# BARAD'S FEMINIST NATURALISM*

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Naturalism is now the predominant meta-philosophy in the English-speaking world. The homages to naturalism offered even by its supposed opponents are the best evidence for its predominance. Here are two illustrative examples. Kantian ethicist Christine Korsgaard recently described the contemporary philosophical situation in this way: "For us, reality is something hard, something which resists reason and value, something which is recalcitrant to form" (1996, 4). John Haugeland, who argues that the authority of science itself is constituted through an "existential commitment" comparable to faith or love, nevertheless concedes that the resulting "norms of objective correctness [must] be understood in a spirit of naturalism, appropriately construed, [which is] the thesis that people are, though distinctive, still naturally evolved creatures somehow implemented in whatever physics tells us about" (1998, 317, 358n15).

Early in the past century, when anti-naturalism was perhaps as widely entrenched as naturalism is today, philosophers sought to ground empirical scientific knowledge on other, normative grounds: formal logic or semantics, phenomenology, transcendental conditions for representation, or an existential analytic of Dasein were among the more prominent alternatives. Naturalists reject such philosophical projects, however, and insist that philosophical work must be continuous with empirical science, or perhaps even incorporated within scientific inquiry.

Closer examination, however, reveals a fundamental ambiguity among such claims to continuity between philosophy and the sciences. Within philosophy of science, "naturalism" is often taken to mean that philosophy must be closely engaged with scientific practice. This strain of naturalism has been strongly influenced by the demise of logical empiricism, whose accounts of scientific norms came to seem utterly divorced from what scientists actually say and do. In response, such naturalists insist that philosophical reflections on science, life, or mind must engage the work being done in the relevant scientific fields, or perhaps in empirical studies of the history or sociology of science. A different strain of naturalists (principally in philosophy of mind, epistemology, and ethics) has interpreted the continuity between philosophy and science differently. They argue that philosophical understanding of intentionality, knowledge, or morality must ultimately be accommodated within nature as disclosed by the sciences. If intentional content, epistemic authority, or moral norms are to be philosophically respectable, the latter naturalists argue, these must be explicable in the nonnormative terms of natural laws, causal powers, selective mechanisms, or

predictive enhancements.

When pushed, almost everyone acknowledges the need somehow to conjoin these two strains of philosophical naturalism. After all, the only plausible reason to insist that norms must be explicable in terms of laws, mechanisms, or causal powers would be if that is what the world consists in, according to science. The obvious reason to take philosophical inquiry to be continuous with what scientists do would in turn be because sciences are among the best available ways to understand the world. Yet too often, such conjunctions of the two strains of naturalism remain unfunded promissory notes. Promissory handwaving is often quite explicit: John Searle (1983, ch. 10) blithely tells us that someday science will demonstrate that intentionality just is a biological property, while Patricia Churchland (1986) and Paul Churchland (1989) have each countered that someday very soon, folk psychology will have already been eliminated by computational neuroscience. Haugeland, in the passage I quoted earlier, only says that norms of objectivity are physically implemented "somehow." Yet promissory deferrals of reconciliation between naturalists' conceptions of science and of nature also flourish where they are not acknowledged. Alexander Rosenberg's "Field Guide to Recent Species of Naturalism," (1996), for example, trenchantly shows how other philosophers of science appealing to Darwinian principles have not yet made good upon the naturalistic commitments that he joins them in endorsing.

This promissory gap within philosophical naturalism is not just a local problem. Although I cannot argue the point here, a central theme in Rouse 2002 is that much of 20th Century philosophy has been shaped by a debilitating dualism between nature and the normativity of thought, language and action. A "dualism" in this sense is, in Brandom's phrase,"a distinction whose components are [conceived] in terms that make their characteristic relations to one another ultimately unintelligible" (1994, 615). In this context, scientific practices have been the pineal gland of contemporary philosophy: the postulated location for the magical reconciliation of what has been conceived from the start as irreconcilable. The sciences are conceived as richly meaningful, normatively binding disclosures of the semantically and normatively inert inexorability of nature, a natural world that nevertheless incorporates those scientific practices.

