SIX SIGNS OF SCIENTISM[1]

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ABSTRACT: As the English word "scientism" is currently used, it is a trivial verbal truth that scientism – an inappropriately deferential attitude to science – should be avoided. But it is a substantial question when, and why, deference to the sciences is inappropriate or exaggerated. This paper tries to answer that question by articulating "six signs of scientism": the honorific use of "science" and its cognates; using scientific trappings purely decoratively; preoccupation with demarcation; preoccupation with "scientific method"; looking to the sciences for answers beyond their scope; denying the legitimacy or worth of non-scientific (e.g., legal or literary) inquiry, or of writing poetry or making art.

KEYWORDS: scientism, honorific use of "science", demarcation of science, scientific method, science and values

A man must be downright crazy to deny that science has made many true discoveries. C. S. Peirce[2]

Scientism ... employs the prestige of science for disguise and protection. A.H. Hobbs[3]

Science is a good thing. As Francis Bacon foresaw centuries ago, when what we now call "modern science" was in its infancy, the work of the sciences has brought both light, an ever-growing body of knowledge of the world and how it works, and fruit, the ability to predict and control the world in ways that have both extended and improved our lives. But, as William Harvey complained, Bacon really did write about science "like a Lord Chancellor"[4] – or, as we might say today, "like a promoter," or "like a marketer." Certainly he seems to have been far more keenly aware of virtues of science than of its limitations and potential dangers.

Yet science is by no means a *perfectly* good thing. On the contrary, like all human enterprises, science is ineradicably is fallible and imperfect. At best its progress is ragged, uneven, and unpredictable; moreover, much scientific work is

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[2] Charles Sanders Peirce, *Collected Papers*, eds. Hartshorne, Charles, Paul Weiss, and (volumes 7 & 8) Arthur Burks (Cambridge: Harvard University Press, 1931-58), 5.172 (1903). References to the *Collected Papers* are by volume and paragraph number.

[3] A. H. Hobbs, *Social Problems and Scientism* (Harrisburg: Stackpole Press, 1953), 17.

[4] My source is Peirce, *Collected Papers* (note 2 above), 5.361 (1877). (Bacon was for a time Lord Chancellor – roughly, what in the U.S. would be called Attorney General – of England.)

unimaginative or banal, some is weak or careless, and some is outright corrupt; and scientific discoveries often have the potential for harm as well as for good – for knowledge *is* power, as Bacon saw, and power can be abused. And, obviously, science is by no means the *only* good thing, nor – only a little less obviously – even the only good form of inquiry. There are many other valuable kinds of human activity besides inquiry – music, dancing, art, story-telling, cookery, gardening, architecture, to mention just a few; and many other valuable kinds of inquiry – historical, legal, literary, philosophical, etc.

As I indicated by giving *Defending Science – Within Reason*[5] its subtitle, *Between Scientism and Cynicism*, we need to avoid *both* under-estimating the value of science, *and* over-estimating it. What I meant by "cynicism" in this context was a kind of jaundiced and uncritically critical attitude to science, an inability to see or an unwillingness to acknowledge its remarkable intellectual achievements, or to recognize the real benefits it has made possible. What I meant by "scientism" was the opposite failure: a kind of over-enthusiastic and uncritically deferential attitude towards science, an inability to see or an unwillingness to acknowledge its fallibility, its limitations, and its potential dangers. One side too hastily dismisses science; the other too hastily defers to it. My present concern, of course, is with the latter failing.

It is worth noting that the English word "scientism" wasn't always, as it is now, pejorative. In the mid-nineteenth century – not long after the older, broader use of the word "science," in which it could refer to any systematized body of knowledge, whatever its subject-matter, had given way to the modern, narrower use in which it refers to physics, chemistry, biology, and so on, but not to jurisprudence, history, theology, and so forth[6] – the word "scientism" was neutral: it meant, simply, "the habit and mode of expression of a man of science." But by the early decades of the twentieth century "scientism" had begun to take on a negative tone – initially, it seems, primarily in response to over-ambitious ideas about how profoundly our understanding of human behavior would be transformed if only we

[5] Susan Haack, *Defending Science – Within Reason: Between Scientism and Cynicism* (Amherst: Prometheus Books, 2003).

[6] According to Friedrich von Hayek, although the earliest example given by Murray's *New English Dictionary* was dated 1867, this narrower usage was already coming into play by 1831, with the formation of the British Association for the Advancement of Science. F. A. Von Hayek, "Scientism and the Study of Society," *Economica* (August 1942): 267, n.2, citing John T. Merz, *History of European Thought in the Nineteenth Century* vol. I (Edinburgh: W. Blackwood and Sons, 1896), 89. See also the entry on "science" in the *Oxford English Dictionary* online (available at http://dictionary.oed.com).

were to apply the methods that had proven so successful in the physical sciences.[7] And by the mid-twentieth century, scientism had come to be seen as a "prejudice,"[8] a "superstition,"[9] an "aberration" of science.[10] By now this negative tone is predominant;[11] in fact, the pejorative connotations of "scientism" are now so thoroughly entrenched that defenders of the autonomy of ethics, or of the legitimacy of religious knowledge, etc., sometimes think it sufficient, instead of actually engaging with their critics' arguments, to dismiss them in a word: "scientistic."

So, as the term "scientism" is usually currently used, and as I shall use it, it is a trivial verbal truth that scientism should be avoided. It is, however, a substantial question exactly *what* it is that is to be avoided – when, and why, deference to the sciences is appropriate and when, and why, it is inappropriate or exaggerated. My primary purpose here is to suggest some ways to recognize when this line has been crossed, when respect for the achievements of the sciences has transmuted into the kind of exaggerated deference characteristic of scientism. These are the "six signs of scientism" to which my title alludes. Briefly and roughly summarized, they are:

> 1. Using the words "science," "scientific," "scientifically," "scientist," etc., honorifically, as generic terms of epistemic praise.
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> 2. Adopting the manners, the trappings, the technical terminology, etc., of the sciences, irrespective of their real usefulness.
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> 3. A preoccupation with demarcation, i.e., with drawing a sharp line between genuine science, the real thing, and "pseudo-scientific" imposters.
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> 4. A corresponding preoccupation with identifying the "scientific method," presumed to explain how the sciences have been so successful.
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> 5. Looking to the sciences for answers to questions beyond their scope.

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[7] See the *Oxford English Dictionary* online (note 6 above) entry on "scientism."

