Primary Journals: Questionable Progress and Present Problems*

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The origin of journals and their gradual development into the forms we now know are examined. Some of the present problems faced by journals are shown to be a consequence of past practices.

My thesis is fairly well indicated by my title. It is timely to appraise the situation of primary journals in relation to the progress of science and to the now terrifying problem of trying to handle them effectively so that they may continue to serve their prime function in the advance of science.

The most rapid change in the history of scientific information is now occurring. New technologies are developing which threaten a revolution as vast in the exchange of scientific information as that which took place with the advent of printing in the 15th century. Painfully written manuscripts served for centuries as the medium for communication and the transfer of information. Since scholars were few, and since ample time was available in the monastaries which stretched from Ireland to Tibet, manuscripts were copied time and again for those who could read, and most of these were in the cloisters, where learning and contemplation were fostered. In static cultures, this system worked well.

With the great growth of populations during the Renaissance, and with the vast increase in travel, curiosity, and commerce, demand for the writings and opinions of others increased enormously. The printing press provided a method for the rapid mass production of literature, and developed amazingly in half a century. It has been estimated that over two million books (titles) were issued between 1460 and 1500. These became the chief means by which scholars exchanged facts and ideas. During the 16th century, books multiplied enormously, and provided the background for the rapid growth of verifiable information, which we call science, and for its effective application in industry and commerce.

By the 17th century, books were beginning to be too slow for the exchange of the new information now being so quickly obtained. Groups of scientists formed societies for the direct exchange of ideas and facts. The reports made at the meetings of such societies began to be printed in order to have a record of what transpired, and to give reference to what someone else had found previously, so that the process of verification could continue. Such societies rose in Italy, France, and England. The most influential was the Royal Society of London.

The lasting success of the Royal Society, and its prestige, was largely due to the devoted enthusiasm, skill, and persistence of one man, the Bremen linguistic theologian, Henry Oldenburg (1617-1677). Coming to London in 1653, he quickly became acquainted with the English intellectual leaders, and met with the Oxford Scientific Group. Travelling over Europe from 1657 to 1661, he became personally acquainted with those engaging in scientific experimentation and in philosophical and medical ideas, and continued a voluminous correspondence with them. When the Royal Society of London was organized, he became its secretary, keeping its records and editing the first 12 volumes of its *Philosophical Transactions*, from 1664 until his death in 1677. By persuading his European friends to send him letters telling about their current work, he invented the scientific report as a method of transmitting scientific information. Simply omitting the usual salutation and closing from the letters, he had his articles ready for printing in the great *Philosophical Transactions of the Royal Society*. This was the first primary journal for science, and it set the pace for all that followed.

Various scientific society transactions and proceedings developed during the 18th century. These were sent to members and gradually were exchanged with similar publications of similar organizations, and libraries for the storage of these volumes became part of the society development. Gradually, the universities and colleges collected such publications for the use of their professors and students. Most major cities of Europe and America had scientific academies which fostered meetings and publications for the exchange and preservation of scientific information.

Specialty journals relating to specific aspects of science began to appear in the 19th century, starting with physics and chemistry, and often associated with pharmacy or medicine. Soon specialty journals in many phases of science appeared in connection with speci l groups of scientists with similar special interests. These proliferated logarithmically during the 20th century. Now their very numbers threaten to overwhelm us, so that we cannot any longer effectively either abstract, index, or review them. Primary journals seem about to collapse under their sheer weight.

CURRENT TYPES OF SCIENTIFIC REPORTING

There are currently five types of scientific reporting. These are: (1) primary journals, such as the great *Journal*

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of the American Chemical Society; (2) periodicals for abstracts of articles in primary journals, such as the huge *Chemical Abstracts*; (3) relatively infrequent periodicals containing reviews of bits of information from primary journals; (4) monographs, combining reviews of the specific subject, often with original new information, and (5) textbooks, including encyclopedic compendia. Chemical literature is replete with excellent examples of each type.

The purposes of these five kinds of scientific reporting vary greatly, and the differences are reflected in the conventional ways in which each type has developed. The pattern for each is now so firmly fixed as almost to be canonic.

