

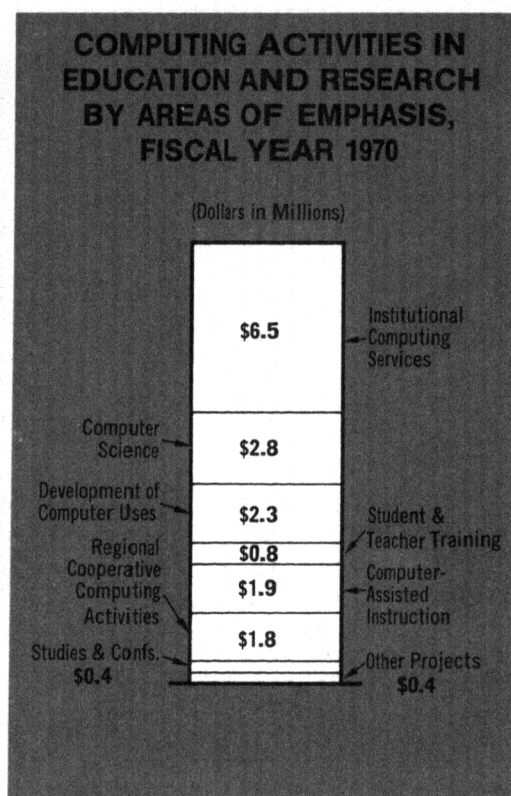
Computing Activities in Education and Research

Computers and related methodologies exert a pervasive influence on research and educational efforts in many disciplines, and particularly in interdisciplinary projects. Hence, various programs throughout the Foundation are involved with computer-related activities, but the Office of Computing Activities is the primary focus for support and coordination of such projects. Since this office was established in 1967, it has developed a variety of programs to promote research, to foster educational innovations, to explore training techniques, to assist the improvement of academic resources, and to promote institutional cooperation in the area of computing.

The figure below shows the distribution of fiscal year 1970 funds by major program categories, and table 10 gives the history of awards. Areas of emphasis during the year are illustrated through a sample of projects supported.

EDUCATION, RESEARCH, AND TRAINING

The technologically advanced computing industry is built on a rather narrow research base, so academic work in computer science helps broaden this base while training future specialists. One of the



principal features of current research is the attempt to bring structure and definition to computer science through providing the experimental evidence and theoretical understanding which will permit guided development. Other thrusts involve studies of the implications of new technology for hardware and software and efforts to extend the utility of computers.

Investigations of theoretical foundations of computing are being supported at various universities throughout the country. A grant to the University of California at Los

Table 10
Computing Activities in Education and Research
Awards by Program Categories, Fiscal Years 1968, 1969, and 1970
[Millions of dollars]

Section	1968		1969		1970	
	Number	Obligations	Number	Obligations	Number	Obligations
Education, research and training.....	64	\$6.1	116	\$5.9	89	\$6.0
Institutional computing services.....	42	10.6	23	6.5	23	6.5
Special projects.....	67	5.3	55	4.6	75	4.5
Total.....	173	22.0	194	17.0	187	17.0

Angeles will enable experiments with computer systems to determine parameters which can be measured as sensitive indicators of systems performance. Also, the development of very complex integrated circuits with components a few thousandths of an inch in size points to new hardware and software possibilities. A project at the University of Texas is concerned with micro-programming, in which the operations of the computer are built up in a flexible way from very simple, fundamental, logical instructions. Other grants, to Rice University and to the Universities of Iowa and Michigan, support research in the application of repetitive arrays of basic logical elements to theoretical aspects of system design.

The use of computers to restructure the teaching of subjects in many disciplines and to develop interdisciplinary, problem-oriented curricula is in the ascendancy. At Dartmouth, the Departments of Sociology and Political Science are developing data bases and an inquiry system which permit students to investigate, through a computer link, various relationships among data elements. In a short time, a student can develop good intuitive understanding of the relative significance of data elements, how to formulate questions to study relations, and how to pursue an evolving direction of investigation based on earlier results. This Project IMPRESS is jointly supported by NSF, the Alfred P. Sloan Foundation, and the Carnegie Corporation.

At the University of Michigan, computer simulations of living systems such as animal populations will serve as the basis for a course in natural resource management. A student will sample important parameters of the simulated populations, analyze data, formulate management programs, and evaluate the effects of his decisions. Through simulations of increasing

sophistication, the student can be exposed to the complexities of real situations, challenged to make decisions based on the incomplete data available, and confronted with the long-term consequence of his actions—all at a computer terminal.

