



The Bogus Science Theorem (and the Junk Science Wager)



Hal Berghel, University of Nevada, Las Vegas

A precise philosophical definition of science is as elusive as one for art. However, some candidates are clearly beyond the scope afforded by common sense and good taste. This specifically includes commoditized, dogmatic, approval-seeking, agenda-driven efforts that amount to nothing more than bogus science.

It's during those periods of passionate tension and uncertainty that scientists are driven to achieve new levels of understanding. They dream up new ideas to displace established ideas once found unworthy. Less accurate theories must give way to more accurate ones. Each mature theory is continuously tested against observation and experimentation. Each is evaluated and compared based on the quality of its predictions. Theories with equal predictive ability are further compared to one another in terms of simplicity, intuitive appeal, the absence of ad hoc

assumptions, generalizability, and explanatory capacity. Little accommodation is made for scientific dead ends, and all research is expected to pass through a peer-review process. When a theory describes all of the observed data, achieves unsurpassed predictive capacity, and explains more of the underlying phenomena than other competing theories, we've achieved scientific rapture, although it's necessarily short-lived. Science, and scholarship generally, is characterized by intense and continuous change. It's no place for wimps.

However, a new generation of bogus scientists has emerged from the community of partisan apologists. This group doesn't buy into the established scientific rigor, and its assertions generally aren't tested through the tried-and-true methods of observation and experimentation. In the popular press, these apologists are sometimes called "deniers" for their gleeful propensity to reject putative facts.

This bogosity has its own particular institutional framework: the modern think tank (the term *think* is used loosely and for political rather than semantic effect). These tanks are usually no more committed to advancing



knowledge than graffiti taggers are to advancing fine art, or advertisers are to consumer advocacy. Their product is a combination of polemic and recombinant babble in service to paying patrons with parochial agendas. Such tanks exist only because patrons found academia too uncooperative to serve as their propaganda delivery system (although this is changing). Patrons have found that interlocking 501(c) front organization-funded think tanks are an ideal way to buy control over the political narratives as long as the public can be persuaded to assume academic standards exist in places where there are none.

Author Jane Mayer refers to these organizations as hyperpartisan think tanks because their primary product is partisan rather than thoughtful.¹ In Mayer's words, these "paid advocates form a national echo chamber." Although think-tankery adopts some of the academy's designations (scholar, fellow, distinguished scientist, and so on), these are noncompetitive and unearned accolades reflecting neither lofty scholarly pursuits nor conformance to rigorous academic standards. They're used purely to claim prestige for an otherwise inconsequential status. Think-tank scholarship is a postmodern tournament sport in which the uninspiring yet unexpired flotsam and jetsam of partisan politics record new scores and settle old ones. Both Mayer and documentary filmmaker Adam Curtis offer illuminating histories of the rise of these tax-exempt propaganda mills.^{1,2}

Although it's difficult for hyperpartisan think-tank patrons to admit, scholarship weaponization dates back at least to the Stalinist era of the Soviet Union. An exemplar is Trofim Lysenko, the agronomist whose rejection of Mendelian genetics and Darwinian evolution better served the "true Soviet reality." Lysenko's fame seems to

derive from an agricultural alchemy, whereby weeds could magically transform themselves into crops through Soviet "natural cooperation"—no selection, mind you, just cooperation. Although there wasn't much of value in Lysenko's work, it did serve Stalin as an alternative to the "bourgeois sciences" (genetics, evolution, and biology) that were so offensive to his vision. "Junk science" is the current vernacular used to discredit scientific efforts and conclusions that create discomfort for those in control. The only substantive difference lies in the nature of the message: Mendelian genetics interfered with Stalin's agricultural vision, just as the surgeon general's reports interfered with big tobacco's business model. It's important to understand that Stalin's Lysenko research programs and the modern partisan think-tank scholarship are cut from the same ideological cloth and used toward the same ends. It's useful in this regard to read Pamela Wrinch's 1951 description of how "In the Soviet Union, views on intellectual subjects—social sciences, philosophy, and even the biological and physical sciences—are frequently regarded as expressions of political views."³

