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This paper is drawn from my book with Erik Conway, *Merchants of Doubt* (2010). I'm pleased to say it is now issued in many different languages. In the book we were trying to answer a number of questions about the history of scientific debate over a set of issues related to environmental science. One of the questions we wanted to answer was: Why did the United States back off its commitment to act on the scientific evidence of climate change? Why did scientists play a major role in challenging that evidence? How was scientific dissent used as a political tool?

The story in some ways begins in 1992 with the UN Framework Convention on climate change. Many Americans have forgotten that the United States is a signatory to the Framework Convention, and that when our first President Bush signed the Convention in 1992, he called on world leaders to translate the written document into, »concrete action to protect the planet.« The UN Framework Convention came into force in 1994 when 164 countries signed on. And yet despite more than 17 meetings of the councils of parties since then, I think it is fair to say that very little has been done to implement those concrete steps. In Copenhagen in 2009, the UN Framework as further articulated in the Kyoto Protocol essentially collapsed. So what happened? Why did the United States not take those concrete steps that we had promised? What happened to the political will that had existed at that time in the United States, to prevent dangerous anthropogenic interference in the climate system?

To answer this question we need to step back one step to answer an earlier question: What happened to the concept of a science-driven framework? It is important for us to understand, particularly people who are interested in science, that the UN Convention was (and is) a science-driven framework. That is to say, it committed the signatories to stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. The perception was that scientists would determine what that level of greenhouse gases would be, and that the world would listen to those scientists and then act accordingly. Thus, a scientific consensus, or the concept of a scientific consensus, was a basic part of the political framework of the UN Framework Convention. Indeed, the UN Framework Convention was a response to more than a century of prior scientific work, which predicted that increased greenhouse gas concentrations and deforestation would lead to disruptive climate change.

In the book we recount some of the history of the development of the scientific knowledge regarding this question, starting with John Tyndall, the Irish experimentalist who first recognized that carbon dioxide was a greenhouse gas, and Svante Arrhenius, the Swedish geo-chemist, who did the first calculations of what would happen to the world's climate if we doubled atmospheric carbon dioxide; he found that it would increase the average temperature by one and half to four and half degrees Celsius. That was at the turn of the 20th century, more than 100 years ago. Also important was Roger Revelle, a professor at the University of California, who was involved in the effort to begin the monitoring of carbon dioxide in the atmosphere and his colleague Charles David Keeling. In 1958 Keeling began the systematic measuring of carbon dioxide, which has demonstrated today the dramatic increase in greenhouse gases. Indeed, by 1965 »Dave« Keeling's work had already come to the attention of President Lyndon Johnson in the United States, who in a special message to Congress said, »This generation has altered the composition of the atmosphere on a global scale through a steady increase in carbon dioxide in the burning of fossil fuels.«

By 1979 scientists around the globe, both in the United States as well as in Europe and elsewhere, were attempting to communicate to political leaders that there was a consensus – a scientific consensus – that climate change would result from man's combustion of fossil fuels and changes in land use. Thus, already by 1979 we see the emergence and articulation of a scientific consensus that if we continue to burn fossil fuels, and if we continue to deforest the planet, climate change would be the consequence. Now the 1979 work of the National Academy of Sciences was part of a much larger pattern of work emerging at that time, including very importantly the World Meteorological Organization, who met in Geneva in 1976 and issued, what is arguably, the first real call to action on the question of climate change, and a host of other studies in the United States and elsewhere, including the National Research Council in the United States, and the JASON Committee, a secretive group of high level advisors to the US Presidents. Robert White, the American director of the National Oceanic Atmospheric Administration, wrote in 1978 (speaking for the scientific community): »We now understand that industrial wastes such as carbon dioxide released during the burning of fossil fuels can have consequences for climate that pose a considerable threat to future society. Recent experiences have demonstrated the consequences of even modest fluctuations in climatic conditions and lent a new urgency to the study of climate. The scientific problems are formidable; the technological problems unprecedented; and the potential economic and social impacts, ominous.«

It was this concern, this recognition, that led to the creation of the Inter-governmental Panel on Climate Change in 1988, and to their second

assessment report in 1995, in which they first concluded that climate change was underway. In the 1995 report, scientists concluded that the »balance of evidence« suggested a »discernible human impact on global climate.« Again, here we see a consensus of scientific opinion emerging, not just that climate change was expected, but by 1995 that it was *underway*. In my own work I did analysis of the peer-reviewed scientific literature to test the question of whether or not the IPCC's statements were an accurate reflection of rank and file scientific opinion and was able to show that yes, indeed, it was.

