

Science Is Objective Analysis Rules Not Philosophy

Patrick Frank and Thomas H. Ray

We must know the foundations of science in order to understand just what sort of knowledge it represents. It's also important to know this when contesting ideas with such people as creationists and postmodern skeptics. If science is based on philosophy, as Massimo Pigliucci wrote in *FREE INQUIRY* ("Creationism vs. Scientism," Summer 2003), then the knowledge it offers is no better than the axioms and assumptions it asserts. Disputing creationism or postmodernism then becomes no more than a competition of opinions. Professor Pigliucci's article offers us an opportunity to dispel some mistaken notions about its fundamentals of science that are holdovers from its philosophical induction period. Following that, we will discuss what science actually is.

MISTAKEN NOTIONS

In his article, Professor Pigliucci writes:

[T]he practice of science is built on several fundamental philosophical assumptions, and axioms: realism, the idea that there is a unique and consistent reality "out there"; naturalism, the supposition that the universe can be explained entirely in terms of natural phenomena; Occam's Razor, the idea that one should attempt to explain phenomena by avoiding use of superfluous hypotheses; and Hume's dictum, a fundamental component of skepticism that requires extraordinary evidence for extraordinary claims.

These ideas are very widespread. One encounters them often in conversations about the elements of science. However, they are all either mistaken or mischaracterized. Science is based on no such axioms or assumptions, because science is an objective method of analysis, not a philosophy. We can show this briefly, taking the ideas in their turn.

IS "REALISM" NECESSARY TO DO SCIENCE?

Let's suppose metaphorically (not metaphysically) that you were a disembodied mentality with a consciousness full of detailed and fine-grained hallucinations instead of perceived physical sensation. Would it be possible to do science?

Suppose you were able to divide your hallucinations into two sorts:

A-type hallucinations that can be neither objectively

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described nor verified.

B-type hallucinations that can be both objectively described and verified.

"Objective description" means an unambiguous mathematical claim—one that has only a single meaning. It is indistinguishable from a testable theory. "Verified" means that, if the conditions entering your prior hallucination repeat, the hallucination recurs in the same form as before. Our metaphorical B-type hallucinations, in other words, are not distinguishable from objectively verifiable observations. This means that both the theoretical description and the experience (observation) of the hallucinations are independent of your subjective inner judgment about them.

Therefore, the interpretation of metaphorical B-type hallucinations (observations) is not concerned with meta-

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physical claims about the phenomena—about the "nature of nature"; it is concerned with the method by which the phenomena are described. This method is indistinguishable from the objective theory and the repeatable observation and experiment of science.

All B-type conditions meet the criteria of objective science. The method requires no external, i.e., Platonic or metaphysical, "reality." It requires only that we attain the method of objective description and verification for our hallucinatory inputs. In that case, a body of knowledge can be built up that would be indistinguishable from the science we know today. The critical point here is that the source of our metaphorical B-type hallucinations, of our sensory inputs, doesn't matter. It doesn't matter if we are all brains in vats having B-type hallucinations.¹ All that matters is that we have them and that they meet our objective criteria. All of science follows from that.

The methodological criteria of science propose objective description of phenomena and theory, not philosophical causality. They hypothesize that something like our metaphorical B-type hallucinations, i.e., results or data that can be both objectively described and verified, can be found, described,

and explained. The practice of science is a continual test of that hypothesis. As Jacob Bronowski elegantly said, “All science is the search for unity in hidden likenesses.”²

DOES SCIENCE REQUIRE “NATURALISM”?

Science is the philosophical position of “naturalism” by default only if it is described as the explanation of natural phenom-

“Scientists are opportunists because they must go where the data lead and the theories point. That is the meaning of ‘data-driven.’”

ena.³ However, all we factually know about nature is what science informs us in our theories. If our knowledge of nature consists only in what science tells us, then saying that science is the production of natural explanations reveals nothing about science. That explanation is circular: science is the natural explanation of nature. But science is not philosophy—not *about* nature—but is knowledge for its own sake.

So if searching for “natural” explanations does not describe science, what does describe it? In a revealing conversation with Niels Bohr about science, Einstein said:

The reciprocal relationship of epistemology and science is of noteworthy kind. They are dependent upon each other. Epistemology without contact with science becomes an empty scheme. Science without epistemology is—insofar as it is thinkable at all—primitive and muddled. However, no sooner has the epistemologist, who is seeking a clear system, fought his way through to such a system, than he is inclined to interpret the thought-content of science in the sense of his system and to reject whatever does not fit into his system. The scientist, however, cannot afford to carry his striving for epistemological systematic that far. He accepts gratefully the epistemological conceptual analysis; but the external conditions, which are set for him by the facts of experience, do not permit him to let himself be too much restricted in the construction of his conceptual world by the adherence to an epistemological system. *He therefore must appear to the systematic epistemologist as a type of unscrupulous opportunist:* he appears as realist insofar as he seeks to describe a world independent of the acts of perception; as idealist insofar as he looks upon the concepts and theories as the free inventions of the human spirit (not logically derivable from what is empirically given); as positivist insofar as he considers his concepts and theories justified only to the extent to which they furnish a logical representation of relations among sensory experiences. [Italics added.]⁴

Let’s repeat the relevant crux of that, “[T]o the systematic epistemologist [the scientist must appear] as a type of unscrupulous opportunist. . . .” This opens a critically central point regarding science and the scientist. Scientists are opportunists because they *must* go where the data lead and the theories point. That is the meaning of “data-driven.” A foundation in the criteria of objectivity rather than in the perception of natural phenomena frees science from any inherent connection to philosophy.