[8] Hayek, "Scientism and the Study of Society" (note 6 above), 269 (describing scientism, the "slavish imitation of the method and language of science" as a "prejudice").

[9] E. H. Hutten, *The Language of Modern Physics* (London: Allen and Unwin, 1956), 273 (describing scientism as "superstitious").

[10] Peter Medawar, "Science and Literature," *Encounter* XXXI.1 (1969): 23 (describing scientism as an "aberration of science").

[11] There are exceptions, such as Michael Shermer, who adopts the word "scientism" as a badge of honor, writing in "The Shamans of Scientism," *Scientific American* 287, 3 (September 2002): 35 that "[s]cientism is a scientific worldview that encompasses natural explanations for all phenomena, eschews supernatural explanations, and embraces empiricism and reason as the twin pillars of a philosophy of life suitable for an Age of Science." But this *is* an exception.

6. Denying or denigrating the legitimacy or the worth of other kinds of inquiry besides the scientific, or the value of human activities other than inquiry, such as poetry or art.

I will take these six signs in turn – always trying, however, to keep their interrelations in sight, to signal the mistaken ideas about the sciences on which they depend, and to steer the sometimes very fine line between candidly repudiating scientism, and surreptitiously repudiating science. And, then – taking advantage of the opportunity provided by the last of these signs of scientism – I will comment briefly on some of the tensions between contemporary, scientific culture and the older traditions that, in much of the world, it has by now at least partially displaced.

1. The honorific use of "science" and its cognates

Over the last several centuries, the work of the sciences has enormously enriched and refined our knowledge of the world. And as the prestige of the sciences grew, words like "science," "scientifically," etc., took on an honorific tone: their substantive meaning tended to slip into the background, and their favorable connotation to take center stage. Advertisers routinely boast that "science has shown" the superiority of their product, or that "scientific studies" support their claims. Traditional or unconventional medical treatments are often dismissed out of hand, not as ill-founded or untested, but as "unscientific." Skeptical of some claim, we may ask, not "is there any *good* evidence for that?" but "is there any *scientific* evidence for that?" Needing to craft a test to help judges determine whether expert testimony is reliable enough to be admitted, the U.S. Supreme Court suggests that such testimony must be "scientific knowledge," arrived at by the "scientific method."[12] A historian arguing that there is no foundation in the evidence for the idea that ancient Greek philosophy was borrowed from the Egyptians describes this idea as "unscientific."[13] The titles of conferences and books speak of "Science and Reason,"[14] as if the sciences had a monopoly on reason itself. A recent editorial in

[12] *Daubert v. Merrell Dow Pharms., Inc.*, 509 U.S. 579 (1993). See also Susan Haack, "Trial and Error: The Supreme Court's Philosophy of Science," *American Journal of Public Health* 95 (2005): S66-73; reprinted in Haack, *Putting Philosophy to Work* (Amherst: Prometheus Books, 2008), 161-82.

[13] Mary Lefkowitz, *Not Out of Africa* (New York: Basic Books, 1996), 157.

[14] I am thinking, for example, of the conference at the New York Academy of Sciences in which I participated in 1996, and the corresponding volume. Paul R. Gross, Norman Levitt, and Martin Lewis, eds., *The Flight from Science and Reason* (Baltimore: Johns Hopkins University Press, 1997). I had suggested that the terms be reversed ("Reason and Science") – but my suggestion wasn't taken up.

the *Wall Street Journal* describes studies of charter schools where students are chosen by lottery as "scientific and more reliable" than studies of schools that select their students on merit.[15] The honorific usage is ubiquitous.

Naturally enough, once "science," "scientific," etc., have become honorific terms, practitioners uneasy about the standing of their discipline or approach like to use them emphatically and often. In 1953 Prof. Hobbs provided a splendid list of excerpts from publishers' blurbs for sociology texts: "a scientific approach"; "scientifically faces the problems of ... marriage"; "approaches social problems from the ... scientific point of view ... unassailable [conclusions]"; "sternly scientific"; and so on and on.[16] And nowadays, of course – though departments of physics and chemistry feel no need to stress that what *they* do is science – universities offer classes and degrees in "Management Science,"[17] "Library Science," "Military Science," and even "Mortuary Science."[18]

But this honorific usage of "science" and its cognates leads to all kinds of trouble. It makes it easy to forget that, remarkable as the achievements of the natural sciences have been, not all, and not only, scientists are good, thorough, honest inquirers; it tempts us to dismiss bad science as not really science at all; and it seduces us into the false assumption that whatever is *not* science is no good, or at any rate inferior. Yes, the best scientific work is a remarkable human cognitive achievement; but even this best scientific work is fallible, and there is plenty of good, solid work in non-scientific disciplines such as history, legal scholarship, music theory, etc. – not to mention the vast body of practically useful knowledge accumulated by farmers, sailors, ship-builders, and artisans of every kind, and the considerable resources of knowledge of herbs, etc., embodied in traditional medical practices.[19]

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[15] "Do Charters 'Cream' the Best?", *Wall Street Journal*, September 24th (2009): A20.

[16] Hobbs, *Social Problems and Scientism* (note 3 above), 42-3.

[17] For a skeptical view of this supposed discipline, see Matthew Stewart, "The Management Myth," *Atlantic Monthly* 297, 5 (2007): 80-87.

[18] In 1968 C. Trusedell gave a list based on a random search of graduate school catalogues: "'Meat and Animal Science' (Wisconsin), 'Administrative Sciences' (Yale), 'Speech Science' (Purdue), ... 'Forest Science' (Harvard), 'Dairy Science' (Illinois), 'Mortuary Science' (Minnesota)." Trusedell, *Essays in the History of Mechanics* (New York: Springer, 1968), 75. The list, and especially "Mortuary Science," became famous among philosophers of science when Jerome Ravetz cited it in *Scientific Knowledge and Its Social Problems* (Oxford: Clarendon Press, 1971), 387, n. 25.