Yet despite the consensus, the commitments of the UN Framework Convention, and the century and a half of science that it was based on, the world has not taken action sufficient to prevent dangerous anthropogenic interference in the climate system. As most of you know, carbon dioxide continues to climb. In 1958, when Dave Keeling first began to measure it, carbon dioxide in the atmosphere was at 315 parts per million. We know from ice core data that before the Industrial Revolution it was about 280 parts per million. Today, it is at 400 and climbing. Additionally, as we know from the work of the IPCC Working Group II, the impacts are also discernible, not only in the form of increased average surface temperatures but also in the form of accelerating sea level rise, higher sea surface temperatures, and intensified heat-waves, droughts, fires, and floods.

There are many reasons why the world has failed to act on climate change, and some, I would argue, are not particularly mysterious: inertia, vested interests, money, power. However, one aspect of this story did seem to us to be a little bit mysterious, namely, why *scientists* would challenge well-established science. This is the question of how scientific dissent came to play a political role. Since the time of the UN Framework Convention, a small handful of self-proclaimed ›sceptics‹ have challenged the scientific basis for concern, insisting that there was not actually a consensus and that the scientific jury was still out. This challenge, we document in our book, began with the work of three men in the United States who in 1984 created a think tank called the George C. Marshall Institute. Some people have expressed scepticism that so much damage could be done by so few people, but everything in life has a beginning, and often those beginnings start small and grow large. This is a story of a beginning that started small and grew very dramatically, and very damagingly.

The three men were all physicists who had come to positions of power and political influence in the Cold War as advisors to the US Government, based on their work in US weapons and rocketry programs. They were Robert Jastrow, an astrophysicist, William Nierenberg, a nuclear physicist who had worked on the atomic bomb during the Manhattan Project, and Fredrick Seitz, a solid-state physicist, well-known to most

physicists for his work with Eugene Wigner in solid-state physics. Seitz had risen to power and influence in the United States as President of the US National Academy of Sciences; he had also worked on the hydrogen bomb. In 1984, these three men created a think tank. The initial purpose was to defend Ronald Reagan's Strategic Defence Initiative (SDI), or what most of us in the United States called ›Star Wars.‹ The majority of American scientists and engineers opposed SDI, as they believed it would be destabilizing because it threatened the Cold War doctrine of Mutual Assured Destruction. These men, however, supported the SDI, and they began to challenge their scientific colleagues, began to argue that there was not a consensus, that there was a debate, and therefore that the media needed to give them equal time for their dissenting views. This turned out to be a very powerful strategy. Thus, following this strategy in the mid-1980s, they also began to challenge the scientific evidence of the risks of nuclear winter. Then in the late 1980s, as the Cold War came to an end, they found a new set of issues to become involved with: challenging the scientific evidence of the reality and risks of climate change. Why? Why would distinguished, prominent, successful scientists – indeed, brilliant scientists – men who clearly understood science, reject the work of their own colleagues, reject the scientific evidence of all of these threats?

It took us five years to answer this question. We found it by looking at who these men had worked with; who their allies were as this movement grew, and what other science they also challenged. It was not just climate science and nuclear winter and SDI. It was also acid rain, and stratospheric ozone depletion and the harms of radar and asbestos and second hand smoke. It also involved an argument around the pesticide DDT. Indeed, perhaps the strangest part of this story was the challenge to the scientific evidence of the harms of DDT and the legacy of the book *Silent Spring*. 2012 was the 50th anniversary of the publication of Rachel Carson's *Silent Spring* and one of the questions we asked ourselves was, why would these people want to re-open a 50-year-old scientific debate?

As some of you may know, the book *Silent Spring* is considered a classic of modern environmentalism. It was serialized in the United States in *The New Yorker* magazine, and it quickly became a bestseller. Carson became one of the most famous and admired women in the United States at that time. The book is widely credited with launching the second, or modern, environmental movement by calling attention to the risks of chemicals in the environment, particularly persistent pesticides. It provided a major impetus in the United States for the creation of the US Environmental Protection Agency. Moreover, it led to a major review of the question of pesticide use by the President's Science Advisory Committee, and ultimately to the decision to ban the use of DDT in the United States.

