RECEIVED BY DT[illegible] OCT 10 1967

AIP Report No. AIP/SDD - 1 (Rev.)
USAEC Report No. NYO - 3732 - 1 (Rev.)

MASTER

THE ROLE AND DISTRIBUTION OF WRITTEN INFORMAL COMMUNICATION IN THEORETICAL HIGH ENERGY PHYSICS

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August 25, 1967

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This project supported by the U. S. Atomic Energy Commission under Contract No. AT(30-1)-3732 and by the American Institute of Physics Information Study Project

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ABSTRACT

A study of "preprint" distribution in theoretical high energy physics has been conducted by the American Institute of Physics with support from the U. S. Atomic Energy Commission. Based on interviews with 45 high energy physicists and other preliminary studies, a questionnaire was developed and circulated to all known high energy theorists. A second questionnaire was sent to a representative sample of "preprint librarians" at various institutions both in the U. S. and abroad. Based on the facts, opinions, and suggestions so gathered the study concluded that an experiment with centralized "preprint" distribution is clearly desirable but that great caution must be exercised. Consequently, a two-step experiment, which would run for 18 months, has been designed for consideration by the physics community. The first step, to run for the full 18 months, would provide a centralized "preprint" announcement service and a directory of high energy theorists. In response to needs determined by the study, a format for the announcement service has been designed to indicate subject category, type and status of each entry. The second step, to run for the last 12 months, would add an experimental distribution system designed to introduce speed, efficiency and economy into informal communication and relieve the author of some of his present burden while retaining for the author all the controls he now has. This would provide for distribution of copies of "preprints", under strict control of the authors, directly to certain selected and authorized individuals. To help in determining the demand for such services charges would be made for about the last six months.

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PREFACE AND ACKNOWLEDGEMENTS

This is a revision of the final report of a study of "preprint" distribution in theoretical high energy physics conducted by the American Institute of Physics (AIP) with support from the U. S. Atomic Energy Commission (AEC) under Contract No. AT (30-1) -3732. While the major share of the cost was borne by the AEC contract, the AIP also bore an appreciable portion of the cost. Statistical soundness was improved under NSF Grant No. GN-623.

The purpose of the study was to determine the desirability of a centralized "preprint" distribution system in theoretical high energy physics and, if such a service seemed desirable, to prepare a rough design for an experiment with such a service. This has been done.

This report will be referred by the AIP first to the Subcommittee on Studies in Communication Patterns in Physics of the Advisory Committee on the AIP Information Program, then to the full Committee. The AIP will develop its position with respect to the proposed experiment on the basis of a number of things, including the results of these referrals.

The report has purposely been left somewhat detailed, hence lengthy, to better support the decision process. Persons with no responsibilities or interests affecting the decision-making, but who want to get some feel for the report, should be able to do so by reading Section X, starting on page 63, but they should remember that important elements of the problem are discussed elsewhere.

The authors wish to thank both the AIP and the AEC for their wholehearted support and cooperation. Special thanks are due Dr. William D. Garvey, Director of the Johns Hopkins University Center for Research in Scientific Communication for his continuing interest and assistance. In particular, he arranged for Mr. Zaltman's participation in the project and he and his staff provided invaluable advice on the development and analysis of the main questionnaire used.

Special thanks are also due Mrs. Pauline A. Atherton, now at the School of Library Science, Syracuse University. First as a member of AIP's staff, then as a consultant, she supervised the preparation and analysis of the questionnaire to "preprint" librarians. Also, at the beginning of the project, she provided much needed continuity between the project's planning phase which, for AIP, had been under the late Dr. Van Zandt Williams, and its actual conduct.

The authors also wish to acknowledge with gratitude invaluable advice and assistance received from many on the staff of AIP and the Johns Hopkins University and others who served as consultants or advisors. Space permits mention of only a few of these: Mr. C. M. Gottschalk, Mr. Robert J. Howerton, Miss Stella Keenan, Mr. Paul Kliauga, Dr. Nan Lin, Miss Clarebeth Maguire, and Dr. Nicholas Mullins.

Finally, the best of efforts could not have succeeded without the outstanding cooperation of the very many physicists who provided the necessary information by completing the questionnaire, by helping in interviews, and in other ways.

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I. INTRODUCTION

A. General

In theoretical high energy physics, as in many other fields of science, the overall communication of scientific information is in part accomplished by means of the writing and distribution of informal communications. These communications are loosely referred to as "preprints", since most of them appear to be drafts and manuscripts of papers intended for eventual publication.

It has recently been proposed that some centralization of "preprint" distribution in theoretical high energy physics would be a great service. This proposal, through a chain of circumstances detailed in the next section, resulted in the establishment of a study project by the American Institute of Physics (AIP) with the support of the U. S. Atomic Energy Commission (AEC). This is a revision of the final report of that study project.

The project was initiated and conducted to provide information on the basis of which enlightened decisions affecting "preprint" distribution in theoretical high energy physics can be made. That is, it was established primarily to assist those in the physics community responsible for establishing or implementing policy. Accordingly, this report is primarily a staff study. As such, its function was to formulate and document recommendations based on analysis of the best information it could gather. Such recommendations are made, but it must be understood that they represent only the considered opinions of the authors. Specifically, they do not in any way represent the views or policy of the AIP, the AEC, or any other person or organization.

It turned out that, in order to accomplish its purpose, the project often had to formulate hypotheses, attempt measurements and entertain conclusions which were beyond those safely permitted by the present state-of-the-art. To this extent, then, the project was also a research effort. Therefore this report includes material applicable to one or the other but not both functions. For instance, Section II goes into more detail about the historical sequence of events leading up to the inception of the study than would be required in a research report. On the other hand, some discussions of hypotheses and findings are more detailed than would be required in a staff study.

B. Terminology

Terminology problems start with the heart-word "preprints". A "preprint" used to be an advance print of an article, book chapter, monograph, etc., which was intended for publication. It has come to be used very loosely to cover almost any written communication outside of the established literature. This has led to much semantic confusion and it has plagued this study project. One man's "report" is another's "preprint" and yet another's "manuscript".*

As a result, we felt it would be better to avoid using the term "preprint" as far as possible. We will instead use the term "written informal communication", which we will abbreviate as "WIC", to indicate inclusion of the entire family of

*See for instance the different definitions used in the debate on "preprint" exchange in Physics Today by Moravcsik[1] and Pasternak[2], and for a general treatment of related concepts, The American Psychological Association[13].

written communications outside of the established literature. This family will be considered to include reprints at one end of the spectrum and "notes" and multiple-addressee letters at the other. Reprints are included because the way they are used must be considered as constituting a distinguishable medium of informal communication, even though the material so transmitted is clearly a part of the established literature. Personal letters to single individuals are excluded on grounds of expediency; the project had neither the time nor the resources to consider them.

For all practical purposes, however, the discussion will be most applicable to manuscripts, or drafts of articles to be submitted for publication, since these are by far the most common element of "preprints" as the term has come to be used. We will assume that a reprint would not be circulated. On the other hand, there would be no reason to arbitrarily say that a personal letter to an individual could not, under some circumstances, be treated as a WIC. To save space and tedium we have also permitted ourselves to acronymize with "PIE" for "physics information exchange" and "THEP" for either "theoretical high energy physics" or "theoretical high energy physicists", according to the context.

C. The Data Base

Most of the tables and figures presenting data collected by the project are based on analysis of the first 977 responses of theoretical high energy physicists to the questionnaire prepared for and sent to individual high energy theorists (see Section III). Some, however, are based on the first 557 responses received since time and resources have not permitted re-doing the entire analysis. Where possible, the number of responses on which specific results are based have been indicated, e.g. by "(N=743)". In general, the pattern shown by the later responses seems to be sufficiently similar to that shown by the first 557 to support a high degree of confidence that analyses based on the first 557 are representative. It must be remembered in each case however that the fact that the marginals show the same patterns does not justify an assumption that cross-correlations, on which much of the data presented is based, will necessarily also show the same patterns.

D. Plan of Report

After Section II on background, the approach to the problem taken by the study project is explained in Section III. Sections IV and V describe the development of the directory, interviews and questionnaires used by the project. The quantitative findings of the project with respect to communication within THEP are then presented in Sections VI, VII and VIII in terms of the network, information flow in it and attitudes of the THEP community. Next, a specific design is proposed in Section IX for an 18-month PIE experiment. This, and material presented in earlier sections, form the basis for the discussion in Section X. Section XI discusses cost estimates. Finally, Section XII is a very brief statement of the conclusions. More of the details of procedures followed, the basis for estimates, etc., than usual have been left in the text in the hope that they may help in further discussions. Persons finding the report too lengthy should be able to get the gist of the report from Section X but should remember that important elements of the problem are discussed elsewhere.

II. BACKGROUND

The specific events leading to this study* started with the proposal by M. J. Moravcsik in March, 1965,[3] of a number of measures to improve communication in physics. One suggestion was:

> "For each large field of physics (e.g., elementary-particle physics) a central preprint registry should be established. This would be located at some institution active in the field, and would consist of one full or part time clerk whose duty would be to list the title, author, and author's institution of preprints arriving in the registry, and publish the list, say, fortnightly. This list could be obtained on a subscription basis by anybody in the world, by airmail."

Another suggestion was:

> "Each small group of physicists working in a given field should establish for itself a preprint library, whose address would be made available to the people in the field to be put on the mailing list. With the increasing number of physicists working in each field it is becoming impossible to send out enough preprints to cover everybody individually. Nor is it really necessary to do so, since most of us are sincerely interested only in a rather small fraction of the preprints we receive. Thus, if, say, four or five people could form a group with one address on preprint mailing lists, the situation would greatly improve. This is done, to some extent, in certain institutions, but it is not nearly prevalent enough. This system would also drastically reduce the number of changes one has to make in one's preprint list, which in turn would permit the most efficient use of time- and labor-saving devices such as addressographs or Xeroxed labels."

On 29 April 1965 the Subcommittee on Techniques for the Distribution of Scientific Information of the Committee on Nuclear Science of the National Academy of Sciences - National Research Council invited Moravcsik to elaborate on his proposals. During this meeting the chairman, Dr. K. Way of Oak Ridge National Laboratories, suggested that the U. S. Atomic Energy Commission might be interested in organizing and maintaining a preprint registry such as that proposed by Moravcsik. Presumably acting upon this suggestion, the Division of Technical Information (DTI) of AEC began in June, 1965 to explore with Moravcsik the feasibility of conducting an experiment in preprint distribution. Based on encouraging results from a mail survey by Moravcsik of some 12 leading theoretical physicists, C. M. Gottschalk of DTI, in collaboration with Moravcsik, developed a particular plan based upon the original preprint suggestion. They called this plan "Physics Information Exchange" (PIE). Using clerical personnel already available and no additional funding, AEC would receive preprints deemed worthy of circulation by their authors, reproduce them and mail them to appropriate individuals on the basis of previously prepared interest profiles. It was also stated that members would be encouraged to form local preprint libraries in which a small number of researchers with common interests could share single copies. Where this was done PIE's distribution would be to the libraries, not

*Earlier suggestions by Price[7] and the IEG experiment (see Section X.A) are among earlier related contributions.

to individual members.

With the plan thus outlined, further consultations were held with others in the AEC and in the physics community. The AEC plan was discussed at the American Physical Society's Information Symposium on 29 January 1966, in an invited paper presented by Moravcsik. There was considerable discussion from the floor on that occasion. On 30 January Dr. Way's subcommittee again discussed the PIE plan. This time a resolution was adopted recommending that initiation of PIE be deferred. At this point DTI, in consultation with the late Dr. Van Zandt Williams, Director of AIP, agreed to take no further action on PIE until a study committee to be appointed by Dr. Williams could review the desirability of such an experiment. Such a committee was convened on 15 April 1966. The discussion at the meeting of this AIP Ad Hoc Advisory Panel, capping previous consideration by the AIP, convinced the AIP that before any such program as PIE was established a study should be conducted to determine its desirability and to prepare a rough design for an experimental service if that seemed desirable. Such a study was proposed to the AEC in a proposal dated 6 May 1966. A contract granted by the AEC effective 14 June 1966, initiated this study project.

Some thought was given to including experimental high energy physicists. This was not done, mainly because it did not seem that available resources would permit such a greater coverage.

III. APPROACH

A. Introduction

This section describes the approach taken by the study project and how it was formulated. It is imperative to keep in mind that it is the desirability of an experiment that is being studied, not whether or not a service should be established. This distinction is easy to lose sight of because the possible usefulness of a service must be considered in determining the desirability of an experiment. There would be little point in conducting an experiment were it already clear that no service would ever be wanted. On the other hand, the question of a service is far too complex, and, according to some, dangerous, to consider without the additional information an experiment would generate. Even an experiment was considered possibly dangerous enough by some to warrant this study.

The basic framework within which an approach had to be formulated was determined by:

1. The objectives established by those in the AIP and AEC sponsoring the project, and
2. The definition and nature of the problem as seen by the project personnel.

B. Objectives

The main source of information about the first of these determining factors must be the proposal submitted by AIP to AEC, since the principal author, Dr. Van Zandt Williams, died after the proposal was submitted but before the project started and before the authors came to AIP. In the first place, the fact that the study was established at all implied two things: First, those responsible felt that the "Moravcsik proposal", even though implemented as an experiment rather than as a service, needed to be evaluated more carefully before being implemented (as the AEC had planned to do). Second, information already available was not sufficient for such an evaluation.

Information from the proposal which would throw light on the intended objectives is as follows. The study was described as covering

> "a specific, delimited research study and experimental service which is directly related to the AEC's mission. This work . . . will contribute a great deal toward the understanding of the communication network among physicists and as such can be considered the pilot project upon which later work at AIP will be based."

It was further referred to as

> "a study which will provide a useful, controlled, evaluation experiment so that the resultant knowledge can be of direct contribution in developing a future physics information service."

The intended objective may be further deduced by implication from the five principal points of the "Plans for Project", which are briefed as follows:

a. Identify groups in existing network. (Producer, distributor and reader groups were suggested.)

b. Determine status quo in existing network. (This basically referred to collection of opinions from groups identified and collection of data on the established literature, conferences and other types of informational material in theoretical high energy physics.)

c. Prepare report of findings for presentation to respondents and Advisory Committee.

d. Determine desirability of a centralized service for distributing informal communications. Preparation of rough design for experimental service to be reviewed by Advisory Committee, with plans for evaluation and monitoring of service, exploration of alternate methods of production and distribution. (Quoted in its entirety as being the most succinct expression of the fundamental objective for which the study was established.)

e. Ascertain availability of funds and participating personnel for experimental service.

C. Nature of the Problem

The second determinant of the approach, the definition and nature of the problem as perceived by the project personnel, developed concurrently with the approach. Some feeling for the point of departure thereof can be gained by examination of the issues named in the "Debate on Preprint Exchange" in Physics Today[4]. These issues, and those named previously by Moravcsik[3] and Pasternack[5] include speed, quality, disadvantage, "priority", coverage, order, efficiency, and many, many more. While pairs and groups of these could be related, there seemed no more of a comprehensive underlying pattern or natural order than is apparent with respect to the elementary particles in contemporary high energy physics. This made it difficult, if not impossible, to establish direct and quantifiable or even qualifiable relations between all identifiable effects. An example is provided by the Physics Today Editor's necessarily oversimplified characterization of some of the pros and cons. On the one hand, he said, some felt that PIE

> "would do rapidly and efficiently what is already being done and . . . would provide a needed channel of communication."

On the other hand, he pointed out, others felt that PIE would

> "flood physics institutions with unneeded, unwanted literature of doubtful quality and . . . would threaten orderly physics communication."

Some of the concepts mentioned - rapid, efficient, flood - might seem quantifiable. Others - needed, unneeded, unwanted, orderly - do not, but rather seem to require some sort of value judgment or qualitative comparison. Further analysis of the expressions of opinion already available, study of available correspondence review of relevant literature, and talking with available people, confirmed that a deeper understanding of the forces and processes involved would somehow have to be gained to provide a basis for assessing trade-offs between such apparently

uncomparable things as quality and speed.

To summarize, the objectives established for the project called for a combination of opinion-gathering and network description based on extensive data collection; a first look at the problem by the project personnel indicated a need to understand more deeply the issues involved and the relations between them. The only safe assumption to make at the beginning of the project was that all of these things, at least, were needed.

D. Determination of the Relevant Population

It was clear that the overall problem under study could be extremely important to the healthy development of communication within theoretical high energy physics. There was agreement that improvement in theoretical high energy physics communication was needed. There was also agreement that the decision with respect to PIE could be vital to theoretical high energy physics - the PIE proponents claiming that a decision against PIE could leave communication in an increasingly unsatisfactory situation, the opponents that a decision for PIE would wreck communication. It was, therefore, important that statistically reliable data be provided as a basis for decisions.

However, to obtain a random sample of a population it is necessary to know the population. The situation with respect to the one alternative to random sampling, namely stratified sampling, requires even greater knowledge of the population. Unfortunately, nothing remotely approaching a directory of the world's theoretical high energy physicists could be discovered. It had been hoped that the Physics roster of the National Register of Scientific and Technical Personnel files would serve this function but it could not be used because there was no one category that covered theoretical high energy physicists alone.

Detailed quantitative information about the population was also needed in its own right. Data on the number of theoretical high energy physicists in the world community, the number of their organizations, their distribution among those organizations, how they are divided between research, teaching, etc., were needed to settle objectively some of the disputed points.

There was another factor to be considered. If eventually an experiment were conducted, each individual theoretical high energy physicist should be informed about its existence and presumably invited to participate. The only sure way to determine how hard it would be, and how long it might take, to develop such a directory of high energy theorists was to prepare one.

All considered, it appeared that nothing short of attempting a 100% sample of the entire theoretical high energy physics community would provide a sufficiently reliable reading of facts and opinions to serve as a basis for the important decisions to be made. The development of the directory required to make such an attempt is discussed in Section IV, next.

E. Choices of Technique

Another problem was who to ask for what information. Producer, distributor and reader groups were mentioned in the proposal. The producer and user groups certainly consist of physicists and overlap sufficiently to be

considered as one. This did not mean that we could drop the distinctions between producers and users. It simply meant that we could wait to distinguish between physicists as producers and physicists as users until after we had reached them with whatever "tool" (e.g. interview, questionnaire) we were using. Thus the community of theoretical high energy physicists, encompassing both the producers and the users, was one group on which we had to concentrate for opinions and for information.

We also needed information about how "preprint libraries" operated and how effective they were. For example, we needed information about processing times, costs, equipments, growth rates, how these vary with size, nationality, and location, etc. On the basis of the debates and other available material it appeared that a lot of this kind of information would be needed to fully illuminate the problem. Thus, the "preprint librarians" constituted another group on which we had to concentrate - separately, because of the fundamental differences involved.

1. The Physicists

With respect to the high energy theorists it was necessary both to (1) determine their opinions, as a group, of the desirability of a PIE experiment, and (2) get information about their actual use of written informal communications, so that some of the heat discernable in the "debate" could be replaced by light. The suggestion had been made that we conduct an opinion poll at the XIIIth International Conference in High Energy Physics, which was scheduled to be held at Berkeley, California. This had to be rejected because we would have had no way of knowing whether those fortunate enough to have been invited (or less solidly in the "invisible college(s)", or less well known, or less wealthy, etc.) might feel differently. It was just such circumstances that caused us to decide to try for a 100% sample. This decision necessarily implied use of a questionnaire. The two would complement each other - the mailing list for the questionnaire would come from the directory; the directory would be purified and enlarged on the basis of the returns from the questionnaire.

This left the problem of what information the questionnaire should seek, and how. This problem requires application of the techniques and methodology developed in information science and in the behavioral sciences, but first and foremost it is one of selecting and formulating those questions which are most insightful and germane to the substantive problem at hand. To send out a questionnaire long enough to attack every conceivable issue would guarantee few, if any, responses. Therefore, we decided to use the Berkeley Conference not to get answers but to get questions. This would be done by means of semi-structured interviews with attendees in which certain questions would be asked but which would otherwise be open-ended and seek to draw out the person being interviewed. The interviews, and the subsequent questionnaire development, are reported in Section V.

2. The "Preprint Librarians"

The "preprint libraries" presented an entirely different problem. Here we were more concerned with facts than with preferences or opinions - and the facts were about collective behaviors rather than individual behaviors, with many of them being of a totally different kind (e.g. about costs). A separate questionnaire was chosen as the basic tool because it was desired to include a number of foreign "preprint libraries" and because much of the information

needed was not the kind a person could be expected to know without spending some effort to gather and organize the necessary data. In this case, we felt that a sampling procedure could be used based on the following two-valued stratifications:

U. S. A. vs. other than U. S. A.
Large vs. small institutions
Educational vs. non-educational

Further information on the development of this questionnaire is reported in Section V.

IV. DEVELOPMENT OF A DIRECTORY OF HIGH ENERGY THEORISTS

To develop a directory of the world's population of theoretical high energy physicists, sources were needed that not only identified a person as a high energy physicist but which also distinguished theorists from others. About the only source that was available which listed only high energy theorists was the list of referees used by the editors of The Physical Review for papers on high energy theory. It, of course, included only a relatively small fraction of all high energy theorists.

"Preprint" distribution lists seemed the next most reliable source but each had only a very limited coverage. As many as possible of the high energy physicists interviewed at the Berkeley Conference were asked for suggestions. The DESY* index was the only one that seemed to be regarded as apt to be a very useful source for the directory. It lists both the established literature and "preprints" and distinguishes theoretical papers.

It was decided to use all sources that we could keypunch in the available time and to use automatic data processing (ADP) equipment to bring all the names so collected into one big alphabetized list. The following were used as sources:

1. DESY Volume 2 (1964) - all authors of documents indexed as being theoretical and their institutions. This covered the entire year of 1964.

2. DESY Volume 3 (1965) - the same, except that only those which were included on a magnetic tape provided by DESY were obtained. This was estimated to include the equivalent of about 7 months listing.

3. DESY Volume 4 (1966) - the same as for Volume 2, except that only Numbers 1 through 7 (January 1966 through July 1966) were able to be included.

4. A magnetic tape listing high energy physicists provided by the AEC. All names entered on the tape were used but it turned out that many of these were experimentalists instead of theorists.**

5. The lists of invitees and attendees at the XIIIth Conference on High Energy Physics at Berkeley (1966). (An attempt was made to use only names of theorists.)

6. A list of persons used as referees for papers on high energy theory by The Physical Review (1966).

*High Energy Physics - An Index, produced by DESY (Deutsches Electronen Synchrotron), Hamburg, Germany

**A valuable follow-on study will be possible thanks to the many experimentalists who were interested and considerate enough to return completed questionnaires. This will be especially valuable since a number of physicists, including both theorists and experimentalists, have expressed the opinion that experimental high energy physicists should be able to participate in the PIE experiment.

7. The personal "preprint" lists of three prominent high energy theorists and of two large institutions (1966).

In all, the combined alphabetized printout contained 8644 entries consisting of name, initials, institutional affiliation (where possible), and source. When the same person appeared several times, as was usually the case, the professional staff selected the entry that seemed to be the most likely spelling, assigned the most likely initials and, when different institutional affiliations appeared for the same person (the rule rather than the exception), selected the one that seemed most likely to be current. Frequently, decisions had to be made whether two entries were two different persons or two versions of one name. Concurrently a directory of organizations had to be developed, both to eliminate the necessity of retyping or repunching many identical addresses when generating mailing labels and also to enable the automatic generation of such statistics as the number of different places involved (one of the issues that had been disputed) and the distribution of persons among them.

3557 names were left after the manual selection process. A few cases of known duplication were left, where it seemed better to mail the same questionnaire to the same person at two different addresses than to accept a high probability that he might not get the questionnaire at all.

Since the initial mailing of the questionnaire, names have been deleted from the master copy of the developing directory because:

1. Some addressees have indicated on returned questionnaires, or by letter or otherwise that they, and/or certain other addressees are not high energy theorists.

2. Additional information, such as names given as part of the answers to questions on the questionnaire, has enabled us to decide which one of duplicated names on the list is the correct one.

On the other hand, names have been added to the directory because:

1. It was discovered that some names had been accidentally dropped in processing the first mailing list.

2. Names not already on the list were given as answers to questions.

3. Persons suggested that questionnaires be sent to other persons. Estimates of numbers of THEP's and others resulting from these processes are given in Section VI.

V. INTERVIEWS AND QUESTIONNAIRES

This section reports briefly on the development of each of the two questionnaires which served as the principal research tools used by the study project.

A. Berkeley Conference Interviews

The already referred-to interviews conducted at the XIIIth International Conference on High Energy Physics at Berkeley, California, 29 August to 3 September 1966, determined the subsequent course of the project although they were intended primarily to assist the development of the questionnaire for physicists. These interviews were "semi-structured". That is, the interviewers had a number of questions for which they wanted answers, but the exact method of wording these questions and their timing and sequence in the interview were considered less important than establishing a free-flowing and relaxed conversation in which the interviewee would feel free to express his opinions and to volunteer suggestions of his own.

