

Welcome to the Sausage Factory

Every May, the Materials Research Society visits Washington, D.C., for our annual involvement in Congressional Visit Day (CVD), where MRS staff, officers, and volunteers go to Capitol Hill to speak with U.S. lawmakers. Communicating the view of the scientific community on “The Hill” is an ongoing part of MRS’s outreach. We meet with senators and members of Congress, or, more usually, with their staffers, who are frequently responsible for framing policy issues. This activity allows us to raise or highlight issues that are crucial to our members: not only funding issues that affect our U.S.-based members, but also visa and immigration issues important to new students and overseas members visiting the States. CVD is organized by an informal coalition of major U.S. scientific and engineering societies. The forum is designed to foster awareness of the physical sciences among U.S. policymakers and involves the leadership of almost all of the large U.S. professional societies in the physical sciences.

The making of laws has been famously compared to the making of sausage: Close examination of the process is not recommended to those who wish to maintain their delusions about, or enjoyment of, the end product. My impressions on visiting Washington are usually the opposite. I am impressed every year by the intelligence, dedication, commitment, and sincerity of those involved in the process of lawmaking, while I continue to be frequently alarmed and appalled by the end product of their efforts. Notably, ugly sausages have been produced recently in the United States in areas including visas and immigration, export controls, and funding for applied research. I remain convinced that to improve the end product, the scientific community needs more outreach and stronger and more coherent communication of the issues and opportunities that seem so obvious to us scientists. I also think we need to reexamine some of our own priorities.

Lawmakers are, in general, susceptible to simple, direct issues. This comes primarily from their necessary connection to their constituencies. They have a duty and an obligation to be responsive to those issues that exercise their voters. This means that straightforward issues of daily concern to a large percentage of their voters will get their immediate attention. Security, taxes, health. Jobs, roads, wars. These are areas where policy decisions have an immediate impact on the well-being of large numbers of voters in ways that everyone understands. They are also issues of undeniable



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importance and crucial impact. On one visit to Washington, I left an office as a legless veteran was coming in.

In contrast to health and taxes, the issues in science policy are rarely simple or direct. Why does basic research matter? If science funding was zeroed out next week, the impact on the 2006 economy would be negligible. And if the impact is economic, is it obvious that conducting scientific research is the proper activity of a central government? Recently, however, policymakers seem to have moved beyond these basic questions. From a macroeconomic standpoint, Nobel Laureates in economics have estimated that over half of all economic growth is attributable to technology innovation. Half of all growth. Consensus has also emerged that a lack of industry funding does not imply that research and development (R&D) in a given field is not profitable, merely that the R&D is not profitable for the investing party. In general, this is because profits are expected to be shared among a whole industry rather than a single monopoly established by one technology leader.

Basic research affects the economy in two ways, both of which have about a 10-year delayed impact. First, the technologies themselves typically take about 10–20 years to mature. Even those technologies that have very direct applications take a long and often circuitous path to the economy: the laser, MOSFETs, superconductivity. Those who argue that industry should be supporting these basic innovations should also be arguing for an extension of the duration of a patent to match that for the

development of commercial applications of superconductivity (maybe 70 years).

The second impact of basic research on the economy is the researchers themselves. The graduate students, postdocs, and other researchers in basic science are rocket fuel for the advanced economy. Although this benefit of basic R&D is often overlooked, its impact is frequently more direct and rapid than that of the technologies. Economists said the net present value of an immigrant of a high school graduate has been estimated at \$200,000. Students enrolled in a doctorate program are presumably far more valuable, which makes an excellent argument for the funding of fundamental research such as that conducted by the National Science Foundation (NSF) or the Department of Energy Office of Basic Energy Sciences. (Each student amounts to paying around \$120k to acquire an asset—the student—worth well in excess of \$200k.) Visa controls that prevent non-U.S. students from entering U.S. universities directly undermine this engine for growth.

The economic rationale for basic research currently seems to be widely accepted in political circles. So what should scientists be doing about the sausage problem? We need to continue to communicate to lawmakers. The economists have made the basic argument that science underpins the knowledge-based economy. I believe the politicians who are funding agencies are primed to back us. We need to communicate clearly and coherently to our policymakers (see the MRS Web-based tool for writing to your representatives, *Materials Voice*, at www.mrs.org).

Most importantly, I think we need to ensure that the publicly funded work we do actually lives up to the economic rationales, which I would argue includes allowing a larger admixture of applied science into our basic research portfolios. In the medical community, the National Institutes of Health requires involvement from a clinician who links the research to actual practice. Contrast the physical sciences, where involvement of an industrial partner is far rarer and generally less well regarded. Economists and politicians believe in the importance of science in economic growth in a global economy. This could be the time for the scientific community to assume a central role—if we can demonstrate that we understand our ability and obligation to deliver for the broader economy.

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