[19] See Dagfinn Føllesdal, "Science, Pseudo-Science and Traditional Knowledge," ALLEA (All European Academies) *Biennial Handbook*, 2002: 27-37; citing Fenstad, E.-J., et al., *Declaration on Science and the Use of Scientific Knowledge*, UNESCO World Conference on Science 2003,

And, inevitably, the honorific use of "science" encourages uncritical credulity about whatever new scientific idea comes down the pike. But the fact is that all the explanatory hypotheses that scientists come up with are, at first, highly speculative, and most are eventually found to be untenable, and abandoned. To be sure, by now there is a vast body of well-warranted scientific theory, some of it *so* well-warranted that it would be astonishing if new evidence were to show it to be mistaken – though even this possibility should never absolutely be ruled out. (Rigid dogmatism is always epistemologically undesirable, rigid dogmatism about even the best-warranted scientific theory included.)[20] But this vast body of well-warranted theory is the surviving remnant of a much, much vaster body of speculative conjectures, most of which came to nothing – a fact which is bound to be obscured if we use "scientific" more or less interchangeably with "reliable, established, solid," and so forth.

2. Inappropriately borrowed scientific trappings

Besides encouraging the honorific use of "science" and its cognates, the successes of the natural sciences have also tempted many to borrow the manners, the trappings, of these fields, in hopes of looking "scientific" – as if technical terminology, numbers, graphs, tables, fancy instruments, etc., were enough by themselves to guarantee success. When Friedrich von Hayek wrote of the "tyranny" that "the methods and technique of the Sciences ... have exercised ... over ... other subjects"[21] he had in mind social scientists' efforts to look as much as possible like physicists – despite their radically different subject-matters. And there certainly *is* something objectionably scientistic about adopting the trappings associated with physics, chemistry, etc., not as useful transferable tools, but as a smoke-screen hiding shallow thinking or half-baked research. Even those who work in disciplines no one would hesitate to classify as sciences sometimes focus too much on form and too little on substance. An epidemiologist testing the side-effects of a morning-sickness drug meticulously calculates the statistical significance of his results, but fails to distinguish women who took the drug during the period of pregnancy when

"Preamble," 4 (available at <http://www.unesco.org/science/wcs/eng/declaration_e.htm>, last visited September 15, 2009).

[20] As I was writing this paper, newly-discovered fossils obliged evolutionary biologists to re-think the ancestry of *homo sapiens* – we are, it now seems, less directly related to chimpanzees than was formerly supposed. See Robert Lee Hotz, "Fossils Shed Light on Human Past," *Wall Street Journal* October 2 (2009): A3.

[21] Friedrich von Hayek, *The Counter-Revolution of Science* (Glencoe: Free Press, 1952), 13.

fetal limbs were forming from those who took it later;[22] another offers impressive-looking tables of cases, but fails to check whether the information in the tables matches the information in the text.[23]

But this kind of misuse of scientific tools and techniques is even commoner in the social sciences, where, as Robert Merton puts it, practitioners only too often "take the achievements of physics as the standard of self-appraisal. They want to compare biceps with their bigger brothers."[24] Lengthy introductory chapters on "methodology" in sociology texts are sometimes only window-dressing; and more often than one would like the graphs, tables, and statistics in social-scientific work focus attention on variables that can be measured at the expense of those that really matter, or represent variables so poorly defined that *no* reasonable conclusion can be drawn. David Abrahamson's Second Law of Criminal Behavior is a classic example: "A criminal act is the sum of a person's criminalistic tendencies plus his total situation, divided by the amount of his resistance," or: "C = (T+ S)/R."[25] The highly mathematical character of contemporary economic theory has contributed to the curious idea that economics is the "Queen of the social sciences" – a title to which psychology[26] would seem to have a much more legitimate claim. But too often those elegant mathematical models turn out to be based on assumptions about "rational economic man" true of no real-world economic actors.[27] And, sadly, policy recommendations based on flawed sociological statistics or flawed economic models often acquire an undeserved status because they are perceived as "science-based."

Inappropriately borrowed scientific trappings are also common in philosophy, where many journals and publishers have adopted such practices as the

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[22] Olli P. Heinonen, Denis Slone, and Samuel Shapiro, *Birth Defects and Drugs in Pregnancy* (Littleton: Sciences Group, 1977); see in particular the description of the project design and data collection, 8-29. The record in *Blum v. Merrell Dow Pharms, Inc*, 33 Phila. Co. Rptr., 193 (Ct. Comm. Pleas Pa. 1996), 215-7, shows that Dr. Shapiro admitted under oath that the study had failed to distinguish these two sub-groups of the sample.

[23] Christine Haller and Neal A. Benowitz, "Adverse Cardiovascular and Central Nervous System Events Associated with Dietary Supplements Containing Ephedra Alkaloids," *New England Journal of Medicine* 343 (2000): 1836. (The table is incompatible with the text on the same page.)

[24] Robert Merton, *Social Theory and Social Structure* (1957; enlarged ed., Glencoe: Free Press, 1968), 47.

[25] David Abrahamson, *The Psychology of Crime* (New York: Columbia University Press, 1960), 37.

[26] Of course, psychology also suffers from scientism; and also has a therapeutically-oriented wing in which inquiry takes second place to practice.

[27] See Robert L. Heilbroner, *The Worldly Philosophers* (1958: 7th ed., New York: Simon and Schuster, 1999), chapter xi. Susan Haack, "Science, Economics, 'Vision,'" *Social Research* 71, 2 (2004): 167-83; reprinted in Haack, *Putting Philosophy to Work* (note 12 above), 95-102.

name-date-page-number style of reference used by psychologists, sociologists, etc., and even their preference for the most recent rather than the original dates (often misleading even on its own turf, inherently more so in a discipline where reliance on authority is wholly out of place, and catastrophic when the historical development of an idea matters). Even giving priority to peer-reviewed publication, another practice adopted from the sciences, is a kind of scientism: for peer review is hardly perfect as a rationing device even for scarce space in scientific journals,[28] and is inherently more susceptible to corruption the more a profession is dominated, as philosophy is, by cliques, parties, and schools.[29] And, of course, in philosophy as in the social sciences, technical terminology is far too often not, as it could and should be, a carefully-crafted sign of hard-won intellectual advance, but only self-important jargon designed to attract others to (what you hope will be) a bandwagon.[30]

None of this is to deny, of course, that sometimes scientific tools and techniques turn out also to be genuinely useful to inquirers in other fields: historians use a cyclotron to determine whether the composition of the ink in two earlier printed versions of the bible was the same as that in the "Gutenberg Bible" of 1450-55;[31] they use DNA identification techniques to test the hypothesis that Thomas Jefferson was the father of the children born to his house-slave Sally Hemings;[32] and even borrow medical imaging devices to distinguish the traces of writing on the lead "postcards" on which Roman soldiers wrote home from the marks of centuries of weathering;[33] General Motors uses a model designed by the

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[28] See Susan Haack, "Peer Review and Publication: Lessons for Lawyers," *Stetson Law Review* 36 (2007): 789-819.