Feminist science studies have often been ambivalent toward this duality between the scientific and metaphysical strains of naturalism, and the underlying dualism between normativity and nature. Most feminist science studies scholars have enthusiastically joined the naturalistic turn toward the study of science as actually practiced. After all, philosophical discussions of objectivity or scientific

method in abstraction from detailed examination of scientific practices have on the one hand obscured gendered, racialized, and colonialist themes in scientific work, and on the other hand have been a prominent source for misconstruals of feminist scholarship as hostile to science itself.[1] Feminist scholars have replaced such discussions with accounts of scientific objectivity as situated within specific practical, historical contexts, and as answerable to concrete responsibilities rather than to abstracted principles. Yet many feminist scholars have been rather less sympathetic toward naturalized conceptions of nature. Metaphysical naturalisms have had a strongly reductionist bent, with either physical laws, genetic constraints, or adaptationist selection mechanisms playing prominent roles, and these conceptions of nature have too often been used to justify exclusionary or hierarchical practices. Feminists have been strongly and effectively critical of such conceptions of nature and their ideological uses.

Constructive feminist responses to these criticisms, however, have reinforced the sense of a one-sided allegiance to the scientific strain of philosophical naturalism: many feminist scholars have been more inclined to express approval of the metaphysical implications of work by favored scientists (Barbara McClintock, Gerald Edelman, Charlotte Nusslein-Vollhard, Richard Lewontin, Stephen Jay Gould, Adrienne Zihlman, and Linda Fedigan, have been prominent examples) than to advance their own programs to conjoin the two strains of philosophical naturalism. To this extent, feminist work has also had some of the promissory character exemplified by Searle or the Churchlands: science itself is expected, eventually, to vindicate a favored conception of the natural world, typically as more complex, interactive, wholistic, and disunified than has been supposed by most metaphysical naturalists.

Yet some work in feminist science studies does offer a more promising approach for reintegrating a conception of "nature" with the concretely situated normativity of scientific practices. Recent work by Karen Barad (1996, 1998, 1999, 2000, forthcoming) has prominently taken up the challenge of integrating feminist philosophy of science with a feminist ontology. By situating Barad's work in the context of debates over philosophical naturalism, I shall defend two claims about the significance of Barad's accomplishment: first, her proposed "agential realism" takes crucial steps toward adequately reconciling the two strains of philosophical naturalism; second, Barad's account provides a persuasive criterion for assessing and rejecting the naturalistic credentials of more traditional metaphysical naturalisms.

One way to express the need to reconnect the two strains of naturalism is to

ask how to account for scientific understanding of nature as part of the nature to be understood. The more or less received answer to this question for recent metaphysical naturalists is that scientific understanding involves correct representations of its objects and their modal properties; these representations acquire content from their causal-functional role within thought and action, and acquire warrant from their reliability, predictive success, or the best explanation of their predictive success. I think this conception confronts irremediable problems, although this is not the occasion to defend that claim. I mention the received view primarily to highlight where Barad departs from it.

I interpret Barad as developing a revised conception of metaphysical naturalism. The crucial point at which she departs from other naturalists is in the conception of nature itself as disclosed through scientific work. The familiar naturalisms treat nature in terms of regularities, laws, causal powers, or causal-functional roles. Nature so conceived is anormative. Although she does not put the point in quite this way, I take Barad to claim instead that nature as understood by the sciences is itself normatively constituted. Phenomena, she argues, are constitutive of the natural world (reality). A "phenomenon" in this sense is a reproduceable local material arrangement or "set-up." Barad introduces this concept in terms of scientific practice, for the most obvious examples of phenomena are experimental arrangements or observational configurations. In this respect, her concept has illuminating parallels in the work of Nancy Cartwright and Ian Hacking; Cartwright, for example, characterizes "a nomological machine [as] a fixed (enough) arrangement of components, or factors, with stable (enough) capacities that in the right sort of stable (enough) environment will, with repeated operation, give rise to the kind of regular behavior that we describe in our scientific laws" (1997, 66). Hacking's (1983) concept of phenomena (as mostly, but not exclusively, created within scientific research) is another well known antecedent. Both concepts have an important but less well-known antecedent in Hacking's (1965) concept of a "chance set-up" (including specific trials performed with it), which provides the material basis for making intelligible the concept of a long-run frequency. In all of these cases, phenomena (or nomological machines, or set-ups and trials) are material configurations of the world, which are frequently but not exclusively the product of scientific research.

