

The Science Question
in Feminism

SANDRA HARDING

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CONTENTS

Acknowledgments	7
Preface	9
1 From the Woman Question in Science to the Science Question in Feminism	15
2 Gender and Science: Two Problematic Concepts	30
3 The Social Structure of Science: Complaints and Disorders	58
4 Androcentrism in Biology and Social Science	82
5 Natural Resources: Gaining Moral Approval for Scientific Genders and Genderized Sciences	111
6 From Feminist Empiricism to Feminist Standpoint Epistemologies	136
7 Other "Others" and Fractured Identities: Issues for Epistemologists	163

5

Contents	
8	"The Birth of Modern Science" as a Text: Internalist and Externalist Stories 197
9	Problems with Post-Kuhnian Stories 216
10	Valuable Tensions and a New "Unity of Science" 243
	Bibliography 253
	Index 263

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PREFACE

Since the mid-1970s, feminist criticisms of science have evolved from a reformist to a revolutionary position, from analyses that offered the possibility of improving the science we have, to calls for a transformation in the very foundations both of science and of the cultures that accord it value. We began by asking, "What is to be done about the situation of women in science?"—the "woman question" in science. Now feminists often pose a different question: "Is it possible to use for emancipatory ends sciences that are apparently so intimately involved in Western, bourgeois, and masculine projects?"—the "science question" in feminism.

The radical feminist position holds that the epistemologies, metaphysics, ethics, and politics of the dominant forms of science are androcentric and mutually supportive; that despite the deeply ingrained Western cultural belief in science's intrinsic progressiveness, science today serves primarily regressive social tendencies; and that the social structure of science, many of its applications and technologies, its modes of defining research problems and designing experiments, its ways of constructing and conferring meanings are not only sexist but also racist, classist, and culturally coercive. In their analyses of how gender symbolism, the social division of labor by gender, and the construction of individual gender identity have affected the history and philosophy of science, feminist thinkers have challenged the intellectual and social orders at their very foundations.

These feminist critiques, which debunk much of what we value in modern Western culture, appear to emerge from outside this culture.

Preface

That is indeed the case insofar as women have been excluded from the processes of defining the culture and have been conceived as the "other" against which men in power define their projects. Yet such destabilizing, "exploding," of the categories of social practice and thought is firmly within the tradition of modern Western history and its explicit commitment to criticism of traditional social practices and beliefs. One such belief is that androcentrism is "natural" and right; another is faith in the progressiveness of scientific rationality. From this perspective, the feminist critiques of science may be seen as calling for a more radical intellectual, moral, social, and political revolution than the founders of modern Western cultures could have imagined. Historically, it is just such revolutions—and not the process of scientific inquiry alone—that have fostered the development of progressive kinds of knowledge-seeking.

This book examines important trends in the feminist critiques of science with the aim of identifying tensions and conflicts between them, inadequate concepts informing their analyses, unrecognized obstacles to and gaps in their research programs, and extensions that might transform them into even more powerful tools for the construction of emancipatory meanings and practices. Motivating my investigation is the belief that these feminist science critiques can be shown to have implications at least as revolutionary for modern Western cultural self-images as feminist critiques in the humanities and social sciences have had.

It should not need to be said—but probably does—that I do not wish to be understood as recommending that we throw out the baby with the bathwater. We do not imagine giving up speaking or writing just because our language is deeply androcentric; nor do we propose an end to theorizing about social life once we realize that thoroughly androcentric perspectives inform even our feminist revisions of the social theories we inherit. Similarly, I am not proposing that humankind would benefit from renouncing attempts to describe, explain, and understand the regularities, underlying causal tendencies, and meanings of the natural and social worlds just because the sciences we have are androcentric. I am seeking an end to androcentrism, not to systematic inquiry. But an end to androcentrism will require far-reaching transformations in the cultural meanings and practices of that inquiry.

The first two chapters provide an overview and theoretical introduction. Chapter 1 identifies five feminist critiques and three feminist epistemological programs, and points to the challenges each of these

faces. Chapter 2 looks at some problems in the understanding of both science and gender in the feminist science criticisms, and shows how these create obstacles to the development of a feminist theory of science; I then develop the more adequate concepts of science and gender that inform the following chapters.

The next three chapters show the connections between the parts of the picture of science that feminist critics have produced, and identify inconsistencies and oversights. Chapter 3 reviews the feminist approaches to equity issues in the structure of science and points to the tensions between these ahistorical images and the reality of science's social structure. Chapter 4 scrutinizes the feminist charges of androcentrism in the selection of problematics (of what is defined as requiring scientific explanation) and the design of research in biology and the social sciences (I include the social sciences here to prepare for later analysis of the inadequate social assumptions that have guided the mainstream understandings of modern science). Chapter 5 examines science's contribution to the construction of gendered meanings for both nature and inquiry and reviews the literature showing that much of what is commonly taken to be biological sex difference and sexual desire is socially constructed.

Chapters 6 and 7 turn to feminist theories of knowledge, the epistemological grounds for modern science, and the alternative justificatory strategies proposed by feminist critics. Chapter 6 examines the "successor science" projects of four theorists—Hilary Rose, Dorothy Smith, Jane Flax, and Nancy Hartsock—and their attempts to envision forms and purposes of knowledge-seeking that are alternative to those used to justify the science we have. In Chapter 7 I describe some obstacles that these epistemologies face; by focusing on the relationship between these feminist projects and similar emancipatory science projects of ex-colonial peoples, I also consider some of the difficult questions the "successor science" projects and feminist postmodernist critiques pose for each other.

Chapters 8 and 9 provide a pause in the argument by returning to the history of science in an effort to account for the deterioration of socially progressive knowledge-seeking (readers who prefer plots uninterrupted by the ghostly appearances of the protagonist's garrulous ancestors may want to skip to Chapter 10). Chapter 8, which treats the institution of science as a personage passing from infancy to adulthood, identifies gaps in the standard stories this adult personage tells about its infancy. Chapter 9 examines one kind of attempt by recent

Preface

social histories of science to fill these gaps, and argues that even they tend to repress what they need to redress by systematically avoiding consideration of gender symbolism and actual social relations between the genders in history.

Chapter 10 returns to the main plot to reflect on some central instabilities and tensions within the feminist theories I have been examining and developing. It identifies questions asked by the science critiques that cannot be answered in the terms in which they have been posed. I conclude by pointing to the way feminist science critiques have assumed a reversal of the "unity of science" thesis so central to the members of the Vienna Circle. For feminists, it is moral and political, rather than scientific, discussion that has served as the paradigm—though a problematic one—of rational discourse.

S.H.

THE SCIENCE QUESTION IN FEMINISM

1 FROM THE WOMAN QUESTION IN SCIENCE TO THE SCIENCE QUESTION IN FEMINISM

Feminist scholars have studied women, men, and social relations between the genders within, across, and insistently against the conceptual frameworks of the disciplines. In each area we have come to understand that what we took to be humanly inclusive problematics, concepts, theories, objective methodologies, and transcendental truths are in fact far less than that. Instead, these products of thought bear the mark of their collective and individual creators, and the creators in turn have been distinctively marked as to gender, class, race, and culture.¹ We can now discern the effects of these cultural markings in the discrepancies between the methods of knowing and the interpretations of the world provided by the creators of modern Western culture and those characteristic of the rest of us. Western culture's favored beliefs mirror in sometimes clear and sometimes distorting ways not

¹I make a sharp distinction between "sex" and "gender" (even though this is a dichotomy I shall later problematize); thus I refer to "gender roles" rather than "sex roles," etc., retaining only a few terms such as "sexism," where the substitution seems more distracting than useful. Otherwise (except in direct quotations), I use "sex" only when it is, indeed, biology that is at issue. There are two reasons for this policy. First, in spite of feminist insistence for decades, perhaps centuries, that women's and men's "natures" and activities are primarily shaped by social relations, not by immutable biological determinants, many people still do not grasp this point or are unwilling to commit themselves to its full implications (the current fascination with sociobiology is just one evidence of this problem). Second, the very thought of sex exerts its own fatal attraction for many otherwise well-intentioned people: such phrases as "sexual politics," "the battle between the sexes," and "male chauvinism" make the continuation of gender hostilities sound far more exciting than feminism should desire.

The Science Question in Feminism

the world as it is or as we might want it to be, but the social projects of their historically identifiable creators.

The natural sciences are a comparatively recent subject of feminist scrutiny. The critiques excite immense anticipation—or fear—yet they remain far more fragmented and less clearly conceptualized than feminist analyses in other disciplines.

The anticipation and fear are based in the recognition that we are a scientific culture, that scientific rationality has permeated not only the modes of thinking and acting of our public institutions but even the ways we think about the most intimate details of our private lives. Widely read manuals and magazine articles on child rearing and sexual relations gain their authority and popularity by appealing to science. And during the last century, the social use of science has shifted: formerly an occasional assistant, it has become the direct generator of economic, political, and social accumulation and control. Now we can see that the hope to “dominate nature” for the betterment of the species has become the effort to gain unequal access to nature’s resources for purposes of social domination. No longer is the scientist—if he ever was—an eccentric and socially marginal genius spending private funds and often private time on whatever purely intellectual pursuits happen to interest him. Only very rarely does his research have no foreseeable social uses. Instead, he (or, more recently, she) is part of a vast work force, is trained from elementary school on to enter academic, industrial, and governmental laboratories where 99 + percent of the research is expected to be immediately applicable to social projects. If these vast industrialized empires, devoted—whether intentionally or not—to material accumulation and social control, cannot be shown to serve the best interests of social progress by appeal to objective, dispassionate, impartial, rational knowledge-seeking, then in our culture they cannot be legitimated at all. Neither God nor tradition is privileged with the same credibility as scientific rationality in modern cultures.

