

In Search of an IMPROVED Science and Public-Policy Process

Taking the lead from the play Cabaret, I assert that it is "both substance and process that makes the world go 'round." Usually, it is preferable to write about substance, but this brief paper will attempt to deal with the unglamorous issues of "process."

Historians tell us that there are many driving forces of history, such as the forces of great persons, the forces that divide or unite nations, and the forces between competing economic systems. My personal conclusion is that science and technology is the foremost driving force of history. What we scientists and engineers discover, the industrialists will produce and society will consume. Take away modern agricultural, military, transportation and communication technologies and a very different society appears. It is clear that society is not going to follow the mythical Ned Ludd to destroy our looms, autos and CD players.

Along with this primal role of creation, physicists have the concomitant responsibility to do our best to determine the impacts of implementation. This is serious business. There is no room for errors of omission or commission. Because the stakes are very high and because science means knowledge, we are obligated to be honest, objective, and open. Too often our analysis fails to mention major uncertainties and competing issues that are not directly comparable. It is our job to lay out all the facts and ask the hard questions.

In my talk at the APS spring meeting, I gave some examples of issues in which I observed a less than stellar science/technology (S/T) policy process, such as:

- lurching towards a plutonium policy in the 1970s
- determining the appropriate level of nuclear deterrence during the Cold War
- debating the extent and significance of Soviet cheating
- considering a 2 mGauss standard for powerlines.

These and other examples have convinced me that the S/T decision process needs help. I would argue that today's general cynicism of rational thought undercuts S/T policy process. As part of this, the anti-science movement has contributed to an environment in which the issues can be clouded and mishandled. This movement is not new -- it has been with us before Galileo was put under house arrest. Our main hope is the credibility of our scientific citizens who use an open, peer-reviewed process to state our limitations and uncertainties. Some ideas on improving the S/T public policy process are:

1. Individual ethics. The 1991 APS statement on "Guidelines for Professional Conduct" and the 1993 AAAS position paper on "Good Science and Responsible Scientists" are excellent statements -- as far as they go -- on nonfabrication of data, authorship, peer review and conflict of interests. In my view, the importance of S/T issues demands a stricter, more pro-active code of ethics. This demands a discussion of:

- uncertainties, ranges of estimates in numbers, and opinions and lists of omissions

-- criteria, such as Hill's on epidemiology, for replicability, linearity for small effects, plausibility with regard to basic laws, coherence of data, possible confounders, economics, etc.

-- peer-review comments from a wide group of reviewers

-- condemnation of those who favor your conclusions, but who use data incorrectly or overstate the case

-- responses to questions from nonpartisan ombudsmen who represent truth-seeking as compared to advocacy.

2. A non-adjudicatory process to determine areas of agreement and disagreement. In the 1970s, there was a flurry of interest in Arthur Kantrowitz's concept[1] of the Science Court in which scientific experts would be the judges and "case managers." These individuals were to be unconnected to the dispute with the hope of removing hard-charging advocacy. The science court was not to be empowered to make judicial decisions, but only to give recommendations to the courts or decision makers.

For a variety of conflicting reasons, the Science Court did not survive, but an excellent result appeared from its byproduct, the Scientific Adversary Procedure. In 1985, under the leadership of Kantrowitz, Edward Gerry (in favor of SDI) and Richard Garwin (in opposition) discussed under formal procedures and drew up a list of agreed statements that both could support. If the fifteen agreed statements had been widely publicized and ultimately accepted as honest output from two excellent scientists who fundamentally disagreed, the SDI debate could have been narrowed and made more rational. For example, consider statement #9: "In the continuing context of deterrence of nuclear war by threat of retaliation, technologies already exist to solve the problem of strategic force vulnerability sooner and at a lower cost than via layered defense with space components." Acceptance of this statement would have clearly helped to narrow the many classified technical meetings on SDI which I attended during the 1980s. At the time, it seemed that the government was locked into an unjustified kill probability of 0.9 in its discussions of the highly complex "preferential targeting" of reentry vehicles. If the Garwin-Gerry results had been read in executive branch and congressional meetings, it would have considerably raised the level of discussion.

3. Questions for the record. Sometimes the Congress has done a good job of handling controversial S/T issues, but often it has not. The Congress has a unique opportunity to produce hearing records with penetrating follow-up questions from and to experts. However, the members of Congress often feel that hearing records are of little importance and they are often printed after the issue has been settled. These decisions are often made by non-scientists who don't care about setting the record straight and don't worry about clarifying the issues. For example, the concern that nuclear waste to be stored at Yucca Mountain might explode could have been rapidly clarified with some penetrating technical questions to those on both sides of the issue. It would not have taken a great deal of effort to show what had and had not been calculated. Of course the National Academy of Science can and does perform this task, but it often seems to take too long for the NAS to produce its product and the system often doesn't

know how to absorb it. And, of course, we can all think of an Academy study that we thought was wrong!

4. Benevolent Ombudspersons. Science must be honest, objective, and open, and the same holds for S/T policy. If two divergent groups of honest scientists could work together and prepare an annual report of errors and overstatements on the S/T issues, this would put pressure on scientists to pay attention to the code of ethics discussed above. The American Physical Society has the credible intellectual talent to do this, but I can't imagine the APS would want to get involved in all of the issues. Perhaps two nongovernmental organizations with differing constituents could develop panels of impeccable scientists to ask questions of the proponents and assess who went beyond the truth. This begins to sound like "Accuracy in the Media," but I am hopeful that our scientific training would make the difference for removing "lies, damn-lies and bad statistics."

5. Other. I am still searching for the perfect wave. Paraphrasing A.E. Houseman's "A Shropshire Lad;"

When I was one-and-twenty
I heard a wise man say
"Give me scientific facts and logical thought
and the society will choose wisely."
Now I am almost two-and-sixty,
And Oh, 'tis not always true, 'tis not always true.

Footnote:

1. A. Kantrowitz, *American Scientist* 63, 505-509 (1975). Task Force of the Presidential Advisory Group on Anticipated Advances in Science and Technology, *Science* 193, 653-656 (1976). P. Boffey, *Science* 194, 167-169 (1976). B. Casper, *Science* 194, 29-35 (1976). S. Jasanoff and D. Nelkin, *Science* 214, 1211-1215 (1981).

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