Research and Education Are Key to Future U.S. Competitiveness

A national report of attitudes among business, university and state leaders, released by the National Science Foundation, shows that an overwhelming majority of survey respondents rate research and education as the key to future U.S. competitiveness. The report also identified university/industry cooperative ventures and greater commercialization of research findings as special areas for improvement.

Aimed at assessing the health of the U.S. research system, the survey and regional forums were conducted by the Conference Board and the National Governors' Association, with the support and participation of NSF.

Of particular concern were science and mathematics education from kindergarten through high school. Recommendations included improving the quality and quantity of teachers at this level through using scholarships, grants and loans; changing certification requirements to allow engineers, physicists and mathematicians to become certified to teach; and providing special school settings to emphasize mathematics and science.

Among the findings, participants in cooperative research relationships between universities and industries reported that industry is not committing its "best and brightest" scientists and engineers to these joint ventures and stressed the need for greater corporate involvement. The survey also showed that despite widespread business support for industry-university partnerships, more than half a sample of business leaders believes that such cooperative research would not have a critical impact on U.S. competitiveness. Only one quarter believe it would have a critical impact on the competitiveness of their firms.

In connection with technology transfer, respondents (business, university, and state) believe that business' lack of long-term goals and vision has hindered the commercialization of U.S. technology. The business community was faulted by its own representatives for lack of patience and for focusing on the next quarter's profits rather than the potential payoff from long-term investments in product development.

Copies of *The Role of Science and Technology in Economic Competitiveness* are available from: Forms and Publications Office, National Science Foundation, 1800 G Street NW, Room 232, Washington, DC 20550; telephone (202) 357-7861.

Research Roundtable Appoints New Members

Five new members have been appointed to the Council of the Government-University-Industry Research Roundtable (GUIRR), a discussion forum of scientists, engineers, administrators, and policy makers sponsored by the National Academies of Sciences and Engineering and the Institute of Medicine. Newly appointed to three-year terms are Joel S. Birnbaum, vice president and general manager, information technology group, Hewlett-Packard Co.; Richard F. Celeste, governor of Ohio; Kenneth H. Keller, president, University of Minnesota; John E. Sawyer, president emeritus, Andrew W. Mellon Foundation, New York City; and Alvin W. Trivelpiece, executive officer, American Association for the Advancement of Science, Washington, DC. The new members join 19 current GUIRR members. The Roundtable is chaired by James D. Ebert, director, Chesapeake Bay Institute, The Johns Hopkins University, Baltimore, MD.

Now in its fifth year, the Research Roundtable was created to foster discussion of crosscutting science and technology policies and problems by high-level representatives of government, universities, and industry. GUIRR conducts most of its work through three working groups that focus on science and engineering talent, university research and its management, and partnership and joint ventures between government, academia, and private industry.

Among the Roundtable's recent publications are the following:

Nurturing Science and Engineering Talent, an up-to-date review of the science and engineering talent pool. The report grew out of a 1986 GUIRR-sponsored symposium and addresses the factors that affect student decisions to pursue science and engineering careers.

Multidisciplinary Research and Education Programs in Universities: Making Them Work, a discussion paper that analyzes past multidisciplinary programs as an aid to new program design.

State Government Strategies for Self-Assessment of Science and Technology Programs for Economic Development, a report summarizing an April 1987 Roundtable workshop sponsored in conjunction with the National Governors' Association and the National Research Council.

Los Alamos Researchers Grow Single Superconducting Crystals

Los Alamos National Laboratory researchers engaged in growing single superconductivity crystals have grown a quarter-inch crystal based on the metal yttrium. "This is one of the largest crystals, perhaps even the largest, grown from this type of material," says Dean Peterson, a high temperature physical chemist in the Lab's Materials Science and Technology division.

Peterson and colleagues are growing the single superconducting crystals because "a single crystal lets an electrical current flow freely without being blocked by other, randomly oriented crystals." Peterson envisions combining superconducting crystals with other substances to alter their physical properties without reducing their superconductivity. Such changes, he said, might let superconducting crystals carry currents quickly and efficiently by being stacked end to end, stretched into thin wires or molded into specific shapes.

To make the crystals, oxides are slowly heated to about 1,600°F, a temperature just below the material's melting point when crystals begin to form. With similar repeated heatings done carefully over several weeks, the crystals continue to lengthen. The crystals are then tested to determine their composition and the extent of their superconductivity and to characterize their chemical and mechanical properties.

NSF and NASA to Link Computer Networks

The National Science Foundation (NSF) and the National Aeronautics and Space Administration (NASA) have signed an agreement to share high speed communications lines. The effort will link university researchers now connected to NSF's national computer communications network to data bases and supercomputers at NASA laboratories, saving hundreds of thousands of dollars that might otherwise be wasted in duplicated efforts by the two agencies.

