The Future of Scientific Journals

A computer-based system will enable a subscriber to receive a personalized stream of papers.

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Surveys of, and complaints about, the information explosion and inundation of the reader are common. While it fits the temper of the times either to join the wailers at the wall or to say that nothing is wrong, the first course is ineffectual and the second ignores the facts.

Mindful of the saying that people always complain about the weather but never do anything about it, we have decided that what is called for is not complaint, but analysis and action. By proposing specific action in the restricted field of scientific journals, we have attempted to make our criticisms and comments clear and to the point.

Scientific journals provide a system for formal, public, and orderly communication among scientists. By *formal* we mean that papers which have appeared in journals can be cited and retrieved unambiguously. By *public* we mean that journals are available to anyone in libraries or by subscription, and that anyone can submit a paper. By *orderly* (*1*) we mean that the inputs are accepted or rejected by the scientific community itself on the basis of merit. We believe that such a system is and will remain vital to the scientific community.

At present, however, scientific journals are threatened by competition both from preprint-exchange systems, which are public but not formal or orderly, and from "invisible colleges" (*2*, chap. 3), which are formal and orderly but not public. The union of these competitors is neither formal nor public nor orderly, and must not be allowed to replace the journals.

Yet there are many real problems associated with communication by way of published papers. Some, such as the ever-increasing volume of literature, are inevitable consequences of the growth of science. Others, such as premature publication and inadequate refereeing, spring directly from frailties of human nature. If we are to make any significant progress, it is important that we avoid quixotic forays against problems of these kinds and concentrate our energies on achievable objectives.

We propose a change in the form of journal distribution, made possible by the advent of large high-speed computers. We believe that this change would offer immediate benefits to readers, authors, and publishers, that it will be adopted by most leading journals during the next few decades, and that the long-range effects will be profound and far-reaching.

We propose that journals stop binding papers into issues and, instead, distribute to each subscriber a stream of papers, abstracts, and titles specially selected to meet his personal and perhaps frequently changing desires. This scheme would certainly not enable a scientist to read all the papers which might be of use to him, but it would permit him to spend his reading time more efficiently than he now does, and to maintain his personal files more effectively. Moreover, the probability of his overlooking or quickly forgetting an important paper would decline substantially.

Here we digress slightly in order to avoid possible misunderstanding. It would of course be possible to request *all* papers accepted by a journal, and it seems likely that many libraries and some individuals would do so. Also, libraries would bind the papers into volumes according to the present system. We recognize, too, that some journals are intended primarily for browsing and must be bound into issues in order to fulfill that role. Such journals might *also* distribute individual papers to those who desire them. Subscribing to individual papers from such journals would be analogous to subscribing to a newspaper clipping service.

The description of a paper should be a list, provided by the author, of the categories of readers to whom the paper should be sent. We consider the following propositions to be fundamental.

1) Descriptions, by subject, of papers and of readers' interests should be based on a simple hierarchical vocabulary, tailored to the interests of the professional society or other community which the journal serves.

2) The description of a paper should be a list, provided by the author, of the categories of readers to whom the paper should be sent. We refer to such a description as a "distribution list." Although many authors consider indexing a tedious and unrewarding chore, most will view distribution as a matter of immediate personal interest.

3) Authors' distribution lists should be reviewed by the referees, and also, if possible, by a member of the editorial staff of the journal in question.

4) The description of a reader's interests should be a list, provided by the reader, of the categories of papers he wishes to receive. We refer to such a description as a "request list."

5) A reader should be permitted to revise his request list whenever he wishes. When he does so, he should receive an acknowledgment showing the revised list. In any case, he should be reminded at regular intervals of his current request list and of the means for changing it.

Our proposal is based on the Mercury system (described below) for selectively distributing internal technical reports at Bell Telephone Laboratories. Our proposed system differs from the IBM system (*3*) and the Ames Laboratory system (*4*) in that, in our system, readers and authors belong to a community of shared interests, and the collection of papers can be viewed and treated as a journal.

Much of our proposal was anticipated in 1948 by J. D. Bernal (*5*), who also advocated a distribution system organized around the journals. However, he apparently failed to recognize the difficulty of the selection process, and,

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furthermore, no such system would be viable without the aid of a large high-speed computer.

