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Jacob Darwin Hamblin

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Introduction by Jacob Darwin Hamblin, Oregon State University

In his *Discourse on Method*, René Descartes famously propounded that it was a greater perfection to know than to doubt. Though he acknowledged the value of subjecting any truth to scrutiny, he distanced himself from those who would “doubt only that they may doubt, and seek nothing beyond uncertainty itself.”¹ And yet today who doesn’t use uncertainty in opportunistic ways? Doubts and uncertainties are routinely played up to illuminate dangers, to point toward fruitful avenues of research, or simply to gain funding for a research project or summer salary. Doubt also has been useful for tobacco companies who resist linking cigarettes to cancer, and to big agribusinesses that wish to tone down links between health problems and the array of strange substances that end up in our food. And of course, doubt is the fuel for climate change skeptics.

The science of climate change—and its human causes—*appears* to be a matter of dispute, percolating up to the top tiers of political discussion. In the 2008 U.S. presidential election, Vice-Presidential candidate Sarah Palin was not willing to attribute climate change to human causes. Since then, several prominent figures in the so-called Tea Party movement have explicitly rejected the science of climate change. At best, they describe the issue as “not settled.”²

In a 2004 *Science* article reporting on nearly a thousand peer-reviewed papers on climate change, Naomi Oreskes found no evidence of dissent to the view that humans were causing climate change. The notion that there remained substantive disagreement about the reality of anthropogenic climate change, she maintained, was simply incorrect.³

So why do we continue to talk about the debate over global warming as if it remains a scientific controversy? It is easy to explain why politicians, economists, and global oil corporations might want to do away the science of climate change. But what is the basis of the scientific counterpoint to the “consensus” view outlined by Oreskes? This is the subject of *Merchants of Doubt*, a team effort by Oreskes and Erik M. Conway, the historian of NASA’s Jet Propulsion Laboratory. Aside from her *Science* article, Oreskes is best known by historians for her work on the history of continental drift, plate tectonics, and oceanography, while Conway is known for his work on the atmospheric sciences and the history of technology. They bring to bear their expertise as historians of the sciences of land, sea, and air, though the book is for a wide audience and published by a trade press.

¹ René Descartes, *Discourse on the Method of Rightly Conducting the Reason, and Seeking Truth in the Sciences*, trans. by John Veitch (Chicago: Open Court, 1910), 30.

² John M. Broder, “Climate Change Doubt is Tea Party Article of Faith,” *New York Times* (20 Oct 2010). <http://www.nytimes.com/2010/10/21/us/politics/21climate.html>

³ Naomi Oreskes, “The Scientific Consensus on Climate Change,” *Science* 306:5702 (2004), 1686.

The authors attribute most of the responsibility for climate science skepticism to very small group of people who exercised a powerful influence not only in the debates over global warming, but also in earlier disputes such as the carcinogenic effects of tobacco smoke. Their thesis is bound to be controversial, and in fact it already has stirred up both praise and scorn. A hint of their thesis had appeared in the journal *Historical Studies in the Natural Sciences (HSNS)*, in which Oreskes, Conway, and then co-author Matthew Shindell singled out physicist (and former director of the Scripps Institution of Oceanography) William Nierenberg for shaping major scientific reports on climate change to fit his conservative views.⁴ This work came under fire on the web and in print because Nierenberg's son, Nicolas Nierenberg, disagreed with their characterization, claiming that they took a great deal out of context. He then teamed up with Walter and Victoria Tschinkel to write a long rejoinder, also in *HSNS*, attempting to show that Nierenberg's views were not out of step with those of other scientists writing the report.⁵ Now with *Merchants of Doubt*, we have the story fleshed out on a larger scale, on subjects ranging from DDT to tobacco smoke and climate change.

I asked Spencer Weart to comment upon *Merchants of Doubt* because of his long association with the history of the physical sciences, as former director of the Center for the History of Physics, at the American Institute of Physics. Scholars of nuclear power and weapons will know Weart's work from *Nuclear Fear*.⁶ More recently, he authored an exhaustive web-based history of the questions, patronage strategies, and political dimensions of the science of climate change. A much-shortened version became a book, *The Discovery of Global Warming*.⁷

Mark Carey's work also crosses over between environmental history and the history of science. His 2007 article "The History of Ice: How Glaciers became an Endangered Species," won the Leopold-Hidy prize for best article in *Environmental History*.⁸ Rather than debate the reality of climate change, he investigates how people in a high-impact area such as the Peruvian Andes have dealt with it, sometimes with the aid of scientific advice and sometimes despite it. Carey's own

⁴ Naomi Oreskes, Erik M. Conway, and Matthew Shindell, "From Chicken Little to Dr. Pangloss: William Nierenberg, Global Warming, and the Social Deconstruction of Scientific Knowledge," *Historical Studies in the Natural Sciences* 38:1 (2008), 109-152.

⁵ Nicolas Nierenberg, Walter R. Tschinkel, and Victoria J. Tschinkel, "Early Climate Change Consensus at the National Academy: the Origins and Making of Changing Climate," *Historical Studies in the Natural Sciences* 40:3 (2010), 318-349.

⁶ Spencer R. Weart, *Nuclear Fear: A History of Images* (Cambridge: Harvard University Press, 1989).

⁷ Weart's full site is here: <http://www.aip.org/history/climate/index.htm>. The short version is Spencer R. Weart, *The Discovery of Global Warming* (Cambridge: Harvard University Press, 2003).

⁸ Mark Carey, "The History of Ice: How Glaciers became an Endangered Species," *Environmental History* 12:3 (2007), 497-527.

recent book *In the Shadow of Melting Glaciers*, will be the subject of a future roundtable.⁹

Neil M. Maher works at the intersection of environmental history and the history of technology. He shares with Erik Conway a deep interest in the technology of space exploration and its connection to environmental issues. He is currently writing a political and environmental history of the space race. His previous book, *Nature's New Deal*, won the Charles A. Weyerhaeuser Book Award for the best book on conservation history.¹⁰

And finally, Ronald E. Doel has published extensively on science during the Cold War era, with particular attention to the earth and environmental sciences.¹¹ When he was postdoctoral fellow at the American Institute of Physics he spent many hours interviewing scientists who were important in climate research. Those of us who have utilized these and others' oral histories know how useful they are as resources in the history of recent science.¹² Since then, Doel has devoted considerable energy to highlighting the opportunities and difficulties in writing about recent science, and is the co-editor of *The Historiography of Contemporary Science, Technology and Medicine: Writing Recent Science*.¹³

I thank the participants for sharing their time and energy to comment on *Merchants of Doubt*. As an open-access forum, *H-Environment Roundtable Reviews* is available to scholars and non-scholars alike, free of charge. I hope that this particular roundtable is perceived as one round, neither the first nor the last, of an ongoing conversation about the connection between historical scholarship and today's environmental issues.

⁹ Mark Carey, *In the Shadow of Melting Glaciers: Climate Change and Andean Society* (New York: Oxford University Press, 2010).

¹⁰ Neil Maher, *Nature's New Deal: Franklin Roosevelt's Civilian Conservation Corps and the Roots of the American Environmental Movement* (New York: Oxford University Press, 2007).

¹¹ For example, see Ronald E. Doel, "Constituting the Postwar Earth Sciences: the Military's Influence on the Environmental Sciences in the USA after 1945," *Social Studies of Science* 33:5 (2003), 635-666.

¹² These oral histories are available through the Niels Bohr Library and Archives.

<http://www.aip.org/history/ohilist/transcripts.html>

¹³ Ronald E. Doel and Thomas Söderqvist, eds., *The Historiography of Contemporary Science, Technology, and Medicine: Writing Recent Science* (New York: Routledge, 2006).

Comments by Spencer R. Weart, Independent Scholar

Denial of Scientific Consensus in Historical and Social Context

The book *Merchants of Doubt* by Naomi Oreskes and Erik M. Conway (O&C) is an important contribution. This has been widely noticed in the media, where the book's message is often boiled down to one brief statement: the tactics of global warming denial, and even some of the people and institutions, are the same as were used to deny the dangers of cigarette smoking. In fact the book covers no less than seven cases of denial of an important scientific consensus. Yet the summary is true enough, for O&C are following a narrow line that connects the two ends, tobacco and global warming. This is not a general history of denial, although it offers much that advances understanding of the history. For the most part it is a prosecutor's case, and a convincing one, against a small number of shady people and institutions and the contemptible methods they deployed.

