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# Computers and Electronics

This special issue of *Science* is devoted to an assessment of the revolution in computers and electronics. Essays on topics of special relevance to the scientific, technical, and medical communities are included. The computer revolution has had profound effects on instrumentation and on the collection, analysis, and storage of data. Changes in modes of communication among scientists are occurring and more are in prospect.

Scientific instrumentation evolved rapidly during the past two decades. In many instances, sensitivities increased by several orders of magnitude. It became possible to make new kinds of measurements, for example, in studies of phenomena that occur in  $10^{-12}$  second or less. Instruments containing dedicated microcomputers became common. In this issue Enke points to potential avenues for further improvement. He discusses the use of the computer to free us from the limitations imposed when we must attempt to hold all variables except one constant during a measurement. The computer also frees us from the necessity of finding sensors that are linear in the quantity measured. Another example is the use of the computer to extend by a factor of 100 to 1000 the already great sensitivity of mass spectrometry. The mass spectrometer can be set by the computer to monitor a parent-daughter mass combination and disregard potentially interfering substances.

Present-day instrumentation can obtain and record enormous amounts of data. The volume of these data is so great that computers and associated memory devices have become essential in data management. There is a need for both on-line and archival storage. At present, wide use is made of magnetic disk storage systems. However, optical and video disk technologies that are under development promise enormous storage capabilities at extremely low costs per bit. Already video disks 12 inches in diameter are available that contain 54,000 frames. In this issue Goldstein tells of activities of many companies in developing optical disks, one of which is designed to store 200 billion bits of information or the equivalent of about 500,000 pages of text. Video and optical disks will have an important role in storage of scientific information, and they may provide a new publication mechanism.

A large fraction of the total number of scientists active in research or development have ready access to computers. Many have terminals near their desks, and increasing numbers have them at home. By using telephone or other linkage, it is possible for them to send electronic mail to distant colleagues and to tap into a very large number of databases. For the transfer of large amounts of data, special links are needed. Most of the databases available are bibliographic and nonscientific. An important example of one that is useful in biomedical research is the base maintained by the National Library of Medicine, which provides coverage of the world's medical literature. The development of scientific numerical databases has been slow, but they are being formed and they will be valuable.

A decade ago, the telephone was the crucial link between members of invisible colleges. Among those who are familiar with computers, there is the beginning of an evolution toward using computer networks as the crucial linkage. In this issue Newell and Sproull discuss conditions necessary for a successful computer network. The pioneering example was the ARPANET, which has served needs of computer scientists and given rise to electronic mail and valuable interaction among the participants. The network links a number of universities, national laboratories, and other installations. Another network is SUMEX-AIM (Stanford University Medical Experimental Computer-Artificial Intelligence in Medicine). It links a group of medical scientists distributed around the country who are concerned with computer applications in medicine. Recently, a group of geneticists formed a network (GENET) to make use of computers in work related to recombinant DNA. Other networks have been authorized or are being planned.

—PHILIP H. ABELSON