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Values and the Practice of Science

Introduction

The popular image of science endorses a stark contrast between facts and values. Because humans inhabit a world with a determinate structure, scientific claims are true or false regardless of human desires or intentions. Values—things that individuals think are worthy of being promoted or advanced—are human projections imposed unto nature, not inherent in nature itself.[1] Consequently, while moral or political values may guide the application of scientific knowledge, permitting considerations of value into scientific inquiry can only corrupt the knowledge it produces.

Despite it being widely accepted, it is not necessarily self-evident. It was not held before the emergence of the "new philosophy" in the seventeenth century and many scholars in recent decades have also called the dichotomy into question. In this paper I will examine the debate about science and values, beginning with a brief description of the origins and motivations for the common view on values. I will then attempt to make a constructive contribution to the debate by arguing for a different challenge to the fact/value distinction, one that draws primarily upon recent literature on the sciences.

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[1] Harold Kincaid, John Dupré, and Alison Wylie, "Introduction," in *Value-Free Science?: Ideals and Illusions* (Oxford: Oxford University Press, 2007), 2.

Origins of the Fact/Value Distinction

While views of nature of medieval scholars are varied and complex, in general values were seen to be inherent in the natural world. The Platonic tradition, embraced and modified by the Church Fathers, argued that God had infused the created world with symbols to point beyond themselves to a superior world of spiritual realities.[2] To focus solely on the inter-workings of material objects would thus be to miss the essential moral function of nature. The Aristotelian tradition of natural inquiry that reached ascendancy in the universities of the high Middle Ages viewed nature as being infused with purpose or *telos*, each thing striving for order and fulfilling the will of the Divine mind. Aristotelian scholastics offered an integrated view of the human and the natural, for an analysis of human action differed only in degree from those of natural processes.[3] Both traditions thus accepted that the natural world was infused with values that, if correctly understood, could help one to live well.

Advocates of the new philosophy in the seventeenth century rejected the medieval view on the relation of values to nature for two central reasons. First, many accepted a new image of nature, a theory that later came to be called the mechanical philosophy. A central characteristic of the various mechanical philosophies is what they allowed to count as a proper explanation. All phenomena were to be explained in terms of the mathematical discipline of mechanics: the shape, size, quantity, and motion of particles of matter.[4] This had

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[2] Peter Harrison, *The Bible, Protestantism, and the Rise of Natural Science* (Cambridge: Cambridge University Press, 1998), 15.
[3] Steven Shapin, *The Scientific Revolution* (Chicago: University of Chicago Press, 1996), 163.
[4] John Henry, *The Scientific Revolution and the Origins of Modern Science*, 2nd ed. (New York: Palgrave, 2001), 69.

remarkable consequences for understanding nature; what for the Aristotelian scholastic were real qualities of the world became, in the mechanical philosophy, merely secondary qualities, or effects of the particles on the senses. Like colors, values were seen as a product of human subjectivity, not existing in the world independent of human perception.

The second reason for rejecting the view of nature in the medieval period was a new conception of natural inquiry. For many advocates of the new philosophy, proper study of nature required the removal of considerations of value, morality, and politics from science.[5] This new conception of inquiry is seen in the emergence of a new meaning of objectivity in the seventeenth century. The term objective (*objectus*) also had a distinct meaning in scholastic philosophy, for it chiefly pertained to objects of thought, rather than objects in the external world or inner dispositions.[6] The term was formulated to solve the problem of how to express the relationship between the representation of something in the mind and the thing itself.[7] Only if the formal concept and the objective concept conformed to one another was a statement considered true.

The meaning of the terms "experience" and "objectivity" changed dramatically as the framework of medieval scholasticism gave way during the early modern period. Seventeenth-century English natural philosophers began to advocate for an experimental approach to the study of nature, emphasizing first-hand experience and experiment over reliance upon authoritative

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[5] Shapin, *The Scientific Revolution*, 162.
[6] Lorraine Daston, "Objectivity and the Escape from Perspective," *Social Studies of Science* 22, no. 4 (1992): 600.
[7] Peter Dear, "From Truth to Disinterestedness in the Seventeenth Century," *Social Studies of Science* 22, no. 4 (1992): 620.

textbooks.[8] This reforming impulse in early modern natural philosophy had to reconcile two opposing impulses: the desire to build a natural philosophy based solely on particular human experience, while recognizing the woeful limits of anyone's individual experience.

