"Expertise, democracy and science communication"

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Prepared for delivery to
International Conference on Public Communication of Science and Technology
Istanbul, Turkey
28 April 2016

[Note: The talk was delivered via pre-recorded video when I was unable to attend the PCST Conference. This revised version is intended as a more formal record of the substance of my talk.]

Often, we think of public communication of science and technology (PCST) as a set of activities trying to achieve a particular set of goals. Science journalism is providing information, science museums are trying to build engagement, science festivals and science cafes integrate science into everyday culture. But I want us to step back and think about the bigger picture: What is PCST for? I want to argue that PCST is fundamentally a tool of democracy, a tool for strengthening the ability of citizens to govern themselves in open, transparent ways that serve social justice. But thinking about PCST in that way faces two challenges:

- First, science and technology themselves depend on expertise. What makes them special is precisely that they *aren't* democratic, that their ability to describe the natural world in reliable ways and to provide solutions for real problems in the world depends on the ability of scientists and engineers to know things that other people don't know. There's a fundamental tension between expertise and democracy (Ezrahi, 1979, 1991; Jasanoff, 2004, 2005, 2007).
- Second, PCST operates in places that aren't always democratic. Many of our colleagues in the PCST world work in countries where decisions are made by autocratic leaders who believe they are acting in the best interests of their citizens and countries, but who are not protecting the rights and interests of many of their citizens. Those of you in Istanbul today are in the midst of a region full of violence caused by conflicts between those autocratic leaders and the citizens they claim to represent. What is the role of PCST – and especially PCST practitioners – in places where people aren't free to fully express their democratic rights?

To think about these issues, I think it's helpful to look at the history of PCST. Of course, it wasn't called PCST until the 1990s. Before then, we talked about science journalism and public health and science education and science museums. We talked about science literacy and public understanding of science. Where did those terms come from?

Natural history museums can be traced back at least to the 1600s, and aquariums and industrial science museums and exhibitions of the sort we're familiar begin in the 1800s (Rader

& Cain, 2014; Sheets-Pyenson, 1988). Itinerant lecturers who did demonstrations of scientific principles were common in my own country 200 years ago (Burnham, 1987). Scientists have been writing for public audiences and giving big public lectures since at least the beginning of the 19th century, and here we are almost two decades into the 21st century. There have been writers who specialize in science going back into the late 1800s, and science journalism as a profession began in the early 1900s (Lewenstein, 1994). People who work as informal science educators or in public health or as public information officers in science – in other words, people who were professionals at public communication of science and technology – can be identified 100 years ago.

Many of these early instances of public communication already demonstrate the challenges that issues of expertise and democracy present. For example, many of the great natural history museums in countries like Canada, South Africa, India, and Brazil were explicitly part of the colonial system, designed to catalogue the natural resources of conquered countries and turn those resources over to the colonial power (Sheets-Pyenson, 1988). Public information officers committed to science didn't begin in universities, but in corporate organizations like General Electric and AT&T, seeking to control and profit from the research they did (Rogers, 1986). I'm not saying that's bad, but I am saying that public communication of science and technology was not always done in a spirit of making information free and open to anyone who wanted it.

All these different forms of science communication began to merge in the years after World War II (Lewenstein, 1992). The outcome of the war seemed to show the value of open democratic societies, especially those of the United States and England. (The Soviet case is more complex, of course.) The war also showed the importance of scientific development. The atomic bomb, of course, was critical. But so were the proximity fuse and radar and penicillin – all scientific developments that had a major impact on the outcome of the war, and that seemed to show the inherent connection between science and democracy.

Indeed, during the war years the great sociologist Robert Merton developed his "norms of science" – communal ownership of information, universalism or equal meaning of knowledge everywhere, disinterestedness or commitment to rational assessment of evidence, and organized skepticism (the institutionalization of rational assessment) (Merton, 1973). Although they came to be known as the "norms" or standards of science, Merton originally developed them in articles called "Science and the Social Order" and "A Note on Science and Democracy" (Merton, 1938, 1942). For many people after World War II, the identification of science and democracy was fundamental (Hollinger, 1983; Turner, 2007).

