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Innocent reflections on science and technology policy

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Abstract

This essay explores one scholar's serendipitous wandering into the world of science and technology policy and suggests that such an idiosyncratic and opportunistic path is probably not really unusual. The paper explores why a historian/philosopher of science has something of value to say on the subject and why science and technology policy matters. I contend that we need more and a broader range of academics to think about science and technology policy and to engage in policy-making action, that we will be better off as a society if we do, and that this innocent-seeming claim should not be seen as entirely non-controversial. Furthermore, I argue that historians and philosophers of science—at least some, but not all, historians and philosophers of science—can effectively join scientists in communicating science to a broader audience, and that this is essential to promoting effective science and technology policy.

Keywords: History and philosophy of Science; Science policy; Congress; Scientific literacy

1. Introduction

In real life, I do not 'do' science and technology policy. I just play a supporting part. As an otherwise respectable academic with a Ph.D. in History and Philosophy of Science and a graduate minor in Biology, I am—at least in part—a traditional sort of faculty member who believes that a rigorous liberal arts education for all is a key to a better society. As a Professor of Philosophy and Biology who does history and philosophy of science and has wandered into discussions of scientific literacy,

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science communication, and science policy, I have always enjoyed straddling the imaginary boundaries of disciplines and cultures.

This essay explains how I came to reflect on science and technology policy and why my serendipitous path is probably not all that unusual. It asks, second, why a historian/philosopher of science has something of value to say on the subject, and finally, why science and technology policy matters. I contend that we need more and a broader range of academics to think about science and technology policy and to engage in policy-making action, that we will be better off as a society if we do, and that that claim is not entirely non-controversial. Furthermore, I argue that historians and philosophers of science—at least some, but not all, historians and philosophers of science—can effectively join scientists in communicating science to a broader audience, and that this is essential to promoting effective science and technology policy.

2. One path to policy making

When Arizona's first district US Congressman, Matt Salmon, suggested in 1996 to officials at Arizona State University (ASU) that he would like to know more about scientific issues, since he had just been appointed to the House of Representatives' Science Committee for the 105th Congress, it was not clear how the university should best respond. One possibility was to connect his staff with people at ASU to answer specific questions. But that approach did not seem likely to work very often because there usually is so little lead time for getting answers, especially given the time-zone difference between Washington, DC, and Arizona.

Alternatively, we might follow the traditional model of the Congressional Fellow, according to which one person is assigned—officially for purposes of his or her own education—to serve as a staff member. This typically requires the Fellow's moving to Washington and helping to pursue the Congressman's agenda. That obviously can help the Congressman, when it works, but does not as obviously serve the university's interests. Our university sought not only to develop connections with the district Congressman, but also to maximize communication and learning more generally. This seemed best accomplished by assigning someone to move back and forth, spending part time in Congress and part time in Arizona (and necessarily, given the distance, a lot of time in airplanes).

We did not know of other cases like this, but decided to pursue this option as an experiment. Everyone agreed that it would be ideal to choose someone with a 'broad perspective' for such a position and, as the proposal developed, they chose me. The training for working across established boundaries afforded by a Ph.D. in history and philosophy of science with a strong biology graduate training seemed ideal. Initially, they had to talk me into the job since it was not obvious what would count as a success, nor that I was the best person for the job, nor even what the job would actually be. But I was willing to explore new things, and my primary research interest focuses on questions about how science works and what forces produce change. This began to seem like an opportunity.

I met with the conservative Republican Congressman and told him that I am neither a conservative nor a Republican. Indeed, I explained, I was somewhat politically illiterate, in effect a political 'innocent'. He responded that as long as I was reasonable and open minded, he did not care. This seemed like a challenge too enticing to miss. I met with the ASU Provost, Vice President for Research, and Dean to discuss the university's hopes and objectives. We drafted a job description, including a central student component, that everyone enthusiastically endorsed. I was appointed as 'senior science advisor' to Congressman Matt Salmon and as 'special assistant' to ASU's President, Lattie Coor. We agreed on a 6-month term, to be renewed for up to a year or 18 months beginning January 1997. In the end, we went 2 years—the full 105th Congress—and surpassed everyone's expectations. Doing things differently attracted attention and support that facilitated getting things done.

This essay reflects on this unique experience of a historian/philosopher of science learning about and working with Congress. I am not an expert in science policy (and still have not quite figured out exactly who is). And I decidedly did *not* develop 'Potomac Fever'. The whole experience was great fun, will undoubtedly improve my teaching and research hereafter, and helped to hone my political instincts—skills that will pay off in academic meetings. It also demonstrated the importance of having in our community of scientists at least some people who are willing to take on staffing roles, whether temporarily or permanently, even where this requires losing political innocence.

