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## *A Role for Postcolonial Histories of Science in Theories of Knowledge? Conceptual Shifts*

1. *Are postcolonial histories of science relevant to theories of knowledge? Post-World War II science and technology studies.* In his widely read study of scientific change, historian Thomas Kuhn asked “How could history of science fail to be a source of phenomena to which theories about knowledge may legitimately be asked to apply?”<sup>1</sup> However, it was not the older, “internalist” intellectual history of science to which he referred, but the new social histories that had begun to appear. The history of science that was to supply phenomena for philosophies, sociologies, and ethnographies of knowledge was no longer to be the familiar repository for “anecdote or chronology” gained from “the study of finished scientific achievements as these are recorded in the classics and, more recently, in the textbooks from which each new scientific generation learns to practice its trade.” Instead, knowledge theorists—philosophers, sociologists, and others—were to draw on resources provided by the emerging “historiographic revolution in the study of science” that was learning how “to display the historical integrity of that science in its own time.”<sup>2</sup> This project has taken on new meanings with the emergence of postcolonial science and technology studies.

Kuhn was just one of the researchers working in various disciplines in the decades following World War II whose treatment of modern sciences as historical, sociological, cultural, and political phenomena, ones no different in many respects from any other social institutions, their cultures, and practices, launched a revolution in science studies. During the same period, widespread public concern about science began to focus on how scientists should be educated, how class, race, gender, imperial and colonial interests and discourses had shaped scientific projects in the past and continued to do so in the second half of the twentieth century, and how destructive the consequences of scientific

and technological change were in such phenomena as Hiroshima, the Viet Nam war, and Cold War politics, as well as for the natural environment and for workplaces. Stimulated by such concerns, political scientists, historians, philosophers, sociologists, ethnographers, and practicing scientists joined the historians in projects designed to display the historical integrity of modern sciences with the rest of the economic, political, and social relations of their eras. Sciences and their societies, it turned out, co-constructed each other.

*Internalist scientific epistemologies and challenges to them.* These studies, and their successors in subsequent decades, have raised fundamental challenges to the conventional epistemology of modern science. A central assumption of this older theory of scientific knowledge is that the success of modern science is insured by its internal features—experimental method or scientific method more generally, science's standards for maximizing objectivity and rationality, the use of mathematics to express nature's laws, the distinction between primary and secondary qualities in nature, or some other. Science is singular—there is one and only one science—and its components are harmoniously integrated by such internal features.<sup>3</sup> That internalist epistemology, as I shall refer to it, first began to take shape with the emergence of modern sciences five centuries ago, though it has been revised and refined many times since then. It is still the prevailing theory of scientific knowledge, disseminated in science texts and popular thought about the sciences and invoked by scientists when speaking to funding sources, Congress, or the general public. It also haunts the imaginations of some of the scholarly science studies still produced in history, sociology, and philosophy—though its overt supporters are becoming scarce in these fields. For those who actually have examined the mass of historical, sociological, and ethnographic evidence produced in more than a quarter-century of examination of the integrity of sciences with the economic, political, and social projects of their eras, the internalist epistemology has become a relic of modern western "folk belief." While it still is articulated with noble intent, no longer can the historical claims upon which its plausibility depends pass the kinds of empirical and theoretical tests to which other historical claims are expected to conform.

This older epistemology has assumed that the representations of nature's order that the sciences produce can be mirror-like reflections of a reality that is already out there and available for the reflecting, in Richard Rorty's phrase.<sup>4</sup> While increasing numbers of scholars no longer believe that the historical evidence lends plausibility to the idea that scientific descriptions and explanations could actually achieve such mirror-like perfection, many of them still think that *trying* to produce them is the best goal for the sciences. After all, many other ideals that are probably unachievable in practice—such as ending jaywalking or litter-

ing, or trying always to tell the truth—are nevertheless regarded as valuable goals of human behavior. It is worthwhile to act as if it were the case that as science progresses, its representations get closer and closer to such a singular and perfectly accurate reflection of nature's unique order, according to this view.

Therefore, when sciences function at their very best, their institutions, cultures, and practices, including scientific methods, will contribute nothing culturally distinctive to the representations of nature that appear in the results of research, this line of reasoning goes. One should try to produce scientific information in which one can find no culturally distinctive interests or discursive resources of the societies that have produced the research. Of course, society and the institutions, cultures, and practices of the sciences should be understood to provide the necessary conditions for sciences to do their work, but they should not influence the results of research in any culturally distinctive way. Any and all social values and interests that might initially get into the results of scientific research should be firmly weeded out as soon as possible through subsequent critical vigilance.

This older epistemology holds not only that a modern science with such goals alone is capable of providing such an account of nature's order, but also that it is capable in principle of detecting all of nature's laws. As the issue was put in the "unity of science" form of this epistemology, there is only one "nature," one truth about it, and one science; and such a science can in principle reveal the complete, unitary, and harmoniously integrated truth about a reality that is ordered in such a way as to be available for such an accounting.<sup>5</sup>

The post-Kuhnian social studies of science projects challenge this internalist epistemology that attributes all of the achievements of the sciences to nature's order plus the sciences' internal processes—especially scientific method, understood as sharply demarcated from any other methods of obtaining knowledge.<sup>6</sup> Yet they do not adopt the "externalist" position that society is entirely responsible for science's achievements and shortcomings—that science is simply a "dupe" of societies and their politics and that nature makes no contributions to scientific claims. Instead, they take what has come to be called, somewhat misleadingly, a constructionist approach, charting how sciences (plural) and their cultures co-evolve, each playing a major role in constituting the other, in bringing it into existence in the first place and maintaining it on a continuing basis, constrained in diverse respects by nature's order. The distinctive ways that cultures gain knowledge contribute to their being the kinds of cultures they are; and the distinctiveness of cultures contributes to the distinctively "local" patterns of their systematic knowledge and systematic ignorance. "Constructivism"—with its misleading suggestion that pre-existing, fully formed "societies"

just make up ("construct") the representations of nature that they want regardless of how the world around them is ordered—is what this innovative thesis of post-Kuhnian science studies was called by those who interpreted it in such a misleading way, and this is the name that has stuck to it in popular thinking. Yet this approach would better be referred to as "co-constructivism," "co-evolutionism," or even "co-constitutionism" to emphasize how systematic knowledge-seeking is always just one element in any culture, society, or social formation in its local environment, shifting and transforming other elements—education systems, legal systems, economic relations, religious beliefs and practices, state projects (such as war-making), gender relations—as it, in turn, is transformed by them.

