Chapter 4
The Implications of the New Materialisms for Feminist Epistemology

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Abstract Feminists drawing on the physical and biological sciences increasingly repudiate the notion that biology and matter are passive or inert and instead recognize the agency of biology or matter in worldly phenomena and social and political behavior. Such 'new materialist' work challenges the linear models of causation that underlie constructivist analyses of the ways power shapes the subjects and objects of knowledge. It provokes feminist epistemologists to develop models of causation and explanation that can account for the complex interactions through which the social, the biological, and the physical emerge, persist, and transform.

Keywords Agency • Causation • Complexity • Materiality • New materialisms

In a recent argument detailing the ways the mineral content of bones is shaped by the interaction between gendered cultural practices and sexual endocrinology, Anne Fausto-Sterling invites feminists to 'accept the body as simultaneously composed of genes, hormones, cells, and organs – all of which shape health and behavior – and of culture and history' (Fausto-Sterling 2005, 1495). This invitation to include the biology of the body in cultural and political analysis might seem a bit bizarre considered at the phenomenological level of daily living – who, after all, could deny the effects of hormone swings, blood sugar, sleep deprivation, and aging as we live, work, think, and play? Yet, at the philosophical or theoretical level, the invitation is less bizarre and instead rather interesting. For feminist philosophers and theorists, the body as a living organism is a vexed object, so vexed, in fact, that in philosophical and theoretical work, it is often sidelined, bracketed, or ignored. In such a context, Fausto-Sterling's solicitation is a provocation and a challenge: in suggesting that feminists should consider intellectually the biology they cannot but

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acknowledge in their daily lives, Fausto-Sterling also demands that feminists rethink some of the deeply held assumptions about causation that have structured feminist critique for a number of generations.

Of course, in many respects, a scholarly and theoretical focus on the body's materiality is nothing new: for several decades, feminists have denaturalized both embodiment and material objects, analyzing and specifying the manifold discursive practices through which bodies and matter are constituted as intelligible. The focus of such work has been on elucidating the processes through which norms and power relations are incorporated as forms of subjectivity or materialized in institutions, cultural practice, and facts. Recently, however, a group of scholars including Fausto-Sterling, Elizabeth Grosz, and Karen Barad have begun to try to include in such analyses the movements, forces, and processes peculiar to matter and biology. These 'new materialists' consider matter or the body not only as they are formed by the forces of language, culture, and politics but also as they are formative. That is, they conceive of matter or the body as having a peculiar and distinctive kind of agency, one that is neither a direct nor an incidental outgrowth of human intentionality but rather one with its own impetus and trajectory.

In seeking to re-introduce biological and material agency into feminist analysis, new materialists do not advocate that feminists renounce insights into the ways in which power infuses bodies and matter to make them into socially and politically intelligible subjects and objects. Quite to the contrary, they are alert to the awful political uses to which biological essentialism has been put historically. What they ask is that feminists leaven our analyses of the discursive constitution of embodiment and material objects with an acknowledgment of the forces, processes, capacities, and resiliencies with which bodies, organisms, and material objects act both independently of and in response to discursive provocations and constraints. For example, in her innovative re-reading of Darwinian evolution, Elizabeth Grosz suggests that it is because feminists are interested in the ways in which bodies are inscribed by culture that we must also ask 'what these bodies are such that inscription is possible, what it is in the *nature* of bodies, in biological evolution, that opens them up to cultural transcription, social immersion, and production, that is, to political, cultural, and conceptual evolution' (Grosz 2004, 2). Making a similar point, Karen Barad suggests that feminists consider 'how the body's materiality – for example, its anatomy and physiology – and other material forces actively matter to the processes of materialization' (Barad 2003, 809). If we do so, she claims, we will better apprehend how the body in 'its very materiality plays an *active* role in the workings of power' (Barad 2003, 809). These new materialists, then, explore how the forces of matter and the processes of organic life contribute to the play of power or provide elements or modes of resistance to it.

