1. 29. THE BASIC KINDS OF INFORMATION SOUGHT BY RESEARCH WORKERS CAN BE REPRESENTED (IN ORDER OF IMPORTANCE) AS:

1. RESEARCH PLANS (OF OTHERS)
2. NAMES (OF OTHERS WORKING IN THE FIELD)
3. DATA compilations
4. METHODS
5. PRINCIPLES
6. THEORIES
7. Review papers and bibliographies on specific subjects

14. MORE EFFECTIVE CLASSIFICATION AND INDEXING IS NECESSARY FOR BOOKS, JOURNAL ARTICLES, AND SPECIALIZED MONOGRAPHS. THERE IS MUCH ROOM FOR IMPROVEMENT IN THE PRACTICES OF INDIVIDUAL LIBRARIES IN THIS REGARD, AND FOR THE DEVELOPMENT OF CENTRAL BIBLIOGRAPHIC SERVICES.

13. IN MANY OF THE HOSPITALS THAT HAVE A RESEARCH POTENTIAL, THE LIBRARY IS TOTALLY INADEQUATE AND ALL TOO FREQUENTLY CONSISTS OF AN ILL-KEPT AND VIRTUALLY RANDOM COLLECTION OF JOURNALS AND BOOKS.

FOR VARIOUS REASONS, MOSTLY ECONOMIC, BIOMEDICAL LIBRARIES HAVE NOT KEPT PACE WITH THE INCREASE IN THE VOLUME OF RELEVANT PUBLICATIONS OR WITH THE GROWTH OF THE SCIENTIFIC COMMUNITY WHOSE NEEDS THEY MUST MEET.

THERE IS SCARCELY A MEDICAL LIBRARY IN THE COUNTRY WHICH IS NOT ALREADY OVERCROWDED AND WHOSE PHYSICAL FACILITIES DO NOT IMPOSE SERIOUS INCONVENIENCES ON ITS USERS.

BIOMEDICAL SCIENTISTS NEED AN INFORMATION CENTER THAT IS NOT AVAILABLE OR GENERALLY EFFECTIVE IN THE SCIENTIFIC COMMUNITY AT THE PRESENT TIME.

22. TO KEEP ABREAST OF DEVELOPMENTS IN A GIVEN FIELD (CURRENT-AWARENESS REPORTING) THE REQUESTOR ~~WOULD LIKE~~ TO RECEIVE ALL THE LITERATURE, BUT IS NOT OVERLY CONCERNED IF HE MISSES SOME PAPERS.

MOST RESEARCHERS DO NOT NECESSARILY WANT A REFERENCE RETRIEVAL SYSTEM TO PROVIDE REFERENCES TO ALL OF THE LITERATURE THAT IS RELEVANT TO THEIR QUESTION.

2. IT IS NOT ABSOLUTELY ESSENTIAL FOR A REFERENCE RETRIEVAL SYSTEM TO FURNISH ALL OF THE MOST CURRENT REFERENCES.

3\. 20. IF TOO MUCH SERVICE IS PROVIDED, THERE IS THE DANGER THAT THE SEARCHER WILL LEAN TOO HEAVILY ON INFORMATION SERVICES AS A CRUTCH.

4\. IT IS CHEAPER (OR EASIER) TO REPEAT A PIECE OF WORK THAN IT IS TO FIND THE INFORMATION ON THE SAME JOB DONE EARLIER.

5\. ALL RESEARCHERS WANT TO HEAR OF NEW PUBLICATIONS IN THEIR FIELDS OF INTEREST AS SOON AS THE MATERIAL IS PUBLISHED (i.e., THEY WANT CURRENT-AWARENESS REPORTING WITH NO TIME LAG)

6\. READING AND ORAL DISCUSSION ARE OF ABOUT EQUAL IMPORTANCE AS A SOURCE OF IDEAS.

7\. ENGINEERS AND SCIENTISTS DOING EITHER APPLIED OR BASIC RESEARCH PREFER TO CONDUCT THEIR OWN SEARCHES, RATHER THAN HAVING THEM DONE BY SOMEONE ELSE

IN MANY TYPES OF PROJECTS, THE NEEDS FOR PUBLISHED INFORMATION AND GENERAL 'STATE OF THE ART' KNOWLEDGE ARE GREATER IN THE EARLIER PHASES, AND THE NEED FOR INTERNAL COMPANY INFORMATION AND CROSS-PROJECT INFORMATION IS GREATER IN LATER STAGES.

MOST INFORMATION NEEDS ARISE AT THE START OF MAJOR PROJECTS OR PROJECT PHASES.

8. A USER'S NEEDS FOR INFORMATION MAY FOLLOW CYCLES RELATED TO THE SIZE OF THE PROBLEM WORKED ON OR THE LENGTH OF THE PROBLEM UNIT.

9. 27. THE RESEARCHER OBTAINS HIS INFORMATION IN A BATCHED RATHER THAN A CONTINUOUS MANNER. HE PERIODICALLY LOADS UP ON INFORMATION, AND THEN COASTS ON THIS KNOWLEDGE FOR SOME TIME AFTERWARD~~, WITH SOMEWHAT OF A FLYWHEEL EFFECT.~~

28. THE USER'S BASIC ~~REASONS~~ needs FOR SEARCHING INFORMATION (IN ORDER OF FREQUENCY OF OCCURRENCE) ARE:

1. TO FIND A SPECIFIC ITEM OF INFORMATION NEEDED FOR ONGOING WORK
2. TO KEEP ABREAST OF PROGRESS IN HIS OWN, AND RELATED FIELDS
3. TO OBTAIN THE NECESSARY BACKGROUND INFORMATION BEFORE STARTING A TASK
4. TO STIMULATE CREATIVE THINKING

THE MAIN FUNCTIONS OF AN INFORMATION SERVICE ARE TO: 1) PREVENT EXCESSIVE DUPLICATION OF RESEARCH; 2) PROVIDE SPECIFIC INFORMATION items AS NEEDED; 3) PROVIDE "CATCHING UP" INFORMATION; 4) PROVIDE CURRENT-AWARENESS REPORTING; 5) STIMULATE CREATIVE THOUGHT.

10. THE WORK ACTIVITIES THAT GENERATE THE MOST SEARCHES ARE NOT NECESSARILY THOSE IN WHICH THE MOST WORKING TIME IS SPENT.

11. 23. THE USERS INFORMATION NEEDS ARE NOT RELATED TO THE SPECIFIC TYPE OF RESEARCH OR TASK THAT HE IS PERFORMING.

MOST RESEARCHERS HAVE A NEED TO CONDUCT A LITERATURE SEARCH AT LEAST ONCE A YEAR.

26. THE INFORMATION NEEDS FOR BIOMEDICAL RESEARCHERS ARE THE SAME AS THE INFORMATION NEEDS FOR ANY OTHER SCIENTIFIC OR TECHNICAL RESEARCHER.

25. ALL RESEARCHERS WANT A FREE CHOICE: TO MAINTAIN THEIR OWN CURRENT-AWARENESS AND PERFORM THEIR OWN SEARCHES; OR, TO REFER THEIR REQUIREMENTS TO OTHERS ~~SUCH AS~~ (in) INFORMATION CENTERS.

24. BECAUSE OF COST AND OTHER PRESSURES, MOST USERS must limit ~~CAN NOT AFFORD TO SPEND MORE THAN 20% OF~~ THEIR TIME IN REVIEWING OR SEARCHING THE LITERATURE to 20% of their total working time

12. THE MORE CREATIVE WORKERS DO MORE TECHNICAL READING THAN THE LESS CREATIVE WORKERS

13. THE DEVELOPMENT MAN GOES TO A LIBRARY IN RESEARCH OF SPECIFIC INFORMATION, WHILE THE RESEARCHER GOES THERE TO BROWSE.

THERE IS A NEED FOR MORE EFFECTIVE COMMUNICATION OF THE RESULTS OF RESEARCH BETWEEN FOREIGN AND AMERICAN SCIENTISTS.

14. PERSONAL FILES PLAY A MAJOR ROLE IN THE RESEARCH OF SOME INDIVIDUAL SCIENTISTS

30. THE MAIN REASONS FOR A USER TO CHOOSE A PARTICULAR SOURCE often OF INFORMATION ARE: 1) ITS ~~CONVENIENCE OR~~ AVAILABILITY & easy; AND 2) HIS KNOWLEDGE OF ITS EXISTENCE.

18. THE MANY (OVER 100) NIH STUDY SECTIONS, REVIEW COMMITTEES, AND SPECIAL ADVISORY GROUPS FORM A UNIQUE FRAMEWORK OF COMMUNICATION IN THE BIOMEDICAL SCIENCE COMMUNITY, AND THE INTERCHANGE OF INFORMATION AMONG THE MEMBERS OF THESE GROUPS IS ONE OF THE MOST VITAL AND PRODUCTIVE OF THE INFORMAL COMMUNICATION PROCESSES.

17. NEW DISCOVERIES, MAJOR FINDINGS, AND NEW CONCEPTS ARE FIRST PRESENTED AND DISCUSSED AT FORMALLY ARRANGED MEETINGS, CONFERENCES, SEMINARS, AND SYMPOSIA--CONSIDERABLY IN ADVANCE OF THE MORE PERMANENT PROCESS OF PUBLICATION.

16. THE RAPIDLY EXPANDING VOLUME OF SCIENTIFIC PUBLICATIONS AND THE INCREASED RANGE OF SCIENTIFIC DESCRIPTIVES INVOLVED IN MANY INDUSTRIAL RESEARCH PROJECTS HAVE GREATLY REDUCED THE EFFECTIVENESS OF ABSTRACTING SERVICES AS A TOOL FOR KEEPING CURRENT.

15. THERE IS TOO MUCH POOR LITERATURE, AND TOO LITTLE GOOD LITERATURE IN THE SYSTEM.

19. THERE IS A RAPID INCREASE IN PUBLISHED PAPERS OF ALL KINDS STIMULATED, IN PART, BY THE ACADEMIC COMMUNITY'S DICTUM, "PUBLISH OR PERISH."

A REFERENCE RETRIEVAL SYSTEM THAT PROVIDED ACCESS POINTS FOR MULTIPLE POINTS OF VIEW WOULD BE MORE USEFUL THAN A SYSTEM WHICH ONLY PROVIDED ASSESS POINTS FOR A SINGLE POINT OF VIEW

A REFERENCE RETRIEVAL SYSTEM THAT IDENTIFIED IN THE REFERENCE ALL ASPECTS OF RESEARCH REPORTED, AND THE EMPHASIS OF THE RESEARCH, WOULD BE MOST USEFUL

A REFERENCE RETRIEVAL SYSTEM THAT HAS A RESPONSE TIME OF ONE DAY OR LESS TO PRODUCE THE MAJOR GROUP OF RELEVANT REFERENCES, IS ADEQUATE FOR MOST USERS.

15. OF ALL THE OBVIOUS PERFORMANCE PARAMETERS, SPEED OF RESPONSE IS THE MOST IMPORTANT.

MOST USERS WOULD PREFER TO RECEIVE THE ORIGINAL DOCUMENTS (RATHER THAN ABSTRACTS, CITATIONS) IN RESPONSE TO THEIR SEARCH REQUEST.

21. THE MOST FREQUENT type of REQUEST RECEIVED AT A TECHNICAL INFORMATION CENTER IS FOR A SPECIFIC DOCUMENT REQUESTED BY TITLE, AUTHOR, OR NUMBER

User Requirements – Hypotheses

(1)

IN MANY TYPES OF PROJECTS, THE NEEDS FOR PUBLISHED INFORMATION AND GENERAL 'STATE OF THE ART' KNOWLEDGE ARE GREATER IN THE EARLIER PHASES, AND THE NEED FOR INTERNAL COMPANY INFORMATION AND CROSS-PROJECT INFORMATION IS GREATER IN LATER STAGES.

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by whom?

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e.g.

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delete?

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#3 on p. 1?

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pay positively

define

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info file hypotheses

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state POSITIVELY!

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same

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?

IF TOO MUCH SERVICE IS PROVIDED, THERE IS THE DANGER THAT THE SEARCHER WILL LEAN TOO HEAVILY ON INFORMATION SERVICES AS A CRUTCH.

anyone injured?

not info need

IT IS CHEAPER (OR EASIER) TO REPEAT A PIECE OF WORK THAN IT IS TO FIND THE INFORMATION ON THE SAME JOB DONE EARLIER.

same as P. 4

ALL RESEARCHERS ~~WANT~~ [don't NEED rapid notification] TO HEAR OF NEW PUBLICATIONS IN THEIR FIELDS OF INTEREST AS SOON AS THE MATERIAL IS PUBLISHED (i.e., THEY WANT CURRENT-AWARENESS REPORTING WITH NO TIME LAG) but not need daily

READING AND ORAL DISCUSSION ARE OF ABOUT EQUAL IMPORTANCE AS A SOURCE OF IDEAS or information?

use descrip info search pattern not needs

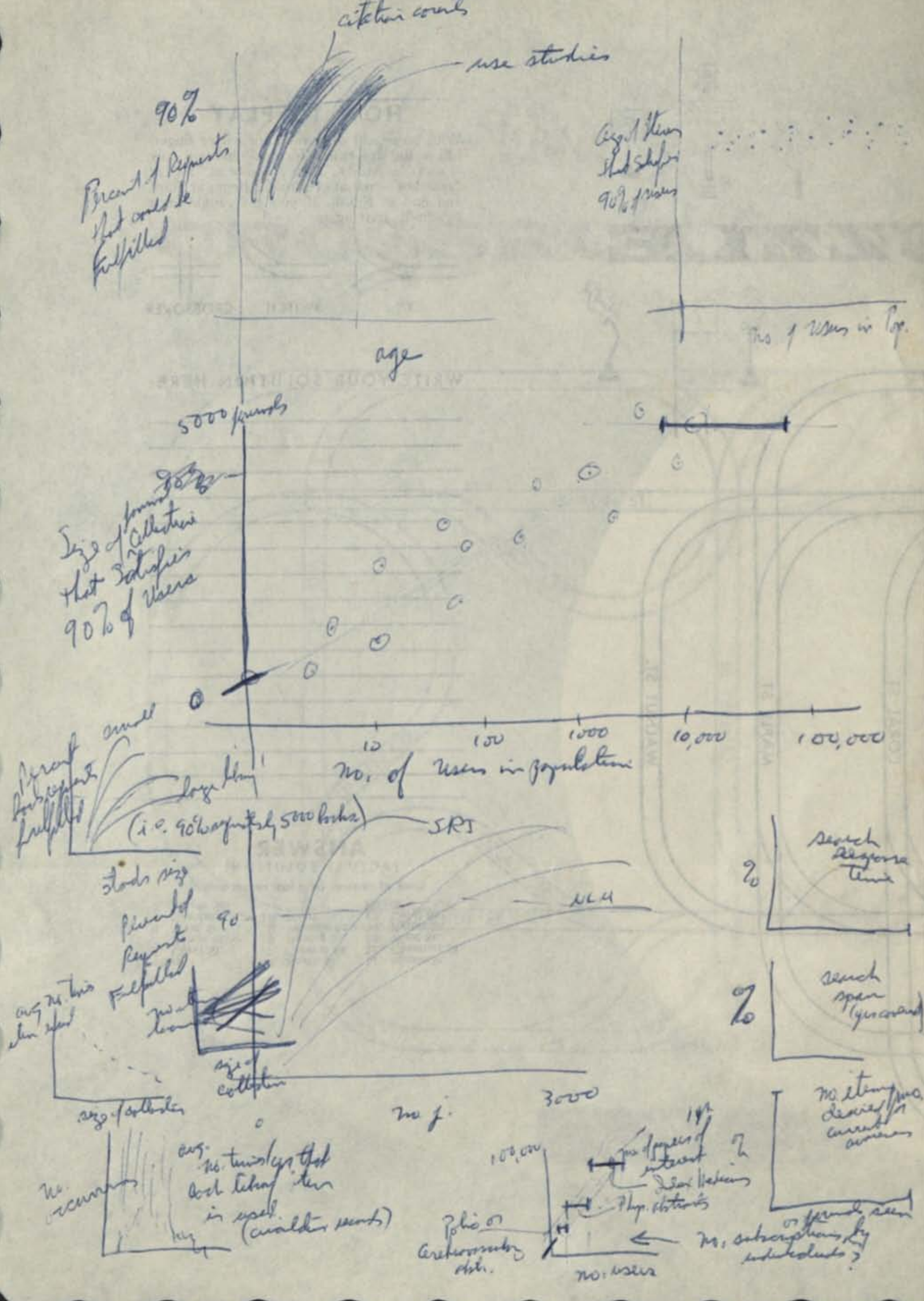
ENGINEERS AND SCIENTISTS DOING EITHER APPLIED OR BASIC RESEARCH PREFER TO CONDUCT THEIR OWN SEARCHES, RATHER THAN HAVING THEM DONE BY SOMEONE ELSE.

over

What about:

1) A biomedical research worker's current-awareness needs could be fulfilled by his browsing through 20 journals each month.