The interviews were conducted by the authors with permission of the Conference management. Preparation for the interviews was extensive and included study of available literature and correspondence and discussions with consultant physicists, behavioral scientists and information scientists. Over 40, or about 10%, of the attendees, were interviewed. Most of these were selected on a target-of-opportunity basis since the interviews took place in halls and corridors usually between the sessions of the Conference.

Cooperation was excellent. Only two or three of those approached declined to be interviewed, usually on grounds of conflicting commitments. All but two or three of those interviewed assented readily to the use of small handheld tape recorders, thus enabling review of many of the interviews after the Conference.

The principal objective was to find out what the Conference attendees, all of whom could be assumed to be esteemed members of the community since they were there on invitation, felt should be asked in a general questionnaire to get to the bottom of the issues and contrasting viewpoints brought out by the PIE proposal. In many of the interviews this question, in essentially those words, was asked of the interviewee.

Of the many valuable items of information gained by the interviewers, three of the most outstanding impressions were:

1. The question of communication within high energy physics (many of the interviewees were experimentalists) is a matter which the interviewees feel to be very important, one in which they are very interested, and one about which, more often than not, they have strong and individualistic feelings.

2. Both the established literature and the practice of exchanging "preprints" are in general accepted as necessary parts of the present communication practice.

3. There are wide variations of opinion and these appeared in many different combinations. In fact, it almost seemed that for every opinion that was expressed a counter opinion could be found in another interview.

B. The Questionnaire for Physicists

The questionnaire for physicists was the principal research tool of the project. As such, every effort was made to get the maximum possible "mileage" from it. The feel for the situation gained from the Berkeley interviews was invaluable in the questionnaire's design. So also were advice, suggestions and comments received from many sources, including AIP staff, consultant physicists, behavioral scientists, and many others.

A most difficult decision concerned length and complexity. We were repeatedly reminded that people in general and physicists in particular don't like questionnaires anyway and just won't bother with them if they look too formidable. There was, of course, a definite danger that if we did not use restraint, we might end up getting too few responses to warrant any conclusions. On the other hand, there were a large number of questions that needed answering. Although an opinion poll with respect to some stated version of the PIE proposal was required by the objectives of the project, we felt very strongly that it was even more imperative to seek understanding, which such a poll would not provide. In the first place, whatever an opinion poll might indicate with respect to any particular PIE proposal, one would wonder how changes to some feature of the proposal would affect the results. This could not be helped as far as the version of the PIE proposal to be used in the questionnaire was concerned - we were there constrained to the version proposed by Moravcsik as nearly as we could encapsulate it. The situation was different with respect to the experimental design the project was to develop if results indicated that some experiment was desirable. For this, it was obviously encumbent on the project to seek understanding that would provide a basis for maximizing the advantages and minimizing the disadvantages seen by physicists, individually or collectively, in a proposal of the PIE variety. In the second place, this study constituted the first project in a much larger and more comprehensive continuing program being instituted at the AIP with support from the National Science Foundation. This overall effort will seek a general understanding of the needs and uses of information by physicists as a basis for innovations to improve physics communication in general and as a basis for the conceptual design of a national information system for physics which would also relate to other national and international systems. If we restricted the present questionnaire to information needed for the immediate task then we would soon have to make another questionnaire study to get the additional information we would need. But then we might be merely trading complaints about the length of questionnaires for complaints about the number of questionnaires. We not only wanted to hold down the number of our own questionnaires, we even hoped that if we were thorough enough in our efforts to coordinate with other organizations we might save our subjects from one or more questionnaires from these sources. We believe that this hope was realized in at least one specific case.

A further consideration was that since individual items of information can be combined (cross-correlated) to generate higher level information and appreciation with respect to whatever is being studied, the final amount of information made available should be a combinatorial rather than a linear or even

an exponential function of the number of individual pieces of information obtained. Such an effort cannot be assumed to hold, or hold as strongly, between two questionnaires of different coverages and different points in time. There were also two factors that made us more optimistic than some of our advisors with respect to the tolerance of our addressees for a longer than usual questionnaire. First, the amount of interest shown by the high energy physics community, especially during the Berkeley Conference, was quite high. Whether or not individuals had heard of the proposal made by Moravcsik, they were quite interested in the problem when it was brought up. Second, we hoped that since it was their own organization, AIP, that would be requesting information for the purpose of improving physics communication, their reaction would be far better than if it came from a commercial or other self-interested source. Considering everything, we decided to trust our addressees to realize that, as perhaps is true in high energy physics, sometimes fairly large and cumbersome-looking equipment is required to make adequately detailed, delicate and reliable measurements of important phenomena. This confidence was vindicated as shown by the excellent response rate (see Section VI.A) and also by the fact that over a third of the respondents were so little disturbed by the questionnaire's length that they went on voluntarily to write (or type) anywhere from a few lines to a full legal page of constructive comments and suggestions.

In various stages of its development the questionnaire was seen by many people and was revised on the basis of their suggestions. As a "dress rehearsal" it was sent for pretesting to twelve physicists (including Moravcsik and Pasternack), eleven bheavioral scientists, and two information scientists. Most of these responded.

A copy of the questionnaire is attached as Appendix A.

C. The Questionnaire to "Preprint Librarians"

Since, as already explained, the information sought by the questionnaire to "preprint librarians" was of a more conventional nature (i.e. costs, numbers, growth rates, etc.), a less elaborate procedure was necessary. Nevertheless, the entire sequence of steps - study, orientation interviews, and pretesting - was followed. This development process was conducted independently of that of the questionnaire to physicists, although the selection of questions and their phrasing was closely coordinated between the two. A total of 83 questionnaires was mailed to addressees which were non-randomly selected from institutions found on the "preprint" distribution lists that we had at our disposal. The entire operation of preparation, mailing and analysis was carried out by Miss Clarebeth Maguire, formerly of the AIP staff, under the guidance of Mrs. Pauline A. Atherton, also formerly of the AIP staff. Miss Maguire's report is included in its entirety as Appendix C.

A copy of the questionnaire, which will be referred to as "Q2" (with questionnaire to physicists being referred to as "Q1"), is included as Annex I to Appendix C.

VI. THE EXISTING NETWORK

This is the first of three sections which report the quantitative findings of the project. This section reports those findings which primarily reveal the structure of the existing information "network" in theoretical high energy physics. First, an estimate of the response rate to the questionnaire to physicists is made. Then, using the data gathered, estimates are made of the number of THEP's, the number of organizations at which there are THEP's, and the distribution of THEP's among those organizations. Since the estimates (1) concern important issues in the PIE question, yet (2) cannot be considered firm, their derivation is explained in some detail to assist those interested in evaluating them.

A. Response Rate from the Questionnaire to Physicists

A total of 3943 questionnaires were mailed, as follows:

3557 - from Directory (see Section IV)
166 - names originally dropped out of Directory by accident
220 - additional names obtained from early returns of the questionnaires

---

3943 - Total mailing

For ease in following the development of this estimate, and the estimate of the total number of THEP's in Section B., following, the tally of returns as of 15 May 1967 is given in Table 1. along with the categories into which the returns were grouped, the abbreviations used for them and explanatory remarks. Any return from, or of, a mailed questionnaire falls into one of these categories. These will be considered as "heard from" since even the return of a questionnaire marked "Unknown" provided us with the information that that questionnaire had not reached anyone. The remainder will be considered as "not heard from".

The best strategy* seems to be to suppose that the distribution of those "not heard from" follows that of the "Total mailings 'heard from'". According to this, 43.7% of 1616, or 706 THEP's, must be assumed to have received the questionnaire but not responded in any way.

The total THEP's receiving the questionnaire would then be 1016 + 706 = 1722. The estimate of the response rate for THEP's receiving the questionnaire would then be $\frac{1016}{1722}$ or 59.0%. While the method of obtaining names for the directory was unavoidably biased towards the "producing" THEP's, there is no reason to feel that there was any significant bias in the mailing list with respect to the "producing" high energy theorists.

B. Number of Theoretical High Energy Physicists

The total number of theoretical high energy physicists in the world physics

*Others seem unjustifiably refined or not borne out by rough checks of trends in the returns.

Table 1. Returns from the Questionnaire for Physicists

Category	Abbreviation	Number	Remarks
Theorists	THEP	1016	Those who called themselves theoretical high energy physicists (usually as indicated by checkmark on the questionnaire)
Experimentalists	E	335	Also per their own statement
Other	O	317	Also per their own statement
"Unknown"	U	423	Our questionnaire was returned marked "Unknown"
Duplicates	D	161	The person addressed had been sent another questionnaire
Address Changed*	A	16	Our questionnaire was returned with a forwarding address given
Moved, No Forwarding Address*	M	59	Our questionnaire was returned with an indication that the person had moved but without a forwarding address
Requested Questionnaire	R	24	THEP's not in original directory who heard of project and requested questionnaire
Total "heard from"		2351	
Total mailings "heard from"		2327	(2351 - 24 "R")
Total persons "heard from" from mailings		2166	(2327 - 161 "D")
Total mailings "not heard from"		1616	(3943 - 2327)

*Lack of time and resources prevented these from being followed up.

community will be an important factor in the PIE decision. This number is estimated, by the process shown below, to be 2800 ± 200. If a respondent answered "yes" to Question 2 on the questionnaire he was counted as a theorist. The few cases that answered both "yes" and "no", or neither, were considered individually on the basis of all available information.

To go from data on the returns to an estimate of the total THEP population requires two steps. First, an estimate of the total number of THEP's in the mailing sample is made. This is carried out in Table 2. and gives a result of 2259 (including the 24 additional THEP's who had requested questionnaires). Second, an estimate must be made of the fraction of the total population which this represents. This follows.

The main trends tending to invalidate the estimate reached in Table 2. of 2259, are believed to be as follows: (1) The later returns showed significantly higher proportions of E's and O's, suggesting that many of these would not have responded had it not been for the reminder letter(s). This seems reasonable and suggests that a much higher proportion of the 1616 not heard from than estimated above would be E's and O's who, seeing that the questionnaire is aimed primarily at THEP's, are not planning to respond at all. This would reduce the final estimate. (2) Many of the U's may have left the theoretical high energy field, died, or may have gotten on the list through error in the first place. This would also reduce the final estimate. (3) The percentage of U's may not hold constant - it might reasonably be expected that "Unknown" post-office returns would come in more heavily at first, then taper off. This effect, surprisingly, has not been observed, but if it existed, it too would tend to decrease the estimated total of THEP's. Considering that all the effects just discussed tend to decrease the final estimate, and that no counter-trend is apparent, the figure of 2259 in Column 7 of Table 2 will be arbitrarily rounded off to 2000 as the estimate of THEP's in the 3943 total mailings.

There is at present no reliable way to estimate how many THEP's are not accounted for by our mailing sample. We had hoped to include a solid block of three years from the DESY Index, our major source of names, but were not able to. Therefore, some whose names appeared as authors in the 1965 and 1966 DESY Indexes were missed. Others missed, of course, are those who did not author anything during the three years. We can assume that some teachers and some administrators fell into this category. In hopes that it would be indicative, we determined what fraction of the authors of items categorized under theory listed in the December, 1966, issue of DESY (which had not been used to generate the directory) were already in our directory. This was 70.2%. Applying this to the previous estimate we would get 2850 THEP's. This is obviously not reliable, but gives a result which intuitively seems to be in the right "ballpark". The results of Price and Beaver[14], reporting an analysis of a generally related phenomenon, the flow of "memos" in IEG #1 (see Section X.A) are not directly comparable, but, again, seem to give "ballpark" confirmation. However, Price[15], commenting on the estimates of total THEP's we are making here, warned that they may be considerably off on the high side.

It is impossible to establish objective error limits for this estimate. For planning purposes, however, and to the extent that judgment based on working with the data can be trusted, we will assume the total world population of theoretical high energy physicists to be 2800 ± 200.

Table 2. Estimate of the Number of Theoretical High Energy Physicists*

Category	Code	Col. 1 Returns as of 15 May 1967	Col. 2 Percent breakdown of "Total mailings 'heard from'"	Col. 3 Distribution of "Mailings 'not heard from'" acc. to %'s of Col.2	Col. 4 Estimated distrib. of Total mailing (Col.1+ Col.3)		Col. 5 Percent breakdown of Total of THEP+E+O from Col.4	Col. 6 Estimated distrib. of Total of U+A+M Col.4 acc. to %'s of Col.5	Col. 7 Estimate of total THEP's on basis of returns: Col.4(THEP) +Col.6+R	Col. 8 Estimate of total THEP's: Col.7 adjusted as explained in text (Section VI.B)
Theorists	THEP	1016	43.7	706	1722		60.9	513	2259	2800 ± 200
Experimentalists	E	335	14.4	233	568	2827	20.1	170		
Other	O	317	13.6	220	537		19.0	160		
Unknown	U	423	18.2	294	717					
Address Changed	A	16	.7	11	27	843				
Moved	M	59	2.5	40	99					
Duplicates	D	161	6.9	112	273					
Requested Questionnaire	R	24	--	--	--					
Total "heard from		2351	100.0	1616 =Total "not heard from"	3943		100.0	843		
Total mailings "heard from"		2327 (=2351-24)								

*Note: Figures in this table refer to persons rather than questionnaires. E.g. the person who wrote a letter saying that his views were already well known would be counted as a THEP but would not be reflected in the number of questionnaires tallied in later reporting of detailed answers and cross-correlations.

C. Number of Organizations

Based on a straight count of different addresses used in the mailings, the number of organizations at which high energy theorists work, another important factor in the PIE decision, is 482. Of these, a negligible number, 5, were apparently private addresses. A much larger number were addresses of, say, a Department of Physics, at an institution for which there was a separate institutional address. It is impossible to know, without writing to each address involved, how many of these cases could be considered as able to be consolidated into one address if, as is the case here, the main concern is to identify the total number of addresses which would apply if distribution of WIC's were to be made to groups rather than to individuals. For such a purpose combinations of the addresses of different departments, of associated institutes or of the parent organization itself can sometimes be made, and sometimes cannot. A quick, necessarily rough, count of the original address list, yielded 176 such cases where there was a separate institutional address. On the other hand, 239 new addresses have been added since that time. While a large number of these are new only in that they add "Dept. of Physics", "Institute of Theoretical Physics", etc., and while some of them will turn out to replace previous addresses (a housekeeping task which our resources have not yet enabled), it would seem that most of them have to be considered as separate organizations unless found otherwise. For planning purposes, and to the extent that judgment can be trusted, we will assume that the total number of separate organizations at which theoretical high energy physicists work is 500 ± 50.

D. Distribution of Physicists Among Organizations

The only means we have been able to use so far to get an approximate idea of the distribution of theoretical high energy physicists among organizations, is based on the addresses used for the total mailing list. This includes the E's and O's as well as those not heard from. This information is given in Figure 1. From this it appears that over 50% of the world's high energy theorists are in the 10 largest organizations, and nearly 90% in the first 50 organizations in terms of size.

E. A Profile of the Population

A number of factors affect a researcher's need for, and his ability to acquire, information important for his work. Many of these are of such a nature that they can't be changed very readily to accommodate a specific and immediate information requirement. Nevertheless, by affecting (1) the number of other physicists with whom the researcher has established contact, (2) the time required to receive information and (3) the kind of information needed, they can influence the likelihood of that need arising and being satisfied. They can thus partly account for both his perceptions and his evaluation of the existing communication system. Several such factors will be discussed in this subsection in the light of the data compiled from, variously, all or part of the first 977 questionnaires.

In all tables where a mode is reported it should be assumed that there may be more than one peak to the distribution curve, but that the one reported is that representing the largest number of respondents.

1. Country In Which Respondent Is Working

The country in which a physicist works has a bearing on whether or not he is in or near the "mainstream" and on the ease with which he can travel

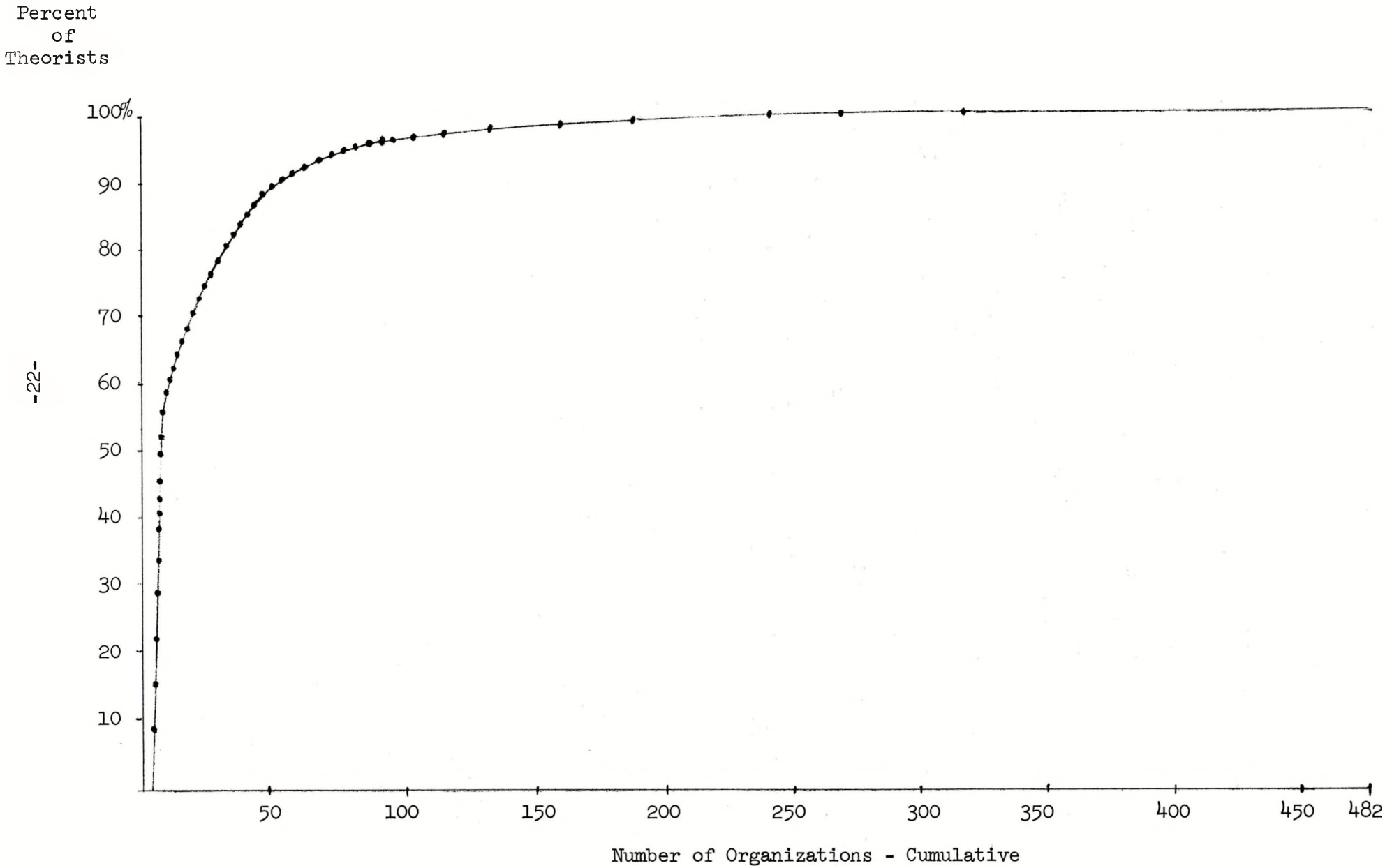
Percent of Theorists
100%
90
80
70
60
50
40
30
20
10
50
100
150
200
250
300
350
400
450
482
Number of Organizations - Cumulative

FIGURE 1

to important research centers. It also affects the time it takes for journals and WIC's to reach him and the expense of air mail.

Table 3. shows the number of respondents according to the country in which they are currently working and also according to citizenship. 42% of the respondents were working in the U. S.; 35% in the member nations of CERN.

This distribution, of course, is not representative of the distribution of world physicists. For example, the U. S. S. R. and the People's Republic of China are seriously under-represented.

2. Formal Education

The respondents as a group exhibit an unusually high level of academic attainment with respect to other physicists, with 81% of the respondents holding a Ph.D., as shown in Table 4.

Table 4. Highest Academic Degree or Level of Professional Certification Held

Degree	B.S.	M.S.	Ph.D.	Other	Could not be determined	No Answer	Total (N=997)
Percent	1.5	6.4	80.8	2.7	6.7	1.9	100

These figures may be compared with those obtained by the National Register which, for 1966, showed 86% of U. S. A. elementary particle physicists holding a Ph.D.[6] The length of time at the present level of academic attainment is also of interest. The date of receiving highest degree is shown in Table 5. for our respondents. Note that 61% have received their academic degree since 1960, as might be expected from the work of Derek de Solla Price[7].

Table 5. Date Highest Degree Received

Date	Before 1951	1951-1960	1961-1967*	Total
Percent	7.4	31.2	61.4	100

*6 respondents received their highest degree in 1967 and 90 received this degree in 1966.

3. Length of Time Working in THEP

The length of time a person has been working in theoretical high energy physics can affect the number of other physicists with whom contact has been established. In general the longer a person has been active in a given field the more satisfactory and efficient is his informal communication. These informal communication networks become more important for providing information in a so-called "hot" area, such as high energy theory than in fields with a slower rate of growth.

As Table 6. shows, 82% have been working in theoretical high energy physics 10 years or less, and 49% have been active in the area 5 years or less. It should be noted that for a mean of 6.3 years there is a relatively large standard deviation. The mode of 3 years represents approximately 10% of the sample. This

Table 3. Country of Employment and Citizenship*

Country	Country of Employment		Citizenship	
	Number	Percent	Number	Percent
Argentina	4	.4	6	.6
Australia	6	.6	7	.7
Austria	7	.7	13	1.3
Belgium	10	1.0	12	1.2
Brazil	1	.1	3	.3
Canada	16	1.6	19	1.9
Chile	1	.1	1	.1
Czechoslovakia	10	1.0	13	1.3
Denmark	8	.8	4	.4
Finland	2	.2	5	.5
France	46	4.7	38	3.9
Great Britain	79	8.1	89	9.1
E. Germany	1	.1	1	.1
W. Germany	21	2.1	20	2.0
Germany**	35	3.5	45	4.6
Ghana	1	.1	1	.1
Greece	--	--	3	.3
Hungary	8	.8	9	.9
India	24	2.4	59	6.0
Indonesia	--	--	2	.2
Iran	--	--	1	.1
Ireland	6	.6	4	.4
Israel	14	1.4	14	1.4
Italy	74	7.5	73	7.5
Japan	84	8.6	108	11.1
Korea	--	--	4	.4
Mexico	3	.3	1	.1
Netherlands	9	.9	10	1.0
New Zealand	1	.1	2	.2
Nigeria	1	.1	1	.1
Norway	--	--	2	.2
Pakistan	3	.3	8	.8
Poland	9	.9	12	1.2
Rumania	9	.9	9	.9
Spain	3	.3	5	.5
South Africa	5	.5	5	.5
Sweden	13	1.3	13	1.3
Switzerland	37	3.7	11	1.1
Turkey	2	.2	2	.2
United States of America	413	42.3	295	30.4
Union of Soviet Socialist Republics	4	.4	4	.4

(continued on following page)

Table 3. (continued)

Country	Country of Employment		Citizenship	
	Number	Percent	Number	Percent
Uruguay	--	--	1	.1
Yugoslavia	3	.3	8	.8
Code lacking	2	.2	9	.9
TOTAL	975	100.0	969	100.0

*The following additional data was recorded on an earlier tabulation but, apparently erroneously, omitted from the later tabulations reported above. For compatibility the percentages are given as if they were based on the Totals given in the main table

Country	Country of Employment		Citizenship	
	Number	Percent	Number	Percent
China	--	--	9	.9
Iraq	--	--	1	.1
Lebanon	1	.1	1	.1
Lithuania	--	--	1	.1
Sudan	--	--	2	.2
Viet Nam	--	--	1	.1

**Respondent did not specify E. or W. Germany

is not unexpected, given the relative recency with which so many physicists have earned their highest degree. No effort was made to determine what other area(s), if any, they had been in before moving into THEP. It should be added that some respondents appeared to include graduate training as part of their time in the area while others counted time only from the date they received their highest degree.

Table 6. Time Working in Theoretical High Energy Physics

Time	Years (unequal time intervals used) 3 or less	3.5-5.0	5.5-10.0	10.5 or more	Total (N=956)
Percent	24.6	24.7	33.1	17.6	1.00

Mean = 6.3 yrs. Mode = 3.0 yrs.
St. Dev. = 9.7 yrs. Range = 0.5 - 34 yrs.