It is crucial at the outset to distinguish the reproducible pattern of a phenomenon from a regularity or Humean constant conjunction. One way to express the difference is that no actual regularity need be involved, for what matters to a phenomenon is not actual repetition but repeatability. Thus, the

repeatable pattern of a physical phenomenon is normative rather than simply regular.[2] Under the right circumstances the pattern would recur, but there need be no actual regularity that it instantiates. Moreover, the pattern is then located in the phenomenon itself, not in the recognition or representation of a regularity.[3] Part of the normativity of phenomena is that their repeatability is differential, and hence not a simple regularity; what matters is not the exact reproduction of the same sequence of events, but the reproduction of a significant pattern despite various differences among instances of the same phenomenon. To repeat an experiment, for example, is not to do the same things exactly, but to try to produce the same phenomenon in different circumstances, and perhaps by somewhat different means.

Hacking relies upon the normative character of phenomena in his insistence that "there are only so many phenomena out there in nature" (1983, 228); in the absence of the "noteworthy, discernible" patterns that indicate phenomena, "there is just complexity" (1983, p. 226). Similarly, Cartwright distinguishes nomological machines, "concrete systems [of a specific kind]" that generate "precise behavior" and make possible "very precise and exact knowledge" from the "vague and imprecise facts" of everyday life (1996, 23-2). John Haugeland makes a related point about the normativity of scientific phenomena in distinguishing science from games like chess. In science, he notes, "the interesting challenge ... is to ascertain whether there's a game at all or not, and if so, what belongs to it and what doesn't. .... Finding a [scientific] game that is playable is therefore a kind of achievement" (1998, 330-31).

Barad's conception of phenomena is more inclusive than theirs. She initiates her distinctive characterization of phenomena by noting that these material configurations of the world constitute a practical or "constructed" cut between a measuring apparatus and a measured "object." There is no inherent boundary between an object and its surroundings, for the location of the cut depends upon the configuration of the apparatus. To see this point, Barad asks that we

> Consider an experiment in which light is scattered from a particle. The scattered light may be directed towards a photographic plate rigidly fixed in the laboratory and therefore used to record the position, or the light may be directed towards a piece of equipment with movable parts used to record the momentum of the scattered light. The first case essentially describes the process of taking a picture of the particle with a flash camera. In that case, the light is part of the measuring apparatus. In the latter case, the light's

> momentum is being measured and hence it is part of the object in question. (1996, p. 171)

Nothing about the interaction between the light and the particle alone fixes what property is defined by their intra-action, or where a cut occurs between the measuring and the measured components of the phenomenon.

A defining feature of a phenomenon is that the intra-action between an "object" and its surroundings leaves discernible marks on those surroundings so as to constitute them as a measuring apparatus (Barad coins the term 'intra-action' to acknowledge that the two poles of the phenomenon, the object and the apparatus, do not exist as such apart from their intra-action). What is measured by those marks, however, is not a property of the object in isolation, but of the phenomenon as a whole. The position marked by the exposure of the photographic plate to scattered light must be regarded as a a characterization of the entire arrangement, and not just of the scattering particle. The need for this referential holism has been most clearly evident in quantum mechanics. On Barad's Bohrian interpretation, position is only a meaningful concept within certain material arrangements, within which momentum is not meaningfully definable. The point is not merely epistemic, suggesting a lack of access to a definite but unknown position of the particle, but ontological. Under circumstances that mark a relatively definite position of a system, that system then has no definite momentum. Moreover, as Bohr and Barad have insisted, and I have elaborated elsewhere (Rouse 2002, ch. 8), this ontological holism of phenomena is not limited to microphysics. Macroscopic phenomena, such as the intra-action of an "organism" with its surroundings, also display comparable tradeoffs, such that concepts like "gene," "phenotypic trait," or "adaptation" are properly ascribed to whole intra-active phenomena rather than as predetermined properties of definite objects.