The first chapter deals with some of the methods the tobacco industry used to delay imposition of restrictions on their products, and like most of the chapters it covers a topic that has been addressed already in full-length books (which O&C use appropriately). The point is to introduce some of the methods and people, in particular Frederick Seitz, who will feature in the global warming story. But to see the authors' approach—what they include and what they omit—we can do better by analyzing the second chapter.

This chapter deals with the defense of Reagan's Strategic Defense Initiative (SDI, "Star Wars") by Seitz and other physicists at the newly founded George C. Marshall Institute, which would later be prominent in global warming denial. Their publications and lobbying were in effect a denial of the widespread consensus in the physics community that SDI could not work. Their dissent reflected a split in the physics community which, as is well known, can be traced back to the early 1950s. The division came into the open with the Oppenheimer Affair, but it had begun when the Atomic Energy Commission decided to build hydrogen bombs. Equally important, the Commission had become politicized, taking a Republican free-enterprise position in a long-running battle over whether civilian nuclear reactors should be in the hands of private corporations or socialized under a government agency. The split in the physics community was thus already identified as Right vs. Left.

The division intensified, spread to other sciences, and took a proto-environmentalist cast in the late 1950s, as scientists battled over whether fallout from nuclear weapons tests constituted a global health hazard. Edward Teller, one of O&C's protagonists, figured centrally in this controversy. Physicists divided further in the late 1960s in controversies over Anti-Ballistic Missiles and Multiple Independent Reentry Vehicles. The hostility between conservative and liberal scientists was exacerbated by dissension over the Viet Nam war, which split even the JASON

military advisory group. Meanwhile another division developed, along somewhat different lines, over the nuclear industry. Many scientists and engineers found the vehement opposition to nuclear reactors entirely wrong-headed. The controversy probably played a significant role in alienating all of O&C's protagonists (and certainly one of them, Dixy Lee Ray) from anything that smacked of environmentalism.

Much more could be said about all this background to the SDI case. In fact O&C say much less, alluding to only a few of these events in brief asides. Their interest is confined to showing the development of ideas and institutions that would feature in later cases of denial of scientific consensus and global warming in particular.

Another example of their approach may be found in the chapter on acid rain. There is a wide international context here, with Europeans in the forefront, of which O&C introduce only the most necessary points. An example of something that O&C do give close attention to is the role of William Nierenberg in crafting a 1983 report on the topic. They show with convincing documentary evidence that he participated in changing the crucial executive summary, responding to the Reagan administration's desire that the panel's warnings be made to seem less urgent. Nierenberg's action does not seem important, however, for nobody was fooled; the press recognized that the panel demanded immediate action lest acid rain cause irreparable harm.¹⁴ But demonstrating Nierenberg's action here becomes useful when O&C address his more significant role in a report on global warming, by a panel that he chaired that same summer. The executive summary was biased to take the sting out of the scientific consensus that global warming posed a severe risk—and that bias did have important political consequences. Here they cannot prove that Nierenberg deliberately distorted the conclusions, but the reader can well conclude that he was responsible for soft-pedaling this report much like the one on acid rain.¹⁵

To mention one more example of O&C's approach, the chapter on the ozone hole gives them, among other things, an opportunity to show how S. Fred Singer developed his tactics. We see him retailing erroneous scientific conclusions while failing to take account of countervailing arguments and facts, of which he could not have been ignorant. It was a practice of cherry-picking that Singer would eventually repeat on a weekly basis for global warming.

¹⁴ Philip Shabecoff, "Panel of Scientists Bids U.S. Act Now to Curb Acid Rain," *New York Times*, June 28, 1983.

¹⁵ A stronger argument was advanced in Naomi Oreskes, Erik M. Conway and Matthew Shindell, "From Chicken Little to Dr. Pangloss: William Nierenberg, Global Warming, and the Social Deconstruction of Scientific Knowledge," *Historical Studies in the Natural Sciences* 38 (2008): 109-52. This was criticized by Nicolas Nierenberg, Walter R. Tschinkel and Victoria J. Tschinkel, "Early Climate Change Consensus at the National Academy: The Origins and Making of *Changing Climate*," *Historical Studies in the Natural Sciences* 40 (2010): 318-49.

The chapter also shows Singer opening up a crucial new front in the battle: ad hominem aspersions on an entire scientific community. In opposing ozone-destroying chemicals, Singer suggested, scientists were chasing “prestige, more grants for research, press conferences . . . [and] the feeling that maybe they are saving the world . . .” (quoted p. 128 from *National Review*, June 30, 1989). Of course science has long been criticized as self-serving and on other grounds—a historical context well-known to all historians of science. But such criticism had never been systematically deployed by scientists themselves in such a controversy, not even in the savage wars over tobacco smoke. Repeated by a few others such as Richard Lindzen, the tactic gave rise to vicious and debilitating direct attacks on specific climate scientists. O&C open their book by describing a landmark 1996 attack on Benjamin Santer. Not a few other scientists were later similarly attacked by bloggers and politicians, but those stories lie outside the book’s purview.

To understand a propaganda effort one must understand its audience. O&C’s tightly focused approach takes for granted that the reader will understand the broader social context that made attacks on climate scientists all too effective. One important element of this context, of course, is the general anti-intellectualism and disdain for elites, especially academic elites, that is found among Americans and especially on the political and religious right. It is manifested most pervasively in skepticism about Darwinian evolution (which also has enrolled some professional scientists, albeit ones far less prestigious than O&C’s protagonists). Since Darwinian and global warming skepticism proliferate in the same groups, it would be interesting to know what O&C make of the similarities and differences.

A second important element of the social context is the fact that in some scientific fields there *is* a significant amount of fraud, and still more borderline dishonest research publication—and the public knows it. For example, the *New York Times* recently reported that “A study of 32 doctors who had each received \$1 million or more from medical device makers in 2007 found that those payments were disclosed in less than half of a sample of the medical journal articles they published in 2008.”¹⁶ Such misconduct is found mainly in biological and medical fields. This matters a lot, for health is the field of science that most concerns people; indeed the only scientifically trained professional that most citizens ever meet is their doctor.

We can understand why misconduct is less prevalent in the physical sciences. First, biological and medical effects are much harder to subject to independent validation than physical phenomena, for they are extremely complicated, often multi-causal, and sometimes inescapably subjective. Second, at stake are billions of dollars, human lives, and sometimes entire ecosystems, which brings pressure on people to weaken their personal standards of conduct whether from greed or idealism. But note that climate research, almost uniquely among the physical sciences, likewise involves irreducibly complex systems and enormous economic, societal and

¹⁶ Caption to illustration in Duff Wilson, “Medical Industry Ties Often Undisclosed in Journals,” *New York Times* (Sept. 13, 2010). <http://www.nytimes.com/2010/09/14/business/14devices.html>

ecosystem implications. This lends plausibility to claims that standards in the field are lax. In fact the only clear violations of standards, from cherry-picking to *ad hominem* attacks, have come from the deniers, but this is not easy for the public to understand.

How much of all this should O&C have included? Writing history in general, and the choice of how narrowly to focus in particular, are largely a matter of personal style and intended audience. This book addresses the general public, and it is well designed to reach them with its clear and lively descriptions of bitter controversies. On the one hand, aiming for such a readership would argue for including more of the context, and I personally would have given it a few pages. On the other hand, brevity is crucial in attempting to reach contemporary readers with such a relatively obscure subject: lose a sentence, gain a reader! So I offer these comments not as criticism but simply to indicate what choices the authors made, and how a teacher who wishes to use their book in the classroom might frame the material.

While short of historical and societal context, the book broadens its topic in other ways. It offers a fine discussion, in the social-studies-of-science mode, of the nature of science and the problems of getting citizens to accept a scientific consensus. These themes are touched on at various points (for example on p. 157 an explanation of the crucial difference between being confident a substance is harmful and being confident it is *not* harmful), and they are fully developed in the book's final sections.

Investigating the personal motivation of their protagonists, O&C find them consistently opposed to regulation, due to an ideological stance in favor of unfettered private enterprise. O&C develop this theme throughout the book and particularly in an excellent chapter dismantling the canard that the American ban on DDT has resulted in millions of deaths from malaria. That topic and not global warming is in fact their final case; at this point the prosecutor's indictment broadens to include the entire ideological opposition to regulation in general. To acknowledge the scientific consensus on global warming or in any of the other cases, as O&C explain, would be "to acknowledge the soft underbelly of capitalism: that free enterprise can bring real costs—profound costs—that the free market does not reflect" (p.237).