Of course, feminists are not the first group to scrutinize modern science in this way. Struggles against racism, colonialism, capitalism, and homophobia, as well as the counter culture movement of the 1960s and the contemporary ecology and antimilitarism movements, have all produced pointed analyses of the uses and abuses of science. But the feminist criticisms appear to touch especially raw nerves. For one thing, at their best they incorporate the key insights of these other movements while challenging the low priority that specifically feminist concerns have been assigned in such agendas for social reform. For

another, they question the division of labor by gender—a social aspect of the organization of human relations that has been deeply obscured by our perceptions of what is “natural” and what is social. Perhaps most disturbingly, they challenge our sense of personal identity at its most prerational level, at the core. They challenge the desirability of the gendered aspects of our personalities and the expression of gender in social practices, which for most men and women have provided deeply satisfying parts of self-identity.

Finally, as a symbol system, gender difference is the most ancient, most universal, and most powerful origin of many morally valued conceptualizations of everything else in the world around us. Cultures assign a gender to such nonhuman entities as hurricanes and mountains, ships and nations. As far back in history as we can see, we have organized our social and natural worlds in terms of gender meanings within which historically specific racial, class, and cultural institutions and meanings have been constructed. Once we begin to theorize gender—to define gender as an analytic category within which humans think about and organize their social activity rather than as a natural consequence of sex difference, or even merely as a social variable assigned to individual people in different ways from culture to culture—we can begin to appreciate the extent to which gender meanings have suffused our belief systems, institutions, and even such apparently gender-free phenomena as our architecture and urban planning. When feminist thinking about science is adequately theorized, we will have a clearer grasp of how scientific activity is and is not gendered in this sense.

Now it is certainly true that racism, classism, and cultural imperialism often more deeply restrict the life opportunities of individuals than does sexism. We can easily see this if we compare the different life opportunities available to women of the same race but in different classes, or of the same class but in different races, in the United States today or at any other time and place in history. Consequently, it is understandable why working-class people and victims of racism and imperialism often place feminist projects low on their political agendas. Furthermore, gender appears only in culturally specific forms. As we shall see in the next chapter, gendered social life is produced through three distinct processes: it is the result of assigning dualistic gender metaphors to various perceived dichotomies that rarely have anything to do with sex differences; it is the consequence of appealing to these gender dualisms to organize social activity, of dividing necessary social

The Science Question in Feminism

activities between different groups of humans; it is a form of socially constructed individual identity only imperfectly correlated with either the "reality" or the perception of sex differences. I shall be referring to these three aspects of gender as *gender symbolism* (or, borrowing a term from anthropology, "gender totemism"), *gender structure* (or the division of labor by gender), and *individual gender*. The referents for all three meanings of masculinity and femininity differ from culture to culture, though within any culture the three forms of gender are related to each other. Probably few, if any, symbolic, institutional, or individual identity or behavioral expressions of masculinity and femininity can be observed in all cultures or at all times in history.

But the fact that there are class, race, and cultural differences between women and between men is not, as some have thought, a reason to find gender difference either theoretically unimportant or politically irrelevant. In virtually every culture, gender difference is a pivotal way in which humans identify themselves as persons, organize social relations, and symbolize meaningful natural and social events and processes. And in virtually all cultures, whatever is thought of as manly is more highly valued than what is thought of as womanly. Moreover, we need to recognize that in cultures stratified by both gender and race, gender is always also a racial category and race a gender category. That is, sexist public policies are different for people of the same gender but different race, and racist policies are different for women and men within the same race. One commentator has proposed that we think of these policies as, respectively, racist sexism and sexist racism.²

Finally, we shall later examine the important role to be played in emancipatory epistemologies and politics by open recognition of gender differences within racial groups and racial and cultural differences within gender groups. "Difference" can be a slippery and dangerous rallying point for inquiry projects and for politics, but each emancipatory struggle needs to recognize the agendas of other struggles as integral parts of its own in order to succeed. (After all, people of color come in at least two genders, and women are of many colors.) For each struggle, epistemologies and politics grounded in solidarities could replace the problematic ones that appeal to essentialized identities, which are, perhaps, spurious.

²Boch (1983). See also Caulfield (1974); Davis (1971). (Works cited in my notes by author and year of publication receive full citation in the bibliography, which lists the sources I have found most useful for this study. Additional references appear in full in the footnotes.)

From the Woman Question to the Science Question

For all these reasons, feminist critiques claiming that science, too, is gendered appear deeply threatening to the social order, even in societies such as ours where racism, classism, and imperialism also direct all our lives. Obviously, the different forms of domination use one another as resources and support one another in complex ways. If we find it difficult to imagine the day-to-day details of living in a world no longer structured by racism and classism, most of us do not even know how to start imagining a world in which gender difference, in its equation of masculinity with authority and value, no longer constrains the ways we think, feel, and act. And the day-to-day world we live in is so permeated by scientific rationality as well as gender that to nonfeminists and perhaps even some feminists, the very idea of a feminist critique of scientific rationality appears closer to blasphemy than to social-criticism-as-usual.

Feminists in other fields of inquiry have begun to formulate clear and coherent challenges to the conceptual frameworks of their disciplines. By putting women's perspective on gender symbolism, gender structure, and individual gender at the center of their thinking, they have been able to reconceive the purposes of research programs in anthropology, history, literary criticism, and so forth.³ They have begun to retheorize the proper subject matters of the understandings these disciplines could provide. But I think the proper subject matters and purposes of a feminist critique of science have, thus far, eluded the firm grip and the clear conceptualizations that are becoming evident in much of this other research. The voice of feminist science criticism alternates among five different kinds of projects, each with its own audience, subject matter, ideas of what science is and what gender is, and set of remedies for androcentrism. In certain respects, the assumptions guiding these analyses directly conflict. It is not at all clear how their authors conceive of the theoretical connections between them, nor, therefore, what a comprehensive strategy for eliminating androcentrism from science would look like. This is particularly troublesome because clarity about so fundamental a component of our culture can have powerful effects elsewhere in feminist struggles.

One problem may be that we have been so preoccupied with responding to the sins of contemporary science in the same terms our culture uses to justify these sins that we have not yet given adequate attention to envisioning truly emancipatory knowledge-seeking. We

³McIntosh (1983).

have not yet found the space to step back and image up the whole picture of what science might be in the future. In our culture, reflecting on an appropriate model of rationality may well seem a luxury for the few, but it is a project with immense potential consequences: it could produce a politics of knowledge-seeking that would show us the conditions necessary to transfer control from the "haves" to the "have-nots."

What kind of understanding of science would we have if we began not with the categories we now use to grasp its inequities, misuses, falsities, and obscurities but with those of the biologist protagonist imagined by Marge Piercy in *Woman on the Edge of Time*, who can shift her/his sex at will and who lives in a culture that does not institutionalize (i.e., does not have) gender? or with the assumptions of a world where such categories as machine, human, and animal are no longer either distinct or of cultural interest, as in Anne McCaffrey's *The Ship Who Sang*?⁴ Perhaps we should turn to our novelists and poets for a better intuitive grasp of the theory we need. Though often leaders in the political struggles for a more just and caring culture, they are professionally less conditioned than we to respond point by point to a culture's defenses of its ways of being in the world.

FIVE RESEARCH PROGRAMS

To draw attention to the lack of a developed feminist theory for the critique of the natural sciences is not to overlook the contributions these young but flourishing lines of inquiry have made. In a very short period of time, we have derived a far clearer picture of the extent to which science, too, is gendered. Now we can begin to understand the economic, political, and psychological mechanisms that keep science sexist and that must be eliminated if the nature, uses, and valuations of knowledge-seeking are to become humanly inclusive ones. Each of these lines of inquiry raises intriguing political and conceptual issues, not only for the practices of science and the ways these practices are legitimated but also for each other. Details of these research programs are discussed in following chapters; I emphasize here the problems they raise primarily to indicate the undertheorization of the whole field.

⁴Marge Piercy, *Woman on the Edge of Time* (New York: Fawcett, 1981); Anne McCaffrey, *The Ship Who Sang* (New York: Ballantine, 1976). Donna Haraway (1985) discusses the potentialities that McCaffrey's kind of antidualism opens up for feminist theorizing.

First of all, equity studies have documented the massive historical resistance to women's getting the education, credentials, and jobs available to similarly talented men;⁵ they have also identified the psychological and social mechanisms through which discrimination is informally maintained even when the formal barriers have been eliminated. Motivation studies have shown why boys and men more often want to excel at science, engineering, and math than do girls and women.⁶ But should women want to become "just like men" in science, as many of these studies assume? That is, should feminism set such a low goal as mere equality with men? And to which men in science should women want to be equal—to underpaid and exploited lab technicians as well as Nobel Prize winners? Moreover, should women want to contribute to scientific projects that have sexist, racist, and classist problematics and outcomes? Should they want to be military researchers? Furthermore, what has been the effect of women's naiveté about the depth and extent of masculine resistance—that is, would women have struggled to enter science if they had understood how little equity would be produced by eliminating the formal barriers against women's participation?⁷ Finally, does the increased presence of women in science have any effect at all on the nature of scientific problematics and outcomes?

