may explain why Communications, as currently present in *Journal of the American Chemical Society* and other publications, seem to satisfy readers as much as they satisfy the authors' need for establishment of priority. On the other hand there is evidence that if the contributions become too short, the reader cannot maintain an interest. This may explain why *Chemical Abstracts* section groupings have never become primary reading fare for any significant number of chemists.

Much more could be said. I have tried primarily to present the structure of the literature as we see it, some of the problems that threaten its destruction, and some of the information we have obtained from reader research and similar sources that indicate ways to overcome our problems and maintain a flow of printed information in the physical sciences. We know that chemists respond to stimuli in the same way that people in general do. We know that they respond to good writing, to significant general subjects, to compact writing, and to help from the author in understanding and interpreting the information being presented.

We know they have a range of willingness to read. We know they have a range of willingness to spend money to have information at their finger tips. We know that they place a higher value on some elements of information than they do on others. And we know that in the last analysis the learning process from the printed word must compete with the learning process by other means, such as by a telephone call to a friend or by the running of a new experiment. From these understandings and from others I have not mentioned, modifications in the nature of the printed literature of chemistry will occur. The pace of change is quickening here as in most other areas of modern life. Experimental journals, overthrow of traditional requirements or criteria, increases in costs and prices, and some entirely new variables will be added to the literature scene. The intriguing aspect of all this is that, for the first time in 300 years, the chemical world may be about to make a significant improvement in the effectiveness of its communications with itself.

But, on the basis of what we know about chemists' behavior, we can feel fairly certain that these improvements will come in a series of small steps over many years, not in a single massive redesign.

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# Symposium on Redesign of the Technical Literature—Introductory Remarks*

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Vannevar Bush described an automated desk library, the Memex, twenty-three years ago. Despite the progress of a quarter century and the very tangible results from investment of millions of dollars in information research, there are still too many words to be read and these are published in too many languages and too many journals. In the last twenty-five years, the technical literature has at least quadrupled, and a larger percentage of it is now in languages other than English. Increased specialization by the user to reduce the amount he must read loses vital information in multidisciplinary research—such as that on cancer or medical use of radioisotopes. Searching the literature for most of us is still uncertain, slow, and wasteful. Serendipity supplants complete searches. Results of search are often too many words to be read in the current forms of presentation. An increasing number of us are coming to believe that we cannot read all necessary technical literature as it is now presented, selected, and distributed. The verbal outputs of research and development as well as the secondary literatures, need re-examination. Would redesign of the technical literatures help to supply all of the right words in readable numbers? Could redesign of verbal or graphic outputs enable us to keep up and to use the record more conveniently? Our Symposium was designed to explore answers to these questions.

The significant contributions of this Symposium show that improvements in the technical literature can, should, and will be made. I am confident that another quarter of a century will not slip by without bringing many of the suggested improvements.

The primary literature seems to function as: 1. a random source of inspiration and serendipity; 2. an unorganized collection of data, largely unevaluated, and sometimes erroneous; and 3. a reward for authors. These three functions do not need replacement, but improvement; especially of those archaic formats that waste time of readers.

We need better communication ahead of the primary literature. While conferences are very important, immediate, written communication among those active in a subject field is also needed. Progress is often so rapid in active fields that published results are obsolete.

The critical review is usually much too slow and there are not enough—even of delayed reviews. We need immediate reviews, such as the microreviews of aphorisms that have been suggested. Microreviews, organized by subject and published even daily, should serve as experience-laden guides to the primary literature.

Repeated search for data and their redundant evaluation constitutes a serious waste of technical manpower—a waste that is exceeded, perhaps, only by the waste

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from nonuse of data. Much more support is needed for retrieving and organizing data from the unorganized primary literature—even if the data must be left unevaluated. Current, evaluated data are, of course, ideal. And while we are organizing data, we should also plan for genuine information retrieval, including theories, propositions, and conclusions, and their evaluation.

Information within arm's length and the rebirth of the personal library are important objectives in redesign of the technical literature. Techniques are here for centralized cataloging, indexing, and abstracting for personal collections. The several papers that emphasize nearby information are indication of the profound significance attached to this aspect of redesign.

Whether it is called continuing education, adult education, keeping up with the literature, preventing functional obsolescence, or upgrading technical personnel, there is tremendous interest and importance in the new and valuable techniques for painless, perfect learning as a way of keeping abreast. Audio-visual and computer-aided instruction have a rapidly expanding role in redesign.

And finally, the precise ways in which computers and related equipment can serve us best are becoming clear, thanks to papers, such as these.

# Condensed Technical Literatures*

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**Scientists have too many words, too many languages, and too many journals to read. Condensation by evaluation, done by authorities, such as authors, editors, and reviewers, can be expressed in sentences like aphorisms stating conclusions, results, intentions, etc. Condensed literatures of organized collections of terse statements would not be substitutes for other literatures, but would provide evaluated guides to them. Backlogs of reading might be avoided because the past would be embodied in the statements that could help professional people to keep up in fields one or two orders of magnitude broader than they now can read.**

"But the problem in fact is how to pass through multiplicity so as to transcend it, and not at all how to escape it."[1]

Professional people have too many words to read in the time available. Too many of the words are in languages other than English and the words appear in too many journals, reports, and books. This is the problem that many of us have been trying to solve for at least a quarter of a century. Chemists, biologists, engineers, and medical men, among others, are finding it increasingly difficult to keep up. Serendipity supplants complete searches. Greater specialization to reduce the amount to be read is successful only to a limited extent. In multidisciplinary fields, such as medicine and pharmaceutical research, increased specialization can lose vital information. Complete searches often yield too many documents to be read. Reading this year's output of 250,000 to 500,000 medical papers, for example, at one hour a day would take two and a half to five centuries. At this rate a medical researcher can read only 0.2–0.4% of the literature. The approach to the primary literature through indexed abstracts is also unsatisfactory, in this respect, because the primary literature retrieved is just as large as before. Plans for condensation of medical and other literatures and the use of computers for selection of references or documents have not solved the problems of too much to read and too little time in which to read and digest it.[2, 3, 4, 5, 6]

The purpose of this paper is to present an approach to solving the problem of too much to read in the limited time available, and to invite comments that will enable evaluation and improvement of this approach.

We need condensed technical literatures[7] that aid us to keep up with pertinent literature in fields perhaps one or two orders of magnitude broader than we now can read. Since we cannot read all necessary words, the literature must be condensed in some way. All condensation requires evaluation—the part selected is considered to be of greater value than the part rejected. It is also apparent that selection, evaluation, and condensation must be done by those knowledgeable in the subject field—otherwise nobody would take time to read the condensed product—nor should they read it. Knowledgeable people who see the results of new work first are: author, editor, and reviewers. These authorities are in a position to produce the promptest condensations. These knowledgeable people will have opinions about the manuscripts that they read. They will have come to conclusions about the manuscript. These opinions and conclusions can usually be expressed in a carefully written sentence. The sentence may resemble an aphorism ("Exclusively of the abstract sciences: the largest and worthiest portion of our knowledge consists of aphorisms." Funk and Wagnalls New Standard Dictionary.) of Hippocrates—e.g., "Persons who are naturally very fat are apt to die earlier than those who are slender."[8] A similar aphorism from current actuarial data might read, "For males between 15 and 69, those who are 30% over the average weight have an excess

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