tory, but were held by the granting agency to be doled out upon request. When he sought the funds for travel, payment was held up for months because an examiner at the agency noted a discrepancy in the planned dates of travel. The discrepancy, as it turned out, was due to a typing error at the agency. To make the trip, tickets had to be purchased with other funds. Eventually, the agency paid up, but only after an extensive exchange of documents.

There is also the tale of efforts to start a new research group at a university. First, approval had to be obtained from the faculty. Then, the Ministry of Education, which provides funds for facilities, had to be persuaded to depart from its normal practice of starting out a new activity with just one appointment. After much effort, the Ministry was persuaded that a lone researcher in this field made no sense. Then it was necessary to restate the case before another agency in order to receive operating funds. A scientist involved in these laborious negotiations stated simply, "In France, there are no package deals."—D. S. GREENBERG

Campus Computers: Federal Budget Cuts Hit University Centers

Federal budget cuts have apparently slowed the previously sharp growth in computer operations on the nation's campuses. Computer centers have been hurt directly by cuts in federal assistance for computer facilities and indirectly by reductions in federal grants for research. What's more, according to some computer center directors, these budgetary stringencies have been compounded because government accounting procedures discourage maximum use of campus computers by driving fees beyond the reach of some faculty members and students.

National figures on how computer expenses in federally sponsored research have recently fluctuated are hard to come by chiefly because individual grassroots researchers rather than central agencies decide on the specific items to be cut from a project. However, some computer center directors feel that computer use is one of the first items to be cut in a research budget.

One indication of such a trend is found in a survey of 37 major universities conducted last January by the National Association of College and University Business Officers. The survey reported that the increase in computer operating expenses at these institutions will drop from 29 percent a year during the period 1965 to 1968 to 13 percent a year between 1969 and 1971. In part, these figures represent an anticipated leveling off in the growth of computer facilities after a decade of rapid expansion, but many of these universities also expected computer use by federally sponsored projects to rise less rapidly under tight budgets. The Nixon Administration's economy drive has convinced some observers that the 13-percent growth figure estimated 9 months ago may be too optimistic.

Surprisingly, federal funds supply only a small share of computer operating expenses at colleges and universities. In 1965, direct federal grants for computer facilities and indirect support through the computer expenses of federal research grants contributed 36 percent of the total operating budgets at university computer centers. The Rosser Report, a federal study of campus computers (see *Science*, 25 February 1966), recommended that this figure increase to 60 percent, but NSF estimates that the proportion of federal support has actually fallen to 23 percent of fiscal 1969's $260 million outlay for computer operations. Despite this low level of federal aid, the budget cuts in some areas of federal support have been large enough to cause some dislocations, especially at private universities. At the University of Pennsylvania, computer use financed by federally sponsored research projects has recently risen 35 percent each year, but university officials predict a 10 percent decrease instead during the next fiscal year. In order to make up the lost revenue the university has sold substantial machine time to the Philadelphia public school system, the Drexel Institute of Technology, and Villanova University.

Harvard and Yale, two of the richest schools in the nation, have also suffered. Revenue from federally sponsored research at Yale has dropped off by 30 to 40 percent in the last year, instead of rising by 10 percent as had been expected. The university had to supply the lost income from its own funds, and, in a minor economy move, the computer center reduced its disk storage. At Harvard, Norman Zachary, director of the computing center, said that roughly 80 percent of Harvard's computing operations in late 1965 were devoted to federally sponsored projects, and that this figure has steadily fallen, to less than 66 percent now. Increased administrative and student use of computing facilities, supported by the university's own funds, account for part of the percentage decline, but since the federal budget cuts, the anticipated rise in government research use of computers has failed to materialize and may well have been reversed, Zachary said.

This second-order effect of research cutbacks varies widely and was not evident in some universities. New facilities at both Princeton and Caltech have cushioned the effect, at least for this year. Atomic Energy Commission and Environmental Science Services Administration laboratories near Princeton have guaranteed that they will use and pay for a certain percentage of the new computer's time. The new Caltech facilities supported by an NSF grant have spurred enough activity to obscure any drop in demand related to the federal spending ceiling.

Uncertainty over future demand on computers for research has curtailed some computer centers' plans for expansion. "We would have expanded much more rapidly if we had been able to count on this revenue stream," Richard G. Mills, director of information processing at M.I.T., told *Science*. Without these funds to support long-term improvement of computing facilities, Mills said, the research plant could enter a "spiral downward." Without updated computing facilities, researchers could not perform the sophisticated experiments that attract the research funds needed to support computer center expansion.

NEWS IN BRIEF

• **ARMS CONTROL OF THE SEABEDS**: The U.S. government recently indicated a willingness to compromise on an international seabeds arms control treaty now under discussion at the International Disarmament Conference in Geneva. Arms Control and Disarmament (ACDA) officials say the U.S. will probably agree to a Soviet proposal for a 12-mile offshore limit beyond which the seabeds arms control treaty would not be effective, rather than the 3-mile limit which the U.S. had originally proposed. The U.S. proposal is regarded as a response to a Soviet offer last month to modify its earlier demands for a complete demilitarization of the seabeds, a position which U.S. officials said was "much too sweeping." The U.S. had proposed that the treaty ban only nuclear weapons and other weapons of mass destruction, implying chemical and biological weapons. This plan would allow the U.S. Navy to maintain antisubmarine sensor tracking devices.

