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Science Diplomacy: Hard-Won Lessons

William R. Moomaw

For me, science has always been a way to frame and understand the world. While working on organic semiconductors for my PhD, I stumbled across the growing scientific literature concerning the environment. Revelations were pouring in on the chemical cause of smog, the eutrophication of Lake Erie, and the seemingly magical bioconcentration of DDT in birds of prey and radioactive strontium in the bones of children. I used my growing knowledge of physical chemistry to make sense of what was happening and, as I began teaching, became a scientist-citizen advisor to local leaders in Williamstown, Massachusetts as they wrestled with water regulations that would clean up the river—but surely add a tax burden.

When Jack Sawyer, the president of Williams College, announced to the faculty the establishment of an Environmental Studies Center in 1967, a group of colleagues and I were eager to engage and debate our fellow economics and social science colleagues about this "new fad" in higher education. I offered the first environmental science course in spring of 1970, without realizing that later that spring we would be celebrating the first Earth Day. A few years later, Williams was fortunate to hire a young lawyer, Tom Jorling, to head the center. He arrived from Washington, D.C., having been one of two chief counsels who drafted the 1970 Clean Air Act. While teaching and conducting research on quantum chemistry, photochemistry, and molecular spectroscopy, Tom noted my engagement with

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environmental science and suggested that I apply for what are now called AAAS S&T Policy Fellowships. In 1975, I entered the third class of fellows to work for Congress. Like my environmental science course, this proved to be perfect timing.

Watergate and the first energy crisis had recently occurred. Congress was eager to acquire technical expertise. It was estimated that more than half the federal budget had a scientific or technical component, and there were perhaps only about thirty technically trained individuals among the four thousand congressional staff members. Our group of some twenty scientists and engineers were in high demand by Congress, and we were fortunate to find placements with lawmakers who sought to use our scientific expertise to develop legislation.

As we went through our intensive orientation program, about a dozen senators and representatives interviewed each of us. I recall one member of the House who said to me, "You clearly know a lot about the issues. But you are too substantive for me. I really operate on the politics of issues." I thanked him for his candor and moved on. Most senators and representatives were lawyers or businesspeople with little technical background. I had taught courses in science for nonscientists and enjoyed translating the arcane language of science into policy-relevant terms. While my departmental colleagues did not always appreciate my spending time teaching non-scientists, it turned out to be a very useful attribute on the Hill.

It soon became clear that there were different types of science-and-technology policies. There were the scientific agencies such as the National Science Foundation, National Institutes of Health, and National Aeronautics and Space Administration—with which we academics were familiar—and I ended up dealing with NASA matters as one of my responsibilities. But in many other areas, the goal was not more or better science, but science as a means to accomplish larger public policy goals in agriculture, health, defense, and the environment. A new agency, the Energy Research and Development Administration, which later became part of the cabinet-level Department of Energy, was formed to address the energy crisis.

I was fortunate to team with freshman senator Dale Bumpers of Arkansas, who was on the newly established Energy Committee and on the powerful Agriculture Committee. He also chaired the new Subcommittee of the Aeronautics and Space Science Committee on the Upper Atmosphere.

The issue under consideration by the subcommittee was stratospheric ozone depletion just one year after the now famous Nature paper by Mario J. Molina and F. S. Rowland.[1] Based on seventy-five-year-old lab science and a fortuitous set of measurements of atmospheric chemicals by James Lovelock, the authors predicted that the widely used chlorofluorocarbons (CFCs) could potentially destroy the protective stratospheric ozone layer. These ubiquitous chemicals propelled aerosols from spray cans, cooled refrigerators and air conditioners, and blew foam rubber, rigid insulating foam, and Styrofoam cups, The loss of the ozone layer would expose us to skin cancer from ultraviolet radiation, cause cataracts, and decrease agricultural and marine fisheries productivity. The science behind this issue was just the kind of photochemistry that I studied, and I was the only staffer in the entire Congress who had this technical background. Senator Bumpers was just beginning hearings when I arrived, and I was plunged into the fray. During the hearings, I met most members of the atmospheric science community, including Ralph Cicerone, whom I had tutored during his freshman year. Despite that experience, he became a prominent atmospheric scientist and the president of the National Academy of Sciences.

