Primary Journals Today and Tomorrow†

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Received August 12, 1985

This paper analyzes the paths of information flow among the various components associated with the traditional, printed scientific journal. Time delays are found in many of the interactions and contribute to overall slowness of the present system. Current computer-based advances are identified for many system components, and the way in which these advances might collectively provide the basis for a truly electronic publishing system is explored briefly.

INTRODUCTION

Technological developments and opportunities are currently providing the framework for a potentially quite different flow of communications from that which has traditionally been associated with the printed journal. The primary journal system has remained virtually unchanged for many years; however, elements of the process have— and are in the midst of—undergoing change. It is the contention of this paper that the present traditional system will continue unaltered in overall outline for at least another 10 years. The individual components within the system, however, will continue to undergo changes until—at some point—they could potentially support a system of communication very different in character from that of today.

COMPONENTS OF THE PRIMARY JOURNAL SYSTEM

The basic purpose of the primary journal system is to transmit scientists' (authors') research findings to interested subscribers and readers and the scientific community at large,[1] via an accessible and comprehensible medium. Figure 1 presents a simplified view of the components in the primary journal system that include the author, editor, reviewer(s), copy/production editing, compositor/printer, fulfillment system, postal service, and subscriber/user. No attempt is made in Figure 1 to show the direction of information flows or interactions.

In the traditional mode, a paper manuscript moves—generally within the mail system—among authors, editors, and reviewers until a revised paper version of the manuscript is accepted and sent for editing, typesetting, printing, and distribution to the subscriber/user.

The components collectively provide a number of benefits that make the traditional printed journal system a respected and valued pillar of science. Peer review, as practiced by all "good" journals, tends to ensure excellent quality control, and professional-level editing leads to readability, consistency of units, and nomenclature clarity. Wide distribution at an affordable price via a reasonably durable medium (i.e., print on paper) makes the journal a tangible, assured, accessible archive of good quality. However, the system is also slow because the components shown in Figure 1 are typically at separate physical locations. The operation and flow of the primary journal system rely heavily on the efficiency of the U.S. postal service and, in the case of authors and readers worldwide, on the variable degrees of competence of the world's national post offices, international ships, and air freight services.

INFORMATION FLOW IN THE SYSTEM

Figure 2 suggests how the information contained in the typical manuscript flows—generally by mail—among the components of the primary journal system. As the arrows indicate, the information moves back and forth many times between the author, editor, reviewer(s), copy/production editors, compositor/printer, etc. before it is finally published in a journal and mailed to the subscriber/user—if, of course, it is not rejected by the journal at an earlier stage.

Table I. Speed (or Lack of It) in the System (Ranges for ACS Journals)

fastest journals	9–10 weeks receipt to acceptance
slowest journals	30–40 weeks receipt to acceptance
fastest journals	10–20 weeks acceptance to publication
slowest journals (those with backlogs)	30–40 weeks acceptance to publication

Needless to say, it takes several weeks at a minimum for a manuscript to appear in a primary journal. The number of weeks before a manuscript is published in a primary journal is illustrated in Table I, which contains ranges for journals of the American Chemical Society.

The fastest speeds are recorded by those journals that consciously accelerate the peer review process and that can publish a paper shortly after a galley proof has been returned. The *Journal of the American Chemical Society*'s Communications to the Editor are an example. The slowest speeds show up on journals where the logistics of the review process require multiple movements of manuscripts among editorial offices and where page budgets are insufficient to accommodate the rate of acceptance, with the consequent development of backlogs.

The primary journal system is, in addition to being slow, expensive to operate. Particularly because of the expense—and to some extent because of the speed—publishers have sought to increase the production efficiency and decrease the cost of those components of the system under their control. Most of the "players" in the present system are agents of the publisher—either employed by the publisher or acting for him—except authors, reviewers, and subscribers/users, and publishers have naturally put cost-control emphasis on their controllable agents.[2]

COMPUTER SUPPORT IN THE SYSTEM

Recent trends, still within the confines of the traditional system, have been to attack costs of those elements under the control of the publisher by using computer-assisted methods. The computer has become very evident in publishing areas such as fulfillment, record keeping of subscribers' names and addresses, composition systems, marketing information, peer review and word processing systems in editorial offices, and online correction methods in copy editing offices. Figure 3 characterizes the components within the primary journal system as "uncommon or lacking", "increasing availability", or "commonly present" with respect to computer support.