4. Mobility

It is reasonable to suppose that the degree of mobility of a population is an important factor in both formal and informal communication. Its effects are not yet well understood; they undoubtedly range from the very important to the very trivial. One mundane, but perhaps not unimportant, consideration pertinent to the present case is that if moves are frequent and drastic there will be appreciable portions of a person's life when mailed communication of all sorts (journals as well as WIC's) reach him either late or not at all.

Table 7. gives the length of time THEP's have been at the institution where they are currently employed. Where Table 6. revealed a young population, Table 7. reveals a mobile one. In the majority of cases, THEP's have been at their present institution for 4 years or less. 13% of the sample accounted for the mode of 0.5 years.

Table 7. Length of Time at Current Employing Institution

Time	1	1.5-2.5	3.0-4.0	4.5-5.5	6.0-7.0	7.5	Total (N=952)
Percent	23.6	21.7	19.1	8.9	8.0	17.9	99.2

Mean = 4.5 yrs. St. Dev. = 9.0 yrs.
Range = 0.5 - 29 yrs. Mode = 0.5 yrs.

5. Professional Activities and Areas of Research

The kinds of activities and areas of research a scientist is engaged in affect his information needs. A physicist involved in administrative work, for instance, may have a somewhat greater need for material providing a general awareness of the current state of THEP than for that providing him with specific information as to who is working on what problems. Though the same source may

serve both functions, it will still be most important for the former.

As Table 8. shows, the activity ranked as most time-consuming is "Research and/or Development". 98% of the physicists spent at least some time in this activity; 79% ranked it first. The next most time-consuming is "Teaching", followed by "Research Guidance of Students or Subordinates". There is a relatively sharp break between these three activities and all others.

It is possible to get an overall ranking of these activities by looking at both the numbers of physicists engaged at all in each one and the modal rank assigned to it. To the extent that this modal rank corresponds to a ranking of that activity, based on the number of persons engaged in it at all, we can obtain an overall ordering of activities for physicists as a group. There is a very close correspondence between these two ranking criteria for the first four. For example, more respondents were engaged in "Research and/or Development" than any other activity and these respondents most frequently ranked it first in terms of time spent. Teaching was the second most engaged-in professional activity and it was also most frequently ranked second by respondents in terms of time spent. This holds all the way through the fifth most time-consuming activity, the performance of refereeing and/or editorial work for scientific and technical journals. Approximately the same number of persons were engaged in this type of work as were in administrative work, and nearly the same number of persons ranked it fourth as ranked it fifth.

6. Area of Theoretical High Energy Physics

Whether a person is working in one of the so-called "classical" areas in high energy theory or in a new, or a "hot", area may well determine how concerned he is with the timeliness of the information reaching him. The possible importance of this factor is underlined by the facts, shown in Table 8., that 98% of the respondents are engaged in R & D to some extent and that 79% of these spend most of their time on it.

The problem of making a functionally useful, non-overlapping, breakdown of theoretical high energy physics was too difficult to be undertaken during the study project. If an experiment is conducted this must be tackled but an empirical means of testing its usefulness will then also be available. In the meantime, the best that could be done was to use the list of areas in THEP from the program of the XIIIth International High Energy Physics Conference. The way this question was worded is to be particularly noted, "If one session were to be devoted to each area, which ones would you attend because you are currently working in that area? DO NOT SELECT MORE THAN 10. Enter the area number in the space provided and indicate how long you have been working in each area. Since this list is not exhaustive, space is provided for you to indicate other areas."

Table 9. shows these areas, the number of respondents listing each area, the average number of months working in that area and the standard deviation of the time. In virtually all cases the standard deviation was very large, indicating that the times reported varied over a wide range. On the average, respondents selected about five different areas.

7. Sociometric Structure

The elaboration of the sociometric structure of the THEP community was not an objective of this project. However, some of the questions we had to ask

Table 8. Professional Activities Engaged In Ranked According to Time Spent

Activity	Rank Assigned*									Percent of entire sample engaging in this activity (N = 977)
	1	2	3	4	5	6	7	8	Total	
Research and/or development (N = 951)	79.0	15.3	4.3	1.1	-	-	-	-	99.7	97.6
Teaching (N = 721)	20.2	54.2	20.5	3.7	1.1	-	-	-	99.7	73.8
Research Guidance (N = 599)	6.5	31.8	49.5	11.0	.8	-	.2	-	99.8	61.3
Administration (N = 299)	5.0	12.0	23.0	47.1	10.3	2.3	-	-	99.7	30.6
Editorial duties and/or Refereeing (scientific technical journals) (N = 286)	1.3	6.9	11.8	32.5	34.2	11.7	.6	-	99.0	29.3
Consulting (N = 162)	.6	12.9	21.6	31.4	24.6	8.0	.6	-	99.7	16.6
Studying for an advanced degree (Part or full-time student) (N = 105)	28.5	48.5	12.3	5.8	.9	.9	1.9	.9	99.7	10.7
Other (N = 26)	11.5	15.3	26.9	23.0	19.2	3.8	-	-	99.7	2.7

* "1" = Most time-consuming, etc.

Table 9. Areas Within Theoretical High Energy Physics Respondents are Currently Working In*

Area	No. of Respondents	Percent of 977	Mean Time (in months rounded to nearest month)	Standard Deviation (months)
1. Field theory axiomatics	124	12.7	45	51.4
2. S-matrix axiomatics	72	7.3	44	72.4
3. Analyticity in field theory	99	10.1	51	99.4
4. Analyticity in S-matrix theory	191	19.5	38	29.1
5. Asymptotic considerations	138	14.1	34	34.9
6. Theory of weak currents	286	29.2	35	40.5
7. Sum rules	256	26.2	16	18.1
8. Approx. hadron symmetries	304	31.1	32	27.3
9. Theory of T, C, P Violations	191	19.5	38	41.2
10. Theoretical dev. on intermediate vector bosons and neutrino reactions	135	13.8	43	36.7
11. Hadron form factors	209	21.3	30	27.9
12. Violation of quantum electrodynamics	101	10.3	40	39.5
13. Langrangian field theory	209	21.3	71	68.6
14. Hadron initiated reactions	173	17.7	50	39.6
15. Photon initiated reactions	145	14.8	48	46.6
6. General SU_3 considerations	332	33.9	29	18.9

(continued on following page)

Table 9. (continued)

Area	No. of Respondents	Percent of 977	Mean Time (in months rounded to nearest month)	Standard Deviation (months)
17. Electromagnetic mass splittings & magnetic moments of hadrons	162	16.5	25	24.3
18. Origin of octet enhancement	102	10.4	18	12.4
19. Misc. symmetry tests	115	11.7	31	28.5
20. Analytic Structure of partial waves	194	19.8	40	41.0
21. Off-shell dynamical quest.	144	14.7	29	22.1
22. S-matrix dynamics	187	19.1	44	31.1
23. Bootstrap models	190	19.4	32	30.8
24. Theory of small momentum	189**	19.3**	32***	26.5***
25. Theory of large momentum transfers	122**	12.5**	34***	27.2***
26. Others	235**	24.1**	50***	75.0***

*Respondents were asked to select no more than 10 areas. They selected an average of about 5.

**These figures are not, as are the others in this column, based on tabulation of 977 responses. That tabulation was omitted in error. The figures given for numbers of respondents are based on an earlier tabulation of the first 557 responses increased by the factor 1.8, a ratio found to hold quite uniformly between the two tabulations for the other areas. The figures given for percent assume these estimates hold in the population of 977.

***These figures are taken directly from the tabulation based on 557.

for other reasons yielded by-product data of sociometric interest. One instance had to do with the issue of whether or not the more highly regarded and active members of the THEP community would bother to respond to our questionnaire. Primarily to get information on this point, but also to obtain some basis for assessing the impact of the "invisible college" effect in theoretical high energy physics, if that turned out to be important to the PIE decision, we asked respondents to name persons with whom they frequently exchange technical information and also persons they believe to be doing important work in their area. (See Question 12 in Appendix A.) The primary results from these questions are given in Section VIII, Table 30. Some by-product information on the sociometric structure of our sample is shown in Table 10. This shows that, for example, 28%, or 274, of our 977 respondents were named once by some other respondent as being one of two persons with whom they "most frequently exchange information about their research".

Table 10. Frequency of Respondents Being Named by Other Respondents as an Information Contact* or a Research Leader

Professional Role		Number of Times Named										
		0	1	2	3	4	5	6	7	8	9	Total
Information contact* at one's own institution												
	Percent	.51	.28	.14	.04	.02	.01	.001	.001	-	-	100.2
	Number	501	274	133	44	17	6	1	1			977
Information contact* outside own institution												
	Percent	.62	.20	.09	.04	.02	.01	.003	.004	.002	.01	99.9
	Number	608	199	88	36	18	14	3	4	2	5	977
Information contact* either in or outside own institution												
	Percent	.36	.27	.16	.09	.05	.03	.01	.01	.01	.01	100.0
	Number	352	265	154	86	50	29	11	12	6	12	977
Research Leader												
	Percent	.79	.11	.04	.02	.01	.004	.007	.001	.006	.02	100.8
	Number	768	107	38	18	11	4	7	1	6	17	977

* "Information contact" is used here to mean a person with whom information is most frequently exchanged about respondent's work.

VII. THE EXISTING PATTERN OF INFORMATION FLOW

This section presents the salient patterns of information flow in theoretical high energy physics that were uncovered during the course of the study project. That this section does not present the total information flow picture within this field of physics is all too well appreciated. Limitations of resources and time required that priority be given to those factors having the greatest effects on the problems at hand. This meant that neither statistics about the established literature in theoretical high energy physics, nor information about oral and other "non-written" means of communication could be given as much attention as would have been desirable. Both will later, however, be studied and related to the present study as a routine part of the program of the AIP Systems Development Division.

A. Number of WIC's Circulated

The data gathered enable only rough estimates to be made of the total number of WIC's* circulated. It is impossible to state the exact number.

Responses to Question 7 of Q1, some of which are shown on Table 14., indicate an average of 7.15 manuscripts received per THEP per 2 weeks, or 186 per year. This cannot be used directly to estimate the total number of "titles" per year, which is the figure of interest, because of the lack of a reliable figure for the overall world average of the number of copies of each title distributed. The largest (plausible) response given to that question can, however, be used to give a minimum estimate, assuming that the respondent was estimating different titles. This was 50, or 1300 in a year. Corresponding maxima for reports and copies of oral presentations give 1560 and 572. Assuming no overlap between categories we get 3432 as a minimum of WIC titles per year. Though these were reported by THEP's they may contain other than theoretical WIC's, however.

Perhaps the most clean-cut source of data for this estimate is to be found in Question 8d of Q1. Of a total of 977 respondents, 176 had "sent out" one WIC in the previous 12 month period and 582 had "sent out" more than one. Since WIC's frequently have more than one author, "sent out" must be taken to include "co-authored". Let us, for convenience, call each such appearance of an author's name on a WIC an "appearance". The remaining 219 either sent none out or didn't answer that question. In terms of percent of the total, 18.0% accounted for one "appearance" and 59.6% accounted for more than one. If "more than one" is conservatively taken as two, then for each 1000 THEP's there were 180 + 2 X 596, or 1372 "appearances" during a 12 month period for an average of 1.4 per THEP per year. However, if "more than one" is taken to be 2.2, to yield round numbers, we have an average of 1.5 "appearances" per THEP per year. This will be used for planning purposes. The total number of WIC's will, using this approach, be dependent on the prevalence of collaboration in authorship and on the estimate of the total THEP population. The best estimate we have been able to make so far of authors versus WIC's in theoretical high energy physics yielded a ratio of 1.85 authors/WIC.** Using this and taking 2800 as the total THEP population, an estimate for the total number of WIC's per year would be:

*Defined in Section I.B, page 1.

**This is generally in accord with values reported by Price and Beaver[14].

$$\frac{1.5 \times 2800}{1.85} = \frac{4200}{1.85} = 2270 \quad \text{- say 2300.}$$

"Ballpark" confirmation can be obtained from Questions 6 and 11 of Q2. In the first case the maximum average number of "preprints" reported being received by a "preprint library" per week was 150 for 7800 per year, but this must have included other than theoretical WIC's. The average reported was 33 (among the U. S. respondents) for 1716 per year. An attempt to estimate the number of WIC's per physicist per year from data obtained in Question 12 of Q2 gives 1.2.

B. Distribution Patterns

Seventy-eight percent (762) of the respondents had distributed copies of unpublished information (excluding private correspondence) about their work to persons outside their institution during the past 12 months. 76% (582) of these (60% of all respondents) had sent out more than one such communication. 91% (690) of those who had distributed replied affirmatively to the question, "Did any of the unpublished information you distributed in the last 12 months constitute the basic content of an article you have submitted to a journal for publication?"

Table 11 shows when this unpublished information tended to be distributed relative to its publication, and the average size of that distribution.*

The standard deviation shows that there is considerable variation among the respondents in terms of the number of copies sent out at any stage. Also many persons seem to distribute the same communication at different stages. 16.2% of those distributing (12% of the total) had submitted the communication to more than one journal. Whether this was because the journal of first choice considered it to be below standard or best suited for publication elsewhere cannot be determined from our data.

The experience of institutions with regard to the number of copies of WIC's sent out was sought by Q2. Their responses are shown in Table 12.

Table 12. Average Number of Copies Made of Each "Preprint"

As reported by:	Average	Range
16 U. S. institutions	233	50-800
11 Non-U. S. institutions	137	25-300

However, this does not equate with the numbers of names reported on institutional mailing lists as given in Table 16. in the next subsection.

Means used by institutions to obtain "preprints" for their "preprint libraries" are shown in Table 13.

*For a discussion of the timing of communications at various stages in a different discipline (psychology), see the American Psychological Association[13].

Table 11. Distribution of Unpublished Information by Stages*

Stage of Distribution Related to Journal Publication	Number of Persons Distributing Only at This Stage	Total Number of Persons Distributing at This Stage**	Average Number of Copies**	Standard Deviation
Before Submitted to Journal	121	198	94	115
At the Same Time It Was Submitted	147	244	134	145
After It Was Submitted but Before It Was Accepted	20	85	63	80
After It Was Accepted	7	62	63	156

*This table based on the first 557 responses received

** Of the 410 physicists responding to this question, 115 had distributed unpublished information at more than one of the stages listed in the question.

Table 13. Means of Obtaining Preprints (U.S./Non-U.S.)

Means of Obtaining Preprints	Institutions' Rank of Source 1st	2nd	3rd
a. By requesting inclusion on preprint mailing lists	12/9	2/2	2/2
b. By routine inclusion on preprint mailing lists	4*/4	9/4	2/2
c. By requesting preprint included on other's list of preprints	-/-	2/2	4/5
d. Individuals in group donate preprints they received	3/1	6/4	7/1
Totals	19/14	19/12	15/10

* Includes one institution with 3 yr.-old collection, one with 6 yr.-old, and two with 8 yr.-old collections.

Additional information on the comparative distribution patterns of various scientific information media is given in Table 14. Respondents were asked to estimate the quantities of the various kinds of communications they had "received or sent during the PAST TWO WEEKS".

C. Distribution Lists

One of the issues raised in discussions of the PIE proposal was the extent to which THEP's would use a mailing list maintained by their institution instead of using a personal mailing list. An effort was made, therefore, to ascertain the present situation with respect to the use of institutional and personal mailing lists. Asked, "Does your institution maintain a mailing list for outside distribution?", 58% (567) answered "yes" to this question. In responding to Q2, 28 of 32 institutions said they maintained institutional mailing lists.

Table 15. shows the relative usage of different means of distributing their unpublished documents based on the first 977 responses. Note that the percentage figures in this table add up to more than 100%. Their meaning is, for example, 36% of the 977 respondents reported that they used the "On Request" mode at some time to distribute information.

Table 15. Means of Distributing Unpublished Documents

Means of Distribution	Percent (N = 977)
On Request	36
Personal Mailing List	64
Institution Mailing List	34
Other	7

Table 14. Scientific Communications Received or Sent in Two Week Period

Media	No. received or conducted at place of work			No. sent (or conducted) outside institution		
	Ave.	St.Dev.	N	Ave.	St.Dev.	N
Journal articles read in own or library copy	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Reprints	5.02	9.05	664	5.34	13.93	581
Manuscripts (including drafts)	7.15	12.46	625	9.10	24.64	493
Technical reports distributed within own institution	1.78	4.73	525	4.81	17.52	412
Technical reports distributed by other than own institution	7.58	12.90	605	n.a.	n.a.	n.a.
Telephone calls	1.62	5.19	530	1.31	4.82	445
Face-to-face discussions with persons working at your own institution	8.93	11.41	8.4	n.a.	n.a.	n.a.
Face-to-face discussions with persons not currently working at your institution (e.g. at scientific meetings, etc.)	2.43	4.99	637	1.67	3.05	436
Copies of oral presentations (including lecture notes and conference proceedings)	1.59	2.58	572	0.98	6.00	385
Private correspondence	1.54	2.67	599	1.51	2.66	518
Other	5.44	7.48	27	*	*	*

* Data not tabulated

Although most respondents have institutional or departmental automatic mailing lists available, only about a third of the total respondents use such lists at all.

Table 16. gives information obtained by Q2 about the sizes of institutional mailing lists.

Table 16. Size of Institutional Mailings Lists

		Number of persons on list		Number of institutions on list		Total Ave.
		Domestic	Foreign	Domestic	Foreign	
U. S.	Average	137	71	66	46	320
(N = 15)	Range	30-314	5-170	15-258	5-110	
Non-U. S.	Average	21	102	10	61	194
(N = 13)	Range	1-45	3-230	3-40	22-113	

D. Functions Served by Information Channels

To have any confidence that a decision or an innovation made with respect to scientific communication is a reasonable one, some general understanding is essential as to what the information functions and needs are in the field under study and what particular scientific communication media, or channels, serve each of them. To date, the identification and characterization of information functions and needs, in the context of an entire scientific community, can only be done in general, intuitive and qualitative terms. Our ability to identify and characterize "scientific communication media, or channels" is not much better. However, given an assumed set of (statements of) such needs, and another assumed set of media, studies can be made to determine the functions for which various media are "competing" and the nature and extent of that competition. It is also important to try to infer which functions are particularly important ones. Whether or not a particular medium is technically the best suited for performing a given function cannot be considered here, nor can judgments concerning the legitimate functions or "exclusive rights" of various media.

1. General Comparison

Table 17. shows the relative frequency with which various media were mentioned by our respondents as best serving particular functions. When journal articles are considered relative to each of the other media for scientific communication it becomes clear that they are very important in serving all information functions. Journal articles are the single most frequently cited medium for all but one function, and in that case it is the second most frequently cited medium. The media that seem to "compete" most consistently with journal articles are "face-to-face discussions with persons working at your own institution" and "manuscripts (including drafts)".

Table 17. Media Selected as Best Performing Certain Information Functions

Media

1. Journal articles read in own, or library copy
2. Reprints
3. Manuscripts (including drafts)
4. Technical reports distributed within own institution
5. Technical reports distributed by other than own institution
6. Telephone conversations
7. Face-to-face discussions with persons working at your own institution

Media

8. Face-to-face discussions with persons not currently working at your own institution (e.g. at scientific meetings, etc.)
9. Oral presentations made at scientific meetings or conferences
10. Copies of oral presentations (including lecture notes and conference proceedings)
11. Private correspondence
12. Other

Functions	Media												N
	1	2	3	4	5	6	7	8	9	10	11	12	
	%	%	%	%	%	%	%	%	%	%	%	%	Number
a. General awareness of current state of theoretical high energy physics	37	4	11	0	7	.2	5	4	14	13	.1	3	922
b. Find out who is working in what area or on what problems	39	3	12	1	10	1	5	13	9	5	1	3	910
c. Source of specific ideas for work in progress	20	6	14	.1	9	1	30	12	2	1	3	2	905
d. Source of specific ideas for new work	22	5	14	1	11	.4	19	16	4	4	1	3	883
e. Inform others of my research activities	23	10	29	7	7	.4	3	6	8	.6	2	3	889
f. Getting up to date in a new area	43	3	4	.4	5	.2	4	3	7	27	.5	3	885
g. Browsing/stimulation	40	3	7	.2	7	.1	13	10	7	8	2	2	834
h. Other functions of importance to your work	17	7	8	0	6	2	15	13	5	1	11	15	110

However, the term "preprint" as it has been used in connection with the PIE proposal encompasses several of the media which are listed separately in Table 17., just as "Journal Articles" probably should be considered as encompassing several separate media such as "Letters", "Articles" and "Reviews". To present a more realistic picture of the decision we are dealing with, Table 18. shows two different groupings of the other-than-journal media. In the first of these groupings only manuscripts, technical reports distributed by other than own institution and copies of oral presentations (a minimal coverage of the concept "preprint") are combined. Other non-journal media are shown combined. In the second grouping reprints and technical reports distributed within own organization are moved from the "other" category to the "preprint" group to form what could be called written distribution outside of the established literature.

It must be remembered that the groupings in Table 18. are artificial and arbitrary. If respondents had been given the opportunity to select the groups as a single medium they might well have come up with different percentages.

Table 18. Comparison of Journal Articles and Other Media of Communication Performing Various Information Functions

	Journal article read in own, or library, copy	Unpublished documents (ms., tech. R. dist. outside +copies of oral pres.	Other	Written informal communi-cations (reprints, ms., tech. R.+co. of oral pres.	Other	N
a. General awareness of current state of theo. high energy physics	32.4	33.8	33.0	37.5	29.3	527
b. Find out who is working in what area or on what problems	36.4	28.0	34.7	32.3	30.4	518
c. Source of specific ideas for work in progress	19.9	21.7	57.7	27.4	52.0	517
d. Source of specific ideas for new work	20.7	28.2	50.1	34.2	44.1	506
e. Inform others of my research activities	21.2	35.3	42.4	52.6	25.1	513
f. Getting up to date in new area	41.5	37.2	20.5	40.6	17.1	516
g. Browsing/stimulation	41.8	20.4	37.2	23.4	34.2	487
h. Other functions of importance to your work	21.9	15.0	62.5	24.5	53.0	73

To get a better picture of the pattern of use of the established literature respondents were asked to indicate what journals they "scan regularly (i.e. at least read Table of Contents or Abstracts or Summaries, etc.)". The results are shown in Table 19.

Table 19. Relative Usage of Primary Journals

Journal	Percent Scanning Regularly (N=977)	Journal	Percent Scanning Regularly (N=977)
Physical Review	94	Progress of Theoretical Physics	45
Physical Review Letters	94	Nuclear Physics	44
Nuovo Cimento	85	Soviet Physics - JETP	44
Physics Letters	80	Physica	13
Annals of Physics	67	Others	29
Journal of Mathematical Physics	51		

2. Alerting as to the Existence of Relevant Information

One of the fundamental questions of the entire scientific communication problem is how the existence of relevant information is, or might be, brought to the attention of those who should see it. This question is obviously generally relevant to the PIE decision. It is particularly relevant if a PIE experiment seems indicated, since it has implications with respect to whether the experiment should call for only an announcement service, for distribution of WIC's to "preprint libraries", for distribution of WIC's directly to individuals, etc. Respondents were asked to select, from a list of six, the one most important way in which they learn about the existence of relevant information. The results are given in Table 20.

Table 20. Media Selected as Being the Most Important Way of Learning of the Existence of Relevant Information

Media	Percent Selecting
Journal and abstract indexes, acquisition lists,etc.	21
Regular scanning of literature	45
Programs and proceedings of scientific meetings	5
Colleagues	22
Librarians and technical information personnel	1
Accidental exposure to information itself	3
No Answer	3
Total (N=977)	100

3. Serving the Purposes of the Authors

What may well be among the most important functions that must be performed in any scientific communication system, or network, are those whose primary purpose is to serve the needs of the authors. This has been recognized by a few for some time.* It is currently being given increasing attention, as exemplified by Kilgour[16] and, particularly, by Storer[8] whose suggestions about the needs of scientists to get competent response to their work are highlighted in Section X.A. Information obtained which bears on these functions is given in this subsection.

Sixty-one percent (467) of the group that said they had distributed copies of unpublished information during the past 12 months said (in reply to a direct question) that they had received responses from the recipients. Respondents were also asked to indicate the extent to which they had previously communicated with the person involved in the most recent instance of this.** This information is shown in Table 21.

Table 21. Extent of Previous Communication With the Person Providing the Most Recent Response to an Unpublished Document

Extent of previous communication	Very frequently	Occasionally	Seldom	Never	
Percent	15	28	16	41	N=454

(Based on 977 returns.)

41% of the physicists providing the most recent response to an unpublished document never had been in contact with the author before and an additional 16% were classified by the authors as having had relatively little prior contact with them.

The time element, by which we mean particularly, but not exclusively, the amount of time elapsing between two specifiable events, is a little understood but presumably important factor in scientific communication in general and in the PIE decision in particular. Of the respondents receiving responses to some prior communication they had distributed, 31% received that response in approximately one week. Table 22. gives the distribution of these time periods on the basis of the first 977 questionnaires.

