

Challenging Knowledge: How Climate Science Became a Victim of the Cold War¹

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The Scientific Consensus on Climate Change

On June 2, 2005, California Governor Arnold Schwarzenegger announced an initiative to curb greenhouse gas emissions in California as a step towards addressing global warming. In his speech, the governor declared, “The debate is over. We know the science. We see the threat, and we know the time for action is now.”²

Schwarzenegger had his science right: the scientific debate *is* over. In fact, it has been for some time. Since the early-mid 1990s, there is a consensus in the scientific community about the basic facts of global warming, which is why the Inter-governmental Panel on Climate Change (IPCC) is able to say with assurance that most of the warming observed over the last 50 years is attributable to human activities.³

What scientific knowledge lies behind this statement? First, that humans have changed the chemistry of the Earth’s atmosphere, most notably by changing the concentration of carbon dioxide from a pre-industrial revolution level of about 280 parts per million to its current level of 385 and rising. (For his systematic work on the measurement of atmospheric CO₂ since 1958, Charles David Keeling

won the 2002 National Medal of Science.) Second, that this carbon dioxide is largely the result of the massive burning of fossil fuels—coal, oil, and gas—since the industrial revolution.⁴ Third, that carbon dioxide is a greenhouse gas, meaning that it is highly transparent to visible light and less so to infrared, so if you change its concentration, it affects the radiative balance of the atmosphere. (This point was first made in the nineteenth century by John Tyndall, and reaffirmed in the twentieth century by various scientists, including Gustav Arrhenius, G.S. Callender, Gilbert Plass, Hans Suess and Roger Revelle.)⁵ Basic physical theory predicts that given the steady increase in atmospheric CO₂ (and other greenhouse gases) we may reasonably expect to see effects on Earth's climate. And we have.

Instrumental measurements reveal an increased average global surface temperature of approximately 0.8° C since the 1860s, when sustained systematic record-keeping began, and these data are independently corroborated by studies of tree rings, coral reefs and ice cores.⁶

Physical theory and computer models predict that the effects of global warming will be seen first, and most strongly, in the Arctic, due to the phenomenon known as the ice-albedo feedback, a prediction first made in the mid 1960s.⁷ Ice and snow strongly reflect solar radiation, helping to keep cold regions cold, but if you melt some of this snow or ice, exposing bare land or sea water, then more solar radiation is absorbed, leading to more rapid warming, more melting, more warming, and so on, so that the same amount of warming has a bigger impact in the arctic than it would in temperate regions. This is known as “polar

amplification,” and predicted effects included thinning and decreased extent of sea ice, and of the Greenland ice sheet, decreased extent of permafrost regions, earlier spring thaws, and ramifying effects of these changes on indigenous peoples who depend on native species for their survival—all of which have now been observed.⁸

Physical theory and climate models also suggest that global warming may lead to an increase in either the frequency or intensity of extreme weather events, such as hurricanes, heat waves, and droughts. In the wake of the record-breaking Atlantic hurricane season of 2005, many people have wondered if this prediction has also come true. There have always been hurricanes, and hurricane seasons are notoriously variable, so no single hurricane or season can confirm or deny this prediction. But statistical studies do suggest an increase in hurricane intensity in the Atlantic, Pacific, and Indian Oceans, and in recent years numerous records have been broken around the globe.⁹ While there is still some argument over whether this is a real change or just an artifact of poor record-keeping, many scientists do believe that this prediction is coming true as well.¹⁰

In short, both theory and evidence support the claim that anthropogenic global warming is underway.

Climate models based on our current scientific understanding predict that unabated increases in greenhouse gases will have serious and irreversible further climatic effects, including sea level rise, further melting of Arctic (and perhaps worse, Antarctic ice), potential changes in ocean chemistry and circulation, habitat destruction, and more. Some of these changes may be mitigated, but mitigation

strategies are typically difficult and expensive, and in many cases will be unlikely to protect non-human species. The most recent scientific literature states that if all human carbon emissions stopped tomorrow, the Earth would still warm at least another 0.5 C.¹¹ But emissions will not stop tomorrow, so the “climate commitment” humans that have made to future warming is much more—most likely at least 2-3° C, and perhaps substantially more.¹²

These concerns and results have been documented in the four assessment reports of the Intergovernmental Panel on Climate Change, an organization created by the United Nations Environment Programme and the World Meteorological Organization, and representing the world’s most prominent atmospheric scientists, meteorologists, geophysicists, geographers, and other scientists. The most recent report, issued in February 2007, represented the combined work of over 800 scientists and 1000 peer reviewers from 130 countries. Virtually anyone who is anyone in the climate research has had the opportunity to participate in the IPCC process.¹³

The IPCC conclusions have been ratified by every major scientific society in the United States with pertinent expertise, including the American Geophysical Union, the American Meteorological Society, and the American Association for the Advancement of Science.¹⁴ Outside the United States, they have been affirmed by the Royal Society in its pamphlet “A Guide to Facts and Fiction about Climate Change,”¹⁵ and by a joint statement of the National Academies of Science of eleven nations, including France, Russia, Germany, Japan, Italy, Canada, China and Brazil.

Robert May, President of the Royal Society, recently summarized the views of academicians around the world: "The scientific evidence forcefully points to a need for a truly international effort. Make no mistake, we have to act now. And the longer we procrastinate, the more difficult the task of tackling climate change becomes."¹⁶ And, in October 2007, the IPCC shared with former Vice President Al Gore the Nobel Peace Prize for their "efforts to build up and disseminate greater knowledge about man-made climate change."¹⁷

Some critics have suggested that the IPCC, being an international organization with links to the United Nations, might be politicized and not accurately reflect the consensus of expert scientific opinion. In 2001, the White House, under George W. Bush, commissioned a report on climate change from the U.S. National Academy of Sciences in which it specifically asked the academy to address this question. The academy laid this argument firmly to rest: "The IPCC's conclusion that most of the observed warming of the last 50 years is likely to have been due to the increase in greenhouse gas concentrations accurately reflects the current thinking of the scientific community on this issue."¹⁸

This conclusion should not have been surprising: the scientific community had broad agreement that global warming would likely become a problem as early as 1979, when the National Academy of Sciences commissioned a study under the leadership of distinguished MIT meteorologist Jule Charney. Charney's committee concluded: "If carbon dioxide continues to increase, [we] find no reason to doubt that climate changes will result, and no reason to believe that these changes will be

negligible."¹⁹

Many people are surprised to learn that scientists recognized so early the dangers of global warming from greenhouse gases, and some might think that Charney's group were outliers, sounding an early warning on warming much like British engineer Guy Callendar in the 1930s.²⁰ But Charney's work was a *review* of numerous studies undertaken throughout the 1970s, and so the press release accompanying it declared: "A plethora of studies from diverse sources indicates a consensus that climate changes will result from man's combustion of fossil fuels and changes in land use."²¹

The Academy's concern was expressed by way of prediction—"climate changes will result"—changes that some scientists thought would be possibly be evident by the end of the century. In the proposal written to the White House Office of Science and Technology Policy, outlining the scope of the proposed report, the Academy wrote, "Plausible projections of future carbon dioxide concentrations suggest several-fold increases by the middle of the next century; experiments with models of the earth's climate system suggest major associated climate changes that might become evident in our own century."²²

They were right. In 1995 the IPCC concluded that effects on climate from human activities were now "discernible." The evidence leading to this conclusion was the motivation for the United Nations "earth summit" in Rio de Janeiro in 1992, which led to the U.N. Framework Convention on Climate Change, signed by U.S. President George H.W. Bush.

Among scientists today, anthropogenic global warming is no longer considered a prediction, but an observation. In the summer of 2005, for example, the new president of the U.S. National Academy of Sciences, Ralph Cicerone, affirmed in testimony to the U.S. Congress: "Carbon dioxide in the atmosphere is now at its highest level in 400,000 years and it continues to rise. Nearly all climate scientists today believe that much of Earth's current warming has been caused by increases in the amount of greenhouse gases in the atmosphere, mostly from the burning of fuels."²³

Given all this, why would any one be confused about the facts of global climate change? Why would anyone think these facts are a matter for partisan political debate? Scientists agree that the Earth *is* warming up, that human activities are largely the cause, and they have been in agreement over these matters for some time. Yet, as recently as 2006, polls showed show that a majority of the American people thought scientists were still arguing the point, and only about 1/3 believed that global warming is "mainly caused by things people do."²⁴

In fact, climate change has become a profoundly polarized issue. For many years, over the internet, AM radio, and even in the U.S. Congress, one could find adamant denials that global warming is real. These denials emanated almost entirely from the right-wing of the American political spectrum. In a letter to the editor of *The New York Times*, Robert Berkman of Rochester, New York, summarized the situation aptly:

What I fail to understand is why global warming has come to be viewed as a political or ideological issue...If you are in a house where there's a strong burning smell and the air is getting smoky, the sane response is to acknowledge that there is a fire somewhere and do something about it--no matter what one's political ideology might be.²⁵

Current confusion and political polarization about climate change is often blamed on the Bush administration, which has made many conflicting statements, but often suggested that the scientific basis for understanding global warming is insufficient to warrant action. The Bush administration *has* repeatedly emphasizing the uncertainties in climate science rather than the accepted and established scientific relationships.²⁶ But the problem is quite a bit deeper, with historical roots in a little known organization called the George C. Marshall Institute. Examining the origins of the Marshall Institute suggests that the answer to Mr. Berkman's question is, at least in part, that climate science became a victim of the Cold War.

The George C. Marshall Institute

Throughout the 1990s, a major source of statements in opposition to the scientific consensus on climate change was the Washington, D.C. think-tank, the George C. Marshall Institute. Today, the Marshall institute continues to insist that there are major unresolved uncertainties, and significant on-going scientific debate.²⁷

The Institute's stated mission is one with which any sensible person could easily agree, "to encourage the use of sound science in making public policy about important issues for which science and technology are major considerations." Examination of their positions, however, reveals that their view of "sound" science frequently clashes with the results of scientific research published in refereed journals, and with the stated positions of leading, professional scientific societies.

