Asking Different Questions: Feminist Practices for the Natural Sciences

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In this paper, Roy attempts to develop a semiprescriptive analysis for the natural sciences by examining more closely a skill that many feminist scientists have been reported to possess. Feminist scientists have often been lauded for their ability to "ask different questions." Drawing from standpoint theory, strong objectivity, situated knowledges, agential realism, and the methodology of the oppressed, the author suggests that this skill can be articulated further into the feminist practice of research agenda choice. Roy illustrates the usefulness of developing such a practice by addressing her own dilemma of conducting in vitro research in a reproductive biology lab.

Sometimes a pipette is just a pipette. As a feminist scientist, I have been party to more than several skirmishes over my intentions of bringing feminism and science together and have found myself retreating at times into conciliatory bottom lines just to keep the conversations alive. Yes—in a science influenced by feminism, pipettes will still be pipettes, one plus one will still equal two, and as Ruth Hubbard has said of gravity, "apples will indeed continue to fall unless someone throws them up in the air" (1995, 206). I have come to realize however that for many individuals, the mere idea of mixing feminism and science together sets well-established modes of reasoning (perhaps even gravity) into topsy-turvy motion.

In the past few decades, we have witnessed outcomes of a feminist restructuring of science and it is evident now that the answer to the question "Has feminism changed science?" is "Yes!" But how has feminism changed science? According to feminist historian of science Londa Schiebinger (1999) and many more feminist science studies enthusiasts, feminism has changed science not only by inviting more women to enter into science and pointing out gender

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biases present in the language and paradigms of science but also by changing the ways in which science is "done." For example, Schiebinger demonstrates that feminism has had its greatest impact in such disciplines as primatology, archeology and biology by motivating scientists to "ask new questions" (1999, 187), thereby altering the scientific knowledge that is produced. I am interested in examining more precisely, however, what it means to say that feminist scientists ask new or *different* questions and the political practices that a feminist draws from in order to arrive at these different questions.[1] My interest stems from a very intimate relationship with the natural sciences.

Several years ago, I completed my Ph.D. in reproductive neuroendocrinology. The importance of my doctoral work was in its contribution to understanding the actions of hormones at the level of the brain, including the gonadal hormones estrogen and androgen, and the pineal hormone melatonin (Roy et al. 1999, 2002; Belsham et al. 1998). I was involved in research projects that examined the effects of estrogen, androgen, and melatonin on an *in vitro* cell line of gonadotropin-releasing hormone (GnRH) neurons of the hypothalamus.[2] My scientific work contributed to evidence that suggests that the hypothalamic-pituitary-gonadal (HPG) axis in the body functions through a series of feedback loops rather than a hierarchy controlled at the level of the brain.[3] This finding has far-reaching impacts on women's health and sexuality as it also suggests that hormone-based contraceptives or hormone replacement therapies may have broader neurological implications (Roy 2007).

As a feminist scientist, I was able to contribute to a new understanding of the body through reproductive biology research. However, I could not have made this contribution without using an *in vitro* cell line model or without using molecular biology techniques. Furthermore, because of my decision to conduct research in reproductive neuroendocrinology, not a day went by during my doctoral work where I didn't face some kind of anxiety-producing dilemma.[4] These dilemmas often stemmed from my hesitations regarding which scientific questions I should ask, which scientific theories and paradigms I should follow, and which methods and technologies I should use to conduct my science. I knew that I wanted to create new scientific knowledges of the body, but I could have used some guidance with what can be referred to as my *research agenda choice*. In many instances, I wasn't sure how to apply my feminist analyses to the "technical core" of the science that I practiced.

I think that if we are willing to accept the idea that feminism and science do meet, and that feminists should engage in the production of scientific knowledge, we cannot just plant a feminist in the lab and hope for the best. Despite encouragement from within feminism for feminists to enter into careers in science and technology and thereby contribute to meaning-making processes of our time, once the feminist answers this call and dedicates herself to becoming a scientist, there exists very little support on the other end. Is it simply enough

that she identify as being feminist while conducting her science? What if she faces a dilemma between the feminism that she practices and the paradigms, methods, technologies, or tools that she uses to conduct science? How can these tensions be resolved? We must begin to address these questions if we are to continue encouraging young feminists to pursue careers in science. If we want the feminist scientist to thrive, I suggest that an effort must be made to articulate concrete strategies as to *how* she can overcome her dilemmas and go about "asking different questions."

From many projects within feminist science studies, two questions are being put forward to address the tensions involved in conducting scientific research, namely: (1) How can feminism influence the ways in which we gain scientific knowledge? And (2) how can the feminist scientist produce scientific knowledge that is relevant to and considerate of those who are marginalized within dominant cultures? These two questions, I believe, relate to the issue of research agenda choice, which does not begin and end with the concern for integrating feminist epistemologies into the sciences. Research agenda choice may begin with choosing between hypotheses, but it also operates at a much more mundane level within the enterprises of science. It has an impact on many more processes of scientific knowledge production, including the everyday choices between paradigms, language, methodologies, methods, apparatuses, techniques, and the tools needed to conduct scientific research. In her work focusing on issues in the epistemology of science, Helen Longino has suggested that feminist interventions in science have helped identify "contexts of discovery" (1993, 109) and thus have shown how social values, such as gender biases, can be introduced into the sciences. However, Longino distinguishes between those feminist analyses that serve a descriptive purpose and those that involve a normative or "prescriptive" purpose. "One way to articulate the distinctions I am urging," she states, "is to treat analysis of the context of discovery as a primarily descriptive analysis of how hypotheses are generated and to treat analysis in the context of justification as involving a normative or prescriptive analysis regarding the appropriate criteria for the acceptance of hypotheses" (102).

My interest in exploring the issue of research agenda choice in the natural sciences corresponds to what Longino has described as analysis in the context of justification, but is not restricted to the acceptance of a hypothesis alone. I agree with Longino's assertion that "although many of the most familiar feminist accounts of science have helped us to redescribe the process of knowledge (or belief) acquisition, they stop short of an adequate normative theory" (102). Prescriptive analysis for the natural sciences is a critical area of scholarship within feminist science studies that must be further developed. I would suggest, however, that in order to be useful for feminist scientists in the natural

sciences, an "adequate normative theory" should also be somewhat flexible and "semiprescriptive" in its gestures. Longino's own contribution toward creating a prescriptive theory that can be applied to the natural sciences involves redefining scientific objectivity and scientific knowledge in the context of communities. She puts forward her criteria for objective communities as a set of prescriptions, and suggests two important strategies in order for these communities to function. The first strategy involves treating science "as a practice or set of practices." The second involves taking up a "model-theoretic theory of theories" (114).

