Book Review

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Review of Three Books on Science: Trust, Corporate Influence, and Militarization

Oreskes, N. 2019. *Why Trust Science*. Princeton, NJ: Princeton University Press. xix, 360 pp. $24.95. ISBN 9780691179007

Michaels, D. 2020. *The Triumph of Doubt: Dark Money and the Science of Deception*. Oxford, UK: Oxford University Press. xxi, 344 pp. $27.95. ISBN 9780190922665

Conner, C. D. 2020. *The Tragedy of American Science*. Chicago: Haymarket Books. xi, 338 pp. $26.95. ISBN 9781642591279

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The year 2020 will be remembered as the harbinger of the global pandemic, which, within twelve months, took the lives of over 2 million people worldwide. But it will also be remembered as a period of great public mistrust and skepticism for science as the source of truth about the empirical world. The past president of the United States continuously flaunted scientific consensus regarding climate change and public health data, while promoting medically disproven therapies for treating COVID-19 infections. Popular opinion supports conspiracy theories over legitimate scientific sources. Both trends, the public denial of scientific consensus in favor of other methods of establishing belief and the occasional public mistrust of science,

while generally holding it as the standard, form the basis for this review of three books about trust in science.

These books address the following questions: Should science be trusted and if so why? Can science be trusted given the undue influence of corporate and governmental agendas undermining its independence? What should science be trusted to do?

Since trust in scientific knowledge is a core theme in reading these books, I am reminded of an essay by philosopher Charles Peirce (1877) titled "The Fixation of Belief," which was published in 1877 in a popular science journal. Peirce claimed that there were four different methods that people use to determine which beliefs they would hold to fix as their own. *Tenacity* is the method of holding on to the beliefs that people already had regardless of evidence or new experience. *Authority* is the method of appeal to an institution or individual that asserts a belief, which people trust as the definitive source. The a priori method is based on uncritical acceptance of the first principles embraced by one or another metaphysical system. Peirce likens this method to that of *taste*, because there is no empirical reason for choosing one metaphysical system and its first principles over another, since it is a matter of what appeals to a person or which belief conforms to the fashion of the times or their lifestyle. Finally, *science* offers a method of reaching an intersubjective agreement by acquiring objective evidence. Of all the methods that people use to arrive at the truth, Peirce claimed, science is the most trustworthy.

Today, there are many reasons why people's trust in science is eroding. Consensus positions and dominant ideas keep shifting grounds in fields like nutrition and cancer etiology. Weight loss diets abound, all claiming to be science-based. And with respect to cancer causation, the public hears about viruses, environmental toxicants, poor nutrition, and genes. As far as the public is concerned, if the experts can't make up their minds, why trust science?

When scientists advance a new theory in the media, before it is actually confirmed, the "hype," which may serve to attract venture capital, may be a factor in the loss of public trust in science (Master and Resnik 2013). Another factor that diminishes public trust in science is the publicity regarding ethical transgressions, including fraud and misconduct in scientific practice. Papers are retracted from journals, scientists are stigmatized, and their careers are tarnished (Neil and Campbell 2020). Or the public becomes skeptical when scientists play dual roles as professors and entrepreneurs (Krimsky 2003; Washburn 2005).

Epistemic trust indicates the confidence one has that some expert will deliver the right answers to us. However, with dueling experts, in whom does the public place "epistemic trust" (McCraw 2015)? Or as Almassi (2012) noted, "How can we make informed decisions of whom to trust in the face of conflicting testimony?"

I shall start my review with the book by Naomi Oreskes, *Why Trust Science*? Oreskes is currently a historian of science at Harvard University. She received her Bachelor of Science in mining geology from the Royal School of Mines of Imperial College, University of London. After graduating, she worked as a mining geologist for the Western Mining Company in outback South Australia, based in Adelaide. She entered graduate studies in the Departments of Geology, Philosophy, and Applied Earth Sciences at Stanford University and received her PhD degree in the Graduate Special Program in Geological Research and History of Science at Stanford.

