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ABSTRACT

The research activities of Project Intrex are directed toward the extension of man's intellectual reach by a new kind of control over access to information. Ways are sought to improve the efficiency of catalog search by utilization of interactive computing techniques, and to provide rapid access to full-text displays by utilizing microfilm storage and facsimile transmission. User experiments, the central subject of the report, show a great deal of work needs to be done, but are mainly encouraging. The principal remedy for existing budgetary constrainsts which have called for drastic retrenchment will be found in the organizational domain. If the purposes of special interest groups can be met at an acceptable cost, utilization of these techniques can spread through interlibrary cooperation and networking to gradually form a multidisciplinary library network. (AB)

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

PROJECT INTREX

SEMIANNUAL ACTIVITY REPORT

15 September 1970 - 15 March 1971

Intrex PR-11

15 March 1971

CAMBRIDGE MASSACHUSETTS

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PROJECT INTREX

Activity Report

I. INTRODUCTION

The research activities of Project Intrex are going forward at a time of deepening crisis in the major research libraries of this country. While struggling with the continuing problems that stem from the accelerating rate at which knowledge is published and used, librarians are now faced with budgetary constraints that call for drastic retrenchment in many services. In these circumstances, the potential role of advanced technology is being discussed with a new sense of urgency.

Where the primary challenge is economical and where near-term solutions are sought within existing concepts of library service, the promise of the new technology is not spectacular. We can expect to see a steady increase in the use of microfilm as an alternative to costly materials in their original form. Office copying techniques will be used for on-demand duplication of a growing volume of journal articles and other short items that will no longer be circulated and will thus remain accessible to other readers. Computers will be used wherever they can reduce the costs of acquisition, serials control, circulation, and other operations.

Important and desirable as these techniques are, they will not, in themselves, restore our libraries to economic health. The principal remedy for today's afflictions will be found in the organizational domain. Interlibrary cooperation and "networking" will have to be raised to new levels of effectiveness by strengthening regional and national backstopping services. The goal of self-sufficiency will have to be abandoned by even the greatest of our libraries. A sensible fee structure will have to be developed to encourage the sharing of resources on a very much larger scale than today's quasi-philanthropic loan arrangements. These organizational advances will be supported not only by the microfilming, duplication, and computing facilities of the individual libraries, but also by interlibrary technology that is now available, such as telephone and teletype communications, facsimile transmission, and data processing services that utilize centralized bibliographic resources.

In contrast with these near-term contributions of new technology toward economic and organizational ends, the technological thrust of Project Intrex is directed toward a more distant and more ambitious goal. The objective of Project Intrex is to extend man's intellectual reach by giving him a new kind of control over his access to information. In pursuit of this objective, we are seeking to improve the efficiency of catalog searches by utilizing interactive computing techniques, and to provide rapid access to full-text displays by utilizing microfilm storage and facsimile transmission. We shall not be satisfied with moderate improvement in these services. We shall have

met the challenge before us only when library users who employ Intrex techniques have come to feel that their command over information resources is so powerful as to constitute a wholly new way of doing intellectual work.

The user experiments which are the central subject of the present report are characteristic of the early stages of user involvement in a technical project, and a good deal of painstaking work remains to be done. But even at this stage the user experiments give strong encouragement to our belief that the aspirations of Project Intrex can and will be realized.

We expect that the techniques of Project Intrex will find their initial use, probably in narrow fields of science and technology, among special-interest groups that have a clear perception of the value of comprehensive and rapid access to information resources. If the purposes of these initial user groups can be met at a cost acceptable to them, we may see the utilization of these techniques spread to other groups and gradually form a multidisciplinary national network. The role of libraries as potential nodes in such a network is not yet clear; its definition will be one of the major tasks confronting the new National Commission on Libraries.

Carl F. J. Overhage
Cambridge, Massachusetts
15 March 1971

II. RESEARCH AND DEVELOPMENT ACTIVITIES (Electronic Systems Laboratory)

A. STATUS OF THE PROGRAM

Professor J.F. Reintjes

Experimentation with the Intrex retrieval system under controlled conditions is consuming a major part of our time. During the Fall 1970 academic term, we undertook a major literature-search operation with eleven students in a graduate subject offered by Professor Frederick McGarry. The motivation for the experiment was a term paper which each student was asked to write as part of his course requirements. The experiment, which extended over most of the fall term, has yielded an abundance of valuable information on several facets of the Intrex retrieval system in comparison with more conventional sources of literature.

Further analysis has been made of our Category-II Experiments on Indicativity which were reported in our two preceding Activity Reports. These experiments seek to determine the effectiveness of different types of catalog information as indicators of the usefulness of documents to users. Deeper insights into the data gathered during the experiments have helped us pinpoint with greater accuracy the significance of results and to guide us to possible loopholes in procedures which may be causing variations in results. Accordingly, a new series of Category-II experiments has been initiated. The goal of this class of experiments is to determine the relative value of several types of document information — title, abstract, subject-matching phrases, and all index phrases — as indicators of usefulness of a document. Results of these experiments are needed in order to be able to specify the quantity and kinds of information that should go into future large-scale machine-stored catalogs. Procedures for our new series have been tightened in order to eliminate possible influence of minor variations in experimental procedures on over-all results.

A cost analysis of machine-oriented literature-retrieval systems has been initiated. The goal of this in-depth study is not only to evaluate operational costs of the Intrex system as they are now being incurred, but to project future costs of large-scale systems in light of specialized computer configurations, data-base, sharing over communications channels, anticipated technological advancements, and so forth.

A major analysis of user reactions to machine-searching for literature through use of computer terminals of the types being employed by Intrex has been made. Our experiences were presented at a workshop sponsored by the American Federation of Information Processing Societies at Palo Alto, January 14 and 15, 1971. A report on our study is in preparation.

Opportunities to use the Intrex retrieval system on an open, noncontrolled, basis are being expanded. In addition to terminals in the Electronic Systems Laboratory and a teletypewriter and a combined catalog and full-text cathode-ray-tube console in the

M.I.T. Barker Engineering Library, we have a teletypewriter terminal in operation at the McKay Laboratory, Harvard University. At present only the catalog of literature stored in the M.I.T.-based computer can be searched at the Harvard location. However, the possibility of providing full-text access over the broadband microwave, coaxial-cable system which now links both campuses is being examined. The installation of an Intrex-terminal facility at the M.I.T. Center for Materials Science and Engineering is underway. The necessary communications channels should be in place within a month or so.

In support of the preceding activities, development of the data base goes forward as does the maintenance and refinement of the various items of electronic equipments being employed in the Intrex system. Approximately 15,000 items are now included in the computer-stored catalog. The second Intrex display terminal which we undertook to build six months ago is in the final debugging stage, and the remote text-access equipment has undergone several refinements to improve its reliability.

B. SYSTEM USAGE: EXPERIMENTS AND ANALYSIS

Staff Members

Mr. A. R. Benenfeld
Mrs. S. Brown
Professor L. S. Bryant
Miss M. A. Jackson
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Miss L. T. Lee
Mr. R. S. Marcus
Miss V. A. Miethe
Professor J. F. Reintjes
Mr. J. O. Silvey
Mrs. F. Spigai

SUMMARY

Major efforts were made during this reporting period in retrieval-system usage experiments and in analysis of the usage made of the Intrex facilities at the M.I.T. Barker Engineering Library and the Harvard University McKay Laboratory. Activities of the group also included: continuation of the Intrex Librarian-Training Program; an indexing and retrieval comparison between Intrex and an abstracting journal; the design and execution of a new experiment measuring retrieval effectiveness involving a whole class of students; the further analysis and design of catalog indicativity experiments; an analysis and evaluation of the Intrex user-system interface; and the installation and use of a new microfilm viewer. A detailed description of the work performed in these areas follows.