The legal system offered a promising way forward for English empiricists who wanted to show how the abandonment of the goal of certain knowledge does not lead to skepticism, for it taught that facts could be established with a high degree of certitude by the witness testimony of ordinary persons.[9] The members of the Royal Society incorporated this view in their promotion of a philosophy that preferred facts over hypotheses, the former which are adequately witnessed and theory-neutral statements of natural events, whereas the latter was conjecture, even if well-founded. In order for the system to work properly, natural philosophers must function as jurists with sufficient impartiality to give testimony to and judgments about matters of fact.

The emphasis on the personal qualities of the natural philosopher, in turn, led mid-seventeenth century English natural philosophy to a new notion of objectivity, which is characterized by "impartiality, freedom from prejudices, lack of bias, and lack of partisanship."[10] Without the scholastic epistemology and its notion of an objective concept, objectivity ceases to provide the ground for truth and instead refers to the personal characteristics of the knower. Objectivity now refers to the state of the individual—meaning it becomes

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[8] ———, *Revolutionizing the Sciences : European Knowledge and Its Ambitions, 1500-1700* (Princeton, N.J.: Princeton University Press, 2001), 64.
[9] Barbara Shapiro, "The Concept "Fact": Legal Origins and Cultural Diffusion," *Albion* 26, no. 2 (1994): 233.
[10] Stephen Gaukroger, *The Emergence of a Scientific Culture: Science and the Shaping of Modernity, 1210-1685* (Oxford: Clarendon Press, 2006), 231.

possible to talk about degrees of objectivity—and is no longer a term describing the relation of knowledge to its object. This was not the only meaning of the word objectivity in early modern philosophy, to be sure, but for those working in this tradition, values played no role in the justification of scientific knowledge.

The two different streams of early modern natural inquiry described above converge in the work David Hume, the Scottish philosopher of the eighteenth century who defined the debate on values for modern philosophers. He endorsed the new view of nature and even hoped to extend the same mechanical analysis to human cognition as Newton did to nature. He also argued that values have no place in inquiry with the famous argument that ought cannot be derived from is, or that values cannot be deduced from facts. Hume wanted to separate descriptive statements that attempt to reflect the way the world is, from normative statements that reflect human desires. If our descriptions of nature include no moral premises, than we can draw no moral conclusions. Hume's work forcefully articulates the consequences of the Scientific Revolution for many in the modern West: science teaches us that nature is an uncaring machine, a vast reservoir of technological power that is unable to support moral claims made about it.

Undoing the Fact/Value Distinction

As I noted in the introduction, an increasing number of scholars object to the fact/value distinction as I have described it. The most common way to object to the distinction is by drawing attention to role of human perspective in all our claims to knowledge. In other words, elements of the human mind penetrate so deeply into "reality" that it becomes impossible to endorse the idea that we can map something that is "mind-independent."[11] The fact/value distinction operates under the assumption that there can be knowledge independent of human perspective, a view from nowhere.

Over the past four decades or so, this argument has been made using the history of science, attacking the Enlightenment conception of scientific inquiry that is often assumed by advocates of the traditional fact/value position. Particularly influential was the argument by Thomas Kuhn in the *Structure of Scientific Revolution* that science is not a mechanical process because extralogical considerations can guide scientific inference.[12] Deciding for or against a paradigm requires considerations of competing evidences in light of estimations of the virtues (e.g., simplicity, usefulness, elegance) that a proper theory should have. Kuhn's work raised many important questions, and many post-Kuhnian studies have pushed his analysis further, showing how the values and interests can shape the production of natural knowledge. All scientific work involves values, it is claimed, and ignoring this fact can allow values to remain hidden behind a "cloak of neutrality."

