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Dysfunctional Universality Claims? Science, Epistemological, and Political Issues

Sandra Harding

1. Universality and modernity. The ability to produce a uniquely universal science is commonly thought to be a distinctive mark of modernity. Such a science should have uniquely valid standards of rationality, objectivity, method, and what counts as nature's order and as knowers. Such purported features of modern science have been called on to legitimate as uniquely socially progressive European models of government, law, education, social policy, and even ethics. From this perspective, modern Europe and its diasporas in the Americas, Australia, and elsewhere provide a uniquely desirable model of human achievements, social relations, and standards of living.

Other cultures' accounts of themselves and the world around them, like those of premodern Europe, cannot really be considered in the same category as modern sciences, this account holds. They should not even be called science traditions since there is one and only the one possible true account of nature, and that is the one modern science has been struggling to piece together. 1 Such other accounts are to be regarded only as "ethnoscience," "folk thought," "precursors of modern science," belief systems "with scientific elements," or - worse - savage and barbaric thought, witchcraft, superstitions, magic, and products of prelogical mentalities.

Moreover, models of objectivity, rationality, scientific method, and their ability to advance modernity have also invariably been defined in idealizations not only of Europeans, masculinity, as...feminist critiques...be.

The desirable virility of European men is often signified by the progressiveness of sciences, and the desirability of dominant manliness by their links to modernity, technology, and social progressiveness. The thinking behavior of women of European descent, too, is assigned to the premodern, according to conventional thinking. 2 Thus, the modern claims to modern science's universality structured in opposition to meanings of work and cultural otherness.

The power of these meanings is in their immunity to empirical evidence contrary, as feminist and postcolonial science technology theorists have pointed out. In how effective other cultures' (including cultures') knowledge traditions are, might have been for enabling effective interactions with natural worlds, they are not countercultural sciences. No matter how much modern science might have incorporated elements of cultures concepts and theories about natural, mathematical and empirical techniques, whole bodies of their accumulated medical, pharmacological, climatological, cultural, manufacturing, or other effective knowledge and control of nature, other bodies of knowledge are - for example, with respect to social

of environmental destruction, or the causes of patterns of carcinogens or contagious diseases— these inadequacies do not count against European sciences' purportedly unique universal validity.

... How is this pattern of prevailing thought to be explained in light of the fact that success at prediction and control of nature are always claimed to be the most reliable hallmarks of a real science?

When assumptions are used to define the unique identity and value of a people, its civilization, and its history in the way the universal science ideal and its supporting internalist epistemology tradition apparently do, critical examination of them obviously is going to draw forth deep psychic anxieties and resistances. When assumptions carry this much moral and political weight, exposing them to contrary evidence is not going to be a comfortable process.

Four unity-of-science claims. In the early twentieth century, the unity of science thesis became an important form in which the universality claim was widely defended. This thesis overtly makes three claims: there exists just one world, and only one possible true account of it ("one truth"), and one unique science that can piece together the one account that will accurately reflect the truth about that one world. What this thesis means—what methodological, metaphysical, or other features could constitute the unity of physics, chemistry, biology, psychology, economics, and so on—are issues about which philosophers and scientists have been concerned to make sense. However, as political theorists are aware, a fourth claim is also assumed in these universality/unity arguments: that there is a distinctive universal human "class"—some distinctive group of humans—who should be taken as exemplars of the uniquely or admirably human to whom the truth about the world could become evident. For early modern scientists and philosophers, such a group was those members of the new educated classes whose minds were trained to reflect the order of nature that God's mind had created, as God's mind had also created human minds "in his own image." God's mind, human minds, and nature's order were assumed to be congruent or homologous. Scientists and the educated classes that could see the truth and importance of scientific accounts represented the universal class that could learn to detect the one possible true account of nature's order. For nineteenth- and twentieth-century Marxists, the proletarit represented this universal class. This class alone, since its labor transformed nature into provisions for everyday human life to exist, had the potential to become the unique representative of distinctively human knowers. This class alone had the potential to detect the real relations of nature and social life beneath the distorted appearances produced by class society. Some forms of feminism have flirted with a similar kind of transvaluation of gender that considers the possibility that women are the uniquely human gender: if it made sense in sexist society to imagine men as the model of the uniquely human, then perhaps it is reasonable to consider how in many respects women's characteristics—their claimed altruism, pacifism, sensitivity to others' needs, or some other putative virtue—are more reasonably regarded as uniquely valuable models of the human, capable of producing less distorted understandings of natural and social orders. And some African Americans have claimed that the suffering, compassion, or some other characteristic of African Americans under the horrible conditions of slavery uniquely equips them to understand natural and social orders in ways unavailable to those who have not had such experiences.

There are important insights behind such claims. In the contemporary world of multicultural, postcolonial, and (more complex and diverse) feminist politics and social theories, however, faith has declined in the possibility and desirability of such a universal class—Enlightenment, proletarian, feminine, or culturally distinctive in any other way. In these worlds in which we all live (whether or not we acknowledge the effects post–World War II emancipatory social movements have had), who could such a distinctively human, universal class be? What group could democratically gain assent to their own abilities uniquely to represent accurately universal human interests and the one true natural and social order such interests supposedly could reveal in the face of other groups' different but also valuable cultural conditions for the production of knowledge for them and their survival? In contemporary life, many kinds of important differences between humans—biological and, more importantly, social, economic, political, psychic, and otherwise cultural—are recognized as resources for producing effective knowledge and advancing democratic social relations.

The universality/unity ideal is no mere philosopher's notion; in one form or another it has been one of the most central and enduring values of otherwise conflicting conceptual and political tendencies in modernity's social theories. However, it is now attracting critical attention from
many groups around the globe which claim that for them it has had primarily bad scientific, epistemological, and political effects.

2. Science and democracy: Allies or enemies? Does the ideal of a single, universally valid science decrease global democracy? Does the goal of global democracy advance or obstruct the plausibility of such an ideal? In the late nineteenth and early twentieth centuries, defenders of the universality ideal hoped that it could serve as a powerful antidote to the tides of racist and nationalist partisan conflict that again and again had resulted in violence and even genocide. For them, appreciation of the universality of science and its standards of rationality and objectivity could only support and advance democratic social relations. Today the universality ideal’s defenders see in the unique standards of scientific rationality and objectivity the main hope for restoring what they think of as the fair and orderly social relations now being disrupted by the claims and demands of multiculturalism, feminism and “relativism” in the post-Kuhnian social studies of science. In effect, these defenders of the universality ideal fear and do not find plausable the analyses produced by the three distinctive schools of science and technology studies that have emerged since World War II.

