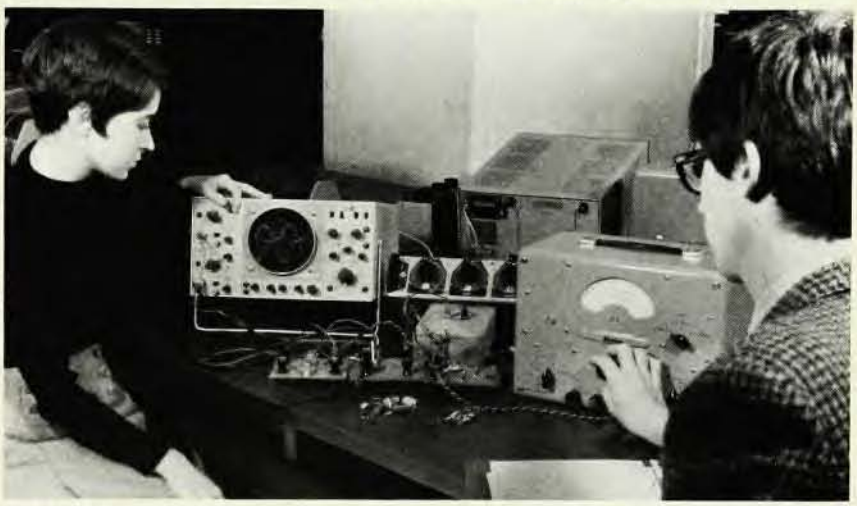
Beefing-up research facilities at universities with less pork

As university heads and scientists tell it, their research "infrastructure," like the nation's roads, bridges and sewer systems, is crumbling faster than it can be repaired or replaced. Horror stories about run-down laboratory buildings and worn-out research instruments filled the air on 8 May before a dozen members of the House Science and Technology Committee. Its chairman, Representative Don Fuqua of Florida, reminded the witnesses in his opening remarks that this was not the first time Congress has heard about the urgency of dealing with the decay of academic research equipment and facilities. For years, many of the same problems have been brought to the attention of the same committee, Fuqua observed. "It is probably not farfetched to say," he said, "that if this happened in a research-intensive industry, management would be severely criticized."



Outdated equipment such as the signal generator and other apparatus in this classroom are signs of a crisis that extends from instructional instruments to research facilities.

For their part, however, the academic administrators took no blame. "The nation is facing a crisis on its campuses," John R. Silber, president of Boston University, informed the committee. This is not a cry of "wolf," he declared, because this time "the alarm is genuine." Another witness, Charles E. Young, chancellor of the University of California at Los Angeles, asserted that "inadequate facilities and outdated equipment are a direct threat, across the country, to the quality of instructional and research programs." President Reagan's science adviser, George A. Keyworth II, added his voice to the concerns of the university leaders. "These deficiencies directly affect the ability of university scientists to conduct frontline research," said Keyworth, "they hamper the ability of students to learn the newest technologies and they make it more difficult for universities to compete with industries for facilities in areas that are strongly dependent on the use of modern research equipment."

As evidence for the case being made, Keyworth cited a report issued a few days before by the National Science Foundation. It spoke of department chairmen and principal investigators in computer science, physics and engineering at 43 of the nation's largest research universities who told NSF that 25% of their laboratory equipment in 1982 was so antiquated or dilapidated that the items were no longer in use. What's more, although one-half of the research instruments had been bought in the previous five years, only 16% could be classified as "state-of-the-art." To make matters worse, more than 90% of those surveyed by NSF claimed that lack of equipment and obsolescence of instruments that year had inhibited the conduct of critical scientific research.

'Golden years.' It turns out that NSF provides about 52% of all Federal support for academic research instruments and systems in the physical and computer sciences, and the Department of Defense accounts for 45% of Federal funds for research apparatus at engineering schools. In the 1960s, the decade that university leaders characterize as the "golden years of academic science," said Keyworth, an unprecedented amount of funding came from NSF, DOD and such mission agencies as NASA, the National Institutes of Health and Department of Energy.

Then, in the 1970s, "With the exception of NSF and NIH . . . the major Federal R&D agencies—DOD, DOE, NASA—diverted research funding away from universities to their own laboratories or to industry," Keyworth continued. "The universities, in a financial bind, did what you or I would probably choose to do. In order to support researchers and students, they cut other expenditures. That meant deferring improvements to facilities, deferring purchase and even maintenance of instrumentation and, in general, conserving programs they had, rather than undertaking new ones. So in a very real sense the economizing actions they had to take in the 1970s, when basic research support fell off, led to some of today's problems."