INTREX FACILITIES IN OPEN ENVIRONMENTS

The Harvard Facility. In early February, 1971, an IBM 2741 typewriter terminal was installed at the Gordon McKay Laboratory of Applied Science of the Harvard University Division of Engineering and Applied Physics (DEAP). The Intrex catalog can now be interrogated at this terminal. The facility is available to all DEAP or other Harvard personnel and is an essentially unmanned operation except that the staff member in whose laboratory room the terminal is located acts as custodian of the instructional material. In particular, the terminal is physically separated from the DEAP library which is located in a separate building.

The initial introduction of the facility to the Harvard community involved a lecture and demonstration to about twenty potentially interested staff and student personnel. The first week of operation has been most encouraging. Users have, in general, mastered the system rather well, and they appear to be getting good, useful results. We suggest that these initial positive results tend to confirm our feelings of the importance of bringing terminals in close proximity to the working area of users with a real need for information in the data base. It also seems that the personal introduction via group demonstration and lecture was a successful tutorial device.

The Barker Engineering Library Facility. During the past six months the Intrex facility in the Engineering Library has been improved in a number of respects. First, the regularly scheduled hours were extended from three to six hours a day. Because manning the consoles continuously for this extended length of time by Intrex advisers was not feasible initially, it was decided to try having the advisers available on a call basis only. This mode of operation gave us an opportunity to test how easy or difficult it would be for users to learn without any personal instruction. We did, in fact, observe that many users had a difficult time learning how to use the system to a high degree of proficiency without personal help. This fact, along with many others derived in whole or in part from the library experience, is outlined below in a later section on The User Interface.

Subsequently, it was decided that the absence of continuous advisory service at the consoles inhibited the use of the facility to its full potential and also led to a loss of information about the manner of system use that could be provided by the advisers. Consequently, it was decided to reduce the regularly scheduled hours somewhat and provide full advisory service during that time. Starting in the spring term, the facility will be in operation daily from 11 AM to 4 PM and at other times by appointment.

Several changes in the physical facilities were also made. The main display console was moved from the main reading room to the ring area of the library where the typewriter console is located. This change permits easy access to the hard-copy typewriter terminal by display-console users and also permits demonstrations to be held without disturbing other library users. A drawback of the new location is that the console is in a somewhat isolated area and is not as often encountered by the casual passerby. A second change was the installation of the combined ARDS/TEXT display console whose physical description and high user acceptance are described below. A third change was the substitution of a Datel Model 30 portable typewriter terminal in place of the IBM 2741 terminal. This terminal is available on loan to users at their regular office or laboratory locations and so provides an additional kind of remote-access service.

As a result of our experience with users, we have extended and modified our instructional aids. These extensions include new guides for the beginning user and new summary sheets for handy reference for the novice user. Attention has been given to the placing of placards to help the user with common problems, such as starting, and correcting errors, and to help locate various features of the system, including the other instructional aids. A telephone has been provided to enable easier communication should additional assistance be required.

The average daily use of the system runs between five and ten persons daily. Although many of these users are students exploring the system, a fair number have a serious interest in the material contained in the system; we are particularly pleased with the number of repeat users. We have found it rather difficult to elicit comments from users while they are using the system but quite easy to obtain comments after they have used it.

User computer dialogs are automatically monitored; complete records of all sessions are stored on disk and later printed out for analysis. A weekly summary of these monitor files is produced which contains information about individual sessions, system performance, schedule maintenance, system problems and their resolution, and user comments. Periodic meetings have been instituted at which both library and ESL personnel discuss experience with users, changes in the system, and suggestions for improvements in operation and experiments.

INTREX LIBRARIAN-TRAINING PROGRAM

The educational program to train Engineering-Library staff and ESL staff indexers as Advisers to operate the Intrex retrieval system has been revised as follows:

An improved unit-content structure. Each unit contains logically related topics. Disparate jumps among unrelated topics have been removed. The general content outline emphasizes individual system features in relation to their role in the total system. There is also increased attention to progression from the more basic features to the more sophisticated system features.

Measures of progress by instructional units. Test demonstrations by the trainee have been incorporated into the program at the end of most instructional units. Frequent testing of trainee progress now allows the instructor to institute reviews of topics at the time they are needed before the trainee moves on to other topics.

Associated reading material. Relevant system documentation bearing on each instructional unit has been distributed to trainees and instructors. These readings are drawn from the Intrex system overview and reference guides, and from several Intrex reports and memoranda.

The revised training program has been implemented with some changes from the initial procedures of last spring. Previously trained advisers are now participating as console instructors, with each instructor working with only one trainee. It has been and continues to be our experience that personalized "one-on-one" instruction with considerable "hands-on" console operation for the trainee best conveys system features, functions, and operations. The console instructors guide the console sessions of the trainees and they develop specific problems to be solved that pertain to the day's topics. However, some of the instructional units are lectures or seminars covering more "theoretical" topics. Those seminars, and the administration of the end-of-unit review tests are given by the training-program developers. Based upon our previous training experience, the units of the revised program were developed to be covered in 25 daily sessions, each session lasting not more than two hours.

At the time this report was written, the first section of the revised training program was still in progress. One reference librarian and one staff indexer are currently being trained. This revised program is running far more satisfactorily to both instructors and students alike than did the initial program.

An outline of the instructional units is given below. The end-of-unit tests have not been listed. The tags "C" and "L" refer to units with console operation or lectures, respectively. Some units require two or three two-hour sessions, whereas others can be covered in less than a session.

Outline of Instructional Units for
Librarian-Training Program

KEY: L - Lecture Session C - Console Session CL - Console and Lecture

Unit A. Overview of System Use

- L 1. History and Experimental Objectives of the Intrex System
- C 2. Basic Steps in Intrex Use: Search; Catalog Output; Text Output
- C 3. External Mechanics of System Use:

  Log-in and out; Console Operations (ARDS, 2741); Typing Errors; Interrupt; The Commands HOLD, BEGIN, LOG, EXIT
- CL 4. Text-Facility Use

Unit B. Subject Searches

- CL 5. Subject Indexing
- C 6. Subject Searches: Commands SUBJECT, RANGE, COUNT, OUTPUT match subject
- L 7. Subject-Search Mechanisms I: Word Stems, Inverted File, Synonyms
- CL 8. Subject-Search Mechanisms II: Lists and List Names
- CL 9. Subject-Search Mechanisms III: Combining Lists and Other Techniques for Overcoming Synonym and Matching Failures; Bookkeeping Problems with Lists

Unit C. Other Inverted-File and Basic Searches

- C 10. Author Searches; Title Searches; Document Number Searches

Unit D. Catalog Information and its Output

- L 11. Catalog-Record Structure; Tagging; Codes; Abbreviations
- 12. Catalog-Record Fields and their Output

Unit E. Search of Uninverted Fields

- C 13. RESTRICT Command and "Eyeballing"

Unit F. Other System Features

- C 14. Other Commands: INFO; LONG; SHORT; TIME; COMMENT
- L 15. Instructional Features On-line: Info; System-Dialog Structure; Error Messages

L 16. Instructional Features Off-line: Overview; Guides; Cards

L 17. Data-Base Coverage and Selection

Unit G. Roles of the Adviser

L 18. Strategies and Strategy Aids

L 19. Roles of the Adviser: Instructing and Observing Users

C 20. Final Test: Demonstration of the Entire Intrex System

INDEXING COMPARISON: INTREX AND ABSTRACT JOURNAL

Background. In the previous two Semiannual Reports several Category-I experiments were described in which Intrex indexing and retrieval were analyzed with respect to standard bibliographies. One of these experiments involved an experimental subject designated ES 1 who had prepared a bibliography on the properties of the compounds $RbMnF_3$, $KMnF_3$, $CsMnF_3$, and $TlMnF_3$, especially with regard to the property antiferromagnetism. It was reported that Intrex searching of this topic gave a recall figure of 0.87, precision of 0.90, and a discovery ratio of 0.22 -- that is, relevant documents found by Intrex and not in the bibliography were 22 percent of all Intrex-found documents. There was some speculation about the relatively low discovery ratio, especially in view of the supposedly much deeper Intrex indexing than that of Physics Abstracts, the abstracting journal, and the fact that about half of the discovery set was attributed to "clerical-error" omission by the bibliography authors, and not to the deeper indexing of Intrex. A subsequent detailed analysis, summarized below, of the indexing of Intrex and Physics Abstracts on this topic has shed considerable light on this and related questions.

