### References

1. J. Monod, *Growth* **11,** 223 (1947).
2. B. Magasanik, in *Mécanismes de Régulation des Activités Cellulaires chez les Microorganismes* (Centre National de la Recherche Scientifique, Paris, 1965), p. 179.
3. J. Monod, *Ann. Inst. Pasteur* **70,** 381 (1944).
4. ——— and A. Andureau, *Ann. Inst. Pasteur* **72,** 868 (1946).
5. S. E. Luria and M. Delbrück, *Genetics* **28,** 491 (1943).
6. O. T. Avery, C. M. MacLeod, M. McCarty, *J. Exptl. Med.* **79,** 409 (1944).
7. J. Lederberg and E. L. Tatum, *Cold Spring Harbor Symp. Quant. Biol.* **11,** 113 (1946).
8. J. Monod, A. M. Torriani, J. Gribetz, *Compt. Rend.* **227,** 315 (1948); J. Monod, *Intern. Congr. Biochem., 1st, Cambridge, 1949,* Abs. Commun., 303; in *Unités Biologiques douées de Continuité Génétique* (Centre National de la Recherche Scientifique, Paris, 1949), p. 181.
9. J. Monod and M. Cohn, *Biochim. Biophys. Acta* **7,** 153 (1951).
10. M. Cohn and A. M. Torriani, *J. Immunol.* **69,** 471 (1952).
11. J. Monod, A. M. Pappenheimer, G. Cohen-Bazire, *Biochim. Biophys. Acta* **9,** 648 (1952).
12. D. S. Hogness, M. Cohn, J. Monod, *ibid.* **16,** 99 (1955); J. Monod and M. Cohn, *Intern. Cong. Microbiol., 6th, Rome, 1953, Symp. Microbial Metabolism,* p. 42.
13. R. Schoenheimer, *The Dynamic State of Body Constituents* (Harvard Univ. Press, Cambridge, 1942).
14. J. Monod, G. Cohen-Bazire, M. Cohn, *Biochim. Biophys. Acta* **7,** 585 (1951).
15. J. Monod and M. Cohn, *Advan. Enzymol.* **13,** 67 (1952).
16. M. R. Pollock, *Brit. J. Exptl. Pathol.* **31,** 739 (1950).
17. J. Monod and G. Cohen-Bazire, *Compt. Rend.* **236,** 530 (1953); M. Cohn and J. Monod, in *Adaptation in Microorganisms* (Cambridge Univ. Press, Cambridge, 1953), p. 132.
18. H. J. Vogel and B. D. Davis, *Federation Proc.* **11,** 485 (1952).
19. G. N. Cohen, *Ann. Rev. Microbiol.* **19,** 105 (1965).
20. J. Monod, in *Enzymes: Units of Biological Structure and Function* (Academic Press, New York, 1956), p. 7; G. N. Cohen and J. Monod, *Bacteriol. Rev.* **21,** 169 (1957).
21. H. V. Rickenberg, G. N. Cohen, G. Buttin, J. Monod, *Ann. Inst. Pasteur* **91,** 829 (1956).
22. C. F. Fox and E. P. Kennedy, *Proc. Natl. Acad. Sci. U.S.* **54,** 891 (1965).
23. I. Zabin, A. Kepes, J. Monod, *Biochem. Biophys. Res. Commun.* **1,** 289 (1959); *J. Biol. Chem.* **237,** 253 (1962).
24. L. Pauling, H. A. Itano, S. J. Singer, I. C. Wells, *Nature* **166,** 677 (1950).