In retrospect, the amendment by then Senator Mike Mansfield of Montana to the Military Procurement Authorization Act of 1969, prohibiting DOD from sponsoring research that did not relate directly to the nation's defense, was "a grave disservice," Keyworth told the House committee. Until then, he said, DOD was "the strongest and in many ways most imaginative supporter of university basic research. . . . Many of the nation's best research universities—places like MIT and Caltech—are strong national resources today precisely as a result of

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that DOD support two decades ago." Now, said Keyworth, he is saddened that DOD has neither the commitment nor expertise that once made its university research so successful. He has discussed the situation with Defense Secretary Caspar W. Weinberger and Undersecretary Richard A. DeLauer, who heads DOD's science and engineering programs, and, in consequence, the department will "play a significant role in maintaining university health." Indeed, since 1982, DOD's University Research Instrumentation program has put $30 million each year, equally divided among the three services, into upgrading academic research facilities.

DOD support. Even as Keyworth spoke, members of the Senate Armed Services Committee issued a report across Capitol Hill on the Omnibus Defense Authorization Act for 1985, lambasting the steady decline of DOD support for university research. Though the committee happily endorsed DOD's instrumentation initiative, it concluded that the program had been so hopelessly oversubscribed that many worthwhile projects were neglected. For instance, the first announcement of DOD's five-year $150-million program resulted in 2478 proposals seeking a total of $645 million. DOD made 204 awards, with each grant averaging $148 000. That represents an award rate of 8% and a funding level of 4% of the amount requested. DOD estimates that perhaps $2 billion would be needed to raise qualified university laboratories to "world-class" status in scientific equipment.

The gap between needs and reality convinced the Senate to demand in its 1985 Omnibus Defense Authorization Act that Weinberger provide a full report by next March on what DOD is doing to improve the infrastructure of university research, among many matters relating to strengthening the nation's defense base of science and technology. The committee concludes: "DOD must do its share to maintain the excellence of our scientific infrastructure through strong support of university research." The act requires DOD to come up with "specific recommendations as to additional legislative authority and appropriations" that would strengthen existing programs and capabilities for future work.

In another action involving university research instrumentation, the Senate–House conference on NASA's budget authorization bill for fiscal 1985 added $7 million for such purposes. When the NASA budget was submitted last February, the agency had not requested any money for university lab equipment, which caused disgruntlement among academic space scientists.

Flat funding. Expenditures for science and engineering equipment and facilities at university research centers are estimated to aggregate about $2 billion per year, which is relatively flat in real dollars since 1968. The Federal share has decreased from about 32% in 1966 to half that in 1981 and 1982. In the 1960s the physical sciences dominated all university capital spending. Today, with the coming of age of biochemistry along with its needs for more complex instruments and new lab space, as well as larger numbers of graduate students, the life sciences receive more than 50% of Federal funds for equipment. Physics gets about 18%.

In his testimony on 8 May, Boston University's Silber told Congress that colleges and universities today can finance no more than half of their science and engineering infrastructure out of their own resources. "We are divided into haves and have-nots," he said. "A comparative handful of major universities—in both the independent and state sectors—are immensely rich." Among the independents, which comprise 1500 institutions, a mere 35 hold some 90% of the total academic bank accounts. The richest state institutions are located in the wealthy industrial states of the Northeast and Mid-Atlantic regions along with Texas and California. What is so worrisome are the other universities of "high excellence but inadequate support," said Silber. "These schools are facing needs in construction that average perhaps $75 million each, representing a total need of $3.75 billion."

Silber's estimate is way low. UCLA's Young claimed that the University of California alone needs more than $4 billion for renovation and construction of facilities in the next decade. Some $1.6 billion of this will be needed to keep pace with the latest advances in various disciplines—most notably, biological and computer sciences. Moreover, says Young, "because California has about 10% of the country's population and receives about 10% of Federal research grants, we could conservatively estimate the national need at ten times $4 billion—or $40 billion. The obvious question is: Where will that much money come from?"

