

From Primary Journals to Technical Business Magazines*

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Virtually from the beginning of the experimental approach to science, there has been strong evidence of a desire to communicate—to report to one's fellow experimenters the results of one's own investigations, and to learn of others' results. Long before any formalized means of communication was established, "natural philosophers" were exchanging information and ideas through personal conversations, group discussions, lectures, seminars, and letters.

It is significant that the Royal Society of London, one of the oldest scientific societies in the world, maintained as an important part of its work at the time of its incorporation 300 years ago an active "correspondence" with philosophers on the European continent. Selections from this correspondence furnished the beginnings of the *Philosophical Transactions*. A portion of the *Transactions* later developed into the *Proceedings of the Royal Society*, which has continued to this day.

In the era when the Royal Society was established, and was creating the first scientific journal, it was possible for the interested philosopher to know of and to understand virtually all that was going on in the field of natural science—or at the very least to read and assimilate essentially 100% of the world's primary scientific literature.

The *Philosophical Transactions* started something which soon was imitated and proliferated. By the beginning of the 19th century, it is reported, there were about 100 scientific journals, and 50 years later, 1000 journals (1). Quite some time before the number of journals reached 1000, there was too much for the individual scientist to read, and an abstract journal appeared. The proliferation process has continued, until now we are offered far more abstracts than a single individual can read. Various other devices, such as permuted title listings, have been designed as aids to the scientist in his efforts to keep abreast of developments. But the next major step seems likely to be a shift to computer-based storage and retrieval systems. In using such systems, the individual scientist will gain access to stored information through the use of a thesaurus that will guide him to ask the machine the right questions in the right way, so that the machine can deliver the precise selection of information he needs and help him to avoid receiving a thousand times more than he wants to know.

Despite the overwhelming volume and disconcerting growth of material published in the primary journals, journals continue to provide an incomparable source of information for the research scientist. In the better journals, conscientious editors and boards of critical reviewers assure the publishing research scientist of assistance in getting into print in good form a sound contribution to

knowledge; at the same time they give the reader confidence in the quality and soundness of what he finds in the journals. In fact, this approach has long since developed to the point where the reputations of scientists are built, in part, on the stature of the journals publishing their papers.

The objective of the machine systems' holding submitted research papers in repository is to be able to provide to the scientist, on demand, a useful collection of selected information. When such a system is well developed, one could predict that journals, as they exist today, will die out. However, there is another important characteristic of the journal which makes its early demise doubtful. The value of the journal to the author assures it a considerable measure of protection. This author-influenced, or producer-oriented, character of the journals, in addition to giving them strength, has also caused them problems. Scientists, knowing of the importance to their own reputations of having papers published, must maintain a strong level of production in print or risk some loss of standing. The "publish or perish" principle is frequently decried, but there is no indication that it will soon disappear. The increasing number of scientists renders competition for a place in the sun more severe, and places an even greater premium on one's being prolific in writing and aggressive in publication. The swelling of the volume of scientific literature is thus accelerated.

In addition to the vested interests of authors as a force in preserving journals in their present form, an important aspect of the primary journals' value to readers should not be overlooked: browsing. Browsing perhaps is a declining art, but still there is reason to believe that the scientist who does a skillful job of selective browsing is likely to develop more effectively than the man of comparable intellect who follows only those references which pertain directly to his work.

The advancement of science gained greatly through the journal. The adaptation of scientific knowledge to agriculture and industry, following the work of men such as Liebig and Perkin, brought a need for dissemination of knowledge of useful applications of science, and encouraged papers on what we might call applied science. The stature of applied science grew. Early in the 20th century, the value of science in industry was recognized in the United States, especially in the field of chemistry. One of the results of the recognition was the beginning of the *Journal of Industrial and Engineering Chemistry*, in 1907. Today we have a host of what can be called journals of applied and industrial science.

Industrial journals helped spread the realization of the value of scientific research and development in industry. Large numbers of scientifically trained men and women

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were attracted into industrial laboratories. About 75% of all U. S. scientists and engineers now are employed in industry (2). Of the members of the American Chemical Society, more than 70% are in industry.

In addition to the journals carrying technical reports, another type of publication, which appears to have begun as almost totally commercial, has had to become more technical because of the increasingly technical basis on which industry operates. This is what we originally called the trade journal. Members of the trade journals group which now recognize and serve the need for technically based trade news we call technical trade journals. They vary greatly, from almost totally promotional instruments to publications presenting technical trade news objectively in both general and specific fashion.