Since the early 1990s, the Marshall Institute has insisted that the scientific evidence of global climate change is uncertain, incomplete, insufficient, or otherwise inadequate. Its spokesmen and members have argued that there is no proof that global warming is real, or if it is real no proof that it is caused by human activities, or if it is real and anthropogenic, no proof that it matters.²⁸ The Institute suggests that regulatory action is premature at best, foolish and damaging at worse. Individuals with links to the Institute have written extensively in mass media outlets and popular magazines, such as *The Wall Street Journal*, the *American Spectator*, *Forbes* magazine, and the *National Review*.²⁹ They have appeared on television and radio, and sponsored web sites and list servers promoting views diametrically opposed to the mainstream of scientific opinion.

One recent report on the subject argues that natural variability is insufficiently understood to permit us to say that current global warming is not natural:

Climate varies naturally on time scales ranging from seasons to the tens of thousands of years between ice ages. Knowledge of the natural variability of the climate system is needed to assess the extent of human impact on the climate system. At present there are no robust estimates of natural climate variability on the decades to centuries timescale that is essential for evaluating the extent to which human activities have already affected the climate system, and to provide the baseline of knowledge needed to assess how they might affect it in the future.³⁰

This position is of course at odds with the scientific consensus described above. Scientists have looked extensively at the issue of natural variability, and concluded it is insufficient to account for the observed changes.³¹

Why does the Marshall Institute insist on a position that opposes professional expert opinion, both in the United States and elsewhere? Why do they consider it necessary to deny global warming? A possible answer is suggested in the second sentence in their mission statement, as currently posted on their web site home page: “Our current program emphasizes issues in national security and the environment.” The connection between national security and the environment is clarified by considering the history of the Institute, and its founders.

The George C. Marshall Institute: Robert Jastrow and SDI

The founder and current director of the Marshall Institute is astrophysicist Robert Jastrow. Born in 1925, Jastrow enjoyed a thirty-year career as a distinguished astrophysicist. He played a leading role in the U.S. space program, chairing NASA's lunar exploration committee. In 1961 he became the founding director of the Goddard Institute for Space Studies. After twenty years as Director of Goddard Institute, he retired in 1981, becoming an adjunct professor of Earth Sciences at Dartmouth College, a position he held until 1991.

While at Dartmouth, Jastrow also took up another cause: the defense of Ronald Reagan's Strategic Defense Initiative (SDI). Proposed in March 1983, the SDI concept was to develop a missile shield through the use of space-based lasers to defend the United States from incoming inter-continental ballistic missiles. Within weeks of its announcement, academic scientists began to express opposition, criticizing the program as unrealistic, undesirable, and potentially destabilizing, as it could undermine the principle of Mutual Assured Destruction on which the Cold War balance of power had long hung. By the end of the year, a few voices of opposition had swollen to a chorus, causing considerable consternation in the Reagan administration.

As historian Rebecca Slayton has discussed, academic physicists organized a historically unprecedented effort to resist the program. While most physicists had long been accepting military R & D funds, they reacted differently to SDI, fomenting a coordinated effort to block the program that culminated in a boycott of

program research funds by academic physicists. By May 1986, 6,500 academic scientists had signed a pledge not to solicit or accept funds from the missile defense research program, a pledge that received abundant media coverage.³²

Jastrow was appalled, both by his colleagues' actions and by media coverage which he felt made it seem as if all scientists opposed SDI. A man with strong administrative and communicative skills, and plenty of contacts in Washington, D.C., he decided to act. Writing on Dartmouth College letterhead in December of 1984, he invited William (Bill) Nierenberg, Director of the Scripps Institution of Oceanography, to join him and Frederick Seitz on the Board of Directors of a new institute, to be called the George Marshall Institute.

Frederick Seitz was a solid-state physicist who had trained under Eugene Wigner at Princeton, with whom he developed the concept of the Wigner-Seitz unit cell, a way of understanding crystal lattices that is now standard. From 1965 until 1968, Seitz was President of the National Academy of Sciences, and in 1968 he became the president of Rockefeller University, a position he held until retiring in 1978.

Bill Nierenberg was also a physicist, having studied with I. I. Rabi at Columbia and worked during the war on uranium isotope separation for the Manhattan project before joining the physics department at Berkeley, and then becoming Director of the Scripps Institution of Oceanography. Both Seitz and Nierenberg served on numerous government panels dealing with national security issues; Nierenberg had a long-time association with JASON, the committee of

scientists with high level security clearances who advise the Department of Defense on science related to national security. So here were three prominent physicists with extensive links to the military-scientific complex joining forces to counter the dominant position of most of their colleagues.³³

Their principal focus would be the mass media: the Institute would set up workshops and programs, and write reports and press releases, to counter the prevailing negative opinion of SDI. Jastrow had taken a first step with articles for *Commentary* and *The Wall Street Journal*. “It seems to have been effective,” he told Nierenberg, “*Commentary* and *The Wall Street Journal* have been getting calls and letters from Sagan, Bethe, Carter, etc.” A debate was now on.

Jastrow believed that if the American people understood SDI, they would support it. But for this to happen, journalists had to present it correctly. The Institute’s first initiative, therefore, would be a “...two-day training seminar for journalists on the fundamental technologies of Strategic Defense.”³⁴ Over the next two years, the Institute built up its program activities in the manner that Jastrow had hoped. By this time, it had clarified its goal and was moving towards getting its message directly where it counted: namely, to Congress, through press briefings, reports, and seminars directly aimed at Members and their staff.

Jastrow’s approach was underlined by a strong, anti-communist orientation. He believed that the opponents of SDI—particularly the Union of Concerned Scientists—were playing into Soviet hands.³⁵ As evidence, he cited a letter written by Soviet Secretary General Mikhail Gorbachev to MIT Professor and Union of

Concerned Scientists' Founder Henry Kendall to congratulate him on the Union's "noble activities in the cause of peace."³⁶ If Gorbachev approved of Kendall's work, something was clearly wrong; Jastrow suggested that Kendall and the Union were stooges of the Soviet Union, noting "the intensification—one could say almost, the ferocity—of the efforts by the UCS and Soviet leaders to undermine domestic support for SDI."³⁷

A major debating point was whether SDI violated the Anti-Ballistic Missile Treaty. The Institute insisted that it did not, an argument used in England by Conservative MP Ian Lloyd in a House of Commons Debate. Quoting directly from Marshall Institute materials, Lloyd insisted that SDI did not violate the ABM treaty, because the treaty did not prohibit research, and he closed with a familiar Cold War argument: that the goal of the arms race was not simply to maintain a balance of terror, but rather to free the Soviet people. SDI was linked to that goal:

[A] fundamental Western interest is the survival of the Russian people as a whole long enough for them to understand, evaluate, and eventually escape for the yoke of their self-imposed tyranny. That is in the interests of the civilised world. The perspective of this decision on SDI on both sides is one that extends well into the next century and clearly embraces that possibility. Our purpose is not merely the survival, but ultimately the legitimate enlargement, of the free world by the voluntary actions of convinced peoples.³⁸

By protecting the United States, SDI would protect the interests of the entire free world.

A consistent theme of Marshall Institute materials was “balance”—that the UCS position papers on SDI were one-sided—and that journalists were obligated to present “both sides.” Fair enough, there were two sides of SDI, conceptually—support and opposition—but those two sides had very different *numbers* of experts associated with them. One was a large majority position, the other was a small minority position. If journalists were to give both sides equal weight or space in their reporting, this would effectively misrepresent the situation in the scientific community. Yet the institute’s insistence on gaining equal time for their (minority) views proved to be highly effective; many journalists acquiesced to their demands. And when the tactic proved effective, it would be applied to a host of other issues, including global warming.

The Institute Turns to Global Warming

In 1986, global warming was not on the Institute’s radar screen. Besides SDI, other issues under consideration included nuclear winter, seismic verification, and the relative merits of manned and unmanned space flight. But in 1989, the Berlin Wall fell, and by the early 1990s the Soviet empire was in collapse. On at least one reading, the Cold War was over.

Perhaps not coincidentally, the Marshall Institute began to address global warming that very year; by the early 1990s, it had become a major focus. As

climate scientists began to consolidate around a consensus position, and world leaders began to converge on Rio, the Institute scientists pursued the same tactic it had used with SDI: they alleged that the majority position was mistaken and that the science it was based on was incomplete, inaccurate, or just plain wrong. And they demanded equal time for their views.

In the case of SDI, the demand for equal time had a certain logic: many scientists' objections to SDI were not exactly *scientific*: they were based on moral and ethical qualms about destabilizing the balance of power. SDI was a political issue, and a great deal of opposition to it was political—so it was fair to insist that there be an open political debate. Moreover, SDI did not yet exist, so in a certain sense there were no facts about it.

Global warming was different. The question of whether it was or was not happening was an empirical matter—at least in principle separable from political decisions over how to respond to it. This was the position taken by most scientists in the U.S. Global Climate Research Program, who drew on traditional fact/value distinctions to defend their own objectivity and political neutrality. So when the Marshall Institute began to attack the scientific *evidence*, mainstream scientists were appalled. Consider one example.

In 1995, Robert S. Walker, Chairman of the House Committee on Science, issued a press statement on global warming which quoting directly from a Marshall Institute report attacking the U.S. Global Climate Research Program. The press release was accompanied not by any statements from the leaders of that program,

but by the Marshall Institute report. John McElroy, Dean of Engineering at the University of Texas, Arlington, and a member of the National Academy of Sciences Space Science Board, penned a three-page, single-spaced letter to the Congressman to register his indignation. The Marshall Institute had criticized NASA's Mission to Planet Earth, the research program that might provide the factual information needed to evaluate the crucial scientific claims. If one wanted to know the truth, how could one possibly attack the program designed to determine that truth?