As the debates surrounding the "Science Wars" in the 1990's demonstrate, these debates are controversial and far from settled. Rather than engaging them further, I would like to develop in the rest of the essay another way to challenge the fact/value distinction, one that coheres with our best understandings of scientific inquiry. For all the debates in twentieth-century philosophy of science, most philosophers portrayed science as a body of knowledge that progresses through the operation of rationality, objectivity, or

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[11] Richard Rorty, "Putnam and the Relativist Menace," *The Journal of Philosophy* 90, no. 9 (1993): 443.

[12] Kincaid, Dupré, and Wylie, "Introduction," 8.

method. The problem with the epistemological orientation of twentieth-century philosophy of science is that philosophers of science too often portray scientists as featureless and abstract reasoners whose main task is to form representations of the world. Instruments and embodied skills, on this view, are only relevant to the extent they provide warrant for belief.

What is significant about recent work on the sciences—those who study how scientists work—is the shift from equating science with knowledge to emphasizing science as an activity. In the history, philosophy, and sociology of science, there have been moves to understand science in action (i.e., focus on the everyday activities of scientific practitioners) and science as action (i.e., science as an embodied skill). Reified notions of science as theories inhabiting a Platonic realm have given way to accounts that stress the embodied nature of scientific reasoning. I will give a brief overview of these changes before considering their impact on the values question.

In the history of science, recent works have identified the elevation of the value of useful knowledge as the key element that transformed medieval natural philosophy into early modern natural philosophy (or science). Philosophers of the early modern period modified the medieval Aristotelian goal of contemplative knowledge of nature into a search for knowledge that can be reliably employed for purposes of control and survival, overcoming the separation of theoretical and practical knowledge in natural inquiry. Historians have identified a number of reasons for this change. One major source of the new emphasis on the usefulness of knowledge seems to have been the Renaissance, where scholars of this period celebrated the practical knowledge of elite craftsmen.[13] Another source was the belief that a new natural philosophy could better accommodate the increasing number of new instruments and discoveries, such as gunpowder, the magnetic compass, and printing press. Finally, many have pointed to the legacy of the vision of Francis Bacon, who argued that natural philosophers should not sit back and contemplate nature's ordinary course of action but actively try to interfere with it in order to find applications that might benefit humanity.[14] Whatever the reason for the shift, "Knowing how" was starting to become in the early modern period as important as "knowing why."[15]

In the sociology of science, work has drawn attention to embodied knowledge by identifying a tacit component to science, along with the complexities that this creates for experimental research programs. For example, in his classic work *Changing Order*, Harry Collins describes in one case study how groups of scientists learned to replicate a new type of laser, first built by a Canadian group in the early 1970s. While there were many trying to build lasers and each had papers explaining how to construct them, the only scientists who were successful had repeated personal contact with an accomplished practitioner. No laboratory was able to build the laser if their information came through persons who had not built the device for themselves. Collins concludes from this and other examples that, "Experimental ability has the character of a skill that can be acquired and developed with practice. Like a skill, it cannot be

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[13] Henry, *Scientific Revolution*, 34.
[14] Gaukroger, *Emergence of a Scientific Culture*, 164.
[15] Dear, *Revolutionizing the Sciences : European Knowledge and Its Ambitions, 1500-1700*, 170.

fully explicated or absolutely established."[16] The tacit knowledge gained from successfully building a laser made the practitioner more valuable than any formal account of the research activity. The larger lesson drawn from these and other sociological accounts of experimental inquiry is that science is more akin to a craft than traditional conceptions of science have acknowledged.

In the philosophy of science, there has likewise been an increased attention on the role of skill in science. The nature of scientific skill is entwined with the character of the human body, in both its ability to shape and be shaped by its environment.[17] To capture the complex relationship of the body to scientific inquiry, many refer to science as a practice, defined as "embodied, materially mediated arrays of human activity centrally organized around shared practical understanding."[18] Whereas ideas can be abstracted and decontextualized in order to be evaluated and transmitted elsewhere, practices only exist to the extent that scientists continually reproduce them.[19] Describing science as a practice is a way to highlight it as a practical activity, drawing one's attention to scientists in action and the embodied nature of scientific knowing.