The relationships among the various types of publications discussed here have grown closer. Between World Wars I and II, the practice of industrial consulting by academic chemists grew; since World War II, it has become almost universal. In addition, the increasingly scientific and technical nature of industrial production, and of the basis of product competition, has built a need for technical training throughout the industrial and business world of chemistry, including sales. As a result, there is now a very large community of people whose interests are in some way related to chemistry. The basis of their work varies so greatly as to require many types of publications to serve their specialized needs. However, there still is a common basis of interest—chemical knowledge.

Clearly it is impossible for any one person today to read a major part of the chemical literature. However, the scientifically or technically trained person who is to avoid obsolescence must be well informed at three levels related to the world of professional and business pursuits based on chemistry. He can keep himself properly up-to-date by: (1) being well read in the specialized segment of chemical knowledge on which he has built his specific competence; (2) maintaining a good knowledge of what is going on generally in a broader area related to his field; and (3) keeping current a sense of the movement of events in the total field of chemistry-based activity. Sources for all three of these types of information are now available. In the latter two, development is more recent but is progressing vigorously. The Chemical Abstracts Service offers abstracting, indexing, and retrieval services which can lead the searcher to any and all published chemical literature. As we are concerned here only with direct contact with the published article, we shall not deal with abstracts.

Primary journals continue to be the basic printed source of scientific information for any scientist in his field of specialization. However, as the total mass grows, the specialization must be increasingly intense. The effect of that limitation can be seen in the proliferation of journals covering fields of decreasing breadth. As an example, we might consider the development of journals of the American Chemical Society. The *Journal of the American Chemical Society* once served, unaided, the entire field of chemistry. Now, in addition to that journal, we have the *Journal of Physical Chemistry*, the *Journal of Organic Chemistry*, *Inorganic Chemistry*, *Biochemistry*, and the *Journal of Medicinal Chemistry*.

The *Journal of Industrial and Engineering Chemistry* has spawned *Analytical Chemistry*, *The Journal of Agricul-*

tural and Food Chemistry, and the *Journal of Chemical and Engineering Data*, and now has three daughter quarterlies: *I&EC Fundamentals*, *I&EC Process Design and Development*, and *I&EC Product Research and Development*.

As we search the whole field, we can see very large numbers of journals whose titles suggest quite limited fields of specialization. The trend can be expected to continue. As a result, the problem of optimum browsing and general reading can be expected to become ever more difficult. At one time we of the ACS publications staff considered experimenting with a system of publishing brief summaries of papers received, providing copies of any of those papers on order, and eventually publishing in a journal only those papers which by some impartial method were judged to be papers of permanent value. The idea for that system was discarded because it rendered temporal in nature much of what would be produced, and because it constituted a radical departure from the present system of bound volumes of all papers judged worthy of publication. One remnant of that proposed system exists in the Research Results Service, described in another paper in this symposium (3).

A certain type of selective system is now in widespread use in many organizations and institutions. It employs the circulation of journals or of tables of contents or brief abstracts from which individuals request copies of papers. Requested copies are provided through machine-copying. This system, should it expand greatly, could lead to serious difficulties for the journals, as support of the cost of publication rests upon subscribers. If subscriptions dwindle near to disappearance, economics of publication may force many journals out of existence and the basic source of material would no longer be available.

Research is under way in the American Chemical Society on another system of selective delivery of manuscripts (4). Manuscripts would be encoded by means of punched paper-tape, suitable as input for a computer. The computer could issue type-setting instructions for a photocomposing machine, which could be used in the preparation of copies of the stored manuscripts. As a foreseeable result of research on such a system, a subscribing scientist could order all the individual papers containing his high-interest key words or word groupings, as pre-selected by him from a catalog or thesaurus, and have delivered to him what would be in effect a privately designed research journal, tailored to his demands. Encouraging progress now has been made on machine-setting chemical structures (5), previously one of the barriers to achieving the goal.

The developments described here indicate a likelihood of major change in research paper publication, but the traditions and the author-oriented aspect of the journals are likely to make the process slow.

Should a major plan, such as that envisioned by Dr. Stafford L. Warren for a national science library (6), find the very large federal support it requires, changes in the journal system are likely to be accelerated.

The scientist or technologist can read only a limited amount from any system of basic journals. In addition, he needs to have sound and accurate information on developments in fields related to the broad general area in which he works—but for which he can read few, if any, of the basic publications. The need for broader and less detailed

coverage suggests a valuable service to be rendered by a summary or review publication relating new findings to the existing body of knowledge. The development of a publication of this kind is now under way with the monthly journal, *Industrial and Engineering Chemistry*.