Table 22. Time Between Sending a Communication and Receipt of Response

Time elapsed:	1 week	1 month	2 months	3 months	3 months	Total
Percent	31	38	13	9	9	100 (N=475)

*S. Goudsmit, Senior Editor of the American Physical Society, pointed this out long ago.

**The technique being used here is called the "critical incident technique" by behavioral scientists, for the benefit of a few who have questioned this particular question. Its validity is, in general, dependent on getting a sufficiently large and randomly sampled number of instances to form a reliable pattern.

Table 23. shows for each of the categories of responding recipients used in Table 21., the distribution of the time elapsing between our respondent's sending the WIC and his recipient's response. (This table is based on the first 557 questionnaires received.) Thus, of those authors whose most recently received reply was from persons with whom they were in very frequent contact, 44% heard within one week. Percentage differences are considerable during the "one week" period. At the "one month" interval they are quite similar for the "very frequently", "occasionally" and "never" categories. Other data (see Table 26.) shows that 62% of all replies came in the form of a letter.

Table 23. Past Communication With Respondent and Time Lag

Extent of Prior Communication	Time elapsed between sending of a communication and the receipt of the most recent reply						
	1 week	1 month	2 months	3 months	>3 months	N	%
Very frequently	44.2	46.5	9.3	--	--	42	100.0
Occasionally	29.9	48.1	6.5	7.8	7.8	77	100.1
Seldom	30.6	26.5	14.3	14.3	14.3	49	100.0
Never	27.5	42.2	13.8	11.0	5.5	109	100.0

The various effects of these replies on the author's work are shown in Table 24. Since most respondents selected only one way in which the reply affected their work in two different distributions were calculated, one based on the first effect selected and a second based on all effects chosen.

It is interesting to note that in only 24% of the cases was the reply of little or no significance or was received too late to have any influence on the document.

Table 24. Effect of Reply on Author's Work

Effects of Reply on Work	Those Making Only One Choice		All Choices	
	No.	%	No.	%
1. It suggested a new approach	39	9	37	7
2. It resulted in a reformulation of a problem	22	5	32	6
3. It caused me to drop plans to publish the information	4	1	11	2
4. It helped me to improve my presentation	126	29	144	26
5. It arrived too late to have any influence on my work	43	10	48	9
6 It served to substantiate my work	61	14	107	20
It was of little or no significance to my work	74	17	80	15
8. Other	65	15	85	16
Total	434	100	544	100

The relative usage of different media by our respondents in sending out their original communications is shown in Table 25. The relative usage of the same media by those who responded to our respondents' communications is given in Table 26.

Table 25. Form of Original Communication

Medium	Telephone	Face-to-face discussion	Letter	Manuscript	Technical report	Reprint	Other	Total (N=456)
Percent	1	5	8	46	25	8	7	100

Table 26. Form in Which Reply Came

Medium	Telephone	Face-to-face discussion	Letter	Manuscript	Technical report	Reprint	Other	Total (N=460)
Percent	8	22	62	5	2	0	1	100

4. Improving the Quality of WIC's

The distribution of WIC's may also perform an editorial function which may be of appreciable consequence. Table 18. shows that in 26% of the cases reported, the author felt the reply had helped him to improve his presentation. Another item of information bearing on the question of quality of WIC's was obtained in responses to Q2: Most institutions have no standard procedure for reviewing WIC's before distribution. However, three of the 19 U. S. institutions responding and four of the 14 outside of the U. S. require a release or approval before a "preprint" is distributed.

D. Importance of Various Information Channels

Respondents were asked to rate the overall importance of each of the various media "in furnishing scientific information for your current work". Their ratings are shown in Table 27. in which each medium is rated independently of the others on a seven-step scale ranging from "Very Important" for the first step to "Of No Importance" for the seventh. The two media rated highest as means of obtaining information, "Journal articles" and "Discussions with persons at one's own institution", represent rather opposite extremes of formality. These same media were the most frequently cited as providing specific ideas for new work in progress (see Table 17.). This suggests that, as might be expected, these functions may be of particular importance to this group of physicists, but does not necessarily imply that other media might not be rated more highly if they were more developed or available.

A manual spot check of those checking "other" in Table 27. indicates that these are almost entirely "preprints". Presumably, then, a distribution of these into the preceding categories would, therefore, affect "Drafts of Manuscripts" most.

Table 27. Rating of Various Media in Terms of Their Overall Importance in Furnishing Relevant Information

Media	Percent Assigning Various Rating*							Percent not ranking media	Total (N=977)
	1	2	3	4	5	6	7		
Journal articles read in own or library copy	61	19	10	5	2	0	0	2	99
Reprints	25	13	14	15	10	9	9	5	100
Drafts of manuscripts	25	12	10	9	6	9	20	9	100
Technical reports distributed within own institution	6	6	10	12	10	13	32	11	100
Telephone conversations	27	15	10	11	8	8	12	8	99
Face-to-face discussions with persons working at your own institution	49	20	11	8	3	2	3	4	100
Face-to-face discussions with persons not currently working at your own institution (e.g. at scientific meetings, etc.)	29	20	18	13	6	5	4	5	100
Oral presentations made at scientific meetings or conferences	8	16	20	18	16	8	8	6	100
Copies of oral presentations (including lecture notes and conference proceedings)	19	23	22	12	7	4	6	6	99
Private correspondence	11	16	18	15	11	10	11	9	101
Other	7	2	1	1	0	0	2	87	100

* "1" = very important, etc.

VIII. ATTITUDES OF THE THEORETICAL HIGH ENERGY PHYSICS COMMUNITY

Many physicists have supposed that the question of whether or not there should be a PIE service - or, in many cases, even a PIE experiment - could be determined simply by determining the attitude of those affected. Others have felt that there were so many complicating factors involved that this would not be a safe policy. The latter have prevailed, which is why this study was established. This does not mean, however, that the attitudes of those who would be affected is not an important factor in the decision as to whether or not an experiment should be conducted. It is an extremely important factor for several reasons. In the first place, if the attitude were hostile enough, no experiment could succeed, even in the sense of gathering useful and reliable data, no matter how well it was designed and run and no matter how sound the original decision to conduct it. In the second place, behind any attitudes there are bound to be reasons, explicit, implicit, or both. These reasons, if they could be determined, would be invaluable guides to the design of an experiment which might hope to provide the most advantages with the fewest disadvantages. Finally, if there are inhomogeneities in the population of such a size or nature as to make an experiment appropriate for one part of the community but not for some other part, this situation might first be brought to light through expressions of attitude.

This section presents our findings about the attitudes of the theoretical high energy physics community. The principal tool used to determine this was a set of three questions (counting as a question one that was merely an open-ended invitation to make comments or suggestions) on Q1. Respondents were given the following description: "Consider a centralized service in which communications in high energy theoretical physics were to be received by a central agency, duplicated and circulated to member institutions. Any institution throughout the world having researchers in theoretical high energy physics would qualify for membership, i.e. researchers at these institutions would be able to both contribute and receive papers. Papers already published would not be included."

They were first asked to describe what they considered the major advantages and disadvantages in such a service. 90% of the respondents provided such information. Since this act in itself involved some effort, it is some indication of concern for the subject of communication in high energy theory. Even more impressive are the actual results. In general, the answers were thoughtful and showed, by listing at least one advantage and one disadvantage, that the respondents had seriously considered the problem. A coarse summary of the statements of advantages and disadvantages is shown in Table 28.

The next question was: "Considering the advantages and disadvantages you have listed in the previous question, do you think such a centralized service should be tried on an experimental basis?" The responses to this, the basic opinion question, are given in Table 29. for the overall respondent group and for various subsets of it discussed below.

Table 28. Summary of Statements by Respondents of Advantages and Disadvantages*

Advantages	No.	%	Disadvantages	No.	%
1. More economical system of distributing preprints	96	7	1. Costly to operate and/or join	77	8
2. New information will be disseminated faster (regular service)	402	31	2. Centralization would introduce additional time lag in the distribution of unpublished documents	127	13
3. More people will be exposed to information	180	14	3. Too large a volume of unpublished documents would result	142	14
4. More information will be disseminated	238	18	4. Proportion of worthwhile material would decrease thereby requiring more effort to find it	54	5
5. Reduce the likelihood of research being duplicated	32	2	5. An undesirable increase in unverified or irrelevant information (lowering of standards)	213	21
6. Easier for small institutions and isolated individuals to receive information	212	16	6. No quality guarantee associated with refereeing process (lack of refereeing)	87	9
7. Novel ideas that do not normally get by the editorial/refereeing process will get exposure	15	1	7. Priority problems might arise	25	2
8. Increase in scientific discourse	18	1	8. Would (might) substitute for journal publication	84	8
9. General endorsement, e.g. "great", "seems to be a good idea"	22	2	9. Too restrictive if limited to only THEP	10	1
10. Suggestion made concerning design of a service	17	1	10. Negative comments concerning mechanics of PIE, e.g. lack of indexing, inconvenient if only one copy sent to an institution, lacks selectivity	64	6
11. Other	61	5	11. General opposition to the idea, e.g. "waste of paper and postage"	19	2
			12. Other	76	8
			13. Could not determine what respondent meant	19	2
Total	1293	98		997	99

*A maximum of three choices from 1-8 advantages and one advantage from 9-11 were coded for each respondent. Up to three disadvantages were allowed from among 1-9 and one from 10-13. 10% (98) of the entire sample did not answer this question; 19% (190) of the entire sample listed one or more advantages but no disadvantages; 6.8% (66) listed no advantages but gave one or more disadvantages.

Table 29. Attitude Toward "PIE" Proposal

	Yes, without reservations	Yes, with some reservations	Undecided	No, but possibly with some modifications	No, absolutely not	Did not answer	Based on # of respondents
1. Total group	42	33	9	7	6	3	977
2. Those rating manuscripts of least importance for their current work	38.3	37.4	8.4	6.5	9.3	-	557 (N=107)
3. Those engaged to any extent with editorial/refereeing duties	32.5	36.7	10.2	6.0	14.4	-	557 (N=172)
4. Those working in the U. S.	34.9	34.9	10.2	8.4	11.6	-	557 (N=249)
5. Those working outside U. S.	48.2	37.6	7.3	2.4	4.5	-	557 (N=245)
6. Those making comments	33.7	37.0	8.2	8.7	12.5	-	557 (N=208)
7. Those not making comments	47.9	35.3	8.7	3.3	4.8	-	557 (N=334)

Of the three major types of WIC's physicists receive from outside their institutions, "manuscripts" received the largest number of low ratings in terms of its overall importance in furnishing scientific information. In fact, it can be seen in Table 27. that 20% of those evaluating manuscripts gave it the lowest possible rating. Since manuscripts may be the type of unpublished documents distributed most frequently by a centralized agency it becomes interesting to see how this group responded to the question concerning the desirability of an experimental service. This is shown on Line 2 of Table 29. That this group of respondents did not vary greatly from the total sample raises the possibility that manuscripts were rated low because relatively few are received and not because they are generally of little value. Otherwise, one would expect this group to be more hesitant in endorsing a program that would disseminate more items they considered of little value.

Approximately 29% of the physicists in the first sample of 977 engaged in some editorial and/or refereeing activities. This group, perhaps more than others, are involved in the process of orderly communication in theoretical high energy physics. Their opinions or attitudes on an experimental program are also shown in Table 29. on Line 3. Line 4 shows the dispositions toward PIE of physicists working in the U. S.; Line 5 of those working outside the U. S.

An unexpectedly large proportion of the respondents (36% of the first 952) have provided constructive and very valuable comments or suggestions by writing

or typing on the last (blank) page anywhere from a line to a full legal length page. These have all been studied, and while the gist of their contributions cannot be summed quantitatively, they are generally consonant with the general attitudes indicated by Table 29., by the Berkeley Conference interviews, and other sources. Lines 6 and 7 of Table 29. which are based on only the first sample of 557, show the response to the attitude question of those who went on to make comments and of those who did not.

As already stated (Section VI.E.7) one issue was whether or not the more highly regarded and active members of the THEP community would bother to respond to our questionnaire. Table 30. indicates that the more often a person is named as a contact or as doing the most important work in respondent's area, the more likely he is to have responded to our questionnaire. This is indeed a heartening confirmation that those held in high regard in the theoretical high energy physics community are acting responsibly, hence that whatever decision the community reaches with respect to the PIE proposal will be the best one that could be made under the circumstances.

On the basis of the attitudes reported in this section and our analysis of the data obtained in general, the development of a design for a possible experiment with some sort of centralized preprint distribution scheme seemed clearly indicated. Such a design is proposed in the next section.

Table 30. Response to Questionnaire by Contacts and Leaders

Number of Times Named	Persons With Whom Most Frequently Exchange Information						Persons Named as Doing Most Important Work		
	In Own Institution			Outside Own Institution					
	Total Physicists Named	Number Responding to Questionnaire (in first 977)	% of Total Named	Total Physicists Named	Number Responding to Questionnaire (in first 977)	% of Total Named	Total Physicists Named	Number Responding to Questionnaire (in first 977)	% of Total Named
0	1676* (2800-1124)	500	30*	1978* (2800-822)	608	31*	2352* (2800-448)	768	33*
1 or 2	1021	407	40	702	287	41	341	145	43
3 or 4	92	61	66	81	54	67	50	29	58
5 or 6	10	7	70	26	17	65	20	11	55
7 or more	1	1	100	13	11	85	37	24	65
Total of those named one or more times	1124	477	42	822	369	45	448	209	47

* These numbers must be considered suggestive only since they are based on the assumption that there are a total of 2800 persons.

IX. PROPOSED EXPERIMENTAL DESIGN

This section details one possible design for an experiment with centralized WIC distribution in theoretical high energy physics. Discussions of alternatives and of reasons for particular choices will be left to the general discussion in Section X of the desirability and nature of an experiment. An exception to this is Section IX.C. where the question of charging participants for products and services provided by the experiment is discussed. The related question of cost estimates is taken up in Section XI.

A two-step experiment is proposed. The first step would consist of a weekly WIC announcement service and a concurrent directory service. These would run for about six months. In the second step, actual hard copy distribution of WIC's directly to certain selected and authorized individuals but under strict control of the authors would be added to the experimental announcement and directory services. There would be a definite termination date set at 18 months after the first step was put into operation.

It is recommended that no membership requirements be imposed, except with respect to field. That is, anyone willing to claim (or able to show, if challenged) that they are working in THEP an appreciable fraction of their time would be sought and welcomed as a participant.

While "a" central agency is referred to, there are many reasons to investigate the possibility of several geographically central agencies working in close coordination under the direction of a single agency. The project has had neither time nor license to explore such possibilities, but it will be undertaken by AIP's staff if it should become apparent that an experiment is to be conducted.

A. Announcement and Directory Service

It is proposed that a WIC announcement service be established on a weekly basis with mailings direct to individuals. In addition a directory would be furnished initially, updated occasionally, and replaced at either a six-month or an annual interval depending on experience with the system.

A format has been designed to be responsive to the needs discovered by the project. This is shown in Figure 2. In the center of the page the title, author and the addresses of the authors would be given together with the number of pages. In the columns at the left would be checked those categories of subject matter which the author had indicated on his submission of a WIC to be announced. These sub-categories, hopefully six to twelve, would be developed by analysis of the answers to Question 4 on Q1 (see Table 9.) carried out with the assistance of theoretical high energy physicists.

In the space on the form to the right of the center column provision is made to indicate the type of WIC being announced and the degree of review or refereeing that it has had. The type is indicated by a check in one of the first three columns following the suggestion by H. C. Wolfe of AIP that these be indicated as "preprints" if it has actually been accepted by a journal, "draft" if it has been submitted or is intended to be submitted to a journal, and "note" if it is an informal discussion, "half-baked ideas tossed out for

SUBJECT CATEGORIES

A - Gneral
B - General Reactions
C - E-M Reactions
D - Strong Interactions
E - Strange Particles
F - Symmetry Principles
G - Field Theory
H - Other

TITLE

Author(s)
Address(es)
Number of pages
Date Accepted

TYPE

STATUS

Preprint
Draft
Notes

Reviewed by
Colleagues
Supervisors

Formal Approval by
Institution
Non-Journal Referees
Journal Referees

A	B	C	D	E	F	G	H	TITLE	Preprint	Draft	Notes	Reviewed by: Colleagues	Reviewed by: Supervisors	Formal Approval by: Institution	Formal Approval by: Non-Journal Referees	Formal Approval by: Journal Referees
	x			x				A Borderline Model for Xi-Squared Proton Scattering Leeb, N. F. Smaje, Q. C. Jones University, Urban, Transylvania 24 pages July 4, 1967	x							x

Suggested WIC Announcement Format

FIGURE 2

comment", criticism of others' WIC's, etc. These categories could be changed or others, such as reports and transcriptions of oral presentations could be added, but it would seem to be better if the number of categories here could be held to about three. Perhaps "preprints" and "reports" should be combined into one category, characterized by no further revisions being anticipated by the author.

The remainder of the columns on the right hand side of the form would be used to indicate the degree of review or refereeing which the document being announced had been subject to. This would enable those respondents who said they would not want to see unrefereed WIC's to avoid asking for them. The column headings suggested for this field are as follows:

1. Reviewed by colleagues
2. Reviewed by supervisors
3. Approved by institution
4. Accepted by referees other than for journal publication
5. Accepted by referees for journal publication

Lack of any refereeing at all would be assumed if no checks were made.

Phase I of the experimental service is presented in flow-charted form in Figure 3 to indicate how it might be reduced to a systematic procedure. By a "name code" is meant a unique numeric (or alphanumeric) representation of a name. Such codes are used in lieu of the name itself for two basic reasons, to save space and time, therefore money, and to require and facilitate a decision at the input to the system that a given name is or not one that has already been entered into the system. Similarly for "address code" with respect to mailing addresses. Most of the name codes and essentially all of the address codes that would be required have already been established in the course of the project. The first box in Figure 3, "Incoming Communication", assumes that some sort of letter, document or message has been received by the system. By a "Phase I Function" in the second box is meany any of the functions that are displayed further on in the flow chart. Anything else would be referred to AIP (or whatever organization was controlling the operation). It is assumed that the system will be computer based and that a name with an address will be treated as two units rather than as a single unit. That is, there will be one list of names and another list of addresses, each with their associated codes. For one thing this means that the only change necessary in the system when a person moves is the change of the address code associated with that person's name. More importantly, it also means that statistics can be gathered and kept under surveillance with respect to such parameters as the number of people at various institutions, the distribution of institutions with various numbers of people, and patterns of the moving habits of theoretical high energy physicists which would help the AIP to develop the understanding it needs to provide services that are tailored to the needs of specific groups in the physics community.

Presumably the entire directory of all known theoretical high energy physicists would be stored in the computer, with a name code already assigned to each name. It cannot be assumed, however, that every name in the directory will be on the mailing list, since some may prefer to be left out of any experiment. Therefore, either a separate mailing list will have to be maintained or it will have to be indicated on the directory list, e.g. by flagging the appropriate names. This is what is implied by the statement "may be simple flag in store" in the box that starts "Add to ML".

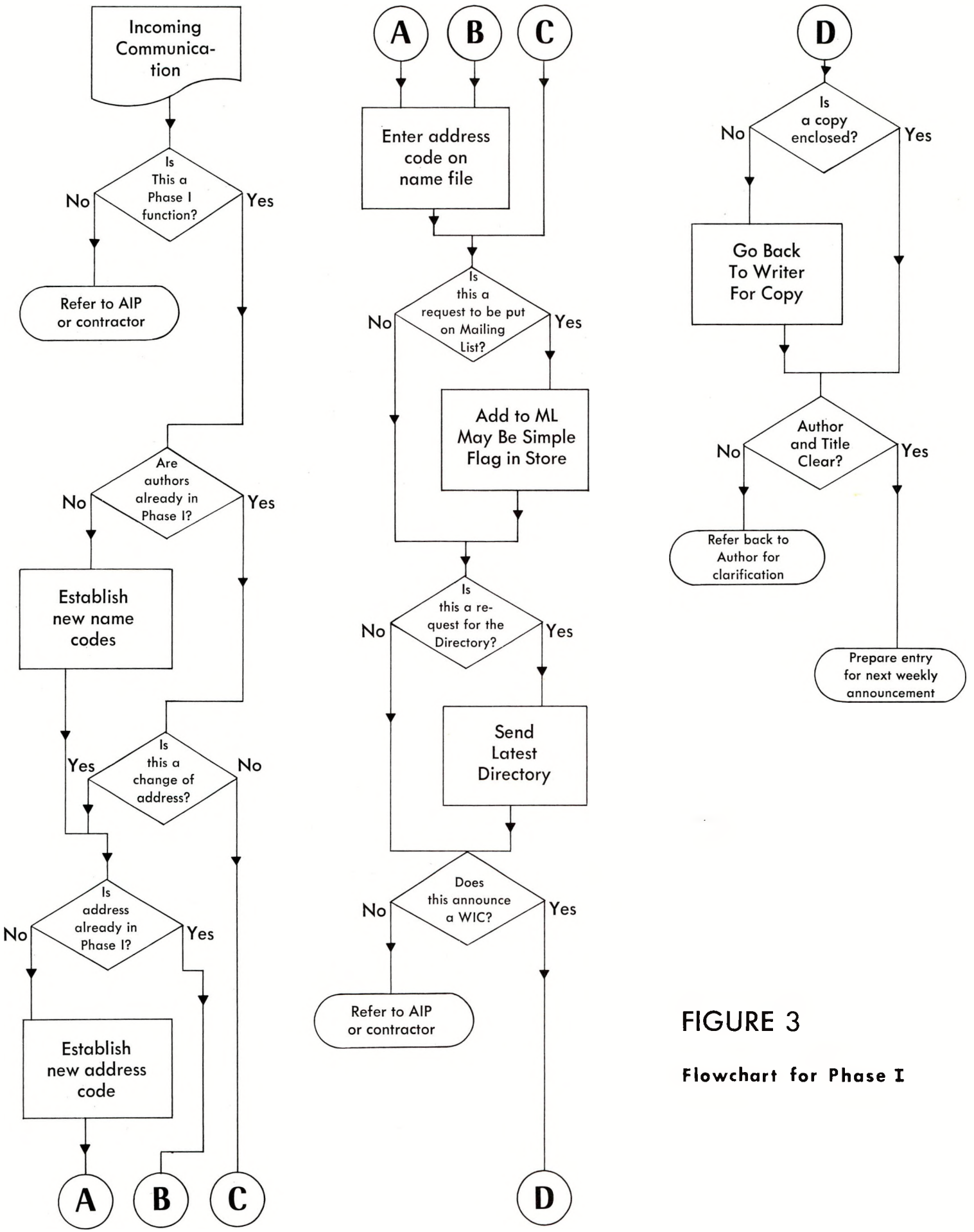

FIGURE 3

Flowchart for Phase I

No mention is made in Figure 3 of the "Subject Categories", "Type" or "Status" information shown in Figure 2, because whatever the author indicates will be incorporated in the announcement without change. If comments or marks which are not standard in the experiment are made by the author, the submission would be referred out of the system to AIP or the controlling organization.

Since the announcement service might stimulate more requests for WIC's than some authors are prepared to handle, some provision of relief for such authors would seem to be needed as a counteractant innovation. Therefore it is proposed that, during Phase I, the central service might offer to assist the authors, at their request, by fulfilling requests for documents beyond those which the authors are able to handle themselves. This would be accomplished by the author passing on to the central service those requests he could not handle, and the central service then providing a copy to the requester.

B. Controlled WIC Distribution Experiment

Between four months and six months after the start of Phase I the monitoring agency (which, for example, might be the AIP staff) would submit a report of its operation to a committee designated by the AIP Director - presumably the same committee that had concurred in the initiation of Phase I. The committee would then be asked to approve the start of Phase II. Phase II would provide for one, or a few, central location(s) to reproduce and mail WIC's directly to selected and authorized individuals in addition to continuing the experimental announcement and directory service established in Phase I. Reasons for the choice of distributing to the individual, rather than to a group, for purposes of the experiment will be discussed more thoroughly in Section X.D.2.

The design proposed for Phase II can be best described by referring to Figure 4. This "system chart" cannot be drawn now at the same level of specificity as Figure 3, nor is such necessary since it will lag Phase I by some six months. This system is based on the assumption that the bookkeeping required is easily within the capability of a medium sized, modern, general-purpose digital computer. It would work, basically, around a set of stored lists such as those shown on Figure 4. Actually, names would probably be represented by name codes and other information by some other coded representation. To start with, each participant would provide "the system" with his personal WIC distribution list. He could, of course, use an institutional list or any other list, according to his desires. Changes to his list(s) other than changes in spelling, titles, addresses, etc., would be made only with his consent. Provision would be made to enable him to give this consent on either a blanket coverage or power-of-attorney basis if he so desired. We would anticipate that enough use of such options would be made to considerably reduce the transaction traffic in the system. The initial job of processing all of these lists would be a considerable one and would have to be started well before the system was to go into operation.