For many feminist, multiculturalist, and post-Kuhnian science studies theorists, however, the universality ideal increasingly appears as a force for maintaining inequality and obstructing democratic tendencies, and for obstructing the growth of knowledge. For these groups, claims to the transcultural truth of modern sciences’ representations of nature, and of only those of modern science, function to mask the ways that modern sciences and their representations of nature’s order tend to distribute the cognitive and social benefits of scientific and technological changes disproportionately to those already positioned to take advantage of them, and the costs primarily to those least able to resist them. Moreover, universality claims legitimate the devaluation and even destruction of knowledge traditions that have enabled women, the poor, and less powerful cultures to interact effectively with their environments. The unique universality claims also have bad epistemological and scientific effects, in addition to their political consequences. In a variety of ways, they function to increase the production of systematic ignorance. From this perspective the universality claims are epistemologically, scientifically, and politically dysfunctional.

Of course the familiar “universalist” response to such claims is to insist that the “anti-universalists” are confused. Lamentable as the worsening situation of women and racially and culturally disadvantaged groups may be (“if this is the situation,” they demur), such arguments only address the applications and technologies of science, and nobody denies that these often are shaped by anti-as well as pro-democratic politics. Of course politics can misuse and abuse applications of sciences and technologies—“Think of Lysenkoism! Think of Nazi science!” they argue. Real sciences could not possibly have any political consequences. “Real sciences” simply provide pure information about nature’s order, according to this older view. One can note that such a position also blocks the argument that science, its rationality and objectivity, support or advance democratic social relations, or have any other social effects, however. If science were culturally neutral, then it could not have any social effects at all. Of course this recognition motivated the invention of “positivism” in Auguste Comte’s proposal that the pure information that sciences produce is politically neutral, and the only positive social effects of science are to be found in its distinctive method.

However, this attempt to disassociate modern sciences from their effects has become increasingly difficult to defend. Earlier chapters reviewed the evidence against this “pure science” claim when they focussed on the explicit mission-directed character of so much valuable scientific research, from Galileo’s work in the Venice armory and Pasteur’s concerns with public health, to contemporary medical, economic, and military-directed scientific and technological projects. Such histories clarify that mission-directed research should not always be conceptualized as an obstacle to the growth of scientific knowledge; obviously, it can produce valuable information about and explanations of nature’s regularities, whether or not one approves of the “missions.” Sometimes the cultural interests and values that constitute a scientific project, its conceptual framework, methods, and purpose are politically relatively uncontroversial; sometimes not. After all, medical research to discover the causes of cancer or of AIDS, and research to establish space satellites for military surveillance have all produced reliable and valuable information about nature’s regularities regardless of how one evaluates the social desirability of such projects. How are the technologies and applications of a science to be regarded as completely separate from that science’s information whether it is produced specifically for social and political applications? Obviously, to star terms of knowledge and ignorance of the collection of sciences generates bear to the culturally local overt purpose associated interests in such information. It is conceptualized at its cognitive co to culturally local medical or in – whether or not individual scientists such a match – in what sense it is it.

Another kind of evidence against science thesis, however, showed itself of scientific research themselves constituting what can count as legit knowledge, and that those research themselves have always been con social, economic, and political pro social, economic, and political con research technologies are par methods, yet modern science’s long cited as value neutral and for science’s unique universality philosophers of science have been aware that what it is about scientific theories makes modern science so effective in a social and political neutrality.

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3. The epistemological status of science. The universality/unity ideals, not the results of empiricism. The question of this chapter is, they should retain their status as many of their defenders seem scientific claims; that the first achievements of science somehow uniquely universally valid and u.

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from that science's information when the information is produced specifically for such technologies and applications? Obviously, to start with, the patterns of knowledge and ignorance that a science or collection of sciences generates bear a close relation to the culturally local overt purposes and unarticulated interests in such information. If such science is conceptualized as its cognitive core in ways suitable to culturally local medical or military purposes or whether or not individual scientists are aware of such a match—in what sense is it "pure"?

Another kind of evidence against the purity-of-science thesis, however, showed that technologies of scientific research themselves contribute to constituting what can count as legitimate scientific knowledge, and that those research technologies themselves have always been constituted through social, economic, and political processes that have social, economic, and political consequences. Such research technologies are part of scientific methods, yet modern science's methods were long cited as value neutral and thus responsible for science's unique universality. Consequently, philosophers of science have been forced to reexamine what it is about scientific methods that makes modern science so effective if it is not their social and political neutrality. Thus, the assumption that the universality ideal can only advance both the growth of knowledge and a democratic social order has come under increased suspicion from a variety of sources.

3. The epistemological status of universality/unity claims. The universality/unity claims express ideals, not the results of empirical observation. The question of this chapter is, therefore, whether they should retain their status as ideals. However, many of their defenders seem to think they are scientific claims; that the history and present achievements of science somehow prove that it is uniquely universally valid and unified.

One stream of common sense captured by the older histories and philosophies of science seems to conjure everyday experience and historical evidence to make the universality thesis appear obviously supported by empirical evidence. In this way of thinking, our observing, perceiving bodies-with-rational-minds and their environments seem to fit together in ways that enable modern sciences to gain greater and greater accuracy in their predictions and control of nature. How else could we account for the many magnificent achievements of modern medicine, the ability of humans to walk on the moon, or the possibility of

composing these sentences on this computer? Modern sciences must be providing more and more pieces of the one coherent account that reflects or uniquely corresponds to how the world is for these technological achievements to be possible. Doesn't the history of such successes constitute incontrovertible evidence that there is one nature, one truth about it, and one science that captures that truth? How could scientific predictions increasingly achieve such accuracy were this not the case?

On the other hand, before the pull of this way of thinking becomes too irresistible, we can recollect that common sense and the history of science also tell us that there is something wrong with it. We all know that scientific claims can never be regarded as once and for all proved (or disproved). They always must be left only tentatively confirmed by observation and reasoning since new evidence continually shows how familiar scientific ways of thinking have limitations that were not earlier visible. Every scientific project makes "background assumptions" about properties of the instruments, theories of vision, what the relevant variable local conditions are, the cultural neutrality of the relevant conceptual framework, and much more that can at another time be thrown into doubt. Perhaps even more importantly, any given scientific framework eventually outlives its usefulness in advancing the growth of knowledge. At moments of revolutionary scientific change, when a new framework promises to replace the older one, old data is repositioned within a different conceptual scheme. Most of the observations made in Ptolemaic astronomy were repositioned within Copernican astronomy. Do they provide "the same information" within these conflicting conceptual frameworks? Well, yes and no. Of course many observations of the moon, the sun, and the planets made prior to Copernicus and Galileo were retained in the heliocentric account. In one sense we see "the same heavens" that cultures did a millennium and more ago. On the other hand, what patterns such observations form, how such patterns are to be explained, and what such observations, patterns, and explanations mean to different groups of scientists and their diverse audiences (intended and unintended)—these differ immensely between the two theories. In important respects, the pre-Galilean observations do not provide "the same information" for heliocentric theories.

