# THE ETHICS OF SCIENCE AND TECHNOLOGY AS KNOWLEDGE

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One defining feature of modern science and technology is their character as knowledge. Not only is science commonly described as both cognitive activity and a body of knowledge, but technological power has become increasingly knowledge-dependent. Unlike power, knowledge is often judged an unqualified good. From Aristotle to the present, knowledge is often taken to be a good without qualification. But in a world in which technoscientific knowledge offers along side its manifest benefits unparalleled opportunities for destructive utilization, and in which individuals are increasingly challenged to come to terms with scientific and technological perspectives on the natural world and themselves, the moral status of knowledge deserves substantive consideration.

## Knowledge Questions

Knowledge has been defined since Plato as "justified true belief," that is, as true opinion with reason or "logos" (*Theatetus* 201d-210d). Epistemology or the theory of knowledge examines what counts as the reasoning that can convert true opinion (which may be quite accidental) into knowledge. Does epistemic rationality require reference to empirical data, systematic coherence, covering laws, or what?

Precisely because of its various possible justifications, knowledge comes in diverse forms. Bertrand Russell (1910), for instance, distinguished knowledge by description (scientific propositions) and knowledge by acquaintance (including technical know how). In relation especially to science and technology each type raises ethical as well as epistemological issues that have seldom been addressed in standard philosophical discussions. Is it not possible for certain types of propositional knowledge or its pursuit to distract human beings from more important activities and ends? Might not knowledge by acquaintance be ethically or politically problematic?

The first question has been broached on the margins of philosophy in information science and knowledge management. These contemporary disciplines have, for instance, examined the

relations between data, information, knowledge, and wisdom — distinctions first suggested by the poet T.S. Eliot in "Chorus from 'The Rock'" (1934). Economist and diplomat Harland Cleveland (1982) and operations research scientist Russell Ackoff (1989) have each proposed different versions of these distinctions in order to highlight how knowledge and understanding can be obscured by data or information.

The second question has been raised in relation to forms of knowledge as diverse as nuclear engineering and genetic screening. For the lead developer of the atomic bomb, J. Robert Oppenheimer (1947), "In some sort of crude sense which no vulgarity, no humor, no overstatement can quite extinguish, the physicists have known sin." For philosopher Ruth Chadwick (1997), information about genetic abnormalities constitutes a kind of knowledge that patients may have a "right not to know" in order to lead their lives without excessive worry. How did it come about that knowledge, so often been seen as a pristine virtue, is now manifest in the contemporary world as both benefit and burden?

## Historical Emergence

Critical reflection on the role of knowledge in society can be traced back to the origins of European civilization. Pre-Socratic philosophers were largely concerned with the natural world, but by the mid-fifth century BCE this had changed. According to Plato, Socrates suggested that he could learn little of human importance from nature (*Phaedrus* 230d), and the *Republic* sets up a keen tension between knowledge and politics.

Plato's *Republic* begins with an account of the various ways political orders can be governed: through violence, religious authority, tradition, or discursive rationality. The first three play inevitable roles. Governments must possess a monopoly over violence, while religious authority and tradition provide the guidance needed to establish behavioral norms. Plato is nevertheless often interpreted as launching Europe on a 2500 year trajectory progressively to free rationality from constraints imposed by these other approaches, a process of structural differentiation that reached apotheosis in the Enlightenment. In the dialogues, however, Plato repeatedly emphasized the tension between philosophy and power. Socrates must be (playfully) coerced to reveal what he knows, and even then he carefully reminds his listeners that the philosophic knowledge of the few looks topsy turvy to the many.

The dialogue reaches a climax in the myth of the divided line and allegory of the cave, where Socrates once again yokes knowledge to politics. These images describe the difficulty of distinguishing truth from shimmering illusions, as well as the way falsehoods can blind someone to the truth. The difficulties are multiplied, however, by Socrates' view that knowledge can also cripple. Inverting the Homeric story in which Odysseus visits the underworld in order to gain the knowledge needed for practical matters, Socrates describes how philosophers can become so dazzled by the brilliance of their insights as to lose any sense of how to relate them to everyday experience.