In the remainder of this article we survey the problems of the journals from various viewpoints, examine the proposed system in more detail, and discuss the operation of the Mercury system.

Too Much and Not Good Enough

The most common complaints about the current literature can be summarized by the phrase "too much and not good enough." It is said that too many papers are written, too few are well written, and too few contain anything new and significant. Many of the complainers imagine that they are describing a new condition, but in fact such sentiments have been heard regularly for more than three and a half centuries. Price (*2*, p. 63) quotes Barnaby Rich as saying in 1613,

> One of the diseases of this age is the multiplicity of books; they doth so overcharge the world that it is not able to digest the abundance of idle matter that is every day hatched and brought forth into the world.

Let us consider the fate of a typical scientist. In choosing a specialty he will surely define his interests narrowly enough so that he can keep up with the literature in some sense. As time goes by his specialty grows, along with the rest of science, so that, after about 15 years (*2*, chap. 1), the number of papers published yearly in his field will have doubled. The most obvious sign of this growth will be pressure to spend more and more time reading and refereeing. If he yields to the pressure, he will inevitably have less and less time left for creative work. His alternatives are to lower his standards of keeping up or to narrow the scope of his activities. Whatever he does, the growth of science will continue, and any relief will be short-lived. Under such circumstances it is only natural to complain.

Our typical scientist's belief that these problems are of recent origin clearly arises from the fact that he did not observe them until several years after he became active. And his belief that too many papers are written can be dismissed as a naive reaction to an unpleasant but unavoidable situation. However, his complaint that most papers are poorly written or contain nothing new derives from several sources which are not immediately evident. First, he may use his own papers as a standard of comparison, and they certainly are clear (to him) and contain ideas that are new (to him and his immediate coworkers). Second, when he narrows his interests, in response to the growth of science, he does not do so deliberately. Instead, he discovers that he has done so when he notices that he is no longer able to read all the papers in what used to be his field. The process of discovery is of course painful, and he is likely to blame the papers whenever possible in order to postpone it. Finally, the growth of science inevitably causes a gradual decline in the proportion of outstanding papers since the total number of scientists (relative to a constant minimum standard) goes up more or less as the square of the number of outstanding ones (*2*, chap. 2). It follows that papers are, on the average, less well written and less significant than they used to be, even though the minimum standards have not perceptibly changed. However, the decline is gradual and predictable, not sudden and alarming.

It is often proposed that this decline should be halted or reversed by harsher refereeing. To attempt this would be both unwise and futile. The primary function of the refereeing system is improvement, not censorship. There are of course some papers which cannot be sufficiently improved to merit publication and must therefore be rejected. Nevertheless, to quote Pasternack (*1*), who has been an editor of *The Physical Review* since 1956,

> The value of [responsible] refereeing lies far less in the yes-or-no judgment of the overall paper than in the service rendered by pointing out flaws that would bother or mislead most other readers. These flaws include misleading claims, omitted details, ambiguous statements, minor errors in the argument, overlooked pertinent references, unrealized implicit assumptions, unrecognized limitations to the conclusions, obscurity, and discursiveness.

It is important to realize that science is a spontaneously growing system, and that society continues to support and profit from its growth. To prevent the publication of large numbers of papers would, in effect, be to deny this growth. Therefore any attempt to do so would result in the birth of new journals, which would of course compete for the best papers as well as the worst.

Too Little and Too Late

Besides the cries of "too much and not good enough" we sometimes hear a nearly opposite complaint—"too little and too late." As a consequence of the explosive growth of science there have arisen a number of fiercely active and competitive specialties in which the workers live in constant fear of being scooped. In such fields every idea or experimental result must be published as soon as it is born, and there is a powerful urge to be aware of all that is written as soon as it is written. In some cases unrefereed documents, euphemistically called "preprints," are distributed to individuals on large semi-public mailing lists, and perhaps never even submitted to journals. In amplified form, the complaint of "too little and too late" is that too few of the important papers are published in journals, and that many of those published are obsolete before they appear.