So in the years after the war, people who worried about building a more democratic world also worried about making science more widely available. By the early 1950s, discussions about public understanding of science were common (Lewenstein, 1992). Then, as the Cold War developed, and especially after the launch by the Soviet Union of the first satellite, Sputnik, the political importance of developing better science literacy (as it was then beginning to be called) was again reinforced. The idea of expertise was especially strong in the United States, where scientists led the charge in the 1960s to re-shape science education so it was focused on

producing the best and brightest scientists – not just for social good, but in order to defend the Western vision of democracy against the Soviet vision of communism (Rudolph, 2002; Terzian, 2013).

But now a different vision of the relationship between science and democracy emerged in the 1960s. Many people – including leading scientists – began to question whether so-called democratic governments actually represented their own citizens (Beckwith, 2002; Commoner, 1966). In the United States, this came out in the civil rights movement and eventually the movement against the Vietnam War. In Europe, this emerged in the student riots of 1968 in France, Germany, and elsewhere.

According to Pierre Fayard, who hosted the first meeting of what is now the PCST Network in Poitiers, France, in 1989, the movement that we now call "public communication of science and technology" emerged with those challenges to authority of 1968 (Fayard, 1988). We can see it in the development of "culture scientifique" in France. We can see it with the opening of the Exploratorium in San Francisco in 1969. The Exploratorium wasn't the first interactive science museum, but it came with an explicit political commitment to challenging the way science and society interacted (Hein, 1990; Rader & Cain, 2014).

The 1970s brought us an explosion of PCST activities and also of scholarship on PCST. I've already mentioned the Exploratorium. The Ontario Science Center also opened that year, and by the late 1970s there were so many of these new kinds of science museums that the new Association of Science-Technology Centers had been founded. Science radio and science television had been moving along slowly, and then the late 1970s brought a boom of popular science magazines and science television shows (LaFollette, 1990, 2008, 2012; Lewenstein, 1987). They also brought us new definitions of science literacy, and the development of regular surveys of public knowledge of and attitudes toward science (Miller, 1983). In 1985 came the classic Bodmer Report in the UK on public understanding of science, calling for more attention to the field (Bodmer, 2010; Royal Society, 1985).

Much of this activity came in an unreflexive way, supported by the science community because of its belief that to know science is necessarily to appreciate science. The ideology of science by this time was that it was both entirely objective and entirely good – despite the historical evidence that the science enterprise has always been deeply shaped by its political context and that sometimes means that science can be used for socially-reprehensible purposes, such as the development of chemical or biological weapons (Hager, 2008; Wolfe, 2013).

But one of the effects of the Bodmer report was an increased attention to research on PCST (Wynne, 1991; Ziman, 1991). And much of that research began to question the purposes of science communication, and especially the relationship between expertise and democracy (Irwin & Wynne, 1996). Studies of sheepfarmers in Cumbria, families dealing with complex genetic diseases, and communities living downwind of nuclear power plants all showed that expertise is not a simple thing. These studies showed that people without formal education, without the certification of a degree or a professional position as a "scientist," can nevertheless

make significant contributions to understanding scientific issues, especially as they move from isolated laboratories to real world situations.

This research led, by the 1990s, to two new terms in the PCST world: "public engagement" and "citizen science" (Bonney, 1996; House of Lords, 2000; Irwin, 1995). At the same time, the rapid emergence of the World Wide Web created all kinds of new opportunities for science communication (Trench, 2007). All of us were excited by these new opportunities and looked for new ways to produce information about science for diverse audiences. We also celebrated the ways that greater access to information across many social groups and international boundaries might increase "democracy" in science.

Yet here again, our lack of reflection sometimes kept us from seeing the tensions. Many of the early users of "public engagement" were people who came to PCST with social critique in mind (McCallie et al., 2009; Wynne, 1992). To engage the public would be to fundamentally alter the governance of science. The power to set scientific agendas, to set social priorities, to define how science and politics might best work together – public engagement meant moving these away from the experts and politically powerful elites, instead truly engaging broad publics in their own control of society (Jasanoff, 1997, 2003). This movement didn't deny that science produces reliable knowledge about the natural world. Instead, it focused on how knowledge, politics, and power intersect and interact.