Oreskes approaches the question in the title of her book by first discussing the philosophical traditions that explore the meaning of science and the structure of its methodology. She reflects on whether science is defined by a unique method or set of methods, by its theories, by its experimental evidence, or by some form of epistemic meritocracy among the gatekeepers of each field. Oreskes recognizes that even the most trusted theories might sometimes be abandoned in favor of new evidence. Aristotle's theory of falling bodies was accepted for nearly 2,000 years before Galileo disproved it. During the period of modern science, many theories and empirical generalizations once considered canonical explanations of natural events were replaced and disappeared in the dustbin of scientific history.

After taking the reader through a series of viewpoints on scientific epistemology, including positivism, conventionalism, and social constructivism, Oreskes summarizes five cases of science "gone awry," by which she means gone wrong. Chapter 2 is titled "Science Awry" (p. 69). From the cases of science gone wrong, she draws insights into the conditions under which we can have trust in science. The first case discusses the limited energy theory proposed by Edward H. Clarke in 1873. Drawing from principles in thermodynamics, Clarke postulated that women's bodies contained a fixed amount of energy, which could be directed at childbirth or higher education, but not both. The second case discusses the theory of continental drift, which held that the earth's continents were not fixed but moved across the earth's surface through geological periods. In this example, Oreskes explained why US geologists rejected a correct theory. For the third case, Oreskes explains the prevalence of false eugenic theories in the

United States and the influence they had on public policy. The fourth case explains the scientific reaction to and rejection of evidence that the birth control pill resulted in depression among many women who were on the pill. The final case was on whether dental flossing contributed to reduced cavities, plaque, and tarter and resulted in better dental health.

In the case of the theory of continental drift, Oreskes builds her analysis on her background in geology. The case involves a schism in international science. Alfred Wegener developed the theory of continental drift. The American scientific community largely rejected the theory, while the European scientists mostly accepted it. Oreskes reviews the reasons American scientists rejected the theory and disputes some of the leading arguments they used against it. She linked the opposition to deeper considerations about the proper methods of doing science and building theories. The Americans believed theories should be developed inductively from data. They considered the European scientific tradition as drifting toward an anti-democratic tradition they referred to as "intellectual authoritarianism." Eventually, new evidence had turned off American skepticism toward continental drift and it was universally accepted. Oreskes uses the case to illustrate mistrust within the scientific community on epistemological and methodological grounds.

These cases are analyzed and provide the insights to Oreskes's response to her question in the title: Why Trust Science? She writes, "We have an overall basis for trust in the process of scientific investigation, based on the social character of scientific inquiry and the collective critical evaluation of knowledge claims" (p. 68). She adds that we trust science (or ought to trust science) when a consensus can be reached by a community of relevant experts in the field; when opposing viewpoints and methods have been dutifully vetted by that community; and when the scientific community is sufficiently diverse in terms of age, gender, race, ethnicity, and country of origin. Each of the cases, which reveal mistakes in scientific judgment, had failed on one or more of the above factors, according to Oreskes.

The second book by David Michaels addresses the corporate influence on science. Before I discuss the book, it is useful to provide some context. Since the mid-1980s, when the *New England Journal of Medicine*, under the editorial leadership of Arnold Relman, asked its authors to disclose their conflicts of interest in submitted articles, the professional journals, universities, and government agencies began to understand how science is affected by commercial interests. The Bayh–Dole Act passed in 1980 gave corporations tax incentives to partner with universities. This resulted in a

growth in academic–corporate partnerships with a new hybrid system of values (Eisenberg and Cook-Deegan 2018; Olivera, Berbegal-Mirabent, and Merigo 2018; Sax 2012; Kumar 2010; Valdivia 2011).

Scholars have reported on how the growth of corporate–university partnerships has resulted in ethical transgressions and biased research. Mirowski (2011) asks, "Has science been 'harmed' by the modern commercial regime?" He cites the decline in publications by academic–industry authors and the increase in proprietary knowledge. Aronowitz (2000) argues that the American universities adopted a business model that defeats the purpose of higher education. "In the bargain of receiving corporate funds, scientists have shifted their priorities to activities whose goal—direct as well as indirect—is to provide commercially useful knowledge." Instrumental education has replaced classical education (Glenna et al. 2011).