2) A biomedical research worker's retrospective search requirement could be fulfilled by a reference retrieval system that covered the literature of the last twenty years.


citation counts
use studies
90%
Percent of Requests that could be fulfilled
age
No. of Users in Pop.
5000 journals
Size of Collection that Satisfies 90% of Users
10
100
1000
10,000
100,000
No. of Users in population
small
large library
SRI
NLM
stacks size
Percent of Requests fulfilled
90
size of collection
size of collection
search response time
%
%
search span
3000
no. of
100,000
Polio or Arteriosclerosis
Phys. abstracts
No. subscriptions by individuals?
no. users
no. items desired
no. of journals seen

retrieval of what? (references, abstracts, full text)

Who is this?
Are there users with different types of needs?

How much of a need?
(enough to pay for it?)
When does he have the need (frequency, result of some other action)?

The (user) has a (need) for a (retrieval) service that will provide (rapid) (answers) to his (queries).

How rapid?

What kind of queries? What time span of info to be covered? What level of intellectual difficulty? What breadth + scope of coverage? ~~What depth~~ How exhaustive the coverage? What is the form of the query (generic, concept vs. specific names or keywords)?
Degree of logical complexity?

~~what kind of answers (references, abstracts, full copy)?~~

Any particular arrangement of answers (by author, by relevancy? by timeliness, by scope, etc.)

In what form (visual display, hard copy, microform, etc.)?

What is reported? (citations, abstracts, full text)

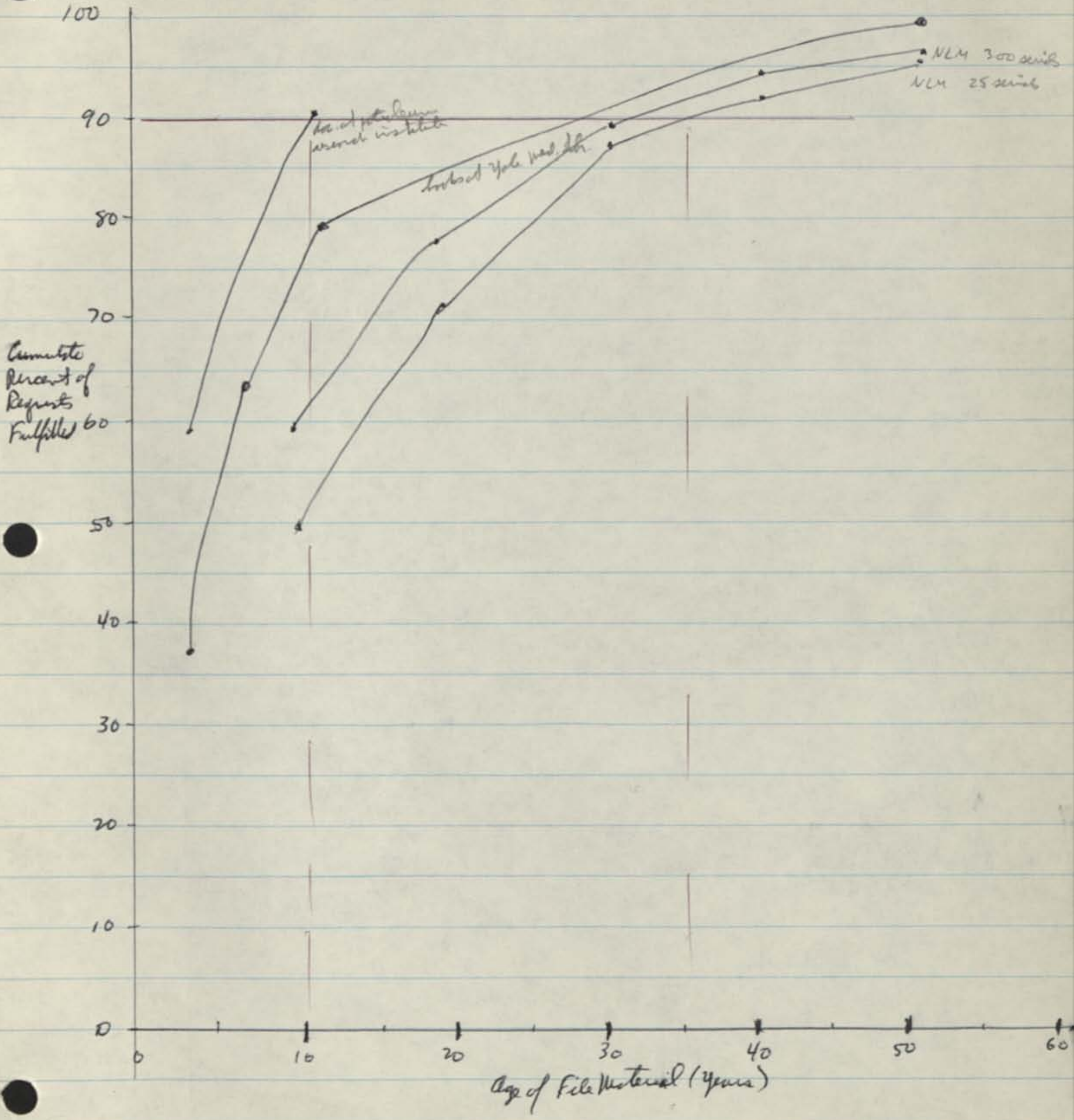
How timely (daily, weekly, monthly)?

The user has a need for a timely ~~current awareness~~ reporting service that will keep him informed of [illegible] information of interest to him.

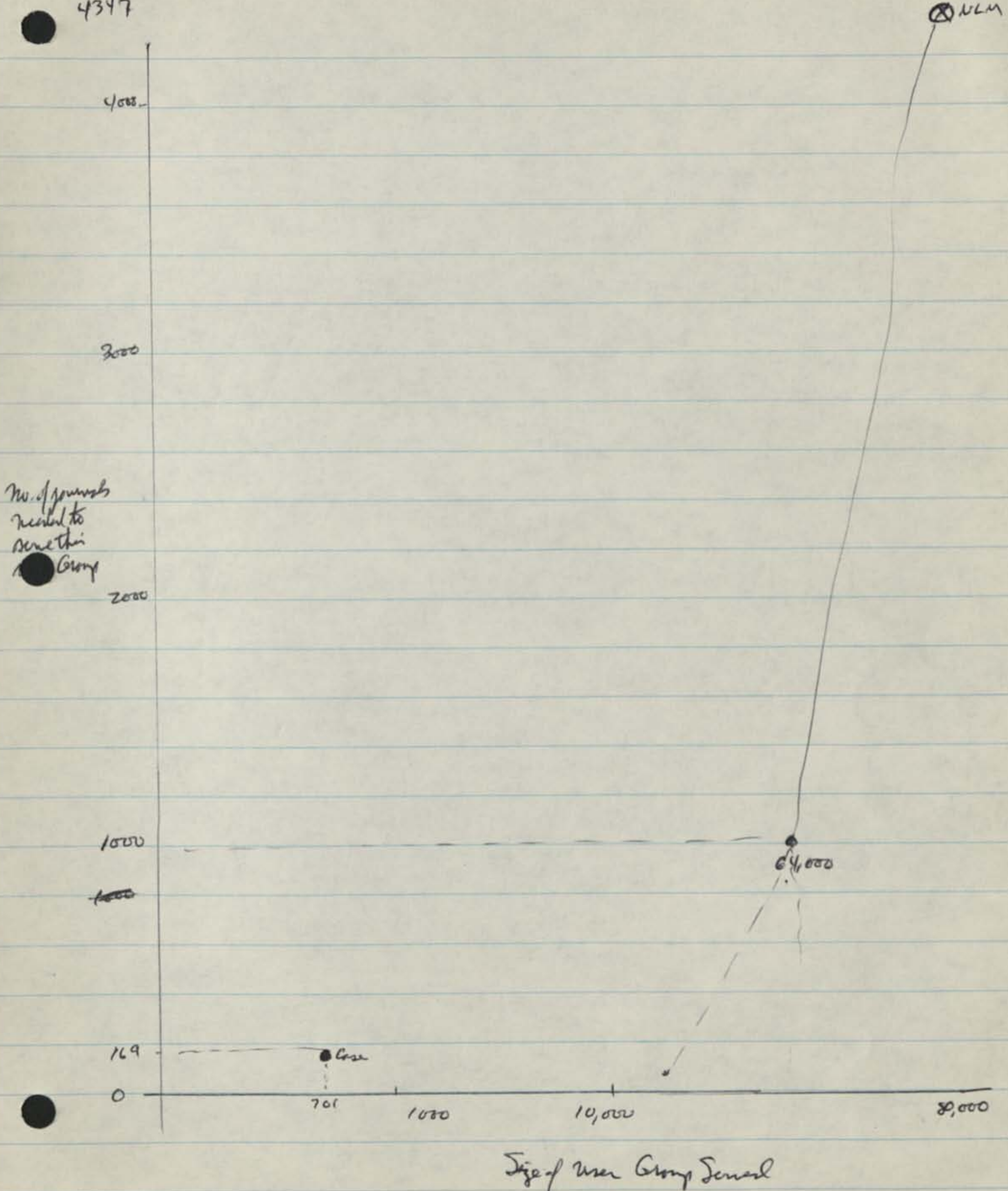
At what frequency or interval?
In what volumes or size of packages?

How current does it have to be? (e.g. everything reported at least by 3 weeks after it happens?)

Of interest "today" or "tomorrow" or when?
Of what degree of interest?


100
90
80
70
60
50
40
30
20
10
0
Cumulative Percent of Requests Fulfilled
0
10
20
30
40
50
60
Age of File Material (Years)
NLM 300 serials
NLM 25 serials

4347


NLM
4000
3000
No. of journals needed to serve this Group
2000
1000
64,000
169
Case
0
701
1000
10,000
80,000
Size of User Group Served

Hypothesis: ALL RESEARCHERS WANT TO HEAR OF NEW PUBLICATIONS IN THEIR FIELDS OF INTEREST AS SOON AS THE MATERIAL IS PUBLISHED (i.e., THEY WANT CURRENT-AWARENESS REPORTING WITH NO TIME LAG)

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
FALSE	Approximately 1,000 research physicists working in all fields of physics	A questionnaire survey disclosed that a reference retrieval system that could retrieve references to the current literature of physics at 3-4 month intervals would satisfy approximately 75% of the requests made by the physicists in this study.	1

Fraction of User Population	Preferred Frequency of Reporting
25%	every 1-2 mos.
35	every 3-4 mos.
32	every 6 mos.
8	every 12 mos.

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
TRUE	Petroleum researchers	None given. The statement is made, "The exploratory researcher . . . needs his attention called promptly to interesting articles in journals he normally would not see."	14

Hypothesis: MOST RESEARCHERS NEED AN EXHAUSTIVE LITERATURE SEARCH ONLY A FEW TIMES A YEAR.

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
TRUE	94 electrical engineers doing applied research	Interviews with 94 electrical engineers from 4 research organizations disclosed the following number of searches that had been conducted or requested in the last year.	2

No. of Searches Requested in the last year	Percent of users with this number of requests	Percent of total users whose search needs could be met by this number of searches per year
0	2	2
1-2	23	25
3-5	23	48
6-10	26	74
11 or more	23	97
unspecified	3	-

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
TRUE	biomedical researchers	None given. The statement was made, "The usual research worker requires an exhaustive search only once during the course of a project --at the beginning, somewhere in the middle, or when he is writing it up for presentation. This means he performs, or should perform, on the average, only one or perhaps two exhaustive searches a year. Since it often takes weeks to digest the results of such a search, he could hardly handle more."	23

Hypothesis: THE MORE CREATIVE WORKERS DO MORE TECHNICAL READING THAN THE LESS CREATIVE WORKERS

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
TRUE	94 chemists in a single industrial research laboratory	Analysis of data from questionnaires led to the following generalization, "The most creative chemist does significantly more technical reading on the job than the least creative chemist."	16
TRUE	chemists and physicists	Using a random alarm device and diary technique, a study of 297 chemists and 404 physicists from 71 organizations (totalling 33,302 observations, of which 735 were reading observations) noted that, "Those who publish papers appear to do more reading than those who do not publish." Comparing publishers versus non-publishers, chemists and physicists did 13.0 and 7.4 percent more reading respectively. One other comment was made, "Both chemists and physicists who work for research departments read journals more than twice as frequently as other chemists and physicists."	28

Hypothesis: MOST RESEARCHERS DO NOT NECESSARILY WANT A REFERENCE RETRIEVAL SYSTEM TO PROVIDE REFERENCES TO ALL OF THE LITERATURE THAT IS RELEVANT TO THEIR QUESTION.

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
TRUE	Approximately 1,000 research physicists working in all fields of physics	A questionnaire survey disclosed that 60% of the requests postulated by the physicists in this study could be satisfied by a reference retrieval system that could retrieve references to the past literature of physics as far back as 1940.	1

Fraction of User Population	Preferred Degree of Retrospection
40%	search back before 1940
20	" " to 1940
40	" " to 1950

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
TRUE	not stated	None given. The statement was made, "When requesting a particular fact or item of information, the user does not want all references that contain the item for which he is looking."	5
FALSE	not stated	None given. The statement was made, "In making a request for a retrospective search of the literature in a given field, the user asks for all relevant references."	5
TRUE	92 electrical engineers in applied research	Interviews with engineers from 4 research organizations disclosed the following data:	2

QUESTION: For all the kinds of searches you have done in the past few years, how often could you have used these types of searches (for the last 5 years of publication) ignoring the fact that you may have been unable to do these searches with current tools?

	Often	Once in a while	Never	No Answer	Total
The contents of 15 or less journals of special interest to you.	82%	16	--	2	100%
The contents of all the journals covered by the major indexing and abstracting services in your field	29%	68	1	2	100

Hypothesis:

Hypothesis Stated To Be	Population Studied	Evidence					Ref.
		Often	Once in a while	Never	No Answer	Total	
The contents of all the U.S. scientific and technical journals		9%	80	9	2	100	
The contents of all English speaking scientific and technical journals		14%	~~60~~ 69	15	2	100	
The contents of all the world's scientific and technical journals		8%	73	17	2	100	

QUESTION: Would your answer differ if you weren't limited to searching the last 5 years of publications?

Response	Percent
No difference	84%
Less often	10
More often	3
No answer	3
	100%

Hypothesis: ENGINEERS AND SCIENTISTS (DOING EITHER APPLIED OR BASIC RESEARCH) PREFER TO CONDUCT THEIR OWN SEARCHES, RATHER THAN HAVING THEM DONE BY SOMEONE ELSE

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
TRUE	92 electrical engineers doing applied research	Interviews with 92 electrical engineers from 4 research organizations disclosed the following data on who actually performed the searches.	2

Searcher	Percent of Total Searches
Self	62
Co-worker	9
Librarian	21
Other	8

All of these 4 organizations had competent library and reference staffs that could have performed the search if requested.

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
TRUE	Scientists in general	None given. In a discussion regarding the search for research ideas, the statement is made that, ". . . the researcher must do his own browsing through the literature; no one can screen the material for him, and he wants no intermediary between himself and the store of information."	5

This has nothing to do with preference

Hypothesis:

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
TRUE	Petroleum researchers	None given. The statement is made, "The exploratory researcher is the 'idea' man--the most creative member of the research staff. He reads a lot and is well informed in his own field of interest. When embarking on a new project, he will usually conduct his own search of the literature--with perhaps some assistance first in compiling a list of apparently important references. He does not need, and should not have an interpretation of the literature." The statements were also made that, "The development engineer . . . is likely to depend on information people for searches that interpret and evaluate older literature." and "The research supervisor . . . must lean heavily on information people to supply his needs."	14
TRUE	94 chemists in a single industrial research laboratory	The following generalization was made after a study of the responses to questionnaires, "Technical Information services offered by the library staff were only of moderate importance to creative chemists. Some of the most creative chemists used these services, but <u>most</u> of them relied in large measure on their own efforts." In a later paragraph the seemingly contradictory statement was made, "The most creative chemists were about <u>equally divided</u> as to whether they preferred to have a literature search done for them or to do it themselves." One further statement was made, "Most (creative chemists) would prefer to search for specific data themselves rather than accept library reference service."	16

Hypothesis:

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
TRUE	14 British libraries (13 industrial, 1 university)	Differences in habits of various occupational groups were noted by direct observation, and by analysis of 290 questionnaires filled in by the library users. The reference made the following comment about working scientists, engineers, and other graduates directly engaged in research or development, "This was by far the largest user group (just over 50 percent of our sample). Their needs and habits are of obvious importance to libraries and librarians. However, they used the library slightly less frequently than the technical executives. The biggest frequency group amongst working scientists and engineers was in the 'once a week' category. The scientist or engineer seems slightly more likely to look for the information himself than to ask the librarian to do it for him. (underlines added) He is not as self-reliant in this request as the technical executive. Primarily, the scientist or engineer comes to the library to collect or check simple facts, or to obtain a description of an object, process, or method. Like the technical executive he formulates his position to the librarian well in most cases, and is fairly easy to know just what it is he does want."	26

Hypothesis: THE USERS INFORMATION NEEDS ARE NOT RELATED TO THE SPECIFIC TYPE OF RESEARCH OR TASK THAT HE IS PERFORMING.

