THE POLITICS OF GLOBAL WARMING*

By John A. Knauss

THE CASE FOR GLOBAL warming resulting from increased concentrations of atmospheric carbon dioxide is discussed in such places as the Wall Street Journal (Seitz, 1996) as well as the scientific literature (Kerr, 1997). Global warming is a political issue. It is not the first, nor will it be the last, environmental science question with political implications. Almost by definition, any environmental issue generated by mankind's activities has both a science and a political component; for example, the role of chlorofluorocarbons (CFCs) in reducing stratospheric ozone, the consequences of dam building for salmon populations of the Columbia River, and the ecological consequences of discharging minimally treated sewage in the offshore waters of San Diego. Each is a challenging scientific problem, the answers to which carry immense social and economic implications and costs. Thus they are not only scientific issues but political ones as well.

Because the systems in which these questions are imbedded are generally very complex, scientists are often unable to provide simple, unambiguous, answers; our conclusions are seldom without caveats. Often, however, the public does not require the kinds of evidence scientists require of one another in our professional journals before being prepared to take action through international treaty, legislation, or regulation. Approximate answers are adequate in many cases. For example:

a. The international treaty (London Dumping Convention of 1972, as amended) that limits what can be deposited in the ocean is more restrictive than a significant number in our community believe is necessary (NACOA, 1982).

b. Large sums of federal and state taxes are spent each year to reduce estuarine pollution, while scientists continue to grapple with, and sometimes disagree about, how an estuary responds to varying levels and kinds of anthropogenic inputs (Nixon *et al.*, 1995).

c. The 1990 revisions to the Clean Air Act call for a larger reduction in sulfate emissions from coal-burning power plants than might appear cost effective on the basis of a decade-long interagency study of acid rain, a study that was published about the time the legislation was passed (NAPAP, 1991).

d. Although no one suggests in hindsight that the treaty that bans CFCs in order to protect stratospheric ozone is too strict, it has been noted that this treaty was negotiated before we had the kinds of scientific proof many would argue should be necessary before agreeing to such a treaty. Early concerns about the role of chlorine in reducing stratospheric ozone were waning in 1984 with the best estimates suggesting a depletion level of about 2% (NRC, 1984). The "ozone hole" over Antarctica with an ozone reduction of >30% was confirmed in 1985, and 2 years later the Montreal Protocol on Substances that Deplete the Ozone Layer was signed. At the time of the agreement there was still some uncertainty as to the reason for the ozone hole (Solomon, 1988).

Some may disagree with at least aspects of the above summary, and this is not the place to expand the arguments. The point I wish to emphasize is that definitive scientific proof is often not required before society agrees to act. Political action is often taken while competent and concerned scientists remain uncertain about the scientific basis for at least some aspect of the proposed action. Similarly, scientific uncertainty can be used as an excuse to postpone action. The role of increasing concentrations of atmospheric carbon dioxide in affecting our climate is an example. In the United States, at least, the public is not prepared to rush to judgment. There may be less public concern about this issue now than there was a half dozen years ago.

What is the difference? Why is the public prepared to make tough political decisions on some environmental issues and not on others? What is different about the greenhouse problem and some of the examples noted above? I suggest five possible reasons.

1. The science of global warming is too difficult to explain to a lay public.

I do not believe this is the reason. I would rather explain the physics of the greenhouse and the role of CO_2 and water vapor to a bright English major than attempt to explain the catalytic effect of stratospheric clouds in reducing the reaction time of chlorine and ozone. In my view the science arguments are no more difficult to explain than those needed to explain the ozone hole, the effect of sulfur dioxide in the atmosphere in forming acid rain, or of nitrogen in estuaries leading to eutrophication—issues that this country has agreed are of sufficient importance to spend significant amounts of money to mitigate.

2. As scientists, we have failed to communicate the severity of the problem.

Again, I believe the answer is no. The Intergovernmental Panel on Climate Change (IPCC) has published two major assessments (IPCC, 1990, 1995). I can recall no other instance since the early days of the atomic bomb where the scientific community has worked so hard to explain the implications of a complex sci-

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entific issue with worldwide significance. There has been some minor (but highly publicized) criticism of the process (Seitz, 1996), but I am not aware of any significant criticism of the reports themselves. To the extent possible, these are consensus documents. Where there is uncertainty, an attempt is made to quantify the uncertainty.