Following Longino's advice, it is my intention in this paper to develop a rough sketch of a semiprescriptive analysis by treating the issue of research agenda choice in the natural sciences as a type of *practice*. Other feminist science scholars, such as Donna Haraway (1997), Karen Barad (2003), and Joseph Rouse (1996; 2002), have also developed the idea of science as practice. Similar to Longino, they have articulated science itself as a set of practices that involves "ongoing interaction with our natural and social environments" (Longino 1993, 116). I believe that these iterations of *practice* may provide the feminist scientist with the necessary framework to create and carry through with political interventions in the sciences—where the scientist can become, or realizes that she has always been, part of the phenomenon.[5] Once she realizes that she is implicated and part of the phenomenon, which "scientific" questions she asks and to whom she asks these questions, is part of the contingency and "various performances" (Rouse 2002, 161) that get played out in any political practice. I also intend to take seriously Longino's strategy of using a model-theoretic analysis of theories. While highlighting the importance of models in the way that they structure our knowledge, Longino states:

> The adequacy of a theory conceived as a model is determined by our being able to map some subset of the relations/structures posited in the model onto some portion of the experienced world. . . . Its adequacy is not just a function or isomorphism of one of the interpretations of the theory with a portion of the world but of the fact that the relations it picks out are ones in which we are interested. A model guides our interactions with and interventions in the world. We want models that guide the interactions and interventions we seek. (1993, 115)

My intention is to suggest a suitable feminist model for the practice of research agenda choice, so that we may guide the interactions and interventions that we seek to make in the natural sciences. This way, the feminist scientist will be able to continue asking different questions—hopefully, with a little more help.

Feminist Standpoint Theory and the Natural Sciences

In my search for a model that will help the feminist scientist with the practice of research agenda choice, I am interested in starting with the highly contested standpoint theory, which like many of its users, remains marginalized within mainstream philosophy of science and science studies (Harding 2004a; Wylie 2004). As Harding comments, this is "intriguing because one of its central conceptual innovations is to describe *and prescribe* the practice of taking on the cognitive, technical core of the natural sciences and their philosophies" (2004a, 26, emphasis added). While describing standpoint theory, Harding states:

> Starting thought from the lives of those people upon whose exploitation the legitimacy of the dominant system depends can bring into focus questions and issues that were not visible, "important," or legitimate within the dominant institutions. . . . Such standpoints are critically and theoretically constructed discursive positions, not merely perspectives or views that flow from their authors unwittingly because of their biology or location in geographical or other such social locations. (1998, 17)

As far as its impact on the natural sciences can be measured, standpoint theory has been used primarily in two ways—to *describe the biases* present in hypotheses and methods constituted by dominant groups and to *describe the inadequacy* in the standards for achieving objectivity (2004a, 26).

I am interested in pursuing the argument that standpoint theory can be used to *prescribe new practices*, such as research agenda choice for the natural sciences. Despite the controversies surrounding standpoint theory, I am drawn to the promise of an approach whose innovations, as described by Harding, "bring into focus fresh perspectives on some of the most difficult and anxiety-producing dilemmas of our era" (2004b, 1). I am also drawn to the call put forward by standpoint theorists for starting off thought from the lives of marginalized peoples. This idea appeals to me because of the necessary "insider-outsider" sensibilities I have had to hone as a feminist scientist. Although I may have been somewhat isolated in the lab, I reached out to and was embraced by a community of feminist activists and scholars from other disciplines. This sense of community made it possible for me to stay in the sciences but also made me appreciate the importance of starting my scientific thoughts from the lives of marginalized others. While putting forward the notion that it matters *who* the knower is, Lorraine Code notes that this proposition also raises the issue of epistemic relativism. But she argues that epistemic relativism need not be immediately aligned with idiosyncratic or purely subjective thinking. According to Code, "Schemes, practices, and paradigms evolve out of communal projects of inquiry. To sustain viability and authority, they must demonstrate their

adequacy in enabling people to negotiate the everyday world and to cope with the decisions, problems, and puzzles they encounter daily" (1991, 3). In theory then, the feminist scientist may be able to reveal herself as a knower and still use standpoint theory as a "communal project of inquiry" in order to negotiate and cope with the decisions of research agenda choice. But why hasn't this been the case? Why hasn't standpoint theory been clearly articulated for the natural sciences? The challenge may be that a transposable model of standpoint theory, appropriate for the natural sciences, is yet to be developed. The feminists with whom I had formed a community while conducting scientific research taught me some skills so that I could negotiate my everyday world as a feminist scientist. Most important, they taught me to think about my political location and markers such as gender, race, class, and sexuality while I worked in a reproductive neuroendocrinology lab. I didn't know it then, but looking back now, perhaps I did use a form of standpoint theory to address the technical core of the science I practiced.

In her paper "Why Standpoint Matters" (2004), Alison Wylie outlines a framework for standpoint analysis of scientific practice. She is convinced of the value of feminist standpoint theory but is troubled by the ways in which this theory is commonly reduced by its opponents to a notion of social locations of individuals and to the relativism of identity politics (341). Although Wylie is concerned with the potential for standpoint theory's impact on the *analyses of* scientific practice within the disciplines of science studies and philosophy of science, she also makes a case for the implementation of standpoint theory within the *production of* scientific knowledge itself.

Wylie notes that standpoint theory can exist as a commitment to some form of situated knowledge (343). In this sense, it allows us to "develop a standpoint *on* knowledge production, a critical consciousness about the nature of our social location and the differences it makes epistemically" (344). For the feminist scientist, developing an awareness of "how" knowledge is produced is integral to seeing the applicability of standpoint theory for the practice of research agenda choice in the natural sciences. The point Wylie emphasizes however is that standpoint theory must exist without "embracing essentialism or an automatic privilege thesis" (345). In order for standpoint theory to survive and not continually be misread, "It must not be aligned with a thesis of automatic epistemic privilege; standpoint theorists cannot claim that those who occupy particular standpoints (usually subdominant, oppressed, marginal standpoints) automatically know more, or know better, by virtue of their social, political location" (341). In order for standpoint theory to move into the natural sciences and assist in the production of scientific knowledge, it must take the place of dominant approaches that are foundational to the scientific method. However, to put forward the claim that some people (those who are marginalized) know better than others (those who are not marginalized) as a

foundational precept of standpoint theory, is too dangerous. In order to make its move into the natural sciences, Wylie's above criteria for standpoint theory is pivotal. Once the feminist scientist acknowledges that as an insider-outsider she knows *differently*, the applicability of standpoint theory for the natural sciences also becomes clear.