A project at Tulane University presents a unique opportunity to foster the utilization of surplus Minuteman I general-purpose digital computers. One hundred of these \$234,000 systems have already been declared surplus, and it is expected that over a thousand will be available in the next few years. These computers have significant potential for educational use, but considerable hardware interfacing with external devices is required. This project will develop tested hardware interface designs which will be available to others, and will explore various computational and control applications of this machine.

INSTITUTIONAL COMPUTING SERVICES

The dynamic growth rate of academic computing and an accompanying increase in sophistication of computer applications in education and research is reflected in the number, substance, and quality of the proposals received in fiscal year 1970. Over 90 proposals were considered for improvement of computing facilities, a greater number than for any other year in the history of the program. Awards were made to 22 institutions for a total Foundation commitment of \$6.5 million. Grants ranged in size from \$5,000 awarded to Western Michigan University for improvement of its computer printing facilities to a \$1 million grant made to the University of California at Los Angeles as partial support of a major new computer system to meet significant new



A camera is mounted on the graphics display terminal, connected to the UCLA computer, for permanent recording purposes. (Photo University of California, Los Angeles)

and innovative computing requirements of the institution. Three awards are described in detail to illustrate program activity and its role in institutional development.

The University of Tennessee at Knoxville, with more than 22,000 undergraduate and 4,500 graduate students, had a medium-size second generation computer as the primary facility to service exploding computing demands. In addition to growing research computing requirements, a new degree program in Computer Science emerged in late 1969 to add to the already heavy demands on an overtaxed system. A substantial upgrading with planned future expansion was needed. To help accomplish this, a Foundation grant of \$500,000 was awarded to support a program with a 3-year budget of \$3.5 million. A large third generation computer has been installed, with memory expansions scheduled at regular intervals, along with periodic additions of remote terminals and on-line peripheral devices. A new building is scheduled for completion in the third year to house the central computer and staff. The result of this program is a modern facility with a planned growth consistent with the developing computer demands of a major institution.

North Carolina A&T State University illustrates a situation where a change in academic curricula and research activity has caused the small but satisfactory computer facility of 5 years ago to be completely inadequate today. Recent accreditation of the School of Engineering, now offering degrees in architectural, electrical, and mechanical engineering, an increased emphasis in Computer Science activity in a growing mathematics department, and increased research activity in physics and social sciences made the establishment of a major computing facility a high priority objective of the university.



Students at North Carolina A&T State University load magnetic tapes on a Control Data tape drive. A Foundation grant will assist in significant expansion of computing facilities at this growing institution. (Photo North Carolina A&T State University)

A large-scale computer with batch and time-sharing capabilities will be installed in the fall of 1970, with new space to be available as permanent quarters for the new Computer Science Center in the spring of 1971. The staff size will be increased from two to 21 in a program with a 3-year operational budget exceeding \$1 million. An NSF grant of \$175,000 will assist this significant expansion, with two private foundations providing another \$280,000.

Bucknell University acquired a small IBM 1620 computer in 1961, and by 1968 there was an obvious need for improved facilities to support a broad class of computer-related activities. These activities extend beyond the university to smaller institutions in the vicinity as a consequence of the keen sense of community leadership which exists at Bucknell. Following a long period of careful planning, a third generation computer system was selected capable of providing a variety of local and remote computing services. The equipment acquisition was closely coupled with a

strong emphasis on the strengthening of faculty and senior professional staff to encourage further developments of educational and research computing applications. A Foundation grant of \$395,000, representing approximately 25 percent of the estimated 3-year project costs, was made to assist Bucknell University in the program. The regional significance of a strong computing center extends beyond the educational institution itself, and this led the Appalachian Regional Commission to provide funds to improve the equipment configuration.

SPECIAL PROJECTS

Regional Cooperative Computing Activities

In fiscal years 1968 and 1969, the Foundation explored the merit of various computer-based cooperative arrangements, principally at the college level. Typically, each regional activity was centered about a major university which provided computer services and technical as-

sistance to help a cluster of nearby institutions introduce computing to faculties and students, thereby developing a potential for further educational innovation. Altogether, 15 regional activities were established including 12 major universities, 116 participating colleges, 11 junior colleges, and 27 secondary schools located in 21 States.

In July 1969, a regional project directors' meeting was held at Oregon State University in Corvallis to study successes and failures and to assemble a reservoir of useful data for others. A *First Report on An Exploratory Program of Regional Cooperative Computing Activities*, available from the Office of Computing Activities, includes descriptions of the participating institutions, hardware and software systems utilized in the various projects, some cost figures, and indications of the educational impact of computer use.