However, post-Kuhnian science studies are not the only such important stream of science and technology studies to emerge after World War II, or to arrive at such a co-constructivist account. Indeed, even this post-Kuhnian stream can sometimes appear parochial if one starts asking epistemological questions from outside the European-American intellectual traditions that certainly contained Kuhn's thinking and are still the prevailing ones in the science studies influenced by Kuhn's moment of disillusion with the internalist epistemologies. The internalist epistemology that Kuhn challenged is also in trouble in increasingly widespread discussions around the globe of "the epistemological crisis of the modern West." So it is fitting that this study will not position itself in the post-Kuhnian stream of science and technology studies, which from other, less eurocentric perspectives can be seen to identify some but not all of the important sources of modern West's epistemological crisis. Instead, it will start off from the borders between it and the postcolonial discussions that began to emerge during the same period. How do the conventional internalist epistemologies of modern science and also the post-Kuhnian co-constructivist accounts appear from such a standpoint, and how do the postcolonial accounts extend, enrich, and also conflict with the post-Kuhnian science studies?

*Another voice: postcolonial science and technology studies.* Postcolonial science and technology studies are only now gaining audiences in scholarly and more widespread public intellectual discussions in the United States and Europe. Though their origins go back to the 1940s and earlier, they now circulate through a recent outpouring of scholarly studies, conference reports, and science policy debates, including increasingly forceful statements by national and international agencies that have been reported in the media. Such events as the Columbian Quincentennial and the United Nations' Rio Earth Summit, both in 1992, also stimulated interest in this work. It is interesting to see how the kind of co-constructivist accounts developed in the northern studies have arrived from a different route and with somewhat different focuses in these accounts.

The chapters that follow will examine how the concerns of these studies have both converged with and diverged from those of post-Kuhnian science and technology studies. Included in such examinations will be important feminist components of both post-Kuhnian and post-colonial science studies: both contain distinctive feminist analyses that take a somewhat different angle from the analyses of their “prefeminist” colleagues. Moments of scientific and technological change are always sites of struggle over how the benefits and costs of change will be distributed. Gender projects interact with international, national, and more local ones in ways that shape the outcome of such struggles. In both post-World War II schools (post-Kuhnian and postcolonial) of science and technology studies, the feminist components are not only in alliance but also in conflict with their “fraternity.” And the northern and southern feminist analyses are also both in alliance and in conflict with each other.

This book’s concern will be to reflect on some of the epistemological lessons that can be learned from these complex, rich, and important convergences and divergences. How should philosophies of science be reshaped to account for modern sciences’ history, achievements, limitations, and possible futures identified in these kinds of studies that share skepticism about the conventional internalist epistemologies of science? How could we best revise conventional ways of thinking about the knowledge traditions of other cultures in light of these revelations?

Though this study will not position itself inside the post-Kuhnian stream of science and technology studies, it will remain in continual alliance and dialogue with it. Continuing such a dialogue begun in preceding paragraphs, one could say that now, more than three decades after the appearance of Kuhn’s account and the first studies for which his work (among others) provided the maps, postcolonial science and technology studies are beginning to create a second “historiographic revolution”—one stimulated by reflections on the integrity in their own times of sciences and technologies with their global contexts. The new postcolonial science studies bring fresh perspectives to charting the integrity of European sciences with Europe’s global economic and political relations, to accounting for the history, culture, and practices of science and technology projects of non-European cultures, and to identifying relationships between European and non-European science and technology projects—especially since 1492.

How did the postcolonial science and technology studies originate? What is so innovative about them?

*Postcolonial origins.* Apparently the first clues to the possibility of postcolonial accounts of the dependency relations between the emergence of modern sciences and technologies in Europe and European expansion began to appear over fifty years ago. A West Indian historian looked at how the immense profits from Caribbean plantations had

played such a large role in making possible industrialization in Europe. And an Indian historian began to examine how the British intentionally destroyed the Indian textile industry in order to create a market for the importation of British textiles.<sup>7</sup> Since scientific and technological knowledge, in Europe and in Europe's overseas targets of imperial control, were central to both historical moments (as we shall see in chapters to follow), it began to appear that scientific and technological growth in Europe were advanced through such processes in European expansion. Moreover, such expansion in turn appeared to be advanced by the development of modern sciences in Europe and the decline of "local knowledge traditions" in the Caribbean and in India. These prefigurings of the subsequently developed world systems theory contained important claims about how European expansion and the growth of modern sciences and technologies in Europe were causally linked.<sup>8</sup> In the 1950s and 1960s, challenges to the prevailing diffusionist model of scientific and technological growth, and to the presumed irrelevance of European imperialism to such processes, emerged in Europe, Australia, and other parts of the world.<sup>9</sup>

The new interest in causal relations between European expansion and the emergence of modern sciences in Europe has also helped bring into focus how scientifically and technologically advanced some other cultures have been relative to Europe's most advanced cultures—in some respects until well into the eighteenth century. Studies of contemporary non-European cultures' scientific and technological practices draw attention to some of their capacities and abilities that European sciences and technologies today lack—topics to be pursued further in the chapters that follow.<sup>10</sup> From the perspective of these studies, it is clear that modern, European sciences and technologies have not been the only highly accomplished ones in the past, that they have serious limitations today, and that there is little reason to think they will be the only highly accomplished ones in the future.