There is increasing availability of computers among authors, editors, reviewers, copy/production editors, and subscribers/users, and most compositors/printers and fulfillment

† Presented in part before the Division of Chemical Information, 189th National Meeting of the American Chemical Society, Miami Beach, FL, April 29, 1985.

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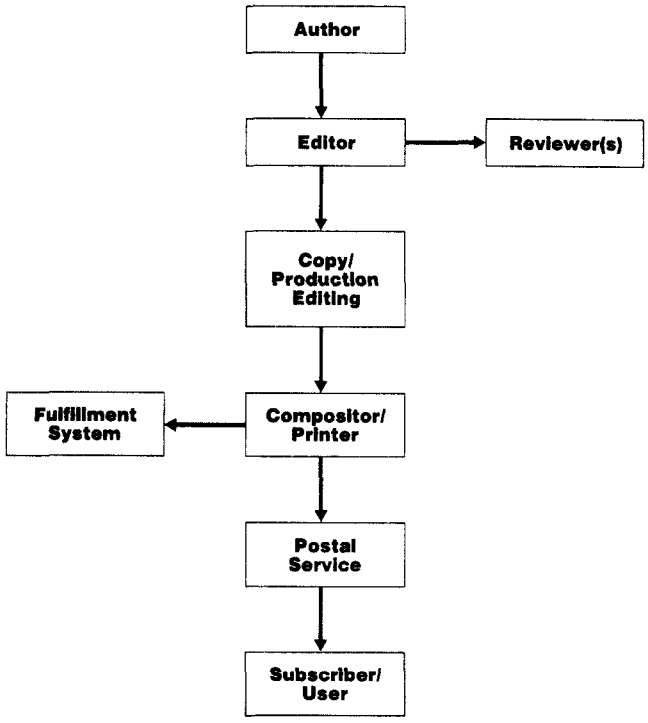

Figure 1. Simplified view of components in primary journal system.

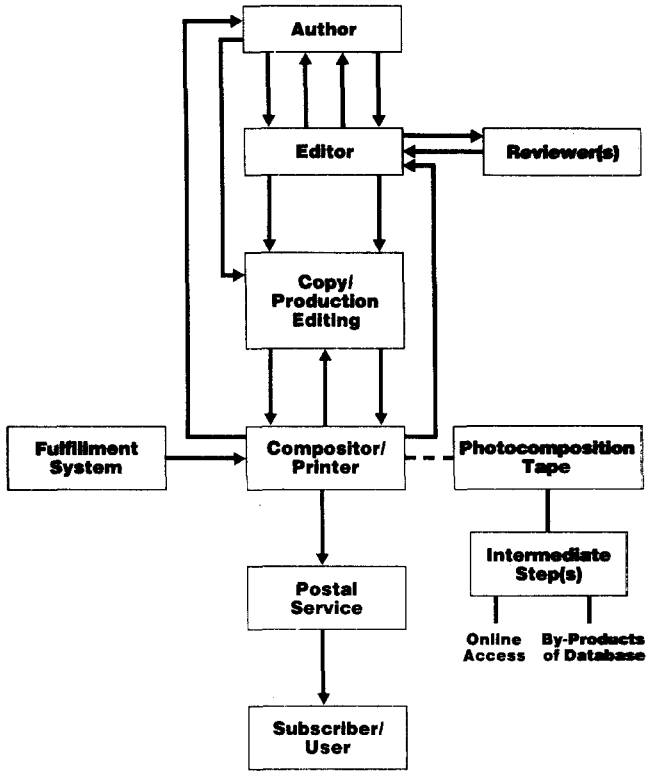

Figure 2. Information (manuscript) flow among components of the primary journal system.

systems currently are fully computer supported. The postal service, too, has started to use computers to speed up the mail. However, the postal system is still logistically dependent on a complicated and discontinuous chain of mostly land-based transportation methods. It remains as one of the most obvious, rate-controlling steps in the entire journal publication process.

