REVIEW OF STUDIES IN THE FLOW OF INFORMATION AMONG SCIENTISTS

✔ Volume I: Text
Volume II: Tables

BUREAU OF APPLIED SOCIAL RESEARCH
Columbia University

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REVIEW OF STUDIES IN

THE FLOW OF INFORMATION AMONG SCIENTISTS

Volume I: Text

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Columbia University

Bernard Berelson, Director

David L. Sills, Director of Research

Review of Science Information Studies

Herbert Menzel, Study Director

Louis Lieberman, Research Assistant

Joan Dulchin, Research Assistant

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ERRATA IN VOLUME II

p. 2, Table E-1, Column 3: change code number of study by Hertz and Rubenstein to 113.

p. 2, Table E-1, Column 6: change code number of study by Herner, 1954, to 111.

p. 9, Table E-5, **Column 5,** Row 3: Replace footnote mark [d] by [f].

p. 27, Table F-15, Column 5: The three figures bearing the footnote mark "v" should instead bear the following new footnote t: Percent of those consulted for specific information which were consulted, respectively, for theory or results or method (but not more than one of these). See p. 92.

p. 27, Table F-15, Column 6: The three figures bearing the footnote mark "v" should instead bear the following new footnote s: per cent of all acts which were consulted, respectively, for theory, results, or method, alone or in combination.

p. 32, Table F-18, Row 2: Delete footnote mark y after "Abstract or index"

p. 32, Table F-18: add a footnote: [U]Percentages computed by the reviewers.

p. 35, Table F-20, Row 2: Delete footnote mark z after "Abstract or index"

p. 39, Table F-21, Columns 16 - 20: Replace all 15 dash marks (——) by triple XXX.

p. 43, Table F-23, add to footnote B: See also Volume I, p. 14, footnote 1.

Chapter One

INTRODUCTION

1. Coverage

Studies of science information services fall into three categories:

(1) Empirical studies of scientific information media, their operation, coverage, cost, etc.

(2) Logical studies of classification, search-and-retrieval systems, languages, etc.

(3) Empirical studies of scientific communication in process. When approached from the point of view of the individual scientist, these are studies of "scientists' communication behavior." When approached from the point of view of any communication medium, they are "use studies." When approached from the point of view of the scientific communication system, they are studies in the flow of information among scientists.

This review is concerned with studies in the third category.

2. Nature of this review

These pages, together with a separately bound volume of tables, ~~constitute~~ a synthesizing review of completed studies of the behavior, habits, usages, experiences, and expressed needs of research scientists with regard to the obtaining of available scientific information. The interested reader is urged to consult the companion volume of tables as well as this text. Each provides independent information, as will be explained in the last section of this chapter (p.7).

The review strives to display in systematic form the diversity of conceptual approaches that have been used in studies of this kind, and the very large variety of topics that can be probed. The emphasis is on showing what research has been done and what research can be done in this area. ~~Recommendations--statements of what research~~ (if any) should be done--must properly await the reactions of workers in several fields, and especially of representatives of the potential users of the research.

In order to obtain an overview of the knowledge and the research methods embodied in the studies surveyed, it was decided to place side-by-side material from any and all of the reviewed studies which would illuminate any given point. For this purpose, a topical organization of the content of all the studies was created, and data from any of the studies which were relevant to any particular point were placed in juxtaposition, after having been recast as nearly as possible in comparable form. A glance at any three or four of the tables submitted in a companion binding will illustrate the results of this effort. The elaborate captions and column headings, and the staggering batteries of footnotes appended to most tables bear witness to the labor that was required to locate and recast data for comparison. They will also convince the reader how far from a desirable level of comparability these data still are, in spite of the effort that has been expended. The chief obstacles in the way of satisfactory comparability will be enumerated in a later section.

Although a number of interesting convergences can be observed in the tables--and others will be brought out in Chapter IV--in spite of these obstacles, the factual results of this collation of data can hardly be claimed as its most significant contribution. What is, in the reviewer's opinion, of much greater value is the systematic laying-out of the different kinds of findings and statements to which studies of the flow of information among scientists can lead. To date there has been little awareness of the wide range of significantly different topics and relationships that have been and can be explored in studies of scientists' information-gathering behavior and experiences. A serious effort has been made here to display the variety of such statements in systematic form in the text and the tables. As a result a number of possibly significant formulations of research questions which have not actually been applied become apparent as gaps in the paradigms. Chapter V will summarize some hitherto neglected approaches.

The variety of which the previous paragraph speaks is not a mere variety of data-gathering techniques. In fact, examination of the material will show that a classification of statements by topic, and even one by conceptualization of units and categories, cuts across any classification by data-gathering techniques.

3. Obstacles to comparability

The obstacles in the way of satisfactory comparability of data from the several studies are of the following kinds:

a. Diverse and ill-defined populations.--The populations from which samples were drawn in the several studies are extremely heterogeneous in many respects--this quite aside from the way the samples were drawn.

Different studies are concerned with individuals working in different countries, different disciplines, and different kinds of establishments, and differing widely in amount of scientific training and involvement in research activities. Some studies confine themselves to basic researchers; others include scientists in industrial development work, engineers, and more or less ill-defined "technicians". Wide coverage of the communication behavior of diverse kinds of personnel is, of course, very desirable; but the diversity of populations reduces the number of studies that can be compared in a meaningful sense, while only a modest number of studies have been completed at all. Unfortunately, few of the data are reported separately for the several categories of people included in a study, and all too often the kinds of people included are not clearly specified.

b. Diverse units of observation and bases of computation.--Studies vary greatly in the units of observation used. Some measure communication behavior in time units, some refer to individual communication acts, and many report what is "usually" done, or simply "what is done", with no further specification. In addition, data on any specific activity are given as fractions or rates of variously conceived total activities. These matters will be taken up in detail in Chapter II, pp. 12-22.

c. Diverse classifications of communication channels.--The different media and channels of communication are not classified in identical ways in the several studies. However, few serious difficulties are experienced, except when it comes to relatively refined classifications of, for example, journals, into sub-types.

d. Paucity of analysis in depth.--The difficulties enumerated above have the most serious consequences in the case of simple descriptive statements, since here different populations, measurements and categories will almost invariably produce different results. They have less deleterious consequences when inferences are made on the basis of multiple converging evidence of diverse sorts, such as are summarised in Chapter IV. Comparisons are also frequently possible in spite of the disparities mentioned when one is interested in certain relationships--for example, in the direction of differences in one variable which are produced by changes in a second variable. The direction of such differences will in many circumstances be invariant to the choice of units of measurement within rather wide limits.

Unfortunately, however, most of the studies under review are content to report descriptive distributions, or simple cross-tabulations, with few attempts at interpretations based on more than one such "fact." It is precisely here that the consequences of differing units of measurement, different indexes, etc., are most keenly felt.

4. Local versus general usefulness of studies.

The usefulness of a science-information study must be evaluated in rather different ways when one thinks of its application to a circumscribed local situation, and when one thinks of its possible application on a more general level. Some of the studies reviewed were carried out for the primary purpose of guiding the activities of single establishments, such as an industrial firm, a laborabory, or a university. For the purposes of action on the local level, many purely descriptive facts will be significant, which would have little interest for action on a more general level. For example, a librarian for a particular establishment may want to know what journals are subscribed to by scientists on the staff, simply in order to determine what additional journals need to be kept by the libraries. Then again, a particular fact may have one kind of implication for action on the local level, but quite a different one for action on a more general level. For example, the knowledge that scientists at a given establishment do not read an important language can mean only one kind of action on the local level, namely, that translations should be furnished in some way. But for long-range planning on the general level, the same knowledge might mean either that translations should be made available, or that scientists and science students should be trained in the language. Finally, this knowledge may lead to effort to devise entirely new ways of furnishing translations; for example, by machines.

On the other hand, the findings which are of interest for general policy-making may have little usefulness for the local information officer. There is probably not much he could do if it should be shown that his scientists often fail in their searches for certain details about equipment setup, because their descriptions are "buried" as incidental remarks in experimental reports. On the general level, however, such a finding might lead to the setting up of new index categories, or to new publications devoted specifically to such matters. Then again, if easy contact among certain scientists from different institutes should prove of material importance to the progress of their work, the single organisation could do very little, but several organisations might decide to coordinate their work schedules so as to make visits easier, and planners might be affected in their choice of sites for new institutes.

To be sure, many studies are carried out within one or a few establishments, but are designed to serve broader interests; and even those that are carried out primarily for guiding local policy can be of more far-reaching significance and interest. This is, however, least likely when the local studies are limited to descriptive statements, as opposed to examinations of functional inter-relationships between the communication behavior and experiences of scientists and other factors. (cf. the remarks on "paucity of analysis in depth," pp. 3-4)[1]

5. <u>Techniques of data gathering.</u>

The techniques of data gathering that have been used in the studies reviewed are listed below:

(1) Library withdrawal records, with or without special questionnaires attached to each document issued.

(2) Records of inquiries made at an information center.

(3) Observations by others, or self-observations, of behavior during specified time intervals.

(4) Diaries.

(5) Self-administered questionnaires.

(6) Personal interviews.

Reference-counting would constitute a seventh data-gathering technique in this series. However, studies using this technique have been omitted from this review for practical reasons.

It is sometimes erroneously believed that the choice of a data-gathering technique is the principal or even the only important issue of research methodology. The reviewer regards this choice as secondary in importance and logic to more fundamental methodological issues which are discussed in Chapter II (especially pp. 12-22). Generally speaking, there is no one-to-one relationship between data-gathering technique and the conceptualisation of units of sampling and observation, although certain bounds to the latter are set by the choice of data-gathering technique.

[1] Saul Herner presents several case examples of the use, on the local level, of knowledge about the communication behavior of the locally employed scientists and also of some general knowledge about the communication behavior of certain categories of scientists: The Relationship of Information-Use Studies and the Design of Information Storage and Retrieval Systems, 1958.

At any rate, neither data-gathering techniques, nor the units of observation, nor any other methodological matter provide the chief principle of organization of the material in this review. The data will, rather, be organized by the subject they deal with.

6. A substantive classification of the findings of use studies.

In order to achieve the announced goal of juxtaposing findings from all studies bearing on any one topic, the findings have been grouped into the following six categories:

a. Exposure. — Tables E-1 through E-14, and Section A of Chapter II concern findings based on descriptions of the information-receiving behavior of scientists which make no reference to the purposes, effects, functions, or value of this behavior. Here belong data on the frequency with which scientists in various categories attend meetings, the number of different journals they read, the conversational settings in which they participate, and so forth — in other words, statements about the exposure of scientists to various communication channels.

b. Function. -- Statements which differentiate information-receiving behavior according to its effects, purposes, or functions are summarized in Tables F-15 through F-24, and are discussed in Section B of Chapter II. Examples are the differentiation of abstracts read in the course of a search and for "keeping up;" or of articles read in preparation of a lecture as opposed to articles read in preparation of an experiment.

c. Performance. — Statements which compare the yield of communication-receiving acts with the expectations or purposes with which the acts were initiated, and reports on failures or unwarranted delays in communication are summarized in Tables P-25 and P-26 and discussed in Section C of Chapter II. Answers to the question "Did you find what you were looking for when you picked up this journal?" provide an example.

d. Evaluation. Section A, Chapter III refers briefly to the numerous tabulations of scientists' verbal evaluations of various media of communication which are not based on separate evaluations of individual information-receiving acts. Actual findings based on such evaluation are not reported in this review, except where there are special reasons for it (cf. Chapter IV).

e. Communication skills and practices; use of library services. -- The following kinds of data are enumerated in Section B of Chapter III, with no attempt to report actual findings:

(1) Communication skills of scientists (for example, their familiarity with languages).

(2) Communication practices and usages other than exposure to channel (for example, the keeping of private card indexes to the literature read);

(3) Utilization of information and library services (for example, the delegation of literature searches to library staff; place and time of reading; ownership of journals; etc.).

f. Inferences from multiple data. -- Chapter IV is reserved for statements based on multiple data. While not suitable for presentation in the review tables, these statements largely constitute the "payoff" of the data that are tabulated, and are recommended to the reader's special attention.

7. Organization of this review

a. Tables and text. -- Tables and text here complement each other in a special way. Each provides independent, albeit related, information. Actual data and findings from the studies under review are reported only in the tables (with their footnotes to "additional data"); they are not recapitulated or summarized in the text. The only exception -- and it is an important one -- is the material of Chapter IV, which summarizes findings which could not be presented in any single table because they are based on joint inferences from multiple data.

The tables are grouped into three sets -- on exposure, functions, and performance (cf. Items a, b, and c, p. 6 above). The three sections of Chapter II parallel these three sets of tables. They describe in some detail how the tabular material is organized, and provide a commentary on basic methodological issues. The kinds of data obtained and the kinds of analyses performed are described and classified; the diverse concepts and categories, units of observation, units of measurement, computations of indices and bases of comparison are enumerated and discussed. The text thus explains the necessarily compact references to these same matters in the legends to the corresponding tables, while the tabular material illustrates and gives more concrete meaning to the statements of the text. The reader is therefore urged to read the sections of Chapter II and the corresponding tables together.

b. Sequence of Tables. Tables marked by the prefixes E, F, and P, report respectively, data on exposure to communication channels, on functions of communication-receiving behavior, and on the performance of the communication system, as these terms were defined above (p.6). Within each of these three sets, tables are further grouped according to schemes which will be described in the sections on exposure, function, and performance in Chapter II. For example, "exposure" tables are grouped according to the categorization of communication channels: data on exposure to all communication channels combined come first, followed by those which differentiate between oral communication and reading of the literature; next come data on exposure to specific types of channels (books vs. journals vs. unpublished reports, etc.), and only then data which differentiate sub-types of these (e.g., journals of different age or language). Perhaps, at this point, a glance at the table of contents of the volume of tables will clarify these principles of ordering.

This is an ordering by the manner in which information-receiving behavior is described; i.e., by what are usually the "dependent variables." It follows that "independent variables" — the presumed determinants of information-receiving behavior — must reappear anew in each of these groups of tables. Thus there are data on the total amount of reading done by scientists of different rank (Tables E-2 and E-3), data on the distribution of reading over different types of literature on the part of scientists of different rank (Table E-7), data on the functions served by reading done by scientists of different rank (Table F-17), and so on.

Within each grouping by "dependent variable," data for "all cases" included in any one study are presented first. (This is what survey analysts call "marginal data.") Only then are "breakdowns" presented which give data separately for separate categories of cases — for example, for scientists working on different types of assignments. Because of the differing populations included in the various studies, some comparisons between groups might also be made by comparing the data on "all cases" of several studies; unfortunately, the obstacles to comparability which were enumerated earlier (pp. 2-4) place the value of most such comparisons in doubt.

c. Material within each table. — Each table brings together data from many studies, bearing on some one topic. Data relevant to the topic which could not be accommodated in the body of a table are reported, or at least, cited, in footnotes grouped under the heading "Additional data." Although the table format has been adapted to the needs of each table, most tables follow fairly closely a standard format, which is well illustrated in Table E-6. Generally speaking, each column represents a different study; however, one study may be represented by a set of columns, if different operations (Columns 3 and 4) or different phases (Columns 5 and 6) have yielded separate relevant figures. In addition, there are several columns for one study when data are separately reported for subcategories of the population (e.g., Table E-7) or of the events (e.g., F-16).

Rows generally represent "dependent variables" -- the categories of events over which distributions are reported, or for which prevalence figures and indexes are given. The rows, therefore, most often represent different channels of communication or different functions and purposes of information-gathering activity. Since a single set of row headings is used for data from several studies, row headings may not coincide verbatim with those in the original documents and are often qualified by footnotes to individual cell entries.

Column headings (or their equivalents in tables not following the standard format) identify the study and page from which the data are taken,[1] briefly describe the population included, define the units reported, and specify the observations and computations underlying the figures as much as space permits. These important methodological specifications, which differ widely from study to study, are frequently elaborated in footnotes and are discussed in Chapter II of this text.[2]

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[1]Study numbers refer to the bibliography at the end of this volume.

[2]Some studies clearly specify the underlying operations wherever figures are reported, but in other instances it was necessary to assemble the specifications from indications more or less concealed in various parts of a report. Reliance was placed on full reports rather than published excerpts, and on verbatim texts of research instruments (diarists' or observers' instructions and forms, questionnaires, etc.) wherever these were available.

Equivalent categories and data reported under different labels in the various studies were diligently searched for. Recasting the data into more nearly comparable form involved the following: determining equivalencies between differently named categories, and recording the necessary deviations and qualifications; pooling of categories; computing or recomputing percentages from frequencies, sometimes after eliminating irrelevant categories from or adding omitted categories to base figures; rotating percentaged cross-classifications 90 degrees; reducing rates to common denominators; computing weighted averages; and other operations.

Wherever it is felt that correspondences between the original data and the data tabulated in this review are not self-evident, footnotes are appended which identify the categories included, or state the operations performed by the reviewers.

The interested reader is invited at this point to inspect the remarks on "Notations and Symbols," p. ii of the volume of tables.

d. Sequence of chapters. -- This introduction constitutes Chapter One and is followed by a chapter devoted to a discussion of the tabulated findings on exposure, function, and performance (cf. p. 6 above). Chapter III briefly enumerates the kinds of data which will not otherwise be reviewed here at all: evaluations; communication skills and practices; and use of library services (cf. Items d and e, pp. 6-7). Chapter IV is devoted to higher-order inferences, that is to say, to conclusions based on the simultaneous consideration of multiple kinds of data. Chapter V recapitulates certain topics, questions, and approaches which have been slighted or not covered at all in the existing studies.

A bibliography of the reviewed studies concludes this volume.

Chapter Two

CATEGORIES AND METHODOLOGY OF THE TABULATED FINDINGS

This chapter is a methodological commentary on the materials reported in the companion volume of tables; it is not a rephrasing or summary of the actual data, nor a selection or any other substitute for the tabulated findings. The term "methodological," however, is to be broadly interpreted: we will discuss here the different ways in which the studies under review delineated areas of inquiry, conceptualized units of observation, categorized events, computed comparative indexes, and so forth. Basic matters will be discussed in the first section below -- that on exposure; necessary elaborations will be added in the sections on function and performance.[1]

A. Exposure (See Tables E-1 to E-14)

1. Two ways of classifying exposure statements

Exposure data are those which describe the attending by scientists to channels of scientific communication without distinction as to the purpose of the attending, its consequences, its utility, or the message transmitted. Here belong all accounts of the range, extent, frequency, duration, periodicity, etc. of scientists' exposure to channels of scientific communication which are not differentiated as to the purposes, effects, or utility of any communication that is transacted. ("Channel" is to be broadly interpreted: a channel may be written or oral, formal or informal; a channel may (e.g.) be a form of literature, a lecture, an occasion for a conversation with a colleague.)

Explicitly or implicitly, the basic unit of all such data is some amount of information-receiving behavior on the part of a scientist vis-a-vis a channel of communication. Hence, one way of ordering exposure statements is according to the manner in which channels are categorized: e.g., is all literature considered as one, are journals distinguished from books or are journals from different disciplines treated separately? This is the chief principle according to which

[1] The division of findings about scientists' information-receiving behavior into those concerning exposure, function, and performance was introduced in Section 6 of Chapter I (pp. 6).

Tables E-1 to E-14 are ordered, and it will be discussed in detail in Section 4 (pp. 23-24). For an understanding of the data of any one of these tables, however, it is first necessary to discuss a second key dimension along which exposure statements can be classified, and that is the manner in which amounts of information-receiving behavior are delineated.

2. The delineation of units of information-receiving behavior

What constitutes an appropriate unit of any form of information-receiving behavior, that can be sampled, observed, recorded, described, counted, and aggregated for comparison with other forms of information-receiving behavior? This crucial decision determines largely what form the analysis of the data can take; it is a more fundamental decision than the choice between direct observation, diaries, questionnaires, and other data-gathering techniques. It seems especially important to clarify this sensitive issue, because researchers as well as critics of communication research seem to have assumed a one-to-one relationship between data-gathering techniques and units of recording--if, indeed, they exhibit any awareness of the multiplicity of possible ways of delineating units of recording.[1] In principle, it would seem that the following four possibilities exist:

(a) Exposure vs. non-exposure. (Has the scientist read a given journal at all?)
(b) Number of acts. (How often has he read it?)
(c) Time consumed. (How many minutes has he devoted to it?)
(d) Messages received. (How many facts has he learned from it?)

a. Exposure vs. non-exposure.--In this seemingly simplest of strategies the issue of delineating units appears to have been by-passed by limiting data to statements that a scientist either does or does not use a given type of channel. Thus, for example, we are informed that 99% of the scientists in a certain sample use journals of primary publication, while only 61% use unpublished reports (Table E-5, Column 1).

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[1]We use the term "unit of recording" rather than the more familiar "unit of observation," in order to include data based on scientists' own accounts as well as those collected by direct observation.

There is some ambiguity in the unqualified statement, in the present tense, that a person "uses" a medium of communication or "reads" a type of book. It is not clear, e.g., whether persons who have read one unpublished report are included among the "users" of such reports, or whether a person who attended annual meetings for many years, but did not get around to any meetings in the last two years is included among those who "attend any technical or scientific meetings." This ambiguity can be eliminated by classifying persons not by whether they "do" a certain thing, but rather by whether they "have done" it; for example, by whether they have ever obtained information from journals, from books, etc. (Table E-5, Column 2).[1] If this unqualified way of asking the question is taken at face value, it places into the positive category any person who has had the relevant experience at least once in his entire lifetime. It will, therefore, give useful results only when applied to reasonably rare events. Ordinarily the specification of a time interval is indicated, so that persons become classified by whether or not they have, for example, made use of abstracts during the past year (Table E-5, Column 4), or have read literature in a foreign language during the past two months or six months (Table E-8, Study 105 and fn. A). It is usually advantageous to choose a time interval that is appropriately related to the probable periodicity of the event in question; for example, to ascertain whether a scientist has attended any society meetings during a 12-month period, and whether he has spoken to a scientist in another discipline during a given week.[2] This is the intention of adding the word "regularly" to the definition of the categories; as, for example, when journals are recorded which scientists read regularly -- that is, in the words of instructions given in at least one study, those of which they see nearly every issue (Table E-5, Column 5 and, in part, Column 3).

When data are obtained on "regular exposure" to a set of individually named channels (for example, individual journals), one obtains, thereby, a measure of the range or diversity of channels to which a

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[1]The qualifying phrase "useful" in the caption to this column will be discussed in Section 3, pp. 22-23

[2]Compare in this connection certain difficulties of interpretation mentioned in Table E-10, fn. a.

scientist is exposed. At least this is so if the set of individual channels (e.g., journals), is, with some degree of tolerance, exhaustive of those which are relevant. Most of the reports on "number of different journals read" (Table E-13) are of this order. When, in addition, the actual periodicity of each channel is known, such data can be converted into statements about the frequency per time interval with which certain types of channels are attended, and thus shade over into the kinds of data next to be discussed.

b Number of acts.--The carving up of a scientist's information-receiving behavior into "acts" has many advantages. (Usually an "act" means the reading of a single article, book, or other identifiable "piece" of literature. More of this anon.) The acts performed during a specified time interval can be counted, and their number can be compared for scientists differing in personal characteristics, work assignments, or institutions (Table E-3). The channels involved in each act can be specified, and the prevalence of the use of each can be expressed as a rate per time interval (Table E-6, Column 1), or as a proportion of all information-receiving acts (Table E-6, Columns 2, 5 and 6).[1] The acts can further be described as to the "sources calling the items to the scientists' attention" --i.e., in terms of previous communication acts which led to the initiation of the act described (Table F-20, Columns 1-4 and 6). They can also be described as to the purpose for which they were undertaken (Table F-15, Columns 2-6), their informational yield as compared to this purpose (Table F-25, in part), and--with restrictions to be noted--as to the use which was made of the information they yielded (Table F-15, Column 1). Acts classified in these and still other ways can be counted and their prevalence compared in manifold ways.