McElroy was enraged by the Institute's allegation that the U.S. Global Climate Research Program was a "perversion of the scientific process;" calling this "a disservice to... the many sober, careful scientists who are attempting to unravel one of the most challenging scientific puzzles that one can conceive." He continued:

[T]he Marshall Institute report.... seriously understates the complexity of the problem and the time that will be required for its solution. [Its] political charge of 'perversion of the scientific process' is reprehensible, ...and is unsupported by evidence that would lend credence to such an allegation³⁹

McElroy concluded by calling the allegations "scurrilous."⁴⁰

That was in 1995. If you visit the Marshall Institute home page today, you will find environment and climate change at the head of its agenda. How did climate change become the focus for an organization created to defend SDI? How

did the Marshall Institute reach the position of grossly offending mainstream scientists such as McElroy? And what does this tell us about the cultural production of ignorance? To answer these questions, we must consider some of the other activities of the Institute's founders, Robert Jastrow and Frederick Seitz.

How SDI, Tobacco, Acid Rain, CFCs, and Global Warming Became Related

Frederick Seitz was the first chairman of the Board of the Institute and continues to be listed as their Chair, Emeritus. Jastrow was right about Seitz's impeccable credentials: Seitz is well known in the scientific community as a past President of the National Academy of Sciences and President Emeritus of the Rockefeller University. Less well known is the fact that he served as a principal advisor in the 1980s to the R.J. Reynolds Tobacco Company.

In the mid 1970s, RJR Nabisco, the parent company of R.J. Reynolds tobacco, established a Medical Research Program to support research that might help them to avoid legal liability, either by establishing causes of cancer other than smoking or by complicating the causal links between life style and cancer. Much of the funded work can fairly be described as basic research—dealing with mechanisms of cell mutation, lung physiology, genetic predispositions, and the like—and a great deal was done at leading American research universities. But was this simple philanthropy, aimed at advancing basic science? Not exactly. Documents released through tobacco litigation discovery show that its goal was to find evidence or arguments that might cast doubt on the links between tobacco use

and adverse health effects, by emphasizing other causal factors such as stress, hypertension, personality traits, and genetic background.⁴¹ These documents also show that between 1975 and 1989, RJR Nabisco spend \$45 million dollars on this program, and a principal advisor in establishing and running it was Frederick Seitz.⁴²

In May 1979, Seitz explained how, when, and why he became associated with R.J. Reynolds.

About a year ago, when my period as President of the Rockefeller University was nearing its end, [I was] asked if I would be willing to serve as advisor to the Board of Directors of R.J Reynolds Industries , Inc., as it developed its program on the support of biomedical research related to degenerative diseases in man—a program which would enlarge upon the work supported through the consortium of tobacco industries. Since...R.J. Reynolds had provided very generous support for the biomedical work at The Rockefeller University, I was more than glad to accept.⁴³

Among others involved in the program was Maclyn McCarty, the man who along with Oswald Avery and Colin MacLeod had first demonstrated that DNA is the material that carries hereditary information in cells. McCarty, a Rockefeller colleague, worked with Seitz to establish the guidelines for the research program.⁴⁴

Seitz had been appointed to an advisory group to the Board of Directors, a group that also included former Reynolds Chairman Colin Stokes. In what appears to have been the introductory remarks to a speech by Seitz, Stokes elaborated on the research program. He asserted that the charges that tobacco was linked to lung cancer, hardening of the arteries, and carbon monoxide poisoning, were “tenuous” (despite their repeated affirmation in Surgeon General’s reports) and that “Reynolds and other cigarette makers have reacted to these scientifically unproven claims by intensifying our funding of objective research into these matters...”. Stokes claimed that “science really knows little about the causes or development mechanisms of chronic degenerative diseases imputed to cigarettes, including lung cancer, emphysema, and cardiovascular disorders,” and that many of the studies that linked smoking to these diseases were either “incomplete or ...relied on dubious methods or hypotheses and faulty interpretations.”⁴⁵

The intent of the program was to develop “a strong body of scientific data or opinion in defense of the product,” and Stokes stressed that this had helped the industry avoid legal liability in the past. “Due to favorable scientific testimony, no plaintiff has ever collected a penny from any tobacco company in lawsuits claiming that smoking causes lung cancer or cardiovascular illness—even though one hundred and seventeen such cases have been brought since 1954. [sic]”⁴⁶

To evaluate and monitor these research projects R.J. Reynolds had “secured the services of a permanent consultant—Dr. Frederick Seitz, former President of Rockefeller University.”⁴⁷

The impact of these research programs is hard to assess, but their purpose is not: to develop arguments to confound the causal links between tobacco and cancer by emphasizing epidemiological uncertainties and biochemical complexities--in effect, to construct ignorance.⁴⁸ The emphasis on uncertainty and complexity would characterize subsequent efforts to challenge the scientific evidence of anthropogenic global warming.

Seitz's work for R.J. Reynolds in funding research that might cast doubt on the cancer-tobacco link seems to have ended around 1989, just when the Marshall Institute began its campaign to deny the link between greenhouse gas emissions and global warming. Seitz was by this time 78 years old, and perhaps not as energetic as he had once been, and the banner was taken up by another retired physicist: S. Fred Singer.

Like Jastrow, Seitz, and Nierenberg, Singer had been a prominent physicist and career science administrator. Like Seitz, he received his Ph.D. in physics at Princeton, beginning a research career in the Upper Atmosphere Rocket Program at the Applied Physics Laboratory at Johns Hopkins University. Throughout the 1950s and early 1960s, he worked on topics in atmospheric physics, astrophysics, and rocket and satellite technology, and in 1962 became the first Director of the National Weather Satellite Center. From there he moved increasingly into the policy dimensions of environmental issues, serving as Deputy Assistant Administrator at the U.S. EPA, where he chaired the Interagency Work Group on the Environmental Impacts of the Super-Sonic Transport (which he supported), and

later as Chief Scientist at the U.S. Department of Transportation in the second Reagan Administration (1987-1989)

In 1989, Singer founded the Science and Environment Policy Project (SEPP) in his home in Virginia. Echoing the mission statement of the Marshall Institute, SEPP was founded to “advance environment and health policies through sound science.” Echoing the pattern established by Jastrow, Seitz wrote numerous popular and semi-popular articles, op-ed pieces, and letters to editors challenging the emerging scientific consensus on global warming.⁵⁰

Between 1989 and 2003, Singer published at least 35 articles, letters and op-ed pieces. Meanwhile, many web sites and list-serves developed on the Internet citing arguments found in his work, and that of other individuals affiliated with the Marshall Institute.⁵¹ This, of course, coincided with the period in which the scientific consensus over global climate change became nearly unanimous. In short, the pattern was identical with that pursued for SDI: attempt to convince the public, through mass media campaigns, to accept an interpretation that was well outside the mainstream of professional science.

Singer’s campaign culminated in 1997 with the publication of a book, *Hot Talk: Cold Science: Global Warming’s Unfinished Debate*, published by the Independent Institute, a conservative think-tank with links to the Hoover Institution, and whose Board of Academic Advisors included the economist Julian Simon, famous for his “cornucopian” theory that, given truly free markets, technological

innovation can and will solve any environmental or social problem. Government intervention is not only unnecessary, but counter-productive.

Two years before, the IPCC had issued its Second Assessment Report, in which it concluded that the balance of evidence suggested that climate change due to human activity, particularly fossil fuel burning and land use changes was now “discernible.”⁵² While the IPCC report has since been ratified by virtually all relevant major scientific societies, Singer’s book claimed that “the evidence [was] neither settled, nor compelling, not even convincing.” Focusing on instabilities and uncertainties, he claimed that “scientists continue to discover new mechanisms for climate change and to put forth new theories to try to account for the fact that global temperature is not rising, even though greenhouse theory says it should.”⁵³

This was flat-out wrong on one count, and misleading on the other. The IPCC summaries made clear that the weight of the available evidence showed that mean global temperature *was* rising. Climate scientists were continuing to address the diverse mechanisms of climate change, but not because they doubted that greenhouse gases were implicated at present. It was to better understand the contributions of various possible forces, to understand how their effects ramify through Earth systems, and to determine whether severe climate change might happen abruptly.

The book’s forward argued that global warming was simply a scare tactic, the result of pandering to irrational fears of environmental calamity by scientists seeking fame and fortune, and that a sober analysis showed that “we do not at

present have convincing evidence of any significant climate change other than from natural causes.”⁵⁴ Who was the author of this sober foreword? Frederick Seitz.

Once again, Seitz was challenging the consensus of the expert scientific community—the men and women who had spent their professional lives addressing the question—to take a position that favored industry positions. And Singer was following a similar pattern, applying the strategy of challenging knowledge to several other issues as well: that acid rain was linked to power plant emissions, that stratospheric ozone depletion was linked to CFCs, and that adverse health effects could be attributed to environmental tobacco smoke.⁵⁵

In the early 1980s Singer had served on the White House Office of Science and Technology (OSTP) Acid Rain Panel. In 1983, two major scientific reports affirmed that that acid precipitation was largely the result of sulfate emissions from power plants, as well as nitrous emissions from automobile exhaust, and that policy steps should be taken to curb those emissions. One report came from the National Academy of Sciences; the other from OSTP itself. When the OSTP report was completed, the Reagan White House stalled the report’s release, arguing that “more research” was needed. Administration spokesmen argued that the science was too uncertain to justify immediate action.⁵⁶

This was exactly the same argument that Singer would make a few years later in *Hot Talk, Cold Science*, and no wonder. According to one member of an acid rain panel on which Singer served, Singer was persistently skeptical of the

scientific evidence, and eventually went along with the majority view only when it became clear that no one else on the committee would support his position.⁵⁷

By the early 1990s, a new environmental issue had gained public attention: the depletion of stratospheric ozone by chlorinated fluoro-carbons (CFCs), chemicals used in refrigerators, air conditioners, and hair spray, among other things. Singer was soon involved in this issue, too.