For reasons that must be left for social scientists to explain, many modern politicians who would have opposed Soviet-style government programs are most welcoming of these Lysenko-style tactics. Some members of our political class eagerly endorse what they consider "patriotic science" (read: consistent with political opinion) in the same way that Stalin did. Take for example the creation, publication, and adoption of modern schoolbooks: here, inconvenient facts routinely take a back seat to the politically expedient.⁴

Derived from some variation of unsubstantiated claims including "science is inconclusive," "science is

corrupt and self-serving," "government uses peer-reviewed science to restrict liberty and reduce freedom," "science is inconsistent with the principles of free-market capitalism," and so forth, the counternarrative is bogus science's most significant contribution. Of course, no evidence is ever adduced in support of these yarns, but history has taught us that truth isn't a prerequisite for an effective counternarrative: the propaganda can stand on its own if the echo is loud and the public compliant.

Counternarrative authors derive what little legitimacy they have from the claimed objectivity of their host tanks, and this claim is eagerly reinforced by sympathetic mass media outlets. This is what Edward Herman and Noam Chomsky⁵ call the propaganda model of mass communication. The agenda, biases, and financial patrons behind the talking heads are never identified. Rather, the audience is only introduced to innocuous names of front organizations touted as impartial, objective, and scholarly.

Of course, this faux objectivity doesn't stand up to the scrutiny of serious onlookers, investigative reporters, and the occasional elected officials, civil servants, and judges who want their truth unfettered. Thus, a complementary tactic was born: cloaking conflicts of interest by hiding behind independent consultancies. It's also particularly useful to consult for political action committees, lobbyists, nonprofit front groups, or law firms that represent the special-interest patrons. The law firm connection is particularly advantageous as the consultant can hide allegiances and/or conflicts under attorney-client privilege. This is particularly effective when giving interviews, testimony, or depositions: "I've never received a penny from the tobacco lobby. I'm a paid consultant of the law firm of Smokedreams and Pipedreams, LLC."

The final counternarrative stage is name-calling. Pejorative terms like junk science, bad science, official science, government science, liberal science, commie science, and the like are used to discredit research results that run counter to the opinions of the established order. If a counternarrative can associate a politically objectionable scientific conclusion with an easily remembered negative catchphrase, the entire counternarrative takes on memetic qualities. The public typically accepts the counternarrative, failing to notice that such memes are used solely to delegitimize peer-reviewed, authoritative scholarship that interferes with parochial biases and agendas of the people in control. In his book *Thought Contagion*, social theorist

the planets. Ptolemy came to the rescue. Holding firm to Aristotle's circular orbits about a stationary Earth, he approximated the true elliptical orbits of planets by postulating that the rest of the solar system was rotating about an point (equant) that was off center from the Earth's center. Ptolemy further accounted for the retrograde motion of the superior planets by postulating that planets revolved around their orbit in epicycles. Although this account was ad hoc and unnecessarily complex, it achieved amazing predictive accuracy for the time, which explains its 1,500-year longevity as the dominant cosmological system.

We know now that the Ptolemaic system was fundamentally flawed as a cosmological model; its contribution

the charge, was the ever-prescriptive Catholic Church in defense of their scriptural anthropomorphism. Geocentricity was deemed so central to the prevailing (though wrong) cosmology that astronomers like Tycho Brahe continued to defend a version of it for decades after Copernicus's death to avoid offending the scriptures.

Copernicus preserved much of Ptolemy's circular deferent/epicycle/equant system, but he changed the model to heliocentricity. But this came with a penalty: his conceptual model was closer to the truth, but it lost ground in terms of observational adequacy and predictive capacity. Copernicus further postulated that Earth was just one of many planets revolving around the Sun, the Sun was nowhere near the stars, and Earth was actually in motion. He knew that these last conclusions wouldn't go down well with the papacy, and therefore resisted publishing this during his lifetime—a practice that astronomer Giordano Bruno wouldn't follow to his great cost. Copernicus knew that being burned at the stake left one breathless to speak truth to power.