Capitalism itself, they imply, must be significantly reformed if we are to preserve our health and environment. Indeed they suggest that the denial of global warming, by discrediting the free-enterprise ideology, may well accelerate the transformation. This line of thought has been followed to a conclusion by the writer Kim Stanley Robinson:

... we are entering a zone of history where the struggle between science and capitalism for dominance of our culture—which I think has been clear all along, but which many do not see or agree is the situation—may become explicit and open. I hope so; this is a scientific culture as well as a capitalist culture ... the utopian ethics and politics buried in the scientific method

makes science the equivalent of the most powerful leftist politics we have ever had. Now the climate crisis may make that much more obvious to everyone.¹⁷

In this confrontation historians stand alongside science. For while history is one of the arts, it is the unique art that, like science, aims to describe external truths in a way that can be independently verified. Adhering to this ideology and its norms, however, does not rule out an accommodation with capitalists willing to consider reform. For there are many shared values and goals.

The planet *will* get hotter. At some point the damage will force people to act, with harsh consequences. And if we know any lesson from history, it is that security emergencies harm not only private enterprise but liberty in general. If we wish to preserve our form of society for our posterity, and even protect their physical well-being, we must start to act now: it is already almost too late. By exposing the misdeeds of a group of traitors to science, O&C have taken a valuable step in advancing this enterprise.

¹⁷ Gerry Canavan, "Science, Justice, Science Fiction: An Interview with Kim Stanley Robinson," *Polygraph* 22 (2010):201-217, at p. 204, online at <http://www.duke.edu/web/polygraph/kimstanleyrobinson.pdf>.

Comments by Mark Carey, University of Oregon

This book provides a fresh and insightful analysis of a variety of issues that environmental historians have been studying for decades. It shows how a small group of prestigious, powerful, and persistent people fabricated scientific controversy and generated false uncertainty in order to stall government action on several issues: tobacco smoking, second-hand smoke, strategic defense weapons, acid rain, the ozone hole, global warming, and DDT. Many of these issues have been well examined by environmental historians. But Oreskes and Conway have a unique angle and offer a compelling, if not shocking, argument about the role of this handful of non-specialist scientists who single-handedly created and spread misinformation in order to derail policymaking. It is a surprising story not so much because powerful people manipulated scientific evidence to suite their own agendas; this, after all, has been happening for centuries. Rather, the more astonishing issue this book reveals is how the same few individuals became involved in so many disparate issues, usually way beyond their areas of expertise. Moreover, the media listened to them, as did leaders in the highest levels of government, right up to the White House. The story about how this same cast of characters influenced such disparate issues so profoundly has not been exposed in other studies. And this highly readable, engaging book will appeal to a broad audience from the general public and undergraduates to professional historians and scientists.

The handful of scientists the book identifies as the "merchants of doubt" in this half-century history are mostly retired physicists who played prominent roles in the development of the atomic bomb, nuclear weapons, or other aspects of U.S military defense during World War II and the early Cold War years. Fred Seitz, Fred Singer, Robert Jastrow, and Bill Nierenberg were the most prominent of these physicists-turned-doubters, and they popped up in an uncanny number of distinct forums. As Oreskes and Conway show, these doubters repeatedly sought to obscure scientific consensus on a range of issues unrelated to their backgrounds and training. They used the prestige they earned and the political connections they developed as notable physicists not only to get recognition and attention, but also to gain access to influential policymakers. In most cases, these scientists joined with--and were funded by--private industries and conservative think tanks, particularly the George C. Marshall Institute.

The merchants of doubt argued persistently and loudly over time that tobacco smoking (and later second-hand smoke) was not bad for people's health, even though scientists and the tobacco companies themselves knew otherwise. They promoted strategic defense initiatives (popularly known as Star Wars) in the 1980s by suggesting in contrast to specialist scientists that nuclear winter was an unlikely possibility that should not deter increased arms production. They argued (falsely) that scientific conclusions about acid rain, the ozone hole, and global warming were inconclusive and could not be linked to anthropogenic causes. And most recently, some have contended that Rachel Carson was wrong, that her impassioned fight against DDT has actually resulted in the death of millions of African children from malaria that could have been prevented with DDT.

The media campaign was a critical component of the doubters' agenda. By getting their views included in the mainstream media, they generated the false impression that scientific controversy existed when it did not. Oreskes and Conway understand why journalists have been swayed by the doubters, who had been scientists and thus knew how to sound like scientists even on issues well beyond their expertise. But the authors are also quite critical of the media, especially regarding the long-term application of the 1949 Fairness Doctrine that Oreskes and Conway believe has been a tremendous disservice to science. On the one hand, this doctrine ensured that distinct sides were given equal treatment. The problem is that, in the cases examined in this book, the supposed two sides consisted of thousands of scientists versus a dozen non-specialists or non-scientists. The result: "'Balance' had become a form of bias, whereby the media coverage was biased in favor of minority—in some cases extreme minority—views" (p. 243). Journalists thus helped generate the illusion of scientific controversy when none existed.

Oreskes and Conway argue that the main motive driving these merchants of doubt was the quest for free markets. As eminent Cold Warriors, the doubters opposed communism and sought to ensure the unbridled rights and activities of private companies. Oreskes and Conway call the doubters "free market fundamentalists," who saw the regulation of private industry as a blow against national security and an infringement on their rights as Americans. The doubters opposed solutions to health and environmental issues if they believed such regulations might curb freedoms of private industry, reduce the U.S. ability to win the Cold War, or otherwise erode free market capitalism. This is why Oreskes and Conway believe the doubters frequently asserted that solutions were too costly, regardless of the scientific evidence pointing to health or environmental impacts—a "billion-dollar solution to a million-dollar problem" they quipped, wrongly it turned out, in their fight against acid rain regulations (p. 101).

This engaging and accessible book is built not only on excellent writing and storytelling, but also on superb research. The authors uncovered the varied lives of these manufacturers of doubt, and they explain their intricate connections to other scientists, think tanks, politicians, companies, journalists, and research institutions. They describe these links fluidly, but historians will recognize the enormous amount of background research necessary to reconstruct such elaborate relationships. The book also offers a compelling example of the social construction of science—how political, economic, and ideological forces affect the historical evolution of scientific knowledge, the communication of science, and the interactions between science and policy. Moreover, it shows how "small numbers of people can have large, negative impacts, especially if they are organized, determined, and have access to power" (p. 213). This is obviously not an optimistic view of the relationship between science and policy. On the other hand, the authors show that in many of these cases, environmental and health regulations did eventually prevail. Like many environmental historians, Oreskes and Conway tell what at times is a tragic tale even while they profess significant faith in "real" science to identify and solve problems.

The authors' favorable treatment of science and scientists generates several questions that transcend the book's focus on specific merchants of doubt. Does peer review really guarantee effective science and free it from the political, economic, and ideological forces that influenced doubters? Is it possible in a book accessible to popular audiences to show that scientists can disagree and debate even while there is consensus on broader issues? Did environmentalists always use reliable and sound science for their agendas, as the book suggests?

Throughout the book, Oreskes and Conway posit science against the political and ideological activities of the doubters, who the authors say practiced only simulacra of science in the cases they examined. This distinction hinges on the authors' definition of science and scientific processes. They identify peer review as the principal feature that makes science credible. But as scholars have long shown, science is socially constructed and never entirely free of political, economic, cultural, or geographical forces. Even when scientific consensus exists and the peer review process works well (and it doesn't always), science is still shaped by a variety of other factors that are not addressed much in this book.

For one, funding for science is often a political process, or at least influenced by political and economic processes that shape budgets for funding agencies such as the National Science Foundation (NSF) or the National Institutes of Health (NIH). The authors even mention briefly that one of the principal doubters (Nierenberg) was offered the position of head of the NSF (p. 78). Would funding priorities have changed had he accepted the position? How do NSF directors, budgets, and decision-making influence science? Peer review is also not exempt from politics. It can be variable, even problematic in some cases, as turf battles, competition, time constraints, or sloppiness affect the process. I do not doubt that the process is the best we have; nor do I wish to challenge the authors' conclusions or claims. Rather, my point is that the production of scientific knowledge and the motives of scientists are complex and often shaped by social, cultural, political, and economic factors—though there is obviously something rather different between getting a new NSF grant and being funded by a private tobacco company while serving on the board of a politically aligned think tank. The question is why such accomplished expert authors as Oreskes and Conway—who undoubtedly understand these nuances—did not illuminate this messier history of science, explicitly drawing distinctions between the types of forces that influenced the merchants of doubt versus the scientists. The book illuminates these forces on the doubter side; but the absence of coverage on the other runs the risk of implying that scientists were immune from the types of societal forces that other historians of science have been exposing for decades.