In an attempt to cope with this problem, the National Institutes of Health established several experimental information-exchange groups (*6*). These public preprint-exchange systems proved to be extremely controversial (*7*) and will not be continued (*8*). A similar proposal (*9*) for the field of high-energy physics is currently being debated (*10*).

The main objection to public preprint-exchange systems is that they threaten formal and orderly communication by way of scientific journals. While agreeing that the threat is real, we believe that the problem of "too little and too late" is also real and requires some response. Furthermore, we believe that the journals themselves can and should provide the required response, and that by doing so they can minimize the dangers.

Specifically, we propose that the journals in highly competitive fields distribute preprints (submitted papers whose authors request distribution in advance of refereeing) to those readers who prefer not to wait for refereeing. A typical reader might elect to receive all papers in one or two narrow subjects and only accepted papers in several other subjects. Each paper could be assigned a paper number and a series of draft numbers. A reference by paper number alone would automatically lead to the latest draft. Some libraries would keep accepted papers only. Others would also keep final drafts of rejected or withdrawn papers, and at least one would keep all drafts of all

papers. Such a system would be formal as well as public, and would offer the reader an explicit choice between orderliness on the one hand and completeness and speed on the other.

The Reader's Viewpoint

Having established that "too much and not good enough" and "too little and too late" are merely inevitable side effects of the growth of science, we are now ready to take a realistic look at the problems of scientific journals from the reader's viewpoint.

Every scientist must divide his time, which is probably his scarcest resource, between the reading of current papers and many other important activities. During his reading time he will attempt to deepen his knowledge of his own field, add to his understanding of its connections with related fields, broaden his appreciation of the arts and sciences as a whole, and keep informed on who is doing what.

These objectives require that he consider papers from many sources, and for each paper that he considers he must spend a part of his reading time deciding whether to study, read, skim, or ignore it, and then whether to file or discard it. If the number of papers he considers is too large relative to the number he reads, then these decisions become burdensome and his reading effectiveness declines. On the other hand, if the number of papers he considers is too small relative to the number written, he risks being seriously uninformed.

It is often suggested that the solution to this dilemma is for journals to send only titles or abstracts to their subscribers, who would then order copies of the papers they really want. This suggestion is apparently based on the belief that one can quickly and reliably reject unwanted papers by reading their titles or their abstracts. In fact, however, it takes little, if any, longer to reject the paper itself, and the process is far more reliable and interesting. If the subscriber has the complete papers at hand, he can skim the cream from those of marginal value to him in less time than it would take him to read their abstracts and order them, and he can read papers of definite value immediately, without further delay.

Titles and abstracts are useful, however, for at least two purposes—for keeping informed on who is doing what, and for building up a file on current literature in relevant fields.

Suppose it were possible to select for a given reader those papers, abstracts, and titles that he really should receive during a given month, in the light of his interests, his background, and the amount of time he can allocate to reading. Then, ideally, those items and no others should be sent him, and accompanying each should be a brief explanation of why it was sent.

Let A be the set of papers, abstracts, or titles which a reader really should receive (as defined above) during a given month, and let B be the set which he actually does receive. We now define the "coverage of B" as the fraction of A which B includes, and the "relevance of B" as the fraction of B which A includes. The coverage tells the fraction of "good" items that are received, and the relevance tells the fraction of received items that are "good."

If the relevance for a reader is low, then too much of his reading time is squandered on decisions. On the other hand, if the coverage is low, then he will miss many of the most valuable papers and waste his precious reading time on less valuable ones.

It is easy to improve relevance at the expense of coverage by rejecting the least valuable sources, and, conversely, it is easy to improve coverage at the expense of relevance by including more sources. It is difficult to increase the product of relevance and coverage, which we call "quality."

In order to improve the quality of the stream of papers, abstracts, and titles which he receives, a reader must have more flexible means of influencing the stream than he now has. Our proposal for a new form of journal distribution is designed to provide these means.

The Author's Viewpoint

For an author, publication provides the opportunity to stake a claim, to influence others, and possibly to achieve immortality.

In the eyes of an author, referees are harsh and incompetent, journals are inexcusably slow to publish, and other scientists rediscover and republish his results as their own instead of reading and citing his papers.