Indeed, the postcolonial studies have been able to bring into focus what a tragedy it would be should the human species arrive at one and only one universally valid scientific and technological tradition. The modern European epistemological dream of a perfectly coherent account of all of nature's regularities, one that perfectly corresponds to nature's order, is beginning to take on the character of a nightmare, as some of the post-Kuhnian studies as well as the postcolonial studies have grasped.<sup>11</sup> However, just what shape global sciences and technologies will take in the future cannot be clearly foreseen in any of these accounts since their future will be an outcome of struggles over their direction that surround and engage us even now.

Finally, the most recent critical analyses of the successes and failures of so-called Third World "development" have highlighted issues that

have only been glimpsed otherwise. Development has been conceptualized in the North as the transfer of European models of industrialization—of European sciences and technologies—to the “underdeveloped” societies in the Third World. However, postcolonial development studies show that this kind of process has primarily de-developed the vast majority of the peoples who were supposed to benefit from such science and technology transfers. These accounts have drawn attention to how such development knowledge systems largely have been constituted by distinctively European and North American cultures’ projects—including distinctively gendered ones—that insure a far more limited grasp of nature’s order than conventionally has been imagined.<sup>12</sup>

Moreover, such studies show that we have appreciated modern sciences in part for the wrong reasons. It is not their ability to immunize their accounts of nature’s order against all the cultural elements in their making and continued use that is responsible for their great successes, as has been assumed. Rather, it is the ability to neutralize some such cultural elements while fully exploiting others that has been responsible both for their successes and their failures. In those cases where they have been most successful, they have been able to maintain a crucial tension between maximally “global” and firmly local elements in the resources they bring to charting nature’s order—though even the particular ways in which “global” elements are used are not culture free. From such a perspective, the “universally valid” versus “merely applied” science distinction appears to have no role to play in the history or philosophy of science since its useful work is done by the historically more accurate and philosophically more coherent accounts of fruitful tensions between the maximally global and the firmly local—a topic to be pursued in later chapters.

*Postcolonial innovations.* The account of the origins of postcolonial science and technology studies already points to important contributions they make to our understanding of the “integrity of sciences” with their distinctive global and local histories. One can conceptualize the innovations created by this kind of study in other useful ways.

For one, the postcolonial studies use as their evidence not the kind of European history and world history most of us learned but, instead, the now widely disseminated postcolonial, multicultural, global histories. In this context, the older form of history can be referred to as “isolationist history,” for it recounted the histories of Europe, Africa, China, the Americas, and the societies of other parts of the world as largely separate and self-contained chronologies, more or less isolated from each other except for the one-way diffusion of the achievements of European societies to the others. In such history, Europe gets to appropriate ancient Greek achievements as the origins of modern European culture, and other cultures in today’s world are presented as the latest stage in



their own historical "tunnels" back through the centuries—that is, where any historical change at all is attributed to these other cultures.

In contrast, the postcolonial histories look at how cultures have been interacting with each other from the beginning of recorded human history. Cultures have exchanged shells, beads, seeds, cattle, manufactured goods, women, and scientific and technological ideas. Scientific and technological ideas have always been the easiest to transport from one culture to another and the quickest to travel through a receiving culture's networks. (They weigh very little, don't have to be fed, and don't run away!)<sup>13</sup>

This new kind of science studies differs from familiar kinds in yet other ways. Its subject—the "speaker" of these studies, the position from which they are organized—is not the "rational man" (European) from the perspective of whose experiences, interests, and desires isolationist histories were organized. Science in global history no longer is to be understood from the conventional eurocentric perspective that shaped earlier studies.<sup>14</sup> Instead, the conceptual framework of postcolonial science and technology studies is organized from the standpoint of other, non-European cultures and the great masses of the world's economically and politically most vulnerable people who live in them. Their scientific and technological needs and desires are not always those of elites in the North or in their own societies. On such "have nots" the development of modern sciences and technologies has had few beneficial and many detrimental effects. Thus, this postcolonial science theory organizes its concerns and conceptual frameworks from outside the familiar eurocentric ones and, in that sense, its "subject" or "author" is not the familiar enthusiastic European beneficiary of northern sciences and technologies. Such a strategy enables postcolonial theory to detect features of different cultures' scientific and technological thought and practices that are not visible from within the familiar western accounts of science. This new kind of account does not merely add new topics to conceptual frameworks that are themselves left unchanged. Instead, it forces transformations of them.

Postcolonial science studies differ from conventional and much of the more recent northern histories and philosophies of science in another way. The former has firmly rejected the role of disinterested observer of sciences in history—mere "handmaids" to the sciences, as John Locke put the point—that is often (though not invariably) the self-assigned role of northern science studies. Instead it engages with both discussions within the sciences about how best to represent nature's order and with science and technology policy. It joins scientists in critically examining which are the scientifically most defensible descriptions and explanations of nature's regularities; in this way it provides resources for more accurate and comprehensive scientific and technological thought. Such

a project has implications for science policy, and the postcolonial studies are interested to propose which kinds of sciences will most advance both the growth of knowledge and the social welfare of the most vulnerable groups in their cultures. Thus, the postcolonial studies provide valuable resources for current public debates about sciences in a multicultural and global society—what kinds of sciences we have had and have now, what kinds we can get, and what kinds we could or should want. Since modern European sciences are desired, produced, and used around the world these days, their “world” is necessarily multicultural, and global international social relations as well as the more local ones that sustain them are also shaped by their effects. This is not to say that the post-Kuhnian accounts never enter such larger public debates; increasingly they are doing so. Rather, in contrast to the postcolonial accounts, their conceptual frameworks mostly have not been organized to serve such overtly “political” projects but, instead, the historical, sociological, and epistemological ones that they share with the postcolonial accounts.<sup>15</sup>

These are controversial issues, and we shall be pursuing them further in subsequent chapters. Here we can repeat Kuhn’s 1960s question with a new inflection: how could the recent interactionist accounts of sciences and technologies in multicultural and global (and gendered) history fail to be a source of phenomena to which theories about knowledge may legitimately be asked to apply?

Before turning to examine in greater detail the claims of postcolonial science and technology studies, it will help to make an initial attempt to clarify central terms and claims in the post-positivist, co-constructivist, postcolonial, feminist conceptual framework within which this essay will explore its topics.