Acts have been used as the units of recording in all the diary studies done to date. In addition, acts are the units of recording of studies based on library withdrawal records; each withdrawal represents an act of reading the item withdrawn (Table E-8, Studies 125 and 123; Table E-9, Columns 1, 2 and 5).[2] Acts also appear as the units in an accounting

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[1]More precisely, of all information-receiving acts through those channels on which data are gathered; most studies are limited to receiving information through the written word, and many further restrict their data to a limited list of written channels. Certain of the omissions are symbolised by XXX, as explained on p. ii of the table volume. See also Section 3, pp. 23 below.)

[2]Information-gathering acts also are the units when inquiries received at an information center are analysed. See fn. 1, p. 30 and Table F-23, data from Study 103. The latter also specifies: sub-categories of the operations in which the information was to be used; (See fn 2, next page.)

by scientists of their activities during the 15-minute period immediately preceding their confrontation by an investigator, who appeared at randomly selected moments (Table E-1, Column 3). Finally acts constitute the unit of recording in a few of the data gathered by interview. For example, information is given on the communication channels involved in each interviewed scientist's most recent literature search (Table F-22, Column 12), or on the locus of publication of the most recent article read by each respondent (Table E-6, Columns 3 and 4).[1] There seems to be considerable room for expansion in the use of acts as recording units in interview studies.

The use of information-receiving acts as units of recording involves two interesting and interrelated difficulties. One of these is the apparent necessity of devising separate rules for delineating "acts" of exposure to the several types of channels, if not for different approaches to the same channel. It is not self-evident where an "act" begins and ends. Some instructions call on diarists to make an entry "each time" literature is used. Other instructions make an "act" tantamount to the reading of some single, recognizable item of literature. The design of blank diary forms often carries implications in addition to the explicit instructions. Generally, an article, even if read partly before and partly after some interruption, would be entered in the diary only once; three articles, even if read in immediate succession, would constitute three entries. On the other hand, a book read in portions on five different days might be entered five times; instructions are often not too clear on this point. Searching the index to Chemical Abstracts for entries under several headings is probably entered as a single act (if at all); whether the reading of eight abstracts located in the process constitutes one act or eight is not always clear. Moreover, it is probable that much reading activity -- especially the quickly accomplished scanning or reading through numerous brief and individually "trivial" items, such as the advertisements, notices, or book reviews in a journal, manufacturers' pamphlets, and the like -- is not recorded at all.

The reviewer believes that all such ambiguities can be overcome

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(Continued from preceding page.)
extensiveness of the answer supplied; channels used in reply; age of literature used; number of times any given journal was used; etc.

Studies based on withdrawal and inquiry records are, of course, limited to acts utilizing the particular library or information center. This eliminates a large amount of literature use which is probably quite different from that recorded, as well as virtually all use of non-literary channels.

[1]The restrictions to "articles of direct use of special interest" will be discussed in Section 3, pp. 22-23.

by appropriate definitions and instructions; in fact many of them are dealt with by special provisions in one study or another. The difficulty is not that ambiguities and omissions cannot be prevented, but that their prevention requires separate definitions, instructions, and provisions for various forms of exposure to information. Only one diary study has attempted to include communication through word of mouth--both of a formal nature (lectures and conferences) and of the informal variety (oral personal communication). Diarists experienced so much difficulty finding "a logical basis on which to decide what to record" as a unit of information received by the spoken word, or even by written private communication, that oral and personal communication was finally omitted from the tabulations published (105, pp. 157 and 169). Here again, it is the reviewer's opinion that this difficulty can be overcome by means of appropriately devised definitions and instructions. However, separate provisions for recording various forms of information exposure not only add to the labor of both the investigators and their human subjects. They also discourage the recording of events which do not seem to fit perfectly any of the forms provided, and they make comparisons between the several forms of information exposure more difficult.

This is related to a second difficulty inherent in the use of information-receiving acts as units of recording. Equal weight is accorded to acts which would, intuitively, seem to be of very different magnitude. This remains true even if all ambiguities of definitions are eliminated. If reading a book (on a single day) counts as one, so does reading an article--whether long or short--or, for that matter, the reading of a portion of an article. Equal numbers of reading acts thus do not necessarily mean the same amount of reading, and it is difficult to interpret the meaning of any single figure given for the rate of reading of a set of scientists in these terms. But this difficulty is not as serious in its consequences as it might seem. For one is seldom interested in single descriptive rates for their own sake, or in the amount of reading done in some "true" sense. Generally speaking, data become useful when they enter into comparisons and into the examination of relationships. And it would still seem meaningful to state, for example, that pure researchers in the atomic energy field devote a much larger portion of their reading acts to journals and a much smaller portion to unpublished reports than their applied colleagues do (Table E-7, Columns 3 and 4); or that journal articles are more often read for general interest, while books are more likely to be consulted for specific uses (Table F-16, Columns 1 and 3, 4 and 7).

On the other hand, the choice of information-receiving acts as units of recording has certain distinct advantages over the choice of other possible units (such as, for example, standard time intervals, number of words, column-inches, or the like). These advantages all stem from the fact that acts are "meaningful" units of behavior. This term, which may appear dangerously metaphysical to some readers of this review, actually denotes a set of concretely observable phenomena. (1) Information-receiving is remembered more readily (if at all) in terms of articles, books, lunch meetings, or searches-through-the-card index, than in terms of smaller segments such as minutes, sentences, word counts, or the like. This fact in itself is relevant only when data are to be gathered, at least in part, from retrospective accounts by scientists; but it is related to the following facts which are relevant regardless of the technique of data gathering. (2) Subjectively defined purposes and motives for exposing oneself to a communication channel, but also objective stimuli for such exposure, can be directly associated with acts of information-receiving, while they can be applied to smaller units only derivatively, if at all. Thus it is, generally speaking, an article rather than a sentence or page that was called to a scientist's attention by some given source; and a lunch meeting rather than any temporally defined fragment of it that he attended for any given conscious purpose. (3) Consequences, in terms of later scientific activity or further communication behavior, can generally be associated with information-receiving acts in cases where they cannot be related to an "arbitrarily" defined portion of an act. Thus, for example, a scientist may become interested in the work of a man, or gain a new understanding of a theory through an article he reads, but whether this result is attributable to this or that paragraph of the article may be impossible to state. A search through a card catalog may result in familiarity with work hitherto unknown to the scientist, while the glance at any particular card may contribute nothing else than the conviction that he must pass on to the next card. And for some research purposes, it is even necessary to consider chains of acts as units. (See Part B, pp. 36-37).

It may, in fact, be argued that the above are not statements of fact but of definition; that is, an "information-receiving act" should, perhaps, be defined as a unit of information-receiving behavior so delineated that certain classes of causes and consequences can be predicated of it. It is in this sense, and in this sense only, that other ways of delineating units may be termed "arbitrary." We will have occasion to refer to this argument again when discussing purposes, consequences, and functions of information-receiving in the next part of this chapter.

The duration of information-receiving acts can be recorded along with other attributes (Table E-4). If acts were weighted by their duration before being tabulated, many of the difficulties enumerated above would, it seems, be removed, and many -- though not all--- of the advantages of acts and of time intervals (see below) as units of recording could be combined. To date, it seems, only one investigator had diarists record the duration of the acts entered in the diaries. (Table E-2, Columns 2 and 3; Table E-3). The accuracy of these statements is not known. It is quite possible that accuracy adequate for the weighting procedure alluded to can be achieved in diaries; besides, diaries are, as was seen, not the only technique which can accumulate data on information-gathering acts, and it may well be possible to devise new combinations of data-gathering techniques which would allow a more objective measurement of the durations of acts, while statements as to their antecedents, yield, and/or consequences would be obtained from the scientists.

c. Time consumed. -- When intervals of time -- for example, "random chemist-moments" -- are made the units of observation, most of the advantages accrue which were mentioned in the opening paragraph on acts: the time devoted to information-receiving can be measured and expressed as minutes-per-week or as a proportion of total time in professional activity (Table E-1, Columns 1 and 2); time devoted to any category of channels can be similarly expressed as a rate or as a proportion of all information-receiving behavior (Table E-2; Table E-6, Cols. 7 and 8). Many other descriptors of the information-receiving behavior can be applied, and will yield rates and distribution figures (Data from Study 101 in Tables E-11, E-12, and E-13). Any such figures can be compared for scientists in different categories, roles, phases of research, or institutions (Table E-2).

In addition, time units have distinct advantages of their own. They are probably the only units of recording which are devoid of ambiguities and which can be uniformly applied to communication-receiving through any and all channels without new definitions for each type. The advantages which accrue from this fact are the counterparts of the difficulties ascribed to acts as units above.

Since communication activity of all types can be measured in the identical time units, none need be omitted from recording--especially since it is possible to call for a complete record of activity during specified time intervals. The meaning of aggregated figures, even when they encompass many different kinds of activity, is unambiguous, and comparisons between the time spent on diverse channels of communication are easily interpreted. Moreover, since activities other than information-receiving can be measured in the same time units, manifold examinations of the relationship of information-receiving to other activity become possible. (See references to Study 101, pp.47 and 50 below.

This unit of recording, however, also has certain drawbacks. The precision on which its value depends cannot be expected in most retrospective accounts, even if recorded fairly shortly after the actual event; really precise time measurement and time sampling can, no doubt, only be obtained at the time that a communication takes place, preferably by observations. (See data from Study 101 in Tables E-1, E-2, E-6, E-11, E-12, E-13.) One study had diarists record the number of minutes expended on the acts recorded in the diary. It is not known how precise these records are. Even interview and questionnaire studies have secured estimates from respondents of time spent on various activities (Table E-2, Columns 4-7). There is good reason to doubt the accuracy of these estimates, although gross differences in estimates probably represent actual differences in the indicated directions. (Table E-2 illustrates data of all three kinds.) Even if accurate, ascertaining the duration of sampled acts is not, however, the same thing as sampling time intervals. It can provide only some of the same advantages.

A second and more fundamental drawback of time intervals as the units of recording of scientists' information-receiving behavior is the counterpart of the corresponding advantages claimed above (p. 17 - 18) for acts. The quantities of information-receiving activity encompassed in the time intervals chosen are likely to be of insufficient scope to allow one to predicate of them certain crucial classes of antecedents and consequences. It may, for example, be useful to ask whether a scientist was successful in his search for information in a given article, while a corresponding question about a two-minute fragment of his reading may be unanswerable. Other hypothetical examples of the different utilities of differently delineated segments of information-receiving behavior were given in the preceding section, and we will not add to them here.

This is not, of course, to say that it is impossible to associate stimuli and effects with "moments" or "minutes" of information-gathering behavior; but to do so usefully will generally require a consideration of the larger units--"acts"-- of which these moments or minutes formed a part. This, of course, would constitute a departure from exclusive reliance on time-intervals as units of recording. Attention has already been called to another possible combined strategy: that of weighting records of information-receiving acts by their duration in minutes. In spite of their apparent symmetry, the distinction between these two approaches is significant: one is to sample time units, from the ongoing stream of time, and to attach to them descriptions which refer, in part, to events occurring outside the sampled time units; the other is to sample acts from the ongoing stream of acts -- or, more frequently, from some sub-set of communication acts --, and to attach to each a record of its duration. The differential advantages of these two particular approaches remain to be explored. Generally speaking, however, it may well be that the time has come to devise new research strategies in which not only several data-gathering techniques but also several ways of delineating units of behavior are articulated in a planned way (not confounded, as they sometimes are at present).

d. Messages. -- A fourth way of delineating the units of observation or recording uses as the basic unit a "message" -- i.e., some kind of unit of information transmitted or of communication achieved. This approach seems to the reviewer to be of exceptional promise for future research in the flow of scientific information, although it has been used in the studies reviewed only sporadically, and then only in peculiarly restricted ways and without clear appreciation of the methodological issues involved. This approach differs markedly from the previous three; for instead of focusing on some piece of the scientist's behavior and then, perhaps, asking what information it yielded, it singles out pieces of information and asks whether and through what behavior they were obtained. The neatest embodiment of this approach would be actual studies of the diffusion of a message — e.g., of the knowledge that an experiment on a given problem was carried out and yielded certain findings. How many scientists in each of various categories were reached by the message? How long did it take to percolate? Through what successive channels did it travel? No such research was found in the reviewed studies of scientist's information-gathering behavior, although message diffusion studies in other contexts are not unknown.[1] Studies are now under way which follow the fate of a given research report, originally rendered at a scientific meeting, through its publication as an article or articles, and on to the appearance of abstracts and their indexes.[2] Since these studies stop short of actual communication to individual scientists, they fall outside of the pale of this review; but such studies could well be extended to the receipt of the messages by individual scientists. Nor would it be necessary to limit such studies to the percolation of messages through the literature.

The following data from the studies reviewed here are based on messages as units of recording: a tabulation of the channels used in finding an answer or solution to a recent problem which had been identified by each interviewed scientist (Table F-22, Column 11); a tabulation of the sources where scientists claimed to have got the idea for their most recent project (Table F-24, Column 1); and the description of circumstances surrounding messages which arrived "too late" -- i.e., which reached a scientist after their potential maximum usefulness to his work had passed, although they had then been available (Table P-26).

Sometimes records are made of those messages which had for their effect a further act of information-gathering. In that case the messages are those which called certain additional items of information to the scientist's attention (Table F-20). It is then simpler to regard the act of attending to

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[1]The most comprehensive of these efforts is soon to be reported in Stuart C. Dodd, Edith D. Rainboth, and Jiri Nehnevajsa, Revere Studies on Interaction, in press.

See also Melvin L. DeFleur and Otto N. Larsen, The Flow of Information, New York: Harper and Brothers, 1958.

[2]Private communication from Richard H. Orr, M.D., Executive Director, Institute for Advancement of Medical Communication.

these additional items as a unit of recording, and not the attention-arousing messages. In one especially interesting case (Table F-20, Column 7), the original units of observation were article cited in the interviewed scientist's own recent work. The scientist then described where he "first learned of the existence of the work" reported in the article. Note that the focus is placed explicitly on a message -- that of the existence of the work -- rather than on the channel (e.g., an article) which may have carried it.

The reader will recognize here the similarity to the well-known technique of reference-counting. Reference-counting studies, which have been excluded from review here for practical rather than theoretical reasons, do indeed seem to have messages for their units of analysis.

Sometimes the choice of messages for analysis is restricted not to those having particular effects, but rather to those obtained by scientists while engaged in some particular activity. In a negative way, this is done when records are collected on messages obtained "by chance" -- i.e., presumably, while the scientist was not engaged in deliberate information-gathering activity (Table F-22, fn. I).[1] When messages are further restricted to those obtained through particular channels, the approach becomes indistinguishable from the one based on information-receiving acts; for example, in the analysis of inquiries to an information center (Table F-23, Columns 7-9).

3. Special restrictions

Some studies restrict the communication-receiving activities which they record and analyse to certain special circumstances, while others do not apply such restrictions.

a. Place and time. -- Several of the studies call on diarists or questionnaire respondents to record only what reading they do during working hours, or while at work, or "in the library." In view of the lack of regularity in the working hours at least of academic scientists, and in view of the proneness of scientists to do a great deal of their reading-- not to mention their listening-- while "away from work," this is a serious restriction. (In Volume II, all such restrictions are mentioned in captions to the data concerned.)

b. Usefulness. -- Some exposure data are, as will be noted in captions, presumably limited to exposure which was found "useful" by the

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[1]Forty-three per cent of the respondents of Study 119 (p. 59), said they could recall no case of "ideas or information arising from chance happenings;" 57% said they could, but only 27% were able to describe such an (Continued on next page.)

scientist (e.g., Table E-5, Column 2; Table E-6, Column 2). With some exceptions, it would seem more appropriate to record the receipt of all information, and to add judgments as to its usefulness, if desired, as a separate datum.

c. Channels excluded. Many studies limit their records to exposure to those channels which are specifically enumerated in forms or instructions; sometimes this restriction is quite severe, and must be taken into account when interpreting the meaning of comparative and percentage statements. Note the use of the symbol XXX to signal deliberately excluded categories in the tables (e.g., Table E-6, Column 2).

4. The classification of channels

The main principle by which exposure statements are ordered in Tables E-1 to E-14 is the manner in which communication channels are classified. The following statement, together with the table of contents to the table volume, may serve the reader as a guide to the tables at the same time that it enumerates the classes of statements that are made in the studies:

a. Tables E-1 through E-4 contain data about a scientist's total communication-receiving activity or his exposure to communication channels not classified in any other way except into oral versus written communication.

The data in Table E-1, Columns 4-6, are based on scientists' own estimates of the relative use they make of various channels. It is not possible to state to what extent these are estimates of the relative amount of time or the relative number of acts devoted to each channel, or perhaps of some other implied unit. Some estimation of the value or use of the information obtained probably also plays a role.

b. Tables E-5 through E-7 classify communication channels into major types. By this is meant a classification of literature into journals, books, abstracts, review publications, and unpublished reports; plus the classification of oral communication channels, if at all recorded, into meetings, conferences, and informal conversations. An occasional sub-division of one of these categories is also included in these tables by means of explanatory footnotes. Figures on exposure to minor channel types which are only given in one or two studies are not reproduced here (e.g., number of reprints received).

(Continued from preceding page.)
event. (Relatively few scientifically qualified men were included in the population of this study.) The word "chance" proved to be too vague a term for this inquiry. Study 116 made a similar experience with the phrase "unlooked-for piece of information."

c. More systematic sub-divisions of channel types are recorded in Table E-8 through E-11. Here, for example, journals are distinguished by language, their age at the time of reading, and by various other characteristics, including the extent to which the presumed field of the journal coincided with the specialty of the reader. (See also Table E-10, fn. F.) It should be noted that some of these characteristics can be attributed to a journal in an absolute sense, while others are relative to the reader.

Regarding scientists' own estimates of the use of domestic and foreign journals (Table E-8, Studies 114 and 111), the remarks made in Item a above apply. Such estimates are to be distinguished from tabulations of acts of exposure as classified by the diarists (Table E-11, Study 102); diary citations of names of journals for subsequent classification by the investigators (Table E-8, Studies 125, 120; Table E-11, Study 101); and scientists' listing of journals by name for subsequent classification by the investigators or experts (Table E-10; Table E-8, Study 116).

d. Tables E-12 and E-13 concern the range of different channels of a given type -- for example, the number of different journals-- to which a given scientist is exposed, and the presumed concentration of his reading on a specified number of channels in each type. Added to this are reports of the consensus or degree of unanimity with regard to choice of preferred journals (or other channels) by the members of a department or other organization.

As for the range of different journals read, one should again distinguish scientists' estimates of the number of journals read (Table E-13, Studies 121, 115) from the investigator's count of the different journals included in records of acts (Table E-13, Study 101; Table E-12, Studies 102, 103, and 101) or in scientists' listings (Table E-13, Studies 102, 119, 116). By including some data on "preferred"journals, Table E-12 goes somewhat beyond exposure statements in the direction of evaluations. More of these in Chapter III, Section A.

e. Table E-14 reports some attempted measures of the intensity with which a given article, journal, or other channel is perused.

f. Not included in this review are reports on exposure to particular channels distinguished by name, for example, on the number of scientists who read some specifically named journal, who have attended the meeting of a particular society, or who read specified abstracting periodicals (but counts derived from the naming of specific journals are included in Tables E-8 to E-13). Identifications of the "most used" channel of a given type (e.g., the abstracting periodical "most used" by each respondent to a questionnaire) are not recorded here, although some information derived from such data is (Table E-12). Also omitted are the very rare reports of exposure to particular sections or features of a channel-type: for example, the listening to papers versus the listening to symposia at meetings, or the reading of particular "features" in scientific journals.

B. Function (See Tables F-15 to F-24)

It is becoming increasingly recognized that scientists address themselves to the literature and other channels of scientific communication for at least two rather distinct kinds of purposes: one is to keep themselves abreast of current developments, while the other is to find answers to specific questions which have already been formulated. We shall now consider reports on scientists' information-gathering behavior which make this or other distinctions as to the purpose with which the scientist addressed himself to a communication channel, or the effect which his communication act had on him.

As we shall see, purposes and effects have been classified in a number of quite different ways; e.g. information used in preparing lectures has been distinguished from that used in one's experimental work; the learning of new techniques has been differentiated from the learning of experimental results; and so on. From a practical point of view, the importance of all these distinctions resides in the likelihood that different media, formats, bibliographic tools, institutional policies and scientists' practices may be optimally suited, for example, for keeping scientists abreast in their chosen fields and for furnishing them the answers to specifically formulated questions. It is, in fact, not unlikely that steps taken to enhance the performance of some communication functions work to the detriment of the performance of others.

1. Purpose, effect, function.

The most frequent technique by which studies of information-gathering behavior have drawn the distinctions alluded to is to have the scientist state for what purpose he undertook a particular information-gathering act — e.g., whether he read an article with writing, current research, or general interest as the "specific purpose in view" (Table F-15, Column 4), or whether theoretical statements, data, or procedures were the "reason [why library material was] consulted" (Table F-15, Columns 5-6). This is a simple technique and, when categories and instructions are devised with care, it is a useful one. A scientist's conscious purpose in addressing himself to a channel of communication is, no doubt, related to his manner of approach as well as to the antecedent stimuli and sources of attention that need to be considered to account for his behavior.

One must, however, remember the very common experience that the information sought is not found; that the information, once gained, finds use in quite unanticipated ways; that information is obtained which was not deliberately sought when one picked up a journal or entered a meeting room; and, finally, that scientific information is obtained on occasions which were not entered for the purpose of information-gathering at all. In view of the frequency of such occurrences it does not seem satisfactory to restrict one's view of the accomplishments of the scientific information system and its elements to what the information-receiving scientist was aware of before he engaged in the activity concerned.[1]

Rather than to ask for what purpose any given information-receiving act was undertaken, it would therefore seem more useful to ask what effect it had on the recipient. At least one study instructed diarists to record "what use was made" of the item read, rather than the purpose for which it was read (Table F-15, Column 1). Records taken at the time information is received are, of course, limited to those effects which become apparent immediately; other methods of dealing with "effects" will be discussed shortly.

Actually we are not interested in all effects of information-receiving behavior, but only in those which add to the (long-run as well as short-run) research potential of the information-receiver. It is therefore appropriate to speak of the "functions of scientific communication activity" -- meaning thereby the particular ways in which the activity contributes to scientific research.

The research actually completed does not distinguish between purposes, effects, and functions. Attention is usually focused on one of these categories in apparent unawareness of the relevance of the others. In the tables and in the remainder of this text, all these matters will be considered under the single heading "function," although it is realized that purposes, effects, and functions are not the same thing.

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[1]The unanticipated ways in which scientific information is often both obtained and used, and the apparent role of "chance" and "accident" in bringing useful information to scientists are commented on in several of the studies, and is discussed by the reviewer in 116 A, pp. 45-49 and passim; 116 B, passim.

2. Ways of classifying functions.

The "ways" in which communication activity contributes to scientific research can, to be sure, be classified in many different manners, even if, as seems proper, one limits oneself to those "ways" which constitute changes in the informational state of the communication receiver.[1] The following classifications of communication purposes, effects, or functions have been used in the studies reviewed:

a. By the scientist's future activities. -- Some studies distinguish communication acts according to the later activity of the scientist in which the information gained was used, or was to be used. For example, a distinction is made between: reading in preparation of the writing of a lecture or article; reading in preparation of current or planned research; reading for general interest (Tables F-15, F-16, and F-17, Rows 1-3). Study 101 also clocked "reading for retransmittal." A very specific function of information is that of furnishing the idea or impetus for a specific piece of work (Table F-24, Columns 1-2).

b. By the type of message. -- At other times a distinction is made among scientific communication receiving acts according to the content of that part of the information that was actually sought or used. Thus, distinctions are made between acts of reading in which the information sought was theoretical statements, results and data, or methods and procedures (Tables F-15 and F-16, Rows 7-10; F-17, Rows 6-8).

c. By the place of the message in the course of the scientist's total information-receiving activity. -- By this is meant, on the one hand, the effect the message has on the scientist's further communication behavior, and, on the other hand, the specificity and scope of the information-gathering activity, if any, whose goal the message helps to fill.