The authors' treatment of scientists as a relatively unified front generates another possibly related question about whether it is possible in a popular book to capture the scientific debates and discussions that occurred even while scientists overall tended to agree that, for example, coal burning caused acid rain that harmed the New England environment. Oreskes and Conway do recognize that science is debated in universities and laboratories, but this is a footnote in this story that generally focuses on scientific consensus. Of course, their point is to address the falsely constructed debates about science that the

merchants of doubt created. But like the production of science, the actual scientific conclusions are much messier when analyzed more closely. None of this prodding for greater nuance, I should reiterate, challenges the authors' broader arguments about a few tenacious doubters who historically fabricated scientific uncertainty to thwart government regulation of private industries.

Comments by Neil M. Maher, New Jersey Institute of Technology and Rutgers University, Newark

The day after I finished reading *Merchants of Doubt* I went out to the bookstore, bought another copy, and walked directly to my local post office to mail it to my annoying relatives in New Jersey. These cousins are annoying not because they live in New Jersey, which gets a far worse rap than deserved, and not because I'm forced to spend holidays with them, but rather because when it comes to global warming they are staunch non-believers. At family birthday parties, at summer barbeques, even at friends' funerals they openly question the science of climate change even though not one of them majored in any sort of science in college. Or, if in a weak moment after one too many burned barbequed burgers they do admit that climatological data from the last quarter century persuasively suggests that global temperatures are, indeed, rising, they steadfastly deny that humans have caused this increase. The heating up is "natural," they claim, or they fall back on the their old standby argument that "global warming is a left-wing conspiracy." *Merchants of Doubt*, I realized about mid-way through, was just what I'd been looking for, for years. The book, to put it bluntly, would shut my cousins up.

Oreskes and Conway persuasively argue the exact opposite of what my Jersey relatives claim. Not only is global warming happening and induced by human actions, but the so-called debate over climate change owes its literal existence to the highly sophisticated, extremely successful promotional effort of a half dozen conservative scientists who for the most part no longer practice science. Yet what makes *Merchants of Doubt* so convincing is that the authors do not stop with climate change; they trail these same right-wing scientists back over the last quarter century and find that they worked together to question, quite publicly, the scientific consensus that had formed around the most significant environmental issues of the post-World War II era. From the debate in the 1970s over whether tobacco smoke caused cancer to the more recent hubbub over *Silent Spring's* supposedly exaggerated concerns regarding the dangers of DDT, this same handful of scientists peddled scientific doubt, often without concrete scientific evidence, to the American public.

Oreskes and Conway organize their narrative according to specific scientific debates, with seven chapters exploring seven postwar moments when it appeared publicly, quite incorrectly it turns out, that an internal squabble raged within scientific circles regarding a host of environmental crises. Readers proceed chronologically through the fight over tobacco, nuclear winter, acid rain, ozone depletion, second hand smoke, global warming, and a new and improved battle over DDT, and encounter the exact same cast of characters over and over and over again. Four physicists led this charge. Some of these men, such as former director of the Goddard Institute for Space Studies Robert Jastrow along with one-time director of the Scripps Institution of Oceanography William Nierenberg had deep ties to the military and weapons industries, while others, including former president of the U.S. National Academy of Science Fred Seitz and NASA satellite developer Fred Singer, often worked as hired consultants for big business, including big tobacco. All of these men also shared a strong passion for conservative politics. "Our protagonists were fiercely anti-Communist, and viewed science as crucial in helping to

contain its spread,” explain Oreskes and Conway. “When the Cold War ended, these men looked for a new great threat. They found it in environmentalism” (*Merchants of Doubt*, 248).

One reason I mailed a copy of *Merchants of Doubt* to my relatives is because the book is so wonderfully readable; the authors intentionally wrote it for a general audience. The writing is conversational and jargon-free, it flows, and each chapter revolves around a narrative describing a single scientific debate. The chapter on global warming, one of the best in the book, reads almost like a spy novel, complete with sick scientists, deathbed betrayals, and uncomfortable confrontations at otherwise solemn memorial services. As important, Oreskes and Conway make the science completely accessible. I enjoyed, and learned, while reading about the science of acid rain, ozone depletion, climate change, and resistance to DDT, and non-environmental historians will too. The book, in other words, reads like a fine piece of investigative journalism.

Yet Oreskes and Conway back up their reader-friendly prose by going the extra step, and digging ever deeper, with their historical research. Indeed, they had to; both of these historians, and their research, were publically attacked on the Internet by right-wing critics before the book was even published (*Merchants of Doubt*, 275). Oreskes was similarly harassed after publication in *Science* of her seminal 2004 article “The Scientific Consensus on Climate Change,” which became a lightning rod in the public debate over global warming. To make their case as airtight as possible, the authors examined tens of thousands of documents from familiar sources such as newspapers and magazines, scientific and trade journals, and a variety of government materials from CIA reports to congressional hearing transcripts to internal memoranda of the Environmental Protection Agency. They then combined these with more unique methods; Oreskes and Conway conducted numerous interviews, in person and by email, with participants in this history. Most important, however, was access to three archives that proved central to this study; the National Academy of Sciences archive, which house the papers of its former president Fred Seitz, the Scripps Institution of Oceanography library, which contains the writings of its former director William Nierenberg, and the University of California at San Francisco’s Legacy Tobacco Documents Library, which contains more than fifty million full-text searchable documents culled from the tobacco litigation of the 1990s (<http://legacy-library.ucsf.edu>). These archives gave Oreskes and Conway access to the other side of this story, to the behind-the-scenes chatter of corporate boardrooms and the personal correspondences of these conservative scientists who, with the help of their industry brethren, sold scientific doubt to the American people.

Oreskes and Conway’s methodology not only allows them to expertly weave the history of science with political history, but also helps them illustrate a much larger, more important point about the complex relationship between science and politics. Without lengthy footnotes referencing Bruno Latour or jargon-filled tutorials explaining the social construction of science, *Merchants of Doubt* illustrates through its narrative the powerful and complex role played by politics within the practice and promotion of science. The authors show how Seitz, Singer, Jastrow, and Nierenberg were not only politically well connected through government appointments by Republican presidents including Ronald

Reagan and George H. Bush as well as their involvement with conservative think tanks such as the George C. Marshall Institute. These physicists were also master manipulators of the media, which they successfully convinced from the 1970s onward to provide “equal time” in reporting both so-called “sides” of these scientific issues. While such balanced reporting on political matters in a two-party system serves the public well, Oreskes and Conway argue that science does not work that way. “Science depends on evidence,” they write, “and not all positions are equally grounded” (*Merchants of Doubt*, 241). As a result “‘Balance’ had become a form of bias, whereby the media coverage was biased in favor of minority – in some cases extreme minority – views” (*Merchants of Doubt*, 243). Balanced reporting thus suggested the appearance of scientific debate when the scientific community as a whole had already reached widespread agreement.

Yet much more could be done with this argument, and this is my main concern with the book. While organizing *Merchants of Doubt* into seven chapters according to different scientific debates results in a wonderfully readable monograph, it also makes for repetition; each chapter follows a similar narrative arc, though the details change. Even more important, such organizational structure limits Oreskes and Conway’s analysis of the “whys” and “hows” of their story. Why did these conservative scientists peddle doubt, and how, exactly, did they get away with it for so damn long? Rather than integrate answers to such questions into their exposé of each of these scientific debates, the authors tend to relegate them to a final concluding chapter that suggests, more than it illustrates, that these right-wing physicists fought federal regulation on tobacco, acid rain, ozone, and the rest because of their deeply held belief in a free market system that would contain communism. “This was precisely what these men most feared and loathed,” explain Oreskes and Conway in their conclusion, “for they viewed regulation as the slippery slope to Socialism, a form of creeping communism” (*Merchants of Doubt*, 249). Maybe, but maybe not. There just isn’t enough evidence in this last chapter to convince me that this is the reason for these scientists’ actions.