Because of the tremendous pressure for space in primary journals, the pattern of reporting has become telegraphic, with such a proliferation of alphabetical abbreviations for chemical names and often concepts as to confuse experts and frighten novices. Further, this pressure results in each report tending more and more to deal with a single bit of information. This aids in abstracting and indexing, but makes a shambles of trying to get the bits together, as in a review of a rapidly developing field. Further, this tendency toward making each article in a primary journal deal with a single bit of new information results in unexpected waste of space in duplicating methods and discussion, when other articles on related bits of new work are reported by the same investigators. The method is a good one for building huge bibliographies of variations on the same theme.

The major purpose of primary journals is to give prompt publication to new bits of information in various special fields. Short reports are essential in order to save space for the flood of such articles, and also to make it easier to assimilate the bit of new information offered. Various less formal methods of reporting are growing in popularity, such as "Letters to the Editor." These do save time and space, but the lack of formality often raises questions about reliability, or reproducibility.

Abstract journals exist for the rapid dissemination of a wide variety of bit information. Even though the various bits that may be substantively related are grouped together, the bits remain separate, like the parts of a huge jig-saw puzzle. Elaborate indices help in locating articles. A conscientious scientist feels that the original article should be consulted, and here indices do help. Then what good is the abstract?

Once, not too long ago, it was possible for a chemist to get every issue of *Chemical Abstracts*, and perhaps get much therefrom. Now only great libraries can afford the whole series, and these are increasingly difficult to scan. Specialization again narrows vision, and cross-fertilization, once a great stimulus to scientific effort, only occurs occasionally, by chance. Abstract journals are threatened, like the primary journals on which they depend, with collapse from sheer size. Even automation breaks down in the midst of the flood, and merely results in increasing the load that is already undigestible.

Review journals are growing in number and importance, for they fill a real need. For young scientists, they afford the best way in which to become acquainted with the concepts and data in special fields of interest. For older scientists, they give the best opportunity to keep abreast of what goes on. If reviews are critical and well written, they still offer some chance at cross-fertilization. If the references are carefully gathered, there comes from the review a gradual recognition of the primary journal articles that are lastingly worthwhile.

The preparation of worthy reviews is a tough task, and requires well-trained scientific judgment and skill in detecting trends and developing concepts. This is a worthwhile scientific career in itself, and deserves the full rewards usually afforded only to bench scientists. Library scientists are increasingly needed, and ways of training and rewarding them are long over-due.

Monographs are usually extended reviews, and are often written by teams of experts. Often they contain much new scientific information, not hitherto put out bit by bit in primary journals. They thus spare much space in primary journals. Yet they suffer often by neglect in abstract journals and in indices. When they are well done, however, they quickly become classics in their respective fields, and are referred to repeatedly by workers in those fields. Further, they have the psychological advantage of permitting more leisurely and reflective study than is afforded by the many distracting articles, either in primary journals or abstract journals. Monographs and review articles, if well done, may be taken as covering the particular subject up to the date of publication. What, then, to do with the huge volume of primary journals and abstracts preceding them? This problem is a terrifyingly real one for modern scientific libraries.

Textbooks and encyclopedic compilations may be considered extended monographs or reviews. They tend, however, to become either dogmatic, in an effort to save space, or voluminous in an effort to justify opinion. Either way, they are usually out-of-date on publication. Since they rarely have the opportunity for annual revision, they are really not as useful for beginning scientists as well prepared and delivered lectures, which can be brought up-to-date rapidly—that is, if the lecturer is really keen and conscientious.

Thus, there are many difficulties in our effort to work out satisfactory methods of scientific reporting and communication, whether in primary journals, abstract journals, reviews, monographs, or texts. Perhaps these difficulties are the reasons for the increasing popularity of scientific meetings and conferences, in which there is a chance for direct personal interchange of scientific information and concepts, with possibly the thrill of synthesizing a wholly new approach. It is interesting that among a few truly dedicated scientists the interchange of ideas and facts takes place, as in the early days of the Royal Society, by letter, phone, or personal visit. Yet the record of such interchange, if it is meaningful, must then go the way of primary journal, abstract, index, review, monograph, and text.

IN PROSPECT

The current problem of primary journals is sheer size, multiplying exponentially, expanding so rapidly that scientific libraries cannot provide space rapidly enough to keep the shelves from collapsing, that abstracting services cannot handle the load without intellectual chaos, and that frustrated scientists often cannot find the bit of information that they want, or if they do find it, tell what its relation may be to other bits of information, verified or not.

The bluntly spoken but sharp question is: can primary journals continue effectively to serve to alert scientists, even in a specialty field? It seems as though the answer is turning negative, because of the incomprehensible number of reports waiting to appear in such journals, even with the slightly ridiculous multiplication of specialty journals.