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
FALSE	chemist and physicists	Using a random alarm device and diary technique, a study of 297 chemists and 404 physicists from 71 organizations (totalling 33,302 observations, of which 735 were reading observations) noted that, "Both chemists and physicists who work for research departments read journals more than twice as frequently as other chemists and physicists."	28

Hypothesis: RESEARCHERS IN THE MORE TRADITIONAL AND RELATIVELY WELL ORGANIZED SUBJECT FIELDS NEED LESS ASSISTANCE IN INFORMATION RETREIVAL THAN THOSE WHO WORK IN THE LESS WELL-DEFINED FIELDS.

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
TRUE	scientists and engineers in a British industrial research center	Three groups of seven people each were established on the basis of the degree to which they worked in a relatively well-organized and traditional subject field. A check was then made on the reference requests (total of 75) made to the organization's information center by each of these 21 people over an 18-month period.	22

Group I comprised occupations in a subject of which the underlying principles are well developed, the literature is well organized, the subject area is fairly well defined (e.g., a search for the structure or the synthesis of a complex organic polymer). Group II has a wider subject area. The information is less well organized (e.g., research into the application of lubricants). Group III has an even greater number and variety of subjects, and there is almost no organization of the literature (e.g., research into the thermal properties of frozen soils). The data that was collected for the researchers inquiries are shown in the table below:

	GROUP I		GROUP II		GROUP III	
	No. of Inquiries	No. of Requestors	No. of Inquiries	No. of Requestors	No. of Inquiries	No. of Requestors
Chemist	3	5	19	2	4	2 (one asked more)
Physicist	0	2	-	-	8	1
Engineer	-	-	9	5	25	3
Metallogist	-	-	-	-	7	1
	3	7	28	7	44	7

The above inquiries are those taking more than 30 min. to answer. short inquires of the people in the above groups also recorded for a 3-month period and were found to follow the pattern of the long inquiries, with totals of 4, 7, 17 inquires for Groups I, II, III, respectively.

Hypothesis:

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
TRUE	researchers at a British petroleum research center	A study of 517 inquiries made to the technical information center over a 10 year period led to the following statement, "More inquiries are received from engineers, per capita, than from chemists with physicists occupying an intermediate position. It is generally accepted that chemists devote more attention, in their university days, to published literature than do engineers and they are usually familiar with Chemical Abstracts, so that they are more able tofind their own answers to inquiries than are engineers, for whom the literature is less well organized." (underlines added)	25

Hypothesis: OF ALL THE OBVIOUS PERFORMANCE PARAMETERS, SPEED OF RESPONSE IS THE MOST IMPORTANT.

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
TRUE	92 electrical engineers in applied research	During interviews with engineers from 4 research organizations the user was asked to rank several system characteristics in terms of relative importance. The following concensus ranking was obtained:	2

1. (Most important) Minimum time to get the major group of relevant references to you.
2. Minimum of relevant material overlooked by the search
3. Certainty that specified sources over certain periods of time were searched
4. References come to you in a form you prefer (complete document, abstract, citation, or document number)
5. Assurance that documents on a given subject do not exist
6. Minimum of effort on your part to communicate your request for a search.
7. (Least important) Minimum of irrelevant material produced by the search.

A statistical test of the rank concordance, or agreement, among the individual rankings showed that it is fair to conclude that there is agreement among the 92 rankings (1% significance level). However, a study of the individual rankings suggested that the main reason for the agreement was the almost universal agreement on speed as the most important characteristic. When this characteristic was removed from the ranking, it was found that generally the users could not agree amongst themselves as to the relative importance of the remaining characteristics.

Is this in
list of
assumptions?

Need to add assumption
PPA cites in her chapter --
quote from ADI 1962 proceedings
(Boston meeting)

Hypothesis: THE USER GENERALLY PREFERS TO HAVE HIS LIBRARY MATERIAL CLOSE AT HAND, AND AT A SINGLE LOCATION.

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
TRUE	Univ. of Michigan faculty members	80% of the University of Michigan faculty (1355 respondents) answered a survey questionnaire that asked questions of their use of the University Library collections and services. They were asked the question, "How does the distribution of library materials in several locations on the campus (branch libraries) affect your work?" The responses were: Favorably 17% Makes little difference 48 Somewhat unfavorably 24 Great source of annoyance 7 Not ascertained 4 100% The report stated that, "The distribution of materials in several locations affects about one-third of the faculty unfavorably... While the balance of feeling seems to be against distributing materials in several locations, in other questions the majority of those having branch libraries vote against centralizing the collections in their own fields."	24
TRUE	14 British libraries (13 industrial, 1 university)	The following comments were made, "Even the geographical location of a library seems to affect volume and type of use. If a library is situated in an inaccessible place--for example at the very top of an old building, or in a separate block from the laboratories or research departments--it is at a mechanical disadvantage. It will probably have less custom than an identical library in a more convenient site, and the custom it does get may be of the wrong type. For example, the neighbouring departments may use it to look up bus maps and address for private purposes, while the laboratory staff will avoid the nuisance of a special trip to the library and will seek other sources	26

of information. These other means are not only less accurate on the whole they usually take longer in the end. Of course, in these circumstances the precise and formulated inquiry, where the user knows exactly what he wants, should still (theoretically) get through to the library by telephone. It was interesting to note that in fact it did not seem to do so! The less forumulated inquiry of the browsing or background-information variety has even less chance of finding its way to the remote library, because in this case it is almost essential that the user be there in person. Several librarians commented that number and type of custom had changed following the removal of the library to new quarters. One library we visited had been shifted from a site actually within the works to the administrative block about three minutes' walk away. Before the move this library was very busy, answering a lot of short practical technical inquiries. Its main customers were technicians. After the move, custom decreased, and was mainly administrative in nature. This, of course, could be a good thing or a bad thing, depending on what the library was supposed to be doing. Obviously, however, a firm contemplating the establishment of a new library needs to consider carefully which departments and persons it will serve most usefully, and situate it close to them."

Hypothesis: THE BASIC KINDS OF INFORMATION SOUGHT BY RESEARCH WORKERS CAN BE REPRESENTED (IN ORDER OF IMPORTANCE) AS:

1. RESEARCH PLANS (OF OTHERS)
2. NAMES (OF OTHERS WORKING IN THE FIELD)
3. DATA
4. METHODS
5. PRINCIPLES
6. THEORIES

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
NOT STATED	research workers in the field of atomic energy	An analysis of 4696 reference questions received by 14 atomic energy research and reference organizations in the U.S. collected over a one-year period during 1956-1957, disclosed that 18.0 percent were non-technical, and the remainder (82.0 percent) were scientific or technical, involving one or more of the natural or engineering sciences.	

The non-technical questions were of the following type:

Category	No./Questions	Percent of Total Non-Technical Questions
Business and Management Techniques	265	31.3
Buyers' information and prices: business and commodity statistics	247	29.2
Information about institutions and organizations	139	16.4
Documentation and communication techniques	28	3.3
Spelling: non-technical definitions: identification of quotations	24	2.8
Meeting programs	22	2.6
Popular information on atomic energy	21	2.5
Safety statistics: general safety programs	20	2.4
Education and training	16	1.9
Laws and regulations	15	1.8
History:dates	14	1.7
Requests for bibliography of specific author	13	1.5
Geographical information	12	1.4
Biographical Data	9	1.1
	845	99.9

The technical questions were of the following type:

(see following page)

Category	No. of Questions	Percent of Total Technical Questions
Description of a process or method of procedure	969	25.5
Physical, chemical, and engineering properties of substances	953	24.6
Description of apparatus or equipment	651	16.8
Physical and chemical constants	635	16.4
Biological effects of substances: Hazards: Toxicology	225	5.8
Radiation effects	112	2.9
Materials for specific applications	101	2.6
Composition of materials	54	1.4
Standards and specifications	46	1.2
Technical definitions	46	1.2
Description of meteorological or geological phenomena	39	1.0
Mathematical constants and methods	20	0.5
Totals	3851	99.9

Hypothesis:

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
NOT STATED	biomedical researcher	None given. This reference stated that the kinds of information needed are: 1. Methods. ("He needs detailed information on methods useful in his research.") 2. Data. ("He needs data, often the raw data so that he may check for himself the conclusions of others or see how their data fits with his own hypotheses.") 3. Theories. ("He needs to know what theories currently provide the conceptual framework for his field.") 4. Stimulation. ("Last, he needs something which ...is less tangible... It could be called 'speculations', but its value to a research worker is to stimulate his thinking.")	23

Hypothesis: THERE IS A NEED FOR MORE EFFECTIVE COMMUNICATION OF THE RESULTS OF RESEARCH BETWEEN FOREIGN AND AMERICAN SCIENTISTS.

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
TRUE	workers in health-related research	None given.	6
TRUE	U.S. medical researchers	Interviews with 500 American medical researchers from 59 medical research organizations in 6 American cities disclosed that 260 of them had not sought or obtained any Soviet research	7

information during the previous 6 months. The primary reasons stated for not using the information were,

1. "First, it was felt that there are no fully adequate keys to make the American scientist aware of the existence of pertinent Soviet information, and that if there are keys, they are not being sufficiently publicized."
2. "Second, the nonusers expressed the feeling that they could not obtain up-to-date Soviet publications."
3. "Third, there was the language barrier and the difficulty of obtaining translations when and as they are needed."
4. "Fourth, there was the problem of inadequate contact, correspondence, and exchange of information with Soviet scientist on a person-to-person basis. This was related, in the minds of a number of the respondents, to security restrictions imposed by both the United States and Soviet governments."
5. "Fifth, and related to the fourth problem, was a lack of familiarity with notable Soviet workers in fields of interest to the respondents."
6. "Sixth, there was an ignorance of what the Soviet Union is doing in pertinent fields and of whether it is worth looking into."

This reference also made the comment that, "...a large percentage of the respondents who had not sought or obtained Soviet information in the previous 6 months,... answered that they simply felt no specific need for Soviet information (per se)... but were interested in pertinent work wherever it was being done." This reference also stated that,"...the small use that is made of Soviet information by American medical scientists is due, in large measure, to a simple lack of interest in it."

Hypothesis: ALL RESEARCHERS WANT A FREE CHOICE: TO MAINTAIN THEIR OWN CURRENT-AWARENESS AND PERFORM THEIR OWN SEARCHES; OR, TO REFER THEIR REQUIREMENTS TO OTHERS SUCH AS INFORMATION CENTERS.

Hypothesis Stated To Be	Population Studied	Evidence	Ref.

Hypothesis: BECAUSE OF COST AND OTHER PRESSURES, MOST USERS CAN NOT AFFORD TO SPEND MORE THAN 20% OF THEIR TIME IN REVIEWING OR SEARCHING THE LITERATURE.

Hypothesis Stated To Be	Population Studied	Evidence	Ref.

TO KEEP ABREAST OF DEVELOPMENTS IN A GIVEN FIELD (CURRENT-AWARENESS REPORTING) THE REQUESTOR WOULD LIKE TO RECEIVE ALL THE LITERATURE, BUT IS NOT OVERLY CONCERNED IF HE MISSES SOME PAPERS.

Hypothesis:

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
TRUE	not stated	none given	5

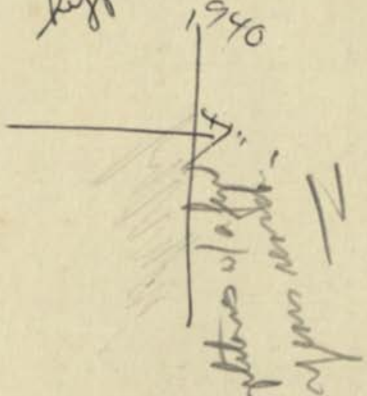
Hypothesis: THE MOST FREQUENT REQUEST RECEIVED AT A TECHNICAL INFORMATION CENTER IS FOR A SPECIFIC DOCUMENT REQUESTED BY TITLE, AUTHOR, OR NUMBER

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
TRUE	Not stated	None given	5

see side slip forward.

card
indx

AIP's work
relates to
hypothesis re retrospective
searches.



Hypothesis: A REFERENCE RETRIEVAL SYSTEM THAT HAS A RESPONSE TIME OF ONE DAY OR LESS TO PRODUCE THE MAJOR GROUP OF RELEVANT REFERENCES, IS ADEQUATE FOR MOST USERS.

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
TRUE	Electrical engineers in applied research	Interviews with 92 engineers from 4 companies disclosed the following data:	2

Response Time	Percent of users that received this response time on their last search	Percent of users that felt that this was the kind of time response that they needed for that particular task	Percent of users that felt that this was the longest time lag that they could have tolerated for that particular task
1 day or less	29%	32%	3
2-3 days	18	18	13
4-13 days	22	22	15
2-7 weeks	20	21	41
2-6 mos.	8	4	19
more than 6 mos.	--	--	5
no answer	3	3	4

In the same study, answers were also received to the following question:
Question: On the type of search we've been discussing, how long from the time you make your request can you generally wait for a search that covers 50% of the potential sources? 80%? All or almost all potential sources?

Time Delay	50% of Sources	80% of Sources	Almost all Sources
≦ 3 days	25%	3%	2%
4-7 days	24	19	5
8-13 days	4	5	8
2-3 weeks	30	33	27
4-7 weeks	14	27	24
2-3 mos.	2	11	22
≧ 3 mos.	--	1	9
No answer	--	1	3
	100%	100%	100%

Hypothesis: A REFERENCE RETRIEVAL SYSTEM THAT IDENTIFIED IN THE REFERENCE ALL ASPECTS OF RESEARCH REPORTED, AND THE EMPHASIS OF THE RESEARCH, WOULD BE MOST USEFUL

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
TRUE	Approximately 1,000 research physicists working in all fields of physics	An analysis of more than 6,000 research requests from the 1,000 research physicists	1

Hypothesis: A REFERENCE RETRIEVAL SYSTEM THAT PROVIDED ACCESS POINTS FOR MULTIPLE POINTS OF VIEW WOULD BE MORE USEFUL THAN A SYSTEM WHICH ONLY PROVIDED ACCESS POINTS FOR A SINGLE POINT OF VIEW

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
TRUE	Approximately 1,000 research physicists working in all fields of physics	An analysis of more than 6,000 search requests from the 1,000 research physicists disclosed that they specify type of research, as well as aspects of research and emphasis of research. Consequently, a more useful reference retrieval system would be one that: (1) specified type of research done (e.g., experimental, theoretical, or both), and (2) what are the aspects and emphasis of the research done (e.g., what property of what object was determined or calculated by what method?).	1

Hypothesis: IT IS NOT ABSOLUTELY ESSENTIAL FOR A REFERENCE RETRIEVAL SYSTEM TO FURNISH ALL OF THE MOST CURRENT REFERENCES.

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
TRUE	92 electrical engineers in applied research	interviews with engineers from 4 research organizations disclosed the following data:	2

Age of Most Recent References Prescribed by the Search	Percent of Engineers that Received this Age as the Most Current Material in their Search Results	Percent of Engineers that Felt that This Age was a Tolerable Minimum
under 3 months	32%	37%
3-5 months	12	15
6-11 months	18	16
1-2 years	21	20
2-10 years	10	5
over 10 years	5	4
no answer	2	3

Hypothesis: MOST USERS WOULD PREFER TO RECEIVE THE ORIGINAL DOCUMENTS (RATHER THAN ABSTRACTS, CITATIONS) IN RESPONSE TO THEIR SEARCH REQUEST.