What are the boundaries of a phenomenon, however? Barad notes that the outside boundary of a phenomenon may seem to extend back indefinitely: not only are there questions about how far the measuring apparatus per se extends, but also "any particular apparatus is always in the process of intra-acting with other apparatuses, and the enfolding of phenomena ... into subsequent iterations of particular situated practices constitutes important shifts in the particular apparatus in question" (1998, 102). This apparent open-endedness of phenomena might then raise the worry that, if properties cannot be ascribed to pre-existing objects, then they cannot be adequately localized at all. A similar problem has emerged in discussions of causality: Mackie (1974), for instance, argued that only

anthropomorphic interests enable a localizable cause to stand out against the background of the properly specified "total cause."

There is both something constructively insightful in this objection, and something fundamentally mistaken. The insight is to recognize that a phenomenon in Barad's sense is not just a larger, more complex object in the world, but a meaningful configuration of the world. It therefore has no intrinsic outside boundary. The mistake is to overlook the ways in which a phenomenon can be configured so as to confer definite intelligibility and more or less definite boundaries upon a more localized situation. Thus, as Cartwright notes in her discussion of relatively stable regularities, the conditions that shield the nomological pattern from interference are a crucial component of what she calls the "nomological machine." Whether those shielding conditions are created by an experimenter for that purpose, as is the Hertz box that protects a Magnetic Resonance Imaging device from other magnetic influences, or are "already there," as is the relative gravitational isolation of the solar system, they (and the specific "external" interferences that they are able to block) are part of the arrangement that constitutes the phenomenon and the locally intelligible pattern that it manifests.

We can now see how to reconcile Barad's insistence that "phenomena are constitutive of reality" (1996, 176) with Hacking's, Cartwright's, and Haugeland's more restrictive analogues to her concept. The latter insist that not every situation in the world constitutes a phenomenon, indeed that very few situations do so, and those only with great difficulty. On Barad's more inclusive conception, the world is articulated by overlapping, intra-acting phenomena, but most of these fail to disclose any pattern of local intelligibility. These confused intra-actions that seem to manifest only undifferentiated complexity still mark the limit case of a phenomenon, however. Consider an experimental run that generates no clear signal standing out from background noise. We might say of such an experiment that there was "nothing there" to be found. But the unintelligible complexity thereby disclosed only shows up through the intelligible configuration of the experiment itself as a locally reproducible arrangement that would have disclosed a significant pattern had the circumstances been different. It is in this sense that phenomena are constitutive of the world "in its entirety," in their complex, intra-active play of intelligibility and unintelligibility.

The question remains, however, what it means for phenomena to constitute patterns of local intelligibility, or for phenomena to exhibit "meaningful patterns." In unpacking these locutions, we will recognize two more of Barad's

contributions, namely her insistence upon the prosthetic performativity of the "agencies of observation," and her account of the conceptual-discursive dimension of scientific intelligibility. Consider again the measuring apparatus whose intra-action with a measured object enables a phenomenon to display a pattern of intelligibility such as a definite measurement or a causal relation. The measuring apparatus cannot just include an experimental setup, shielding conditions, and a target physically marked by its intra-action with the object. By themselves, the marks of such an intra-action such as Uranus's deviations from an elliptical trajectory around the sun in the vicinity of Neptune display no intelligibility whatsover. For there to be intelligibility in the phenomenon, the measuring apparatus has to constitute what Robert Sokolowski (1978) once called a "dative of manifestation," that to which it is intelligible. It is here that anti-naturalists typically invoke a distinctive role for a knowing subject as naturalistically inexplicable. Mind, consciousness, or, in a revealing case, van Fraassen's (1980) appeal to the human organism as the privileged locus of observation, are supposedly essential to any genuine disclosure of the world as meaningful.

Van Fraassen is especially instructive in this context, because he attempted to incorporate a naturalistic element within his constructive empiricism by insisting that science itself should determine what is observable: "what is observable ... is a function of facts about us qua organisms in the world" (1980, p. 57-58). Yet what van Fraassen thereby mistakenly assumed prior to any scientific considerations is that the relevant boundaries for a scientific measuring system must be individual human organisms (a point on which he and Quine 1960 oddly agree). For a scientific naturalist, those boundaries should be specified from within scientific practices and measurement interactions themselves. For a feminist, moreover, van Fraassen's identification of knowers with their supposedly "natural" bodies is deeply problematic.