The referee's apparent harshness often stems from the fact that the paper in question is so written that its message is clear only to the author, and the referee's apparent incompetence, from the fact that he failed to get the message.

The slowness of journals to publish is in part due to their financial problems, which in many cases prevent them from growing and modernizing in response to the ever-increasing load, and in part due to the time which is inevitably required for refereeing.

An author's complaint about other scientists who fail to read his papers and about the lax referees who allow them to republish his results as their own is simply the obverse of the readers' complaint about "too much and not good enough."

An author might very well complain (although few do) about the vast overdistribution that his papers receive when they are published. It is perfectly clear that few, if any, of the papers published in a typical journal are read by more than a tiny fraction of the subscribers, and that therefore any particular paper is sent to many more subscribers than are interested in it. It is this vast overdistribution of individual papers by the journals which results in low relevance for readers, and thereby makes it difficult for them to find the relatively few papers they really should read.

Let A be the set of people to whom a paper, abstract, or title really should be sent, and let B be the set of people to whom it is actually sent. We now define the "coverage of the distribution" as the fraction of A which B includes, and the "relevance of the distribution" as the fraction of B which A includes. The coverage tells the fraction of interested people who are reached. The relevance tells the fraction of reached people who are interested.

Evidently high relevance and high coverage in the distribution of papers, abstracts, and titles is of vital importance to authors, and our proposal for a new form of journal distribution is designed to achieve this.

The Publisher's Viewpoint

From the publisher's viewpoint, the publication of a professional journal is a service to the authors and readers, providing for them a means of com-

munication and a historical record. Although clearly necessary, it is often painful.

The main source of pain is the ever-increasing number of papers submitted yearly. If these are published promptly, there is a constant strain on the financial, physical, and human resources available to the publisher. If they are not, the delay between acceptance and publication grows, and both authors and readers become disgruntled.

Now a typical journal is intended to cover a particular, fairly well defined subject area. As science grows, the number of specialties, the number of scientists, and the number of papers per year within that subject area also grow, and of course the journal grows too. Unfortunately, the relevance of the journal to any particular subscriber decreases as its size increases. Eventually the journal must split into sections, as *The Physical Review* has recently done, or lose a growing share of its business (both authors and readers) to younger and more vigorous journals of narrower scope.

Besides the competition from narrower journals, a journal faces competition from preprint-exchange systems (both private and public) and from invisible colleges. All three forms of competition owe their success, if not their existence, to the failure of the journal to distribute promptly to its subscribers with high relevance and high coverage.

With present methods, a journal cannot achieve this. Our proposal for a new form of journal distribution is designed to make it attainable.

CIAP Applications
- CIAPED Editing
- CIAPGA Graphical Applications. Syn CIGPGA.
- CIAPIA Interactive Applications. Syn CIMMIA.
- CIAPIR Information Retrieval and Dissemination
- CIAPMA Management Aids
- CIAPRT Real Time Control
- CIAPSI Simulation

CIDS Documentation and Standards

CIGP Graphical Processing
- CIGPGA Graphical Applications. Syn CIAPGA.
- CIGPGS Graphical Software. Syn CISOGS
- CIGPGT Graphical Terminals. Syn CIHAGT, CIMMGT.

CIHA Hardware
- CIHAAE Analogue Equipment
- CIHACO Components
- CIHACP Control, Processing, Storage Units
- CIHAGT Graphical Terminals. Syn CIGPGT, CIMMGT.
- CIHANT Nongraphical Terminals. Syn (CIMMNT.)
- CIHASY Systems

CILP Languages and Their Processors. See also CISO.
- CILPAS Assembly
- CILPSC Scientific and Commercial
- CILPSL String and List Processing
- CILPSP Special Purpose

CIMA Machine Aids to Design
- CIMAID Interactive Design. See also CIAPIA, CIMMIA.
- CIMAMI Manufacturing Information
- CIMAPD Parametric Design

CIMM Man Machine Interaction
- CIMMGT Graphical Terminals. Syn CIGPGT, CIHAGT.
- CIMMIA Interactive Applications. Syn CIAPIA.
- CIMMIS Interactive Software. Syn CISOIS.
- CIMMNT Nongraphical Terminals. Syn CIHANT.