In a similar vein, how, exactly, did these men succeed, for more than a quarter century? Here I’m not at all questioning the main argument of the book: that these scientists consciously and successfully sowed doubt, and in doing so prolonged government action for decades on these environmental and health issues. Oreskes and Conway convince me of this, completely. But by the end of *Merchants of Doubt* I’m still unsure about the keys to these scientists’ success. During some scientific debates it seemed that Seitz, Singer, Nierenberg, and Jastrow relied most on their somewhat rusty scientific credentials to hoodwink the national media into covering their “side” of the science. At other moments, it appeared instead that these men’s political connections paved the way for widespread promotion of their questionable points of view. During still other debates they relied heavily on the economic might of corporate America, such as R.J. Reynolds Tobacco Company, to help market their dubious brand of science to the American public. Which raises another important point: why did these debates over postwar science take place predominately in the United States and not across Europe or Asia or Latin America? Thus while certain promotional strategies at different historical moments in specific postwar places proved more successful than others in helping these scientists to dupe the

public, Oreskes and Conway analyze such contingencies only cursorily in the concluding chapter of *Merchants of Doubt*.

One possible solution to this problem would have been for the authors to use, more self-consciously, the individual scientific debates in each chapter to highlight both the *reasons* for these scientists' actions as well as the *strategies* the scientists used to sow doubt so successfully. In other words, the authors could have used their narratives to analyze more deeply the "whys" and "hows" of this history. Their chapter on the controversy over tobacco, for instance, could have told this interesting tale but also used it to analyze more forcefully these scientists' economic ties to the tobacco industry, and in turn the tobacco industry's strategy of funding its own research to counter the mounting scientific consensus regarding links between smoking and cancer. Oreskes and Conway do this — they explain that Seitz received huge amounts of funding from Reynolds for his science at Rockefeller University — but they don't unpack this relationship enough. The authors could have similarly used their narratives about controversies over acid rain, ozone depletion, second hand smoke, and DDT to explore more deeply the various reasons these right-wing scientists acted and the several strategies they used to succeed, which included publicly attacking the research of more junior scientists, consciously misrepresenting other scientists' data, and hiding the inconsistencies of their own science behind the rhetoric of free speech.

This conundrum between strong narrative and deeper historical analysis hovers ominously over all of our work as academic historians. Try as we might to balance the two, audiences and publishers and tenure often push and pull our efforts in ways that feel beyond our control. In the end, I am so thankful for *Merchants of Doubt*. Not only have Naomi Oreskes and Erik Conway written an important book that makes convincing arguments about both the most pressing environmental crises of the postwar era and the often-problematic relationship between science, politics, and economics. They have also written a book that my annoying relatives from New Jersey will pick up, begin reading, and finish. And while I may have originally mailed my relatives a copy of *Merchants of Doubt* with the intent of keeping them quiet, I'm now looking forward to what I know will be heated conversations over cold burgers during next summer's barbeques. If only all our histories could spark such conversations — between adherents of climate change and doubters, between historians and non-historians, between my New Jersey cousins and me.

Comments by Ronald E. Doel, Florida State University

More than two decades ago, the historian of technology Thomas P. Hughes set out the concept of a technological system. As Hughes argued, technological systems—involving “messy, complex, problem-solving components”—are essential for understanding the modern world.

According to Hughes:

They are both socially constructed and society shaping. Among the components in technological systems are physical artifacts, such as the turbogenerators, transformers, and transmission lines in electric light and power systems. Technological systems also include organizations, such as manufacturing firms, utility companies, and investment banks, and they incorporate components usually labeled scientific, such as books, articles, and university teaching and research programs. Legislature artifacts, such as regulatory laws, can also be part of technological systems.¹⁸

In his insightful *A Vast Machine*—which analyses how humans came to discover, understand, and model the planet’s climate system—Paul N. Edwards observes that the effort to create reliable knowledge about global change is *itself* a technological system, one that “collects data, models physical processes, tests theories, and ultimately generates a widely shared understanding of climate and climate change.” It is simultaneously a history of standardization: thermometers, telegraphy, time zones and time-keeping, reporting information to centralized offices, gathering and refining national data sets into global systems, building ever more powerful and comprehensive computer models, international scientific organizations and national patrons, are all essential ingredients. It is inevitable, Edwards argues, that such a system would come into conflict with the energy economy of the planet, built with other, distinct technological systems—including fossil energy companies, automobile manufacturers, and related interests, each with its own interests, experts, lobbyists, and influences on the state.¹⁹ The two systems have vastly different goals, but occupy the same political space.

In *Merchants of Doubt*, Naomi Oreskes and Erik Conway have provided us with a vivid snapshot of how the energy system has attempted to influence the politics of global warming. Seeing its core interests threatened by ever-more-robust models suggesting a warming global climate, with higher sea levels, intensified storms, and modified patterns of drought and precipitation around the Earth, leaders of this

¹⁸ Thomas P. Hughes, “The Evolution of Large Technological Systems,” in Wiebe E. Bijker, Thomas P. Hughes and Trevor J. Pinch, eds., *The Social Construction of Technological Systems* (Cambridge: The MIT Press, 1987): 51-82; see also Thomas P. Hughes, *American Genesis: A Century of Invention and Technological Enthusiasm* (New York: Penguin, 1989): 3-6.

¹⁹ Paul N. Edwards, *A Vast Machine: Computer Models, Climate Data, and the Politics of Global Warming* (Cambridge, MA: MIT Press, 2010): 8.

competing technological system, Oreskes and Conway argue, have sought to undermine popular (and state) confidence in what many climatologists regard as a clear consensus for anthropogenic climate change. Indeed, their aim is wider and more fundamental: they seek to understand how industry titans and sympathetic scientists manufactured doubt about scientific consensus on a wide range of issues that impacted humans and the environment. These include second-hand tobacco smoke, acid rain, the ozone hole (the latter casting a fatal blow to supporters of supersonic transport (SST)), and the attempt to vilify the U.S. ban on manufacturing DDT following Rachel Carson's 1962 *Silent Spring*. On the latter, one commentator proclaimed that eco-hysteria had caused "the blood of millions of people [to drip] from the hands of the WWF, Greenpeace, Rachel Carson, Environmental Defense Fund, and other junk science-fueled opponents of DDT"—their deaths attributable to insect-borne diseases not eradicated, in his view, by the absence of cheap chemical pesticides.²⁰ This is not a new phenomenon: a strong case can be made that these dynamics emerged already in the beginning of the twentieth century, when evidence for dust-borne illnesses such as asbestosis were dismissed by industry-backed or funded scientists who minimized the risk. But high-stakes lobbying to sow doubt about peer-reviewed findings in a wide range of environmental science disciplines has now become a significant issue in the production and application of knowledge.²¹

Oreskes and Conway have shone a bright spotlight on the small cohort of scientists who moved serially from one political controversy involving science to another. In particular, they have emphasized that many scientists who opposed consensus viewpoints on the dangers of tobacco and human-caused climate change frequently were ardent anti-Communists in the Cold War era, intent on maintaining liberty. Leading scientists in this group included former National Academy of Sciences president Frederick Seitz, science administrator S. Fred Singer, and William Nierenberg, former director of the Scripps Institution of Oceanography, libertarians all, allergic to the idea of excessive state regulation of human activity.

Yet there is no index entry for "libertarian" in *Merchants of Doubt*.

Should this matter? There's no doubt that arguments advanced by Seitz and Singer against anthropogenic climate change are currently minority positions within the global climate science community. It is also clear that many climate scientists are sufficiently alarmed by the kinds of futures predicted by their ever-more-sophisticated models that they favor a vigorous state response to reduce emissions of greenhouse gases from industrial processes. For them, inaction on climate change

²⁰ Naomi Oreskes and Erik Conway, *Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming* (New York: Bloomsbury Press, 2010): 232.

²¹ Craig Biegel, "Manufactured Science—the attorneys' handmaiden: The influence of industry in occupational disease research during the twentieth century," M.A. thesis, Oregon State University, 2011.

means that the energy system and its allies have won, and they argue that current climate science is sufficiently persuasive to demand national and international responses. Oreskes and Conway feel similarly: “The failure of the United States to act on global warming and the long delays between when the science was settled and when we acted on tobacco, acid rain, and the ozone hole,” they declare, “are prima facie empirical evidence that doubt-mongering worked.”²² As a historian (and citizen) who has carefully researched these issues, I share these concerns.

But we are also impoverished by not understanding better the full range of motivations, convictions, and world-views that scientists suspicious of anthropogenic climate change have held. It is easy to become hostage to stereotypes, allowing us to castigate individuals who do not accept narratives predicting severe human impacts from human-caused climate warming as beholden to special interests, willing to turn a blind eye to larger urgent human and environmental imperatives. We face a similar challenge in writing comprehensive narratives of the controversy between evolution and creation in modern America. For modernists, conservative religious advocates opposed to evolution are battling against reason and rational thinking—attacking Enlightenment values and a hard-won understanding of the natural world. But for literalist religious conservatives, privileging the claims of scientific inquiry limits insights into ethics, morality, and transcendent truths, a process that historian Peter Harrison has termed “the dissociation of wisdom and knowledge.”²³ There are meta-narratives at play here—and we risk learning only part of a much larger story about U.S. political and intellectual rifts (even if we are convinced about who is correct)—if we fashion David-and-Goliath accounts of truth-seekers battling ideologically-driven opponents.