25. F. H. C. Crick and J. Watson, *Les Prix Nobel en 1962* (Norstedt, Stockholm, 1963).
26. G. Gamow, *Nature* **173,** 318 (1954).
27. F. Jacob and E. Wollman, *Les Prix Nobel en 1965* (Norstedt, Stockholm, 1966); F. Jacob, *Science* **152,** 1470 (1966).
28. A. B. Pardee, F. Jacob, J. Monod, *Compt. Rend.* **246,** 3125 (1958); ———, *J. Mol. Biol.* **1,** 165 (1959); F. Jacob and J. Monod, *Compt. Rend.* **249,** 1282 (1959).
29. D. Perrin, F. Jacob, J. Monod, *Compt. Rend.* **250,** 155 (1960).
30. C. Willson, D. Perrin, M. Cohn, F. Jacob, J. Monod, *J. Mol. Biol.* **8,** 582 (1964).
31. S. Bourgeois, M. Cohn, L. Orgel, in press.
32. S. Benzer and S. P. Charupe, *Proc. Natl. Acad. Sci. U.S.* **48,** 1114 (1962).
33. S. Brenner, A. O. W. Stretton, S. Kaplan, *Nature* **206,** 994 (1965).
34. M. G. Weigert and A. Garen, *ibid.*, p. 992.
35. A. Kepes, *Biochim. Biophys. Acta* **40,** 70 (1960).
36. ———, *ibid.* **76,** 293 (1963); *Cold Spring Harbor Symp. Quant. Biol.* **28,** 325 (1963).
37. J. Monod and F. Jacob, *Cold Spring Harbor Symp. Quant. Biol.* **26,** 389 (1961); J. P. Changeux, *ibid.*, p. 313.
38. C. F. Cori *et al.*, reference in *Les Prix Nobel en 1947* (Norstedt, Stockholm, 1948).
39. E. Helmreich and C. F. Cori, *Proc. Natl. Acad. Sci. U.S.* **51,** 131 (1964).
40. A. Novick and L. Szilard, in *Dynamics of Growth Process* (Princeton Univ. Press, Princeton, N.J., 1954), p. 21.
41. R. A. Yates and A. B. Pardee, *J. Biol. Chem.* **221,** 757 (1956).
42. H. E. Umbarger, *Science* **123,** 848 (1956).
43. J. Monod, J. P. Changeux, F. Jacob, *J. Mol. Biol.* **6,** 306 (1963).
44. J. C. Gerhart and A. B. Pardee, *Federation Proc.* **20,** 224 (1961); *J. Biol. Chem.* **237,** 891 (1962); *Cold Spring Harbor Symp. Quant. Biol.* **28,** 491 (1963); *Federation Proc.* **23,** 727 (1964).
45. J. P. Changeux, *Cold Spring Harbor Symp. Quant. Biol.* **26,** 313 (1961); *J. Mol. Biol.* **4,** 220 (1962); *Bull. Soc. Chim. Biol.* **46,** 927, 947, 1151 (1964); *ibid.* **47,** 115, 267, 281 (1965).
46. D. W. Allen, K. F. Guthe, J. Wyman, *J. Biol. Chem.* **187,** 393 (1950).
47. M. F. Perutz, in *Les Prix Nobel en 1962* (Norstedt, Stockholm, 1963).
48. J. Monod, J. Wyman, J. P. Changeux, *J. Mol. Biol.* **12,** 88 (1965).
49. C. A. Woolfolk and E. R. Stadtman, *Biochem. Biophys. Res. Commun.* **17,** 313 (1964).
50. J. Monod, *Recherches sur la Croissance des Cultures Bactériennes* (Hermann, Paris, 1941).
51. Lyster, unpublished results.