In recognizing the importance of this kind of understanding of the history of science, one need
not hold that new conceptual frameworks are fully incommensurable with the older ones, or that ones from different disciplines leave their practitioners unable to communicate with each other or to work together on scientific projects, as both "incommensurabilists" such as Thomas Kuhn and also his critics claimed must be the case when one gives up these kinds of universalist assumptions. Temporary, local universalizing strategies are devised in the face of the de facto unavailability of reliable universality claims. Historical and sociological evidence shows how scientists continually make effective, "good-enough" translations – pidgin languages – and technical equivalences to get from one conceptual terrain to another and to enable them to work together effectively. Thus, their joint scientific projects can draw on otherwise disunified, heterogeneous, local scientific practices and cultures. For example, Peter Galison examines the "trading zones" scientists create between their otherwise disunified work. When H-bomb designers, logicians, aerodynamical engineers, and statisticians sat down together in the 1940s and 1950s to construct computer-simulated realities, they brought to such interactions very different notions of "randomness," "experiment," and other terms.

While the mathematician thinks about the best definition of "random" quite differently from the physicist, in the cauldron of those early days of computer simulations a notion of "random enough for present purposes" emerged, borrowing from several cultures, yet belonging exclusively to none.\(^{10}\)

Others have pointed to the diversity of such translation devices developed not only in modern science traditions but also in the scientific and technological traditions of other cultures. Modern sciences are like other scientific and technological traditions in that they have developed just such means of establishing effective continuity in scientific and technological projects by peoples with disparate, heterogeneous kinds of knowledge. Historians, philosophers, and ethnographers of sciences and technologies are still struggling to come up with a way to represent adequately the immense innovativeness of scientific and technological workers in developing these complexes of conceptual, technical, institutional, rhetorical, practical, and other kinds of devices.\(^{11}\)

Such analyses of the strategies scientists use to communicate and work together across their heterogeneous cultures have not yet come to inform common sense. Nevertheless, reflection enables anyone to realize that in order for the growth of scientific knowledge to have occurred, scientific change must be more open to the value of alternative models of nature's order than the "one world, one truth, one science" ideal (and one culturally distinctive kind of ideal knower) can suggest. The ideal could not accurately be reflecting the history of science as that is widely understood after more than three decades of the post-Kuhnian, feminist, and postcolonial science studies. These schools of science studies delineated the resources provided for the growth of knowledge by assuming many human worlds, many truths, many sciences, and many culturally diverse knowers.

Thus, the universal science ideal appears to be inconsistent with the best history of science and with the best contemporary scientific practices. If the results of scientific research cannot and should not be protected from historical change, then it is not clear what it could mean to claim them to be universally valid, let alone uniquely so. On the other hand, before leaping gleefully to the presumed final defeat of this particular conceptual framework and the social programs in which it was embedded, we must note that the defenses of the localness, heterogeneity, and disunity of science also should not be taken to be transcultural truths, fully supported by incontrovertible evidence from within the sciences and from the history and sociology of science. The argument here, instead, is only that the universality arguments seem to block our understanding of the history and necessary practices of the sciences. One could say that both the universality and anti-universality arguments are strategies for keeping understandings of human knowledge of nature in balance when confronted with tides that threaten to pull too strongly toward insistence either on unique universality or only on incommensurable localness in knowledge systems.

There is another kind of defense of the unique universality ideal that must be considered. Are there weaker forms of it that might be more plausibly defended?

Weak forms of the universality claims. i. Cultural plurality of scientists attests to universal validity of modern science. Let us set aside first a popular defense of the universality thesis that consists in pointing to how modern science's creators and users today come from many conflicting cultures, yet all agree to scientific claims. The individuals who have made modern sciences have come from Great Britain, Japan, Germany, and many other nations; the religious, political, and other beliefs, yet they have been able to claims though there might which they could agree. Some science must be universally from such culturally diverse place, and then to continue more and more culturally div the globe.

This popular argument must since it is just the one that scientist/philosophers made of world of partisan conflict, others argued in Europe in of the universally valid standpoint provided the only one achieving peaceful resolutions From this perspective, Nazi were the consequence of too li ality. Such icons as this argue to resist the appeal of "one na science."

One can gain a useful pers cip, the fact that Europe agreed to claims that were, at least, a non-European worldview. To take one example, has distinctively for many peoples. It represents origin of all that follows. For everything. Thus, it is often reg quality from all the numbers of the same cultural category as 1, Indeed, the number one often properties in many cultures: unity emerges the heterogeneous world we know. Moreover invented or discovered indep different cultures, in each of w a distinctive place in the other courses. However, it, like all th presumed in modern scientific culturally distinctive meanings in European history prior to it also carried different meanings I us the cultural neutrality pres of the modern European worldw distinctive feature of that wa examined why it is illuminat how such assumptions and ideality are themselves culturally
Great Britain, Japan, Germany, India, Denmark, and many other nations; they have held diverse religious, political, and other kinds of cultural beliefs; yet they have been able to agree to scientific claims though there might well be little else to which they could agree. Something about modern science must be universally valid for it to emerge from such culturally diverse peoples in the first place, and then to continue to gain assent from more and more culturally diverse peoples around the globe.

This popular argument must be taken seriously since it is just the one that the Vienna Circle scientists/philosophers made in other forms: in a world of partisan conflict, Rudolf Carnap and others argued in Europe in the late 1930s, pursuit of the universally valid standards of scientific rationality provided the only imaginable hope for achieving peaceful resolutions to social problems. From this perspective, Nazism and the Holocaust were the consequence of too little scientific rationality. Such icons as this argument make it difficult to resist the appeal of "one nature, one truth, one science."

One can gain a useful perspective on such an issue by nothing that: European scientists have all agreed to claims that were, and for many people from other cultures still are, embedded in other, non-European worldviews. The number "0," if we take one example, has distinctive cultural meanings for many peoples. It represents the beginning or origin of all that follows. From nothing emerges everything. Thus, it is often regarded as different in quality from all the numbers that follow. It is not in the same cultural category as 1, 2, 3 and the others. Indeed, the number one often has such distinctive properties in many cultures: from homogenous unity emerges the heterogeneous multiplicity of the world we know. Moreover, zero has been invented or discovered independently in several different cultures, in each of which it has occupied a distinctive place in the prevailing cultural discourses. However, it, like all the other numbers, is presumed in modern scientific thought to have no culturally distinctive meanings at all, thought even in European history prior to the modern era zero also carried different meanings for different groups. Is the cultural neutrality presumed for numbers in the modern European worldview itself a culturally distinctive feature of that worldview? Chapter 4 examined why it is illuminating to understand how such assumptions and ideals of cultural neutrality are themselves culturally distinctive. 12

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To take another example, acupuncture has been integrated into European medical practices for the control of chronic pain. Of course what has been extracted from the Asian systems of thought and practice from which it has been borrowed is just those elements that will fit into modern biomedicine. Discarded are the rest of the Asian beliefs about bodies that get in or out of "balance," and how to keep them in balance, that do not coherently fit into modern biomedicine's ontology and epistemology. Yet we can ask: if these elements of other cultures' knowledge systems have become scientific once they have been adopted into the culturally distinctive ontology, epistemology, psychic structures, and political economy of European sciences, why weren't they just as scientific before, when they were embedded in different culturally distinctive interests, discourses, and ways of organizing the production of knowledge? After all, zero and acupuncture "worked" both theoretically and practically in those contexts no less than they do in this one. And why should we regard those larger bodies of culturally distinctive beliefs of other cultures as only containing obstacles to the growth of knowledge about the natural world when those cultural values and interests produced the thinking and practices of zero and acupuncture that have proved so valuable far beyond their cultures of origin?

