

SYMPOSIUM

Science: Uses and Abuses

The papers in this symposium were originally presented at the fifth national conference of the National Association of Scholars titled "Objectivity and Truth in the Natural Sciences, the Social Sciences, and the Humanities." The conference took place in Cambridge, Massachusetts, from 11 to 13 November 1994. Subsequently prepared for publication, these essays reflect the intention of the organizers to bring together panelists with varying outlooks on the proper role and conduct of scientific research.

Scientific Study and Political Reaction

Michael B. McElroy

A brief look at two controversial environmental issues, ozone depletion and climate change, may shed some light on the public and political dimensions of scientific research.

In the early 1970s, scientists began to think about the possibility that we could change stratospheric ozone globally. That dialogue was sparked by concern that flying supersonic aircraft could add oxides of nitrogen to the stratosphere. These exhaust gases build up in this stable region of the atmosphere over years. A large fleet of supersonic transports ultimately could cause a reduction of several percent in the level of global stratospheric ozone. Expanding on those concerns, the late Professor James McDonald pointed out that even a small change in the abundance of stratospheric ozone could have significant effects in transmitting more ultraviolet radiation to the surface of the earth. Perhaps, he said, that change could affect the incidence of skin cancer.

Coincidentally, a program of research began under the auspices of the Department of Transportation. The supersonic transport plane proposed by the United States was canceled in the early 1970s but, before stratospheric ozone research could die, Mario J. Molina and F. Sherwood Rowland, in a paper published in 1974, raised the possibility that industrial chlorofluorocarbons (CFCs) used in such bizarre applications as aerosol propellants for underarm spray, had the potential to do more damage than five hundred supersonic aircraft flying eight hours a day around the world.

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The public reaction was interesting. We published a paper in *Science* a year or so after Rowland and Molina raised this issue. In that paper we tried to estimate what the effect on the ozone would be if growth of CFC use were to continue at the then current rate of 10 percent per year. Though there remained serious uncertainties, it was fairly clear that eventually you would expect to see some significant effects on ozone. We also explored implications of various policy options to reduce emissions, taking into account the roughly hundred-year life of CFC gases in the atmosphere. Even if you stopped using the gases there was a long recovery time.

The research continued. People developed the ability to fly precise instruments on high-altitude balloons, on aircraft, on the ER2—successor to the famous U2. They conducted wonderful experiments in the lab; they built good models. Stratospheric ozone research was a high-quality endeavor. Along the way, politicians were quick to recognize this as a win-win situation. Here we had a wasteful technology—after all, there are other ways to apply deodorants. Several billion aerosol spray cans were sold in the United States in 1972. Maybe there were other ways to apply these chemicals. And so, very quickly the United States Congress and the governments of several other countries moved to ban the use of CFCs as propellants for nonessential purposes.

The Reagan administration picked up this topic, I think, for exactly the wrong reasons. We had banned the use of CFCs in aerosol propellants, but our trading partners, the British, the French, the Germans, the Japanese had not. The administration set out politically to level the playing field. This was not a proper reflection of the reality. American manufacturers had been exporting CFCs all over the world. The playing field was, in fact, tipped in our favor. But the process initiated by the Reagan administration led eventually to the Montreal Protocol—the first real attempt to limit the emission of CFCs on a global basis—a marvelously complex and extremely effective treaty that was put together in the mid-1980s.

The public acceptance of the treaty was strong, in large measure not because of the original work that was done on CFCs, but because of a surprise. The surprise was the unpredicted discovery that ozone was disappearing over Antarctica every year in spring. In the most remote region of the world there was little ozone left by the early part of November. There had been no predictions that that phenomenon could occur. At this point, our field was relatively mature; we had the ability to move to Antarctica, to make the right kind of measurements, and we rapidly came to an understanding of what was going on in that environment. We knew, without a shadow of doubt, that the loss of ozone, the so-called ozone hole, was in fact directly connected to the accumulation of those industrial gases in the atmosphere. We could also say with some confidence, I believe, that, even with a total ban on CFCs in 1990, the ozone hole would remain with us over Antarctica at least through the early part of the twenty-second century. So, the recovery time was going to be very long.