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
TRUE	92 electrical engineers in applied research	Interviews with engineers from 4 research organizations disclosed the following data:	2

Form of Search Product	Percent of Users that get this form now	Percent of Users that prefer this form	Percent of Users that feel that this form is not preferred, but is adequate	Percent of Users that feel that this form is inadquate
Complete document	47.6%	43.3%	40.5%	--%
Abstract	24.7	46.0	24.7	6.2
Citation	26.5	10.7	32.5	33.5
Document number	1.2	--	2.3	60.3

see SRI study on Japanese science

Hypothesis: RESEARCHERS GENERALLY HAVE AN INTEREST IN, OR WANT TO SEE, SOME FORIEGN JOURNALS ON A REGULAR BASIS.

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
TRUE	U. S. medical researchers	Interviews with 500 American medical researchers from 59 medical research organizations in 6 American cities disclosed that 240 of them had sought or obtained Soviet information in the previous 6 months, and that 58 did see	7

specific Soviet journals on a regular or occasional basis. In all, 15 Soviet journal titles were named by the respondents who did see Soviet journals. These journals, in rank order by the number of times mentioned (figure in parenthesis) are:

- Biokhimiya (16)
- Zhurnal Obshchei Khimii (10)
- Doklady Akademii Nauk S.S.S.R. (8)
- Byulleten Eksperemt lnoi Biologii i Meditsiny (7)
- Fiziologicheskii Zhurnal S.S.S.R. immeni I.M. Sechenova (4)
- Mikrobiologiya (3)
- Biofizika (2)
- Meditsenskaya Parazitologiya i Parazitarnye Bolezni (1)
- Sovetskaya Meditsina (1)
- Terapevticheskii Arkhiv (1)
- Voprosy Virusologii (1)
- Zhurnal Analiticheskoi Khimii (1)
- Zhurnal Mikrobiologii, Epidemiologii i Immunobiologii(1)
- Zhurnal Nevropatologii i Psikhiatrii imeni S.S. Korsakova (1)
- Zhurnal Priklad'noi Khimii (1)

Of these 240 people, 44 had Soviet material translated (monthly within the individual's organizations) during the previous 6 months, most of it from Soviet journals. For the 260 researchers who had not sought or obtained any Soviet research information during the previous 6 months, the primary reasons stated were lack of accessibility, lack of familiarity, language barrier and difficulty of obtaining translations (and not that they weren't interested or didn't need the information).

Hypothesis:

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
NOT STATED	Inter-library loan customers of the National Library of Medicine	A study of the 77,698 loan requests made to NLM during the entire 1959 calendar year disclosed the following data regarding requests for foreign journals. Among the 300 most requested journals:	27

Country of Publication	No. of Titles	No. of Loans
United States	145	22,141
United Kingdom	37	6,116
Germany	32	3,452
France	20	2,237
Switzerland	11	1,038
Sweden	9	1,109
Italy	5	667
Russia	5	387
Belgium	4	312
Canada	4	578
Denmark	4	466
Argentine Republic	3	322
India	3	278
Netherlands	3	422
Australia	2	422
Austria	2	184
Hungary	2	166
China	1	97
Czechoslovakia	1	135
Japan	1	73
Kenya	1	73
New Zealand	1	68
Norway	1	153
Poland	1	66
Spain	1	91
Union of South Africa	1	155
	300	41,208

Of the 300 most requested journals, over one-half of the titles, and almost one-half of the loans were from countries other than the United States. However, this still represents a relatively small number in terms of the total number of U.S. researchers. Approximately 2/3 of the titles and 3/4 of the loans from this group of 300 were in English.

Hypothesis: The library users can be grouped into the following categories, each of which has a different need and habit pattern: (1) administrative type; (2) clerical/secretarial; (3) technical executive-type; (4) working scientists, engineers, and other graduates directly engaged in research or development; (5) technicians; (6) non-scientific specialist employees.

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
TRUE	14 British libraries (13 industrial, 1 university)	Differences in habits of various occupational groups were noticed by direct observation, and by analysis of 290 questionnaires filled in by library users. The following groupings were established:	26

1. Administrative/executive-type users formed 12 percent of our sample, Administrators (defined for our purposes as non-technical, high-level personnel) tended to contact the library personally. They did not send subordinates or secretaries in their place. They seemed, however, more likely than any other group to ask the library staff to find the required information for them. Their queries took longer to answer; the librarian put in far more time on an "executive" inquiry than on an inquiry from any other group. Average time spent was 33.9 minutes, as opposed to, for example, an average of 9.8 minutes per inquiry from a working scientists or engineer. Administrators seemed to use the library to check simple factual matters, or to obtain a description of an object, process, or method. They seemed to be more interested than any other group in obtaining data for, and from, outside sources and firms.

2. Clerical/secretarial users (2 percent of the sample). This group was too poorly represented to provide any positive findings. Negatively, however, this in itself is revealing. It is in line with the findings of other investigators who have concluded that this is not a group for which the library needs to plan or cater. It also indicates that they are not used as a messenger service between executive and librarian, as one might perhaps imagine.

3. Technical/Executive-type users form one of the larger groups (11 percent of the sample). They are graduate engineers, scientists, etc. in executive posts, engaged in planning, directing, or controlling research. Technical executives seem to be the "regulars." They show signs of being the heaviest users in terms of frequency of use, though not in terms of the demands they make on the library staff. Nearly half of this group used the library almost every day. They seem far more likely than administrators of working scientists/engineers to look up information for themselves. This does not mean that they mistrust the capabilities of the library staff. Relations between this group and library staff were noticeably good. The reason for their independence may be that they just are very good at literature searching. They are probably more familiar with the subject and the literature than any other group of users. Their manner when using the library was self-assured. They seemed "at home" in it and knew just where everything was situated. Primarily this group seemed to come to the library for a description of an object, process, or method.

4. <u>Working scientists, engineers, and other graduates directly engaged in research or development</u>. This was by far the largest user group (just over 50 percent of our sample). Their needs and habits are of obvious importance to libraries and librarians. However, theu used the library slightly less frequently than the technical executives. The biggest frequency group amongst working scientists and engineers was in the "once a week" category. The scientists or engineer seems slightly more likely to look for the information himself than to ask the librarian to do it for him. He is not as self-reliant in this respect as the technical executive. Primarily the scientist or engineer comes to the library to collect or check simple facts, or to obtain a description of an object, process, or method. Like the technical executive he formulates his question to the librarian well in most cases, and it is fairly easy to know just what it is he does want.

5. <u>Technicians</u>(those engaged in engineering or scientific work, non-graduate level). This is the second largest user group in our sample (20 per cent) Here the type of document used to obtain the required information differed slightly in comparison with other groups. All other groups depended most heavily on periodicals as information sources, Technicians used handbooks and textbooks more frequently than they used periodicals. Perhaps this is because as a group they are not as expert in their chosen subject field as the others, they are studying and need the texts for this purpose. Technicians seem more likely to ask the librarian for help than the tecnnical executive or the working scientist/engineer, and they take longer to find material if left to do it themselves. The librarian, however, seems to put in less time (average 5.3 minutes) on an inquiry from a technician than he does with any other group except clerical/secretarial workers. This seems to indicate that technicians are the least efficient group when it comes to literature searching, and that they do need help in a library, though the inquiries they bring may not be instrinsically very difficult to answer. Watching technicians using the library one saw that much of this difficulty lay in inability to use the resources (not understanding how to use the catalogue, not knowing where reports were kept, etc.). Librarians commented that technicians had more difficulty in formulating a question precisely. They also said that they were more dependent, and wanted to be "spoon-fed". Technicians using libraries sometimes looked frustrated and bewildered.

6. <u>Non-scientific specialist employees</u>. This is a small group (5 percent of our sample), defined as lower-level administrative staff. Sales staff, artists, and advertising department personnel, etc., come into this category. These employees practice a specific skill within a specific field--but this skill is non-scientific. This is such a small group that it is difficult to draw any general conclusions from their behavior. However, the few we encountered were frequent library users (none used the library less often than once a week). Their queries may be easier to answer than those of other groups (except technicians). They depend on periodicals as information sources, and they come to the library in search of simple factual data. The members of this group seemed to know their way around in a library, and how to use its resources for themselves.

Hypothesis: RESEARCHERS IN DIFFERENT SPECIALTY FIELDS ARE CHARACTERIZED BY MARKEDLY DIFFERENT READING HABITS.

and info use

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
TRUE	scientists and engineers in general.	None given. The statement is made, "Engineers, for instance are very little given to doing any reading. Doctors and other biologists are rather surprisingly given to reading a large number of papers, but most of these are short."	19
NOT STATED	chemists	18,000 observations showed that an average of 9.7 percent of a chemist's time was spent in reading for scientific communication.	20
NOT STATED	researchers at a British petroleum research center	A study of 517 inquiries made to the technical information center over a 10 year period provided the following data:	25

Profession of Inquirer	Total No. of Inquiries	Total No. of Staff	Average No. of Inquiries/Worker			
			Total	Division Heads	Group Leaders	Research Workers
Engineers	266	68	3.9	4.1	5.4	2.8
Physicists	53	23	2.3	7.0	2.8	1.1
Chemists	198	111	1.8	8.3	2.5	0.94

This table does not include 119 inquiries received from higher levels of management and administration; or 18 inquiries received from research staff who were not engineers, physicists, or chemists; or 42 inquiries received from staff below graduate level. There was generally an increased demand for services with increased status or rank within the organization. "It was found that proportionally the greatest use of the technical inquiry service was made by engineers, followed by physicists, and finally chemists. It is generally accepted that chemists devote more attention, in their university days, to published literature than do engineers and they are usually familiar with Chemical Abstracts, so that they are more able to find their own answers to inquiries than are engineers, for whom the literature is less well organized. In other words, the engineer would probably need greater familiarity with the sources of literature available to him if he were to produce, by his own efforts, as satisfactory an answer to his inquiry as would his chemical counterpart."

Hypothesis:

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
FALSE	chemists and physicists	Using a random alarm device and diary technique, a study of 297 chemists and 404 physicists from 71 organizations showed that physicists and chemists spend the same amount of time reading scientific periodicals (approximately 2 hrs/week):	28

	Total No. of Observations	Total No. of Reading Observations	%	Hrs./Week
Chemists	15,408	339	2.2	2
Physicists	17,894	396	2.2	2

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
TRUE	chemists and physicists	Using a random alarm device and diary technique, a study of 297 chemists and 404 physicists from 71 organizations showed that there were significant differences in the stated reasons for doing the reading at that time:	28

	Chemists (%)	Physicists (%)
Reading for specific information	35.5	58.7
Undirected browsing	64.5	41.3
No. of reading observations:	(339)	(396)

Hypothesis: THE DEVELOPMENT MAN GOES TO A LIBRARY IN SEARCH OF SPECIFIC INFORMATION, WHILE THE RESEARCHER GOES THERE TO BROWSE.

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
TRUE	scientists in general	None given. The statement is made, "The antithesis of the development man in search of specific information is the researcher who has come to browse."	13

Hypothesis: THE BIOMEDICAL COMMUNITY HAS FOUR MAIN TYPES OF PEOPLE WITH DIFFERENT INFORMATION NEEDS: 1) RESEARCH WORKERS; 2) EDUCATORS; 3) PRACTITIONERS; 4) ADMINISTRATORS.

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
TRUE	biomedical community	None given. The statement was made, "The members of the biomedical community are of four main breeds as concerns their information needs -- research workers, educators, practitioners and administrators. Of course, a single individual can function in all four categories sequentially if not simultaneously, but it is important to recognize that the information needs associated with these different activities vary widely."	23

Hypothesis: THE MAIN REASONS FOR A USER TO CHOOSE A PARTICULAR SOURCE OF INFORMATION ARE: 1) ITS CONVENIENCE OR AVAILABILITY; AND 2) HIS KNOWLEDGE OF ITS EXISTENCE.

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
TRUE	U. S. medical researchers	Interviews with 500 American medical researchers from 59 medical research organizations in 6 American cities disclosed that 260 of them had not sought or obtained any Soviet research information during the previous 6 months. The primary reasons stated for not using the information were: 1. "First, it was felt that there are no fully adequate keys to make the American scientist aware of the existence of pertinent Soviet information, and that if there are keys, they are not being sufficiently publicized." 2. "Second, the nonusers expressed the feeling that they could not obtain up-to-date Soviet publications." 3. "Third, there was the language barrier and the difficulty of obtaining translations when and as they are needed." 4. "Fourth, there was the problem of inadequate contact, correspondence, and exchange of information with Soviet scientists on a person-to-person basis. This was related, in the minds of a number of the respondents, to security restrictions imposed by both the United States and Soviet governments." 5. "Fifth, and related to the fourth problem, was a lack of familiarity with notable Soviet workers in fields of interest to the respondents." 6. "Sixth, there was an ignorance of what the Soviet Union is doing in pertinent fields and of whether it is worth looking into."	7

Hypothesis: THE INFORMATION NEEDS FOR BIOMEDICAL RESEARCHERS ARE THE SAME AS THE INFORMATION NEEDS FOR ANY OTHER SCIENTIFIC OR TECHNICAL RESEARCHER.

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
FALSE	not stated	None given. The statement is made, "...it could be argued that the requirements of two scientists of similar disciplines but working in different industries might well be different and it would then be important for each industry to examine its own requirements separately."	25

Hypothesis: A USER'S NEEDS FOR INFORMATION MAY FOLLOW CYCLES RELATED TO THE SIZE OF THE PROBLEM WORKED ON OR THE LENGTH OF THE PROBLEM UNIT.

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
TRUE	researchers in general	None given. The statement is made, ". . . when a problem unit divides roughly into segments that might be labelled 'search,' 'experiment,' 'analysis,' 'write-up,' etc., their needs for technical information may follow cycles related to the 'size' of the problems worked on or the length of a problem unit."	11
NOT STATED	biomedical researchers	None given. The statement was made, "The usual research worker requires an exhaustive search only once during the course of a project--at the beginning, ~~researchers~~ somewhere in the middle, or when he is writing it up for presentation."	23

Hypothesis: MOST INFORMATION NEEDS ARISE AT THE START OF MAJOR PROJECTS OR PROJECT PHASES.

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
TRUE	researchers in general	None given. The statement is made, ". . . we find demand patterns which result in swamping the information service personnel at the start of major projects or project phases and which leave them less than fully occupied during later phases."	11
NOT STATED	biomedical researchers	None given. The statement was made, "The usual research worker requires an exhaustive search only once during the course of a project -- at the beginning, somewhere in the middle, or when he is writing it up for presentation."	23

Hypothesis: THE MAIN FUNCTIONS OF AN INFORMATION SERVICE ARE TO: 1) PREVENT EXCESSIVE DUPLICATION OF RESEARCH; 2) PROVIDE SPECIFIC INFORMATION AS NEEDED; 3) PROVIDE "CATCHING UP" INFORMATION; 4) PROVIDE CURRENT-AWARENESS REPORTING; 5) STIMULATE CREATIVE THOUGHT.

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
TRUE	industrial research library	None given. The statement is made that, "... the information flow must (in increasing order of importance): 1. Prevent excessive duplication of research, particularly of experiments destined to give negative results . . . 2. Provide specific information needed by the technical staff ... 3. Provide 'catching-up' information for the individual who finds it necessary to become familiar with a new field . . . 4. Provide an efficient means for enabling the member of the technical staff to 'keep current' in his project and his field ... 5. . . . stimulate creative thought in a way which will maximize the probability of occurrence of creative ideas that are valuable to the company.	12
TRUE	engineers and chemists engaged in R & D work in the chemical industry	None given. The statement is made that, ". . . a current awareness philosophy is needed which will provide a scientist, automatically, with selected articles in his areas of interest from those services which he does not normally review."	15

Hypothesis:

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
NOT STATED	biomedical researchers	None given. This reference suggested classifying the purposes or types of use of the information system in the following way: 1. Everyday. ("Everday' refers to the bread-and-butter type of use where the scientist needs a relatively specific piece of information, e.g. the melting point of a compound, or 'that paper in which Smith mentioned how he made his reagent' and so forth. This type of use is one of the most common, it must be met very quickly or work suffers.") 2. Exhaustive Search. ("The 'exhaustive search' is where it is desirable to find everything that has been written on a given subject.") 3. Current Awareness. ("...a type of use that takes a large part of the scientist's time, especially that away from the laboratory...")	23

Hypothesis: THE USER'S BASIC REASONS FOR SEARCHING INFORMATION (IN ORDER OF FREQUENCY OF OCCURRENCE) ARE:

1. TO FIND A SPECIFIC ITEM OF INFORMATION NEEDED FOR ONGOING WORK
2. TO KEEP ABREAST OF PROGRESS IN HIS OWN, AND RELATED FIELDS
3. TO OBTAIN THE NECESSARY BACKGROUND INFORMATION BEFORE STARTING A TASK
4. TO STIMULATE CREATIVE THINKING

Hypothesis Stated To Be	Population Studied	Evidence	Ref.