If there is any criticism of these reports, it is their failure to capture the public's imagination. The reports are the product of an international group of some of the best and most dedicated scientists actively working in this very complex field. But the reports are addressed to the mind and not the heart. Global change has not yet captured the attention of a Rachel Carson. The implications of the average temperature increasing a few degrees, when we expect yearly temperature cycles many times that magnitude, have been difficult to convey. Nor does the term *global warming* capture the imagination in the same way as does *acid rain* or *ozone hole*.

3. The consequences are too uncertain, and the worst effects are too far in the future.

I believe this is one reason why global warming is not perceived as a major problem. There is not the immediate concern of skin cancer from a widening hole in the ozone layer; nor does some unspecified future change in climate have the emotional impact of seeing trash washed up on beaches, or areas closed to fishing. Most important, global warming is a problem for the future. The worst effects will be faced by our children and our grandchildren. There are even those who believe a little global warming may be helpful. Budyko, the famous Russian climatologist, is not convinced that increased agriculture efficiency will be sufficient to provide the food needs for a world population that continues to expand. He has suggested that global warming may contribute significantly to the solution to the food needs of the future since increased land for growing and increased rainfall are expected to accompany global warming, and a higher concentration of CO_2 should contribute to more efficient photosynthesis (Budyko, 1995).

4. Our data are too sparse, our systems are too complex, our understanding still too inadequate. As a consequence the range of uncertainty in our predictions is too large for the public to take global warming seriously.

I believe this too is part of the problem. No one questions the increase in atmospheric carbon dioxide; the difficulty is linking increasing CO_2 concentrations with increasing temperatures. Global warming became a political issue in the United States in June of 1988, in the middle of a very warm summer of a very warm decade, when Jim Hansen told a United States Senate Committee that he was almost certain that the unusual warm weather they had been seeing was not a chance event but a result of greenhouse gas-induced global warming (Hansen, 1988).

A few warm summers need not constitute a long-term trend. There are yearly and decadal fluctuations. Ironically, the climatological data for demonstrating a long-term warming trend is better now than it was in 1988 (IPCC, 1990, 1995), but finding this signal imbedded in the climate record has not been easy, and some remain skeptical (Singer, 1996). And, although the average temperatures today continue to be among the highest recorded in this century, the last few years have not matched the records of the late 1980s and early 1990s (IPCC, 1995, Fig. 3.3).

5. The costs of mitigation are too high. In the absence of certainty about the relation of atmospheric CO_2 concentration to the mean temperature of the earth, we are not prepared to pay the social and economic costs of mitigation.

I believe this is the key. Because the consequences, whatever they are, are some distance in the future, and because there is some uncertainty of the consequences, I do not believe we are prepared to pay the cost. And by *we* I do not mean just we in the United States. I mean *we* the world. The costs of mitigation are significant:

a. The earth's population continues to grow.

b. We (all of us) want to live better.

c. For those in the developing world, this will require more energy use per capita, and therefore more energy use world wide, even if the developed world can stabilize its energy consumption.

d. There are at present no obvious energy substitutes for fossil fuels.

We can find ways to be more energy efficient, but I know of no credible scenario that will raise significantly the standard of living of those in the developing world without also increasing the use of fossil fuels. Furthermore, we will increasingly need to substitute coal for oil, and there is more CO_2 emission per joule of energy produced from coal than there is from oil or natural gas (the approximate ratios of carbon dioxide released per unit of energy is 1.7 for coal, 1.4 for oil, and 1 for natural gas; NRC, 1992, page 332). Couple the high economic and social costs of mitigation with the uncertainties noted in 3 and 4 above, and I expect the concentration of atmospheric CO_2 will continue to rise. The preindustrial concentration of carbon dioxide in the atmosphere was ~280 parts per million. The IPCC "business as usual" scenario (which assumes extrapolation of present trends, and no effort to reduce greenhouse gas emissions) predicted that by about the year 2060 the concentration of atmospheric carbon dioxide-equivalent greenhouse gases would be twice the preindustrial level (IPCC 1990). Present conservation efforts may postpone that date a few years, but I question whether the "doubling time" date can be postponed beyond the end of the next century.