Senator Bumpers was probably the best non-science student I ever had, and I was his eager student of the art of politics. So my introduction to science diplomacy was in a domestic context but involved the world's first global environmental issue. I was shocked to discover that science and scientific fact were not the final word. I heard senators say in hearings and in committee meetings that while a depleted ozone layer might give their constituents melanoma, manufacturers of CFCs were giving their constituents jobs. No one wished to give up air-conditioning or refrigeration. I met weekly with the manufacturers of CFCs, who assured me that halting CFC use would lead to botulism from unrefrigerated food and flaming heads and armpits from hydrocarbon substitutes for the propellants used in hair and deodorant sprays. There was much at stake.

Finally, Senator Bumpers decided to propose a ban on "nonessential uses" such as spray can propellants. This drew denunciations from industry and free marketeers, who argued that "the market" should solve this problem. How that might happen, they did not say. Bumpers also faced the challenge that Arkansas was the nation's leading producer of bromine, and volatile bromine compounds were even more effective ozone depleters than chlorine-containing molecules. Yet he remained steadfast, convinced his colleagues, and eventually CFCs in spray cans were banned with the assistance of another former APS Fellow, Haven Whiteside, who was the staff member for the 1977 Clean Air Act Amendments for the Senate Public Works Committee.

Europe and developing countries did not immediately follow our lead, but when a British scientist discovered the springtime "ozone hole" over Antarctica in 1985, Prime Minister Margaret Thatcher of the United Kingdom broke with her colleagues and called for action. Since U.S. corporations had already made the transition to CFC substitutes, they favored action that disadvantaged their international competition. They convinced the anti-regulatory Reagan administration to lead the international effort to first reduce and then ban CFCs and other ozone-depleting substances globally. This was science diplomacy in action.

During a hearing Senator Bumpers prodded the CEO of DuPont to promise to cease manufacturing CFCs if credible scientific evidence found his company's chemicals were harming the ozone layer. Thirteen years after finishing my fellowship, a definitive paper was published that proved it was indeed CFCs that were depleting stratospheric ozone over Antarctica.[2] I contacted Bumpers and his Senate staff and, utilizing my best congressional training, wrote a one-page memo to the senator, drafted a letter to the new DuPont CEO from Senator Bumpers reminding him of his predecessor's pledge, and enclosed a copy of the research article that contained the smoking gun. Three weeks later, DuPont announced the end of CFC production. I cannot prove that the letter made the difference, but DuPont is a science-based company and had already found a substitute that was more profitable than CFCs. Science diplomacy is an important component of successful policy making, but it must always be considered in the context of additional factors, including the availability of alternatives for meeting the perceived need, economics, evolving public opinion, and leadership from both policy makers and business.

I also provided staff support for Senator Bumpers in the reauthorization of the national forest Multiple-Use Sustained-Yield Act of 1976. I also assisted him as he responded to the first energy crisis with the Energy Policy and Conservation Act of 1975, which set vehicle fuel-economy standards, established a fifty-five-mile-per-hour speed limit, and permitted right turns on red, unless specifically prohibited, in all states. The last item was a favorite of the senator, who hated waiting at red lights and asked the Congressional Research Service to calculate how much gasoline could be saved by allowing right turns on red. Another AAAS S&T Fellow, Dave Hafemeister, worked for Senator John Glenn of Ohio, and the two of us helped our members increase R&D funding for solar energy by more than a hundredfold from a meager $1 million the previous year. In each case, it was essential to get the science more or less right, but economic interests or external events often shaped the final outcomes.

International Science Diplomacy

During the 1980s, science continued to play an important role in reducing transboundary air pollution in Europe and in implementing the UN Convention on the Law of the Sea. Science formally entered climate diplomacy with the creation of the Intergovernmental Panel on Climate Change (IPCC) in 1989. This was a move that some governments hoped would give them some leverage over scientists, but that proved to be a futile aspiration.

I served as a lead author of three major IPCC reports, and was a coordinating lead author of two more over a period of nearly twenty years. Two coordinating lead authors for each chapter shared the responsibility to produce a finished chapter by a specific deadline at the end of a three-year period. Bringing together twenty-some scientists from a dozen or more countries with multiple disciplines required a different form of diplomacy. Negotiating what should go into the chapter that had been outlined by governments, and responding to the harsh public peer- and government-review system, required tact and discipline. The coordinating lead authors, moreover, were responsible for co-writing the technical summary of a three-thousand-page report that, along with the full report, was off-limits to government meddling.