As we have seen in the Trump administration, science has been politicized. Climate science was considered a hoax, public health science was denied because it does not conform to the political agenda, and the views of university scientists were dismissed because they were tagged as liberal. Greenberg (2001) anticipated the current trends in his book *Science, Money and Politics.* "No single disinfectant can cope with the corporate contamination of academic scientific integrity, especially when the recipients are willing, even eager, to be contaminated" (p. 473). Medical science has been hit particularly hard by corporate influence (Kassirer 2005).

Academic science has been the leading source of knowledge of industrial chemical risks, along with government and industrial scientists. It is, therefore, incumbent on society to protect this source of knowledge from capture by commercial organizations that seek to protect their products. Regulatory agencies are legally bound to utilize the best science to evaluate the risks of chemicals. For corporate entities that seek to protect their chemical product from regulation, they either fund university science, often with hidden agendas, hire private contract companies to undertake studies, or use in-house scientists. While the two latter methods are easiest for companies to control, the high stature of academic science (refereed published research) brings significant corporate funds to universities. When faced with the threat of regulation of one of their products, companies will present their funded research to agencies or to the courts if there is litigation. The agencies are heavily lobbied. Scientists in those agencies who advocate regulation may find themselves in conflict with the agency head, who is more

responsive to political pressures (Lewis 2014). Can we trust science that is unduly influenced by corporate stakeholders?

In his book *The Triumph of Doubt*, David Michaels writes about the role of science in policy-making and regulation. This is a follow-up to his previous book *Doubt Is Their Product: How Industry's Assault on Science Threatens Your Health*. Michaels holds his BS degree from City College of New York, and an MPH and PhD from Columbia University. Dr. Michaels served as the Department of Energy's Assistant Secretary for Environment, Safety, and Health from 1998 through January 2001. And he served as the Twelfth Assistant Secretary of Labor for the Occupational Safety and Health Administration (OSHA) within the Obama administration from 2009 to 2017, the longest-serving assistant secretary in OSHA's history. Currently, he is a professor in the Department of Environmental and Occupational Health at the Milken Institute School of Public Health of the George Washington University.

This book is based on Michaels's extensive experience as an administrator and public health scholar in dealing with and studying "product defense firms." These are consulting entities hired by industries to help those companies prevent a product from undergoing health, safety, or environmental regulations. Michaels provides a set of cases to illustrate the methods the "product defense firms" used to establish doubt against public health professionals and scientists who have published studies that show specific products are unsafe. Organizations with names like "The Responsible Science Policy Coalition" are front organizations for companies that seek to undercut any efforts at regulating their products. Terms like "junk science" (reminiscent of "fake news" by the past administration) have been used in popular articles to dismiss the findings published in peer-reviewed journals.

The case studies in *The Triumph of Doubt* include brain injury in football, PFAS (polyfluoroalkyl chemical substances used in numerous consumer products including Teflon and Scotchgard), alcohol consumption, diesel fuel, opioids, glyphosate, Volkswagens with dangerous exhaust, and silica dust.

What makes Michaels's perspective valuable and unique is that he has been in the roles of both a public health scholar and of a public health administrator who has had direct contact with lobbyists and "product defense firms." He has had to testify before congressional committees on the health and safety of substances. The agencies he has worked for have been litigated. He has had access to litigation discovery documents, which reveal the tactics of companies seeking to derail the legislation. No public

health administrator of whom I am aware has been as forthright, honest, and factual in explaining how the corporate sector creates its own science to support its financial interests regardless of their own and other independent studies that disclose the dangers of its products.