The decision to ban DDT in the United States was not based on *Silent Spring* but on the scientific evidence behind *Silent Spring*, evidence which was subsequently reviewed in the United States by the President's Science Advisory Committee. It was based on thousands of peer-reviewed scientific articles, numerous scientific reports from federal and state government scientific agencies, such as the US Fish and Wildlife Service and many state fish and game departments, and reviewed by the US Department of Interior and then ultimately by the newly created EPA. In short, it was based on a scientific consensus. And that scientific consensus became the foundation for a political consensus. In the late 1960s and early 1970s, on the basis of this scientific evidence, a political consensus emerged in the United States, among both Democrats and Republicans, conservatives and liberals, that the harms of DDT outweigh the benefits. This man shown in Figure 1 is William Ruckelshaus, the first director of the EPA, who announced the ban in 1972. He is seen here being sworn in next to the man who appointed him, Republican President Richard Nixon (Figure 1).

Since 1972 further scientific study has amply corroborated the early work. We now know for certain that DDT is highly damaging to wildlife and we know why it is damaging: because it is an endocrine disruptor. It disrupts the reproductive mechanisms of birds and fish and posed among other things a major threat to the Bald Eagle, the symbol of American freedom. It is also a bio-accumulator – it accumulates in the fatty tissues of mammals, and therefore works its way up the food chain, ultimately making its way into mammalian breast tissue, so that DDT was found in the breast milk of both cows and humans in the United States, and elsewhere. Moreover, it is an extremely persistent chemical, so even today, 50 years after the publication of *Silent Spring*, and 40 years after its banning, we still find DDT and its residues in fish and birds of prey in California, in areas near the factory where DDT was produced 40 years ago.

Much of the criticism of Rachel Carson at the time was that she cared more about fish and birds than people, but *Silent Spring* discussed the risks of persistent pesticides to humans as well as to fish and birds. Indeed, one of the most controversial claims at the time was the claim that DDT did pose a threat to people. Carson acknowledged that the direct evidence for human impacts was less clear, although she stressed that any harm to the world around us must inevitably affect us as well. However, in 2005, the British medical journal *The Lancet* published a meta-analysis of the scientific evidence regarding the harms of DDT. The analysis found that when it is used at the levels required for mosquito control – so-called ›ambient levels‹ – DDT exposure is associated with significant impacts on human reproduction. Indeed, and perhaps not entirely surprisingly, many of the same reproductive impacts that affect fish and birds also affect people. In Africa, and elsewhere, where DDT

has continued to be used, scientists observe an increased rate of preterm births, low birth weight babies and possibly birth defects. Among nursing mothers, DDT exposure is associated with a shortened duration of lactation and early weaning, which are correlated with higher infant mortality.

A major question in the 1970s was whether or not DDT caused cancer. At that time, there was no scientific consensus on that question; some scientists even today still find this to be somewhat controversial. It was a difficult question to answer, primarily because of the very long latency effects of cancer, which is a similar problem that we see in evaluating radiation exposure, tobacco, radon, asbestos, and many other forms of carcinogens. In 2007, however, a group of scientists in Berkley, California, did a very clever and interesting study. They went back and looked at blood samples that had been taken from reproductive aged women who had been exposed to DDT in the 1950s and 1960s; thus before the ban. Then they said, let us look at these women now 40, 50 years later – what were their rates of mortality and morbidity from breast cancer? Their epidemiological analysis revealed a five-fold increase in breast cancer among women with high levels of serum DDT or its metabolites. That is to say: there was a clear correlation between high blood levels of DDT in young women and breast cancer later in life.

The science is clear: DDT was and is dangerous, both to wildlife and to human beings. There was strong scientific evidence of this in the 1950s, 60s and 70s, and this has been corroborated by later studies. We now have more than half a century of consistent, accumulated scientific data. And yet, starting in the 1990s and continuing to the present day, there have been widespread attacks on Rachel Carson, on *Silent Spring*, and on the decision to ban DDT in the United States. These attacks do not simply include wondering about the evidence; it is not simply a matter of asking the question, well, what was the evidence, and was it really robust? Nor is it a question of revisiting the issue in light of new evidence which, as a scientist and a historian of science, I would argue is always legitimate. It is always legitimate to reopen a debate if we have new data. But the claim here is that the ban on DDT was a mistake, and not just any old mistake, but a mistake of historic proportions, that millions of people have died unnecessarily, from malaria, caused by »the hysterical overreaction about DDT.« The claim goes so far to say that Rachel Carson has blood on her hands and that she is guilty of genocide.

