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EDITORIAL

Reorientation of Research Objectives

The support and conduct of research in the federal government, industry, and universities are in the process of ultimate drastic change. This was emphasized in presentations at the annual AAAS Colloquium on Science and Technology Policy held in Washington, DC, 6 to 8 April. The evolution of emphasis from containment of communism to international economic competitiveness will affect employment in different parts of the research and development (R&D) system unevenly and at different tempos. Many of the national laboratories face an uncertain future. Industry continues to curtail its R&D efforts. The research universities will find it necessary to modify their curricula, especially in the physical sciences and mathematics.

The colloquium included many influential and articulate speakers. One of them was John D. Rockefeller IV, chairman of the Senate Committee on Science, Technology, and Space. He spoke of the need to maintain America's preeminence in broad categories of space, science, and technology. But he further noted, "We also have to recognize the growing public pressure on all public investments to be 'relevant.'" Many scientists have voiced concern about a proposal that the National Science Foundation be reorganized to have a structure similar to the National Institutes of Health with divisions devoted to so-called strategic areas. Senator Rockefeller indicated opposition to the proposal. He asked, "If NSF is reorganized around 'strategic areas,' how will it move into new areas?"

A wide-ranging discussion of "New Relationships in Science and Technology" was provided by Erich Bloch. He is a former director of the National Science Foundation and now an influential fellow of the Council on Competitiveness. Some of the current trends he mentioned as affecting R&D are downsizing in industry, a difficult labor market for new graduates and experienced professionals, an increasing number of consortia of many kinds, and the proposed freezing of overhead at universities. Bloch touched on some of the adjustments—many drastic—that will be made in academia, industry, and government laboratories. For example, government laboratories—which account for a third of the federal R&D budget—are likely to be affected greatly. Bloch also implied that the academic research system faces the prospect of downsizing and of adjusting curricula to the changing future needs of students.

John Armstrong, former IBM vice president for research, has had long experience in R&D and the conversion of new science into commercial products. He reminded the audience that costs of research represent no more than 5% of the cost of creating a successful product. He asserted that world leadership in basic research will confer a competitive advantage only if it is coupled with world-class performance in the extensive set of skills, institutions, and investments that are required for the creation of economic wealth.

Earlier in a lecture at the University of Virginia, Armstrong pointed out that the importance of university research results has declined in the areas of electronics, telecommunications, and computing, and in the hardware technologies that underlie these industries. He stated, "Not only is the bulk of the new technical knowledge in these fields derived from industrial R&D, but we are seeing the leverage of new knowledge in these fields to confer competitive advantage is decreasing strongly, as well."

Armstrong stated that the academic science and engineering research faculty need to reevaluate the relative importance of research results and other aspects of the training leading to the Ph.D. The research results are usually in a narrow field. What the Ph.D.'s know "that is of lasting value is how to formulate questions and partially answer them, starting from powerful and fundamental points of view."

Jobs for most of the graduates and Ph.D.'s in the physical and earth sciences will be in industry or government. Experience at the typical campus does not adequately prepare the young for their future roles. Armstrong has stated that "there is little or no encouragement, and a lot of implicit discouragement, for the young person who wants to spend time during graduate school off campus in a setting where technical knowledge is actually used. There is, in short, almost no value assigned to technical breadth or to real-world experience as an essential part of Ph.D. training."

This is a deficiency that should be repaired. In addition, a broadening of the curriculum to prepare students for the turbulent world of the future is necessary.

Philip H. Abelson