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Electronics and Scientific Communication

We are in the early phase of major change in scientific communication. Electronic storage and retrieval of information has become so efficient that enthusiasts are now talking of paperless communication. This possibility is raised at a time when traditional scientific publishing has lost some of its effectiveness. For about 300 years, traditional forms of journal communications among scientists remained quite satisfactory. But in every half-century since 1750 the number of scientific periodicals increased tenfold, and by 1950 there were about 100,000 journals and 300 abstract journals. Keeping abreast of the literature and retrieving earlier published information became difficult, especially in chemistry, medicine, and other large disciplines. To maintain scientific communication, changes were needed.

At this point the electronics revolution began to influence many areas of science. It provided an alternative to journals in the form of memory banks, and it has affected publication in other ways. An important early achievement was computer-controlled composition. Today *Science* is composed in this way, as are many other journals, including all of the 16 published by the American Chemical Society.

One of the pioneers in computer-controlled composition was the National Library of Medicine (NLM). It first produced *Index Medicus* by this means in 1964. The NLM now indexes about 20,000 articles a month from about 3000 journals. Since the information in *Index Medicus* is in the computer, it is available for machine searching. Beginning in 1971, on-line searching became possible nationwide, and today, with time-sharing, searches are made at the rate of about 1 million a year. Users include individuals in 40 countries.

The need for computer-assisted retrieval of information is particularly urgent in chemistry. Already 5 million chemical substances are known, and the number is increasing at the rate of about 350,000 a year. *Chemical Abstracts* covers the literature of chemistry and its applications, including biochemistry, chemical engineering, chemical substances, organic and inorganic chemistry, and physical and analytical chemistry. In addition, peripheral fields are partially covered, such as solid-state physics, metallurgy, and agriculture. Source materials include some 6500 journals, patent specifications, reviews, and monographs. The data base CA SEARCH provides information about the contents of *Chemical Abstracts*.

Two other large data bases are SCISEARCH, the machine-readable form of *Science Citation Index*, and BIOSIS Previews, which provides access to *Biological Abstracts*. But the data bases cited are only a few of the many now publicly available or being created for science and technology. The capital cost of equipment needed to access these data bases is not very great. For about $3500 one can obtain a terminal that includes a video screen and printer. This terminal can be connected to a telecommunications net through the telephone. The net, in turn, connects to the data base through a vendor or in some cases directly.

With the use of new equipment and new techniques, data are being obtained at an unprecedented rate. It would be impractical to publish all of the data in journals. This stage is rapidly being reached in the study of nucleotide sequences in DNA. The exact sequences of thousands of nucleotides are already known, and this year the sequences of about 1 million nucleotides will be discovered. Such data, printed in dozens of different journals, would be unwieldy to compare. Stored in a computer, they would be highly amenable to manipulation and study.

Given the present state of electronic technology and the inertia of creatures of habit, major journals are not in immediate peril. Indeed, it could be argued that computer-aided searching of abstracts has increased the value of such publications. But electronics is a dynamic enterprise that will surely have additional impacts on scientific publication later in this decade.

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