For practice theorists, the goal of science is not merely to produce true beliefs but to transform human ability to cope with the world. As the philosopher Joseph Rouse explains, "Biologists understand cells in the sense in which we say that a good mechanic understands cars. Biologists and mechanics

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[16] H. M. Collins, *Changing Order: Replication and Induction in Scientific Practice* (Chicago: University of Chicago Press, 1992), 129.
[17] Theodore R. Schatzki, "Introduction: Practice Theory," in *The Practice Turn in Contemporary Theory*, ed. Theodore R. Schatzki, K. Knorr-Cetina, and Eike von Savigny (London: Routledge, 2001), 2.
[18] Ibid.
[19] Joseph Rouse, *Engaging Science: How to Understand Its Practices Philosophically* (Ithaca: Cornell University Press, 1996), 26.

can, if asked, produce many true sentences about what they work on, but that is hardly the point in either case."[20] To do science properly requires skill, which means that one cannot become a scientist merely by obtaining a conceptual grasp of the content of a scientific theory. If that were the case, one could become a scientist by memorizing the information given in scientific lectures. But as Thomas Kuhn argued, students often believe they have a proper understanding of a theory but then are unable to solve problems at end of chapter in their textbooks. One cannot say that they fully know a theory unless they are able to properly use it.

Practices are the accomplishments of competent members of collectives and are not reducible to any individualistic account.[21] Accounts of scientific practice try to hold in tension the local character of scientific knowledge with its status as a shared practice that is unintelligible without reference to the larger community of practitioners. On the one hand, scientific knowledge and activities are constantly adapting to local niches. Not only are practices themselves open to multiple interpretations, but there is considerable room for drift in the ongoing reproduction of the same practices because "scientific practitioners are geographically dispersed, responsive to local opportunities and constraints, imperfectly communicative, discontinuously policed, and differentially located within fields of overlapping scientific practices."[22] On the other hand, as

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[20] ———, "Kuhn's Philosophy of Scientific Practice," in *Thomas Kuhn*, ed. Thomas Nickles (Cambridge: Cambridge University Press, 2003), 116.
[21] For reductive analysis of practice, see Stephen P. Turner, *The Social Theory of Practices: Tradition, Tacit Knowledge, and Presuppositions* (Chicago: University of Chicago Press, 1994). For a response, I follow Barnes closely in this paragraph. Barry Barnes, "Practice as Collective Action," in *The Practice Turn in Contemporary Theory*, ed. Theodore R. Schatzki, K. Knorr-Cetina, and Eike von Savigny (London: Routledge, 2001).
[22] Rouse, *Engaging Science*, 26.

participants in a shared practice, scientists must continually orient and adjust their work to the activities of others in order for their own work to be intelligible and significant.[23] While an individual may apply his or her skills in private, members of practices must continually coordinate their actions with others.[24] Repeated performance of skilled activity in isolation and independent from other practitioners is not a practice; it is a habit. Practice and habit are distinguishable because a practice is enacted well or poorly, but a habit is not. It is only through an intentional commitment to a group—where members both contribute to and are shaped by each other—that a practice is identifiable and sustainable, which allows members of the group to distinguish between correct and incompetent enactment. While practices are composed of individual performances, they cannot be properly understood apart from their belonging to the interaction of multiple performances over time.[25] Scientists continually offer and reconfigure narratives of their own work, trying to make sense of their actions and relations to other people. Scientific knowledge, then, is both local and dynamic, a fact that is missed if one only encounters science through textbooks.

Emphasizing the role of skill in science has brought new issues to prominence, including scientific pedagogy. For example, idea-centered philosophies of science have tended to neglect the training needed to inculcate the skills that are intimately connected to and undergird the completed theories of scientific textbooks. But a pedagogically oriented philosophy of science studies "those conditions that make it possible to know, to develop, and to apply

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[23] Ibid., 27.
[24] Barnes, "Practice as Collective Action," 25.
[25] Joseph Rouse, "Practice Theory," in *Philosophy of Anthropology and Sociology*, ed. Stephen P. Turner and Mark W. Risjord (Boston: Elsevier, 2007), 505.

such collections of ideas."[26] Emphasizing the power of training leads to a more nuanced understanding of the influence of local context on producing knowing subjects. Scientific training shapes not only behavioral habits but also self-image, perspectives, attitudes, values, desires, and objectives, all of which bear the marks of time and place.[27]

To sum up the point of scientific practice, James Secord says, "The move to study practice has, in my view, been the single most significant transformation in [the field of the history of science] during the past twenty years."[28] As I have briefly described above, this shift has been significant for all disciplines that reflect upon the nature of scientific inquiry. The question, then, is what difference does this shift imply for the traditional distinction between facts and values?