In similarity to Oreskes, who does not place her trust in a single scientific study, Michaels notes:

> It does not—or should not—follow that any article that has been peer-reviewed is of high quality. In the case of product defense publications in journals, the peer review is often conducted by other scientists who are themselves committed to exonerating toxic chemicals from regulation . . . . Part of the proliferation of academic journals in recent decades has been the rise of what are in essence vanity journals—publications whose editorial boards are controlled by scientists who are united in their financial relationships with industries. These journals are just a different kind of front group. And they are the product defense industry's vehicle for speaking their wishes into scientific existence. (p. 24)

Oreskes's book deals with professional scientists with values and ideology. Michaels's work enters a world where people are hired to act like scientists, specifically in fields like epidemiology and toxicology. These people are not part of the working scientific community willing to debate and consider alternative explanations. Their job is to please their corporate funders by protecting their products from regulation. But there is more to it than that. Some people who are professional scientists (i.e., toxicologists) are willing to be paid a hefty sum to write a paper supporting a company's product against allegations that it is harmful at the current exposure levels. They publish in peer-reviewed journals or journals that claim to be peer-reviewed. The new onslaught of "predator journals" makes it more difficult to sort out responsible science from "public-relations" science.

In the regulatory world, agencies look at the weight of evidence. If there are enough articles claiming a product is safe, it balances out the articles that find a product dangerous. Under such circumstances, companies can claim that science does not indicate a weight of evidence against their product. While the products discussed in the *Triumph of Doubt* are quite varied, the techniques used by the "product defense firms" are remarkably similar. Not only do they seek control over the published science, in some cases by packing the journal advisory boards or financially supporting corporate-friendly journals and their editors, but they also lobby and

intimidate federal regulatory agencies, and support elected members of Congress who have oversight of the regulatory agencies. A company opposed to a ruling by the WHO's International Agency for Research on Cancer (IARC) will lobby to have the United States defund the WHO.

If there is one case study in Michaels's work that illustrates what it is like for an honest regulator to be working against all the forces seeking to stop any sensible public health rulemaking, it is the discussion about whether talc and silica should be declared carcinogens (Chapter 8, "Deadly Dust"). Michaels takes us to the inside discussions of the National Toxicology Program (NTP), created in 1978, which is responsible for producing updates on its *Reports on Carcinogens*. He presents a timeline of regulatory and legal actions so we can see how policy develops and how the silica industry influences the policy-making process.

Michaels writes, "By law, OSHA is not supposed to make decisions by weighing costs against benefits—which really amounts to pitting employers' costs against workers' lives lost and lungs destroyed" (p. 129). But OSHA reality has not been able to live by the law.

While at OSHA, Michaels served as the chair of NTPs Executive Committee and when he left government, he was appointed to its Board of Scientific Counselors. Eventually, after years of lobbying, talc was withdrawn from NTP's list of carcinogens. Michaels's writes, "Talc is different and important because we have access to the inside story—how one well-organized industry and its product defense hires were able to bring NTP to its knees" (p. 156). Here, we learn from the firsthand experience of a regulator about the methods used by corporate stakeholders to remove a dangerous chemical from the priority list.

Science, with its higher educational systems, journals, professional societies, and international standing, appears to be an independent sector. Yet we have seen how it can be influenced by ideology, prejudicial hypotheses, and fashionable theories that resist falsification. We have also seen how corporations contest reputable scientific findings in an effort to protect their dangerous products from regulation. There is one additional major way that external factors influence science, namely, the "militarization of science." While the term has several meanings, first and foremost, it means deploying scientific talents for the production of weapon systems.

During World War II, it was science that gave the military the atomic bomb, radar systems, and code breaking. After the war, the military poured large sums of money into universities and scientific think tanks like the Rand Corporation to steer scientific innovation toward the defense industry

or what Dwight Eisenhower called the "military–industrial complex." By 1958, before transistors were used in consumer products, vast quantities of high-performance transistors were procured by the military (Chomsky 2004).

The military's investment in science was not only for weapons and defense systems such as the Strategic Defense Initiative (SDI), drones, or the new field of artificial intelligence. The social sciences were an important component of militarization. Project Camelot was a US$6 million military project at American University, the purpose of which was to fund social sciences to understand the sources or revolutionary movements and insurgencies in South America and to propose anti-insurgency strategies (Rohde 2013; Price 2011). Another program called Minerva funds basic social science research that helps the Department of Defense understand the causes of instability and insecurity around the world (Smart 2016).