In fiscal year 1970, 47 additional grants totaling approximately \$1.8 million were awarded involving 15 major universities and 79 participating colleges in 24 States. Three new regional activities were established, two of which are unique in that they provide models for State-wide cooperative computing activities, one in North Carolina and one in Georgia. (See figure.)

In Georgia, 19 grants totaling \$519,300 enabled the University System of Georgia to extend by telephone lines the computing resources of the Georgia Institute of Technology and the University of Georgia to other institutions throughout the State. One grant for \$233,200 to the University System of Georgia provided partial support of its central staff of curricular experts and computer specialists. Two grants of \$66,000 each were made to the University of Georgia and the Georgia Institute of Technology, and 16 grants were made to participating institutions ranging in size from \$1,500 to \$14,000. Twenty-

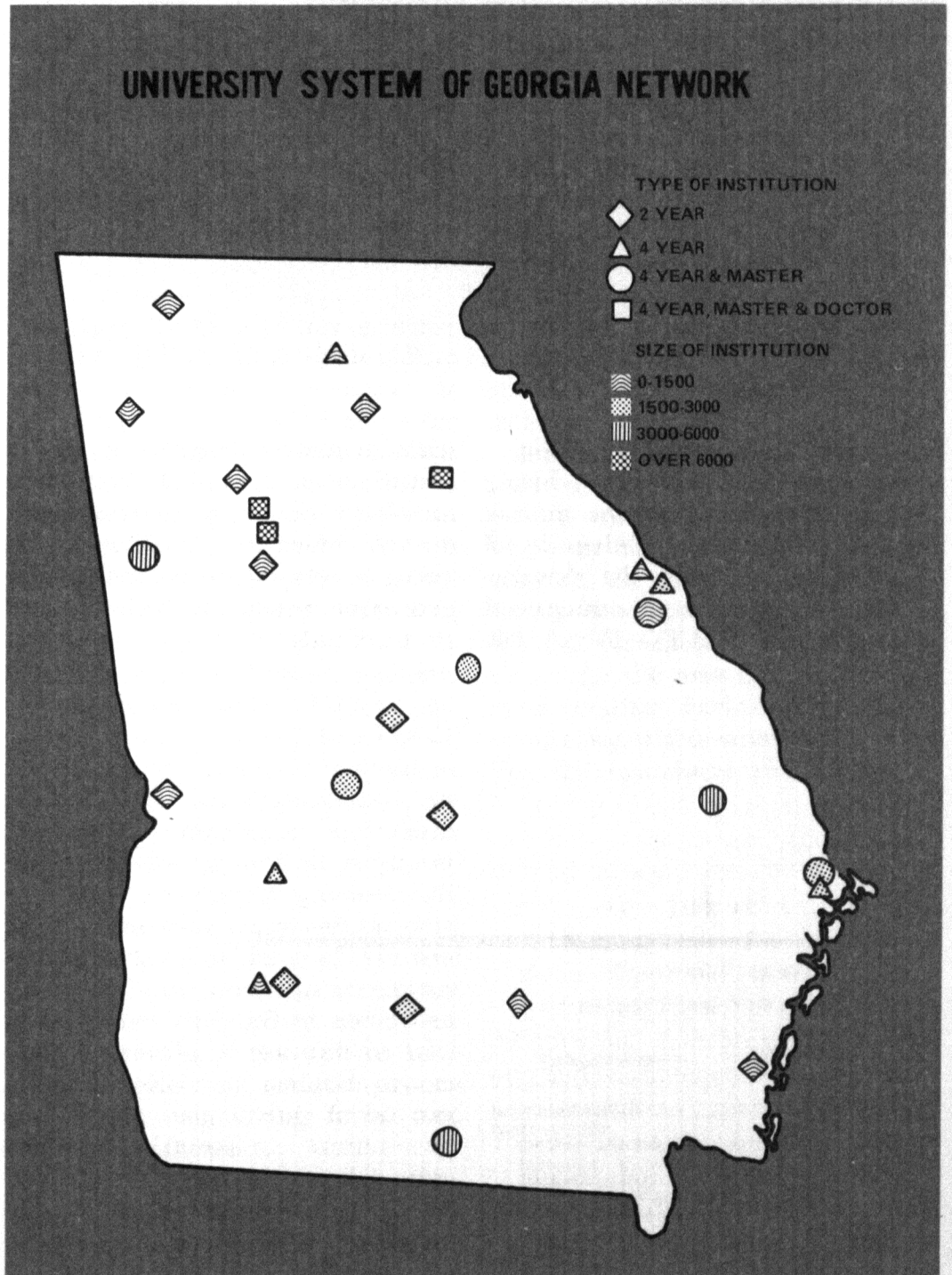
eight institutions are currently participating in the project. State and institutional contributions to this project now exceed \$1,675,000.