The initial corrections, adaptations, and adjustments during the first few months of the system's operation might also be rather large but there is every reason to suppose that this would rapidly taper off to a reasonable steady state. To follow Figure 4 in greater detail: After a list had been furnished the system by the participant, he could at any time make permanent

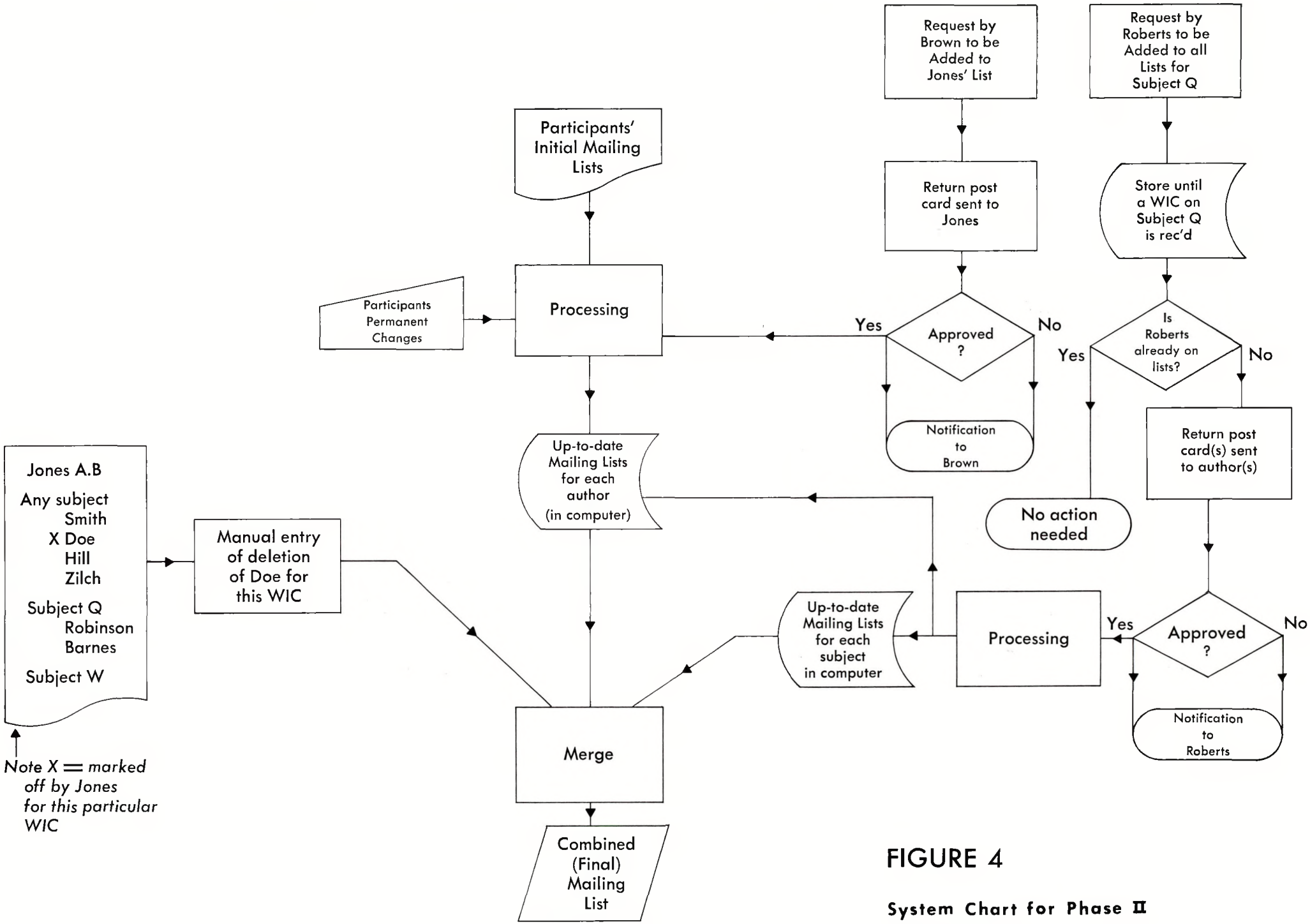

FIGURE 4

System Chart for Phase II

changes to the list simply by sending in a copy of the list (which would have been provided to him by the system) with the additions, deletions or changes he wished made, together with an indication, probably by simply checking a box, that these were permanent changes to his list. Whenever he sent a document in to the system he would accompany it with another copy of his list on which he would indicate any changes that were to be made of an ad hoc nature, i.e. with respect to only that particular document. These changes only would be entered into the system presumably by manual keypunching of change cards only. (If such a system were ever to be greatly extended, say, to all of physics, it might be economically better to provide automatic entry by optical character reading devices.) The changes would be merged by the computer with the participant's stored master list and a mailing list prepared.

Consider now the case where another participant, let's say Brown, wishes to be added to the first person's list - let's call the first person Jones - for everything Jones writes. His request, presumably on a standard form, would be entered into the computer which, unless Jones had registered a blanket permission, would prepare a return postcard to Jones requesting his concurrence. Suspense files and tickler actions would be built in as part of the system. When Jones' reply was received, Brown would be notified and the called-for actions taken.

Suppose now that Brown's request to the system is that he be sent all documents by Jones on subject A. His request would be placed in the system and kept in a special suspense list. When a document from Jones which he had labeled as being on subject A (perhaps among other subjects) was received by the system, Brown's name would be sent to Jones with a request that he approve Brown's receipt of that particular document and that he also indicate whether or not he would be willing to have Brown's name added to his list for future automatic receipt of documents on subject A only. (Here again it is believed that the initial deluge of transactions would fairly rapidly subside and reach a tractable steady state situation and that a general permission option would be used enough to have a powerful alleviating effect on the transaction volume in the system.) In addition to retrieving the mailing list previously described of persons receiving everything Jones writes, the system would check the lists for each of the subjects indicated. All persons on these subject lists which were not already on Jones' list would be added to the mailing list for that particular WIC.

Provisions for two additional degrees of flexibility could easily be made on the list that Jones would send in with each newly submitted WIC. A column could be provided in which Jones would be requested to check the names of any persons to whom he had already sent, or planned to send, copies. That possibility must be provided for so that authors would still feel free to attach a copy of the WIC to a letter to a colleague without fearing that they were thereby causing a duplication. A space would also be provided on the list for Jones to request a number of copies of the document for his own use. It is believed that with these features the authors would be left with as much or more control than they have at present without being saddled with additional work. In cases where there could be any doubt, the author would be sent a list of those to whom his WIC was finally sent. In the interests of accuracy of experimental data collected it would be hoped the authors would, whenever practicable, also inform the central agency how many WIC's they sent out themselves and if possible, to whom.

C. Charges to Participants

It has been pointed out that if a product or service is free, the "demand", or consumption rate, does not reflect the actual need for, hence worth of, that product or service. Therefore, it has been claimed, a PIE experiment would not obtain a true picture of the need for whatever products or services it was testing unless the consumers had to pay for them. This argument is certainly valid under many circumstances. In fact, there are other reasons for considering charges, each of which also has unquestionable validity under the right circumstances. However, there are also reasons for not making charges. These, too, are valid at times. The question is not simple. As a basis for understanding the later recommendation, and to encourage greater awareness of the problem in any debates that may ensue, the next two paragraphs point out some of the more obvious pros and cons of the question. In neither case is the discussion at all exhaustive.

Factors favoring charges are:

1. If, under a PIE experiment, a person is able to get all the WIC's he asks for (we assume for the sake of this argument that all the authors are willing!), he may ask for far more than he really needs. This would not merely give a false indication of the demand, it would also cost extra copies, postage and labor.

2. If, eventually, a service were set up under AIP's auspices, AIP policy would require, or at least prefer, that it be made self-supporting at as early a date as possible. Making charges during the experiment would provide about the only reliable basis for estimating the speed - or even the possibility - of making such a service self-supporting.

3. Making charges either during an experiment or for a later service would save public funds.

4. Making charges would, in certain instances, provide a basis for making quantitative comparisons and measurements.

Factors unfavorable to charges are:

1. Consumers don't buy unknown goods and services. If the experiment doesn't provide an opportunity to see what they would be missing, a later service for which charges were made might not have many takers.

2. To the extent that they get them at all, most present services of the same sort are free to the recipient.

3. Since such a large amount and proportion of the public funds goes into support of high energy physics, it might be in the public interest to support the fullest possible use of the resulting information to insure that the maximum value is obtained from the public funds already spent.

4. It would cost a lot to do the bookkeeping necessary if charges were made, especially with foreign currencies and postage involved.

Two additional comments need to be made:

1. In addition to considering charges to people who want to receive WIC's, consideration should be given to charging the authors, or their institutions, after the fashion of the present page charge which AIP pioneered some years ago.

2. If a service were under different auspices than AIP, a different policy might prevail with respect to the service becoming self-supporting. It is also not inconceivable that this particular policy of AIP's might be changed or modified in this instance.

Considering all the foregoing, the following proposals, and the reasons therefor are offered: No charge should be made for products and services during Phase I. (Note that this use of "service" is different from the usage which refers to something that might be instituted after an experiment.) It can safely be assumed that essentially all theoretical high energy physicists will want, and legitimately need, both the announcement service and the directory service. This is strongly indicated by many of the suggestions made on the last page of Q1. With respect to the cost of providing copies of WIC's which the authors have referred to the PIE operation during Phase I as being beyond their means to provide: (1) the number should be considerably smaller than the number that would be envisioned later, when Phase II started, and (2) each request would have greater validity since it would have the added endorsement of the author. Furthermore, the possibilities for administrative confusion if charges were made would be tremendous, and the cost of correspondence and bookkeeping would add significantly to what had to be charged. However, the person in charge should be empowered to charge for providing these copies during Phase I if he felt that to be necessary.

During the first six to eight months of Phase II, it would be expected that all products and services would be offered without charge, but the person in charge of the experiment would be authorized to impose charges as necessary to exercise control over the experiment. Otherwise, if things got out of hand or unforeseen developments occurred the only means of control available would be the total elimination of a product or service. During the last four to six months, the timing being at the discretion of the person in charge of the experiment, charges would be made for all products and services. These charges would be based on covering at least half of the direct labor and materials involved in the day-to-day operation of the experiment (not including computer time) but could be more, at the discretion of the person in charge, up to complete coverage of all operating costs including computer costs. Such an arrangement would, it is believed, at least eliminate those who were only taking what they could get for free, and would provide ample basis for predicting whether or not a later service could be made self-supporting.

If possible, an option of receiving WIC's on microfiche would be offered. The feasibility of this would be determined after some experience with Phase II had been gained.

As soon as possible after the termination of the 18-month experiment, a follow-on report would be made. This would assess the experiment, make a recommendation as to whether or not a regular service should be established, and, if such a service was recommended, propose a detailed design therefor, including financial aspects. Such a follow-on report would not only poll

opinions of those who participated in the experiment, but would also attempt to show whether or not any significant changes had occurred in the network and information flow patterns reported in Sections VI and VII of the present report.

X. DISCUSSION

The preceding sections have reported the accomplishments of the study project, the more significant data gathered about the existing information situation in theoretical high energy physics, and the attitudes of the theoretical high energy community towards the WIC distribution centralization question. Also they have presented a rough design for an experiment in WIC distribution without much discussion of the specific choices made or of alternatives. The proposed design has been presented in advance of the discussion, since discussions tend to be vague, opinionated and generally of little value in the absence of a sufficiently detailed plan to use as a point of reference. As can be seen from Table 29. about half of those responding (the sum of the three middle categories in the attitude question) showed that their attitude would depend on just how the experiment would be designed.

To a quite considerable extent the proposed design has been determined by the respondents. There are features of both phases which might not have been thought of, and probably would not have been incorporated, without the benefit of the respondents' advantage-disadvantage listing and their comments and suggestions. This has enabled the development of a design which, it is believed:

1. Has most of the advantages listed by respondents.
2. Avoids most of the disadvantages.
3. Includes adequate controls and safeguards, and
4. Has the capability to obtain data adequate to enable further progress to be made towards maximizing advantages and minimizing disadvantages, as well as to permit an objective assessment of how well this is already provided for.

In this section we will use the material that has been presented to consider the two basic questions for which the project was established. "Is an experiment desirable?" and "If so, what kind of an experiment?" First a digression is necessary to introduce two important inputs to the discussion which come from outside of the project efforts. One of these is, if anything, too purely experimental, the other is, if anything, too purely theoretical. After briefly describing each of these we will proceed with discussion of the two fundamental questions.

A. The IEG Experiment

In 1961 an Information Exchange Group (IEG) was established under the auspices of the National Institutes of Health (NIH) to provide a communication medium felt by many to be needed by persons doing research on the subject of oxidative phosphorylation and terminal electron transport[17]. Since then, six additional groups in other research areas were formed. The experiment was recently terminated[9] having grown from an initial 32 participants to over 2500 with prospects of continuing growth at at least the same rate.

The experience gained in this experiment is being analysed and will be, but has not yet been, reported. The termination announcement gave two primary reasons for the action:

> "First, the original purpose of the experiment has been achieved. The IEG concept is workable, if the chosen research area is focused to an easily described and identifiable research phenomenon or problem around which the group can be built.
>
> "Second, the rapid growth of IEG in the last two years has now reached the threshold limit for the NIH facilities to accommodate. Further, once the original concept has been tested, it does not appear equitable to all research areas to continue IEG services to a few groups on a service basis alone."

There are enough similarities between IEG and PIE to be able to profit from the IEG experience. On the other hand, there are enough differences between the two to preclude uncritical application to PIE of any specific or general practice or conclusion based on the IEG experience. Roughly speaking PIE would be about the same size as the total of all seven IEG's together at the time IEG was terminated. On the other hand, PIE, since it would start out with the entire field of theoretical high energy physics, would not grow (except of course as the total number of theoretical high energy physicists grew). In IEG any paper submitted was automatically reproduced and sent to every member of the particular IEG group of which the author was a member. The experiment as proposed would distribute only to author-authorized lists. It seems reasonable to expect (but not to assume without an experiment) that the effect of this would be to keep the number of copies of a WIC in theoretical high energy physics to an average and range perhaps not too dissimilar from the IEG experience. This author control should also tend to bring out the subject-structure of the field in a much more systematic fashion than was the case in IEG. The establishment of subject areas in IEG was an open-ended proposition. In the proposed experiment it would be done within a closed system, therefore the establishment of a new subject category would tend to decrease instead of increase the total size and cost of the operation.

B. A Proposal for a Theoretical Framework

As was suggested in Section III.C., the most missed element in the entire picture of scientific communication is a theoretical framework to bound and assist in the process of relating the different pieces and the already put-together groups of pieces of the puzzle. Without a theoretical framework, evaluating such trade-offs as that between quality and speed, or that between minor inconveniences to major physicists and major inconveniences to minor physicists are not merely impossible, they are meaningless. Unfortunately this requirement for a theoretical framework was not appreciated until the entire modern system of headaches referred to as the "information explosion" made them painfully obvious. This was only very recently, which is why the contribution about to be briefed is still too new to have withstood the test of time and criticism. Nevertheless, the contribution to the present problem made by "The Social System of Science" by Norman W. Storer[8] still has to be introduced in the absence of anything better as an indication of the type and complexity of thinking that must enter into an intelligent resolution of the PIE problem.

Hypothesizing "competent response" as the very life-blood of science as a social system, Storer says:

> "We might suppose that a good deal of the concern expressed by scientists about the publication explosion has its roots in their

> fear that competent response to their own work will be more difficult to obtain, even though hesitance to proclaim their interest in professional recognition makes them formulate their arguments in terms of a fear of inefficiency and wasteful duplication of effort. This concern has generated a good deal of interest in the development of new mechanisms that would offset the difficulties of keeping up with the literature by making access to it quicker and more efficient."

These "new mechanisms" are concerned with means and media whereby an author can get his message to those he feels are the appropriate persons to be able to understand and react to it. If the "established literature" is considered as broadcast transmissions, as indeed it can be, these new mechanisms are in some sense beamed transmissions. If the established literature is for dissemination to the public, these are, in the terms of Garvey[10], for dissemination to a "restricted audience". If the established literature is the communication of an individual to the community, these are, in the terms of Williams, Hutchisson and Wolfe[11], communication from the individual to a "select group".

Starting from the foundations laid by Robert K. Merton, Warren O. Hagstrom, and others, Storer develops a case for science constituting a fifth distinct social system within the total human society; the others are the economic, political, family and religious systems. In each case he discusses these as distinct social systems on the basis of there existing in each case a different and unique commodity, the exchange of which serves as the circulating medium and the reward-bearing mechanism. He proposes three basic principles as underlying the viability of, and the distinctions between, such social systems:

1. The participants in the exchange-system must want the commodity in question.
2. The commodity in question must be obtained through exchange with others.
3. Individuals must not compromise different exchange systems.

In an ingenious discussion of creativity and an insightful explication of the norms of science he develops his fundamental thesis, that the desire to be creative operates as the basis of the exchange system within science by motivating scientists to share their creative products with others in return for the others' response to it. "Competent response", an extension of the concept of professional recognition, is then the actual reward-medium, the exchange-commodity, which is the life-blood of science as a social system.

The implications for the dissemination of information are immediate, basic and powerful. This is particularly true for the originator's interest in getting his work published or otherwise distributed. They are mainly, but not solely, related to what Storer calls "the norm of communality" which "directs the scientist to share his findings with other scientists freely and without favor" and "encourages the scientist to take the initiative in placing his finding before his fellow scientists". Thus he suggests that security restrictions are disliked "not so much because they prevent a scientist from learning what others have done as because they prevent him from telling others what he has done". Other complexities of the interaction between publication, informal dissemination and "competent response" are well illustrated in the following quotation:

> "The 'hotter' a field is, the more rapidly advances in knowledge are being made, the more likely it is that the main work is being done by scientists who participate a great deal in small, informal groups. This situation develops in fast-moving fields in part because of the 'publication lag' and in part because such advances usually involve comparatively basic reconceptualization of the field that has not yet had time to become established and widely accepted. Informal communication networks are thus the only type of structure that can facilitate the scientist's work and assure him of a competent audience for his creativity. In such cases . . . priority is assured by personal knowledge rather than simply through publication."

Storer deals explicitly with many more of the issues being debated with respect to the PIE proposal and dissemination of information outside of the established literature in general. Such issues include speed, editorial policies, quality of journal articles, of "informal" documents and of refereeing and many more. What Storer has done is at least to make clear, in language that any educated person can understand, that the situation is subtle and intricate - efforts to improve the information dissemination situation are needed but they must be approached in the realization that basic and far-reaching consequences could easily follow.

C. Desirability of an Experiment

In considering the question, "Is an experiment desirable?" we will use the broadest sense of "desirable". That is, not only, "Is there something to be gained by conducting the experiment?" but also, "Is that something worth the cost, and worth taking whatever chance there is that some sort of harm could result?" It should be kept in mind that the question of desirability depends on the specific form of the experiment. Ideally, one should talk about the desirability of each of a family of experiments; expedience will limit us to a discussion of the experiment as proposed in Section IX.

The first question to consider is, "If an experiment were conducted and if it did result in a workable service, is there reason to suppose that such a service might be worth the bother and expense of having gone through the experiment in the first place?" The fact that such a service was proposed and supported by many working high energy theorists is relevant. A better basis on which to answer this question is analysis of the advantages and disadvantages listed by our respondents (see Table 28.) because these were stated with respect to a service rather than an experiment. 92.5% of those respondents who listed advantages or disadvantages could see one or more advantages that such a service might have. Another way to look at this question is to consider the importance of WIC's as a medium of communication and then to ask whether or not such a service might appreciably enhance that communication. Study of the responses we obtained and of many statements that have been made recently by, among others, Storer, Garvey[10], Swanson[12], and Williams, Hutchisson and Wolfe[11] indicate that indeed WIC's must definitely be considered an essential element of scientific communication at this time in the development of theoretical high energy physics. As to the effect that such a service might have on this element of communication, it must be supposed that it at least could be extremely important. If the introduction of system and order into the established literature by such means as the editorial and refereeing mechanisms is as important as most people feel, it must be supposed that the introduction of system and order into another important channel of scientific communication could conceivably have commensurately important effects.

We now consider as a separate question whether or not it seems desirable to conduct an experiment. If the service can be considered potentially useful, why not institute it without an experiment? The answer is that there is far too much at stake and there are still far too many unknowns which could only be determined by an experiment. Although, as stated above, most of the respondents who listed advantages or disadvantages could see one of more advantages in such a service, the other side of the coin is that 78.4% could also see one or more disadvantages. A comparable statement could be made about the comments and suggestions. Most of the questions that enter into the design of an experiment, such as those to be discussed in Section D and many more, will be unknown until an experiment is conducted. The basic reason for feeling that an experiment should be conducted is thus simply that the question of the desirability of a service is too complex to be made without a controlled experiment having been conducted - yet it is too important to be decided by default.

The attitudes of the THEP community towards an experiment were given by responses to Question 16 of Q1 (see Table 29.). These therefore speak directly to the point we are now considering. About 75% of the respondents felt that an experiment should be tried although about 44% of these had some reservations. Only about 13% of all who responded were opposed to trying an experiment and about 54% of these felt that they might favor trying an experiment if the experimental service described just before Question 15 were modified in some way. As indicated by Table 29. we made some attempts to see if particular segments of the THEP population might differ markedly from that of the overall community. We found no differences from the general trend that could be considered significant enough to change the picture.

This leaves the important and difficult question of whether or not the conduct of an experiment might pose any sort of danger to physics either directly or indirectly through danger to the established mechanisms of scientific communication, namely the "established literature". Again, the answer would be expected to vary according to the particular experimental design. Certainly any possible threat to the established literature from an experiment of the general type being discussed must be carefully guarded against. The many important functions in which the established literature plays the leading, though not the only, important role were shown by the data in Table 17. The high regard in which the established literature is held by the respondents is indicated in a different context in Table 27. Accordingly every effort was made to include controls and safeguards in the proposed experimental design. The most important safeguard is simply that the experimental design attempts to effect the least possible perturbation of the existing state of affairs beyond extending it throughout the entire physics community in as efficient and systematic a manner as possible. This is actually, of course, the direction in which things are moving anyway as more money and more duplicating facilities become available. However, the present progress is haphazard, erratic, unknown and uncontrolled. It would seem that an experiment - controlled during its progress and subject to a specific stated termination date - might well be regarded as itself a safeguard that those most concerned with preserving the integrity of the established literature should have invented themselves. It might, for example, throw some light on what is behind such phenomena as the decline in the number of individual subscriptions per physicist to both the primary and secondary journals. As it stands, the proposed experiment would be strictly under the control of the authors of WIC's, therefore, completely under the control of the physics community itself. It would, of course, be possible to provide for additional control by the central agency if, for example, it were deemed mandatory that the maximum number of copies of a single WIC be kept under some preset ceiling. This is

not recommended. Since the only part of the experiment in which WIC's would be actually reproduced and distributed would be in Phase II, and since this would not last more than a year, it would seem better to let nature take its course, find out what the tendencies are, and avoid the resentment of the participants. It does not seem likely that participants would cancel their subscriptions to either primary or secondary journals knowing that the experiment would stop soon and not having any assurance as to when, or even if, a follow-on service would be established. It would, of course, be a primary objective of the experiment to determine - or at least to obtain information and understanding on the basis of which the THEP community could determine - whether or not an actual service might pose any threat to the established literature.

D. Design Alternatives for an Experimental Design

We here discuss some of the choices made in the experimental design presented in Section IX, reasons behind them, and alternatives. Each of these, of course, should be considered in the light of a choice which might affect the decision as to whether or not to conduct an experiment. Since discussing them in such a fashion would become too cumbersome, they will be discussed as if that decision had been made and the problem was therefore to select the best combination of design alternatives within some sort of overall limits of acceptability.

1. Phasing and Announcement and Directory Service

Many different choices as to the nature, order and relative durations of phases could, of course, be made. The Phase I presented was chosen as being the minimum that really amounted to anything. About the only lesser thing would be a directory alone - and this in fact was the suggestion of several respondents. That would have comparatively limited usefulness, yet would require considerable effort to develop.

The announcement service selected as the main element of Phase I would unquestionably be very useful - it was the suggestion made more often than any other single one by the respondents. The process of developing the mailing list for an announcement service and keeping it up to date would yield the directory as an essentially free by-product. The substantial resources that have been and are regularly being put into the preparation of WIC announcement lists now give objective and impressive evidence for their usefulness (e.g. the CERN list, Preprints, the DESY High Energy Physics - An Index, lists produced by Brookhaven, Trieste, etc.).