Analysis. Some 56 documents from the Intrex data base were selected for study. A total of 51 of these had been retrieved by Intrex in the searches conducted during the experiment. The searches were on the chemical-compound formulas. Five others had been in the bibliography of ES 1 and in the Intrex data base but not retrieved by the above search strategy. Five of the 51 retrieved had been judged not relevant by the author of the bibliography.

As the first part of the new analysis, these 56 documents were scanned to determine if any of the four chemical formulas or a word with the stem antiferromagnet exist in the title of abstract of each of the documents. There were 128 occurrences of these five terms in the titles and abstracts. The breakdown by term and location is given in the following table.

TERM

Location	$RbMnF_3$	$KMnF_3$	$CsMnF_3$	$TlMnF_3$	Antiferro-magnet	Totals
Title	21	9	0	4	17	51
Abstract (also Title)	18	6	0	3	16	43
Abstract (not Title)	5	11	2	0	16	34
Totals	44	26	2	7	49	128

The above figures refer to the existence of a term within the title and/or abstract of a document; multiple occurrences of a term within an abstract or a title of a single document are counted as only one occurrence. It may be observed that for 51 occurrences of terms in title, the same terms also appeared 43 times in the abstract. We may also note that the effect of adding abstract words to title words has added about 67 percent (34/51) to the number of different term-in-document occurrences. We ignore the 43 co-occurrences of terms in abstracts since they already are covered by title words.

Let us now look at these 85 (51 + 34) instances of terms in documents to see how they were indexed. All 51 title terms were indexed in Intrex, of course, inasmuch as all non-common title words are regularly indexed by Intrex. Physics Abstracts (PA) indexed 44 of these terms (86 percent). All of the 51 terms came from documents rated relevant to the topic by the author of the bibliography. There was a marked difference between PA indexing of the chemical compounds only, where 33 of the 34 (97 percent) of the title occurrences were indexed, and the indexing of the property antiferromagnetism, where only 11 of 17 (65 percent) of the abstract-only terms were indexed as such. A document was considered indexed under the term antiferromagnetism if it appeared under any heading with that word, or a word with the same stem, in it; namely, the PA headings Antiferromagnetic resonance, Antiferromagnetism, and Magnetic properties of substances/antiferromagnetic.

With respect to the 34 abstract-only words, Intrex indexed 27 (80 percent) of them. PA indexed just half (17 of 34, or 50 percent) of these same occurrences. The greater emphasis on chemical compounds in Physics abstracts is also found here, but to a lesser degree; 56 percent (10/18) of the chemical compounds were indexed by PA, while only 44 percent (7/16) of the antiferromagnetism were indexed by PA. Three of these 34 occurrences came from two documents which were considered not relevant to the bibliography. Intrex indexed 2 of these 3, and PA one. It can be determined from the figures that the overall coverage of PA indexing of title and abstract words is (44 + 17)/(51 + 34) = 61/85 = 72 percent. Intrex coverage is (51 + 27)/85 = 92 percent.

It is instructive to consider what range numbers* are associated with the Intrcx index terms containing one or more of the five words under study. The table below gives the range number of abstract-only terms indexed by Intrex in each range, which of these were indexed by PA, and how many were from irrelevant documents. Where a word was indexed in more than one Intrex term, only the term with the higher range number was considered, where the order of importance from high to low is taken as 5 (title), 1, 2, 3, 4, 0. (Note, of course, there are no title words in abstract-only terms.) The seven abstract-only words that were not indexed by Intrex are also indicated.

	Intrex Range Number					Not Indexed
	1	2	3	4	0	by Intrex
Intrex Indexing	12	7	4	4	1	7
PA Indexing	8	4	0	1	0	1
Irrelevant	0	1	1	0	0	1

It can be seen from the results of the analysis that Intrex indexing to a depth of range 1 is roughly equivalent to PA indexing in that Intrex title and range 1 terms cover some 63 (51 title plus 12 range-1 terms) of the 85 terms, whereas PA indexing cover 61 of the 85 terms. Notice, also, that the abstract-only terms indexed by PA tend to be indexed under the more important range numbers in Intrex, indicating that the range numbers are properly serving their intended function in that the PA-indexed terms should be those with the more important relationship to the document.

A sample of 1969 citations indexed by PA indicates that between 3 and 4 headings are assigned to each document; a total number of 15-20 words per document are involved in subject headings on the average. This, again, can be characterized as "expanded title" depth indexing and related to the Intrex title and range-1 indexing.

In addition to the title and abstract terms that were indexed, Intrex indexed the five topic words on 15 occasions when they appeared in neither title or abstract. On only a single occasion did PA do likewise. Five of the 15 Intrex terms came from documents that were judged not relevant to the topic, the one PA term was from a relevant document. The breakdown by range number follows:

* Intrex uses a range number after each subject-index phrase to indicate the extent of the document to which the phrase applies. For a detailed description of range number see: 15 September, 1970 Intrex Semiannual Activity Report, p. 17.

	Intrex Range Number				
	1	2	3	4	0
Total Terms	0	3	7	5	0
Irrelevant	0	0	4	1	0

Note here, also, that the range numbers help differentiate more important, or relevant, documents in that all of the irrelevant documents had low range numbers.

Let us sum the terms from the 51 relevant documents in three categories: (1) title terms, 51; (2) abstract-only terms, 34 - 3 = 31; text-only terms, 15 - 5 = 10; for a grand total of 92 terms from relevant documents (8 terms were from non-relevant documents). Taking this as a kind of "recall base for terms," we may then calculate overall recall and precision figures as follows:

	Intrex	PA
Recall	(58 + 26 + 10)/92 = 0.95	(44 + 16 + 1)/92 = 0.67
Precision	87/(87 + 2 + 5) = 0.93	61/(61 + 1) = 0.98

Breaking this down by Intrex range number, we have

	Intrex Range Number					
	5(title)	1	2	3	4	0
Recall*	51/92 = 0.55	63/92 = 0.69	72/92 = 0.78	78/92 = 0.85	86/92 = 0.94	87/92 = 0.95
Precision*	51/51 = 1.0	63/63 = 1.0	72/73 = 0.99	78/84 = 0.93	86/93 = 0.93	87/94 = 0.93

These figures are plotted on Fig. B-1. The estimated cumulative percent of index words for a given range is taken from data-base averages, as described in the 15 September 1970 Semiannual Report.

The number of terms indexed by Intrex but not by PA is 92 - 61 = 31; the number indexed by PA but not Intrex is just one. The discovery ratio for Intrex is then 31/87 = 0.36. The number of relevant documents not indexed by PA under any of the five terms was determined to be 10. Thus the discovery ratio on a document basis is 10/51 = 0.20.

Interpretation. The Intrex discovery ratio of 0.20 with respect to Physics abstracts on a document basis is more in line with our previous results — compare this with the discovery ratio of 0.23 reported for the bibliography on "fatigue" with respect to the journal Metals Abstracts. One reason that the previously reported figures appeared so variant is that the Intrex discovery ratio of 0.11 on the antiferromagnetism bibliography was taken with respect to the bibliography itself, whereas the figures given above are with

* Cumulative figures for all range numbers up to, and including, range given.

respect to abstract-journal indexing only. Thus, the lower figure of 0.11 resulted partly from the fact that the author of the bibliography went beyond simple searches in one abstract journal.