Answers differ. University administrators such as Young and Silber argue that the largesse provided by the Federal government in the past creates an obligation for assistance now and in the future. During the 1960s, when the nation faced the problem of a widely increasing number of undergraduates and graduates and a rapidly expanding body of scientific and technological knowledge, NSF operated yearly Science Development Programs. During the 11 years of the programs, ending in 1972, the foundation provided $233 million to some 260 departments or projects in 102 institutions to improve science and engineering research and teaching, much of this in infrastructure. Of that total, $63 million went to 45 departments in physics and astronomy—the largest sum among all disciplines.

Inconclusive studies. A recent report by Congress's Government Accounting Office concluded, after reviewing seven different studies of university research equipment, including the one by NSF, that the real needs are uncertain. While all the studies showed that research infrastructure is a major concern of the scientific community, the GAO found the scope of the studies to be limited to only a few fields and that significant changes had occurred in the cost and type of equipment and facilities since the studies were completed—in some cases, several years ago.

In the meantime, a few universities have decided to bypass the conventional "peer review" procedures used by NSF, DOE and NIH in funding research and to rely instead on political muscle to gain congressional support for their projects. Last year, an undignified squabble broke out between the Association of American Universities, which lobbies Congress on behalf of the 50 most prominent research universities, and Catholic University of Washington, D.C., and one of AAU's own members, Columbia University. Both had hired the same Washington lobbying firm, Schlossberg–Cassidy and Associates, to make an "end-run" around the DOE advisory system to pay for new research buildings (PHYSICS TODAY, August 1983, page 45). Thanks to the personal intervention of Thomas P. ("Tip") O'Neill Jr, speaker of the House of Representatives, both universities got what they wanted, to the consternation of some university administrators and nonpolitical scientists. Though the "bricks and mortar" for neither university appeared in the Reagan administration's budget request for fiscal 1985, the Senate–House conference on the DOE section of the Energy and Water Development Appropriation Bill (HR 5653), agreed to give Catholic University another $8.9 million for its Vitreous State Laboratory and Columbia $3 million more for a chemistry research center.

Pork-barreling. To make matters worse, the conference committee also allotted $7 million in the DOE budget for a supercomputer center at Florida State University, which happens to be within Representative Fuqua's Congressional district. As chairman of the House Science and Technology Committee, Fuqua is on record as abhorring "pork-barrel" politics for science projects. But the Florida State center, say DOE officials, had not been put to open competition or peer review. Fuqua insists he had nothing to do with

the plum for Florida State, which is expected to cost some $55 million over the next five years. On a weekly television show called "The Lawmakers," over the Public Broadcasting Service on 14 June, Fuqua said: "All these projects have to be put into a proper perspective of whether or not it's pure science we're talking about or is it certain facilities that the government or the Congress feels necessary."

Still another contretemps involves Georgetown University, a private Catholic institution perched in one of Washington's most fashionable residential areas. It took its case for a $220-million coal-gasification and fuel-cell demonstration facility directly to the Department of the Army and DOE for funding, then to Congress for approval—also without appearing in the Pentagon and DOE budgets for fiscal 1985 and without any peer review.

Such antics by prestigious universities confounds and infuriates science policy makers such as Keyworth and Roland W. Schmitt, chairman of the National Science Board, which oversees NSF. Keyworth told Fuqua's committee that the Federal government would have to help rebuild the nation's university research infrastructure and cautioned that any capital investments by the government should not be disconnected from the country's most important research needs and from sound cost-containment principles. To facilitate this, he announced that the White House Science Council, which reports to him, is starting a study under David Packard, chairman of Hewlett–Packard, to examine the policy questions affecting the health of higher education—among these, the Federal government's ability to ensure a productive research infrastructure. "While we have no intention of even suggesting an entitlement program for research," said Keyworth, "neither do we see much sense in forcing the most productive researchers and teachers to waste so much of their time playing the grantsmanship games."

