Journal of Scientific Exploration, Vol. 20, No. 3, pp. 421–427, 2006 0892-3310/06

ESSAY

The Two-Edged Sword of Skepticism: Occam's Razor and Occam's Lobotomy[1]

HENRY H. BAUER

Dean Emeritus of Arts & Sciences, Professor Emeritus of Chemistry & Science Studies, Virginia Polytechnic Institute & State University
e-mail: hhbauer@vt.edu

Abstract—Skepticism views the probability of a proposition as always less than 1, whereas belief or disbelief are absolute, asserting that the probability equals 1 or 0. The proper spirit of skepticism is constructive: it seeks to improve knowledge by stimulating better estimates of probability. That means micro-skepticism, questioning the soundness of every detail of fact, method, logic; it is empirical. By contrast, macro-skepticism is deductive; it relies on current scientific knowledge, which makes it backward-looking and destructively critical rather than constructively critical. It appeals commonly to Occam's Razor: it is always "simplest" to explain things in the way we are used to doing. But knowledge advances through change; so the Razor becomes a Lobotomy as people forget Einstein's insistence that theories should be as simple as possible, but no simpler.

Strong skepticism about new claims safeguards science against error. But the failure to maintain skepticism after a theory has been incorporated fosters dogmatism. There are a mounting number of contemporary examples where the native conservatism and dogmatism of science have become tyrannies—knowledge monopolies and research cartels—because science has become so much governed by official bureaucracies.

Keywords: skepticism—Occam's Razor

I was asked to talk about the ***benefits*** of skepticism in science; partly as a counterweight to the unappealing practices of self-styled "skeptics" organizations, which bring the notion of skepticism into bad repute; but also because true skepticism is so necessary for us who are interested in taking serious anomalous claims seriously. Since I agree wholeheartedly with these aims, I said, "Yes", without really thinking about it. But when I started to write some notes, I realized that there's nothing to be said, because the benefits of skepticism are so obvious.

That reminded me, as it often does, of T. G. Room, professor of pure mathematics at the University of Sydney. He was working a proof for us in class, and was saying, "And it is obvious that . . .". Then he paused. He stood back, looked at what he'd written on the chalk-board, mumbled, "But is it obvious?" He turned back to us and

said, "I'll be back in a few minutes", and he left the room. When he came back, he was smiling. He said, "Yes, it's obvious", and continued with the rest of the proof.

Nothing should really be taken as obvious until one has given it some thought. The reason skepticism in science is obviously beneficial is this: It's quite unlikely that we already know everything that is to be known. Therefore, some of what we now know is wrong, if only through being incomplete. But we don't know exactly what part of what we now believe is wrong, and we certainly don't know in what way it's wrong. So skepticism is the only intellectually justifiable approach. It is one of the four or five so-called "norms" that define modern science; and skepticism exercised by professional colleagues in the form of peer review is widely agreed to have been one of the main ingredients responsible for the success of modern science. (The other norms described by Robert Merton [1942], founder of modern sociology of science, are that knowledge is universal, it is a public good, and scientists should be disinterested. John Ziman [1994] considers originality to be a fifth norm.)

A useful dictionary definition of skepticism is, "The doctrine that absolute knowledge is impossible and that inquiry must be a process of doubting in order to acquire approximate or relative certainty[M2]. That makes clear immediately that skepticism is not the same as disbelief. Skepticism views the probability of a proposition as always less than 1, whereas belief or disbelief are absolute and assert that the probability equals 1 or 0 respectively.

"Approximate" and "relative" mean that we should always attach to any given bit of knowledge an estimate of the probability that it is true. Now the questions become very interesting instead of obvious: How to assign these probabilities? How to increase them? How much skepticism is the right amount under which circumstances?