Rather than spend my time interviewing or interacting with the obvious and visible figures in the science world—Congressmen Gingrich, Sensenbrenner, Ehlers, Brown (though my students and I did talk to them on several occasions)-and rather than zipping around Washington talking with high-level people at NSF, NASA, DOE, EPA, and such, I decided to work from the bottom up. The first 6 months, I attended many hearings and meetings and read all those piles and piles of materials from just about everybody that arrive in Congressional offices. I listened carefully and kept records, not at all sure what—or whether—I was learning. Everything was so different that it seemed important to absorb, to meet people, and just to keep listening for a while.

Ideas finally began to gel, and we articulated some goals and outlined projects: taking the Congressman to visit the National Science Foundation (NSF) and the American Association for the Advancement of Science (AAAS), and organizing events at ASU that took NSF director (and just-then-appointed Presidential Science Advisor) Neal Lane, AAAS policy director Al Teich, Congressman Ehlers, and others from Washington to ASU. A statewide meeting to survey federal investment in R&D in the state and to consider how strategic initiatives might work attracted over 400 people, and we had to turn others away. Neal Lane met with Arizona's Governor, Jane Hull, to discuss opportunities, and the news media got more excited about science and technology than they usually do.

I also took undergraduate students to Washington in a project to study public approaches to issues of scientific literacy. That evolved into a group paper presentation at the AAAS annual meeting in Philadelphia (the only undergraduates on the program) and an invited editorial in *Science* (the only undergraduate-authored edi-

torial anyone could recall). In turn, that effort informed the NSF's thinking on 'scientific literacy', as reflected in the most recent *Science and Engineering Indicators 2000* [1,2].

3. The process

The primary lesson drawn so far is that I, and I believe most people who become involved with advising and staffing science policy in Washington, get there by circuitous routes and in accidental and opportunistic ways. The atypical is the typical. Therefore, we need to learn to take advantage of those opportunities. Importantly, the community needs to support those who are in positions to do so. It is not the case that every academic should be involved in direct action, but the academic community as a whole needs to be alert to possibilities and to facilitate contact, communication, and interaction where possible and where pragmatic. We need to reward those who take on these extra roles, and also those who stay at home and pick up the heavier load left behind.

Along the way, amidst the exploration of people, process, and projects, I followed specific legislative proposals and how they played out during the 105th Congress: Cloning (and ethics); Women in Science (and workforce issues); Global Warming (and the constellation of environmental concerns); the International Space Station (and those pesky, bankrupt Russians); for example. The science policy report by Congressman–physicist Vernon Ehlers attracted attention, high hopes, and some disappointment throughout the 2-year period as well. My roles as member of the AAAS Program and History Committee (1998 was their 150th year) brought reflection on what an organization to advance science really does and should do, and how that has changed over time. And chairing NSF's Social, Behavior, and Economic (SBE) Sciences Directorate's advisory committee brought additional perspective on vexed issues of how science and society intersect and how the issues play out in the various communities. Occasional attacks on federal funding of the social sciences brought opportunities to educate my Congressman about how proposals get generated, the role of peer review, and the efforts to insure that what is funded is 'sound science'. After a visit to NSF and a talk with Neal Lane and others, Congressman Salmon became a strong advocate for the NSF approach, even making a statement on the House floor about the importance of avoiding Congressional micro-managing of research funding.

A dominant theme emerges from this story: communication is difficult—and necessary—between the communities and across the boundaries. Conflicts arise because people do not know how to understand each other. They think they are arguing about 'fact' or about what counts as 'sound science', but they often are really at odds about how to interpret or to use the science available, or about underlying core values. Those who are willing to listen, learn, and work at exploring and explaining have considerable advantage over those who are not willing or cannot because of the constrained roles they play (as representative for some constituency, lobbyist, as a non-profit explicitly non-lobbyist). Another lesson about opportunity.

Science struggles in Congress—struggles to be heard or noticed. Congressmen are, with very few exceptions, not scientists. Nor, in most cases, are they even very scientifically literate. They are neither stupid nor ignorant, but along with most of the American public they do not understand the statistical, evolutionary, or community nature of much of the scientific process. They do not delight in the creative and critical inquiry into the workings of nature. They typically believe that when we know something, it should stay known and not give way to apparently contradictory results. They often wish they knew more about science, but it is difficult to learn as life and constituents' urgent business press on around them every hour of every day. There is little time for strategic or long-term thinking because it is time to vote or time to meet with important campaign contributors right now. This is largely true of staff as well.