Pilot program. Obviously annoyed by the spate of academic pork-barreling, Schmitt and the Science Board, at their monthly meeting on 22 June, directed NSF to introduce a new program in fiscal 1986 that would provide financial support for construction and renovation of academic research centers in three big new programs that the foundation would introduce in fiscal 1986, which begins on 1 October 1985—biotechnology, engineering and advanced scientific computing. In its resolution calling for the pilot program, the science board said that while programs had been started recently at several Federal agencies, including NSF, to help universities buy up-to-date research instruments, none had

Education

Shakhashiri: Entertaining lecturer moves to NSF


NORMAN LENBURG

On 8 May, a few days before submitting his resignation to the White House as director of the National Science Foundation, Edward A. Knapp announced the appointment of an assistant director for science and engineering education. The new NSF executive is Bassam Z. Shakhashiri, professor of chemistry at the University of Wisconsin, where he is renowned as a dynamic lecturer and innovative director of the Institute for Chemical Education. He succeeds Laura P. Bautz, who has been acting assistant director since last October. Bautz returns to her former job as director of NSF's Division of Astronomical Sciences.

One of six NSF posts requiring Presidential approval and Senate confirmation, the education directorship seems destined to assume increased importance and visibility as the Reagan administration and Congress channel more money into the agency's precollege activities and graduate fellowships. The job had been abolished when the NSF education directorate was ravaged in the Reagan administration's first-year budget cuts. The staff was cut to 15, and they were left to carry out perfunctory functions.

In Senate–House conference on 26 June, the NSF appropriation for science education was raised to $87 million from the administration's budget request for $75.7 million, the increases to go mainly for larger stipends to more graduate fellows and for additional teacher training programs. Of the total appropriation, $54.7 million would go to improve precollege science and mathematics instruction—the same as in fiscal 1984. This includes summer workshops for teachers, improved undergraduate education for teachers and graduate research fellowships, as well as for materials development and research in science and math instruction techniques.

With his background and qualifications, Shakhashiri is likely to win Senate approval without great difficulty. As the organizer and first director of the Institute for Chemical Education, he has brought hundreds of high-school science teachers and industrial chemists to the Wisconsin campus at Madison for workshops to devise course content, write new syllabi, prepare computer programs and develop laboratory demonstrations.

A native of Lebanon, Shakhashiri attended the American University in Beirut for one year and came to the US in 1957. He received a BA from Boston University and MS and PhD from the University of Maryland. He taught general chemistry at the University of Illinois, where he was twice named outstanding lecturer of the year in the late 1960s, before joining the Wisconsin faculty in 1970. Phillip Certain, Wisconsin's chemistry department chairman, hails Shakhashiri as a "phenomenal chemistry educator." For his efforts, Shakhashiri has won teaching prizes the past six years. His final lecture each fall is titled "Once Upon a Christmas Cheery in the Lab of Shakhashiri." In it he makes use of Christmas ornaments, balloons and other playful items to demonstrate scientific concepts in the tradition of children's science shows begun 160 years ago by England's Michael Faraday. For the past three years he has conducted "Chemistry Can Be Fun" workshops and lectures for precollege students. His outreach efforts have included collaborating on a series of handbooks on chemistry demonstrations for teachers at all levels and helping develop an interactive exhibit called "Everyday Chemistry" at the Chicago Museum of Science and Industry.

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been initiated to deal with the "physical infrastructure problem." The board took a broad view of the problem. Academic science infrastructure, it said, means "Construction of new and renovation of existing facilities—understood to include buildings and research platforms of various kinds, such as ships, field stations, etc.—and provision of the personnel required to operate and maintain those facilities."

The whole subject is now under review by an NSF-led ad hoc Interagency Committee on Academic Research Facilities, made up of representatives from the NIH and departments of Agriculture, Defense and Energy. Though the committee's report is due by next February, Schmitt, who is vice president of research at General Electric and unaccustomed to waiting for answers to most questions, asked Erich Bloch, who has recently been appointed as director of NSF after serving as an IBM vice president, but has not yet been confirmed by the Senate (PHYSICS TODAY, July, page 59), to report to the board in August on the proposed pilot program. The board made it clear that the "entire process" that would put NSF back into the business of funding a building boom on campuses would be subject to peer review. As Schmitt put it to his NSB colleagues: "If you go out to the universities and kick the tires, you are sure to hit the soft spots." —IG

At UNESCO politics and science don't mix

The Reagan administration's threat to pull out of UNESCO at the end of this year dismays many US scientists who have worked closely with the organization. Criticism has been voiced on Capitol Hill, where two committees of the House of Representatives have held joint hearings on the issue once a month since March, and in other forums, such as the lively session at the May meeting of the American Association for the Advancement of Science. Even members of the White House Science Council, which provides advice to the President's chief scientist, George A. Keyworth II, expressed their opposition and recommended that the government reconsider its proposed action or, at the least, postpone withdrawing for a year, until a better assessment could be made of the risks and benefits of staying in UNESCO or abandoning it.