Leading universities had laboratories funded by the Defense Department such as MIT's Lincoln Lab and Draper Lab, where they developed air defense, guidance systems, and computerized anti-aircraft systems, and Stanford's Microwave Laboratory where they worked on microwave bomb sites (Leslie 1993). During Eisenhower's farewell address in 1961, he expressed concern that the massive military funding going into universities would be detrimental to the nation's scholars by influencing their research interests away from basic science.

This brief background takes us to the final book in this trilogy review, *The Tragedy of American Science*. Its author is Clifford Conner, a historian of science who taught at the School of Professional Studies, City University of New York (CUNY) Graduate Center. He received his undergraduate degree from the Georgia Institute of Technology and his PhD from the Graduate Center at CUNY. Conner is the author of several books including *The People's History of Science*.

Conner begins his book by telling the reader that "the tragedy of contemporary science is less about science than about economics, politics and public relations" (p. xi). The scientists, he says, are not the main cause of the problems discussed in his book. We should read his book as a political economy of science because science is embedded in a perverse set of cultural constraints and incentives allowing it to be misused and manipulated in a way that endangers our democracy. Conner views science writ large, encompassing theory (disciplinary science) as well as technology. In contrast to Oreskes (Can we trust science?) and Michaels (Can we protect science from corporate pseudoscientists?), Conner asks "Who does science and technology serve?" The three major themes in the book are the

corporatization of science, the rise of anti-science sentiments, and the militarization of science.

Among the cases from which Conner draws his analyses are nutrition science (specifically the sugar debates), genetically modified organisms (GMOs), tobacco, conflicts of interest in medical research, climate science, artificial intelligence, and military science and technology, the latter of which consume an enormous percentage of the US national budget.

Conner explores the world of think tanks, which have been so influential in shaping US policy and charitable foundations and which do the bidding for corporate benefactors under the guise of a nonprofit public interest entity. The ultra-right-wing mega-entrepreneur Charles Koch is associated with seven foundations and many think tanks. He has supported leading neoliberal groups such as the Cato Institute, Heritage Foundation, the Heartland Institute, the American Enterprise Institute, and the Manhattan Institute, referred to collectively by the author as "Kochtopus."

By far the most rewarding part of the book for this reviewer, perhaps because I am less familiar with the subject, is Conner's analysis of military science since World War II. Among the scientific and technological military projects discussed by Conner, which are rarely investigated in today's popular press, are cluster bombs, Multiple Independently Targeted Reentry Vehicles, drones, cyberwarfare, the SDI, and nanotechnologies, those "tiny insect-mimicking drones that operate in swarms, sneak into private dwelling spaces of targeted victims, and blow their heads off with microexplosive bombs . . ." (193). One quote from the book epitomizes the theme on the militarization of American science.

> Because the form, content, and direction of science have been so strongly influenced by expenditures on war-related research, knowing why that money is spent is essential to understanding the place of science in contemporary America. (p. 148)

When I teach policy, such as science policy, I apply a conceptual framework I developed to help students understand the factors involved in a policy structure and implementation. I reduce policy decisions to six factors (dimensions), which I shall apply to science policy: context/framing dimension (how the science policy issue is bounded), knowledge dimension (what our current knowledge is of the science policy sector understudy), critical dimension (what if anything is wrong with the current conditions of science?), normative dimension (what should science at its best look like?), strategic dimension (how do we get from the current state of science to the

desired state?), and assessment dimension (how we know if the goals of our changes have been met or whether the goals are worth the costs?). These factors are not meant to be exclusive or independent. How we frame a science policy may affect how we study it empirically. Each of the factors represents different questions and/or different analytical approaches for policy analysis and thus can be useful as a framework.

The three authors have covered in detail the knowledge dimension and the critical dimension of the current state of science, namely, what it looks like today and how it ought to be changed. At the end of the three books, the authors discuss the normative and strategic dimensions of science policy: how can science perform at its best and what can be done to make the change?