Given the political concern that has been expressed about the role of carbon dioxide and global warming, I find it interesting that there appears to be little political enthusiasm for developing alternative energy sources. Forty years ago, we might have expected to hear from the nuclear power industry or the hydroelectric industry. Nuclear power is a non-starter in this country at present, and there is increasing concern about the ecological effects of major hydroelectric dams. During the OPEC oil crisis of the 1970s, the United States invested in the development of a number of so-called exotic energy sources such as photovotaics, wind, tides, and geothermal—support that slowly dried up as that crisis dissipated. To the best of my knowledge, the threat of global warming has not generated any similar effort by Congress or either the Bush or Clinton administration to accelerate research and development in non-fossil fuel energy sources.

Finally, let me turn to the question of what effect the politics of global warming has had on global change science and what the future might hold. I became NOAA administrator in the summer of

1989, almost exactly a year after Jim Hansen made global warming part of the political agenda of the United States. In retrospect, his timing was ideal. Not only were we having a series of hot summers, but other actions converged to make global warming a very hot political potato for the Bush administration. The first major foray into this subject by the World Meteorological Organization (WMO) was at the 1979 first World Climate Conference in Geneva. Eight years later the WMO and the United Nations Environmental Program (UNEP) established the IPCC, whose charge includes assessing the scientific information that is related to the various components of the climate change issue, as well as the environmental and socioeconomic consequences of climate change. Six months after the Hansen statement, the UN General Assembly asked WMO and UNEP to consider possible elements in an international convention on climate, a convention that it was hoped would be ready for signature at the UN Conference on Environment and Development scheduled for Rio de Janeiro in 1992. To meet that schedule required in-depth discussions and negotiations to begin immediately. During my first eighteen months in Washington, I attended four ministerial level conferences on global warming (Noordwijk, Netherlands, November 1989; Washington, DC, April, 1990; Bergen, Norway, May 1990; and Geneva, Switzerland, November 1990; the last two as head of delegation), and I was not even involved in the negotiations on the climate convention itself. That was another group.

The policy lead in the Bush administration was taken by John Sununu, the President's chief of staff, the former governor of New Hampshire, and a former university professor of mechanical engineering with a PhD from MIT. Sununu had a simple one-dimensional global warming model developed by Warren Washington of NCAR that he could play with on his desk top computer. I do not wish to imply that U.S. policy on this subject was driven by a one-dimensional model, but I do suggest that Sununu was not uninformed. Those who disagreed with him had better come prepared with a well reasoned case.

Models connecting the costs to the U.S. economy of reducing CO_2 emissions were crude during the Bush administration, and given the parameters that must be factored in, I assume they remain so (NRC, 1992, Chapter 20), but it was generally accepted that because the United States used more fossil fuels per capita than either Japan or any country in Europe, the social and economic costs of reducing CO_2 emissions would be more for us than for others. The response of the Bush administration was obvious. If the United States was to be more severely impacted economically than others, we needed a realistic estimate of the consequences. For various CO_2 emission scenarios, what is the change in sea level? the change in rain fall distribution? the change in air temperature? and what are the social and economic consequences of these changes?

Given the importance of these issues to the administration, one might expect a significant investment in the research budget related to global warming, and the global change science community was fortunate in having highly skilled advocates in Washington: the most important being the interagency Committee on Earth and Environmental Sciences (CEES) under the President's Science Advisor, Alan Bromley, whose leaders were Shelby Tilford, Mike Hall, and Bob Corell, along with Jack Fellows from OMB. But the Bush administration, any administration, has an overflowing plate of important social and economic issues that require addressing. In addition to wanting to understand the science, there was an additional reason why the global change science budget increased as rapidly as it did. The White House had an international political problem. It could not argue in the international arena for a delay in establishing CO_2 emission regulations until the climate consequences were better understood, without at the same time making a major effort to improve that understanding. I am convinced that the need for the United States to demonstrate international credibility as it hung tough on atmospheric CO_2 stabilization was a very important reason for the rapidly increasing budget this program received under President Bush. During the 4-y period from 1989 to 1993, federal support for global change research, as defined by the amount reported in the annual CEES reports, grew by a factor of 10, from 134 million to 1.3 billion. I know the present competition for research funds is tough, but I suggest it would be much tougher today if it had not been for the decision of the Bush administration to greatly increase support for global change research for reasons that were only indirectly related to the intrinsic importance of global change science.