Second, studies of the uses and abuses of biology, the social sciences, and their technologies have revealed the ways science is used in the service of sexist, racist, homophobic, and classist social projects. Oppressive reproductive policies; white men's management of all women's domestic labor; the stigmatization of, discrimination against, and medical "cure" of homosexuals; gender discrimination in workplaces—all these have been justified on the basis of sexist research and maintained through technologies, developed out of this research, that move control of women's lives from women to men of the dominant group.⁸ Despite the importance of these studies, critics of the sexist uses of science often make two problematic assumptions: that there is a value-free, pure scientific research which can be distinguished from the social uses of science; and that there are proper uses of science with which we

⁵See, e.g., Rossiter (1982b); Walsh (1977).

⁶See Aldrich (1978).

⁷Rossiter (1982b) makes this point.

⁸See Tobach and Rosoff (1978; 1979; 1981; 1984); Brighton Women and Science Group (1980); Ehrenreich and English (1979); Rothschild (1983); Zimmerman (1983); Arditti, Duelli-Klein, and Minden (1984).

The Science Question in Feminism

can contrast its improper uses. Can we really make these distinctions? Is it possible to isolate a value-neutral core from the uses of science and its technologies? And what distinguishes improper from proper uses? Furthermore, each misuse and abuse has been racist and classist as well as oppressive to women. This becomes clear when we note that there are different reproductive policies, forms of domestic labor, and forms of workplace discrimination mandated for women of different classes and races even within U.S. culture at any single moment in history. (Think, for instance, of the current attempt to restrict the availability of abortion and contraceptive information for some social groups at the same time that sterilization is forced on others. Think of the resuscitation of scientifically supported sentimental images of motherhood and nuclear forms of family life for some at the same time that social supports for mothers and nonnuclear families are systematically withdrawn for others.) Must not feminism take on as a central project of its own the struggle to eliminate class society and racism, homophobia and imperialism, in order to eliminate the sexist uses of science?

Third, in the critiques of biology and the social sciences, two kinds of challenges have been raised not just to the actual but to the possible existence of any pure science at all.⁹ The selection and definition of problematics—deciding what phenomena in the world need explanation, and defining what is problematic about them—have clearly been skewed toward men's perception of what they find puzzling. Surely it is "bad science" to assume that men's problems are everyone's problems, thereby leaving unexplained many things that women find problematic, and to assume that men's explanations of what they find problematic are undistorted by their gender needs and desires. But is this merely—or, perhaps, even—an example of bad science? Will not the selection and definition of problems always bear the social fingerprints of the dominant groups in a culture? With these questions we glimpse the fundamental value-ladenness of knowledge-seeking and thus the impossibility of distinguishing between bad science and science-as-usual. Furthermore, the design and interpretation of research again and again has proceeded in masculine-biased ways. But if problems are necessarily value-laden, if theories are constructed to explain

⁹The literature here is immense. For examples of these criticisms, see Longino and Doell (1983); Hubbard, Henifin, and Fried (1982); Gross and Averill (1983); Tobach and Rosoff (1978; 1979; 1981; 1984); Millman and Kanter (1975); Andersen (1983); Westkott (1979).

problems, if methodologies are always theory-laden, and if observations are methodology-laden, can there be value-neutral design and interpretation of research? This line of reasoning leads us to ask whether it is possible that some kinds of value-laden research are nevertheless maximally objective. For example, are overtly antisexist research designs inherently more objective than overtly sexist or, more important, "sex-blind" (i.e., gender-blind) ones? And are antisexist inquiries that are also self-consciously antiracist more objective than those that are not? There are precedents in the history of science for preferring the distinction between objectivity-increasing and objectivity-decreasing social values to the distinction between value-free and value-laden research. A different problem is raised by asking what implications these criticisms of biology and social science have for areas such as physics and chemistry, where the subject matter purportedly is physical nature rather than social beings ("purportedly" because, as we shall see, we must be skeptical about being able to make any clear distinctions between the physical and the nonphysical). What implications could these findings and this kind of reasoning about objectivity have for our understanding of the scientific world view more generally?

Fourth, the related techniques of literary criticism, historical interpretation, and psychoanalysis have been used to "read science as a text" in order to reveal the social meanings—the hidden symbolic and structural agendas—of purportedly value-neutral claims and practices.¹⁰ In textual criticism, metaphors of gender politics in the writings of the fathers of modern science, as well as in the claims made by the defenders of the scientific world view today, are no longer read as individual idiosyncrasies or as irrelevant to the meanings science has for its enthusiasts. Furthermore, the concern to define and maintain a series of rigid dichotomies in science and epistemology no longer appears to be a reflection of the progressive character of scientific inquiry; rather, it is inextricably connected with specifically masculine—and perhaps uniquely Western and bourgeois—needs and desires. Objectivity vs. subjectivity, the scientist as knowing subject vs. the objects of his inquiry, reason vs. the emotions, mind vs. body—in each case the former has been associated with masculinity and the latter with femininity. In each case it has been claimed that human progress requires the former to achieve domination of the latter.¹¹

¹⁰Good examples are Keller (1984); Merchant (1980); Griffin (1978); Flax (1983); Jordanova (1980); Bloch and Bloch (1980); Harding (1980).

¹¹The key "object-relations" theorists among these textual critics are Dinnerstein (1976); Chodorow (1978); Flax (1983). See also Balbus (1982).

Valuable as these textual criticisms have been, they raise many questions. What relevance do the writings of the fathers of modern science have to contemporary scientific practice? What theory would justify regarding these metaphors as fundamental components of scientific explanations? How can metaphors of gender politics continue to shape the cognitive form and content of scientific theories and practices even when they are no longer overtly expressed? And can we imagine what a scientific mode of knowledge-seeking would look like that was not concerned to distinguish between objectivity and subjectivity, reason and the emotions?

Fifth, a series of epistemological inquiries has laid the basis for an alternative understanding of how beliefs are grounded in social experiences, and of what kind of experience should ground the beliefs we honor as knowledge.¹² These feminist epistemologies imply a relation between knowing and being, between epistemology and metaphysics, that is an alternative to the dominant epistemologies developed to justify science's modes of knowledge-seeking and ways of being in the world. It is the conflicts between these epistemologies that generate the major themes of this study.

A GUIDE TO FEMINIST EPISTEMOLOGIES

The epistemological problem for feminism is to explain an apparently paradoxical situation. Feminism is a political movement for social change. But many claims, clearly motivated by feminist concerns, made by researchers and theorists in the social sciences, in biology, and in the social studies of the natural sciences appear more plausible—more likely to be confirmed by evidence—than the beliefs they would replace. How can such politicized research be increasing the objectivity of inquiry? On what grounds should these feminist claims be justified?

We can usefully divide the main feminist responses to this apparent paradox into two relatively well-developed solutions and one agenda for a solution. I will refer to these three responses as *feminist empiricism*, the *feminist standpoint*, and *feminist postmodernism*.

Feminist empiricism argues that sexism and androcentrism are social biases correctable by stricter adherence to the existing methodological norms of scientific inquiry. Movements for social liberation "make it

possible for people to see the world in an enlarged perspective because they remove the covers and blinders that obscure knowledge and observation."¹³ The women's movement produces not only the opportunity for such an enlarged perspective but more women scientists, and they are more likely than men to notice androcentric bias.

This solution to the epistemological paradox is appealing for a number of reasons, not the least because it appears to leave unchallenged the existing methodological norms of science. It is easier to gain acceptance of feminist claims through this kind of argument, for it identifies only bad science as the problem, not science-as-usual.

Its considerable strategic advantage, however, often leads its defenders to overlook the fact that the *feminist empiricist solution* in fact deeply subverts empiricism. The social identity of the inquirer is supposed to be irrelevant to the "goodness" of the results of research. Scientific method is supposed to be capable of eliminating any biases due to the fact that individual researchers are white or black, Chinese or French, men or women. But feminist empiricism argues that women (or feminists, whether men or women) *as a group* are more likely to produce unbiased and objective results than are men (or nonfeminists) as a group.

Moreover, though empiricism holds that scientific method is sufficient to account for historical increases in the objectivity of the picture of the world that science presents, one can argue that history shows otherwise. It is movements for social liberation that have most increased the objectivity of science, not the norms of science as they have in fact been practiced, or as philosophers have rationally reconstructed them. Think, for instance, of the effects of the bourgeois revolution of the fifteenth to seventeenth centuries, which produced modern science itself; or of the effects of the proletarian revolution of the nineteenth and early twentieth centuries. Think of the effects on scientific objectivity of the twentieth-century deconstruction of colonialism.