Copernicus's assertions weren't enough to deal the geocentric models the death blow. That came from Galileo's explanation of the phases of Venus, which could be explained easily by heliocentricity, but not by geocentricity unless ad hoc assumptions were invoked that would uncomfortably stretch the imagination. The phases of Venus became the geocentrists' flytrap: it could be said that the geocentric system ultimately succumbed to Venereal disease. So, although the geocentrists and heliocentrists saw the same sunset, only the latter really understood what they were looking at.

Galileo's work had become so threatening to the papacy that he was put under house arrest for life. Even so, heliocentricity won the day. Johannes Kepler added his three laws of planetary motion, Isaac Newton subsumed them under his more general laws of

A millennium and a half later, Copernicus gave Ptolemy's geocentric "spindle of necessity" the shaft when he came up with a new and improved version of Aristarchus's heliocentric model.

Aaron Lynch refers to such memes as adversative—their sole purpose being to sabotage competing ideas.⁶ The effectiveness of such tactics is inversely related to the audience's level of understanding.⁷ The scientific and scholarly communities have largely failed to appreciate that their ideas are drawn into the political debate, whether they like it or not. As an aside, note that the term "conspiracy theory" also serves as an adversative meme, and for the much the same reasons as the scientific counternarrative.⁸

THE REAL DEAL

Astronomy provides a useful framework to explain real science at work. We begin with Aristotle's geocentric universe. This system satisfied the theoretical virtue of simplicity, but failed in almost all other respects. Aristotle's cosmological map was inadequate: it neither accounted for elliptical orbits nor the apparent retrograde motion of

was that it enabled predictive capacity pro tem. Aristarchus (a contemporary of Aristotle) proposed the correct heliocentric model 400 years before Ptolemy, but without apparent effect. Deniers controlled the public narrative, one presumes. Although we need to concede to Ptolemy his accurate predictions on the location of planets, for mundane purposes (predicting upcoming growing seasons and solstices, and the like) the Ptolemaic system gained little over the ancient Egyptian civil calendar; as a model, it was a long-lived, scientific dead end.

A millennium and a half later, Copernicus decided to give Ptolemy's geocentric "spindle of necessity" the shaft when he came up with a new and improved version of Aristarchus's heliocentric model. The resulting Copernican Revolution upset many important apple carts. Geocentric astronomers went into immediate denial and, along with them, or perhaps leading

motion and theory of gravitation, and these, in turn, gave way to Albert Einstein's more expressive theories of special and general relativity.

Thus, cosmology's evolution forms a story arc driven by the quest for objective, confirmable truths. The combination of a historical narrative of a long period of study by multiple scholars in different places, together with an epistemology that was understood to be inherently fallible, is the foundation of legitimate scientific inquiry. Scientific breakthroughs were constantly tested both in terms of consistency with observation and whether the resulting predictions could be confirmed. Verification was always central, and all putative advances had to be made in good faith in order to qualify as serious.

Such an approach is in direct opposition to bogus science (or quasiscience or pseudoscience), wherein the story arc is spontaneous and ephemeral, and its fallibility is never questioned. In fact, the so-called think-tank approach produces a "scientific narrative" that is circumstantial and reactive to a perceived threat to prevailing opinion, profit structure, or religious belief. This is a critical point of contrast, for bogus science is always manufactured or invented for a specific purpose or campaign and is guided therefrom, and not from a search for enlightenment. However, advances in legitimate science are almost always narrative preserving—new narratives don't just spring up without antecedent, they build upon past achievements. It can't be overstated: scientific reasoning is by its very nature defeasible, and each conclusion is offered as the best available explanation at that moment. There are no eternal truths in science (yet), just well-reasoned conclusions. Like scholarship generally, science is spawned by virtually unlimited curiosity, a cautious use of intuition, the application of objectivity, an avoidance of bias, an aversion to polemic, the commitment to truth, and an expectation of an evolutionary narrative.