You may doubt that people would really say these things, so I will give you some examples of where and how they are indeed said. As far as we have been able to determine, this campaign began with an organization called the Competitive Enterprise Institute, which, like the Marshall Institute, is a think tank based in Washington D.C. In the mid-1990s they launched a campaign which they called *Rachel Was Wrong* and wrote,

»As it turns out Rachel Carson was wrong. Over thirty years after *Silent Spring*'s publication a wealth of scientific evidence suggests that many of the concerns Carson raised were unfounded.« This is where they begin to claim that the basic concern was unfounded, but the attack becomes more shrill. The Cato Institute, also a think tank in Washington D.C., claims that banning DDT was disastrous; that no scientific study has been able to replicate a case of actual harm from DDT. (We just saw that that is incorrect.) Another website reminds us that April 25 is World Malaria Day, which reminds us of that wonderful, magical chemical, DDT. »Malaria kills a child every twelve seconds and two hundred and fifty million adults every year. It is genocide,« said Oregon Institute of Science and Medicine's Art Robinson. I will tell you more about Art Robinson later.

The overall argument is that millions of people die every year from malaria, but these deaths could have been prevented by using DDT. Hence, this is genocide, and Rachel Carson is personally responsible. She has, »blood on her hands«; she is a mass murderer »worse than Hitler or Stalin.«

Steve Milloy is a commentator frequently featured on Fox News – a very widely watched news television station in the United States – and he runs a website which he calls, apparently without irony, junkscience.com. He has written, »It might be easy for some to dismiss the past forty-three years of eco-hysteria over DDT with a simple ›never mind,‹ except for the blood of millions of people dripping from the hands of Rachel Carson, Environmental Defence Fund and other junk science fuelled opponents of DDT.« Michael Crichton is the novelist famous for writing *Jurassic Park* and *The Andromeda Strain*, and one of the best-selling authors in the United States in the second half of the 20th century. In 2004, he wrote a book called *State of Fear* which was mainly a polemic against climate science but had a character in it who insists that banning DDT killed more people than Hitler: »It was so safe you could eat it.« Thomas Sowell, a conservative writer associated with the Hoover Institution at Stanford University, has written, »There has not been a mass murderer executed in the past half century, who has been responsible for as many deaths of human beings as the sainted Rachel Carson.« The Heartland Institute, who got a lot of attention in United States in 2012 for some leaked documents about their activities (and is a major source of contrarian claims about climate science) says on their website »that some one million African, Asian and Latin American lives could be saved annually had DDT not been banned by the US Environmental Protection Agency.« Other websites say that »fifty million are dead, more deaths are likely: this is the worst crime of the century.« (It seems particularly strange reading that here in Germany.) After the right-wing radio host

Rush Limbaugh parroted the Rachel Was Wrong attack, the Competitive Enterprise Institute nominated him for the Nobel Peace Prize.

It is important to point out that these claims have, in the United States, seeped into what is considered to be the mainstream or prestigious media. Even the *New York Times* has repeated these claims. John Tierney is a long time columnist for the *New York Times* who has claimed that *Silent Spring* was a hodgepodge of science and junk science. He argued that the person who got the science right was an obscure man named I.L. Baldwin, a professor of agricultural bacteriology at the University of Wisconsin. (I find this particularly peculiar since DDT has nothing to do with bacteria.) No one listened to him, Tierney insisted, because Baldwin did not scare people; his calm demeanor was no match for Carson's rhetoric which quote, »still drowns out real science.« Tina Rosenberg, also writing for the *New York Times*, who won a prestigious MacArthur fellowship in 2004, instructed her readers: »What the World Needs Now is DDT.«

What are we to make of all of this? Was Rachel wrong? We have already seen that the answer to this is no. It is ›no‹ for several reasons, but perhaps the most important is that all of these claims are illogical, and completely counter-factual, for one simple, basic reason: *the ban on DDT in the United States did not apply in Africa or anywhere else*. Other countries were free to use DDT in malaria control, and many did. Some countries still do. So whatever did or did not happen in Africa, Asia and Latin America was not because of the US decision to ban DDT in the United States. Indeed, when EPA administrator William Ruckelshaus announced in 1971 that the United States was going to ban the use of DDT in the United States, he stressed that US manufacturers were free to continue to manufacture and sell the product for disease control overseas, and for many years they did. In fact, the DDT toxicity we still have in California today comes from a plant in Orange County that continued to manufacture DDT into the 1980s for use in disease control overseas. Moreover, Ruckelshaus stated explicitly that his agency would »not presume to regulate the felt necessities of other countries.« So whatever did happen in Africa, it was no more the fault of Rachel Carson than it was of William Ruckelshaus, or Richard Nixon.