We shall also see that a key origin of androcentric bias can be found in the selection of problems for inquiry, and in the definition of what is problematic about these phenomena. But empiricism insists that its methodological norms are meant to apply only to the "context of justification"—to the testing of hypotheses and interpretation of evidence—not to the "context of discovery" where problems are identified and defined. Thus a powerful source of social bias appears completely

¹²See Flax (1983); Rose (1983); Hartsock (1983b); Smith (1974; 1977; 1979; 1981); Harding (1983b); Fee (1981). Haraway (1985) proposes a somewhat different epistemology for feminism.

¹³Millman and Kanter (1975, vii).

The Science Question in Feminism

to escape the control of science's methodological norms. Finally, it appears that following the norms of inquiry is exactly what often results in androcentric results.

Thus, feminist attempts to reform what is perceived as bad science bring to our attention deep logical incoherences and what, paradoxically, we can call empirical inadequacies in empiricist epistemologies.

The feminist standpoint originates in Hegel's thinking about the relationship between the master and the slave and in the elaboration of this analysis in the writings of Marx, Engels, and the Hungarian Marxist theorist, G. Lukacs. Briefly, this proposal argues that men's dominating position in social life results in partial and perverse understandings, whereas women's subjugated position provides the possibility of more complete and less perverse understandings. Feminism and the women's movement provide the theory and motivation for inquiry and political struggle that can transform the perspective of women into a "standpoint"—a morally and scientifically preferable grounding for our interpretations and explanations of nature and social life. The feminist critiques of social and natural science, whether expressed by women or by men, are grounded in the universal features of women's experience as understood from the perspective of feminism.¹⁴

While this attempted solution to the epistemological paradox avoids the problems that beset feminist empiricism, it generates its own tensions. First of all, those wedded to empiricism will be loath to commit themselves to the belief that the social identity of the observer can be an important variable in the potential objectivity of research results. Strategically, this is a less convincing explanation for the greater adequacy of feminist claims for all but the already convinced; it is particularly unlikely to appear plausible to natural scientists or natural science enthusiasts.

Considered on its own terms, the feminist standpoint response raises two further questions. Can there be a feminist standpoint if women's (or feminists') social experience is divided by class, race, and culture? Must there be Black and white, working-class and professional-class, American and Nigerian feminist standpoints? This kind of consideration leads to the postmodernist skepticism: "Perhaps 'reality' can have 'a' structure only from the falsely universalizing perspective of the master. That is, only to the extent that one person or group can

From the Woman Question to the Science Question

dominate the whole, can 'reality' appear to be governed by one set of rules or be constituted by one privileged set of social relations."¹⁵ Is the feminist standpoint project still too firmly grounded in the historically disastrous alliance between knowledge and power characteristic of the modern epoch? Is it too firmly rooted in a problematic politics of essentialized identities?

Before turning briefly to the feminist postmodernism from which this last criticism emerges, we should note that both of the preceding epistemological approaches appear to assert that objectivity never has been and could not be increased by value-neutrality. Instead, it is commitments to antiauthoritarian, antielitist, participatory, and emancipatory values and projects that increase the objectivity of science. Furthermore, the reader will need to avoid the temptation to leap to relativist understandings of feminist claims. In the first place, feminist inquirers are never saying that sexist and antisexist claims are equally plausible—that it is equally plausible to regard women's situation as primarily biological *and* as primarily social, or to regard "the human" both as identical *and* nonidentical with "the masculine." The *evidence* for feminist vs. nonfeminist claims may be inconclusive in some cases, and many feminist claims that today appear evidentially secure will no doubt be abandoned as additional evidence is gathered and better hypotheses and concepts are constructed. Indeed, there should be no doubt that these normal conditions of research hold for many feminist claims. But agnosticism and recognition of the hypothetical character of all scientific claims are quite different epistemological stances from relativism. Moreover, whether or not feminists take a relativist stance, it is hard to imagine a coherent defense of cognitive relativism when one thinks of the conflicting claims.

Feminist postmodernism challenges the assumptions upon which feminist empiricism and the feminist standpoint are based, although strains of postmodernist skepticism appear in the thought of these theorists, too. Along with such mainstream thinkers as Nietzsche, Derrida, Foucault, Lacan, Rorty, Cavell, Feyerabend, Gadamer, Wittgenstein, and Unger, and such intellectual movements as semiotics, deconstruction, psychoanalysis, structuralism, archeology/genealogy, and nihilism, feminists "share a profound skepticism regarding universal (or univ-

¹⁴Flax (1983), Rose (1983), Hartsock (1983b), and Smith (1974; 1977; 1979; 1981) all develop this standpoint approach.

¹⁵Flax (1986, 17). Strains of postmodernism appear in all of the standpoint thinking. Of this group, Flax has most overtly articulated also the postmodernist epistemological issues.

The Science Question in Feminism

ersalizing) claims about the existence, nature and powers of reason, progress, science, language and the 'subject/self.'¹⁶

This approach requires embracing as a fruitful grounding for inquiry the fractured identities modern life creates: Black-feminist, socialist-feminist, women-of-color, and so on. It requires seeking a solidarity in our oppositions to the dangerous fiction of the naturalized, essentialized, uniquely "human" (read "manly") and to the distortion and exploitation perpetrated on behalf of this fiction. It may require rejecting fantasized returns to the primal wholeness of infancy, preclass societies, or pregender "unitary" consciousnesses of the species—all of which have motivated standpoint epistemologies. From this perspective, feminist claims are more plausible and less distorting only insofar as they are grounded in a solidarity between these modern fractured identities and between the politics they create.

Feminist postmodernism creates its own tensions. In what ways does it, like the empiricist and standpoint epistemologies, reveal incoherences in its parental mainstream discourse? Can we afford to give up the necessity of trying to provide "one, true, feminist story of reality" in the face of the deep alliances between science and sexist, racist, classist, and imperialist social projects?

Clearly, there are contradictory tendencies among the feminist epistemological discourses, and each has its own set of problems. The contradictions and problems do not originate in the feminist discourses, however, but reflect the disarray in mainstream epistemologies and philosophies of science since the mid-1960s. They also reflect shifting configurations of gender, race, and class—both the analytic categories and the lived realities. New social groups—such as feminists who are seeking to bridge a gap between their own social experience and the available theoretical frameworks—are more likely to hone in on "subjugated knowledge" about the world than are groups whose experience more comfortably fits familiar conceptual schemes. Most likely, the feminist entrance into these disputes should be seen as making significant contributions to clarifying the nature and implications of paradoxical tendencies in contemporary intellectual and social life.

The feminist criticisms of science have produced an array of conceptual questions that threaten both our cultural identity as a demo-

¹⁶Flax (1986, 3). This is Flax's list of the mainstream postmodernist thinkers and movements. See Haraway (1985), Marks and de Courtivron (1980), and *Signs* (1981) for discussion of the feminist postmodernist issues.

From the Woman Question to the Science Question

cratic and socially progressive society and our core personal identities as gender-distinct individuals. I do not mean to overwhelm these illuminating lines of inquiry with criticisms so early in my study—to suggest that they are not really feminist or that they have not advanced our understanding. On the contrary, each has greatly enhanced our ability to grasp the extent of androcentrism in science. Collectively, they have made it possible for us to formulate new questions about science.

It is a virtue of these critiques that they quickly bring to our attention the socially damaging incoherences in all the nonfeminist discourses. Considered in the sequence described in this chapter, they move us from the Woman Question in science to the more radical Science Question in feminism. Where the first three kinds of criticism primarily ask how women can be more equitably treated within and by science, the last two ask how a science apparently so deeply involved in distinctively masculine projects can possibly be used for emancipatory ends. Where the Woman Question critiques still conceptualize the scientific enterprise we have as redeemable, as reformable, the Science Question critiques appear skeptical that we can locate anything morally and politically worth redeeming or reforming in the scientific world view, its underlying epistemology, or the practices these legitimate.

2 GENDER AND SCIENCE: TWO PROBLEMATIC CONCEPTS

Feminist critics face immense obstacles in trying to construct a theory of gender as an analytic category that is relevant to the natural sciences. These obstacles have their origins not only in familiar but inadequate notions of gender but also in certain dogmatic views about science toward which even feminists are often insufficiently critical.

OBSTACLES TO THEORIZING GENDER

In such other disciplines as history, anthropology, and literature, the need to theorize gender appeared only after the limitations of three other projects were recognized. The "woman worthies" project was concerned with restoring and adding to the canons the voices of significant women in history, novelists, poets, artists, and so forth. Their achievements were reevaluated from a nonsexist perspective. The "women's contributions" project focused on women's participation in activities that had already appeared as focuses of analysis in these disciplines—in abolition and temperance struggles, in "gathering" activities within so-called hunter cultures, in the work of significant literary circles, for instance—but were still misperceived and underdeveloped subject matters. Here, the goal of a less distorted picture of social life logically called for new accounts of these already acknowledged disciplinary subject matters. Finally, "victimology" studies documented the previously ignored or misogynistically described histories and present practices of rape, wife abuse, prostitution, incest, workplace discrimination, economic exploitation, and the like.

