

## American Association for the Advancement of Science

*Science* serves its readers as a forum for the presentation and discussion of important issues related to the advancement of science, including the presentation of minority or conflicting points of view, rather than by publishing only material on which a consensus has been reached. Accordingly, all articles published in *Science*—including editorials, news and comment, and book reviews—are signed and reflect the individual views of the authors and not official points of view adopted by the AAAS or the institutions with which the authors are affiliated.

**Publisher:** Richard S. Nicholson

**Editor:** Daniel E. Koshland, Jr.

**Deputy Editor:** Ellis Rubinstein

**Managing Editor:** Monica M. Bradford

**International Editor:** Alun Anderson

**Deputy Editors:** Philip H. Abelson (*Engineering and Applied Sciences*); John I. Brauman (*Physical Sciences*); Thomas R. Cech (*Biological Sciences*)

## EDITORIAL STAFF

**Assistant Managing Editor:** Dawn Bennett

**Senior Editors:** Eleanor Butz, Martha Coleman, Barbara

Jasny, Katrina L. Kelnner, Phillip D. Szuroni, David F. Voss

**Associate Editors:** R. Brooks Hanson, Pamela J. Hines, Kelly

LaMarco, Linda J. Miller, L. Bryan Ray

**Letters:** Christine Gilbert, *editor*; Steven S. Lapham

**Book Reviews:** Katherine Livingston, *editor*; Teresa

Fryberger

**Contributing Editor:** Lawrence I. Grossman

**Chief Production Editor:** Ellen E. Murphy

**Editing Department:** Lois Schmitt, *head*; Denise Gipson,

Julianne Hunt

**Copy Desk:** Joi S. Granger, Margaret E. Gray, MaryBeth

Shurtle, Beverly Shields

**Production Director:** James Landry

**Production Manager:** Kathleen C. Fishback

**Art Director:** Yolanda M. Rook

**Assistant Art Director:** Julie Cherry

**Graphics and Production:** Holly Bishop, Catherine S. Siskos

**Systems Analyst:** William Carter

## NEWS STAFF

**Managing News Editor:** Colin Norman

**Deputy News Editors:** John M. Benditt, Jean Marx

**News and Comment/Research News:** Ivan Amato, Ann

Gibbons, David P. Hamilton, Constance Holden, Richard A.

Kerr, Robert N. Langreth, Eliot Marshall, Joseph Palca,

Leslie Roberts

**Bureaus:** Marcia Barinaga (West Coast), Michelle Hoffman

(Northeast), Anne Simon Moffat (Midwest)

**Contributing Correspondents:** Jeremy Cherfas, Barry A.

Cipra, Robert Crease, M. Mitchell Waldrop, Karen Wright

## BUSINESS STAFF

**Marketing Director:** Beth Rosner

**Circulation Director:** Michael Spinella

**Fulfillment Manager:** Marlene Zendell

**Business Staff Manager:** Deborah Rivera-Wienhold

**Classified Advertising Supervisor:** Amie Charlene King

## ADVERTISING REPRESENTATIVES

**Director:** Earl J. Scherago

**Traffic Manager:** Donna Rivera

**Traffic Manager (Recruitment):** Gwen Canter

**Advertising Sales Manager:** Richard L. Charles

**Marketing Manager:** Herbert L. Burkland

**Employment Sales Manager:** Edward C. Keller

**Sales:** New York, NY 10036: J. Kevin Henebry, 1515 Broad-

way (212-730-1050); Scotch Plains, NJ 07076: C. Richard

Callis, 12 Unami Lane (201-889-4873); Hoffman Estates, IL

60195: Jack Ryan, 525 W. Higgins Rd. (708-885-8675); San

Jose, CA 95112: Bob Brindley, 310 S. 16th St. (408-998-

4690); Dorset, VT 05251: Fred W. Dieffenbach, Kent Hill Rd.

(802-867-5581); Damascus, MD 20872: Rick Sommer, 11318

Kings Valley Dr. (301-972-9270); U.K., Europe: Nick Jones,

+44(0647)52918; Telex 42513; FAX (0647) 52053.