[29] Nowadays, thinking about the condition of the philosophical journals, I'm afraid I sometimes find this observation of Michael Polanyi's coming unbidden to mind: "if each scientist set out each morning with the intention of doing the best bit of safe charlatanry which would just help him into a good post, there would soon exist no effective standards by which such deception could be detected." Michael Polanyi, *Science, Faith and Society* (Oxford: Oxford University Press, 1946), 40.

[30] See Susan Haack, "The Meaning of Pragmatism: The Ethics of Terminology and the Language of Philosophy Today," *Teorema* XXX/III.3 (2009): 9-29.

[31] It was; and historians now believe that Gutenberg printed all three. See Robert Buderi, "Science: Beaming in on the Past," *Time* Mar. 10 (1986), available at <http://www.time.com/time/printout,0,8816,96050,00.html> (last visited October 1, 2009).

[32] See Jefferson-Hemings Scholars' Commission, *Report on the Jefferson-Hemings Matter* (April 12, 2001); William G. Hyland, Jr., *In Defense of Thomas Jefferson: The Sally Hemings Sex Scandal* (New York: St. Martin's Press, 2009). (The reasonable conclusion seems to be a very modest one: that one of Sally Hemings' children was fathered by some male member of the Jefferson family.)

[33] "Wish You Were Here," *Oxford Today* 10, 3 (1998): 40.

Centers for Disease Control to track an "epidemic" of defects in its cars and trucks.[34] And so on. What is scientistic is not borrowing scientific tools and techniques, as such, but borrowing them, as it were, for display rather than serious use.

3. Preoccupation with "the problem of demarcation"

Once "scientific" has become an honorific term, and when scientific trappings only too often disguise a lack of real rigor, it is almost inevitable that the "problem of demarcation," i.e., of drawing the line between genuine science and pretenders, and with identifying and rooting out "pseudo-science," will loom much larger than it should.

Not surprisingly, as the honorific use of "science" began to take hold in the early decades of the twentieth century, so too did an increasing preoccupation with demarcation: in Logical Positivism (where a key theme was the demarcation of empirically meaningful, scientific work from high-flown but meaningless meta-physical speculation); and, most strikingly, in Karl Popper's philosophy of science.[35] The Positivists had proposed *verifiability* as the mark of the *empirically meaningful*; Popper turned this on its head. Noting that, while no finite number of positive instances could show an unrestricted universal statement true, a single counter-instance is enough to show it false, Popper proposed *falsifiability*, *testability*, or (as he also says) *refutability* as the criterion of demarcation of the genuinely *scientific*.[36] A real scientific theory, according to Popper, can be subjected to the test of experience and, if it is false, can be shown to be false; while a theory that rules nothing out is not a scientific theory at all.

This sounds simple enough. But in fact it never became entirely clear what, exactly, Popper's criterion was, nor what, exactly, it was intended to rule out, nor, most to the present purpose, what exactly – besides the honorific use of "science" – the motivation was for wanting a criterion of demarcation in the first place; in fact, it became increasingly *un*clear. For example, initially it sounded as if Popper intended to exclude Marxist "scientific socialism," along with Freud's and Adler's psycho-analytic theories, as unfalsifiable. But in *The Open Society and Its Enemies* (1945) Popper grants that, after all, Marxism *is* falsifiable – in fact, it was falsified by

[34] Gregory L. White, "GM Takes Advice from Disease Sleuths to Debug Cars," *Wall Street Journal*, 8 April (1999): B1, B4.

[35] The origins of this idea are described in Karl R. Popper, *Unended Quest* (La Salle: Open Court, 1979), 31-38 (published as a book after first appearing in *The Philosophy of Karl Popper*, ed. Paul A. Schilpp (La Salle, IL: 1974), 3-181.

[36] Karl R. Popper, *The Logic of Scientific Discovery* (1934; English ed., London: Routledge, 1959).

the events of the Russian revolution.[37] What went wrong was not that the theory was unfalsifiable but that, instead of abandoning their theory in the face of contrary evidence, Marxists made *ad hoc* modifications to save it. So Popper's supposedly logical criterion was transformed into a partly methodological test – a test, moreover, according to which badly conducted science is not really science at all.

Again: for a long time Popper claimed that his criterion of demarcation excluded the theory of evolution; which, he wrote, is not a genuine scientific theory but a "metaphysical research programme."[38] Then he changed his mind: evolution *is* science, after all.[39] And again – quietly shifting from writing of falsifiability as a criterion of the scientific to suggesting that it is a criterion of the empirical – Popper acknowledged that the category of "non-science" includes not only pseudo-science, but also such legitimate but non-empirical areas of inquiry as metaphysics and mathematics.[40] By the time you notice that he describes his criterion as a "convention,"[41] and even, in the introduction to the English edition of *The Logic of Scientific Discovery*, writes that scientific knowledge is continuous with everyday empirical knowledge,[42] you can hardly avoid the conclusion that the apparently simple idea he started with has become something of an intellectual monster.

With the benefit of hindsight, it looks as if Popper's criterion of demarcation proved so attractive to so many in part because it was amorphous – or rather, polymorphous – enough to seem to serve a whole variety of agendas: such as federal courts' interest in distinguishing reliable scientific testimony from "junk science,"[43] or in determining whether "creation science" is really science, and hence may constitutionally be taught in public high schools.[44] Other criteria have been

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[37] Karl R. Popper, *The Open Society and Its Enemies* (1945; revised ed., 1950), 374.

[38] Popper, *Unended Quest* (note 34 above), 167-180.

[39] Karl R. Popper, "Natural Selection and Its Scientific Status," a lecture of 1977, first published in *Dialectica* 32 (1978); reprinted in *A Pocket Popper*, ed. David Miller (London: Fontana, 1983), 239-246.

[40] Popper, *The Logic of Scientific Discovery* (note 35 above), 39.

[41] *Ibid.*, 37.

[42] *Ibid*, 18.

[43] *Daubert* (1993) (note 12 above). Of course, though the Supreme Court doesn't realize this, it is hard to think of a philosophy of science less suitable than Popper's – which expressly denies that any scientific theory is ever shown to be reliable – to serve as a criterion of reliability. See Susan Haack, "Federal Philosophy of Science: A Deconstruction – and a Reconstruction," *NYU Journal of Law & Liberty*, 5.2 (2010): 394-435.