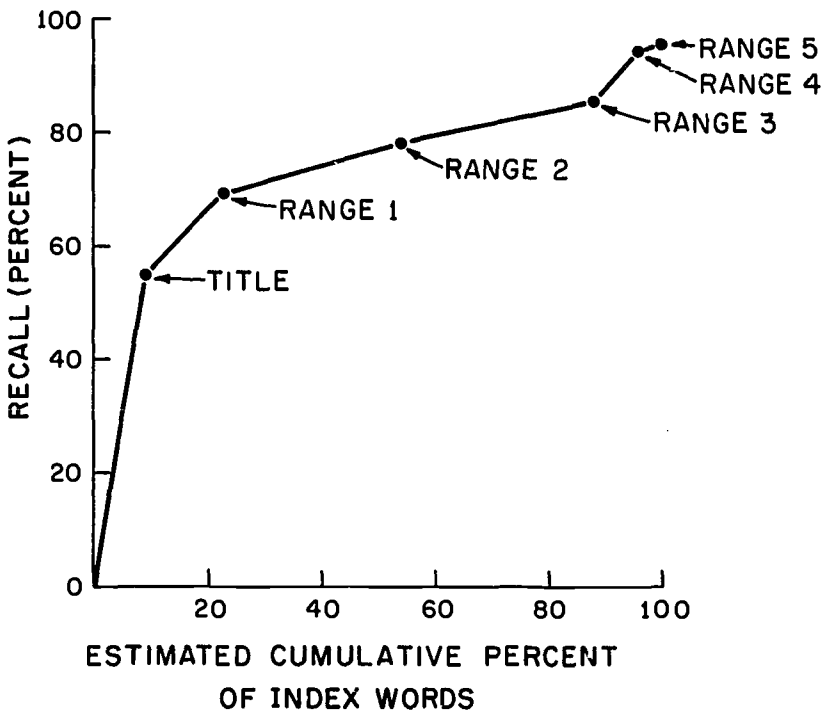

Fig. B-1 Recall as a Function of Depth of Indexing.

Another point to consider is the much higher discovery ratio on a term basis (0.36) than on a document basis (0.20). This reflects the fact that any search on a strategy more sophisticated than just a single word — here a disjunction of five one-word terms — will tend to counteract isolated indexing deficiencies. This interpretation raises again the question of why the discovery ratio on the single term "fatigue" appears to be so low, and this question will be further investigated.

The paradox as to why the discovery ratio on a term basis (0.36) appears so small in view of the supposedly much greater depth of Intrex indexing with respect to Physics Abstracts can now be resolved. The statement of the paradox is that Intrex has about 80 entry points (subject words) per document whereas the PA index has only about 4; therefore, the discovery ratio should be about 20. However, as noted above, the PA index entry point is usually a multi-word phrase and the actual number of words represented may average about 15 to 20. Also, the Intrex indexing is purposely highly redundant on a word basis — in order to allow subject terms to "stand alone" for greater

indicativity for the user and in order to provide a linking mechanism for greater searching precision by the Boolean command WITH. A recent analysis of the Intrex inverted files indicated that the redundancy on a word basis over the whole data base was on the order of 2.5, so that of the 80 subject words in the catalog record for the average document there may be only about 30 different word-stem types. This implies a discovery ratio of about (30 - 20)/30 = 0.33, which is very close to the 0.36 figure we actually observed in this experiment.

Summary. The analysis described above has helped to resolve certain questions about the comparison of Intrex indexing with respect to other kinds of indexing, especially in regard to how depth of indexing affects retrieval effectiveness. This analysis will serve as a pattern for additional analysis which will attempt to further quantify the factors affecting retrieval effectiveness for a greater variety and number of searches. One particular aspect of future analyses is to explain why Intrex title and range-1 terms for this experiment seemed to have a significantly greater effectiveness when compared to lower range terms than reported for some previous experiments.

THE CLASS EXPERIMENT ON RETRIEVAL EFFECTIVENESS

Nature of the Experiment. An experiment on retrieval effectiveness was conducted during the fall semester with the full cooperation of Dr. Frederick McGarry, Professor of Civil Engineering, in conjunction with a term-paper assignment for eleven graduate students taking his subject "Strength of Structural Materials." The data from this experiment are now being analyzed and interpreted. We discuss here the objectives of the experiment, its implementation, and some initial results and observations.

The basic purpose of this experiment is a comparative study for the same search topic of retrieval effectiveness using Intrex and traditional library sources. The effects on retrieval of indexing features of Intrex and of the several library sources, and the searching strategies employed in all of the sources are of particular interest. A secondary purpose is the evaluation of the interactive features of the on-line Intrex system. The quantitive measures employed are: recall as a function of effort, the latter being measured by time invested and number of searches; and recall and precision for individual searches and for combinations of searches. An important feature is that we are able to provide comparisons and averages of several searchers working independently on the same problem, and among several search groups, each assigned a different topic. In addition, the effects of preceding Intrex searching by library searching, and the reverse, are being studied.

Implementation. The implementation of the experiment followed these major steps:

1. The active cooperation and approval was obtained from the professor who is the leader of one of the five research groups whose interests comprise the thrust of the Intrex data base.

2. A general introduction to the experiment was given to the eleven students in the class. The professor and the students together suggested fourteen potential topics for the class term papers. Our main interest was in the literature-searching methods and the materials gathered for the papers.

3. A quick test on the breadth of the fourteen potential topics was made in Intrex and in major abstracting sources. Three topics were selected which were the least likely to bias results because of a simplistic search procedure, or by too few or too many references in Intrex and other sources. These topics are:

   (a) Irradiation embrittlement of metals.
   (b) Effect of microstructure on the fracture toughness of steels.
   (c) Effect of processing history on the fracture toughness of aluminum alloys.

4. Each student selected one of the three topics. The topic group sizes were 4, 5, and 2 in the order of the topics listed above. Half of the students in each group began literature searching with Intrex, whereas the other half began literature searching with library sources. The second part of their searches in the other source did not begin until completion of the first part.

5. Each student was given a set of written general instructions in mid-October 1970. He also received copies of guides to the several campus libraries, including the Engineering Library. He was asked to contact Intrex personnel when he was ready to begin his Intrex searches. The completed term papers, reference bibliographies, source listings, and a 500-word critique of their use of the Intrex system were due shortly before Christmas.

6. The general instructions requested the students to format their term papers along the lines of a paper containing a comprehensive bibliography which might appear in an "annual review" volume covering their topic. In particular,

the literature appearing since January 1967 was to be surveyed, although a brief introduction might also cite a few classic papers on the topic.

7. When a student was ready to start his Intrex search, an Intrex analyst gave him a demonstration (about one-half hour in length) at a console using sample searches unrelated to his search problem to indicate general system features. The student also received at that time hard copies of a system overview and a more detailed reference guide to the Intrex system. A ten-minute interview covering the student's general educational background and previous computer and library experience, preceded the demonstration. If the student had previously completed the library part of the assignment, then the general interview was followed by a debriefing of those search events and results. At the conclusion of the demonstration itself, the student was asked to arrange a specific time to begin his first Intrex search session.

8. A student was allowed as many Intrex search sessions as he felt he needed. An Intrex analyst was present during each session to assist the student with technical problems and to record observational data. The analysts were instructed to encourage the students to use the Intrex system and related instructional materials as much on their own as possible. This is similar to the mode of operation of Category-III experiments described in previous reports.

9. A short debriefing about results to date and conscious changes in the approach to the next Intrex search session preceded each subsequent session. A tape recording of the complete dialog between student and analyst was made for each session which also included the analyst's interpretive comments about use of the text-access system and system malfunctions. Complete monitor files of all catalog system transactions were maintained. No charge was made for requests for microfiche and hard copies of text of documents found through the Intrex system.

10. For the conventional-library search work, each student was requested to keep data on the time he expended in searching and examining literature sources; he was also asked to document the headings searched under in those sources and to list

potentially useful references from the headings. A worksheet to record the data was provided. If the library search was done after completion of the Intrex search, a debriefing on the library-search effort was separately arranged.

11. Each Intrex search session plus the library search was documented in memorandum form by an analyst from data provided by the monitor files, recordings, worksheets, and the analyst's own recollections of observations and impressions.

12. Copies of the final term papers, the Professor's comments on them, and the 500-word critiques of the Intrex system were secured.

13. After concluding the formal experiment, we invited the students to attend an informal meeting at which time we discussed the larger goals of the experiment and presented some of our initial findings to them. We encouraged and received many additional comments about the experimental procedure and about the Intrex online retrieval system.