Chemical engineering and chemical technology are proceeding on an increasingly scientific base, and the chemical engineer or applied chemist who is to progress during the next decade needs some means of following the scientific progress that underlies the work he will do; he needs assistance in relating new theoretical developments to his existing knowledge as a basis for improving his current practices. *Industrial and Engineering Chemistry* has been redesigned with the objective of providing such assistance. Its three alternating quarterly publications carry only scientific research papers, in keeping with the titles of these journal units: *I&EC Fundamentals*, *I&EC Process Design and Development*, and *I&EC Product Research and Development*. The monthly publication was designed, and is now being developed, to carry authoritative articles by leaders in the field who relate the most advanced scientific progress to the general body of technical knowledge on which advancing practice is based.

The combination of the monthly and one or more quarterlies makes it possible for the chemical engineer or applied chemist to stay abreast of new developments and stave off technical obsolescence.

In basic chemical science, also, it may be desirable to provide brief reviews of limited fields, written by scientists directly engaged in research in the limited areas surveyed. The ACS is now seriously considering establishment of a journal of brief reviews in current chemical science.

For the well-informed professional scientist, technologist, or industrial manager in a technically oriented industry based on chemistry, a sense of the general movement of events in the total chemical-related field is necessary. A general news medium, *Chemical and Engineering News*, has been developed along such lines. Just as members of the literate population today find the newspapers and newsmagazines a significant factor and valuable service in their lives, so there is a place in the lives of technically literate people for something comparable serving their professional needs.

The material in *Chemical and Engineering News* is designed not to teach the specialist in the field concerned, but rather to inform him accurately, reliably, and promptly, although not in depth, of the happenings of broadest importance to the chemical world.

Chemical and Engineering News is not a technical trade journal, but is a broadscope scientific and technical news magazine serving the whole field of work based on chemistry. It serves an audience of widely varying pursuits, as can be seen in Table I. While more than two-thirds of its subscribers are employed full- or part-time in industry, not all of those have their primary interests in the business or economic aspects of industry. Therefore, the content of *Chemical and Engineering News* is only about one-third industrial. The distribution by general class of material is shown in Table II.

As the basis of news selection must be highly current, a full-time staff of editors is employed. Approximately half the staff members are stationed in geographically distributed field offices, so as to be in hourly contact with

Table I. Distribution of C&EN Circulation, 1963

Industrial	
Business and production management, including works managers and foremen	16,700
Research and development managers and executives	9,600
Chemists and metallurgists	23,300
Engineers	7,800
Sales and other industrial personnel	4,900
Consulting chemists and engineers	7,200
Total industrial	69,500
Government	
Chemists and engineers in government installations and public utilities	8,500
Total government	8,500
Academic	
Professors and instructors (of whom 13% are industrial consultants)	14,900
Students	11,450
Universities and colleges	2,100
Total academic	28,450
Other and unclassified	4,300
Total	110,750

centers of chemistry-related activity and with the most knowledgeable people who are able to give good, critical evaluation of the importance of events as they happen. Furthermore, the entire editorial staff, with but one or two exceptions, is chemically trained. The policy of hiring only chemically trained reporters and editors is based on observation that a writer who has been so trained, and who has worked with chemists and chemical engineers, is much better equipped to write from a point of view that will be grasped by the C&EN audience.

Chemical and Engineering News comes near to being unique in news coverage of the type and breadth it delivers. It probably is truly unique on one score, that of editorial reporting to a scientific and technical audience on new developments from scientific research laboratories. While this is a controversial matter (some scientists believing that only the scientist himself should write about his research), it is our belief that there is real value in promptly reporting to a broad audience news of research of special interest. In order to present such material to an audience accustomed to reading about scientific research only in the journals, special care is needed. Therefore, the C&EN operation has been de-

Table II. Distribution of Content in C&EN, Including Features, 1963

	% of total columns
Industrial	32.9
Research and education	12.3
Technology	16.3
Professional (books, ACS news, associations, people)	26.7
Service and miscellaneous	11.8
	100.0

veloped so as to use the services of qualified outside advisers in the selection of research topics to be reported, and thereafter to have the benefit of critics' evaluation of what has been written, as well as checking by the originator of the research work described. During the past few years, a staff with special qualifications in research has been built. There are on the C&EN reportorial staff five men with Ph.D. degrees.

In performing the difficult tasks assigned to *Chemical and Engineering News* in its position as the publication of a large scientific and educational society, we are greatly aided in having the benefit of the critical evaluation and assistance of very large numbers of highly qualified people. One of the problems, however, is that while C&EN is designed for skimming and selective reading, and may sometimes give only enough detail to fix a reliable framework and direct readers to sources of further information, the more scholarly reader may sometimes feel dissatisfied. Perhaps the most frequent criticism from readers arises from confusing depth and detail of information with accuracy. Failing to find in C&EN the detail they are accustomed to finding in a journal, some readers are left unsatisfied, and ascribe the deficiency they have sensed to inaccuracy rather than to lack of detail. C&EN makes no claim to being a journal, but does claim to maintain an exceptionally high level of accuracy and reliability in scientific news reporting.