[44] *McLean v. Arkansas Board of Education*, 529 F.Supp.1255 (1982). Of course, though the court in *McLean* didn't realize this, in view of Popper's ambivalence about the status of the theory of

proposed – that real science relies on controlled experiments, for example (which, however, would rule out not only anthropology and sociology, but also – most implausibly of all – astronomy). The best we might hope for, I believe, is a list of "signs of scientificity" none of which would be shared by all sciences, but each of which would be found, in some degree, in some sciences. The fact is that the term "science" simply *has no* very clear boundaries: the reference of the term is fuzzy, indeterminate and, not least, frequently contested.

This is not to say that we can't, in a rough and ready way, distinguish between the sciences and other human activities, including other human cognitive activities; but it is to say that any such distinction can *only* be rough and ready. I might say, as a first approximation, that science is best understood, not as a body of knowledge, but as a kind of inquiry (so that cooking dinner, dancing, or writing a novel, isn't science, nor pleading a case in court). At a second approximation, I would add that, since the word "science" has come to be tied to inquiry into empirical subject-matter, formal disciplines like logic or pure mathematics don't qualify as sciences, nor normative disciplines like jurisprudence or ethics or aesthetics or epistemology). And at a third approximation, to acknowledge that the work picked out by the word "science" is far from uniform or monolithic, it makes sense to say, rather, that the disciplines we call "the science*s*" are best thought of as forming a loose federation of interrelated kinds of inquiry.

But if we want to get a clear view of the place of the sciences among the many kinds of inquiry, of the place of inquiry among the many kinds of human activity, and of the interrelations among the various disciplines classified by deans and librarians as sciences, we will need to look for continuities as well as differences. For there are marked affinities between (as we say) "historical" sciences like cosmology and evolutionary biology, and what we would ordinarily classify simply as historical inquiry. There is no sharp boundary between psychology and philosophy of mind, nor between cosmology and metaphysics.[45] Nor is there any very clear line between the very considerable body of knowledge that has grown out of such primal human activities as hunting, herding, farming, fishing, building, cooking, healing, midwifery, child-rearing, etc., etc., and the more systematic knowledge of agronomists, child psychologists, etc.[46]

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evolution it is far from clear that his criterion would enable us to classify evolution as science, and creation "science" as non-science.

[45] See Susan Haack, "Not Cynicism but Synechism: Lessons from Classical Pragmatism" (2005), in Haack, *Putting Philosophy to Work* (note 12 above), 79-93.

[46] For that matter, there are also some very significant differences among the various disciplines conventionally classified as sciences – between the natural and the social sciences, of course, but also between physics and biology, between sociology and economics, and so on.

Scientific inquiry is recognizably continuous with more commonplace and less systematic kinds of empirical inquiry – inquiry into the causes of spoiled crops, the design of fishing boats, the medicinal properties of herbs, etc.. It is more systematic, more refined, and more persistent; but sometimes it rediscovers, and builds on, traditional knowledge: as Linnaeus, for example, built on traditional Lap taxonomies of plants and animals;[47] or as many drugs now part of the arsenal of modern scientific medicine were derived from what were originally folk remedies. An example would be digitalis, extracted from a plant called the foxglove: long used as a folk remedy, digitalis was first named in 1542; its clinical properties were first described by William Withering in 1785; and by the mid-twentieth century it was in common use by physicians for the treatment of heart ailments.[48]

Suppressing the demarcationist impulse enables us to see the Popperian requirement that a theory rule something out, that it not be compatible with absolutely *anything* and *everything* that might happen, for what it really is: a mark, not of its being scientific specifically, but of its being genuinely explanatory. And willingness to take contrary evidence seriously can also be seen for what it really is: a mark not, as Popper supposes, of the scientist specifically, but of the honest inquirer, in whatever field. (The historian who ignores or destroys a document that threatens to undermine his favored hypothesis is guilty of just the same kind of intellectual dishonesty as the scientist who ignores or fails to record the results of an experiment that threatens to falsify his theory.) "Scientism," as Hayek shrewdly observes, confuses "the general spirit of disinterested inquiry" with the methods and language of the natural sciences.[49]

And suppressing the demarcationist impulse will also have the healthy effect of obliging us to recognize poorly-conducted science as just that, poorly-conducted *science*; and of encouraging us, instead of simply sneering at "pseudo-science," to

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[47] I learned this from Føllesdal, "Science, Pseudoscience and Traditional Knowledge" (note 19 above); Føllesdal again cites the 2002 UNESCO report (note 19 above).

[48] Jeremy N. Norman, "William Withering and the Purple Foxglove: A Bicentennial Tribute," *Journal of Clinical Pharmacology* 25 (1985): 479-83. Susan Wray, D. A. Eisner, and D. G. Allen, "Two Hundred Years of the Foxglove," *Medical History*, *Supplement* 5 (1985): 132-50. Dale Groom, "Drugs for Cardiac Patients," *American Journal of Nursing* 56, 9 (September 1956): 1125-1127. James E. F. Reynolds, ed., *Martindale: The Extra Pharmacopoeia* (London: Pharmaceutical Press, 30th ed., 1993), 665-6. Another example would be quinine, derived from the bark of the cinchona tree, now standard in the treatment of malaria. See Tropical Plant Database file for quinine (available at <http://www.rain-tree.com/quinine.htm>, last visited October 6, 2009); Lexi Krock, "Accidental Discoveries" (available at <http://www.pbs.org/wgbh/nova/cancer/discoveries.html>, last visited October 6, 2009).

[49] Hayek, *The Counter-Revolution of Science* (note 21 above), 15.

specify what, exactly, is wrong with the work we are criticizing: perhaps that it is too vague to be genuinely explanatory; perhaps that, though it uses mathematical symbolism or graphs or fancy instruments, these are purely decorative, and do no real work; perhaps that claims which are thus far purely speculative are being made as confidently as if they were well-warranted by evidence; and so on. If we still had a use for the term "pseudo-science," it might be best reserved to refer to such public-relations exercises as the Creation Science "movement" – what a revealing word! – which, so far as I can tell, really involves no real inquiry of any kind.

