14

Bullshit at the Interface of Science and Policy: Global Warming, Toxic Substances, and Other Pesky Problems

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In recent public discussions about the use of science in policy-making, confusion has bred bullshit. The interface between science and policy is notoriously difficult, requiring technical competence and political savvy. At this difficult boundary, the need for quality science advice remains a pressing concern.

Ever since Plato's parable about the stargazer as expert navigator for the ship of state in *The Republic*, governments have grappled with the problem of how to get accurate and reliable expert advice on technical matters central to policy-making. In recent decades, as the scope of government concern has expanded and the need for technical advice becomes more acute, the debate surrounding the quality of science advice for policy-making has shifted, from excluding pseudoscience, to worries over "junk science," to the most recent concern over "politicized science." These shifts, however, merely rephrase the same question: On whom should we rely for expert advice? The question is not easily answered, and the resulting confusion allows bullshit to proliferate.

Two different kinds of bullshit flourish at the science-policy interface. The first trades on the complexities of evidence and technical detail on which many substantive policy choices rest—complexities that make it easy to confuse the public about the extent of uncertainties and contravening evidence in particular cases. This leads to a pervasive kind of bullshit in which statements are made that are not false, and thus not lies, but are deeply misleading. Operators on the interface can propagate

these true but misleading statements, thus building support for desired policy choices.

The second kind of bullshit is more pervasive. It occurs when critics of scientific claims suggest that the evidence on which a decision is based is insufficient to support the decision. What makes this argument bullshit in most cases is that it often presupposes that we have a universal standard of evidential support which all claims must meet in order to be "scientific." Yet there is no such standard—particularly in cases where one must take into account evidence from multiple sources—and thus any appeal to such a standard is pure bullshit. Usually, what the critic really thinks is that the evidence is insufficient in this case to overcome their concerns about the implications of the claims, particularly if the claim is wrong and is accepted (or correct and is rejected). The consequences of error, of making an inaccurate empirical claim with political implications, is what is of concern to the critic, but rather than discuss these concerns openly, the critic simply declares that the evidence available does not meet the standards of "sound science" or is an example of "politicized science." This move confuses genuine cases of junk or politicized science from cases where burdens of proof are disputed, helping only to obscure the issues at stake.

Both of these kinds of bullshit are prevalent in discussions of science and policy-making, and they will be difficult to eliminate. The technical and esoteric nature of much of the evidence on which policy is based will make the first kind of bullshit attractive to anyone seeking to score political points in a science-based dispute. Constant vigilance is the only remedy. The second kind of bullshit is more amenable to cure, but only if we adjust our ideas about scientific reasoning to emphasize the weighing of evidence, uncertainty, and the consequences of error. Unfortunately, this will make science-based policy debates more complicated, and the temptation to oversimplify things and assume the existence of a universal standard of proof will always have an allure, especially in our sound bite age. Bullshit is more compact, portable, and convenient than full and open discussion.

Bullshit of the Isolated Fact

In many policy disputes that depend on technical or scientific backgrounds, a welter of facts are relevant to the issue at hand.

Even in the relatively simple cases of regulating toxic substances, for example, one needs to know the details of animal toxicology studies, whether there have been any accidental human exposures studied, what is known about the biochemistry of the substance, and how humans are currently exposed and to what levels. This welter of facts must then be considered in total to figure out whether and how to regulate a substance. Missing just one crucial piece of the puzzle can throw the whole picture off. For example, if a chemical causes liver cancer in rats, and is consumed by many people (although no studies of human effects have been conducted), it would seem prudent to regulate the chemical. But if one also knows that the rats have a substance in their livers that interacts with the chemical of concern to produce their cancers, a substance that is absent in humans, one will likely be much less alarmed. One must have as much of the available picture as possible.[1] But having that takes a lot of work to develop, takes time to present to others, and even worse, may undermine the political outcome you desire. It's much easier in these inherently complex cases to pick and choose one's facts rather than grapple with all of the available evidence.