Many chemicals break down rapidly in the natural environment, but CFCs are extraordinarily long-lived, and stable. This led atmospheric chemists Sherwood Rowland and Mario Molina to propose, in an article in *Nature* in 1974, that they might reach the stratosphere, where they would finally break down, releasing free chlorine which would in turn combine with, and destroy, stratospheric ozone. Rowland and Molina's hypothesis stimulated vigorous scientific debate. More than a few scientists agreed that the potential for damage was significant, but the relevant empirical evidence was contradictory. So the US Government established an extensive research program in 1977 to investigate the potential for CFC-induced ozone destruction. The Second Assessment, issued in 1985, became the scientific basis for the 1987 Montreal Protocol on Substances that Deplete the Ozone Layer, requiring 50% cuts in chlorofluorocarbon production by the year 2000. It also required the signatory parties to revisit the Protocol periodically in the light of new evidence, so that it could be tightened or loosened if the scientific case for CFC-induced depletion changed.⁵⁸

In 1985, as the assessment was being finalized, British measurements in Antarctica revealed the now-famous Antarctic Ozone “hole,” a continental-size region with depletion rates far higher than expected by the scientific community. In 1986 and 1987, the American Chemical Association, the National Oceanic and Atmospheric Administration, and NASA mounted joint expeditions to Antarctica to investigate further, and the expedition scientists concluded that the combination of high levels of anthropogenic chlorine and extremely low Antarctic stratospheric temperatures produced the large ozone losses.⁵⁹ The 1989 international ozone assessment document puts it this way: “The weight of scientific evidence strongly indicates that chlorinated (largely man-made) and brominated chemicals are primarily responsible for the recently discovered substantial decreases of stratospheric ozone over Antarctica in springtime.”⁶⁰

In 1989 US President George H.W. Bush acted on this evidence, calling for a complete phase-out of production by the year 2000. In 1992, he acted again on new findings to accelerate the ban.⁶¹ Instead of weakening the Montreal Protocol in the light of new scientific results, world leaders used its adaptive nature to tighten the Protocol considerably. In 1995, Rowland, Molina, and Paul Crutzen shared the Nobel Prize in Chemistry for their work on demonstrating the relation between CFCs and the depletion of stratospheric ozone.

Singer, meanwhile, had been arguing that the scientific basis for regulatory action on CFCs was insufficient. In the late 1980s, as the ozone hole was discovered and monitored, and in the early 1990s, as the Bush administration

signed the Montreal Protocol, Singer wrote popular articles and letters challenging the science, with titles such as “Ozone Scare Generates Much Heat, Little Light,” published in *The Wall Street Journal*, and “The Hole Truth about CFCS,” published in *Chemistry and Industry*.⁶² These articles suggested that the observed depletions might just be natural variability and that the environmental arguments were nothing more than scare tactics.

In 1995, the House Energy and Environment Subcommittee on Science, chaired by Republican Robert Walker (the same Walker mentioned above), held hearings on “scientific integrity” focusing on three issues: ozone depletion, climate change, and dioxin. In the very year that Rowland and Molina would win their Nobel Prize—indeed, just weeks before the prize was announced, Singer testified to the U.S. Congress: “[T]here is no scientific consensus on ozone depletion or its consequences.”⁶³

And there was yet another area in which Singer challenged science: environmental tobacco smoke (ETS). Today, the Department of Health and Human Services says that “there is no risk-free level of exposure to secondhand smoke: even small amounts...can be harmful to people’s health,” but this is not a new conclusion.⁶⁴ The 1986 Surgeon General’s report, “Health Consequences of Involuntary Smoking,” concluded that secondhand smoke is a cause of disease, including lung cancer, in healthy non-smokers. Yet in 1994, Singer challenged this scientific evidence, too.

In a report “EPA and the Science of Environmental Tobacco Smoke,” written on behalf of the Alexis de Toqueville Institution, an anti-regulatory think-tank, and funded by a \$20,000 grant from the Tobacco Institute, Singer asserted that “scientific standards were seriously violated” in drawing the conclusion that ETS was a hazard. In assessing the risk, the U.S. Environmental Protection Agency had assumed a “linear dose-response curve”—that is to say, had assumed that the risk was directly proportional to the exposure, even at very low levels. Singer rejected this idea, and argued that the EPA should assume a “threshold effect”—presuming that low doses would have no effect.⁶⁵

Like Jastrow before him, Singer had a point: some substances that are clearly harmful at high doses do appear to be innocuous at very low levels. But he provided no *evidence* that this was the case for ETS; he merely asserted that it might be, and used this to challenge the knowledge on which the EPA (and, indirectly) the Surgeon General) had relied. But the EPA had followed normal scientific practice, as recommended in the well-known “Red Book” on risk assessment, published by the U.S. National Research Council.⁶⁶ One chemist who has worked closely with the EPA for many years has put it this way.,

Forthcoming in *Agnotology: The Cultural Production of Ignorance*, edited by Robert Proctor and Londa Schiebinger, Stanford University Press.

"Linear dose-response is the "official" EPA default [position]." If there is sufficient evidence for a non-linear mode of action then that is used. Otherwise, it is linear. I think it is always linear... This is [also] laid out in EPA's cancer guidelines. ... <http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=116283>." ⁶⁷

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Comment: Does the link belong in the quote??

As his co-author on the report put it in a letter to his Tobacco Institute sponsors, "'I can't prove that ETS is not a risk of lung cancer, but EPA can't prove that it is.'" ⁶⁸

Today, the home page of the Sierra Club of Canada compares the denial of global warming to the denial of the scientific evidence that smoking causes cancer. In both cases, there is strong scientific evidence supporting current scientific understandings, and the vast majority of scientific experts support the reality of the alleged links. But what the Sierra Club doesn't say, and perhaps doesn't know, is that the similarity in these positions is no coincidence. The same tactics, and in some cases even the same individuals, have been responsible for both.

What Impact Has This Had?

It would be a different paper to assess the impact of the Marshall Institute campaigns. But consider this. In the early 1990s, underscoring uncertainty became the official strategy of the Republican party. In a now-famous memo, leaked to the press in

2003, Republican pollster and media advisor Frank Luntz urged candidates in the 1992 mid-term elections to use scientific uncertainty as a political tactic. "*The scientific debate remains open.*" he wrote emphatically. "Voters believe that there is **no consensus** about global warming. Should the public come to believe that the scientific issues are settled, their views about global warming will change accordingly." Therefore, ***you need to continue to make the lack of scientific certainty a primary issue in the debate...***⁶⁹

Evidence suggests that this tactic was successful. A 2007 Gallup-Yale University poll showed that while a large majority of Americans now believe that global warming is happening, 40% think that there is still "a lot of disagreement among scientists."⁷⁰

In 1979, scientists had a consensus that that warming would happen, and by the mid 1990s they had a consensus that it was beginning. The lion's share of this work was done in the United States. Yet the United States has refused to participate in the Kyoto Protocol to the United Nations Framework Convention on Climate Change, and we remain one of only four countries to do so (the others are Australia, Lichtenstein and Monaco). Polls also show that Americans have been consistently less concerned about global warming than citizens of other nations. Sociologists Aaron McCright and Riley Dunlap note that, at minimum, the arguments of climate change deniers have aligned with the anti-regulatory ambitions of the U.S. Republican party, in control of Congress from 1994-2006.⁷¹

Fred Singer continues to write articles for business journals such as *The Wall Street Journal*, *Forbes*, and *Business Investor's Weekly*, and to challenge the work of

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Comment: This date can't be right. The treaty was negotiated in 1996/1997, and signed in 1998. The Byrd/Hagel Resolution in 1997 had produced a "Sense of the Senate" that was 95-0 against ratification. I rewrote.

scientists (and others) who represent the consensus view.⁷² He continues to be widely quoted in the popular media by reporters needing “balance” for their stories.⁷³ And his arguments continue to be extended by others, some of whom have been influential.

In 2001, Cambridge University Press released *The Skeptical Environmentalist*, written by a young Danish political scientist, Bjørn Lomborg. Covering everything from acid rain to overpopulation, the book’s chapter on climate change echoed the Marshall Institute: that the science is uncertain and the likelihood of serious harm grossly exaggerated. Echoing Julian Simon, Lomborg argued that government regulation is the wrong way to address whatever real problems might exist, because it inhibits the economic growth and technological innovation that are the real solutions to human misery. There may be environmental challenges ahead, but free markets will provide the appropriate solutions.

Prominent scientists criticized the book for its misrepresentation of the scientific evidence and arguments and its flagrantly anthropocentric weltanschauung. *Scientific American* dedicated a large part of its January 2002 issue to a rebuttal entitled, “Misleading Math about the Earth,” in which four experts--Stephen Schneider, John Holdren, John Bongaarts and Thomas Lovejoy--critiqued Lomborg’s arguments on global warming, energy, overpopulation and biodiversity.⁷⁴ While Lomborg claimed that his book was based on extensive review of the relevant scientific literature--and Cambridge Press championed the

book for its nearly 3000 endnotes--his critics noted that a very large proportion of his citations were to media articles and secondary sources, rather than to refereed scientific literature.⁷⁵ Schneider called Lomborg's strategy one of "selective inattention," ignoring reams of relevant scientific evidence that undermine his views.⁷⁶

While it is impossible to say how much actual impact—as opposed to media flurry—Lomborg's book had, in 2004 he was named by *Time* magazine as one of the most influential thinkers of the year.⁷⁷ At minimum, it took up many hours of the time of distinguished scientists like Schneider to refute Lomborg's claims. In Schneider's words: "What a monumental waste of busy people's time."⁷⁸ (Full disclosure: the authors of this paper have also spent significant amounts of time over the past two years answering phone calls and emails offering "skeptical" questions.)