One especially significant effect which the receipt of a scientific message may have on the recipient is that of leading him to seek out an additional message. This may be done by calling his atten-

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[1] I.e., we shall omit here a consideration of the extra-informational functions of scientific communication, which are likewise contributions to the progress of scientific work. For example: publications are an essential element in the reward system of the scientific professions; conversations with colleagues reinforce one's faith in the worthwhileness of one's chosen activity; society meetings provide periodic, and often salutary, deadlines for the completion of reports.

tion to the existence of the second message; by pointing out its relevance to his own interest; or by identifying the particular locus in the literature (or elsewhere) where it can be found. A number of studies have considered this function, under the rubric "source calling item to scientist's attention," while tabulating records on the receipt of the second message (Tables F-20 and F-21). These studies do not distinguish clearly between the sources which helped a scientist locate a piece of information for which he was already searching, and the sources which aroused his interest in a given piece of information for the first time (see also fn. z, Table F-18). Related are data on exposure to "secondary sources," as distinguished from "direct" or "primary" sources (Table E-7, Columns 14-16; Table F-21, Columns 16-23); but it should be remembered that an outsider's classification of publications into "primary" and "secondary" ones does not necessarily coincide with their use by the reader as ultimate sources and as locating tools. Abstracts may e.g. function as guides to primary sources, or as substitute reading (last two entries in Table F-19). Sometimes the effect of a message is not merely to lead a scientist to a particular second message, but rather to persuade him henceforth to include an entire new subject matter among the topics he tries to keep up with — his "area of attention." (Table F-24, fn.C).

If keeping up with developments in one's area of attention is one goal of a scientist's information-gathering activities, finding answers to specific questions is another, of markedly narrower and more specific scope. The frequently made distinction between "keeping abreast" and "searching" (Table F-19 and Table F-22, Columns 6-11) therefore falls under the present heading, although it overlaps a distinction as to the activity in which the information is (or is to be) used: any specifically envisaged activity vs. none (Tables F-15 and F-16, Rows 4-6; Table F-17, Rows 3-4; Table F-18; and Table F-22, Columns 1-5). But keeping abreast and searching for the answer to a specific question do not exhaust the possible scopes and specificities of information-gathering goals. Among other possibilities are "brushing up" on the recent years' work in an area with which one has not been familiar (Table F-24, fn. C), and doing an exhaustive literature search on a given topic (Table F-22, Column 12). The singling out of the "first steps" undertaken in attacking a research problem may, perhaps, also be mentioned here

(Table F-24, Columns 3-6).

d. Refinements and cross-classifications. -- It is, of course, possible to subdivide some of the categories of informational purposes and functions even further. Keeping abreast of developments in one's own primary field has been distinguished from keeping abreast -- presumably to a lesser extent -- in a graded series of secondary fields (Table F-22, Columns 7-9 and fn. O). Keeping abreast of developments in the top institutions in one's field has been singled out for special attention, as have searches for specific information in the secondary fields (Table F-22, fn. H and Column 13).

The types of publications which contained information called to a scientist's attention by previously received messages have also been taken into account (Table F-21, Columns 7-11 and 22-23). The "first steps" taken in the attack on routine and fundamental problems have been examined seperately (Table F-24, fn. D).[1]

Several distinctions in terms of future activity, content of message, and scope and specificity of goal can also be considered simultaneously. Different content (theory, data, methods, etc.) may be either kept up with (Table F-15, Columns 3 and 4) or searched for (ibid., and Table F-23). The further information called to a scientist's attention by a given source may keep him generally abreast, or may be immediately useful in specific activities (Table F-18; Table F-21, Columns 5-6).

e. Systematic classifications. -- A few writers on the subject have attempted to develop systematic classifications of the functions of or needs for scientific information, on either theoretical or empirical grounds. The emerging categories focus chiefly on the place of a message in the scientist's total information-receiving activity (Item c above). Of all the distinctions enumerated above, this is perhaps the most likely to bear on the way in which the functions are performed, and hence the most significant for the planning of improvements in the system.

The reviewer has elsewhere suggested the following battery of functions of the scientific communication system: furnishing answers to specific questions; keeping scientists abreast of current developments; brushing up; certifying to the reliability of a source of information; broadening a scientist's area of attention; furnishing responses to the

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[1]In one study the content of questions received by certain information centers was categorized, and their conceptual structure was described by the number of different concepts involved in each question. (Study 126, pp. 171-77).

scientist's own statements; and helping the scientist to assess the position of a research topic within the current research market (Study 116, Chapter III and passim).

Melvin J. Voigt in an unusually interesting and thoughtful paper based on interviews with Scandinavian scientists and scientific reference librarians, as well as on "observations ... gathered in twenty-five years of work with scientific literature," presents three approaches to information, corresponding to "three identifiable needs." The "current approach" derives from the "need to keep up-to-date with the current progress of /one's/ field." The "everyday approach" stems from the "need for specific information directly connected with the research work, or the problem at hand." The "exhaustive approach" is designed to satisfy "the need to find and go through all of the relevant information on a given subject ... when the researcher starts work on a new investigation and ... at the time he reports on the results." It will be recognized that these three categories correspond to what appears in the reviewed data as "keeping up," "searching for answers to specific questions," and (much less frequently) as "literature search." Voigt believes that most current efforts to improve the scientific communication system are of a nature that will benefit the exhaustive approach, to the neglect of the two others, especially of the current approach. "To many observers," he writes, "scientists and information specialists alike, the exhaustive approach is the only one which they seem to think of when they speak or write about literature use or discuss solutions to its problems."[1]

Egan and Henkle present a searching analysis of the purposes or functions of information in scientific research, derived from a consideration of the researcher's activities in the various phases of research work. They differentiate the following: creating a background or formalized body of systematic knowledge /in each research worker/; a continuing process of keeping up with new developments ... in the field of his primary interest and perhaps with a limited number of other fields closely related to his own; and knowledge sought once the scientist has entered into a research situation. The latter class of knowledge-

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[1]Voigt, Melvin J., "Scientists' Approach to Information," typescript, 1959, pp. 26-27, 39, and passim; also his "The Researcher and his Sources of Scientific Information" Libri, 1959, 9, pp. 177-193.

seeking is divided into eight categories, derived from a schematic statement of the steps in the research process, as follows:[1]

THE RESEARCH PATTERN

STEPS IN RESEARCH PROCESS	PROBABLE USE OF RECORDED KNOWLEDGE
1. Perception of a problem. May arise from observation of environment or from results of previous research.	Theoretical treatises, or research reports.
2. Definition, or precise statement of the problem, with identification of significant elements and their relationships, assumed or known.	Intensive search for prior investigations of the same problem or of similar problems. Search for accepted definitions of relevant concepts, and for verification of assumed relationships, in order to narrow the element of the unknown as much as possible.
3. Formulation of the hypothesis.	
4. Choice of a method of investigation.	Knowledge of the literature of methodology probably acquired earlier but may need to be refreshed or extended. Recourse may be to the general literature of methodology rather than to the subject field.
5. Choice of techniques to be used in gathering and analyzing evidence.	As in 4, plus: Possible recourse to the literature of statistics; to laboratory manuals; to accounts of investigations in other subject fields in which similar or adaptable techniques have been developed; or to trade catalogues for available equipment.
6. Search for evidence or data.	Continuing use of materials as in 5. In social research, recourse to factual or descriptive literature, as statistical compendia or works from a variety of subject fields, frequently non-scholarly materials, e.g. newspapers.
7. Conclusions concerning original hypothesis, with corollary implications.	May include discussion of apparently contradictory conclusions found in other research studies or of conflict with theoretical statements found in the literature.
8. Discussion of consequences, perhaps in the form of desirable policies to be adopted.	Possible scanning of polemical works.

Hertz and Rubenstein, like Egan and Henkle, categorize the communication requirements of those engaged in research operations by derivation from an analysis of the activities that must be performed. Unlike

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[1]Egan, Margaret, and Herman H. Henkle, "Ways and Means in Which Research Workers, Executives, and Others Use Information," in Jesse H. Shera, Allen Kent, and James W. Perry, eds., Documentation in Action, New York: Reinhold, 1956.

Egan and Henkle, and most other authors, however, they are not content to specify the information required for the job performance of each individual researcher; they add to this the communication necessary for the coordinated functioning of a research team in the setting of larger organization. The "communication" of which they speak includes not only "scientific information" as understood by most of the authors reviewed here; it extends also to the communication of internal working arrangements, of orders from management, and so forth. Consequently, most of their effort is concerned with internal communication within research teams. They present the following categories of information:[1]

(1) Conceptual information; relating to concepts and ideas about modern physical theory.
(2) Empirical information; either reported by someone else or observed by the worker.
(3) Procedural information; the methods of science which are part of the culture of a given set of problems (e.g., social science, physics, etc.)
(4) Stimulatory information; which has established or which keeps the worker's activities moving in the direction of work on a particular type of problem.
(5) Policy information; relating to research problems and environmental problems such as the general scope of his work, his allowed behavior, hours, assistance, pay, travel, etc.
(6) Directive information; with respect to the problem the group is supposed to attack (proceeding from the team focus which may be the entire team acting collectively, or a group leader, etc.)

The three last-mentioned documents are carefully thought out and rich in insights extending considerably beyond those which can be summarized here.[2]

3. Two methodological approaches

Certain methodological issues remain to be resolved in the study of functions of scientific communication regardless of the manner in which they are classified. There are two quite distinct questions which one may ask in this connection. One is of the format "What are the functions served by a given channel?" For example, are abstracts more frequently read for the purpose of keeping abreast or for the purpose of finding a particular piece of information? This approach is followed in Tables F-15 to F-19. The other question is of the format "What are the communication channels which serve a given function?" For example, is it colleagues, journals, or books which most commonly provide a scientist with an idea for

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[1]Herts, David Bendel, and Albert H. Rubenstein, Team Research, New York: Columbia University Department of Industrial Engineering, 1953, (Study 113), pp. 1-6 and passim.

[2]To this must be added the pertinent passages of the thoughtful and insightful analysis by J. D. Bernal, "The Transmission of Scientific Information: A User's Analysis," ICSI, pp. 67-85.

new research? This is the approach of Tables F-20 to F-24.

It seems to the reviewer that the planning of future information dissemination among scientists calls especially for analysis of the second kind (channels performing each function). The fundamental question that needs answering seems to be: "Given that such and such a function must be performed if scientific research is to progress, how is it, in fact performed? How often is it performed by any given kind of communication medium or communication exchanging instrument -- and how satisfactorily?" The research completed to date, however, favors the other kind of analysis (function performed by each channel). It is true that answers to questions of both kinds can be derived from a single body of data, provided that the information-receiving act is used as the unit of observation, and both the communication channel and the purpose or function of each act are specified. Such data can be tabulated once so as to show the proportions of acts using any particular channel which served various functions, and another time so as to show the proportion of acts serving any particular function which made use of various channels. Even when percentage breakdowns in only one direction are published, it has in several instances been possible for the reviewer to compute new percentage breakdowns in the other direction.[1] (Compare Table F-18, Columns 5-6, with F-21, Columns 5-6; or Table F-16, Columns 1-7, with F-22, Columns 3-5 and 1-2.) More usually, however, this logically simple transformation from one type of analysis to the other is not possible. This fact is especially deplorable because a number of circumstances seem to militate against the presentation of data on the channels performing each function.

4. Factors militating against analysis of "channels performing each function."

As long as no deliberate effort in that direction is made in the design of studies, the following circumstances will conspire to make adequate analyses of "channels performing each function" much less likely than the reverse and to make transformations from one type of analysis to the other difficult:

[1]This is of course, possible only when original frequencies or N's as well as percentages are published.

a. Restrictions to selected channels. -- Few studies extend beyond communication-receiving through the written word, and many cover only a selected number of even the written channels. Any resulting tabulation of the number of times that a given function was performed by various channels will, of course, describe only those instances in which the function in question was indeed performed by some of the channels included in the study. Instances in which the given function was performed by other channels -- for example, by information coming from colleagues in various contexts -- will be excluded. When, however, data are originally collected by some manner of sampling the instances when the given function was performed, then a complete breakdown of channels that have served that function can be given (within the limitations of the sampling procedure).[1]

b. "Most often" and "usually" in place of frequency counts. -- Many statements about functions or purposes of communication activity are based on scientists' estimates of the relative frequency of certain events. These are necessarily gross estimates. Generally, in fact, they merely state what sort of thing occurs "most often", "more often", or "usually" -- for example, whether abstracts are used "principally as an aid in keeping up, for reference, or both." (Table F-19). Even when equivalent figures are also given for journals, books and other channels, it is not possible to transform them into any statement about the relative frequency with which the various channels contributed, for example, to "keeping up."

Transformations in the opposite direction are also excluded when such forms of estimates are given for the channels which perform a specified function -- for example, from the proportion of interviewed scientists who rank each communication channel as "most important in calling to /their/ attention" developments in their primary fields, or who state that they "depend /on each/ to a considerable extent" for the same purpose (Table F-22, Columns 6-7). Sometimes scientists are not

[1]It is, however, possible to exclude information obtained through certain channels, even when the sampling is, in principle, one of performances of a given function. Thus, Study 116 (pp. 10-17) asked: "Can you tell me about the last time you used another channel than just the literature to find the answer to some question that arose in connection with work?" Half the messages described in reply were of a kind not likely to be published or at least not likely to be indexed. About half of these inquiries had been addressed to top experts in the field concerned, the others to colleagues who were close at hand.

even called upon to make comparative statements, but to declare simply whether each channel does, for example, make them "become aware of information in /their/ field" (Table F-21, Columns 16-23) -- that is, whether each of these channels ever performs this function at all. The similarity of this procedure to statements on exposure or non-exposure (pp. 12-14 above) will be recognized.

c. Sampling difficulties, sleeper effects, chains and synergisms. It is simpler and easier to obtain a reasonably satisfactory sampling of instances in which a scientist made use of some particular channel -- for example, of instances of journal-reading -- than it is to obtain a sample of instances in which a particular function was served. One reason for this difficulty is, of course, the difficulty of satisfactorily defining some of the functions in question. Another is the fact that while the channel of communication of which use is made at any particular point in time can be rather unambiguously recognized by the scientist himself or by an observer, the function served by a communication act is not easily held in view and may, besides, not be recognized for a long time, if then. Without an elaborate examination of the scientist's behavior over a considerable period of time only the scientist himself can describe the function of an act; and it may well remain obscure to him, at least for a considerable period of time.

Some significant effects of the receipt of a message do not take place until considerable time after receipt of the message has elapsed. Who has not experienced instances of the relevance of a particular message not being realized until long after the message had been received?[1] Moreover, functions of scientific communication are often performed not by a single act but rather by a chain or network of acts. Thus, for example, a search for a piece of information may take a scientist to a long array of different potential sources, each pursued on different days; one source leads to another, but whether contact with any given source will turn out to be fruitful may not be realised until the whole chain has been gone through. At other times the important effect of the reading of a given article may, for the given scientist, be that it enables him better to understand a message received from

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[1]For some examples, see the reviewer's Study 116, pp. 42-45, and passim.

another source at a later date; and so on. Short of extremely cumbersome and inefficient observational procedures, such convergent effects or delayed effects can probably only be recognized by identifying instances in which a given effect has been achieved, and then calling upon the scientist to reconstruct retrospectively how it came about.[1]

5. A third approach.

One potentially major way of studying the effects of different kinds of communication-receiving activity has not yet been mentioned here, because it is not represented in the studies under review. This method requires ways of measuring the occurrence of the hypothesized effect among scientists; for example, it requires a way of measuring to what extent various scientists are, in fact, "abreast" of developments in some specified field.[2] Once the occurrence of hypothesized effects among scientists has been systematically ascertained, it can be cross-tabulated with the scientists' exposure to various forms of scientific communication -- either as it occurs in their ordinary life, or even as it has been manipulated experimentally for such research purposes. This would make it possible to state, for example, whether those reading certain journals are better informed than those reading others. Such methods have, to the reviewer's knowledge, not been used,[3] but they have been discussed to a limited extent and must be regarded as serious possibilities for the future. More about this will be said in a later chapter.

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[1]These considerations are important in chosing between time intervals, acts and messages as units of recording. See pp. 14-22 above.

[2]The Bureau of Applied Social Research of Columbia University is planning an attempt to develop such measures, to be applied to practicing physicians in the course of interviews.

[3]It is true that exposure to communication channels has been correlated with performance, as rated by colleagues and supervisors (Studies 115 and 117:), or as indicated by the amount of one's publications, standardized on age (Study 104). (Cf. data from Study 115, Table E-13; from Study 104, Table P-26; and from Study 117, pp. 48-49 below) However, correlations with performance, unlike those with achieved level of information, would not presume to specify the particular way in which exposure to a channel contributes to research potential. In addition, there are serious problems in the measurement of performance and in the control of factors other than information exposure. (See also Chapter V.)

C. Performance (See Tables P-25 and P-26)

The effects of various kinds of communication activities, and their contributions to the progress of scientific work, have already been pre-empted in the preceding part of this chapter. The heading "Performance" is here reserved for the comparison of the results obtained through specified kinds of communication-gathering behavior with some explicit or implied standard.

Comparisons of the informational yield of a given communication-gathering act with the expectation with which it was undertaken would be the clearest example of reports on performance in this sense. While, as we have seen, it is not uncommon for studies to specify either the purpose with which a given communication-receiving act was undertaken or the presumably useful result actually obtained through it, no studies have been found which report both of these, and in fact few make the distinction very clear. There are, however, a few studies which tabulate scientists' statements as to whether a particular information-gathering act yielded what the scientist had expected of it or not. These, showing a variety of question wordings, are reported in Table P-25.

An even smaller number of studies provides some information on instances of failures of information to reach a scientist, even though the information was, in some sense, available at a time when he could have used it. While mention was made in the preceding section of collections of descriptions of ways in which a particular communication function was most recently performed, what we are referring to now are, as it were, instances of failures of functions to have been performed. Scientists' brief descriptions of instances of undesirable duplication in their work caused by lack of information on research carried out elsewhere were collected in the course of one study, and similar descriptions of instances in which information had arrived too late were collected in another. A summary of the way in which these episodes were categorized will be found in Table P-26.

In addition to these evaluations made of particular communication-receiving acts, and the failure of particular messages to arrive in time, the studies under review contain a large number of reports based on scientists' verbal evaluations of communication channels. These will be mentioned in Part A of the next chapter.

Chapter Three

FINDINGS NOT REPRODUCED IN THIS REVIEW

It has been decided to omit from this review certain classes of statements made in science information studies. This chapter will merely state what these classes of statements are -- they correspond to Items d and e Chapter I, pp. 6-7 -- and will briefly enumerate the principal forms which they take.

A. Evaluation

1. Opinion polls vs. interview surveys.

Numerous tabulations of scientists' verbal evaluations of scientific communication facilities have appeared. In the minds of some critics these opinion reports seem to be regarded as typical, if not exhaustive, of studies of scientists' information-gathering behavior, at least of questionnaire or interview studies. This identification of communication research with opinion polling is a serious error. Research on scientists' communication behavior, even if based on interview data, need not be confined to opinions and evaluations, and may not be concerned with them at all. Interview data can be and have been gathered on scientists' communication behavior and experiences as can be seen from the material summarized in the companion volume of tables and discussed in the preceding chapters.[1]

Nevertheless, many tabulations of scientists' opinions, evaluations, judgments, ratings, and rankings of communication channels are contained in the studies reviewed, and many of them rest content to report distributions of these attitudes, with little attempt at interpretation. This extensive array of data is not summarised in the companion volume of tables and will not be reviewed here, save for briefly listing the various forms in which such data have been cast (Section 2). Only where data of this sort are used in conjunction with other data to arrive at inferences which recognise and, in fact, utilize, their subjective nature, will they make their appearance in Chapter IV.

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[1]Furthermore, even opinion data can--and must--be treated as data to be analysed, not as conclusions and certainly not as recommendations, as some critics seem to believe. Descriptions of the ~~distribution~~ (prevalence) of opinion or other phenomena are the beginning, not the end, of the survey researcher's main job, which is to make inferences from "what goes with what under what conditions." For an elaboration of this argument and counter-argument see Shaw's review and the present reviewer's comment in College and Research Libraries, 1959, 20, pp. 163-64 and 419-20.

Except when not used in such "higher-order" inferences, reports on scientists' evaluations of communication channels are, in the reviewer's judgment, of little usefulness to the planning of action of more than local scope. On the local level, they may be instructive; the librarian of a particular establishment may be helped in his decision-making by knowing how the scientists he serves evaluate each periodical on a long list, how satisfied they are with the various services furnished by his libraries, and what criticisms they have to make. On the more general level, such information does not seem likely to be useful, although useful ideas may come from the more detailed evaluations or criticisms that scientists have sometimes been called upon to make of specific features of different communication channels.[1]

2. Forms of evaluation data.

Evaluations reported in the studies under review take the following forms:

a. Satisfaction with the communication system as a whole. -- In some instances scientists are asked to express their general satisfaction with scientific communications or to rate their own ability to keep up with new developments. (Study 122, p. 36; Study 106, p. 140; Study 116, p. 59).

b. Evaluation of channel types. -- More commonly, scientists are asked to give an evaluation of a particular channel type, or to rank a number of channel types as to their usefulness either for particular purposes or in general. For example, scientists have been asked:

--to say whether they find scientific sessions of their society satisfactory, in need of some improvement, or in need of much improvement (Study 106, pp. 156, 279);

--to rate on a six point scale from "essential" to "no use" each of eight different communication channels, ranging from official meetings through contact with others to reports and technical papers (Study 114, pp. 42-43, 9);

--to state whether they "obtained a significant amount of information in their field from attending meetings", (Study 111, pp. 229, 234);

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[1]The differential usefulness of knowledge for action on the local and general level is discussed in Chapter I, pp. 4 - 5. It should also be remembered that expressions of opinions are peculiarly sensitive to even minor changes in the wording of questions or instructions. This further reduces the value of purely descriptive accounts of distributions of opinions, and makes it even more difficult to draw simultaneous inferences from a multitude of local studies.

--to check whether they "depended on each of [6 channels] to keep up with advances in their field" and also "how adequate they find each of these sources" (Study 106, pp. 279, 144; cf. Table F-22, Column 6).

c. Evaluation of the quality of particular features. -- Perhaps more informative are the instances in which scientists were asked to evaluate channels separately with regard to certain of their characteristics. For example, scientists were asked to evaluate as good, medium, or poor, each of eight features of an abstracting service, ranging from "breadth of coverage of articles" through "grouping of abstracts in the journal" to "overall effectiveness". (Study 109, p. 8; and 107, p. 7-8). In this matter, incidentally, it was found that biologists appeared to be more satisfied with coverage than with the promptness of publication of Biological Abstracts, while figures on actual coverage and promptness called in the investigator's judgment for precisely the opposite evaluation. In at least one study scientists were asked to render judgment on certain policies of periodical publishing in their discipline: did they believe that present editorial policies slanted their discipline toward or away from certain fields "very much" "some," or "not appreciably"; that there was a shortage of good expository papers; that the "referee system" creates barriers to publications by subjecting authors to annoying requirements; and so on (Study 104, pp.121,132,134).