This is an exciting and provocative development in interdisciplinary feminist scholarship, for it represents an effort to supplement cultural or discursive analysis of social and political phenomena with scientific insights about biological, physical, or chemical processes. But of course, it is also a project that likely raises some alarm among feminists whose insightful analyses of gender, racial, and sexual politics have proceeded through the careful delineation of the processes through which normative imperatives have been naturalized to support arguments that social

and political formations arise through the agency of nature or biology. In working against biological essentialism, feminists quite understandably have tended to deny matter or biology any agency at all in shaping social or political relations. And many are likely to be suspicious of any 'biologizing' move that might, advertently or inadvertently, dress up power relations and disciplining norms as a force of nature or a biological imperative.

However, the problem raised by new materialists is not the problem of essentialism: it is only when we think about causation in simple linear terms that essentialism can be seen as the inevitable outcome of an attempt to think about the agency of matter or biology. Indeed, the new materialist work exposes the explanatory narrowness of the models of causation that underwrite feminist efforts at denaturalizing power relations. New materialists aim to shift feminist critical analysis from a framework within which the agency of bodies and material objects is understood largely as an effect of power – a unidirectional account of agency – to a framework within which, for example, culture and biology have reciprocal agentive effects upon one another.[1] In calling for feminists to acknowledge that matter and biology are active in their own right, new materialists push feminists to relinquish the unidirectional model of causation in which *either* culture *or* biology is determinative and instead to adopt a model in which causation is conceived as complex, recursive, and multi-linear. To shift our understanding or model of causation in this way represents a huge challenge: feminists will have to retool their theories of explanation and political critique so that they encompass both an awareness of the ways in which power is discursively naturalized and an appreciation of the distinctive and effective agency of organisms, ecosystems, and matter. This in turn will demand that feminists rethink how to apportion responsibility for injustice and assess the possibilities for and paths toward social and political transformation.

To understand the stakes and the implications of the new materialisms, it is perhaps helpful to distinguish them from other approaches to thinking about matter, most notably the Cartesian account of matter as essentially inert and the historical materialist understanding of matter as transformed and given agency by humans' labor and cultural practices. In neither of these latter two cases does matter have a distinctive agency of its own. Rather, as Barad rightly observes, 'matter is figured as passive and immutable, or at best inherits a potential for change derivatively from language and culture' (Barad 2003, 801).

For René Descartes, matter is passive, unmoving in itself and subject to the mechanistic laws of physical cause and effect when compelled to move by an external force. This conception of matter is central to his notorious metaphysical dualism and his claim that the thinking self is an immaterial substance ontologically distinct from the embodied, material self.[2] According to this framework, thinking is a

[1]For a small sample of works not otherwise discussed in this essay, see Alcoff, *Visible Identities* (2006); Barad, *Meeting the Universe Halfway* (2007); Braidotti, *Metamorphoses* (2002); Capra, *The Web of Life* (1996); Haraway, *When Species Meet* (2008); Hayles, 'Computing the Human' (2005); Kirby, *Telling Flesh* (1997); Masters, 'Biology and Politics' (2001); Oyama, *The Ontogeny of Information* (2000a); Young, *On Female Embodied Experience* (2005).

[2]See René Descartes, *Philosophical Writings* (1985).

purely rational intellectual activity distinct from the passions and opposed to the provocations and arousals of the body-in-the-world. Indeed, Descartes's portrayal of the body as essentially unthinking underpins the modern understanding of the human self as a rational, free, and self-determining agent.[3]