Thus the spirit of skepticism is constructive, it is a means toward improving knowledge, toward making better estimates of probability. By contrast, belief and disbelief are destructive—they offer no means toward improving knowledge because certainty is already being asserted. For example:

Claim	Destructive (pseudo) "skepticism"	Constructive skepticism
Scientific anomaly.	Extraordinary claims require extraordinary proof.	I don't find this evidence in itself convincing; but here's what I might find convincing: ...
Extrasensory perception is real but not (yet?) reproducible at will.	Anecdotes mean nothing.	How to assess the significance of anecdotes? Can one get any further by assigning probabilities to each anecdote and weighting the apparent characteristics of the phenomenon?
	Anything not reproducible is not scientific.	Are there ways to study a capricious phenomenon? Can one create a statistical framework to do so?
"Cold fusion": Heavy water electrolyzed at palladium generates more heat than any chemical reaction could; there must be a nuclear reaction.	Absurd. Nuclear reactions can only occur under conditions similar to those inside the sun or inside an atomic bomb. No matter how deuterium nuclei fuse, they will always yield the same products.	Surface phenomenon or not? Why so long an incubation period? Why only palladium? Try alloys. Is overvoltage necessary? If so, how much? Steady or varying voltage? If varying, how?

These examples suggest that the distinction between destructive and constructive skepticism might equally be seen as a distinction between *macro*-skepticism and micro-skepticism. The destructive criticisms are based on the large picture, on generalities, on theory; they are deductive. That also makes them backward-looking. The history of science teaches that all our current theories are just living on borrowed time. Today's science will tomorrow be looked back on as benighted superstition, just as we now look back on alchemy, phlogiston, phrenology, and much else. Even in the 20th century, Nobel Prizes were awarded for lauded advances in medical science that now seem abhorrent as well as benighted, for example, seeking to cure schizophrenics by infecting them with malaria or by cutting out bits of their brains. The question is not whether today's theories will be superseded, but when and how they will be superseded. Macro-skeptics—or pseudo-skeptics, as Marcello Truzzi aptly called them--question whatever seems not to fit with the prevailing scientific paradigms; they fail to be properly skeptical about contemporary scientific beliefs.

A common pseudo-skeptical claim is that reliance on current scientific knowledge, being the simplest explanation, is justified by the philosophical principle of Occam's Razor. As Jack Good points out (Banks, 1996), that can become Occam's Lobotomy, trying to oversimplify complex matters; as Einstein insisted, theories should be as simple as possible, but no simpler.

The crucial weakness in macro-skepticism is its reliance on current theories. That misunderstands the nature of scientific theories. Theories are never actually true; or, rather, they can never be known to be true, which amounts to the same thing (for everyone except metaphysicians, that is). Theories are short-hand descriptions or classifications of discovered facts and laws, and they are useful guides to further research. One may legitimately argue as to which theory is more likely to stimulate productive research; but such arguments are also futile, because they can only be settled through knowing things that are not yet known. Fishing is an often-used analogy here. If you need to feed your family, by all means cast your nets where you know there are fish, even if the fish are very small; but there's no need to cast stones or to laugh at the lean fellow next to you who prefers to stay a bit hungry in the hopes of catching eventually something really big.

Micro-skepticism is agnosticism as to whether any given claimed anomaly is the harbinger of a monster of a catch. So it is forward-looking, or at least it is not backward-looking. Constructive micro-skepticism is skeptical not because a claim contradicts some theoretical presumption but because it is aware of the difficulties in acquiring knowledge and looks for loopholes in the offered evidence; so it safeguards science against Type I errors, against accepting something that isn't so. Theory-based macro-skepticism does that too, of course, but it goes too far, leaving itself prone to Type II errors, namely, missing something important. Macro-skeptics never bring about scientific revolutions, and they resist them to the bitter end.

So much for skepticism as an intellectual approach. But skepticism is not something abstract, it is exercised by individuals and also in a sense collectively, by groups of individuals. An approach that may seem intellectually correct might not always be the most fruitful one in practice, however.