# EDUCOM: Interuniversity Communications Council

Institutions have joined forces to foster application to higher education of the burgeoning information sciences.

James G. Miller

Almost every schoolboy knows the story of how, in the early 1820's, Abraham Lincoln walked several miles to obtain one of the few books in his neighborhood so he could read it by the light of a pine-knot fire. The number of places throughout the world where such a situation exists is decreasing rapidly; in little more than a century, America has changed from a nation of information deprivation to one of information glut. The manifestations are familiar, but, to cite one, it has been said that the number of scientific journals has doubled every generation since 1800.

This dilemma of information explosion affects all aspects of higher education, the primary function of which may be viewed as information processing, broadly conceived—including creation of new information (research), transmission of information (teaching), learning of information by students, and storage and retrieval of information in libraries. Administration and management of universities also involve many sorts of information processing. Because knowledge is being created faster than ever before, educational institutions are faced with what seems to be an essentially impossible squeeze play. It is a true overload of information, which educators must recognize for what it is.

Less obvious to many educators, but of potentially revolutionary significance to education, is the fact that many data-processing techniques have been developed during the last few years which are ripe for use in higher education, but which have scarcely begun to be exploited in this field. Various sorts of electronic "hardware" (computers, light pens, graphic displays, and the like) and "software" (computer programs) are now available and applicable to university functions. Some of them offer great promise for increasing efficiency and for markedly decreasing costs. Each of them, however, needs to be evaluated carefully for effectiveness and costs in human time and money in comparison with more traditional methods. Emphasis must remain on the human goals of educational institutions rather than on gadgets. It is to evaluation of this kind, and to encouragement of technological progress in communications, that the new Interuniversity Communications Council (EDUCOM) is dedicated.

At present EDUCOM has 50 mem-

The author, formerly executive director and now principal scientist of EDUCOM, is also director of the Mental Health Research Institute, University of Michigan.

ber organizations in 26 states, representing 167 campuses on which there are about 40 percent of all university students in the United States. It has grown from a belief that interinstitutional cooperation will enable the academic community to profit maximally from these emerging concepts and systems. Among the academic information-processing activities with which the new organization will be concerned are both computational and linguistic uses of computers, computerized programmed instruction, library automation, educational television and radio, computerized cognitive aids, and the utilization of computers in university administration and in clinical practice.

### Council Incorporation

In October 1964, a few days after the nonprofit Council was incorporated in Michigan, six founding universities sent delegates to an initial meeting in Denver. They were Duke University, the State University of New York, and the universities of Virginia, Pittsburgh, Michigan, and California. Subsequently, two more charter universities entered, Rochester and Illinois (*1*).

A grant of $750,000 was made by the W. K. Kellogg Foundation to subsidize organizational expenses over a 5-year period.

William N. Hubbard, Jr., dean of the University of Michigan Medical School, was elected chairman of the Council and treasurer; William G. Anlyan, dean of the Duke University School of Medicine, was elected chairman of the board of trustees; and I was elected executive director and secretary. The eight charter institutions formally announced the organization in Chicago on 9 June 1965 and outlined its broad goals as follows:

(i) To provide a forum where the best minds of the academic community can discuss, debate, and effectively appraise the current "state of the art" of the communication sciences and technology and the problems and opportunities involved in incorporating them into the planning and programs of colleges and universities as they carry out their total obligations to society.

(ii) To establish interuniversity task forces to focus the expertise already available within our universities and colleges upon specific current problems in educational communications of interest to the academic community. It has become traditional for government and industry to improve their functioning by calling upon the competence and skills of scholars, irrespective of their institutional affiliations. It would seem desirable that universities and colleges take steps to avail themselves collectively of this resource.

(iii) To provide a framework that will stimulate cooperation in the processing of scientific information and in the development and operation of interuniversity systems. Here the emphasis will not be on machines and methods, but on the application of existing techniques to broaden and deepen human intellectual capacity.

More specifically, the objectives were said to be of two types:

(i) Dissemination of information about new technologies. New concepts, techniques, and applications of the communication sciences develop with increasing rapidity. There is a need for orderly acquisition and dissemination of information about these developments, to expedite the transmission of information, in useful form, from developer to consumer. EDUCOM will maintain a fund of current information about the capabilities of the nation's universities with relation to educational communications developments.

(ii) Establishment of task forces in areas of critical development. EDUCOM has been organized to achieve ends which its member universities cannot accomplish individually.

### Current Operations

EDUCOM activities are taking shape in several areas. Edison Montgomery, formerly vice chancellor at the University of Pittsburgh, became president of EDUCOM on 1 June. At the same time the position of executive director was eliminated and I became principal scientist. The headquarters is now located in Pittsburgh, Pennsylvania.

Membership is open to all accredited colleges and universities in Mexico, Canada, and the United States. Annual dues are $250, and a simple procedure for application has been established. The president or a similar responsible official of an institution should write a letter to the Council's president (Fifth Avenue and Bigelow Boulevard, Pittsburgh, Pennsylvania 15213) to indicate that admission is desired. The Council accepts the interpretation of each applicant institution as to whether it is an independent unit or part of a university system.

An independent unit may become a member on its own, but if the applicant institution is part of a university system it should request the head of the system to apply for membership for the system as a whole. A request is acted on at the next monthly meeting of the 17-man board of trustees, in which day-to-day direction of Council activities is vested. If the request is approved, the institution appoints a representative to the Council who will represent all campuses of the institution if it has multiple campuses. The representative may be changed at any time at the discretion of the institution.