In his *Nicomachean Ethics* Aristotle also emphasizes the relation between knowledge and desire: "Both the reasoning must be true, and the desire right, if the choice is to be good" (VI, 2; 1139a25). On Aristotle's account, excellence in reasoning and right desire are cultivated through the moral and intellectual virtues. Moral virtues such as courage, generosity, and magnanimity are governed by a principle, the doctrine of the mean, that seeks out the midpoint between the extremes of excess and deficiency. The intellectual virtues — which Aristotle examines in order as *episteme* (science), *techne* (craft skill), *phronesis* (practical judgment), and *nous* (intuition) — identify the different ways human beings can acquire truth.

Crucially, however, there appears to be no principle of the mean governing these intellectual virtues. There is no discussion of the possibility that there could be an excess as well as a deficiency in any of these perfections of the rational soul after the manner of the moral virtues. Nor, for that matter, is there any account of how the moral and intellectual virtues relate to one another. When Aristotle turns to a fifth intellectual virtue, *sophia* (wisdom), he describes it as the combination of intuition and science — leaving out technical skill and practical judgment. Wisdom consists of theoretical knowledge lacking any clear relation to practical matters. For Aristotle, the highest form of knowledge appears to escape any the problematic of Plato.

In the Platonic tradition, which became through Augustine a vehicle for Christian theological reflection, the problematic aspects of knowledge nevertheless found multiple if marginal expressions. Consider the story of Leontius (*Republic* IV, 439e ff.). Walking along the wall outside the Piraeus, Leontius spies the corpse from an execution, and desires to feast his sight on the repugnant image. Recognizing this as a degraded use of the most noble of the

senses, he struggles to resist temptation. Failing in moral stamina, he finally runs toward the rotting body and exclaims in sarcastic irony: "Look, you damned wretches, take your fill of the fair sight!"

The problem of the custody of the eyes became in fact a major moral issue in the Christian tradition. According to biblical narrative, the knowledge of good and evil was associated with a tree in the midst of the Garden of Eden that was "a delight to the eyes" (Genesis 3:6), but from which Adam and Eve had been forbidden to eat. When they succumbed to the visual temptation, their eyes were opened in ways that brought hardship upon them and the human race that followed their expulsion east of Eden. During the medieval period this notion of dangerous knowledge was elaborated especially in the monastic tradition. In an extended commentary on chapter seven of the *Rule of St. Benedict*, Bernard of Clairvaux, in the *Steps of Humility* (1120), criticized "curiositas" as a form of pride. Thomas Aquinas, working under the influence of Aristotle, sought to qualify such criticism, although even he admitted that "curiosity about intellective sciences may be sinful" (*Summa theologiae* II-II, Q.167, art.1). But with the coming of the modern age the restriction on knowing was set aside in favor of a view of cognitive activity and its products as unqualified goods in an even stronger sense than found in Aristotle himself.

In the modern era, traditional boundaries on scientific pursuits began to drop away as interrogation undertook new active forms in dealing with both nature (the performing of autopsies and instrumentalized experimentation) and the sacred (subjecting the Bible to the same kinds of analysis as any other book). René Descartes represents a signal turning point. Offering a distinctively modern scientific sense of reason, he claimed that with his method "there is no need for the mind to be contained within any limits" (*Rules for the Direction of the Mind*, 1620s). For Descartes there were new rules to replace those of the monasteries, and new meditations to replace spiritual reading, through which human beings might become the "masters and possessors of nature" for which they had been divinely predestined. This project approaches fulfillment in the 21st century, as scientific and technological advances create possibilities that herald wholesale changes in nature, society, body, and mind.

