of Human Societies, New York: Norton, 1997; Alfred Crosby, Ecological Imperialism: The Biological Expansion of Europe 900-1900, Cambridge: Cambridge University Press, 1986; and William McNeill, Plagues and Peoples, Garden City, N.J.: Anchor, 1976.