4. The quest for "scientific method"

The preoccupation with demarcation in turn encourages (and is encouraged by) the idea that real scientific inquiry, the genuine article, differs from inquiry of other kinds in virtue of its uniquely effective method or procedure – the supposed "scientific method." However, we have yet to see anything like agreement about what, exactly, this supposed method *is*. A whole range of different, and incompatible, candidates have been proposed: various forms of inductivism (from an older, stronger version according to which scientists arrive at their hypotheses by induction from observed instances, to more recent, weaker versions according to which scientists arrive at hypotheses by a process better described as imaginative than as inferential, but then test them inductively); various forms of deductivism (Popper's conception of scientific method as a matter of "conjecture and refutation," i.e., making an informed guess, deducing its consequences, and then trying to falsify it, and Imre Lakatos's quasi-Popperian, post-Kuhnian distinction of regressive versus progressive research programs); and, most recently, Bayesian, decision-theoretic, etc., approaches.

Already by 1970 Paul Feyerabend famously drew the radical conclusion that the only methodological principle that would not impede the progress of science is "anything goes."[50] Other philosophers of science have suggested, somewhat more plausibly, that there is no *constant* scientific method, only a method that shifts and changes as science proceeds; or that there is no *single* scientific method, but many different scientific method*s* in different areas of science. But a thoughtful physicist had put his finger on the essential point as early as 1949. "There is a good deal of ballyhoo about scientific method," Percy Bridgman wrote; though, as he shrewdly observed, "the people who talk most about it are the people who do least about it." But no working scientist, he continued, ever asks himself whether he is being "scientific" or using the "scientific method." No: "he is too much concerned with

[50] Paul K. Feyerabend, *Against Method* (London: New Left Books, 1970).

getting down to brass tacks to be willing to spend his time on generalities."[51] "[I]nsofar as it is a method," Bridgman comments, the scientific method is a matter simply of "doing one's damnedest with one's mind, no holds barred."[52]

These bracingly commonsense observations are exactly right. *Any* serious empirical inquirer, whatever his subject-matter, will make an informed guess at the possible explanation of the event or phenomenon that puzzles him, figure out the consequences of that guess, see how well those consequences stand up to the evidence he has and any further evidence he can lay his hands on, and then use his judgment whether to stick with the initial guess, modify it, drop it and start again, or just wait until he can figure out what further evidence might clarify the situation, and how to get it. Over centuries of work, however, scientists have gradually developed an array of tools and techniques to amplify and refine human cognitive powers and overcome human cognitive limitations: techniques of extraction, purification, etc.; instruments of observation from the microscope and the telescope to the questionnaire; mathematical techniques from the calculus to statistics to the computer; and even internal social arrangements that – up to a point, though only up to a point – provide incentives for good, imaginative, honest work, and disincentives to sloppiness and cheating.[53]

The underlying procedures of all serious empirical inquiry – taking a stab at an answer, and then checking it out[54] – are not used *only* by scientists; the scientific "helps" to inquiry, which are constantly being adapted and improved, and are often local to some specific area of science, are not used by *all* scientists. So there *is no* "scientific method" used by all and only scientists. But, far from suggesting that it is simply a mystery how the natural sciences can have "made many true discoveries," this approach suggests a plausible account of how they have gradually managed to refine, amplify, and extend unaided human cognitive powers. It also throws some light on whether the social sciences really use the same method as the natural sciences, or a distinctive method of their own. Like natural-scientific inquiry, social-scientific inquiry will follow the underlying pattern of all serious empirical inquiry. Like natural-scientific inquiry, it will benefit from internal social arrangements than encourage good, honest, thorough work, and discourage

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[51] Percy Bridgman, "On Scientific Method" (1949), in Bridgman, *Reflections of a Physicist* (New York: Philosophical Library, 1955), 81.

[52] Percy Bridgman, "The Prospect for Intelligence"(1945), in Bridgman, *Reflections of a Physicist* (note 50 above), 535.

[53] These ideas are developed in detail in Haack, *Defending Science – Within Reason* (note 5 above), chapter 4.

[54] Calling this underlying pattern the "hypothetico-deductive method," as if it were a special, technical procedure, and peculiar to science, is itself a kind of scientism.

cheating. But at least many of the special tools and techniques of which it will have need are likely to be very different from the special tools and techniques most useful in the natural sciences.[55]

5. Looking to the sciences for answers to questions beyond their scope

There are many questions clearly within the scope of one or another of the disciplines conventionally classified as sciences to which there are as yet no warranted answers. (This is why credulity about current scientific speculation, even flimsy and as yet untested speculation, is itself a sign of scientism.) There are also many questions within the scope of the sciences which it is not yet possible even to ask – as once, before DNA was identified and the concept of macromolecule worked out,[56] questions about the structure and function of DNA the answers to which are now known were not so much as conceivable. Still, all these are questions clearly within the scope of the disciplines conventionally classified as sciences; and looking to the relevant sciences to answer them is entirely proper. But there are also are many legitimate questions outside the scope of the sciences altogether: legal, literary, culinary, historical, political, etc., questions – and philosophical questions, on which I shall focus here.

Some issues once within the purview of philosophy of mind or the epistemology of perception have proven susceptible to treatment by the science of psychology; the baffling metaphysical question, "why is there something rather than nothing?" has in part been resolved as cosmologists have tackled the problem of (what they call) "the accretion of matter."[57] Such boundary-shifting is not always or necessarily scientistic – indeed, it has often been a real intellectual advance. But when scientific answers that leave central elements of the older questions untouched are taken to be sufficient, this is scientism.

Results from the sciences frequently have a bearing on questions of policy: environmental science might tell us what the consequences of damming this river would be, medical science at what stage a human fetus becomes viable, social-scientific studies the consequences of changing tax incentives in this way or that, of

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[55] These ideas are developed in detail in Haack, *Defending Science – Within Reason* (note 5 above), chapter 6.

[56] The stuff we now call "DNA" was discovered in 1859 by Friedrich Miescher (who called it "nuclein"). The concept of a macromolecule was introduced by Hermann Staudinger in 1922. See Franklin H. Portugal and Jack S. Cohen, *A Century of DNA: A History of the Discovery of the Structure and Function of the Genetic Substance* (Cambridge: MIT Press, 1977); Robert Olby, *The Path to the Double Helix* (Seattle: University of Washington Press, 1974).