Much of the debate over Lomborg's work concerned whether he had got the facts straight, but another book would soon suggest that, when it comes to climate change, facts didn't much matter. In 2005, science fiction writer Michael Crichton's novel, *State of Fear*, reached number three on *The New York Times* bestseller list, its premise being that global warming is a hoax perpetrated by radical environmentalists bent on bringing down western capitalism. The book is a work of fiction, but it includes an appendix alleging that its central premise is correct—that global warming is a left-wing hoax—supported with a long list of claims highly redolent of Marshall Institute reports. Crichton has spoken at the

American Enterprise Institute and many other venues promoting his claims, which have in turn been taken up Oklahoma Senator James Inhofe. In 2005, Crichton was invited to the White House to meet U.S. President George W. Bush.⁷⁹

James Inhofe, Chair of the Senate Committee on Environment and Public Works until 2007, has suggested that global warming might be the “greatest hoax ever perpetrated on the American people.” On September 28, 2005, he sponsored hearings on science in environmental decision-making, in the wake of hurricane Katrina. Who was the star witness? Michael Crichton.⁸⁰ Vermont Senator James Jeffords summed up the cultural construction of ignorance perfectly when he asked: “Mr. Chairman, ...why are we having a hearing that features a fiction writer as our key witness?”⁸¹

How Climate Science Became a Victim of the Cold War

On first glance, it seems just plain weird that several of the same individuals—all retired physicists—were involved in denying that cancer causes smoking, that pollution causes acid rain, that CFCs destroy ozone, and that greenhouse gas emissions are causing global warming. But when you put these things together—tobacco regulation, the banning of CFCs, the delay of controls on CO₂ emissions—then they do add up, summing to a radical free market ideology that opposes any action restricting the pursuit of market capitalism, no matter the justification.

Throughout the literature of climate change denial, a recurrent theme is that environmentalists are motivated by the desire to bring down the capitalist system and to replace it with socialism or communism. Along with this, there is the implication or overt accusation that the environmentalist goal is world government.

In a 1991 piece on global warming, for example, Fred Singer suggested that the threat of global warming had been manufactured by environmentalists based on a “hidden political agenda . . . against business, the free market, and the capitalistic system.”⁸² Singer asserted that the true goal of those involved in the global warming issue was not so much to stop global warming—which he insisted did not exist—but rather to foster “international action, preferably with lots of treaties and protocols.”⁸³

A similar argument was made by political scientist Aaron Wildavsky in a 1992 preface to a book denying global warming.⁸⁴ Wildavsky suggested that the true goal of the environmentalist movement was wealth re-distribution, and that characterizing environmentalists this way was no “caricature...but an accurate rendition of what environmentalist-cum-postenvironmentalist leaders are trying to accomplish.”⁸⁵ This, he suggests, is why environmentalists are so enamored of international treaties and regulation: they view them as levers towards achieving a new world order.

As the basis for his view that global warming is a fiction, Wildavsky credited the Marshall Institute Report, “Scientific Perspectives on the Greenhouse Problem,” written by Seitz, Jastrow and Nierenberg. But the real issue at stake, he continued,

was not science, but “central planning versus free enterprise, regulation versus free enterprise, spontaneity versus control.”⁸⁶ Clearly, this is what Wildavsky believes is at stake, but whether climate scientists view it that way is another matter.

In her Ph.D. dissertation, anthropologist Myanna Lahsen studied the phenomenon of physicists who deny global warming, and suggested that their actions were driven in large part by the downfall of physics as America’s “prestige science.” The reduction of funding and opportunity in physics, and its succession by biological and Earth sciences as the dominant sciences of the era, led them to challenge climate science in a kind of turf war. Moreover, these physicists had little regard for the distinctively different methodologies and standards of evidence of these sciences, seeing them as less rigorous than the methods and standards of physics. Members of an “old guard” no longer connected to the highest levels of science, they could not accept that a new generation of scientific leaders, from “lesser” sciences than physicists, were replacing them in the role of speaking truth to power.⁸⁷

To be sure, the men in this story were used to the limelight—to having their opinions sought and heeded on many deeply important issues over the better part of three decades. To some extent, they may have been addicted to the limelight: by challenging climate science, they ensured they remained in the center of attention long after their scientific opinions were actively sought in most government circles. However, we find little evidence in the historical documents that their actions were *motivated* by epistemic concerns about scientific methods.

Robert Jastrow had built the climate modeling effort at Goddard, and hired the man who has since become America's premier spokesmen on climate models: James Hansen. William Nierenberg similarly built the Climate Research Division at Scripps, hiring numerous climate modelers and other scientists directly engaged in developing the evidence of global warming. It simply does not seem plausible that they would attack the science they helped to build because it was the wrong kind of science, methodologically, or even disciplinarily.

We believe that Lahsen is closer to the mark with another point. Following Richard Hofstadter, she situates these men within the political tradition that Hofstadter called "the paranoid style" in American politics: a style that sees grand conspiracies to undermine America's free-market system and constant threats to American liberty. The political preferences of climate change "contrarians," including Singer, Nierenberg, and Seitz, can be characterized, Lahsen argues, as anti-communist, pro-capitalist, and anti-government interference.⁸⁸ We agree. Indeed, philanthropist George Soros has given this perspective a more succinct label: "market fundamentalism."⁸⁹ Market fundamentalists hold a dogmatic, even quasi-religious, belief in unfettered market capitalism, and oppose *anything* that restrains the business community, be it restrictions on the sale of tobacco or the emission of greenhouse gases.⁹⁰

There is something very peculiar about this, because many people believe in the merits of free markets but still accept the reality of global climate change. One can argue the merits or demerits of carbon taxes, emissions control, carbon credits,

and all kinds of other potential responses to climate change without denying the scientific facts—and indeed, all over the world, people are doing just that.

Political scientist Roger Pielke, Jr., has emphasized in his work that knowing the scientific facts does not determine what policy actions should follow.⁹¹ The widely-held “linear model” of science-policy interaction—which assumes that facts lead directly to policy—is simplistic and inaccurate. It is perfectly possible to accept the reality of global warming and believe that nothing should be done about it.⁹² Indeed, that *had* been Nierenberg’s position in 1983, when he chaired a major National Academy of Sciences study of climate change—and before he became involved with the Marshall Institute.⁹³

Pielke’s critique of the linear model has been largely directed at scientists, who, he suggests, have a naïve faith that determining the scientific facts automatically determines the required policy action. And yet in their own way, the climate change deniers presumed the linear model, too: that if global warming was proven true, then government interference in free markets would necessarily follow. Thus, they *had* to fight against the emerging consensus, either by challenging the scientific evidence directly or by striving to create the impression of ongoing scientific debate. When Frank Luntz argued--- “The science is closing against us but not yet closed. There is still a widow of opportunity to challenge the science.”⁹⁴--this was the linear model in action.

The Cold War is over. We face now not a binary choice between communism and capitalism (if ever we did), but rather, the realization that capitalism has had unintended consequences. When humans began to burn fossil fuels, no one intended to create global warming, but they did. Capitalism triumphed over communism, but now must deal with its own waste products.

In this sense, the anxieties of climate change deniers are not wholly unfounded: capitalism *will* need to be adjusted or adapted to address its own impacts, and this is the part that the climate change deniers simply cannot accept. The U.S. won the Cold War—and Nierenberg, Jastrow and Seitz played a role in that victory—but now we have to figure out a way to win the (ever-warmer) peace.

It is risky to blame everything on the Cold War and its legacies, but the link here is clear, and accounts for the origins of this story in the debate over SDI—a late Cold War response to the perceived continued threat of the Soviet Union. Most physicists opposed SDI on either technical or political grounds, but its defenders believed that the Soviet threat was undiminished, and that the science that had contained it throughout the Cold War—namely, physics—could and should continue to do so. SDI was one more way in which physicists could defend America.

While the USA was different from the Soviet Union in various ways, to the physicists in this story the crucial difference was its ideological center: communism vs. capitalism, government control of the economy vs. free markets. The initiatives of the Marshall Institute make sense in this light, as an uncompromising

commitment to market capitalism—indeed, market fundamentalism—and a willingness to do just about anything to defend it against creeping government control. To accept that the unregulated free market may be creating profound problems that the free market cannot solve would be, as one of us has argued elsewhere, “ideologically shattering.”⁹⁵ When scientific knowledge challenging their world view, these men responded by challenging that knowledge.

Believing in free market capitalism does not *require* one to dispute the scientific evidence of global warming or to misrepresent that state of scientific debate. But in the hands of the Marshall Institute, and those it has influenced, climate science has been profoundly misrepresented, and a great deal of confusion and ignorance produced.

The great economist John Maynard Keynes famously noted that there is no free lunch. The western world has experienced 150 years of unprecedented prosperity built by tapping the energy stored in fossil fuels. That was our lunch. Global warming is the bill.

Notes

¹ This paper was first presented at the conference “Agnotology: The Cultural Production of Ignorance,” Stanford University, October 7-8, 2005. Subsequently, some of the same territory has been covered by George Monbiot in *Heat: How to Stop the Planet from Burning* (London: South End Press, 2007), although his emphasis is different from ours. Similar material is also covered by Ross Gelbspan, *The Heat is On: The Climate Crisis, the Cover-Up, the Prescription* (New York: Perseus Books, 1995), and *Boiling Point: How Politicians, Big Oil and Coal, Journalists and Activists Are Fueling the Climate Crisis--and What We Can Do to Avert Disaster* (New York: Basic Books, 2005). Gelbspan’s focus is primarily on the role of the fossil fuel industry and its link to the administration of President George W. Bush, whose motivations are obvious. Our question is slightly different: why would did distinguished *scientists* challenge scientific knowledge?

² “Feeling the Heat,” *The New York Times*, June 14, 2005 (late edition), A22.