The methodology of science can be extracted from Einstein’s words above. Science inheres methodological opportunism. The progress of science exactly tracks what has worked to explain the details of prior data and to predict what is to be discovered. Nowhere do scientific journals describing progressive results invoke “naturalism,” or make an appeal to

“nature” in order to bolster or justify the interpretation of a result. Nature is merely everything that science describes. As more phenomena impinge upon us, our description of nature expands to accommodate them. If so-called supernatural phenomena were accessible to science, the supernatural would be demoted to the natural by philosophers. To scientists, however, what was “supernatural” would only be one more observational result that has been explained by an unambiguous and objective theory but with no superfluous appeal to the nature of nature; that is, no appeal to philosophy.

Einstein characterized the scientist as appearing to be a realist, as opposed to actually being one. The appearance extends only “insofar as he seeks to describe a world independent of the acts of perception.” This is identical to the criterion of objectivity noted above: observation and experiment that are independently verifiable and free of opinion or personal belief.

This means that results are objectively communicated in a common language by mathematical standards that are closed to interpretation. For example, the primary result of the theory of special relativity, $E = mc^2$, refers to a very specific equivalence

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of energy and mass. The claim is that whatever I measure from my position in space-time can be shown objectively to agree with what you measure from yours. What we mean, then, by “closed to interpretation,” is that the theory of relativity describes only its own standard and offers one and only one interpretive meaning. No other standard of meaning has any relevance to the observations it commands. On the other hand, the standard of one theory neither dictates nor obviates any other measurement standards of any other theories (such as quantum mechanics). All good theories in science must hew to this same standard of internal unity of meaning—of closed interpretation.

IS OCCAM’S RAZOR PHILOSOPHY?

The testability of scientific theories makes Occam’s razor an obvious consequence of the method. That is, superfluity makes no independent predictions. Theory is pared to explanation plus prediction. More than that provides no useful theoretical content. Occam’s razor is therefore less philosophy than a form of scientific housekeeping necessitated by the strict criterion that all theoretical content be predictive.

DO EXTRAORDINARY CLAIMS REALLY REQUIRE EXTRAORDINARY EVIDENCE?

Finally, Hume’s dictum about extraordinary evidence is useful only if one wants to put off the claims of “It’s a miracle!” by creationists. Within science, an extraordinary claim, such as that continents move their vast bulk through the sea, is met by very ordinary evidence; in this case, laser interferometry from space. Almost all the claims of modern science are extraordinary: causeless universes from quantum mechanics; chemical biogenesis from atomic theory plus micro-paleontology; intelligence from evolutionary biology. None of those extraordinary

deductions require extraordinary evidence. They are the theoretical outcomes of our attempt to explain ordinary evidence gathered over years.

WHAT IS SCIENCE?

So, if science is not realism plus naturalism, what is it? In the sparest terms, all of science reduces to theory and result.⁵ Neither alone is sufficient. The content of science journals is little more than that. What remains of science after the relentless winnowing by scientists is no more than that. Published science seeks to eliminate superfluities, retaining only knowledge that is measured by objective standards. That is the knowledge we call "objective." It is independent of anything we can say about it.

No finite amount of experimental data can ever prove a scientific theory. Scientific theory displays strength exactly because of its vulnerability to falsifying data.⁶ Scientific theory is progressive because it remains subject to being discarded and replaced by a better theory that supports more, or different or contradictory, data. The content of theory does not determine the contents of our observations and experiments as it would do if science truly were axiomatic.

Science is not philosophy. That disparity was settled in the sixth century B.C.E., when Thales of Miletus decided to test his ideas against objective phenomena. It's just taken us another 2,600 years to recognize that distinction.

Notes

1. Our thanks to physicist Robert Reiland for forcefully making this analogy and for reviewing this manuscript prior to submission.

2. Jacob Bronowski, *Science and Human Values* (New York: Harper Torchbooks, 1956), p. 23.

3. A useful review of the philosophical approaches to explaining what science does is Robert W. Proctor and E. J. Capaldi, "Empirical Evaluation and Justification of Methodologies in Psychological Science," *Psychological Bulletin* 127 (2001): 759-72.

4. Paul Arthur Schilpp, *Albert Einstein: Philosopher-Scientist* (Cambridge, U.K.: Cambridge University Press, 1949), Neils Bohr's report of conversations with Einstein and Einstein's reply.

5. T.H. Ray, "When Science Becomes Mathematics: The New Demarcation Problem," *Karl Popper Centenary Congress: Volume of Abstracts* (Vienna: Karl Popper Institute and the University of Vienna, 2002). The abstract is available in pdf file format at: <http://www.univie.ac.at/karlpopper2002/>.

6. Karl Popper, *Conjectures and Refutations* (London: Routledge and Keagan, 1963).

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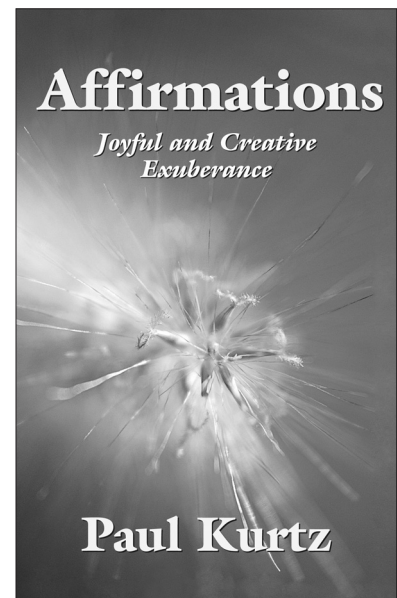
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