Scientists do abound in Washington, of course, and very good scientists. A few are at the Congressional Research Service, filling requests from Congressional staff for information or reports. Others work at the National Research Council (NRC), directing committees in deliberations and construction of reports on whatever they are commissioned to report on. The National Institutes of Health has forty buildings full of scientists and staff, each pursuing their designated research projects at the Medical Center in Bethesda, while the NSF houses scientific staff-some permanent, some 'rotaters' on loan from other institutions. A few serve to advise the President at the Office of the Science and Technology Policy, and many of those are on loan as well. The AAAS, other non-governmental organizations, and a host of lobbyists occupy often contested and unstable ground.

It is not true, therefore, that there is no science in Washington. Rather, the scientists are largely not directly in contact with those making legislative decisions. Therefore, science struggles to be understood in Congress. And there are clashes in culture as the deliberative scientific process confronts the adversarial partisan politics. This presents challenges along with the opportunities to learn and share.

4. History and philosophy of science in the public interest

In 1974, Stephen Brush asked whether the History of Science should be X-rated [3]. After all, we may not want scientists to realize how science really works. The recent calls at the NSF and elsewhere for teaching and telling about 'science as science is done' may have dangerous side effects, we might worry. Will people not catch on that part of scientific research is serendipity, part misguided, and part confused? Will the public fail to fund science as generously if we demystify the process?

Ideally, the counter-argument goes, if students realize that science is fallible and a human enterprise that involves small steps toward great ideas, they will see that they too can be scientists and that it can be fun and rewarding. History shows that science is done by normal, ordinary people, or at least that some scientists are normal and ordinary people like the rest of us. Philosophy shows that science is a logical, sensible application of careful observation, empirical generalization beyond single cases, good insights, and occasional theoretical creativity. This reasoning leads to a

policy promoting 'learner-centered' education, for example, and to refined definitions of what we mean by scientific literacy such that it is more important (in theory) to know how to figure out why it is hotter in summer than to memorize that it is. (Hint: this is NOT because the earth is closer to the sun, which is the most common answer given.)

By providing stories, exploring case studies, and tracing concrete examples where scientists worked out ideas in the context of real-world constraints, teachers can introduce students to science as an ongoing process done by teams of scientists. This appreciation for the process should lead to greater confidence in the conclusions—for now, with the understanding that what counts as knowledge today will evolve. This improved literacy about how science works, the argument goes, will provide a more educated public made up of more informed and better citizens. This set of driving assumptions, and the suggestions for action that follow, should therefore inform policy.

As the NRC report explains, the *National Science Education Standards* "use history to elaborate various aspects of scientific inquiry, the nature of science, and science in different historical and cultural perspectives". In addition, as the NRC report points out, these standards "are closely aligned with the nature of science and historical episodes described in the American Association for the Advancement of Science *Benchmarks for Scientific Literacy"*. In addition, the philosophy of science informs discussion of the nature of science and values since "science distinguishes itself from other bodies of knowledge through the use of empirical standards, logical arguments, and skepticism, as scientists strive for the best possible explanations about the natural world". Also, "because all scientific ideas depend on experimental and observational confirmation, all scientific knowledge is, in principle, subject to change as new evidence becomes available" [4, pp. 250–251].

History and philosophy of science can inform policy in broader ways as well. Only gradually are some scholars beginning to realize that there is great value in being able to point to past investments and resulting successes, for example, to support lobbying efforts for the sciences. Just continually asserting that investment in research yields knowledge and therefore a better society, with better lives for each of us individually, is not likely to be always effective. Especially in down markets and challenging political climates, being able to drive such arguments with solid data is extremely valuable. History can provide the data to demonstrate the effects. History can provide examples of 'nuggets' from past successes that help to develop an argument to justify continued investment. While we call for 'assessment' in many aspects of government and education these days, we are only gradually and rather haltingly coming to the realization that history can actually help us do some assessment if we only ask the right questions.

What I learned from this is that history and philosophy of science do have value. While the Hill rushes forward every day making decisions and taking action now, immediately, for the future, on the cutting edge, etc., etc., there is room for logical thinking, careful analysis, and deriving conclusions about process and practices from historical data. We have only begun to develop the significant possibilities here.