Initial Results and Observations. The students, in general, learned to use the system readily and effectively. The controlled monitoring and observation of their behavior was an important factor in developing the analysis of the user-system interface described in the section below. A gross picture of the primary statistics describing the experiment is given by the Table B-1. These statistics represent just the very initial results on this experiment. Further analysis and interpretation of the results are in process and will continue.

It is tempting to use these statistics to get estimates of the effectiveness of the Intrex and library searches as measured by the number of references found per hour. However, several considerations make it difficult to do this on a simple basis. In the first place, the time spent with Intrex included text reading on the display CRT screen whereas time spent in the library, in general, did not include reading text. Secondly, the references not obtained from Intrex were not always found during library search time. For example, references included the class textbook and relevant technical papers handed out in class, as well as lists of reports supplied on letter request by government agencies. A more thorough analysis will have to be done before sound figures can be derived.

Roughly speaking, however, it appears that when the above considerations are taken into account, the effectiveness factor would favor Intrex searching somewhat over standard library searching. The main reason, apparently, that the much greater speed and ease of Intrex searching did not weigh more heavily is that the general literature for these topics is much more voluminous than the coverage given the topics in the Intrex

Table B-1

Statistics on the Class Experiment

Statistic	STUDENT											Total	Average
	A1	A2	A3	A4	B1	B2	B3	B4	B5	C1	C2		
No. of Intrex Sessions	3	1	2	2	2	1	1	2	2	1	5	22	2
Time of Intrex Sessions (hours at the console)	5.2	2.5	4.6	2.5	4.8	7.2	2.5	3.2	6.5	1.7	13	53.7	4.9
First Searched Intrex (I) or Library (L)	I	L	I	L	I	L	L	I	I	I	L	6I,5L	
Time Spent in Library (hours)	3	1+	15	8.5+	4	8+	35	3	1+	1+	27	106+	9.6
Length of Term Paper (pages)	13	18	24	24	17	16	41	27	25	9	30	244	22.5
No. References in Term Paper	12	12	39	51	19	33	37	20	31	4	16	274	25.0
No. References in Term Paper Found through Intrex	4	2	4	9	7	13	0	6	18	2	5	70	6.4

NOTES

(1) + indicates an additional amount of time was involved but this hasn't been fully determined yet.

(2) Student-code prefixes A, B, and C refer to the three topics of Section 3 above.

data base. The students were essentially unanimous in their comments, as expressed in their critiques, on the inherent great potential of an Intrex-like system and the corollary point that all that was needed to achieve this potential was a more comprehensive data base.

It is interesting to note that several of the students have returned to the Intrex system, and introduced fellow students to it, since the end of the experiment. They have reported useful results in problem areas separate from the class topics in so doing.

Our preliminary analyses tend to show that students who searched in Intrex before the library found a somewhat higher percentage of their references through Intrex. This is probably due to the factor of the students in wishing to finish up their term papers as quickly as possible. For example, the fact that student B3 shows the complementary effect in that his use of none of the references he found in Intrex apparently reflects the fact that he had finished his term paper before using Intrex.

A statistic suggesting that Intrex has good recall capabilities is that of 73 references used which existed in the Intrex data base, 70 were actually found through Intrex searching.

There is evidence that the speed and ease associated with Intrex use by the students resulted in large measure from the unitary appearance of the data base to the user. That is, a single search request in Intrex will result in a list of documents which

match over the entire time span of the data base; also in-depth catalog or text output on these documents is immediately available at the user's station. In contrast, searching in abstracting journals involves looking through many different issues under several headings — phrase decomposition and co-ordinate word matching is lacking. Furthermore, the immediate result is usually only a document title; procurement of the corresponding abstract and text requires two additional locating operations per document.

Preliminary results suggest that the greater depth of Intrex indexing did not result in as much additional recall as we would have predicted. This appears to result largely from the fact that the students — for lack of time or other reasons, — chose not to be nearly so comprehensive and exhaustive in their searching as we hoped they would be. This reinforces the notion — important to measures of overall system utility — that many users prefer a few "good" documents to a comprehensive list.

From other initial investigations it appears that there is often little difference in search results between the free-vocabulary aspect of the Intrex indexing and the controlled-vocabulary aspect of the abstract-journal type indexing. This may be due to: (1) the abstract journal primarily using title and some abstract words as the basis for indexing — essentially similar to Intrex, and (2) the key words directly associated with the student's topics were all fairly standard metallurgical terms, not too specific, and hence, part of the controlled vocabulary. If this result is found through further analysis and experiment to be general, it may be that the superiority of free-vocabulary indexing would rest on grounds such as ease of manual indexing, adaptability to automatic indexing and avoidance of controlled-vocabulary problems such as teaching searchers the vocabulary or updating the vocabulary by system analysts.

THE CATALOG INDICATIVITY EXPERIMENTS

Summary. The catalog indicativity experiments, previously designated as the Category-II experiments, are designed to test the effectiveness of different types of catalog information as indicators of the usefulness of documents to users. Since completion of our first experimental program (Series A), work on these experiments has progressed on two major fronts. First, more data have been obtained from experimental subjects (ESs) 20 and 25, who participated in Series A, and an in-depth study of their responses as ESs in Series A has been made. Second, an improved design for the catalog indicativity experiments has been devised and is being utilized in the Series B experimental program, which is now underway.

Further Experimentation on Previous Experimental Subjects. ESs 20 and 25, both of whom are Ph.D. candidates in the Department of Engineering and Applied Physics at Harvard University, were chosen for additional study because their responses in Series A were anomalous in certain respects. For ES 20, titles appeared more indicative of the usefulness of documents than were any of the other four types of catalog information

presented — abstracts, subject phrases, author, and the combination of title, author, location, and matching subject phrases. ES 25 was unusual in that he gave value ratings of '4' ("cannot make a judgment") to approximately one quarter of the subject-phrase occurrences.

In this follow-up study ESs 20 and 25 were asked to reexamine the fields and full texts of documents whose ratings of one or more fields differed from the full-text rating. They were asked to explain, if they could, why each discrepancy between field and full text ratings occurred — whether some information about the document was missing from the field, whether the field was misleading, whether the field rating was actually borderline, or whatever. From the explanations of the ESs, we were able to perform an informational-factor analysis similar to the one reported in the 15 September 1970, Activity Report. The recent analysis, however, differs from the previous one in two notable respects: information factors were assigned to individual "discrepant" fields, rather than to documents as a whole, and borderline cases were not always given an information factor of '0', but were given '1/2' when there was evidence that the catalog information was responsible for the borderline rating. Following is the code used to assign information factors to fields:

0 A variational factor relating to the judgment of the ES was responsible for the discrepancy.

1/2 The field rating differed from the full-text rating by 1/2 point (borderline case), and the catalog information was in some way responsible for the discrepancy (information missing or misleading); or the ratings differed by one point, but a combination of informational and variational factors was responsible for the discrepancy.

1 The field rating differed from the full-text rating by one point, and the catalog information was in some way responsible for the discrepancy.

Table B-2 below represents the total information factors per catalog field divided by the total number of discrepant ratings per field. The author field is omitted because all the discrepant ratings in that field were attributable to the field's low information content. Notice that the catalog information is responsible for approximately 60 percent of the discrepancies between field and full-text ratings; the other 40 percent are attributable to variational factors of the ESs.

Table B-3 displays data on indicativity (fraction of cases in which field ratings concur with full-text ratings) and "adjusted" indicativity. The latter measure is obtained by adding to the concurrent ratings those discrepant ratings that are attributable to variational factors of the ESs. The combined indicativity levels for both ESs were raised over a range from 3 percent to 10 percent, with the most dramatic improvements for abstracts and subject phrases.

Through similar analyses yielding adjusted indicativity scores, we believe we can gain a more accurate picture of the actual value of the catalog fields as indicators of document usefulness than we could with raw indicativity scores alone.