As feminist scholars have pointed out, historically, this Cartesian understanding of the passivity of matter was figured in racialized, gendered, and class terms that in turn were used to justify racial, gender, and class inequities.[4] Women, the lower classes, and people of various cultural or national origins were construed as trapped in and by the body because they were perceived as lacking the wherewithal to distance themselves from the body's operations and to steer a rationally-defined course for their behavior and actions. That is to say, the 'others' of modernity were construed both as subject to the determinations of the biological or animal functions of the body and as vulnerable to a kind of a behavioral determinism, a vulnerability which derived from the inability of a weak intellect to protect the volitional faculty from the solicitations, seductions, and predations of the social and cultural milieu. Feminists have not only elucidated the historical and ideological basis of such figurations, tracing the power relations and institutions conditioned and sustained by the presumption that certain classes of humans are by nature irrational, bound by their bodies and emotions, or vulnerable to the pressures of social forces. They have also asserted the equality of all humans in their capacity to reason and know and revalued the passions, experience, and social wisdom as forms of insight and knowledge.[5] For new materialists, however, it is not enough to assert the rationality of modernity's others, to revalue the passions of the body or phenomenological experience. They seek also to challenge the very notion that matter is passive and unthinking, to undo the opposition between reason and passions, and to question the distinction between self and world that positions individuals as separate from yet in relation to the contexts of their actions (Wilson 1998; Brennan 2004).

For historical materialists, matter is less inert and more plastic than it is for Cartesian substance dualists. Marx suggests in *The German Ideology* that humans have a peculiarly intimate relationship with the material world: their thoughts and their experiences of themselves are formed and transformed by the activities through which they work upon and transform matter for their own or others' purposes (Marx 1978, 150). But this mutually formative relationship between humans and the matter upon which they work is not one in which humans are possessed of complete self mastery. For as Marx notes in his analyses of capital, commodities,

[3]For feminist critiques of Descartes's rationalism, see Bordo, *The Flight to Objectivity* (1987); Lloyd, *The Man of Reason* (1984). For new materialist critiques of the way a Cartesian account of matter underwrites modern accounts of the self, see Lloyd and Gatens, *Collective Imagining* (1999) and Frost, *Lessons from a Materialist Thinker* (2008).

[4]See, for example, Wiegman, *American Anatomies* (1995); Mills, *The Racial Contract* (1997); McClintock, *Imperial Leather* (1995); Pateman, *The Sexual Contract* (1988); Macpherson, *The Political Theory of Possessive Individualism* (1962). See also Schiebinger, *Nature's Body* (1993).

[5]Eg. Bryson, 'Mary Astell' (1998); Cornell, *At the Heart of Freedom* (1998); Dalmiya and Alcoff, 'Are "Old Wives' Tales" Justified?'(1993); Archer, *Being Human* (2001).

and the social and political relations that emerge through productive activities, the products of labor become constitutive elements of the economic and political structures that direct, constrain, and compel individuals' behavior. In other words, when it is worked upon and transformed by human labor, matter can be an agent by proxy, absorbing and translating the agency of individuals in ways that exceed each agent's deliberate intentions. The agency of matter, here, is an indirect extension and aggregate effect of the productive activities of the humans who work upon it. Invested with and animated by this agency, matter consolidates the social and political relations that are the historical condition of its productive transformation. Yet, material objects and institutions do not *necessarily* confront humans as alien, constraining, and determinative conditions for human action. As Georg Lukács points out in 'The Standpoint of the Proletariat,' the labor activities demanded by the capitalist production process generate experiences for the proletariat that contradict the governing ideological forms of self-understanding. Through these contradictions, individuals and classes of people can develop critical awareness of the ways in which the agency of matter is actually their agency absorbed and translated into concrete social, political, and economic structures, an awareness that forms the basis of a revolutionary class consciousness (Lukács 1971).

Feminist and critical race theorists found in historical materialism an epistemology that can generate critical standpoints from which to analyze the sexual and racial dimensions of the division of labor. In thus appropriating historical materialism, they have articulated forms of oppositional political subjectivity and challenged the entrenchment of gender, racial, and colonial power relations in the institutions and material practices that structure and organize our lives.[6] Other theorists have wrested the insights of historical materialism from their basis in a critique of political economy and used them to generate a broader constructionist understanding of the creative and constraining force of human activity with respect to matter. Within this broader constructionist view, matter is more completely saturated with power: institutions, objects, and bodies themselves quite literally materialize or incorporate the imperatives that drive power relations. The norms and cultural formations that arise through historical practice not only constrain but also invite us to discipline our behavior, shaping our desires, our physical posture and gestures, and our phenomenological experience of self.[7] In keeping with this shift, feminist epistemologists have not only analyzed the gendered and racialized assumptions implicit in the disavowal of the role or place of embodiment, emotions, and intersubjectivity in the production of knowledge.[8] They have also elucidated the embodied and