It was only in doing such work effectively that feminist scholars came to recognize the inadequacy of these approaches. The situation of women who managed to become significant figures in history or recognized artists and poets was by definition privileged in comparison with women's situation more generally. The lives of these women offer us little more understanding of the daily lives of the vast majority of women than lives of great men reveal the lot of the "common man." Furthermore, women's contributions to traditional history and culture have still been contributions to what men, from the perspective of their lives, think of as history and culture. Such analyses tend to hide from us what women's activities in these men's worlds meant to women, as well as how women's daily activities have shaped men's very definitions of their worlds.¹ Finally, the victimology studies often hide the ways in which women have struggled against misogyny and exploitation. Women have been active agents in their own destinies—even if not within conditions of their own making—and we need to understand the forms and focuses of their struggles. These three kinds of studies have all provided valuable insights into matters that traditional inquiry bypasses. But their limitations led feminists to see the need to formulate gender as a theoretical category, as the analytic tool through which the division of social experience along gender lines tends to give men and women different conceptions of themselves, their activities and beliefs, and the world around them.

In the natural sciences, these projects have been only marginally useful. Women have been more systematically excluded from doing serious science than from performing any other social activity except, perhaps, frontline warfare. The inevitable examples of Marie Curie and now Barbara McClintock notwithstanding, few women have been able to achieve eminence in their own day as scientists. A variety of historical, sociological, and psychological studies explain why this is so, but the fact remains that there are few woman worthies to restore to science's halls of fame. Studies of women's contributions to science have been somewhat more fruitful though still limited by the same constraints.² The victimology focus, which appears in all five of the feminist science critique projects, has proved valuable chiefly in exploding the myth that the science we have had actually is the "science

¹See, e.g., Smith (1974; 1977; 1979; 1981); Kelly-Gadol (1976); Gilligan (1972).

²See, e.g., Rossiter (1982b); Walsh (1977).

The Science Question in Feminism

for the people" (Galileo's phrase) imagined at the emergence of modern science.

The fact that these approaches, useful in the social sciences and humanities, have been able to find only limited targets in the natural sciences has obscured to the science critics the need for more adequate theorization of gender as an analytic category—with one important exception: in the critiques of biology, there have been great advances in providing more developed and accurate views of women's natures and activities (see Chapter 4). Here the need to theorize gender as an analytic category can be seen in identifications of a gap between the way men and women think about reproduction and reproductive technologies, in questions about whether sex difference itself is not an issue of interest more to men than to women, in suggestions that scientific method's focus on differences might be implicated in the androcentrism of such problematics, and in proposals that the concern in biology, anthropology, and psychology with interactive relationships between organisms, and between organisms and environments, may reflect a specifically feminine way of conceptualizing very abstract relationships.³

But biology is only one of the focuses of the feminist critiques of science. In general, the areas in which there is a need for gender as an analytic category and the directions such theorizing should take still remain obscure to many feminist critics of natural science, and totally incomprehensible to most nonfeminist scientists as well as historians, sociologists, and philosophers of science. At least some of these critics do have the resources of their social science disciplines and of literary criticism with which to try to understand natural science in terms of gender categories. The methods of psychoanalysis, history, sociology, anthropology, political theory, and literary criticism have produced valuable insights; however, scientific training (and I include training in the philosophy of science) is hostile to these methods of seeking knowledge about social life, and gender theory is a theory about social

³However, these suggestions raise as many questions as they answer. For instance, does not this approach tend to universalize the feminine, and thereby reinforce problematic modernist tendencies in feminism toward a politics (and epistemology) based on identities rather than solidarities? And are not interactive models the obvious alternative to the hierarchical models of Darwinian dogma? That is, do not reasons internal to the logic of theory development suggest the fruitfulness of pursuing interactive models at this moment in the history of the biological sciences? Furthermore, does not the desire to replace hierarchical with interactive models reflect widely recognized political realities at this time in world history, rather than only feminine characteristics? We shall pursue these questions later.

life. Characteristically, neither scientists nor philosophers of science are socialized to value psychoanalysis, literary criticism, or the critical interpretive approaches to be found in history and anthropology as modes of knowledge-seeking. No wonder we have found it difficult to theorize the effects on the natural sciences of gender symbolism, gender structure, and individual gender.

In the social sciences, those areas of research most hospitable to the introduction of gender as a theoretical category are the ones with a strong *critical* interpretive tradition. (I say "critical" to distinguish this *theory* of human action and belief from the kinds of unselfconscious interpretations, rationalizations, we all routinely provide to ourselves and others in explaining our beliefs and actions.) These traditions hypothesize that "the natives" may sometimes engage in irrational actions and hold irrational beliefs that defeat the actors' conscious goals and/or unconscious interests. The causes are to be found in the contradictory social conditions, the no-win situations, within which humans must choose actions and hold beliefs. Marx and Freud provide just two examples of theorists who attempted to identify the social conditions that lead groups of individuals to patterns of irrational action and belief. The effects of their methodological proposals can be seen in the critical interpretive traditions in many areas of social science research—whether or not these traditions call themselves Marxist or Freudian or are concerned with the particular kinds of social phenomena of interest to Marx and Freud. In these inquiry traditions it is legitimate—indeed, often obligatory—to reflect on the social origins of conceptual systems and patterns of behavior, and to include in this subject matter the conceptual systems and behaviors shaping the inquirer's own assumptions and activities. Here there is not only conceptual space but also, we might say, moral permission to reflect on gendered aspects of conceptual systems and on the gender circumstances in which beliefs are adopted. In contrast, research programs where remnants of empiricist, positivist philosophies of social science hold sway have been systematically inhospitable to gender as a theoretical category.⁴ At best they have been willing to add gender as a

⁴See Stacey and Thorne (1986), who make a number of these points about sociology. Pauline Bart has also pointed out (in conversation) that in speculating about the comparative resistances that different disciplinary fields offer to feminist insights, we should not underestimate the comparative levels of personal and political threat to the leaders in these fields—primarily men—that are presented, for instance, by sociological analyses of contemporary and nearby cultures in comparison to historical or anthropological analyses of cultures temporally or spatially distant from us. This line of reasoning

The Science Question in Feminism

variable to be analyzed in their subject matter—as a property of individuals and their behaviors rather than also of social structures and conceptual systems.

The physical sciences are the origin of this positivist, excessively empiricist philosophy. Their nonsocial subject matter and the paradigmatic status of their methods appear to preclude critical reflection on social influences on their conceptual systems; indeed, prevalent dogma holds that it is the virtue of modern science to make such reflection unnecessary. We are told that modern physics and chemistry eliminate the anthropomorphizing characteristic of medieval science and of the theorizing we can observe in “primitive” cultures and children—not to mention in the social sciences and humanities. The social progressiveness, the “positivism,” of modern science is to be found entirely in its method. There is thought to be no need to train physicists, chemists, or biologists as critical theorists; consequently, little in their training or in the ethos of scientific endeavor encourages the development or appreciation of the critical interpretive theory and skills that have proved so fruitful in the social sciences.

However, the history, sociology, and philosophy of science are not themselves natural sciences. Their subject matters are social beliefs and practices. In the philosophy of science, the focus is on ideal beliefs and practices; in the history and sociology of science it is on actual beliefs and practices. Whether ideal or real, social beliefs and practices are the concerns of these disciplines. Here one would have thought that critical interpretive theory and skills would be central to understanding how scientists do and should explain the regularities of nature and their underlying causal tendencies. The sociology of knowledge does take this approach, though it has been limited by its preoccupation with what we can call the “sociology of error” and the “sociology of knowers” to the exclusion of a sociology of knowledge.⁵ And this tradition, too, has been stalwartly androcentric. But androcentric or not, its influence on thinking about natural science has yet to be felt within the philosophy of science or the natural sciences themselves, and is only beginning to make inroads into the traditional sociology and history of science. The philosophy, sociology, and history of the natural sciences have been dominated by empiricist philosophies hostile

would support my argument that feminist critiques of the natural sciences meet even greater hostility than critiques in other areas; scientific rationality is directly implicated in the maintenance of masculinity in our kind of culture.

⁵See Bloor (1977) for criticism of the sociologies of error and knowers.

to theories of belief formation within which gender could be understood as a part of science’s conceptual schemes, as a way of organizing the social labor of science, or as an aspect of the individual identity of scientists.

For these reasons the feminist science critics face even greater disciplinary obstacles than do feminists who seek to introduce gender as a theoretical category into the social sciences, literature, and the arts. These obstacles seem to originate in the unusual notion that science enthusiasts have of the proper way to understand the history and practices of science: this kind of social activity alone, we are told, must be understood only in terms of its enthusiasts’ understanding of their own activities—in terms of the unselfconscious, uncritical interpretations “the natives” provide of their beliefs and activities. That is, scientists report their activities, and philosophers and historians of science interpret these reports so that we can “rationally” account for the growth of scientific knowledge in the very same moral, political, and epistemological terms scientists use to explain their activities to funding sources or science critics.

Social theorists will recognize this approach as a hermeneutic, intentionalist one that systematically avoids critical examination of the identifiable causal, historical influences on the growth of science which are to be found outside the intellectual, moral, and political consciousnesses of science practitioners and enthusiasts.⁶ Kuhn’s alternative account of the history of science has generated a veritable new industry for the social studies of science, studies that have begun to show the mystification perpetrated by such “rational reconstructions.”⁷ But traditional science and philosophical and popular enthusiasm for the traditional vision of science remain pugnaciously hostile to such critical causal accounts. From this perspective, my approach to science in this book may be understood as a more thorough naturalism than science enthusiasts themselves are apparently willing to defend: I seek to identify the causal tendencies in social life that leave traces of gender projects on all aspects of the scientific enterprise.