[57] See John Maddox, *What Remains to be Discovered: Mapping the Secrets of the Universe, the Origins of Life, and the Future of the Human Race* (New York: Simon and Schuster, 1998), 25 ff.

increasing the number of charter schools, of abolishing the death penalty, or, etc. But though a good deal of scientific work is policy-relevant, scientific inquiry – if it is to be genuine inquiry, and not what is oxymoronically called "advocacy research" – is policy-neutral. Environmental science can't, by itself, tell us whether the benefits of damming the river outweigh the drawbacks, and certainly not whether building the damm is a good idea; medical science can't, by itself, tell us whether abortion is morally acceptable (nor, of course, whether it should be legally permitted); economics can't, by itself, tell us whether we should change the tax system in this way or that. To be sure, environmental scientists, sociologists, economists, etc., will probably have opinions about the policy questions on which their scientific work has a bearing; and it is entirely legitimate for them to express such opinions publicly. But something goes wrong when they allow their ethical or political convictions to affect their judgment of the evidence, or when they present those ethical or political convictions as if they were scientific results.

These relatively simple arguments suggest a relatively simple conclusion: that results from the sciences can give us information about the relation of means to ends, but cannot by themselves tell us what ends are desirable. This is true, so far as it goes; but it doesn't go nearly far enough. It leaves a much deeper matter – whether, and if so, how, scientific results can have *any* bearing on questions about what ends are desirable – untouched. And on this deeper matter, I'm with John Dewey, who wrote that "restoring integration ... between a man's beliefs abut the world in which he lives and his beliefs about the values and purposes that should direct his conduct is the deepest problem of modern life"[58]: the idea of science as *purely* factual, as *entirely* "value-free," and an *wholly irrelevant* to normative questions, is far too crude.

Here (setting aside questions about epistemological, aesthetic, etc., values), I will focus on the ethical. As I see it, ethics is neither a wholly autonomous, a priori discipline, nor simply as a sub-branch of the human sciences. (This is a kind of modest ethical naturalism, informed by the idea that what is good or right for humans to do cannot be entirely divorced from what is good for humans.) Knowledge of what truly enables human flourishing – knowledge to which not only biology but also psychology, sociology, economics, etc., might contribute – though never *sufficient by itself* to tell us what to do, can have *contributory relevance* to ethical questions.

A recent paper in the *Lancet* provides a vivid illustration of the pitfalls of appealing to scientific results as if they were sufficient to answer ethical questions. The authors' thesis is that the morally best system for allocating scarce medical

[58] John Dewey, *The Quest for Certainty* (1929; reprinted, New York: Capricorn Books, 1960), 255.

resources is the "complete lives" principle, which gives priority to adolescents and young adults over infants and older adults. As evidence, they cite empirical surveys showing that "most people think" that the death of an adolescent is worse than the death of an infant.[59] Set aside the fact that they cite only two such studies, neither of which actually reports exactly what their summary suggests.[60] The essential point is that "*most people think* x is morally best" and "x *is* morally best" are different propositions altogether.[61] Conflating them is a sure sign of scientism.

The "evolutionary ethics" offered by E. O. Wilson looks at first blush like another example, albeit a more sophisticated example, of the same kind of scientism. The definition of the moral sentiments, Wilson tells us, falls to experimental psychology, investigation of the heritability of these sentiments to genetics, investigation of the development of the moral sentiments to anthropology and psychology,[62] and the "deep history of the moral sentiments" to evolutionary biology.[63] If the claim is that such scientific investigations are *all* that ethical theory requires, it is surely mistaken: it rests on the unargued presumption that ethics must be understood in terms of moral sentiments; it doesn't tell us *what* sentiments are moral; and, in and of itself the fact (supposing it *is* a fact) that these sentiments can be given an evolutionary explanation does not by itself show that they are, or that they aren't, ethically desirable. It is a kind of scientism.

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[59] Govind Persad, Alan Wertheimer, and Ezekiel J. Emanuel, "Principles for Allocation of Scarce Medical Resources," *The Lancet* 373, Jan 31 (2009): 423-31. (Mr. Emanuel is health adviser to President Obama.)

[60] Aki Tsuchiya, Paul Dolan, and Rebecca Shaw, "Measuring People's Preferences Regarding Ageism in Health: Some Methodological Issues and Some Fresh Evidence," *Social Science and Medicine* 57 (2007):688-96 (finding that people are broadly in favor of giving priority to older over younger patients, but noting that how the questions are asked may affect the upshot); Jeff Richardson, "Age Weighting and Discounting: What Are the Ethical Issues?", Working Paper 108, Health Economics Unit, Monash University (Australia) (using the term "empirical ethics" to refer to surveys of people's *beliefs about* ethical questions).

[61] The authors of the *Lancet* paper also fudge the relation of economic values to ethical ones. Perhaps there is a plausible economic argument that society has made a greater economic investment in adolescents or young adults than in infants, and can expect greater future return on the investment in adolescents or young adults than on older people; but Persad et al. simply dismiss the economic fact that society has invested less in underprivileged adolescents or young persons – this irrelevant, they say, because it is itself the result of "social injustice." "Measuring People's Preferences" (note 58 above), 428.

[62] While I was writing this paper a new book suggested fascinating conjectures about the origins of empathy, in humans and other animals. Frans de Waal, *The Age of Empathy* (New York: Harmony, 2009). See also Robert Lee Hotz, "Tracing the Origins of Human Empathy," *Wall Street Journal*, September 26 (2009): A11.

[63] E. O. Wilson, *Consilience: The Unity of Knowledge* (1998; reprinted New York:Vantge, 1999), 279.

But Wilson's evolutionary ethics is one aspect of a larger picture of what he calls "the unity of knowledge"; and his understanding of this "unity" is ambiguous in a crucial way. Sometimes he seems to be offering only the modest thesis that all knowledge must ultimately fit together in a coherent whole (which is obviously true); at other times, the much more ambitious thesis that all knowledge must ultimately be derivable from scientific knowledge (which is – I believe, no less obviously – false). So perhaps it is not entirely surprising that, after seeming to suggest that results from the biological sciences might be sufficient to answer ethical questions, Wilson goes on to ask how the moral instincts can be ranked and which are best subdued, which moral principles are best incorporated into law and which admit of exceptions, etc.[64] This is as much as to acknowledge that biology is relevant but not, after all, sufficient; which, by my lights, is *not* inappropriate, and *not* scientistic, but potentially a step in the right direction.