Cherry-picking one's facts, thus producing bullshit of the isolated fact, is particularly problematic in the case of the climate change debate. If the case of toxic substances seems complex, the case of global climate change magnifies this complexity many times over. Here we need to reflect upon past climate and its variability, current climate measurements, and future climate projections, which need to take into account as much of the earth's energy dynamics as possible. At the same time, we need accurate descriptions of atmospheric chemistry and physics, including the particulars on the many greenhouse gases that have been identified.[2] All this complexity is in place before one

[1] And having a more complete mechanistic account may not reduce all the concern. For a real case with such complexity (regarding saccharin and bladder cancers in rats) see D. Guston, "Principal-Agent Theory and the Structure of Science Policy Revisited: 'Science in Policy' and the US Report on Carcinogens," *Science and Public Policy* 30:5 (2003), pp. 347–357.

[2] Although carbon dioxide gets most of the attention, we should also remember chlorofluorocarbons, nitrous oxide, methane, and of course, water. Each has a different capacity to trap heat, and a different average lifespan in the atmosphere, ranging from a few years to centuries.

even begins to address the possible effects of climate change on human and natural systems. It is little wonder that with such a complicated issue and such high stakes, the lure of selecting particular facts, even true ones, that in isolation prove totally misleading, is so tempting.

One example of this selectivity, and the bullshit that results, can be found in the use of recent climate records in the debate over climate change. Modestly reliable global temperature readings became available in the late nineteenth century, as climate data collection locations spread across the globe and regular sea surface temperature data began to be taken. The temperature records based on this data indicate a climate *warming* from 1890 to 1940, and then a climate *cooling* from 1940 to 1975. In the mid-1970s, the earth began to *warm* again according to these records, and has continued to do so. At first glance, this recent climate record does little to support the idea that humans, in producing greenhouse gases, are warming the climate. The early warming period corresponds to a modest increase of greenhouse gas production, but greenhouse gas production really went up after 1940, when the cooling began. This means that the world warmed during the smaller increase in greenhouse gases, and then cooled during the larger increase in greenhouse gases. If humans were influencing the climate between 1940 and 1975, why were global temperatures dropping?

This was a legitimate scientific question during the 1980s. Although global temperatures had begun to rise again by the mid-1970s, why temperatures had dropped during one of the most intensive periods of industrial expansion—and the accompanying increase of greenhouse gas productions—was unclear. In the early 1990s, however, as more research was completed on the functioning of the global climate, scientists discovered the importance of *aerosols* for the climate. Aerosols are particulates, including dust and sulfates, that cool the atmosphere. They tend to be short-lived in the atmosphere, washing out after a few days (or a few years at most), but their impact on global climate can be dramatic. Research on aerosols allowed climate modelers to successfully predict the amount of global cooling that would follow from the eruption of Mt. Pinatubo in June 1991, an eruption that spewed significant quantities of aerosols into the atmosphere.[3]

[3] R.A. Kerr, (1993), "Pinatubo Global Cooling on Target," *Science* 259 (1993), p. 594.

Volcanoes are not the only important source for aerosols however. The burning of fossil fuels also produces aerosols, aerosols that not only cool climate, but can cause acid rain. When we became concerned about acid rain in the 1970s and began to reduce the release of sulfates into the atmosphere (using "scrubbers" on smokestacks), we reduced the amount of aerosols that could cool the climate. The excess aerosols left in the atmosphere washed out in a few years, and when combined with the continued build-up of greenhouse gases, the warming trend reappeared. Thus, the increased industrial output from 1940 to 1975 produced both more greenhouse gases and more aerosols. The cooling effect of the aerosols likely masked the warming effect of the greenhouse gases during this period, and with the reduction of aerosol releases by industry, the warming trend re-emerged. The longer-lasting greenhouse gases were finally having their impact.

Including the fact of aerosols in one's understanding of climate records could be inconvenient, but ignoring aerosols produces bullshit. The research on aerosols was widely available by 1993. Several prominent articles and essays had appeared in *Science*, the foremost journal for scientific research in the United States.[4] The research was summarized for a more popular audience in *Scientific American* in 1994.[5] While questions remained about the precise impact of aerosols on the climate, aerosols had become an important part of understanding the climate and a likely explanation for the decrease in global temperatures between 1940 and 1975. Anyone who honestly participated in the climate change debate was aware of this crucial scientific development.