Evaluations of sub-categories of given channel-types were also called for. For example, scientists were asked to rate on a six-point scale the usefulness of basic journals, and again that of applied journals, in each of four categories of age of publication (Study 114, p.46).

d. Evaluation of the importance of particular features. -- Scientists were not only asked to evaluate how well existing media performed in specified respects, but also what the relative importance of satisfactory performance in these respects was. Others were, in fact, asked to vote their preferences as to changes in editorial policy and the like. For example, scientists were asked:

--whether they considered as "essential in an abstracting journal" of their discipline each of six different characteristics, ranging from "complete coverage of the selected journals," through "publication of abstracts within one year of appearance of original articles" to "inclusion in each issue of a full subject index" (Study 107, p. 8);

--to rank, as to their importance, five features of abstracts, ranging from "wide coverage of technical journals" to "maintenance of cost to user below five dollars a year" (Study 109, p. 10);

--whether they favored establishing an expository journal; whether the system of refereeing submitted papers should be changed in either of two proposed ways; and so forth (Study 104, pp. 133-135);

--to indicate what, in their opinion, distinguished good from bad review articles. Their replies, recorded verbatim, were classified into eight categories (Study 116, p. 143).

e. Pseudo-quantitative estimates. -- Some scientists were asked to perform the difficult feat of estimating "what percentage of their research information was obtained from domestic as against foreign periodicals" (Study 114, p. 46 and 22); or to "give approximate percentages of the use of conferences and of scientific literature...if considerable technical information is obtained from both conversations and conferences and scientific literature" (Study 111, p. 229). Some such data are included in the tables submitted herewith (Table E-1, Columns 4-6; Table E-8, Study 111).

f. Enumeration of difficulties. -- Scientists are sometimes asked to describe or to categorize the difficulties they have encountered with specified kinds or channels of scientific information, or with scientific information in general. Scientists were asked, for example, whether they found any obstacles in keeping up with advances made in foreign countries, and, if so, to specify the languages involved (Study 116, pp. 154-5); or whether they found Soviet information in their field to be readily available, and if not, to describe the particular problems encountered (Study 110B, p. 5). (It turned out that 54% of those who did not consider Soviet information readily available had never tried to obtain it). In another instance the scientists were asked to list on a questionnaire some of the difficulties they had in obtaining required information and keeping up with advances in their field. Their written replies were classified into 14 categories (Study 122, p. 53).

g. Evaluations of particular channels. -- The studies contained a goodly number of reports of scientists' evaluations, rankings or ratings of particular abstracting services, particular periodicals and the like. In several instances scientists were asked to select what they considered the best channel of a given type, for example, to state which were the three most important journals for them to read. Such questions have been used as a basis for describing the consensus of choice among scientists in a given department or other unit, and also as starting points for assessing the concentration of their reading on particular channels. These derivative data have been summarized in Table E-12.

B. Communication Skills and Practices; Use of Library Services

No attempt is made here systematically to review reports on the languages scientists are able to read, their keeping a personal index, the place where reading is done (library, home or laboratory), their delegation of literature searches to librarians and similar matters. The following list merely enumerates the kinds of communication skills, practices, and services on which data have been collected in the reviewed studies.

1. With information-receiving acts or time intervals as units.

We list first those items which were used in studies using the diary technique to describe each reading or communication-receiving act:[1]

> Private index, library index, library personnel, accession list, bibliography prepared by the library, or notification slip from the library as sources calling an item to the diarist's attention (Study 105, p. 159);
>
> whether an article was read in the form of a reprint, in a journal which was the property of the diarist, routed to him by the library, requested by him from a library of his own department, or from another library, etc. (Study 102, pp. 595 and 632-633; Study 120, pp. 23 and 45 and *passim*; Study 114, p. 27);
>
> whether reading was done in the library, office or laboratory, at home, while traveling on duty, or elsewhere (Study 120, pp. 25 and 47; Study 114, p. 26);
>
> whether the item was copied, indexed, or otherwise processed by the respondent (Study 120, pp. 26 and 48; Study 102, p. 633).
>
> whether communication activities clustered on certain days or certain hours of the day (Study 101, pp. 60-63).

2. With other units.

The studies contain an even larger variety of statements about scientists' communication skills and practices, and their use of library services which are not tied to particular information-receiving acts. Reports may state, for example, how many scientists have ever made use of a given service; how many possess a certain skill; or how they rate the usefulness of one service or another. The following topics are dealt with in this manner in the studies shown, but this is not an exhaustive list:

> Skill in foreign languages, having read scientific works in foreign languages, having used translation services (Studies 122, 110B, 104, and 116);
>
> keeping of personal indexes (Study 122);
>
> regularity with which literature searches are performed, and reasons for their omission (Study 110A);

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[1]See Chapter II, pp. 12-22 concerning the use of "acts" and other units of recording in science information studies. Classifications of reading acts by language in which read have been summarized in Table E-8.

delegation of literature searches to own assistants or to library personnel (Studies 122 and 114);

where reading is done (Study 119);

when reading is done (Studies 119 and 101);

use and evaluations of library reference services, reference catalogues, accession lists, bibliographies especially made up, notification slips, guidance by library personnel, etc. (Studies 122 and 111);

the manner of obtaining literature, such as purchasing books, subscribing to journals, reading reprints, obtaining journals from departmental or firm libraries, from other libraries, from private loans, etc. (Studies 122, 114, 119, 107, and 120).

Chapter Four

INFERENCES FROM MULTIPLE DATA

This chapter has been reserved for those results of the reviewed studies which could not be incorporated into the volume of tables, because they are based on multiple data, complex computations, or verbal reasoning from the data. Here are interpretations of the joint occurrence of diverse phenomena, conclusions from the comparison of rates and indexes, and inferences from the convergence of multiple evidence. The fact that it was possible to garner these passages into a single, residual, chapter, while the bulk of the findings could be reported in tables of one, two, or — rarely — three variables, shows how little intensive analysis has been undertaken in this area. Descriptive statements combining, at best, two variables, are the rule; possible confounding variables are seldom controlled; and interpretations rare.

The passages below summarize the nearest examples of "analysis in depth" (cf. Chapter I, pp. 3-4) that could be found in the reviewed studies.[1] Although there is no reason to assume that their topics are representative of the topics that can be "analyzed in depth", these summaries deserve the reader's careful examination as indicators of the potential yield of intensive analysis of behavior data.

a. Personality, work assignment, and milieu as determinants. — Several studies report data separately either for scientists engaged in pure research and applied research, or else for scientists employed at pure and applied research institutions. But what happens to pure researchers in applied environments, and vice versa? Does a scientist's own work and the milieu in which he works make independent contributions to his communication-gathering behavior? Engineers in the Applied Physics Laboratory of Johns Hopkins University were found, in general, to "follow the pattern of the applied scientists, while engineers of the School of Engineering "veered in the direction of the pure scientists." This, according to the investigators, "demonstrates the effect of type of organization on methods of gathering technical information." (Study 111, pp. 230-33).

Does the intellectually more active technologist "read the literature because it helps him to solve tis technical problems, or is it

[1] But cf. also the work of Voigt, cited on p. 31 above.

merely that he is the type of person who likes to read the literature?" Study 119 finds claims to have referred to the literature as a first step in dealing with one's current problem much more prevelant among those dealing with long-term, fundamental and research problems, than among those dealing with short-term, routine, administrative and production problems. These claims also vary according to the person's age, his academic qualifications, and his position in the company. But when the pertinent figures are standardized on the nature of the problem currently worked on, differences disappear almost entirely between age groups, partly between academic ranks, and hardly at all between management, production, and research personnel. The investigators conclude that "factors related to the individual, and independent of the particular problem, /as well as/ factors related to the problem itself ... influence people to refer to the literature ... but the personal factors appear to be rather more important than the problem factors." (Study 119, pp. 53-54).

b. Access to channels as a determinant. -- The amount of time chemists devote to reading on the job was found directly related to the ease of their access to scientific literature. Reading time was directly related to the availability of journals at chemists' desks, to the location of library facilities in the chemists' building, and to the existence of company library facilities (Study 101, pp. 56-58). On the other hand, chemists were found to spend less time in discussion when they were outnumbered by other scientists in their firms (Study 101, p. 59).

c. The latent functions of scientific meetings. -- A paradox noted by more than one investigator is the regularity with which scientists attend meetings of scientific societies, while they deny with almost equal regularity that listening to papers at such meetings is of any use. Among the particular features of meetings from which scientists claim to have derived most information benefit, the role of informal contacts looms quite large when juxtaposed to that of the official program of the meeting. (Study 116, pp. 158-64.) This is true especially for pure researchers (Study 111, p. 234). Moreover, it is precisely scientists in the categories of most frequent meeting attendance -- those most active in research and most highly qualified academically -- who most frequently deny obtaining significant information from meetings (119, pp. 37 and 38).

One concludes that the functions of scientific meetings are not those which ostensibly motivate the bulk of their programs, but other forms of communication -- symposia, corridor meetings, the presence in one room of those interested in a single area -- as well as extra-informational functions, such as setting deadlines for the completion of reports.

d. Sending - receiving ratio. -- The amount of time spent by chemists in sending and receiving scientific information has been compared for both oral and written transmission. In conjunction with estimates of the relative time required to read, write or speak-and-hear a given amount of informational material, this leads to tentative conclusions concerning the rate of information exchange between industrial chemists and other scientific groups, and the relative efficiency of the spoken and written word (Study 101A, pp. 34-37).

e. Dispersion of relevant information over many sources. Relationship of dispersion to satisfaction with the communication system in different disciplines. -- The average chemist in the sample of Study 116 perceivedmuch of the work relevant to himself as concentrated in a small number of institutions; the average biochemist perceived his news as more dispersed, and the average zoologist even more so. In addition, chemists came closer to agreement in their choice of the "five ... institutions most significant in your field" than the biochemists, and the biochemists showed greater agreement than the zoologists. Almost exact parallel findings are obtained when the "three most important journals for you" are substituted for each scientist's five top institutions. Apparently there either is greater heterogeneity of interest among zoologists than among biochemists or chemists; or else it is rarer for an institution to lead in more than one specialty in zoology than in the other two disciplines. On the other hand it seems that the interests of chemists are more neatly defined along generally recognized principles of specialization (corresponding to the division of labor between institutions and journals) than is true for zoologists or biochemists.

Greater perceived concentration of important work in a few top institutions or in a few journals was found, as hypothesized, to be associated with satisfaction with one's ability to keep abreast of scientific developments, even when discipline was controlled (Study 116, pp. 50-53 58-60, 135-136).

In study 122, by contrast, "The hypothesis that research workers in large cities with relatively easy access to sources of information and more abundant contact with colleagues would estimate their ability to keep up with advances to be better than those working in the countryside and in smaller cities was not supported." It should, however, be noted that this study deliberately excluded those over 40 years old, professors, directors of institutes, "and other persons in top positions who can be expected to know personally most of the scientists in their own field." (Study 122, pp. 32-33 and 36).

f. Familiarity with a source is a stimulant to its use. -- The countries most often named by a sample of scientists as those "whose research activities they would like to know more about" are the very countries from which information is known to be easily available. The investigators conclude that "one of the greatest stimulants to the use of information is familiarity with its source." (Study 110B, pp. 6 and 7)

g. Creative scientists are open to external influences. --

"The successful technologist is the one who is open to external influences, who is aware of the outside world both as something that modifies him and as something that he modifies." This is inferred from the following findings: (1) Many respondents stated that most ideas or stimulation for new work had not come through any channels of communication but rather from their own intuition and thought, but this was especially true for those who were in fact not working on a current problem. (2) Having a problem to work on was correlated with general high activity including high communication activity. The investigators also tentatively ascribed to the good technologist "an ability to make use of chance events", but, according to their own statements, had no satisfactory way of testing this hypothesis. (Study 119, pp. 58-59.)

The association between the performance of scientists and the diversity of their contacts with the rest of the world is corroborated in a very different way in Study 117. The rated performance of scientists was compared to the frequency of their contacts with the five colleagues they rated most significant to their work. The correlation is positive when colleagues differ from the interviewed scientist in attitude and nature of prior employment, but slightly negative when the colleagues were just like the scientist himself in these respects. When, instead of five colleagues, the single most important colleague was considered alone, the correlations were positive throughout. The authors conclude tentatively: "For maximum performance it is helpful to have at least one close colleague with a similar orientation — someone who talks the same language ... But one or two such individuals are enough. To provide the stimulation of new ideas, it is important that the remaining contacts be with people of dissimilar orientations." (Study 117, pp. 313-19.)

h. The necessity of rediscovery and double exposure. — Sometimes pieces of work which have been ignored by the scientific community prove to be highly significant when someone finally stumbles upon them in the back volumes. Two such instances are described in Study 116, along with cases of information which had reached a scientist sometime in the past, while its relevance to his own work did not become apparent to him until it was brought to his attention a second time at a later date and by another source. It is suggested tentatively that it is often necessary to publicize information repeatedly, lest it fail to enter the stream of communications which will lead to its ultimate user. From the point of view of the consumer of the information, it seems sometimes necessary to be exposed to the information repeatedly before it will make an impact. More knowledge about the prevalence of such occurrences and of the details of the histories involved would be necessary to test this hypothesis and to determine the causes at work. (Study 116, pp. 42-45.)

i. Utilisation of published articles. -- On the basis of information on chemists' reading time and on the number of articles abstracted in Chemical Abstracts in a given year, it was concluded that only about one half of one per cent of the articles published in chemistry are read by any one chemist. (Study 101, pp. 6, 38, 41 and 65.)

j. General activity level. — The overwhelming positive intercorrelations (among respondents engaged in research) between six items descriptive of communication gathering activity, and "working on a problem," leads the authors of study 119 to postulate a "general activity level." This interpretation is bolstered by a factor analysis of these variables, as well as by the finding that each of a whole series of characteristics of readers correlates positively with the presence of presumably desirable characteristics among the journals they read

k. Relationships of time allocated to various activities. -- Study 101 undertakes an analysis of time budget patterns, ascertained by ovservations of the activities of chemists at random moments distributed over a period of nine consecutive working days. Correlations between the time spent in scientific communication, equipment use, and various other activities are shown, with ceiling effects controlled. Thus, for example, it is reported that "as scientific communication increases, all other scientific activity tends to decrease more than would be expected." (Study 101, p. 50) Since, of course, no actual increase (change over time) was observed in this survey, the above may be restated as follows: the more time is spent on scientific communication by the chemists of a company, the smaller is the share of time that other scientific activities occupy among all remaining activities.[1] Corresponding relationships are reported for other categories of activity. (Study 101, pp. 43-50)

l. Reading more does not mean reading less intensively. -- "It appears that there is no conflict between seeing many journals and reading them thoroughly ... it seems plausible to conclude that seeing many journals and reading them thoroughly are both reflections of the same factor." This is inferred from the finding that those who claim regularly to see many journals classify as "read" (rather than "scanned") almost as large a proportion of their journals as do those who claim to see few (Study 119, pp. 23 and 101).

m. Individual accident -- aggregate regularity. -- The learning of new developments by "chance" -- (i.e., while not deliberately engaged in "keeping abreast") -- is often of great importance to scientists; and even information which is actively sought not infrequently comes to their attention through unexpected sources. On the basis of a number of indications of the prevalence of these experiences, Study 116 suggests that what appears as an accident from the point of view of the individual may be an expected occurrence from a larger point of view. This receives some corroboration from the occasional experience that a scientist will

[1]Since these are so-called ecological correlations, based on scatter plots of companies rather than of individual chemists, it is left open whether the same chemists who spend much time in scientific communication devote less of their remaining time to other scientific activities, or whether, perhaps, in plants where some chemists spend a great deal of time on scientific communication, other chemists spend disproportionately less time on other scientific activities.

have facts of relevance to his own work brought to his attention through several routes, each of them "accidental," and each independent of the others. One such case is described in detail. It is recommended that the information network among scientists be considered as a system and that it may be possible to increase the likelihood of desirable "chance" communication. (Study 116A, pp. 48-49; 116B, pp. 196-97.)

n. Literature used more for ideas than for reference. — The conclusion that "to the technologists in our sample, the main function of the technical literature is not that of a reference source for consultation, but a primary source of stimulation" is reached by the authors of Study 119 on the basis of the conjunction of a number of separate findings which, in their own words, "fall into a more meaningful pattern" when this interpretation is applied. The findings in question are the following:

> Few technologists believe that they can get from the technical literature useful information in solving their problems;
>
> many technologists say that they get most of the ideas or stimulation for improvements and methods from written materials;
>
> a large portion of articles read and considered useful have been met with by chance;
>
> very few of the respondents were able to give the title of an abstracting journal that they have used in the previous quarter year; when used, abstracts are stated to have been used more often for current use than for searches;
>
> more than half of those whose firm had a library did not use it, while those who did use firm libraries were usually satisfied with them although "by what seemed to be reasonable criteria the libraries within British industry are generally regarded as seriously inadequate."

The authors conclude that "there is thus a good deal of circumstantial evidence for the hypothesis that the literature is used very much more for news than for reference." (Study 119, pp. 57-58).

o. Ease of personal communication and satisfaction in different disciplines. — Personal communication seems to flow more easily among zoologists than among chemists in the sample of Study 116, and more easily among chemists than among biochemists. This conclusion is based on the following indications:

> For keeping informed of work at the major insiitutions in their respective specialties, zoologists valued personal communication more highly than chemists, and chemists more highly than biochemists.
>
> When invited to point out weaknesses in the communication system, 75% of the biochemists voiced complaints about publications, as opposed to 66% of the chemists and 55% of the zoologists; only 7% of the biochemists remarked on personal contacts while 20% of the chemists and 15% of the zoologists did so.

65% of the zoologists, but only 48% of the biochemists and 45% of the chemists, said that they would ask someone when in need of specific information in their secondary fields.

95% of the zoologists, 80% of the chemists and only 58% of the biochemists ranked forms of personal communication among the four channels most frequently calling to their attention developments in their primary fields of attention.

Several of the biochemists, but none of the chemists or zoologists, volunteered the statement that personal contacts seldom furnished them with news of work in progress in other places. Many chemists and zoologists made statements to the contrary, for example, "I can keep up via the grapevine."

Zoologists expressed greater satisfaction with the communication situation than chemists or biochemists, and that in spite of the fact that they also perceived the greatest dispersion of vital information over many sources. (Compare Item e above)

These facts are conjecturally related to the following structural characteristics of the three disciplines: recency of their establishment as recognized parts of the scientific world; involvement in enterprises outside of the academic world; differential pace of development; number of people and places doing important research work; rapidity of recent expansion and turnover in personnel; communication customs and traditions (Study 116, pp. 58-63).

p. Journal characteristics related to the characteristics of their readers.— A very thorough and interesting analysis of the relationship between characteristics of journals and characteristics of their readers is undertaken in study 119. It is first shown that there are certain correspondences between the findings obtained by three different interview questions about journal readership. Next, the number of journals (from a list of 97) in which respondents claimed to have "read or scanned at least one article during the past year " is shown to be related to the following characteristics of the respondents: age, number of years with firm, experience in present work, nature of responsibilities, technical qualifications (cf. Table E-13). These are discussed in detail and the question of possible spuriousness of some of these relationships is examined.

Journals are next classified by a librarian according to eleven different dimensions, including: relevancy to respondent's specialty; technical preparation necessary for an understanding of the journal; presence of reports on fundamental work; presence of reports on applied work; and so on. The per cent of respondents who had "read or scanned at least one article during the past year" in the average journal in each class is shown (cf. Table E-10, Columns 1 and 2).[1]

[1]Such percentages, to be sure, are affected by the number of journals in each class which are included in the check list. The more exhaustive the list of journals in a given category, the smaller will be the percentage of readers having read articles in the average journal in that category.

The implications of these figures are discussed, with proper caution regarding any inferences as to the direction of causality.

Then follows a classification of respondents according to eight different dimensions. The per cent of the respondents in each respondent category who had "read or scanned at least one article during the past year" in the average journal in each journal category is computed (Study 119, p. 83). From these contingency tables a matrix of contingency coefficients is constructed, revealing the pattern of relationships between journal characteristics and reader characteristics (Study 119, p. 20; cf. our Table E-10, Columns 3-6). The Investigators forego a "formal factor analysis /as/ not justified," but in view of the remarkable consistency of the signs of these relationships they suggest that a "general factor runs through the characteristics ... it seems reasonable to describe /it/ as intellectual activity." The relative magnitude of the contingency coefficients contributed by each of the reader characteristics is then examined, and the relative magnitude of the contingency coefficients contributed by each journal characteristic is subjected to a similar examination. Thus it is found that among the reader characteristics "easily the most important variable is the number of journals read, and this is followed by use of abstracts and /by technical/ qualifications." Among the journal characteristics, "the two most important variables are the presence of reports of fundamental work and the absence of advertisements." A note of caution regarding inferences about the direction of causality follows.

In spite of the relationships, journals containing many advertisements, containing no reports of fundamental work, being easy to read, etc., enjoy higher average readership than their opposite numbers even among the "intellectually active" readers — although less markedly than among the rest. In fact, "there is only one group we have examined which prefers fundamental journals to non-fundamental, and that is the group of those who claim to read more than 20 journals in all."[1] The investigators point out that "the journal characteristics associated with the reading of the more intellectually active part of the population are

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[1] This study covers "technical grades from foreman upwards", and the analysis here described does not single out the scientists as a separate category.

precisely those characteristics which tend to go with a low readership figure -- or, in rough terms, the brighter readers are more inclined to favor the less popular journals. In this respect the technical journals follow just the same pattern as general newspapers and magazines." (Study 119, pp. 11-22.)[1]

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[1]Actually, disproportionately high readership of less popular journals by the "intellectually more active part of population" does not necessarily bespeak a more refined taste on their part, but would follow necessarily if two conditions held: (1) the intellectually more active read a larger number of journals; (2) the more popular journals are read by almost everyone, at least among the intellectually less active. In that case, the only way one could raise the number of one's journals above the average would be by selecting some of the less popular ones. Consequently, the less popular journals would loom disproportionately large among those read by the readers of many journals.

In fact, none of the journals are read by almost everyone, but the more popular ones, by definition, more nearly approach this state. ("Reading" here, after all, requires merely "reading or scanning at least one article during the last year.") Therefore, at least a part of the favor in which "brighter readers" seem to hold the "less popular journals" can be accounted for by simply assuming that they read a larger number of journals.

The investigators do not present the number of journals read by the "brighter readers" -- i.e., by those ranking high on components of "intellectual activity." They do, however, show that the several components are correlated with one another; and of all these components, "Number of journals read" turns out to be the best predictor of kind of journal read. One may surmise that the number of readers of a journal would have been the best predictor of the characteristics of its readers, if it had been included in the analysis.

For a systematic discussion of the arithmetic properties of "popularity," see William N. McPhee, "Haphazard Exposure and Popular Renown," Public Opinion Quarterly, forthcoming.

Chapter Five

SOME NEGLECTED APPROACHES

The many different approaches, topics and research questions that have been entertained by inquiries into the information-receiving behavior of scientists have been outlined in the preceding chapters. Here and there, as the different kinds of past research efforts were identified and classified according to a systematic framework, gaps became apparent -- approaches that seemed both feasible and promising, yet had actually been little used or -- in some instances -- not at all. The following pages recapitulate these neglected approaches in outline form and add one or two further ones.[1]

1. In general:

a. "Functions to be served" as the starting points of inquiries. -- Research which focusses on functions of the scientific communication system and which asks in what ways each is being met by existing channels of communication, how adequately, and how efficiently (cf. p. 34). This, in turn, calls for efforts -- both theoretical and empirical -- to identify important functions of the system (cf. pp. 30-33). Less exclusive attention to one or two of these functions (cf. p. 31).

b. Interplay of channels; chains of acts; sleeper effects. -- Consideration of the interplay of events -- often distributed over a period of time and involving several communication channels -- which may have been necessary to bring a message to a scientists or to make him appreciate its relevance to his work. Consideration of the possible relevance of a message to a man's work which may not become apparent until some time after the message has been received (cf. pp. 36-37).

c. Messages and acts as units of recording. Combined research strategies -- Research which systematically makes messages the units of recording. In general, more deliberate choice of the units of sampling and recording and use of new combinations of conceptualisation, sampling and data-gathering techniques. The following seem worth exploring: acts as units, weighted before tabulation by their duration in minutes (p. 18); acts and messages as units in interview studies (cf. p. 15); time sampling

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[1]This list has benefited from a preliminary discussion with members and guest of the Documentation Research Panel of the Science Information Council, October 5, 1959.

of events by observation or diary , with subsequent interviewing concerning their antecedents, yield, and/or effects (cf. p. 20).