E.F. Schumacher (1977) in a simple but insightful characterization, described the transition introduced by Descartes and others as one from the pursuit of "science as

understanding" to "science for manipulation." Whereas the former sought to integrate knowers with the known, to raise human beings out of their material state by means of insight into higher things, the latter began with a sense of knowers as separated from the known and sought to assert this separation by means of analysis. The overarching theme concerning knowledge since the 1500s has been the progressive application of the principle of analysis. Descartes provides the classic statement of the analytic method in his *Discourse on the Method for Rightly Conducting the Sciences* (1637). Items were to be understood by being broken into their constituent pieces. The goal was to arrive at the smallest possible elements. Once these "simples" were identified and completely examined, knowledge would be re-constructed on unshakeable foundations. Complemented by the empiricist methods deriving from Francis Bacon, who also sought new forms of knowledge, there has flowed forth an ever increasing stream of results, including but not limited to the growth of academic disciplines.

## The New World of Knowledge and Its Production

In the epistemological world opened up by Bacon and Descartes new categories and forms of knowledge multiply without bounds. In the nineteenth century natural philosophy divided into physics, chemistry, and mathematics, while natural history morphed into biology with an experimental component that challenged the traditional emphasis on description and taxonomy. The social sciences — sociology, psychology, economics, political science, and anthropology — arose to address the new social conditions, applying a scientific approach to the problems of industrialized experience.

The disciplines that have become known as the humanities — philosophy, classical languages, modern languages, history, art, and music — formed a rump out of what was left following the extraction of the scientific specializations. The term itself was an adaptation from the Renaissance *studia humanitatus*, when humanist scholars looked to ancient thinkers such as Cicero for inspiration and guidance. A few of these latter-day humanists protested the rise of specialization and disciplinarity and the new emphasis on research, but in general the humanities accommodated themselves to the novel paradigms of knowledge. Abandoning the traditional notion of expounding a perennial philosophy, fields such as literature and philosophy today train specialists whose role is to develop new insights. Having given over the study of nature to the

physical sciences, and the study of culture to the social sciences, the humanities have been left to conduct meta-analyses or pursue some version of *l'art pour l'art*.

Analytic assumptions concerning knowledge also promoted the concept of expertise. Expertise in the modern sense depends on phenomena being understood in isolation from each other. In politics this makes democracy at once necessary and problematic — necessary to do the relating that can no longer be done by knowledge, and problematic to the degree that intelligent decision making requires specialized knowledge. Specialization and expertise lead to what can be called epistemological myopia, where a powerful understanding of the details comes at the cost of appreciating larger implications of a phenomenon. This in turn has led to calls for interdisciplinary approaches to knowledge.

While problematic even within the sciences, the analytic approach to knowledge as had its most destructive effects in the humanities. Even as the intellectual division of labor has become more and more fine-grained, there was no part of knowledge explicitly concerned with the development and relation of knowledge between and across disciplines. Philosophy, the traditional location for such knowledge, also embraced specialization and professionalization, and new claimants to interdisciplinarity such as the sociology of knowledge or science, technology, and society (STS) studies, in short order came under the gravitational attraction of their own disciplinary formations. Disciplinary myopia in turn has run parallel to and contributed to the progressive loss in public ability to rationally debate the ends of life, which has reached the point that to even speak of "the good life" often invites derisive commentary — or relegation to the private sphere of personal preference.

Disciplinary specialization and its corresponding cognitive productivity was thus bought at the cost of ignoring the lateral connections between one subject and the rest of the universe of thought and action. The issue here is the dominance of the metaphor of the laboratory, which presumes that it is relatively unproblematic to separate a bench experiment from the world at large: creating conditions that can be replicated, by controlling the materials used and constraining the parameters of the experiment (Frodeman, 2003). Even fields quite far from science, and in some cases quite disdainful of it, have applied this presumption in their own work. To offer just one example, it is presumed by literary scholars that it is more central to the work of their field to further probe the depths of the *Prelude* than to explore how William

Wordsworth might illuminate the experience of employees of US National Parks, and through them, the park-visiting public.