Is it ironic that natural science, presented as the paradigm of critical, rational thinking, tries to suffocate just the kind of critical, rational thought about its own nature and projects that it insists we must exercise about other social enterprises? Perhaps not, if we think of

⁶See Fay and Moon (1977) for discussion of the virtues and problems of intentionalist approaches to social inquiry.

⁷Kuhn (1970).

The Science Question in Feminism

science's story about itself as a kind of origins myth. Science's self-image presents a myth about who "our kind" of people are and about what destiny nature and scientific rationality hold in store for us. As anthropologists tell us, origins myths frequently violate the very categories they generate: in other cultures they may report that those cultures came into existence through incest, cannibalism, bestiality, sexual unions between gods and mortals—activities subsequently forbidden in those cultures. The origins myth for our scientific culture tells us that we came into existence in part through the kind of critical thought about the social relations between medieval inquiry and society that is subsequently forbidden in our scientific culture. This is a magical—perhaps even a religious or mystical—conception of ideal knowledge-seeking. It excludes itself from the categories and activities it prescribes for everything else. It recommends that we understand everything but science through causal analyses and critical scrutiny of inherited beliefs.

THE DOGMAS OF EMPIRICISM

Empiricist conceptions of scientific method and the scientific enterprise create obstacles both *for* and *in* feminist thinking about science. I suggest that we should regard these mystifying beliefs as reflections of and additions to the "dogmas of empiricism" familiar to philosophers.

In the 1950s, the philosopher of science Willard Van Orman Quine identified two dogmas of empiricism that he thought should be abandoned. "Modern empiricism has been conditioned in large part by two dogmas. One is a belief in some fundamental cleavage between truths which are *analytic*, or grounded in meanings independently of matters of fact, and truths which are *synthetic*, or grounded in fact. The other dogma is *reductionism*: the belief that each meaningful statement is equivalent to some logical construct upon terms which refer to immediate experience."⁸ Quine argued that both dogmas were illfounded, and that if they were abandoned, we would be inclined to see as less clear the purportedly firm distinction between natural science and speculative metaphysics. We would also recognize pragmatic standards as the best we can have for judging the adequacy of scientific claims.

Since then, historians and sociologists of science as well as philosophers have supported Quine's rejection of these two dogmas of em-

piricism. Studies of the social construction of what we count as real—both inside and outside the history of science—make it highly implausible to believe that there can be any kind of value-free descriptions of immediate experience to which our knowledge claims can be "reduced" or thought equivalent. Furthermore, there is now widespread acceptance of Quine's first claim that when epistemological push comes to shove, we can never tell for sure when we are responding to the compulsions of our language rather than to those of our experience. Facts cannot be separated from their meanings. Thus the test of the logical adequacy of a statement or argument is ultimately not different in kind from tests of its empirical adequacy. In both cases, (social) experience expressed through (culturally shaped) language is all we have to fall back on. (Quine was not concerned with what creates social variation in experience or language.) Quine recommended substituting pragmatic and behaviorist questions for the traditional philosophical ones, replacing what he thought were undesirable philosophical preoccupations with what he thought were desirable scientific ones. We can appreciate the pragmatic tendencies in his thinking without having to agree to his behaviorism—to his program for replacing philosophy with what appears to many theorists as a still far too reductionist and obsessively empiricist social science.

The philosophical preoccupations that concerned Quine were developed in their contemporary forms to explain the emergence of modern science;⁹ philosophers and scientists explicitly honored those dogmas. However, both the resistance of the natural sciences to a feminist critique and the many theoretical and political contradictions within the feminist critiques make clear that by no means have the dogmas Quine identified been abandoned—nor are there only two—in either scholarly or popular thinking about science.

Here I want to discuss a series of reflections of and additions to the assumptions Quine criticized which stand as conceptual obstacles to our ability to analyze science, too, as a fully social activity. I think these excessively empiricist beliefs still haunt most of the feminist critics of science and prevent us from adequately theorizing gender in feminist discussions of science. Furthermore, it is belief in these dogmas that leads scientists and traditional philosophers and historians to be hostile to the very idea of a feminist science critique.

⁹See Rorty (1979).

⁸Quine (1953, 20).

Sacred Science.

I have already hinted at one of these dogmas: the belief that science is a fundamentally unique kind of social activity. Like other kinds of origins stories, the ideology of science claims that science properly violates the categories it generates. We are told that human understanding is decreased rather than increased by attempting to account for the nature and structure of scientific activity in the ways science recommends accounting for all other social activity. This belief makes science sacred. Perhaps it even removes scientists from the realm of the completely human—at least in their own view and the view of science enthusiasts. It sets limits on human rationality for what are best thought of as religious or mystical reasons.

We can illustrate that the problem lies in inadequate conceptions of scientific rationality rather than in specifically feminist claims by considering the following hypotheses—which do not even refer to gender.

A. The predictable contribution that physics could make to social welfare today is relatively negligible, since moral and political injustices, rather than ignorance of the laws of nature, are the greatest obstacles to social welfare.

B. “More science” in a socially stratified society tends to intensify social stratification.

C. While individual scientists may well be motivated by the loftiest of personal goals and social ideals, their current activity in fact functions primarily to increase profit for and maintain social control by the few over the many.

These claims may be true or false; I think they are closer to truth than to falsity. Determining their truth or falsity—their correspondence with the way the world is—should be considered a matter for empirical investigation. Yet these statements appear blasphemous to the vast majority of both scientists and nonscientists—not bold hypotheses that should be scientifically investigated to determine whether or not they can be refuted but psychologically, morally, and politically threatening challenges to the Western faith in progress through increased empirical knowledge. They also appear as challenges to the intelligence and morals of the very bright and well-intentioned women and men who enter and remain in science. The usual responses to such suggestions are raised eyebrows, knowing smiles (not directed toward the speaker), or overtly hostile glares—responses that are hardly paradigms of rational argument. Alternatively, listeners may indicate that

they think they are hearing simply expressions of personal hurt: “You must hate scientists,” they reply—as if only disastrous personal experience or a warped mind could make such hypotheses worth pursuing. These kinds of statements raise the possibility not just of an interesting empirical discovery that we have been in error about the progressiveness of science today but of a painful, world-shattering confrontation with moral and political values inconsistent with those that most people think give Western social life its desirable momentum and direction. Obviously, more is at issue here than checking hypotheses against facts—just as more was at issue in the social acceptance of the Copernican world view than the relationship between Copernicus’s hypotheses and the evidence to be gained by looking through Galileo’s telescope.

The project that science’s sacredness makes taboo is the examination of science in just the ways any other institution or set of social practices can be examined. If one substituted “novels,” “drama,” “marriage,” or “publicly funded education” for “science” in these claims, many people might be outraged (or consider the claims merely silly), but the hypotheses would not then generate the same deep feeling of threat to our moral, political, and psychological intuitions. Why is it taboo to suggest that natural science, too, is a social activity, a historically varying set of social practices? that a *thoroughgoing* and *scientific* appreciation of science requires descriptions and explanations of the regularities and underlying causal tendencies of science’s own social practices and beliefs? that scientists and science enthusiasts may have the least adequate understanding of the real causes and meanings of their own activities? To what other “community of natives” would we give the final word about the causes, consequences, and social meanings of their own beliefs and institutions? If we are not willing to try to see the favored intellectual structures and practices of science as cultural artifacts rather than as sacred commandments handed down to humanity at the birth of modern science, then it will be hard to understand how gender symbolism, the gendered social structure of science, and the masculine identities and behaviors of individual scientists have left their marks on the problematics, concepts, theories, methods, interpretations, ethics, meanings, and goals of science.

Let us pursue for a moment the way this belief in the sacredness of science is defended. Science and society are analytically separate, we are told. Thus social values are distinct from (and detrimental to the determination of) facts; the meanings scientific statements carry in a

The Science Question in Feminism

culture are distinct from (and irrelevant to) what scientific statements actually say; consideration of the social uses and abuses of science are distinct from (and irrelevant to) assessments of the progressiveness of science; the social origins of scientific problematics, concepts, theories are distinct from (and irrelevant to) the "goodness" of these problematics, concepts, and theories. These beliefs are defended in one form or another every time a social criticism of science appears. Furthermore, these beliefs permit continual discussions in which the languages, meanings, and structures of science are assumed to be uniquely asocial, as a quick perusal of any of the standard philosophy of science journals or texts will reveal. These beliefs structure the internalist vs. externalist dispute in the history of science; they ensure that most science enthusiasts will mean by "history of science" only the history of consciously held scientific beliefs.

Defenders of the analytic separateness of science from society will say that maybe science is not immune from *all* kinds of social influences; anyone can see that idiosyncrasies of individual investigators have influenced the history of science—otherwise, why would we give Nobel prizes to some individuals and not to others? And yes, the funding priorities of the economy and state do influence the selection of problematics. And it's also true that shoddy research sometimes survives longer than it should because of social enthusiasm for the ill-begotten interpretations of its results: think of Lysenkoism and "Nazi science," they say. And of course enthusiasm for modern science is fundamentally motivated by democratic social values: science is constituted by certain social values, but at its best it neither defends nor recommends any particular social values.