Hypothesis: THE RESEARCHER OBTAINS HIS INFORMATION IN A BATCHED RATHER THAN A CONTINUOUS MANNER. HE PERIODICALLY LOADS UP ON INFORMATION, AND THEN COASTS ON THIS KNOWLEDGE FOR SOME TIME AFTERWARD, WITH SOMEWHAT OF A FLYWHEEL EFFECT.

Hypothesis Stated To Be	Population Studied	Evidence	Ref.

Hypothesis: THERE IS TOO MUCH POOR LITERATURE, AND TOO LITTLE GOOD LITERATURE IN THE SYSTEM.

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
TRUE	entire scientific community	None given.	6, pg. 95

not in your list?

Hypothesis: IN MANY TYPES OF PROJECTS, THE NEEDS FOR PUBLISHED INFORMATION AND GENERAL 'STATE OF THE ART' KNOWLEDGE ARE GREATER IN THE EARLIER PHASES, AND THE NEED FOR INTERNAL COMPANY INFORMATION AND CROSS-PROJECT INFORMATION IS GREATER IN LATER STAGES.

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
TRUE	researchers in general	none given.	11

Hypothesis: THE WORK ACTIVITIES THAT GENERATE THE MOST SEARCHES ARE NOT NECESSARILY THOSE IN WHICH THE MOST WORKING TIME IS SPENT.

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
TRUE	92 electrical engineers doing applied research	interviews with 92 electrical engineers from 4 research organizations disclosed the following data regarding the relationship of work activities with need for searches, and amount of working time expended:	2

Type of activity	Percent of engineers ~~that~~ that stated this was the activity in which they spent the most working time	Percent of engineers that stated this was the activity that accounted for the majority of searches
Design of equip., systems, and procedures	39.7	23.3
Correlation of experimental results with theory, or vice versa	10.8	8.9
General project planning	10.0	6.0
Conduct of lab experiments or field tests	8.3	5.6
Theoretical design of experiments	7.5	8.5
Search for novel technical ideas on which to base new projects or new research	6.6	11.7
Review and evaluation of specific project or product (critique)	5.8	3.6
Technical report writing	4.1	4.8
Serving as a consultant	3.3	2.8
Preparation of lectures or technical papers	1.6	5.6
Technical proposal writing	0.8	4.8
Keeping current with technical advances	0.8	13.3
Other	0.8	1.2

Hypothesis: IT IS CHEAPER (OR EASIER) TO REPEAT A PIECE OF WORK THAN IT IS TO FIND THE INFORMATION ON THE SAME JOB DONE EARLIER.

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
TRUE	Research and development organizations	None given. The statement is made, "A familiar phrase in some large R & D organizations is that 'it is cheaper (or easier) to repeat a piece of work than it is to find the information on the same job done earlier.'"	11
FALSE	Not stated	Reference is made to work by Connolly, and the statement is made, ". . . as compared with laboratory invention, much time can be saved and earlier filing of patent applications made possible by extensive use of the literature."	16

Hypothesis: PERSONAL FILES PLAY A MAJOR ROLE IN THE RESEARCH OF SOME INDIVIDUAL SCIENTISTS

true - Becker

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
TRUE	researches in general	None given. The suggestion is made that, "Rather than treat them as subversive, as they are in many organizations, the information specialist should seek ways of augmenting them and making them even more useful to the individual researcher, if they are important to his work." This same article also quoted a recommendation from a study within the United Kingdom Atomic Energy Authority, "In view of the considerable amount of work which is put into personal indexes of data by R & D staff, some guidance on systematic arrangement and indexing should be given by libraries and information staff, to improve their usefulness both to their compilers and those who consult them."	11
[redacted]			
TRUE	94 chemists in a single industrial research laboratory	Analysis of questionnaire results led to the generalization that, ". . . most of the most creative chemists not only want the library to maintain an index of current journal articles, but also want to maintain such an index themselves."	16

Hypothesis:

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
TRUE	University of Michigan faculty members	80% of the University of Michigan faculty (1355 respondents) answered a survey questionnaire that asked questions of their use of the University Library collection and services. They were asked the question, "To what extent are your book and journal needs satisfied by sources other than the University Library and its branches (e.g. private collections, books belonging to your colleagues or department, research unit, etc.)?" The following data was obtained:	24

Branch or Dept.	Completely or to a great extent	Somewhat	Rarely or never	Sample Size for this question
Psychology	87%	9%	4%	46
Social sciences, other than psychology	53	34	13	95
Zoology	24	55	21	38
Physical sciences and natural sciences, other than Zoology	37	48	15	94
English	39	37	24	54
Mathematics	38	33	29	45
Other departments	27	53	20	125

Those who answered that they used non-university sources completely or to a great extent were asked to specify the particular sources. The following data was obtained:

Non-University Library Sources	Percent of those who answered "completely" or "to a great extent"	Percent of all respondents
Own library or subscriptions	62	28
Libraries or subscriptions of colleagues or friends	26	12
Library of department or research unit	28	13
Private collections, not further specified	7	3

Non-University Library Sources	Percent of those who answered "completely" or "to a great extent"	Percent of all respondents
Other sources	10	5
Not ascertained	6	3
"Somewhat," "rarely or never" or "not ascertained" extent of use of non-University sources	----	54
	N = (624)	N = (1355)

The columns add up to more than 100% because more than one response was possible.

Hypothesis: IF TOO MUCH SERVICE IS PROVIDED, THERE IS THE DANGER THAT THE SEARCHER WILL LEAN TOO HEAVILY ON INFORMATION SERVICES AS A CRUTCH.

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
TRUE	Petroleum researchers	None given.	14

Hypothesis: MORE EFFECTIVE CLASSIFICATION AND INDEXING IS NECESSARY FOR BOOKS, JOURNAL ARTICLES, AND SPECIALIZED MONOGRAPHS. THERE IS MUCH ROOM FOR IMPROVEMENT IN THE PRACTICES OF INDIVIDUAL LIBRARIES IN THIS REGARD, AND FOR THE DEVELOPMENT OF CENTRAL BIBLIOGRAPHIC SERVICES.

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
TRUE	biomedical sciences	None given	3

Hypothesis: IN MANY OF THE HOSPITALS THAT HAVE A RESEARCH POTENTIAL, THE LIBRARY IS TOTALLY INADEQUATE AND ALL TOO FREQUENTLY CONSISTS OF AN ILL-KEPT AND VIRTUALLY RANDOM COLLECTION OF JOURNALS AND BOOKS.

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
TRUE	biomedical sciences	None given.	3

Hypothesis: FOR VARIOUS REASONS, MOSTLY ECONOMIC, BIOMEDICAL LIBRARIES HAVE NOT KEPT PACE WITH THE INCREASE IN THE VOLUME OF RELEVANT PUBLICATIONS OR WITH THE GROWTH OF THE SCIENTIFIC COMMUNITY WHOSE NEEDS THEY MUST MEET.

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
TRUE	biomedical sciences	None given.	3

Hypothesis: THERE IS SCARCELY A MEDICAL LIBRARY IN THE COUNTRY WHICH IS NOT ALREADY OVERCROWDED AND WHOSE PHYSICAL FACILITIES DO NOT IMPOSE SERIOUS INCONVENIENCES ON ITS USERS.

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
TRUE	biomedical sciences	None given.	3

Bloomquist

Hypothesis: BIOMEDICAL SCIENTISTS NEED AN INFORMATION CENTER THAT IS NOT AVAILABLE OR GENERALLY EFFECTIVE IN THE SCIENTIFIC COMMUNITY AT THE PRESENT TIME.

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
TRUE	biomedical scientists	None given.	6, pg. 22

Hypothesis: THE MAIN CHANNELS OF SCIENTIFIC INFORMATION ARE: 1) PERSONAL CONTACTS; 2) ORAL REPORTS; 3) PUBLICATIONS; 4) INFORMATION SERVICES.

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
TRUE	biomedical researchers	None given. This reference defines information services as abstracting and indexing services, other bibliographic tools, librarians, and specialized information centers.	23

TRUE 1082 technologists in 127 medium-size establishments in the British electrical and electronics industry. The term "technologist" was broadly interpreted, and covered all persons engaged in research. In the whole sample, 17% held academic degrees.

During interviews, the users were asked, "Can you recall the most recent article in any paper, journal, pamphlet, etc., that was of benefit use or special interest to you? How was your attention drawn to this article?" The answers to the last question are shown in the following Table.

Attention drawn to this article by	Percent	
Colleagues within the establishment or firm	19	30
Persons outside	8	
Persons unspecified	3	
References in journal or books	5	
Abstracts	4	
Mass media	2	
Attention was not drawn:		
Searched in literature	18	
Came across it by chance	41	
	100	

Hypothesis: THE MAIN PRINTED SOURCES FOR SEEKING INFORMATION NEEDED IN CONNECTION WITH CURRENT RESEARCH ARE: (1) HANDBOOKS, AND (2) BOOKS OF METHODS.

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
TRUE	Scandanavian biological scientists	None given. The statement was made that, "recently Melvin J. Voigt cound in the case of Scandanavian scientists ... in seeking information needed in connection with current research the most used printed sources were handbooks, books of methods, and, particularly in systematic work, hand lists or check lists."	17

Hypothesis: THE MAIN PRINTED SOURCES FOR KEEPING UP TO DATE IN A FIELD ARE: (1) CURRENT JOURNALS; (2) ABSTRACT JOURNALS; (3) INDEXES; (4) REPRINTS; (5) REVIEWS (BOTH IN PERIODICALS AND IN ANNUAL SERIES); (6) AND TO A LESSER DEGREE, MONOGRAPHS AND TREATISES.

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
TRUE	Scandanavian biological scientists	None given. The statement was made that, "Recently, Melvin J. Voigt found in the case of Scandanavian scientists keeping up to date in biology that 'current journals, abstract journals, indexes, reprints, reviews (both in periodicals and in annual series), and to a lesser degree, monographs and treatises are the principal printed sources used.'"	17
FALSE	U.S. medical researchers	Interviews with 500 American medical researchers from 59 medical research organizations in 6 American cities disclosed the following information	7

in response to a question of, "how he become aware of the existence of scientific information in general, of foriegn-language in general, and of Soviet information."

Tools or Methods	For Information in general (%)	For Foriegn Information (%)	For Soviet Information (%)
Footnotes or other cited references	97	79	29
By chance or accident while looking through publications	96	70	31
Indexing and abstracting publications	95	86	53
Personal recommendations	88	61	25
Personal reference files	81	49	10
Book reviews	70	26	4
Library card catalogs	69	17	2
Publisher's advertisments	67	16	1
Library acqusition lists	59	21	4
Separate bibliographies	42	16	5
Other	2	2	13
AVERAGE NO. OF METHODS USED:	7.6	4.4	1.6

Hypothesis: NEW DISCOVERIES, MAJOR FINDINGS, AND NEW CONCEPTS ARE FIRST PRESENTED AND DISCUSSED AT FORMALLY ARRANGED MEETINGS, CONFERENCES, SEMINARS, AND SYMPOSIA--CONSIDERABLY IN ADVANCE OF THE MORE PERMANENT PROCESS OF PUBLICATION.

also APA studies

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
TRUE	suggested in context of biomedical sciences communication	None given.	3
TRUE	biomedical researchers	None given. The statement is made, "at present there is no quantitative information on this question, although the consensus seems to be that today most workers customarily present their work at meetings before they publish it."	18

Hypothesis: THE RAPIDLY EXPANDING VOLUME OF SCIENTIFIC PUBLICATIONS AND THE INCREASED RANGE OF SCIENTIFIC DESCRIPTIVES INVOLVED IN MANY INDUSTRIAL RESEARCH PROJECTS HAVE GREATLY REDUCED THE EFFECTIVENESS OF ABSTRACTING SERVICES AS A TOOL FOR KEEPING CURRENT.

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
TRUE	industrial researchers	None given.	12

25E U.S. medical researchers. Interviews with 500 American medical researchers from 59 medical research organizations in 6 American cities disclosed the following information . . . . . (copy from Hypoth on more printed sources for keeping current) 7

This same study noted that, in all, 40 different indexing & abstracting publications were mentioned by the respondents as having been used for locating or learning of Soviet information. The ones most frequently mentioned (in order of rank) are:

Chemical Abstracts
Biological "
Current List of Medical Lit.
Chemisches Zentralblatt
Excerpta Medica
Translation Monthly
Libr. of Congress Biblio. of Translations from Russian Sci. & Tech. Lit. (discontinued in Dec 1956)
Libr. of Congress Monthly List of Russian Accessions
Psychological Abstracts
Quart. Cumulative Index Medicus
Tenberrin Abstracts
Consultants Bureau list of avail. Soviet translations

The use made of the first 5 sources was greater than for the remaining 35.

what aux & main memory is avail.? access time? buffering?
time to search text on a word for word basis ?

Hypothesis: THERE IS A RAPID INCREASE IN PUBLISHED PAPERS OF ALL KINDS STIMULATED, IN PART, BY THE ACADEMIC COMMUNITY'S DICTUM, "PUBLISH OR PERISH."

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
TRUE	Entire scientific community	None given.	6, pg. 98

Hypothesis: THE MANY (OVER 100) NIH STUDY SECTIONS, REVIEW COMMITTEES, AND SPECIAL ADVISORY GROUPS FORM A UNIQUE FRAMEWORK OF COMMUNICATION IN THE BIOMEDICAL SCIENCE COMMUNITY, AND THE INTERCHANGE OF INFORMATION AMONG THE MEMBERS OF THESE GROUPS IS ONE OF THE MOST VITAL AND PRODUCTIVE OF THE INFORMAL COMMUNICATION PROCESSES.

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
TRUE	Biomedical Sciences	None given.	3

Hypothesis: READING AND ORAL DISCUSSION ARE OF ABOUT EQUAL IMPORTANCE AS A SOURCE OF IDEAS.

Hypothesis Stated To Be	Population Studied	Evidence	Ref.
TRUE	94 chemists in a single industrial research laboratory	Analysis of questionnaires from this group led to the following statement, ". . . although the majority of both the most and least creative chemists found both reading and oral discussions of about equal importance as a source of ideas, significantly more of the most creative chemists found reading more stimulating than oral discussion."	16
FALSE	Comments are made in the context of biomedical sciences	None given. The statement is made, "Direct relationships between and among persons through the spoken word and correspondence under both formal or informal circumstances constitutes the fundamental and undoubtedly the most powerful, immediate and effective means of conveying information in the scientific and professional world." The comment is also made that, ". . . methods of personal communication. . . have, in the opinion of some scientists, replaced the traditional process of publication as the primary means for initial and immediate dissemination of research results to those portions of the scientific community to whom they are of the first and greatest significance."	3

Reading ~~and oral discussion are of about equal~~ is more important than oral communication as a source of references to information

TRUE

1082 technologists in 127 medium-size establishments in the British electrical and electronics industry. The term "technologist" was broadly interpreted, and covered all persons engaged in research. In the whole sample, 17% held academic degrees.

During interviews, the questions were asked, "Can you recall the most recent article in any paper, journal, pamphlet, etc., that was of direct or special interest to you?" The answers to the last question are tabulated below.

Attention drawn to this article by	Percent	
Colleagues within the establishment or firm	19	} 30
Persons outside	8	
Persons unspecified	3	
References in journal or books	5	
Abstracts	4	
Mass media	2	
Attention was not drawn:		
Searched in literature	18	
Came across it by chance	41	

added later

AUTHOR: CPB

DATE: 25 MAY 63

SUBJECT: Bibliography on User Requirements for Information

FORMAL DESCRIPTORS:

SEE ALSO:

REFERRED FROM:

LINK NAME:

COPIES TO: CPB

ABSTRACT: A list of references to papers and reports that contain some information regarding users' requirements for information.

TEXT:

1 Atherton, P., "Indexing Requirements of Physicists," in the Literature of Nuclear Science: Its Management and Use, pp. 215-222, Report TID-7647 of the U. S. Atomic Energy Commission, Oak Ridge, Tennessee (Dec. 1962).

2 Bourne, C. P., et al, "Requirements, Criteria, and Measures of Performance of Information Storage and Retrieval Systems," Stanford Research Institute, Menlo Park, Calif. (December 1961) AD-270 942, OTS price $10.50

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Bourne

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OAR-1 Office of Aero Aug. 1961 *

14. ~~13.~~ Directory of University Research, Bureaus and Institutes.
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INSTITUTE FOR ADVANCEMENT OF MEDICAL COMMUNICATION
9650 WISCONSIN AVENUE · BETHESDA 14, MARYLAND
Telephone: 656-2900

February 27, 1963

Memo to Task Force

Attached is a list of possible sources of unpublished data that may be useful. These are only those that readily come to my mind, and I am sure the list is far from complete. Please send me a list of other sources that occur to you, giving the person to contact and the type of data they are likely to have. If you know any more about the sources I have listed, I would also appreciate getting this information.