The initial 12-page issue of *EDUCOM* appeared in January 1966. It is a nontechnical bulletin, published about ten times during the academic year, that reports to faculty members of participating institutions on research, development, and academic applications in the information sciences.

The Council sponsored its first conference on educational communications at Duke University in April. EDUCOM will devote concentrated attention to the question of the relationships its participating universities should have to the other agencies, private and public, that are concerned with communications. This was one of the purposes of the sessions at Duke. In the country at large, as well as within universities, specialists tend to be separated according to media. That is, people concerned with books and libraries and information storage and retrieval are not communicating as effectively as they might with those who operate the computing centers, with those who operate educational radio and television and other audiovisual aids, or with those who use computers for clinical purposes or administrative operations. Yet it can be profitable to analyze carefully trade-offs across these media. In other words, one can attempt to determine when, in college instruction, it is best to use a textbook, a discussion session, a television lecture, or computerized programmed instruction. For a given subject and student group, which method will provide the best learning situation with the least expenditure of time and money? Thus, a primary aim of EDUCOM is to discuss the relations within these different media in education and in society at large in terms of the major purposes of the universities.

### University Role in Communications

There has been a rapid surge of interest in various aspects of communications in higher education, and yet there has been no organized voice of higher education, nor any concerted effort by colleges and universities to coordinate their efforts in applying such methods.

The first function of EDUCOM is to be a voice for its participating universities in relation to the other two

major forces in our society, government and industry, in a continuing three-way dialogue regarding their relative roles. Internally, EDUCOM can evaluate the new technologies as they relate to all aspects of university activities—an interesting example, incidentally, of professors consulting for their own institutions, which has been much less common than consulting for government or industry.

New developments in scientific and scholarly communications are not being well coordinated either across media or across the various academic fields. For instance, the Engineers Joint Council is developing a sophisticated information storage and retrieval network. The American Chemical Society, American Psychological Association, and American Psychiatric Association have each been studying information processing in their disciplines. The MEDLARS system of the National Library of Medicine (*2*) was designed to assist medical schools and the health sciences. With National Science Foundation support, the American Institute of Physics has set up a computerized documentation project that could provide a network nucleus (*3*). There are obvious overlaps in content. For example, the engineers overlap with the physicists, with the psychologists in engineering psychology, and with the biologists and physicians in bioengineering. Since each of these disciplines is represented in the universities, the universities have a concern with the evolution of some rational relationship to all of them.

The need for closer communications among institutions of higher learning has been further underlined since World War II as these schools have assumed important new roles in social developments—research on national defense, space science, health, and foreign policy. Examples are the operation of medical programs in Veterans Administration hospitals and the operation of educational television stations. Recent federal legislation has given universities a role in communicating health information through regional heart, cancer, and stroke centers and for the administration of statewide scientific and technical information networks under the Technical Services Act.

Perhaps the central idea of EDUCOM is information networks, the basic concept of which is not new. President Washington's cabinet included a postmaster general who administered the first information network in this country, the mail system, carried out, according to the British tradition, by the federal government. But in the 19th century, when the telegraph and telephone came along, they were operated by private utilities rather than by the British method of government operation.

With the kind of electronic communication grids that EDUCOM is considering, however, the matter of control may be considerably more complex. By means of such a computerized net, with one or many common-access data stores and methods of rapid transmission, a large amount of information can be stored and be available for dissemination not only over the campus locally, but also, if desired, throughout the country or the world. Cooperation in the use of these technologies may ultimately save the universities large sums of money in library construction and may provide easier access to more relevant information than small institutions—or indeed any institution—could otherwise obtain.

The question becomes one of whether these networks should be operated by government, by industry, or by the universities. My personal view is that the universities will not necessarily want to run the networks, nor all the long-lines and computers. What the universities will hope to assure is that the information on the networks includes everything that will be useful to their scholars, scientists, students, practitioners, and administrators, and not be limited to that material on which the operating agency believes it can reap a profit. Because of similar considerations, university presses often put out scholarly books which cannot make a profit for them and which, therefore, commercial publishers usually could not afford to publish.