What the defenders of the fundamental value-neutrality, the purity, of science really mean, they say, is that science's logic and methodology, and the empirical core of scientific facts these produce, are totally immune from social influences; that logic and scientific method will in the long run winnow out the factual from the social in the results of scientific research. But we shall try to locate the pure, value-free core of science responsible for the purportedly inherent progressiveness in scientific method, in model claims in physics, in the mathematical language of science, and in logical reasoning. If, as I shall argue, pure science cannot be found in these places, then where should we try to find it?

We do know where to find the historical origins of the mystical belief that science's inherent progressiveness resides in the separation of its

logic and its facts from its social origins, social uses, and social meanings; Chapter 9 examines the political reasons for its adoption. Prior to Newton, such a positivist view of science did not exist (though the term "positivism" appeared much later, the idea can already be detected in late seventeenth-century thinking). The separation does not in fact exist today, but its fetishization lingers on.

Science as a Unique Method or a Set of Sentences.

Does the feminist case that science is gendered have to rest on showing scientific method to be sexist? Does a degendered science have to produce a new method of knowledge-seeking? Or does the feminist case have to rest on showing that the best confirmed claims the sciences have made are sexist? Does it have to show that Newton's or Einstein's laws are sexist in order to provide a plausible argument for the gendered nature of science?

The common view (or dogma) is that science's uniqueness is to be found in its method for acquiring reliable descriptions and explanations of nature's regularities and their underlying causes. Authors of science texts write about the importance of value-free observation as the test of beliefs, and especially about collecting observations through the "experimental method." We are told that it is the refined observation characteristic of experimental method that permitted Galileo's and Newton's views to win out over Ptolemy's and Aristotle's.

But exactly what is unique about this method remains obscure. For one thing, the different sciences use different methods; not a great deal is common to the methods of astronomy, particle physics, and molecular biology. For another thing, in parts of what are regarded as highly rigorous and value-free sciences—contemporary astronomy and geology, for example—controlled experiment plays an extremely small role. And controlled experiment is not a modern invention—after all, Aristotle was an experimentalist. Moreover, just try to identify the formal methodological features of knowledge-seeking that will exclude from the ranks of scientists farmers in premodern agricultural societies yet will include junior but highly trained members of biochemical research teams. When push comes to shove in the philosophy of science, we are told that induction and deduction are supposed to compete for honors as the core of scientific method.¹⁰ But presumably, human infants as well as apes and dogs regularly use induction and deduction.

¹⁰Popper (1959; 1972); cf. Harding (1976).

These kinds of considerations lead to the suspicion that science is both more and less than any possible definition of scientific method.

Faced with these kinds of arguments, one leading philosopher of science says that what distinguishes scientific from nonscientific explanation is science's *attitude* toward its claims.¹¹ That is, what makes a belief or activity scientific is the psychological stance one takes toward it. In all other kinds of human knowledge-seeking, we can identify assumptions that are regarded as sacred, as immune from refutation by experience; the explanations offered by non-Western, "primitive" cultures, theology, psychoanalytic theory, Marxist political economy and astrology are the favorite examples of such pseudoexplanations. We are told that only science holds all of its beliefs open to refutation by experience.

However, in particular areas of scientific inquiry the immunity to criticism of grounding assumptions is easily demonstrated. Why should the situation be different for the scientific world view as a whole? How about (one is tempted to ask) the belief that there are no uncaused physical events? Or that we can meaningfully distinguish between the world's physical and nonphysical events or processes?

In light of these kinds of considerations, it is hard to see why a distinctively feminist science would have to produce a new method, at least if we mean by scientific method no more than (1) putting beliefs to the test of experimental observation, (2) relying on induction and deduction, or (3) being willing to hold all of our assumptions open to criticism. The first and second of these activities are not at all unique to modern science, and the second and third are not characteristic of what everyone counts as the most methodologically rigorous inquiry. What we have in this dogma is the reduction of the purportedly inherent progressiveness of science to a mythologized and obscure notion of its method (this should be—but is not always—what feminists criticize when they challenge positivism), but the distinguishing features of this scientific method cannot even be specified in a plausible way.

A second obscuring conception can be found in the history of the philosophical and scientific preoccupation with science as a particular paradigmatic set of sentences. The mathematical expressions of Newton's laws of mechanics or Einstein's theory of relativity are two of the most frequently cited examples. Unless critics can show that these mathematical statements are value-laden, it is claimed, no case at all

¹¹Popper (1959; 1972).

can be made for the hypothesis that the science we have is fundamentally suffused with social values—let alone with gender values. But why should we continue to regard physics as the paradigm of scientific knowledge-seeking? And is it true that mathematical statements bear no social fingerprints—that there is such a thing as pure mathematics?

Paradigmatic Physics.

Physicists, chemists, philosophers of science, and most of the rest of us believe that physics is the paradigm of science, and that science without physics as its paradigm is unimaginable. Minds reel at the suggestion that perhaps, in the science of the future, physics will be relegated to the backwaters of knowledge-seeking and thought to be concerned only with esoteric problems that have little impact on how we live. Perhaps even today its problematics, methods, and favored languages already provide distinctly atypical examples of scientific inquiry that should not be models for other areas. We can entertain this thought even while we appreciate the historical reasons why physics has been the paradigm of scientific inquiry: Newton's physics permitted a far more useful understanding of many kinds of phenomena than did the Aristotelian physics it replaced, and its explanatory success created great optimism that Newton's "method" could produce similar success in every area of human inquiry. Indeed, mechanism, the metaphysics of Newton's laws, still guides useful research in many areas of the physical sciences, though its limitations are becoming increasingly apparent. However, as Kuhn pointed out, paradigmatic theories in particular areas of inquiry eventually wear out as fruitful guides to research. Shouldn't this also be true for science as a whole?

If it is reasonable to believe that physics should always be the paradigm of science, feminism will not succeed in "proving" that science is as gendered as any other human activity unless it can show that the specific problematics, concepts, theories, language, and methods of modern physics are gender-laden—especially, one hears from philosophers, mathematicians, and physicists, that the mathematical expressions of Newton's laws of mechanics and Einstein's relativity theory are gender-laden. Here, surely, we can distinguish the value-neutral logical structure and empirical content of scientific belief from its social origins, meanings, and applications. From this perspective, the feminist science critiques appear to have as their targets only the "less rigorous" or "less mature" biological and social sciences. Resistance to the plausibility of the feminist critique is made to rest on the value-

The Science Question in Feminism

neutrality of mathematical expressions of the laws of physics. Thus feminist criticisms can appear to support the claim that specific examples of sexist and androcentric science are only cases of "bad science"; that greater attention to the methodological constraints modeled by physics for all inquiry would result in a science free of sexism and androcentrism.

The fact is, however, that all the reasons social scientists have given for thinking that social inquiry requires fundamentally different metaphysical assumptions and methods from those of inquiry in physics can be understood as reasons for thinking that the status of physics as the model of science should deteriorate.¹² I will argue that a critical and self-reflective social science should be the model for all science, and that if there are any special requirements for adequate explanations in physics, they are just that—special. (We will see that much of biology should already be conceptualized as social science. Thought of as the bridge between—or, from a postmodernist perspective, the crucible in which are forged—the natural and the social, nature and culture, biology must frequently make kinds of metaphysical and methodological assumptions that are foreign to physics and chemistry.) Let us see how the arguments about the different conditions for adequate social inquiry can be transformed into arguments for regarding the conditions of scientific explanation in physics as nonparadigmatic.

In the first place, the subject matter of physics is so much less complex than the subject matters of biology and the social sciences that the difference amounts to a qualitative rather than just a quantitative one. Physics looks at either simple systems or simple aspects of complex systems. The standard model of the solar system is an example of the former; the aspects of physiological or ecological systems that physics can explain are examples of the latter. A major reason for the simplicity of these systems and the ability of their models to make reliable predictions is that they are conceptualized as self-contained and deterministic. Yet human activity can have consequences for the functioning of the solar system—we could, presumably, blow up this planet. But the regularities and causal tendencies of such kinds of "interference" are not supposed to be the professional concern of physicists. Whereas the social sciences must consider physical constraints on the phenomena they examine, the objects, events, and processes of

concern to physical scientists are limited to those that can be isolated from social constraints.

Second, the concepts and hypotheses of physics require acts of social interpretation no less than do those in the social sciences. The social meanings that explanations in physics have for physicists and for the "man and woman in the street" are necessary components of these explanations, not scientifically irrelevant historical accidents. Perhaps it is appealing to imagine that the mathematical formulations of Newton's laws *are* the explanations of the movements of matter because it takes only a little effort for us modern folk to get a sense of what these formulas mean in ordinary language. But should we think of a formula so long that only a computer could read it in one hour as an *explanation* of a type of phenomenon? The answer to this question is "no." An explanation is a kind of social achievement. A purported explanation that cannot be grasped by a human mind cannot qualify as an explanation. If no human can understand, can hold in the mind, the purported explanation, then explanation has not been achieved. In other words, Newton's explanations include not just the mathematical expressions of his laws but also the interpretations of those formulas that let us know when we have cases in front of us that exemplify the formulas. The formula " $1 + 1 = 2$ " is meaningless unless we are told what is to count as a case of 1, of +, of =, and so on. The history of chemistry can be understood in part as the struggle to determine what should count as the 1's, the +'s, and the ='s of chemical "addition." And it is not just in physics and chemistry that the appropriate meanings and referents for such apparently obvious terms are debated. As a famous physicist is alleged to have remarked, if we put one lion and one rabbit in a cage, we rarely find two animals there one hour later! Scientific formulas are like legal judgments: the laws become meaningful only through learning (or deciding) how to apply them, and doing so is a process of social interpretation.