Wylie further argues that standpoint theory "offers a framework for understanding how, far from compromising epistemic integrity, certain kinds of diversity (cultural, racial, gender) may significantly enrich scientific inquiry" (339). She suggests that there is value in what the marginalized or insider-outsider standpoint has to offer. The values she refers to include: (1) access to evidence whereby the position of marginality makes one see evidence not normally seen; (2) inferential acuity whereby an individual makes connections between power dynamics; (3) an expanded range of interpretations and explanatory hypotheses for making sense of the evidence; and as a condition for the first three values, (4) critical dissociation from the taken-for-granteds that underpin authoritative forms of knowledge (346). The moment the feminist scientist realizes that her location, relations, and position held within power dynamics give her the required critical consciousness needed to bring a "new angle of vision to bear on old questions and raise new questions for empirical investigation" (349), the hesitations regarding the relevance of standpoint theory in the natural sciences should be put to rest. Wylie's list of values provides the reasons for including standpoint theory in the practice of research agenda choice in the natural sciences. By listing a set of values, Wylie answers the question *why* the marginalized, insider-outsider standpoint is important and can enrich scientific inquiry by producing different knowledges. In fact, her analysis makes it clear as to why we should seek to occupy this standpoint. However, for the feminist scientist who is working in the natural sciences, sitting at her lab bench and scratching her head, I believe the question that remains is *how*?

Reconfiguring Objectivity

To address this last question, I am interested in drawing from standpoint theory but moving toward strong objectivity and situated knowledges, and through to agential realism. For the feminist scientist then, who by the very "nature" of her existence qualifies as a marginalized knower, the idea of developing feminist theories such as standpoint theory for the natural sciences should be attractive, but not without one significant hesitation (at the very least). The main hesitation, I believe, in making such a move has to do with reconfiguring her ideas of objectivity. If she bases her practice of research agenda choice on a set of values derived from feminism, can she still be objective?

In order to address this issue, the feminist scientist should be made aware of the fact that her training as a scientist would have required her to think

about objectivity in a very limited way, one that is appropriate for producing knowledge specifically through the scientific method. It has to be brought to her attention that the concept of objectivity is much more complex. As has been noted by many historians and philosophers of science, "objectivity is not and has never been a monolithic and immutable concept, at least since the seventeenth century" (Daston 1992, 598). However, the many different forms of objectivity do indeed share one purpose. As Lorraine Daston and Peter Galison note, "Each of the several components of objectivity opposes a distinct form of subjectivity; each is defined by censuring some (by no means all) aspects of the personal. The history of the various forms of objectivity might be told as how, why, and when various forms of subjectivity came to be seen as *dangerously* subjective" (1992, 82). Daston argues that two particular forms of objectivity, namely aperspectival objectivity (1992) and mechanical objectivity (Daston and Galison 1992), have come to play crucial roles in practically every step of modern-day scientific inquiry, but that they did not originally develop within scientific traditions. Rather, Daston suggests that aperspectival objectivity, the idea that one can be a "featureless observer," originated in moral and aesthetic philosophy in the late half of the eighteenth century (1992). As she explains, "Just as the transcendence of the individual viewpoints in deliberation and action seemed a precondition for a just and harmonious society to eighteenth-century moralists, so the transcendence of the same in science seemed to some nineteenth-century philosophers a precondition for a coherent scientific community" (1992, 607). Mechanical objectivity, associated with automated or mechanized procedures, also had as its primary function a "morality of self-restraint" (Daston and Galison 1992). The goal of this form of objectivity was to remove human emotion or judgment, and therefore any idiosyncrasies from observations made of one's surroundings.

Heather Douglas has also recently suggested that there is no single meaning of objectivity, and has in fact been able to identify eight distinct senses of the concept. She suggests that the senses of objectivity most commonly deployed in scientific research are "manipulable" and "convergent" objectivity (2004, 457). Both of these senses, similar to aperspectival and mechanical objectivity, deal with attempts made by humans to "directly get at the objects" (455) of their surroundings without interfering with them. From her account of the various senses of objectivity, Douglas makes an extremely insightful comment that is pivotal for a feminist reconfiguration of objectivity. She states:

> The complexity of objectivity provides for both its flexibility in usage and the strength of its normative force. There are multiple grounds from which to call for trust of a claim, from which to endorse that claim to others. It should also be clear that the complexity allows room for change. We might decide that some

> meanings should be dropped (as I think value-free objectivity should be). And we might find that new meanings will be added as our practices change over time. There is no ahistorical fixedness to objectivity to date; there is little reason to think we are finished developing the term. (468)

As Douglas suggests, by tracing these accounts of objectivity the feminist scientist can realize not only the freedom that comes with complexity but also the possibility for change. In fact, Harding has put forward one of these new meanings of objectivity and developed the term with her idea of 'strong objectivity.' Strong objectivity extends the notion of scientific research to include systematic observations of background beliefs, and also draws attention to ideological assumptions built into scientific research (1991, 149).

Douglas also proposes that there are many locations from which one may gather "trust" for making a claim. The idea of strong objectivity allows us to see that there may be different ways of knowing and not just one adequate standard for knowledge that is gained only through traditional modes of objectivity. More important, it provides the grounds for placing trust in a community of marginalized knowers. For instance, related to the ideas of strong objectivity and the importance of acknowledging a community of knowers, Alan Irwin has described the notion of "citizen science" while bringing to light the importance of local and particular knowledges (1995). He suggests that communities of knowers, as in the case of sustainable development, play a crucial role in "criticizing expert knowledge but also generating forms of knowledge and understanding— in serving as 'living laboratories' in an active as well as passive fashion" (1995, 112). Also in the context of local and participatory knowledge, Frank Fischer has provided an extraordinary example of how a community of knowers can provide the grounds for laying trust in a claim. While discussing the example of the people's science movement in the Indian state of Kerala, Fischer notes that the success of this participatory strategy lies in the fact that it "speaks directly to the concerns of citizen empowerment, democratic theory, and environmental democracy" (2000, 168). The citizens of Kerala designed research projects related to the everyday issues of their own lives. However, the local knowledge that they produced, which was "designed to help less-privileged citizens in their struggles to better understand and confront the realities and choices that shape their own interests and concerns" (145), also informed the type of "expert" scientific knowledge that was produced.