## Library Automation

Because of the central importance of networks and the many problems they raise, its Task Force on Information Networks was the first of several interuniversity technical panels established by EDUCOM. Under the chairmanship of George W. Brown of the Graduate School of Business Administration, University of California at Los Angeles, it is studying multiple recommendations for various sorts of university-linked nationwide information systems. One aspect of the forging of these systems would be the automation of libraries. Methods such as those discussed by J. C. R. Licklider (*4*), C. F. J. Overhage and R. J. Harman (*5*), and others are under consideration. Huge electronic memories that can store millions of bits of information are already a reality, and one is under construction that will store 1 trillion bits. A relatively small number of such systems could contain the entire text of the National Library of Medicine, for instance, and make it all speedily accessible on demand, across the nation, to an individual anywhere on a network.

In 1963 I conducted a survey among major corporations in the data-processing field for the Surgeon General's Office of the United States Public Health Service. Even then there was a general recognition in the industry that national data networks are technically feasible. Various advances make networks possible, including the handling of language as well as numbers by computers, time-sharing computers which can be addressed concurrently by dozens or hundreds of remote typewriters or other terminals, efficient and increasingly cheaper long-distance transmission of information, photoreaders that can read typed (and sooner or later printed) matter directly into electronic storage at rates greater than 1000 characters a second, and fast telefacsimile printers that can reproduce both printed and graphic materials. They are not all perfected yet, but they soon should be.

There are new man-machine interfaces for information processing, carrels, terminals, or consoles, including some with TV-like screens on which a person can write or draw with a light pen graphic material that can be stored in computer memory and then retrieved at will. In various stages of advancement are programs designed to enable a computer to abstract and index documents, translate them from one language to another, inform readers automatically of new publications that fit their interest patterns, or search the texts of electronically stored publications and print out sentences from them that would answer a wide range of queries. Some of these functions are now possible or they will be very soon. Others may not be feasible for a decade or more. All justify intensive work, however.

In order to plan a pilot network, which it is hoped can go into experimental operation before the end of the 1967–68 academic year, the EDUCOM Task Force on Information Networks held a summer study at the Boulder campus of the University of Colorado, which is one of EDUCOM's participant

universities, 5–29 July. The study was supported by a grant from the National Science Foundation and funds from the director's office of the National Institutes of Health, the Division of Regional Medical Programs (Heart, Cancer, and Stroke) of the National Institutes of Health, the National Library of Medicine, and the Office of Education. More than 170 participants from various universities, private professional and scientific organizations, foundations, government agencies, and industries attended. Working in a number of small groups, they developed engineering and operational plans for a pilot network to connect EDUCOM universities. Alternate designs for such a network were evaluated. A report will be issued. One product of this study will be a detailed proposal for an interuniversity pilot network, probably involving large funding, which will be submitted to a number of agencies of the federal government this fall. It is hoped that the necessary money can be obtained by 1 July 1967 to make possible implementation of the network. Dr. Thomas Keenan, director of the Computer Center of the University of Rochester, took leave to join the EDUCOM staff 1 August 1966. One of his primary responsibilities will be the implementation of the network plan developed during the summer study.

The Task Force on Information Networks has also been invited by the National Library of Medicine to act as an advisory group on the planning of a national center for biomedical communications.

Each of the study and action groups being formed by the Council will, in one way or another, feed into and interdigitate with the work on information networks. This will be particularly true of the Task Force on Educational Systems and Technology, headed by Ralph W. Gerard, dean of the Graduate Division, University of California at Irvine. Of interest to this task force is the broad spectrum of teaching and learning systems, including computerized programmed instruction, audiovisual aids, and educational TV, along with the consoles, carrels, and other devices whereby students and others can interact with such educational materials. During the next year this task force plans to develop courses of computerized programmed instruction in various content areas for experimental use and evaluation by several EDUCOM universities.

## Effect on Networks

Congress has appropriated millions of dollars to aid in the construction of college and university medical and dental libraries. The inception of national networks with the equipment I have described might, at costs comparable with those of other items in federal budgets, generate much more efficient, rapid, and complete information storage in all the nation's libraries. Conceivably, further construction for traditional libraries would gradually taper off.

Networks, however, would require the construction, in colleges and universities, of local information centers. These stations would conduct control and switching functions for information stored in or transmitted over them. From computers operating in a time-sharing mode such centers would radiate local networks to terminals in carrels, offices, libraries, classrooms, laboratories, dormitory rooms, clinics, and hospitals in the region. A user could type a request from any terminal, and receive an immediate response, either by typewriter or by a visual display on a modified TV screen also linked to the computer. He also could signal the computer by pointing or drawing with a light pen on the TV screen.