2. *Conceptual shifts. a. Science.* There are several reasons why readers may find it strange to use the term “science” to refer to beliefs and practices of non-European cultures, as will be the practice here. For one, such usage can appear to ignore important differences between achievements of European cultures during the last five centuries and what are often regarded as only traditional beliefs and practices of other cultures. Commitment to the difference in kind of the beliefs and practices advanced by European sciences is central to the self-conception of many people around the world as modern, enlightened, progressive, and guided in our beliefs and behaviors by the highest standards of objectivity and rationality. Thus, modern science has been conceptualized as contrasting with earlier European and non-European cultures’ magic, witchcraft, pre-logical thought, superstitions or pseudosciences; with “folk explanations” or ethnosciences that are embedded in religious, anthropomorphic, and other only local belief systems; with merely technological achievements or merely speculative claims about the natural world; or with “precursors” to true sciences. Clearly, northerners

have had a problem figuring out how to refer to the science and technology traditions of other cultures.

Perhaps there is something useful still to be found in such contrasts. However, whether or not this is so, they restrict the meanings and references of "science" in ways that are intellectually costly, as chapters that follow will explore. That is, one does not have to demonstrate that there is no longer anything at all useful in such contrasts in order to justify abandoning them or using them only very, very carefully in very limited contexts. One can instead point out that the costs outweigh the benefits of continuing to employ them. Such contrasts are often invoked only implicitly—for example, through locating the examination only of modern European sciences in a history or philosophy of science curriculum or course, while the study of "indigenous knowledge systems" must be pursued elsewhere, in the anthropology department. Through such practices do history, philosophy, and anthropology departments become complicit in eurocentric depictions of objectivity and rationality as at home in the West and "bias" and irrationality as at home with the rest of the world's cultures. These forms of institutional and social eurocentrism serve eurocentric interests even more effectively than do the overt references to witchcraft and superstitions, and so on, that educated middle classes are sometimes today taught to avoid in the name of tolerance. This study will use a more inclusive definition of science, one that encourages us to reexamine just when it is useful and when it is too costly to invoke a more restrictive definition. "Science" will be used to refer to any systematic attempt to produce knowledge about the natural world, just as "social science" refers to systematic attempts to produce knowledge about social worlds.<sup>16</sup>

However, this usage risks advancing eurocentrism on another front. Why should a cultural practice have value only if it can be squeezed into categories designed by Europeans to appreciate European institutions, their cultures and practices? Though the extension of this term to other cultures' science and technology traditions clears a space for countering eurocentrism and for advancing the growth of knowledge in one way, it can appear to promote eurocentrism and its forms of systematic ignorance in another way. Why not just leave "science" referring to European projects and critically appreciate in the terms used by other cultures their inquiries into nature's regularities and the best explanations of them? The Chinese, Arabic, and Andean indigenes did not refer to their systematic knowledge about the natural world as "science." (At this point northerners could recollect that neither did Europeans until fairly recently. "Natural philosophy" was the term used to refer to the accomplishments of Galileo, Kepler, Harvey, Boyle, and Newton until well into the nineteenth century. The term *scientist* was first used by William Whewell in 1840.)<sup>17</sup>

Attractive as such anti-eurocentric reasons are for continuing past practice, in my view they are not good enough to restrict the term in conventional ways only to sciences that have emerged in Europe. The contrast between science and superstition, precursors, and so forth, has been too useful a tool of eurocentric thinking to leave familiar usage a good choice for this study. Therefore, this study will stick with the more inclusive usage, though readers should keep in mind the way this enacts yet another piece of cultural imperialism that we will wish to move away from in other contexts. One should note here also that even this inclusive definition already is more restrictive than is common in Europe, where "science" is assumed to refer also to social sciences and even to the humanities. What is meant by "science" will be expanded and complexified in yet other ways in the chapters ahead—for example, as we come to see how knowledge about the natural world is intertwined with and even constituted by knowledge about the social world, and vice versa, in both the so-called natural and social sciences.

One of the conventional contrasts with "real science"—namely technology—deserves a few more words at this point. Does this study conflate science with technology when it consistently links science and technology studies, and when it refers to practices of other cultures as scientific that conventionally are regarded only as technological? The short answer is "no"; there are good reasons to link science and technology studies and to expand the referents of "science" to include systematic knowledge about the natural order produced in societies that do not have what is conventionally thought of as modern sciences. Most crucially, modern scientific knowledge is itself constituted through the technological practices of scientific research—a point mentioned in opening this chapter. The experimental method that is claimed to distinguish modern sciences, whether practiced in laboratories, field sites, or at computers, constitutes (co-constructs) scientific knowledge through technical interventions in nature. Thus, quite apart from how the information science produces is used, the very production of that information is technical. Moreover, such research technologies also often prefigure the applications and technologies for which such scientific information will be useful. Thus, scientific knowledge is inseparable from the technologies of its production, these have social and political preconditions and effects, and they provide blueprints for subsequent technological innovations.

On the other hand, there may well be reasons to discuss technological knowledge and its advancement without reference to advances in scientific knowledge, since it is clear that the former can occur without the latter. There was no new scientific knowledge necessary for the invention of the infant back carrier—the "baby backpack"—now so widely used in the West in the last quarter century. Historians of public health

have argued that improved nutrition and public health practices, not advances in medical sciences, were largely responsible for the great decreases in mortality that occurred in late-nineteenth- and early-twentieth-century Europe and North America. Historians of science have begun to doubt that advances in scientific knowledge were responsible for as much of European industrialization prior to the late nineteenth century as is conventionally claimed. Thus, the growth of technological knowledge cannot be conceptualized as dependent upon the growth of scientific knowledge (and may even have its own epistemology), though the latter seems to be dependent on the former.<sup>18</sup>

Further on we will see how a number of other dualisms used to police the borders between "real sciences" and "not really sciences" are no longer useful or have far more limited usefulness than has been assumed.