THE BOGUS SCIENCE THEOREM

Imagine a village with two "scientific" communities that we'll call *veridical* and *bogus*. The veridical community is committed to the unfettered, curiosity-inspired research that we described above. The bogus community eschews any such commitments, but rather proffers untested and perhaps unprovable "theories" and allegations that reinforce the opinions of their patrons or the business models of their sponsors. The veridical scientists must openly compete for an ever-shrinking pool of community funds. Bogus scientists have only to demonstrate that their "research" supports the parochial interests of their wealthy patron(s) and sponsor(s). The patrons' funds are limitless and available to all sycophants in proportion to the value perceived.

Theorem: bogus science will have a considerable funding advantage over veridical science. There will be no legitimate peer review to interfere with the bogus science objectives. Funding mechanisms won't be limited, competitive, and regulated. To the contrary, the absence of standards, peer review, oversight, and budgetary constraints means that there will always be potentially unlimited resources available and thus the frequency and volume of bogus science will be greater as well. For any sufficiently affluent patron and any non-self-contradictory agenda, one would expect an adequate supply of volunteers willing to support that agenda.

A corollary to this theorem is that the bogus product will be easier to publish than legitimate research because, again, the skids are greased in favor of sponsored bloviations that bypass serious review and go directly to subsidized outlets of the patrons themselves or their captive think tanks, foundations, or partners. In the world of idea promulgation, heavily underwritten and sponsored propaganda will always find an easier path to market than respectable scholarship, in the same way that advertising has an advantage over journalism.

A second corollary to our theorem is that veridical science is at a disadvantage when it comes to marketing and disseminating published work. Mass media shares the same ideological pedigree as the partisan think-tank patrons. As a result, economic forces tend to converge in support of such illusions as necessary to maintain powerful interests.^{5,9,10} This is but another component of what sociologist C. Wright Mills calls the "accumulation of advantage" enjoyed by the power elite.¹¹ They can rely on symbiotic media outlets to promote their interests, whereas the scholarly and literary communities better bring bling if they want so much as a mention. Science isn't usually glamorous, and truth, by itself, captures little of commercial media's interest: if it doesn't bleed, it doesn't lead.

I'd be remiss without mention of the related "Junk Science Wager," which holds that for any significantly large industry, if there is a scientific hypothesis in conflict with increasing corporate profits (global warming vs. big energy, DDT toxicity vs. big chem, smoking kills vs. big tobacco, some drugs do more harm than good vs. big pharma, and on and on), there will always be plenty of funds available for bogus scientists to counter the hypothesis, usually through the aggressive use of counter-narratives.

POSTPARTUM

Modern science and scholarship are frequently underrated, underappreciated, and misrepresented, which comes at a considerable social cost. Straightforward solutions are rarely given adequate consideration because they're drowned out by bogus science background noise. The most effective way to weigh competing ideas is to consider them in the context of the reputation of the scientists, their institutions, and their sources of funding.

In the case of bogus science and its related tanks, funding sources are intentionally hidden. This emphasizes the importance of keeping one's crap

detectors in full working order.^{12,13} Answers to questions such as “Did this message pass through peer-reviewed channels, or is it the product of a partisan think tank?” should be a prerequisite before accepting as truth any media coverage pretending to be objective. To uncover any undisclosed motives, journalists should investigate possible conflicts of interest prior to the quoting or hosting of any “expert.” Audiences need such information to make an informed assessment of what they’ve heard.

Unfortunately, under current law, regulatory attention to 501(c) organizations relates to their tax-exempt status, rather than the misuse of tax exemption to fund propaganda mills and support political activity and lobbying. The overwhelming majority of foundations that fund partisan think tanks do so under the 501(c) banners despite the fact that no reasonable person would find what they do substantially different than lobbying and/or advertising, which don’t qualify for similar IRS status. And the fact that the contributions are tax deductible to the partisan donors should be offensive to all taxpayers.