2. In assessing the effects of information-receiving behavior:

a. Studies of how functions are served, as above.

b. Yield of scanning special categories of channels. -- For example, investigation of the relative yield of scanning journals close to one's field of interest and those peripheral to it, with the thought that such data might suggest ways to facilitate scanning, or to pull together for scientists in a particular field leads to information in peripheral fields.

c. Correlation with achieved level of information. -- Studies of the effect different patterns of exposure have on scientists' knowledge. For example, efforts to identify new items of information that should be of interest to a large number of persons in a given field and then to test their knowledge of the information -- perhaps at successive dates -- or their skills in locating it. Do those who read certain journals know more of the developments of a given field than those who read fewer journals but talk to more colleagues who do? Which group hears of the developments sooner? (cf. p. 37).

d. Correlation with performance. -- Controlled experiments to compare the progress of scientists on identical or comparable research problems, while being randomly assigned to various patterns of access to information sources and services. Correlations of exposure patterns with performance in uncontrolled situations, which have been attempted, face the double difficulty of measuring performance on dissimilar tasks and of controlling statistically other determinants of performance (notably, elements of scientific curiosity) which are themselves correlated with exposure to information (cf. p. 37).

e. True diffusion studies. -- Studies that take individual units of information (messages) and attempt to discover how they percolate through the scientific community (cf. p. 21) -- perhaps by means of measurement of achieved level of information, as above. How long does it take for news of a given discovery to reach researchers in various fields, at various types of institutions, with various communication habits? Do messages that fail to reach significant numbers have any special earmarks? (Publication in obscure journals? lack of informative titles? Special content: procedure, formula, availability of material?) How many scientists are eventually reached by each kind of news, and what are the characteristics of scientists that are missed? (cf. p. 21).

3. In describing information-receiving behavior:

a. Informal and oral communication.-- Systematic inclusion of personal communication among scientists in various settings and of information-receiving which was not planned by the recipient (cf. p. 27).[1] Research on the operation and usefulness of scientific meetings and conferences (cf. pp. 46-47).

b. Patterns of exposure. -- Ascertaining the range of channels to which each scientist is exposed; for example, are heavy journal readers frequent meeting-goers, or are these two different breeds of people? Do those who read few journals make up for it by reading many reviews, or not? (cf. pp. 50, 52-54).

c. Radius of exposure. -- Classification of what is read and attended to by its closeness to the reader's own field of specialization. What is the range, or breadth of horizon, that a scientist scans? How much of his information-gathering is concentrated on his own field (subject dispersal)?

d. Interpersonal complementarity of exposure -- Are scientists who do not read certain journals, or who do not attend certain meetings, in touch with others who do? What is added to each scientist's own reading horizon, for example, by the information-receiving behavior of colleagues with whom he talks -- either informally, or as fellow-members of a research team? Do all team members read the same journals, for example, or is the number of different journals read by the team as a whole substantially greater than that read by any individual?

4. In accounting for information-receiving behavior:

a. Role and contextual determinants. -- Correlation of information-receiving behavior and experiences with the milieu in which the scientist works and the rôles he occupies besides that of researcher. For example, what difference does it make whether he teaches, serves on research grant committees, consults with outside agencies, etc.? Do scientists in certain positions act as relays of information to others? What are the effects on a scientist's information-receiving experiences of geographic isolation from centers of research; being a lone specialist in a given field; presence of good information services in one's organisation? (cf. pp. 45-56).

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[1] On the possibility of planned action to enhance the benefits of personal and "unplanned" communication, see Study 116, pp. 164-172.

b. Nature and phase of research. -- How does information-receiving behavior differ with the nature of the projects worked on? How does it change through time as one moves from one phase of a project to another? (cf. p. 46).

c. Simultaneous consideration of several determinants. -- What is the communication behavior of "pure" scientists in "applied" institutions? How do interests, nature of work, and milieu interact in determining one's communication behavior? Is it primarily a function of one's own enduring characteristics, or of the nature of the current work assignment? (cf. pp. 46-56).

In general, more multivariate correlations and more "analysis in depth."

* * *

This list has enumerated some of the major approaches and considerations that seem to hold promise, yet have been little attended to in the research which has been completed. The list is not intended as a program for future research; nor would it be a well-balanced one, since it does not attempt to recapitulate what is worthwhile in the approaches that <u>have</u> been emphasized to date. It is simply intended to round out the announced purpose of this review: to display the variety of research that has been done and can be done in the flow of information among scientists.

The emphasis throughout has been on general approaches and strategies and on basic methodological issues. A list of more detailed and specific topics for research has already been submitted in another context.[1] Although this review does not constitute a program for further research, it is hoped that it will be found useful in formulating one. Such a program must take into account not only the views of other communication researchers, but especially the views of those specialists who will be ultimate users of any research in this field: operators and policy makers of the scientific

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[1] Study 116. See especially the pages printed on blue paper, and Chapter IV.

communication system. This prominently includes scientific editors, documentalists, information specialists, and experts in special library work. But it also includes science educators, officers of scientific bodies and institutes, and others; for there is good reason to assume that the implications of research in scientific information-flow will extend beyond the handling and processing of written documents; there may well be call for action concerning conferences, work schedules, professional duties, educational policies, location of institutes, and other matters.[1]

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[1]See footnote 1, p. 57.

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102		Bernal, J. D., "Preliminary Analysis of Pilot Questionnaire on the Use of Scientific Literature," The Royal Society Scientific Information Conference, 1948. pp. 589-637.
103		Cole, P. F., "The Analysis of Reference Question Records as a Guide to the Information Requirements of Scientists," J. of Documentation, 1958, 14, 197-207.
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REVIEW OF STUDIES IN

THE FLOW OF INFORMATION AMONG SCIENTISTS

Volume II: Tables

Prepared for the

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BUREAU OF APPLIED SOCIAL RESEARCH

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BUREAU OF APPLIED SOCIAL RESEARCH
Columbia University

Bernard Berelson, Director
David L. Sills, Director of Research

<u>Review of Science Information Studies</u>

Herbert Menzel, Study Director
Louis Lieberman, Research Assistant
Joan Dulchin, Research Assistant

CONTENT

Notation and Symbols used in Tables

Important qualifications in companion volume. These tables are intended for reading in conjunction with a companion volume of text, which contains important caveats regarding the interpretation of the data here reproduced, often in abbreviated form. The companion volume also explains the organization of the data and some of the terms used here, lists complete citations to the original documents, and discusses their methodologies.

Figures in any one table not fully comparable. Each table juxtaposes data from many studies which bear on any one subject. Because studies differ from one another in populations, definitions of terms, and many other methodological points (see text volume), the figures placed side by side in any one table here are not fully comparable. A conscientious effort is made to record the crucial matters in the captions, supplemented by footnotes. Nevertheless, full justice could not always be done to the operations underlying each datum.

"Additional data." Footnotes grouped together under this heading reproduce or cite data pertinent to a given table which could not be accommodated in the body of the table.

Information in column headings. In each table, a legend -- usually, a column heading -- precedes the data from each study. It contains the following information, reading from the top:

(1) A code number identifying each study, and referring to the bibliography in the companion volume; followed by the page number of the original document from which the data are taken. (When material from many different pages is included in one column, page numbers appear where appropriate.)
(2) Authors' names; year of publication, if more than one study by the same authors is included in this review.
(3) A concise definition of the population included in the study.
(4) Explanation of the data reproduced, showing units of observation and measurement, bases of computation, etc., as far as possible. Data gathered by direct observation, self-observation, withdrawal records, and records of inquiries will be easily recognized by the wording of this explanation. The words "diary" or "diarist" appear in the legends to all data coming from diary records. All other data originated either in self-administered questionnaires, or in personal interviews; for a distinction of these two, see bibliography.
(5) If applicable: designation of sub-categories of population or events

Footnotes. Footnotes are symbolized in four different ways and grouped accordingly for the reader's convenience:

(1) Small letters starting with "a" denote elaborations of matter generally included in column headings, especially as described in Item (4) above.
(2) Capital letters from the early part of the alphabet denote additional data (other than minor subdivisions of row categories).
(3) Small letters starting with "z" denote elaborations or qualifications of row headings.
(4) Capital letters from the late part of the alphabet stand for other notes.

Capital and small versions of the same letter (for example, m and M) are never used in the same table.

Empty cells. There are frequent instances of categories (rows) for which figures are not given by all the studies represented in a table. In the interest of clarity, the following convention is followed:

(1) A blank space or dash --- indicates an absence of data for a given category, which in no way affects the data given for other categories in the same column.
(2) A tripple XXX indicates that the cases which would fall into the given category have been omitted from the tabulation, including totals, bases for percentaging, etc.
(3) A triple dot ... indicates that the cases which would fall into the given category (according to definitions used in other columns) have been assigned to other categories in the same column.
(4) An actual report of "zero" is always indicated by the digit, 0, never by a blank space or other symbol.

When the distinction between the last two classes is in doubt, the triple dot is used. This is the case in a few of the instances where categories were constructed by investigators from replies to "open-ended" questions.

Cross-references. Page numbers refer to original documents. Table numbers refer to this review.

TABLE E-1 -- Exposure to all channels combined. Exposure to written and oral channels compared.

		101; pp. 24, 30 Ackoff & Halbert Chemists in universities or industrial organizations with 5 or more chemists in 150 US metropolitan areas	
		Type of Organization[EF]	
		Universities[b] (1)	Industrial organizations[b] (2)
1.	Hours per week spent in scientific communication (both in and out of work-area and working day)	--	16.5 hours
	Percent of chemist-moments in work-area during working day which were devoted to:		
2.	Scientific communication	23.5%	32.0%[c]
3.	Receiving oral scientific communication (listening)[z]	7.6%	13.7%
4.	Receiving written scientific communication (reading)[y]	4.3%	9.3%
5.	Receiving scientific communication[x]	11.9%	23.0%

Notes about column headings

[a] "A communicative act. . . is defined as any reported verbal or written transfer of information, where information. . . is used in a broad sense to include any kind of message.. . . Each group member reported his contacts and other activities for approximately 30 fifteen-minute intervals randomly selected over a five-week period."

[b]The figures for industrial organizations "represent our adjusted estimates based upon data obtained from both surveys" (p. 25), i.e., from a 1957 survey with the aid of observers, and a 1958 survey based on self-observation among a sub-sample. The manner of adjustment is not specified. The figures for universities are based on the observer figures only and are "unadjusted." (Cf. figures for "scientific communication--in-time" on pp. 24, 26, and 30.)

[c]The corresponding "unadjusted" figure is 26.7%. (p. 26).

Additional data

[D]Figures also given by field of research (121, p. 38; 110, p. 230).

[E]Corresponding figures for "sending oral," "sending written," and selected other categories are given on p. 30.

[F]Correlations of the time allocation of chemists with characteristics of the companies that employ them are shown on pp. 53-57. E.g., more time is given over to scientific communication in petroleum than in pharmaceutical companies; unpublished material occupies more time in companies engaged in applied research than in those engaged in basic research; where chemists are surrounded by more non-chemical scientists, the chemists devote less of their time to scientific communication in general and to group discussion in particular, but more to reading published material.

[G]Also given separately for Earth Sciences, Mathematics, Physics, Chemistry, Biology, Engineering, Medicine (pp. 230-231).

TABLE E-1 (Continued)

		112, pp.73-4, 91-2 Hertz & Rubenstein Professional researchers in 9 industrial research and development teams Average number of communicative acts (scientific and other) per 15-minute period[a]	121, p. 37 Tornudd, 1958 Danish-Finnish junior research workers Median respondent's estimate of the importance, to him, of professional literature (as opposed to conversations, correspondence, meetings, courses, and study tours)[D]		110, pp.230-231 Herner, 1954 Professional members of scientific divisions of Johns Hopkins University. (50% had doctoral degrees) Median respondent's estimated "percentage of use of scientific literature" (as opposed to conversations and conferences)[DG]
		(3)	(4) Danish	(5) Finnish	(6)
1.	All respondents		75-80%	75-80%	60%
	Type of institution:				
2.	Academic		80-85%	85-90%	50%[w]
3.	Research		75-80%	70-75%	80%[v]
4.	Industrial		70-75%	75-80%	--
	Respondent's work:				
5.	Pure research				75%
6.	Both				60%
7.	Applied research				50%
	Rank:				
8.	Supervisors	.85			
9.	Professionals	.68			
10.	Assistants	.63			
	Size of Team:				
11.	2-4 members	.35			
12.	6-8 members	.91			
13.	9-11 members	.63			
	Tasks assigned to team:				
14.	Many short-run problems assigned individually	.68			
15.	Few long-term problems assigned to group as whole	.71			

Notes about row headings

[z]Consists of the categories "receiving, oral," and "general discussion," the latter accounting for about two-thirds of each figure. The statement (Study 101, p.64) that "the industrial chemist spends almost twice as much time at work with recorded information as with oral" is contradicted by the figures given on p. 30, unless "general discussion" is ommitted.

[y]Consists of the categories "receiving, written" and "reading for retransmittal."

[x]Consists of the sum of the two preceding lines, and is equal to the category "scientific communication" minus the sum of the categories "sending, oral" and "sending, written."

[w]Engineers in the School of Engineering (predominantly a teaching institution).

[v]Engineers in the Applied Physics Laboratory (full-time missile development).

TABLE E-2 -- Reading Time per week.

	From observations at random moments	From time recorded for each reading act in a diary		From retrospective estimate on self-administered questionnaire[D]	
	101, p. 30 Ackoff & Halbert	120 Shaw			
	Chemists in universities or industrial organizations with 5 or more chemists in 150 US metropolitan areas	Scientists and engineers on research staff of US Forest Products Laboratory (GS 5 to GS 14)			
	Percent of chemist-moments in work-area during working day which were devoted to reading[bc]	Average hours per week devoted to reading acts [Ea] (Diary)		Average "time spent per week on library materials" (Questionnaire)	
		Study 1[G] p. 28	Study 2[G] p.49,36	Study 1[H] p. 14	Study 2[H] p. 36
	(1)	(2)	(3)	(4)	(5)
1. All respondents	--	1.9U	1.6U	4-5[W]	3-4
Type of institution:					
2. University	4.3%	--	--	--	--
3. Industrial	9.3%	--	--	--	--
Rank of scientist:[z]					
4. High			3-4	7-8	7-8
5. Medium high			1-2	5-6	3-4
6. Medium low			1-2	3-4	3-4
7. Low			less than 1	1-2	3-4

Notes about column headings

[a] Instructions specified that "very brief references to working tools (say 1 minute or less) need not be recorded."

[b]With respect to "working day" or "in-time," Study 101 states (pp. 14, 30): "Relative to this method of observation, the work week of the chemist consists of 27.5 hours, five days of five and one-half hours each." The reviewer assumes that this constitutes a definition of the hours during which observations were made, not an empirical description of the time chemists spend in their work area. Since the latter is not indicated, presentation of the above percent figures seems preferable to conversion into hours.

[c]"Reading" here is made up of the categories shown in Study 101, p. 30, as "reading for retransmittal," plus "receiving, written."

Additional data

[D]Study 115, (Maizell--research chemists of a large chemical company) had supervisors rate chemists as "high," "middle," and "low" in creativity. 56%, 20%, and 19% respectively, stated that they spent more than five "hours per week on the job. . .reading and consulting the technical or scientific literature (other than reports and correspondence)." 77%, 61%, and 63%, respectively, stated that they spent more than 2 hours per week at home in similar activity. Creativity rating and having a Ph.D. made independent contributions to these differences. (Questionnaire--pp. 45, 48, 66).

[E]Also given separately for routed and non-routed material and by respondent's discipline.

[F]Also given separately for researchers engaged, according to their own account, in pure science (5.9 hours), in applied science (4.8 hours), and in both (6.6 hours). Instructions read: "Pure science stops before any aspect of production."

Table E-2 (Continued)

	From retrospective estimate on self-administered questionnaire[D]	
	102, p. 636 Bernal	121, p. 8 Tornudd, 1953
	Scientists at Cambridge University and various British research organizations	Scientists at the Mellon Institute[V]
	Average "estimate of the time spent per week on 'the literature.'"	Average number of hours per week reading or consulting material in the library
	(6)	(7)
1.	5.3	5.2[F]
2.	5.6[y]	
3.	5.1[x]	
4.	5.1	
5.	5.7	
6.	4.3	
7.	4.9	

Additional data

[G]Also given separately for Chemistry, Engineering, Bot. Science and Physics, (pp. 28, 49, 36.).

[H]Also given separately for Chemistry, Engineering, Bot. Science and Physics, (pp. 14, 36 Percentages to be computed).

Notes about row headings

[z]The four ranks, reading from highest to lowest, are:--for Study 120; GS14, GS 12 and 13; GS 9 and 11; GS 5. (Figures for GS 7 are omitted here.) For Study 102 the four ranks are: professors and directors; lecturers and assistant directors; senior research workers; junior research workers.

[y]Consists of "Cambridge," "Medical Research Council," and "Rothamsted."

[x]Consists of "Department of Scientific and Industrial Research," and "Industrial Research Laboratories."

[w]Weighted average for the several ranks computed by the reviewers.

Other notes

[V]Excludes technicians. "The primary field is chemistry and chemical technology. . . the preparatory stage of each fellowship includes a critical study of the literature."

[U]Computed by the reviewers by dividing total minutes per 2-month and 1-month diary period by 60 times the number of diarists (105 and 101) times the number of weeks (assuming 1 month equals 4.33 weeks).

TABLE E-3--Reading acts per week

	120, pp. 5, 55 Shaw: Scientists and engineers on research staff of US Forest Products Lab (GS 5 to 14) — Average number of reading acts per diarist per week[VD]		114, pp. 25-27 Hogg & Smith: Scientists and technologists in R&D branch of UK Atomic Energy authority[U] — Average number of acts of reading in specified kinds of literature, per diarist per week[a]	
	Study 1	Study 2	not including abstracts	including abstracts
	(1)	(2)	(3)	(4)
1. All respondents	5.8	4.8	7.2	7.7
Rank of Scientist:[y]				
2. High	--	--	...	...
3. Medium high	--	--	19.5	20.7
4. Medium low	--	--	7.8	8.2
5. Low	--	--	6.2	6.6
Scientist's work:				
6. Pure research	--	--	--	--
7. Applied research	--	--	--	--
Institution devoted mainly to:				
8. Pure research[x]	--	--	--	--
9. Applied research[w]	--	--	--	--

Notes about column headings

[a]Diarists kept records of reading four kinds of literature on as many forms: "Abstract journals, etc.;" "Periodicals (journals, review journals, proceedings, transactions of societies), etc.;" "Reports etc. and Committee Papers (not minutes);" and "Textbooks, Symposia, and Annual Reviews." Diarists were instructed to "confine your record to the kinds of literature shown;. . . we have omitted data tables and handbooks, dictionaries, patents, standards, etc."

[b]Figures in Column (6) are based on Diary Form A, intended for "current issues of journals and abstracts looked through to see whether they contain anything of interest, and individual papers read in detail." Figures in Column (7) are based on Diary Form B, intended for "back or current numbers of journals, or reprints, consulted with a specific purpose in view."

Additional data

[C]Also given separately for physicists, engineers, chemists, biochemists, and biologists.

[D]Also given separately for Chemistry, Engineering, Bot. Science and Physics (pp. 5, 55 Percentages to be computed).

TABLE E-4--Time per reading act

Scientist's present field of work	Was publication devoted to a subject identical to scientist's present field of work?[z]	120[a] Shaw — Scientists and engineers on research staff of US Forest Products Laboratory (GS 5 to 14) — Average number of minutes recorded for each reading act in a diary — Was material spontaneously routed to the respondent by the library? — Routed: Study 1 (1)	Routed: Study 2 (2)	Non-routed: Study 1 (3)	Non-routed: Study 2 (4)	Total: Study 1 (5)	Total: Study 2 (6)
1. All reading acts (pp. 28,49)		12.2	12.0	41.3	37.2	21.0	20.2
		(pp. 29-30)	(pp. 50-51)	(pp. 31-32)	(pp. 52-53)		(pp. 40-41)
2. Chemistry	own field	14.3	15.5	49.7	42.1	--	26.2
	all fields	12.1	12.1	55.8	35.7	--	19.6
3. Engineering	own field	8.9	6.6	47.4	33.7	--	19.6
	all fields	12.0	11.4	38.9	41.9	--	19.9
4. Botany	own field	24.6	33.5	29.8	28.3	--	29.6
	all fields	12.4	12.8	34.0	34.1	--	21.0

Notes about column headings

[a]Instructions specified that "very brief references to working tools (say 1 minute or less) need not be recorded."

Notes about row headings

[z]Publications (not specific articles or chapters) were classified as to subject according to "a modification of the U.S. Department of Agriculture system." In Study 1, twenty-two subject classes were used, including the three shown above; in Study 2, twenty-four.

Other notes

[y]Separate figures for physicists are omitted here, as only two physicists participated.

TABLE E-5 --Exposure and non-exposure to each channel type[J]

	122, p. 42 Tornudd '58 Danish-Finnish junior research workers	119 Scott & Wilkins Technical grades from foreman upwards in British electrical or electronics industry[C]			
	% "using"	% "remembering useful information obtained from" each of 19 listed channel types (p. 60)[K]		% "seeing regularly," "making use of" or "attending"	
	(1)	(2)		(3)	
Channel Type:					
1. Journals	99%	63%[s],	39%[v]	90%[a]	(p. 13)
2. Books	97%	72%[w],	62%[v]	--	
3. Abstracts	83%[u]	33%		31%[b]	(p. 34)
4. Reviews	63%	35%		--	
5. Unpublished reports	61%	--		--	
6. Meetings	--	...		40%[c]	(p. 37)
7. Conferences or lectures	--	32%[s],	52%[r]	39%[d]	(p. 38)

Notes about column headings

[a]List any "journals.../of/which you see nearly every issue."

[b]"Make use of abstracts" (But only 21% were able to name an abstracting periodical used "in the past quarter year.")

[c]"Attend any technical or scientific society meetings."

[d]"attend" at least one "external conference or course in a year."

[e]check any journals /listed/ " which you regularly scan."

[f]"regularly scan any periodic abstracts, bibliographies, indices, or reading lists."

[g]"regularly scan any annual review volumes."

[h]List any "scientific meetings and conferences attended during the last 12 months."

[i]List any seminars, colloquia, etc., which they "attend in the University" at least once weekly during the academic year.

Additional data

[J]See also Table E-7 for figures from Study 111 (Herner 1954), which can only be given for three categories of scientists separately.

[K]Corresponding figures are also given for eleven additional channel types.

[LL]Also given separately for Biochemists, Chemists, and Zoologists

TABLE [illegible] -- (Continued)

	112, p. 4980 Herner & Myatt '54 Scientists and engineers at one company engaged in rocket fuel research % using in past year (4)		116, pp.142, 147, 159 Menzel Biochemists, Chemists and Zoologists on Columbia U. Faculty % scanning, reading, or attending regularly[LL] (5)		Diverse other studies See footnotes N - I See footnotes N - I (6)
1.	67%[x]		100%[e]		--
2.	96%[w],	85%[v]	--		--
3.	69%[u]		65%[dq]	(p. 147)	88-98%[N], 87%[M], 32%[L]
4.	25%		75%[g]	(p. 142)	76%[M]
5.	85%		--		--
6.	--		80%[ph]	(p. 159)	55-67%[K], 26%[J]
7.	--		85%[i]	(p. 28)	16%[I]

<u>Notes about row headings</u>

[z]Trade Journals

[y]Learned Society Journals

[x]Research Journals, 79% used technical news, or house or trade publications.

[w]Reference Books, Handbooks

[v]Text or Instruction Books, or Monographs

[u]Abstracts and Indices

[t]Annual Review Volumes

[s]Conferences

[r]Lectures

[q]75% also regularly read abstracts of papers given at certain meetings when they cannot attend them.