Such reflections suggest that we need a different way of thinking about the fact that the claims of modern sciences, like those of other cultures, "hold true" -- or, can be useful -- far distant from their sites of original observation, and for phenomena that may be described and explained very differently in other cultures. They enable accurate prediction and control of nature. Evidently claims emerging from other knowledge traditions also can be regarded as universal or universally valid in this sense no less than modern scientific claims. And we can ask how such knowledge is different from the ways Ptolemaic astronomy and Aristotelian physics, in spite of their culturally local meanings and referents, predict accurately a great deal that Copernican astronomy and Newtonian physics respectively also predict. Don't modern sciences in such cases agree to the claims of knowledge traditions that are not modern European ones? It no longer appears reasonable to argue that while some cultures manage to stumble upon empirically adequate claims, only modern science's claims are produced by culturally neutral, and thus universally valid, methods.
Thus, these post-Kuhnian science and technology studies arrive at the same assessment that the postcolonial and feminist science theorists do: science cannot plausibly be understood as one single kind of thing at all. “There is no set of features peculiar to all the sciences, and possessed only by sciences. There is no necessary and sufficient condition for being a science.” In the face of such disunity, many different kinds of techniques serve as “unifiers,” as Hacking refers to them. Mathematics is the earliest recognized to have such a function. However, it turns out that there is no “one thing” that is mathematics since it, like the sciences to which it gives an appearance of unity, is a motley collection of principles and practices, as he and other historians of mathematics point out. And numerous other such unifiers are to be found among scientific instruments, techniques, attitudes...all those inventive strategies that occur in the “trading zones” within which scientists in the modern West, like other indigenous knowers, work to communicate across the diverse cultural and natural conditions that separate them.

Thus, common sense, the history of science, and observation of contemporary scientific practice do not support either the inherent singleness or “integrated harmony” of modern science. Moreover, earlier chapters explored the scientific, epistemological, and political advantages of understanding science as necessarily and desirably plural. Let us briefly review those findings and then turn to consider some techniques pointed out in the postcolonial and feminist accounts through which the illusion of the unity and universality of modern sciences has been historically established.

4. Producing illusions of unity and of universality. Some of the most important cognitive, technical resources of modern sciences are to be found in their distinctively local features, as post-Kuhnian, postcolonial and feminist science studies showed in earlier chapters. Of course nature’s order – “reality” – has a great deal to do with what sciences – modern or other – come up with as the best results of research. “Nature” is a major player in producing sciences’ most reliable and widely accepted claims, as is the case also with much of the belief of everyday life. People who do not pay attention to known regularities of nature, or who are disinterested in charting what turn out to be important regularities of nature, are among those who tend to live shorter lives as they are filled by avoidable “accidents” and other threats to life and limb. But nature does not have everything to do with even the basic social values, interests, and in visible in such claims – let alone such claims that the sciences of different cultures tend to produce, it turns out that can be protected from cultural methods, its research technology of nature’s fundamental order other concepts, metaphors, structures, or even formal language plays in advancing the great questions: distinctive patterns of systems systematic ignorance that it genetically constituted theories about systems with nature’s order, but congruency with it; none unique, indeed, we should not want from all cultural influences, for precisely responsible for their absence for their continuance in the future. This is where the unity out to be costly to the growth of their.

Indeed, it was precisely the way that enabled modern sciences to according to postcolonial acco...
...everything to do with even the best representations of such regularities. Scientific claims are not mere reflections of nature's order such that no traces of social values, interests, and inquiry processes are visible in such claims — let alone in the patterns of such claims that the sciences of different eras and different cultures tend to produce. As earlier chapters explored, it turns out that nothing in science can be protected from cultural influence — not its methods, its research technologies, its conceptions of nature's fundamental ordering principles, its other concepts, metaphors, models, narrative structures, or even formal languages that all play crucial roles in advancing the growth of knowledge — that is, its research questions and the consequent distinctive patterns of systematic knowledge and systematic ignorance that it generates. Many socially constituted theories about nature can be consistent with nature's order, but none are uniquely congruent with it; none uniquely correspond to it. Indeed, we should not want to protect sciences from all cultural influences, for many of these are precisely responsible for their great successes and are necessary for their continued successes in the future. This is where the universality ideal turns out to be costly to the growth of scientific knowledge.

Indeed, it was precisely the use of local resources that enabled modern sciences to emerge in Europe according to postcolonial accounts. European expansion and the growth of modern sciences in Europe were causally linked in that each contributed important resources to the success of the other. Without the knowledge of those daunting aspects of nature's order that Europeans encountered in their "voyages of discovery," knowledge provided by the emerging modern sciences, Europe could not have successfully developed the imperial and colonial relations that permitted it to achieve global leadership. Modern sciences helped Europe shift from being just one of a number of cultures around the globe that were living through the beginning of the end of feudalism in the late Middle Ages to becoming the single most important center of the early or proto-capitalist global economic and political relations that it would spread around the globe. Moreover, without the diverse resources provided by European expansion, modern sciences would have had a far more difficult time emerging — perhaps they would not have emerged in Europe.

Through this process, modern sciences developed distinctive patterns of systematic knowledge and systematic ignorance, traces of which remain visible in contemporary modern science. Early modern science produced information about those aspects of nature's order that European societies needed in order successfully to expand into the Americas, around the Cape of Good Hope, into Asia and eventually Australia, New Zealand, and Africa (and, now, out into space stations and onto other planets in our solar system). As some of the development theorists have argued, the "science and technology transfer" involved in post-World War II so-called development projects that overtly were intended to bring the "under-developed countries" up to the standard of living of the "developed countries" in fact have continued the colonial process begun five centuries earlier. These expansionist projects shaped what modern sciences would and would not know about nature's order.