5. Staffing science policy

Let's look at a few examples, somewhat randomly chosen to reinforce the point about opportunism and responding to local conditions and constraints. First came renewable energy. My Congressman served as a leader in the bipartisan Renewable Energy Caucus in the House. One day, not long after my arrival, it was time to think about budget requests. Five staff members met in the chair's office and started with the previous year's budget and the original budget request. Basically, during the Gingrich Congress, not much happened with renewable energy. Science and technology would solve all the problems, so we did not have to think about renewables, or something like that seemed to be the reasoning. Yet there was a small program and a small budget. The program leaders did not believe in earmarks, which rather limited their prospects.

One staff member said that he favored adding a 10% increase to last year's appropriation, with the expectation that it would be cut radically. Another said that we should ask for 3% since that had been the previous increase. There was much discussion about strategies, and I asked (innocently enough) why not compromise and ask for, say, 5% in the overall, but why not target initiatives and ask for an increase in a couple of specific areas that seemed likely to succeed. "Oh, great idea, what do you have in mind?" I said that I did not know much about this, just having arrived, but it looked like there was bipartisan interest in a couple of areas and why not target those. The lead staff person said "Well, you're the scientist, so let's go with that". So, that's the way the budget request went forth—and through the subcommittees and relevant committees—until it was hacked to death by the Appropriations group.

The point is that this seemed so idiotically random and unplanned. I am not an expert in renewable energy issues, but neither was anyone else in the process. This is a silly, small, unimportant example in the grand scheme of things. Yet it is instructive. This was not even in the context of crisis mode—that operating in desperation to pass an 'omnibus bill' at the last minute to continue funding and keep the government open that happens all too often when Congress is at odds with itself. That happened later, and magnified the inability to do any serious strategic thinking. There was no staff member in the room doing this planning who had more than the most ridiculously minimal knowledge of any of the programs involved, nor of the specific funded initiative projects from earlier years. We saw pet projects of powerful people, but no planning or priorities. This seemed depressing to me, but it is reality. Importantly, there are ways to learn more about the past actions and what works, and to develop strategies and plans that do have persuasive power into the future.

Next, and more important, came the 'Women in Science' bill (H.R. 3007, The Commission on the Advancement of Women in Science, Engineering and Technology Act). Congresswoman Morella and others had been proposing a bill to study the role and place of women in science for several sessions. Finally, increasing awareness of a growing technical workforce shortage brought enough support to move the modified bill forward and eventually into law.

Yet at one point along the way, there was what I as the innocent, politically naïve

academic saw as an embarrassing problem. The bill, as initially proposed, called for a commission of people who it made no sense to bring together, and it seemed easy enough to change that. More importantly, the bill called for a number of steps, including one for the NSF to carry out a study (unfunded, of course) of women and minorities in science and technology. Fortunately, from my work with the SBE directorate at NSF, I knew that the NSF already did that study. Furthermore, it seemed likely that a historical look at such studies could show us much of value about the trajectories in the workforce and the implications. We worked with Morella's staff, and to their great credit they immediately modified the bill in all the ways we suggested. Again, a minor victory. The bill moved into law, we had helped to make it a better and tighter bill, but not much hinged on that improvement.

Nonetheless, I learned a lot from that process. When I began to challenge the details and wording and to suggest changes, I was startled by the reaction of some women leaders in the community. One told me that of course she knew the bill was flawed, but that it would be better to keep quiet and move ahead to get it passed, and then fix things. She was hoping, she confessed, to serve on the commission that would result. She did not want to 'rock the boat'. Perhaps she was right, and certainly this was not a very important issue. Perhaps this is one symptom of that struggle of science and Congress, as attempts to develop and implement policy play out in the real world. Academics nonetheless have an important role to play, though it would be a mistake for us to arrogate to ourselves the role of moral authority. Perhaps we can best serve to provide perspective. Again, historical and philosophical perspective on the nature of science, as it plays out in society, is important. Helping to provide that would make a major contribution to science and technology policy.

Normally in making decisions, we call on 'experts', but who are the experts on science and technology policy? Scholars who study policy academically are part of the picture, as are the politicians who make the policy. There is also a place for scientists and those who study science to play a role as some-time advisors and policy 'experts' as well. As the late Congressman George Brown said to me and several of my students one day, "Why not come and work with me and the Science Committee. We need a historian around to remind us". He did not say of what historians might remind, nor who would be the recipients of the reminding. But we can use our imaginations and draw our opportunities in many ways. Congressman Brown was inviting us to step up and become experts.