In addition to the technical summary, coordinating lead authors wrote a draft "summary for policy makers." Governments reviewed this summary and could request changes to the text during an intense week of negotiation. When a section was discussed for which one was responsible, that coordinating lead author, stood before eighty or ninety government negotiators and responded to the concerns expressed in often-conflicting government proposals. The key was to ascertain the interest of each country and then find acceptable language that remained true to the report's underlying science. If the scientist concluded the proposed change did not conform to the report, a contact group of interested governments joined him or her to work it out. Language choice was important, and I was always grateful to have an Englishman in the group who could find the best word to satisfy a range of country interests. If no solution could be found within twenty-four hours that met the approval of the entire group of nations, the passage in question was dropped from the summary for policy makers—but the report and technical summary remained unchanged. In response to each assessment report and multiple special reports, national governments took action to adopt first the UN Framework Convention on Climate Change, then the Kyoto Protocol, and most recently, in 2015, the Paris Agreement.

The Evolution of Science Diplomacy

Addressing global issues requires international science diplomacy that reconciles different economic and social systems as well as differing economic costs and benefits, beliefs, and fundamental values.

There is a profound difference between the earlier climate treaties and the Paris Climate Agreement in terms of the diplomatic strategy. Updated science played a central role in defining specific limits for planetary temperature limits instead of a previous general statement to avoid "dangerous anthropogenic concentrations of greenhouse gases in the atmosphere." However, instead of treating emissions as a "pollution problem" that must be curbed,[3] climate change was cast as a development problem. Meeting the development needs of countries became the organizing principle, and nations were invited to submit their own Intended Nationally Determined Contributions (not Commitments) that would reduce their emissions of heat-trapping gases. For many poorer countries, these "contributions" are to be implemented by protecting tropical forests and utilizing more renewable energy. Every developed and developing nation submitted a plausible contribution that would enable it to reduce emissions. The result is that if all these contributions are followed, the future temperature in 2100 will still be about 1 degree Celsius less than without them—not enough to stay within the 2 degrees Celsius limit called for in the agreement. But it is a move in the right direction, and is subject to review every five yards with the intention of "ratcheting up" the contributions as needed. Scientific analysis concludes that a temperature rise greater than this would commit the world to irreversible climate change. Mutual gains, meanwhile, are defined by the affected parties themselves. At the Fletcher School of Law and Diplomacy at Tufts University, we have identified these as critical diagnostics for sustainable development diplomacy,[4] the process to negotiate and govern sustainable agreements successfully.

One striking difference in the political role of science between the present and the 1970s is that members of Congress and diplomats at that time used science to justify taking unpopular actions. "Science made me do it!" they would say when they banned CFC propellants in spray cans or lowered the speed limit during the energy crisis or took some other action that could potentially anger their constituents. Other than tobacco company claims, there were few "alternative facts."

The attitude toward science today is quite different, with science denial common within the decision-making class. There is often hostility toward science itself when it conflicts with economic interests or ideology. To address some of these challenges, the IPCC is structured to include a gender balance of scientists from many countries and relevant disciplines, with representatives from academia, government, and industry. The coordinating lead authors for each chapter include a field appropriate scientist from a developed country and one from a developing country. In my two times as a coordinating lead author, I worked closely with one partner from Brazil and one from Zambia. What I learned was that my developing-country colleagues asked questions that did not occur to me and brought insights about innovative mitigation and adaptation strategies that were appropriate to the conditions in the developing world.

Lessons Learned

When invited to participate in science diplomacy, scientists tend to focus on technical solutions to environmental problems. It was not until I was invited to start an International Environmental Policy Program at the Fletcher School of Law and Diplomacy at Tufts that I came to fully understand the human dimensions of science diplomacy. Larry Susskind, a professor at the Massachusetts Institute of Technology, asked me to co-teach a new course he had introduced on international environmental negotiations. He has been a prime developer of consensus building through the Mutual Gains Approach to negotiation. When I proposed co-teaching to my registrar, I was rebuffed because Tufts lacked an official relationship with MIT. Undaunted, Larry and I agreed that he would teach a course called International Environmental Negotiations with an MIT number, and I would teach a course of the same name but with a Fletcher number. We should simply teach the two courses at the same time in the same room. Two years later during my annual review, Dean Jes Salacuse asked how we had found a way to teach together. When I told him, he smiled and declared it “a mutual gain.” We taught the course together for nineteen years.

