



Research and the Scholar

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IN THE SCIENCES particularly, the development of new knowledge has in the last half century far outstripped the rate of development for all of the preceding centuries. For some time now we have been faced with the problem of whether even our most modern devices are adequate for the dissemination of the information that is being developed. The situation is immeasurably complicated by the fact that the book is no longer the primary medium for the introduction of new scientific discoveries. It has been succeeded in this role by the scientific journal, and the number of these journals has now multiplied to the point where no one knows exactly how many there are in the world and what they are.

In an effort to provide this information, the National Science Foundation is supporting a project at the Library of Congress for the compilation of data on scientific journals, with emphasis initially on those published in the United States and Russia. It is hoped that this project can be expanded to provide eventually a card file of descriptive data on scientific journals that can be kept up to date and used for the preparation of comprehensive or specialized lists of journals. The journal question carries with it the related problems of abstracting and indexing, without which much information would be "lost."

One rather sweeping innovation is the issuance of separates in lieu of complete journals. The American Society of Civil Engineers has, in fact, abandoned publication of its proceedings in full and is issuing its papers as separates. Each member is entitled to receive forty papers without charge and selects, by subject categories, those in which he is interested. This trend will be interesting to watch.

Have we not reached a new crisis in the history of learning that calls for a revolution in method as far-reaching and as radical as the invention of paper and the printing press?

Obviously the capacity of the printing presses far outstrips our
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Research and the Scholar

ability to handle the output efficiently. In the sciences, the situation is crucial, particularly at the present time when so much depends upon the efficient utilization of the scientific skills we possess. We are acutely aware that we are not producing scientists fast enough to meet all the needs of teaching, of research, of industry, and especially to meet the urgent needs of national defense. How important it is that time should not be wasted in the unwitting duplication of effort.

Perhaps if there were a more vigorous expression of demand on the part of the scientist, greater effort would be expended on solutions to the literature problem. One suspects that scientists, as well as scholars in other fields, are inclined to be traditionalists as far as their working habits are concerned. Many scientists feel, for example, that they and their colleagues are fully abreast of every important development in their fields. This awareness is based on knowledge of published literature and close contact with other leaders in the field. Such methods are becoming increasingly inadequate, however. Furthermore, even if it were possible for scientists to keep abreast of all that is going on in their own fields, it is obviously impossible for them to keep up with other fields, even those closely related to their own.

The literature system that we all know and use grew up around the individual disciplines and is oriented primarily toward Western science. Today, however, the old barriers between the disciplines are gradually breaking down; it is becoming more and more important for a man to know what is going on in other fields, and consequently the old single discipline system of literature is inadequate to his needs. In similar fashion we are learning that it is no longer enough to be informed merely on what is significant in countries of the West. Several of the Asiatic nations are making rapid strides in science, and we certainly cannot afford to ignore these developments on the other side of the world.

A few scientists who have become actively interested in the literature problem are trying to interest other scientists by demonstrating how much information on the state of the art, in a given subject, eludes even the most assiduous investigator. Maurice B. Visscher, Professor of Physiology at the University of Minnesota Medical School, stressed this point before the Conference on International Aspects of Librarianship last August. Drawing upon his own experience, he said:

At the present time with one of my colleagues I am preparing a critical review of the literature on a very small physiological topic, pulmonary edema. We have identified in three months about fifteen hundred relevant references and are in the process of scanning the

papers and studying those which appear to us to be important. There have been a dozen fragmentary reviews of this topic in the last decade, but we find that some of the most important papers are not mentioned. And especially, we have found that many of the more important contributions are not abstracted or indexed under headings identifying them as being relevant.

I mention this personal experience primarily to stress the point that much scientific information is at present buried in the libraries of the very institutions in which people are as busy as bees repeating the same studies and spending precious years rediscovering established facts. Even more deplorable is the failure to take the established facts into account in planning studies on facets of problems indirectly related to them. For this reason the new studies are not as well oriented as they could be.¹

Visscher also took note of the increasing problem of languages, noting that scientific literature tends to appear in more, rather than fewer, languages. He cited a number of examples of wasted effort brought about through an ignorance of results published in other languages. He noted that between 1947 and 1952 scientists in the United States spent hundreds of thousands of dollars repeating work on stereovectorelectrocardiography which had been done in Japan and published in Chinese in 1939. He also reported that the Russians had published, in the early thirties, an account of the first demonstration that stored blood could be used safely for transfusion purposes. This work did not come to the attention of western European and American students of the problem until some years later.

The fact that Russian now stands near the head of the list of languages of greatest frequency in scientific publications has prompted the National Science Foundation to explore the problem of making Russian scientific literature more generally available. As an experimental effort, the Foundation is supporting the translation of a number of significant Russian scientific papers. These are being published through cooperative arrangements with the U.S. Atomic Energy Commission and are being distributed to certain government agencies and to forty depository libraries. Remaining copies are offered for public sale by the Office of Technical Services.