Information for contributors appears on pages 35–37 of the

4 January 1991 issue. Editorial correspondence, including

requests for permission to reprint and reprint orders, should

be sent to 1333 H Street, NW, Washington, DC 20005. Tele-

phone: 202-326-6500. **Advertising correspondence** should

be sent to Tenth Floor, 1515 Broadway, New York, NY 10036.

Telephone 212-730-1050 or WU Telex 968082 SCHERAGO,

or FAX 212-382-3725. **Subscription/Member Benefits**

**Questions:** 202-326-6417. **Science:** 202-326-6500.

**Other AAAS Programs:** 202-326-6400.

## Industrial Interactions with Universities

Many university administrators seem to believe that research conducted by staff can be exploited through patents and innovations to produce substantial revenues for their institutions. A recent publication of the National Academy Press provides a contrasting view of the industrial interactions with universities. The report is a summary of interviews with 17 senior industrial officials.\*

Bringing profitable products to market requires a different set of motivations, organization, and culture than does the creation and dissemination of knowledge. Companies have also noted that for every \$1 spent on research \$10 is devoted to development and \$100 to design and construction of plants. Much of this activity requires participation of goal-oriented interdisciplinary teams.

In many industries a major activity is to improve quality or manufacturing processes of existing products. This often occurs through small incremental improvements. The report notes that “incremental technological advance . . . is the dominant step in the process of innovation . . . related to competitiveness and international trade.” Parenthetically, most of us are aware that an important factor in Japanese economic triumphs has been their vigor in improving existing products for which there was already a market.

Most of the industry officials interviewed supported the view that “industry is the primary source of innovation because industry fosters entrepreneurial awareness of profitable emerging fields and ideas . . . [and that] industry scientists and engineers know more about a technology, its detail, and its system than do academic scientists and engineers. Industrial scientists . . . tend to be better at setting goals and at interdisciplinary research and can assess what needs to be done to develop a field.” An exception is in biotechnology where advances require close collaboration with research at universities. In general, how much companies rely on universities varies with the technical field, the maturity of the industry, the stage of research, and the size of the company.

All the officials interviewed mentioned the importance of collaboration with universities, which furnish new knowledge needed to build new technologies and to improve old ones. But companies can be discriminating in the choice of fields in which to collaborate. Some of their most valued assets are their stores of proprietary information, guarded zealously. Martin Marietta prefers to fund research at universities that will provide entry into an area where the firm has only limited expertise. “Otherwise,” said Albert R. C. Westwood, “the flow of information tends to be from the company to the university.”

Considerable attention in the report is devoted to the various forms that collaboration takes. These include participation in consortiums, centers, affiliates, large multimillion-dollar university–single company alliances, and one-on-one interactions of university and industry scientists. It is the latter form of collaboration that is now most favored. It may involve support by a company for an individual’s research that is being conducted at a university, or it may take the form of consultation by professors at industrial research facilities. The industry officials interviewed were cool toward other types of arrangements.

Consortiums and centers that include participation of several companies may be effective in basic science and in addressing generic issues in the development of new technologies, but they are said to be unlikely to have a significant role in the process of innovation. Companies are less and less interested in participating in industrial affiliates’ programs or in consortiums. S. Allen Heininger of Monsanto, who is president of the American Chemical Society, commented on Monsanto’s large multimillion-dollar alliances with Harvard and with Washington University. He took the position that these two major collaborations have not yet demonstrated success. He said that products need to be developed if a major collaboration is to be judged successful for both parties. Otherwise, “Monsanto’s participation becomes a charitable donation to the university.”

In many ways the report outlines the magnitude of the chasm that exists between the viewpoints and culture of universities and industry. Heininger attributes part of the chasm to the mechanisms of federal funding of university research. Peer-review decisions have emphasized the pursuit of scientific knowledge while not necessarily providing a balancing input of what society’s future needs are likely to be. —PHILIP H. ABELSON

\*Government-University-Industry Research Roundtable, “Industrial Perspectives on Innovation and Interactions with Universities” (National Academy Press, Washington, DC, February 1991).