While struggling with my own research agenda choices, I arrived at a need to question my notions of scientific objectivity by way of Donna Haraway's work. It was her ideas on partial vision and more important, my own dilemma of having formed a kinship with a transgenic mouse and her *in vitro* cell line of hypothalamic neurons that brought me to this place. In my simultaneous

workings as a lab dweller, transgenic mouse cell line handler, and member of a feminist community of knowers, I had cause to reflect on the meanings of objectivity in deep and intimate ways. Haraway states that "feminist objectivity is about limited location and situated knowledge, not about transcendence and splitting of subject and object. In this way we might become answerable for what we learn how to see" (1991, 190). Haraway's concept of situated knowledges is intimately connected to standpoint theory. Emphasizing location and partial vision, Haraway believes that knowledge can never be universal. However, at the same time, situated knowledges should not be reduced to individual idiosyncrasies or to epistemic relativism. Like standpoint theory, it advances knowledge by helping make visible aspects of nature, science and social relations that are not usually seen or are kept hidden.[6] Objectivity becomes a "positioned rationality" (1991, 196), open to multiple connections. The reason that standpoint theory, strong objectivity, and situated knowledges offer potentially mind-altering experiences for the feminist scientist is that rather than placing value solely on aperspectival and mechanical objectivity, they invite the engaged and invested investigator, who belongs to a community of knowers, to practice her research agenda choice through a "positioned rationality."

Positioned Rationality and Materiality

Situated knowledges should be acknowledged for not being a theory that simply reduces itself and the matter it touches, into matter made apparent or assembled *only* by the processes of social construction. Rather, situated knowledge positions the feminist scientist in order to engage in a performative (to borrow from Barad's use of the term) account of scientific knowledge production—one with which she is intimately connected and politically concerned.

Indeed, some feminist science studies scholars have previously attempted to incorporate feminist values into science by what has been referred to as social constructivist approaches. While describing social studies of science and technology, David Hess states that "the term 'social constructivism' is often used as a general label for studies that examine how social variables shape the pattern of choices about what research gets done, how it is done, how choices among theories are made in controversies, and the extent to which observations, laws, theories, and other knowledge claims become accepted in wider scientific communities" (1997, 34). Harding has suggested using the term *co-constructivism* instead to better represent how science and culture "co-evolve." For Harding, the term *constructivism* implies that "pre-existing, fully-formed 'societies' just make up or construct the representations of nature that they want regardless of how the world around them is ordered" (1998, 4). I believe however, that to align research agenda choice in the natural sciences with social constructivist or co-constructivist arguments would be highly problematic. Feminist science

studies scholars, such as Haraway (1991), Barad (2003), and Nancy Tuana (2001), have forwarded sharp criticisms of social constructivist arguments by raising difficult questions regarding the issue of materiality, particularly in the case of the natural and physical sciences. Both Barad and Tuana suggest that when it comes to the issue of materiality, the tendency of feminist scholars and philosophers of science has been to easily slip into the scientific realism versus social constructivism debate. Reiterating the tensions and problems of this debate is not feasible in the scope of this essay, nor is it my intention. Suffice to say, for the purposes of developing research agenda choice into a *practice* and putting to proper use our reconfigured conceptions and possibilities for objectivity, feminist interventions into science cannot be sustained if these efforts are aligned with either realist or social constructivist arguments. Barad suggests:

> A performative understanding of discursive practices challenges the representationalist belief in the power of words to represent preexisting things. . . . The move toward performative alternatives to representationalism shifts the focus from questions of correspondence between descriptions and reality (for example, do they mirror nature or culture?) to matters of practice/doings/actions. (2003, 802)

Barad's theory of posthumanist performativity offers new possibilities for dealing with matter and bodies in the natural and physical sciences. While describing the problems in linking discursive practices to the materiality of the body and explaining her idea of agential realism, Barad also brings together for us a reconfigured objectivity that fully employs the freedom of complexity. Moving Harding's idea of strong objectivity and Haraway's depiction of objectivity as a positioned rationality even further, she states,

> On an agential realist account, it is once again possible to acknowledge nature, the body, and materiality in the fullness of their becoming without resorting to the optics of transparency or opacity, the geometries of absolute exteriority or interiority, and the theorization of the human as either pure cause or pure effect while at the same time remaining resolutely accountable for the role 'we' play in the intertwined practices of knowing and becoming. . . . On an agential realist account of technoscientific practices, the 'knower' does not stand in a relation of absolute externality to the natural world being investigated—there is no such exterior observational point. It is therefore not absolute exteriority that is the condition of possibility for objectivity but rather agential separability—exteriority within phenomena. 'We' are not outside observers of the world." (2002, 812, 828)

Remaining accountable for the roles "we" play is the political part of this practice. Why would the feminist scientist be conducting research if she were not concerned with the questions she was asking or the outcomes of her work? But what happens after the feminist scientist has reconfigured her sense of objectivity and becomes aware that she is embedded within the phenomenon? Can she take advantage of a momentary "agential cut" (815) and use her feminist politics to have a hand in the arrangement of intra-actions for which she will be held accountable? In other words, even though she may realize that she is part of the phenomenon, how can she define and then utilize her standpoint or situatedness in the scientific research that she conducts or research agenda choices she makes? In their own ways, strong objectivity, situated knowledges, and agential realism all help the feminist scientist reconfigure her ideas of objectivity and connect with the scientific research she conducts in more intimate and implicated ways. I think, however, that we may best be able to address the issue of *how* the feminist scientist can localize her politics while she "enacts a local resolution" (815) within a phenomenon by turning to Chela Sandoval's concept of differential consciousness (2000).

Moving Toward Differential Consciousness: Hopscotching in Cyberspace

In order to address the issue of how the feminist scientist can engage in scientific inquiry and practice research agenda choice that is informed by the local politics of communities to which she belongs, I believe that we must take a leap of faith, or at least a leap between disciplines. My hope here is to describe the process entailed in taking such a leap, and in doing so, also finally attempt to develop a *semiprescriptive* model of practices that can be used by other feminist scientists to address the problem of research agenda choice. In her work, Chela Sandoval utilizes Haraway's ideas of the cyborg identity and suggests that the cyborg is not just a human(oid) creature born of our technological present and future. Although many theorists treat the idea of the cyborg as a futuristic entity that has evolved through an age of oppositional politics with globalization and technology, Sandoval explains:

> My argument has been that colonized peoples of the Americas have already developed the cyborg skills required for survival under techno-human conditions as a requisite for survival under domination over the last three hundred years. . . . Cyborg consciousness can be understood as the technological embodiment of a particular and specific form of oppositional consciousness that I have elsewhere described as "U.S. third-world feminism." (1995, 408)

Like Sandoval, I interpret Haraway's cyborg as a trope not only for the union of organic material and technological machine but also primarily as a type of consciousness that is based on the lived experiences and skills developed by several types of marginalized people, including the colonized in the United States. In an attempt to integrate "U.S. third-world feminism" into U.S. feminist theory, Sandoval argues that the differential forms of oppositional consciousness do not solely belong to the U.S. third-world feminist but rather is threaded throughout the experience of social marginality and cyborg "politics" (1995; 2004).

