Taconic, and New York foundations, working out a restructuring proposal. It calls for election of the president and trustees by the university community, with final authority in the hands of a joint legislature composed half of students, half of faculty. But not a single person could be found who believes these reforms will be adopted.

Cynicism about the whole process is a common result. Student apathy is indicated by a vote of only 411 for election to another restructuring committee last spring and by an indifferent turnout in early November for an election to various governing committees and a referendum on rules. But then, students, like the faculty, were not particularly interested in restructuring in the first place. "When I sat on the sidewalk watching the cops advance toward me I wasn't there because I wanted to vote on curriculum," commented one moderate student recently. "I was there because I was angry about the issues—mad at the destruction of the neighborhood, sick about the University's ties with IDA and CIA." The leadership of SRU has drifted away, discouraged by the gap between the reforms they think are needed and the little they know they will be permitted to achieve; last year's second-string is now in command. As for SDS, it attempted to mobilize a renewed assault on the university this fall and met with dismal failure; the organization then decentralized and is now occupying itself with smaller study and action projects. SDS leaders feel, as one said recently, that "the revolution went about as far as it could go."

It is, at best, an uneasy peace. To what extent the outside community will remain pacified is not clear. The university has hired architect I. M. Pei as master planner, and officials have said they will revise expansion plans to minimize encroachment on the neighborhood, concentrating on high-rise, multipurpose buildings. On campus, affairs are muddled. The gym issue is in abeyance, but not resolved; the IDA affiliation has been altered, but not definitively. Secret research may be on the way out. Some faculty believe that matters are improved, or at least that the situation will never again degenerate so badly; they believe that, in the future, major institutional decisions will be taken only after broader consultation. But, while administration moves may satisfy the faculty, they are unlikely to apepase many students, for whom the issues were always symbols of a deeper racism and a deeper complicity. Chicago, the Nixon-Humphrey contest, and ambiguities of the Paris peace talks, and the renewal of huge draft calls immediately following the election do nothing to suggest that, in the larger world they face, real progress toward democratic reform can be made. For Columbia—and for other universities—the question is not whether the alienation that leads to revolt exists; it is only whether and when combinations sufficiently explosive to bring the universities down can be put together.

—ELINOR LANGER

A former member of the Science *news staff, Elinor Langer is now a free-lance writer living in New York.*

Mathematics: More Funds Urged for Science's "Leading Wedge"

*The Mathematical Sciences: A Report** is the latest in the series of National Academy of Sciences surveys of the condition, prospects, and needs of various scientific disciplines. Like such predecessor surveys as those for chemistry and physics, this report, prepared under the aegis of the Academy's Committee on Science and Public Policy (COSPUP), seeks to build a case that will encourage federal agencies to lay on the dollars with a generous hand. In fact, its authors†, who are distinguished practitioners of basic and applied mathematics, statistics, and computer science (plus a Nobel laureate in theoretical physics), contend that mathematics is entitled to special treatment. In their view, not only should federal support for graduate students and academic research in mathematics be increased at 16 percent a year, overall, for some time to come but this rate of growth should not be reduced until the growth rate for other sciences which depend on mathematics has been cut back.

The survey group, called the Committee on Support of Research in the Mathematical Sciences (COSRIMS), takes the view that mathematics is the "leading wedge" of a large national scientific effort involving many fields besides mathematics itself. It observes, moreover, that the payoff from mathematical research, though sometimes long in coming, is often high, especially in relation to the comparatively modest sums required to support such research. Accordingly, the committee recommends, as an easy rule of thumb, that the growth of federal support for academic research and "research apprenticeship" keep up with the number of qualified investigators and graduate students available.

There is no doubt whatever, COSRIMS observes, that American mathematics has moved into a position of world leadership during the period in which federal support of research has grown. "Before World War II, the United States was a consumer of mathematics and mathematical talent," the committee said. "Now the United States is universally recognized as the leading producer of these." During the four most recent international congresses of mathematicians, the report points out, more than a third of the addresses presented were by American mathematicians.

"At present," COSRIMS says, "there are more first-rate mathematical centers in the United States than in the rest of the world. Nowhere else, with the exception of Moscow and Paris, is there

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† The survey group was chaired by Lipman Bers, Columbia University. Other members were T. W. Anderson, Columbia; R. H. Bing, University of Wisconsin; Hendrik W. Bode, Bell Telephone Laboratories; R. P. Dilworth, Caltech; George E. Forsythe, Stanford; Mark Kac, Rockefeller University; C. C. Lin, M.I.T.; John W. Tukey, Princeton; F. J. Weyl, National Academy of Sciences; Hassler Whitney, Institute for Advanced Study; and C. N. Yang (Nobel laureate in physics), State University of New York at Stony Brook. The executive director was Truman Botts, University of Virginia.

such concentration of leading mathematicians in various fields as in the five to ten leading American universities. Princeton, the Cambridge area, the New York area, the Bay area in California, and Chicago are well recognized as exceptionally strong centers in mathematical life."