Table B-2

Fraction of Discrepant Ratings between Field and Full Text which can be Attributed to Inadequacies of Catalog Information

Experimental Subjects	Title	Title, Author, Location, Matching Subject Phrases	Abstract	Subject Phrases	All Fields
ES 20	$\frac{4}{6}$ (.66)	$\frac{7}{9}$ (.78)	$\frac{5}{7}$ (.71)	$\frac{6}{8}$ (.75)	$\frac{22}{30}$ (.73)
ES 25	$\frac{9}{9}$ (1.00)	$\frac{7\ 1/3}{11}$ (.67)	$\frac{2}{10}$ (.20)	$\frac{4\ 7/8}{13}$ (.375)	$\frac{25\ 6/24}{43}$ (.54)
Both ESs	$\frac{13}{15}$ (.87)	$\frac{14\ 1/3}{20}$ (.72)	$\frac{7}{17}$ (.41)	$\frac{10\ 7/8}{21}$ (.52)	$\frac{45\ 5/24}{73}$ (.62)

Table B-3

Raw and Adjusted Indicativity Scores

Experimental Subjects	Title	Title, Author, Location, Matching Subject Phrases	Abstract	Subject Phrases	All Fields
ES 20 Indicativity	$\frac{14}{20}$ (.70)	$\frac{9}{18}$ (.50)	$\frac{11}{18}$ (.61)	$\frac{12}{20}$ (.60)	$\frac{46}{76}$ (.61)
ES 20 Adjusted Indicativity	$\frac{16}{20}$ (.80)	$\frac{11}{18}$ (.61)	$\frac{13}{18}$ (.72)	$\frac{14}{20}$ (.70)	$\frac{54}{76}$ (.71)
ES 25 Indicativity	$\frac{26}{35}$ (.74)	$\frac{36}{47}$ (.77)	$\frac{19}{29}$ (.66)	$\frac{22}{35}$ (.63)	$\frac{103}{146}$ (.71)
ES 25 Adjusted Indicativity	$\frac{26}{35}$ (.74)	$\frac{39\ 2/3}{47}$ (.84)	$\frac{27}{29}$ (.93)	$\frac{30\ 1/8}{35}$ (.86)	$\frac{122.8}{146}$ (.84)
Both ESs Indicativity	$\frac{40}{55}$ (.73)	$\frac{45}{65}$ (.69)	$\frac{30}{47}$ (.64)	$\frac{34}{55}$ (.62)	$\frac{149}{222}$ (.67)
Both ESs Adjusted Indicativity	$\frac{42}{55}$ (.76)	$\frac{50\ 2/3}{65}$ (.78)	$\frac{40}{47}$ (.85)	$\frac{44\ 1/8}{55}$ (.80)	$\frac{176.8}{222}$ (.80)

Utility of Fields as a Function of Number of Words. As stated in previous Reports, we have formulated a length hypothesis for catalog data, which states that as field length increases, indicativity increases, but indicativity per word decreases; this is a statement of the law of diminishing returns as it applies to catalog data. We tested this hypothesis with respect to ESs 20 and 25, who, as indicated above, provided us with certain anomalies in their results to our Catagory-II experiments.

A count was made of all words (not solely content words) in the four fields under test of documents evaluated by ESs 20 and 25. In Fig. B-2 average field length is plotted against indicativity. The figures show that, after adjustment of the data, the anomalous results on these two ESs with respect to the length hypothesis tend to deviate less from the length hypothesis than do the raw data. It may be remarked that a similar effect was observed with analysis of ES 12 and ES 23 reported earlier. There are, of course, deviations from a completely consistent adherence to the hypothesis as would be expected in any probabilistic situation. We must consider further the statistical evidence, especially in the new, better-controlled, Series-B experiments, in order to determine the extent of adherence to the length hypothesis and the nature and reasons for deviations from it*.

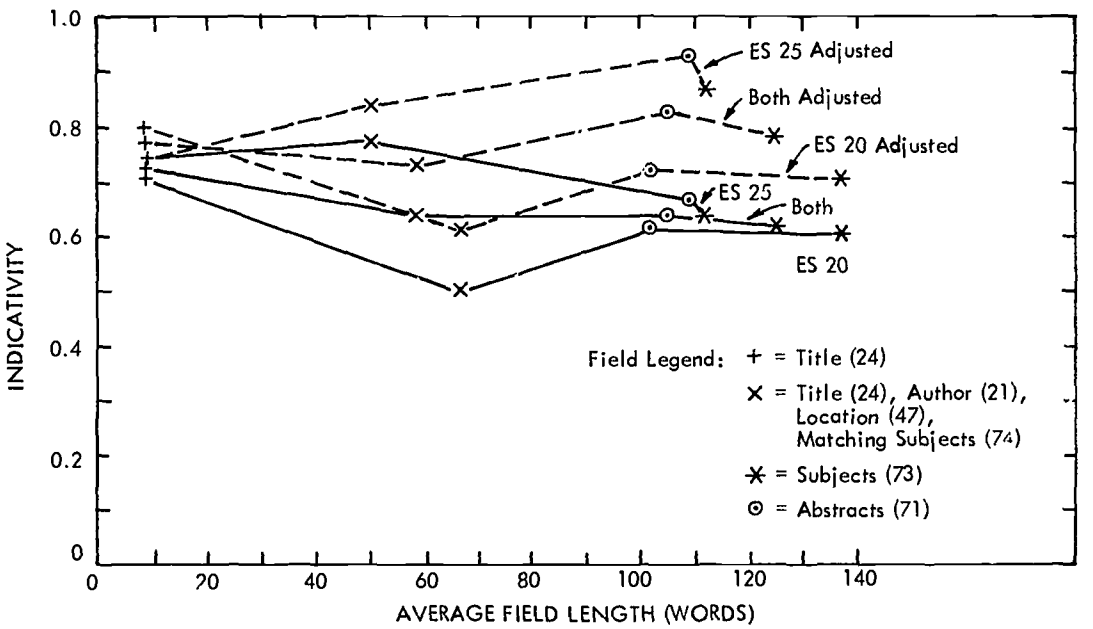

Fig. B-2 Indicativity as a Function of Average Field Length.

* Independent investigations generally supporting the length hypothesis have been reported in:

(1) Hagerty, Katherine, "Abstracts as a Basis for Relevance Judgment", Working Paper No. 380-5, University of Chicago Graduate Library School, February, 1967. (PB 174 394).

(2) Saracevic, Tefko, "Comparative Effects of Titles, Abstracts and Full Texts on Relevance Judgments", Proceedings of the 1969 ASIS Annual Conference, October, 1969. pp. 293-299.

There are, of course, other factors beyond just length that affect the utility of catalog fields as indicators of document value. Some of these were highlighted by the interviews with ES 20 and ES 25. For instance, titles performed quite well for ES 20, even though they had the smallest number of words. ES 20 remarked that he would have preferred to go immediately from titles to full text, primarily because he could never be certain that a document would be useful until he examined the document itself. ES 25 also expressed preference for certain kinds of catalog information. He found abstracts most useful because of their summary nature; subject phrases, on the other hand, were, in his opinion, too long and disconnected. Their pastiche quality made him unsure whether documents would be useful, and hence he was unable to make judgments on a substantial portion of subject-phrase occurrences. It should be noted, however, that over the course of the catalog indicativity experiments to date, the subject-phrase field has appeared to be at least as useful as the abstract field. Nevertheless, we shall further consider in our analysis whether the subject-phrases field may cause users more difficulty — say in terms of increased time to make a decision.

Improved Experimental Design. A revised experimental design has been drawn up and is currently in use for our indicativity experiments. Substantial changes from the Series-A design are in the areas of: selection of experimental subjects, statements of search topics, selection of documents, and number and type of experimental sessions. Some less consequential modifications of Series A procedures have also been made.

Selection of Experimental Subjects. We will continue our analysis of doctoral students who wish to obtain information relevant to their thesis topics. We will, however, also include other types of users in our study — undergraduates, graduates, faculty, and staff members. These various types will compose a heterogeneous group, whose results will be compared to those of the thesis students. Our greater diversity in sampling will permit us to draw conclusions about the indicativity of catalog fields for various user populations.