An EDUCOM Task Force on Computer-Based Systems for Clinical Activities has been established with Dr. Max O. Woodbury, professor of biomathematics and mathematics at Duke University School of Medicine, as chairman. Many of the present EDUCOM member institutions have programs in the health sciences, and the purposes of the clinical activities task force are to aid them by advancing specialized studies in the utilization of computers and information processing techniques in diagnosis and prognosis, patient care, laboratory automation, and maintenance of clinical records. Several EDUCOM universities—for example, Duke, Tulane, Oregon, Missouri—have pioneered in projects in these areas.

Dr. Jordan Baruch has directed the design of an on-line, time-sharing system now being operated on a trial basis at the Massachusetts General Hospital in Boston, which carries out many patient-care procedures and is capable of performing many more. This is a model of one type of clinical information system which EDUCOM institutions might implement jointly. This system currently has terminals in the wards and in the admissions office, the pharmacy, clinical and bacteriology laboratories, and some offices of researchers. Among the automated procedures so far developed at Massachusetts General are: (i) The computer poses questions to the admitting officer, who asks them of a patient being admitted and then enters responses into the computer memory by typewriter. (ii) Instantly available in the computer memory is a record, accurate up to the minute, of every room and bed, together with what type of room it is, the daily price of the room, which beds are filled, and so forth. (iii) Clinical laboratory reports also are stored and are available on request to every typewriter on-line. (iv) Drugs can be prescribed by the computer system. A physician may request pharmacological information about a drug. If he misspells the name of the compound, the computer suggests the correct spelling. It also tells him the method for administration, maximum and minimum doses, and similar information.

Storing hospital records in computers would make them a data base not only for patient care but also for research on differential diagnoses and prognoses, such as determining the probability for various diagnoses in the present patient on the basis of the hospital's experience with similar patients in the past. They could also be used for epidemiological research.

A national electronic network for transmitting hospital records is now feasible. Over it hospital records could be sent electronically from any health sciences center or hospital to any other where the patient might be ill.

## Copyright Problems Raised by the New Technologies

EDUCOM has also established a Committee on Copyright, with Benjamin Kaplan of Harvard Law School as chairman and Arthur Miller of Michigan Law School as co-chairman. This group will advise the Council and the member universities on the intricacies of copyright laws as they relate to the modern practices of storage, retrieval, duplication, and dissemination of information, particularly by electronic networks. This is a troubled area. Congress is delving into the question of fair use of published material in the light of new photocopying and other techniques. For example, how many copies of copyrighted material can be made without

breaking the law? Because Congress is likely to make major revisions in the copyright laws soon, these are enigmas of some urgency, and there are differences regarding them between some educators and some publishers.

Although it is generally held to be desirable in the public good to continue to reward the creative enterprise of authors by royalties—which many university professors receive—it is also desirable to have unrestricted—not necessarily monetarily free—access to scholarly and scientific information, and the copyright law should not restrain this.

In rewriting the law, little consideration has been given to the concept of electronic networks and their implications. Our task force, made up of copyright lawyers, librarians, and experts in computer science, is meeting with government officials, copyright specialists, and publishers' representatives, to seek a common and mutually acceptable solution that will make legal operation of educational networks possible while still appropriately compensating publishers and authors for their work.

The Committee on Copyright in the future will have an extended mission, dealing with all the complex legal and ethical problems of operating an interuniversity network. It will be called the Task Force on Legal and Related Activities.

EDUCOM intends to put much emphasis on continuing education in medicine, dentistry, engineering, business management, and other fields. It has established a Task Force on Continuing Education concerned with lifetime learning for practitioners or professionals. This task force, under the chairmanship of Dr. George E. Miller, director of the Office of Research in Medical Education at the University of Illinois Medical Center, will carefully investigate the opportunities for advancing continuing education in medicine, dentistry, and other fields by the use of nationwide interuniversity networks for information processing. This task force will sponsor an EDUCOM conference next spring to survey the problem of continuing education.