Having said that C&EN comes near to being unique, we still must face the question of proof of its utility. This is a difficult matter, but through a number of surveys we have been able to gather indications of the extent to which it is used and on that basis to conclude that it is rendering an extensive service. Some of these surveys have been our own, but we have also had the benefit of the results of studies by several groups which are not a part of the management of the ACS Publications. Results of these surveys are shown in Tables III-IX. (In evaluating some of these results, it should be noted that the journals *Biochemistry* and *Inorganic Chemistry* were quite new at the time the studies were done.)

To supplement the types of publications described here, one can find a great range of general scientific and tech-

Table IV. Ranking of Journals by Chemists' Reading Time^a (1959 Study)

Rank	Journal	Reading time, %
1	<i>Chemical and Engineering News</i>	15.7
2	<i>Journal of the American Chemical Society</i>	7.0
3	<i>Chemical Engineering</i>	4.3
4	<i>Analytical Chemistry</i>	3.7
5	<i>Chemical Abstracts</i>	3.3
5	<i>Journal of the Chemical Society</i>	3.3
5	<i>Chemical Processing</i>	3.3
8	<i>Industrial and Engineering Chemistry</i>	3.0
8	<i>Journal of Polymer Science</i>	3.0
10	<i>Chemical Week</i>	2.7

^aFrom an Operations Research Study of the Dissemination and Use of Recorded Scientific Information by the Operations Research Group, Engineering Administration Dept., Case Institute of Technology, Dec. 1960. Reading times of 297 chemists and 404 physicists in 71 institutions were studied.

Table V. Ranking of Journals by Physicists' Reading Time^a

	Reading time, %	Cum. %
1 <i>Physical Review</i>	11.9	11.9
2 <i>Journal of the American Chemical Society</i>	7.8	19.7
3 <i>Review of Scientific Instruments</i>	6.6	26.3
4 <i>Physics Today</i>	6.1	32.4
5 <i>Journal of Physics and Chemistry of Solids</i>	4.1	36.5
6 <i>Physical Review Letters</i>	3.8	40.3
7 <i>Proceedings of the Institute of Radio Engineers</i>	3.5	43.8
8 <i>Chemical and Engineering News</i>	3.0	46.8
8 <i>Scientific American</i>	3.0	49.8

^aFrom an Operations Research Study of the Dissemination and Use of Recorded Scientific Information by the Operations Research Group, Engineering Administration Dept., Case Institute of Technology, Dec. 1960. Reading times of 297 chemists and 404 physicists in 71 institutions were studied.

Table III. Ranking of Journals by Chemists' Reading Time^a (1958 Study)

Rank	Journal	Reading time, %
1	<i>Journal of the American Chemical Society</i>	12.4
2	<i>Chemical and Engineering News</i>	10.5
3	<i>Chemical Abstracts</i>	8.6
4	<i>Chemical Week</i>	4.9
5	<i>Journal of Organic Chemistry</i>	3.7
6	<i>Journal of Polymer Science</i>	3.7
7	<i>Analytical Chemistry</i>	3.5
8	<i>Journal of the Chemical Society (London)</i>	2.8
9	<i>Industrial and Engineering Chemistry</i>	2.6
10	<i>Oil and Gas Journal</i>	2.4

^aFrom an Operations Research Study of the Dissemination and Use of Recorded Scientific Information by the Operations Research Group, Engineering Administration Dept., Case Institute of Technology, Dec. 1960. Reading times of 297 chemists and 404 physicists in 71 institutions were studied.

Table VI. Study of Reading by Subscribers to ACS Research Journals^a

Question: Which publications do you read or look through regularly?

<i>Chemical and Engineering News</i>	89.7
<i>Journal of the American Chemical Society</i>	86.5
<i>Journal of Organic Chemistry</i>	53.9
<i>Journal of the Chemical Society</i>	53.6
<i>Science</i>	50.1
<i>Nature</i>	38.2
<i>Tetrahedron or Tetrahedron Letters</i>	37.4
<i>Analytical Chemistry</i>	36.4
<i>Journal of Chemical Education</i>	33.1
<i>Journal of Physical Chemistry</i>	30.2
<i>Biochemistry</i>	25.8
<i>Journal of Biological Chemistry</i>	24.8
<i>Journal of Chemical Physics</i>	19.3

^aFrom a study sponsored by the Director of Research Journals, ACS.

