

DO EXTRAORDINARY CLAIMS REALLY REQUIRE EXTRAORDINARY EVIDENCE?

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Carl Sagan had a rare gift for making clear rather abstruse ideas. To the readers of *Skeptical Inquirer*, perhaps no example is more familiar than the succinct rendition of David Hume's treatment of miracles that Sagan popularized: "extraordinary claims require extraordinary evidence."¹ Hume wrote a highly controversial essay on miracles in 1748, and philosophers and theologians are still talking about it. The essay is important not only to skeptics but to scientists at large, because it lays out some important observations about the nature of evidence and how it relates to the acceptance of hypotheses.

A recent caustic critique of Hume's work has been published by John Earman (in a collection entitled *Bayes's Theorem*, edited by Christian theologian Richard Swinburne). In essence, Earman claims that Hume is vague about what he says, and that his arguments can be interpreted in a fashion that ranges from the trivial (one ought to be careful about accepting eyewitness testimony in the case of miracles) to the absurd (no testimony will ever be sufficient to establish a miracle). Earman couches his critique in terms of Bayes's theorem on conditional probability (see my Thinking about Science column in the May/June 2004 *Skeptical Inquirer*), claiming that Bayes's theorem can be interpreted as a devastating blow to Hume's "pompous" opinion on the matter.

I think Hume can be read precisely as proposing a rather sophisticated Bayesian account of miracles and the nature of evidence, and that there is nothing vague, trivial, or absurd in the Scottish philosopher's essay. Let us proceed first by quoting (as does Earman) Hume himself on the definition of miracles: "A miracle is a violation of the laws of nature," i.e., miracles are in Hume's view a wholly different matter from unusual or exceptional natural phenomena. The skeptical philosopher then goes on to say that "no testimony is sufficient to establish a miracle, unless the testimony be of such a kind, that its falsehood would be more miraculous than the fact which it endeavors to establish." This should make it clear that Hume is *not* saying that testimony could *never* establish the truth of a miracle, only that the standard of acceptance should be exceedingly high; as Sagan put it, given that we are trying to establish the truth of a very extraordinary claim, it stands to reason that we need an extraordinary degree of evidence to back up such a claim.

But what of highly unusual, naturalistic phenomena, such as some quantum events? Earman charges that when accepting Hume's dictum about miracles, one is then forced to either throw away a significant number of scientific findings or to adopt a double standard as far as evidence is concerned. I suggest that Hume's writing is consistent with the second option, and that, contrary to how it may appear at first glance, this is a very reasonable position indeed.

Earman himself points to the following excerpt from Hume's essay: "suppose all authors, in all languages, agree, that, from the first of January 1600, there was a total darkness over the whole earth for eight days. Suppose that the tradition of this extraordinary event is still strong and lively among the people: that all travelers, who return from foreign countries bring us accounts of the same tradition without the least variation or contradiction: it is evident, that our present philosophers, instead of doubting the fact, ought to receive it as certain. . . ." That is, testimony *can* be sufficient to establish the truth of a highly unlikely, even unique, event; no need to throw away quantum mechanics just because some of it deals with unusual occurrences.

What, then, is the difference between the case of a highly unusual, even never before observed, natural phenomenon and a miracle? Why do we need so much more testimony to accept the latter than the former? Aren't we just ideologically biased against miracles? Hume's distinction can make perfect sense within the framework proposed by his contemporary, Thomas Bayes. Bayes's theorem essentially says that the probability we attach to a hypothesis, given the available evidence—let's call it $P(h|e)$ —depends on the relationship between three quantities: (A) the probability of observing that evidence, if the hypothesis is in fact true; (B) the *a priori* probability of the hypothesis, based on prior knowledge we have of the world; and (C) the probability of observing

the evidence given our prior knowledge of the world. In fact, Bayes showed that $P(h|e) = (A \cdot B)/C$.

Hume's argument about the proportionality between the extraordinariness of claims and the evidence necessary to back them up can be interpreted (although Hume did not, of course, use a Bayesian framework) as saying that the *a priori* probability we attach to miracles (quantity B above) is much lower than the *a priori* probability we grant to any natural phenomenon, because we have daily experience of phenomena that can be explained naturally, and rarely, if ever, do we even need to consider supernatural causes. Furthermore, quantity C, the probability of observing the evidence given our prior knowledge, is also much lower in the case of alleged miracles, simply because nobody has ever, in fact, made a convincing case for the occurrence of a miracle, so far. Hence, the only way to increase our *a posteriori* probability that the hypothesis (the miracle) is true, given the evidence, is to increase term A in the Bayesian equation. This means to attach a high probability to the evidence, given the hypothesis in question. The only way to do that is if, as Hume put it, the chances of the testimony being false would be more "miraculous" (i.e., improbable) than the miracle itself.

Hume's argument against miracles, therefore, is neither trivial nor absurd, and it can be couched in terms of modern conditional probability. Furthermore, it illuminates important points about the relationship between evidence and hypothesis in both science and pseudoscience. Sagan (and other scholars before and after him) was right: extraordinary claims do require extraordinary evidence.

NOTE

1. Before Sagan formulated that statement in *Cosmos* and later works, it was made by the late sociologist Marcello Truzzi in his opening editorial in the first issue of the *Skeptical Inquirer*, then called *The Zetetic*, vol. 1, no. 1 (Fall/Winter 1976).