Letter from the President

Why Do Basic Research? And Why Double It?

"It is a different sort of genius that audaciously posits the subtle interactions among a complicated ensemble of atoms."

Harry A. Atwater

More so than in any previous year, this year's Nobel prizes in both chemistry and physics stand as triumphal moments for materials research. The physics prize to Herbert Kroemer, Zhores I. Alferov, and Jack S. Kilby for semiconductor heterostructures and integrated circuits recognized the profound link between seminal research ideas and enormous societal impact. The chemistry prize to Alan J. Heeger, Alan G. MacDiarmid, and Hideki Shirakawa recognized ideas critical to the understanding of electrical conductivity in polymers, which hold promise for organic light-emitting diodes and plastic transistors. Against tradition, the Nobel committees cited achievements that are indisputably technological, in contrast to the usual tendency to favor discoveries probing extremes of nature that are inaccessible to the knowledge and imagination of most people. Because this year's chemistry and physics prizes celebrate the Materials Research Society's values of interdisciplinary, goal-oriented materials research, they have for all of us a special tangibility and proximity. And so, now it is indeed possible to find a few past (and probably some future!) Nobelists in the MRS directory.* As never before, a young MRS member somewhere can say with conviction, "Gee, I *could* win a Nobel prize…."

Was this work basic research?

Science writer John Horgan in his 1996 book *The End of Science* asserts that all the truly important and knowable basic scientific ideas and phenomena have already been discovered and understood. From Horgan's perspective, all that lies before us are the unknowable or untestable ideas of "ironic science," such as the existence of superstrings or the end state of the universe. Beyond that, all that remains for him is the dull and dreary task of sorting and matching known basic principles to churn out mundane applications.

Such a viewpoint, it seems to me, belies the magical premise of materials. For what is science, if not the attempt to make sense of the world around us in its complexity as well as its simplicity? And materials are complex ensembles of atoms that in concert—almost in conversation—define the macroscopically observable properties of the physical world around us. To reach an understanding of materials, it is necessary but ludicrously insufficient to know the masses of the nucleons or the force laws governing two-body interactions. We materials researchers also have to postulate notions of complexity, such as the idea that *many* atoms might be involved. Or that subtle changes in atomic positions, coupled with the presence of astutely chosen impurities, might enable the high conductivity in Heeger et al.'s polymers. Or that substituting some Al atoms for some Ga atoms would allow electrostatic potential wells to be created that allowed the electron- and hole-confinement required for realization of a quantum-well laser, as in Kroemer and Alferov's heterostructures. So this type of research can be viewed as basic, but a different sort of basic, from determination of the charge on the electron or finding the full complement of quarks. A different sort of genius it is that audaciously posits the subtle interactions among a complicated ensemble of atoms. It is basic materials research.

So why do basic materials research? For this year's Nobelists, it was likely curiosity followed by the sheer joy of elucidating a new scientific possibility. Many other answers are also possible. For many young scientists, it might be the notion of a research apprenticeship as the start of a multidimensional career encompassing science, technology, and business. For the growing cadre of young scientists from developing nations, the meritocratic nature of basic research is attractive, being relatively unimpeded by language-based and cultural barriers that they might face in other professions.

Why do corporations do basic materials research? Increasingly, the honest answer is that, in large measure, they don't. The financial pressures on publicly held corporations act to deter corporate leaders from making long-term research investments. In the information era, it is simply more profitable for companies to exploit the results of research done elsewhere under other support to create the building blocks for new technologies. A modicum of basic research serves some companies well in the form of public relations via patronage of basic research as a kind of highly technological branch of the fine arts. The excitement generated by such basic research may also aid in recruiting talented employees. Though they are willing recipients of its insights, by and large, corporations cannot be significant sources of basic research in the current economy.

So it is left to governments to provide substantial support for basic research. Data from the American Association for the Advancement of Science† indicate that in the United States, research and development as a fraction of gross national product have remained constant at approximately 2.7% over the last 40 years. The U.S. government's share has dropped from 1.9% to 0.8% over the same period, with an increase in industrial research and development from 0.8% to 1.9%. However, since industry's support is disproportionately for development rather than basic research, these numbers represent an overall decline in basic research in the United States from 1960 to 2000. In the last 10 years, support for research by the Departments of Energy and Defense (which are large patrons of materials research) declined by 20% and 10%, respectively, in constant dollars. Meanwhile, sup-

*Heeger and MacDiarmid are currently members of MRS.

†Access www.aaas.org/spp/dspp/rd/guihist.htm.

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port for research by the National Institutes for Health (NIH) has risen by 80% in the same period. This has prompted even prominent biologists such as Harold Varmus, former director of NIH, to call for parity in funding between physical sciences and engineering and biological sciences. Sen. Joseph Lieberman (D-Conn.), former Speaker of the U.S. House of Representatives (1995–1999) Newt Gingrich, and the president of the NASDAQ stock exchange are unlikely allies in support of legislation that would double spending on basic research, with balance between physical and biological sciences. Why do they agree on this issue? Because they see the potential for balanced basic research investments by the federal government to promote a future of economic growth, better health, improved education, and increased military and energy security.

Unknown to most scientists, the success at raising the visibility of basic research funding in Congress is due to the efforts of a small group of Washington-based volunteers, legislators, and lobbyists known informally as the "doubling group," who have worked both hard and selflessly on this issue out of a sense of its importance to the United States and the world. Their efforts may not be wholly successful in this cycle of the federal budget, and if not, they will persevere. To them, on behalf of the young materials researcher who now thinks she or he *can* win a Nobel prize, I say "thank you." I hope you will join me.

HARRY ATWATER
2000 MRS President

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