Statements of Search Topics. ESs will be encouraged to write short statements about the nature of their research topics and about the kind of information they wish to extract from the Intrex data base. If their research topics are clearly formulated before the experiment, the basis on which they make evaluations will hopefully remain more stable during the course of the experiment. Variability will be reduced, and hence the validity of our measures will be improved.

ESs will also be advised to prepare a list of search words which will be used to retrieve articles from the data base.

Selection of Documents. Each ES will be given approximately 20 documents to evaluate. We have found that evaluating more than 20 documents can be quite time-consuming; with large numbers of documents, ESs tend to make their evaluations more speedily, and hence less carefully.

The 20 documents will be selected from all documents retrieved by use of a standardized technique. Specified numbers of documents will be picked randomly from documents retrieved by certain search words, until the quota of 20 documents has been filled. With this technique we hope to obtain a wide spectrum of documents, ranging from highly useful to completely unsuitable.

Number and Type of Experimental Sessions. ESs will participate in two experimental sessions — one in which they evaluate field information and another in which they evaluate full texts. The sessions will take place in the Intrex Laboratory under controlled conditions. After these sessions have been completed, ESs will be interviewed for background information and for their reactions to the experiment.

Following the interview, a procedure similar to the one described above, in the section on ESs 20 and 25, will be followed. ESs will be given the fields and full texts of ten or fewer documents having discrepant ratings between field and full text. They will be asked to explain, if they can, why the discrepancies occurred. At the same time ESs will be given a list of the fields in the catalog record, with a short description of the general content of each field. They will be asked to check fields whose type of information would have been most helpful to them in judging the usefulness of their documents. They will also be presented with the actual catalog records of three documents which were used in the experiment; they will be instructed to check the fields which contain the information that would have been most helpful to them in evaluating the utility of those particular documents. The ESs' responses about the catalog record will help us to determine which fields, besides those already isolated for study, are most useful as indicators of document utility, and which additional fields, if any, should be included in the catalog indicativity experiments for evaluation by ESs.

Other Modifications of Series-A Procedures. The numerical-rating scheme has been changed as follows to measure the degrees of a single variable, namely, usefulness:

1. The article is highly useful.
2. The article is somewhat useful.
3. The article is not useful.

The '4' rating — "cannot make a judgment" — has been omitted. However, ESs will be permitted to put a '?' by any evaluation about which they are unsure, and they will be asked to explain why they are unsure. They will be allowed to make borderline ratings in exceptional cases.

ESs will be instructed to rate all articles on the basis of their usefulness, regardless of any prior familiarity with them. However, they will be asked to indicate which articles they recognize.

In order to understand more fully the basis on which ESs make judgments of the usefulness of documents, we have prepared a list of possible reasons why ESs might not judge a document to be "highly useful":

	Insufficient Relevance of Article
(a)	The article is not at all relevant to my research topic.
(b)	The article is only indirectly relevant to my research topic.
(c)	Only a small portion of the article is relevant to my research topic.
	Nature of Article
(d)	The quality of the article is inferior.
(e)	The article's treatment of the topic is too superficial or elementary.
(f)	The article is not fully understandable; or it lacks textual clarity.
(g)	The article contains no new information, does not move beyond the current state of knowledge in the field.
(h)	The results of the article are outdated.
(i)	The article is experimental, rather than theoretical.
(j)	The article is theoretical, rather than experimental.
(k)	The orientation of the article is not appropriate (it is overly mathematical, is about the wrong material, etc. — please specify).
	Other
(l)	Please Comment

ESs will be requested to record one or more of the letters, each time they rate a document as "somewhat useful" or as "not useful", to explain why the document was not rated as "highly useful."

The author field will be omitted from the first(main) part of the Series-B experiments. Three reasons are that author names do not indicate content value, and hence are not in themselves good indicators of document usefulness, and author names will undoubtedly be included in standard information-retrieval systems in any event, and will

most commonly be utilized by users in conjunction with other catalog information — which is the context in which they will be evaluated in Series B.

Matching subject phrases will appear alone (without title, author, and location). As a result of this change we will be better able to draw conclusions about the precise value of matching subject phrases per se.

In the first experimental session, catalog information will not be presented by fields, but entries from all fields will be mixed together in random order. The ordering of catalog information will help to eliminate biases caused by interest changes of ESs which occur over time (fields evaluated first might be affected by variational factors not present at the beginning of the field evaluations). It will also eliminate variables which may occur as a result of the order in which fields are evaluated. In the second experimental session the full text will appear without title, abstract, and citation.

To test the reliability of our experimental procedures, we plan to present the field entries and full texts of five documents two times for evaluation during the course of the experiment.

Summary of Design Changes. We have constructed tighter controls in all phases of the experiment in order to improve the validity and reliability of our experimental techniques. Procedures have been developed to obtain added information from the ESs about the nature of their judgments and about the causes of failures of catalog information to indicate document usefulness. We have expanded our experimental sample. As a result of these changes, we expect to have richer and more extensive data concerning catalog indicativity; and we will be able to determine with greater confidence the operative variables that are influencing the results.

USER INTERFACE

Background on Workshop and Paper. A paper describing the user interface of the Intrex retrieval system, and our evaluation of that interface was prepared for the "Workshop on the User Interface for Interactive Search of Bibliographic Data Bases," held at Palo Alto, California, on January 14, and 15, 1971. The workshop was sponsored by the AFIPS Information Systems Committee and our paper will appear in the proceedings. It was one of eleven invited papers that provided the basis for the workshop discussion in which two Intrex staff members participated. A digest of the paper is presented here.

Our paper provides a unified, comprehensive description of the current user interface and some preliminary results of our evaluation of that interface. The manner in which the user interface is implemented has been described in earlier Intrex Semiannual Reports, but in our paper all the pertinent information has been gathered in one place. A major portion of the paper is devoted to a summary of our evaluation of that interface based on our experiences with system use. A significant portion of that experience has resulted from work during the current reporting period.

General Conclusions. In general, we conclude that the user interface, as currently implemented, does a good job of meeting user needs, as evidenced by the high degree of user acceptance. Our evaluation is based on: (1) several dozen detailed observations of system sessions including pre- and post-session debriefings, and both

computer and human monitoring of the user's interactions; (2) several hundred usages of the M.I.T. Engineering-library station which were monitored automatically by the computer and some of which were also monitored by the Intrex Advisers; (3) information gathered in the course of more formal and controlled experiments; (4) observations of training sessions for Intrex Advisers.

The evaluations presented in the paper are carefully qualified to indicate that they are only preliminary results and that more experimentation and analysis is needed.

Users appear particularly pleased with the interactive nature of the system, its ease of use and its rapid response, particularly when compared with standard library techniques. They appear to be able to make good use of the catalog data and the manner in which it is presented. They find that the command language is easy to learn, at least in its general outlines, and that many of the instructional features provided are helpful. Although no single console configuration combines all the features that users want, all consoles have met with favorable response.

We have observed, however, that there are a number of cautions to be given to designers of interactive retrieval systems. For example, although the Intrex retrieval system seems easy for most users to get started on, they seem to be relatively slow in developing mastery of its full capabilities if adequate personal instruction is not provided. (A similar observation is often made by librarians with respect to users of the traditional library catalog.) We warned designers of other systems not to expect any single approach in the instructional material to satisfy all, or even a majority of users but we noted that younger users, particularly those with some computer experience, have a relatively easier time learning to use the system than do older persons. This augurs well for the future.

Many of the difficulties that our users have encountered appear to arise from system features that either do not work well or do not work in the manner described in the documentation. We feel that these difficulties are due, at least in part, to the experimental and evolutionary nature of the system. A second source of difficulty is system complexity. For experimental purposes, we intentionally offer more options than one would expect in an operational system, and many users have difficulty mastering all, or even a major portion, of the variations offered. An operational system would be more streamlined. Users also seem to require particular instructional help before they can make optimal use of the free-vocabulary indexing. Although this kind of indexing is, in a sense, easier to understand than controlled-vocabulary indexing, and it is one of the things that lets users get going quickly, many users fail to realize the importance of strategies such as synonym usage because they are so familiar with controlled-vocabulary indexing that they have come to expect it without further thought. The difficulty can also be expected to diminish as the use of free-vocabulary indexing grow more

widespread. In this connection, it is interesting to note that a majority of the participants in the Workshop favored at least some aspect of free-vocabulary indexing for interactive systems.