Increasing availability of computer support permits many cost- and time-saving features to enter editorial offices; examples are word processing, database support to manage the logistics of manuscript handling, categorization of reviewers (their specialties and addresses), automatic letter and report

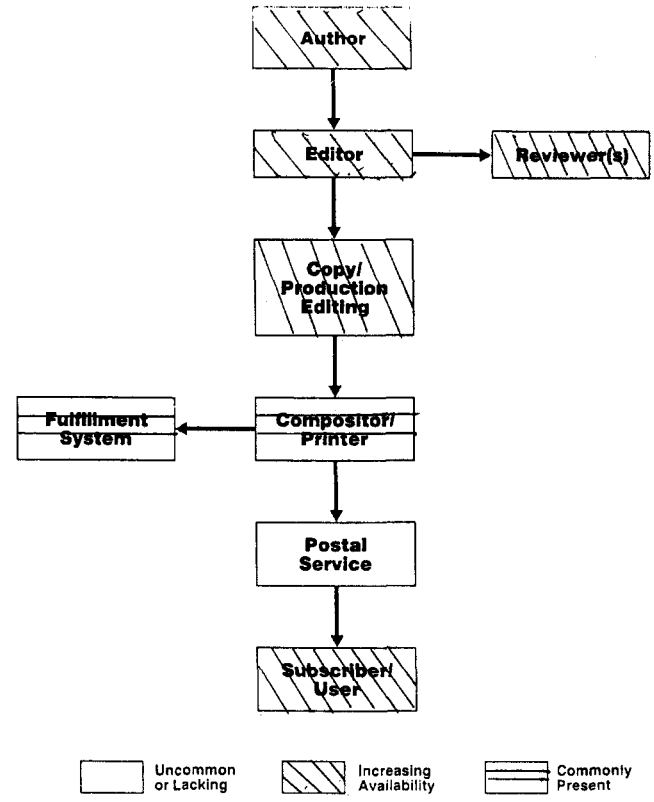

Figure 3. Current levels of computer support in components of primary journal system.

generation, and basic record keeping.[3] Computer support in the copy/production editing office provides logistical support, record keeping, online correction, electronic mail to and from remote editorial offices, and in some cases direct transmission of manuscripts to the compositors.

An American Chemical Society research and development study in 1984 showed that 75% of the authors who submit manuscripts to ACS journals use some type of word processing equipment for manuscript preparation. Needless to say, the question has arisen as to why most publishers are therefore not asking authors to submit more manuscripts in computer-readable form. The basic reasons are simple: (1) the lack of compatibility of computer systems; (2) the absence of an effective way to handle nontext such as figures, graphs, tables, and half-tones. Currently, it is usually less costly for publishers to reinput these items at the precomposition stage. Author input in electronic form will become more common when the basic technical and cost problems are solved. The Association of American Publishers is compiling stands and guidelines for the handling of electronic manuscripts. Submission of manuscripts in computer-readable form will undoubtedly become more widely used in the future because of a savings of both time and money to the publisher.[4]

To summarize Figure 3, all components of the primary journal system are becoming increasingly able to communicate within their own confines and for their own limited purposes. All components are moving toward a situation in which they will communicate with each other electronically.

CHANGES IN THE FUTURE

What changes are in store for the primary journal system in the next few years? Each component will probably enjoy more, and increasingly sophisticated, computer support; and each will perform its own function in the overall system more reliably and efficiently. However, as long as the interaction among the components of the system remains wedded to the mail system, there will continue to be built-in limits to the

general speed of the process. There will coexist (with the paper journal) electronic byproducts of the composition system, such as online full text[4] and volumes on CD-ROM disk, which will be increasingly available to the more sophisticated computer-supported user. But the overall system will continue to look much as it does today, while the final product—the printed journal—is to all outward appearances identical with that of a half-century ago.