Yet skeptics of global warming continued to point to the 1940–1975 decline in temperature as being out of sync with what one would expect were humans really changing the climate. For example, in his essay from *The True State of the Planet*, published in 1995, Robert Balling Jr. reinforces his skepticism over human-caused global warming by pointing to the lack of warming between 1940 and 1975.[6] As he complains

[4] See, for example, Volumes 255, 256, 258, 259, and 260.

[5] R.J. Charlson and T.M.L. Wigley, "Sulfate Aerosol and Climate Change," *Scientific American* (February 1994), pp. 48–57.

[6] Robert C. Balling Jr. (1995), "Global Warming: Messy Models, Decent Data, Pointless Policy," in R. Bailey, ed., *The True State of the Planet* (New York: Free Press), p. 91.

about how pre-1990 models predict more warming (based on greenhouse gas increases) than was actually measured, he fails to mention the research on aerosols and their masking effect. This slight omission was probably unnoticed by the casual reader, but it allowed Balling to suggest that the entire global warming scenario was poppycock. Such is the effectiveness of isolated fact bullshit.

Fred Singer is probably the most egregious spreader of this brand of bullshit for the global climate change debate. In a series of essays published in newspapers and other public sources, Singer repeatedly casts doubt on the reliability of climate models because of this warming, then cooling trend in the temperature record.[7] He never mentions the possibility that human-produced aerosols might account for this record, nor that research was continuing on the topic. And the bullshit spread beyond Singer and Balling. In his report in Toronto's *Globe and Mail* newspaper in 1997, Guy Crittenden cited Singer and Balling as two of the "four horsemen of the nonapocalypse," giving heavy credence to Singer and Balling's claims, emphasizing the pre-1940 warming trend.[8] So much the worse for public debate about climate change.

This is not to say that there were no problems with global climate models and the theory of climate change in the 1990s, or that they are all settled today. One concern was the discrepancy between land-based and satellite temperature readings of the planet. Satellites launched in the late 1970s had been collecting temperature data for over a decade, but the results did not square with ground-level temperature readings. The satellite data showed almost no warming where the ground level readings showed significant warming for the period 1980–1995.

Skeptics *legitimately* made much of this discrepancy, which was quite baffling to climate scientists. Indeed, the satellite data,

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[7] "A More Sensible Approach to the Environment," *Wall Street Journal Europe* (28th January, 1994), p. 10; "Climate Claims Wither Under Luminous Lights of Science," *Washington Times* (29th November, 1994), p. A18; "Is Man-Made Global Warming a Proven Environmental Threat? No: Doomsayers Are Just Trying to Scare Money out of Government," *Insight* 11 (1995), p. 19; "The Global Warming Debate: . . . Not Scientific Consensus," *Wall Street Journal* (25th July, 1997), p. A14; and "Global Warming Is Not Happening," *Natural Science* (29th January, 1998).

[8] Guy Crittenden, "The Day the Earth Warmed Up," *The Globe and Mail* (22nd November, 1997), p. D1.

coming from the purity of space, uncontaminated by human error or local land-use changes, seemed to have a *prima facie* claim to greater reliability. Eventually, however, closer examinations of the data revealed that the satellite data *agreed* with the ground-level readings after all.[9] The absolute reliability of satellite data, both in terms of instrumental purity and ability to capture global temperature accurately, could not be sustained. When the systemic errors of satellite readings were accounted for, and the raw data properly processed, there was a steady and significant warming trend. Although this re-examination of satellite readings has been widely publicized among scientists (with articles and news stories in *Science* and a National Academy report on the issue, cited in footnote 9), we can expect some skeptics to once again ignore this development as they claim that the earth is not *really* warming.

