

LETTERS

Vannevar Bush Was No Scientific Purist

I feel the need to clarify the historical record as presented in "Redefining the Endless Frontier: NSF Confronts the 'New Reality'" (September, page 53). This news story closed with a memorable quotation from Vannevar Bush's "Science—the Endless Frontier," the core of which is "applied research invariably drives out pure." As the story noted, this quotation is from an appendix that contains the report of the Committee on Science and Public Welfare, one of the panels that contributed to Bush's final report.

This particular line has been cited by many commentators (including in the APS's "What's New," 21 August 1992) since NSF announced plans for the commission to study the agency's future. My sense is that the people citing it hope to imply that any steps toward applied research would be at odds with what Bush intended for NSF.

It is worth noting that Bush disagreed with these words. While he undoubtedly thought that the United States needed a higher ratio of basic to applied research than prevailed in 1946, his lifelong commitment was to a balance of research activities. He envisioned a research foundation that would support both "pure" research and "pioneering efforts of a technical sort" as exemplified by the Wright brothers. According to reports, he was very annoyed when he learned the panels working with him did not think that "a couple of bicycle mechanics working on a flying machine would . . . be doing research."¹

Reference

1. J. M. England, *A Patron for Pure Science: The National Science Foundation's Formative Years, 1945-1957*, NSF, Washington, D. C. (1982).

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Roundtable: Not Well Rounded Enough?

I found the effort to discuss the topic of "science under stress" (February

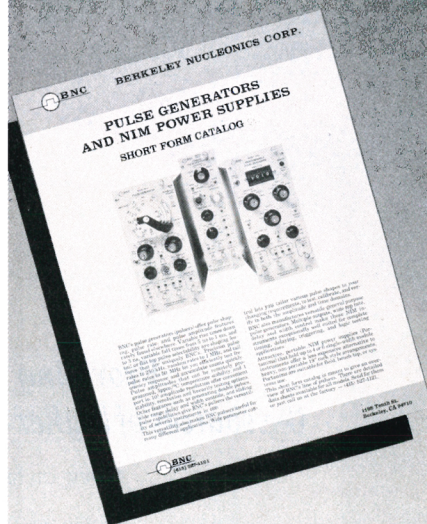
1992, page 38), in a roundtable format and at length, very commendable. Having Representative George E. Brown Jr present was extremely important, and most of the other participants were about right. However, one very obvious participant was missing: a physicist who believes that society, if it pays the bill, must write the agenda for physics. Everyone at the roundtable was a believer in the old-fashioned ruling paradigm that the emperor has wonderful new clothes, although we may quarrel about the color and cut. Most of those present seemed totally ignorant of how wide the gulf now is between the reality experienced by 99% of the world's citizens and the world of well-funded physics. The conversation could have been among cardinals in the Vatican (before Vatican II) about the Vatican's finances. No one except Brown calibrated the discussion to the nation's needs, not science's needs. No one challenged the assumption that more or better science would fix our problems, even though those problems grew while our science was number one. Only Brown talked about "society under stress." For shame: Aren't physicists part of the society from which they want such huge sums as \$10 billion for the SSC? Isn't the smallest reciprocal gesture on the part of physicists ever considered?

I have a suggestion that may help us to prepare better for the inevitable denouement when the public recognizes the absence of any clothes, that is, when it realizes it has been had for 50 years by the science community's "Immaculate Assumption"—"that [anything called] science leads inevitably to innovative technology and thus to prosperity," as PHYSICS TODAY (April 1985, page 63) described the position of President Reagan's science adviser, George A. Keyworth II.

I start by making a Kennedyesque request of physicists: Ask not for tens of billions more, but what you can do for your country (not for a tiny corner of physics). What actions can we in the science community, given no more money, take to reform our own structures and processes to better serve our nation? Let's begin by educating physicists about the nation's finances

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on which they seek to draw. In several dozen speeches to technical professional groups, from national society gatherings on down, I found that less than 10% of my audience had even an approximate feel for the gross national product, the Federal budget, this year's deficit, the debt, the foreign trade deficit and so on.