6. Now what?

The point is that policy does get made, and that there is room for historians and philosophers of science, and for other scientists and other academics and scholars to step out of our supposedly innocent and ostensibly objectively pure 'real lives' of research for at least a defined period. We can enter the policy world, sample it, make connections, and still go back to normal lives. But our lives will never be quite the same again, they will never be as apparently innocent, and that is good. That innocence is also potentially insidious when it precludes us from taking leader-

ship positions that will shape the decisions on which our futures depend. Both the policy world and the individuals who make the jump will have expanded perspectives. Scientists and those who study science become more politically literate, while policy makers become more scientifically aware. The values and perspectives honed through time and played out in a slower and more reflective context of academia meet the political world of urgency and immediacy. Both gain. Win–win, as they say in Washington.

But is this really so obvious? Let's go back to basic assumptions for a minute. Vannevar Bush and company set us on course with a policy based in the root assumption that science and technology make a better society [5]. Congressman Newt Gingrich certainly assumed that, and so did Congressman Ehlers when Mr Gingrich asked Mr Ehlers to develop an update on the Bush report. Most Congressmen and most Americans assume that, at least when the questions are asked in the right way.[1]

Yet most Americans do not understand science, favor creationist over evolutionary explanations of the development of life, and do not know which way the planets go around or why. There is a certainty that science-and not presumed technological results—are good, but not a deep or reflective support for research. The public does become irritated by the constant reports that 'coffee causes cancer' or 'caffeine helps cure cancer', or 'red wine prevents heart attacks' but 'no, we mean all alcohol' but 'don't drink because that affects heart attacks and cancer, at least in women and on Mondays'. Or whatever. You know those stories. Science and technology, in general, are thought to be good and lead us to better lives. But not always, and we are not sure why.[2]

Some academics also challenge that assumption, trying to shout down the arrogance of the scientific hegemony. Mostly, these are humanists. And mostly they look foolish. Especially in our modern research universities that depend increasingly on public funding of research, which means mainly science and medicine, these voices remain isolated and powerless. A good economy makes it even harder to get attention, and a declining economy focuses attention elsewhere.

Someday, however, somebody may loudly and directly challenge the assumption that science is good. Already there is little evidence that President Bush and his advisors consider science and technology a high priority. Three months into the new administration and he has appointed a (probably temporary) chief of staff for the White House Office of Science and Technology Policy, but no science advisor or other staff. Science- and technology-related appointments remain unfilled throughout the agencies. Even as technology stocks fall on Wall Street, there is little interest in assessing the place and impact of science and technology on the economy or on society. What action we do see points to serious limitations, for political reasons, being placed on medical research with stem cells, for example. It will be up to academia to carry out the studies about impacts and attitudes. And those informed

[1] As various surveys by solid research groups like Research!America continually show.

[2] NSF's Science and Engineering Indicators [1, Chapter 8], provides valuable data on public attitudes and interpretations of science and technology.

by experience in Washington and with Washington are likely to ask better questions, or even to ask such questions at all.

Let us consider what evidence we will be able to marshal to demonstrate rather than simply to assert that science and technology pay off in better life. How can we even ask that question to achieve reliable and useful results? To what extent, and in what ways, do different science and technology policies have different results with respect to these issues?

Or more specifically, did physicist and Congressman Ehlers' report really contribute to Unlocking our Future?'; did it matter? [6] Not much—or at least not yet, but why not? Perhaps because it sought to outline the situation but not really to make policy. There are implications, even some far-reaching and important implications. Yet nobody has followed up. It could lead to policy, but it has not yet. Mr Ehlers has tried in some cases, but the current chair of the House Science Committee will have to take a lead if we are going to have an effect. Similarly, it remains to be seen whether any effective policy recommendations arise from the much-awaited report from the Women's Commission. What are the solid implications, and how do they play out? How can we take the platitudes, the political rhetoric, and the good will and make it policy, then implement the action? How do we even know what will work?

Here policy makers must team with academic scholars and analysts. What do we know about the past and what works—or not? Let us think more about how to make policy as science is done, so to speak. Can we draw on the processes and progresses of what has worked in science—whether through scientific and logical thinking or through effective social action-and draw on that experience in making science and technology policy? I should think so, though it will take work. We need for some academics to engage in policy making. Not just as professional policy makers, but as additional partners with different perspectives. As goes the argument for term limits for politicians, there is value in bringing in fresh blood and limiting the kind of accumulating debts and invested interests.

We need improved communication. We need improved and expanded scientific literacy. We need improved, expanded, and more widespread involvement by scientists and the academic community in staffing and engagement in science and technology policy making. The new Gordon Conference on New Frontiers in Science and Technology Policy can help, and the first official conference will occur in summer 2002, with another in summer 2004. This will take work. There are opportunities and challenges ahead. Let's take them on together and enjoy the ride.

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