The feminist scientist is such a being who exists on the social margins—she is a cyborg.[7] Bound to be an insider-outsider-within type of hyphenated creature, cyborg politics may offer her a space for theoretical asylum. We can all agree that in order for the feminist scientist to become a mutated modest witness and survive within the scientific institution, she is required to form a resistance to a number of factors, depending on her sex, gender, race, class, age, and more.[8] She must also learn to resist, for example, the sexist and racist biases that run rampant within the theories, paradigms, and language used to produce scientific knowledge. She is used to "resistance-building." But to be "effective in opposition," the feminist scientist must also have a way to *express* her "differential consciousness" in the space where she resists.[9] What I would like to suggest here is that while suspended in an "agential cut" (Barad 2003, 815), the expression of her differential consciousness can guide the feminist scientist through the practice of research agenda choice, allowing her to politicize her engagement within the processes of the scientific method and to embed her knowledge practices within a community of marginalized knowers.

Sandoval argues that U.S. third-world feminism presents a new form of "historical consciousness" that developed just outside of the dominant feminist theory that emerged in the 1970s (2004, 195). In this consciousness, "no enactment is privileged over any other, and the recognition that each site is as potentially effective in opposition as any other makes possible another mode of consciousness" (200). Her aim is to harness the collective energies of people seeking "affective liberatory stances in relation to the dominant social order" (2000, 43–44). Sandoval states,

> The idea here, that the citizen-subject can learn to identify, develop, and control the means of ideology, that is, marshal the knowledge necessary to "break with ideology" while at the same time *also* speaking in, and from within, ideology, is an idea that lays the philosophical foundations enabling us to make the vital connections between the seemingly disparate social and political aims. . . . Differential consciousness is the expression of the new subject position called for by Althusser—it permits functioning within, yet beyond the demands of dominant ideology. (2000, 44)

Sandoval is suggesting that one can reside within an "ideology" in order to change that ideology. This is where the feminist scientist is at an advantage. As an insider, she has intimate knowledge of the traditional scientific method and the dominant ideologies influencing her research agenda choice. But as Sandoval suggests, in order to change the dominant social order created by traditional conceptions of objectivity and scientific method, and go on to create different scientific knowledge by "asking different questions," the feminist scientist must learn to *identify*, *develop*, and *control* the means of ideology. Indeed, Sandoval has named a "set of processes, procedures, and technologies for decolonizing the imagination as the methodology of the oppressed" (2000, 69).

Standpoint theory and situated knowledges help us recognize our place within dominant ideologies. Sandoval's methodology of the oppressed takes this further and shows us how to *develop* and *control* these ideologies. As is the case with most feminist theory, however, the insights and approaches of the methodology of the oppressed readily translate into new research agendas for feminists residing within the humanities and social sciences, while remaining an abstract notion (if at all) to feminists within the natural sciences. For the remaining portion of this paper, I will attempt to begin this process—to move the feminist scientist from a state of anxiety to a place of mutant modest witnessing by demonstrating the applicability of the methodology of the oppressed in the practice of research agenda choice.

Vectors, Transfections, and Transformations

Sandoval has described the methodology of the oppressed as consisting of five components that she alternately refers to as "technologies": (1) semiology; (2) deconstruction; (3) meta-ideologizing; (4) democratics; and (5) differential movement (1995, 409). Put together, these technologies are seen as a form of cyborg resistance. There are two main reasons for choosing the methodology of the oppressed for my own work. First, I think that this methodology can be seen as an intricate extension of standpoint theory and situated knowledges, and is both logical and creative in its design. Because of both its structure and flexibility, it can be used to develop a semiprescriptive model of practices for the feminist scientist in the natural sciences. The second argument for using the methodology of the oppressed in my project is that it is simply too tempting not to. Sandoval is fond of using technological metaphors, such as vectors, for the description of very real social maneuvers. I appreciate this willingness to move across disciplines, across liberating causes, and across cyborg-inhabited spaces. Indeed, she has already started the experiment from her location in the labs of the humanities and social sciences. But in order to make this political practice more accessible to the feminist scientist in the labs of the natural sciences, I would like to conduct a technology-transfer of sorts. I would like to

mutate Sandoval's mathematical vectors into biological vectors, also known as plasmids. Biological vectors are used to introduce "new" information into an organism. This molecular biology-based technology is referred to as *transfection*. For the remainder of this paper, I share a series of transfections that introduces the methodology of the oppressed into the natural sciences. My hope is to illustrate the relevance of this feminist theory to the feminist scientist and provide her with an example of how this political practice can be used to conduct her research agenda choice.

Transfection 1: Differential Movement

For Sandoval, differential movement is a "split consciousness" where one is able to "shuttle between realities" and "see from the dominant viewpoint as well as one's own" (2000, 83). By shuttling between realities, a hyphenated creature is able to go back and forth from the inside to the outside, and by doing this, even exist in an "interstitial site or third space" (2000, 83). As described earlier, this third space, or cyborg-space, is a familiar site for the feminist scientist. Engaging in differential movement will likely be dizzying for the feminist scientist in the beginning, but acknowledging a "split consciousness" is a necessary first step in developing the practice of research agenda choice. Therefore, the first mutation to Sandoval's methodology of the oppressed is to bring her last technology, the vector of differential movement, upfront in a feminist practice of research agenda choice. If the feminist scientist is able to appreciate the relevance of feminist theory for the natural sciences and reformulate her ideas of objectivity, she should also have come to the realization that her position as an insider-outsider allows her to see from the dominant viewpoint as well as her own. This split consciousness allows or even forces her to look at science differently than her nonfeminist peers. By looking at science differently, I mean to suggest, for example, that she may be concerned with what counts as knowledge and how knowledge is produced. She may be concerned about the theories and paradigms used to organize and conduct her experiments. She may also be concerned with the techniques used to conduct research, gather evidence, and put her findings into scientific language. Any one or all of the concerns above may present a dilemma for the feminist scientist and send her whirling. But at the same time, these concerns present opportunities for practicing research agenda choice as a political action and from a position of differential consciousness. In fact, it is her ability to first articulate a dilemma in the science that she practices while simultaneously seeing from the dominant scientific viewpoint that ultimately stabilizes her in "differential movement," providing her with the impetus to "ask different questions."