Barad responds to both concerns by asking how the "agencies of observation" are themselves constituted as a material component of a phenomenon. She begins with the whole complex set of arrangements that make up the material apparatus of an experimental or observational setup. This apparatus typically includes the detector marked by its intra-action with the object, the preparatory apparatus sometimes needed to configure the object to intra-act in the right way, the shielding of the phenomenon from intrusive noise, and the interpretive apparatus that enables these marks on the detector to be manifest as effects measuring the object in some definite respect. This apparatus cannot be conceived as a group of objects or tools which are then assembled into a more

complex tool, for their unification in a repeatable phenomenon is a matter of how they intra-act performatively:

> Apparatuses are not preexisting or fixed entities; they are themselves constituted through particular practices that are perpetually open to rearrangements, rearticulations, and other reworkings. This is part of the creativity and difficulty of doing science: getting the instrumentation to work in a particular way for a particular purpose (which is always open to the possibility of being changed during the experiment as different insights are gained). (Barad 1998, 102)

To the extent that human bodies fit into this performatively constituted apparatus, they do so not as natural objects characterizable in isolation, but as constitutive components of this dynamically functioning apparatus.[4] Human agency is always prosthetically extended and performative in its contribution to the "dative of manifestation" constituted in scientific practices.

This iterative, normative performativity of scientific practices is indispensable to how they allow the world to be intelligible. Consider again the example of the pattern displayed by the anelliptical deviations in the orbit of Uranus that exhibit its gravitational intra-action with Neptune. I earlier claimed that the shielded two-body "apparatus" composed of the sun and Uranus is not sufficient by itself to allow the gravitational capacities of Neptune to be intelligible. Yet Barad would also reject non-naturalist invocations of mind, consciousness, interestedness, or shared presuppositions of a scientific community as the difference-maker for intelligibility. So how does the incorporation of material systems like planetary orbits within a larger performative apparatus display them as intelligible without magical invocations of subjectivity? The first step is to incorporate within the phenomenon the prosthetically embodied practices of registering positions, tracking them successively, transposing them into trajectories, and projecting these trajectories geometrically or analytically. Only when these practices are in place is there a manifest pattern that displays the intelligibility of orbits as marks of gravitational intra-action. "Practices" in this sense are not regularities of behavior, but further patterns of normative intra-action (Rouse 2002, ch. 5). They are normative in the sense that further practices of correcting, refining, teaching and otherwise differentiating correct from incorrect performance are ongoing parts of the practice. These practical intra-actions need never come to rest upon some final regularity. Indeed, I think it is constitutive of genuinely normative (and thereby intelligible) intra-action that it not do so. The possibility of further correction is constitutive of pattern-recognition as opposed to

mere differential-responsiveness (Haugeland 1998, ch. 11, insightfully discusses the interdependence of pattern and pattern-recognition). I shall later return to the question of what such openness to correction amounts to.

Before doing so, however, we need to turn from the prosthetically extended embodiment of the "agencies of observation" to their conceptual and discursive character. Barad argues that phenomena are always "material-discursive." I take that to mean that the interpretive aspects of the "agential" side of the phenomenon always implicate the phenomenon within a field of discursive practice. To see what that means, consider again Barad's example of a particle-scattering experiment. A measuring apparatus whose parts are rigidly fixed to one another is needed in order to for the intra-active marking of that apparatus to measure position, and reference to such an apparatus at some point is indispensable to the intelligible use of the term 'position'. Thus, Barad endorses Bohr's insistence that "descriptive concepts obtain their meaning by reference to a particular physical apparatus which in turn marks a constructed cut between the 'object' and the 'agencies of observation'.... For Bohr, measurement and description entail one another." (1996, 172)[5].