[6]Eg. Hartsock, 'The Feminist Standpoint' (1983); Combahee River Collective, 'A Black Feminist Statement' (1983); Collins, 'The Social Construction of Black Feminist Thought' (1989); Mohanty, 'Women Workers and Capitalist Scripts' (1997); Sandoval, *Methodology of the Oppressed* (2000); Harding, *The Feminist Standpoint Theory Reader* (2004).

[7]Eg. Butler, *Bodies That Matter* (1993); Stoler, *Race and the Education of Desire* (1995); Ahmed, *The Cultural Politics of Emotion* (2004); Alcoff, *Visible Identities* (2006).

[8]Eg. Code, *What Can She Know?* (1991); Grosz, *Volatile Bodies* (1994); Damasio, *Descartes' Error* (2000).

socially and historically situated character of epistemological subjects and the constituting powers of language, institutional arrangements, and interpersonal interactions.[9] Further, they have sought to develop and articulate modes of knowing or knowledge production mindful of their own occlusions and elisions.[10]

Constructivism has been tremendously useful for feminist epistemologists in their efforts to denaturalize and politicize knowledge claims that disavow the historicity of empirical facts – that refuse to acknowledge the mediation of perception by language and culture, the identification and demarcation of objects of knowledge through social practice, or the production of knowing subjects through the elaboration of norms and disciplinary procedures. Indeed, as a critical project, constructivism has prompted the exhaustive search for the mark and agency of the social in any knowledge claim, a quest not simply to identify the social, linguistic, or cultural dimensions of perception but also to specify the social and political relations, negotiations, and practices through which both subjects and objects of knowledge come to be constituted as such. From studies of the economic, imperial, and political forces that historically have shaped biological classifications of sex and race, to analyses of the ways in which political and cultural imperatives shape the movements of identification and desire, to explorations of the extent to which social and cultural practices transform bone and flesh, the insights and methods of constructivism have been crucial to feminist challenges to claims that import, encode, and at the same time deny power relations by presenting propositions as true or certain knowledge or as objective or natural fact. But importantly, such insights into the materialization and embodiment of power remain rooted in the historical materialist sense that the agency of matter is derivative of deliberate human activity.

New materialists aim to counter the figuration of matter as an agent only by virtue of its receptivity to human agency. They try to specify and trace the distinctive agency of matter and biology, elucidate the reciprocal imbrication of flesh, culture, and cognition, investigate the porosity of the body in relation to the environment in which it exists, and map the conditions and technologies that shape, constrain, and enhance the possibilities for knowledge and action.[11]

However, in bringing the processes, movements, and activities of biology and matter into their analyses, they must often confront the suspicion that they might be suffering from a political amnesia and intellectual myopia through which the essentialisms of old might reassert themselves. The concerns here are twofold and related.

The first concern is about the political obtuseness of generality. The feminist insight into the implicit normativity of metaphysical categories has resulted in an ever-more refined specification of the various power relations through which

[9]Eg. Fausto-Sterling, *Sexing the Body* (2000); Potter, *Gender and Boyle's Law of Gases* (2001).

[10]Eg. Harding, *Whose Science, Whose Knowledge?* (1991); Haraway, *Simians, Cyborgs, and Women* (1991a); Hubbard, *The Politics of Women's Biology* (1990); Longino, *The Fate of Knowledge* (2002); Nelson, *Who Knows* (1990).