An organizational meeting has also been held of an EDUCOM Task Force on Academic Management. Such a group would study the application of computerized techniques to a wide range of problems that include handling of student and faculty records, budgeting, purchasing, personnel records, scheduling of classes, registration of students, planning for use of space, cost-effectiveness evaluation of programs, management decision-making, and the creation of institution-wide simulation models of colleges and universities. The chairman and members of this task force will be announced soon.

In the next few months we expect to set up a Task Force on Precollegiate Education that will be devoted to employing the new information technologies in university-monitored programs for secondary and primary education.

A Task Force on International Affairs will eventually be set up to investigate possible cooperation with other countries besides Canada, Mexico, and the United States.

## Human Uses of Technology

Since the fundamental philosophy of the Council is humanistic, the emphasis of all EDUCOM programs will always be on the men, not the machines—on the welfare of the scholar, the scientist, the student, and the patient. Intriguing and attractive though the gadgetry may be, it is of interest to EDUCOM primarily because it promises to relieve professors, students, administrators, and practitioners of drudgery, thus giving them more time for creativity.

Each new system and method will be analyzed carefully in comparison with more traditional means in order to answer such questions as: Does it advance the goals of education more effectively? Does it accelerate and improve scholarship by making access to information more rapid, more complete, and easier? Is it less costly in human effort or in money?

Many college teachers and administrators still look askance at automation of educational information processing, almost as if these new procedures were about to eliminate their jobs, as they sometimes do affect laborers in industry. Or they fear that the machines will dehumanize education. This need not be. Instead of each faculty member doing his own individual information processing in repetitive lecture sessions, often to large numbers of students, he might reconceive his role as a teacher. He might let the textbooks, the taped television lectures by the country's leaders in each specialty, and the computerized programmed instruction handle the problem of communicating the rote information, the basic facts of the field. The student could then take objective examinations to indicate a passing knowledge of a small or large segment of the field and after that he could meet with a faculty member.

The ideal situation might be for four members of the faculty, with new-found leisure from not having to do more-or-less rote lecturing, to meet in a group session with about 30 students who are already, to some degree, expert on the topic under consideration. The students would ask questions of the faculty and thus initiate active participation in a discussion in a community of scholars. The students would observe the more mature and experienced scholars, the professors, and see how they cope with their own inevitable problems of information overload, their lack of knowledge.

With the vast new extension of all aspects of our world of living and nonliving phenomena, we can no longer pretend that all of them are handled adequately. If we are not to collapse under the load, we must master techniques for handling some matters in depth and others more superficially, delaying study of some and depending on the opinions of experts for others. An educated man intermingles the techniques dynamically and flexibly according to the situation. Most of all, it is desirable for teachers to realize that their students, whether trying to encompass the English novel or Indian history, are grappling with this problem. By illuminating it for them and by showing them the various human and mechanical methods of handling the problem and when to use these methods, teachers can provide students with powerful tools for their future intellectual endeavors.

During the next year EDUCOM intends to expand its efforts to use the new information-processing technologies to aid those who learn, teach, do research, and perform other services in colleges and universities and in related activities throughout Canada, Mexico, and the United States.

## Summary

The Interuniversity Communications Council has been formed to provide collaboration among institutions of higher learning in their efforts to utilize the emerging communication sciences. Given a W. K. Kellogg Foundation grant for administration, eight charter

members announced the nonprofit organization in June 1965. There now are 50 institutional members, representing 167 separate campuses. Interuniversity task forces have been assigned to the study of computerized regional and national educational information processing networks, educational systems and technology, computer-based systems for clinical activities, the copyright problems inherent in the new media, the use of the new information technologies in continuing education, and the use of computers in academic management. Other task forces will also be established.

All information-processing activities in higher education are of concern to EDUCOM, including computational use of computers, computerized programmed instruction, library automation, educational radio and television, computerized cognitive aids, and the use of computers in clinical operations and university administration. Its primary purposes are to organize interuniversity cooperation in these fields, to disseminate reports on the state of educational information technologies, to investigate areas of critical development, and to facilitate useful applications.