So far as collective skepticism goes, I have already mentioned it as one of the traditional norms of scientific activity. The need to convince peers, or at least satisfy them that what one suggests is not absurd, has helped to make what is published and accepted as "science" more reliable than it would otherwise be. However, once a discovery has been accepted by the scientific community, collective skepticism about it is dropped. What Kuhn has called "normal science" now proceeds just as if this discovery were true for all time. If it happens to be a substantive fact, such as that the earth is approximately spherical, no problem; but if it is a law or a theory, then it will, sooner or later, need to be modified. In the meantime, it acts to suppress other views, including those that will supersede it in the future. Collective skepticism is now directed, as usual, only toward challenges of the conventional viewpoint and not toward that viewpoint itself. And such a stance essentially enthrones macro-skepticism as the order of the day.

The sin committed perhaps most commonly by reviewers of manuscripts, and by the editors who let them get away with it, is the deployment of macro-skepticism instead of micro-skepticism. That's what leads people to speak about a dogmatic Scientific Establishment. That sin is easily slipped into, perhaps even inevitably. Research has to be guided by something. Normal science is guided by what is already known, in the expectation that new discoveries will fit in with current theories. Normal science produces huge amounts of useful data that benefit many applications of science. So most scientists most of the time are guided fruitfully in their work by the prevailing paradigm. That is unexceptionable. But it is one thing to be guided in one's own research by what is already known; it is quite another thing to block or decry the endeavors of people who choose to look for or to pursue anomalies that might presage the next scientific revolution.

The optimum degree of skepticism is different at different stages of knowledge-gathering. Small novelties that make no waves are, again appropriately, regarded with little skepticism, if any. The most significant new discoveries shake things up and are quite appropriately resisted strongly by the scientific community, in other words there is a high degree of skepticism about them. But skepticism should not translate into *suppression.*

The scientific community is really a mosaic of small communities, what Derek Price called "invisible colleges", whose membership is usually of the order of hundreds. Typically, the invisible colleges trust their peer colleges, so that once one of them has reached a verdict, it tends to monopolize the whole scientific community. That is what makes periodicals like Science and *Nature* so influential: it is from them that most scientists derive their beliefs about fields outside their own specialty.

Unfortunately, these so-called "flagship" journals have a very poor record of appropriate skepticism — insufficient toward people of established reputations, far too great toward others. Science, for example, rushed into print four articles by Robert Gallo just as soon as his discovery of HIV had been announced — prior to peer review — by the Secretary of Health and Human Services. It has taken years of later investigation to reveal that everything in those papers is untrustworthy because some of it has been shown to be false (Crewdson, 2002). Even a cursory reading of those papers makes one wonder how they could have passed competent peer review, because of their lack of specific detail about crucial experiments and sources of the most critical biological material. As to rejecting novelties inappropriately: Paul Lauterbur, who received a Nobel Prize for inventing MRI (magnetic resonance imaging), had his first paper on that rejected by Nature. He has suggested that "You could write the entire history of science in the last 50 years in terms of papers rejected by Science or Nature" (Goodspeed, n.d.).

In recent times, a number of people have, apparently independently, come to recognize that the accepted views on scientific matters of public importance have become too much shielded from appropriate skepticism; we now have what I have called knowledge monopolies and research cartels (Bauer, 2004). Michael Crichton (2003) has even suggested that whenever we are told that the scientific consensus is such and such, we should disbelieve it — the appeal to "everyone knows" being a poor substitute for being shown substantive proof. James Hogan (2004) has described a number of issues on which the primary scientific literature is at odds with the officially promulgated view: as to global warming, DDT, the ozone layer, asbestos, HIV/AIDS, and more. Joel Kauffman (2006) has demonstrated through careful literature reviews that what we are told from all quarters is wrong, about aspirin and lowering cholesterol and greenhouse gases, among other things. But when the inadequacies of these monopolistic dogmas are pointed out, the dissidents are met with what Edmund Storms has nicely called pathological skepticism. Skepticism proper, micro-skepticism, constructive skepticism, is empirical: it looks skeptically *at* the evidence, because all observations and experiments are fallible; pathological skepticism, macro-skepticism, destructive theory-based skepticism, refuses to look at the evidence because it already knows that the evidence has to be invalid.

