

The Seven Warning Signs of Bogus Science

The Chronicle of Higher Education, 3.1.31

<http://chronicle.com/weekly/v49/i21/21b02001.htm>

By ROBERT L. PARK

I have identified seven indicators that a scientific claim lies well outside the bounds of rational scientific discourse. Of course, they are only warning signs -- even a claim with several of the signs could be legitimate.

1. The discoverer pitches the claim directly to the media.

The integrity of science rests on the willingness of scientists to expose new ideas and findings to the scrutiny of other scientists. Thus, scientists expect their colleagues to reveal new findings to them initially. An attempt to bypass peer review by taking a new result directly to the media, and thence to the public, suggests that the work is unlikely to stand up to close examination by other scientists.

One notorious example is the claim made in 1989 by two chemists from the University of Utah, B. Stanley Pons and Martin Fleischmann, that they had discovered cold fusion -- a way to produce nuclear fusion without expensive equipment. Scientists did not learn of the claim until they read reports of a news conference. Moreover, the announcement dealt largely with the economic potential of the discovery and was devoid of the sort of details that might have enabled other scientists to judge the strength of the claim or to repeat the experiment. (Ian Wilmut's announcement that he had successfully cloned a sheep was just as public as Pons and Fleischmann's claim, but in the case of cloning, abundant scientific details allowed scientists to judge the work's validity.)

Some scientific claims avoid even the scrutiny of reporters by appearing in paid commercial advertisements. A health-food company marketed a dietary supplement called Vitamin O in full-page newspaper ads. Vitamin O turned out to be ordinary saltwater.

2. The discoverer says that a powerful establishment is trying to suppress his or her work.

The idea is that the establishment will presumably stop at nothing to suppress discoveries that might shift the balance of wealth and power in society. Often, the discoverer describes mainstream science as part of a larger conspiracy that includes industry and government. Claims that the oil companies are frustrating the invention of an automobile that runs on water, for instance, are a sure sign that the idea of such a car is baloney. In the case of cold fusion, Pons and Fleischmann blamed their cold reception on physicists who were protecting their own research in hot fusion.

3. The scientific effect involved is always at the very limit of detection.

Alas, there is never a clear photograph of a flying saucer, or the Loch Ness monster. All scientific measurements must contend with some level of background noise or statistical fluctuation. But if the signal-to-noise ratio cannot be improved, even in principle, the effect is probably not real and the work is not science. Thousands of published papers in para-psychology, for example, claim to report verified instances of telepathy, psychokinesis, or precognition. But those effects show up only in tortured analyses of statistics. The researchers can find no way to boost the signal, which suggests that it isn't really there.

4. Evidence for a discovery is anecdotal.

If modern science has learned anything in the past century, it is to distrust anecdotal evidence. Because anecdotes have a very strong emotional impact, they serve to keep superstitious beliefs alive in an age of science. The most important discovery of modern medicine is not vaccines or antibiotics, it is the randomized double-blind test, by means of which we know what works and what doesn't. Contrary to the saying, "data" is not the plural of "anecdote."

5. The discoverer says a belief is credible because it has endured for centuries.

There is a persistent myth that hundreds or even thousands of years ago, long before anyone knew that blood circulates throughout the body, or that germs cause disease, our ancestors possessed miraculous remedies that modern science cannot understand. Much of what is termed "alternative medicine" is part of that myth. Ancient folk wisdom, rediscovered or repackaged, is unlikely to match the output of modern scientific laboratories.

6. The discoverer has worked in isolation.

The image of a lone genius who struggles in secrecy in an attic laboratory and ends up making a revolutionary breakthrough is a staple of Hollywood's science-fiction films, but it is hard to find examples in real life. Scientific breakthroughs nowadays are almost always syntheses of the work of many scientists.

7. The discoverer must propose new laws of nature to explain an observation. A new law of nature, invoked to explain some extraordinary result, must not conflict with what is already known. If we must change existing laws of nature or propose new laws to account for an observation, it is almost certainly wrong.

I began this list of warning signs to help federal judges detect scientific nonsense. But as I finished the list, I realized that in our increasingly technological society, spotting voodoo science is a skill that every citizen should develop.

Robert L. Park is a professor of physics at the University of Maryland at College Park and the director of public information for the American Physical Society. He is the author of *Voodoo Science: The Road From Foolishness to Fraud*, Oxford University Press, 2002.

Here are the critical questions to ask when confronted with seemingly outlandish claims:

1. What is the source? Is the person or entity making the claims someone with genuine expertise in what they're claiming? Are they hawking on behalf of someone else? Are they part of a distributed marketing scam? Do they use, for example, a Website or magazine or newspaper ad that's made to look sciencey or newsworthy when it's really one giant advertisement meant to make you think it's journalism?

2. What is the agenda? You must know this to consider any information in context. In a scientific paper, look at the funding sources. If you're reading a non-scientific anything, remain extremely skeptical. What does the person or entity making the claim get out of it? Does it look like they're telling you you have something wrong with you that you didn't even realize existed...and then offering to sell you something to fix it? I'm reminded of the douche solution commercials of my youth in which a young woman confides in her mother that sometimes, she "just doesn't feel fresh." Suddenly, millions of women watching that commercial were mentally analyzing their level of freshness "down there" and pondering whether or not to purchase Summer's Eve.

3. What kind of language does it use? Does it use *emotion* words or a lot of *exclamation points* or language that sounds highly technical (amino acids! enzymes! nucleic acids!) or *jargon-y* but that is really meaningless in the therapeutic or scientific sense? If you're not sure, take a term and google it, or ask a scientist if you can find one. Sometimes, an amino acid is just an amino acid. Be on the lookout for **sciencey-ness**. As Albert Einstein once pointed out, if you can't explain something simply, you don't understand it well. If peddlers feel that they have to toss in a bunch of jargon science terms to make you think they're the real thing, they probably don't know what they're talking about, either.

4. Does it involve testimonials? If all the person or entity making the claims has to offer is testimonials without any real evidence of effectiveness or need, be very, very suspicious. Anyone—*anyone*—can write a testimonial and put it on a Website. *Example:* "I felt that I knew nothing about science until The Science Consumer blog came along! Now, my brain is packed with science facts, and I'm earning my PhD in aerospace engineering this year! If it could do it for me, The Science Consumer blog can do it for you, too! THANKS, SCIENCE CONSUMER BLOG! –xoxo, Julie C., North Carolina"

5. Are there claims of *exclusivity*? People have been practicing science and medicine for thousands of years. Millions of people are currently doing it. Typically, new findings arise out of existing knowledge and involve the contributions of many, many people. It's quite rare—in fact, I can't think of an example—that a new therapy or intervention is something completely novel without a solid existing scientific background to explain how it works, or that only one person figures it out. It certainly wouldn't just suddenly appear one night on an infomercial. Also, watch for words like “proprietary” and “secret.” These terms signal that the intervention on offer has likely not been exposed to the light of scientific critique.