Cannon, former research director for Rockwell International, and its head of research is John Rowell, the former assistant vice president of solid-state science and technology research at Bellcore (see PHYSICS TODAY, November, page 38).

—WILLIAM SWEET

DISCONTENT WITH PhD PROGRAMS VOICED AT AAPT–APS CONFERENCE

All is not well with physics doctoral programs in the US, Robert Resnick of Rensselaer Polytechnic Institute found after speaking with physicists at some 50 of the nation's 170 PhD-granting universities over the past two years. The litany of woes worried him so much that he convinced the American Association of Physics Teachers and The American Physical Society to hold their first conference on the subject at the fourth in a series of meetings of physics department chairs. Discussions at the meeting, held 22–23 May in Arlington, Virginia, did little to allay his anxieties, or those of about 75 department heads and representatives from many of the nation's leading universities, about maintaining a continuing flow of highly trained graduate students and PhDs. They concluded that unless several things are done, the situation will surely worsen.

One of the first actions they agreed upon was to send a letter to President Bush's designated science adviser, D. Allan Bromley of Yale University, who had been chosen for the job a month before. Signed by nearly all the participants at the conference, the letter called attention to the "serious difficulties" faced by graduate physics departments "in ensuring an adequate supply of doctoral physicists to satisfy national needs." It went on to express "our deep concern over the ability of Federal agencies to address adequately this important national problem." The nature of the problems is an oft-told story: the impending retirement of an aging physics faculty that itself was educated in the 1940s and 1950s; the increasingly dim prospect of replacing this group with equally talented and motivated professors; the decline in funding (when inflation is taken into account) over the past decade for individual researchers upon whom graduate students often rely for support and equipment, with the bleak outcome that "young physicists are choosing not to embark upon university careers."

Bromley, of all people, hardly needs reminding of the present plight of academic physics. He rang the tocsin in 1986 when he wrote "A Renewed Partnership," the report by the White House Science Council on the faltering health of the nation's research universities (PHYSICS TODAY, March 1986, page 65). Participants at the AAPT–APS meeting were painfully aware of the problems. "The issues in graduate physics education are interrelated with academic research programs," said Homer Neal of the University of Michigan, chairman of the conference.

Elaborating on Neal's assertion, Resnick listed more than a dozen key issues he had gathered from his talks with academic physicists. Some involved research directly: the need to learn to use supercomputers in research projects, the problem of completing a PhD thesis while engaged in an experiment involving a large group, and the seemingly ever-increasing specialization by teachers and researchers, with its inevitable casualty—less likelihood of achieving the longed-for unity in physics.

Other issues raised questions about traditional appurtenances in graduate education: Does the Graduate Record Examination properly reflect undergraduate physics major programs, and does it properly represent the preparation required for graduate work? Is a better impedance match possible between undergraduate and graduate physics education? Should department qualifying exams be used for deciding course levels or degree qualifications for students? What training do teaching assistants need so that they can head up classroom studies and introductory sections of physics labs? Should physics departments seek to improve the English of foreign-born TAs, who often lack the ability to communicate well with Americans? Have we given enough thought to the virtues and defects of using graduate TAs and to the alternatives to this type of teaching? How can we attract and retain more US-born physics students in graduate degree programs? What ways can we devise to bring more women and underrepresented minority students into graduate physics? Do the exciting new developments in physics call for revisions in graduate school curriculums? Can the length of time be shortened for attaining a physics PhD? What should be the role of graduate programs in preparing physics teachers for high schools, community colleges and even universities?

Resnick considers the problems so perverse and pervasive that he doubted if any single conference could come to grips with them. Nobody was surprised that the answers were not all forthcoming. "The overwhelming problem is the physics pipeline," declared Kent Wilson, acting assistant director of the National Science Foundation's Directorate for Mathematical and Physical Sciences. "We have always solved this problem by immigration to this country, and the only difference between the past and present is that now I find many of the names harder to pronounce.... Women and minorities in physics present a more difficult problem. I must admit I don't have a clue as to how to solve the problem. Whatever we've been doing at NSF obviously has not been working."

NSF's tight budgets in the past decade have led the agency's program officers to impose high cutoffs for research proposals and fellowship applications, with obvious dire consequences for graduate education. "Our cutoffs are now set so high, we are making choices from among high-quality proposals—often turning down 50% of those we get," said Wilson.

At a panel discussion of NSF's responsibilities in improving graduate education, Thomas W. Appelquist of Yale said the agency's physics advisory committee, which he belongs to, had recently completed a survey, under the leadership of Joseph Cerny of the University of California, Berkeley, revealing, among other things, that the grad students and postdocs who suffer most from inadequate funding are those in atomic and molecular physics and in nuclear physics theory. James A. Krumhansl of Cornell, the president of APS, argued that NSF may be altering graduate education in significant ways by promoting such initiatives as science and technology centers and the Presidential Young Investigators program. According to Krumhansl, the PYI program has caused an unanticipated squeeze on NSF's research grants, which have not grown to accommodate the increased cost, let alone the higher cost of doing research.