## The Knowledge Explosion and Its Discontents

Despite the tremendous explosion of knowledge, there is no discipline that takes as its provenance understanding the relation between the disciplines. Knowledge and information workers multiply even faster than sex workers. Hundreds of thousands of bachelor degrees and tens of thousands of doctorates are awarded each year; in the United States the annual national budget for science is now over $150 billion (with twice as much coming from private sources); and a sky-rocketing stream of publications floods the infosphere in hardcopy, electronic, and various other media. Twittering turns quotidian life into electronic information streaming. As more than one social commentator has repeated, we are increasingly the most information and knowledge-intensive society in history (see Machlup 1962, Rubin *et al.* 1986, Castells 1996, and Mokyr 2002). To adapt a prescient distinction from Albert Borgmann (1999), knowledge about reality (science) and knowledge for reality (engineering) have become knowledge as reality. But the knowledge society appears to have little or no program for how to live in or with this information rich possibility space other than to affirm the personal construction of meaning, some synthesis (perhaps by means of Adam Smith's "invisible hand" or G.W.F. Hegel's "cunning of reason") in knowledge communities and their management, or Vannevar Bush's linear hypothesis from *Science: The Endless Frontier* (1945): just fund basic research and good results will flow to advance national security, public health care, and economic competitiveness.

In the area of science policy, selective voices have questioned the received view that all knowledge production is good knowledge production. According to Daniel Sarewitz (1996), David Guston (2000), and Philip Kitcher (2001) there are good reasons to doubt that simply giving more money to science is always the best social investment. A few isolated analyses point in rather more radical directions, for instance with provocative studies on the theme of "forbidden knowledge" by Nicholas Rescher (1987), Roger Shattuck (1996), and Agnieszka Lekka-Kowalik and Daniel Schulthess (1996). Among others, Carl Mitcham and Robert Frodeman (2002) have sought to extend the argument for balance in science funding to a broader balance in knowledge production. Subsequent to 9/11, new forms of knowledge restriction have

been debated in the sciences themselves. All together, such efforts suggest that the traditional research philosophy in favor of unfettered scientific autonomy and unrestricted knowledge production is running up against both epistemological and political limits. The *epistemological* limits of knowledge production are evident in the increasingly complex nature of both knowledge and societal problems: our lives are becoming more interwoven on global scales, and many of the problems that are most easily isolated have already been addressed. The *political* limits are found in the increasing public demand that publicly funded research and education clearly demonstrate their connections to community needs. Although the repeated call for interdisciplinarity in education and research is often an effort to respond to such problems, in many instances the interdisciplinarity that emerges does little to address such issues, since it leads only to more and more refined disciplinarity.

## What Is To Be Done?

Existing ethical assessments of science focus on methodological norms in knowledge production. In exceptional cases, critics have contested claims to scientific knowledge on ethical and religious grounds (as in the challenge to evolutionary theory), although they have not questioned the value of knowledge per se. Existing ethical assessments of engineering and technology focus largely on the active use of technical knowledge rather than the knowledge itself. By contrast, the argument here is that knowledge itself deserves ethical analysis and criticism.

What might this involve? To begin with, it will depend on some recognition, however provisional, of knowledge as an ethical issue beyond the belief in knowledge as an unqualified good. But such acknowledgment could also find support from one or more of five complementary approaches to the knowledge question.

First, there is phenomenological work on the character of scientific knowledge by philosophers such as Hans Jonas (1966 and 1974) who has argued the inherently practical character of modern natural science. Such an argument poses obvious challenges for any classical defense of knowledge as inherently good or neutral.

Second, there is the argument by scientists themselves from the 1970s on the possible dangers in and limitations for scientific research, because of the complexities with which it had

become involved. Although some of the early arguments to this effect (e.g., Holton and Morison 1978) were subsequently challenged, later studies in complexity theory (e.g., Pagels 1988) raise related issues that have yet to be fully appreciated. This argument has arisen anew in relation to security issues associated with protecting dual-use knowledge from terrorist use.