³ IPCC, *Climate Change 2001: Synthesis Report, A Contribution of Working Groups I, II, and III to the Third Assessment Report of the Intergovernmental Panel on Climate Change* (Cambridge, UK: Cambridge University Press, 2001), 5. For discussion of global warming as a discovery or realization, in the mid 1990s, see Spencer Weart, *The Discovery of Global Warming*, (Cambridge: Harvard University Press, 2003). For background on early recognition of the potential for greenhouse gas emissions to affect climate, see James Roger Fleming, *Historical Perspectives on*

Climate Change (New York Oxford University Press, 1998, and *Callendar Effect: The Life and Times of Guy Stewart Callendar, the Scientist who Established the Carbon Dioxide Theory of Climate Change* (Boston: American Meteorological Society, 2006).

⁴ On the evidence that the observed CO₂ has been produced by burning fossil fuels (and not, for example, volcanoes), see Prosenjit Ghosh and Willi A. Brand, “Stable Isotope Ratio Mass Spectrometry in Global Climate Change Research,” *International Journal of Mass Spectrometry* 228 (August 2003): 1-33; and Taro Takahashi, “The Fate of Industrial Carbon Dioxide,” *Science* 305 (July 2004): 352 – 353.

⁵ The best historical studies of climate change are James Rodger Fleming, *Historical Perspectives on Climate Change* (New York: Oxford University Press, 1998) and Spencer Weart, *The Discovery of Global Warming* (Cambridge, MA: Harvard University Press, 2003).

⁶ IPCC, *Climate Change 2001*, 30-34, 47-50.

⁷ Mott Greene discusses the history of the ice-albedo feedback in: Mott T. Greene, “Arctic Sea Ice, Oceanography, and Climate Models,” *Extremes: Oceanography’s Adventures at the Poles* eds. Keith R. Benson and Helen M. Rozwadowski (Sagamore Beach: Science History Publications (2007), 303-329.

⁸ *Impacts of a Warming Arctic: Arctic Climate Impact Assessment*. (New York: Cambridge University Press, 2005). See also Andrew C. Revkin, "In a Melting Trend, Less Arctic Ice to Go Around," *The New York Times*, September 25, 2005 (late edition), A1.

⁹ P. J. Webster, G. J. Holland, J. A. Curry, and H.-R. Chang, "Changes in Tropical Cyclone Number, Duration, and Intensity in a Warming Environment," *Science* 309 (2005): 1844-1846; Kerry Emanuel, "Increasing Destructiveness of Tropical Cyclones Over the Past 30 Years," *Nature* 436 (2005): 686-688. For a discussion of the controversy over interpreting recent hurricane events and the resistance of some elements of the hurricane forecasting community to recognizing the role of global warming, see Chris Mooney, *Storm World: Hurricanes, Politics, and the Battle over Global Warming* (New York: Harcourt, 2007).

¹⁰ Chris Mooney, 2007. *Storm World: Hurricanes, Politics, and the Battle over Global Warming*, New York; Harcourt.

¹¹ T. M. L. Wigley, "The Climate Change Commitment," *Science* 307 (2005): 1766-1769. Wigley states that the extant commitment "may exceed 1 C." In the same issue of *Science*, a multi-authored paper puts it at a half degree C for no further increase of carbon dioxide. See Gerald A. Meehl, Warren M. Washington, William D. Collins, Julie M. Arblaster, Aixue Hu, Lawrence E. Buja, Warren G. Strand, and Haiyan Teng, "How Much More Global Warming and Sea Level Rise?" *Science* 307 (2005), 1769-1772.

¹² James E. Hansen, director of the Goddard Institute for Space Studies, places the Earth's climate sensitivity to a doubling of the pre-industrial carbon dioxide levels as 3 C, based on paleoclimate data. The last time the Earth was this warm, 3 million years ago, sea level was about 25 meters higher than it is today. See James E. Hansen, "Is There Still Time to Avoid 'Dangerous Anthropogenic Interference' with Global Climate?" (Keeling Lecture, American Geophysical Union annual meeting, San Francisco, December 6, 2005).

¹³ For the report itself and information about it, see <http://www.ipcc.ch/>.

¹⁴ Naomi Oreskes, "Beyond the Ivory Tower: The Scientific Consensus on Climate Change," *Science* 306 (2004): 1686.

¹⁵ The Royal Society, "A Guide to Facts and Fictions About Climate Change," <http://www.royalsoc.ac.uk/page.asp?id=2986>, accessed February 16, 2006.

¹⁶ Stephen Pincock, "Scientists Demand Action on Climate," *The Scientist* 19 (July 2005): 47.

¹⁷ <http://www.guardian.co.uk/environment/2007/oct/12/gorecitation>

¹⁸ Committee on the Science of Climate Change, Division on Earth and Life Studies, National Research Council, *Climate Change Science: An Analysis of Some Key Questions* (Washington, D.C.: National Academy Press, 2001); see also Oreskes, "Beyond the Ivory Tower," 1686.

¹⁹ U.S. National Academy of Sciences "Carbon Dioxide and Climate: A Scientific Assessment," (Charney report), 1979.

²⁰ Fleming, *Callendar Effect*.

²¹ National Academy of Sciences Archives, An Evaluation of the Evidence for CO₂-Induced Climate Change, Assembly of Mathematical and Physical Sciences, Climate Research Board, Study Group on Carbon Dioxide, 1979, Film Label: CO₂ and Climate Change: Ad Hoc: General

²² Proposal for Support of Carbon Dioxide and Climate Change: A Scientific Assessment, submitted by the National Academy of Sciences, to the White House Office of Science and Technology Policy, June 26, 1979, on p. 1.

²³ Senate Committee on Energy and Natural Resources, *Climate Change*, 109th Cong., 1st sess., 2005, CIS S 31-20050721-01.

²⁴ ABC News _Poll, March 2006, abcnews.go.com/technology/GlobalWarming/Story?id=1750492, see also Pew Research Center for The People and the Press, July 2006, <http://people-press.org/reports/display.php3?ReportID=280>

²⁵ Robert Berkman, "It's Time to Talk About Global Warming," *The New York Times*, October 1, 2005 (late edition), A14.

²⁶ Chris Mooney, *The Republican War on Science* (New York: Basic Books, 2005). It is also true that a lot of conflicting and contradictory claims have emanated from the current administration. On misrepresentation of the scientific work on climate change prior to the administration of George W. Bush, including the role of the Marshall Institute, see Ross Gelbspan, *The Heat is On: The Climate Crisis, the Cover-Up, the Prescription* (New York: Perseus Books, 1995), and Boiling Point:

How Politicians, Big Oil and Coal, Journalists and Activists Are Fueling the Climate Crisis--and What We Can Do to Avert Disaster (New York: Basic Books, 2005).

²⁷ <http://www.marshall.org/subcategory.php?id=9> For example, in October 2007, the site was highlighting the book “Shattered Consensus: The true State of Global Warming,” a book which insists on “disparities between what has been predicted about climate change and what has actually been observed,” and “highlight[s] substantial anomalies and new information not generally discussed in mainstream reports about climate science.”

<http://www.marshall.org/article.php?id=357>. The editor of the book is Patrick J. Michaels, a well-known contrarian who, before he became involved in global warming, was also a contrarian who opposed the growing scientific consensus that a meteorite was largely responsible for the demise of the dinosaurs (Brooks Hansen, Pers. Comm., February 2006). Other authors include other well-known contrarians, including Sallie Baliunas, who testified along with Fred Singer in Congress in 1995, against the mainstream scientific view on CFCs and ozone. Baliunas, an astrophysicist, testified that ozone depletion would not lead to increases in skin cancer, a position that directly contradicted the statement submitted by the American Academy of Dermatology that ozone depletion would lead to increases in both basal cell carcinomas and malignant melanomas (Scientific Integrity

hearings, note 63 , Baliunas testimony on 123- 133. Cf. statement from American Academy of Dermatology on pp. 7-11.

²⁸ We focus here on the Marshall Institute, one of the first think-tanks to engage the contrarian position on global warming. Aaron M. McCright and Riley Dunlap note that, between 1990 and 1997, this strategy was taken up broadly by “prominent conservative think tanks.” These authors emphasize that while science studies scholars have emphasized the social construction of scientific knowledge, and sought to understand how scientists established the reality-problem of global warming, conservatives constructed a parallel narrative of “non-problematicity”, which few scholars have analyzed. We quite agree, except for departing from accepting the label of “conservative” to describe the individuals and ideologies involved. We consider it radical market fundamentalism, discussed below.

McCright and Dunlap, “Challenging Global Warming as a Social Problem: An Analysis of the Conservative Movement’s Counter-Claims,” *Social Problems* 47 (2000): 499-522.

²⁹ These include particularly Patrick Michaels, Frederick Seitz, and S. Fred Singer. Michaels has been a visiting scientist at the Marshall Institute, Seitz was the founding Director (as discussed below), and Singer is the author of a chapter in a book recently published by the Marshall Institute. Some characteristic articles include Patrick Michaels, “Benign Greenhouse,” *Research & Exploration* 9 (1993):

222-233; Patrick Michaels, "Global Warming - Failed Forecasts and Politicized Science," *Waste Management* 14 (1994): 89-95; Patrick Michaels, "Global Warming Warnings: A Lot of Hot Air," *USA Today Magazine* 129 (2001): 18-20; Patrick Michaels and Robert C. Balling, *The Satanic Gases: Clearing the Air About Global Warming* (Washington, D.C.: Cato Institute, 2000); Frederick Seitz, S. Fred Singer, and H. W. Ellsaesser, "Coverup in the Greenhouse? (Letter to the Editor)" *Wall Street Journal*, July 11, 1996 (eastern edition), 15; S. Fred Singer, "The Science Behind Environmental Scares," *Consumers Research Magazine* 74 (1991): 17-21; S. Fred Singer, "No Scientific Consensus on Greenhouse Warming (commentary)," *Wall Street Journal*, September 23, 1991 (eastern edition), 14; S. Fred Singer, "Global Warming Remains Unproved (Letter to the Editor)," *The New York Times*, September 19, 1995 (late edition), A20.

³⁰ George C. Marshall Institute, "Natural Climate Variability," <http://www.marshall.org/article.php?id=340>, accessed on February 16, 2006.