This bullshit of the isolated fact, the selected emphasis on particular data, is seductive. Science is a continually changing body of knowledge, and few can claim to be fully up-to-date on any given issue. Even scientists working in the field have difficulty in maintaining a cutting-edge awareness of every new piece of evidence, of every new interpretation. By bringing forth an isolated fact, and ignoring the complexities that undermine the desired significance of that fact, bullshitters play upon our intellectual limitations. They may succeed in some cases, but repeated emphasis on the isolated fact—especially after new evidence and its significance have been placed in prominent scientific outlets (such as *Science*, *Nature*, or a National Academy report)—is to show oneself to be playing a disingenuous intellectual game. As Harry Frankfurt suggests, it is to reveal oneself to be unconcerned with the truth. It is to show that one is willing to spread bullshit to win.

Bullshit of Universal Standards

While isolated-fact bullshit trades on the impossibility of staying well-informed about every technical issue central to modern governance, universal standards bullshit has a more philosoph-

[9] R.A. Kerr, "Getting Warmer, However You Measure It," *Science* 304 (2004), pp. 805–07; see also B.D. Santer *et al.*, "Influence of Satellite Data Uncertainties on the Detection of Externally Forced Climate Change," *Science* 300 (2003), pp. 1280–84; and National

ical source. Rather than showing a lack of concern for available evidence as with the isolated fact bullshit, universal standards bullshit appeals to a nonexistent standard of proof for science. It assumes that there is one standard met by all scientific claims worthy of the name, and that we can tell what is sound science or good science from what is junk science or bad science (or non-science or pseudoscience) by simply checking with this standard. Lately, the universal standards bullshit has found new employ in bolstering arguments about the politicization of science. This is a disturbing trend, increasing not only the spreading of this bullshit, but also obfuscating crucial issues in the use and misuse of science in political life.

Where does a sense of universal standards in science come from? Most likely, it comes from the way most of us were taught science in school—from a textbook. The textbook lays out the complexities of science, both theory and fact, and then uses exercises at the end of each chapter to test our comprehension. How to apply the newly learned science to the specific case in the problem can be a challenge, but we were all reassured that there is a right answer, if not in the back of the book, then in the back of the *teacher's* book. This leads us to think of science as a black-and-white affair of facts, organized by theories into concrete knowledge. Occasionally, textbooks may hint at the frontiers of science, where the theories and facts are not so well nailed down. But they generally make science look like a done deal, ready to be applied to any problem situation. And the answers are all there, in the back of the book.

Any honest look at science in action, however, shows that things are far messier. For many problems, even the experts disagree over which theory to apply, and how to apply it. And, frustratingly, most of our science policy issues sit in areas like this where science is developing and textbooks have yet to be written. While some facts are undisputed—indeed that something is undisputed among scientists is the only reliable marker that it is a scientific fact—there is much that remains controversial. Universal-standards bullshit assumes that there is some threshold that any body of evidence must meet before it is "sci-

Research Council, *Reconciling Observations of Global Temperature Change* (Washington, D.C.: National Academy Press, 2000).

entific" and "proven" and only then can we act on it. It assumes there is a universal standard of proof that allows some ideas into the vaulted halls of science, and keeps the rest out. What I want to suggest here is that not only is there no such standard, but that we don't want one. Thus appealing to this standard as if it both existed and could solve all of our problems at the science-policy interface perpetuates a pernicious form of bullshit.

Appeals to the universal standard of proof appear in criticisms of politicized science from all sides. The Union of Concerned Scientists, in their report on *Scientific Integrity in Policy-Making*, rightly points to suppression of evidence and the refusal to release studies as examples of politicizing science.[10] If the evidence cannot be made public and discussed, then science's open forum of debate is severely compromised. But the report also considers *the weighing of uncertainty* by the Bush administration to be a politicization of science. It says that "Bush administration spokespersons continue to contend that the uncertainties in climate projection and fossil fuel emissions are too great to warrant mandatory action to slow emissions" (p. 5). If this is politicizing science, however, then there must be some objective universal threshold that once passed make the uncertainties irrelevant.

But there is honest debate about both the level of uncertainty in climate projections (although that uncertainty is generally decreasing each year) and about what level of certainty we would need to have to warrant mandatory fossil fuel use reductions. The latter choice is clearly a political decision, and depends on how protective one wants to be of the fossil fuel industry versus the global climate's stability. We might lambaste the Bush administration for valuing the former too much over the latter, but any appeal to some universal standard of proof, a nonexistent ideal, to address this issue would be bullshit.