A weakness of the COSRIMS report is the fact that its analysis of the need for increased federal support of academic research in mathematics proceeds from a discussion of figures derived from the fiscal 1966 budget, figures now 3 years old. Because of war-induced budgetary stringencies, however, the mathematics research budgets for the National Science Foundation and other agencies have remained largely static and, in some cases, have actually declined (fully up-to-date federal-support figures are not available).

In fiscal 1966, federal obligations for research in the mathematical sciences totaled nearly $125 million, according to COSRIMS. Of this amount, about $46.5 million was reported to be for basic research (including research in applied mathematics that is not narrowly "mission-oriented"), and, of this, some $35 million was for research done at academic institutions.

Funds provided by the Department of Defense, and especially by its Army, Navy, and Air Force research offices, accounted for about 70 percent of the total federal support. On the other hand, NSF was, and is, by far the most important source of support for academic research, having provided for this purpose almost $15 million in fiscal 1966, or about 45 percent of all such support.

According to COSRIMS' wishful projections, federal support for academic research would almost double, reaching $66 million a year by fiscal 1971; support for research apprenticeship would increase to about $30 million, up from roughly $10 million in fiscal 1966. Though calling for a 16-percent-a-year growth rate overall for research and graduate education, COSRIMS was giving the higher priority to the latter, recommending an annual rate of growth of 24 percent for research apprenticeship, as against a rate of 14 percent for research. COSRIMS proposed that federal support, in the form of research assistantships, fellowships, and traineeships, be given to at least a third of full-time graduate students, and that the number of research assistantships be not less than the number of senior investigators supported.

Mathematics has fared tolerably well in the competition with other sciences for able students, but, for reasons which COSRIMS finds not altogether clear, far fewer Ph.D.'s have been conferred in mathematics than in other fields. According to U.S. Office of Education statistics, 21,190 bachelor's degrees were conferred in mathematics in the 1965–66 academic year, compared with 18,020 conferred in the physical sciences and 25,680 in the biological sciences. In the same year, 5220 master's degrees were conferred in mathematics, 5470 in the physical sciences, and 4390 in the biological sciences. But, in the case of the Ph.D., only 770 were conferred in mathematics, as opposed to 2960 conferred in the physical sciences and 2030 in the biological sciences. According to Office of Education projections, the disparity will lessen by 1975, but the 2200 new Ph.D.'s in mathematics projected for that year will not satisfy the demand which COSRIMS foresees for Ph.D.'s in teaching and research.

The wide discrepancy between the number of masters and Ph.D. degrees conferred in mathematics, COSRIMS indicates, can be attributed partly to the fact that many students are preparing for secondary school teaching careers and do not seek a Ph.D. It suspects, however, that another reason may be simply that doing research acceptable for the Ph.D. degree is harder in mathematics than in other fields, leading fewer to try for this degree in mathematics and causing a higher attrition rate among those who do. COSRIMS suggests, as one means of encouraging people competent to teach (if not competent to create new mathematics and win a doctorate) to enter or remain in undergraduate teaching, that an "associate Ph.D." be awarded students who meet all requirements for the doctorate except for completion of the dissertation.

The COSRIMS report is long (251 pages) and somewhat diffuse. One goal of the committee has been to inform the scientific community and, to some extent, the scientifically literate lay public of the "state of the mathematical sciences." A third of the report is devoted to that end. (A supplementary volume, *The Mathematical Sciences: A Collection of Essays*, to be published by M.I.T. Press, will carry this effort further.)

Inasmuch as it required a combined effort on the part of the 12 members of COSRIMS and of numerous panelists, preparation of the report provided an unusual opportunity for people from all branches of pure and applied mathematics to learn more of one another's problems and opportunities. For example, as Harvey Brooks, chairman of COSPUP, noted in a letter accompanying the report, COSRIMS has called attention to the special problem of computer science in universities. "The development of computer science only as a by-product of the application of computer techniques in other fields often results in failure to develop a distinctive body of theory and technique in computer science in its own right," Brooks observed.

In a section on "criticisms and tensions," COSRIMS acknowledges that, while the penetration of mathematics into other scientific fields has been generally recognized, mathematicians are nevertheless sometimes said to have alienated themselves from the mainstream of scientific development. "It is also claimed that what contemporary pure mathematicians do is of interest only to themselves and most, if not all, of it will never be used in any other discipline," the report says.

It is true, COSRIMS concedes, that pure mathematics has, in fact, separated itself from sister disciplines, such as physics and astronomy. But, it says, "the history of science has shown that it is impossible to predict what mathematical theories will turn out to be useful outside of pure mathematics."

—LUTHER J. CARTER

RECENT DEATHS

Walter H. Boyce, 43; dean of men at Bates College in Missouri; 8 November.

Denniston Burney, 79; British inventor of the major antisubmarine paravane; 13 November.

Michael Duda, 59; president of California State College, California, Pa.; 12 November.

Joseph Pick, 60; professor of anatomy at New York University School of Medicine; 9 November.

Kirill I. Shchelkin, 56; one of the Soviet Union's leading atomic scientists; 8 November.

William B. Snow, 65; former acoustics engineer with Bell Telephone Laboratories, Inc., and Bissett-Berman Corporation; 5 October.

Albert Tyler, 62; professor of biology at California Institute of Technology; 9 November.