• **NSF AUTHORIZATION**: The National Science Foundation (NSF), which saw its proposed budget cut $80 million by the House appropriations committee, may have glimpsed a ray of hope when the Senate passed, on 18 September, a bill authorizing a total of $500,150,000 for NSF in fiscal 1970. The rescue operation was conducted by Sen. Edward Kennedy's (D–Mass.) special NSF subcommittee, but the NSF budget still faces the Senate Appropriations Committee and a joint conference.

• **IBP GRASSLANDS STUDY FUNDED**: The National Science Foundation (NSF) has given the finance-troubled International Biological Program (IBP) a boost by awarding a $1.8 million grant—the largest to date—for an American grasslands ecological study. IBP officials estimate that 18 universities and about 100 scientific researchers will be involved in the grasslands project. George Van Dyne, professor of ecology at Colorado State University, has been named principal investigator. The IBP, which has suffered a series of setbacks and financial worries since its inception in 1964 (*Science*, 22 March and 24 May 1968), was organized to study ecological systems on a worldwide scale. The U.S. effort, overseen by a committee of the National Academy of Sciences, has relied principally on NSF for funding.

Besides cutbacks in research grants, which have an indirect effect, there has been a dropping off in direct government support of computer centers. Since 1957, NSF has made direct institutional grants to ease the heavy expense of installing new computing facilities. This program has dropped from $11.3 million in fiscal 1967 to $6 million in fiscal 1969. The Senate has not yet approved the NSF appropriation for fiscal 1970, but if it follows the House's lead in holding the line on the agency's spending, NSF officials see little hope that their program for aid to computer centers will even approach the 1967 level during the present 1970 fiscal year. So far, this cut in direct aid is probably larger than the indirect revenue loss from research-grant cutbacks. However, the effect on any one university is hard to assess, since most requests for direct assistance are screened out even during a peak spending year.

Despite a shortage of funds, several universities have recently made major improvements in their computer plants, but the overall result of the budget cuts made to date has apparently been a slowdown in the growth of university computer operations.

Another financial problem facing some computer centers arises from government accounting procedures. The Bureau of the Budget requires that all users of a computer that handles government-sponsored projects be charged the same rate for the same service. That is, rates should be "nondiscriminatory"—a requirement designed to prevent government research from subsidizing student and other nongovernmental programming. Thus, at universities with federal research grants, the Bureau of the Budget guidelines determine the computer accounting system. The nondiscriminatory regulation is the cornerstone of the accounting policy, with details negotiated between the university and a single federal agency representing the government. At most institutions, programmers are charged directly for machine use, and the basic rate for a unit of machine time is computed by dividing the total cost for a fiscal year's operations by the total use.

Determining expenses over a 1-year period raises problems, especially with third-generation machines, said George S. Walker, business manager of Yale University's Computer Center. With the fourth generation of computers still several years away, many computer centers expect the present third generation to become obsolete later than had been originally expected. Thus in some cases it appears more profitable to purchase machines than to rent them, as has often been done in the past. One director of a large university computer center estimated that he would save an average of $100,000 a year by purchasing machines rather than renting them. However, third-generation computers can be expensive. Where a second-generation machine cost $2 million to buy, a third-generation machine might cost $6 million, Walker said, and the initial expense of installing the machine would make average costs for the first year or two very high, especially since few students and faculty members would have enough confidence to use the machine extensively. High costs and limited use mean that average rates for the first year might be high enough to scare away researchers with a fixed budget. At the end of the computer's lifetime, use would be heavy and costs for simple maintenance and operation would be low. Thus rates would drop sharply. If the university could spread the initial expenses over the lifetime of a machine—roughly 4 to 6 years—rather than over a 1-year period, the rates would not "rise and fall absurdly" Walker said.

The Bureau of the Budget's requirement that rates be nondiscriminatory leaves some computer centers with machine time that goes unused because the university is unable to pay for the time or grant student and faculty users free use. At Harvard, for example, each machine sat idle for an average of 7 hours out of each 22-hour work day last year, said Zachary. Each machine was needed at peak periods of operation, but the center was sparingly used at night and on weekends. Some universities sell excess computer time to business firms, but they then lose part of the educational discount granted to universities by computer manufacturers. Sales to commercial firms would also violate the nonprofit status of many universities.

Zachary has proposed a basic revision of the rate-charging system to make more time available for educational use. He would charge all users, both educational and research, the same rate for those variable costs that are dependent on the number of hours of use. This would include items such as the cost of paper for printing. Educational users, however, would not be charged for the major fixed costs of computer operation, such as machine rental. This plan would encourage class-

room use of computers by lowering rates for educational use. Others have proposed that computer use be included with library maintenance and university administrative expenses as an overhead item. Thus computer users would be charged a general indirect fee rather than a direct charge for the specific computer services used. Both of these proposals, however, would require a revision of government accounting policy.