Let me propose a re-framing of the story Oreskes and Conway have told as one of risk perception. What risks are most important to humans, and why? Indeed, Oreskes and Conway have already taken helpful steps in this direction by calling attention to the libertarian sympathies of researchers who have opposed consensus science on tobacco health risks, ozone hole depletion, and climate change. This kind of reframing is particularly familiar to environmental historians, who have taken their analysis much further. William Cronon’s influential 1995 *Uncommon Ground* brought this issue into sharp focus, as it included Richard White’s “‘Are You an Environmentalist or Do You Work for a Living?’ Work and Nature” as well as James D. Proctor’s “Whose Nature? The Contested Moral Terrain of Ancient Forests.”²⁴ Calling attention to Cronon’s observation that “the notion of nature as wilderness

²² Oreskes and Conway, 267.

²³ Peter Harrison, “Disjointed Wisdom and Knowledge: Science, Theology and the Making of Western Modernity,” in Hubert Meisinger, Willem B. Drees, and Abigniew Liana, eds., *Wisdom or Knowledge? Science, Theology and Cultural Dynamics* (London: Y & T Clark International, 2006): 51-73, on p. 64.

²⁴ William Cronon, ed., *Uncommon Ground: Rethinking the Human Place in Nature* (New York: W.W. Norton & Company, 1995).

has led American environmentalism down a peculiarly narrow path,” Proctor argues that in the spotted owl controversy, a key “point of difference was thus not one of whether people should care about nature or how and why... Whose nature ought we protect? This is the troubling question that arises out of acknowledging that environmental ethics are enshrined in ideas of nature.”²⁵

The issue of climate change on a global scale is of a different magnitude than the spotted owl controversy, of course. But what can we learn if we ask similar questions about the nature of scientific knowledge (and its reliability)—turning first to academics and researchers, then to members of the general public with limited science training? Climatologists will take comfort that many insurance companies take current climate models seriously, and have urged states to mitigate climate change to reduce anticipated future losses.²⁶ But members of the general public in the U.S.—increasingly distrustful of experts, wary of imminent warnings of environmental doom, uncertain what to make of the ‘Climategate’ leak of emails from embattled University of East Anglia climate researchers, unfamiliar with how science is vetted, worried about the costs of environmental regulation—might embrace a consistent but distinct worldview (or environmental view) about which many academics know little.²⁷ We need to understand more about this—and also see how we in the social sciences and humanities contributed to these doubts, as the insights of Thomas Kuhn and subsequent postmodern scholars on the social construction of knowledge have seeped into public awareness. That all scientists simply ‘follow the money’ in denying tobacco-cancer links (or supporting anthropogenic climate change) now seems realistic to many Americans—a stark contrast to the highly moral character Sinclair Lewis created in his Pulitzer Prize-winning *Arrowsmith* in 1925, the straight-arrow pioneer of medical science. These trends worry the sociologist of science Harry Collins, who recently argued that we must “replace postmodernism with ‘elective modernism.’ To support this, the social scientists must work out what is right about science, not just what is wrong—we cannot live by skepticism alone.”²⁸

The same applies, I would argue, even to critics of scientific consensus. Let me point to one small example of how we might learn more. On page 103 of *Merchants of Doubt*, Oreskes and Conway describe the work of the Columbia University geochemist J. Laurence Kulp, who in the 1980s (for the Reagan Administration) wrote a study arguing that the threat of acid rain was overblown. This conclusion led a concerned *New York Times* science writer to declare that his report was

²⁵ James D. Proctor, “Whose Nature? The Contested Moral Terrain of Ancient Forests,” in Cronon, *op. cit.*, 285, 288.

²⁶ Asher Alkoby, “Globalizing a Green Civil Society: In Search of Conceptual Clarity,” in Gerd Winter, ed., *Multilevel Governance of Global Environmental Change: Perspectives from Science, Society, and the Law* (New York: Cambridge University Press, 2006) 106-146, on p. 138.

²⁷ Insight on this issue may be found in Roger Pielke, Jr., *The Honest Broker: Making Sense of Science in Policy and Politics* (New York: Cambridge University Press, 2007).

²⁸ Harry Collins, “We Cannot Live by Scepticism Alone,” *Nature* 458, 5 (2009): 30-31, on p. 30.

“inaccurate and misleading”—in retrospect, still a fair assessment. But Oreskes and Conway characterize Kulp as “well-known for his conservative religious views; colleagues at Columbia referred to him as a ‘theochemist’ for his efforts to reconcile geological evidence with Christian belief.”²⁹

Kulp was in fact an extraordinarily complicated figure: framing him simply as closet creationist is not helpful. He was indeed privately dubbed a “theochemist,” yet this label came from young, secular graduate students recruited to Columbia’s Lamont Geological Observatory in the giddy postwar years who did not know what to make of the clean-cut, bobby-sox-wearing, Wheaton College graduate who took no part in Lamont’s legendary Friday evening parties. Indeed, early in his career, Kulp remained an active participant in the American Scientific Affiliation, a big-umbrella group of evangelical scientists who eagerly hoped to undermine “unscientific defenses of the Bible” by integrating “the facts of science and the Holy Scriptures.” While Kulp hoped to inspire youth towards Christianity by reducing apparent contradictions between modern science and theology, he soon grew exasperated by conservative ASA members who attacked carbon-14 dating methods to understand Earth’s more recent past—techniques he had learned from his mentor, the chemist Willard Libby of the University of Chicago, who later received the Nobel Prize for this work. Becoming an advocate of evolution, Kulp blasted literal readings of Noah’s account, arguing that the “science of geology precludes certain interpretations of Genesis, but does not make impossible acceptance of plenary inspiration of the scriptures.”³⁰ Later he drifted ever further from his fundamentalist evangelical roots. At the same time, Kulp trained a generation of young geochemists in revolutionary carbon-dating methods, placing them at prominent universities. He helped lead an initially secret Atomic Energy Commission project in the 1950s to determine the extent humans around the world had been exposed to bomb-produced nuclear fallout (Project Sunshine). He also became an expert in using radioactive tracer elements to study the dynamic environment of the world oceans. Kulp later left Columbia to found a successful company (Isotopes, Inc.) and ended his career as Vice President for Research and Development at the Weyerhaeuser Company, a major Pacific Northwest timber company.³¹ I do not find him easy to understand. But his intellectual, religious, and professional journey through mid- and late twentieth century America was extraordinarily rich—and the label ‘theochemist’ was already three decades out of date by the time he wrote his then-influential report disparaging the economic and social impact of acid rain.

²⁹ Oreskes and Conway, p. 103.

³⁰ Mark Alan Kalthoff, “The New Evangelical Engagement with Science: The American Scientific Affiliation, Origin to 1963” (Ph.D. dissertation, Indiana University, 1998): 18.

³¹ Kulp’s research trajectory is treated in Ronald E. Doel, “Quelle place pour les sciences de l’environnement physique dans l’histoire environnementale?”, *Revue d’histoire moderne & contemporaine* 56, 4 (2009): 137-164.

How many Larry Kulps were there in the Cold War era? I don't know—but that, I think, is precisely what we *need* to know. He seems to share with Seitz and Singer an increasingly libertarian outlook, and a common perception of what risks mattered most for society. Historians must continue to analyze the titanic clash between the energy system and the distinct technological system that produces reliable climate knowledge. By exposing industry's role in manufacturing doubt across the environmental sciences, Oreskes and Conway deserve much credit for highlighting a crucial factor in modern American politics. But if another key question we face is to understand *differing perceptions of environmental risk*, then we have much interesting work still ahead of us.

**Authors' Response by Erik M. Conway, Jet Propulsion Laboratory,
and Naomi Oreskes, University of California, San Diego**

We want to thank Jacob Hamblin for organizing the roundtable review of *Merchants of Doubt*. We also want to thank Mark Carey, Ronald Doel, Neil Maher, and Spencer Weart for their cogent reviews. It's gratifying to see a book that we wrote for a broad audience gaining so much attention and respect in academic circles. Ours is a narrative, written both for colleagues and the public, about the undermining of science in the public sphere. It is an attempt to explain why scientists would not only participate in challenging established scientific conclusions, but actively initiate it. The book's omissions were deliberate choices, and may well be viewed as strengths, given our goals.