In my case, for instance, the very first dilemma I faced in my Ph.D. work was regarding the use of animals in my research. In reproductive biology research, it

is unusual to conduct experiments without using what is referred to as "animal models." I knew that killing and conducting research on animals was going to be expected of me as a graduate student. And so, when the question came whether I had done animal work before, I responded that I hadn't and in fact planned on never conducting *in vivo* research to do my scientific work. This dilemma produced a difficult moment in my Ph.D. interview and in the years that followed. Fortunately, my supervisor was supportive. She allowed me to use an *in vitro* neuronal cell line to conduct my work and never pressured me into doing animal work. But at every step of the way, including my Ph.D. defense, I had to defend myself to other scientists for not conducting any of my research on "whole" animals. In retrospect, I now see that my decision not to conduct animal work was not in and of itself what made my project feminist, but was in fact an example of my practice of research agenda choice. I was making a choice between using biological theories that support *in vivo* research versus those that support *in vitro* research. I was also making a theoretical choice between the materials of my research, which directly influenced the methods and technologies I used. Instead of using cages and an animal facility to house mice, I used plastic Petri dishes and a 37°C incubator to grow neuronal cells. My decision to use an *in vitro* model had its own problems, but ultimately, it was a very important decision that stabilized me in my own differential movement. Articulating my dilemma while simultaneously seeing from the dominant scientific tradition—at least enough to defend my decision to conduct only *in vitro* research to other scientists—allowed me to continue contributing to the production of scientific knowledge.

Transfection 2: Democratics

I interpret Sandoval's technology of democratics to be the driving force, the inspiration, and the motivation for wanting change. Sandoval notes that such authors as Frantz Fanon and Patricia Hill Collins have referred to this technology as a type of politics that demands for "egalitarian social relations" (2000, 83). The demand for "egalitarian social relations" also applies to the feminist scientist, who like all other feminists is concerned with the "redistribution of power" so as to eliminate injustices based on differences coded under categories of race, gender, sex, age, class, and others (112). In the case of the feminist scientist in the natural sciences, she would be concerned with practicing research agenda choice in such a way as to eliminate injustices that result from decisions regarding which scientific knowledge gets produced, the ways in which this scientific knowledge is produced, and whose lives are affected by this knowledge, both in its production and consumption. For instance, she may want to practice her research agenda choice so as not to base her research on the naturalization of inequities that may be rooted in biological determinism.

However, to develop a strategy for the "redistribution of power" in the natural sciences, the feminist scientist must first have a grasp of the "distribution of power" in her specific scientific setting. Her education and training within the dominant traditions and institutions of science would have provided her with this insight. In fact, it is the experience of knowing the distribution and dynamics of power that informs her as to *what needs to change* in this distribution. This may include changes in the ways an individual researcher interacts with other researchers within the intimate settings of her own lab, the ways in which experimental materials or subjects are handled, the language used to represent scientific findings, or even on a different scale, the inequities within science that are produced at an institutional level such as gender disparities in hiring practices. She may, however, have to choose the battles for egalitarian relationships in which to invest her energies—step-by-step and perhaps even day by day.

In order to briefly illustrate how the feminist scientist may implement "democratics" into the practice of research agenda choice, take for instance once again, the choice between conducting *in vivo* and *in vitro* research. A feminist scientist, concerned with the "redistribution of power" may be concerned with eliminating injustices based on perceived differences established through not only the categories of race, class, sex, and gender and so forth, but also that of *species*. My exposure to animal facilities, to some scientists who seemed to draw pleasure from killing animals, and to the language of science which misleadingly referred to the killing of animals as "sacrifice"—as if the animals willingly gave their lives for research purposes—led me to the decision to use a cell line instead of animals. I chose to put my energies toward a specific redistribution of power by finding alternate ways to continue my scientific research. But my decision to redistribute power in this way was not without its own apprehensions. Starting from the mice that had to be killed years before I started my Ph.D. work in order to develop the *in vitro* cell line model that I used, to the principles of reductionism and targeted mutagenesis used to create the cell line in the first place, my demand for one egalitarian social relation led to an awareness of different but related tensions that I would later try to address within my scientific research.

Transfection 3: Semiotics

This technology has already been dealt with to some degree while discussing Haraway's theory of situated knowledges. In the case of the methodology of the oppressed, semiotics involves learning the "science of signs in culture" (Sandoval 2000, 82) and "recognizing the dominant social reality as an *interested* construction" (86). Drawing from the work of Frantz Fanon and Roland Barthes, Sandoval states that the "science of semiology," so named by Barthes,

is a method for freeing consciousness from the domination of social order and identifying the grounds for coalition among the "subordinated" (88). She goes on to say that a "commitment to sign reading emerges as a means of survival" (86). For the feminist scientist who has articulated her anxiety-producing dilemma(s) through the technology of *differential movement*, and is formulating her ideas on the distribution of power in the technology of *democratics*, the next step involves transforming her relationship within the science that she practices. She begins this transformation with semiotics, the process of sign reading.

For example, part of the dominant social reality held by scientists in reproductive biology research is a shared belief in the validity of using *in vivo* animal models. The "animal model" is a *sign* that exists in the culture of scientific enterprise. Haraway has already discussed the sign of the oncomouse at great length (1997). As the term "model" connotes, these animals are used for the processes of meaning making. But not only are they used for the processes of meaning making, they are in some cases entirely constructed, literally and figuratively for this purpose, particularly in the case of designing transgenic animal models for the study of disease. Scientists have come to rely on these animals—these *interested constructions*—for their access to scientific knowledge and breakthroughs. These transgenic animal models simultaneously represent that which we have no previous knowledge of and therefore must become aware, that which is difficult to interpret and therefore requires endless study, and that which we as scientists can control and create—answers to our own riddles. Realizing the construction of this social reality and the contradictions that emerge can free the feminist scientist from following along with this particular dominant social order.

Transfection 4: Deconstruction

Directly connected to the technology of semiotics is the technology of "deconstruction," which Sandoval defines as "the process of challenging dominant ideological forms" (2000, 83). The realization that "ideology is a pattern" is integral to this technology. Sandoval's vector of deconstruction aims to "un-form" dominant social ideologies. To deconstruct dominant social ideologies, however, the feminist scientist, being a novice sign-reader, must once again go to the beginning and bring form to that which she must un-form. For example, she must start seeing patterns in the ideologies or paradigms used to create scientific knowledge. She must "tease open to show the sticky economic, technical, political, organic, historical, mythic, and textual threads," which wound together make the "knots of knowledge making practices" (Haraway 1997, 68) and thereby bring to light the socially produced consciousness of her surroundings. Deconstruction in this sense then is the practice of revealing patterns of

ideology by making connections not normally made, or in fact constructing new and alternate connections while located within the margins. For the feminist scientist, the fourth step of a feminist practice of research agenda choice involves bringing to light the hidden, but ever present patterns of ideology that influence both the scientific paradigms and nonscientific beliefs on which she herself relies to produce scientific knowledge.