From Larry, I learned that outcomes improve when the discussion focuses on the interests of parties instead of their positions. For example, reframing the economic benefits of more efficient LED light bulbs from reducing climate-altering emissions to address climate change to benefiting the user economically and creating new manufacturing jobs can engage otherwise hostile constituencies. Similarly, the solar panel industry has brought back manufacturing and non-exportable installation jobs—jobs that now exceed all fossil fuel employment. But utility companies see this development as a threat to their business model and successfully slow the addition of more solar energy onto their electrical grid. What if utilities could join in reaping the economic benefits of solar? The advent of electric vehicles will substantially increase demand for electricity, and a smart grid operated by utilities along with charging stations could “fuel” vehicles, which in turn could provide electrical storage. A different economic-return model for regulated utilities could accommodate both distributed rooftop solar with larger centralized solar and wind facilities as well as battery and other storage services. Creating value for multiple parties provides the mutual gains that will lead to successful agreements that address climate change far more effectively than a win-lose or a weak “compromise” over inconsequential positions.

The hard-won lessons for science diplomacy include recognizing that the boundaries we create within and between governments and stakeholders often make it difficult to achieve anything other than lowest common denominator compromises. Universities organized by schools and departments are a major barrier to establishing and conducting interdisciplinary teaching and research programs that cross from science and technology into economics, social science, and the humanities. To be successful, these programs must reconcile strongly held values.

Scientists have not helped their cause by denigrating anti-evolution beliefs or the ideological, economic, or religious beliefs of climate doubters. I would argue that scientists have made it more difficult to create policies based upon scientific facts by ridiculing any other viewpoint as ignorance. Effective action for addressing climate change, immunization programs, fluoridation of drinking water, and a transition to sustainable energy and transportation systems has suffered because of the failure to account for the human dimension of science diplomacy. Those who see climate change as a threat to their economic interest or religious beliefs simply dismiss science as either incorrect or as a conspiracy among scientists. The failure to use this tension creatively to understand alternative worldviews and the unique ability of science to have testable explanations has been an opportunity lost.

How much better off might we be today if we had discussed the economics and long life of LED lighting than to have ended up with the "Light Bulb Freedom of Choice Act" that was enacted into law to prevent the government from setting energy-efficiency standards that would phase out inefficient incandescent lamps and reduce greenhouse gas emissions?

From a very different perspective, the 2015 encyclical of Pope Francis, *Laudato Si'*,[5] clearly confirms the importance of science in addressing climate change but reveals that we must consider the fundamental ethical dimension as well. He places climate change within a framework that transcends differences among nations and interests by making clear that a changing climate is a threat to "our common home." An appeal to our better nature that produces a mutual gain.

Let me conclude with two wonderful examples of scientists who have reached out to those who may be hostile to science. Among the many books written by the famous Harvard biologist E. O. Wilson is one that addresses the conservative fundamentalist religious groups that he came to know in his childhood. He points out that his term nature and their term creation are two different names for the same thing. Regardless of what term each uses, it is too sacred and too important to be defiled.[6]

Similarly, the climate scientist Katharine Hayhoe has joined with a religious leader to write a book for Christians explaining the climate system and how and why we are changing it.[7] Like Pope Francis, she uses the language of religion familiar to her audience to elucidate the science. In the process, she remains true to both her religious beliefs and scientific knowledge, and evidently wins over some religious skeptics. She has also created ATMOS Research and Consulting, "where we bridge the gap between scientists and stakeholders to provide relevant, state-of-the-art information on how climate change will affect our lives to a broad range of non-profit, industry and government clients."[8] She clearly excels as a scientist-diplomat who can find agreement with those who may not see the world from a scientific perspective.

Not all of us are equipped to accomplish what Wilson and Hayhoe have done, but we can learn an important lesson from these pioneers. Like them, we can engage others who see a given issue through a different lens. If we wish to teach students who will be the stewards and practitioners of future science diplomacy, we need to be pragmatic and open to ideas and values that extend beyond science. We can engage others to support scientifically valid solutions to climate change and other complex issues by understanding their perspective, rather than by dismissing them because they do not see the world as we scientists do. SD

Endnotes

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