That said, our reviewers raise a number of interesting points of scholarly concern, some of which have appeared elsewhere. We'd like to respond to two specific critiques, as a means of more fully exploring what we argued in *Merchants*, as well as the deeper questions they provoke. The first critique is offered by Ron Doel, who contends that we have provided "a vivid snapshot of how the energy system has attempted to influence the politics of global warming." In a word, no. *Merchants of Doubt* is not primarily about the activities of corporations, their public relations firms, or even about the "think tanks" that infest official Washington. It's primarily about a handful of physicists who devoted their retirement years to fighting the growth of business regulation in America. Crucially, in the case of global warming (which consumes only one of our seven chapters), they began downplaying the severity of the problem *before* there before there was any substantial corporate funding of global warming denial. The first coordinated corporate campaign to prevent carbon regulation we were able to identify formed in 1989, but Nierenberg's *Changing Climate* report was written in 1983. Nierenberg's attempt in that document to position global warming as a non-problem had nothing directly to do with the energy system.

Our argument was that our physicists' efforts to downplay the severity of the health risks of smoking, and of the environmental impacts of ozone-destroying gases, acid rain, and carbon pollution was rooted in their beliefs about political economy. Doel quotes from Hughes' "The Evolution of Large Technological Systems, to suggest the situated character of technological systems. Of course. But as Hughes also notes: "Technological affairs contain a rich texture of technical matters, scientific laws, economic principles, political forces, and social concerns."³² The fossil energy system to which Doel refers to is embedded in a political system, and it is this political system, and beliefs about it, that drives our story. Thus the question is, what kind of politics could cause a group of physicists to challenge the work of their own colleagues—and spin their analyses in a fossil-friendly direction?

³² Thomas P. Hughes, *Networks of Power* (Baltimore, MD: Johns Hopkins University Press, 1983), p. 1.

In *Merchants of Doubt*, we argued that our protagonists' beliefs were best described by George Soros' term, market fundamentalist. Doel asks, in essence, why not call them libertarians? We chose market fundamentalist over libertarian after much consideration. The term "libertarian" has come to represent a wide variety of views that are sometimes in conflict. Some versions of libertarianism favor strong private property rights, while others reject private property. There are "right" and "left" libertarians. Moreover, some of the think-tanks we wrote about call themselves libertarian, yet support extensive subsidies to the fossil fuel and nuclear power industry.³³ And the main protagonists of our story—Robert Jastrow, Frederick Seitz, William Nierenberg, and S. Fred Singer, built their own scientific careers in government-funded scientific and technological research programs—hardly a libertarian stance. Thus, we concluded that the term had only limited explanatory value, and did not seem to accurately to describe the dominant ideology involved.

A better term might be classical liberal, given that the key players in our story strongly emphasized personal liberty, and worried about what government regulation of tobacco or pollution might mean for individual freedom. But this term too has weaknesses in this context. The central component of that classical liberalism is a commitment to a minimalist state, but that is difficult to square with the actions of Seitz, Singer, Nierenberg and Jastrow, who were active participants in the construction of our modern national security state, complete with classified agencies, classified research, and classified budgets, which tend to undermine democratic accountability and to compromise individual rights. We question whether a classical liberal would sanction Jastrow's founding and constructing the National Aeronautics and Space Administration's Goddard Institute of Space Science, or William Nierenberg's active solicitation of hundreds of millions in federal dollars to support scientific research at the Scripps Institution of Oceanography. Classical liberalism, like right-libertarianism, restricts legitimate state functions to national defense and policing. NASA (as well as the National Science Foundation, the National Institutes of Health, and the National Oceanic and Atmospheric Administration) is a non-defense research agency. Such agencies strike us as illegitimate under a pure interpretation of classical liberalism. Yet Jastrow and Nierenberg were both active supporters of NASA, and Singer was once chief scientist of one of NOAA's predecessor agencies, the National Weather Satellite Service. Thus we discarded classical liberalism as not quite accurate, either. These men were not supporters of a minimalist state.

Recently, there has been increasing historical attention to the doctrine of neo-liberalism. This ideological position diverges from classical liberalism in accepting the necessity of a powerful, activist state. Among other things, in David Harvey's words, under neo-liberalism, "If markets do not exist (in areas such as land, water,

³³ Eg. Ronald J. Sutherland, "'Big Oil' at the Public Trough? An Examination of Petroleum Subsidies," *Cato Institute Policy Analysis* no. 390, 1 February 2001. http://www.cato.org/pub_display.php?pub_id=1249, accessed 17 June 2011.

education, health care, social security, or environmental pollution), then they must be created, by state action if necessary.”³⁴ Once markets have been created, though, neoliberalism preaches that state intervention be minimized. It is this doctrine that has been the basis of the drive for “deregulation, privatization, and the withdrawal of the state from many areas of social provision.”³⁵ Neoliberalism is consonant with the idea of “pollution markets,” which Singer and Nierenberg seem to have supported, if not very strenuously; it is also not obviously at odds with state-supported non-defense research institutions. The ascension of neoliberalism to a position of intellectual and political dominance coincides with the period during which our protagonists were most active in their post-retirement careers of undermining science—an important historical contingency, which helps to explain how and why their views gained so much traction. Our protagonists were directly involved in the Reagan administration, which was the first U.S. administration to embed neoliberalism into policy on a large scale. (It was the Carter administration in the United States, and Margaret Thatcher in the United Kingdom, who initiated the era of deregulation, but Carter at least did not survive politically to bring the idea to its fullest sweep.)

For these reasons, we believe neoliberalism is the doctrine that best describes our protagonists’ stated beliefs, as well as those we can interpret from their actions. But the term neoliberalism does not, in our view, go quite far enough. We chose free market fundamentalism instead, because the idea that markets should be created by state action is, in a powerful way, evangelical. In *Merchants* we cited George Soros’ argument that neoliberalism has become a religious dogma, but Soros is not alone. The conservative economist Robert H. Nelson has made this argument at length in his *Economics as Religion*.³⁶ Our argument was that Jastrow, Nierenberg, Singer and Seitz believed so strongly in the religion of the market that they could not accept the empirical evidence of market failure: the demonstrable fact that human activities were altering the environment in harmful ways that the free market could not correct.

Doel apparently believes this is traceable to different perceptions of environmental risk. We believe perceptions of risk derive to a significant degree from political and religious views. The “environment” is a market externality, and if one’s world-view is defined by markets über alles, one is unlikely to consider the “environment”—at least in its unutilized form—to have much value. The ecological economist Herman

³⁴ David Harvey, *A Brief History of Neoliberalism* (NY: Oxford University Press, 2005), p. 2.

³⁵ Harvey, p. 3. Also see Rob Van Horn and Philip Mirowski, “The Rise of the Chicago School of Economics and the Birth of Neoliberalism,” in *The Road from Mont Pelerin: The Making of the Neoliberal Thought Collective*, eds. Philip Mirowski and Dieter Plehwe (Cambridge, MA: Harvard University Press, 2009).

³⁶ Robert H. Nelson, *Economics as Religion from Samuelson to Chicago and Beyond* (University Park, Pennsylvania: The Pennsylvania State University Press, 2001). Nelson argues that environmentalism and economic theology are competing dogmas that have some areas of overlap but are generally opposed.

Daly likes to tell of an experience at the World Bank involving an illustration that had a box labeled “the economy” with an arrow pointing in, for inputs, and one pointing back out, for outputs. “That,” he wrote, “was it.”³⁷ He wanted to draw a circle around it for the “the ecosystem;” after all, the stuff going into the “economy” box came from there (and eventually went back there, too). The Bank deleted the figure rather than acknowledge an obvious, but uncomfortable, fact. We do not assign risk levels to things with no value, and we avoid what Festinger called “cognitive dissonance” that comes with confronting undesirable truths through a variety of means, including outright denial.³⁸

Mark Carey has many kind words for our book, which we deeply appreciate. He especially notes what we considered the crucial aspect of our story, when he writes: “The more astonishing issue this book reveals is how the same few individuals became involved in so many disparate issues, usually way beyond their areas of expertise....As Oreskes and Conway show, these doubters repeatedly sought to obscure scientific consensus on a range of issues unrelated to their backgrounds and training.”