Next we could make our processes much more democratic, easily and at no cost. I propose what I proposed to former National Academy of Sciences President Philip Handler in the 1970s—that every NAS committee be required to incorporate at least one radical dissenter: a Karl Morgan on radiation committees, a Henry Kendall on nuclear power committees, a Frank von Hippel on energy committees and so on. If we cannot deal with the views of those very responsible scientists in committee, how will we deal with them in the real world of society? And how will we deal with those elements of the public who are not believers in the same "religion"? (And there they are gaining the upper hand.)

Your roundtable group lacked someone—and there are dozens—who would have articulated the positions that science in total, far from hurting, is gloriously overfunded by the public purse compared with many other investment goals; that the only studies made¹ have shown that Nobel Prize-winning science is negatively correlated with growth of gross domestic product; that, for example, particle physics—a noble calling for any individual or private foundation—has been overfunded by an order of magnitude from public funds. Let us apply the Weinberg criteria.² As Alvin Weinberg put it: "The criteria can be divided into two kinds: internal and external.

"... Internal: 1) Is the field ready for exploitation? 2) Are the scientists in the field really competent?

"... Three external criteria can be recognized: technological merit, scientific merit and social merit.

"... Relevance to neighboring fields of science is therefore a valid measure of a field of basic science."

Can anyone challenge my assertion that had particle physics been funded at the lower level, not 1 citizen in 1000 would have noticed, nor would any neighboring field of physics have missed it?

I respectfully propose that in the future this kind of helpful editorial exercise embrace a spectrum of viewpoints to approximate intellectually the national spectrum, and not just the circle within which there is so much agreement to start with.

References

1. C. Hill, Sci. Policy Study Background Rep. 3, Congressional Res. Service, Washington, D. C. (September 1986).
2. A. M. Weinberg, *Minerva* **I**, 159 (Winter 1963); **III**, 3 (Autumn 1964).

RUSTUM ROY

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GLORIA B. LUBKIN AND IRWIN GOODWIN OF *PHYSICS TODAY* REPLY: Rustum Roy makes an important and instructive point—though he is not right in every detail. At least one of the seats at our "science under stress" roundtable was occupied by an articulate critic of unrestricted big science: Erich Bloch. Nor is Congressman George E. Brown Jr an easy mark for scientific entitlements and megabuck projects. He represents a largely nonscientific constituency with an agenda that contains some, but not all, of the needs and wants of the rest of the panelists.

Contrary to Roy's observation, Brown was not alone in arguing that science is only one aspect of our society, which we know to be under stress. Daniel Kleppner said this right at the start, and Bloch expressed a similar thought a short while later. As if in anticipation of Roy's criticism, Alvin Trivelpiece related an anecdote from one of his experiences before an appropriations committee of Congress in the mid-1980s that makes the exact impression Roy would have wanted someone outside the physics community to have created at the roundtable. Trivelpiece recollected that a prominent member of Congress cautioned him about seeking more funds for physics exotica, no matter how priceless the opportunity, in dire fiscal times.

Bardeen, Shockley and Transistor Firsts

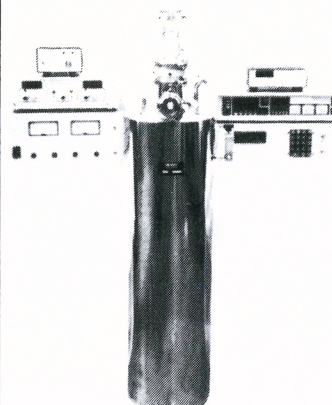
It was a pleasure to read your April 1992 special issue on that great physicist and gentleman John Bardeen. His contributions are outstanding enough that it is not necessary to overstate them at the expense of William Shockley to ensure him a major place in history. Nick Holonyak Jr, in his article on page 36, quotes a passage from the preface to Shockley's book *Electrons and Holes in Semiconductors* to show that he himself attributed the invention of the transistor to Bardeen and Walter Brattain. That statement, however, is an example of undue modesty on Shockley's part—a vice that he appar-

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