[p]80% had attended society meetings during the past 12 months; 55% had attended conferences; 87% had attended one or the other or both (p. 159).

<u>Other notes</u>

[O]Only 43% were engaged in "research, development, or design, with or without other duties." Another 40% were engaged in "production, supervision or inspection." Only 39% had any university degree or "technical qualification."

[N]107--Glass, p. 6, 1955--per cent of several samples of American biologists "making any use whatsoever of abstracts of the biological literature"--(questionnaire).

[M]102--Bernal, p. 636--"Do you read abstracts?" "Do you make use of reviews?" (Scientists at Cambridge University and at various British research organizations--Questionnaire).

[L]114--Hogg and Smith, p. 26--diary indication that at least one abstract in a 2-month period was consulted (scientists and technologists in R&D branch of U.K. Atomic Energy Authority.)

[K]111--Herner, 1954, p. 234--55% of applied scientists and 67% or pure scientists "regularly attended" (Professional members of scientific divisions of Johns Hopkins University; 50% had doctoral degrees--Interview).

[J]118--Scates and Yeomans, p. 3--"engaged in...meetings of professional societies... during this past year." (Scientists and Engineers at Philadelphia Naval shipyard; only 41% had college degrees.--Questionnaire.)

[I]118--Scates and Yeomans, p. 3--"engaged in...lectures...past year. (See Note J.)

TABLE E-6--Acts or time units devoted to each channel type[EF]

	114, p. 25[a] Hogg and Smith	105, p. 158[b] Fishenden
	Scientists and technologists in R&D branch of U.K. Atomic Energy Authority[P]	Scientists in "honor graduate" grades at Atomic Energy Research Est., Harwell
	Average number of reading acts per diarist in 14-day period	Per cent of "useful items of information" obtained in 2-month diary period from each channel type
	(1)	(2)
Channel type:		
1. Journals	5.2[z]	50%
2. Books	4.0[y]	9
3. Abstracts	.9	XXX
4. Reviews	XXX	4
5. Unpublished reports	5.3	37
6. Other literature	XXX	XXX
		100%

Notes about column headings

[a]114 called for entries only for the reading of "abstract journals, etc.," "periodicals" "reports, etc. and committee papers," and "textbooks, symposia, and annual reviews." Reading of other matter, such as "handbooks, patents, standards, etc." was to be omitted. In 114, the figure given for abstracts refers to the average number of times abstracts were consulted in the 14-day period. The figures given for journals, books, and reports refer to the number of titles or issues; an issue of a journal which was read twice during the 14-day period, for example, would be counted only once. However, the number of different articles read (5.2) is not much larger than that of different journal issues read (4.0).

[b]105 called for an entry for each different "report," "published paper," "review," or "book." (For abstracts or other locating media, see Tables F-20 and F-21.)

[c]120 instructed diarists to fill out a card each "time" literature was used, but allowed a single card for publications used intermittently. 120 and 101 called for citations to all items read; categorization was performed by the investigators into 30 channel types (120) and 7 channel types (101).

[d]The distribution of reading time over the channel types shown is taken from the "unadjusted" figures of the 1957 survey. For the second column, the figures were changed by the reviewers so as to total 40 per cent, since reading time constitutes 40% (9.3 divided by 23.0) of scientific communication receiving time according to "adjusted estimates," the remainder being made up of "receiving, oral" (16%) and "general discussion" (44%). Cf. Table E-1, including fn. b.

[e]Instructions in Study 119 called for a response only for one "article," but the items actually named were categorized by the investigators into 8 channel types.

TABLE E-6 --(Continued)

	119, p. 27[e] Scott & Wilkins		120, pp. 17, 38[c] Shaw		101, p.37[c] Ackoff & Halbert	
	Technical grades from foreman upwards in British electrical or electronics industry[N]		Scientists and engineers on research staff of US Forest Products Lab (GS 5 to GS 14)		Chemists in industrial organizations with 5 or more chemists in 150 US metropolitan areas	
	Per cent interviewees for whom "most recent article of direct use or special interest" appeared in each channel type		Per cent of reading acts devoted to each channel type[H]		Industrial "chemist-moments" devoted to each channel type	
	% of those recalling an article[O]	% of total[O]	Study 1 2-month diary period	Study 2 1-month diary period	as per cent of reading time in work area during working day[d]	as % of all Sci. commun. rec. time in work area during working day[d]
	(3)	(4)	(5)	(6)	(7)	(8)
1.	73%	52%	68%[w]	60%[v]	47%	19%
2.	4	3	9	14	16[t]	6[t]
3.	1	1	5	7	10[s]	4[s]
4.	...	...	...	...	...	...
5.	0	0	12[u]	17[u]	15[r]	6[r]
6.	22[x]	15[x]	5	2	13[q]	5[q]
	100%	71%[O]	100%	100%	100%	40%[d]

Additional data

[F]Study 116 (Menzel), p. 159, reports that biochemists, chemists, and zoologists on the Columbia University faculty attended a median of 1.36 society meetings, 0.78 conferences, and 2.16 meetings and conferences combined during the 12 months preceding an interview. Figures are also given separately for each discipline.

[G]Study 121 (Tornudd 1953) reports scientists indicating an average of 2.9 hours per week "reading journals and other primary material in the library" and 2.3 hours "consulting reference material in the library". The corresponding figures for those engaged in "pure science" are 2.7 and 3.2 hours; for those in "applied science," 2.8 and 2.0 hours; for those engaged in "both," 4.2 and 2.4 hours. (Self-administered questionnaire; scientists at Mellon Institute, See fn. V, Table E-2.)

[H]Also given separately for Chemistry, Engineering, Bot. Science and Physics.

Notes about row headings

[z]includes review journals, proceedings, transactions.

[y]exclusive of handbooks, dictionaries, data tables, etc.

[x]one-half of "other" literature consisted of advertisements.

[w]28% research journals, 37% trade journals, 3% house organs and general magazines.

[v]27% research journals, 31% trade journals, 2% house organs and general magazines.

[u]includes bulletins of government agencies and other research laboratories.

[t]excludes handbooks.

[s]abstracts and summaries.

[r]bulletins, pamphlets, and proceedings.

[q]handbooks, tables, patents, and miscellaneous.

Other notes

[P]62% had university degrees.

[O]29% of respondents could not recall any "recent article of direct use or special interest."

[N]see fn. O, Table E-5.

TABLE E-7--Exposure to channel types, by characteristics of scientists and their institutions[CED]

	105, p. 163-64[b] Fishenden				119, p. 60[FG] Scott & Wilkins		
	Scientists in honors graduate grades at Atomic Energy Research Establishment, Harwell				Technical grades from foreman upwards, in British electrical or electronics in industry[F]		
	Per cent of useful items of information obtained in 2-month diary period from each channel type by:				% "remembering useful information obtained from each of 19 listed channel types, among those engaged in:		
Channel type:	Sr. (1)	Jr. (2)	Pure Research Worker (3)	Applied Research Worker (4)	Management (5)	Research (6)	Production Supervision (7)
1. Journals	48%[w]	51%[w]	73%[w]	43%[w]	69%[v], 39%[u]	63%[v], 25%[u]	62%[v] 52%[u]
2. Books	10	9	11	8	69%[t], 64%[s]	63%[t], 53%[s]	82%[t] 7[illegible]%[s]
3. Abstracts	XXX	XXX	XXX	XXX	42% (24%)[s]	19% (28%)[s]	46%(13%)
4. Reviews	3	4	6	3	39%[r]	29%[r]	40%[r]
5. Unpublished reports	38	36	11	46	-	-	-
6. Lectures	XXX	XXX	XXX	XXX	59%	47%	56%
7. Conferences	XXX	XXX	XXX	XXX	44%[y]	30%[y]	30%[y]
	100%	100%	100%	100%			

Notes about column headings

[a]Figures shown are for those who replied that they used the channel types indicated either "frequently" or "occasionally." Study 122 (p. 42) also gives corresponding figures for "frequently" only; it also gives figures for the use of "patents and specifications."

[b]Entries were called for under the four channel types shown only.

Additional data

[C]Breakdowns by discipline are not reproduced in this review, but are cited in fn. LL, Table E-5, and fn. H, Table E-6.

[D]See Table E-5, fn. K, re meeting attendance by pure and applied scientists.

[E]Study 118, p. 3, finds the per cent who attended professional society meeting during the past year rising with years of education. (Scientists and engineers at Philadelphia Naval Shipyard--Questionnaire.)

[F]Study 119, (p. 60) gives corresponding figures for eleven other channel types in addition to those shown.

[G]Because figures in Study 111 are given only as per cent of nominations and not as per cent of respondents, they cannot be directly compared with those cited above from other studies, except in terms of rank order. In addition, more of the self-designated "pure" than "applied" scientists stated that they "used" each of the 15 "direct sources of [written] information," except: trade publications, classified research reports, patents, and standards (Fig. 1, p. 231). Also, of the engineers in the teaching environment of the School of Engineering more "used" monographs and journals than any other listed type of literature; of the engineers in the Applied Physics Laboratory (missile development), more "used" handbooks and classified research reports than monographs or journals.

TABLE E-7 -- (Continued)

	122, p. 42[a] Tornudd 1958						111, p. 231[q] Herner 1954		
	Danish-Finnish junior research workers % "using" each channel type, among those employed at:						Professional members of scientific divisions of Johns Hopkins University. Rank-order of the number of respondents indicating that they "use" each of 15 listed types of "direct" publications (excluding abstracts and indexes). Presently working in:		
	Danish Institutions			Finnish Institutions					
	Academic (8)	Research (9)	Industrial (10)	Academic (11)	Research (12)	Industrial (13)	Pure Science (14)	Applied Science (15)	Both simultaneously (16)
1.	96%	97%	100%	100%	100%	100%	1-2	2-4	2-3
2.	85%	93%	97%	100%	100%	100%	1-2[q]	1[q]	1[q]
3.	85%[r]	72%[r]	79%[r]	89%[r]	85%[r]	87%[r]	XXX	XXX	XXX
4.	56%	72%	68%	69%	64%	56%	4-5	10-12	6-8
5.	48%	69%	53%	63%	68%	66%	6-9	2-4	5
6.	--	--	--	--	---	--	XXX	XXX	XXX
7.	--	--	--	--	--	--	XXX	XXX	XXX

Notes about row headings

[z]Percentages in parentheses denote respondents who were able to name an abstracting periodical used in the past quarter year (p. 34).

[y]Approximately 47% each of managers and researchers, and 29% of production supervisors, stated that they "attended technical or scientific society meetings." The same was true for 62% of those with and 25% of those without university degrees or technical qualifications. (p. 37)
42% of managers and researchers and 31% of production supervisors attended "external conferences or courses." The same was true for 44% of those with and 32% of those without university degrees or technical qualifications, and for 54% of those under 25 years of age, 28% of those over 55, and approximately 38% of the intermediate age group (pp. 38-39).

[x]published papers

[w]Articles in Trade Journals

[v]Learned Society Journals

[u]Reference Books

[t]Text or instruction Books

[s]Summary Publications

[r]Abstracts and indices

[q]Figures given are for "advanced textbooks and monographs." "Handbooks" take third rank among the pure researchers; they are tied for 2nd-4th rank among the applied workers and for 2nd-3rd rank among those engaged in both kinds of work. "Mathematical and physical tables" are tied for 4th-5th rank among the pure researchers; they occupy 5th rank among the applied researchers and 4th rank among those doing both.

Other notes

[p]Only 43% were engaged in "research, development or design, with or without other duties." Another 40% were engaged in "production supervision or inspection." Only 39% had any university degree or "technical qualification".

TABLE E-8--Country of Origin and Language of the Literature Read[AB]

Study / Population	Question	U.S.A.	U. K.	Other Foreign	Total Foreign
		Where Published			
114, p. 22 Hogg & Smith Scientists and technologists in R&D branch of U.K. Atomic Energy Authority	Q. 60--Would you say about what percentage of your research information is obtained from British as against foreign periodicals?	...	57%	...	42%
105, p. 159 Fishenden Scientists in "honor graduate" grades at Atomic Energy Research Est., Harwell	Percentage of diary keepers in 3-month period making use of foreign literature				30%
125, p. 4[T] Wilson Users of the Royal Aircraft Establishment Library	Per cent of periodical withdrawals during one year.	32%	45%	24%	56%
123, p. 416 Urquhart 1948 Users of the Science Museum Library	Per cent of withdrawals during 2-week period	50%[Z]	25%	25%	75%
111, p. 232 Herner 1954 Professional members of scientific divisions of Johns Hopkins University	Q. III d.--estimate the percentage of domestic and foreign periodicals consulted (interview)				
	Pure Research Workers	70%	...	...	30%
	Applied Res. Workers	90%	...	...	10%
102, p. 634 Bernal Scientists at Cambridge University and various British Research Organizations.	Per cent of journals and articles read during diary period (name of journals)[C]				
	Per cent of journals	...	36%[V]	...	65%
	Per cent of articles	...	41%[V]	...	59%
116, p. 153 Menzel Biochemists, chemists and zoologists on Columbia University faculty	Per cent of journals regularly scanned[X] Discipline:				
	Biochemists	68%	26%[W]	6%[U]	32%
	Chemists	63%	23%[W]	14%[U]	37%
	Zoologists	71%	19%[W]	10%[U]	29%
	All	68%	22%[W]	10%[U]	32%

TABLE E-8 --(Continued)

		Language of Publication			
		English	German	French	Other
125, p. 5[T] Wilson — Users of the Royal Aircraft Establishment Library	Percentage of library slips for each language	82%	8%	5%	5%
120, pp. 2?, 42 Shaw — Scientists and engineers on research staff of US Forest Products Lab (GS 5 to GS 14)	Per cent of total and of foreign publications used by diary keepers				
First Study	% of Total	95%	--	--	--
	% of Foreign	XXX	58%	9%	33%
Second Study	% of Total	98%	--	--	--
	% of Foreign	XXX	52%	21%	27%

Additional data

[A]According to Study 110, (Herner 1958), 30% of medical scientists interviewed at 59 U.S. research organizations chosen as "most likely to have facilities for Soviet information," stated they had read some technical literature in foreign languages in the past six months (110 B, p. 2) Slightly less than half had sought or made use of Soviet information (p. 3). 12% (58 of 500) saw at least one Soviet journal regularly or occassionally, including 2% who did so in translation (p. 4). More on circumstances surrounding the use of Soviet and other foreign literature will be found in Study 110 B.

[B]Records of language skills or translating facilities available are not reproduced here.

[C]Also given separately for Mathematics and Physics, Engineering, Chemistry, Geology, Botany and Agriculture, Zoology and Animal Husbandry, Medicine-Physiology-Bio-chemistry, p. 624.

Notes about row headings

[z]Figure for all North America.

[y]Including Commonwealth nations.

[x]Checked or added in reply to: Q. 8.11--Here is a list of scientific journals. Please check the journals which you regularly scan... Are there any others?

[w]Non-U.S. English-language journals.

[u]Foreign-language journals.

Other notes

[T]Percentages computed by the reviewers.

TABLE E-9--Age of publications read or scanned.

123, p. 412 Urquhart '48 — Users of the Science Museum Library — Per cent of withdrawals involving items published in years shown (1)	
1947[Y]	27%
1946	7
1941-5	21
1931-40	33
1921-30	7
up to 1920	5
	100%

124, p. 278 Urquhart '58 — Users of the Science Museum Library — Per cent of serial publications issued which had been published in years shown.[Z] (2)	
1955-56	28%
1950-1954	28
1940-1949	21
1930-1939	14
1920-1929	5
1910-1919	1
1900-1909	1
1857-1899	1
	100%

120, p. 21, 43 Shaw — Scientists and engineers on research staff of US Forest Products Lab. (GS 5 to GS 14) — Per cent of reading acts devoted to publications of ages shown (Diary)	Study 1 (3)	Study 2 (4)
1 month	51%	53%
2 mos.-1 yr.	3	26
2 years	3	3
3-5 years	55	6
6-10 years	3	3
11-20 years	4	3
21 or more yrs.	2	2
no response	—	4
	100%	100%

125, p. 3 Wilson — Users of the Royal Aircraft Establishment Library — Per cent of periodicals withdrawn during one year which were published in years shown (5)	
1956	26%
1952-56	65%
1947-51	17
1942-46	7
1937-41	5
1936 or earlier	5
	100%

[Z] Percentages computed by the reviewers.

[Y] Not all 1947 issues had been tabulated at the time of the survey.

TABLE E-10--Other characteristics of the Journals read[CD]

	119 Scott & Wilkins Technical grades from foreman upwards, in British electrical or electronics industry [Y] Percent of respondents who had "read or scanned at least one article during the past year" in the average journal falling into each category (among 98 journals listed on a show card)[a]	
	All respondents (p. 16)	Those engaged in research only (p. 22)
	(1)	(2)
Journal Categories[zF]		
Relevancy to electrical or electronics engineering:		
Strictly relevant	10%	13%
Borderline	6%	7%
Can be understood:		
Only by degree specialist	5%	8%
By specialist without degree	10%	12%
Without previous knowledge of subject	8%	8%
Contains reports of fundamental work:		
Yes	5%	9%
No	9%	10%
Contains reports of applied work or developments:		
Yes	9%	11%
No	7%	8%

Notes about column headings

[a]Since frequency or amount of reading in each journal is not taken into account, the percentages and coefficients are indicative of the dispersion of the use of a journal over different readers, rather than of the amount of use that is made of it.

[b]Signs presumably added to coefficients by inspection. Each listed coefficient is based on a contingency table in which rows represent journal categories and columns represent reader categories. Each cell entry shows the number of respondents who claimed to have "read or scanned at least one article during the past year" in the average journal falling into each category (i.e., the number of "mentions" divided by the number of journals in the journal-category). The contingency tables are reproduced on p. 83 in percentaged form (i.e., with each cell entry divided by the number of respondents in the given respondent-category).

TABLE E-10--(Continued)

119 Scott & Wilkins			
Technical grades from foreman upwards, in British electrical or electronics industry[Y]			
Contingency coefficient showing association between journal characteristics shown at left, and the following characteristics of respondents who had "read or scanned at least one article during the past year" in the average journal falling into each category (p. 20)[abE]			
Having University degree or technical qualification	Number of journals in which "read or scanned at least one article during the past year"	Making use of abstracts	Working on a problem at the moment
(3)	(4)	(5)	(6)
-.070	-.113	-.151	-.082
.140	.208	.172	.096
.195	.261	.258	.137
.015	-.031	-.041	-.020

Additional data

[C]Exposure tabulations employing classifications of journals by discipline are not considered here. If related to the discipline of the reader, they are summarized in Table 9.

[D]See also Table E-5, fn. x (112); Table E-6, fn. w and v (120).

[E]Respondent characteristics are explained on p. 18. These tabulations are also reported for the following additional respondent characteristics: "Refers to literature as first step" (cf. Table F-10 of this review); "Attends meetings;" "Has experienced role of chance."

[F]These tabulations are also reported for the following additional journal characteristics: Number of issues per year; number of pages not exclusively devoted to advertising; number of pages exclusively devoted to advertising; inclusion of review articles, abstracts, or book reviews; inclusion of notes on new equipment; inclusion of new appointments etc.; inclusion of advertisements of appointments vacant.

Notes about row headings

[z]The 98 journals listed on the show card were classified by "a librarian with special experience of technical and scientific literature," using such criteria as applicable U.D.C. numbers where possible.

Other notes

[Y]Only 43% were engaged in "research, development or design, with or without other duties." Another 40% were engaged in "production supervision or inspection." Only 39% had any university degree or "technical qualification."

TABLE E-11 --Concentration on own field[D]

102, p. 632[z] Bernal 1948 Scientists at Cambridge University and at various British Research organizations.	Per cent of papers "looked through to see whether they contain anything of interest ... in current issues" of journals classified by the diarist as:[aG]			
	own field	related fields	general	total
All diarists	50%	23%	27%	100%
Institution devoted to:				
Fundamental science[W]	52%	21%	26%	100%
Applied science[V]	46%	26%	28%	100%
Rank of scientist:				
Professors, directors	54%	25%	21%	100%
Lecturers, asst. dirs.	55%	27%	23%	100%
Senior research workers	46%	28%	26%	100%
Junior research workers	46%	17%	33%	100%

101, p. 38 Ackoff & Halbert Chemists in industrial organizations with 5 or more chemists in 150 U.S. metropolitan areas	Per cent of those industrial chemist-moments which were devoted to journal reading in work area during working day, which involved the reading of:	
	chemical journals	72.5%
	scientific non-chemical journals	24.8
	non-scientific journals	2.7
		100.0%

[a]Instructions gave the following examples "in the case of a biochemist:" own field--Biochemical journal, related fields--Journal of Physiology: general--Nature.

[b]Publications (not specific articles or chapters) were classified as to subject according to "a modification of the U.S. Department of Agriculture system." In Study 1, twenty-two subject classes were used, including the four shown above; in Study 2, twenty-four.

[c]Instructions in Study 115 specify: "As, for example, if an organic chemist or physical chemist, you consult a book or journal on analytical chemistry." (p. 120.)

TABLE E-11 (Continued)

115, pp. 49-50, 67-8
Maizell
Research chemists of a large chemical company

Supervisor's creativity rating[F]	Per cent "consulting material in fields of chemistry other than the particular branch in which /they/ specialize"[G]: several times a week or more	Per cent "consulting material in fields of chemistry other than the particular branch in which /they/ specialize"[G]: several times a month or more	Per cent "consulting material on scientific or technical subjects other than chemistry or chemical engineering" several times a month or more
High	38%	85%	42%
Middle	28%	67%	33%
Low	16%	47%	16%

120, pp. 19, 40-41
Shaw
Scientists and engineers on research staff of US Forest Products Lab (GS 5 to GS 14)

Per cent of reading acts in publications devoted to subjects identical to scientist's present field of work[bE]

Scientist's present field of work: [Y]	Study 1 2-month diary period	Study 2 1-month diary period
Chemistry	46.7%	46.5%
Engineering	16.0%	10.6%
Botany	8.9%	10.5%
All fields[X]	22 %	32 %

Additional data

[D]See also: Table E-10, first two lines Study 119 ("strictly relevant" and "borderline" journals.)
Table F-22, Study 116 (Ranking of channels calling to attention developments in primary and secondary fields of attention)

[E]These figures are also given separately for routed and non-routed material (Study 120, pp. 29-32, 50-53). In Study 2 they are also given as "per cent of reading time" (as reported by diarists).

[F]Creativity rating and having a Ph.D. made independent contributions to these differences.

[G]Also given separately for Physicists, Engineers, Chemists and Biochemists.

Other notes

[Z]Text of Study 102, p. 595, gives figures at variance from the above, which are taken from Appendix table, p. 632.

[Y]Separate figures for physicists are omitted here, as only two physicists participated.

[X]Computed by the reviewers from weighted percentages for individual fields.

[W]Recomputed by the reviewers from weighted percentages for Cambridge Medical Research Council, and Rothamsted.

[V]Recomputed by the reviewers from weighted percentages for Dept. of Scientific and Industrial Research, and Industrial Laboratories.

TABLE E-12--Concentration on particular journals or sources. Consensus in choice of journals or sources.