The only real difficulty that can be foreseen in doing this on a systematic and community-wide basis is the danger, already mentioned, that authors might now receive requests for more copies of their announced WIC's than they would be able to provide. Means to cope with this have been suggested in Section IX. The question of what would happen to the existing lists during the experiment would have to be up to each institution. Presumably most would be happy to be able to suspend production for that period.

While a WIC announcement service might indeed be a useful thing, and conceivably could be that to which an eventual operating service should be limited, the spirit of the responses obtained by the project clearly indicated that more than that is desired and expected for an experiment. Nothing short of some kind of actual WIC distribution is going to provide the experience and information on the basis of which to decide the important question of what kind

of assistance, if any, the THEP community wants given to its informal communication media.

Though it would be nice to be able to plan a really exhaustive and informative experiment, this would take far too long. By the earliest time Phase II could start the THEP community will already have waited over two years since the AEC decided to hold in abeyance its plans to establish a system for central WIC distribution.

With respect to duration, if an experiment should turn out to pose some real danger to the established communication channels then the longer it ran the greater would be the damage done. On the other hand, it would seem that about a year is the least time in which anything approaching a steady state condition might be reached for a fairly minimal experiment with actual distribution such as that proposed. As far as being minimal is concerned, it is hard to see how a systematic overall experiment involving actual distribution could be designed that, in principle, at least, would constitute less of a perturbation of the existing situation.

2. Individual versus Group Distribution of WIC's

One of the basic questions has been whether or not distribution should be directly to individual physicists or to groups of some sort. If the latter, they would then be responsible for further distribution to their constituents. The choice of individual distribution for the experimental design is based on the fact that some of the same questions that are at issue here are also at issue in the basic question of whether or not there should be any eventual service at all. A very fundamental question of this sort concerns the "competent response" hypothesis of Storer's, described earlier. To the extent that this is valid, distribution to individuals would seem to be favored, primarily so that the author would know who received his communication. The mere possibility that this consideration might underlie the observed importance of the entire informal communication network - or at least be a vital element thereof - is enough to dictate that the experiment at least include a phase in which distribution to individuals would be tested.

While none of our respondents' comments and suggestions were lengthy or analytical enough to relate directly to this point, some did relate directly to other points suggested by Storer. These include the possibility that authors may, in at least some cases, not want their informal communications to be generally available - or they might not want them to be available to specific persons or organizations. A related point was that reserving control to the authors would leave the physics community with a means to respond appropriately to any case of improper conduct that might occur. Another unknown factor affecting the individual versus group question is the nature and strength of the "invisible college phenomenon" pointed out and explored by Derek de Solla Price[7]. While all these points are relevant, one factor was almost deciding by itself in the choice of individual dissemination. It was that the information so obtained would enable the establishment and conduct of an eventual service based on distribution to groups, should that be desired, whereas if the experiment were conducted only on the basis of distribution to groups the information required to set up a service based on distribution to individuals, should that be desired, would not have been obtained.

An example of this concerns the number of copies to be distributed. On the surface it might appear that since there were fewer institutions than people

fewer copies would have to be distributed. Actually it is hoped that the opposite may turn out to be the case. The total number of copies of all different WIC's summed over, say, a year, might be less on the basis of a distribution to selected individuals based on either subject matter or author's control or, better, both.

There are some inherent inconsistencies in the arguments that arise over this point that can only be resolved by experiments and perhaps then only by experiments using a considerable degree of ingenuity or innovation. It has been claimed that although the recipients would object to a "flood" of WIC's they would be so afraid of missing an interesting WIC that they would ask to be put on all possible distribution lists. Even theoretical high energy physicists cannot have their cake and eat it, too.

Actually there is every reason to believe that an intelligently designed and conducted selective dissemination scheme would eventually be able to satisfy its users that they would receive the documents of greatest interest to them so that in the long run they would elect to receive the smaller number of higher relevance documents. It should be noted that it is quite possible that a sine qua non for this to happen might be the accompaniment of such an SDI system by a concurrent announcement system. This would enable the users to see, at least by title-author-subject combination, WIC's which they might want to request specifically.

Other issues such as differences in mail costs, clerical burdens, mailing list maintenance, mailing label preparation, etc., are in the first place relatively minor and in the second place subject to amelioration by the application of a modicum of intelligence. For example, if bulk mailing costs are cheaper the individual envelopes might still be put together and mailed to an institution, then mailed from there. Or they might be carried by air freight to a central postoffice.

One further point needs to be considered. If we assume that charges have to be made for at least part of the experiment in order to obtain more valid indications of need, then again distribution to individuals seems favored. It would be far simpler to implement charges for individual distribution and far simpler to interpret any effects. Charges to groups of different sizes, in different kinds of institutions, etc., could pose extremely difficult policy problems. The interpretation of the effects of such charges would be of a higher order of difficulty. If the physics community should choose an experiment based on group distribution, we would strongly recommend that no charges of any kind be made.

Notwithstanding the foregoing, it must be recognized that negative results from the experiment as outlined would not necessarily establish that an experiment based on distribution to groups would not work. This should be kept in mind by the person in charge, who in the event of clearly adverse results, should recommend that a switch to group distribution be considered.

3. Miscellaneous

The innovations in the format shown in Figure 2 for the announcement service are indicative rather than final. They are designed to be responsive to the needs discovered in the project, and will, hopefully, eliminate or at least reduce to manageable proportions, some of the disadvantages that were feared by respondents. The subject categorization on the left would actually

be replaced by a set of categories which would be arrived at with the help of high energy theorists. The answers given to Question 4 of Q1, in which up to ten sub-fields of current interest were named, partly summarized in Table 9., should help. It would be hoped that six to twelve categories might be effective in dividing the THEP field in a way most useful for the purpose of WIC distribution.

Similarly, the column headings on the right in Figure 2 are indicative rather than firm recommendations. They are intended to help the user to know what to ask for. Whether they will be as useful to the majority as to those who suggested the need for some such indications can only be determined by experiment.

Some may wonder why nothing has been said about the problem of "priority", i.e. the establishment by physicists of claims to ideas, discoveries, solutions, etc. The reason is that we did not find any indication that that particular Pandora's Box needs to be opened at this time, if ever. This was one of the more important questions we asked consistently at the Berkeley interviews. It simply did not appear to be regarded as an issue. It was not avoided but most seemed to regard it as a fait accompli that WIC's were routinely used to establish priority. Accordingly no specific question was asked about priority in either questionnaire. Our assumptions on this point were borne out by the very few times the matter was brought up by respondents in connection with either the advantages-disadvantages listing (see Table 28.) or the comments and suggestions, and also by the tenor of the comments when it did appear.

Another matter that has not been mentioned is that of purging of WIC files. This has not seemed useful in view of the relatively short duration proposed for the experiment. A task of the experiment would be to investigate optimal policies and procedures to be followed by any later service on such matters as file management and purging.

XI. COST ESTIMATES

Any estimate of costs will be no better than the estimate of the total number of pages that would have to be reproduced and distributed. The latter is estimated below using data already presented in Sections VI and VII. Cost experience of the IEG experiment will then be applied to obtain a cost estimate.

We will take the estimated number of WIC's/year as 2300 from Section VII.A. If a weekly experimental announcement service is provided there would be an average of 44 per week to be announced. At 8 per page, 6 pages per week would have to be prepared, reproduced and mailed to, at most, 2800 THEP's. The preparation will be included later in an office cost estimate. The printing is estimated at $200 per week and the mailing, Air "Printed" rates at 1400 x $.40 + 1400 x $.50 = $560 + $700 = $1260, for a total of $1460 per week assuming all originate in the U. S. At this rate, 1 1/2 years of the announcement service would be estimated to cost $113,880.

For an estimate of the average number of copies of each WIC to be reproduced and distributed we will use 500. This is not out of line with the averages presently reported for U. S. institutions in Table 12. of 233 if ample allowance is made for increases due to availability through PIE. It also happens to be the same number we would use if we were making this estimate on the basis of group distribution using the estimate of 500 institutions from Section VI.C. This gives an estimate of total copies of WIC's per year as 500 x 2300 or 1,150,000. In the IEG operation it was estimated that it would cost $369,665 to print and mail 1,012,780 copies. These copies were estimated at 30 pages each; responses to Question 17b of Q2 give us an estimate of 22 pages for THEP WIC's. Applying both of these "corrections" we would get $369{,}665 \times \frac{1{,}150{,}000}{1{,}012{,}780} \times \frac{22}{30} = \$307{,}800$. Office costs of $44,500 were estimated, which if we accept directly, would give us a total estimate of $352,300.

Checking the printing cost above with estimates of printing costs made by the AIP Publications Division:

$$1{,}150{,}000 \text{ copies} \times 22 \frac{\text{pages}}{\text{copy}} \times \frac{\$ \ .014^*}{\text{page}} = \$354{,}200 \qquad *\text{minimum by offset}$$

Or using a batch pricing schedule:

$$1{,}150{,}000 \text{ copies at } \frac{\$207}{500 \text{ copies (at 22 pages each)}} = \$476{,}100$$

If microfilm were provided to all users, which is not now contemplated, since, by introducing additional unknown effects, it would make the entire experiment valueless, an estimated cost would be:

$$1{,}150{,}000 \text{ copies} \times 22 \frac{\text{pages}}{\text{copy}} \times \frac{\$ \ .00133}{\text{page}} + 2300 \text{ masters} \times \frac{\$1.15}{\text{master}}$$

$$= 33{,}649 + 2645 = \$36{,}294$$

All the above estimates are based on steady state operation for a full year. This is not a realistic basis for an actual cost estimate. Also, it ignores the fact that so few Russians responded to the questionnaire that their participation would, unfortunately, have to be expected to be minimal or non-existent. Considering these factors it would seem that a factor of 3/4 could be safely assumed. Applying this to the printing part of the estimate based on the IEG experience gives $230,850. Adding the office costs gives $275,350.

For an estimate of total costs we will use this figure and the IEG estimate of office costs for the WIC operation. For the announcement operation we will use the above estimate for printing and mailing costs and assume that office costs can be absorbed in the WIC office costs for the last year. A figure proportional to direct costs will be added for the first six months. This would be:

$$\frac{1}{2} \times \frac{113,880}{230,850} \times \frac{2}{3} \times 44,500 = \$7,300$$

The total cost estimate would then be:

Announcements (1 1/2 years)	$113,880
Office costs (1st 1/2 year)	7,300
Office costs (last year)	44,500
WIC's (1 year)	230,850
Total	$396,530

From this would be deducted funds received from any charges made. These could be estimated at 1/6 of one year's cost of the WIC operation, or $38,475 yielding a total estimate for funding required of $358,055, or about $360,000.

It should be remarked that there are a number of ways in which this estimate might be reduced. Some of these, such as the possibility of using several centers to reduce mailing costs, would not impair the validity of the experiment and should be done if possible. Others, however, such as imposing arbitrary limitations on membership, geographic coverage, etc., could seriously impair the validity of the experiment, since not enough is known to be able to estimate the sizes of the effects so introduced. Such ways should be considered only as a last resort. It must also be remembered that the present incomplete, inefficient "system" of distributing WIC's is far from cost-free: the costs are simply buried in the budgets of many governmental and private institutions.

XII. CONCLUSIONS

The principal conclusions of the study project are:

1. The possible value of a centralized distribution service for written informal communications in theoretical high energy physics would appear sufficient to justify an experiment.

2. Such a service should not be instituted without first conducting an experiment of the general nature of that outlined in this report.

3. The directory developed by the project constitutes a useful by-product of the project and is adequate as a starting point for such an experiment.

4. Both Phases I and II of the experiment proposed by this report are desirable and should be conducted if funding support, estimated at approximately $360,000 for a 1 1/2 year experiment, can be obtained.

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Form Approved
Bureau of the Budget No. 38-66003

HIGH ENERGY PHYSICS
INFORMAL COMMUNICATIONS PROJECT

Conducted by THE AMERICAN INSTITUTE OF PHYSICS
335 EAST 45 STREET, NEW YORK, N.Y. 10017

IF YOUR NAME OR ADDRESS AT LEFT IS INCORRECT, PLEASE ENTER CORRECT INFORMATION BELOW:

_____

_____

_____

1. a. How long have you been at current employing institution (to nearest half year)?_____

   b. Citizenship (specify country)_____

   c. Highest degree (or level of professional certification) held_____ Date received_____

2. Are you currently working in the general area of theoretical high-energy physics?_____

   a. ☐ NO Please describe your area of specialty in the space provided _____

   _____

   _____

   b. ☐ YES Approximately how long have you been working in this area? Number of years to nearest half year_____

3. Please rank all of the items below that are included among your professional activities, using the number 1 for the most time consuming, 2 for the next most time consuming, etc. Leave blank those which are not included among your activities.

Rank		*Rank*	
a. ☐	Teaching	f. ☐	Editorial Duties and/or Refereeing (scientific technical journals)
b. ☐	Research and/or Development	g. ☐	Studying for an Advanced Degree (part- or full-time student)
c. ☐	Administration	h. ☐	Other_____ *(please specify)*
d. ☐	Consulting		
e. ☐	Research Guidance (of students or subordinates)		

4. Listed below are the areas in theoretical high energy physics appearing in the program of the XIII International High Energy Physics Conference held in September, 1966. If one session were to be devoted to each area, which ones would you attend because you are currently working in that area? **DO NOT SELECT MORE THAN 10.** Enter the area number in the space provided and indicate how long you have been working in each area. Since this list is not exhaustive, space is provided for you to indicate other areas.

1. Field theory axiomatics
2. S-matrix axiomatics
3. Analyticity in field theory
4. Analyticity in S-matrix theory
5. Asymptotic considerations
6. Theory of weak currents
7. Sum rules
8. Approximate hadron symmetries
9. Theory of T,C,P Violations
10. Theoretical developments on intermediate vector bosons and neutrino reactions
11. Hadron form factors
12. Violation of quantum electrodynamics
13. Lagrangian field theory
14. Hadron initiated reactions
15. Photon initiated reactions
16. General SU_3 considerations
17. Electromagnetic mass splittings and magnetic moments of hadrons
18. Origin of octet enhancement
19. Miscellaneous symmetry tests
20. Analytic structure of partial waves
21. Off-shell dynamical equations
22. S-matrix dynamics
23. Bootstrap models
24. Theory of small momentum transfers
25. Theory of large momentum transfers
26. Others (please specify)

_____

Area No.	*Years (nearest month)*	*Area No.*	*Years (nearest month)*
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

5. Please check journals you scan regularly (i.e. at least read table of Contents or Abstracts or Summaries, etc.)

a. ☐ Annals of Physics
b. ☐ Journal of Mathematical Physics
c. ☐ Nuclear Physics
d. ☐ Nuovo Cimento
e. ☐ Physica
f. ☐ Physical Review
g. ☐ Physical Review Letters
h. ☐ Physics Letters
i. ☐ Progress of Theoretical Physics
j. ☐ Soviet Physics – JETP
k. ☐ Others _____ *(please specify)*

6. Please rate each of the following media in terms of the overall importance it has in furnishing scientific information for your current work in high energy physics. Circle the appropriate number, e.g. 1 for "Very important," 7 for "Of no importance," etc.

Media	*Very Important*						*Of No Importance*
a. Journal articles read in own or library copy	1	2	3	4	5	6	7
b. Reprints	1	2	3	4	5	6	7
c. Drafts of manuscripts	1	2	3	4	5	6	7
d. Technical reports distributed within own institution	1	2	3	4	5	6	7
e. Technical reports distributed by other than own institution	1	2	3	4	5	6	7
f. Telephone conversations	1	2	3	4	5	6	7
g. Face-to-face discussions with persons working at your own institution	1	2	3	4	5	6	7
h. Face-to-face discussions with persons not currently working at your own institution (e.g. at scientific meetings, etc.)	1	2	3	4	5	6	7
i. Oral presentations made at scientific meetings or conferences	1	2	3	4	5	6	7
j. Copies of oral presentations (including lecture notes and conference proceedings)	1	2	3	4	5	6	7
k. Private correspondence	1	2	3	4	5	6	7
l. Other _____ *(please specify)*	1	2	3	4	5	6	7

7. Listed below are various media for scientific communication. Please provide for each of these the information requested in Columns a-e with reference to the communications you received or sent during the **PAST TWO WEEKS.** Enter the approximate numbers in the unshaded blocks.

	Scientific Communications **RECEIVED** By You in Past Two Weeks			Scientific Communications **SENT** By You in Past Two Weeks	
Media	a Number Received (or Conducted) at Place of Work	b How Many of Those in Col. a Did You Get Because You Asked Specifically for that Item	c Number Read or Scanned	d Number Sent (or Conducted) Outside Institution	e Number of Those in Col. d Sent on Request
Journal articles read in own or library copy					
Reprints					
Manuscripts (including drafts)					
Technical reports distributed within own institution					
Technical reports distributed by other than own institution					
Telephone calls					
Face-to-face discussions with persons working at your own institution					
Face-to-face discussions with persons not currently working at your institution (e.g. at scientific meetings, etc.)					
Copies of oral presentations (including lecture notes and conference proceedings)					
Private correspondence					
Other _____ *(please specify)*					

8. a. Have you, during the **PAST 12 MONTHS**, distributed copies of unpublished information (exclude private correspondence) about your work to persons outside your own institution?

☐ YES ☐ NO (IF NO, go on to Question No. 11)

b. Does your institution or department maintain a mailing list for outside distribution?

☐ YES ☐ NO

c. Which one of the following means did you use to distribute this information? Check as many as appropriate. Double check the one used most often.

(i) ☐ Distributed on request only

(ii) ☐ Distributed via own personal mailing list

(iii) ☐ Distributed via own institution's automatic list for outside distribution

(iv) ☐ Other _____
(please describe)

_____

_____

d. Does your answer to Question No. 8c above represent the distribution of

☐ one communication? ☐ more than one communication?

e. If, during the **LAST 12 MONTHS**, such information was distributed via your own personal mailing list, and not via your own institution's automatic mailing list, what considerations prompted this?

_____

_____

_____

9. a. Did any of the unpublished information you distributed in the **LAST 12 MONTHS** constitute the basic content of an article you have submitted to a journal for publication?

☐ YES ☐ NO (IF NO, proceed to Question No. 10.)

IF YES, consider the LAST INSTANCE OF THIS and proceed to b and c.

b. Please name the journal(s) to which it was submitted.

Journal of first choice _____

(If submitted to more than one journal, please name the other(s) _____

_____)

c. At what stage(s) was this information disseminated and approximately how many copies were distributed at each stage?

Stage of Distribution of Information	*Approx. Number of Copies Distributed*
(i) ☐ Before it was submitted for journal publication	_____
(ii) ☐ At the same time it was submitted for journal publication	_____
(iii) ☐ After it was submitted but before it was accepted	_____
(iv) ☐ After it was accepted for publication	_____

10. a. Have you received during the **LAST 12 MONTHS** any responses from the recipients of any of your unpublished report(s) concerning their contents?

☐ YES ☐ NO (IF NO, proceed to Question No. 11.)

IF YES, please try to recall the MOST RECENT INSTANCE of this and answer items b-g.

b. Name of the person responding and his institution _____

_____

c. To what extent have you communicated with this person before?

☐ Very frequently ☐ Occasionally ☐ Seldom ☐ Never

d. Approximately how much time elapsed between receiving his response and sending out the communication to which it referred?

☐ One week ☐ One month ☐ Two months ☐ Three months ☐ More than 3 months

10. e. Form in which the reply came: (check one) ☐ Telephone call ☐ Face-to-face discussion
☐ Letter ☐ Manuscript ☐ Technical report ☐ Reprint Other _____
(please specify)

f. Form of original communication you sent out: (check one) ☐ Telephone call ☐ Face-to-face discussion
☐ Letter ☐ Manuscript ☐ Technical report ☐ Reprint Other _____
(please specify)

g. Effect of this reply on your work (Please write appropriate number(s) from list below: _____)

1. It suggested a new approach.
2. It resulted in a reformulation of a problem.
3. It caused me to drop plans to publish the information.
4. It helped me to improve my presentation.
5. It arrived too late to have any influence on my work.
6. It served to substantiate my work.
7. It was of little or no significance to my work.
8. Other _____
(please specify)

11. Please select the one medium of scientific communication which best serves each of the functions listed below. Enter the corresponding number in the blank next to each function.

Functions

a. General awareness of current state of theoretical high energy physics _____

b. Find out who is working in what area or on what problems _____

c. Source of specific ideas for work in progress _____

d. Source of specific idea for new work _____

e. Inform others of my research activities _____

f. Getting up to date in a new area _____

g. Browsing/stimulation _____

h. Other functions of importance to your work. _____

_____
(please describe)
_____

Media for Scientific Dommunication

1. Journal articles read in own, or library, copy
2. Reprints
3. Manuscripts (including drafts)
4. Technical reports distributed within own institution
5. Technical reports distributed by other than own institution
6. Telephone conversations
7. Face-to-face discussions with persons working at your own institution
8. Face-to-face discussions with persons not currently working at your own institution (e.g. at scientific meetings, etc.)
9. Oral presentations made at scientific meetings or conferences
10. Copies of oral presentations (including lecture notes and conference proceedings)
11. Private correspondence
12. Other _____
(please specify)
_____

12. a. Please name the two persons at your institution with whom you exchange information most frequently about your research.

_____

_____

b. Please name the two persons outside your institution with whom you exchange information most frequently about your research.

Name: _____

Institution: _____

Name: _____

Institution: _____

c. Please name no more than three persons whom you believe are doing the most important work in your area of research

Name: _____

Institution: _____

Name: _____

Institution: _____

Name: _____

Institution: _____

13. Please check the most important way in which you learn about the existence of relevant information (SELECT ONE)

a. ☐ Journal and abstract indexes, acquisition lists, etc.

b. ☐ Regular scanning of literature

c. ☐ Programs and proceedings of scientific meetings

d. ☐ Colleagues

e. ☐ Librarians and technical information personnel

f. ☐ Accidental exposure to the information itself

14. Are you familiar with the Physics Information Exchange (PIE) proposal for a central organization to receive, duplicate, and give rapid, widespread distribution to "preprints"?

a. ☐ YES ☐ NO

IF YES:

b. When did you first become aware of the PIE Proposal? _____ , _____
Month *Year*

c. What was the source of this first awareness?

(i) ☐ American Physical Society meeting (January, 1966)

(ii) ☐ Read about it in *PHYSICS TODAY*

(iii) ☐ Read about it elsewhere. _____
(please specify)

(iv) ☐ Colleague

(v) ☐ XIII Conference on High Energy Physics

(vi) ☐ Preprint _____
(please specify)

(vii) ☐ Other _____
(please specify

_____

Consider a centralized service in which communications in high-energy theoretical physics were to be received by a central agency, duplicated and circulated to member institutions. Any institution throughout the world having researchers in theoretical high-energy physics would qualify for membership, *i.e*, researchers at these institutions would be able to both contribute and receive papers. Papers already published would not be included.

15. Please describe what you consider the major advantages and disadvantages in a service such as that described above.

Advantages	*Disadvantages*
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

16. Considering the advantages and disadvantages you have listed in the previous question, do you think such a centralized service should be tried on an experimental basis? Check one.

a. ☐ Yes, without reservations

b. ☐ Yes, with some reservations

c. ☐ Undecided

d. ☐ No, but possibly with some modifications

e. ☐ No, absolutely not

17. Are there any comments or suggestions you would like to make relative to:

(1) the existing preprint distribution situation

and/or

(2) improving scientific communication in high energy physics?

(Use the reverse side of page three for your answer.)

APPENDIX B

SAMPLE COMMENTS

Advantages- I don't know any
Disadvantages- Waste of labor and postage...Political difficulties
Comments- Too much, too unselective. I think that communication is excellent.

Advantages- Speed
Disadvantages- Restricted access for researchers...Too many reports ...No restriction on low quality work...Build-up of a huge, chaotic "underground' literature.
Comments-1.Lower the time interval between arrival of manuscript at journal office and publication by: (a) acceptance or rejection of manuscripts be refereed must occur within a set time interval, e.g. three weeks. If no action is taken within this period the manuscript is automatically accepted. (b) use of newer techniques for publishing, e.g. the centuries-old method of setting type may have outlived its usefulness for scientific journals. It should be possible, with strict requirements on the appearance of a manuscript, to directly go from the manuscript to the printed page.
2. Have manuscripts accepted or rejected on their own merits by submitting manuscript to referee with page giving name(s) of author(s), institution and acknowledgments missing.

Advantages- Uniform, rapid, and democratic
Disadvantages- Non-selective, enormous no feedback, probably get swamped.
Comments- I belong to a heretic group probably but I actually believe that there is too much communication and it is getting worse. It takes time to think and over-emphasis on the latest vogue is not without peril. (Had my paper, referred to earlier in 10 been published at letter journal speed (it was accepted by JMP, but they move slowly) it would have contained a serious - and embarassing error)....Publication in letter journals has been a "prestige contest" and the quality of the majority of papers there is poor, and more and more incomplete and arcane. Rapid dissemination of abstracts might almost function as well. But nevertheless I both read (sometimes write) for PRL and Physics Letters.... Preprints are highly valuable and - - when personal - - are "self-selecting." PIE or no they will continue. . .Let me admit I have no solution.