All historians know that disagreement and dissent are crucial activities in the life of any scientific community. Indeed, the conventional heroes of science are generally individuals who disagreed with prevailing views and provided evidence to support an alternative--or at least evidence sufficient to persuade colleagues that the existing views were inadequate and needed to be reconsidered. But, as Carey suggests, normally such disagreement and dissent occurs *within* communities of experts, among men and women who have developed pertinent expertise. It is for this reason that science studies scholars have recently paid increased attention to expertise, since it is essential to understand what it is, what gives it agency, and what limits (or ought to limit) its power and efficacy.³⁹

³⁷ Herman Daly, “Economics Blind Spot is a Disaster for the Planet,” *New Scientist* (15 October 2008), <http://www.newscientist.com/article/mg20026786.300-special-report-economics-blind-spot-is-a-disaster-for-the-planet.html>, accessed 4 June 2011.

³⁸ The classic study of the refusal of the highly religious to accept contravening evidence is, of course, Leon Festinger’s “When Prophecy Fails: A Social and Psychological Study of a Modern Group that Predicted the Destruction of the World” (Minneapolis, MN: University of Minnesota Press, 1956). Festinger is also the architect of the concept of cognitive dissonance.

³⁹ H.M. Collins and Robert Evans, 2002. The Third Wave of Science Studies: Studies of Expertise and Experience, *Social Studies of Science* vol. 32: 235-296; Sheila Jasanoff, 2003. Breaking the Waves in Science Studies: Comment on H.M. Collins and Robert Evans, ‘The Third Wave of Science Studies,’ *Social Studies of Science* 33: 389-400; Brian Wynne, 2003. Seasick on the Third Wave? Subverting the Hegemony of Propositionalism, *Social Studies of Science* 33: 401-417; and further discussions in Questioning Expertise, *Social Studies of Science* June 2008 38: 461-470. Scientists have recently taken up the issue as well; see for example William R.L. Anderegg, James W. Prall, Jacob Harold, and Stephen H. Schneider, 2010. Expert Credibility in Climate Science, *Proceedings of the National Academy of Sciences* 107: 12107-12109.

As we stressed in *Merchants*, contemporary scientific research is so specialized, complex, even arcane, that it takes considerable effort to become an expert in any field, much less in several disparate ones. The fact that the men in our story asserted their authority on topics far afield from their training and research experience in nuclear, solid-state, and astrophysics should have been a clue to any astute observer that something was not quite right. When they claimed to be experts simultaneously on totally unrelated fields such as oncology and atmospheric chemistry, it should have become crashingly obvious. Yet it did not.

The fact that even trained science journalists proved unable to sort the wheat from the chaff of scientific debate, to understand the nature of modern expertise, and to appreciate the difference between peer-reviewed journal articles and editorials in *The Wall Street Journal*, speaks strongly to the point that neither journalists, nor their editors, nor their readers, understand how scientific debate actually operates, how scientific knowledge coalesces. There are certainly many reasons for this, including the persistent hagiography of the “lone dissenter” in science—an ideology that particularly resonates with American individualism; the lone genius is a cultural variant on the theme of the Lone Ranger. But surely some of the fault for this lies not in the cultural stars, but in ourselves—we, the professionals who study science as an intellectual, cultural, social, and economic activity. Why have we not done a better job explaining this to our fellow citizens, including editors and journalists?

We might venture to guess that the answer is fairly obvious. Because of a general academic suspicion of those who write for “broader audiences”—including a widespread disdain for “popularization”—most academics write only for other academics, and typically in language that is impenetrable to those outside the inner sanctum of academic life (and sometimes not even to them). We, professional historians of science and scholars of science studies, have left the playing field of explaining science to journalists and, yes, popularizers, who continue to perpetuate the myths of the lonely genius and the brave dissenter, myths that played into the hands of doubt-mongers, some of whom have explicitly compared themselves to Galileo, Einstein, and Alfred Wegener. We agree strongly with Carey that there is a pressing need for more and better explanations of how science actually works—both the good and the bad, the politically-salient and the relatively politically inconsequential. There is certainly a greater need for understanding the internal politics of science funding decisions. We hope that the success of our book may encourage some colleagues to take up the challenge.

Carey also asks “Does peer review really guarantee effective science and free it from the political, economic, and ideological forces that influenced doubters?” Obviously the answer to this question is no. But, as we argue in the book, peer reviewed science *is* the proper basis for discussion of the state of scientific knowledge, because it *is* the state of scientific knowledge. Of course it is fallible; all human activity is. But the alternative—the Potemkin science we describe-- is far worse.

Science may well be inescapably political, on some level, but the doubt-mongering campaigns we describe were purely political. And they continue today.

Carey also asks “Did environmentalists always use reliable and sound science for their agendas?” The answer to this question is “probably not”. Yet it is striking to us that in every case we track in our book, the environmentalist interpretation was the one that was broadly supported by peer-reviewed science. It may perhaps be a coincidence that environmentalists got these issues right. But we would suggest, following our argument above, that the folks who “got” the issues right were the scientists who studied them, and, indeed, in most cases *discovered* them. (None of us would know about the ozone hole were it not for the work of scientists, and while foresters and fishermen did notice damage to forests and fish, they would have been unable to attribute its cause without scientific analyses.)

It’s not so much that “environmentalists got the science right,” but rather that environmentalists were quick to embrace the scientific results, because they were consistent with their *weltanschauung*, or at least did not offend it. In contrast, executives of tobacco and fossil fuel corporations, and American conservatives, were rather slower to accept the data, because they challenged their worldview, implying as they did the need for government interventions in the marketplace. As one of us argued some years ago in our work on the rejection of continental drift, we are all more likely to accept evidence consistent with our pre-existing world view, scientists included. But as Richard Posner has recently put it in his fascinating summary of the global financial crisis, *A Failure of Capitalism*, “A rational decision-maker starts with a prior probability...but adjusts that probability as new evidence comes to his attention.”⁴⁰ And as Robert Merton famously noted decades ago, scientists have organized mechanisms for evaluating new evidence and adjusting their priors, but this is precisely what those who rejected the realities of our book—from the harms of tobacco to global warming—failed to do.

Let us be clear: we are *not* suggesting that there were no legitimate uncertainties surrounding the scientific issues raised in our story.⁴¹ There were. And there were—and still are—major, legitimate questions about what should be done about these issues. Indeed, at least one of us is somewhat sympathetic to the tobacco industry argument that adults in a free country should be allowed to make their own choices about the risks they accept--presuming, of course that those adults have access to accurate information. But this is precisely the point: the American people did *not* have access to good information on these crucial issues, precisely because of the systematic misinformation campaigns described in our book.

It is clear from our research that neither journalists nor the broader public seemed able to distinguish between what Merton called the “certified knowledge” that has withstood the organized skepticism of communities of experts, vs. the simulacrum

⁴⁰ Posner, *Failure of Capitalism*, p 310

⁴¹ See <http://climate.nasa.gov/uncertainties> for Conway’s take on major climate uncertainties.

of science produced by the tobacco industry, the Marshall Institute, and the dozens of other smaller players who also played a role in our story. So the answer to Carey's question—"why such accomplished expert authors as Oreskes and Conway...did not illuminate this messier history of science, explicitly drawing distinctions between the types of forces that influenced the merchants of doubt versus the scientists"—would seem to us self-evident in the context of professional history of science and science studies. In our other work we *have* explored them in depth. We are most assuredly not advocating for blind trust in science—and we would be surprised if any of our colleagues took us to be doing so.

And yet, just because the details of a picture are messy does not mean that the overall picture is not clear. It is a truism of art appreciation that by standing back the larger image often becomes clearer—or at any rate that different perspectives may reveal different things. The patterns we uncovered would not have been evident had we only studied the story of acid rain, or only the ozone hole, or only global warming.

And sometimes it is important, even crucial, *not* to get mired in the details. Doubt-mongers tried to undermine scientific evidence in part by focusing on unresolved details, in order to give the impression that the larger debate was open. This was highly misleading. There is much we still do not know about the mechanisms of carcinogenesis, yet we know that smoking does cause cancer. There is still debate about the exact character and extent of forest damage from acid emissions, but we know that sulfate air pollution has damaged forests and killed fish. General circulation models of the Earth's climate system remain highly parameterized and serious questions can be raised about the accuracy of the chosen parameters, yet we know that the basic prediction made by scientists decades ago—that increased atmospheric greenhouse gases from combustion of fossil fuels would warm the planet, overall—has come true. Sometimes details get in the way of seeing what matters most—sometimes we do indeed miss the forest for the trees. While not denying the value, virtue, and indeed necessity of studying trees, we felt it important—indeed, might we even say urgent—to tell *this* story, a story of a forest, and a rather black one at that.

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