I have identified four respects in which this kind of postcolonial account as well as the post-Kuhnian and feminist accounts argue for the advantages as well as the limitations that local resources provide for the growth of scientific and technological knowledge for every culture's knowledge projects. There it was pointed out that different cultures are located in different parts of heterogeneous nature's order; their environments are always local ones whether restricted to a Pacific isle or the trajectory between Spain and the Caribbean, or Cape Canaveral and the moon. Cultures are interested in whatever they count as their own environments, but even in "the same" environment, they will tend to have different interests generating different questions about the world around them. For example, on the shores of the Atlantic, one culture will be interested in fishing, another in coastal trading, a third in oil and minerals lying beneath the ocean's floor, a fourth in possibilities for transporting slaves, sugar, and rum back and forth across it, a fifth in using the ocean as a toxic dumping site, and so forth. Such culturally local interests lead to different patterns of knowledge and ignorance about local environments.

Moreover these patterns are organized and produced through culturally distinctive discursive resources. Both advancing and limiting a culture's patterns of knowledge are metaphors, models, and narratives about, for example, the Garden of Eden, peaceable kingdoms, wild and unruly nature, nature as a machine, or as a product of God's mind, as a computer, a spaceship, and a lifeboat; about noble, innocent, childlike, animal-
like, primitive, or evil natives; about manly, heroic explorers, conquistadors, and natural philosophers, or ones that purportedly represented the admirable national temperaments of Spain, England, France, or other European nations. These kinds of discursive resources represent a distinctive European legacy rather than, for instance, one that could be found in an Islamic or Native American culture. Finally, the production of knowledge is organized in the distinctive ways that different cultures tend to organize social activities more generally. The characteristic ways that work, travel, conquest, and other social relations were organized in fifteenth- through twentieth-century societies of Europe and its diasporas shaped how the work of science and of European expansion were organized. The “voyages of discovery” were distinctively European ways of organizing the production of these parts of modern sciences’ knowledge. Though these four kinds of local resources have been described here as if they were completely separate, in daily practice they are partly interlocked and shape each other.

Similarly, as earlier chapters explored, post-Enlightenment and feminist histories, sociologies, ethnographies, and cultural studies of modern sciences produced in the last thirty years have charted precisely the ways that scientists have used local resources to generate new theories and interpretations. Thus, the postcolonial studies converge with northern science and technology studies, and with feminist components of both, in highlighting the strengths as well as the limitations of sciences’ uses of local resources. Modern sciences are “local knowledge systems” no less than are the science and technology knowledge systems of other cultures. Of course modern sciences in many respects are much more powerful than other cultures’ knowledge systems, though other cultures’ knowledge systems also have their relative strengths over modern sciences, for their locations in nature, interests, discursive resources, and ways of organizing the production of knowledge enable them to learn patterns in nature’s order that are not visible from modern science’s perspective. But no matter how global the successes of modern science’s predictions of nature’s order, they can never achieve a unique universality in the sense of being culture free, or destined to persist through history with their meanings and conceptual contexts unchanged. Further, significant parts of the knowledge systems of other cultures also have been able to achieve effective prediction far from the original cultural location of their production.

If it is not useful to think of modern sciences as single or harmoniously integrated in the various senses reviewed above, how is it that we have all been fooled about this? Noted above were various strategies of translation, “trading zones,” mathematical and other unifiers that have permitted modern scientists to think and communicate across their disparate projects. Postcolonial histories of science and technology enable us to identify several practices of European expansion that have also contributed to this effect. First, as such expansion turned the world into a laboratory for emerging European sciences, Europeans could test the hypotheses they developed over vastly larger and more diverse natural terrains than could other cultures. European expansion gained access for European sciences to a far greater diversity in nature’s order than was available to cultures not so engaged in expansion and, in some cases, whose trade routes and other travels Europeans curtailed. Not all the sciences benefited equally from this aspect of European expansion, of course. Astronomy, physics, and chemistry benefited less than did cartography, geology, geography, climatology, and many kinds of biology, though they still did benefit as they addressed the challenges of expansion and its effects on European economies, and, more indirectly, as they became funded through riches gained from the Americas. Agricultural, pharmacological, and medical sciences immensely benefited from expansion, as did such social sciences as linguistics and anthropology. Of course any culture engaged in such expansionist projects could also have developed their systematic knowledge about natural and social worlds. Indeed, they would have to have done so in order to succeed at travelling through or settling in unfamiliar environments and climates, and cohabiting with the indigenes they encountered. The internalist epistemology of modern science has provided no resources for understanding the effects on European sciences of these expansionist projects.

Second, European sciences could forage in other cultures for elements of those cultures’ “ethnosciences” to incorporate into European sciences. It was not just “hypotheses” about nature’s order that Europeans came up with all by themselves that were tested in the course of expansionist projects. Native informants taught Europeans about the local flora and fauna and how to use them, minerals and ores and how to extract them, climates and how to survive them, diseases and health and how to avoid them, remedies, agricultural, fishing practices, land and sea routes, rest of the knowledge tradition stored in local cultures. Incongruent European sciences were those that knowledge that fit into the preconceptual frameworks. Those fit were ignored or rejected. As it out, not all the resources for modern European encounters it knowledge traditions were in use, but even the quite mechanical notions they could not and even centuries later, and that knowledge that only now are the ceutical companies systematic gathering. A history of “unborn” can provide an illuminating account histories of borrowed knowledge.

Moreover, the Europeans gathered through obsessive from one part of the globe gained elsewhere to create something that could not emerge from fe and culture. This, too, is a unexample. Linnaeus’s categories accommodate species from another world; Darwin’s hypotheses result of thinking back for had learned at different sites conceptual frameworks designed between observations made around the globe contributed to versal sciences were in the making.

Third, at the same time, I suppressed or destroyed — by intentionally — competitive systems. Some cultures were inadvertently carried by the E infected before there was a conquer, as one historian Others were destroyed by colonists; the cultures took to the grave knowledge about nature and so.

Even when the indigenes encounters with Europeans, t traditions were often destroyed intentionally and unintentionally. British set out to destroy the try, and succeeded in doing so British-made textiles in the I
Now to survive them, diseases and other threats to health and how to avoid them, pharmacological remedies, agricultural, fishing and engineering practices, land and sea routes, and much of the rest of the knowledge traditions developed and stored in local cultures. Incorporated into the European sciences were those parts of this local knowledge that fit into the prevailing European conceptual frameworks. Those parts that did not fit were ignored or rejected. As the historians point out, not all the resources for modern sciences that the Europeans encountered in other cultures’ knowledge traditions were initially perceived to be such, however. Europeans encountered mathematical notions they could not use till decades had passed even centuries later, and pharmacological knowledge that only now are the northern pharmaceutical companies systematically interested in gathering.25 A history of "unborrowed knowledge" can provide an illuminating accompaniment to the histories of borrowed knowledge.