Many of these sources are in the Washington-New York area, and I have contacts for most; therefore, Dr. Leeds and I will undertake the liaison work, unless another member of the task force is the logical choice. We will not be able to cover them all; but we are starting now to "mine" those that seem most promising. At the next Staff meeting we will discuss priorities for covering the remainder.

R.H.O.

February 27, 1963

Partial List of Possible Sources of Useful Unpublished Data

National Library of Medicine	-- new survey of drug-related literature, changes in number of authors/paper, changes in average length of papers, new figures on volume of biomedical literature and number of serials, ? unpublished studies by academic medical libraries
National Federation of Science Indexing and Abstracting Services	-- details on abstracting services
American Psychological Association	-- broad study of communication in psychology with special emphasis on meetings, metabolism of information, informal communication, characteristics of users ←
IAMC Studies:	
Russian Translation Study	-- citation patterns of American journals, interview data on biomedical scientists' use of current awareness and search tools, medical librarians' use of same ←
Metabolism of Information Study	-- interview data and habits of biomedical scientists with reference to oral reports and publication, and attitudes towards preprint distribution service ←
Cardiovascular Literature Project	-- analysis of growth and scatter of literature on effects of drugs on cardiovascular system, 1930-present
Psychopharmacology Literature Project	-- same as above for 194?-present
Cerebrovascular Literature Project	-- detailed interest profiles on a sample of biomedical scientists, reactions to an experimental current awareness and search tool such as MEDLARS will produce ←
Editorial Refereeing Project	-- analysis of editorial evaluation of all papers submitted to <u>American Journal of Physiology</u> and <u>Journal of Applied Physiology</u> from 1957-1962
Doctoral Theses Study	-- analysis of research trends in basic biomedical sciences in past 10 years

FASEB:

Manpower Registry	-- biennial census data on preclinical scientists
Meetings	-- data on attendance, number of papers, disciplinary mixing, etc., at FASEB annual meetings
Study of Physiologists	-- data on information habits of physiologists
American Society for Clinical Investigation	-- much the same data as for FASEB meetings
American Federation for Clinical Research	-- much the same data as for FASEB meetings
Institute for Scientific Information	-- citation index for 300 biomedical journals
Science Information Exchange	-- demand for their services, ? data reflecting change toward multidisciplinary research teams
American Hospital Association	-- survey of hospital libraries, holdings and services
Herner and Co.	-- feasibility study of Mental Health Information Clearinghouse
National Institute for Mental Health (Psychopharmacology Service Center)	-- unpublished studies on scientists' information needs
National Cancer Institute (Chemotherapy Section)	-- growth and characteristics of cancer chemotherapy literature, use of unpublished data on testing
NIH (Division of Research Grants)	-- data on privileged progress reports, volume of publication generated by extramural and intramural research, characteristics of grantees, changes in dollar support per grantee, etc.

National Science Foundation:

Manpower and Support Studies	-- ? more detailed analyses than in their published reports
Publication Studies	-- cost of scientific publications, editorial practices, etc.
American Rheumatism Association	-- study of literature of arthritis and rheumatism
University of Minnesota	-- study of diabetes literature and needs of research workers in field
Western Reserve University	-- study of literature of communicable disease vectors, ? user's reactions to new information service

Columbia University	-- growth and characteristics of literature of tissue culture
Miscellaneous Abstracting Services	-- data on literature of narrow subject-matter areas in biomedical field, e.g., leukemia, ulcerative colitis
Senator Humphrey's Office	-- unpublished reports pertaining to biomedical information
AIBS-Biologic Communication Study Project	-- ? unpublished studies
New York Medical Library Project	-- data on holdings of major medical libraries in metropolitan New York
Midwest Library Center	-- data on holdings of midwest medical libraries, ? analyses of inter-library loans

243 ✓
37 Never ordered*
40 ✓
42 ✓
43 ✓
46 ✓
48 ✓
51 Arr
55 ✓
57 ✓
64 Arr
65 Never ordered*
87 See 59
96 Never ordered*
204 ✓
63 Arr
123 ✓ — include in CPB bibliog.
205 ✓
219 ✓
226 ✓

* If you have need, we will try to order

BLANK FORMS

Hypothesis:

Hypothesis Stated To Be	Population Studied	Evidence	Ref.

Hypothesis:

Hypothesis Stated To Be	Population Studied	Evidence	Ref.

Hypothesis:

Hypothesis Stated To Be	Population Studied	Evidence	Ref.

Hypothesis:

Hypothesis Stated To Be	Population Studied	Evidence	Ref.

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Hypothesis Stated To Be	Population Studied	Evidence	Ref.

Hypothesis:

Hypothesis Stated To Be	Population Studied	Evidence	Ref.

~~Suggestions~~

Suggestions	Ref.
1. Set up a procedure by which one can subscribe to journals on an annual basis or purchase single articles at a unit price.	AIBS - 629
2. Establish National centers which will serve as depositories for primary publications to eliminate duplication of works & loss of primary material	AIBS - 1029
3. Information usage can be partitioned into the following general categories: (1) specific document requested by title, author, or number; (2) current awareness; (3) specific subject information; (4) retrospective search; (5) exhaustive search; (6) search for research ideas.	Borko, SP - 973
4. Provide grant funds for travel necessary for scientists to enlarge the personal interchange of information.	~~Murtaugh & Payne~~ 3, pg 1171
5. Support the construction, expansion, & renovation of medical libraries under a national plan reflecting research, academic, & service needs	3, pg 1181
6. Establish training programs to enlarge the number of trained & specialized library personnel.	3, pg 1181

Suggestions (contd.)

Ref

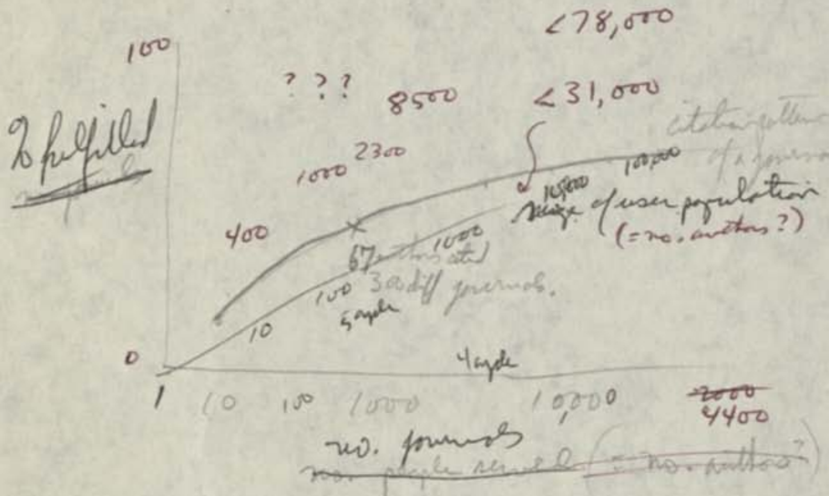
7. Support the basic library services & acquisition of books & specialized equipment to strengthen & extend library functions, particularly in the research & service areas — 3, pg 1181

8. More R&D in the process of storage & retrieval, & in application of electronic technology to the handling of bibliographic materials & the extension of library services — 3, pg 1181

9. Encourage the generators of info. to provide with it, the access to that info. (i.e. indexing at source). — 15

NOTES & MEMOS

No. journals required for a user population = K of (no. of people served)



→ assumption: these people didn't cite in other fields or weren't working or interested in other fields

"For a single specified area of interest in most of the fields of science & technology, a specified portion of a user population's information needs can be fulfilled by a corresponding number of publications of his choice."

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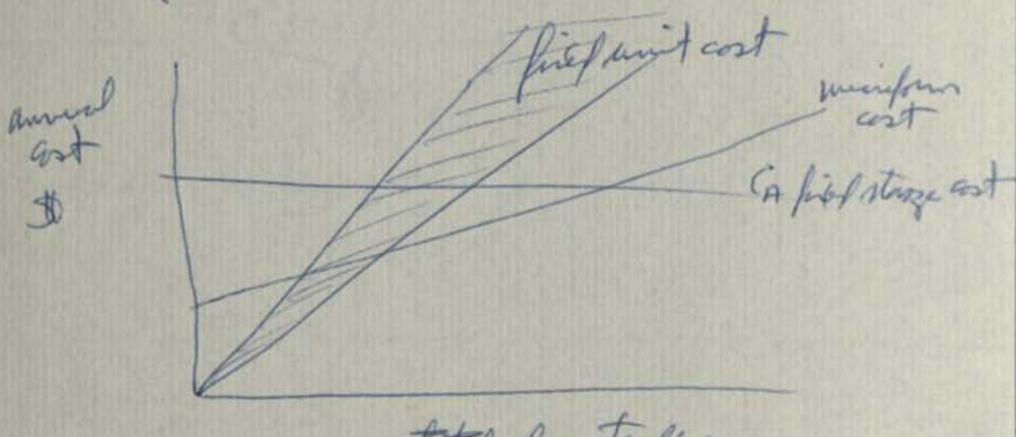
Annual Cost

C_A = storage cost of all matl over 40 yrs. old

C_B = (fixed unit cost of ILL)(10% of total no. of journal requests)

C_C = (amortized costs of acquisition & storage of microform copies of matl over 40 yrs. old)

+ (reproduction cost of 10% of total journal loans)



Cost to furnish matl over 40 yrs. old.

1 10 100 1000 10000 100000 1000000

cross sections for a large variety of nuclear reactions. For example, from the assumptions of the statistical model, one sees that the decay probability of the compound nucleus to a given energy band in the residual nucleus is proportional to the corresponding level density of the residual nucleus. This means that in the nonelastic interaction of fast nucleons with medium-weight or heavy nuclei (one needs quite a few nucleons in a nucleus for the statistical model to be valid) the energy distribution of the emitted nucleons (usually neutrons) can be related to the level structure of the residual nucleus. Furthermore, by invoking the reciprocity theorem and the thermodynamic relations between level density, entropy, and temperature, one obtains the approximate relation for the energy distribution of emitted neutrons: $N(E)dE \propto Ee^{-E/T}dE$, where E refers to the energy of the emitted neutrons and T plays an analogous role in the evaporation of nucleons as does the temperature of a drop of liquid in the evaporation of molecules. This equation corresponds to the "Maxwellian" velocity distribution one observes in a normal evaporation process.

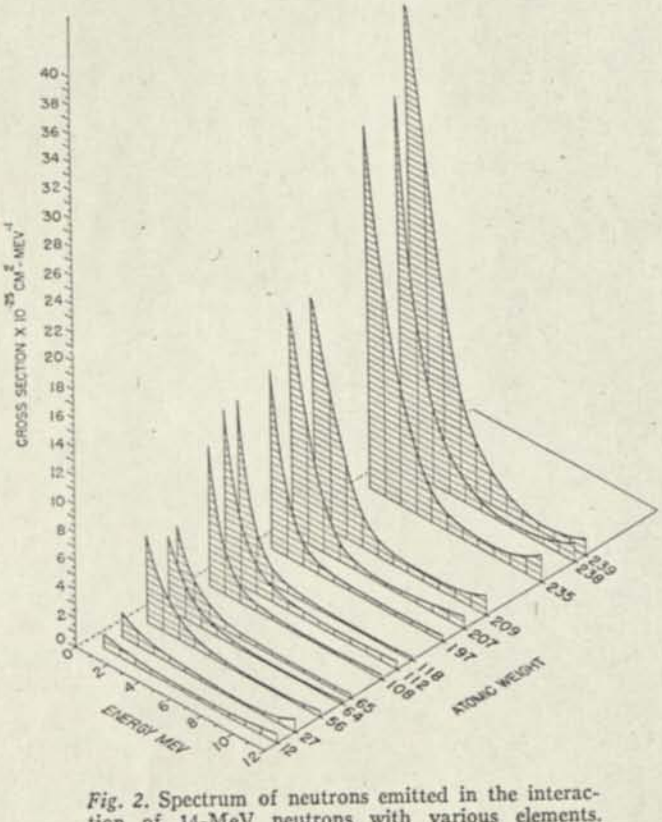


Fig. 2. Spectrum of neutrons emitted in the interaction of 14-MeV neutrons with various elements. Nucleonics **11**, No. 8, 44 (1953).

Figure 2 shows some of the early nonelastic neutron energy distributions for a large number of elements and for an incident energy of 14 MeV. If the evaporation concept is applicable, the data, as plotted, should yield curves of Maxwellian shape. In plotting $\ln[N(E)/E]$ vs E, one does indeed get quite straight lines over the energy region corresponding to a highly excited residual nucleus. The above experiment and many others indicate that, on the whole, the statistical method of determining the yield of nuclear reactions gives a fairly good account of their most important features. It predicts correctly the Coulomb-barrier effects, both as concerns the initiation of reactions and the decay of the compound nucleus, the average energy of emitted particles as compared to total excitation energy available, and other salient features. However, as more and better data became available, serious exceptions emerged. Even in the data above cited, it was observed that the nuclear temperature, T, does not decrease properly with increasing nuclear size. It seems to remain pretty much a constant, which suggests that the same number of nucleons are participating in the formation of a compound nucleus in iron, for example, as in lead, and this was worrisome. Also, there appear to be too many high-energy neutrons. However, there were even more basic difficulties to worry about. In particular, work on the energy and mass dependence of neutron cross sections (Fig. 3) produced a pattern which is in contradiction to the strong-interaction hypothesis and which is what one might anticipate from scattering by, of all things, a potential well. The point is this: The free nucleon-nucleon cross section, together with the density of nucleons in a complex nucleus, would imply, on the basis of the strong interaction picture, that a complex nucleus is essentially black for incident nucleons of a few MeV in energy. That is to say, the total reaction cross section (and this does not include elastic scattering) should simply be πR^2. Since $R = r_0 A^{\frac{1}{3}}$ for complex nuclei, the reaction cross section should increase monotonically with increasing mass number and should also be constant with energy so long as the nucleon wavelength, $\lambda \ll R$. For lower-energy nucleons, the cross section should show a monotonic increase with decreasing energy. In actual fact, the experiments which led to the data in Fig. 3 were in serious contradiction to the above expectations. Nor were these the only contradictions. As more detailed experiments were performed on the angular and energy dependence of the particles emitted from an excited compound system, it was observed that particles are fre-

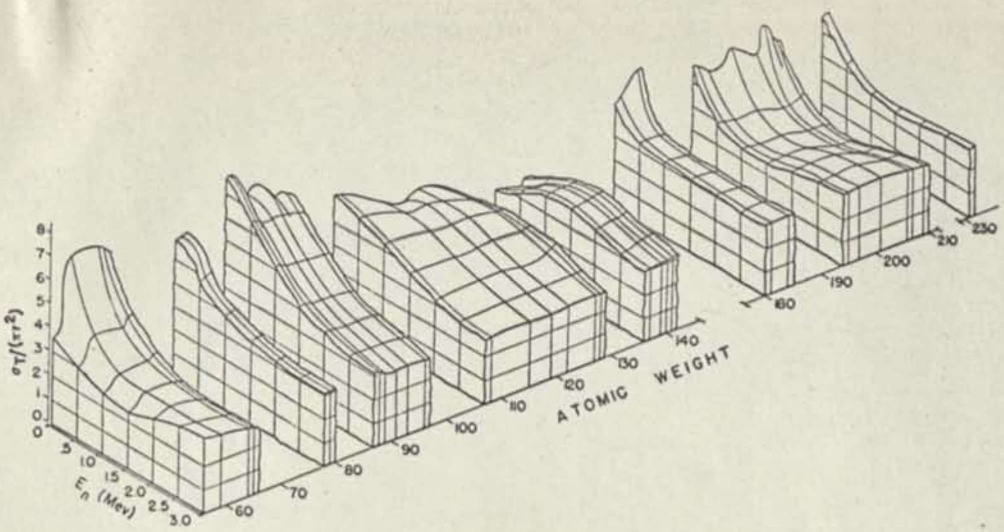


Fig. 3. Variation with incident neutron energy of total cross section (divided by geometrical cross section) for a number of medium-weight and heavy elements. Phys. Rev. **86**, 431 (1952).

quently emitted with energies much larger than those expected from an evaporation-type process, and the angular distribution of these particles was often peaked towards small scattering angles.