### References and Notes


1. As of 15 October 1966, EDUCOM consisted of, in addition to charter members, the universities of Akron, Alabama, and Arizona, Polytechnic Institute of Brooklyn, Carnegie Institute of Technology, Cleveland State University, University of Colorado, Dartmouth College, Emory University, University of Florida, Florida State University, Georgia Institute of Technology, universities of Georgia, Indiana, Iowa, and Kansas, Kent State University, Lehigh University, Marquette University, University of Miami, Michigan State University, universities of Minnesota, Missouri, and New Mexico, New York University, University of North Carolina, Northeastern University, Northwestern University, universities of Notre Dame, Oregon, and Pennsylvania, Pennsylvania State University, Purdue, Texas A and M, Tufts and Tulane universities, Washington University, University of Washington, Washington State University, Wayne State University, Western Reserve University, and University of Wisconsin.
2. L. Karel, C. J. Austin, M. M. Cummings, "Computerized bibliographic services for biomedicine," *Science* **148**, 766–772 (1965).
3. P. Atherton, *American Institute of Physics Documentation Research Project* (American Institute of Physics report, New York, April 1965).
4. J. C. R. Licklider, *Libraries of the Future* (M.I.T. Press, Cambridge, 1965).
5. C. F. J. Overhage and R. J. Harman, Eds., *INTREX: Report of a Planning Conference on Information Transfer Experiments* (M.I.T. Press, Cambridge, 1965).


**NEWS AND COMMENT**

# Social Sciences: Where Do They Fit in the Politics of Science?

Social scientists and a growing number of people in Congress and the Administration are beginning to give hard thought to the place of the social sciences in the scheme of social science–government relations. Thus far there seems to be no consensus as to what new institutional arrangements should be created, but the feeling is strong that something should be done. The catalog of problems which intrude upon relations between the social scientists and government is still being compiled. Problems which must appear obvious to many social scientists, however, are those having to do with money, professional independence, and influence and visibility.

The mounting interest of members of Congress in the social sciences is undoubtedly a reflection of the increasing seriousness of such problems as the upheavals in the Negro ghettos, the overwhelming demands on big-city school systems, and the near-chaos in public transportation. The rapid growth of federal support for the social sciences, and of the involvement of social scientists in the work of government, is evident from NSF figures showing that the total federal contribution to research in these fields increased from $35 million in fiscal 1960 to $188 million in fiscal 1966.*

Nothing has done more to alert social scientists and government to the problems inherent in their deepening involvement with one another than the "Camelot" incident. Project Camelot, the long-since canceled U.S. Army–sponsored study of political instability in Latin America and elsewhere, produced, even before it was well launched, a political furor in Chile (*Science*, 10 September 1965). The reverberations of Camelot are still being heard and seem sure to influence the proposals certain to be made in the next few years to safeguard, in appearance as well as in fact, the scholarly independence of government-sponsored research done in the United States and abroad. The echoes from Camelot will be part of the background noise while relations betwen the social scientists and government are being studied.

The National Academy of Sciences is engaged in two major studies. A NAS study chaired by Donald R. Young, visiting professor of sociology at the Rockefeller University, will analyze social science–government relations in a historical perspective. Another study, led by Ernest R. Hilgard, professor of psychology at Stanford, and sponsored by the Social Science Research Council as well as by NAS, will survey the present state of the social sciences, their potentialities for aiding in the solution of national problems, and their requirements for federal support. SSRC participation in the study should enhance its standing among social scientists, for, while the council is not a delegate body, it has close ties to the professional social science associations. Henry W. Reicken, vice president of SSRC, is vice chairman of the study panel. The two studies are only beginning, and 2 years or more may elapse before their results are fully available.

Certain members of Congress are hurrying ahead with their own examination of social science–government relations. Senator Fred R. Harris, an Oklahoma Democrat, plans to hold hearings early next year on his bill, which he and 20 cosponsors introduced on 11 October, to establish a national social science foundation ("NSSF") as a parallel agency to the National Science

* Of the $188 million, the Department of Health, Education, and Welfare provided $72 million; the Department of Agriculture, $29 million; the Office of Economic Opportunity, $26 million; the Department of Commerce, $20 million; NSF, about $16 million; the Department of Defense, nearly $9 million; and the Department of Labor, about $8½ million; the balance was accounted for by a number of smaller social science research programs of other agencies. Support for social psychology, which is not included in the foregoing figures, totaled, in fiscal 1966, more than $87 million, of which HEW provided almost $71 million and DOD about $11$^{2}/_{3}$ million.