Moreover, the Europeans could combine knowledge gathered through observation or foraging from one part of the globe with knowledge so gained elsewhere to create kinds of knowledge that could not emerge from fewer sites in nature and in culture. This, too, is a unifying strategy. For example, Linnaeus’s categories were designed to accommodate species from many different parts of the world; Darwin’s hypotheses came to him as a result of thinking back and forth between what he had learned at different sites in his travels. Conceptual frameworks designed to explain the relation between observations made at different sites around the globe contributed to the idea that universal sciences were in the making.

Third, at the same time, European expansion suppressed or destroyed — both intentionally and unintentionally — competitive local knowledge systems. Some cultures were wiped out by diseases inadvertently carried by the Europeans; they were infected before there was a chance for them to be conquered, as one historian puts the point.26 Others were destroyed by conquest. In both cases, the cultures took to the grave their repositories of knowledge about nature and social relations.

Even when the indigenes survived their first encounters with Europeans, their local knowledge traditions were often destroyed nevertheless, both intentionally and unintentionally. For example, the British set out to destroy the Indian textile industry, and succeeded in doing so, in order to sell their British-made textiles in the Indian market. In the United States, Native Americans were neither permitted to speak their native languages in the government schools nor to develop their traditional repositories of knowledge there. Again, the British did not permit Indians to learn the mathematics that had been created by Indian mathematicians.27 Land upon which local knowledge traditions depended was appropriated by Europeans, turned to "scientific" agriculture, forestry, or other profit production for Europeans, and often environmentally impoverished. In such ways the basis for local knowledge traditions was removed from local access and often destroyed.28 So the suppression of other cultures’ knowledge traditions also contributed to producing the illusion that only European sciences were and could be universal ones.

A fourth way the illusion of unique success was created has been through the dissemination of a predatory conceptual framework for and by European sciences. This conceptual framework spread through the societies Europeans encountered as a central feature of the imposition or adoption of European culture. What is meant by a “predatory conceptual framework”? One way this occurred was through the persistent substitution of abstract, transcultural and ahistorical concepts of nature and processes of gaining knowledge for concrete, locally situated, and historical ones. The former were claimed unique to modern sciences and responsible for their successes, and the latter devalued as merely characteristic of “folk science.” For example, features of local environments become aspects of omnipresent “nature” to be explained adequately only by universally valid laws of nature.29

There is nothing wrong with abstractions and generalizations in themselves. The point is rather that such abstract concepts always must in fact be accompanied by local knowledge about how to apply such concepts — when and where they are relevant, how to revise and extend them. Yet such an abstract, universalizing conceptual framework devalues this very local knowledge that it needs in order to complete our understanding of it as empirical knowledge — how it relates to the world around us. One could say that the abstract and universal perpetually depend upon and reproduce the “premodern” forms of local knowledge required for the “universal” to be regarded as empirically relevant. It is not that modern science actually replaces its premodern predecessor; rather, it insists on its continual production as a devalued
form of knowledge. Moreover, such "foreign" concepts consistently have been used to legitimate the authority of powerful groups over economically and politically vulnerable ones.

Most effective in establishing the impression of universality is simply insisting upon it as an empirical fact; there is one and only one kind of "right" or "real" science, and that is the kind practiced in modern Europe. This replication in modern science of the monologic voice of the Judeo-Christian God is buttressed with various supporting theses—scientific accounts are value free, nature is value free, no kinds of interventions in or uses of nature are forbidden either by nature or by science, and so on. However, as reviewed above and in earlier chapters, such claims are not themselves the results of scientific or historical investigations, nor is there anything logically necessary about them. They are, instead, articles of faith, as is the insistence in modern science on its own "solo performances," that are so well suited to the belief in nature's "monovocality."

Thus, the appearance of universality is created not by any internal epistemic features of modern sciences, as the universality ideal assumes. Instead, it is produced by the kind of hard scientific work reported in the post-Kuhnian accounts and by contingencies of history and political strategies, obscured by, or fit into, a dogmatic conceptual framework that is persistently rhetorically elaborated. This will sound like a harsh judgment. Yet it is important to state as clearly as possible these findings of postcolonial science studies that are strongly supported also by the other two schools of science studies examined here. We need better ways to conceptualize the successes and limitations of modern sciences than are provided by the universality ideal of the internalist scientific epistemology. The ideal neither fits the facts of state-of-the-art history, sociology, and philosophy of science, nor does it make sense in light of what is now understood about how human knowledge of the nature's order must be gathered, preserved, and expanded.

S. The local-global continuum: An alternative conceptual frame. If the successes of sciences—modern or other—cannot be attributed to their internal epistemic features—such as a uniquely universally valid metaphysics, methodology, language, or standards of objectivity and rationality—what does account for them? Apparently there is no distinguishing feature of a science, as we saw earlier, but we still might usefully ask about causes of, or influences on, variations in the powers of different science traditions.

One strategy of many science and technology observers has been to try to bring into visibility the set of practices through which different modern scientific projects have maintained valuable tensions between the local and the global. Knowledge systems, any knowledge systems, are always constituted initially through a set of local conditions. However, the most widely successful ones, such as many parts of modern sciences, manage to travel effectively to become useful in other sets of local conditions—parts of nature, interests, discursive resources, ways of organizing the production of knowledge—that are different in significant respects from those that initially produced them. Without claiming a universality for them that we now can see is historically and conceptually misleading, how could we usefully think about valuable tensions between the local and the global, or ability to travel, that has characterized parts of modern sciences in particular, but also parts of other knowledge systems (e.g., the concept zero and acupuncture)?

"Technoscience," proposed by Bruno Latour, is one term that has proved useful for drawing attention to the value of maintaining certain kinds of tensions between the local and the global in modern scientific practices. Other science observers have focussed on different sets of components of such complexes that enable them to maintain the local/global tensions. As Helen Watson-Verran and David Turnbull point out, this is an area of study still emerging since no single analysis so far proposed quite captures all of the heterogeneous practices modern technosciences have developed.

Though scientific culture is now being more frequently recognized as deeply heterogeneous (see, e.g., Law, 1991; Pickering, 1992), there is, at present, no term in general usage that adequately captures the amalgam of places, bodies, voices, skills, practices, technical devices, theories, social strategies, and collective work that together constitute technoscientific knowledge/practices. Foucault's epistemes; Kuhn's paradigms; Callon, Law, and Latour's actor networks; Hacking's self-vindicating constellations; Fujimura and Star's standardized packages and boundary objects, and Knorr-Cetina's reconfigurations—each embraces some of the range of possible components but none seems sufficiently all-encompassing.  

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Watson-Verran and Turri interestingly because of their and other cultures' respective extents. They are other scientific and technological kinds of balances between the most successful in Deleuze and Guattari's ten more satisfactory ways to conceptualize "power practice" in different ways to maintain between the local and the global. And Turnbull show how medical builders, the Anasazi aborigines, and Pacific navigists, develop "social systems" that enable them and connections whereby different and isolated knowledges can develop and spread space and time from the local to their production and app and times.  