I have confined my discussion to incident and outgoing neutrons for simplicity, since Coulomb-barrier effects complicate the situation in that they emphasize surface effects. However, parallel results were obtained in experiments involving charged particles in entrance and/or exit channels.

The better the available data, the greater became the doubts concerning the assumptions of the statistical model, and even the independence hypothesis appeared to be open to question. The forward-directed particles suggested that the nucleus does, at least on occasion, remember how it was formed. Also the high energies associated with a sizable fraction of the particles cast doubt on the assumption of equal transition probabilities and brought forth the question whether one can always count on the complete, immediate sharing of energy previously postulated.

Shell Model

Nor was this development completely unexpected. I have thus far neglected one of the central problems of nuclear physics—the systematics of excited states, or nuclear spectroscopy. Here one studies directly, and with great precision, the discrete quantum states in complex nuclei. Just as atomic spectroscopy paved the way for our rather complete understanding of atomic structure, so is it felt that nuclear spectroscopy should facilitate our understanding of nuclear structure. It is for this reason that you will hear many papers on nuclear energy levels.

One way of studying nuclear levels is by means of inelastic scattering of neutrons and charged particles. In one type of experiment, nucleons of well-defined energy are permitted to impinge on the nucleus being studied. Some of the encounters result in the transfer of part of the energy of the projectile to the target, thus elevating the target nucleus to one of its excited states. From the way these states are populated and from their characteristics—energies, energy widths, spins, parities—one can deduce a good deal about the configuration of nucleons in the target nucleus, their vibrations and rotations, and the shape of the nucleus as well. (There are many other ways to study nuclear energy levels. Some of these are: total cross-section measurements, where one observes the fluctuations in the energy dependence of the probability that a nuclear reaction will take place when a nucleus is bombarded by nucleons—the so-called transmission measurements; "stripping" and "pickup" reactions, such as (d, p) and (d, t), in which the target nucleus is enriched or depleted by one neutron; β and γ spectroscopy of unstable nuclei. In recent years, a whole armory of new and marvelous instruments has been invented for measuring the energy of protons, neutrons, β rays, and γ rays which emerge from nuclear reactions, and the rewards for this effort will certainly be great.)

As a result of systematic studies of level strucat least qualitatively, a large variety of elastic scattering and reaction cross-section data.

(I should say that one of the most powerful arguments for abandoning the picture of the nucleus as an opaque spherical body with sharp edge and uniform density, which can be characterized by simply specifying the radius, emerged from the high-energy electron-scattering experiments.)

Adoption of the diffuse-edge form of potential appeared to constitute an important step in the right direction. Only at backward angles did there still remain real discrepancies between theoretical predictions and experimental results. To eliminate these, it was found necessary to include yet another term in the potential, a spin-orbit term of the form

$$\frac{1}{r}\frac{\partial\rho(r)}{\partial r}\,\mathbf{L}\cdot\mathbf{S},$$

where L and S represent the orbital angular momentum and the spin of the incoming nucleon.

Why a spin-orbit term? According to the shell model, the configuration of nucleons in a nucleus, and the ordering of levels, is determined not only by the central potential, but also by the presence of a strong spin-orbit potential—a potential generated by the interaction of the spin of each nucleon with its orbital angular momentum. Nucleons with spins parallel to their orbital angular-momentum vectors have different energy states than those in which the two vectors are oppositely directed. If this be so, why shouldn't this force manifest itself in nucleon-nucleus interactions for nucleon energies in the region of nucleon binding energies in stable nuclei?

The spin-orbit force in the shell model was, of course, an assumption, as was also its inclusion in the optical model. How can one verify this assumption?

It can be shown that if a spin-orbit force exists, it should manifest itself by causing the alignment, to a greater or lesser extent, of the spin of nucleons which are elastically scattered from complex nuclei. The implication here is that nucleons with spin "up" have different scattering cross sections from those with spin "down", and that this difference results from a spin-orbit force. On the basis of the optical model, this spin polarization of the nucleon should vary in a smooth and systematic way with scattering angle and with the mass of the target nucleus. If the polarization is strictly a diffraction phenome-

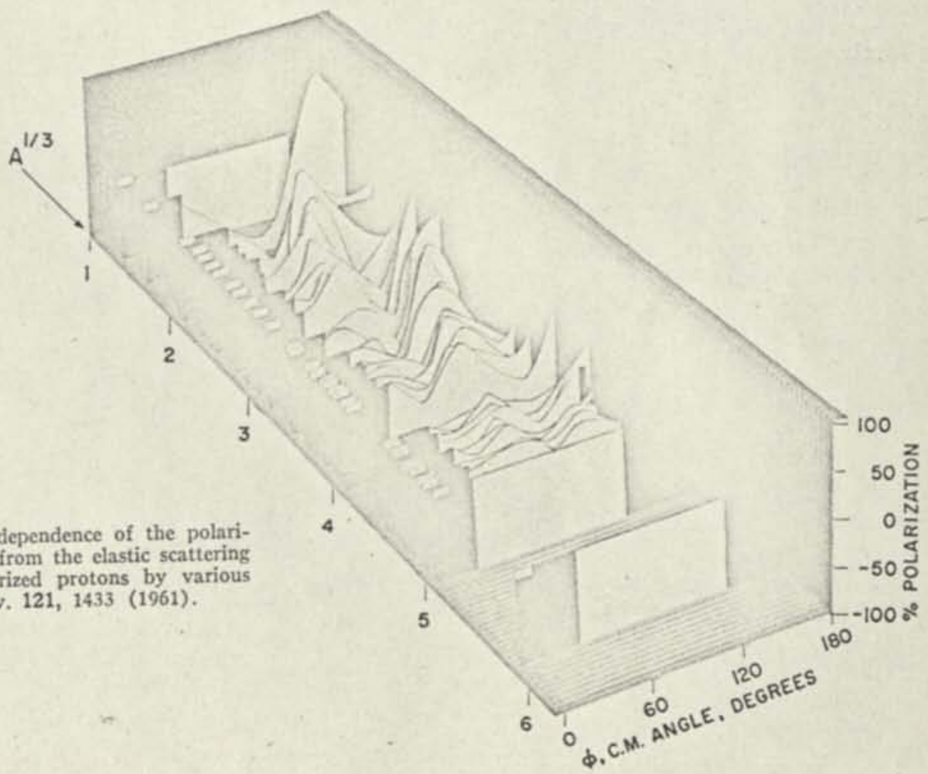


Fig. 4. Angular dependence of the polarizations resulting from the elastic scattering of 10-MeV polarized protons by various nuclei. Phys. Rev. 121, 1433 (1961).

Fussler, H. H. Patterns in the Use of Books in Large Research Libraries

(Univ. of Chicago Library, 1961)

not ASRI

cited in Bowker 1963 annual p. 165

Kingery & Tauber Book Catalogs (Scarecrow Press)

not ASRI

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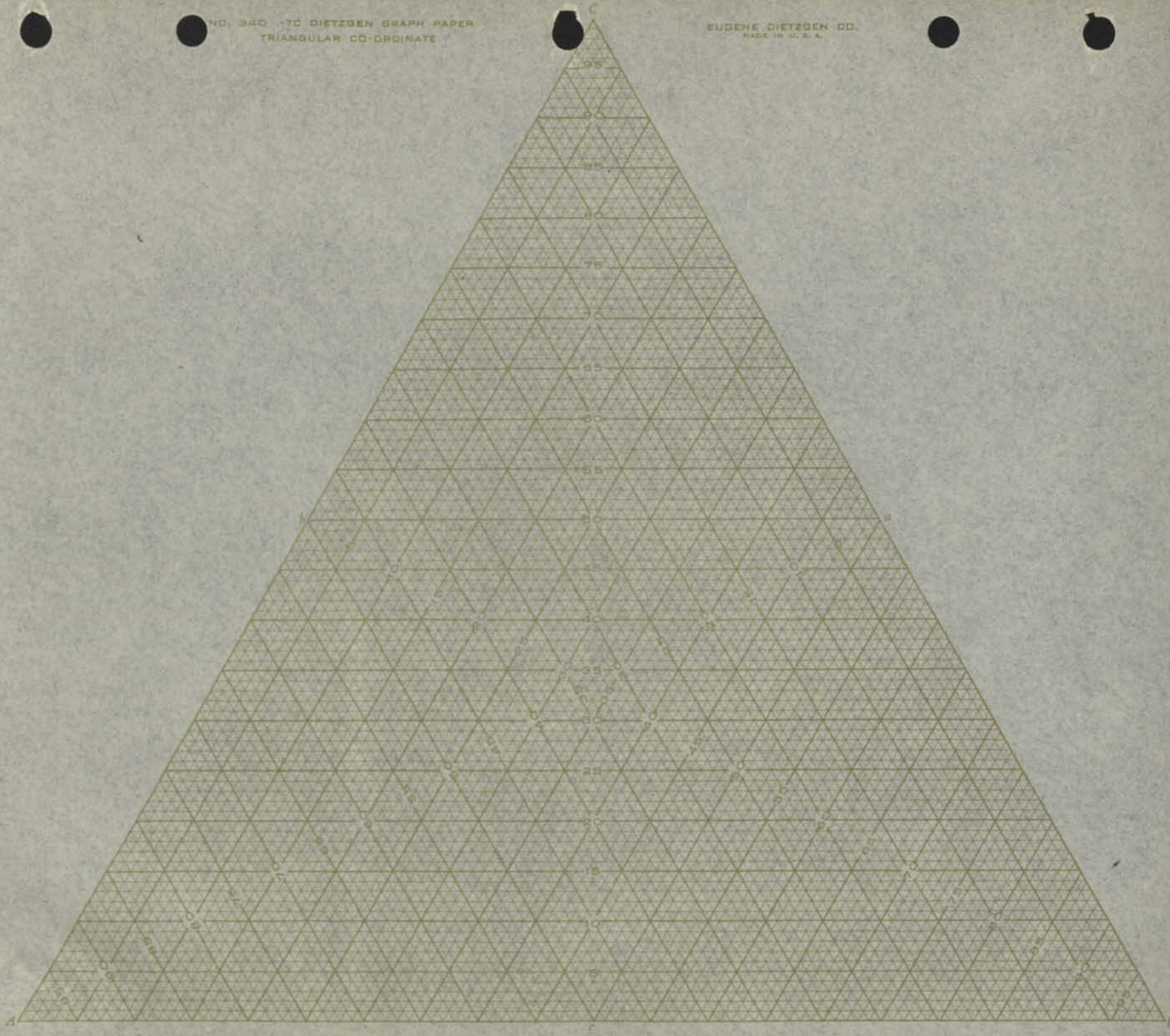

INSTITUTE FOR SCIENTIFIC INFORMATION 33 SOUTH SEVENTEENTH STREET PHILADELPHIA 3, PA.
telephone 215/564-4400
EUGENE GARFIELD, *Director*

December 19, 1963

Mr. Charles P. Bourne
Research Engineer
Stanford Research Institute
Menlo Park, California

Dear Charlie:

In reply to your letter of December 12, we very definitely have some information regarding the distribution of ages of cited articles in the Science Citation Index. A portion of this information will appear in the introduction to the five volume set that is coming out on December 23rd. If Stanford Research Institute is planning to purchase this set, you might advise them to take advantage of the pre-publication offer which expires on January 15th. If they decide against it, then let me know and I will try to obtain the information you want. However, I would appreciate your being more specific as to your requirements.

I was very glad to have you comment, as you did at the last ADI Council meeting. It is always difficult to speak the truth when it has to hurt somebody, particularly when those people are "nice people". I am afraid there is much to be desired about the way the ADI affairs have been conducted in the past, but all of us bear a certain amount of responsibility for this.

Sorry you could not attend our seminar recently in San Francisco.

Best wishes for the holiday.

Sincerely yours,

Gene

Eugene Garfield
Director

EG/SS

December 12, 1963

Dr. Eugene Garfield, Director
Institute for Scientific Information
33 South Seventeenth Street
Philadelphia 3, Pa.

Dear Gene:

Have you published any information regarding the distribution of ages of cited articles in your citation indexes? Has much information been obtained from an analysis of your file? I would be very interested in getting the data for the distribution of the number of cited articles for various ages at the time of citation (e.g. 40% of citations were to articles < 5 year olds,.... 80% of citations were to articles < 15 year olds.). Is this available?

Best wishes for the Holiday Season.

Sincerely,

Charles P. Bourne
Research Engineer

CPB/na

age of items cited should consider date that article was submitted — not the date of publication. —

Diff. lags for diff. journals. — another source of error.

freq. of pub. e.g. semi-monthly vs. weekly — affects age of cited items.

~~To fields!~~

~~Use citation index to get statistics of age of items cited?~~

Assumption: Each transaction has equal value

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The 1961 Biological Chemistry section of Chem. Abstracts contained 35,046 abstracts of papers.
The 1960 Biol. Chem. section contained 29,224 abstracts from 2365 journals. The linguistic and national origin of the 1960 abstracts are noted below, in rank order.

Language	Percent of Total Abstracts	Country	Percent of Total Abstracts
English	52.5	U.S.	29.6
German	10.7	Japan	10.
French	8.9	England	9.3
Japanese	7.4	Germany	9.2
Italian	5.6	France	6.6
Russian	5.2	Italy	5.7
Undetermined	1.5	Soviet Russia	4.9
Spanish	1.5	Netherlands	3.3
Polish	1.0	Switzerland	2.4
		Belgium	2.3
		Poland	1.5
		Canada	1.4
		India	1.4
		Denmark	1.2
		Czechoslovakia	1.2

The following scattering data is provided for 1960.

For the N most productive journals	Total No. Abstracts furnished	% of Total
5	3224	11
10	4878	16
25	7663	26
2365	29,224	100

2. I. D. Welt preliminary results of a paper being written for ACS on the literature of psychopharmacology.

Total no. papers published per year = 2800

No. of primary journals contributing = 50 core, perhaps 200 total

Linguistic origin (ranked) = English (2/3), French, German Italian, Russian

National origin (ranked) = U.S. (½), England, France

3. I. D. Welt informal comments on Cardiovascular literature.

Total no. papers published per year = 3500

No. of primary journals contributing = 500, with 80-90% in 150 journals

Linguistic origin (ranked) = English (45%), German, French, Italian, Japanese

National origin (ranked) = U.S. (1/3), England, Germany, France, Italy

4. Greg Abbin informal comments on Mental Health literature.

Total no. of papers published per year = 100,000

5. The Airlie House report (pg. 31) states (from an unstated source) that the world's biomedical research literature has the following linguistic origin:

Language	Percent of Total
English	40
German	13
French	12.9
Japanese	7.8

6. The Airlie House report (pg. 17) states that 1/11 of the full-time U.S. biomedical researchers are on the NIH staff. It also stated that during FY '62 1600 NIH papers appeared in the journal literature. An extrapolation suggests that there are 11 x (1600) = 17,600 papers/year produced by U.S. biomedical researchers. If 30% of the biomedical research literature is produced in the U.S., then an extrapolation suggests a grand total of 58,700 papers/year produced by biomedical researchers.

7. NLM List of Biological Serials 1950-1960 contained 8939 of the 18,500 NLM titles. It was estimated that 5711 of these were still alive in 1960.

H. Bloomquist, "The Status and Needs of Medical School Libraries in the United States. A Report," (Oct. 1962)
On Pg. 8, Bloomquist mentions that the NLM recently published a list of biomedical serials published between 1950 and 1960 (Biomedical Serials, 1950-1960, NLM, Wash. D.C., 1962). The list contains 8939 titles, selected from the 18,500 titles at NLM. It is estimated (Bloomquist) that 5711 of these titles were alive and being published at the end of 1960.

8. H. Bloomquist, "The Status and Needs of Medical School Libraries in the United States. A Report," (Oct. 1962)
On pg. 17, Bloomquist states, "Research grants by NIH in 1960 approximated 715 million dollars and were productive of about 70,000 papers." The following reference was cited: Adams, Theropeutic Notes 69:204, 1962.

9. V. Pings, "Notes on Abstracting Services," 28 Feb. 1963, Pg. 5. 1961 Sponsorship of Abstract Services:

Sponsor	No.	%
Inter-Society	23	30
Professional Society	19	24.7
Industrial	14	18.2
Foundations	9	11.7
U.S. Govt.	6	7.8
Commercial Publishers	6	7.8
	100	

10. Cardiovascular Diseases (Excerpta Medica Found.) 3400 abstracts/year from 2500 journals. (NFSAIS Guide to U.S. Indexing and Abstracting Services, pg. 34)

11. Chest Diseases (Excerpta Medica Found.) 2800 abstracts/year from 2500 journals. (NFSAIS Guide to U.S. Indexing and Abstracting Services, pg. 35)

12. Dick Orr suggested that approximately ½ of the biomedical researchers are in colleges and universities.

13. Cancer (Exerpta Medica Found.) 4700 abstracts/year from 2500 journals (NFSAIS Guide to U.S. Indexing and Abstracting Services, pg. 28).