Advantages- Rapid dissemination of information...Informality of exchange. ..arguments, release of negative results...Puts all institutions on the same level as far as acquisition of information is concerned...Counter-

acts somewhat effects of physics "cliques"
Disadvantages- Will produce glut of preprints..Too expensive to maintain...Would coexist with old preprint system rather than displace it.
Comments- After reflection and discussion with others, I have shifted my position in the recent past from unqualified support of PIE to support with some reservations. The Problem of an information explosion in preprints has lately bothered me and I am coming around to the view that a modified version of PIE involving some effort on the part of potential recipients of preprints would be preferable to the automatic receipt of all preprints. Let me suggest an alternative scheme. Cooperating individuals and institutions would send their communications to the central distribution point. They would very rapidly receive 50, 70, etc. preprints (the number could be subject to further discussion). They would agree not to produce their own preprints In addition to the authors' copies, the central information office would put out weekly preprint lists. Interested institutions which are members of the distribution system could then apply to have specific preprints sent to them by the central office. Presumably the central office would very quickly gain enough experience to have a pretty good statistical idea of how many copies of a given preprint to produce. . .A second and somewhat simple version of this scheme (but relying somewhat unduly on the authors' unwillingness to send preprints to all who request them) would be to have the central office act only as a source of the preprint list. . .Since preprint lists could be air mailed to distant countries, there would be essentially no delay in the receipt of preprints at any place on earth.

Advantages- Easier access to information...Quicker intercommunication...Bigger audience
Disadvantages- Greater circulation of trash...Unreliability due to absence of refereeing.
Comments- If PIE were to incorporate "refereeing" at some stage, its usefulness would be greatly increased. Such refereeing could be done by an informal panel of referees who would be requested to do the job more expeditiously than e.g. Phys. Rev. referees. These referees would be regionally distributed to facilitate communication; also direct referee-author communication should be allowed in order to encourage the exchange of useful suggestions.

Advantages- Increases dissemination of latest work to less well known groups...Will save much repetitious cataloging at various institutions
Disadvantages- May encourage distribution of unsound or poorly written manuscripts.
Comments- It seems to me that it would be advantageous to require authors to catalog their manuscripts with respect to the Phys. Rev. subject index in order to facilitate access to papers in a certain area of high energy theory. Any abstracting or preprint listing service should be accompanied by this classification.

Advantages- It would facilitate communication and meaningful discussion about ideas, and reduce premature journal publication of unfinished work to establish priority.
Disadvantages- None, in my opinion

Advantages- Stop theorists from publishing badly prepared papers in PRL...Would remove bickering over unfair refereeing...Would allow people at small institutions to see papers as soon as people at the major institutions
Disadvantages- Encourage people to send even more badly prepared papers to PIE in order to be first to claim priority.
Comments- Restrict PRL to only experimental HEP....If the standards for publication as stated in the journal are true then refereeing is impossible. No one can tell at the time of submission which papers are significant contributions. Attempts at determining which are very significant have resulted in the present situation in which all the high energy theorists in the world jump from one bandwagon to another with a time constant of about one year. It would be more productive to slow things down a little and get more diversity.... This also might result in better written papers. The stress of getting a paper out in a few days seems to be too much for many people....Finally it is almost impossible to present any theoretical idea in the 800 word limit supposedly in PRL. Few ideas could not be better handled in a PR paper.

Advantages- Speed of communication...Important communications will not be missed...Will save money and time particularly for developing countries like India. Some uniformity and standardization will result, hopefully.
Disadvantages- Useful papers will be diluted with unimportant ones... Lot of unedited material will be circulating.
Comments- Enormous amount of preprints are distributed through the mailing lists of institutions as well as through personal lists. However, the most adequate and successful (from the point of view of benefits) system is even now the circulation by the library of all reports received by it. An excellent library (like the one in CERN) thus acts like a centralized body. A bigger version of such a body (PIE) will be ideal, because it will not load one with preprints from one's own institution and therefore the reader gets a better perspective of his field by being able to look at all preprints circulated by the centralized body. However, question: Will the present system be discontinued if PIE proposal comes into effect?... Improving scientific communication is tied up with so many aspects -- one crucial thing of course is the refereeing system at present practiced by journals. As more and more young physicists are

acting as referees nowadays, there is a great deal of bias and personal prejudices exercised in judging whether a certain paper is worth publication. While nobody can rightly judge as to the merit and demerit of a certain idea employed in a paper, every referee seems to take great delight in turning down a manuscript on very extraneous or erroneous grounds. Editorial policies also keep fluctuating with the result that sometimes 6 papers appear unrefereed in a single issue whereas the seventh one, though deserves publication, gets the axe from the editorial policy... . Because of personal elements involved in refereeing, the authors receive reports with statements like "there is nothing new in this paper" or "this is already contained in some one's private communication" or "the authors have not understood the spirit of" etc. with the consequence that one gets often discouraged, particularly when one lags behind what is considered as "fashionable" on that date... Can we eliminate this personal element in refereeing?

Advantages- --
Disadvantages- --
Comments- I am against the centralized service as defined by you. My principal argument is this. A source of this kind gives (whether intended or not) formal status to a preprint. It is de facto a "pre-journal journal." I find this bad because (a) a man X can send a half baked idea into formal circulation as a trial balloon without intent to publish (b) if at a later stage Mr. Y does publish (in the conventional sense) a result which has overlap with X, then X can claim priority. In my opinion high energy physics especially demands at times the courage of the individual to stand by his ideas. I think that giving formal status to a preprint will undermine the spirit of our field and will tend to encourage those communication of which X can say later at his convenience "oh, that, I only circulated a suggestion, I didn't take that too seriously, you know, as you can see because I never published" --or--"yes, I knew this and told everybody etc." depending on how the chips fall. As a veteran in the field I have seen such situations many times... On the other hand I do think a centralized service could and should the following two purposes...(a) it should collect a list of institutions desirous to be kept informed on what goes on in H.E.P. elsewhere. It should send to all institutions involved a full list of such institutions, for the purpose of helping all institutions in having an adequate institutional mailing list...(b) it should request of all these institutions immediate communication of titles and authors of papers about to be circulated in preprint form. It should institutions immediate communication of titles and authors of papers about to be circulated in preprint form. It should institute a weekly first class (air mail) service in which these lists are distributed to all institutions. In this way Mr. X at an affiliated institution, can select things he particularly is concerned with and then he can be in direct touch with Mr. Y who is the author in question....I believe this proposal is more efficient, less costly and also that it gives everyone in the field the needed sense that he belongs and is not left out.

Advantages- Fast information on the current state of research
Disadvantages- None
Comments- At least the regular production of the list of all preprints concerning the high energy physics is highly desirable. It would be especially important for physicists working at relatively small institutions with little connections to large laboratories. The possibility of receiving papers from a central institution would surely contribute significantly to the utilization of capacities of small institutions.

Advantages- The service would be of immense benefit to those of us who work in remote places
Disadvantages- I can't think of any
Comments- I am not aware of any preprint distribution system at the moment except the very good ones in Trieste and CERN, Argonne, Rochester and a few others do occasionally remember us but I wish there were a centralized agency like PIE.

Advantages- Fast awareness to the physics community...Will stop useless duplication of efforts
Disadvantages- Will be hard to establish priority --or credit to proper person..Underdeveloped, and distant countries will hardly get this information in time unless sent air-mail.
Comments- There should be given an official status (in terms similar to those given to a publishing journal) to this organization and individuals in smaller places should be also included even if the mailing costs are substantial... It would be hard to keep track of individuals in a mobile society... Proper credit should be required for any use of such a material before even it is published... People may be asked not to send any "junk" material which may not be of general or of advanced specialized nature.

Advantages- --
Disadvantages- --
Comments- The existing preprint system is a mess. Any new experiment cannot make this situation worse.

Advantages- Completeness...orderliness...availability
Disadvantages- Cost...superfluousness
Comments- I think a deficiency in scientific communication more serious than the chaotic preprint system is the problem of keeping up with fields in which one is not working. Could it be arranged that 25 to 50 experts write monthly (5 pages) resume of developments in a list of 25 areas like that of question 4... They could read all preprints and the rest of us would be able to concentrate on the good (important) (or representative) ones... Volunteers should not be hard to find; I would enjoy doing it for a year.

Advantages- Rapid dissemination of information
Disadvantages- Whatever happended to the concept that physics was fun?
Comments- What's the all-fired hurry? One good idea is certainly preferable to six undistinguished papers. The speeding up process, the formalization of procedures tends to turn us all into technicians. I am not certain that the publication time lag is a bad thing. It may be a very useful built-in safety valve whose value will only be appreciated after it has disappeared.

Research in Informal Communication
Among High Energy Physicists

Study of Existing Network

by Clarebeth Maguire

A mail survey was addressed to 36 U. S. and 47 foreign institutions identified as having a preprint collection for the use of theoretical high energy physicists. The purpose of the survey was to obtain information about the procedures currently established for preprint distribution from those persons who handle the distribution.

A questionnaire, with covering letter, return envelope and postage, was mailed on November 28, 1966.

The questionnaire was divided into three parts: GENERAL information about the preprint collection (years in existence, position of person and his hours spent in collection's maintenance, number of theoretical high energy physicists serviced); information about INCOMING preprints (volume, maintenance and notification procedure, use); information about OUTGOING preprints (types of material distributed, reproduction and distribution procedure, quantity, cost). Respondents were requested to use their experience in 1966 as the basis for their answers.

As of December 30, 1966, 19 U. S. and 14 foreign institutions responded. The preprint collections maintained at these institutions serve approximately 600 theoretical high energy physicists. Although the exact number is unknown, it has been estimated that there is a total of 2500 theoretical high energy physicists at 500-600 institutions in the U. S. and abroad. Therefore the data in the attached report should be used with care. The report presents information about the procedures of 33 institutions - these procedures may or may not be similar to those of all or most institutions.

This report summarizes the responses from U. S. and foreign sources separately. Both summaries follow the format of the questionnaire with table numbers referring to items in the questionnaire.

Annex I is a copy of the questionnaire, Annex II gives comments made by respondents.

U. S. PREPRINT COLLECTIONS

General

(1) The 19 U. S. institutions included in this summary are located as follows:

California	3
Colorado	1
Florida	1
Hawaii	1
Illinois	2
Indiana	1
Iowa	1
Massachusetts	2
Michigan	1
New Hampshire	1
New York	2
Ohio	1
Pennsylvania	1
Tennessee	1

The person completing the questionnaire for each of the above institutions reported on the one (or major) preprint collection of theoretical high energy physics material.

(2) Fourteen of the 19 institutions have had a preprint collection for four years or less. The median age of the collections is two years.

Age of preprint collections (PPC):

$\frac{1}{2}$, 1, 1, $1\frac{1}{2}$, 2, 2, 2, 2, 2, 2, 3, 3, 4, 4, 6, 8, 8, $8\frac{1}{2}$, 10 years.

(3)

Position of person maintaining PPC	No. of insts.	Average hours spent each week on PPC	Average number of preprints received each week	Number of preprints distributed in 1966
Secretary	5	$\frac{1}{2}$, 4, 5, 35, 50	16, 20, 33, 50, 150	4, 5, 7, 45, 57
Librarian	7	4, 4, 5, 20, 40, 70	5, 10, 20, 30, 30, 46, 85	13, 39, 57, 64
Graduate Student	1	1	10	3
Physicist	2	1, 1	5, 10	4, 1
Secretary, plus*	4	1, 2+, 8, 50	10, 15, 35, 40	4, 12, 34, 70

Total: 620 by 19 institutions or 33 average

*A librarian at one institution, a physicist at three institutions.

(4) Number of theoretical high energy physicists being served:

2, 2, 2, 3, 4, 5, 7, 7, 8, 10, 15, 16, 16, 20, 33, 85 = $\frac{235}{16}$ inst.

The number of theoretical high energy physicists (THEP) was not reported for two institutions.

Note: The exact number of THEP is not known but one estimate of the total in the U. S. is $\backsim$ 1200.

The number of THEP is cross-tabulated with other data in items (10) and (12).

(5) The THEP being served at 15 institutions are defined as a "group". The THEP cannot be defined as a "group" at four institutions.

INCOMING PREPRINTS

(6) The average number of preprints received per week in 1966

from domestic sources - 16 average

from foreign sources - 10 average

Total - 33 average*

*Four institutions did not give a breakdown of foreign and domestic sources.

Age of PPC	Average number of preprints received per week
≤ 2 years	5, 5, 10, 15, 16, 20, 30, 30, 40, 85 = 26 average
≥ 3 years	10, 10, 10, 20, 33, 35, 46, 50, 150 = 40 average

(7) The respondents ranked all applicable means of obtaining preprints for their collections. The following table shows the 1st, 2nd and 3rd most productive sources.

Means of Obtaining Preprints	Institutions' Rank of Source 1st	2nd	3rd
a. By requesting inclusion on preprint mailing lists	12	2	2
b. By routine inclusion on preprint mailing lists	4*	9	2
c. By requesting preprint included on other's list of preprints	-	2	4
d. Individuals in group donate preprints they received	3	6	7
	19	19	15

*Includes one institution with 3-year-old collection, one with 6-year-old and two with 8-year-old collections.

(8) Respondents checked each of the following that apply to the maintenance of their incoming preprint collection.

Maintenance Procedure	No. of Insts.	
a. Prepare acquisition list	16	(10 weekly, 1 three times monthly, 2 semimonthly, 3 monthly)
b. Prepare card file	12	(5 by author, 4 author & inst., 1 by inst., 1 author & subject, 1 by author, inst., subj., title)
c. Delete duplicates	15	(9 regularly, 6 occasionally)
d. Purge preprints	18	(purged when 3 to 48 months old; median 12 months old)

(9)

Notification Procedure	Own group only	Own group & others at your inst.	Own inst. & others outside your inst.	No. of insts.
List of acquistions maintained at preprint library for use by:	1	8	6	15
List of acquisitions routed periodically to:	3	3	6	12
Individual notification of relevant preprints:		3		3
Circulation Procedure				
Circulation of actual preprint to interested individuals:	4	1	2	7
Preprints available for perusal where collection is maintained:	2	7	9	18
Preprints may be borrowed from collection by:	3	10	4	17
Reproduction Procedure				
Copies of preprint are reproduced on request from:	5	1	3	9
Copies are reproduced and distributed routinely to all individuals believed to be interested:			1	1

(10) Thirteen respondents estimated the average number of preprints used each week by THEP in their group.

No. of Preprints		
67	are used by 16 THEP.	(20% of group)
18	are used by 22 THEP.	(40% of group)
21	are used by 31 THEP.	(60% of group)
6	are used by 5 THEP.	(80% of group)
4	are used by 4 THEP.	(100% of group)
116		

43% or 116 of the total 267 preprints received weekly at these institutions are used. There are 90 THEP. at the institutions.

OUTGOING PREPRINTS

(One of the nineteen respondents to the survey reported that preprints were not distributed by his institution.)

(11) The respondents checked the types of preprints distributed by the THEP. in 1966 and estimated the percentage of the total each type represented. Data for 17 institutions are tabulated below.

No. of Preprints dist.-1966 (17 insts.)	Draft ms. of research paper		Final ms. of research paper		Draft ms. of conference paper		Final ms. of conference paper		Technical report		Work papers not for publ.		Rough notes	
	%	#	%	#	%	#	%	#	%	#	%	#	%	#
1			100	1										
1	10	-	90	1										
3			100	3										
4			50	2			30	1			20	1		
4	x	2			x	1			x	1				
4	40	2	40	2	5	-					10	-	5	-
5			80	4			20	1						
7			80	5			20	2						
10	30	3	30	3			10	1	30	3				
12	7	1	79	9			7	1			7	1		
13			x	8			x	3	x	2				
34	40	14	40	14			10	3			10	3		
39			78	30			22	9						
57									10	6	90	51		
57	x	1	94	54			4	3			x	-	x	-
64			75	48			23	15	2	1				
70			100	70										
385		22		254		1		39		13		56		
100%		7%		66%		-		10%		3%		14%		

To

x= respondent checked type but did not report percentage. The percentage was estimated.

(12) The number of preprints distributed

in 1966: 421 preprints (16 institutions) 26 average
in 1965: 282 preprints (11 institutions) 26 average
in 1964: 237 preprints (10 institutions) 24 average

The number of THEP at each institution and the number of preprints distributed in 1966 is shown on Figure C-1.

(13) Two respondents said preprints are circulated internally for review and comment before being prepared for distribution. Most of the institutions (10) have no standard procedure but five reported no internal review.

A release or approval is required by three institutions before a preprint is distributed. Fourteen reported no such requirement at their institution.

(14) All eighteen respondents reported that multiple copies of their preprints are reproduced. Twelve use reproduction facilities available at their own institution; three use commercial facilities; three use both.

The most frequently used processes are:

Process	No. of insts.	Total pages reproduced/preprint
Offset	6	24,000, 14,000, 4,000, 750, 3,250
Mimeograph	5	1,600, 3,000, 3,000, 1,750
Xerox	2	850, 500
Multilith	3	1,250, 12,000, 9,000

(15) In order to obtain information on the work involved in preparing a preprint for publication, the following phases were listed on the questionnaire:

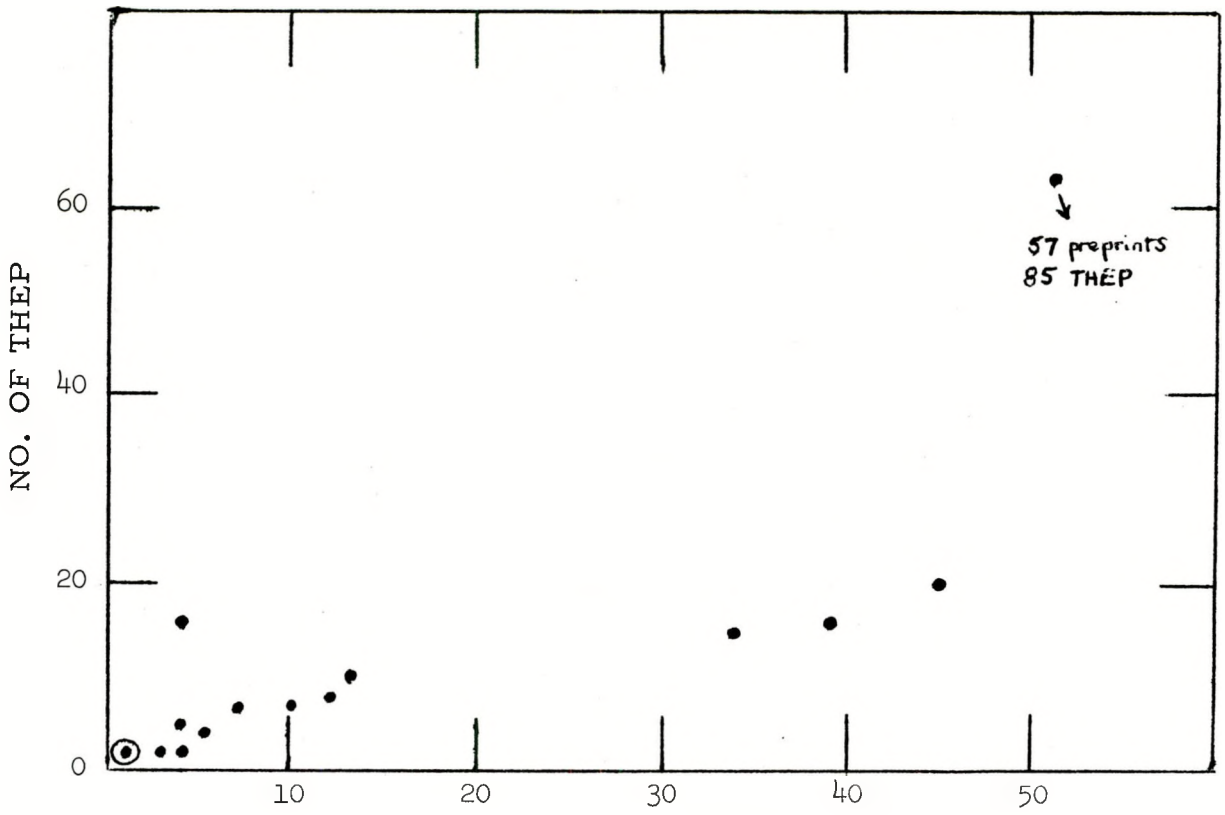
Typing	Printing
Proofing	Binding
Editing	Addressing
Drafting art	Other

All appropriate phases were to be checked and the hours required per preprint for each phase were to be estimated.

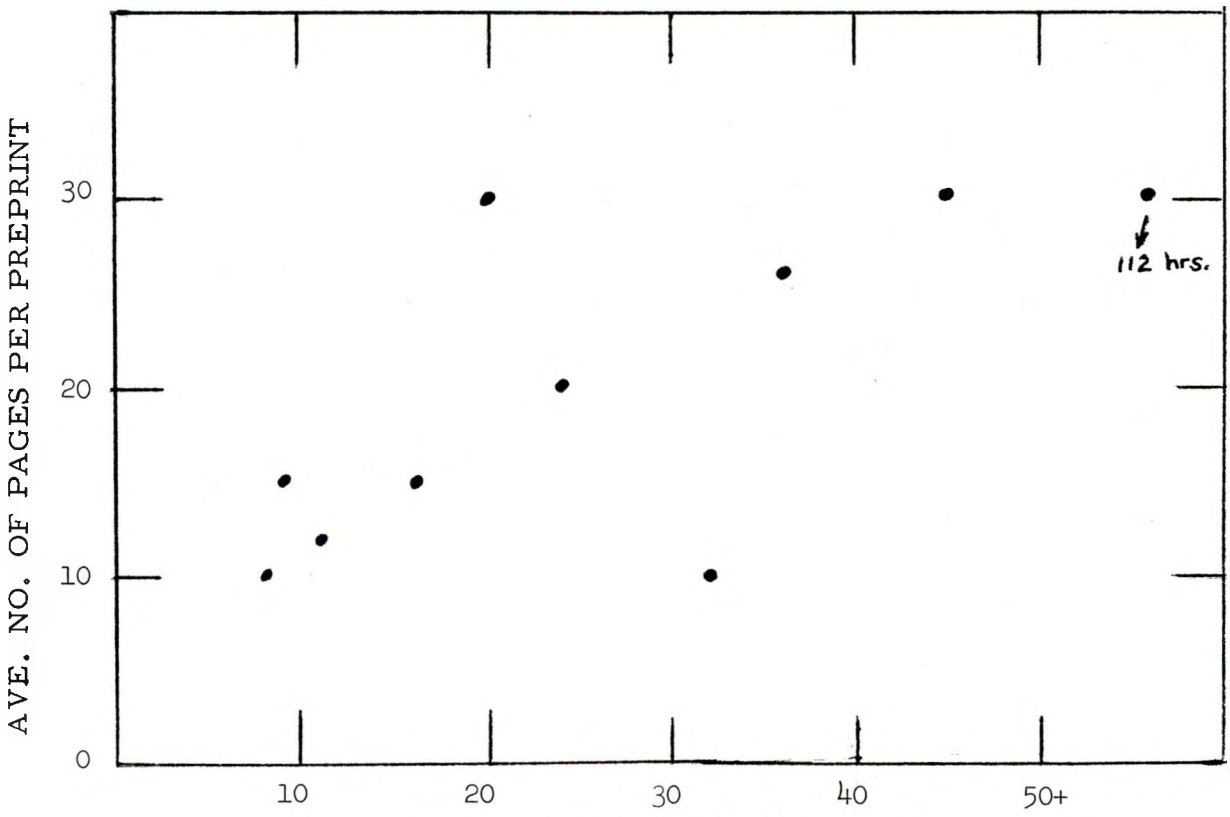
Nine reported the total hours listed below and shown on Figure C-2.

8, 9, 11, 16, 20, 24, 32, 36, 45, 112 hours

The phases checked by these nine were similar - editing was checked by only two, binding was changed to stapling by several and not checked by three, two wrote "stuffing envelopes" in other.



Number of "Preprints" Versus Size of Organization - - U.S.
FIGURE C-1



"Preprint" Processing Times - - U.S.
FIGURE C-2

(16) The 1966 expenditures for preprint reproduction and distribution were estimated by six respondents.

Repro. Cost	Dist. Cost	Ave. no. of cps.	Ave. no. of pages	Repro. process	No. of Preprints 1966	Cost per page
$500	$100	400	30	multilith	4	1¢
250	100	200	15	mimeograph	4	2¢
20	10	125	10	multilith	5	½¢
4	4	50	15	offset	1	1¢
3000	1800	800	30	offset	39	½¢
- 12000 -		125	26	offset	57	7¢

Note: The cost shown above probably does not include support-staff time.