³¹ See for example, IPCC 4: "The observed widespread warming of the atmosphere and ocean, together with ice mass loss, support the conclusion that it is *extremely unlikely* that global climate change of the past fifty years can be explained without external forcing...." *IPCC Climate Change 2007: The Physical Science Basis*, Summary for Policy-makers, on p. 10., released February 2007.

³² Rebecca Slayton, "Discursive Choices: Boycotting Star Wars between Science and Politics," manuscript submitted to *Social Studies in Science* (2006).

³³ Robert Jastrow to Robert Walker, Letter, December 1, 1986, Box 21, George Marshall Institute 9/86-1/88, S.I.O. Office of the Director (Nierenberg) Records, 1904-1992, AC2, Scripps Institution of Oceanography, University of California, San Diego.

³⁴ George C. Marshall Institute to William Nierenberg, Draft Proposal, December 12, 1984, 75:6, George Marshall Institute 9/86-1/88, S.I.O. Office of the Director (Nierenberg) Records, 1904-1992, AC2, Scripps Institution of Oceanography, University of California, San Diego.

³⁵ Robert Jastrow to Robert Walker Letter, 1986.

³⁶ *Ibid.*

³⁷ *Ibid.* Kendall would win the 1990 Nobel Prize in Physics for his work on inelastic electron scattering.

³⁸ James Frelk to William Nierenberg, Enclosure of an excerpt of Strategic Defense Initiative of February 19, 1986, December 2, 1986, Box 21, George Marshall Institute 9/86-1/88, S.I.O. Office of the Director (Nierenberg) Records, 1904-1992, AC2, Scripps Institution of Oceanography, University of California, San Diego.

³⁹ John McElroy to Robert Walker, Letter, June 19, 1995, Box 21, Marshall Institute Correspondence, 1993-1995, S.I.O. Office of the Director (Nierenberg) Records, 1904-1992, AC2, Scripps Institution of Oceanography, University of California, San Diego. A copy was faxed to Nierenberg from the Marshall Institute, raising the interesting question of how the Institute got a copy.

⁴⁰ John McElroy to F. James Sensenbrenner, Letter, June 20, 1995, Box 21, Marshall Institute Correspondence, 1993-1995, S.I.O. Office of the Director (Nierenberg) Records, 1904-1992, AC2, Scripps Institution of Oceanography, University of California, San Diego.

⁴¹ For general background on the tobacco industry activities, including their scientific research programs, and entry into the copious on-line documents regarding tobacco industry activities made public during litigation, see Stanton A. Glantz, John Slade, Lisa A. Bero, Peter Hanauer, and Deborah E. Barnes, eds., *The Cigarette Papers* (Berkeley: University of California Press, 1996). For a discussion of the role of the research program in exploring other causes of cancer, such as stress and “personality traits,” see Executive Summary, and Summary of the RJR Nabisco, Inc., Biomedical Research Grants Program for 1987, <http://tobaccodocuments.org/rjr/507720494-0525.html> accessed on February 16, 2006; re-checked on August 3, 2007.

⁴² Executive Summary and Summary of the RJR Nabisco, Inc., Biomedical Research Grants Program for 1987, <http://tobaccodocuments.org/rjr/507720494-0525.html> accessed on February 16, 2006; re-checked on August 3, 2007; see also Frederick Seitz to H. C. Roemer, Vice President and General Counsel RJ Reynolds Industries, May 1, 1978, Summary of RJR Nabisco, Inc., Biomedical Research Grants Program for 1987, in <http://tobaccodocuments.org/tplp/504480670-0672.html>, accessed February 19, 2006; re-checked 3 August, 2007.

⁴³ Frederick Seitz, "Draft of Presentation "Presentation to the International Advisory Committee—R.J. Reynolds Industries." 5/9/79, pp 1-2, at <http://tobaccodocuments.org/tplp/504480541-0562.html>, accessed on February 16, 2006, and checked on August 2, 2007.

⁴⁴ *Ibid.*, on p 2 of the document, p. 3 of the web site.

⁴⁵ Colin Stokes, "Draft Presentation Prepared by RJR Managerial Employee for Review and Approval by RJR in-house legal counsel Concerning A Scientific Research Program and Containing Hand-written Marginalia of RJR in-House legal Counsel Concerning Same." 24 August 1979, http://tobaccodocuments.org/bliley_rjr/504480518-0529.html, accessed on February 19, 2006.

⁴⁶ Colin Stokes, "Draft Presentation Prepared by RJR Managerial Employee for Review and Approval by RJR in-house legal counsel Concerning A Scientific Research Program and Containing Hand-written Marginalia of RJR in-House legal Counsel Concerning Same." 24 August 1979, http://tobaccodocuments.org/bliley_rjr/504480518-0529.html, accessed on February 19, 2006.

⁴⁷ Colin Stokes, "Draft Presentation Prepared by RJR Managerial Employee for Review and Approval by RJR in-house legal counsel Concerning A Scientific Research Program and Containing Hand-written Marginalia of RJR in-House legal Counsel Concerning Same." 24 August 1979, http://tobaccodocuments.org/bliley_rjr/504480518-0529.html, accessed on February 19, 2006.

⁴⁸ Robert N. Proctor, *Cancer Wars: How Politics Shapes What We Know and Don't Know About Cancer* (New York: Harper Collins, 1996); Glantz et al., *The Cigarette Papers*.

⁴⁹ On the history of the SST, see Erik Conway, *High-Speed Dreams: NASA and the Technopolitics of Supersonic Transportation, 1945—1999* (Baltimore: The Johns Hopkins University Press, 2005).

⁵⁰ S. Fred Singer, "No Scientific Consensus on Greenhouse Warming (Letter to the Editor)," *Wall Street Journal*, September 23, 1991, 14; S. Fred Singer, "Global Warming's Domsday Nowhere in Sight (Letter to the Editor)," *New York Times*, September 28, 1993, 18.

⁵¹ <http://www.sepp.org/>, accessed on February 16, 2006.

<http://heartland.org/>, accessed on February 19, 2006.

<http://www.aei.org/>, accessed on February 19, 2006.

<http://www.marshall.org/>, accessed on February 16, 2006.

⁵²Summary for Policy-makers: The Science of Climate Change, IPCC Working Group I, 1995, <http://www.ipcc.ch/pub/sarsyn.htm>, accessed on February 19, 2006.

⁵³ S. Fred Singer, *Hot Talk, Cold Science: Global Warming's Unfinished Debate* (Oakland: Independent Institute, 1997), ix.

⁵⁴ S. Fred Singer, *Hot Talk, Cold Science: Global Warming's Unfinished Debate* (Oakland: Independent Institute, 1997), viii.

⁵⁵ S. Fred Singer, "Ozone Scare Generates Much Heat, Little Light," *Wall Street Journal*, April 16, 1987 (eastern edition) 30; S. Fred Singer, "Drastic Remedies Are Not Needed," *Consumer Research Magazine* 71 (1988): 32-33; S. Fred Singer, "My Adventures," 34-38; S. Fred Singer, "Hot Words on Global Warming (Letter to the Editor)," *Wall Street Journal*, January 15, 1996 (eastern edition), 13; S. Fred Singer, "Climatic Change: Hasty Action Unwarranted," *Consumer Research Magazine* 80 (1997): 16-20; S. Fred Singer, "Global Warming: What We're Not Told (Letter to the Editor)," *Washington Post*, January 26, 1998, 22. See also the discussion on Scripps Institution of Oceanography in Mooney, *The Republican War*, 56-59; Ross Gelbspan, *The Heat is On*, 34-36, 46-49; William K. Stevens, *The Change in the Weather: People, Weather, and the Science of Climate* (New York: Delta Books, 1999), 245-249.

⁵⁶ Mooney, *The Republican War*, 41-43.

⁵⁷ F. Sherwood Rowland, personal interview, September 7, 2005.

⁵⁸ Richard Elliot Benedick, *Ozone Diplomacy: New Directions in Safeguarding the Planet*. (Cambridge, MA: Harvard University Press, 1991), 99. On the Protocol as an “adaptive regime,” see Edward A. Parson, *Protecting the Ozone Layer: Science and Strategy* (New York: Oxford University Press, 2003), 197-244.

⁵⁹ The “missing science” from the 1985 assessment was that the scientific community had not considered the possibility that the chemical reactions taking place on ice and particle surfaces might be significantly different than those taking place solely in the gas phase. The presence of ice accelerated the release of active chlorine, producing higher ozone destruction rates. Cold temperatures in the Antarctic stratosphere allowed the formation of “polar stratospheric clouds,” which were composed primarily of ice crystals. Several different research groups demonstrated this phenomenon in laboratory experiments during 1986. See Parson, *Protecting the Ozone Layer*, 149-153.

⁶⁰ World Meteorological Organization Global Ozone Research and Monitoring Project, *Scientific Assessment of Stratospheric Ozone: 1989*, no. 20, vol. 1. (Washington, DC : National Aeronautics and Space Administration, 1989), vii.

⁶¹ Parson, *Protecting the Ozone Layer*, 163, 214-216. See also United Nations Environment Programme, Ozone Secretariat, “Montreal Protocol,” http://www.unep.ch/ozone/Treaties_and_Ratification/2B_montreal_protocol.asp, accessed on February 16, 2006.

⁶² S. Fred Singer, “Ozone Scare Generates Much Heat, Little Light,” 1; S. Fred Singer, “The Hole Truth about CFCs,” *Chemistry and Industry* 6 (1994): 240.

⁶³ "Scientific Integrity and Public Trust: The Science behind Federal Policies and Mandates: Case Study I: Stratospheric Ozone: Myths and Realities. (Washington, D.C.: U.S. Government Printing Office, 1996), pp. 50-65, quote on p. 54. See also Mooney, *The Republican War*, 57.