6. Denigrating the Non-Scientific

Steven Weinberg writes of the gradual "demystification" of the world through scientific advances.[65] And indeed, developments in cosmology and evolutionary biology have provided natural explanations of phenomena once thought to demand *super*natural explanations; and in the process, have shown that questions about "design," whether of organs such as the eye, or of the universe generally, rest on false presuppositions. To acknowledge this is not, by my lights, scientistic. But it *is* scientistic to imagine that advances in the sciences will eventually displace the need for any other kind of inquiry.

Here as elsewhere, the line between appropriate respect for science and inappropriate deference is often a fine one. It is not scientistic to value well-conducted empirical studies of the effects of legal changes (e.g., of the effect of abolishing the death penalty on the murder rate, or the effects of imposing a cap on punitive damages in medical-malpractice suits on the number of physicians a state attracts). It is, however, scientistic to assume that social-scientific "empirical legal studies" are inherently more valuable than traditional interpretive legal scholarship. Again, it is not necessarily objectionable for a university to give priority to medical research with the potential to improve health significantly over other, less practical, research; but it is a real loss – and not only because it is so unpredictable what work really will have important practical applications – if universities cease to value serious intellectual work for its own sake, regardless of subject-matter or potential payoff.

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[64] Wilson, *Consilience*, 279-80.

[65] Steven Weinberg, *Dreams of a Final Theory* (1992; reprinted New York, Vintage, 1993), 245.

Moreover, though our capacity for inquiry is a remarkable human talent – strikingly manifested in the sciences, though not only in the sciences – we humans have other talents, too: for story-telling, for singing, dancing, painting, ..., and so on. (It has been conjectured, in fact. that the human capacity for speech – without which neither science nor story-telling would be possible – may have arisen out of a more primitive musical capacity.)[66] Focusing for the moment on story-telling, I note that, loose talk of "two cultures" notwithstanding,[67] there are significant similarities as well as significant differences between science and literature. As Peirce observes, there is nothing more necessary to scientific work than imagination – though the scientific man, he continues, "dreams of explanations and laws,"[68] while a novelist dreams of imaginary people, events, and worlds. By my lights, not only is it scientism to assume that scientific inquiry is inherently better than other kinds of inquiry; it is also scientism to assume that science is inherently more valuable than literature (or art, or music, or, etc.). "Which is more important, science or literature?" is a hopelessly misguided question – as hopelessly misguided as "Which is more important, a sense of humor or a sense of justice?"

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What we now call "modern science" arose in Europe, and was the work mostly of white men. Post-colonialist, feminist, and other "science critics" sometimes complain that science is racist and sexist – a white male thing. This is a silly idea. Modern science grows out of much older human efforts to understand the world; there were many important anticipations of modern science: in China, in the Arab world, and elsewhere; and by now there are capable scientists of virtually every race and gender. Science isn't a white male thing; it's a *human* thing – as I was forcibly reminded, not long ago, when I talked at length with two post-docs working at a medical research institute in Switzerland,[69] a young woman from Canada, and a young man from Uzbekistan: culturally worlds apart, they shared a common scientific heritage, and common scientific aspirations.

But of course, modern science is also a (relatively) *recent* thing. Moreover, scientific advances can pose a real threat to comfortable ideas about ourselves and

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[66] Robert Lee Hotz, "Magic Flute: Primal Find Sings of Music's Mystery," *Wall Street Journal*, July3-5 (2009): A9.

[67] C. P. Snow, "The Two Cultures" (1959), in *The Two Cultures and a Second Look* (Cambridge: Cambridge University Press, 1964).

[68] Peirce, *Collected Papers* (note 2 above), 1.48 (c.1896).

[69] The Friedrich Miescher Institute, Basel. (Recall from note 55 that it was Miescher, a native of Basel, who discovered DNA.)

our place in the universe, and to familiar, traditional ways of doing things. So it should come as no surprise that such advances sometimes meet resistance from those who value older ways. Sometimes, the resistance is foolish. I read, for example, that some prominent Indian social scientists favor the traditional custom of variolation – inoculation with human smallpox matter, accompanied by prayers to the goddess smallpox – over the modern scientific practice of vaccination using cowpox vaccine, which is much less likely to cause smallpox in the patient.[70] This, in my view, is worse than silly.

Nonetheless, it must be frankly acknowledged that when older traditions are displaced by newer, scientific practices and methods, there can be loss as well as gain. (I say "newer, scientific practices and methods"; but I am uncomfortably aware that discriminating the effects of scientific advance from the effects of industrialization, of urbanization, and now of globalization, is formidably difficult, and perhaps not even possible.) Once, the Panare Indians of Venezuela worked together to clear trees with stone axes; with the introduction of new, labor-saving steel axes they could clear trees much faster and more efficiently – but the traditional, agreeably cooperative ways of working died out.[71] Affluent American consumers who appreciate the solidity and craftsmanship of their old-fashioned, low-tech construction techniques sometimes seek out Amish builders to work for them.[72] Academics notice with dismay that students with the vast resources of the internet available to them seem to have forgotten, if they ever knew, how to read an actual book. Virtually all of us, probably, have benefited in one way or another from advances in medical science; many of us, I suspect, like myself, also feel some unease about the impersonal character of technologically sophisticated modern medicine.

Such examples could be multiplied almost without limit; but I will stop here, with a simple thought: that to forget that the technological advances that science

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[70] See Meera Nanda, "The Epistemic Charity of Social Constructivist Critics of Science and Why the Third World Should Reject the Offer," in *A House Built on Sand: Exposing Post-Modern Myths about Science*, ed. Noretta Keortge (New York: Oxford University Press, 1998), 291; Nanda cites Fredérique Apfel Marglin, "Smallpox in Two Systems of Knowledge," in *Dominating Knowledge: Development, Culture and Resistance*, eds. Fredérique Apfel Marlin and Stephen Marglin (Oxford: Clarendon Press, 1990), 102-44.

[71] Katherine Milton, "Civilization and Its Discontents: Amazonian Indians," *Natural History* 101, 3, March (1992): 36-42.

[72] "Amish" refers to a religious sect that eschews modern technology, still using horses and buggies instead of motor vehicles, etc. Nancy Keates, "From Barn Raisings to Home Building: Consumers Hire Amish Builders, Citing Craftsmanship, Costs," *Wall Street Journal*, August 15 (2008): W1.

brings in its wake, much as they have improved our lives, have also sometimes come at a real cost in the displacement of valuable traditional practices and skills, is itself a kind of scientism.[73]

[73] My thanks to Mark Migotti for very helpful comments on a draft, and to Pamela Lucken for help in finding relevant material.