Moreover, as I have already pointed out, the peer-reviewed scientific research has overwhelmingly showed that DDT does harm eco systems and the people in it; it is not so safe you can eat it. Well, you could eat it, because the harms from DDT do not come by eating it – they do not come from conventional ingestion toxicity – they occur because it is an endocrine disruptor. Thus, our conventional notions of toxicity had to change with DDT. The scientific evidence moreover shows that DDT is not and never was a magical chemical, as if such a thing could ever exist. Its use was phased out or greatly decreased around the world because in

most cases it stopped working when mosquitoes evolved resistance. This is probably the most important part of why all of these contrarian claims make no sense, because the World Health Organization and the US Centers for Disease Control agree that the global malaria eradication campaign – which was ended in 1969, *before* the US ban – did not achieve its stated objective. That is to say, it failed to eradicate malaria, primarily because the disease vectors, namely mosquitoes, developed resistance. Even before the US ban, the World Health Organization began to decrease its use of DDT because DDT had stopped working. The World Health Organization also notes there are major additional causes of persistent malaria, including the »inappropriate use of anti-malaria drugs, which contributed wide spread resistance in the malaria parasite.«

It is important to acknowledge that malaria is an extremely serious disease; the World Health Organization estimates that about one million people die every year, mostly in Africa, and mostly infants and young children. However, these deaths are not because of Rachel Carson or the US ban on DDT. These deaths are because of *evolution*, because mosquitoes and parasites evolve faster than our ability to invent new pesticides and new drugs. The World Health Organization says that the best way to control malaria is to control the malaria-bearing mosquito, and this can be done in a number of ways, including providing insecticidal nets to high risk groups, mainly children and pregnant women, and by indoor residual spraying with pesticides that can include DDT. DDT is not banned and it can help when used appropriately. But it is not a magic chemical.

So who are the people attacking Rachel Carson and claiming against all evidence that DDT was a magical chemical, that it was banned and that this ban amounted to genocide? If we recapitulate the names, some of them I have already mentioned – John Tierney, Michael Crichton, Steve Milloy, the Competitive Enterprise Institute, the Heartland Institute, the Cato Institute, the Hoover Institution, Arthur Robinson, the Oregon Institute of Medicine Science and Medicine – these are all names that appear in the story of the merchants of doubt. Not one of these individuals is an expert in DDT; not one is an entomologist, an epidemiologist, or a public health expert. In fact, of all of them, only Arthur Robinson is a scientist of any kind, and I will tell you more about him in a moment. Most of these people are simply not scientists at all; that is to say, these are not scientific experts making these claims – they are novelists, commentators for right-wing radio and newspapers, journalists etc. Moreover, none of these organizations, not one of these institutes, is a university or scientific research institute. On the contrary, these are groups and individuals with a long history of attempting to challenge scientific evidence on a host of topics, from the harms of tobacco to the reality of climate change. All of them have been involved all along the way

of challenging the scientific events of acid rain, the ozone hole, climate change; they are what we call ›serial contrarians.‹ They are merchants of doubt. All of them share the same political ideology: the defence of free market capitalism and deregulation.

Let me tell you a little bit more about some of these individuals: Steve Milloy is the founder of a group called TASSC, the Advancement of Sound Science Coalition, which sounds like a good idea but was actually a front organization created by the Philip Morris tobacco corporation in the 1990s to attack the US Environmental Protection Agency over the question of second hand smoke. The documentary evidence of this is overwhelming; it is in our book. Steve Milloy also attacked the scientific evidence of acid rain, global warming, asbestos and more. The Competitive Enterprise Institute has been for long a source of scepticism about climate change. The Heartland Institute is the funder of a group called the Non-governmental Panel on Climate Change, which sets itself up as an alternative to the IPCC. They are also the major funders of a man named Anthony Watts, who runs a very prominent climate-denial blog in the United States. They have a long association with the Tobacco Industry and were very active in the 1990s campaigning against the Clinton Administration's healthcare initiative. The Cato Institute is also a long time source of funding for climate change scepticism, contrarianism and denial.

Many of these groups, when they talk about DDT, do the same thing they have done for years. We talked about this in the book: they cite scientific studies in order to give their claims the veneer of scientific respectability and create the impression of scientific dissent. Very often they repeatedly cite one or two isolated studies, ignoring the bulk of the scientific evidence. Or they cite a »scientific study« that is not really a scientific study at all.

