

Education

NSB panel wants NSF to lead drive to improve college labs

A recent report to the National Science Board on science and engineering education at the undergraduate level minces no words. "The nation's undergraduate programs in science, mathematics and engineering have declined in quality and scope to such an extent that they are no longer meeting national needs," the report says in its opening sentence.

The report was prepared by the NSB Task Committee on Undergraduate Science and Engineering Education, headed by Homer A. Neal, a physicist who is provost of the State University of New York at Stony Brook. Physics also was represented on the committee by Thomas B. Day, a particle physicist who is president of San Diego State University in San Diego, California, and Norman C. Rasmussen, the MIT nuclear engineer who headed the committee that issued "WASH-1400," a much-debated report on the risks of nuclear power plant accidents.

"The most striking and pervasive change of the 1980s," the Neal report claims, "is the shift to a global economy. The only way that we can continue to stay ahead of other countries is to keep new ideas flowing through research; to have the best technically trained, most inventive and adaptable work force of any nation; and to have a citizenry able to make intelligent judgments about technically based issues. Thus, the deterioration of collegiate science, mathematics and engineering education is a grave long-term threat to the nation's scientific and technical capacity, its industrial and economic competitiveness and the strength of its national defense."

The report gives the US credit for spending \$101 billion annually to support what it calls "the most varied and extensive network of colleges and universities in the world." It complains, however, that state funding for higher education has not kept pace with economic inflation during the past decade, that industrial contributions have gone primarily to graduate research and that mission-oriented Federal agencies have had little money to spend on improvement of undergraduate educa-

tion as such. NSF, for example, has just two programs that specifically support undergraduate education in science, mathematics and engineering: the College Science Instrumentation Program, budgeted at \$5.5 million per year, and a teacher-preparation program for future teachers of mathemat-



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ics and science, budgeted at \$6 million per year.

As the Neal panel sees it, there have been efforts in recent years to improve pre-college education and the flow of research results from universities and laboratories to industry and business, but "attention has not yet been focused on the essential bridge between the schools and the national apparatus for research and development"—namely, undergraduate education in mathematics, engineering and the sciences.

Conclusions. Based on testimony from science and education leaders, reports by NSF staff, a literature survey and other information provided by scientific organizations and corporate executives, the Neal committee concludes that the principal weaknesses in undergraduate education are poor laboratory instruction, inadequate continuing education for faculty, and out-of-

date courses and curricula.

The report's main—or most noted—recommendation is to increase NSF spending on undergraduate education by \$100 million above current spending by fiscal 1989. The committee thought the additional new funds should be allocated roughly as follows: laboratory development, \$20 million; instructional instrumentation and equipment, \$30 million; faculty professional enhancement, \$13 million; course and curriculum development, \$13 million; comprehensive improvement projects, \$10 million; undergraduate research participation, \$8 million; minority-institutions program, \$5 million; and information for long-range planning, \$1 million.

The report places considerable emphasis on its recommendation for higher NSF funding, which is bound to be controversial. The recommendation is made "in full knowledge of the current Federal budget exigencies, including the possible effect of the Gramm-Rudman-Hollings act," and the recommended programs "should be initiated within the existing NSF resources rather than wait until incremental funds are made available."

At the same time, the committee emphasizes that responsibility for the health of undergraduate education "resides primarily in the nation's colleges and universities and their governing bodies." It accordingly makes miscellaneous recommendations to state governments, academic institutions, the private sector and mission-oriented Federal agencies, such as:

► States should adopt legislation aimed at attaining a minimum level of support for laboratory instrumentation of \$2000 per science and engineering graduate student per year.

► Academic institutions need to develop both short-range and long-range plans for modernization of undergraduate instructional and research equipment.

► Federal agencies such as NASA, DOD, DOE and the National Institutes of Health should expand their efforts to involve undergraduate faculty and students in their research activities.

► NSF and the Department of Education should collaborate in a major effort at the pre-college level aimed at reversing the "steadily increasing demand for remedial mathematics and science instruction in colleges and universities."

The Neal report's demand for an increase of \$100 million in NSF funding for undergraduate education has aroused some consternation in the physics research community because of worries associated with the Gramm-Rudman-Hollings budget-reduction law. The concern is that if spending on education goes up, spending on research will have to go down by a similar proportion.

Background. AAPT and APS were among the organizations that testified to the Neal committee, and considering that their principal recommendation was for increased funding for laboratory equipment (PHYSICS TODAY, February, page 65), it would seem that their message got through.