14. Radiology (Exerpta Medica Found.) 2000 abstracts/year from 2500 journals (NFSAIS Guide to U. S. Indexing and Abstracting Services, Pg. 24).

15. Aerospace Medicine (Exerpta Medica Found.) 700 abstracts/year from 250 journals (NFSAIS Guide to U. S. Indexing and Abstracting Services pg. 26)

1/64-47 Fejér, István. "Adalék a szakirodalom elévülésének vizsgálatához," [Contribution to the investigation concerning the ageing of scientific and technical literature.] In Országos Müszaki Könyvtár és Dokumentácios Központ. Évkönyv, 1961. Budapest, 1962, p. 127-46.

Based on a critical review of cited publications on the subject, the author analyses the methodology of the investigation and the basic principles of valuation. The value of the method based on the counting of citations is disputable because citations i, are secondary content elements and ii, are not characteristic of all the forms and types of scientific and technical literature.

In a thorough analysis the author points out that the ageing rate of technical literature varies according to the various subject areas, the various forms and types of technical literature and the language areas on which it will be used, and it depends everywhere on the prevailing information demands, and always on the primary content elements of literature. The value of any given type of technical literature, as information carrier, will be qualified and determined by the primary content elements of the total information content assimilated in it.

While in the case of the use-value the primary content element is a qualifying factor, in the case of the ageing rate for the determination of the use-value of technical literature is, therefore, misleading, because it will not provide comprehensive values for estimation.

Because of the general interests of documentation and information, and because of the main role of regional factors affecting both the ageing rate and the use-value of technical literature, extensive investigations should be organized by the FID and carried out by its regional bodies. The results of these investigations might then be discussed and evaluated on the international level. (Author)

from Library Science Abstracts

changing user requirement.

measurement error in determining [illegible] e.g. ± 1 yr. due to length of study period, sample numbers, nominal publication dates, etc.

What Specific Requirements can be Stated ~~in this way~~ at this time?

Few ~~studies~~ stated requirements have been ~~stated~~ supported by good evidence. Often very subjective. — also critical tables of user require.

One can be suggested at this time: "For all fields of science & technology, 90% of requests for journal articles will be satisfied by the ~~[illegible]~~ -most recent years of publication."

If this is too general, then a ~~more specific~~ separate number can be derived for each defined subject field. There may be arguments about the nos. I have suggested, & some evidence may be furnished to suggest that it should be some other no. — I expect this to happen as a natural consequence. — But it will undoubtedly be the specific no. that will be challenged, & not the fact that ~~such~~ the requirement can be stated in these terms.

This is based on compilation of data from — studies (primarily by counting age distributions of footnote references). representing such fields as chem, Phy. etc. I would be interested in ~~[illegible]~~ obtaining any such data from other ages.

Data may be in error because of method. probs (see Rosig #60). — However the specific nos. can be corrected for the correct statistical treatment — — this doesn't alter the fact that such measures can be made.
— See tests of this criterion by Brodman #62

Summary It seems reasonable to state req. in terms of what's required to satisfy a specified percentage of the user population. It has been shown that it is possible to state some of the important user req in this way, one examples ~~[illegible]~~ ~~[illegible]~~ Have tried similar statements of program. — supported by substantial evidence can be proposed. Further hope is that it might be shown that req. as stated in this way might not be significantly different between user groups. This would permit more, systematic statement of req. & criteria for design & evaluation.

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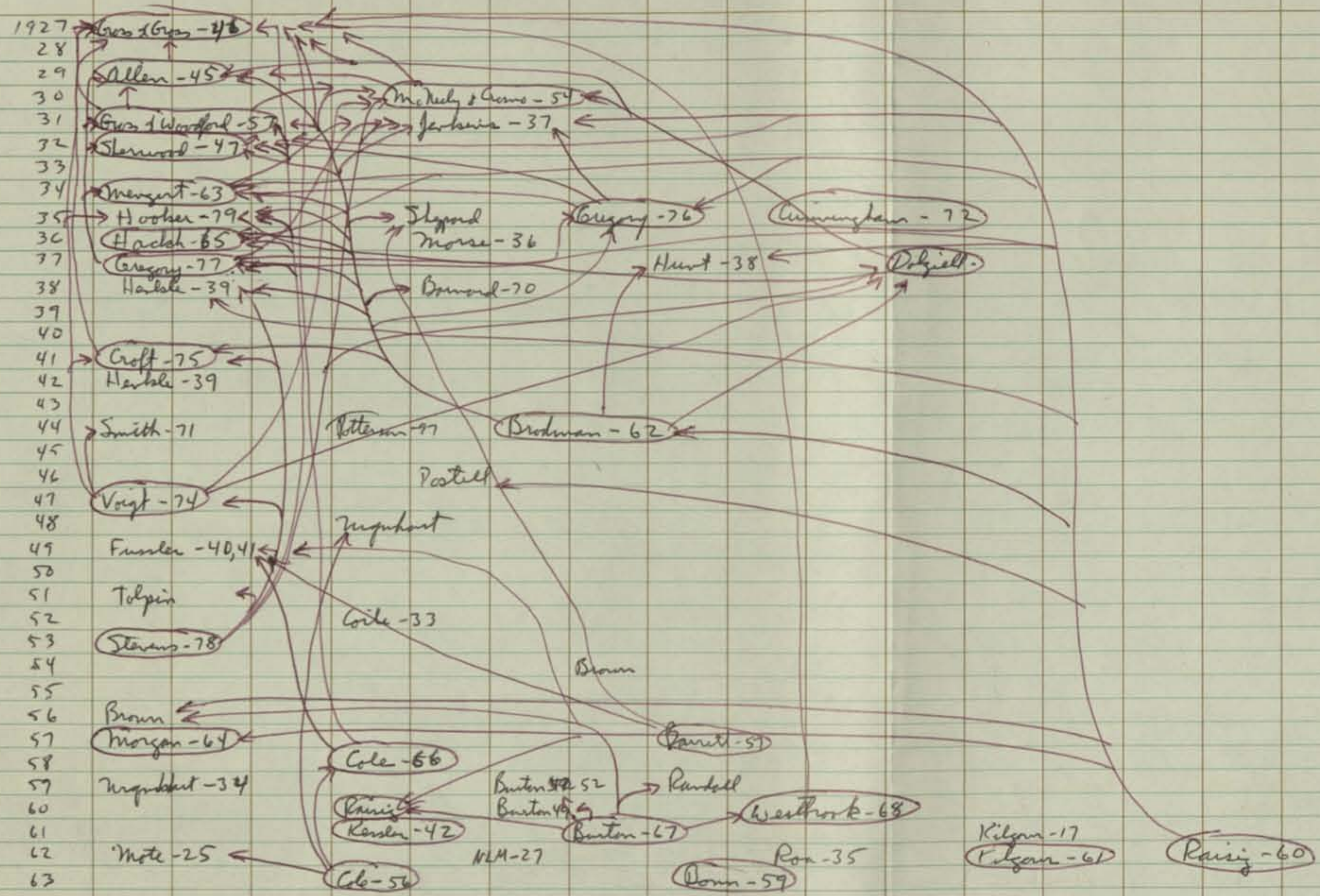

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WHAT ARE WE LOOKING FOR?

Phyllis Allen Richmond

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What Are We Looking For?

Attention to the nature of scientific discovery would produce better information retrieval systems.

Phyllis Allen Richmond

Currently there is a stampede into science information retrieval systems—that is, systems designed to recover factual data from the printed mass—and, to a lesser extent, into document retrieval systems—those designed to disinter a book, article, review, or report, per se, for someone who will then read it to retrieve its information content. There has been too much focusing of attention on ways and means, particularly lucrative ways and means, accompanied by a plethora of silly arguments and downright battles, all obscuring the need to answer the fundamental question: What are we looking for?

The general argument is that we are looking for scientific work that has already been done so that it will not be necessary to do it over again. If we are indeed looking for something like a method of synthesizing a compound, or if we want to know whether such a compound has been made, probably the science information retrieval systems available are as good or bad as we deserve. But suppose we are looking for a new field theory or a scientific approach that will open up new lines of research. Factual retrieval systems will not suffice. Again, what are we looking for?

The author is supervisor of River Campus Science Libraries, University of Rochester Library, Rochester, N.Y.

Scientific Method

At this point, it would be worth while to consider the nature of scientific method, scientific research, and scientific discovery.

Scientific method may be defined as a means of studying the universe and its contents which is characterized by a critical, systematic process of active investigation and reasoning, leading in general to publicly verifiable conclusions (*1*). The investigational approach may be either observational (direct) or experimental (indirect); it may be based on common-sense procedures or on procedures arising from the acquisition of specialized knowledge. The reasoning from the data produced by either approach may be influenced by hypothesis or theory and may result in generalizations, further theories, predictions, or even quantitative laws (*2*). The requirement for publicly verifiable conclusions eliminates those areas of human knowledge that are characterized by a high reliance on probability, and areas in which "observations" are deduced long after the event.

Scientific method is used in research. Research is defined as "the more or less systematic investigation of phenomena intended to add to the sum total of verifiable knowledge" (*3*). This broad definition excludes experimentation of the trial-and-error type, or pure chance observation. Some degree of planning is involved, certainly mental preparation, although experimentation is not necessarily indicated. Research may be of two main kinds: fundamental and applied. Fundamental research is research motivated by intellectual curiosity rather than by any attempt to solve a specific practical problem. Although fundamental research does undertake to solve particular problems, these are intellectual problems which must be solved in order to bring theoretical structure into line with experimental results, or to suggest new lines of development. Fundamental research ultimately may produce an original theory, or it may elaborate on, prove, or disprove existing theories. Applied research seeks a more limited objective—the production of some well-defined specific scientific occurrence or material. The end product is very often patented; it must be usable, practical, to be eligible for this protection.

The major result of scientific method and scientific research is scientific discovery (*4*); this may come at any time, at any place, and to any man, provided he has the genius to recognize it. A scientific discovery results from a combination of circumstances. The time is ripe—that is to say, a scientific breakthrough is due. The man is available, trained, and intelligent ("Chance favors the prepared mind"; a fool would not recognize opportunity if it bit him). Usually the time is characterized by simultaneous discoveries (examples are the discoveries of anesthesia and the calculus). There is a factor of luck involved, too. The pages of scientific journals are full of works by men who "almost" made a discovery. Robert Koch's teacher, Jakob Henle, foresaw very clearly how to prove the germ theory, but he could not prove it. The luck, of course, was in starting with anthrax; anyone who picked a virus disease failed.

To futher complicate the picture, there are many premature discoveries. Josiah Willard Gibbs's research on thermodynamics is a shining example. Rediscovery brought belated recognition of the real value of his work. Even more common are missed discoveries: the essential discovery was made but not recognized. Pasteur's attempts to get pure cultures, uncontaminated by antibiotics, are an example. He was so intent on establishing the germ theory of disease that he missed the significance of the germ killers. There are even accidental discoveries, such as Roentgen's discovery of the penetrating powers of x-rays. The scientist in such a case then goes to work to see if the "discovery" really is a discovery and so brings all his scientific training to bear on the problem.

A discovery may seem to be a flash of intuition or even of creation, given the favorable circumstances mentioned earlier, but more probably it stems from rigid self-discipline, intensive learning, and prolonged use of the scientific method in fundamental research. It is possible for embryonic field theory to result from applied research, as in the case of Michael Faraday, but this is less usual.

Retrieval

The method, the type of research, the discovery all have a bearing on what is recovered in information and document retrieval. Results of applied research are easier to retrieve than results of fundamental research because, as a rule, applied research is more limited in scope, more definite in procedure, and more clear-cut in exposition. Sometimes trying to describe the reasoning involved in fundamental research is like trying to nail currant jelly to the wall. In the light of subsequent information the ideas seem more clear, but contemporary readers of many expositions of theoretical work must have found them considerably less than lucid. The work on the developing germ theory is a classic case in point (*5*).

Hypotheses and theories are very difficult to classify and index unless they have become quantified laws or principles. It may be almost impossible to convey deductive and inductive reasoning in sufficiently abbreviated form. Yet the reasoning can be more significant than the observational or experimental data. Ultimately, one might say, it always is. It is, for example, rather common for scientists making an experiment to be unable to explain the results obtained. The experiment of Michelson and Morley showed the theory of the ether to be invalid, but Einstein must have been more interested in the explanations which occurred during the next 30 years than in the experiment which made them necessary. Document retrieval, as opposed to information retrieval, is a *sine qua non* for finding this type of information. The scientist must read the article as the author wrote it, with the argument intact.

Discovery is just as hard to pin down as hypothesis and theory. An accepted discovery is no great problem, but almost every accepted discovery has a history of many premature discoveries. The priority quarrels are usually extremely bitter, because there is rarely any doubt that someone other than the man who got the credit first had the idea. Often it is several men. Some, like Mendel, receive full recognition for their discoveries. Others, like Semmelweis and Gibbs, receive credit after they are dead. More often, the man who is able to *establish* the idea, who produces it at the right time, receives the approbation; the others are scientific curiosities, to be mentioned by the historian of science who resurrects them from limbo. There is little reason to believe that any system can perform retrieval of the kind the historian performs. That a premature discovery should be identified as a discovery as soon as possible, in the light of subsequent advances, and that this be publicized, is greatly to be desired, but how are the indexers, classifiers, and abstracters to know when to make such a search and what to look for? More realistically, it would be extremely helpful if, at the very first announcement of a discovery, the premature forerunners could be produced by a retrieval system. This could not be done with an information retrieval system. It is a remote possibility with a document retrieval system. On the other hand, in view of the multiplicity of interested scientists when the times are finally propitious for the acceptance of a discovery or a new idea, is it necessary to worry unduly about a discovery really getting lost? The humanists say that nothing worthwhile is ever lost. Does this not apply to science as well as to the humanities?

An information retrieval system can provide the answer to a request for information of a very specific and limited type, and this is certainly a legitimate and very necessary function in industry and sometimes in government, but an information retrieval system cannot, by its very nature, be a really satisfactory means of keeping up with scientific research. There is no substitute for reading the book, article, review, or report. Every article (including this one) has three meaning patterns: what the author said, what the author thought he said, and what the reader thought the author said. The last is by far the most important pattern of the three. No abstracter or indexer can convey adequately the thought sequence or all of the ideas in any scientific article that is more than a cut-and-dried laboratory report. Not all readers, by any chance, can understand what an author said. In the case of the premature discovery, only a much later rereading, in the light, probably, of events which had not occurred when the article was written, will convey the desired information.

Ends, Then Means

This all comes back to the original question: What are we looking for? We are looking for new scientific knowledge. We are looking for new scientific knowledge of all types—not just for knowledge about how to make something or about what has been produced to date. We are looking for scientific knowledge that does not necessarily fit the present ground rules, and especially for that which contradicts them. We are looking in particular for the kind of new scientific knowledge that will open new paths of research, both fundamental and applied. We are looking for new scientific knowledge that is in advance of its time and that may be obscured among the mass of current publications. We are looking for new ideas in science at all levels of scientific method, not just at the lower levels represented by observation and experimentation.

When a scientist is looking for scientific information of this kind, he must *look*. He should not be satisfied to have anyone else do his looking for him, beyond the point of indicating the source of the sort of information he requires. He may say that he does not have time. If he is involved in fundamental research he must find the time, even if it means working on only one thing at a time. For no one can do his looking for him. No one else has the background, the learning, the attitude of mind necessary for recognizing and grasping the meaning of the information when it comes along. The documentalist and the librarian must design systems to make it easier for the scientist to do his own looking. But they should never interpose themselves between the scientist and the written word. He must read the material himself.

All of the systems, both conventional (that is, library solutions) and nonconventional (documentation solutions), suffer from the weakness that too much attention is paid to means, too little to ends. Nine hundred and ninety-nine separate rules to "clarify" entry still do not make library books easy to find. Hardware belongs in a hardware store until we are intellectually capable of using it—and this has not happened yet. The specific problems to be solved in any kind of retrieval system are still the basic philosophical ones: What is the best way to organize knowledge? How can the system devised accept constant and unlimited changes in this knowledge? How do we show the overlapping, interrelated, multidimensional nature of modern knowledge? Solutions to these problems are vital to successful dissemination of scientific information, particularly of the type necessary for further major advances. In the quest for such solutions, let us, above all, keep in mind what we are looking for—and then make it easier to find.

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