Third, virtue epistemology makes a case for relating knowledge and virtue that also has implications for relating knowledge and vice. Virtue epistemology is concerned with identifying the virtues that undergird the cognitive process in ways that transform true belief into knowledge (see, e.g., Zabzebski 1996). But here ethics is simply incorporated into an ethical epistemology, while what is equally called for is an epistemic ethics and metaphysics.

Fourth, information ethics in its two forms — the ethics of library science and the ethics of computer information generation and manipulation — both suggest the need for ethical assessments of knowledge in relation to issues of privacy and equity. How can all knowledge be inherently good when some of it is inherently invasive or promotes inequalities? Moving in the directions of moral psychology, there is also research that suggests certain types of propositional knowledge might limit the exercise of intuitive knowledge (Gladwell 2005). Extending such a notion, is it not possible that certain types of knowledge could distract human beings from more important goods? Is the acquaintance with the phenomena on which know how depends never psychologically problematic?

Finally, science studies research on transformations in the social character of knowledge production have developed suggestive analyses with implications for any ethics of knowledge. A useful reference here is the work of Michael Gibbons and others, *The New Production of Knowledge* (1994), which distinguishes what it terms "Mode 1" and "Mode 2" knowledge. Mode 1 is the standard form of modern knowledge generated in disciplinary and academic frameworks. Mode 2 knowledge originates outside academic research institutions. Mode 2 knowledge production is

— governed by practical, problem solving concerns (rather than by more academic or epistemic ones),

— transdisciplinary in character,

— engenders linkages among subfields and heterogeneous sites,

— subject to economic and social accountability, and

— incorporates social, economic, and political interests

Although this analysis and a companion volume by Helga Nowotny at others (2001) suggests little more than adaptive strategies in response to such transformations, they open up space for more normative assessments. Deborah Johnson (1999), for instance, has argued that recognition of the new social constructive context of science offers opportunities for re-framing the question of forbidden knowledge. More generally, Nico Stehr (2005) has argued the inherently political character of contemporary scientific and technological knowledge.

On the basis of these kinds of existing research one may propose the following overlapping questions for any future ethics of science and technology:

(1) Historically and socially, what is the moral status of a kind of knowledge with inherently applied characteristics? Is the distinction between ancient, contemplative knowledge and modern, inherently manipulative knowledge defensible? Furthermore, has the character of technoscientific knowledge itself undergone morally relevant change of the types suggested by social studies of science?

(2) Conceptually, what are the ethical dimensions of distinctions between the forms knowledge (in the general sense) as data, information, knowledge (in a strict sense), and wisdom?

(3) From the political and policy perspectives, what is the proper balance between knowledge and knowledge production in the technosciences, the social sciences, the humanities, and the arts? How do different forms of cognition properly interact, not just to produce knowledge but to promote the good life?

(4) Psychologically, what are the moral implications of the proliferation of technoscientific knowledge? Does more knowledge always promote better thinking or acting?

(5) Ethically (in a narrow sense): What are the morally relevant consequences of knowledge and knowledge production? Are there no deontological limits on knowledge and knowledge production? With regard to virtue, are there no extremes to epistemological practice that deserve censure?

Although not exhaustive of any future ethics of science and technology as knowledge, responses to such questions could begin to provide guidance for the co-creative interaction between knowing, making, and doing in the an expansively human sense.

Appendix

Two reports recently published by the European Commission constitute further contributions to the issues raised here:

Ulrike Felt, Brian Wynne, et al., *Taking European Knowledge Society Seriously*, Report of the Expert Group on Science and Governance, to the Science, Economy and Society Directorate, Directorate-General for Research, European Commission, 2007.

Zaneta Ozliņa, Carl Mitcham, Jack Stilgoe, et al., *Global Governance of Science*, Report of the Expert Group on Global Governance of Science to the Science, Economy and Society Directorate, Directorate-General for Research, European Commission.

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