Now, what was the response to all of this? In very short order there appeared a number of books. Among them was *Trashing the Planet* by the late Dixy Lee Ray.¹ This book was especially insidious, because early on she announced that she was a scientist and a politician and that other scientists and reporters had done a poor job of representing the truth, and that she was going to repair the damage. That she was a scientist with credentials made her errors particularly serious. Dixy Lee Ray believed, for example, that acid rain is not related to the use of coal. It is very difficult to find anybody, even in the coal industry, who would take so extreme a point of view. Dixy Lee Ray also seemed to believe that if you put sulphur into the atmosphere, somehow it will go away. Well, it does go away. It comes down in the form of acidic compounds and it can do damage to streams and soils.

The book had an impact, especially when picked up by Rush Limbaugh, a new apostle of environmental science. I do not remember exactly how many listeners Mr. Limbaugh has per week, but it is certainly more than the number of people who read either *Science* or *Nature*. He has influence.

I got slightly involved in this controversy a few years ago when I responded to an op-ed piece that appeared in the *Wall Street Journal*. The piece was so full of errors that I felt obliged to sit down and try to correct some. I tried hard not to make my letter controversial, so I wrote in a style of, "Look, here's an error. Here's a fact and here's the way it's misrepresented in this particular op-ed piece."

I was astonished at the response. A large amount of mail came to my office, almost all of which was negative. Some of it was actually personally abusive and quite threatening. Had I received some of those letters at home, I should have been quite concerned. There was a common theme in all of them; the same misinformation was repeated. You could see the Limbaugh-Ray connection. I was accused of all kinds of bad thinking.

Now, let me switch to the issue of climate, which is in many respects a more complicated matter. In the case of dealing with CFCs, the Montreal process did essentially the job that had to be done. Maybe it was done too late, but I doubt that the scientific understanding of the problem justified earlier action. In any case, we have moved imaginatively and forcefully to eliminate the use of the more obnoxious CFCs.

The developing world is committed in the Montreal process to reduction of emissions on a nation-by-nation basis. A country like China, which had very low usage of CFCs, committed to reduce its emissions from a 1990 usage level, defined not in per capita use, but with reference to national emissions. Penalties made it difficult for developing countries not to sign on to the process.

By contrast, international measures addressing climate change are much more complicated, since the burning of fossil fuel and the release of carbon dioxide involves a much larger part of a country's economy. It is not controversial to say that the level of carbon dioxide in the earth's atmosphere is

rising. It has increased by about 25 percent since the beginning of the Industrial Revolution. It continues to increase predictably every year. You can see that increase all over the world, whether at the North Pole, the South Pole, the top of a mountain in Hawaii, or a hundred miles above the surface of the earth. It is clearly increasing; no serious scientist would dispute that.

Another obvious fact, which is surely not controversial, is that a major contributor to that increase is the burning of fossil fuel and the consequent release of CO₂. Carbon dioxide is the largest single waste product that we produce as an industrial society. We produce some six billion tons of carbon, transformed to CO₂ per year. That is more than a ton per person in the world and the figure is almost five tons per person in the United States and we are largely unaware of it. But it does have the potential to alter the climate.

Again, without controversy, the Greenhouse Effect is real. If you did not have gases, such as carbon dioxide, that trapped infrared radiation in the earth's atmosphere, the earth's surface system would be comfortably, or uncomfortably, below the freezing point of water all around the globe, even at the equator. Planet life as we know it would not exist. No serious scientist disputes the reality of the Greenhouse Effect. The question is: will adding CO₂ gases to the atmosphere produce a significant change in climate? On this question there is indeed legitimate uncertainty. The models that are applied to that particular problem are not up to the job of giving you a reliable long-range weather forecast. So, if you wish to take the view that because of the uncertainties we should take no action, that's a potentially defensible point of view.