In the case of DDT, the principal article that they cite is entitled, ›DDT – a case study in scientific fraud.‹ This article presents the central claim that the worldwide effect of the US ban has been millions of preventable deaths. This is the core claim: millions of preventable deaths. But if we ask: what is this paper? Is this a legitimate scientific paper? The answer is no – it is published in a journal called the *Journal of American Physicians and Surgeons* – which is not recognized by the Institute for Scientific information as a peer-reviewed scientific journal. In fact, it is edited by a man by the name of Arthur Robinson, who works out of his home, which he calls the Oregon Institute of Science and Medicine. Robinson was also the source of the so-called Oregon Petition, a very famous petition declaring that 30,000 American scientists did not believe in climate change. This petition was widely cited on contrarian and sceptical websites, but it was fraudulent. It was not a petition of climate scientists. Many of the people who signed this petition – well, it was

not really clear who these people were – but they included the singers The Spice Girls and the actor Michael J. Fox. The Oregon Institute also circulated an article claiming to refute the evidence of anthropogenic global warming, which was formatted to make it appear as if it were a scientific article published in the Proceedings of the National Academy of Sciences. It was not. This is an example of what Erik Conway and I have called the creation of a »scientific Potemkin Village.« In this case, the misrepresentation was so egregious that the US National Academy of Sciences issued a press release to dissociate itself from this publication.

What is going on here? Why are people – who are not scientists – trying to reopen a 50- year-old scientific debate with claims that are easily shown to be factually incorrect? Why are they the same people who deny the scientific evidence of the harms of tobacco, acid rain, chlorinated fluorocarbons and global warming? If you go to their websites, these organizations are not shy about telling you what their political ideology is. Cato, Competitive Enterprise Institute, Hoover, and Heartland are all dedicated to the defence of free market capitalism and opposition to government regulation of the market place. Many of them have ties to the tobacco industry, and all of them are at least partially funded by either regulated industries, like the tobacco industry; industries that are worried about being regulated, like the cell phone industry (who are now a major funder of some of these groups); or by libertarian foundations in the United States such as the Koch Foundations, Olin, Scaife, and, Smith Richardson. Many of these foundations derive their money from traditional oil and fossil fuel wealth, but they all share a common political ideology. It's what George Soros has called ›free market fundamentalism‹ – a fundamental faith in the power of free markets to solve social problems. Thus, what we are seeing is a toxic nexus of political ideology and financial interest.

I think the best way to think about free market fundamentalism is to see it as a kind of end-member of what in Europe would be thought of as neo-liberalism, but focused on deregulation and releasing the so-called »magic of the marketplace.« This idea – the idea of deregulation as a powerful driving force – was promoted going back to the late 1970s, by UK Prime Minister Margret Thatcher in the United Kingdom and by Presidents Jimmy Carter and Ronald Reagan in the United States. Since them, other European leaders have promoted this idea as well, especially Nicolas Sarkozy in France. Indeed, it is important to recognize that it was not just conservatives, Tories, or Republicans in the United States. It was promoted throughout the 1990s by the so-called Washington Consensus, led by US Democratic President Bill Clinton and UK Labour leader Tony Blair. Indeed, right up until the global financial collapse of 2008, there was a by-partisan consensus in the United States, the United Kingdom and in many parts of Europe on the virtues of moving

towards deregulation of financial markets, and the solution of environmental problems by creating environmental markets, such as emissions trading programs to control greenhouse gas emissions.

The intellectual roots of this movement can be found in the United States in the work of Milton Friedman, the Chicago economist who wrote a book that was very influential in Ronald Reagan's thinking called *Capitalism and Freedom*. Friedman's central argument was that economic freedom was essential to political freedom because once a government intervenes in the marketplace to determine how goods and services are distributed, or what employment a person could have, it is only a matter of time before governments began to diminish civic and political liberty as well. Friedman owed his inspiration to the Austrian neo-liberal economist Friedrich von Hayek and his seminal book, *The Road to Serfdom,* published in 1944, near the end of World War II. Von Hayek believed that social democracy – Western European social democracy – was a slippery slope towards communism, one which would put Western Europe on the road to serfdom. He was a very strong critic of Western European social democracy for this reason.

In the United States – I'd like to point out – one can be a political conservative who believes in free market principles and also accept the scientific evidence of the harms of DDT and the realities of climate change. Indeed, that is what President George H.W. Bush did in addressing acid rain by creating an emissions trading system for sulfur dioxide pollution. It is what the European Union has done to set up an emissions trading system for carbon. President Bush was a conservative Republican, an advocate of market-based mechanisms to solve these problems, and this is why he implemented emissions trading to control acid rain in the United States and Canada in the 1990s. This is also what Arnold Schwarzenegger implemented in California under California Law AB32: an emissions trading system similar to the European's emissions trading system to control greenhouse gases.