In my example, the *sign* of the animal model represents a dominant ideological form. Most of the scientists with whom I have worked accept that one should never rely completely on *in vitro* work as using an *in vivo* animal model interestingly enough has come to represent a "(w)holistic" approach to conducting reproductive biology research. It is conveniently put aside that inserting genes into animal embryos in order to create transgenic animal models, keeping animals locked up in cages, or removing their gonads and pumping them up with hormones may be counterintuitive to the idea of working with "whole" animals. In fact, this is one rare instance (and only because it is convenient) when most scientists will take a stance against reductionism. *In vivo* research or animal model work is a dominant ideological form in this scientific research because there are knots of knowledge making practices that have supported it in making it so. In thinking about transgenic animal model work, it is not a difficult task to see the patterns in this dominant ideology, starting from the use of subordinated bodies in medical and scientific research, where the bodily histories of animals and women have so often converged, to the lucrative economic potential of a circular ideology, whereby the scientist must constantly create and destroy the "object" of study. These hidden patterns of ideology easily unwind in the case of transgenic animals and animal models more generally to bring to light the socially produced consciousness under which most scientists in this field operate.

Transfection 5: Meta-ideologizing

The last mutation to the methodology of the oppressed places meta-ideologizing in the final position in the practice of research agenda choice. As stated earlier, one reason for choosing the methodology of the oppressed is that it provides a semiprescriptive analysis and practical framework for change. According to Sandoval, the technology of meta-ideologizing is the "operation of appropriating dominant ideological forms, and using them whole in order to transform them," which "is absolutely necessary for making purposeful interventions in social reality" (2000, 83). The feminist scientist is at an advantage as an insider-outsider and has the opportunity to use this technology to intervene in the production of scientific knowledge by "asking different questions." She is perfectly poised to meta-ideologize. She has the potential through new scientific discoveries "either [to] display the original dominant ideology as naïve—and no

longer natural—or to reveal, transform, or disempower its signification in some other way" (109). With the goal of revealing, transforming, and/or disempowering dominant forms of scientific ideology, meta-ideologizing comprises the last step in the practice of research agenda choice.

One last time, let us consider the decision to conduct *in vitro* versus *in vivo* research and what this may mean for a feminist scientist in terms of practicing research agenda choice as a political action. As a foundational tenet of modern science, reductionism—the idea that every complex biological organism can be understood by examining individual components and simple mechanisms—is perhaps one of the most dominant ideological forms that a feminist scientist will encounter. However, in my own research in reproductive biology, I was concerned with another dominant ideology that although related to a great extent to the ideology of reductionism, also specifically framed parts of the female body involved in reproduction in a hierarchical relationship. My belief was and still is that much of the scientific research that affects the reproductive and sexual health of millions of women around the world is deeply influenced by this dominant ideology that places the brain in control of the pituitary gland and gonads. In my scientific work, I decided to use molecular biology techniques on an *in vitro* cell line, which was itself produced through the principles of reductionism, to counter this hierarchical ideology. As an insider-outsider within the dominant traditions of science, my double serving of reductionism was in fact driven by my desire to intervene in a scientific construction that directly affected the lives of women who use contraceptives and other hormone-mediated reproductive technologies. I used the principles of reductionism in order to develop a new feminist practice. By using reductionism in the form of conducting molecular biology as well as *in vitro* research, I attempted to appropriate this dominant ideology in order to create new scientific knowledge and to *speak to* the very scientists who use reductionism to develop the hierarchical model of reproductive biology in the first place. It can be said that I "used" reductionism to try to "reveal, transform, and disempower" the signification of reductionism in another form. The research agenda choice to conduct *in vitro* research may therefore be seen as a political maneuver, one that has the potential to function at the level of meta-ideologizing.

The Promise of New Feminist Technologies

I have attempted in this paper to speak to a few different audiences. I am of course concerned with formulating strategies that the feminist scientist can use in her everyday scientific activities. But by aligning dilemmas, research agenda choice and the ability to "ask different questions" with feminist *practices*, I have also attempted to create a conversation among feminist scientists, feminist science studies scholars, and philosophers of science who, in my estimation,

are all concerned with these issues, even if for distinct reasons. As Rouse has stated while defining his idea of practice:

> This normative conception of practices . . . changes how one should think about the semantic, epistemic, and political dimensions of scientific practices, and about the ways they are interconnected. . . . Philosophical reflection upon practices conceived in this way must critically engage with the practices themselves, in ways that are also accountable to what is at issue and at stake in those practices. (2002, 162)

This is where the creation and use of *new feminist technologies* as practices become pivotal. Technology may be evil, but technological illiteracy is worse. Calling upon technologies such as vectors and transfections in order to describe the political maneuvers of a practice *is* a political maneuver. It is a way to engage critically with the scientific practices themselves. If there is to be an ongoing interdisciplinary conversation on practices between the audiences above, all parties concerned may have to tolerate metaphors, analogies, and perhaps even a little bit of humor.

I have chosen somewhat of a rhizomatic approach to map connections among standpoint theory, strong objectivity, situated knowledges, agential realism, and the methodology of the oppressed, in order to develop what I think may serve as a series of loosely defined prescriptions and a suitable framework for the practice of research agenda choice in the natural sciences. I have also attempted to reach out as a feminist scientist and follow the cues for transposing *differential consciousness* into the natural sciences. More specifically, I have demonstrated how the methodology of the oppressed can be used to transform the traditional scientific practices—from the inside.

Drawing from the strengths of an insider-outsider positionality, a feminist *practice* of research agenda choice is not meant to completely discard or erase all of the traditional activities of scientific inquiry, but rather to provide the feminist scientist with the necessary tools to produce interruptions or positive disruptions in the processes of scientific knowledge making. It is a practice that can transform anxiety-producing dilemmas into the ability to "ask different questions." This ability ultimately translates into her power to produce *different* scientific knowledge, which at the end of the day, is the goal for every feminist scientist.

Notes

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1. "Asking different questions" is a phrase feminist philosophers of science and feminist scientists commonly use while trying to describe the ways in which feminism can intervene in the processes of science. I first came across this expression while watching the film *Asking Different Questions: Women in Science* (1996).

2. I am grateful to my Ph.D. supervisor Denise Belsham for providing me the opportunity to participate in these research projects and to benefit from her expertise in reproductive neuroendocrinology and molecular biology.

3. In her influential work *The Woman in the Body* (1987), Martin critiqued scientific theories used to study menstruation and menopause. She made the observation that a common paradigm used by scientists to conceptualize the female hypothalamic-pituitary-gonadal (HPG) axis was that of a hierarchy, with a region of the brain known as the hypothalamus in control (41).

4. I borrow the phrase *anxiety-producing dilemma* from Harding (2004b, 1).

5. I am drawing here from Barad's use of the term *phenomena* to mean "the ontological inseparability of agentially intra-acting 'components.' That is, phenomena are ontologically primitive relations—relations without preexisting relata" (2003, 815).