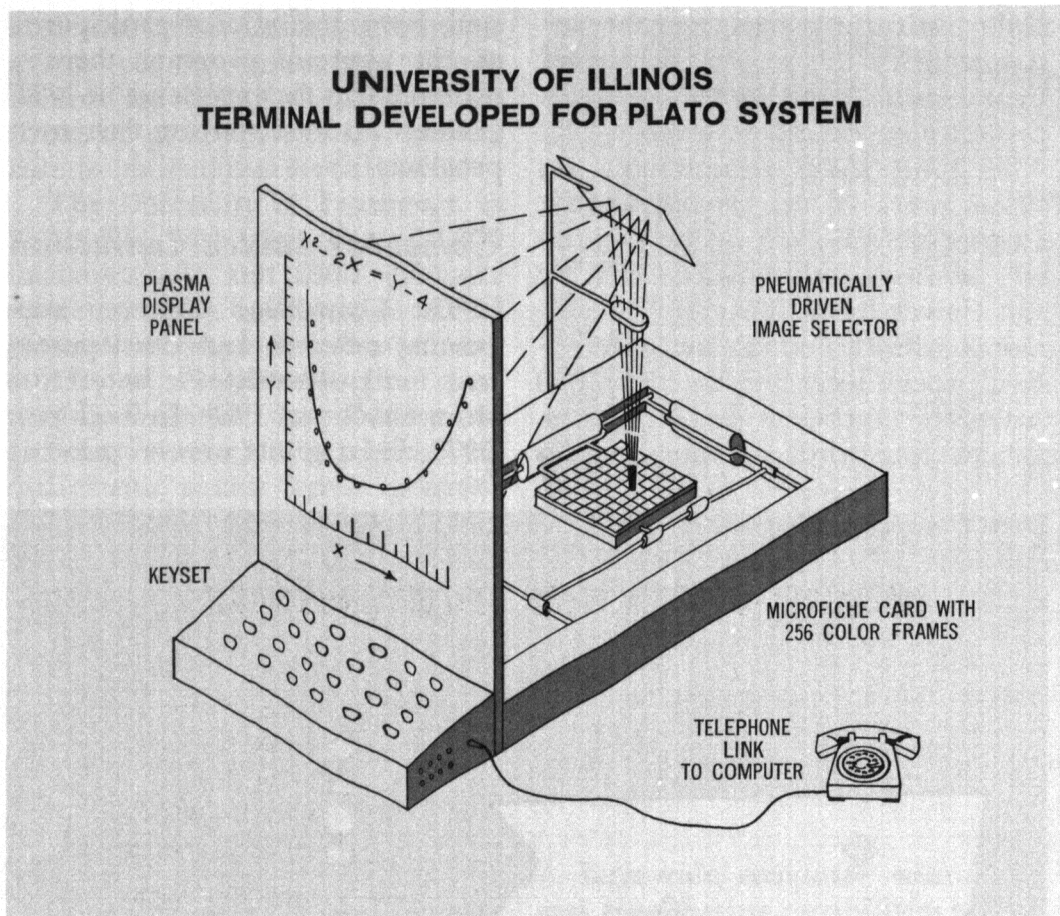
In June 1970, a conference on "Computers in the Undergraduate Curricula" was held at the University of Iowa, sponsored jointly by the University of Iowa and the National Science Foundation. Seventy-five papers were presented to 800 attendees representing 48 States. About one-third of these papers

were from institutional participants of the regional program, thereby transmitting the experience of NSF grantees to those starting their own programs.

Computer-Assisted Instruction

The Foundation has been supporting research and development in computer-assisted instruction since fiscal year 1968. In fiscal year 1970, eight grants were awarded in





the total amount of \$1.9 million.

Of particular interest among these awards is one in the amount of \$430,000 to the University of Illinois to accelerate the development of a prototype educational system called PLATO IV. A full-

scale system is designed to service simultaneously 4,000 student-terminals based on a novel plasma-display device invented at Illinois and being developed commercially. The prototype system will include up to 10 terminals.