A similar example can be found in the introductory chapter of the volume *Politicizing Science*,[11] in which Michael Gough, in providing an overview of the book, writes that:

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[10] Union of Concerned Scientists, *Scientific Integrity in Policymaking: An Investigation into the Bush Administration's Misuse of Science* (2004). Available at www.ucsusa.org.

[11] M. Gough, "Science, Risks, and Politics," in M. Gough, ed., *Politicizing Science: The Alchemy of Policymaking* (Washington, D.C.: Marshall Institute, 2003), pp. 1–25.

> The authors of the chapters . . . describe scientists masking policy decisions as 'scientific', and politicians labeling politically driven decisions as scientific, attempting thereby to place them outside the realm of political discussion, debate, and compromise. But this is an illusion. All policy matters involving human health and the environment are political. The more that political considerations dominate scientific considerations, the greater the potential for policy driven by ideology and less based on strong scientific underpinnings. (p. 3)

This sounds like a useful unmasking of politicized science, but only until one asks what those strong scientific underpinnings are supposed to be. When is a body of evidence enough to be considered "strong"? Surely we want evidence to serve as one basis for our decisions, but is evidence alone sufficient? Even Gough admits it is not. He writes a few pages later that Karl Popper has informed us science requires two things: hypothesis formation and hypothesis testing[12] (Gough p. 12). He then claims that neither models underlying predictions of human cancer rates nor climate change models can be tested. (The ability to predict the cooling following the eruption of Mt. Pinatubo mentioned earlier can be considered a fair short-term test of climate models.)

Yet hypothesis formation and testing are not sufficient for something to be an acceptably strong scientific underpinning for a policy decision. The crucial issue is usually *how much* evidence and testing there has been, *what kinds* of testing have been done, and whether the available evidence is enough. Deciding that it is enough is in part a political decision, as it requires the weighing of the acceptability of uncertainty. Gough is implicitly relying upon a non-existent universal standard of proof for science, one that he never articulates or defends. Thus is it easy to claim that those who attempt to martial evidence in favor of increased regulation have failed to provide sufficiently strong evidence. Unnamed universal standards can always be adjusted higher when desired.

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[12] Ironically, Gough lampoons philosophers at the end of his chapter, quoting Feynman: "Philosophers say a great deal about what is absolutely necessary for science, and it is always, so far as one can see, rather naive, and probably wrong." Gough seems completely unaware that he has undermined a key point made earlier in his chapter when he was relying upon *philosopher* Karl Popper.

Why is there not one standard of proof, one hurdle for evidence before a claim becomes credible and scientific? In part, it is because the evidence that supports claims about the world comes in so many different forms. The evidence that would support a claim of causation about a chemical substance causing cancer in a mammal (evidence from animal toxicology and perhaps biochemistry) looks quite different from evidence that would support a claim about a geological causal process that leads to certain mountain formations. Even statistical significance claims, arguably a "gold standard" in science (commonly thought to be $p < 0.05$ or a less than a one-in-twenty chance that the results are spurious) are not universally applicable. Not all evidence is statistical, and some studies require more stringent or less stringent standards for the results to be "statistically significant." Among different disciplines and fields, what it takes to convince the scientists in those fields will vary, depending on what they already take to be accepted knowledge and accepted techniques. As the adage goes, extraordinary claims require extraordinary evidence. But what an extraordinary claim *is* can vary with disciplinary background and personal experience.

Perhaps we could standardize all this complexity, and require that scientists keep to a single standard for sufficient evidence. One could argue that drug testing has developed such standards—that a statistically significant result from a double-blind control study with placebos is the standard that must be met. But does this standard make sense for climate studies, for example, where there is no alternate earth on which to experiment? These studies involve predictions about how perturbations will affect the climate, and such predictions provide useful checks on climate models. But a simple model for controlled experiments when applied to environmental sciences is neither accurate nor helpful. Also, consider whether the universal standard employed by the Food and Drug Administration (FDA) is really so simple. Even with this standardization of study type, the FDA must still decide whether the study was conducted with an appropriate sample of people, and whether the study ran for long enough, to support the claims made for the drug. And it must decide whether the apparent risks of a new drug are outweighed by their benefits, a judgment made in the context of other medications available. So even with the apparently standardized approach to evidence, judgment in weighing the risks

and benefits of error is needed. The question will still remain, is the evidence enough?