I believe that the greatest danger to good science nowadays is that bureaucracies fund and control and disseminate science (Bauer, 2004). Bureaucracies do not practice skepticism of any sort. Individuals may find it hard to admit error, but it takes a revolution to correct bureaucratic mistakes.

These circumstances make the roles of individuals that much more important. In a propitious environment, collective norms and collective behavior can help individuals transcend personal limitations. I believe that individuals in the military, on the whole, behave more bravely than they might without the training and discipline afforded by their institution. I believe, too, no matter the prominence of some recent scandals, that—again, on the

whole—ministers and nuns and priests are helped to behave better through having taken vows.

On the other hand, there can also be environments that bring out the worst, say, Nazi Germany or the Soviet Union. The traditional norms of science encouraged scientists to be disinterested, working for the public good, transcending local attachments, loyal to the universality of scientific truth. But science has become a highly organized activity, funded and managed through bureaucracies. As already pointed out, bureaucracies do not practice skepticism about their own practices. Whistle-blowing may be honored and protected in principle, but in practice it is hazardous to careers and sometimes to health. Ombudsman offices are rare, and ombudsman offices with appropriate autonomy and power are even rarer.

In this environment, the skepticism that science needs, to be reliable and to progress, depends increasingly on individual actions by individuals who increasingly need great strength of character and, preferably, private means of support. They also need to exercise judgment about how much skepticism to exercise under different circumstances. Toward the conventional wisdom, they need to direct a general willingness to be skeptical, and they must be open to specific clues and claims—scientific anomalies—that indicate where skepticism should be most directed. Of course, they must also direct a somewhat greater degree of skepticism toward those unorthodox claims—but only *micro*-skepticism, constructive skepticism to help the proponents of the anomalies see what they must do if they are to become convincing.

However, for that rare person who actually makes a genuinely novel discovery, skepticism toward that discovery can be counterproductive: discoverers had better believe strongly in their discovery, had better not be too skeptical about it, otherwise they might lack the will to carry on in face of the community's inevitable resistance—resistance that may well come even from erstwhile colleagues and friends. Forty years ago, Bernard Barber pointed out that most scientists find themselves at different times on both sides of the fence, sometimes resisting discoveries by others and sometimes insisting on discoveries that others are resisting.

As with most things in practice and in life, circumstances alter cases, and all generalities need to be modified in exceptional cases. Some skepticism is sometimes good and sometimes bad. Skepticism sometimes serves some people better than it does others. Judgment is always needed: when to deploy it, and how much of it.

Notes

[1] Invited presentation at the 24th Annual Meeting of the Society for Scientific Exploration, Gainesville, FL, May 2005.

[2] American Heritage Dictionary (3rd ed.), Houghton Mifflin, 1992 (in Microsoft Bookshelf 1994).

References

Banks, D. L. (1996). **A** conversation with I. J. Good. *Statistical Science,* **11,** 1–19.

Bauer, H. H. (2004). Science in the 21st century: Knowledge monopolies and research cartels. *Journal of Scientific Exploration, 18,* 643–660.

Crewdson, J. (2002). *Science Fictions: A Scientific Mystery, a Massive Cover-up, and the Dark Legacy of Robert Gallo.* Little, Brown.

Crichton, M. (2003). *Aliens cause global warming.* Caltech Michelin Lecture, January 17; Available at: http://www.crichton-official.com/speeches/speeches_quote04.html.

Goodspeed, M. (n.d.). *Science and the coming dark age.* Available at: http://rense.com. Accessed 10 October, 2004.

Hogan, J. (2004). *Kicking the Sacred Cow.* Baen.

Kauffman, J. (2006). *Malignant Medical Myths: Why Medical Treatment Causes 200,000 Deaths in the USA each Year, and How to Protect Yourself.* Infinity.

Merton, R. K. (1942). The normative structure of science. In Storer, N. W. (Ed.), *The Sociology of Science* (pp. 267–278). University of Chicago Press (1973).

Ziman, J. (1994). *Prometheus Bound: Science in a Dynamic Steady State.* Cambridge University Press.