Neal says that testimony to the committee, including the reports by Robert R. Wilson (Cornell) and Anthony P. French (MIT) on the conference of physics-department heads, was a major

factor in the committee's conclusions. In addition, Neal says, many nonspecialists such as university presidents brought the message that some needs once addressed by Federal programs are no longer being addressed. The wealth of information at NSF itself also was useful, Neal observes, and Betty Vetter, executive director of the Scientific Manpower Commission, provided valuable data. Finally, he says, the committee members had their own personal experiences and impressions to draw on.

Neal reports that in the next phase, workshops will be set up at NSF to evaluate specific needs in mathematics, engineering and the physical sciences. Participants in the workshops will be asked what programs should be supported if NSF increases funding to the levels recommended by the Neal panel. Participants will also consider, according to Neal, matters such as whether a few centers should be set up around the country for laboratory and curriculum development and how the new NSF-supported engineering research centers might play some direct role in undergraduate education.

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and the Departments of Defense and Energy. A thorough survey of the dynamics of the field is timely, perhaps even tardy, explains Chaudhari, for both intellectual and business reasons. "The field is known for its scientific excitement and its practical engineering applications," says Chaudhari.

The task statement calls for "a unified view" of recent progress and new directions in materials science and engineering and for a full assessment of future opportunities and needs. The study is organized into five panels, each dealing with a different aspect:

► The first panel will set forth various opportunities and requirements for advancing the field. Describing the work of this panel, Chaudhari says, "It will ask materials researchers, along with government officials in places like the Defense and Energy Departments and people in selected private industries, to put on their visionary caps and tell us what lies ahead for materials science and engineering during the next decade or decade and a half."

► The second panel will examine how knowledge and technology reach scientific practitioners and the ways ideas are translated into technology. Considering the cultural history of technology transfer in the US, says Chaudhari, "it will be interesting to find out if our processes and procedures are better or worse than those in Europe or the Far East. We want to know how new

Survey of materials research is launched

Materials research has evolved in the past two decades from work going on separately in physics, chemistry, metallurgy, electrical engineering and other disciplines. As researchers merged their theories, concepts, techniques and analytic tools, it became difficult to identify those fields separately. "We now appreciate that there are unifying factors that distinguish us," says Praveen Chaudhari of the IBM Thomas J. Watson Research Center. "This is not only true in understanding nature but in applying that understanding to important new technologies."

The specialty has been championed recently on many fronts—from the Commerce Department to the National Research Council and the House Science and Technology Committee—as central to the nation's scientific leadership and competitive edge in electronics, energy and defense technologies. Since the steady advances in solid-state technology of the 1950s and 1960s, scientific understanding of complex materials has increased rapidly, due in large part to progress in electron microscopy, neutron-scattering techniques, synchrotron radiation sources and such spectroscopies as nuclear magnetic resonance.

Despite the obvious success, exciting opportunities in materials science and engineering may be stymied, argue

many in the field, by the lack of Federal support for new equipment, facilities and researchers. After listening to academics and industrialists issue such dire forecasts, Representative Don Fuqua, the Florida Democrat who is chairman of the House Science and Technology Committee, decided it was about time to "take stock" of the field. He asked Frank Press, president of the National Academy of Sciences, to undertake an examination of materials science and engineering. In response to Fuqua's letter, NAS and its companion National Academy of Engineering directed the National Research Council to launch the first extensive survey of materials research. The study began last December.

Modeled on the sweeping *tours d'horizon* that panels of the Research Council have conducted for physics and chemistry, the materials study is expected to be equally comprehensive. Its participants will number about 100 in all. A 17-member committee (see box) under the joint chairmanship of Chaudhari and Merton C. Flemings of MIT will coordinate the activities of this group. Moreover, the tour will be guided by a steering committee headed by Albert Narath of AT&T Bell Laboratories and Arden Bement of TRW, Inc. The survey is expected to take two years and cost about \$750 000, mainly from the National Science Foundation

Materials science committee

Praveen Chaudhari, IBM Corp, *cochairman*
Merton C. Flemings, MIT, *cochairman*
Martin Blume, Brookhaven National Laboratory
Alan Chynoweth, Bell Communications Research Inc
Jerome Cohen, Northwestern University
W. Dale Compton, Ford Motor Co (now National Academy of Engineering)
Robert S. Hansen, Ames Laboratory, Iowa State University
John Hulm, Westinghouse Electric Corp
R. Glen Kepler, Sandia National Laboratory
James Langer, University of California at Santa Barbara
Terry L. Loucks, Norton Co
George Parshall, E. I. DuPont de Nemours & Co
Rustum Roy, Pennsylvania State University
Lyle Schwartz, National Bureau of Standards
James O. Stiegler, Oak Ridge National Laboratory
George Whitesides, Harvard University
James C. Williams, Carnegie-Mellon University