Suppose, however, that (1) cost-effective technology becomes widely available for digitizing graphics and half-tones and for printing out completely legible, aesthetically pleasing full pages from digitized files, (2) telecommunication costs drop substantially, because of competition and increased carrying capacity, to the point that it becomes actually *less* expensive to telecommunicate the content of the manuscript than to mail a paper copy, and (3) coding and compatibility problems are resolved.

In such a scenario, conditions would be in place for (1) authors to telecommunicate manuscripts to editors, (2) editors to transmit copy electronically to reviewers, (3) reviewers to send comments on manuscripts to editors by electronic mail, (4) editors to telecommunicate manuscripts to copy editorss, and (5) copy editors to edit online and transmit the manuscript to the printer—with no more inputting necessary. Under these circumstances, the existing system would become both less expensive and quicker, with information moving at electronic speed rather than with the gait of the mailman. At the same time, however, one must recognize that conditions would then exist for a parallel—and conceivably competitive—system, in which authors could post their manuscripts on an electronic bulletin board from which anyone with valid access could read or print out a copy.

It seems certain that these technology advances will eventually occur. Some of them have already occurred. But certain questions will need to be answered first before one can confidently predict that an all-electronic primary journal system will (or should) supplant the "mail and paper" system. How will the quality-control function be exercised? How will the archive's permanence be guaranteed? Will such a system conform to the sociological needs of the scientific author?

The author's personal response to these questions is that he has been for many years a publisher of print journals; as such, it is constitutionally difficult for him to envisage a system that does not center on the print journal. Possibly, the main compulsion to think in this fashion is the difficulty he has conceiving of an electronic archive that has the obvious and imposing permanence of a shelf full of bound volumes of JACS! The main attraction of the present, paper-based system is linked to an author's unshakeable conviction that his written ideas leave a legacy in ink that the centuries will not erase. This author, for one, does not believe that sheer ease of transmission of ideas will, in practice, override his subconscious fears of leaving his creative legacy in an archive that head crashes or warped disks could render nonexistent in a picosecond! On the other hand, attitudes toward the electronic handling of information are changing so rapidly that any predictions seem, by the very nature of the subject matter, to be speculative and unlikely to be accurate. The next 10 years will, without doubt, provide strong clues to the real answers.

REFERENCES AND NOTES

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Scientometrics with Some Emphasis on Communication at Scientific Meetings and Through the "Invisible College"†

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Received August 12, 1985

Scientometrics uses quantitative methods to investigate science as an information process. Studies were made of attendance and speakers at several scientific meeting series. Data from these and other investigations lead to the conclusion that "invisible colleges" exist within science and that advancement is often through interactions within these informal organizations. Studies have also been made of what happens to oral presentations (are they eventually published?) and how journals communicate with other journals. Such investigations aid in understanding the communication process in science.

Science is an information process, developing with time. As such, it can be investigated quantitatively. The term scientometrics was introduced in 1969 by V. Nalimov[1] to stand for those quantitative methods that deal with the investigation of science viewed as an information process. Such studies had been made, of course, for many years before 1969, but the development of computers and computer techniques has made possible rapid search and research that in the past would have taken years to complete. Garfield seized the opportunity provided by computer information processing to found ISI and use of his *Citation Indexes* and complementary publications is now almost de rigueur for any scientometric study. Terms such as citation rate, impact factor, and immediacy index probably coined and certainly popularized by Garfield have become a part of scientometric jargon even as bit, byte, boot, and Basic have come into the literature through the computer terminal.

Whole volumes can be and have been written on scientometric methods; one of the best and most recent is by Braun, and Bujdoso.[2] Scientometrics has its own journal called, not suprisingly, *Scientometrics*, and scientometric papers have appeared in numerous journals including such disparate

† Presented before the Division of Chemical Information, 189th National Meeting of the American Chemical Society, Miami Beach, FL, April 19, 1985. Research was sponsored by the Office of Energy Research, U.S. Department of Energy, under Contract DE-AC05-840R21400 with Martin Marietta Energy Systems, Inc.

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