I do not take that point of view because I believe the potential for serious damage is very real. I believe that the scientific evidence supports the possibility that climate systems can change rapidly. They have changed very rapidly in the past. A shift of the Sahara Desert into Southern Europe—that kind of thing has happened in the past—or a shift of the Sonoran Desert into the grain-producing areas of the United States, is not that unlikely and would be very serious for global society. An increase in rainfall in India or a change in the characteristics of the monsoon affecting Chinese agriculture, for example, would be serious. The fact that I can make the argument scientifically that such changes could occur in periods as short as a decade means that I think that we should take them seriously.

Doing something about global warming can be good for us and the remedies may not have a serious cost. There are win-win strategies. For example, there is a proposal that appeared in a neat little book by Andrew Tobias on auto insurance. What Tobias proposed was not in connection with the Greenhouse problem but had to do with uninsured motorists on the roads of California. He proposed that it would be a good idea if you bought your auto insurance at the pump when you paid for your gasoline. On a national scale, that is a wonderful idea. I suspect that very few people realize how much they

pay for auto insurance because they pay insurance bills so seldom. However, on a national average, if insurance was added, gasoline prices would be eighty cents per gallon higher than they are today, almost twice the current rate. It would be even more expensive for people in the Northeast. We're paying the price already, but if we had a sense of what we were paying, then presumably it would influence our driving habits. It would create a tendency toward conservation. It would provoke political pressure for urban transportation, and so on.

Or, let's take the possibility of a carbon tax, or more simply, a gasoline tax. The Clinton administration initially proposed a carbon tax. Then they talked about a BTU tax, and they finally compromised with Congress on a tax on gasoline that was less than four cents a gallon. The tax was so small that market fluctuations caused gasoline prices actually to be lower after the tax was implemented. It had no effect on conservation.

As of late 1994, it seems to me that on Wall Street the issue that seems to engage the financial community most is the question of whether the economy is growing too fast. If we are prospering, Wall Street is concerned, the bond market hiccups, the stock market follows, and the pressure is on the Federal Reserve System to increase interest rates. How about trying to solve the problem in a different way? Suppose we decided to institute a gasoline tax set, for example, at fifty cents a gallon. That would raise fifty billion dollars a year at current usage rates in the United States. One cent translates to one billion dollars in terms of gasoline taxes. That would slow the economy. That would obviate the need to increase interest rates. That, in turn, would have a double effect on the federal deficit. It also would have an effect on imported oil and on our balance of trade. It would provide revenue and it would cut down on carbon emissions, essentially buying time. But now I get to what my real concern is here. Could you imagine insurance at the pump or a gas tax becoming a part of the current political discourse?

The problem as I see it is that any solution that is not reducible to a single-sentence sound bite is going to be destroyed by association with another sound bite like "taxes." We have lost the ability to discuss serious problems in a serious way and to arrive at solutions that perhaps address several issues at the same time.

One of the underlying problems in environmental science is the generally low level of scientific literacy in the public. We do not have a scientifically literate public, and we are paying the price for that. We also have a public with an exceedingly short attention span. That goes for the general public as well as for political leaders. For it to be recognized, a complex problem has to be reducible to a small number of words, less than a sentence. And complexity in solutions is unacceptable. Unfortunately some of the problems involving the interface of science and the general public are not simple issues. They require thoughtful consideration.

There are no simple answers to the issues of ozone depletion and of global climate change. I cannot simply say, "I am absolutely sure; my science supports the view that there will be this particular disaster occurring in this particular year." I can give you a weighing of the probabilities and a personal view of what our chances are. Then, ultimately, a political response is called for. Political discourse should take place in an informed, intellectual way. That is not our current approach.

Note

1. Lou Guzzo and Dixy Lee Ray, *Trashing the Planet: How Science Can Help Us Deal with Acid Rain, Depletion of the Ozone, and Nuclear Waste (among other things)* (Washington, D.C.: Regnery Gateway, 1990).

This item, titled "Guilt Trip," appeared in the 12 April 1995 *Dartmouth Review*, page 4:

Even in Sheldon Hackney's absence, P.C. silliness persists at the University of Pennsylvania. A grievance was filed against the campus group White Women Against Racism by a black student who was denied entrance to one of its meetings. One WWAR member defended its policy by stating, "We believe racism is a white problem."