6. While describing Haraway's theory of situated knowledges, Campbell notes that "situated knowledges then, offers a strategy for developing a feminist model of reflexive science studies but ultimately does not develop that model. Despite its promise, "Situated Knowledges" does not answer the science question in feminism" (2004, 173). I would disagree with Campbell's assessment of the progress made by Haraway in developing and delivering a feminist model relevant to the sciences. I see situated knowledges and Haraway's conception of the technoscientific body as stem cells and sticky threads as a "model in progress" that was not necessarily designed with the intent of providing *an* answer—or *the* answer. Rather they serve as means to *finding* answers and toward developing feminist practices. Although it may not have "answered" the science question in feminism, I believe that situated knowledges addressed the science question in feminism in a way that no other previous attempts at theorizing feminist scientific practices had succeeded in doing.

7. I am aware that Haraway, in her own words, has "gone to the dogs." In her recent work, *The Companion Species Manifesto* (2003), Haraway moves away from her use of the cyborg, explaining, "I have come to see cyborgs as junior siblings in the much bigger, queer family of companion species" (11), and that cyborgs can "no longer do the work of a proper herding dog to gather up the threads needed for critical inquiry" (4). I choose, however, to continue using this queer sib as a trope for the feminist scientist. At this point in my project, I may be more successful in bringing feminist theory to the feminist scientist who is isolated in her lab by reaching out with a cyborg appendage rather than a paw. Once they're in, I am all for things going to the dogs.

8. Haraway has created the figure of the mutated modest witness to help us imagine constructive feminist engagements within the worlds of science and technology. She explains that her modest witness, instead of being "simply oppositional," is by necessity implicated in the "net of stories, agencies, and instruments that constitute technoscience." The task of the mutated modest witness is to "learn and practice the mixed literacies and differential consciousness that are more faithful to the way the world works" (1997, 3). By moving from Haraway to Sandoval, my hope is to tease out and further explain the relevance of practicing differential consciousness to the feminist scientist who is living in the domains of the natural sciences. She is already an implicated modest witness, but her mutation is required in order to ask different questions successfully.

9. *Resistance building*, *effective in opposition*, and *differential consciousness* are all terms used by Sandoval (2000).

References

Asking different questions: Women and science. 1996. Montreal: National Film Board of Canada.

Barad, Karen. 2003. Posthumanist performativity: Toward an understanding of how matter comes to matter. *Signs: Journal of Women in Culture and Society* 28 (3): 801–31.

Belsham, Denise, et al. 1998. Regulation of gonadotropin-releasing hormone (GnRH) gene expression by 5α-dihydrotestosterone in GnRH-secreting GT1-7 hypothalamic neurons. *Endocrinology* 139: 1108–14.

Campbell, Kirsten. 2004. The promise of feminist reflexivities: Developing Donna Haraway's project for feminist science studies. *Hypatia* 19 (1): 162–82.

Code, Lorraine. 1991. *What can she know?* Ithaca, N.Y.: Cornell University Press.

Daston, Lorraine. 1992. Objectivity and the escape from perspective. *Social Studies of Science* 22 (4): 597–618.

———, and Peter Galison. 1992. The image of objectivity. Special issue, *Representations* 40: 81–128.

Douglas, Heather. 2004. The irreducible complexity of objectivity. *Synthese* 138: 453–73.

Fischer, Frank. 2000. *Citizens, experts, and the environment: The politics of local knowledge*. London: Duke University Press.

Haraway, Donna J. 1991. *Simians, cyborgs, and women: The reinvention of nature*. New York: Routledge.

———. 1997. *Modest_Witness@Second_Millenium.FemaleMan©_Meets_ Oncomouse™: Feminism and technoscience*. New York: Routledge.

———. 2003. *The companion species manifesto: Dogs, people, and significant otherness*. Chicago: Prickly Paradigm Press.

Harding, Sandra. 1991. *Whose science? Whose knowledge? Thinking from women's lives*. Ithaca, N.Y.: Cornell University Press.

———. 1998. *Is science multicultural? Postcolonialisms, feminisms, and epistemologies*. Bloomington: Indiana University Press.

———. 2004a. A socially relevant philosophy of science? Resources from standpoint theory's controversiality. *Hypatia* 19 (1): 25–47.

———. 2004b. Introduction: Standpoint theory as a site of political, philosophic, and scientific debate. In *The Feminist standpoint theory reader: Intellectual and political controversies*, ed. Sandra Harding. New York: Routledge.

Hess, David. 1997. *Science studies: An advanced introduction*. New York: New York University Press.

Hubbard, Ruth. 1995. *Profitable promises: Essays on women, science, and health*. Monroe, Me.: Common Courage Press.

Irwin, Alan. 1995. *Citizen science: A study of people, expertise, and sustainable development*. New York: Routledge.

Longino, Helen. 1993. Subjects, power, and knowledge: Description and prescription in feminist philosophies of science. In *Feminist Epistemologies*, ed. Linda Alcoff and Elizabeth Potter. New York: Routledge.

Martin, Emily. 1987. *The woman in the body: A cultural analysis of reproduction*. Boston: Beacon Press Books.

Rouse, Joseph. 1996. *Engaging science: How to understand its practices philosophically*. Ithaca, N.Y.: Cornell University Press.

———. 2002. *How scientific practices matter: Reclaiming philosophical naturalism*. Chicago: University of Chicago Press.

Roy, Deboleena. 2007. Somatic matters: Becoming molecular in molecular biology. Special issue, *Rhizomes: Cultural Studies in Emerging Knowledge* 14 (Spring).

———, and Denise Belsham. 2002. Melatonin receptor activation regulates gonadotropin-releasing hormone (GnRH) gene expression and secretion in GT1-7 GnRH neurons: Signal transduction mechanisms. *Journal of Biological Chemistry* 277: 251–58.

——— et al. 1999. Estrogen directly represses gonadotropin-releasing hormone (GnRH) gene expression in estrogen receptor-α (ER-α)- and ERβ-expressing GT1-7 GnRH neurons. *Endocrinology* 140: 5045–53.

Sandoval, Chela. 1995. New sciences: Cyborg feminism and the methodology of the oppressed. In *The cyborg handbook*, ed. Chris Hables Gray. New York: Routledge.

———. 2000. *Methodology of the oppressed*. Minneapolis: University of Minnesota Press.

———. 2004. U.S. third-world feminism: The theory and method of differential oppositional consciousness. In Harding, *Feminist standpoint theory reader*.

Schiebinger, Londa. 1999. *Has feminism changed science?* Cambridge: Harvard University Press.

Tuana, Nancy. 2001. Material locations: An interactionist alternative to realism/social constructivism. In *Engendering Rationalities*, ed. Nancy Tuana and Sandra Morgen. New York: SUNY Press.

Wylie, Alison. 2004. Why standpoint matters. In Harding, *Feminist standpoint theory reader*.