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For one, the unique of the legitimacy of appeals monolithic "science" to specific claims, rather than own—and to "face the tribu the crutch of the gen erence. Feminist and post
Watson-Verran and Turnbull's work is especially interesting because of the way it links European and other cultures' scientific practices in these respects. They are concerned to show how other scientific and technology traditions besides those of modern science have achieved similar kinds of balances between the local and the global in their most successful projects. They develop Deleuze and Guattari's term “assemblage” as a more satisfactory way to capture the set of technoscientific “power practices” that enable cultures in different ways to maintain that crucial tension between the local and the global. Watson-Verran and Turnbull show how medieval European cathedral builders, the Anasazi, the Inca, Australian aborigines, and Pacific navigators, like modern scientists, develop “social strategies and technical devices” that enable them to create “equivalences and connections whereby otherwise heterogeneous and isolated knowledges are enabled to move in space and time from the local site and moment of their production and application to other places and times.” This is not the place to explore their interesting account in greater detail. Rather, they provide a good example of the postcolonial arguments showing that it is not internal epistemological features but diverse combinations of technical and social strategies that enable both some modern and “indigenous” technoscientific traditions to become more successful than others. We do not need the notion of universal validity under consideration in this chapter, for other frameworks are becoming available that can preserve what was valuable in the universal science framework without the severe costs of the latter's historical and conceptual inadequacies.

It is time to summarize those costs for the sciences, for epistemologies, and for democratic social relations.

6. Dysfunctional universality claims: Scientific, epistemological, and political costs. To conclude, whatever the remaining benefits of supporting the universality ideal, the sources and arguments reviewed here show that its costs are significant. Let us look first at scientific and epistemological and then political costs of maintaining this ideal.

For one, the unique universality thesis supports the legitimacy of appeals to the authority of a single, monolithic “science” to support individual scientific claims, rather than each having to stand on its own—to “face the tribunal of observation” without the crutch of the general authority of modern science. Feminist and postcolonial critics have pointed this out again and again. Hypotheses about women’s psychologies, reproductive systems, or physical abilities have achieved legitimacy when they can claim to be scientific ones, whether or not rigorous testing of such hypotheses has occurred. The empirical reliability of agriculture and forestry principles developed for European environments has been presumed superior to local practices in African, Indian, and other environments when the former can claim the status of modern scientific principles rather than only the ones local farmers and peasants have developed and improved for generations. In such cases individual scientific claims have not had to face the empirical tests that are demanded of claims that cannot appeal to modern science for their legitimacy.

This argument has been voiced far more widely. As philosopher John Dupre puts the point, “The political power of science rests in considerable part on the assumption that it is a unified whole.” If science is disunified, then “particular appeals to the authority of science must stand on their own merits.” The unity-of-science thesis and its unique universality claim encourage what Dupre refers to as the “unity of science.” Without the crutch of such dogmas as the universality claim, many purportedly viable scientific claims would have to face much more rigorous tests of empirical and theoretical adequacy.

Secondly, the universality claim legitimates resistance to the most valuable criticisms of contemporary science. Feminist theorists frequently are challenged either to show the ideological bias in physics, or admit the irrelevance of any other kind of evidence to support their claims of androcentric assumptions in the constitution of scientific claims. Criticisms of modern sciences that cannot be recognized as coming from within the sciences can be devalued or ignored without the kind of consideration that criticisms from within the sciences would receive by those who hold the unique universality ideal. Yet it is precisely the fact that they come from what is perceived to be outside the sciences that makes such critiques especially valuable. It is only by starting from outside the dominant conceptual frameworks that such frameworks can themselves come into sharp focus, as the arguments in earlier chapters for standpoint epistemologies and their standards for “strong objectivity” pointed out. This issue has been central in the postcolonial accounts also. The global authority of a claimed uniquely unitary science, especially one associated
with increasingly widespread eurocentric ideals of modernity, progress, unique human potential, and manliness defined in eurocentric terms, conspires to silence what are potentially the most viable alternatives to modern sciences' claims and concerns. The universality claim makes it difficult to see the limitations to modern sciences' institutions, cultures, and practices that accompany their strengths. Moreover, the universality claim works against the overt, valuable claim of modern sciences and their philosophies that it is vigorous criticism that most advances the growth of knowledge. Instead of encouraging such criticism, the universality thesis suppresses it. The way the universality ideal tends to immunize sciences against their most telling criticisms points to the problematic assumption of a single, unified "class" of knowers to whom responsibility for discovering nature's order should be assigned. Women, non-Europeans, and activists/scientists among such groups, who "bring their special-interest politics into science," have never been considered appropriate members of such a class of knowers by those who have benefited most from scientific and technological change.

Third, the universality thesis is dysfunctional for the growth of scientific knowledge in another related respect. It has the effect of decreasing valuable forms of cognitive diversity, as the postcolonial critics in particular have argued. There is no evidence that the kinds of sciences favored in the modern North today will remain the most useful ones in the future either for other cultures or for the heirs of modern European cultures. Indeed, the arguments here, and many others explored earlier in this book, point to ways in which the ontologies and methodologies of modern sciences, and the interests and discursive resources that shape them, are not the most useful ones for many scientific research projects today. The universality ideal functions to delegitimize any but the scientific problems found interesting in the modern West.

Fourth, the strongest form of the universality ideal has raised distinctive obstacles to our understanding of certain kinds of ways the world is arranged and changes over time. It does this by promoting only narrow conceptions of both nature and science. As long as physics is assigned the status of the model for all sciences, whether on historical, ontological, methodological, logical, or other grounds, modern sciences will unnecessarily generate a certain kind of distinctive pattern of ignorance about the world around and in us. When physics, especially the narrowest conceptions of it, is permitted to set the standards for what counts as nature and what counts as scientific accounts, our knowledge will tend to focus disproportionately on discrete, isolated, short-term, and "purely physical" aspects of the world around us. (Here, the phrase "nature's order" starts to look suspiciously narrow.) It blocks our ability to get into focus the social elements - institutions, practices, languages, meanings - in what are often presented as purportedly merely natural, scientific, and technological changes. It makes it especially hard to see those that are distant, broadscale, and long-term.

Moreover, it blocks our ability to grasp systematic patterns of ignorance that any preferred pattern of knowledge will also generate. The universality ideal encourages the unfortunate tendency to internalize the benefits of scientific and technological change and externalize their costs. The benefits tend to be seen as the consequence of internal features of the epistemology of modern sciences, and the costs as the consequence only of misapplications of scientific knowledge or of their technologies, but not of scientific processes themselves.

Finally, such a model in the natural sciences also promotes the reproduction of systematic ignorance in the social sciences. There are the social sciences that overly model themselves on the natural sciences: physicalist psychologists, rational choice theorists in economics and international relations, and positivist sociologies, for example. But there are also the social sciences that conceptualize their projects in such single-minded opposition to the naturalistic models prevailing in their research areas that they cannot get at the ways that more global forces shape or are the consequences of the social phenomena that they study. They get stuck in the local as a reaction to naturalistic social sciences' devaluations of the local. In such cases universalism's conceptual world is advanced in unarticulated forms.