*b. Eurocentrism.* What is eurocentrism? There is a widespread temptation to understand it as the overt or covert prejudices of individuals. Thus, eurocentrism is thought of as an expression of individuals' false beliefs and bad attitudes, just as are related cases of racism and sexism. However, it has long been demonstrated that the beliefs and behaviors of individuals are more adequately understood as the consequences, not the causes, of institutional, societal, and civilizational (or "philosophical") social structures and discursive assumptions. The prejudice account does not fit the empirical evidence, for the groups whose actions are most responsible for maintaining institutional, societal, and civilizational racism, sexism, and eurocentrism often are not at all prejudiced toward those who bear the costs of such discrimination. These administrators and managers of transnational corporations, of local, national, and international government agencies, of educational, research, and health care systems, and so on, often have good attitudes toward people of other races, genders, and cultures, and sometimes have relatively few false beliefs about them. Educated to understand how hurtful and unseemly it can be to express such false beliefs and bad attitudes, these groups practice "tolerance" instead.<sup>19</sup> However, such practices can often mask the far more powerful forms of institutional, social, and civilizational/philosophical eurocentrism that such groups are assigned to administer and manage.

Understood only as a set of beliefs and attitudes, eurocentrism is one of those socially powerful *incoherent* concepts, the usefulness of which is to be found in its incoherence.<sup>20</sup> When eurocentrism is understood as prejudice, the least-visibly eurocentric groups can, intentionally or not, most effectively advance eurocentric institutional, societal, and civilizational practices. To say this is not to attribute such eurocentric motivations inevitably to those who design and maintain eurocentric institutions, for while some have such covert intentions, others may not. Some

may actively abhor eurocentrism and yet end up with beliefs and behaviors that advance it. Thus, good intentions and tolerant behaviors are not enough to guarantee that one is in fact supporting anti-eurocentric beliefs and practices. It is therefore useful for those who bear the costs of eurocentrism—and many peoples of European descent will correctly perceive themselves to be in this group, as we shall explore later on—to understand it as fundamentally a set of institutional, societal, and civilizational arrangements for distributing scarce economic, social, and political resources.

In pursuing the analyses of this study, it will help to keep in mind five forms that eurocentric and other such discriminatory beliefs and practices can take in order to distinguish which kind is the target of criticism in each analysis.<sup>21</sup> The first two forms, overt and covert eurocentric beliefs and practices, are intentionally enacted by individuals. The overt ones are openly expressed and practiced; covert ones are hidden by their perpetrators. For example, to dismiss openly the effectiveness of acupuncture as merely “folk belief” or of herbal pharmacologies as superstitions would be to practice overt eurocentrism. However, to dismiss them on the grounds that one’s doctor does not recommend them, while believing that because they are non-European health practices they must be inferior, would be to practice covert eurocentrism.

Institutional eurocentrism occurs when medical associations do not admit trained acupuncturists or herbal pharmacologists, medical and pharmacology schools do not include training in such treatments, history of science and medicine journals will not publish accounts sympathetic to such practices, and history of science and medicine courses leave such traditions out of their accounts, perhaps sending students who request such information to the anthropology department or the ethnic studies program. Here, institutional practices have eurocentric effects upon both Europeans and non-Europeans. In such cases, perfectly well-intentioned individuals, even ones who understand the health value of such nonmodern European practices, advance institutional eurocentrism to the extent that they fail to challenge the conceptual frameworks that legitimate such discriminatory practices in these institutions.

Societal eurocentrism occurs when the kinds of beliefs evidenced by such institutional practices are in fact held by the larger culture that establishes and maintains the institutions mentioned in the preceding paragraph. The institutions’ practices simply express widespread social assumptions. Thus, it would be a case of institutional and societal eurocentrism if virtually no one in the larger U.S. culture disagreed with such a low opinion of acupuncture and herbal pharmacologies, but only institutional eurocentrism if the medical associations, the medical and pharmacological schools, the journals, and history courses refused to

recognize the value of these traditions in the face of obvious acceptance of such practices by otherwise "perfectly rational" and informed members of the larger society—the situation that is, one hopes, about to be avoided in these two cases in the United States as a few leading medical and health care institutions begin to legitimate these bodies of knowledge—these sciences—and their therapeutic technologies.

Civilizational or philosophic eurocentrism occurs when the beliefs and practices at issue are held by entire "civilizations" over large periods of history, not just by one of their subcultures. These are the most difficult to identify because they structure and give meaning to such apparently seamless expanses of history, common sense, and daily life that it is hard for members of such "civilizations" even to imagine taking a position that is outside them. "The scientific worldview," "the modern worldview," the Christian, Judaic, Islamic, Ancient Greek, or Chinese worldview provide examples of such widespread and long-term belief systems within which, in spite of great diversity of many beliefs and practices over time and between subcultures, distinctive shared or continuing beliefs and practices nevertheless can be identified. In such broad contexts, eurocentrism appears as an ethic, an ontology, and an epistemology; we can speak meaningfully of eurocentric ethical, ontological, and/or epistemological beliefs and practices. The assumption that modern science is trans- or a-cultural, and thus could not be multicultural or androcentric in any fundamental way, is just such a civilizational belief for most members of the educated middle classes in Europe, the Americas, and elsewhere around the globe. The "European diaspora" has greatly expanded the boundaries of eurocentrism.

As a civilizational practice, eurocentrism is a "discourse" in the rich, materialist sense that includes, but is not restricted merely to, ways of thinking or speaking.<sup>22</sup> Central among the presuppositions of eurocentric discourses are that peoples of European descent, their institutions, practices, and favored conceptual schemes, express the unique heights of human development. Moreover, peoples of European descent and their civilization are presumed to be fundamentally self-generated, owing little or nothing to the institutions, practices, conceptual schemes, or peoples of other parts of the world. These assumptions have organized in different ways in the last several hundred years—but especially since the eighteenth century—economic, political, historical, legal, geographical, archeological, sociological, linguistic, anthropological, psychological, pedagogical, literary, art historical, philosophical, biological, medical, and technological institutions and their practices.<sup>23</sup>

What is most startling, and disturbing, from such a perspective of institutional, societal, and civilizational eurocentrism is to realize that even individuals with the highest moral intentions, and with the most up-to-date, state-of-the-art, well-informed, rational standards accord-

ing to the prevailing institutions and their larger cultures, can still be actively advancing institutional, societal, and philosophic eurocentrism. The prevailing institutional and cultural standards turn out themselves to be significant obstacles to identifying the eurocentrism of institutional, societal, and civilizational beliefs and practices.<sup>24</sup> It is these more extensive, harder to detect, forms of eurocentrism with which this study is concerned.