The agreement is in accord with a report just released by the White House Office of Science and Technology Policy (OSTP). The report, *A Research and Development Strategy for High Performance Computing,* recommends improvements in networking to enhance U.S. leadership in the field and to provide the linkages needed for collaborative research by scientists working at different institutions.

Three NASA facilities will be linked to

existing NSF regional networks, which in turn are connected through a national backbone network. The Goddard Space Flight Center in Greenbelt, Maryland will be linked to the Southeastern Universities Research Associates Net (SURANET). The Ames Research Center in Mountain View, California will be linked to the Bay Area Regional Research Net (BARRNET). The Johnson Space Flight Center in Houston will be linked to SESQUINET, a regional network in Texas.

Authorized scientists will be able to remotely access and use NASA data in their research, and can apply for time on NASA supercomputers. NASA-funded scientists at universities served by NSF regional networks will be able to communicate and collaborate with their colleagues at the NASA centers.

NSF already shares networking facilities with the Office of Naval Research and the Defense Department's Defense Advanced Research Projects Agency. The OSTP report calls for accelerated efforts to expand interconnections among agencies.

[*See related article on NSFNET Expansion in the February issue of the MRS BULLETIN, p. 6.*]

Laser Beam Picks Up Live Microscopic Cell

Laser beams can be used as microscopic tongs to pick up individual live cells less than one-thousandth of an inch thick. Being perfected by Tudor Buican, a biophysicist in Los Alamos National Laboratory's Life Sciences Division, the cell manipulation technique will be a boon to biomedicine, and also clears the way for biology experiments in the weightlessness of space.

An extension of earlier work by physicists who used laser optical trapping to observe light rays as they were scattered by microscopic particles, Buican's method uses one or two laser beams to pick up a cell. With the single-cell method, the laser light traps the cell within the beam, and the cell will go wherever the beam is pointed. When the laser's intensity is reduced, the cell drops off and can be recovered later. With the two-beam method, the cell is trapped at the intersection of the beams. The cell can be moved in any direction before it is set down.

Early research shows that laser cell manipulation has several major advantages over other methods. Cell-manipulation experiments can be done in a completely enclosed container as small as a fingernail. "This eliminates the threat of contamination and is ideal for experiments in space," said Buican. "The only way to examine them [cells] in space, without having to constantly refocus a microscope because the cells are floating in weightlessness, is to examine them while they are held in an optical trap," he continued. "Then, the weightlessness is not a factor and the experiments can be performed in an enclosed chamber, which is important in space."

Another advantage is the ability to move one cell at a time. It enables a scientist to attach two specific cells together, which is valuable in cellular research such as cancer and leukemia studies.

Research plans are to automate the laser-beam cell manipulation, producing a computer-operated system which will automatically separate and position particular cells identified by characteristics such as shape and size.

NAS Honors 18 for Major Contributions to Science

The National Academy of Sciences has selected 18 individuals to receive awards honoring their outstanding contributions to science. The awards will be presented at the Academy's 125th annual meeting, April 25, in Washington, DC. Included in the 1988 honors are two awards given for the first time: the National Academy of Sciences Award in Mathematics and the National Academy of Sciences Award in the Neurosciences.

The 1988 awards and recipients include:

NAS Award in Mathematics—Robert P. Langlands, The Institute for Advanced Study, Princeton, NJ.

NAS Award in the Neurosciences—awarded jointly to Seymour S. Kety, Intramural Research Program, National Institute of Mental Health; and Louis Sokoloff, Laboratory of Cerebral Metabolism, National Institute of Mental Health.

Cyrus B. Comstock Prize—awarded jointly to Paul C.W. Chu, University of Houston, Texas; and Maw-Kuen Wu, University of Alabama, Huntsville.

Daniel Giraud Elliot Medal—awarded jointly to Charles G. Sibley, San Francisco State University; and Jon Edward Ahlquist, Ohio University.

Gibbs Brothers Medal—Leslie A. Harlander, L.A. Harlander & Associates.

Jessie Stevenson Kovalenko Medal—Maclyn McCarty, The Rockefeller University.

NAS Award in Chemical Sciences—Established by the Occidental Petroleum Corp. in Honor of Armand Hammer—Harden M. McConnell, Stanford University.

NAS Award for Initiatives in Research—Established by Bell Laboratories in Honor of William O. Baker—Marc L. Mansfield, Michigan Molecular Institute.

NAS Award for Scientific Reviewing—Established by Annual Reviews Inc. and the Institute for Scientific Information in Honor of J. Murray Luck—Eric R. Kandel, Columbia University College of Physicians and Surgeons and Howard Hughes Medical Institute.

NAS Public Welfare Medal—John E. Sawyer, president emeritus, The Andrew W. Mellon Foundation.

Gilbert Morgan Smith Medal—Ruth Sager, Harvard Medical School, and chief, division of cancer genetics, Dana-Farber Cancer Institute.