The many proliferating specialty journals pose an unpleasant prospect. This is the danger of specialty bias, dogma, or orthodoxy, resulting from the near impossibility of noting ideas, techniques, or data from another special field which might be well applied in the specialty under consideration. Often this orthodoxy can result from the all-too-human trait of editors and referees of thinking of themselves as final authorities in their respective specialties, and being biased against any idea with which they may not be familiar, or which they may not have discussed over cocktails or lunch. Geographic separation plays a big role in creating dogma.

What ways are there by which we can get out of the mess we are now in? Many scientific journals compound the problem by running "Letters to the Editor," which are simply more bits of information or data, often not verifiable, and difficult to abstract, index, or review. Can conferences and their proceedings help? Perhaps, depending on the way the conference discussions are reported. They can result in excellent monographs. On the other hand, they can be very frustrating through poor organization of material or poor editing, and they are difficult to abstract, index, or review.

The big scientific meetings generate an enormous amount of reporting, much of which finds its way into primary journals, as in the case of the American Chemical Society, the American Medical Association, and the Federation of American Societies for Experimental Biology. A lot of the reporting at these meetings is repetitious of something already reported elsewhere. The Federation sessions are simply overwhelming. What can a young scientist do at one of the huge Federation meetings, when confronted with a program of 4000 reports, all of which are already in abstract? What an editorial feat it is to arrange these, program them, index them, print, and distribute them in about 60 working days! Then most of them go to primary journals, and are abstracted over again, some of them finally being worth bringing together in a review. Somewhere in all of this, there is vast waste of people-power, time, and intellect.

Are there adequate alternatives to primary journals? As yet we do not know, for we are still experimenting. We have the technical capacity to handle a primary scientific report at central depositories by microfilm or card, to index it fully, to retrieve it promptly, and to deliver it by closed TV or teletype to whomsoever wishes to use it. Consider what the great interlocking reservation systems are for major air-lines, with amazingly quick print-out of complicated individual reservations for long and complex journeys.

Can private enterprise undertake such information and communication service for busy scientists? The answer could be yes, if our great scientific societies would work together toward this end, and if scientific laboratories, whether in universities, institutes, or industry, would pool their resources for such a purpose. The Bell Telephone System could do it. But would government stay out? Or would scientists rather have government handle it? Then, how about the international aspects of essential scientific service, if the welfare of people and their environments everywhere is to benefit?

Russia, of course, handles the scientific communication problem by efficient public service, without extensive gadgetry, but with huge numbers of people. Advantage is taken there of the big revolution that is occurring in our reading habits: the printed page goes out, as TV floods in. Even with the transitory character of TV, the scientific record can still be kept in central repositories to be retrieved when needed.

Libraries, whether university, industry, or institute, could well undertake the microfilming or microcarding of scientific publications, with great saving of expensive space. One of the most effective examples I have seen of this development is in the relatively small but very efficient library of the Philadelphia College of Pharmacy and Science. Here, faced with the necessity of spending many hundreds of thousands of dollars for a new library building, it was decided to microfilm the back-files of some 1500 complete sets, and microfilm all journals as they would come in. Using student help, this was accomplished for some $30,000, with all the primary journals in drawers in a cabinet occupying about 30 feet of wall space. Staff and students quickly learned to use the big viewers, which can print out separate sheets which may be wanted for reference. Some 15 of these serve the institutional community of about 1500. The library itself has the standard reference works, and monographs, in the usual way. Anyone who has visited the great Lenin Library in Moscow will recall the huge reading room for all the functional biological sciences from virologies to ecologies, with its mezzanine holding 36 large viewers, with all biological primary journals on microfilm in cabinets along the walls, each easily found and readily accesible.

Primary sources for new scientific information will always be necessary, if science is to continue to serve us. Whether primary journals can continue to serve this need is becoming increasingly doubtful. Economic factors play a role, as big science publishing concerns realize: every budding science library needs back files of primary journals, and must keep up with the new ones. Maybe scientific societies should assume responsibility for the effective exchange of scientific information among scientists, and take away the profit motive in such exchange, even for themselves. Maybe only the resources of great national governments can do the job, and then will they co-operate to keep science international? Primary scientific journals do pose many tough problems these days. What solutions evolve will depend on their survival value in a world where survival is increasingly precarious.