[11]For a sampling of such work, see Coole and Frost, *New Materialisms* (2010).

particular forms of matter, materiality, or embodiment are rendered intelligible. Feminists have argued that there is no 'matter' in general, no 'human body' in general, nor even 'women's bodies' in general. Rather, there are particular bodies produced or constituted through a complex interplay of racial and sexual economies of power, language and ideology, historically and geographically contested cultural formations, and psychological identifications and resistances. From this perspective, to talk of matter, biology, or the body in the register of the singular or general is to occlude these manifold and historically specific constituents of objects and embodiment, to obscure or even perpetuate the power relations that both make possible and produce facts, things, and subjectivities.

The second concern is about the ineluctable mediation of perception and knowledge by language, culture, and power. The worry is that in their efforts to consider the peculiar agency of organic or inorganic matter, new materialists might, wittingly or unwittingly, read linguistic, cultural, or political facts and meanings into the material – that they might misrepresent *as* biological, physiological or natural what is actually social and historical. And of course, such misrepresentations would be problematic because they would naturalize social and political artifacts, which is to say that they would essentialize gender and race.[12]

These concerns about power and essentialism are extremely important. But as Susan Oyama points out, incredulity toward the real and anxiety about essentialism are part of the legacy of Cartesian dualism and they sometimes function as 'traps' that shut off paths of intellectual inquiry.[13] Indeed, Elizabeth Wilson claims that the 'compulsive antiessentialism' that underlies such criticisms demands that new materialists acknowledge the inevitable power and pervasiveness of culture or discourse in their very effort to consider what might condition culture or discourse (Wilson 1998, 1).[14] It is possible, however, to recast or re-examine these concerns from within a different framework. Feminist scientists and historians of science have done a marvelous job breaking down the modern binary of nature and culture by showing how the natural environment or aspects of biological processes and behavior are shaped by the social and cultural. Non-scientific feminists, however, have been wary of if not downright resistant to reconsidering biology or materiality as anything but discursive formations, as historically specific products of power relations, linguistic practices, and cultural beliefs. As Lynda Birke notes provocatively, even scholars who critically engage the sciences of genetics or reproduction

[12]For a fascinating on-going discussion about the dangers of racial and sexual essentialism in genetic sciences, see the contributions to the on-going Social Science Research Council forum 'Is Race "Real"?'.

[13]As Oyama observes critically, within such a framework, 'if one voices skepticism about some "biological" interpretation, then, one is assumed to be an environmental determinist, and vice versa. This assumption is a trap, and it is better to dismantle traps than to step into them (or, for that matter, to set them for others)' (Oyama, *Evolution's Eye*, 2000b: 154).

[14]In an ironic formulation, Wilson claims that 'compulsive antiessentialism' is a 'disciplining compulsion' that has 'been naturalized not simply as good critical practice, but as the sine qua non of criticism itself' (Wilson 1998, 1–2).

can forget 'the "meat"' that 'is busily reconstructing itself' while they elaborate their discursive analyses (Birke 2000, 145). To put the point differently, feminists have been more comfortable with denaturalizing nature than with what we might call 'deculturalizing culture' – or admitting that matter or biology might have a form of agency or force that shapes, enhances, conditions, or delimits the agency of culture. Yet, this wary reluctance, understandable as it is given historical precedent, is structured by an understanding of causation that binds feminists to the binaries they have otherwise been deconstructing.

First, as noted in the discussion above, feminist epistemologists in the West have generally aligned themselves with arguments that any social or political significance attributed to bodily differences is a social and political construct. They proceed with the sense, if not a consensus, that biological organisms in themselves can be objects of theoretical or epistemological indifference because biology has no political entailments. However, their evident sense of the danger involved in the effort to explore, identify, or specify how different aspects of biology might shape behavior reveals an implicit concern that sexual or racial differences, if specified, might in fact entail particular social policies or political relations. Fueling this concern is the assumption that causation can only be unilinear and unidirectional: either the one or the other, biology or culture, is the causal agent in social phenomena. Within such a causal framework, the argument about the social constructedness of race and gender can be maintained only if the social is granted complete immunity to the biological. Conversely, to acknowledge that biology might have some agency would entail giving up the claim to construction – which is political ground that simply cannot be ceded. It is as if implicit in the fear of essentialism is the worry that were we to release biology from the conceptual confines of the role of absorbing – and perhaps transmitting – cultural mandates, it would hijack the causal arrow, run rampant in social and political institutions and practices, and effectively steal from us our rational agency and our capacity for individual and collective self-determination. In other words, underwriting the concern about 'the risk of essentialism' is, paradoxically, the presumption that a material, biological agency would override and overwhelm the effects of culture and politics and would end up being the determinative force in our lives no matter what kinds of efforts we might undertake to make it otherwise (Oyama, *Evolution's Eye* 2000b, 164–165).