Last but not least, there are the political costs. Feminist and postcolonial theorists especially have argued that the bad political effects of modern sciences' universality ideal are in part a consequence of the scientific and epistemological costs of this ideal. We have seen in this chapter and earlier ones how the universality thesis supports the devaluation of forms of knowledge-seeking that have proved valuable in non-western and premodern cultures, and in devalued West (and elsewhere), such as Indeed, modern sciences have etonically usually, partners with social projects when they lend destruction of other peoples an sustain them, not just their know the inevitable costs of "human centrality of European science to the further development of advantaged peoples in the nam planes" is one place where the universality ideal can be a versity thesis legitimates access to nature's resources in already the most economica vulnerable to those who are allo tioned to take advantage of universality thesis elevates to models of the distinctively re civilized, and human that are position to, in terms of th non-European, the econo the feminine. Indeed, the univ otes authoritarianism - the ability of acknowledging the le Notes

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true account of the world — to a necessity for the distinctly rational, progressive, civilized, and human.

The philosophies of modern sciences have always claimed that such modern knowledge-seeking contributes to democratic social relations. One can find such assessments throughout the evaluations of modern sciences from the Baconian New Science Movement in the seventeenth century through the advent of Comte's positivism in the nineteenth century, the logical positivist philosophies of the 1930s and 1940s, to today's debates about the appropriate projects for sciences and technologies after the Cold War. However, the explorations of the scientific and epistemological dysfunctionality of the universiality thesis support long-voiced arguments that there is another, conflicting story to be told about the relationship between modern sciences and democratic social relations. Other conceptual frameworks can do the historical, empirical, and theoretical work that was provided by the universality ideal without invoking the latter's scientific and epistemological dysfunctionality or its ethnocentric, antidemocratic politics.3

Notes

1 As noted in earlier chapters, there are also postcolonial reasons to resist subsuming all cultures’ traditions of systematic knowledge about themselves and the world around them under what the West has in the last century or so referred to as “science.” (Even in the West, the term is a recent one, since Galileo, Newton, and Boyle's work was referred to as “natural philosophy.”) After all, why should other cultures' projects have to be named in European terms in order to be taken seriously by Europeans? 2 Compare, e.g., Susan Bordo, The Flight to Objectivity: Essays on Cartesianism and Culture (Albany: State University of New York Press, 1987); Alison Jaggar, “Love and Knowledge: Emotions in Feminist Epistemology,” in Gender/Body/Knowledge, ed. Susan Bordo and Alison Jaggar (New Brunswick: Rutgers University Press, 1989), Evelyn Fox Keller, Reflections on Gender and Science (New Haven: Yale University Press, 1984); Genevieve Lloyd, The Man of Reason: “Male” and “Female” in Western Philosophy (Minneapolis: University of Minnesota Press, 1984); Phyllis Rooney, “Recent Work in Feminist Discussions of Reason,” American Philosophical Quarterly 31:1, 1–21.


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1995). For an older harbinger of these arguments, see Patrick Suppes, "The Plurality of Science," *Philosophy of Science Association 1978*, vol. 2, ed. P. Asquith and I. Hacking (East Lansing: Philosophy of Science Association, 1978). Chapter 4 above, "Cultures as Toolboxes for Sciences and Technologies," examined what it is about nature and social relations that insures that science and technology inevitably and desirably must be plural. Note that the universalality claim in its unity of science form, as well as in other forms, asserts the uniquely maximal reliability of scientific claims (often expressed in terms of their truth, or in terms of the "fact that science works") and the unique validity of sciences' logic of research and explanation that produced them. The focus here will be primarily on the validity claim since it is sciences' logic of research and explanation that is thought responsible for its production of empirically reliable claims.

5 Such insights are the beginning of the development of standpoint epistemologies—only the beginning, not the end, since these insights express "identity epistemologies" while standpoint epistemologies center not socially unmediated experience but distinctive kinds of critically and dialogically achieved discourses as generators of knowledge. See chapters 8 and 9, and, e.g., Patricia Hill Collins, *Black Feminist Thought: Knowledge, Consciousness, and the Politics of Empowerment* (New York: Routledge, 1991).

6 Thanks to Val Plumwood for pointing out to me this fourth assumption in the unity of science thesis.


9 This was a major point of Thomas Kuhn's *The Structure of Scientific Revolutions*, 2d ed. (Chicago: University of Chicago Press, 1970) and the outpouring of subsequent histories, sociologies, ethnographies, and philosophies of science and technology that followed it. For the demise of the idea of "crucial experiments," see also Sandra Harding, ed., *Can Theorems Be Refuted? Essays on the Duhem-Quine Thesis* (Dordrecht: Kluwer/Reidel, 1976).


14 Galison, *Diversity*, 5.

15 Ibid., 3–8.


21 These issues were discussed in earlier chapters. In addition to the citations against the unique universality of modern science provided above, see, e.g., N. Katherine Hayles, "Constrained Constructivism: Locating Scientific Inquiry in the Theater of Representation," in *Realism and Representation*, ed. George Levine (Madison: University of Wisconsin Press, 1993); Das Van Prassen and Jill Siggman, "Interpretation in Science and in the Arts," in *Realism*, ed. Levine.


25 Joseph, *Crest*.

26 J. M. Blaut, *The Colonizer's R* *Geographical Diffusionism* and *New York: Guilford Press, 1991*.


29 Compare Tom Patterson's arg *cept "nature" has a cl* *Introduction* by protocoaliti *groups in their own soci *wants and/or farmers *power to decide how land *Patterson, "Nature: The Sha *founding", and his *Inventio *Monthly Review *issues about "nature" raise *See chapter 7 for related disc *ency of modern, masculiniz *purportedly premodern ve *Mies makes similar argum *Accumulation on a World Sta*
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Joseph, Greve.


Michael Adas, Machines as the Measure of Man (Ithaca: Cornell University Press, 1989).


Compare Tom Patterson's arguments that the concept "nature" has a class history. It was persistently introduced by protocapitalist "outside experts" (often groups in their own society) in their struggles with peasants and/or farmers over who would have the power to decide how land was to be used. Tom Patterson, "Nature: The Shadow of Civilization," (forthcoming), and his Inventing Western Civilization (New York: Monthly Review Press, 1997). See also the issues about "nature" raised in chapters 5 and 6.


Similar criticisms have been made of the idea that the sciences do and should make truth claims. For one review of the issues, see "Are Truth Claims Dysfunctional?" by Sandra Harding, in Philosophy of Language: The Big Questions, ed. Andrea Nye (New York: Blackwell, 1998).

References


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