Even pro-business jurist Richard Posner questions the value of these arrangements, though for the wrong reasons. Posner says “[the] perpetual charitable foundation, however, is a completely irresponsible institution, answerable to nobody. It competes neither in capital markets nor in product markets (in both respects differing from universities), and, unlike a hereditary monarch whom such a foundation otherwise resembles, it is subject to no political controls either. It is not even subject to benchmark competition. ... The puzzle for economics is why these foundations are not total scandals” (<http://uchicago.law.typepad.com/beckerposner/2006/12/charitable-foundations--posners-comment.html>). But it’s the tax-exempt feature and the willful violation of IRS rules governing the purpose of such foundations that provide

the moral hazard, not the lack of controls and noncompetitive nature. The issue we should focus on is whether the organization’s claimed purpose is its real purpose. Under political pressure from these organizations, patrons, and their Congressional apologists, the IRS has taken the view that because there’s no precise dichotomy between legitimate and fraudulent 501(c) organizations, no distinction is possible. On that basis, there’s no distinction to be made between hot and cold running water.

It’s unlikely that we’ll see changes in the tax code anytime soon—the think-tank patrons who enjoy this special flavor of tax relief also hold a lot of sway over Congress. What we must do is critically assess the tanked reports and tank talking heads. They are just paid actors, their message is just soapbox science, and they should be recognized as such. They have no intellectual authority and represent neither scientific nor scholarly discipline. They’re in a league with astrologists and palm readers.

Of course, I must end with the inevitable caveats. First, my exposition of astronomical evolution has been simplified for present purposes. As Thomas Kuhn described,¹⁴ there’s much more to this. Second, not all think tanks are engaged in bogus science. Some actually do good work. But those fueled with a mix of ideological fever and hidden sources of funding do not. That’s where the art of crap detection comes in. Perhaps the Bogus Science Theorem and the Junk Science Wager will provide a useful complement in that regard. ■

REFERENCES

1. J. Mayer, *Dark Money: The Hidden History of the Billionaires behind the Rise of the Radical Right*, Doubleday, 2016.
2. A. Curtis, “The Curse of Tina,” blog, BBC.com, 2011; www.bbc.co.uk/blogs/adamcurtis/2011/09/the_curse_of_tina.html.

3. P.N. Winch, “Science and Politics in the USSR: The Genetics Debate,” *World Politics*, vol. 3, no. 4, Cambridge Univ. Press, 1951, pp. 486–519; doi:10.2307/2008893.
4. J. Loewen, *Lies My Teacher Told Me: Everything Your American History Textbook Got Wrong*, rev. ed., Touchstone, 2007.
5. E.S. Herman and N. Chomsky, *Manufacturing Consent: The Political Economy of the Mass Media*, Pantheon, 2002.
6. A. Lynch, *Thought Contagion: How Belief Spreads Through Society*, Basic Books, 1996.
7. C. Mooney and S. Kirshenbaum, *Unscientific America: How Scientific Illiteracy Threatens Our Future*, Basic Books, 2010.
8. L. DeHaven-Smith, *Conspiracy Theory in America*, Univ. of Texas Press, 2014.
9. C. Mooney, *The Republican War on Science*, Basic Books, 2005.
10. N. Oreskes and E. Conway, *Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming*, Bloomsbury, 2010.
11. C.W. Mills, *The Power Elite*, Oxford Univ. Press, 2000.
12. H. Rheingold, “Crap Detection 101,” blog, SFGate.com, 30 June 2009; <http://blog.sfgate.com/rheingold/2009/06/30/crap-detection-101>.
13. N. Postman, “Bullshit and the Art of Crap-Detection,” presentation, National Convention for the Teachers of English, 28 Nov. 1969; http://marcmarengo.net/uploads/3/1/4/1/3141857/crap_detection.pdf.
14. T. Kuhn, *The Structure of Scientific Revolutions*, 4th ed., Univ. of Chicago Press, 2012.

HAL BERGHEL is an ACM and IEEE Fellow and a professor of computer science at the University of Nevada, Las Vegas. Contact him at hbl@computer.org.