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U.S. Science Adrift

THE IDEA OF THE frontier has been central to American history and thought. The colonies' frontier status shaped their social and political character in the seventeenth and eighteenth centuries: the nation was shaped in the nineteenth century in large part by the expansion west. In the twentieth century, as the geographical frontiers closed, other frontiers emerged; among them was U.S. science, which was transformed by the two world wars and the influx of refugee scientists from Europe. So in 1944, when President Roosevelt asked Vannevar Bush, who had led the wartime scientific effort, for a plan for postwar science, it is hardly surprising that Bush invoked this old and powerful idea to explain his plan, and called his report to the President, delivered in July 1945, *Science—The Endless Frontier*.¹

The report argued that organized exploration of this hinterland, if supported by the federal government, could bring both intellectual adventure and rich economic rewards to the nation. And for twenty years *Science—The Endless Frontier* seemed remarkably prescient. U.S. science enjoyed a flowering like none it had had before—or any other nation's science had had. U.S. scientists garnered the lion's share of Nobel Prizes; our large, well-funded, and diversified science effort was the envy of the world. U.S. technology also flourished, as did the major industries such as electronics,

chemicals, plastics, and pharmaceuticals—many of which were emerging at the war's end.

But now, things seem to have gone sour. The commanding lead of the postwar years has been dissipated. In many fields, U.S. technology no longer leads. Some science-based technology, such as supercomputers, is racing neck and neck with that of Japan, and will be for the foreseeable future. U.S. science, after a decade of level or declining budgets followed by slow increases, is under strain too. Several explanations have been proposed for the current problems: lack of enough federal money, too much regulation, and so on. In our view, the problems are deeper. They stem from the structure and values of the postwar science system that was based in part on *Science—The Endless Frontier*. The problems were intrinsic to the system, but masked by two decades of prosperity in the 1950s and 1960s. In our view, today's declining high-technology trade balance, the fragility of U.S. industries, and the serious lack of public understanding of science show that the United States has not exploited the frontier of science as well as it might have. Moreover, basic science itself faces serious difficulties, even with federal funds finally starting to rise (see Figure 1).

This essay is an experiment in science criticism. It expresses our jointly held opinions: one of us is a senior practicing materials scientist and laboratory administrator; the other is a science journalist. It does not try to be definitive or comprehensive, and it cannot discuss the detailed problems of each sector, from biotechnology to materials science to automotive research, because the problems vary from field to field. It falls, we hope, between science journalism and conventional science policy analysis. We are here only presenting a case, based on our discussions with a number of scientific managers in government, industry, and universities. We believe our empirical approach is as necessary and useful as the reductionist, pseudo-scientific study of details that characterizes much science policy literature. The readers, of course, will judge for themselves.

The reader should imagine that, in our respective careers, we have been to the theater, have talked about the show, and have written a review of it. And just as no theater director would use a reviewer's comments as a verbatim script for the next night's per-

formance, our recommendations are not precise prescriptions. But practicing scientists and those who make research policy in universities, industry, and federal and state government should welcome reviews from sympathetic spectators. For one obstacle to a candid debate about what is wrong with U.S. science has been the vanity that the study of science, and the management of it, must be “scientific.” We think good science is a creative activity, like good theater, art, or even sports. Science supported by the public purse is just as open for serious scrutiny as a show that sells tickets to the public. We hope that our experiment will stimulate others and liven up the debate about the future of the science profession.

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The touchpoint for this essay is the report Roosevelt commissioned as World War II was winding down and the contributions of scientists to the war effort were becoming known in and out of government. The moment was ripe to plan for postwar science. Bush, responding to the President, asked many key figures in the science community to sit on committees that would write individual reports to answer Roosevelt’s query. (Four such committees were established: one on a program to continue the work in medicine and related sciences, chaired by W. W. Palmer of Columbia University; one on the proper roles of public and private sectors, headed by Isaiah Bowman, President of Johns Hopkins University; one on discovering and developing scientific manpower, headed by Henry Allen Moe, Chairman of the John Simon Guggenheim Memorial Foundation; and one on the lifting of military secrecy, headed by Irvin Stewart, Executive Secretary of the Office of Scientific Research and Development.) Bush had managed the wartime scientific effort through the Office of Scientific Research and Development (OSRD), and one more report to the President was hardly a chore. Except that this one would discuss, in effect, his and his colleagues’ future.

Nine months later, on 4 July 1945, Bush reported back to the President. “We did not take five years,” he wrote later, “because within our committees there has been an extraordinary consensus.”²