The Duality of Quick and Archival Communication*

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The relative strengths and weaknesses are discussed of formalized, centralized preprint exchanges when organized around a profile of interest, phenomenon, or problem area. The advantages and disadvantages are contrasted with those of the conventional journal system. A complementary set of virtues and weaknesses for the two modes raise the suggestion that scientific societies and journals should investigate formalized preprint exchanges as an extension of present scientific communication mechanisms. The observations are based upon the six-year experience of the Information Exchange Groups program in biomedical areas of the National Institutes of Health.

I have been encouraged to discuss in this paper a related area but a bit one side of the main interest of the symposium. Although I shall have something to say about the technical journals, I should like to discuss a quicker mode of scientific communication. Quick communication of scientific results is a modality whose organized use is presently limited. Yet there is great interest in various solutions to quicker communication and new proposals may play a greater future role with journals than at present. It has been commented upon by de Solla Price,[1] Skolnik,[2] and Moore[3] in recent years, publicly debated by Moravcsik[4] and Pasternack,[5] and referred to recently by Cairns in his ACS presidential address.[6]

We all know that when a scientist submits a paper to a journal in any of the disciplines in science, it is likely to be several months before it gets into print. Some journals are quicker than others; *Science* is one of these with a median of about 10 weeks lag time. This lag time of course includes the important process of refereeing, and to have refereeing done quickly requires an editor capable of putting on the pressure with quality results. Any margin of time gained makes some contribution toward speeding the publication service available to the body of scientists engaged in research, but for a certain type of operational unit within the community of scientists the speed attainable falls short of the need.

It is to this particular operational unit within the total of scientists to which I want to call attention. The researchers in this operational group work on a single phenomenon, a single problem, or a readily recognized set of closely related phenomena or problems. This group we may designate as one whose members have a highly similar profile of primary interest by research area and information need. These have been referred to as iso-profile or simply as profile groups (Figure 1). There are many hundreds, or thousands, of such operational units.

Most journals, as we have developed them in science, are not directed toward the immediate information needs of these groups. That is, the need to know as soon as possible the most recent findings of other members of his profile group. Most journals and societies are far broader.

We have thousands of scientific journals, each with its necessary lag time, which we may estimate will average out at about 6 months. But 6 months between write-up of a research report in any given profile area and its dissemination to those scientists working in the area is slow compared to the need (Figure 2). The informal communication between leading laboratories and exchanges at meetings and in informal private preprint exchanges lead the published literature by at least 4 to 6 months, perhaps a year. Research results caught in the pipeline of the publication process are known only by a fortunate few who are beneficiaries of the informal private preprint exchange processes of the central core groups.

This in no way disparages the valuable role journals play. Journals are a necessity and they are here to stay. However, for a very specific communication need, the

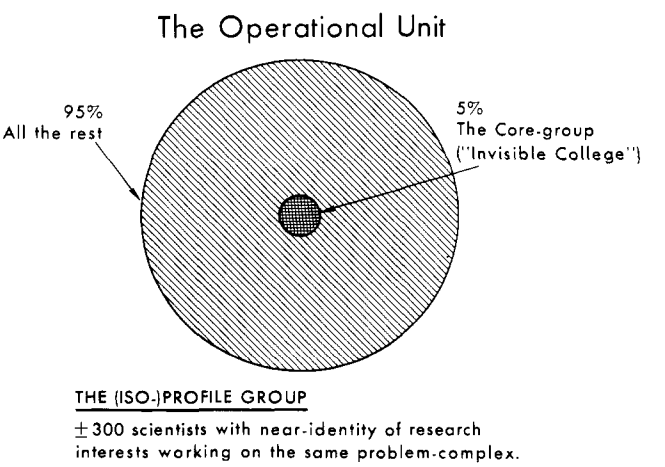

Figure 1. The operational research unit as a group of scientists defined by a common specific research interest and information need

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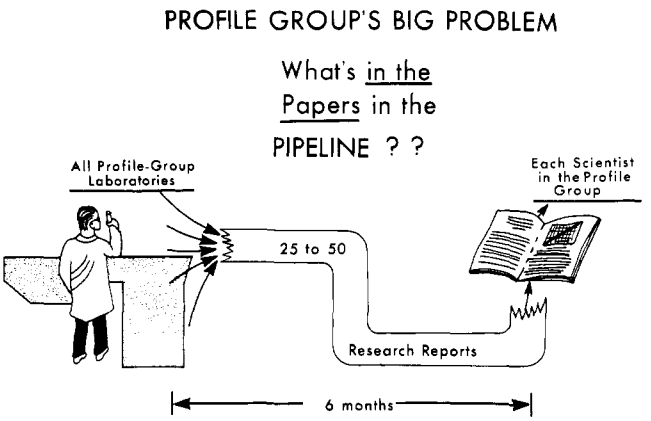

Figure 2. Illustration of the information lag problem

need to know quickly the most recent research findings made by others in an iso-profile group, journals are unable to do the job.

