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EDITORIAL

The Road to Stiff Competition

In an editorial almost exactly 30 years ago (*Science*, 15 July 1966, p. 253), Philip H. Abelson (now Editor Emeritus) noted that the relation between humans and computers had entered a new era. Improvements in capabilities and ease of use portended a great expansion of computers' role in science and society. As highlighted in this Special Issue on Computers (organized by editors Tim Appenzeller and Gilbert J. Chin), Abelson's predictions have been well borne out. Every aspect of scientific research is now facilitated by computers, from e-mail and World Wide Web-based distribution of information to data collection, analysis, and sharing; and from the graphical portrayal and simulation of data to reference searching and management, grant accounting, and maintenance of supplies and equipment.

No scientist or academic scholar today could maintain a competitive position without computer assistance. Indeed, as noted in the Council on Competitiveness' recent report *Endless Frontier, Limited Resources** (available on the World Wide Web at <http://nii.nist.gov/>; also see *Science*, 5 April 1996, p. 25), the extraordinary advances made in computer, information, and communication technologies have become a major driver of the global R&D enterprise. Unfortunately, this report, although endorsed by Senator Mark Hatfield, chairman of the Senate Appropriations Committee, and by John Gibbons, Assistant to the President for Science and Technology, has received almost no attention from the scientific community and even less from policy-makers. The council finds that R&D is being transformed by three factors: "the end of the cold war, the globalization of the world economy, and the drive to eliminate the federal deficit." As a result, under current budget plans, the United States would drop from its 1986 status as the world's most R&D-intensive country into the second rank of industrialized nations. Reducing the amount of U.S. gross domestic product invested in R&D from 2.8% (from government and private sources combined) in 1986 to 2.2% by the turn of the century will allow other countries to become much stiffer competitors. The Japanese government in particular (see *Science*, 14 June 1996, p. 1567) has authorized a Science and Technology Basic Plan that will increase government investment in R&D by as much as 17 trillion yen (approximately \$150 billion) over the next 5 years.

As a step toward lessening the limitations on support for scientific research in the United States, the Council on Competitiveness recommends that government, industry, and academia form cooperative partnerships to pursue shared R&D objectives, which would optimize these sectors' limited but important resource pools. One potential source of such new resource pools has been suggested by Hal Berghel, professor of computer sciences at the University of Arkansas.† Berghel recognizes that largely irreconcilable cultural differences now separate research in industry (where knowledge is proprietary and informally documented) from that in academia (where knowledge is public and disseminated through the peer-reviewed literature). To bypass the forced choice between basic and applied research, Berghel advocates "strategic research" (a term that has been under scrutiny for some time), in which applications are anticipated before research begins. Strategic research would be peer-reviewed like basic research but would be judged (an aspect deemed problematic) by how well it innovates to produce applications. In Berghel's view, strategic research could conform to the highest standards of science and yet focus on solving real problems that are worthy of business investment.

The Council on Competitiveness concludes that the main objective of federal support for R&D is to stimulate civilian research. Government support of science is then neither a subsidy to a financially strapped industry nor a contract to procure specific items, but an investment with important economic and social multipliers. Adding a new pool of funds from government-university-corporate partnerships for the solution of the small body of problems that are ready for strategic research efforts could help move both science and society ahead in this time of constraint. To some scientists, such cooperation with industry will be too radical a departure from the present system, and will perhaps be seen as a first step toward diminished long-term federal support. *Science* encourages comprehensive national debate on these crucial questions and welcomes the views of its readers.

Floyd E. Bloom

Endless Frontier, Limited Resources: U.S. R&D Policy for Competitiveness* (Council on Competitiveness, Washington, DC, 1996). †*Commun. ACM* **39, 15 (1996).