*c. Postcolonial.* This brings us to the term *postcolonial*. For most beneficiaries of colonialism, the colonial conceptual framework functioned at institutional, societal, and perhaps even civilizational levels. While such beneficiaries could always imagine postcolonialism as a possible future nightmarish state of affairs against which they had to defend themselves, there was no hint in the thinking of most of them that anticolonial institutions and their underlying assumptions could be reasonable and/or desirable ones for people like themselves.

The term has had many other referents and meanings. There is also its temporal reference to the period of time that began in the 1960s, marked by the end of formal European colonialism, that will persist indefinitely far into the future—the postcolonial era. There is the condition of being no longer formally a colony or member of such a colony of one of the European states; new nation-states and their citizens are postcolonial. However, a variety of concerns and stances called postcolonial also appear in discussions about what are the most accurate and desirable understandings of colonialism, what are and should be the present relations between ex-colonials and their former colonizers, and what should be their future relations with each other. For example, there is the postcolonialism that is still imagined to lie only in the future by those who find the contemporary development policies of the international agencies and northern nations merely “colonialism by other means.” There is the postcolonialism that is a return to or revival of precolonized voices, institutions, cultures and practices by the formerly colonized. There is the postcolonialism that appeared within colonialism as a critical counterdiscourse by the colonized, and the different postcolonialisms that appeared within colonialism by those with the privileges of the colonizers—the discourses of the critics, protesters, dissidents. These postcolonialisms, along with “the end of colonialism” mentioned above that is always imagined as a possible future feared by the colonizers, were features of colonialism itself.

The critical counterdiscourse by the colonized can appear either as an oppositional discourse, by those who, say, actively work to overthrow the rule of the colonized, or as a more ambivalent, complicitous discourse by those who criticize the evils of colonialism even as they also extol its virtues and its necessity. There is the postcolonial critique of those in hybrid conditions at the borders between the colonizers and the



colonized—educated Indians in London, or French visitors to the eighteenth-century American South. Today many students, scholars, and citizens in Europe and the United States provide such postcolonial critiques from these borderland locations.<sup>25</sup> Another kind of postcolonialism appears in the critique by those settler colonials who themselves were also colonizers of the indigenes—for example, in the successors to “commonwealth literature” from Australians, Canadians, and British South Africans, but also present in the Spanish, Portuguese and French Americas, and other such places around the globe. Moreover, there are forms of postcolonialism linked to postmodernism and/or to postorientalism, and forms that are not.<sup>26</sup>

These different historical positionings with respect to colonialism create different concerns in the postcolonial science and technology studies also, and it is not always easy to sort them out without more detailed knowledge of the histories of their development. However, there are three guidelines one can extract from even this mere glimpse of the diversity of meanings and referents for the term and the complexity of the conceptual and political terrains on which it has been found useful. One is the obvious observation that postcolonialism is not monolithic, and the diversity of its concerns and stances provides valuable resources for thinking about the social and historical contexts in which scientific and technological changes occur. What looks like a reasonable claim or practice in one context can be problematic in another. A second is that we might do best to follow anthropologist David Hess’s lead and think of “the postcolonial” as a kind of critical discursive space opened up both within and after the end of formal colonialism, where diverse positionings, discussions and other practices can occur.<sup>27</sup> We can employ the category of the postcolonial strategically as a kind of instrument or method of detecting phenomena that otherwise are occluded.

Third, it can be useful to speak of “decolonization” and “decolonizing” as a distinctive political and intellectual tendency within postcolonial spaces and their diverse discussions. Such terms draw attention to the necessity of active intervention in still prevailing and powerful discourses, their institutions, and practices, in order to end the forms of colonialism and neocolonialism that still structure most people’s lives in the North and everywhere else around the globe. Such terms counter the tendency to think of the postcolonial as a kind of state of grace from which we lucky people get to benefit without exerting any political or intellectual effort. This book is most interested in science studies that aim to decolonize thinking about sciences, nature, and history and, thus, the ongoing practices of sciences and their technologies in the North and the South.

*d. Postcolonial and feminist standpoints.* This study will operate from a postcolonial and feminist *standpoint*.<sup>28</sup> What does this mean? For one,

as the discussions above reveal, these adjectives mark critical and theoretical positions or possibilities. *Postcolonial* is not a geographical, national, or racial category, nor is *feminist* a women's identity, let alone a biological category. *Postcolonial* and *feminist* are not identities in the sense of pre-existing natural or social roles into which one is born or which one otherwise unreflectively acquires. However, if one conceptualizes identities in a different way, as commitments to chosen political struggles or to distinctive visions of the future, as has been widely argued for example about such identities as "black" and as "chicano," then "postcolonial" and "feminist" could usefully be thought of as identities. No one is born black, chicana, postcolonial, or feminist, in this way of thinking. Nor can anyone simply exert one's will power and choose one or more of these as a legitimate identity. Nevertheless, these are chosen identities.<sup>29</sup>

Less problematically, postcolonialism and feminism can usefully be thought of as thinking spaces that have been opened up by changes in social relations and in ways of thinking about them—by changes in "discourses." Within such spaces, new kinds of questions can be asked and new kinds of possible futures can be articulated and debated. Starting thought from the lives of those people upon whose exploitation the legitimacy of the dominant system depends can bring into focus questions and issues that were not visible, "important," or legitimate within the dominant institutions, their conceptual frameworks, cultures, and practices.<sup>30</sup> Postcolonialisms and feminisms articulate such standpoints. Important postcolonial analyses have been produced by Egyptian, English, Afro-Caribbean, Pakistani, Brazilian, French, U.S., and Sri Lankan citizens, among others, of many "races," ethnicities, and mother tongues. Important feminist accounts have been produced by men.<sup>31</sup> Thus, such standpoints are critically and theoretically constructed discursive positions, not merely perspectives or views that flow from their authors unwittingly because of their biology or location in geographical or other such social relations.