CISO Software. See also CILP.
- CISOFM File Maintenance
- CISOGS Graphical Software. Syn CIGPGS.
- CISOIS Interactive Software. Syn CIMMIS.
- CISOIT Information Transfer
- CISOMS Monitor Systems
- CISONM Numerical Mathematics. See also CISOSM.
- CISOSD Statistical and Data Analysis
- CISOSM Symbolic Mathematics. See also CISONM.

CITC Theory of Computing & Information
- CITCCD Computability and Decidability. Syn MALOCD.
- CITCTL Theory of Languages

Fig. 1. The Mercury Vocabulary of Computing and Information Sciences.

Overview of the Proposed System

Let us now consider the operation of the proposed system, its costs, and some of its effects. An author will submit his manuscript to the editor as he does at present except that he will send with it a distribution list, consisting of one, two, or perhaps three subject terms from the standard vocabulary. Similarly, a reader will submit his request list to the editor, to be entered into the system. He may request complete papers in some subjects, abstracts in others, and only titles in others.

The system may be so organized that a reader (i) receives papers and abstracts separately as they come out, or (ii) receives them in batches at regular intervals (perhaps monthly). In the first case, the computer will print a set of addressing labels for each paper or abstract. In the second case, the computer will print an addressing label and a list of papers and abstracts for each reader. In either case, the computer will print a list of titles for each reader at regular intervals.

Readers will be delighted by the vastly increased relevance of the material they receive, and they can be expected to subscribe to more journals in order to get better coverage as well. They will also find separately bound papers easier to file and to retrieve than complete issues.

Since large journals will have relevance equal to that of small ones and greater coverage, journals will tend to grow larger rather than more numerous.

Under the present system the cost of printing and distributing a paper in a high-circulation journal can be more than $50 per page. Because of an order-of-magnitude reduction in the number of copies that would be required, the proposed system would result in substantial savings in certain areas. In particular, the cost of paper and ink would be greatly reduced, and it might be possible to use less expensive methods of printing. Unfortunately, these savings might not offset the increased handling costs which would inevitably accompany any attempt to treat each reader, and each paper, on an individual basis.

We are convinced that the value, to readers and authors alike, of such individual treatment would far outweigh the cost. Under the present system, the costs are divided between authors, readers, and advertisers. (However, some journals do not charge their authors, some do not charge their readers, and some do not carry advertising.) Under the proposed system this kind of apportionment will continue. The size of an author's payment will depend not only on the number of pages in his paper but perhaps also on the number of subjects in his distribution list. The size of a reader's payment will depend on the number of subjects in his request list and on the options he chooses. Journals which carry advertising will, presumably, bind in a few ads with each individual paper. Advertisers, like authors, will use the standard vocabulary to achieve selective distribution, and the distribution of an ad, like the distribution of a paper, will have improved relevance and coverage.

Statistics about the interests of authors, readers, and advertisers will provide a motion picture of scientific activity, which will be of great value to those concerned with the education or financial support of scientists, or with the history, philosophy, or sociology of science.

At the heart of the proposed system is a standard vocabulary, in terms of which authors' distribution lists and readers' request lists are composed. To achieve distributions of high quality, it is necessary to make sure that most individuals use the same term to designate a given subject and always mean the same subject when they use a given term. This goal requires that the vocabulary be sufficiently small and well-structured to be comprehended as a whole. A thick directory containing many thousands of terms is not suited to the task. What is needed is a carefully structured hierarchical vocabulary of, at most, a few hundred terms.

The limitation to a few hundred terms is imposed also by another consideration. To fulfill its purpose, the vocabulary must represent a world view of the subject area covered by the jour-

MERCURY SERVICE
BELL TELEPHONE LABORATORIES, INCORPORATED
Author Distribution Form

(Please follow the instructions on the reverse side.)

Author(s) (Name, Location, Telephone, Organization):
H. I. Jackson, MH 2B-222, Ext. MH 4321, Dept. 1217

Document Title: An Algebraic Method in Differential Equations

MM No. 66-1217-3 Filing Case (5 digits only): 20878

☐ Check here if no cover sheet exists, as in the case of a one-page seminar announcement.