"Withdrawal from UNESCO will deal a serious blow to some American science," Arthur K. Solomon, emeritus professor of biophysics at Harvard and a scientific member of the US delegation to UNESCO in 1976 and 1978, told Congress at its first hearing on the agency. "American science needs the international network provided by UNESCO, especially oceanography, climatology and the earth sciences. UNESCO is the nexus of multilateral cooperation in global scientific programs . . . International science has long recognized that if there were no UNESCO, one would have to be created."

Last December, when the State Department publicly announced the US decision to withdraw from the United Nations Educational Scientific and Cultural Organization, it rested its case on political and financial grounds. The agency, said Gregory J. Newell, assistant secretary of State for international organization affairs, has "extraneously politicized virtually every subject it deals with" and "exhibited hostility toward the basic institutions of a free society, especially a free market and a free press, and . . . demonstrated unrestrained budgetary expansion." In delivering this characterization, the State Department largely ignored a report by a Federal interagency panel, led by the National Science Foundation, which concluded that the scientific benefits the US derives from UNESCO "clearly warrant our continued participation."

Academy fear. The State Department also appeared to pay little heed to a National Academy of Sciences review that found science to be UNESCO's "most succcessful effort." In his cover letter to Newell, the Academy's foreign secretary, Walter A. Rosenblith, a biophysicist at MIT, expressed the worry that "there is much criticism leveled at UNESCO programs, structure and management, but in the area of sciences at least, there is no real alternative to UNESCO at the present time."

UNESCO has a remarkable record of achievements. The organization did pathbreaking work in reducing functional illiteracy in many Third World countries and in salvaging such cultural treasures as Venice, the Acropolis and Abu Simbel. It organized and coordinated the International Geophysical Year of 1957–1958, helped originate and support the International Centre for Theoretical Physics at Trieste and laid the foundation for European particle physicists to build CERN. UNESCO also pioneered solar-energy research in the 1950s, and enabled scientists in such historically hostile nations as Greece and Turkey to collaborate on earthquake studies.

Accordingly, just before Congressional hearings began, the State Department amended its view in a policy review that awarded UNESCO high marks for several scientific programs. Among those considered praiseworthy were: the International Brain Research Organization, which advances neurobiology, the Intergovernmental Oceanographic Commission, providing US scientists with marine data on foreign sites that would be difficult or impossible to obtain otherwise, and Man in the Biosphere, involving 105 nations in studying and managing the world's major ecosystems. In the case of the Man in the Biosphere program, Paul T. Baker of Pennsylvania State University told congressmen last March, not only is there no plan to participate if the US left UNESCO, but no US funds are earmarked for continuing MAB beyond 30 September. Clearly, said William A. Nierenberg (Scripps Institution of Oceanography) at the same hearing, the survival of MAB and the International Geological Correlation Program would be in jeopardy without UNESCO. By contrast, such organizations as the International Oceanographic Commission and the International Union of Pure and Applied Physics do not require UNESCO affiliation for membership. Consequently, Nierenberg observed, in evaluating the benefits of US participation in UNESCO scientific programs it is necessary to distinguish between observational sciences that rely on geographical access and experimental or theoretical science that do not.

Last April a staff study for the House Committee on Foreign Affairs was critical of the State Department for neglecting to see the critical implications of "abandoning US leadership in UNESCO." The House staff report urged withholding final judgment on leaving the organization until Congress's Government Accounting Office completed an investigation of UNESCO that Congress had requested. The GAO report, concentrating mainly on the tangled and comparatively imperfect financial and management practices of UNESCO, is due for release in September.

Spreading wariness. The US is not alone in its dissatisfaction with UNESCO. In March, 23 other countries, including Britain, West Germany, Canada and Japan, served notice that they would consider leaving unless there were substantial changes in the organization's financial management, personnel practices, program development and political policies. Even the Soviet Union has since demanded reforms, without providing specifics, while significantly omitting for the first time its customary support of UNESCO Director General Amadou-Mahtar M'Bow, a longtime teacher, education official and Minister of Education and Culture in Senegal before and after its independence from France.

In a recent study of UNESCO, "An Idea and Its Servants," Richard Hoggart, a