102, p. 597
Bernal
Scientists at Cambridge University and at various British research organizations

Of "the 1,821 papers" /consulted with a specific purpose in view during the diary period/ "one-quarter are to be found in the first six journals, . . . one-half in the first thirty journals, . . . three-quarters are contained in 100 journals . . . , but the remaining quarter is to be found in 327 journals, none of which contains more than four references." (Diary)

103, p. 203
Cole
Users of the British Petroleum Company's Technical Information and Library Service

Number of times any given journal was cited in references supplied by the service in response to questions submitted over a 9-year period

Number of times cited	Number of journals
1	101
2	28
3	14
4	14
5	9
6-10	15
11-15	4
16-20	5
21-30	4
over 30	3

101, p. 39
Ackoff & Halbert
Chemists in industrial organizations with 5 or more chemists in 150 US metropolitan areas

Cumulative per cent of chemist-moments devoted to journal reading in work area during working day, which are accounted for by the nine journals most frequently read:

Number of journals	Cumulative per cent of journal-reading chemist-moments
1	12.4%
2	22.9%
3	27.8%
4	31.5%
5	35.2%
6	38.7%
7	41.5%
8	44.1%
9	46.5%
428	100.0%

TABLE E-12--(Continued)

116 Menzel Biochemists, chemists, and zoologists on Columbia University faculty	Biochemists	Chemists	Zoologists	Total
p. 135: Perceived fraction of articles read by each scientist which are accounted for by his "three most important journals" (Average for each department)	.56	.64	.24	.49
p. 136: Number of different journals necessary to account for:				
50% of the nominations of "3 most important journals"	2.38	2.88	7.00	
75% of the nominations of "3 most important journals"	5.25	8.18	15.76	
p. 51: Number of scientists who perceive "the five labs or institutions carrying on the most significant work in /their/ field" as accounting for the following fractions of the work in the field that they "actually keep track of:"				
less than 30%	10	7	10	27
31% to 60%	7	5	8	20
over 60%	4	7	2	13
p. 52: Number of different institutions necessary to account for:				
33% or the nominations as five top institutions	4.33	4.23	5.00	
50% of the nominations as five top institutions	8.33	7.92	10.11	

TABLE E-13 --Number of different journals read or scanned

121, pp. 40-41
Tornudd '53

Average numbers given in reply to the interview questions:

Q. 6--How many scientific and technical journals and series do you personally:

Danish-Finnish junior research workers	Subscribe to or obtain through membership?		Subscribe to, obtain through membership, or follow regularly in addition?	
Employed at:	Danish	Finnish	Danish	Finnish
Academic institutions	2.7	2.7	20	14
Research institutions	3.8	2.7	16	17
Industrial institutions	4.1	2.7	17	18
All	3.5	2.7	18	17

102, p. 636
Bernal 1948

Average number of journals listed in reply to Questionnaire:

Scientists at Cambridge University and various British research organizations:	Q. 6 (i) List of journals to which you subscribe	Q. 6 (ii) list of journals which you read regularly
Institution devoted to:		
Fundamental science[z]	3.0	9.1
Applied science[y]	1.3	6.3
Rank of scientist:		
Professors, directors	4.2	8.4
Lecturers, asst. dirs.	1.5	10.8
Senior Research workers	2.8	6.0
Junior research workers	1.1	6.0
All	2.0	7.7

119, pp. 13-14
Scott & Wilkins[DC]

Average number of journals listed in reply to the interview question:

Q. 13--Can you now list for me the journals which you see regularly? By "regularly" I mean those which you see nearly every issue?

Technical grades from foreman upwards, in British electrical or electronics industry[x]	
Age	
Under 25	2.6
25-34	4.7
35-44	4.9
45-54	4.7
55 and over	5.1
Duties performed	
Management	6.4
Research	5.4
Production supervision	3.5
Qualifications	
Higher degree	11.5
First degree only	6.1
Technical qualifications only	5.8
No qualifications	3.7
All	4.7[b]

TABLE E-13 --(Continued)

101, p. 38-39 Ackoff and Halbert Chemists in industrial organizations with 5 or more chemists in 150 U. S. metropolitan areas	A random sample of "chemist-moments" yielded 428 observations of reading scientific journals, involving 139 different journals. Nine of these journals accounted for 46.5% of the observations.

116, p. 135 Menzel Biochemists, chemists, and zoologists on Columbia University faculty	Average number of journals checked or added in reply to the interview question: Q. 8.11--Here is a list of scientific journals. Please check the journals which you regularly scan. Are there any other/s/?	Perceived fraction of articles read by each scientist which is accounted for by his three most important journals. (Average for each department)[a]
Discipline:		
Biochemists	13	.56
Chemists	12	.64
Zoologists	30	.24
All	17	.49

115, pp. 46, 48, 67 Maizell Research chemists of a large chemical company	Per cent subscribing to more than 2 technical or scientific journals	Per cent regularly examining more than 5 technical or scientific journals from company libraries
Supervisor's creativity rating:[E]		
High	42%	39%
Middle	36%	22%
Low	31%	3%

Notes about question wording

[a]Computed from replies to the following interview questions:
Q. 8.41--Would you tell me which are the three most important journals for you to read?
Q. 8.42--About what fraction of the articles you actually read appears in these three journals?

[b]No prompt list was used with this question. Respondents checked an average of 7.8 journals on a prepared list when asked: "Here is a list of journals which apply...Mark off the ones in which you have read or scanned at least one article during the last year." "Generally similar results /i.e., associations with reader characteristics/ are found, except that the research group now claims more journals than the managers." (p. 15). Complete frequency distributions are given on p. 13.

Additional data

[C]Also broken down by "years with firm," and by "years of experience in present type of work" (p. 14).

[D]See also Table E-14 of this review for breakdown by intensity of reading.

[E]Creativity rating and having a Ph.D. made independent contributions to these differences.

Notes about row headings

[x]Consists of "Cambridge," "Medical Research Council," and "Rothamsted".

[y]Consists of "Department of Scientific and Industrial Research," and "Industrial Research laboratories."

Other notes

[X]See fn. Y, Table E-10.

TABLE E-14--Intensity of exposure[A,B]

114, p. 25 Hogg & Smith Scientists and technologists in R&D branch of U.K. Atomic Energy Authority (62% had university degrees)	Fraction of reading acts devoted to indicated channels during a 14-day diary period, which were marked as "scanned" (as opposed to "read")
Periodical articles	about half
Reports	a little under half
Textbooks	two-thirds

119, p. 23 Scott & Wilkins Research, planning and development personnel in British electrical and electronics industry Intensity of reading	Number of mentions of journals as "seen regularly--i.e., you see nearly every issue" which were marked as read with intensity shown at left	
Read on average one or more articles in full per issue	293	58%
Scan actual articles--going over pages	167	33
Index refer to, and look up articles which appear interesting	32	6
Advertisements are main concern	16	3
Total reader-journals (among a sub-sample of 105 respondents)	508	100%

(Journals marked for more than one category are counted only in the category of greatest intensity.)

Additional data

[A]Study 115 (Maizell, p. 51) reports the per cent of chemists who indicated varying frequencies with which they verify desk handbook data in other sources, or recalculate data in articles or patents.

[B]For a comparison of the number of papers "looked at" and "consulted" per week, see Table E-3, Columns (6) and (7).

TABLE F-15 --Functions Served by Reading[D]

	114, p. 30 Hogg and Smith[Ea]	123, p. 414 Urquhart '48[a]
	Scientists and Technologists in R & D branch of U.K. Atomic Energy Authority	Users of Science Museum Library
	Percent of articles, reports, textbooks, symposia, and annual reviews read during 2-week diary period of which each type of "use was made"	Per cent of withdrawals from Science Museum Library during 2-week period in which the "information sought was required for" each purpose
	(1)	(2)
Reader's activity in which the information was used or was to be put to use:		
1. Writing for publication, lecturing, or teaching	12%	
2. Current or planned research	48	
3. Transmittal to a colleague	4	
4. Total specific uses	64%	80%[x]
5. For general interest	33	20
6. Not found useful[z]	3	...
Total	100%	100%
Nature of message sought:[y]		
7. Theoretical statements		26%
8. Results and Data		20%
9. Methods and procedures		27%
10. Technical development work		30%

Notes about column headings

[a]Diarists had to record "use," "purpose," or "reason" in each study under the specific categories which were provided. These were essentially like those shown in the table, insofar as figures are entered against them under the study, and with the exceptions noted in footnotes to some of the entries. Study 123 also allowed for "preparation of abstracts," "preparation of review," "manufacturing details," and "a lecture to students."

[b]Excludes "current issues...looked through to see whether they contain anything of interest, and individual papers read in detail." Cf. also Table E-3, fn. b.

[c]Figures in column (4) were computed by the reviewers so as to include the papers "looked through," etc., which were excluded from Column (3). All are assigned to the row "For general interest." -- Instructions to diarists called for the recording of abstract as well as journal article reading, but it is believed that only journal articles are included in the count of "papers."

Additional data

[D]Study 101 (Ackoff and Halbert) p. 6, reports that "about half of the reading that the chemists do is for general information rather than for specific use in connection with their current task." Study 105 (Fishenden) finds that 50% of the "useful" reports, papers, reviews and books read by diarist constituted information "acquired in background reading," rather than being "directly applicable to your job."

TABLE F-15 — (Continued)

	102, p. 632-33[F] Bernal '48		120, pp. 24, 46[a] Shaw	
	Scientists at Cambridge University and at various British research organizations		Scientists and engineers on research staff of US Forest Products Lab. (GS 5 to GS 14)	
	Percent of journal articles read for each purpose during diary period, among those:-		Percent of reading acts for which "reason consulted" was as shown	
	"consulted with a specific purpose in view"[b]	"looked through" or "consulted with a specific purpose in view"[c]	Study 1 2-month diary period	Study 2 1-month diary period
	(3)	(4)	(5)	(6)
1.	13%	3%		
2.	63[w]	18[w]		
3.	...	...		
4.	76%[x]	21%[x]	21%	66%
5.	24	79	78	32
6.	...	...	...	...
	100%	100%	100%	98%[u]
7.	22%[v]	6%[v]	11%[v]	13%[v]
8.	30%[v]	8%[v]	16%[v]	16%[v]
9.	31%[v]	8%[v]	17%[v]	14%[v]

Additional data

[E]114, p. 31, finds that the per cent of reading which was for general interest is invariant to total amount of reading.

[F]Also given separately for Physicists, Engineers, Chemists, Biochemists, Biologists (pp. 632-33). For a comparison of the number of papers "looked at" and "consulted" per week, see Table E-3, Columns (6) and (7).

Notes about row headings

[z]This category used in Study 114 only.

[y]These categories not used in Studies 114 and 105. In Study 120, their use is explicitly confined to those reading acts undertaken for the sake of "specific information." In Studies 123 and 102, no such restriction was made.

[x]Not given as a separate figure in Studies 123 and 102. Above entries were computed as: 100% minus general interest.

[w]Not given as a separate figure in Study 102. Entry computed as 100% minus general interest minus writing, lecturing, teaching.

[v]These figures add up neither to 100%, nor to "total specific uses." Apparently answers were frequently omitted.

[u]2% did not respond.

TABLE F-16 --Functions served by reading in publications of diverse type and age[B]

Reader's activity in which the information was used or was to be put to use:	114, p. 30[a] Hogg and Smith — Scientists and Technologists in R & D branch of U. K. Atomic Energy Authority		
	Per cent of articles	Per cent of reports	Per cent of textbooks, symposia, and annual reviews
	Read during 2-week diary period of which each type of "use was made"[U]		
	(1)	(2)	(3)
1. Writing for publication lecturing, or teaching	6%	19%	12%
2. Current or planned research	29	57	65
3. Transmittal to a colleague	4	4	4
4. Total specific uses	39%	80%	81%
5. For general interest	57	18	18
6. Not found useful[z]	4	1	2
Total	100%	100%	100%

TABLE F-16 --(Continued)

	105, p. 158 a[V] Fishenden — Scientists in "honor graduate" grades at Atomic Energy Research Est., Harwell				123, p. 414[a] Urquhart 1948 — Users of Science Museum Library		
	Per cent of "useful": Published papers	Reports	Reviews	Books	Per cent of withdrawals from Science Museum Library during 2-week period, in which items have been published in:		
	read during 2-month diary period, containing information "acquired in background reading" (general interest) or "directly applicable to your job" (specific interest)				1947	1941-5	1931-40
	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1.							
2.							
3.							
4.	47%	52%	53%	64%	74%[x]	80%[x]	74%[x]
5.	53	48	47	36	26	20	26
6.	...	...	...	...	...	...	...
	100%	100%	100%	100%	100%	100%	100%
			Nature of the message sought:[y]				
7.			Theoretical statements		24%	15%	46%
8.			Results and Data		11%	16%	49%
9.			Methods and procedures		17%	20%	54%
10.			Other		29[w]	45[w]	43[w]

Notes about column headings

[a]See fn a, Table F-15.

Additional data

[B]Note also that figures from Study 102 in Table F-15 are limited to journal articles.

Notes about row headings

[z]This category used in Study 114 only.

[y]See footnote y, Table F-15.

[x]See footnote x, Table F-15.

[w]Technical development work.

Other notes

[V]Percentages computed by the reviewers.

[U]These figures estimated by the reviewer from inspection of bar chart in Study 114.

TABLE F-17 — Functions served by reading, for different categories of respondents and their institutions[CD]

102, p. 633
Bernal '48

Scientists at Cambridge University and at various British Research organizations - Questionnaire

Per cent of journal articles "consulted with a specific purpose in view" during the diary period, which were "consulted by the respondent with each purpose in view"[aE]

	Respondent's Position				Institution devoted mainly to	
1. Reader's activity in which the information was used or was to be p t to use:	Professor and Director (1)	Lecturer and Assistant Director (2)	Senior Research Worker (3)	Junior Research Worker (4)	Fundamental research[W] (5)	Applied[V] research (6)
1. Writing for publication lecturing, or teaching	19%	17%	24%	9%	13%	13%
2. Current or planned research	63 y	62 y	58y	70 y	63 y	64 y
3. Total specific issues	82%[x]	79%[x]	82%[x]	79%[x]	76%[x]	77%[x]
4. For general Interest	18	21	18	21	24	23
5. Total	100%	100%	100%	100%	100%	100%
Nature of message sought:[z]						
6. Theoretical statements	17%	18%	25%	25%	20%	25%
7. Results and Data	34%	35%	23%	29%	31%	29%
8. Methods and procedures	25%	26%	24%	33%	29%	36%

Notes about column headings

[a] Excludes "Current issues...looked through to see whether they contain anything of interest, and individual papers read in detail," which are analyzed separately on p. 632 of Study 102. Computation of combined figures is possible Compare Table F-15, Col. (4) and footnote C.

[b] See footnote [a], Table F-15.

Additional data

[C] Additional datum: Study 101 (Ackoff and Halbert), p. 30, finds industrial chemists devoting 6.8 per cent of "in-time" to receiving written scientific communication; this consists of 3.7 per cent of "reading for use" and 3.1 per cent of "reading for general information." For university chemists, the corresponding figures are 2.5 per cent "receiving written," 1.6 per cent "reading for use," and 0.8 per cent "reading for general information."

[D] Breakdowns by discipline are not repooduced within review, but cited in fn.[F], Table F-15.

[E] For a comparison of the number of pages "looked at" and "consulted" per week by scientists in these categories, see Table E-3, Collums (6) and (7).

[z-V] for footnotes z to V see facing page

Additional footnotes to Table F-17

Notes about row headings

[z] See footnote [y], Table F-15.

[y] See footnote [v], Table F-15.

[x] See footnote [x], Table F-15.

Other notes

[w] Weighted averages for Cambridge. Medical Research Council, and Rothamsted computed by the reviewers.

[v] Weighted averages for Dept. of Scientific and Industrial Research, and Industrial Laboratories computed by the reviewers.

TABLE F-18 - Functions served by reading of literature to which attention was called by different sources[a]

	123, p.413[CU] Urquhart 1948 Users of Science Museum Library — Per cent of withdrawals[b] from Science Museum Library during 2-week period, among those to which "a reference was obtained from" each source, where the information sought was:		114, p.30 Hogg & Smith Scientists and technologists in R&D branch of U.K. Atomic Energy Authority — Per cent of articles, reports, textbooks, symposia, and annual reviews read during 2-week diary period, among those to which "reference was found" through each source, which were read for:		105, p. 158[D] Fishenden Scientists in "Honor grad." grades at A.E. Res. Est.Harw. — Per cent of "useful" reports, published papers, reviews, and books, among those "found" through each source during 2-month diary period, which were read for:	
Source[z]	required for gen. information (1)	sought for a specific purpose (2)	"general interest" (3)	a specific purpose (4)	back-ground reading (5)	a specific purpose (6)
1. Routine perusal of current literature	XXX[w]	XXX[w]	45%	55%	67%	33%
2. Abstract or index[y]	25%	75%	...	...	52%	48%
3. Cross-reference	28%	72%	14%	86%	30%	70%
4. Found by search[y]	21%	79%	21%[v]	79%[v]	26%	74%
5. Previous use, hunch, memory	...	...	34%	66%	15%	85%
6. Sent or notified by author	XXX	XXX	...	...	39%	61%
7. Library's own initiative[x]	23%	77%	23%	77%	66%	34%
8. Personal recommendation	24%	76%	17%	83%	46%	54%

Notes about column headings

[a] See also fn. [c], Table F-20

[b] With exceptions noted on p. 409.

Additional data

[C] Also given for "information sought for" diverse specific uses.

[D] Also given separately for reports, articles, reviews, and books.

Notes about row headings

[z] Source 1 represents coming across an item in the course of one's routine "keeping abreast" activities. 3, 4, and 5 represent, for the most part, finding an item while studying the given subject matter. 6, 7 and 8 represent the spontaneous calling of an item to the scientist's attention by someone else, although Source 8 may also include responses to inquiries. Source 2 (abstracts) may be perused as part of "keeping abreast" as well as in a deliberate search; studies do not distinguish in the present context.

[y] Includes library catalog, personal index, bibliography, reference work, etc. and overlaps with "abstract or index."

[x] Includes accession list; routing of article, report (but not of a periodical for routine perusal); library notification slip.

[w] Withdrawals from Science Museum Library practically exclude routine perusal.

[v] Abstract journals or library catalog

TABLE F-19 - Functions served by reading abstracts

Source	Population	Finding	Per cent
114, p. 26 Hogg & Smith	Scientists and technologists in R & D branch of U.K. Atomic Energy Authority	Per cent of abstract reading acts in 14-day diary period which were:	
		to keep abreast of recent developments	67%
		to locate or identify past literature	33%
105, p.158 Fishenden	Scientists in honors graduate grades at Atomic Energy Research Est., Harwell	Percent of "useful" publications read during 2-month diary period which had been "found" through abstracts and were read for:	
		background reading	52%
		use	48%
107, p.7 Glass 1955	Several samples of American biologists[A]	Per cent of questionnaire respondents indicating they use abstracts principally:	
		as an aid in keeping up	25%
		for reference	30%
		both	45%
109, p.10 Gray	U. S. Physicists who had returned an earlier questionnaire	Per cent of questionnaire respondents indicating they use abstracts principally:	
		for keeping up	22%
		as a reference tool	30%
		half and half	48%
111, p. 233 Herner 1954	Professional members of scientific divisions of Johns Hopkins University; 50% had doctoral degrees - Interview[B]	"If significant use is made of indexing and abstracting publications, are these used mainly:	
		as a means of keeping abreast of the current literature in your field,	45%
		or for searches of the past literature	55%
		or both?"	—

TABLE F-19 - (Continued...)

119, p.35 Scott & Wilkins	
Technical grades from foreman upwards in British electrical or electronics industry[Z] (Asked only of the 31% who claimed to "make use of abstracts.")	"Do you use /abstracts/ for searches or for news of current developments?" News wholly or mainly 43% Searches wholly or mainly 21% Both about equally 34% (No answer: 2%)

107, p.7 Glass 1955		
Several samples of American biologists[A]	Per cent of questionnaire respondents indicating they use abstracts principally:	
	as guide	49%
	as substitute	5
	half and half	46
109, p.10 Gray		
U.S. Physicists who had returned an earlier questionnaire	Per cent of questionnaire respondents indicating they use abstracts principally:	
	as guide	46%
	as substitute	6
	half and half	48

Additional data

[A] Study 107 adds: "Biologists in hospitals and clinics /as opposed to those in colleges and universities/ lead in the use of abstracts for keeping up."

[B] (111) for applied scientists, the division was about 50-50; "pure scientists made slightly greater use...for searches of the past literature."

Other notes

[Z] Only 43% were engaged in "research, development, or design, with or without other duties." Another 40% were engaged in "production supervision or inspection." Only 39% had any university degree or "technical qualification."

TABLE F-20 --Sources calling items of information to scientist's attention.[E]

Source:[c]	114, pp. 27-9 Hogg and Smith — Scientists and technologists in R&D branch of U.K. Atomic Energy Authority — Per cent of articles, reports, textbooks, symposia, and annual reviews read during 2-week diary period to which "reference was found" through each source (1)	105, p. 158 Fishenden — Scientists in "honor graduate" grades at Atomic Energy Research Est., Harwell — Per cent of "useful" reports, published papers, reviews, and books read during 2-month diary period which was "found" through each source (2)	120, pp. 22, 44 Shaw — Scientists and engineers on research staff of US Forest Products Lab (GS 5 to GS 14) — Per cent of reading acts for which "source of reference" was as shown — Study 1 2-month diary period[F] (3)	Study 2 1 month diary period[G] (4)
1. Routine perusal of current literature, or "chance"[x]	21%[w]	23%	70.6%	68.6%
2. Abstract or index[z]	...	12	1.0[n]	1.1[n]
3. Cross-reference	6	9	3.0	4.9
4. Found by search[z]	4[r]	7[t]	4.0	3.6
5. Previous use, hunch, memory	18[q]	10	12.7	14.2
6. Sent or notified by author	...	6	...	...
7. Library's own initiative[y]	14[p]	21[s]	.9	1.5
8. Personal recommendation	41[o]	11	3.7	3.6
9. Other	...	...	4.1	2.5
	104%[L]	100%	100%	100%

Notes about column headings

[a]With exceptions noted on p. 409.

[b]Omits respondents (29% of total interviewed) who could recall no such recent article.

[c]See fn. z, Table F-18. Diarists had to record sources of attention under specific categories provided, which were essentially like those shown in the table, insofar as figures are entered against them under each study, except as shown in footnotes to some of the entries. Exceptions are Studies 108 and 119, in which free replies were classified by the investigators into 16 categories (108) and 8 categories (119), further simplified by the reviewers as shown.

[d]Study 102 recorded sources calling items to scientist's attention only for items recorded on "Form B." This excludes the approximately 74% of papers in "current issues...looked through to see whether they contain anything of interest, and individual papers read in detail."

Additional data

[E]See also Table F-21 for figures from Study 111 (Herner 1954), which can only be be given for three categories of scientists separately, and for figures from Study 110 (Herner 1958), Column (21).

[F]Also given separately for Chemistry, Engineering, Botanical Science, Physics,

[G]Also given separately for Physicists, Engineers, Chemists, Biochemists, Biologists.

TABLE F-20 --(Continued)

	123, p. 412 Urquhart '48	102, p. 633 Bernal '48	108, p. 186 Glass & Norwood '58	119, p. 27 Scott & Wilkins
	Users of Science Museum Library	Scientists at Cambridge University and at various British research organizations	50 Biologists and other scientists	Technical grades from foreman upwards, in British electrical or electronics industry[K]
	Per cent of withdrawals[a] from Science Museum Library during 2-week period to which "a reference was obtained from" each source (Questionnaires attached to publication as withdrawn)	Per cent of journal articles "consulted with a specific purpose in view" during diary period, which the scientist "was led to consult" by "way" of each source[dG]	Per cent of references cited in and "of major significance to" one of respondent's recent publications, where respondent first learned of the existence of the work through each source (interview)	Per cent of respondents to whose attention the most recent recalled "article...of direct use or special interest" was drawn by each source[b] (interview)
	(5)	(6)	(7)	(8)
1.	XXX[m]	13.8%[d]	30.4%	41%
2.	33%	20.7	5.2	4
3.	38	42.5	6.9	5
4.	9	...	9.5	18
5.	...	...	6.4[v]	...
6.	XXX	8.2	5.8	...
7.	4	...	0.9[u]	...
8.	16	16.1	26.9	30
9.	...	...	5.5	2
	100%	100%	100%	100%

Notes about row headings

[z] This includes library catalog, personal index, bibliography, reference work, etc. This category overlaps with "abstract or index."