However, these have been the exceptions; President Bush and Governor Schwarzenegger have been the exceptions in the American political scene. The dominant reaction for the past 20 years, really ever since Rio, has been for free market advocates to deny the reality of the problem, to deny the *need* for a response, and to pursue a strategy of doubt and fear instead. Free market fundamentalists have exploited scientific uncertainty and dissent – both real and exaggerated – as a political strategy. They have sowed doubt about the science and fear of what acting on it will lead to. Specifically, the fear that acting on the science will lead to government intrusion, not just in the market place but in our personal lives as well.

This comes out most clearly in the debate that took place in the 1990s over second hand smoke. For this part of the story I need to introduce

one more character, another physicist, by the name of S. Fred Singer. Like the others, Singer had come to prominence during the Cold War; he was a pioneer in the US rocketry programs, and in the early 1990s worked with the Philip Morris tobacco company helping to challenge the US Environmental Protection Agency over the issue of second hand smoke. In 1993, working with a lawyer named Kent Jeffries, Singer published a report that was funded by the Tobacco Institute, entitled »*EPA and the science of environmental tobacco smoke.*« Like the others, Singer was a physicist and, as I have just mentioned, Jeffries was a lawyer affiliated with Cato and the Competitive Enterprise Institute, again names we've heard.

Why did a physicist and a lawyer write a report about tobacco? The answer is that an EPA scientific advisory panel had concluded that environmental or second hand smoke was a class A, or proven, carcinogen. The scientific evidence suggested that it was responsible for 3,000 additional adult lung cancer deaths every year in the United States, and many more in Europe and Japan. (Quite a bit of the evidence for this actually came from Germany and Japan.) Second hand smoke also caused between 150,000 and 300,000 cases of bronchitis and pneumonia in infants and young children, and showed a statistical correlation with sudden infant death syndrome, or cot death. The independent peer-review panel indeed found that the first draft of the report was weaker than the evidence warranted. This was an interesting detail on the study. These climate sceptics often accuse climate scientists of being alarmists; of exaggerating the harms. One of the questions we were interested in our book was: Was there any evidence that was true? Was there evidence that scientists had overreacted to the data?

This turned out to be a very interesting case, because we found strong evidence that the opposite was true: that scientists had actually been conservative. The draft report was reviewed by an independent peer-review panel who criticized it for being too *weak*. They found »the evidence for respiratory health effects in children to be stronger and more persuasive than the report stated and [they] suggested that the panel consider the possibility that the impact of environmental tobacco smoke on respiratory effects in children may have much greater public health significance than the impact on lung cancer in non-smokers.« When the peer-review panel reviewed the final report they still found the overall assessment of the risk to children to be ›on the conservative side.‹ On the central question of labelling environmental tobacco smoke as a class A carcinogen, the committee was unanimous in endorsing this classification.

Thus: no doubt, no debate, no dispute, no dissent whatsoever among either the scientific panel or the independent peer-review panel that second hand smoke was a carcinogen, caused pneumonia and bronchitis infants and young children, and was correlated with sudden infant

death syndrome. So why did these people – why did a *rocket scientist* – challenge this work? Singer answers this question in his own words: »If we do not carefully delineate the government's role in regulating dangers, there's essentially no limit to how much government can ultimately control our lives.« Here in a nutshell you see the capitalism and freedom argument: the road to serfdom. The argument that if we allow the government to intervene in the marketplace to protect us from second hand smoke, it is only a matter of time before we find ourselves living in a totalitarian society. Indeed, throughout our story we see this anxiety, that environmentalists are socialists who want to control our lives. Contrarians refer to environmentalists as watermelons: green on the outside but red on the inside. George Will, who writes for the *Washington Post* – not generally considered to be an environmentalist newspaper – has called environmentalism a green tree with red roots. Senator James Inhofe, the Oklahoma senator who has threatened to indict climate scientists for conspiracy to lie to congress, has called climate science a liberal conspiracy to bring down global capitalism (to which I reply scientists should be so organized). And the Viscount Monckton of Brenchley, formerly an advisor to Margaret Thatcher and now the latest climate denier to get attention in the United States, calls climate scientists, »greens too yellow to admit they are red.«

This argument has now spread in the United States so widely that it has affected essentially the entire Republican Party. In June 2012, when presidential candidate Mitt Romney broke with the majority of his party in saying that he did accept the scientific evidence of climate change (which incidentally he's backed off that since that time), his opponent, former house speaker Newt Gingrich, retorted that the »push to address climate change is just the newest excuse to take control of our lives.« In short, the argument here is that environmentalists and environmental scientists are actually socialists with a hidden agenda which is anti-business, anti-technology and anti-free market.