This study is only *a* standpoint, not *the* postcolonial and/or feminist standpoint. The standpoint of this book is itself historically locatable in just the way that are the cultural histories, their practices and meanings, that it examines. (Though it is not thereby epistemologically relativist, as paragraphs below and later chapters will show.)

Such an epistemological stance is positioned against the "positivist," internalist epistemological ones that, explicitly or implicitly, largely continue to frame systematic knowledge-seeking projects about nature and society. However, it is also not an ethnography of the scientific and technological cultures of other societies, though it will draw on such ethnographies for evidence for its claims. It does not seek to show the "rationality" of other scientific and technological cultures from the

perspective of their inhabitants, as ethnographies so often have done. It does not speak *for* others, for peoples from non-European cultures, though it is informed by their accounts. It does not “study down,” sympathetically describing for metropolitan audiences the beliefs and practices of peoples located at their peripheries, though it uses such accounts as evidence for its claims. These kinds of projects, with which this study might be conflated, can be worthy ones (or not), but they are not the project of this study.

Instead, the standpoint from which this work is organized is one shared with other projects interested in countering eurocentric and androcentric science and technology policies and their effects. It intends to bring into clearer focus new questions but, like all standpoints, is not usually able to answer them in any final way. Instead, I hope that it generates wider discussion of crucial issues that were either invisible, considered unimportant, or delegitimated. I further hope that it can advance the growth of knowledge by making visible aspects of nature, sciences, history, and present-day social relations that are hard or impossible to detect from within the ways of thinking familiar in the dominant European and North American institutions, their cultures, and practices.

*e. Strong objectivity: In opposition to epistemological relativism.* Does using postcolonial and feminist standpoints necessarily decrease the objectivity of the arguments that follow? Does it commit this study to a relativist position? For many readers, these may seem like the necessary consequence of abandoning the familiar internalist epistemology and framing this work within postcolonialisms and feminisms. However, they would be wrong to draw such a conclusion. Instead, this study is committed to strengthening the objectivity of understandings of modern sciences and technologies, of the sciences and technologies of other cultures, and of historical and possible future relations between them. Identifying eurocentric and androcentric elements in the conceptual frameworks used to think about scientific and technological change, and in sciences and technologies themselves, expands our knowledge of nature, sciences, and social relations. “Starting thought from marginalized lives,” as standpoint epistemologies recommend, thus provides more rigorous, more competent standards for maximizing objectivity.<sup>32</sup>

Such a program for stronger standards for objectivity draws attention to the sociological or historical relativism of all assumptions and knowledge claims—even the most abstract and apparently transcultural ones of modern European sciences. Assumptions and claims always originate from the projects of some particular culture at a determinate historical moment, and they continue to prove useful, or not, to these and other later cultures. However, the strong objectivity program rejects the epistemological or judgmental relativism that assumes that because all

such assumptions and claims have local, historical components, there is no rational, defensible way to evaluate them. It rejects the idea that all claims are equally valid, that all cultures' science and technology projects are equally defensible, for any and all purposes. It rejects the assumption that if one recognizes the social, historical relativism of knowledge claims, one is forced to epistemological, judgmental relativism.

One problem with such a justification for epistemological relativism is that every epistemological position—internalism's absolutism no less than the historical relativism, as well as standpoint approaches—assumes that different cultures, peoples, or eras hold different beliefs about nature and social relations. Recognition of historical or sociological relativism does not force the absolutists to a relativist position; they hold that, nevertheless, there is one and only one defensible knowledge system, namely that of modern Europe. The standpoint approach, with its strong objectivity program simply disagrees: different cultures' knowledge systems have different resources and limitations for producing knowledge; they are not all "equal," but there is no single possible perfect one, either.

Thus, this study's third position conflicts with the epistemological relativist's about the logical consequences of historical/sociological relativism. Not all proposed standards for knowledge are equally good—indeed, some are not only inadequate, but dangerous to their believers' lives. One can easily be killed by poisonous foods, wild animals, excessive availability of handguns, drunk drivers, toxic environments, dangerous and faulty technologies, and cigarettes, for example, if one does not carefully evaluate the standards that friends, strangers, and diverse institutions use to sort knowledge claims into the reliable and the unreliable. However, there also is not just one adequate standard for knowledge, but different ones for different purposes. Some standards for adequate knowledge claims produce a rapid growth in knowledge about causes of cancer to be found within individuals and their lifestyles, and they also produce systematic ignorance about environmental causes of cancer for which military, governmental, and transnational economies are responsible. Other standards for adequate knowledge claims could produce different patterns of knowledge and ignorance about the causes of cancer.<sup>33</sup>

Hence, the postcolonial and feminist positioning of this study is precisely what advances its commitment to stronger standards of objectivity and against epistemological relativism.

f. After "*realism versus constructivism*." It should not need to be said, but probably does, that the choice between absolutist forms of realism and constructivism offers only inadequate options from the perspective of this study. Of course "there is a world out there," "reality exists," and successful, useful sciences and technologies, modern or not, have to be

good at grasping a great deal about the realities of the parts of the world with which they interact. However, scientific and technological ideas and principles, too, bear distinctive marks of their social production and uses, though, as indicated earlier, "co-constructed" is a better way than "constructed" to think about the relationship between cultures and their knowledge systems. The old duality of "realism versus constructivism," like the others mentioned, has become an obstacle to our understanding of nature's order and the resources and limitations of current practices and proposals for developing knowledge about it. We can retain the best of both realist and constructivist understandings of the relations between our social worlds, our representations, and the realities our representations are intended to represent by thinking of co-evolving, or co-constructing, cultures and their knowledge projects.