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Table VII. Study of Reading by Subscribers to ACS Research Journals^a

Question: From which of the publications do you usually read at least half of the articles and research reports?

<i>Chemical and Engineering News</i>	44.8
<i>Journal of the American Chemical Society</i>	38.2
<i>Journal of Organic Chemistry</i>	26.0
<i>Science</i>	20.2
<i>Journal of Chemical Education</i>	16.0
<i>Journal of the Chemical Society</i>	13.3
<i>Analytical Chemistry</i>	11.9
<i>Tetrahedron or Tetrahedron Letters</i>	10.9
<i>Journal of Biological Chemistry</i>	10.3
<i>Biochemistry</i>	10.1
<i>Journal of Medicinal Chemistry</i>	8.8
<i>Nature</i>	8.0
<i>Journal of Physical Chemistry</i>	7.0
<i>Inorganic Chemistry</i>	6.3
<i>Journal of Pharmaceutical Sciences</i>	6.1
<i>Journal of Chemical Physics</i>	5.1

^aFrom a study sponsored by the Director of Research Journals, ACS.

Table VIII. Study of Reading by Subscribers to ACS Research Journals^a

Question: Which of these publications does the best job of providing you with information helpful to you in your work?

<i>Journal of the American Chemical Society</i>	37.0
<i>Journal of Organic Chemistry</i>	24.4
<i>Chemical and Engineering News</i>	18.3
<i>Journal of the Chemical Society</i>	12.8
<i>Analytical Chemistry</i>	10.7
<i>Journal of Biological Chemistry</i>	9.5
<i>Journal of Physical Chemistry</i>	9.2
<i>Journal of Chemical Education</i>	8.9
<i>Biochemistry</i>	8.8
<i>Science</i>	6.6
<i>Tetrahedron or Tetrahedron Letters</i>	5.0
<i>Journal of Medicinal Chemistry</i>	4.9
<i>Inorganic Chemistry</i>	4.7
<i>Angewandte Chemie</i>	4.1

^aFrom a study sponsored by the Director of Research Journals, ACS.

nical review publications which serve very broadly, and technical trade magazines serving limited areas. The variation among these is so great as to require a separate paper.

What has been described here, and is shown schematically in Figure 1, is a system of scientific and technical communication composed of primary journals, derivative or review and survey journals, and a general scientific and technical newsmagazine. That system offers: (1) detailed authoritative material in specialized fields; (2) authoritative reviews of progress in limited areas related to a specialized field; and (3) general news of significant developments in a total field. While major changes can be expected during the next decade, especially in primary journals and probably to some extent in derivative or review journals, we believe that a three-level system such as that described probably offers the

Table IX. New York Public Library Survey

Most Used Periodicals, Division of Science and Technology Reference Department, April 1, 1960 to March 31, 1961

	Photo-service use	Reading room use	Combined use
<i>Chemical and Engineering News</i>	358	6800	7158
<i>Industrial and Engineering Chemistry</i>	237	5700	5937
<i>Journal of the American Chemical Society</i>	613	2200	2813
<i>Engineering News-Record</i>	32	2091	2123
<i>Oil and Gas Journal</i>	196	1922	2118
<i>Aviation Week</i>	61	2038	2099
<i>Scientific American</i>	57	1623	1680
<i>Physical Review</i>	632	933	1565
<i>Nature</i>	514	898	1412
<i>Analytical Chemistry</i>	441	750	1191
<i>Chemistry and Industry (London)</i>	139	900	1039
<i>Journal of the Chemical Society</i>	529	492	1021
<i>Electronics</i>	259	757	1016
<i>Science</i>	128	751	879
<i>Iron Age</i>	115	681	796

Scheme for a Primary Information System

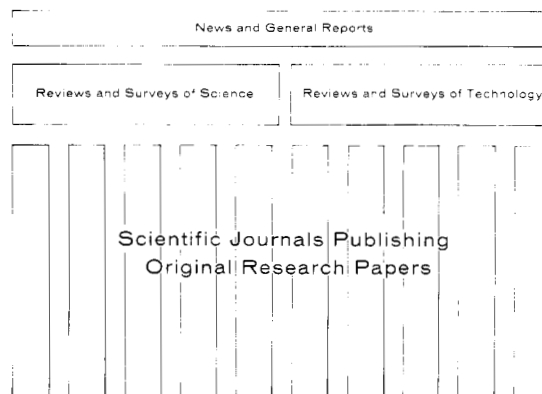


Figure 1.

best available and practically useful literature system for keeping a professional scientist or technologist adequately informed today.

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