

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

News Editor: Ellis Rubinstein

Managing Editor: Patricia A. Morgan

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

EDITORIAL STAFF

Assistant Managing Editor: Monica M. Bradford

Senior Editors: Eleanor Butz, Martha Coleman, Barbara

Jasny, Katrina L. Kelner, Phillip D. Szurmi, David F. Voss
Associate Editors: R. Brooks Hanson, Pamela J. Hines, Kelly LaMarco, Linda J. Miller

Letters Editor: Christine Gilbert

Book Reviews: Katherine Livingston, *editor*; Teresa

Fryberger

Contributing Editor: Lawrence I. Grossman

Chief Production Editor: Ellen E. Murphy

Editing Department: Lois Schmitt, *head*, Mary McDaniel, Patricia L. Moe, Barbara P. Ordway

Copy Desk: Joi S. Granger, Margaret E. Gray, MaryBeth Shartle, Beverly Shields

Production Manager: James Landry

Assistant Production Manager: Kathleen C. Fishback

Art Director: Yolanda M. Rook

Graphics and Production: Holly Bishop, Julie Cherry, Catherine S. Siskos

Systems Analyst: William Carter

NEWS STAFF

Correspondent-at-Large: Barbara J. Culliton

Deputy News Editors: John M. Benditt, Jean Marx, Colin Norman

News and Comment/Research News: Mark H. Crawford, Constance Holden, Richard A. Kerr, Eliot Marshall, Joseph Palca, Robert Pool, Leslie Roberts, Marjorie Sun, M. Mitchell Waldrop

European Correspondent: Jeremia Chertias

West Coast Correspondent: Marcia Barinaga

Contributing Correspondents: Joseph Alper, Barry A. Cipra, Robert Crease

BUSINESS STAFF

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 Broadway (212-730-1050), Scotch Plains, NJ 07076: C. Richard Callis, 12 Unami Lane (201-889-4873), Chicago, IL 60914: Jack Ryan, 525 W. Higgins Rd. (312-885-8675), 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 page XI of the 22 December 1989 issue. Editorial correspondence, including requests for permission to reprint and reprint orders, should be sent to 1333 H Street, NW, Washington, DC 20005. Telephone: 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.

The Lost U.S. Excellence in Manufacturing

Americans are accustomed to thinking of their country as leading the world in technology. But when they do, they are living in a dream world. "American manufacturing has never been in more trouble than it is now." The quotation is the first sentence of a report issued by the Office of Technology Assessment (OTA) detailing factors contributing to a continuing decline in U.S. manufacturing capabilities.*

The toughest challenge in manufacturing technology is coming from the Far East. Korea and Taiwan are newly strong competitors. But Japan's record is unique. It has led all major countries in productivity growth for decades. It has become preeminent in important industries that were once dominated by Americans. The Japanese success is attributable largely to great competence in manufacturing technology. They have been alert to opportunities to improve existing products and have made the necessary capital investments to create or obtain superior production equipment. They have been skilled in using equipment, organizing work, and managing people to make the products.

The United States has most of the world's best universities and some of the best industrial laboratories. It excels at making scientific and technical discoveries. But foreign companies and especially the Japanese have repeatedly beaten U.S. firms in getting new and improved versions of products to market while keeping quality high.

The reasons for inferior performance in the United States are many, and they are described in the OTA report. Weaknesses include deficiencies in capital markets, labor, government, and management. A major deterrent to essential investments in technology and equipment is very high U.S. capital costs. To obtain funds necessary to meet federal budget deficits requires high interest rates. Correspondingly, the rates for industrial capital investments are even higher. The behavior of financial markets has also been detrimental. Pressures are exerted on companies by the stock market, particularly by institutional investors and takeover raiders. For many companies the most important future consideration is the bottom line for the next quarterly report.

Educational deficiencies constitute another handicap for American companies. On the earlier production lines, the workers used their hands, not their heads. But needs have changed. Workers who cannot cope with math or problem-solving are a liability in advanced manufacturing. In the 1960s our students performed in math as well as students anywhere, but now the performance is comparatively mediocre.

Future excellence in manufacturing technology is likely to be dependent on applications of microelectronics. In this fast-moving field leadership in using the best in new capital equipment is usually decisive. In the past two decades U.S. industry has become steadily more dependent on foreign manufacturers for the production machinery. Japanese suppliers dominate the market for computer numerically controlled machine tools. American producers of semiconductor production equipment are fast losing the lead to Japanese rivals. Ten years ago, U.S. firms held more than three-quarters of the world market for semiconductor production equipment. By 1988, the U.S. share was down to 47% and dropping. Losses in the status of the U.S. equipment are a handicap for U.S. semiconductor producers. For some critical production equipment, U.S. users say they can only buy the latest model from Japan after it has been in wide use by Japanese producers for months.

Producers of supercomputers in the United States also risk dependence on Japanese suppliers of components. The highest performance memory and biofocal logic components come only from Japan. Cray, a U.S. manufacturer of supercomputers, has at times been told that the latest and best of these components are "not yet available for export from Japan." They are, however, available to Japanese supercomputer manufacturers, and the resultant Japanese supercomputers are ready for export.

Japanese skills in improving technology, in production, and in marketing are admirable. But often they engage in forms of economic warfare that have weakened this country. The United States must take steps to improve its skills and to avoid overdependence on crucial items from others.—PHILIP H. ABELSON

*Office of Technology Assessment, *Making Things Better: Competing in Manufacturing* (Government Printing Office, Washington, DC, February 1990).