These debates were not about the science. These were not debates among scientists, in the halls of research universities, arguing about evidence or methods. I have spent most of my professional career writing about debates that were those kinds of debates, and this is not that. These are debates about *governance* – about the appropriate role of government in the market place and in our lives, and specifically about regulation. This becomes clear when we look at who these people are as well as their affiliations. It becomes clear then as I mentioned – Steve Milloy, Michael Crichton, Thomas Sowell – none of these people is a scientist. None of these organizations is a scientific institution. *This is political opposition being camouflaged, for politically strategic reasons, as scientific dissent.* The political opposition is based on a commitment to laissez-faire capitalism – the belief that government should not intervene

in the market place – so where there is scientific evidence that business activities are endangering the public in ways that might warrant government intervention, the merchants of doubt doubt the science.

To return to DDT in the late 1990s and 2000s, DDT became a target because banning it was the original environmental regulation; it was the first major federal regulation in the United States to ban a product because of the harms that it was causing, harms that were recognized and documented by scientists. The challenges to the banning of DDT, the attacks on Rachel Carson, and the attempts to rewrite history are all part of an attempt to undermine the concept and legitimacy of environmental regulation. Indeed, part of the current attempt to undermine the Environmental Protection Agency is the issue of climate change. Because the United States did not sign onto the Kyoto protocol and walked away from the Framework Convention on climate change, the political debate in the United States has now shifted. It shifted to the role of the EPA, because in the most important US court case that we have had to date on the question of climate change, the case of Massachusetts and 13 other states against the EPA, the Supreme Court of the United States ruled that carbon dioxide is a pollutant, and the EPA has a legal obligation to regulate it under the Clean Air Act. Not surprisingly, this finding is being challenged again: a political coalition is trying to stop the EPA from doing what the Supreme Court empowered it to do. That coalition includes many of the same people involved on the attack on Rachel Carson and the attempted rehabilitation of DDT.

Why? Think of it this way: if you can show that the original environmental regulation – the most famous thing that the EPA ever did – was a mistake based on a fallacy, based on junk science, then you can undermine the EPA as a whole. And you can weaken the political will for the EPA to regulate greenhouse gases that cause climate change. This is why the same people who claim that global warming is not real or does not matter or there is no consensus amongst experts, also claim – equally counterfactually – that DDT was a magical chemical. It is the same people who try to make us believe in the magic of the market place. In the 1950s, the famous anthropologist Ashley Montagu concluded that reality has a well-known liberal bias. Erik Conway and I would argue that it might not be a liberal *bias*, but reality has underscored the limits of capitalism, the problem of market failure.

This is the common thread that unites all the diverse science that was challenged by the merchants of doubt. They all involve the recognition of market failures; they all involve examples of behavior that generated large external costs and therefore provided potential justification for government intervention in the market place. This is why the British economist Nicholas Stern, former Chief Economist of the World Bank, has called anthropogenic global warming, »the greatest and widest ranging

market failure ever seen.« Reality, in the form of scientific evidence, has shown us that free market capitalism, like any human activity, has its limits. These limits are the so-called negative externalities: costs that accrue to people who did not reap the benefits of the activities that generated them, costs that are not reflected in the price of that good or that service in the market place. This is why our story then begins and ends with old cold warriors, because having fought and won the Cold War, they could not, would not, accept that capitalism might be undermined from within by its own inability to deal with market failure.

Nuclear winter, second hand smoke, acid rain, the ozone hole and DDT toxicity were all real threats. So is global climate change. But free markets left to their own devices have not provided us with adequate solutions to these problems. Scientific reality has demonstrated the need for some kind of government action, whether it be taxation as we did to handle tobacco, the buying and selling of permits, as we did for acid rain – or the outright banning of a product, as we did for chlorinated fluorocarbons. This explains then why so many people latch on to the doubt mongering, even some who are highly educated or who want to become President of the United States. It also, I think, explains why resistance to action on climate change has been so particularly strong – really virulent – in the United States, because Americans would much rather believe that these things were not true. We would much rather believe that our way of life is fine and that we don't have to change anything. We would all rather believe in magic. But as the novelist Kim Stanley Robinson has pointed out, the invisible hand never picks up the cheque.

Reference

Oreskes, Naomi; Conway, Erik (2010): *Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming*. London: Bloomsbury.