Second, and related, when the determinist dangers associated with claims about the possible agency of the biological propel feminists away from biology to focus on the cultural, the linguistic, or the discursive formation of embodiment, the subsequent focus on construction reinstates the modern terms of subject-formation as an exercise in self-creation. To be sure, the creation at stake here is conceived as social, cultural, and/or political in character. But each of these forms of construction or constitution recenters the human as the definitive agent of order, meaning, and action (Smith and Jenks 2005, 147). In turning to culture to evade the determinism implicitly associated with the biological body, feminists recapitulate the modern fantasy of freedom, autonomy, and self-determination that they have otherwise so carefully dismantled. That is, the concern about unwitting essentialism is bound by

the terms of Cartesian dualism that put rationality, freedom, and agency on one side of an ontological divide and matter, passivity, and determinism on the other.

In their quest to unravel the ubiquitous threads of Cartesian dualism by reconceptualizing matter and embodiment, the scholars and theorists of the new materialisms concur with many of the insights about science, philosophy, and politics shared by feminist epistemologists of various ilks. However, they also present feminist epistemologists with some suggestive points of departure for rethinking their models of causation as they continue their critical and reconstructive work.

In their effort to denaturalize nature *and* deculturalize culture, new materialists push feminists to decenter human intentionality and design in the conceptualization of the relationship between nature and culture. In tracing the dynamic interactive processes that constitute objects and organisms as at once '100% nature and 100% nurture' (Fausto-Sterling 2005, 1510), they insist that we attend to both the agency of the human or cultural upon the biological or natural and the agency of the natural or biological upon the human or cultural. Indeed, to pose the issue in just such a way – as if there are two agencies that are distinct from one another and that interact in relation while maintaining their integrity as distinct entities – does not quite capture the reciprocally transformative nature of the relationship.[15] Susan Oyama contends that neither biology nor culture operates as a pure unfettered force. To the contrary, there is a 'stunning array of processes, entities, and environments – chemical and mechanical, micro- and macroscopic, social and geological' that shape and are shaped by biological constitution and social behavior. If we attend to the 'interdependence of organism and environment,' then we can elucidate the ways in which 'organisms and their environments define the relevant aspects of, and can affect, each other' (Oyama *Evolution's Eye*, 2000b, 3). Making a similar point in her reconceptualization of the interactions between biology and culture involved in evolution, Elizabeth Grosz argues that 'biology does not limit social, political, and personal life: it not only makes them possible, it ensures that they endlessly transform themselves and thus stimulate biology into further transformations. The natural world prefigures, contains, and opens up social and cultural existence to endless becoming; in turn, cultural transformation provides further impetus for biological becoming' (Grosz 2004, 1–2). As Grosz suggests, then, to admit into our analyses the ways in which biology prefigures culture is neither to delimit nor to predetermine cultural possibilities. To the contrary, she claims that the patterns of adaptation, innovation, and diversification that are the hallmark of evolution undermine the commonplace that nature is a constraint, a hindrance, or an obstacle to cultural creativity: 'Nature is open to any kind of culture, to any kind of "artificiality," for culture itself does not find pre-given biological resources, but makes them for its own needs, as does nature itself' (Grosz 2004, 72). The key insight in work by the likes of Fausto-Sterling, Oyama, and Grosz is that biology and culture, organisms and contexts, are co-emergent; they provoke, challenge, and consequently shape one another.