Values in the Practice of Science

To see the significance of scientific practice on the question of values, consider again that traditional view. One presupposition underlying the fact/value distinction is that facts, or knowledge more generally, is morally neutral. I may have factual knowledge of how to download pirated software, but I am only morally culpable if I choose to act upon such knowledge. Or to give a scientific example, knowledge of how to develop atomic weapons is not morally objectionable, using them against others is.

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[26] Andrew Warwick and David Kaiser, "Kuhn, Foucault, and the Power of Pedagogy," in *Pedagogy and the Practice of Science: Historical and Contemporary Perspectives*, ed. David Kaiser (Cambridge, MA: MIT Press, 2005), 402.
[27] Rouse, "Practice Theory," 512.
[28] James A. Secord, "Knowledge in Transit," *Isis* 95(2004).

Most objections to the fact/value distinction dispute the claim that facts are morally neutral. Because human factual knowledge is inescapably shaped by particular social and historical locations, facts are not neutral descriptions of the way things are independent of human knowledge. Alasdair MacIntyre has made this claim most provocatively, linking such optimism about facts to idealistic Enlightenment epistemologies. He argues that facts—when understood as value-free units of public experience—are like telescopes and wigs for gentlemen, an invention of the seventeenth century.[29]

My objection to the fact/value distinction is based upon the assumption that scientific knowledge is independent of action. Based upon my presentation of scientific practice, this assumption cannot be defended. Scientific inquiry is inextricably connected to the way a practitioner tries to engage the natural world. Science is not merely about developing an accurate world-picture but also about techniques that give us power over matter. Of course, traditional views of science allow for this dual character by making a distinction between pure and applied science. However, a main implication of a philosophy of scientific practice is that the strict separation of pure and applied science is not helpful: there is too much practice in the theory of science, and too much theory in the practice of science. This is why an increasing number of historians and sociologists have begum employing the term *technoscience* in order to avoid making sharp distinctions between natural knowledge and technology.[30]

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[29] Alasdair C. MacIntyre, *Whose Justice? Which Rationality?* (Notre Dame, Ind.: University of Notre Dame Press, 1988), 357.
[30] Steven Shapin, *The Scientific Life: A Moral History of a Late Modern Vocation* (Chicago: University of Chicago Press, 2008), 3.

If this claim about technoscience is correct, then values are inextricably tied to scientific inquiry, for each step along the path of inquiry involves actions that can be morally evaluated. Whether for applications that are seen as morally suspect (e.g., weapon research), morally praiseworthy (e.g., medical research), or, more likely, as neither (e.g., research into the chemical composition of stars), the acquiring of new knowledge requires a moral stance by the researcher as they shape and are shaped by the world around them. Still, this position is not committed to the stronger view that the hermeneutical aspect of scientific inquiry makes rational agreement impossible between those with differing value systems. One can demonstrate the value-laden nature of scientific inquiry, I think, without having to engage controversial debates about scientific rationality.

The position articulated here is strengthened when considering the issue of scientific significance.[31] What scientists seek about the world is not truth—there are too many truths in the world to catalog them all—but significant truths, truths that are important from a human perspective. Scientific theories are thus analogous to maps: they must filter out most features of the terrain in order represent that which is of cartographical significance to the person that produced it. The question thus arises, since the terrain that the sciences attempt to cover is too vast, what do we find significant? What questions will we attempt to answer using our finite resources? The vast majority of science since World War II has been industrial science or research funded by large companies or national governments. Consequently, what are most significant are those projects that can maximize profits or destruction. Especially for this reason,

[31] This is discussed in length in Philip Kitcher, *Science, Truth, and Democracy* (Oxford: Oxford University Press, 2003), 55ff.

questions about the moral nature of scientific inquiry are thus are as important now as they ever have been.

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