We need to understand this "mutual entailment" in both directions. Description requires measurement for the reasons I have just cited. The specific performative configuration of the apparatus, for example with internally fixed parts and use appropriate to that arrangement, determines what is being measured and described, in which respect. Measurement in turn requires description. What allows the mark of a photon on a photographic plate to measure position is its (possible) inferential role in a subsequent chain of performances that are held normatively accountable to appropriate intra-actions with that mark. The inferentially accountable use of concepts like position is an indispensable component of the interpretive apparatus belonging to a phenomenon, through which the phenomenon becomes intelligible. Barad thus extends Sellars' (1997) familiar point about perceptual identifications to apply to practical intra-action with an apparatus: a parrot that utters 'red' in the presence of red surfaces has not actually used the concept rather than just the sound, unless it can also use it inferentially in other contexts; likewise, a mark on an experimental apparatus is not a measurement of position unless it is involved in an appropriate inferential nexus. Discursive practices as characterized by a pragmatically inferentialist semantics (Brandom 1994) are thus an indispensable component of any intelligible phenomenon, and a crucial part of Barad's "agencies of observation" (Rouse 2002, ch. 6-8).

This appeal to the inferential normativity of discursive practices reinforces rather than undermines Barad's commitment to a broadly naturalistic orientation, because she takes meaning and its interpretation to be thoroughly natural, that is, material phenomena. On her conception, I argue, Davidsonian radical interpretation or Brandom's "discursive practices" should also be understood as measurement intra-actions, comparable to the particle-scattering example already mentioned. Semantic interpretation can only be undertaken toward some material system: it must begin with marks on bodies, whether these are movements, vocalizations, or inscriptions. Moreover, these marks on bodies are only meaningful in relation to the publicly accessible circumstances that occasion them. There are then two alternative practical cuts that can show such performances to be semantically intelligible. If the occasioning circumstances are part of the "agencies of observation," the response to these "utterances" interprets them as meaningful in a language "antecedently understood." This is the familiar model of radical interpretation. Alternatively, the utterances can themselves be part of a "measuring apparatus"--given a specific interpretation in the home language, those marks are a measure of their surroundings (roughly, do those circumstances, including auxiliary assumptions, confirm or falsify this expression?). The marks then express part of the semantic significance of those circumstances, namely their correct description in these words. Thus, from Barad's broadly naturalistic perspective, meaning and truth are comparable to position and momentum, organism and environment, or adaptive trait and niche: the meaning of an expression and the correlative truth about the world are not simultaneously determinate, for the determinacy of each requires mutually incompatible practical configurations of the world (for more extensive discussion of these points, see Rouse 2002, ch. 8).

The material and discursive aspects of a phenomenon are thus also comparable in their irreducible normativity. There is nothing about the letters p-o-s-i-t-i-o-n or the sound pə-zi´-shən that magically (Wheeler 2000) connects them to what is disclosed in measurements using apparatus with internally fixed parts; only their actual ongoing use in such circumstances, in reliably recognizable and normatively accountable ways, can account for their discursive significance. The same is true of other marks on bodies that are the material indications of a phenomenon. Thus, when I spoke earlier about how utterances can be normatively accountable to the outcome of a measurement, I chose quite carefully the phrase "appropriate intra-actions with [a] mark [on a photographic plate]." One cannot say that later inferential uses of the term 'position' are accountable to the physical

mark itself, because that leaves unspecified in what respect they are accountable to it. Nor can one say that they are accountable to the position of the mark on a photographic plate, because 'position' is only being articulated through these inferential relations. To make perceptual recognition of the mark what is crucial will not do, for that would be a return to an empiricist foundationalism. What one needs instead are material intra-actions with marks on bodies (such as establishing a reference frame, marking off and counting equal unit divisions, standardizing the units, and so forth), along with practices of differentiating correct and incorrect performance. Those practical intra-actions are thereby held accountable to what is at stake in their performance.

This reading of Barad does not substitute a normative foundationalism for a now-discredited empiricist foundationalism, by interpreting measurement practices in terms of accountability to something at stake in the practice. What is "at stake" in the practice need not be articulated or agreed upon in advance in order for it to govern the intra-actions that constitute a measurement; it can govern the practice, without serving as a normative "given." Alasdair MacIntyre has helpfully expressed this point in terms of the normative authority of traditions:

> What constitutes a tradition is a conflict of interpretations of that tradition, a conflict which itself has a history susceptible of rival interpretations. If I am a Jew, I have to recognize that the tradition of Judaism is partly constituted by a continuous argument over what it means to be a Jew. (1980, 62).