[15] Karen Barad suggests the term 'agential intra-action' to capture such a relational ontology. See Barad, 'Posthumanist Performativity' (2003), 814.

Clearly, to conceive of causation in singular, linear, and unidirectional terms is to elide the mutual and on-going transfigurations, the serendipitous, surprising, and sometimes anomalous developments that emerge through the kinds of interactions highlighted by these new materialists. The dynamic interactive processes that constitute organisms, objects, and environments require feminists to develop a theoretical vocabulary for talking about the complexity of causation. If we are to do justice to the ways in which objects, organisms, and cultural forms and practices emerge and transform through relationships that develop and reconfigure themselves over time, we must adjust the terms we use to capture or represent the multiplicity, the recursivity, and the varied temporality of causes and effects.

The complexity of causal processes brought to the fore by new materialists also brings into more emphatic focus the interdependencies that define the contexts in which both objects and knowers exist. In fact, the innumerable networks of interdependencies that constitute and shape the interactions between subjects and objects suggests that, methodologically, feminists must think ecologically not only about objects of knowledge but also about individual knowers and their epistemological communities. To think ecologically is not to simply note the broad context as a background against which objects exist or are known nor is it to delineate the forms of cultural and political embeddedness that shape and constrain what a subject may know. Rather, as Jane Bennett explains, 'to call something ecological is to draw attention to its necessary implication in a network of relations, to mark its persistent tendency to enter into a working system' that is 'more or less mobile, more or less transient, more or less conflictual' (Bennett 2004, 365). It is to emphasize that 'humans are always in composition with nonhumanity, never outside of a sticky web of connections' (Bennett 2004, 365). Or as Lorraine Code suggests, to think ecologically is to think in terms of 'diverse, complex, multiply interconnected *milieux*' when we conceive of epistemological subjects, to consider not simply 'individuals' or 'communities' but rather the dynamic interrelationships between subjects, objects, and habitats and the transformative effects of those relationships upon subjects, objects and the successively larger eco-systems within which they exist and interact (Code 2006, 27).[16]

And finally, the shift towards thinking in terms of complex causation and interdependencies brings into focus a form of ignorance or a limit to knowledge that challenges the aspiration towards cognitive and practical mastery over the world. As suggested above, for new materialists, objects always exist in dynamic 'assemblages' and connections that affect what they are and how they behave. Accordingly, it does not make sense to conceive of an object as a bounded and distinct thing – as if it existed in isolation from other objects and humans (Bennett 2004, 365).[17] Indeed, in their admission of the agencies and interdependencies of

[16]For similar efforts, see also Braidotti, 'Feminist Epistemology after Postmodernism' (2007); Grasswick, 'Individuals-in-communities' (2004).

[17]Bennett notes that in her interest in the agency of material objects, she considers not 'the thing as it stands alone, but rather the not-fully-humanized dimensions of a thing as it manifests itself amidst other entities and forces' (Bennett 2004, 366).

matter and organisms, new materialists find themselves confronted by an important kind of epistemological impossibility: the impossibility of complete and predictive knowledge of complex causal processes. Because the complex causal relations at issue here are multi-directional and recursive, the manifold interacting elements of an open system can '"spontaneously" develop collective properties or patterns… that do not seem implicit…within the individual components'(Urry 2005, 5). According to John Urry, '[s]uch emergent characteristics emerge from, but are not reducible to, the micro-dynamics of the phenomenon in question' (Urry 2005, 5). The irreducibility of such complex interactions demands, as Monica Greco suggests, that 'we acknowledge, and learn to value as the source of qualitatively new questions, the possibility of a form of ignorance that cannot simply be deferred to future knowledge' (Greco 2005, 24). That is to say, we must learn to incorporate the possibility of an impossibility of knowing into our epistemologies that is not indexed to the limits of perception or to the development of technology but rather intrinsic to the complexity of objects or processes themselves.