(17) a. The average number of copies made of each preprint ranged from 50 to 800. The average for the 16 respondents to this question is 233 copies.

50, 50, 50, 50, 80, 125, 125, 200, 200, 250, 250, 300, 350, 400, 450, 800.

b. The average number of pages per preprint ranged from 10 to 40. The average for 14 respondents is 22 pages.

10, 10, 12, 15, 15, 17, 20, 20, 26, 30, 30, 30, 35, 40

(18) Fifteen of the 18 institutions distributing preprints maintained a mailing list. Six do not use the same mailing list for all members of their THEP group.

	Number of personal names on mailing list		Number of insts. on mailing list	
	Domestic	Foreign	Domestic	Foreign
Range	30-314	5-170	15-258	5-110
Average	137	71	66	46

Twelve institutions send preprints abroad via surface mail; four use air mail.

(19) All respondents fill requests for preprints after initial distribution.

(20) Four respondents withdraw preprints from circulation when reprints of published paper are available. Twelve reported there was no standard procedure at their institution.

Foreign Preprint Collections

GENERAL

(1) The 14 institutions outside of the United States included in this summary are located as follows:

Canada 1

Britain 5

Belgium 1

Italy 2

France 1

Spain 1

Switzerland 1

Netherlands 1

Poland 1

The respondent at one institution reported that there is one other preprint collection at the university for THEP; six others were reported at another place and three others at a third.

(2) Age of preprint collections:

$\frac{1}{4}$, 1, 2, $2\frac{1}{2}$, 4, 4, 5, 5, 5, 7, 7, 7, 9, 10 years

The median age of the collections is 5 years. (U.S. collections have a median of 2 years.)

(3)

Position of person maintaining PPC	No. of Inst.	Ave. hours spent each week on PPC
Secretary	8	$\frac{1}{4}$, 1, 1, 2, 3, 5, 8, 16
Librarian	3	4, 10, 27
Research assoc.	2	2, 3
Secretary plus Libr.	1	6+

Ave. no. of preprints received each week	
7, 10, 15, 17, 18, 20, 30, 50 6, 32, 75 20, 40 30	Total: 370 by 14 insts. or 26 ave.

(4) Number of theoretical high energy physicists:
4, 5, 6, 6, 10, 15, 20, 20, 20, 25, 30, 40, 100 = $\frac{301}{13}$ inst. (In U.S. $\frac{235}{16}$ inst.)

The number of THEP at one university was not reported.

(5) The THEP at 10 institutions are defined as a "group." There are three groups at one place (30 THEP). A second place reported that their 5 THEP cannot be defined as a group.

INCOMING PREPRINTS

(6) The average number of preprints received per week in 1966:
from domestic sources - 4 ave.
from foreign sources -23 ave.
Total -27 ave. (U.S. ave. 33)

Age of PPC	Ave. no. of preprints received per week
≤ 5 yrs.	6, 10, 15, 17, 20, 20, 32, 40, 50 = 23 ave.
≥ 6 yrs.	7, 18, 30, 30, 75 = 32 ave.

(7) The respondents ranked all applicable means of obtaining preprints for their collections. The following table shows the 1st most productive sources, the 2nd, and 3rd. (Same pattern as U.S.)

Means of Obtaining Preprints	Institutions rank of sources 1st	2nd	3rd
a. By requesting inclusion on preprint mailing lists	9	2	2
b. By routine inclusion on preprint mailing lists	4	4	2
c. By requesting preprint included on other's list of preprints	-	2	5
d. Individuals in group donate preprints they received	1	4	1
	14	12	10

(8) Respondents checked each of the following that apply to the maintenance of their preprint collection. (Same pattern as U.S.)

Maintenance Procedure	No. of Insts.	
a. Prepare acquisition	12	(7 weekly, 1 biweekly, 3 semimonthly, 1 monthly)
b. Prepare card file	8	(3 by author, 2 by inst., 1 by author & subj., 1 by author & inst., 1 by author inst. & title)
c. Delete duplicates	11	(5 regularly, 3 occasionally, 3 neve
d. Purge preprints	10	(purged when 4 to 24 mos. old; Median; 12 mos.)

9)

Notification Procedure	Only own group	Own group & others at inst.	Own inst. & others outside inst.	No. of insts.
List of acquisitions maintained at preprint library for use by	2	5	3	10
List of acquisitions routed periodically to	4	2	2	8
Individual notification of relevant preprints	2			2
Circulation Procedure				
Circulation of actual preprint to interested individuals	2	1	1	4
Preprints available for perusal where collection is maintained	2	6	2	10
Preprints may be borrowed from collection by	9	4	1	14
Reproduction Procedure				
Copies of preprints are reproduced on request from	4	1	1	6
Copies are reproduced and distributed routinely to all individuals believed to be interested				0

(10) Eleven respondents estimated the average number of preprints used each week by THEP.

No. of preprints		
91	are used by 30 THEP	(20% of group)
34	are used by 58 THEP	(40% of group)
23	are used by 70 THEP	(60% of group)
14	are used by 10 THEP	(80% of group)
35	are used by 36 THEP	(100% of group)
197		

78% or 197 of the total 250 preprints received weekly at these institutions are used. There are 181 THEP at these 11 institutions.

OUTGOING PREPRINTS

(One large institution was unable to give data for this section. Distribution handled by each group).

(11) The types of preprints distributed in 1966 and the percentage of the total each type represents is listed below for eleven institutions.

No. of Preprints dist.-1966	Draft ms. research paper		Final ms. Research paper		Draft ms. Conference paper		Final ms. Conference paper		Technical report		Work paper not for publication		Rough notes	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%
3	-	10	2	80			1	10						
8	-	5	5	65	1	10	1	10	1	10				
9			8	85	-	5			1	10				
8			7	90	1	10								
9	1	10	2	30	2	20			2	20	2	20		
10			10	100										
10	1	10	9	90										
21			21	100										
27	2	7	22	70			1	5	1	4	1	4		
48			44	90			2	5			2	5		
				x		x		x						
Total 153	4		130		4		5		5		5			
100%	3%		85%		3%		3%		3%		3%			
(U.S.)	(7%)		(66%)				(10%)		(3%)		(14%)			

x = respondent checked the types of preprints but did not report the percentages; the number of preprints distributed in 1966 was also unknown.

(12) The number of preprints distributed

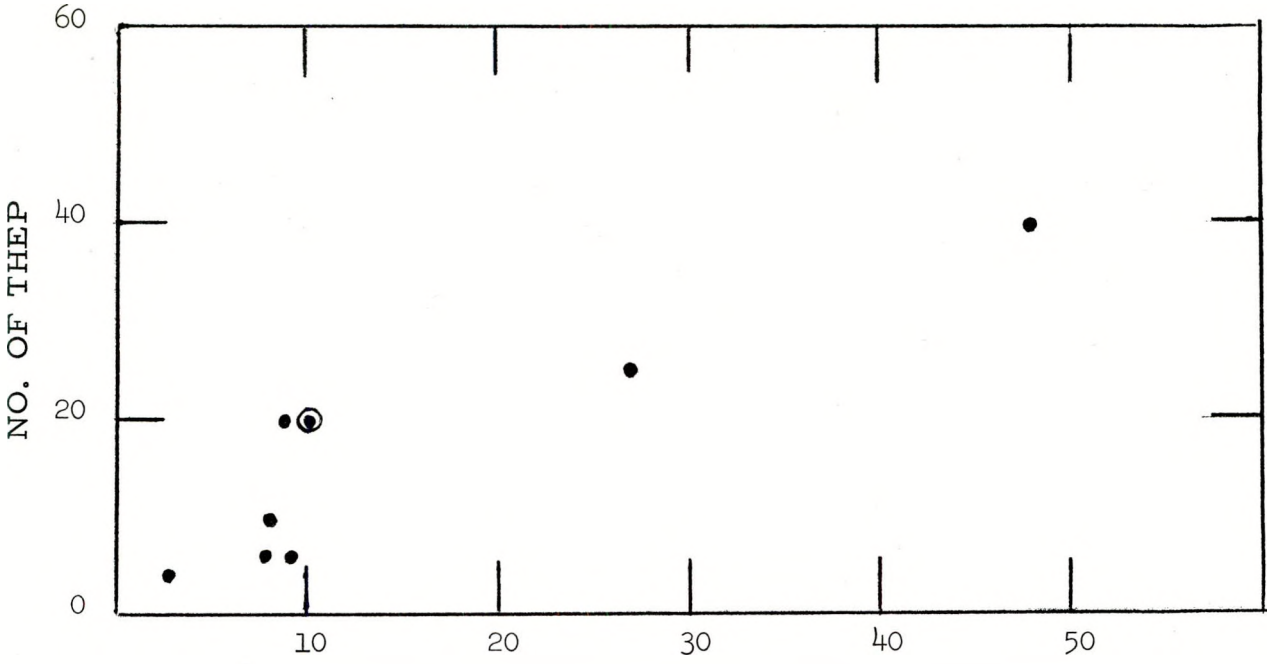
in 1966: 153 preprints (10 institutions) ave. 15 (U.S. ave. 26)
in 1965: 142 preprints (7 institutions) ave. 20 (U.S. ave. 26)
in 1964: 134 preprints (5 institutions) ave. 27 (U.S. ave. 24)

See Figure C-3.

(13) Five respondents said there was no internal reviewing of preprints before distribution; nine reported their institutions have no standard procedure.

A release or approval is required by 4 institutions before a preprint is distributed. The remaining ten have no requirement.

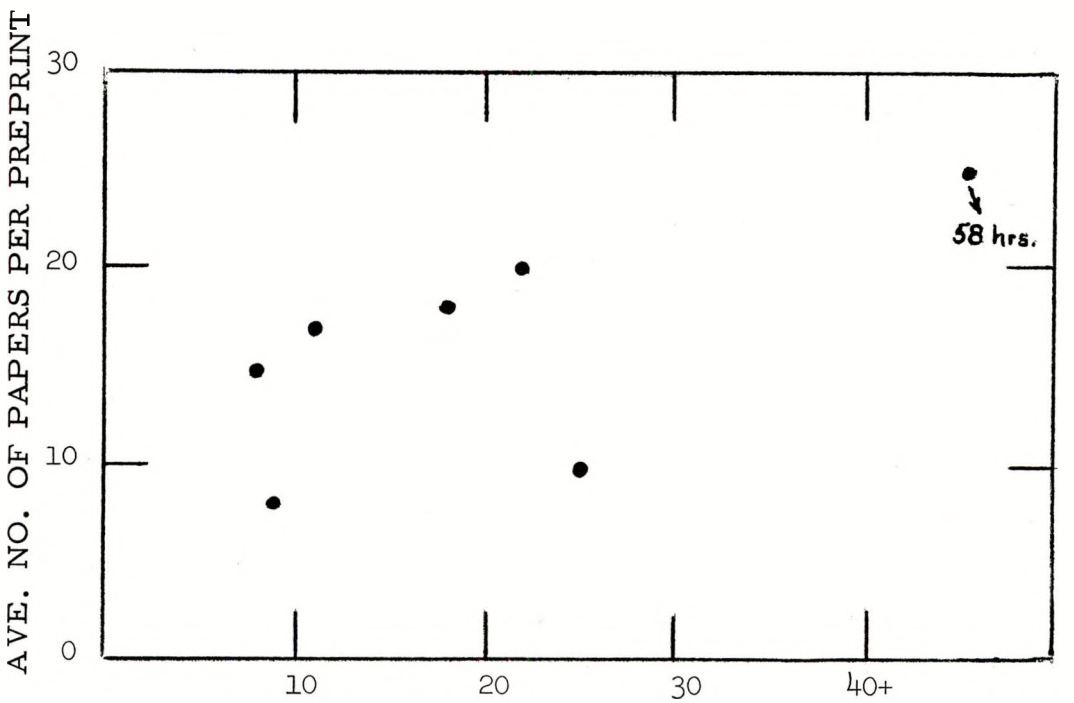
(14) All 14 institutions reproduce multiple copies of preprints using facilities at their institution.



NO. OF PREPRINTS DISTRIBUTED IN 1966

Number of "Preprints" Versus Size of Organization - - Other than U. S.

FIGURE C-3



TOTAL HOURS FOR PREPRINT PREPARATION

"Preprint" Processing Times - - Other than U.S.

FIGURE C-4

Reproduction Process	No. of insts.	Total pages reproduced/reprint
Offset	3	3,000, 3,750
Mimeograph	9	400, 900, 1,700, 2,500, 3,750, 5,000, 6,000
Xerox	1	25 copies (pages not reported)
Multilith	1	1,260

(15) Seven respondents estimated the number of hours required to prepare a prepint for distribution; four did not include editing in their estimates, three did not include drafting art, and two did not include printing.

The total hours are:

8, 9, 11, 18, 22, 25, 58

(16) The 1966 expenditures for preprint reproduction and distribution were estimated by five respondents.

Repro. Cost	Dist. Cost	Ave. no. of cps.	Ave. no. of pages	Repro. Process	No. of Preprints -1966-	Cost per Page
$1000	$ 100	100	30	Offset	?	-
-	100	70	18	Multilith	9	-
3000	1000	250	10	Mimeo.	27	6¢
150	25	75	45	Mimeo.	8	6/10¢
100	70	60	15	Mimeo.	10	2¢

Note: Cost shown probably does not include support-staff time.

(17) a. The average number of copies made of each preprint ranges from 25 to 300. (50-800 in U.S.)

25, 50, 60, 70, 75, 100, 100, 150, 250, 250, 300

The total average for 11 reporting institutions is 137 copies. (U.S. - 233)

b. The average number of pages per preprint ranges from 8 to 45. (U.S. - 10-40 pages)

The total average for 10 respondents is 21 pages. (U.S. - 22 pages)

8, 10, 15, 17, 18, 20, 20, 25, 30, 45

(18) Thirteen of the institutions distributing preprints maintain a mailing list. However, six do not use the same list for all preprints distributed - changes made according to author's request.

	Number of personal names on mailing list		Number of insts. on mailing list	
	Domestic	Foreign	Domestic	Foreign
Range	1-45	3-230	3-40	22-113
Average	21 (137 U.S.)	102 (71 U.S.)	10 (66 U.S.)	61 (46 U.S.)

Eight institutions send preprints abroad by surface mail; two via air mail.

(19) All respondents fill requests for preprints after initial distribution.

(20) Three institutions withdraw preprints from circulation when reprints are available. Seven reported having no standard procedure.

Survey to Determine Procedures of Preprint Distribution
in the
High Energy Physics Research Community

1. a. Is a preprint library or collection for the use of theoretical high energy physicists maintained at your institution?

☐ YES ☐ NO

b. Is more than one such preprint collection maintained at your institution?

☐ Yes, there are _____ others.
number

☐ No

Please write below the name and position of the person (or persons) who maintain other preprint collections used by theoretical high energy physicists.

_____

_____

THIS QUESTIONNAIRE IS DIVIDED INTO THREE PARTS: GENERAL information about the preprint collection, information about INCOMING PREPRINTS, and information about OUTGOING PREPRINTS.

PLEASE ANSWER THE FOLLOWING QUESTIONS WITH RESPECT TO THE ONE PREPRINT COLLECTION WITH WHICH YOU ARE MOST FAMILIAR. USE YOUR EXPERIENCE IN 1966 AS THE BASIS FOR APPROXIMATING QUANTITIES.

GENERAL

2. How many years (to the nearest half year) has the preprint collection been in existence?

☐ Years

3. a. What is the position of the person who maintains the preprint collection?

☐ Secretary ☐ Librarian ☐ Research Assoc. ☐ Graduate student

☐ Other _____
(specify)

b. Approximately how much of his time is spent on all phases (incoming and outgoing preprints) of this work?

☐ Hours per week

4. Please check the people this collection of preprints serves.

☐ Theoretical high energy physicists (approx. no. _____)

☐ Experimental high energy physicists (approx. no. _____)

☐ Others, specify _____ (approx. no. _____)

5. a. Can the theoretical high energy physicists using the preprint collection be identified as forming a group?

☐ Yes ☐ No

b. More than one group?

☐ Yes, there are _____ others.

☐ No

INCOMING PREPRINTS

6. What is the average number of preprints received per week in 1966? _____

How do these split between those received:

From other groups in your country _____ number

From groups in foreign countries _____ number

7. Please rank all applicable means of obtaining preprints for the collection you maintain by indicating the 1st most productive source, the 2nd, etc.

Rank

☐ By requesting inclusion on preprint mailing lists maintained by other institutions or individuals.

☐ By routine inclusion on preprint mailing lists.

☐ By scanning lists of preprints available from other groups and requesting specific preprints.

☐ Donation of preprints received by individuals in your group.

☐ Other _____ (specify)

Please check each of the following which applies to the maintenance of your collection of incoming preprints.

☐ A list of acquisitions is prepared weekly _____
monthly _____
other _____ (specify)

☐ A card file of preprints is maintained by author _____
subject _____
institution _____
title _____

☐ Duplicates are deleted regularly _____
occasionally _____
never _____

☐ Checks are made to purge preprints received _____ months ago.

9. Please check all of the following which apply to your procedures for notifying and supplying individuals with the preprints you receive.

	Own group	Others at your inst.	Others outside your inst.
List of acquisitions maintained at preprint library for use by	_____	_____	_____
List of acquisitions routed periodically to	_____	_____	_____
Individual notification of relevant preprints	_____	_____	_____
Circulation of actual preprint to interested individuals	_____	_____	_____
Preprints available for perusal where collection is maintained	_____	_____	_____
Preprints may be borrowed from collection by	_____	_____	_____
Copies of preprint are reproduced on request from	_____	_____	_____
Copies are reproduced and distributed routinely to all individuals believed to be interested	_____	_____	_____

.0. Please estimate the use of the preprints received. (Use the average number of preprints received weekly in 1966 as the basis for your estimate.)

Average No. of Preprints	
	TOTAL RECEIVED PER WEEK IN 1966
	are used by 20% of group
	are used by 40% of group
	are used by 60% of group
	are used by 80% of group
	are used by 100% of group

OUTGOING PREPRINTS

11. Listed below are several types of preprints. Please check all types which have been distributed by your group in 1966 and give the approximate percentage of the total each type represents.

Check	Percent	
___	___	Draft manuscripts of research papers in stage just prior to final form.
___	___	Manuscripts in final form - ready for journal publication.
___	___	Draft manuscript of conference paper.
___	___	Manuscript of conference paper in final form - ready for publication in proceedings.
___	___	Technical reports prepared to fulfill terms of contract.
___	___	Working papers that are not intended for publication.
___	___	Rough notes of latest ideas.
___	___	Other, please specify _____

12. Please indicate the number of preprints distributed by your group.

TOTAL: _____ preprints in ___ years.

_____ preprints in 1966 (first 10 mos.)

_____ preprints in 1965.

_____ preprints in 1964.

13. a. Are preprints circulated internally for review and comment before they are prepared for distribution?

☐ YES ☐ NO ☐ No standard procedure

b. Is there normally a release or approval process before preprint is distributed?

☐ YES ☐ NO

If yes, please explain arrangement _____

_____

14. a. Are multiple copies of preprints reproduced?

☐ YES ☐ NO

By facilities at your institution? ☐ YES ☐ NO

By commercial facilities? ☐ YES ☐ NO

b. Please rank all reproduction processes used by indicating 1st most frequently used, 2nd, etc.

☐ Offset

☐ Verifax

☐ Mimeograph

☐ Xerox

☐ Other _____
(specify)

15. Please check all appropriate phases of preparing preprints for distribution. Estimate the hours required (per preprint) for each phase.

Check		Hours	Check		Hours
_____	Typing	_____	_____	Printing	_____
_____	Proofing	_____	_____	Binding	_____
_____	Editing	_____	_____	Addressing	_____
_____	Drafting art	_____	_____	Other	_____

16. Please estimate the expenditures in 1966 for preprint reproduction $_____

for preprint distribution $_____

17. a. How many copies are made of each preprint?

Average number ☐

b. What is the average number of pages in each reprint?

Average number ☐

18. a. Do you maintain a preprint mailing list?

☐ Yes ☐ No

If yes,	Domestic	Foreign
How many names are on the list?	_____	_____
How many institutions are on it?	_____	_____

Is the entire mailing list normally used for distribution of preprints prepared by all the members of your group?

☐ Yes

☐ No (explain arrangement) _____

Please enclose a copy of your mailing list.

b. If you mail preprints abroad, please specify your mailing procedure. (e.g.; surface mail, air mail, packet to central site, etc.)

_____

_____

19. Do you fill requests for preprints after your initial distribution?

☐ Yes ☐ No

20. Please indicate your policy for taking preprints out of circulation.

☐ Preprints withdrawn when notified that paper will be published.

☐ Preprints withdrawn when reprints of published paper are available.

☐ Preprint withdrawn when notified paper will not be published.

☐ Preprint withdrawn when contents of unpublished paper are considered superceded.

☐ No standard policy.

☐ Other, specify _____

21. Consider a centralized service in which communications in high-energy theoretical physics were to be received by a central agency, duplicated and circulated to member institutions. Any institution throughout the world having researchers in theoretical high-energy physics would qualify for membership, i.e., researchers at these institutions would be able to both contribute and receive papers. Papers already published would not be included.

Are there any comments or suggestions you would like to make relative to:

(1) the existing preprint distribution situation

and/or

(2) improving scientific communication in high energy physics?

(Use the reverse side of this page for your answer.)

Completed by: _____
Name

_____
Position

_____
Institution

_____
Address

ted States

An Assistant Professor: -

....quite happy with our arrangements..
....centralized agency..a clear danger that half-baked and erroneour ideas would come out and, in absence of decent refereeing,..tremendous waste of time for readers and general lowering of standards...do not want to be flooded with all kinds of preprints. Abstracts and lists of preprints from Brookhave, Syracuse, Trieste satisfy some of the needs a centralized agency is supposed to fulfill. ...developing countries need help ..severe financial burden for them...new way should be devised to relieve though proposed centralized agency is not the answer.

A Chief Librarian: -

....if delay of publication in journals were drastically cut, most of our effort in dealing with preprints would be unnecessary. ...Given the way in which physicists actually use preprints in the present system, it might be worth considering a central agency which would publish a timely weekly list of preprints (perhaps with abstracts) to be airmailed to physicists around the world. Physicists could then request copies of the few preprints which really interest them. These might be quickly reproduced to order and sent airmail in the manner of DDC documents. Or, copies might be requested directly from the author or his institution... (Most of the theoretical physicists questioned seemed, in fact, to prefer to consult a timely, comprehensive list of titles rather than to receive large numbers of preprints)...

An Assistant Professor: -

....don't see how any scientist can argue against an experiment with such a system, provided the experiment does not have a built-in self-perpetuating feature....present preprint distribution system has faults; but the solution may well not be to increase the present deluge...

A Library and Publications Assistant: -

Standardize coding and numbering of reports by issuing insts.

A Librarian Grad. Student: -

....suggests a decided effort on the part of all..to exchange preprints as soon as they are ready for distribution...

An Assistant Professor: -

....considerable difficulty maintaining necessary contact with developments. Two of us are young recent PhD's. Feel need of receiving many preprints.. most useful are the research report and lecture note types which is not designed to be published formally. We would argue that a good deal of this "non-publishable" material should continue to be circulated.

A Research Assoc.: -

> Preprints a mixed blessing..so much trivia and error. Solution might be inner-group refereeing before distribution. Scans list of preprints and finds 3/20 of interest which he has not received.

A Post-doctoral Fellow: -

> (Centralized agency) would be a great help....perhaps with random comments and critiques by Grandmasters to accompany the wide circulation of un-refereed manuscripts...

Foreign

.... Assistant Professor: -

Proposed system is a very good one...makes preprint distribution more systematic...will reach a larger group.

A Lecturer: -

We support the idea...

A Lecturer: -

(Existing system) lesser known institutions do not get enough papers...

A Senior Lecturer: -

...suggestion would be very acceptable.

A "Head, Science Information Service": -

...present situation satisfactory, as it is fast and direct. It is doubtful whether this speed could be maintained if all preprints had to be channelled through a single centralized agency...

A Director of Library: -

...existing..situation can be improved...do not believe that the solution would be Central Agency you suggest. It would be sufficient if all institutions (1) had a preprint library, (2) regularly send their preprints on a mutual exchange basis. ...unnecessary to concentrate all preprint exchanges in one place ..valuable if there is an Agency in each continent. ..a single agency, wherever it would be, is not an appropriate means for a fast exchange of information & preprints.

A Research Association: -

Only accepted institutions should be amde responsible for papers submitted to centralized service. A daily journal of preprints would be desireable.

A Librarian: -

...Centralized service might be very useful provided its operation rapid. It would be convenient to have, beside USA, a European office (at CERN)...

A Research Association: -

...projected service would work good provided only papers sent officially by an institute will be accepted.