The problem of languages can be met on a long-term basis only by stiffer language requirements for science students. At the Fourth National Conference of the U.S. National Commission for Unesco, held in Minneapolis in September 1953, American neglect of foreign languages was repeatedly criticized. Now that our interest and our

Research and the Scholar

responsibilities are global in scope, surely it is more than ever incumbent upon us to develop skills in languages other than our own.

The literature problem as a whole can only be solved by concentrated and imaginative research efforts. Although the National Science Foundation is eager to encourage, and even to support, research along these lines, few proposals have been received that suggest any new approach. It is rather strange that this should be so, for the history of science is filled with examples of the invention of new tools and instruments for research, which scientists have devised to further their work in the laboratory. One could mention, among many such examples, the centrifuge, the oscilloscope, and the electron microscope. Even radar, which was developed for specific wartime applications, made possible the creation of very short electromagnetic rays, which have led to basic new discoveries regarding the nature of the nucleus.

Science has also successfully developed some exciting new tools for scholars in other fields. Several years ago, Willard F. Libby and his co-workers at the University of Chicago demonstrated the feasibility of using the carbon-14 content of carbonaceous materials to determine the age of such samples. Since then, radiocarbon-dating has developed into a powerful research tool of value to the anthropologist, archaeologist, biologist, geologist, and chemist. The National Science Foundation is currently supporting a new project in radiocarbon-dating at the University of Colorado, which plans to develop a cooperative program through which valuable service can be rendered to institutions in adjoining states.

Is it not time, then, that science seriously attacks the overwhelming literature problem before it engulfs us completely? Obviously any successful solution in the field of scientific literature would be likely to produce beneficial results in other fields as well.

The availability and use of research material is a matter of fundamental concern, for it is by these means that we hand down not only our culture and our accumulated knowledge but our precious traditions of freedom. Throughout the long and troubled history of mankind, those who have sought to suppress men's freedom have sought to cut them off from the written word. Ernest Cushing Richardson² has pointed out that in ancient times books were kept from the common people because the written words gave superhuman power. A careless librarian might lose his life "because he incautiously and contrary to the rules loaned out a book of magic to the wrong persons." The *Encyclopaedia Britannica* notes that "The quality of printing began to deteriorate in the 16th century, owing somewhat to

the fact that the ruling powers in church and State became alarmed because the new art seemed to be creating too much freedom of thought. Measures of repression were adopted and printing ceased to be an art and became merely a vehicle for the conveyance of information.”³

Many early scientists were accustomed to state their findings in the form of anagrams or codes not readily intelligible to other people. Thus the seventeenth-century physicist, Robert Hooke, tells us that he printed his theory of springs “in an anagram at the end of my book of the descriptions of helioscopes, viz. c e i i i n o s s s t t u u, id est, ut tensio sic vis; that is, the power of any spring is in the same proportion with the tension thereof.”⁴ Such devices served a two-fold purpose: they helped to establish the priority of an idea, and they afforded a measure of personal security for the scientist, who was liable to be charged with witchcraft or necromancy if his theories were widely known.

Throughout history, also, libraries have been a principal target for invaders. The library of Christ Church, Canterbury, was destroyed by the Danes in the ninth century, and the earliest and most famous library of Italy, that attached to the Abbey of Monte Cassino, was fired by the Saracens, also in the ninth century. All wars have produced this type of vandalism against centers of culture and learning.

Today, as in other troubled times, universities and the libraries have an important part to play in the preservation and perpetuation of our liberties. Numbers and size are not always significant. According to some authorities, the largest library in the world, with the largest number of daily readers, is the State Library in Leningrad. *The World of Learning* reports that in 1951 there were some 300,000 libraries throughout the U.S.S.R. Obviously, libraries must be something more than the physical collections of books, periodicals, and manuscripts. In a free country they must jealously stand guard over man's right to read what he will, to think, and to make up his own mind. There is today a very real threat to intellectualism of all kinds. Our schools and our libraries are the refuge and guarantors of intellectual freedom and at such times they are subject to attack, as the citadels of learning have been throughout history. For our own sakes, and for the sake of our children, they must continue firmly to withstand assaults upon the independence of the mind and spirit. In the words of President Eisenhower:

The libraries of America are and must ever remain the homes of free, inquiring minds. To them, our citizens—of all ages and races, of all

Research and the Scholar

creeds and political persuasions—must ever be able to turn with clear confidence that there they can freely seek the whole truth, unwarped by fashion and uncompromised by expediency. For in such whole and healthy knowledge alone are to be found and understood those majestic truths of man's nature and destiny that prove, to each succeeding generation, the validity of freedom.⁵

References

1. Visscher, M. B.: *The Interdependence of Knowledge and Information in the World Today*. Address delivered at the Conference on International Aspects of Librarianship, August 1953.
2. Richardson, E. C.: *Some Old Egyptian Librarians*. New York, Scribner, 1911, p. 16.
3. *Encyclopaedia Britannica*. Chicago, Encyclopaedia Britannica, Inc., 1949, Vol. 18, p. 500.
4. Magie, W. F.: *A Source Book in Physics*. New York, McGraw-Hill, 1935, pp. 93-94.
5. Letter from the President to R. B. Downs, President of the American Library Association, June 26, 1953.