*g. After the universality ideal.* Similarly, we can ask what is gained and what is lost by conceptualizing scientific and technological claims as universal versus only as merely local ones. The argument here will be that cultures are not only "prison houses" for the growth of scientific and technological knowledge, as they have usually been conceptualized. They are also "toolboxes" for such projects. Cultures generate scientific and technological projects to serve distinctively local interests and needs in the first place. Moreover, the diversity of the cultural resources that they bring to such projects enables humanity ever to see yet more aspects of nature's order. Cultures' distinctive ways of organizing the production of knowledge produce distinctive repositories of knowledge and method—through different kinds of laboratory or field experiments, through the "voyages of discovery," through farmers', travelers', mothers', and cooks' daily practices over time. The limit of such resources can never be reached as long as cultures continue to change over time and new ones emerge in the diasporas and interstices of older cultures. Thus, we would do better to think of scientific and technological claims as located on a continuum where "global" occupies one pole, "local" the other, and "universal" disappears as no longer useful.

Does it need mentioning that, of course, nature's "law of gravity" will have its effects on us whether we are Chilean or British, Catholic or Moslem, masculine or feminine, and whether or not we are aware of or believe it? What is at issue in the universal science disputes is not such phenomena, but whether there is one and only one best way for all purposes, now and in the unforeseeable future, to represent such an aspect of nature's order.<sup>34</sup> These issues, too, will be explored further below.

*h. Robust reflexivity.* And what is the epistemological status of this account? It, too, must be understood as a local knowledge system, developed from a determinate location in contemporary social relations and available discursive resources. It must acknowledge for itself the same critical standards it proposes for everyone else's knowledge sys-

tems. It will have to meet “robustly reflexive” standards—the very conditions it claims most advance the growth of knowledge in the scientific and technological cultures it examines. It cannot exempt itself from the conditions it identifies in the best historical examples of the growth of knowledge, as is characteristic of the “positivist,” internalist epistemology as well as the uncritical, epistemologically relativist positions to which it objects. It must understand itself as shaped by social, historical conditions, just as it does the epistemologies and sciences it examines. And yet it must nevertheless be able to provide plausible evidence for its claims. This is what is required by a “robust reflexivity”—another issue to be explored below.

*i. Strategic categories and concepts.* Finally, it follows from the considerations raised above that the necessarily simplifying categories to be used in this account should be understood not as claims to “name reality” in some authoritative, perfect manner, but rather as ways of gaining a fresh perspective that can bring to our attention aspects of scientific and technological cultures and the worlds within which they exist that would otherwise be hard to detect. Thus, these categories are strategic rather than ontological. For example, the question here is not “are sciences (and our accounts of science) really realist or really constructivist?” but, rather, what can we learn about nature’s order and about sciences by employing such frameworks, and what kinds of systematic ignorance are created by imagining there to be only two such discrete categories into which we are supposed to stuff all claims to empirically and theoretically adequate beliefs and practices? The categories and concepts found most useful for the project of this study at this time may well not be the best ones for other projects or in other contexts.

3. *Conclusion: Political stakes.* These are some of the main conceptual landmarks that have helped to map the space within which the concerns of this study will be pursued. Such maps, and the concerns that they make it possible to pursue, have more than scholarly consequences.

As the old saying goes, knowledge and power are intimately linked. That is nowhere more obvious than in the global political economy today. It is commonplace to note that since World War II, the base of this economy has shifted from heavy industry to information technologies and service industries. Thus, scientific innovation has moved even more firmly to the base of the contemporary economy. Whoever already owns “nature” and has access to it, whoever has the capital and knowledge to decide just how they can best access nature’s resources and how such resources will be used—these are the peoples to whom the benefits of contemporary scientific and technological change largely will accrue. The majority of the world’s peoples, in the North and the South, and especially women in every culture around the globe, have few of these resources. They do not own parts of nature; they do not have the resources to access its energies and powers; and they are systematically

denied access to the knowledge of how to gain access to such parts of nature or technical resources. Since moments of scientific and technological change are always sites of political struggle over who shall get the benefits and who bear the costs of such changes—and over who gets to make such decisions—the majority of the world's peoples will lose such struggles. Under such circumstances, it is difficult to understand how “more science and technology” of the kinds favored by the world's “haves” can fail to further enlarge the gap between themselves and the “have nots.” This is a disturbing recognition for all of us who thought that more science and technology could advance *human* welfare and *social* progress, not the welfare and progress predominantly of the economically and politically most well-off at the expense of the welfare and progress of the vast majority of the globe's populations that are already the most economically and politically vulnerable.

Thus, scientific and technological changes do play central roles in advancing or blocking processes of global democratization. And the dreadful scenario just sketched out appears to be worsened as “modernity,” with its distinctive scientific and technological worldview, is further disseminated around the world as part of the advance of western economic forms and the spread of western forms of democratization. The scientific worldview travels with both of these and is strengthened by them, as has always been the case, according to the postcolonial accounts. The internalist theories of scientific knowledge that are the target of criticism by so many schools of post-World War II science studies are inadequate as guides for historians and philosophers to how science works. But, even worse, they may well be dangerous to human life, the environment, and maximally democratic social relations. The stakes in working to develop empirically, theoretically, and politically more useful science and technology theories are higher than one might at first have imagined.

Fortunately, it is not only the economically and politically most vulnerable who can recognize the limitations of the conventional conceptual frameworks. Increasingly, powerful groups within the North are coming to see that their pride in northern cultures, and their legitimacy as rational participants in local, national, and international institutions—not to mention their life and health—depend upon reworking such frameworks. It is a propitious moment to avail ourselves of the resources provided by postcolonial and feminist standpoints in order to try to make a difference to the outcome of this emerging reevaluation. In an important sense, the postcolonial and feminist standpoints are also firmly *within* conventional dynamics of northern sciences committed to critical self-evaluation.

Let us turn to pursue the postcolonial narrative, as promised earlier.