☒ Please mail the expanded distribution list to the first-named author.

☐ Please mail the expanded distribution list to

(Name)	(Location) (Telephone)
COMPLETE MEMORANDUM TO	COVER SHEET ONLY TO
MAALLA	CISOSM
MAANOD	Center 121
Department 1217	
K. L. McNeil - MH	

Fig. 2. Author distribution form.

nal—a view shared, or at least understood, by nearly all the members of the professional society (or other community) which the journal serves. If the vocabulary is very large, then the world view it presents is necessarily very detailed and controversial, and cannot be widely shared.

One might question whether a vocabulary of only a few hundred terms is large enough for our purposes. Such a small vocabulary would certainly not be adequate for cataloguing a large library or for distributing all of the current scientific literature. Fortunately, the problem of distributing papers within a professional society (or similar community) is much easier. A library user often seeks a few documents from a collection of perhaps a million. By contrast, a journal subscriber may want to receive 1 to 10 percent of the papers which the journal publishes. Since distribution of most papers will be based on subject terms at the narrowest level in the vocabulary, the number of papers per year distributed on the basis of any one term will be, at most, a small multiple of the ratio of papers-per-year to terms. The vocabulary needs only enough terms to keep this ratio from being too high.

Unfortunately, it is difficult to write a suitable vocabulary. The main problem is that the world view which the vocabulary presents must seem right not only to the generalists who see the field as a whole but also to the many specialists who see various portions of the field in intimate detail.

In constructing treelike classification systems such as the Dewey Decimal System, librarians have always been troubled by the one-place-on-the-shelf problem. Stated simply, the aim of such a system is to permit one, in principle, to arrange all of the books in the collection on a single very long shelf in such a way that the distance between books is an approximate measure of their dissimilarity, but the nature of knowledge is such that this is impossible. The impossibility becomes manifest when one tries to find a rational division of a subject into *disjoint* subsets. If the division is rational, the subsets always seem to overlap. Fortunately, the journal-distribution problem does not involve a shelf, real or conceptual, and therefore this problem can be evaded by abandoning the requirement that the subdivisions of a given subject be disjoint. Instead, any two subjects at a given level may overlap, and the overlap may manifest itself in a shared descendant at the next narrower level. For example, both physical chemistry and chemical physics might be subdivisions of both physics and chemistry.

For most retrieval purposes the distribution vocabulary will be too coarse. Therefore, journals will continue to publish indices, as at present, However, for some retrieval purposes, including the construction of bibliographies, the distribution vocabulary may be very suitable. In order to fulfill its primary purpose, this vocabulary will require periodic (perhaps annual) revision, reflecting changes in man's understanding. Since a search for a paper written in a given year will necessarily be based on that year's edition of the vocabulary, libraries will have to keep all editions, and users of an old edition will have to be aware of the world view which prevailed when that edition was compiled.

MERCURY SERVICE

BELL TELEPHONE LABORATORIES, INCORPORATED

Reader Request Form

(Please follow the instructions on the reverse side.)

☒ I am a new MERCURY Reader

☐ I am now a MERCURY reader and would like to

- ☐ Add the items shown below to my MERCURY interest profile.
- ☐ Delete the items shown below from my profile.
- ☐ Replace my previous MERCURY profile with this one.

Name: A. B. Smith

Location: MH 1A-111

Telephone: MH 1234

Organization: 1377

Option: Check here ☐ if you want to receive an extra cover sheet with each complete memorandum.

COMPLETE MEMORANDA FROM	COVER SHEETS ONLY FROM
CIGP*	MACO*
CIMM*	MAGE*
MAPRCG	MAPR*
CIMA	MA
CI	CI*
C. D. Jones – WH	Center 137
E. F. Johnson – MH	Case 54321
Department 1377	

Fig. 3. Reader request form.

Options

Once a reader has decided that he is interested in papers which pertain to a particular subject or set of subjects, there are a number of options he may wish to consider. Alternatively, he may want to select a set of options first and then list the subjects to which that set applies. In either case, different options can apply to different

subjects. The following list of possible options is intended to be suggestive, not exhaustive.