The journal is not the only formalized communication medium that the scientist may use in pursuing his research if we accept formalized quick communication as a separate and equally necessary mode of communication. Journals are essential for all other purposes. Formalized quick communication is essential within and strictly limited to each iso-profile group. They may represent a possible solution (Figure 3).

The NIH Experiment. This brings us to the NIH experiment concluded over a year ago. In early 1961, under Errett Albritton at the DRG, NIH set up a preprint distribution center for one selected profile group in biochemistry around the phenomena of oxidative phosphorylation and electron transport. It was set up as a feasibility study and pilot test group. By the end of four years, six more groups had been added. These were: four phenomena—Hemostasis, Muscle Control, Interferon, and Nucleic Acid Control of Protein Synthesis; one field—Immunopathology; and one problem—Computer Simulation of Biological Systems. At the end of the six years, having demonstrated the feasibility of centralized formal preprint distribution, and having learned something about what the problems are in such an operation, we brought the experiment to a close. We could not extend it to more groups for financial reasons and the load on the NIH printing facilities had become critical. However, the feasibility had been accepted by scientists in the research areas involved and the concept had been tested on a trial basis. While the operation had not "caved in" as stated by Cairns[6] further loading without further resources might have produced that effect. Some journals were objecting to the system. We closed it with considerable regret, for we were serving over 3600 scientists around the world in seven different interest profile groupings.

The operation was simplicity itself. Any scientist member of one of the seven exchange groups could send a first carbon or Xerox copy of a paper he was submitting to a journal. It would be duplicated by photo-offset and copies rushed out to all members of the author's profile group wherever they were all around the world. At the height of this activity, we were duplicating an average of 36 scientific papers a week as a total for the seven groups and more than 24,000 individual copies per week. With photo-offset duplication of incoming papers, no refereeing at the distribution center was possible for the rapid preprint service. Nevertheless, the quality was high for 87% of the papers preprinted were eventually published in reputable scientific journals after editorial review.

The specialized need that gives quick communication its urgency to meet the needs of the iso-profile group makes it desirable that papers be preprinted at or even before the time of submission to a journal—you might say, "complete with any errors they may contain." This then forms the main distinction between quick and archival scientific communication. The former is valuable only to a highly selected group in a highly focused area. The latter, though slower, is valuable to any scientist searching and screening with a broader profile of interest. It is highly trustworthy. It contains "the scientific record."

Different Need-Different Use. Here (Figure 4) are the two modes of communication, each with its best foot foremost. Preprints are quick; journals are archival. Nothing should go into the archives of science unless it has been perfected until no detectable error in fact or judgment at the time is left. Journals are properly the guardians of excellence. Reputable journals feel a responsibility not only to the present generation but to all future generations. Yet the reported number of journal publications are growing so rapidly that scientists concerned with quality are asking, "Is the literature worth retrieving?"[7] and, "Is the literature worth reviewing?"[8] Moreover, as mentioned earlier, much first knowledge of contemporary scientific findings and advances does not come through journals but through informal private channels.

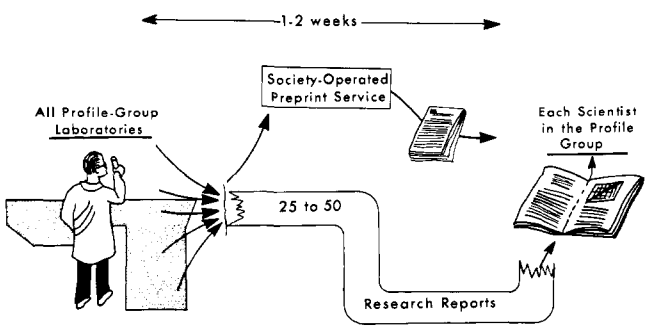

Figure 3. Possible solution of the information lag problem

NEEDED
Two Modes of Formal Communication, Not Just One

Preprints	Journals
Speedy (one to two weeks), but unrefereed, not polished, may contain an occasional error; not entitled to admission to the recorded body of science.	Refereed and perfected, becomes part of archives of science, but much too slow (6 months) for communication needs within a profile group.