[y] Includes accession list; routing of article, report (but not of a periodical for routine perusal); library notification slip.

[x] These figures are listed under "routine perusal" in studies 114, 105, 108 and "chance" in 120, 102, 119. In Study 108, there is an additional 2.6% listed under "chance."

[w] "Diarist's own property" (15%) and "Periodicals circulated by the library" (6%).

[v] General background, common knowledge, or can't remember

[u] Book list

[t] Sum of categories numbered 9, 11, 12 and 15, in Study 105.
[s] Sum of categories numbered 13, 14, 16 and 17 in Study 105.
[r] Abstract Journal or library catalogue.
[q] Includes "chance."
[p] Includes library assistance.
[o] Includes documents passed on by senior or colleague by nature of job (23%), as well as spontaneous recommendation (18%).
[n] Includes reviews.
[m] Withdrawals from Science Museum Library practically exclude routine perusal.

Other notes

[L] "The 4% difference represents diarists' errors" (p. 29).
[K] See footnote Z in Table F-19

TABLE F-21 --Sources calling items of information to scientists' attention, by type of respondent, type[D] of publication called to his attention, and purpose for which read.[D]

105[z] Fishenden

Scientists in "honor graduate" grades at Atomic Energy Research Establishment, Harwell

Per cent of "useful" published papers, reviews, reports and books read during 2-month diary period which was "found" through each source

Source[c]	Rank (p.163) Senior (1)	Rank (p.163) Junior (2)	Work of Respondent (p.164) Pure Resch (3)	Work of Respondent (p.164) Applied Resch. (4)	Purpose for which Publication was read (p.158)[TG] Background Reading (5)	Purpose for which Publication was read (p.158)[TG] Directly Applicable to Job (6)
1. Routine perusal of current literature	23%	24%	32%	17%	32%	15%
2. Abstract or index[y]	10	12	6	15	12	11
3. Cross-reference	11	7	17	6	5	12
4. Found by search[y]	7	9	5	9	4	11
5. Previous use, hunch, memory	6	12	10	10	3	17
6. Sent or notified by author	8	6	2	7	5	8
7. Library's own initiative[x]	23	21	11	25	28	14
8. Personal recommendation	12	11	15	11	10	12
	100%	100%	100%	100%	100%	100%

Notes about column headings

[a] Sources of attention identified by respondents were ordered by the investigators into 11 categories, further simplified by the reviewers as shown.

[b] With exceptions noted on p. 409.

[c] See fn. z, Table F-18, and fn. c, Table F-20, regarding Studies 105 and 123.

Additional data

[D] Breakdowns by discipline are not reproduced in this review but are cited in fn. F and G, Table F-20.

[E] Because figures in Study 111 are given only as per cent of nominations and not as per cent of respondents, they cannot be directly compared with those cited above from other studies, except in terms of rank order. In addition, more of the "pure" than of the "applied" scientists "became aware of sources of information" through each of the listed sources of attention except for personal recommendation and library card catalogues, with a tie in the case of routine perusal.

[F] This breakdown is also given separately for senior and junior workers, and for pure and applied research workers.

[G] This breakdown is also given separately for type of publication.

TABLE F-21 --(Continued)

105, p. 158[zTF] Fishenden	123, p. 412 Urquhart '48
Scientists in "honor graduate" grades at Atomic Energy Research Establishment, Harwell	Users of Science Museum Library
Per cent of "useful" published papers, reviews, reports and books read during 2-month diary period which was "found" through each source	Per cent of withdrawals[b] from Science Museum Library during 2-week period to which "a reference was obtained from" each source (Questionnaires attached to publication as withdrawn)

	Type of Publication called to Attention					Year of publication of item withdrawn			
	Report (7)	Publ. Paper (8)	Review (9)	Book (10)	Any read in Foreign Language (11)	1947 (12)	1941-5 (13)	1931-40 (14)	1921-30 (15)
1.	3%	38%	43%	16%	24%	xxx[w]	xxx[w]	xxx[w]	xxx[w]
2.	17	11	5	1	8	55%	30%	20%	15%
3.	5	13	20	6	24	14	40	48	62
4.	8	6	4	15	5	7	14	11	4
5.	8	4	7	49	5	...	...	...	...
6.	15	2	0	0	0	xxx	xxx	xxx	xxx
7.	31	18	9	4	24	9	3	3	0
8.	14	10	12	10	10	15	4	18	19
	100%	100%	100%	100%	100%	100%	91% [s]	100%	100%

Notes about row headings

[z]See fns. t and s, Table (F-20), concerning the pooling of original categories

[y]"Found by search" includes library catalog, personal index, bibliography, reference work, etc., and overlaps "abstract or index."

[x]Includes accession list; routing of article, report (but not of a periodical for routine perusal); library notification slip.

[w]All entries in this column refer to withdrawals from Science Museum Library, hence include no routine perusal.

[v]Figures given are for "bibliographies." "Library card catalogs and "book reviews and publishers' announcements" occupy 5th and 6th rank among engineers in the Applied Physics Laboratory, otherwise 6th or 7th rank throughout.

[u]Figures given are for "personal reference files ." Library card catalogs were mentioned by 69%, 17%, and 2% of the respondents; separate bibliographies by 42%, 16%, and 5%.

TABLE F-21 --(Continued)

	111, p. 232[E] Herner 1954					110 B, p. 3[a] Herner 1958		
	Professional members of scientific divisions of Johns Hopkins University					Medical scientists at 59 U.S. research organizations "most likely to have facilities for Soviet information"		
	Rank-order of the number of respondents indicating that they "become aware of sources of information in your field" through each of 7 listed sources of attention					Per cent of respondents who "become aware of existence of scientific information" through each source of attention shown		
	Any respondents presently working in:			Engineers only:				
	Pure Science (16)	Applied Science (17)	both simultaneously (18)	In School of Engineering (19)	In Applied Physics Laboratory (20)	For info. in general (21)	For Foreign Info. (22)	For Soviet info. (23)
1.	3-5	3	3	2	3	96%	70%	31%
2.	3-5	4	4	3	4	95%	86%	53%
3.	1	2	1-2	1	2	97%	79%	29%
4.	3-5[v]	5[v]	5[v]	4[v]	7[v]	81%[u]	49%[u]	10%[u]
5.	--	--	--	--	--	...	...	...
6.	--	--	--	--	--	...	...	...
7.	--	--	--	--	--	59%	21%	4%
8.	2	1	1-2	5	1	88%	61%	25%

Other notes

[T]Frequencies added and percentaged by the reviewers.

[S]Unexplained error in original document.

TABLE F-22 --Channels serving to keep abreast vs. to find answers to specific questions.

	Keeping up and Question Searching Compared				
	105, p. 158 Fishenden		114, pp. 29-33[g] Hogg & Smith		
	Scientists in "honor graduate" grades at Atomic Energy Research Est., Harwell		Scientists and technologists in R & D branch of U.K. Atomic Energy Authority		
	Per cent of "useful" items of literature read during 2-month diary period in each source, among those:[c]		Per cent of items of literature read during 2-week diary period in ea. source, among those "used"[e]		
	directly applicable to job	acquired in background reading	for current or planned research	for other specific purpose[d]	for general interest
	(1)	(2)	(3)	(4)	(5)
1. Journal Articles	46%	54%	22%	20%	65%
2. Reports	38	36	42	53	19
3. Reviews	4	4	XXX	XXX	XXX
4. Books	12	6	36[z]	28[z]	16[z]
5. Abstracts & Indices	XXX	XXX	XXX	XXX	XXX
6. Total Literature	--	--	--	--	--
7. Personal Contacts	XXX	XXX	XXX	XXX	XXX
8. Meetings & Seminars	XXX	XXX	XXX	XXX	XXX
9. Other	XXX	XXX	XXX	XXX	XXX
	100%	100%	100%	100%	100%

Notes about column headings

[a]Data in these four columns are based on free statements by respondents, classified by the investigators into 8 (Study 119), 6 (110, App I), 12 (110, App. IV), and 5 (116) categories, and further simplified by the reviewers as shown.

[b]Scientists in each discipline were presented with a long list of sub-specialties and were instructed to mark those "where you try to keep up with current developments in detail." (Primary fields of attention.) Later they were instructed to mark "fields on this list where you also need to keep up to some extent, but not as much" (Secondary fields of attention.) For each set of fields, the scientist was shown a card listing 14 channels of communication and was asked to rank those four which he considered "most important in calling to your attention the current developments" in his primary and secondary fields, respectively. (Q. 4.1 and 4.2).

[c]Diary entries analyzed in Study 105 were limited to reports, published papers, reviews, and books. Figures corresponding to the above are also given separately for information to which respondent's attention was called by diverse sources.

[d]"Other specific purpose" includes: writing report, publication, or lecture; and information for transmittal to a colleague.

[e]Diary entries analyzed as to use in Study 114, were limited to "periodicals," "reports and committee papers," and "textbooks, symposia, and annual reviews." Handbooks, standards, etc., were explicitly excluded. Figures above were computed from inspection of bargraph, p. 30.

[f]Alternatives for checking were: "to some extent;" "to little or no extent."

[g]Apparently the literature searches referred to here involved more comprehensive topics than the single "problems or questions" referred to in the preceding column.

TABLE F-22 --(Continued)

	106, p. 144 Gerard — U.S. and Canadian Physiologists	Keep Up Only[HIJ] — 116, pp. 69, 72[M] Menzel — Biochemists, chemists and zoologists on Columbia University faculty[bM]		
	Per cent checking that they "depend on each of /six listed/ sources to keep up with advances in your field of specialization to a considerable extent"[f]	Per cent of scientists giving each channel one of first four ranks as calling to their attention developments in their primary fields of attention	Per cent of scientists giving each channel first rank as calling to their attention developments in their	
			Primary field of attention	Secondary field of attention[O]
	(6)	(7)	(8)	(9)
1.	86%	88%[v]	67%[v]	50%[v]
2.	--	...	...	...
3.	31%[j]	64%[u]	3%[u]	15%[u]
4.	20%	9%	2%	2%
5.	41%	39%	8%	10%
6.	--	--	--	--
7.	--	77%	14%	16%
8.	25%[k]	47%	6%	8%
9.	--	4%	0%	0%

Additional data

[H]News from top institutions: In Study 116, interviewed scientists were also asked: Q. 9.11--What would be, say, the five labs or institutions that carry on the most significant work in your field? And Q. 9.2--...How do you manage to keep informed of work at these important institutions. Twenty-eight per cent mentioned official sources (publications, meetings and conferences) only; 17% mentioned mainly personal communication; the rest relied on both in varying degrees. More of the biochemists than of the chemists and zoologists mentioned official sources only (p. 56).

[I]Useful information obtained "by chance:" In Study 116, scientists were asked: Q. 3.4--Have there been any instances during the past year when some unlooked-for piece of information came your way that turned out to have bearing on your work? Supplementary questions were asked in order to obtain complete accounts of experiences. After eliminating information learned while engaging in scanning the literature or engaging in any other activity explicitly designed to find out "what's new," there remained 4 accounts of information come across while searching the literature for another topic, 26 of information obtained from colleagues in various contexts, and 5 others. Almost half of these items had actually been published at the time. About one quarter were "know-how" or "Know-where" items. (pp. 31-38)

[J]Study 110 also asked respondents to enumerate ways in which they "generally keep abreast" Journals, meetings, and colleagues constituted 77% of the source-mentions. No other figures are given in the article cited.

[K]See also Table F-23, Column (9).

[L]Study 116 also obtained 29 accounts of searches for answers to specific questions through personal channels in reply to Q. 3.33--Can you tell me about the last time you used another channel than just the literature to find the answer to some question that arose in connection with your work? About half the items mentioned concerned details of techniques, apparatus, or materials. About half the scientists giving these accounts had addressed themselves to top experts in the field concerned; the others had addressed their questions to scientists who were not top experts but were more accessible to the questioner (pp. 10-17)

TABLE F-22 --(Continued)

Question Searching Only[K]

	119, p. 55[aN] Scott & Wilkins	110, p. 274 (App I)[aP] Herner '58	110,p.275 (AppIV)[aP] Herner '58	116, p. 141[aL] Menzel
	Technical grades from foreman up- wards, in British electrical or elec- tronics industry[NN]	Medical scientists at 59 U.S. research organizations "most likely to have facilities for Soviet info."	Medical scientists at 59 U.S.research organizations "most likely to have facilities for Soviet info."	Biochemists, chem- ists and zoologists on Columbia U. Faculty
	Per cent respon- dents who state that they "usually /address them- selves/first" to the sources shown when wanting "in- formation on a technical problem"	Per cent of source- mentions in respon- dents' telling "how he had gone about finding an answer or solution" to a "re- cent problem or question" which he had described [OO]	Percent of source- mentions in respon- dents' telling "how he went about doing the search" in the most recent "ques- tion or problem that involved a literature search" which he had des- cribed[g]	Per cent of scien- tists naming each channel as answer- ing specific ques- tions in their secondary fields of attention[M]
	(10)	(11)	(12)	(13)
1.	...	33%[w]	39%[w]	7%
2.	...	...	...	...
3.	...	...	9[s]	...
4.	...	14	10	27[r]
5.	...	15	16	8
6.	22%	--	--	--
7.	73[t]	24	15	52
8.	...	...	...	...
9.	5	14	12	7
	100%	100%	100%	100%

Additional data

[K]Corresponding figures are also given for biochemists, chemists, and zoologists separately.

[N]For corresponding data specific to several types of problems, see Table F-23.

[O]In a few instances the same sub-specialty was named as a primary field by some scientists and as a secondary field by others. In this pseudo-controlled situation, meetings and abstracts were ranked higher for primary fields, review articles and volumes for secondary fields. (p. 71).

Notes about row headings

[z]Exclusive of handbooks, data tables, etc.

[y]Annual review volumes

[x]Society meetings, 25%; Seminars and conferences, 21%.

[w]Includes "cited references."

[v]Articles found through own scanning of journals only.

[u]Review articles and review volumes.

[t]46% "someone within the establishment;" 27% other personal contacts.

[s]Includes bibliographies as well as review papers

[r]Reviews and texts.

Other notes

[Q]Figures estimated from graphic presentation in the original document, and repercentaged by the reviewer.

[P]Percentages computed by the reviewer.

[OO]Percentages shown were computed after eliminating "own experiments" as a source.

[NN]See footnote Z, Table F-19.

TABLE -23 - Channels serving to find answers to diverse types of questions[A]

119, p. 56
Scott & Wilkins
Technical grades from foreman upwards, in British electrical and electronics industry[V]
Q. 7 - "Here is a list of some items of information you may need in your work. How would you go about getting information on each?"

	An account of an apparatus (1)	A standard or specification (2)	A physical or chemical constant (3)	A method or procedure (4)	An established scientific theory (5)	A new scientific theory (6)
1. Literature	33%	23%	51%	26%	72%	48%
2. Supplier or Customer	1	1	3	2	3	6
3. Personal contact: Within Establishment	24	28	38	37	18	24
4. Outside Establishment[z]	42	16	8	34	8	23
	100%	68%[y]	100%	100%	100%	100%

Additional data

[A] See also fn. L, Table F-22, regarding Study 116.

[B] "Operating information" called for older publications, on the average but for a smaller number of journal references per inquiry (pp. 203, 206).

Notes about row headings

[z] Includes: parent firm; governmental research station; other research stations; person unspecified outside the firm; person unspecified. ("Persons unspecified" constituted 5% or less of responses in all categories except "method or procedure" where it constituted 18%).

[y] The remaining 32% replied "British Standards Institute."

TABLE F-23 - (Continued)

103, p. 203[B]
Cole

Users of the British Petroleum Company's Technical Information and Library Service[W]

Per cent of questions submitted to the service over a 9-year period, to which answers were obtained from sources shown

	Operating information for direct use (7)	Information for educational, briefing, or rounding-out use (8)	All questions (9)
1. Journals	58%	65%	58%
2. Internal and external reports	21%	10%	18%
3. Textbooks, yearbooks, handbooks, etc.	20%	23%	21%
4. Pamphlets	15%	12%	14%
5. Trade catalogues	8%	6%	5%
6. External information sources	2%	5%	4%
7. Other sources	7%	10%	8%

Other notes

[X] Per cent figures were recomputed by the reviewer after eliminating those who "had no need for this information," or "didn't know". They ranged from 6% of the total interviewed for "standard or specification" to 29% for "a new scientific theory." Respondents' free statements were classified into nine categories by the investigators.

[W] Users are staff members of the company; "many are by training scientists, but concerned largely with management and technical customer relations."

[V] Only 43% were engaged in "research, development or design, with or without other duties." Another 40% were engaged in "production supervision or inspection." Only 39% had any university degree or "technical qualification."

TABLE F-24 - Channels serving diverse functions other[b] than "keeping abreast" or "finding answers to specific questions"[c]

	110 (Appendix II) p. 274[a] Herner 1958 — Medical scientists at 59 U.S. research organizations "most likely to have facilities for Soviet information" — Per cent of source-mentions in reply to "Do you recall where you got the idea for your present or most recent project?"[Y]	119, p. 57[a] Scott & Wilkins — Technical grades from foreman upwards, in British electrical or electronics industry[V] — Per cent of source-mentions in reply to "Can you say by what means you get most of your ideas...for new ideas for improvements or for new methods?"[X] (Q. 4)
	(1)	(2)
1. Literature	39%[z]	52%
2. Personal contacts	35	32
3. Lectures, Meetings, Courses	12	9
4. Thought about it	XXX	XXX
5. Practical action	XXX	XXX
6. Other	13	8
	100%	100%

Notes about column headings

[a] Data based on free statements by respondents, classified by investigators into 8 (Study 110), 5 (119, p. 57), and 5 (119, p.50) categories, not counting those whose counts were omitted by the reviewers. The reviewers further simplified the remaining categories as shown.

[b] From replies to the following interview questions: Q5 — "Are you working on any problem at the moment?...What is the nature of the problem?...Can you tell me the very first step you took to deal with it?...the next?...What steps did you take today or yesterday?"

Additional data

[C] Study 116 (Menzel--biochemists, chemists, zoologists on Columbia University Faculty), had interviewed scientists recount episodes of their "brushing up" on a particular area of research, and episodes of their attention being directed to new areas of interest. Sources of communication in the small number of episodes recounted in each instance are enumerated on pp. 98 and 110. Study 116 also contains discussions of the following additional functions of the scientific communication system: Certifying (giving testimony to the reliability of a source of information); Eliciting reactions (furnishing the scientist with responses to his own statements); and Locating (helping the scientist to assess the position of a topic within the current research market).

[D] Distribution of "first steps" is also reported separately for "short-term," "long-term routine," and "long-term fundamental" problems, as well as for "administrative," "production," and "research" problems (p p. 51-2). Reference to the literature increases, while personal contact generally decreases as first steps in the order given. In apparent independence of this relationship to the nature of the current problem, "literature" as a first step is also reported more frequently by those with university degrees or technical qualifications, and by those who are usually engaged in research (p p. 52-55).

TABLE F-24 (Continued)

	119, p. 50[a] Scott & Wilkins			
	Technical grades from foreman upwards, in British electrical or electronics industry[V]			
	Percent of respondents who named each source or activity when describing the 1st step taken to deal with the problem currently worked on[WbD]	2nd step	3rd step	Yesterday's step
	(3)	(4)	(5)	(6)
1.	12%	5%	3%	2%
2.	26	20	16	21
3.	...	...	...	...
4.	5	3	1	3
5.	54	66	74	71
6.	3	6	6	3
	100%	100%	100%	100%

Notes about row headings

[z] Includes "omissions in the literature" and "disagreements with the literature."

Other notes

[Y] Percentages recomputed by the reviewer after eliminating "own previous work,", observation of patients," "assignments from superiors," and "teaching activities" (i.e., 47% of all mentions) as sources. The intent is to restrict the analysis to the role of channels of communication in bringing information of the work of other scientists.

[X] Percentages recomputed by reviewer after eliminating "intuition and thought," "observation or experiment," "requirements of job or customer," (i.e., 37% of all mentions) and "don't know (1%) as sources. See preceding footnote.

[W] In this instance, entries are not limited to channels of communication, since the question was not worded so as to focus on them, and other "steps" constitute the bulk of those recorded. Contrast the two preceding footnotes.

[V] Only 43% were engaged in "research, development, or design, with or without other duties." Another 40% were engaged in "production supervision or inspection." Only 39% had any university degree or "technical qualification."

TABLE P-25--Perceived yield of communication-receiving acts[c]

108, pp. 186-87
Glass & Norwood, 1958

50 Biologists and other scientists

Per cent of respondents to the progress of whose work it would (would not) have made any significant difference if they had learned sooner than they did of the work reported in at least one of the references cited in and "of major significance to" one of their own recent publications:

would have made a difference	18%
would not	68
no answer	14

120, pp. 26 & 48
Shaw

Scientists and engineers on research staff of US Forest Products Lab (GS 5 to GS 14)

Per cent of reading acts in which respondent "found what he sought," among those in which he sought something:[z]

Study 1 (2-month diary period)	86%
Study 2 (1-month diary period)	88%

123, p. 415[z]
Urquhart 1948

Users of Science Museum Library

Per cent of publications withdrawn[a] from Science Museum Library during 2-week period which respondent would have obtained /even/ if he had been able to see a summary beforehand 83%

123, pp. 414-15[z]
Urquhart 1948

Users of Science Museum Library

Percent of withdrawals[a] from Science Museum Library during 2-week period to which "a reference was obtained from" sources shown at left, which contained:

Source of reference	the required information	not the information sought, but other information of value	no information of value	Total
Periodical article	84%	13%	3%	100%
Abstracts or digest	79%	13%	8%	100%
Book	68%	29%	3%	100%
Science Library Accessions List	62%	15%	23%	100%
Verbal recommendation	72%	23%	5%	100%
Private index	85%	3%	12%	100%
All sources	77%	15%	8%[b]	100%

(The author adds: "The percentage of failures appeared to be unaffected by the use for which the information was required")

[a]With exceptions noted on p. 409.

[b]Includes 1% "publication was no use because it arrived too late."

Additional Data

[c]See also "not found useful," Tables F-15 and F-16, Study 114.

[z]Percentages computed by the reviewers.

TABLE P-26--Information which came "too late"

122, pp. 53-55
Tornudd '58

Danish-Finnish junior research workers

Per cent of respondents stating that specific instances of undesirable duplication of research had occurred in their work, caused by the lack of information on research carried out elsewhere; among those employed at:

Academic institutions	13%
Research institutions	16%
Industrial institutions	26%
All institutions	21%

(Only 10 per cent, or 19, of the respondents followed the instruction to describe a specific instance in this self-administered questionnaire. In at least five of the nineteen instances the material had not been published at the time the duplication of work was undertaken. Details are given on pp. 53-55.)

104, p. 144
Committee on the Survey[Z]

Ph.D.'s in mathematics from U.S. and Canadian universities, awarded 1915-54

Has long delay in publication of the work of others caused you needlessly to duplicate the work of others, or otherwise hampered your research?	All respondents	Those whose publication record placed them relative to their age group, in the: Top 15% (P-4)	Next 35% (P-3)	Bottom 50%: At least 2 papers publ. (P-2)	Bottom 50%: less than 2 papers publ. (P-1)
Yes	16%	31%	20%	12%	8%
No	57	60	67	59	42
No answer	27	10	13	29	50
Total	100%	100%	100%	100%	100%

116, p. 42
Menzel

Biochemists, chemists and zoologists on Columbia University faculty

Per cent who were able to recall a recent concrete instance of existing "knowledge that would have made a difference in [their] work reaching [them] too slowly," with the information

published	13%
not published	10%

at the time of the missed opportunity.[A]

(The estimated effect of the information, had it reached the scientist in time, is given on p. 42; other details, pp. 38-42.)

Additional Data

[A] Also given separately for Biochemists, Chemists and Zoologists (percentages to be computed). p. 42.

[Z] Percentages computed by the reviewers.