J. Lawrence Smith Medal—A.G.W. Cameron, Harvard University.

Troland Research Award—Eric I. Knudsen, Stanford University School of Medicine.

USX Foundation Award in Molecular Biology—H. Robert Horvitz, Massachusetts Institute of Technology.

James Craig Watson Medal—Robert B. Leighton, William L. Valentine Professor of Physics Emeritus, California Institute of Technology.

National Lab Survey Assesses Economic Impacts of High Tc Superconductors

A survey on the economic impacts possible if the new high temperature superconductors can match the performance of existing superconductors was recently completed under the leadership of Argonne National Laboratory. The conclusions are familiar: New high temperature superconductors could cut the costs of electrical generators by as much as 60%, reduce operating costs of large electrical motors by as much as 25%, and give the United States the equivalent of as much as 15% additional generating capacity by allowing utilities to use existing generating facilities more efficiently. But several years of research are still necessary, and many applications which rely on current-carrying wires and tapes will be impractical until the new material's current-carrying ability is increased 10-100 times and its strength and flexibility are improved. Besides electricity production and delivery, the study also covered magnetically levitated trains and magnetic separation methods.

Other organizations participating in the study were Brookhaven National Laboratory, Los Alamos National Laboratory, Massachusetts Institute of Technology, Oak Ridge National Laboratory, and Pacific Northwest Laboratory.

[*See the April 1988 issue of the MRS BULLETIN for a report on the Fifth DOE Information Meeting on High Temperature Superconductivity held January 25-26, 1988 at Sandia National Laboratories.*]

U.S. and Soviet Academies Sign Cooperative Exchange Agreement

On January 12, 1988, Frank Press, president of the U.S. National Academy of Sciences, and Guriy Marchuk, president of the Academy of Sciences of the USSR, signed a new five-year agreement for scientific exchanges and cooperation. The new agreement was signed during the two-day annual meeting of the officers and other representatives of the two Academies. It replaces an earlier two-year agreement due to expire in April.

Provisions in the new agreement call for a comprehensive evaluation of the program after two years, prior to extending it the additional three years. The agreement also provides for a continuation and expansion of current programs for exchanges of individual scientists, cooperative research, and bilateral workshops. In addition, the two delegations agreed to a number of specific topic areas for both bilateral workshops and cooperative research.

The following topics were selected for scientific workshops in 1988 and 1989:

- Nonlinear systems in the prediction of earthquakes
- Development of new vaccines
- Use of lasers in photochemistry
- Nonlinear processes in dense plasmas
- Dynamical symmetries and supersymmetries
- Planetary sciences
- Biotechnology and applications in agriculture
- Structure in eucaryotic genome and regulation of its expression
- Astrophysics

Other types of cooperative efforts will be continued or initiated in a number of areas including the following:

- Condensed matter theory
- Evolution of geological processes in the history of the earth
- Arctic research in solid earth geosciences
- Abating erosion of the global ecology
- Energy conservation research and development
- Nuclear reactor safety
- Economic aspects of the industrialization process

According to Press, the meeting produced several new developments for future cooperation between the U.S. and Soviet Academies. These include the promise of greater access for Americans to Soviet universities and other non-academy research institutions; increased participation of scientists of all ages in the program, including a planned four-week summer science workshop for scientists under 30 years old; and cooperative research on the Soviet economic restructuring program and on science education.

Copies of the full agreement are available from the Advisory Committee on the USSR and Eastern Europe, National Academy of Sciences, 2101 Constitution Avenue, NW, Washington, DC 20418; telephone (202) 334-2000.

Scientists Probe Laser Welding

Los Alamos National Laboratory scientists are probing molecular and atomic compositions to improve laser welding, the most recent development in a metal joining technique used since prehistoric times. The team's studies are concentrating on a type of laser commonly used in industry for such tasks as welding auto parts on an assembly line.

One of the keys to increasing the effectiveness of lasers for welding and cutting is to improve the laser beam's coupling with the surface of the object. Metal typically reflects 50-90% of the laser beam, so less than half of its intensity is actually used. An improvement could greatly speed the time to perform a weld while at the same time substantially increasing the strength of the weld. Laser cutting and drilling would also be improved.

"Through laser experimentation and computer modeling of the laser-material interaction, we are attempting to better understand and improve on the efficiency of the laser welding process," said team metallurgist Gary Lewis. "Some of the areas being investigated include the effects of the welding atmosphere and the laser's power density on the size and shape of the weld."

The team also is investigating the laser plume, which can be up to 4 inches tall from the surface of the material being processed. "We think we have a way to determine the depth of a weld by observing what the center of the plume looks like. We also think it can help us determine the strength of the weld," said physicist Ray Dixon. "Now, welds are sometimes x-rayed to check their strength, but it's an inexact method. Our method can point out deficiencies in the weld as it is being made," he continued. The scientists believe their method will lead to designing other diagnostics for welding, especially ways of predetermining laser operation to accomplish a particular kind of weld or cut. □