Oreskes tells us what the scientific community can do to improve its performance, avoid the most egregious errors, and gain a higher level of public approval. First, disciplinary consensus must be reached before a scientific claim with important implications can be accepted. Had that been the case, Oreskes suggests, scientists might not have accepted eugenic theories and the "limited energy theory." Second, scientific claims should be vetted by diverse segments of the scientific community (moreover there should be a diverse scientific community). She claims, "Diversity is crucial because, *ceteris paribus*, it increases the odds that any particular claim has been examined from many angles and potential shortcomings revealed" (p. 249). Her thesis still has to address "who are the relevant experts?" and "does meritocracy in science amount to anything?" Oreskes's book is largely an internalist analysis of science, although she does discuss the importance of listening to nonexperts when their experiences are relevant.

Michaels takes an externalist view of regulatory science by interpreting how corporations infuse their values into the scientific literature of product assessment. He offers several recommendations for protecting honest science from contamination by corporate consultants and ideological NGOs as well as some methods for achieving those ends. Michaels argues that no scientific study should be paid for by or through attorneys on behalf of a client. Also, "rigged data reanalyses," a common method used by product defense epidemiologists to create doubt in findings, should be prohibited. In addition, Michaels calls for full disclosure of conflicts of interest in science and medical journals, public comments on the proposed rulemaking, and editorials. Only unconflicted scientists, according to Michaels, should evaluate the evidence on product health effects. Favoring transparency over protected business information, Michaels argues that corporate discovery

documents in litigation on product safety should be publicly available. His solutions leave open some gaps, such as corporate-funded scientists, who by virtue of the fealty internalize the values of their benefactor and produce what appears to be respectable, albeit biased, science.

Conner's normative discussions are the broadest, least specific, and most systemic of the three books. He does not believe that internal changes to science can save society from its misuse without nationalizing Big Pharma, the fossil fuel and electric power generating industries, and banks and insurance companies as well as breaking the "chokehold of militarism on U.S. policy" (277).

Three books on the limitations and misuse of science have overlapping critiques but offer significantly different approaches to establishing a more dependable, credible, and publicly trustworthy system for establishing truthful claims. Each of these books in its own way places a challenge on American science and American culture. How can science's fundamental mission, the pursuit of objective knowledge, be shielded from political, financial, or ideological influences?

It is no simple task to insulate science from nonepistemic interest groups. Scientists working at universities are relatively free agents who can acquire contracts and grants from virtually any sources. The university administration does play a partnership role in these awards in ensuring that they are carried out in accordance with academic standards and in fulfillment of ethical guidelines. One responsibility university administrators should bear, in my view, is to preview any incoming award to ensure that it contains no clauses that reduce the autonomy of the principal investigator to define the problem, utilize accepted methodologies in the discipline to investigate the problem, and to reach conclusions based on their assessment and interpretation of the evidence. The researcher should have the sole right where or when to publish and that should not be determined by the funder of the external award. Contracts or grants with secret covenants that transfer research or publishing rights to the funder should be rejected by the university.

Still, there remain opportunities where investigators internalize the values of a funder, even when appearing to be autonomous, as when a pharmaceutical company is looking for a "safety and efficacy" finding for their experimental drug. More funding comes with a "favorable" result. The solution I came up with (Krimsky 2003) recommended a National Institute of Drug Testing (NIDT) where pharmaceutical companies would send their new drugs for testing. NIDT would select the investigators and thus prevent a cozy relationship between a drug company and a scientist evaluating their

product. The principle is that there should be a firewall between the manufacturer and the evaluator of a product.

Regulatory science can be improved in several ways. US agencies should follow the guidelines of the IARC and make decisions based only on peer-reviewed, published science. This would curtail the practice of companies submitting unpublished, internal, or contracted studies that are labeled proprietary to regulatory agencies. Scientists working at federal regulatory agencies should be able to publish scientific papers, without policy statements, without having to get approval from the Office of Management and Budget or policy supervisors. They should have the same autonomy to publish their science as their colleagues at universities. Professional societies should consider a certification system of journals in their disciplines. This will communicate to the public and the science journalists that articles published in these journals are appropriately vetted by peer review and that the editors are established scholars. These types of improvements along with maximum transparency are likely to improve public trust in science and regulation.

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