Figure 4. Characteristics of the duality

And the more distinguished the scientist, the less he depends on the journals for information of research findings within his profile area (Figure 1). The reason this small group of top scientists—5 to 10% of the total profile group—do not have to depend on the journals for word of new findings in their profile area is that they practice quick communication by private preprint exchange among themselves and by editing the papers of their less distinguished colleagues. In short, the core group— the "invisible college"—discovered the merits, indeed the necessity, of quick communication long before NIH thought of running its feasibility study. (The group of scientists who organized into the Royal College of London, founded circa 1660, collected their correspondence with continental philosophers as an important part of the published *Philosophical Transactions*, one of the early beginnings of the present journal form.)

Quick communication is needed particularly at what has been described as "the cutting edge of science." There it may be a necessity. However, probably three-quarters or more of the scientists in any profile area are still without this form of quick communication. We would call them the disadvantaged majority. NIH's experiment, while it lasted, removed the disadvantage for seven such profile groups. However, even while the exchange operated, the members of these groups did not stop reading journals. They still needed to browse wider areas and they still read in journals the specific papers that had been sent through the exchange for any changes made in the "perfecting process" of journal publication.

From the small amount of evidence we have collected from the NIH experiment and from what we have been told by scientists involved in our feasibility study, we could venture that the hazards in using unrefereed information are far smaller than the hazard in not knowing what is in the 25 to 50 or more unpublished papers in the publication pipeline when making research decisions.

I want to make it clear then, that in my opinion, preprints of unrefereed scientific reports have a very limited legitimate use—only by scientists in the profile area represented by the preprint. Their use contains a risk— the risk that some item of information relied upon in a research decision will not stand up under refereeing, or will not fall within the subject area of a journal or within the journal's threshhold of excellence. For this reason as well, the interest area of the profile group should be sharply defined and limited. Large vaguely defined areas such as molecular biology, metallo-organic compounds, and chemical genetics are too broad to serve as the basis for the functioning of an information exchange of this kind. Preferably the basis should be centered on phenomena or on discrete problems.

The Hazard of Unnecessary Duplication. Martyn[9] has reviewed and commented on the extent to which unintentional duplication of research occurs. While not the only component, failure in the communication system coverage and timeliness is largely responsible. From our experience there is no question that quick communication, profile-area-wide, reduces the hazard of unnecessary and unplanned duplication of research. The quicker it is, the more the hazard shrinks. We believe, from the NIH experience, that the advance information furnished the seven groups acted to prevent waste of research time and funds. In a final questionnaire that was sent to all scientists in the program, we provided among other questions one question as an opportunity for the members to provide documentation of instances in which the preprint service had provided early research leads, saved research time, or prevented unnecessary duplication (Figure 5). About one-third of all members responded to the questionnaire. Of the 1100+ respondents, more than a third, about 40%, provided one or more cited instances in which research services were positively influenced by the service. Half of those providing documentation cited incidents of preprints which prevented unnecessary duplication. Four per cent of the cited instances were cases in which misleading information in preprints had delayed research.

Question # 1 of
The IEG Questionnaire

(One third of the IEG members responded to the Questionnaire; one third of this third (= 483 scientists) tackled Question # 1.)

456 (of the 483) reported incidents in which advance information brought by preprints *influenced research decisions.*

Half (235) reported *"prevented unnecessary duplication"* of research effort.

Two-thirds (329) reported "gave new leads earlier" (new concepts, new understanding, new techniques, new problems)

Figure 5. Preliminary results of final IEG questionnaire

A full report of the IEG experiment will be made at another time. Because of the timing involved, we could not send out the questionnaire until the experiment was announced to be ending. Less than a third of the members replied. We can only assume that many did not respond realizing that their answer was not related to continuing the service. We can also assume that many of the non-respondents may not have felt that they benefited enough to respond. We cannot, therefore, project these figures to the entire membership nor do I place any quantitative reliance on a survey return of this nature. Its timing precluded a full response.