⁶⁴ <http://www.hhs.gov/news/press/2006pres/20060627.html>

⁶⁵ "Draft Only the Epa and the Science of Environmental Tobacco Smoke (sic), http://tobaccodocuments.org/nysa_ti_m2/ti40481951.html, NYSA Numbers 0221 B1793 04A, Box 9017 Walter Woodson files, Executive Committee Meeting Mailings and meetings, 5/94, loaded 27 January 2005 accessed 6/26/2006.

⁶⁶ "Risk Assessment in the Federal Government: Managing the Process. National Academy Press, Washington DC 1983. This is the book that first firmly established definitions for hazard identification, dose-response assessment, exposure assessment, risk assessment and risk management. At the time of this paper, a new NRC committee was "revising" the Red Book, "Improving Risk Analysis Approaches Used by the US EPA," chaired by Tom Burke.

⁶⁷ Judith Graham, email comm.. August 6, 2007 7:03:12 AM PDT.

⁶⁸ --August 11, 1994 Letter from Samuel D. Chilcote to The Tobacco Institute, Members of the Executive Committee, http://tobaccodocuments.org/nysa_ti_m2/TI10882879.html1.html, accessed 7/10/2006

⁶⁹ The Luntz Research Companies—Straight Talk” on p 137. See also Mooney, *The Republican War on Science*.

⁷⁰ American Opinions on Global Warming, Anthony Leiserowitz, Principal Investigator, <http://environment.yale.edu/news/5305-american-opinions-on-global-warming/> Polls also show that Americans have known about global warming for a long time, but in the late 1990s the issue became more politicized—with Republicans much more likely to disbelieve the scientific evidence, suggesting that the disinformation campaigns were effective—having reached their intended audience. See, for example, “American Opinion on Global Warming: The Impact of the Fall 1997 Debate.” Jon A. Krosnick, Penny S. Visser, and Allyson L. Holbrook, *Resources* 5 (133): Fall 1998, pp. 5-9.

⁷¹ McCright and Dunlap note that surveys show that most Americans *do* believe that global warming is a serious problem, suggesting that the misinformation campaigns have not been successful in producing public ignorance of the issue. However, the Leiserowitz work demonstrates that they have been effective in convincing the public that the scientific jury was still out, and for some significant sector of the population, this was consistent with believing that action was still “premature.” (see, for example Pew Research Center for The People and the Press, July 2006, “Little consensus on warming,” July 12, 2006, <http://people-press.org/reports/display.php3?ReportID=280>; re-accessed 10/15/07. In February 2007, on the release of the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Vice President Richard Cheney continued to insist on

the uncertainty, saying in an interview with ABC news, "I think there's an emerging consensus that we do have global warming. ...Where there does not appear to be a consensus...is the extent to which that's part of a normal cycle versus the extent to which it's caused by man, greenhouse gases, etc." Yet, the IPCC had explicitly addressed the causal issue, writing "...most of the observed warming over the last 50 years is very likely to have been due to the increase in greenhouse gas concentrations...." "The observed widespread warming of the atmosphere and ocean, together with ice mass loss, support the conclusion that it is *extremely unlikely* that global climate change of the past fifty years can be explained without external forcing...." (IPCC, FAR, Summary for Policy-makers, on p. ---).

As of this writing (October 2007), the White House was continuing to reject all but voluntary action, citing scientific uncertainties as justification [see, for example, Elizabeth Kolbert, *Field Notes from a Catastrophe: Man, Nature, and Climate Change* (New York: Bloomsbury, 2006)]. Perhaps the real effect of the climate agnotological campaign has been to provide political cover for inaction, and to generate sufficient confusion among the American public to make such inaction politically acceptable.

⁷² Including us.

⁷³ For evidence that those presenting anti-consensus views have received press and political attention greatly disproportionate to their numbers, see Aaron M. McKnight and Riley E. Dunlap, "Defeating Kyoto: The Conservative Movement's

Impact on U.S. Climate Change Policy," *Social Problems* 50 (2003): 348-373; Maxwell T. Boykoff and Jules M. Boykoff, "Balance as Bias: Global Warming and the US Prestige Press," *Global Environmental Change* 14 (2004): 125-136. This point has been underscored recently by Eugene Linden, *The Winds of Change: Climate, Weather, and the Destruction of Civilizations* (New York: Simon and Schuster, 2006), based on his own experience as a science writer.

⁷⁴ *Scientific American*, "Skepticism Toward *The Skeptical Environmentalist*," <http://www.sciam.com/article.cfm?articleID=00000B96-9517-1CDA-B4A8809EC588EEDF>, accessed February 16, 2006; see also Stuart Pimm and Jeff Harvey, "The Skeptical Environmentalist: Measuring the Real State of the World," *Nature* 414 (2001): 149-150; Stephen Schneider, "Hostile Climate: On Bjørn Lomborg and Climate Change," *Grist Magazine*, December 12, 2001, <http://www.grist.org/advice/books/2001/12/12/hostile/>, accessed on February 19, 2006.

⁷⁵ Committee for the Scientific Investigation of Claims of the Paranormal, "The Skeptical Environmentalist: A Case Study in the Manufacture of News," <http://www.csicop.org/scienceandmedia/environmentalist/>, accessed February 16, 2006.

⁷⁶ Stephen Schneider, "Hostile Climate."

⁷⁷ *Time Magazine*, "The 2004 Time 100 Scientists and Thinkers," <http://www.time.com/time/2004/time100/scientists/>, accessed February 16, 2006.

⁷⁸ Schneider, "Hostile Climate."

⁷⁹ Bush's Chat with Novelist Alarms Environmentalists, Michael Janofsky, *The New York Times*, 19 February 2006,
<http://www.nytimes.com/2006/02/19/national/19warming.html?ei=5088&en=a7ab8a51ec6cf4df&ex=1298005200&partner=rssnyt&emc=rss&pagewanted=print>

⁸⁰ Michael Janofsky, "Michael Crichton, Novelist, Becomes Senate Witness," *The New York Times*, September 29, 2005 (late edition), E1; American Institute of Physics, "Senate Hearing Demonstrates Wide Disagreement About Climate Change," <http://www.aip.org/fyi/2005/142.html>, accessed February 16, 2006.

⁸¹ U.S. Senate Committee on Environment and Public Works, "Statement by Sen. Jeffords at EPW Hearing on Science and Environment," <http://epw.senate.gov/pressitem.cfm?id=246511&party=dem>, accessed February 16, 2006.

⁸² S. Fred Singer, "Global Warming: Do We Know Enough to Act?," *Environmental Protection: Regulating for Results*, ed. Kenneth Chilton and Melinda Warren (Boulder, CO: Westview Press, 1991), 45-46.

⁸³ *Ibid.*

⁸⁴ The book was by geographer Robert C. Balling, Jr., *The Heated Debate: Greenhouse Predictions Versus Climate Reality* (San Francisco: Pacific Research Institute for Public Policy, 1992).

⁸⁵ Aaron Wildavsky, "Global Warming as a Means of Achieving an Egalitarian Society: An Introduction," preface to Robert C. Balling, Jr., *The Heated Debate:*

Greenhouse Predictions Versus Climate Reality (San Francisco: Pacific Research Institute for Public Policy, 1992), xvi.

⁸⁶ Wildavsky, "Global Warming," xxxi.

⁸⁷ Myanna H. Lahsen, "Climate Rhetoric: Constructions of Climate Science in the Age of Environmentalism" (Ph.D. dissertation, Rice University, 1998), 358-369, 372-373, 379. See also "Technocracy, Democracy and U.S. Climate Science Politics: The Need for Demarcations." *Science, Technology, and Human Values*, 30(1), 137-169 (2005); idem, "The Detection and Attribution of Conspiracies: The Controversy Over Chapter 8" in George E. Marcus (ed.), *Paranoia Within Reason: A Casebook on Conspiracy as Explanation*, Vol. 6, Late Editions Series of *Cultural Studies for the End of the Century*, 1999, and idem., "Seductive Simulations: Uncertainty Distribution Around Climate Models." *Social Studies of Science* 2005 35, 895-922.

⁸⁸ Myanna H. Lahsen, "Climate Rhetoric: Constructions of Climate Science in the Age of Environmentalism" (Ph.D. dissertation, Rice University, 1998), 358-369, 372-373, 379.

⁸⁹ George Soros, "The Capitalist Threat," *The Atlantic Monthly* 279 (February 1997): 45-58.

⁹⁰ In her dissertation on the history of fisheries management, M. Carmel Finley shows how a similar ideology informed American fisheries policy, which shifted

the burden of proof onto those arguing for regulation, and helped to prevent meaningful restrictions on fishing effort which might have served to prevent the collapse of world fisheries. See "The Tragedy of Enclosure: U.S. Fisheries Science, Development, and Management, 1945-1995. University of California, San Diego, 2007.

⁹¹ Roger Pielke Jr., "When Scientists Politicize Science: Making Sense of Controversy Over The Skeptical Environmentalist," *Environmental Science and Policy* 7 (2004): 405-417.

⁹² It is also possible to be a communist and have no opinions whatsoever about global warming.

⁹³ National Academy of Science, *Changing Climate: Report of the Carbon Dioxide Assessment Committee* (Washington, DC: National Academy Press, 1983), xiii-xvi, 1-4; William Nierenberg, "Climate, CO₂ and Acid Rain," presented at the 80th Anniversary of the Scripps Institution of Oceanography, October 13 1983, Box 169, Folder 17, MC13, Papers of William Aaron Nierenberg, Scripps Institution of Oceanography Archives, University of California, San Diego; and see physicist Alvin Weinberg's scathing denunciation of the 1983 study's 'do nothing' attitude: Alvin M. Weinberg, "Comments on NRC Draft Report of the Carbon Dioxide Assessment Committee," July 6, 1983, Box 86, Folder 7, MC 13, Papers of William

Aaron Nierenberg, Scripps Institution of Oceanography Archives, University of California, San Diego.

⁹⁴ Mooney, *The Republican War*, 74.

⁹⁵ Erik M. Conway, *A History of Atmospheric Science in NASA* (Baltimore: Johns Hopkins University Press, forthcoming).