Being a Jew in this sense is a normative status rather than a determinate matter of fact. The normative significance of this status is sustained by its mattering to all parties to get it right about what is appropriately at stake here for all of them, even though they have not yet reached, may never reach, and in some cases may not even seek agreement about what that is. Moreover, it matters that these stakes be binding on everyone involved. The intelligibility of anyone's participation in a practice turns on there being something at stake for everyone in getting it right. That does not mean that the intelligibility of practices depends upon the possibility of ultimate agreement about and conformity to what those stakes are. Rather, it depends upon an implicit mutual recognition of and by those to whom the practice matters, such that they (ought to) hold themselves responsible for their different interpretations, and accountable to one another.

This appeal to agential responsibility to explicate "objectivity" (as the accountability of scientific practices to materialized phenomena) is one of at least two important respects in which Barad's work distinctively contributes to feminist

theory and feminist science studies (other feminist treatments of objectivity in terms of responsibility or kindred notions include Haraway 1991, ch. 9, Code 1991, Longino 1992, Wylie 1999, Nelson 1993). A second distinctively feminist feature of her analysis is her identification of the locus of such responsibility as a prosthetically embodied engagement in material-discursive practices. Barad puts the first point this way: accountability to the world as material "is not about representations of an independent reality, but about the real consequences, interventions, creative possibilities, and responsibilities of intra-acting within the world." (1996, 188). Knowing the world by participating in the configuration of phenomena makes one accountable for all of their consequences. More traditional conceptions of objectivity limit the responsibility of knowers. Knowers then need only attend to the correct functioning of the apparatus for immediate epistemic purposes, accepting and accommodating the data (the specific marks on the apparatus that indicate the outcome of an experiment or observation) within their overall economy of belief and research practice. Barad's conception of objective accountability is more encompassing. Scientific practice not only makes the world intelligible in specific ways and in its own terms; it also forecloses other patterns of intelligibility, and other agential engagements with the world. Responsible ("objective") science is accountable not just to the outcomes of the phenomena it participates in, but for the specific boundaries, exclusions, and impositions that it thereby helps to realize in the world.

A second distinctively feminist theme in Barad's work is her interpretation of the loci of such agential responsibility. Understanding and agency are traditionally located in the rational, human subject, and/or the natural body she inhabits and partly controls. The self-contained character of the subject would then be defined by inherent boundaries between self and other, whether in the self's inner deliberations or outer bodily performances. For Barad, there are no such inherent boundaries: "what gets defined as a 'subject' (or 'object') and what gets defined as an 'apparatus' is intra-actively constituted within specific practices" (1998, 105). The locus of responsibility is thus a prosthetically embodied, performatively constituted agency: "we are responsible for the world in which we live not because it is an arbitrary construction of our choosing, but because agential reality is sedimented out of particular practices that we have a role in shaping" (Barad, 2000, 247). That recognition leaves a conceptual and practical space for understanding and being accountable to nonhuman agency, not because there are no differences between human and other agencies, but because agency is not an all or nothing affair. There are many forms of intra-active

involvement in the ongoing re-production of phenomena, and many ways in which we are responsible to and for them. As Barad concludes,

> Learning how to intra-act responsibly within the world means understanding that we are not the only active beings–though this is never justification for deflecting that responsibility onto other entities. The acknowledgement of nonhuman agency does not lessen human accountability; on the contrary, it means that accountability requires that much more attentiveness to existing power asymmetries. (1998, 116-17)

I can now conclude with Barad's challenge to other metaphysical naturalists. She has abandoned one of the core commitments of most contemporary naturalist metaphysics, namely that nature as disclosed by the natural sciences is anormative. On her account, nature as disclosed by the sciences is already meaningfully configured and normatively accountable. It both sediments a history of prior intra-action, and effectively shapes the field of possible subsequent action by the various human and non-human "agencies" it encompasses. Barad cogently summarizes this agential conception of the world:

> The new ontology offered here also makes it possible to take account of the material dimensions of constraints and exclusions without presuming matter to be a fixed ground existing outside of time, history, or culture. ... Reference to the material constraints and exclusions and the material dimensions of power is possible within the framework of agential realism because "materiality" refers to **agential reality**, which is explicitly not nature-outside-of-culture. (1998, 109)

She has, however, given up on a traditional metaphysics of nature so as to retain other core naturalistic commitments that are more fundamental, but in conflict with claims of nature's anormativity.