We can see another way in which social interpretation is a fundamental component of the laws of physics if we think about the fact that we, unlike fifteenth- to seventeenth-century Europeans, no longer find it bizarre or morally offensive to conceptualize nature as a machine. This analogy has become so deeply embedded in our cultural consciousness that no longer are we aware when we draw on it. But we do not think of concepts or hypotheses "interpreted" through *unfamiliar* social analogies as contributing to explanations. "Nature is like a 'speak bitterness' meeting" might conceptualize nature in a way that could

¹²See Fay and Moon (1977) for a review of how mainstream philosophers think about the differences between the physical and social sciences.

The Science Question in Feminism

fruitfully guide scientific inquiry in some cultures but not in ours (perhaps Chinese ecologists might find this a useful metaphor). An "explanation" we cannot grasp is not an explanation. A theory's interpretation may overtly appeal to social or political metaphors at one time and not at another, but *some* social act of interpretation is necessary if we are to understand how to use the theory. Interpretation of formal "texts" through socially familiar models and analogies is central to explanations in physics.¹³

In the third place, whereas the evolutionary biologist or economic geographer must take into account purposeful and learned activities by humans and perhaps even members of other species—nonhuman feeding and mating preferences, for example—the physicist need not consider self-reflective and intentionally directed causes of the motions of mere matter. He need not do so because the observable regularities of "matter in motion" do not have these kinds of causes. I mention evolutionary biology and economic geography to indicate how deeply the social extends into what we think of as the natural. After all, explanations of apes' adaptation to (perhaps we should say "creation of") their environments and of patterns of forestation at least since our species came into existence must include considerations of just the kind of purposeful and learned behaviors (dare we say "activities"?) that are the subject matter of social inquiry. Insofar as the world around us continues to become more and more suffused with the presences and residues of social activities, there is less and less "out there" amenable to the kinds of explanations that have been so fruitful in physics. The history of the "progress" of our species is simultaneously the history of the disappearance of pure nature. I need hardly even mention the silliness of assuming that physics can provide the model for anthropological explanations of all we want to know about the regularities and underlying causal tendencies creating different kinds of kinship structures, or for historical explanations of all we want to know about the regularities and underlying causal tendencies in relationships between, say, forms of child rearing and forms of the state. I suggest that the totally reasonable exclusion of intentional and learned behaviors from the subject matter of physics is a good reason to regard inquiry in physics as atypical of scientific knowledge-seeking.

Finally, explaining social phenomena requires the interpretive skills

¹³Later (esp. Chapter 9) I examine the use of androcentric metaphors, models, and analogies in the history of Western science, and the inadequate account of the nature and functions of these figures of thought in the philosophy of science.

necessary to grasp the meanings and purposes an intentional act has for the actor—skills that have no analogue in physics. Indeed, the differences between the ontological assumptions and methods appropriate for physics and social inquiry are even more extensive than such a statement indicates. In social inquiry we also want to explain the origins, forms, and prevalence of apparently irrational but culturewide patterns of human belief and action. Freud, Marx, and many later social theorists have taken just such culturewide irrationality as their subject matter. Why, then, should we take as the model for all knowledge-seeking a science that has no conceptual space for considering irrational behavior and belief? Moreover, possibly explanations even in physics would be more reliable, more fruitful, if physicists were trained to examine critically the social origins and often irrational social implications of their conceptual systems. For instance, would not physics benefit from asking why a scientific world view with physics as its paradigm excludes the history of physics from its recommendation that we seek critical causal explanations of everything in the world around us? Only if we insist that science is analytically separate from social life can we maintain the fiction that explanations of irrational social belief and behavior could not ever, even in principle, increase our understanding of the world physics explains.

I have been suggesting reasons for reevaluating the assumption that physics should be the paradigm of scientific knowledge-seeking. If physics ought not to have this status, then feminists need not "prove" that Newton's laws of mechanics or Einstein's relativity theory are value-laden in order to make the case that the science we have is suffused with the consequences of gender symbolism, gender structure, and gender identity. Instead, we should regard physics as simply the far end of the continuum of value-laden inquiry traditions. Even though there are good historical reasons why physics gained such a central position in the thinking of philosophers and scientists, we need to ask whether its paradigmatic status today should be regarded as anachronistic, and as a reflection of distinctively androcentric, bourgeois, and Western concerns.

Let me emphasize that I do not intend to direct attention away from attempts to show how Newton's and Einstein's laws of nature might participate in gender symbolization. Improbable as such projects may sound, there is no reason to think them in principle incapable of success. Such successes would make immensely more plausible the feminist claims that the natural sciences, too, are deeply gender-biased.

In Chapters 5, 8, and 9, in examining some of the androcentric and bourgeois social values that have in fact been projected onto nature, I will show that modern astronomy and physics anthropomorphize nature no less than did the medieval sciences they replaced. But here I am making a different point. I am arguing that such a project need not be undertaken in order to convince us that modern science is androcentric. Instead, we should understand physics not as the model for all scientific inquiry, but as atypical of inquiry just insofar as its ontological and methodological assumptions can in fact secure value-free results of research.

Pure Mathematics.

The belief that mathematics has no formal social dimensions—that the “external” social history of mathematics has left no traces on its “internal” intellectual structures—provides grounds for regarding science as fundamentally a set of sentences (such as Newton’s laws) and physics as the paradigmatic science. For if the nature that modern physics describes and explains “speaks in the language of mathematics” (as Galileo claimed), and if the cognitive content of mathematics has no social characteristics, then the formal statements of physics must also have no social characteristics. We have already argued that explanations in physics cannot be “reduced” to mathematical “sentences” shorn of social interpretation. But the dogmatists’ case for a value-neutral core of pure science is even weaker than that argument suggests. Even if one could “reduce” the laws of physics to mathematical expressions, there are not sufficient reasons to think that those mathematical expressions themselves are value-free.

Of course, everyone knows that the field of mathematical inquiry has a social history. Different mathematical problems preoccupied different historical groups of mathematicians. We are told that different concepts, calculation strategies, and methods of proof were “discovered” at identifiable historical moments. But we are also told that this social history of mathematics is entirely external to the cognitive structures, the logical structures, of mathematics. The social history of mathematics is said to leave no traces on its logical structures. These “discoveries” are presented as merely examples of the always cumulative and progressive growth of mathematical knowledge.

It is sometimes claimed that if feminism is to show the value of using gender as a category to analyze science, it must show that mathematical concepts and methods of proof are androcentric, and it must

produce an alternative, feminist mathematics; perhaps feminists must even show that modern logic is sexist and that there could be a nonsexist alternative logic. This argument satisfies its makers that they have reduced to an absurdity both the very idea of a radical feminist critique of the scientific world view and the possibility of an alternative science guided by feminist principles.

I will not argue that mathematics is, in fact, *male*-biased; but two considerations make it plausible to regard as mythical the possibility of *pure* mathematics. In the first place, no conceptual system can provide the justificatory grounds for itself. To avoid vicious circularity, justificatory grounds always must be found outside the conceptual system one is trying to justify. The axioms of mathematics are no exception to this rule. Leading mathematical theorists point out that the ultimate test of the adequacy of a mathematical concept or proof always has been pragmatic: Does it “work” to explain the regularities in the world for which it was intended to provide an explanation? The history of the last two centuries of the philosophy of mathematics can be seen as the history of the struggle to arrive at this pragmatic understanding of the nature of mathematical “truths.” Our interests here do not permit a review of this history.¹⁴ But on the basis of this now widespread (if not totally convincing to all mathematicians) understanding of the status of mathematical “truths,” we should think of “discoveries” in the history of mathematics as responses to the recognition that mathematical concepts and theories, too, are tested against the historical social worlds they are designed to explain.

In the second place, in support of this kind of argument, historians of mathematics have pointed to the reasons why mathematical statements regarded as true at one time in history are occasionally regarded as false at a later time. They show that the plausibility or usefulness of what have sometimes appeared as impossible, contradictory, mathematical concepts has had to be socially negotiated.¹⁵ One kind of social imagery for thinking about mathematical objects comes to replace another. For example, the ancient Greeks—no mean mathematicians—did not regard one, the first in a series of integers, as a number, nor did they consider it either odd or even. We, of course, think of it as

¹⁴See the accounts provided by Kline (1980) and Bloor (1977). Kline argues that Andrzej Mostowski, Hermann Weyl, Haskell B. Curry, John von Neumann, Bertrand Russell, Kurt Gödel, and Quine are among the eminent mathematicians and logicians who have defended a pragmatic view of mathematical truth.

¹⁵See Bloor (1977) for discussion of these cases.