The "preprint option" permits a subscriber to receive both preprints and final papers in the given subject area, instead of final papers only.

The "abstracts-only option" permits a subscriber to receive only abstracts of papers in the given subject area. He can then order complete copies of any papers he wants.

The "titles-only option" permits a subscriber to receive only titles (cumulated periodically) of papers in the given subject area. He can then order abstracts or complete copies as desired.

The "panoramic option" applies only to subjects which are not at the narrowest level in the vocabulary. A paper distributed on the basis of such a subject term is supposed to cover the subject broadly and is not supposed to be included within any one or two of its subdivisions. The panoramic option permits a subscriber to receive only these broad papers. Otherwise he would also receive all papers distributed on the basis of narrower subject terms.

The "specified-author option" permits a subscriber to receive all papers written by a specified author.

The "specified-institution option" permits a subscriber to receive all papers written by authors from a specified institution.

Finally, the "citation option" permits a subscriber to receive all papers which cite a particular paper or a particular author.

Mercury

We next describe the Mercury system (*11*) for selectively distributing internal technical reports at Bell Telephone Laboratories. These reports collectively constitute a scientific journal in the sense that they provide a formal, public, and orderly means of communication *within the company*. Mercury embodies most of the features of our proposed distribution system for scientific journals, and might well serve as a prototype.

At present the Mercury vocabulary consists of three sections, one each for *Ma*thematics (MA), *P*sychology (PS), *C*omputing and *I*nformation Science (CI). Additional sections are planned. Each term is represented by a code word, which is obtained by appending its two-letter abbreviation to the code word of its parent. If a term has several parents, then it has several code words, each of which is shown as a synonym of all the others. Each of the three sections is printed on a single page, with scope notes on a second page, to clarify the intended usage of some of the terms. The section for the Computing and Information Sciences is shown in Fig. 1.

To distribute a technical report, an author fills out a "Mercury distribution form," shown in Fig. 2. In addition to subject code words, he can also list individuals and organizational units. To enroll as a reader, a staff member fills out a "Mercury request form," shown in Fig. 3. In this example the asterisks beside four-letter subject code words indicate that the panoramic option does not apply. When a reader receives a cover sheet (that is, an abstract) or a complete copy of a technical report, the addressing label includes a brief explanation of why the document was sent.

Mercury became operational at Bell Telephone Laboratories, under the auspices of the Library Systems Department, in March 1966. Prior to that time, internal technical reports were distributed exclusively to named individuals, who in many cases were personally known to the authors. Others could order copies from a monthly list of titles. For most readers this system provided high relevance but low coverage. Typical Mercury readers now get much greater coverage with slightly reduced relevance, although some who choose very few subjects get, instead, greater relevance with about the same coverage. In either case there is a significant increase in quality.

We believe not only that Mercury is valuable in its present context but also that it is relevant to the larger problems of scientific journals.

Summary

Since many of the problems that beset readers, authors, and publishers of scientific journals are caused by the growth of science or by the frailties of human nature, we cannot hope for complete solutions. In an effort to make progress, within the framework of the possible, we propose that journals stop binding papers into issues and, instead, distribute to each subscriber a personalized stream of papers, abstracts, and titles. This type of distribution, which has been made possible by the advent of high-speed computers, would not affect the traditional roles of editors, referees, and libraries. We also propose that journals recognize the need for very rapid communication in certain fields, and meet the threat of public preprint-exchange systems in these fields by themselves publishing preprints in an appropriately limited manner.

A journal is an integral part of the professional society or other community which it serves. The vocabulary which readers use in requesting papers and which authors use for distributing them should be tailored to the views and interests of this community. It should be small enough to be comprehended as a whole, but large enough to provide a reasonable degree of selectivity among the published papers. It seems unlikely that the vocabularies of different journals will be identical or even compatible in the regions of overlap, but we believe that a reader will be able to understand and use all the vocabularies which intersect his fields of interest.

The proposed system will enable journals to treat their readers and authors as individuals, and thereby to serve them more effectively. Furthermore, it will help them to meet the competition from invisible colleges and preprint-exchange systems, and to grow without breaking apart.

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