In fairness to Barad, she has nowhere asserted that her position is naturalistic, or that she endorses any of the specific theses that I characterize as naturalistic commitments. I assert, however, that it makes good sense of Barad's program and her core commitments as she expresses them to connect them in this way to the naturalistic tradition in philosophy. Among the naturalistic commitments that Barad maintains, sometimes more stringently, are: the continuity between philosophy and science; the insistence that philosophical explication of science be accountable to ongoing scientific practice; a thoroughgoing materialism (albeit in the sense of agential materiality, not a more traditional physicalism); and the rejection of any appeal to the magical or supernatural. Perhaps more important, Barad's account offers a constructive

reintegration of the two strains of naturalism: a scientific understanding of nature through agential engagement in the construction-and-articulation of phenomena is clearly and straightforwardly a part of the nature it makes intelligible, which is constituted as phenomena.

To those who still wish to retain a more traditionally naturalistic metaphysics, for which normativity must be reducible to or supervenient upon physical objects and their causal interactions or lawful regularities, Barad's work then offers a fundamental challenge. Any naturalistic metaphysics must incorporate the understanding of nature within nature as understood, and must accept that scientific practices at their best embody (part of) whatever understanding of nature has thus far been attained. The challenge is then to display the connections between the concepts employed in their metaphysics (such as objects, causes, functions, or laws), and the material apparatus through which scientific practices could hold those concepts accountable to marks on bodies. Barad herself puts the challenge this way: "Any attempt to reinstate materiality as natural [in the more traditional sense] would be exposed as quite bizarre, since this would be to assign materiality to a place outside the real, ... the objective referent [of scientific practices]" (1998, 109). The suspicion underlying this challenge is that other metaphysical naturalists illegitimately help themselves to their core concepts. Their uses of these concepts cannot be supported by the appropriate use of material and conceptual apparatus to meaningfully situate them within a broadly scientific and non-supernaturalist engagement with the world.

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# NOTES

*. Earlier versions of this paper were presented at conferences on "Feminism and Naturalism" at Washington University and the University of Missouri at St. Louis in September 1999, and on "Sciences as Social Practices" at Carleton University in March 2000. Many thanks to the participants for helpful comments.

1. Lloyd (1996) notes that constructive feminist demystifications of scientific work may mistakenly seem "anti-scientific" if one's conception of science is abstracted from attempts to clarify the strengths and weaknesses of actual inquiry.

2. Rouse 2002, ch. 8-9 also discusses the contrast between phenomena and regularities across possible worlds

3. Strictly speaking, a Baradian phenomenon does incorporate the recognition of a pattern, but the capacity for recognition is itself part of the apparatus that belongs to the phenomenon, and the phenomenon is then not just the regularity itself, but the larger configuration of the world which enables the regularity to be manifest. See the discussion below, and in Rouse 2002, ch. 8. This point also explains why Cartwright sees regularities as properties of nomological machines and Hacking ascribes

long-run frequencies to chance setups.

4. To measure the capacities and characteristics of human bodies in the way that van Fraassen suggests would itself require a different apparatus, and the bodies measured would be on the other (the "object") side of the relevant practical cut. The point is not that such measurements of human capacities are irrelevant to the interpretation of measurement outcomes (as Barad noted following the passage I just quoted, "any particular apparatus is always in the process of intra-acting with other apparatuses, and the enfolding of phenomena ... into subsequent iterations of particular situated practices constitute(s) important shifts in the particular apparatus in question and therefore in the nature of the intra-actions that result in the production of new phenomena, and so on" 1998, 102). Rather the point is that it requires a different phenomenon to measure the body as object, and still others to connect the two phenomena together.

5. Bohr spoke of "classical" descriptive concepts, which he distinguished from quantum mechanical concepts. Howard (1994) gives a speculative but highly plausible reconstruction of Bohr's conception of classical concepts. I omit the term "classical," because I think that Barad's account of how descriptive concepts are implicated in phenomena does not depend upon

Bohr's more contestable view of the ineliminability of classical concepts.