A similar dilemma for NSF has been caused by today's scientific revolutions in, say, condensed matter physics, observed Judy R. Franz of West Virginia University. APS mem-

bership in this field has burgeoned from 3803 to 9254 in the decade since 1979. The number of university faculty in condensed matter theory alone has increased by 100 in the past two years and reached 691 now. During this period, NSF's support of condensed matter theory has decreased in constant dollars, said Franz. "This has meant that the level of excellence required to get a proposal funded has become intolerably high," she stated, "so that prominent physicists with outstanding publication records are getting their proposals turned down." Her point was underscored by Albert Schindler, director of NSF's materials research division, who observed that the agency had funded only 25 of more than 250 proposals received this year in the exciting new field of high-T_c superconductivity.

Grad students in condensed matter theory at MIT, noted Robert Birgeneau, that school's department head, usually got the highest grades on the Graduate Record Examinations, and those in experimental condensed matter and in elementary-particle physics were tied for second. "But we can't seem to hold onto many of these high achievers," he continued. "One-third of the condensed matter experimentalists go into electrical engineering and want to wind up at Bell Labs or IBM." That's because they realize that's where the money is, explained James Wynn of IBM, one of the few industrial physicists at the conference. IBM now offers an annual salary of $57 000 to a PhD fresh out of the University of Chicago, he said, and even more for electrical engineers from MIT or Stanford. This remark led to a short discussion of the attraction of industrial labs, where young physicists do not take time out of their research work to write proposals and compete for grants as they would have to do in academe.

IBM and AT&T, it so happens, often choose their fellowship winners from among NSF fellowship winners whose grants run out before they have completed their PhDs, reported Terence Porter of the foundation's science and engineering directorate. The practice is a self-fulfilling prophecy. "The companies support the best of the best," said Porter, "for their own reasons, such as attracting bright stars to their research galaxy."

Eugene C. Loh of the University of Utah said interviews with physics students revealed that many were unsure of "making it." Loh found that students had no "clear-cut" idea about career opportunities. "Academic life is not rewarding. Our students listen to our grumbling more than we do," said Loh. "And they don't know how physicists fare in industry." What would help is to define physics and clarify career opportunities with the help of industry, he said.

That might be beneficial, claimed Robert Swenson of Montana State University. He criticized Birgeneau for arguing that if NSF would fully fund the nation's top ten physics departments all the problems would disappear. Swenson considered the statement elitist, particularly in light of the problems with attracting grad students from among women, minorities and the geographically dispersed. The wide distribution of PhD-granting physics departments is important, he said, in providing physicists to many newly formed companies. "The new jobs are coming from start-up high-tech firms, not the IBMs and Bell Labs," Swenson claimed. "Why, even Boseman, Montana, has five new laser optics firms with help-wanted signs for PhDs."

Swenson stated that he believes the US lacks a support system to steer the best and brightest into physics. In Britain, students take physics because they are interested in gravity, particle physics and astrophysics, he said. In Montana, he went on, "those interested in physics are encouraged in high school to go into engineering."

In the end, the conference passed three resolutions:

▷ Physics departments ought to review the curriculum requirements for PhD students with a view toward reflecting contemporary theory and research, for example in such fields as nonlinear phenomena and computational methods.

▷ In the light of the length of time required to obtain a PhD in physics, the American Institute of Physics, in cooperation with APS, AAPT and department heads, should undertake a study of the PhD program.

▷ PYI awards were established originally to provide scientists with external research support during the critical early stages of their careers. Recently NSF guidelines for the program have been changed so that established scientists transferring from industrial or government labs to academic settings are also eligible for the awards. The conference endorsed the original intent of the PYI awards and strongly supported a return to it.

—IRWIN GOODWIN

NEW DIRECTORS AT FERMILAB, OAK RIDGE AND LAWRENCE LIVERMORE

Shortly after Charles V. Shank was named this spring to succeed David A. Shirley as director of Lawrence Berkeley Laboratory (PHYSICS TODAY, May, page 68), it was announced that John Peoples Jr would succeed Leon Lederman as director of Fermi National Accelerator Laboratory. Meanwhile, Alvin Trivelpiece has taken over as head of the Oak Ridge National Laboratory, and John H. Nuckolls has settled in as director of the Lawrence Livermore National Laboratory.

Nuckolls, Trivelpiece and Peoples each assume reponsibility for laboratories that are facing unique challenges. Nuckolls heads a lab that has been subject in recent years to the vicissitudes of the Strategic Defense Initiative, even as LLNL staff have exchanged charges and countercharges about how the lab's work on missile defenses is represented to the public. Trivelpiece takes over at Oak Ridge as the lab is seeking new directions, having seen its traditional mission—the development of advanced nuclear technologies—undercut by slumping prospects for nuclear energy. Peoples, fresh from the Superconducting Super Collider's somewhat troubled magnet development program, will be running a lab that had tied its destiny strongly to the SSC.

Nuckolls

Nuckolls, a physicist, earned a BS (1953) at Wheaton College and a

John Nuckolls