No universal answer to this question is available because the contexts in which these judgments must be made vary so widely. Whether the evidence available is sufficient depends in large measure on what the risks are of getting it wrong. These risks arise because of the uncertainty inherent in the enterprise of science, uncertainty that is endemic and unavoidable (although reducible). Even if uncertainty is similar in two cases, the risks of error vary with the claim being examined and the context of the claim. Consider a few everyday examples. Suppose I told you I thought it likely that your gas tank gauge was off, and that you would run out of gas on the way home. The risk of error in rejecting my claim is not terribly huge. It would be inconvenient for you to run out of gas, but probably not life-threatening. You would want to know exactly why I thought this about your as gauge, on the basis of what evidence, and decide whether it really was enough to get you to take the car directly to a mechanic rather than wait and see for yourself. On the other hand, if I told you I thought there was a bomb in your car, the slightest amount of evidence would suffice to get you to think twice about driving it, just as the mere presence of an unattended package at a major airport can cause terminals to be evacuated.

Decisions at the interface of science and policy are no different. If you care deeply about climate stability and not much about the economic health of oil companies, less evidence will be needed to convince you that we have sufficient reason to act to curtail climate change—that the scientific underpinnings are strong enough. If, on the other hand, you care deeply about the health of oil companies and not much about climate stability, far more evidence will be needed to convince you that the we have sufficient evidence to act. Decisions about uncertainties are political (and ethical), and thus the decision that evidence is sufficient *is* a political decision.

This is not to say that science can't be politicized. It can. One can suppress evidence, by either refusing to record it because one doesn't like it, or by refusing to allow it to be published. One can refuse to allow politically unpopular views to be pursued. One can ignore studies one doesn't like, or fire people who produce the "wrong" results. One can surround oneself

with pseudo-experts who only say what one wants to hear. Science can be detrimentally and catastrophically politicized. Yet, there is no standard for how much evidence is enough to settle a scientific dispute. The only standard we have is that we should consider all the available evidence. How much evidence we need before a claim is sufficiently well-supported to be scientific, to enter the canons of science, changes with the context. To appeal to a non-existent universal standard of proof in science is bullshit.

Combatting the Two Kinds of Bullshit

With the ever-increasing importance of scientific or technical expertise as a basis for policy-making, it's not surprising that we are increasingly confronted with the problem of how to ensure quality in that advice. How do we make sure we are hearing all the available evidence? How do we ensure that the debates occurring among experts are not being distorted by political pressure to not say some things, or to say others, because it pleases certain powers? How do we know whom to trust?

Isolated-fact bullshit plays upon our inherent intellectual limitations that keep us from being fully informed and up-to-date on all the important issues of our time. As long as political operators want to win debates no matter the cost, this kind of bullshit will occur. Those who refuse to acknowledge fair criticism of their claims, that they are ignoring key work, should be rejected as intellectually dishonest. While we can exclude dishonest operators from the academic forum, the public forum must remain open to all. Fred Singer can continue to write commentaries resting on the isolated fact, and some newspapers will publish them, spreading the bullshit. Only those who follow the particular issue closely are likely to notice the spreading of bullshit in these cases, bullshit that is borne of selective omission and emphasis. Even those who spread such bullshit may not realize the nature of their claims, as the claims often wear an apparent obviousness.

But universal standards bullshit can be permanently undermined once we recognize that there are no such things. We should be asking about the strength of evidence and the risks of error for science-based policy, rather than waiting for something to become "scientific" or text-book science. With a more robust

discussion on these terms, perhaps isolated-fact bullshit will lose some of its appeal as well. When we get used to expert disagreement, and understand better its causes, settling a debate on the basis of one expert raising one isolated fact might be recognized for the naive approach it is. We can only hope this would reduce the bullshit in the end.