The problem of computer time going unused was particularly acute at Stanford until 1967, said Edward A. Feigenbaum, former director of the computation center there. Then a committee of federal-agency representatives and the university adopted a pilot agreement that changed the source of the center's income from fees determined by average costs to prices that reflect supply and demand. Instead of simply averaging the total cost of computer operations over a year, the Stanford system "identifies many components of computer service," Feigenbaum said. A computer user first pays for a particular combination of computer hardware and processing speed, then he decides what sort of priority he can afford. If he pays for a high priority, his program will run ahead of lower-priority programs. For example, a computer programmer who wants to run through four debugging phases during a day would pay for a high priority to get quick results and make best use of his time, whereas a student doing a term paper would pay for a lower priority to conserve his financial resources.

What to do about idle time? "When the demand slackens off, you just drop your prices," said Feigenbaum. A computer program run on Friday afternoon when demand is heavy would carry a $2.50 surcharge, while the same program, with the same priority rating and processing speed, might receive a 50-percent discount if run early on Saturday morning. "It's a utility concept," said Stanford's controller, Kenneth D. Creighton. Computer programmers, like electricity users, "get their own special rate when use is low at 2 a.m."

Presumably a student with limited funds for computer expenses would try to save money by running a low-priority program during off-hours. But since other users could request the same type of service at the same rate, there is basically no question of rate discrimination. The rates for some types of service at Stanford have changed quarterly or even monthly to reflect fluctuations in demand, and some administrators hope to experiment with more dynamic pricing to determine how often prices for campus computer service should change.

Other universities have adopted priority systems but Stanford's flexible pricing plan remains something of an experimental model. Creighton sees two general transitions developing in computer accounting. One is from "costing" over a single year to costing over a longer time period, and the other is from costing to pricing.

Government negotiators have often interpreted the Bureau of the Budget's guidelines liberally, especially in hardship cases, but the Bureau last revised them in 1965—almost a generation ago on a computer time scale. It may issue a new revision as early as November.

As the fall semester began, directors of university computer centers appeared concerned over federal budget cuts. Accustomed to rapid expansion and limited academic funds, they are no strangers to financial headaches, but the cuts have compounded their problems this year.—MARK W. OBERLE

APPOINTMENTS

M. R. Schroeder

J. T. Wilson

Manfred R. Schroeder, director, Acoustics, Speech and Mechanics Research Laboratory, Bell Telephone Laboratories, to director, III. Physics Institute, University of Goettingen, Germany. . . . **John T. Wilson**, dean of faculties, University of Chicago, has been appointed provost of the university. . . . **David Pramer**, chairman, department of microbiology and biochemistry, Rutgers University, to director, biological sciences at the university. . . . **Richard D. Moore**, professor of pathology, Case Western Reserve University School of Medicine, to head, pathology department, University of Oregon Medical School. . . . **Rolla B. Hill, Jr.**, professor of pathology, University of Colorado, to chairman, department of pathology, State University of New York Upstate Medical Center. . . . **Marvin W. Scott**, acting chairman, natural sciences department, Longwood College, appointed chairman. . . . **George Z. Williams**, chief, clinical pathology department, clinical center, NIH, to director, Research Institute of Laboratory Medicine, Institute of Medical Sciences, San Francisco. . . . **Bernard Sigel**, professor of surgery, Woman's Medical College, Pa., to dean of the college. . . . **Emanuel D. Rudolph**, professor of botany, Ohio State University, to director, Institute of Polar Studies at the university; and **Colin B. Bull**, former director of the Institute, to chairman, geology department at the university. . . . **Sydney L. W. Mellen**, deputy director, European Office of the Communications Satellite Corporation, elevated to director. . . . **Frank Farner**, president of Federal City College, to director of program development, American Association of State Colleges and Universities. . . . **Robert E. McDermott**, associate dean, Graduate School, Pennsylvania State University, to dean, Graduate School, University of Arkansas. . . . **Robert E. Van Atta**, professor of chemistry, Southern Illinois University, to head, chemistry department, Ball State University. . . . **Karl G. Lark**, professor of biology, Kansas State University, to chairman, biology department, University of Utah. . . . **Philip I. Marcus**, professor of microbiology and immunology, Albert Einstein College of Medicine, Yeshiva University, to head, microbiology section, University of Connecticut. . . . **Edmund J. McTernan**, chairman, allied medical sciences division, Northeastern University, to dean, School of Allied Health Professions, State University of New York, Stony Brook. . . . **Phillip R. Fordyce**, acting dean, College of Education, Florida State University, appointed dean of the college. . . . **Donald B. Johnstone**, chairman, microbiology and biochemistry department, University of Vermont, to dean, Graduate College at the university. . . . **Chung-ming Wong**, senior executive adviser, Astronautics Company, McDonnell Douglas Corporation, to director, Office of Saline Water, U.S. Interior Department. . . . **C. Eugene Sunderlin**, special assistant to the president, National Academy of Sciences, to vice president of Rockefeller University. . . . **Robert S. Sullivant**, chairman of the political science department, University of Missouri, St. Louis, to dean, Graduate School at the university.