If global change politics has been an important factor in the support of global change science in the past, will it continue to provide support in the future? I can imagine two quite different scenarios. What might be seen as a portent of the future was in an Op-Ed piece in the San Diego Union Tribune a few days after President Clinton was inaugurated for a second term (Perkins, 1997). It begins, "No sooner had Al Gore been sworn to a second term as vice president before speculation began about his presidential prospects." Joseph Perkins, the author, lists a number of perceived problems that candidate Gore will need to address, including his former ties to tobacco interests, his role in the last campaign in helping raise money from foreign interests, and his pressure on the Immigration and Naturalization Service to speed up the approval of new citizens before the election. But the strongest section was entitled "He's an environmental extremist," and continues, "Of all the putative threats to the ecosystem, the vice president perceives global warming to be the most dangerous of all, notwithstanding the fact that the overwhelming majority of climatologists disagree with him. . . . Gore's proposal to attack this non-problem is to punish Americans for using fossil fuels by forcing them to pay a 'carbon' tax, which would drive up the costs of both gasoline and electricity."

You will note that a scientific minority has been translated by Perkins to be "the overwhelming majority of climatologists," but precision of speech has never been a hallmark of a Presidential campaign. I expect public debate on the subject of greenhouse gases and global warming may get nasty in the next four years, and the discussion will have less and less to do with global change politics of the kind characterized by the Bush administration, and more to do with Presidential election politics. In the process, in ways I do not pretend to understand, but that make me nervous, support for global change science may deteriorate. Thus, just as politics gave a big boost to global change research in the early part of this decade, politics may be responsible for its lack of support in the future. I do not believe this will be the case, and I cer-

tainly hope it will not, but one can never be certain of the fallout from the meat grinder of a Presidential campaign.

For those whose support comes from global change science, my second scenario is much more positive, although it does not bode well for the future of our planet. If I am correct in my belief that society is not prepared to pay the price for reducing the use of fossil fuels, and if the IPCC reports are correct, and I assume they are, then we can expect global warming. It will become increasingly urgent for us to know what the future holds: what are the details of changing rainfall patterns and sea level change? Will there be more hurricanes or fewer? What effect, if any, will global warming have on the frequency and strength of El Niño's? I may be concerned about the future habitability of our earth, but I am very bullish about the future support for those engaged in this type of research. If greenhouse gases continue to rise, it will become increasingly important to understand the climatic consequences, which in turn means more generous support for those engaged in this type of research.

References

Budyko, M.I., 1995: Response to receiving Horton Medal. *EOS* (transactions of the American Geophysical Union), *76,* 76.

Hansen, J., 1988: Testimony before the U.S. Senate Committee on Energy and Natural Resources, June 23.

IPCC, 1990: *Climate Change, the IPCC Scientific Assessment.* J.T. Houghton, J.G. Jenkins and J.J. Ephraums, eds. Cambridge University Press, Cambridge, 365 pp.

———, 1995: *Climate Change 1995, The Science of Climate Change.* J.T. Houghton, L.G. Meira Filho, B.A. Callander, N. Harris, A. Kattenberg and K. Maskell, eds. Cambridge University Press, Cambridge, 572 pp.

Kerr, R.A., 1997: Greenhouse Forecasting Still Cloudy. *Science, 276,* 1040–1042.

NACOA, 1982: *The Role of the Ocean in a Waste Management Strategy.* Report of the National Advisory Committee on Oceans and Atmosphere, U.S. Government Printing Office, Washington, DC, 103 pp.

NAPAP, 1991: *Acidic Deposition: State of Science and Technology.* Summary Report of the U.S. National Acid Precipitation Assessment Program. P.M. Irving, ed. U.S. Government Printing Office, Washington, DC.

Nixon, S.W., S.L. Granger and B.L. Nowicki, 1995: An assessment of the annual mass balance of carbon, nitrogen, and phosphorus in Narragansett Bay. *Biogeochemistry, 31,* 15–61.

NRC, 1984: *Causes and Effects of Changes in Stratospheric Ozone: Update 1983.* National Research Council, National Academy Press, Washington, DC, 339 pp.

———, 1992: *Policy Implications of Greenhouse Gas Warming.* National Research Council Committee on Science Engineering and Public Policy, National Academy of Science Press, Washington, DC, 917 pp.

Perkins, J., 1997: A few blemishes on the Gore image. *San Diego Union-Tribune,* Op-Ed page, January 24.

Seitz, F., 1996: A major deception in global warming. *Wall Street Journal.* Op-Ed page, June 12.

Singer, S.F., 1996: Climate change and consensus (letter to editor). *Science, 271,* 580.

Solomon, S., 1988: The Mystery of the Ozone "Hole." *Rev. Geophys., 26,* 131–148. ❑