Many other members of the PCST community saw public engagement differently. For them, engagement isn't about politics, but about education (Bell, Lewenstein, Shouse, & Feder, 2009). It's about attitude and cognitive attention (Abell & Lederman, 2007). A science museum or a science fair should engage people by getting them excited about science, by getting them to spend time thinking about or even pursuing science (Chicone & Kissel, 2013). People in this community often focused on science as a thrilling intellectual endeavor, or on science as a process for solving critical social problems such as water quality, food security, or energy sustainability. They were less interested in the politics of how these problems came to exist, even if science itself – or the scientists who operated as experts in elite settings – had played some role in creating those problems.

The idea of citizen science illustrates the same tension. In the middle 1990s, two different communities started using the phrase "citizen science." One of them was the social critic community, arguing that more political engagement would improve science, that a form of "citizen science" would emerge in which broad publics would more effectively harness the power of scientific work for social good. Citizen science in this sense is about democracy. The sociologist Alan Irwin was the one who most fully developed this meaning of "citizen science" (Irwin, 1995).

The other use of "citizen science" was more tied to the scientific community itself. This was the idea that large numbers of people could be recruited to help gather data across large geographic spans, from bird observations to water quality testing to measuring noise pollution. In the most common version of this citizen science, scientists still control scientific work. The

tension between expertise and democracy wasn't at risk, as scientists – the experts – still decided what counted as science (Bonney, 1996; Bonney et al., 2009).

What's fascinating to watch today is how these different strands of expertise, democracy, and science communication are coming together. Citizen science now often involves local communities challenging established political powers, getting them to address problems of air or water pollution (Cooper & Lewenstein, 2016; Frickel et al., 2010; Ottinger, 2010, 2013). Even for what's sometimes called "contributory" citizen science, where scientists are in control of the process, the expertise of public contributors is recognized as a fundamental and necessary part of science (Bonney et al., 2014; McKinley et al., 2015). Moreover, science communication is built into these projects – to recruit participants, to explain the scientific process, to present the results.

A similar evolution is happening in other areas of PCST. By the 1980s, for example, science journalism had become a specialized area of journalism, requiring deep expertise both of journalism and of science (Friedman, Dunwoody, & Rogers, 1986; Nelkin, 1987). Many science journalists spent considerable time and effort policing the boundaries of their expertise, showing how important it was to distinguish between journalism and public information, between explanatory science writing and investigative science journalism. For them this was an important distinction, in part because of the critical role that independent journalism plays in democratic societies (Crewdson, 1993). But then along came the Internet. Today, we don't know who counts as a science journalist. Scientists journalists are hosting meetings and online discussions around the question: "Are we all science journalists now?" Professional associations such as the U.S. National Association of Science Writers (NASW) are at the time this paper is written struggling with the permeability of the line between being critical of science and promoting science. The line between expert science journalists and other kinds of people who produce science journalism – scientists, public information officers, high school students, patients, etc. – is extraordinarily hard to identify in the web-connected world. Moreover, in countries with more control over the media, such as China and many countries in the Middle East, the idea that science journalists are independent experts is easy to challenge (Lewenstein, Joubert, & Radin, 2002).

So what does all this mean for those of us in the PCST community, whether we are practitioners or researchers? I don't think it means we need to choose. I don't think we need to decide if we are "for" science or "for social critique." I don't think we have to decide if we're interested in educational engagement or political engagement. I don't think it means we have to decide if citizen science is about societal governance or about large data-gathering projects.

But to be professionals in our field, we need to be reflective (Abbott, 1988). A lawyer doesn't go to law school to learn to write a contract. A lawyer goes to law school to learn to think like a lawyer, to reflect on what makes something a contract. That's what makes a lawyer a professional. You can make a similar argument about being a physician. It's not knowing which medicine to prescribe that makes someone a physician. Instead, it's knowing how to reflect about the patient, the patient's symptoms, the patient's social setting and access to resources, the economics of the medical system in your country, and so on. And then, based on that reflection, one can make better decisions about how to treat the patient.

Similarly, I think we in the PCST community need to be reflective. I think that each of us, as a practitioner or as a researcher, needs to be aware of the tensions between democracy, expertise, and science communication. We need to be attuned to times when those tensions affect our work. We need to be aware of when the source of our funding shapes the stories or exhibits or demonstrations or research that we produce. We need to be questioning what, exactly, our expertise is in. We need to think about what democracy means in our own countries and how our work contributes to that democracy.

These are big issues, and I don't think they lead to single answers. I look forward to continuing discussions in the PCST community about these issues.

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