Four of us who read through the returned questionnaires concluded that the great majority of the members who cared enough to respond believed that the experimental service was valuable to them (the author, E. C. Albritton, C. Allan Moore, and I. L. Miale). The respondents' general comments, taken as a whole, indicated that in their experience the concept was feasible, acceptable, and met a need in their information requirements in a specified profile of interest area.

What About the Cost? I cannot go into the cost details here but will say that based on an estimate of total cost of 37¢ per preprint mailed, a profile group of 300 averaging 1.3 papers per man per year could conduct a formal centralized preprint distribution service for a service fee of about $150 per year per member.

Is It Feasible to Put It Into Practice? Quick communication has been practiced by some of the top scientists in each profile area in science since the early 1600's. The question is, then, is it feasible to let the rest of each profile group in on it? To do this requires centralized formal preprint distribution—something that we tried on a limited scale at NIH for six years. NIH did it, you

might say, to find out if it were feasible, and has shown that, at a cost and with suitable controls, it is.

Centralized formal preprint distribution has actually been in practice, however, since 1921 in one chemical research area, petroleum chemistry, and in other areas not quite so far back (Figure 6). Several societies in industrial chemistry and engineering are already operating centralized preprint services covering laboratory research for their members. It has been proposed and studied for the area of high energy physics for adoption by the American Physical Society. A similar operation would undoubtedly be feasible, carried out by any of the life science societies. A trial operation sponsored by a scientific society in connection with a journal and involving initially three or four profile groups could be practicable and the service fee would pay for it. The number of groups could be expanded as the society journal office felt sure of itself.

ACS Divisions Operating Preprint Services

1921 ACS Div. of Petroleum Chemistry
1940 ACS Div. of Organic Coatings & Plastics
1952 ACS Div. of Rubber Chemistry
1958 ACS Div. of Agricultural & Food Chemistry
1960 ACS Div. of Polymer Chemistry
1961 ACS Div. of Fuel Chemistry
1962 ACS Div. of Water, Air & Waste Chemistry

Figure 6. List of ACS divisions operating preprint services

And How Would This Affect Journals? A quick communication system would tend to take the heat off journals to shorten their lag time, something it may be increasingly difficult to improve. Journals could then subject papers to even more rigorous refereeing if they felt this to be indicated. Rapidly developing areas could have a safety valve in exchange groups.

How Would This Affect Researchers? Scientists in a profile area must browse widely for related research as well as search for new papers in their scientific research problem. Searching would be enormously lightened, for the preprints from the scientist's profile group would alert him to what to look for, and he would know in advance the essence of the published findings. His browsing in papers in the remainder of his discipline, and in other disciplines, might increase, resulting in more journal interest, not less.

Minimum Guidelines. From the observations made and experience gained, we have formulated some minimal rules required for successful operation:

That such centralized formalized preprint exchanges be established only in connection with scientific societies or formally organized scientific groups and organized in conjunction with journals published by the society or group. Opposition to the NIH experiment by some journals appeared to be based principally on the fact of its existence outside the established journal system, the consequent lack of control by scientific societies, and perhaps an implied threat of potential competition.

From our experience as mentioned before, the research area should be tightly described and limited to a scientific phenomenon or problem or a closely related set of phenomena or problems. Ready identification of profile interest is essential.

An executive committee for each exchange group should be composed of two or three universally recognized leaders in the scientific research area, to set policy and membership eligibility.

The birth, lifetime, and death of the groups should be controlled by a representative board of the scientific society. Annual decisions for justifying the continuation of each preprint exchange group should be made.

SUMMARY

The need for quick information at the cutting edge of science has been discussed. Its need is profile-area-wide where the most related decisions have to be made. If the need is satisfied, the consequence is a more informed individual management of research time and funds. This means more rapid advancement of science in the profile areas that are fortunate enough to have it. Quick communication of this type is a presently impossible task for journals. The relationship that exists between preprinting as an institution and journal publication has been discussed. The first maximizes speed of delivery, the second maximizes excellence for the record. Separately, neither is adequate. Ideally, the two forms should join operations to form a responsive system of communications services. Together, they form a complementary duality. Scientific societies are urged to give consideration to this relationship in their publication planning. A formalized preprint exchange experiment at NIH has been shown to be relatively costly but rapid, feasible, and acceptable if highly focused as to subject area concept and applied to a highly active research area in which prospective members recognize an immediate identity of interest.

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The observations and opinions made are those of the author and do not represent official positions of the National Institutes of Health.