What is at issue in this impossibility is not the partiality of perspective that is so central to the various iterations of standpoint theory – although, as Donna Haraway has pointed out, the recognition of such partiality is both a useful prompt to political humility in the face of diversity and a goad to coalition building (Haraway 1991b). Nor is it the politically productive forms of ignorance that are implicated in the orders of knowledge through which disciplinary political powers are elaborated and made effective – although feminist philosophers and theorists are beginning to do fascinating work on the political work accomplished by regimes of ignorance.[18] Rather, what is at stake in thinking in terms of complexity, interdependence, and ecology broadly construed is epistemological and political humility in the face of the organic and inorganic world: an acknowledgment of the impossibility of full and definitive knowledge and a corollary surrender of the teleological assumption that we might possibly, at some future point, achieve full mastery over ourselves and the world around us. Of course, to acknowledge a zone of necessary ignorance in complexity is not tantamount to giving up on knowledge altogether: we do not need the promise of full knowledge as the backdrop for scientific investigations. As Karen Barad points out, in our investigations into how things work, we perform 'agential cuts' that effect a separation between objects and subjects existing in interdependence and that thereby constitute each as having distinct, determinate boundaries (Barad 2003, 815).[19] Any explanation or generalization entails a simplification of the causal field: some simplifications are pragmatically useful in that they are replicable and can be instrumentalized to further our purposes. But even tried and true and seemingly innocuous replications and instrumentalizations

[18]See Tuana and Sullivan, *Feminist Epistemologies of Ignorance* (2006). See also Sullivan and Tuana, *Race and Epistemologies of Ignorance* (2007).

[19]Diana Coole offers a similar account of the ways in which human agents carve a space of 'agency' out of a complex array of other organic and inorganic agents. See Coole, 'Rethinking Agency' (2005).

sometimes issue in surprises and unexpected consequences. The key, then, is to remember that we have produced rather than found distinct objects, that we have artificially reduced complexity and not mastered it. As Jane Bennett muses, perhaps recognition of the complexities of the objects and interactions in any given ecology will provoke 'a more cautious, intelligent approach to our interventions in that ecology' (Bennett 2004, 349).

If feminists can figure out theoretically how to acknowledge the manifold recursive interactions through which nature and culture develop and evolve, if they can learn to account for the dynamism, the temporal breadth, the spatial breadth – the complexity – of organic and inorganic materiality, in short, if they can rethink the terms of causation, they may find they have the conceptual tools to engage and criticize essentialism. To acknowledge complexity in causation requires a shift from thinking about essentialism in terms of misattribution ('you're describing the cause incorrectly') to thinking in terms of reductionism ('you're ascribing causes too narrowly'). Whereas the framework of misattribution makes us wary of misrepresenting actions or effects as caused by one kind of cause rather than another, the framework of reductionism makes us wary of over-simplification.[20] In both instances, we can tackle essentialism. But the first strategy conceives of essentialism as a malicious or ignorant misdesignation of a cause that demands the revelation of misrepresentation and (in historical practice) an accompanying disavowal of any relationship between biology and culture. In contrast, the second strategy conceives of essentialism as a reduction of many causes to a single linear one. The response demanded by latter formulation is the rejection of the simplification and the specification and elaboration of the complex, creative, and sometimes surprising interplay between biology and culture. This may be a slower and more difficult task, but it is also surely one to which the critical and political skills feminists have developed are particularly well-suited.

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[20]For instance, Elizabeth Grosz asserts that contrary to the seeming wishes of some western feminists, sexual difference is real and not simply a social construction. Yet, this assertion is not an essentialism in the way that feminists have habitually and suspiciously been wont to claim. As Grosz explains, 'There is an irreducible difference between the sexes, and this difference is not only irreducible to one of its terms, in the case of sociobiology, its reproductive cells; it is also irreducible to any other level, whether cellular, morphological, cultural, or historical. Sexual difference is irreducible difference, yet it is not a measurable, definable difference between given entities with their own characteristics but an incalculable difference that reveals itself only through its temporal elaboration' (Grosz 2004, 67).

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