In the paper we evaluated four major aspects of the user interface: document representation in the catalog, the command language, the consoles, and the instructional material.

Document Representation in the Catalog. The catalog-record structure was carefully designed to support a variety of retrieval and display functions. The analytically structured catalog record was divided into a large number of machine-distinguishable fields and sub-fields on the ground that while distinctions could always be done away with, they could be added later only with difficulty. Most users find our distinctions finer than they need. In this sense, different data elements serving the same function — such as excerpt and abstract — should be combined for users, although internal tags differentiating elements may be necessary for bibliographic control. Some data elements serve more than one function; these elements need to be separately retrievable at a field level and combinable with others to serve a larger function. Present combination fields, such as the ones evoked by the OUTPUT command arguments, NORMAL and STANDARD are quite popular with users.*

Users find the manner in which the information contained in the catalog is displayed quite important but there appears to be little agreement as to what is the best format. We do know that users dislike abbreviations and prefer to have the system do the decoding of abbreviations for them. They also tend to favor the fields with which they are already familiar, a fact we find somewhat disappointing since it makes the evaluation of novel fields in the augmented catalog difficult. (Our new design for Category-II experiments described in the section above is one attempt to solve this problem.) We were hard-pressed to find good names for some of the fields, but most of the names we chose cause little, if any, difficulty.

We note that the utility of the catalog information decreases as the convenience with which full text can be viewed increases.

Our method of subject indexing appears to work well both for retrieval and for judging document utility. The vocabulary used by authors (and hence by our indexers) tends to match the search vocabulary of users. The depth of our indexing serves to find documents that users might otherwise miss, but this causes some difficulties at the interface with users who base their judgments of document relevance on more limited information (e.g., the title). The use of synonyms in the set of subject

* The request "output normal" gives the three fields author, title, and location. The request "output standard" gives the same three fields but in the standard, condensed format of bibliographic citations.

phrases referring to a single document simplifies the user's task by providing a variety of entry points to documents that are "all about" the subject expressed in the user's query.

The subject terms are free-standing indicators of content, which makes them useful as indicators of the utility of a document to users. Separation of individual phrases also makes it possible to give the user the terms that match his subject request. This has at least two benefits at the user interface. It provides, via the "output match" request, an indication of document content that is sensitive to the user's interests as expressed in his subject request and it gives him feedback on the nature of the matching algorithm and how well it is working for his purposes.

Command Language. The Intrex command language features a rigid (but simple) formal syntax, with ordinary English system words. We originally employed some non-English words but we dropped them when we found that users had trouble learning them. Some jargon words in the command language and its description still cause trouble but we have had difficulties finding replacements that improve the situation. Irregularities in the language cause users trouble and we have attempted to minimize these. Ambiguities, where they arise, also cause problems for users. For example, users seem to have particular difficulty in handling the DOCUMENT command and in understanding the use of the AND commd. (This latter difficulty appears to have been noted by a large number of other workshop participants, too.) The difficulty with the AND is that users have trouble deciding whether they are "and-ing" the search terms (they are) or merely summing the document lists (which is the Boolean or). The difficulty with the DOCUMENT command appears to lie primarily in the fact that users think of it as an output command; actually, it is implemented as a search command.

Other command-language facilities that appear to please users include the ability to abbreviate commands and to switch to the "short" mode, which suppresses or shortens most of the instructional material presented in the computer responses. Punctuation in the command language causes some difficulties because users tend to ignore it or treat it carelessly. The fact that no user-originated command can hurt the system and that the system recovers from most errors in such a way that the user can easily get going again is important. Users appear to want a pointing capability, the ability to control stemming and phrase decomposition, the ability to combine arguments and commands, an instructional mode of operation, and user control of such stylistic matters as output format and character size. We are planning to add most of these capabilities when it becomes feasible to do so.

Consoles and the Physical Environment. Users appear to be pleased with all of the consoles provided and with the physical set up in both the Engineering Library and the E.S.L. facility. No single console, either provided by us or available on the

market, combines all the desirable features, but even the more minimal consoles seem satisfactory to users to at least some degree.*

The major advantage of typewriter consoles is that they provide immediate hard copy and they are preferred by some users for this reason alone.

The ARDS console provides more rapid output and silent operation but lacks hard copy capabilities. Users are particularly pleased with our combined configuration in which the ARDS screen is also used for full-text display. The rapid access to full text, may be a major factor in making interactive retrieval systems attractive to the majority of potential users.

The Intrex display console has greater clarity, size and brightness in its characters and this feature elicits a favorable reaction from many users. It also allows users to save and redisplay pages and thus helps to compensate for the lack of hard copy. We do not yet have sufficient information to evaluate the extended character set (192 characters), status lights, programmable buttons, editing features, and other special features of this console.

Instructional Features. We have found that users learn best by actually using the system. Here the rapid and informative responses by the system are extremely helpful. We also find that no single instructional mode pleases all users. Users seem to favor the online instruction even when warned that some of its passages may be out of date. They appear to want both a brief introduction and a complete reference guide, and we have provided these.

We have found that it is much more difficult to instruct users than we had originally imagined, especially from written manuals or guides. One reason for this appears to be intrinsic to the library situation. Users, in general, are much more interested in getting the information that they are seeking than they are in learning about extended use of the system. It is important to provide a simple operational core system, within the more complex, full system, that users can use to "get started." They can then proceed to expand their capabilities as they feel the need. It appears to be quite easy for most users to get started on Intrex. Both the system dialog and the free-vocabulary indexing contribute to this.

Summary. We summarized our paper by observing that the experience to date suggests that the Intrex interface has already achieved a considerable measure of success. Our experience also suggests, however, that improvement is possible in several areas. Among these areas are cost reduction and hardware improvement.

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* For additional discussion on the capabilities and limitations of online, interactive consoles see: Marcus, R.S. and Tewlow, J.S., "Computer Terminals for Newspapers: Applications and Requirements," Proceedings of the IEEE Computer Group Conference, June, 1970.

One observation that we would make as the result of our attendance at the Workshop itself is that there appears to be no other group that is nearly as well equipped at this time to perform carefully controlled experiments to evaluate augmented cataloging, deep and/or free-vocabulary indexing, various console features and online text access. Intrex was unique among the systems represented at the Workshop and the results being obtained from Intrex experiments should be helpful in optimizing future retrieval systems.

MICROFILM READER

Under sponsorship of the U.S. Office of Education, staff members of the Electronic Systems Laboratory have designed and constructed two versions of a microfilm reader with features not ordinarily found in commercially available readers. Heavy emphasis has been placed on human factors, particularly reader comfort and convenience.

Two configurations of the reader have been built; they have been dubbed the "desk-top version" and the "arm-chair version". In both versions a blown-up image of the material contained on a frame of microfilm is created on an opaque surface, and this image is viewed at a comfortable reading distance by the user. In the desk-top configuration, Fig. B-3, the unit is mounted atop a simple desk-like surface and the user is seated in a normal reading-writing position at the desk. The unit can be swiveled or tilted, to accommodate the user's reading preferences. In the other configuration, Fig. B-4, the image is projected onto a larger vertical surface and the user is seated for reading in an arm chair approximately five feet from the reflecting surface. Frames are selected by means of a control box at the arm-chair location. The arm-chair reader has been designed to accept 4-inch by 6-inch microfiche; the desk version takes the 35-mm film strips generated by the film station developed by the Project Intrex staff.

The goal of the designers is to implement a film-reader system which offers the reader a crisp viewing image that closely approximates that of a printed page and a reading environment that minimizes eyestrain and body fatigue over prolonged periods of reading. In contrast to most existing microfilm readers, the devices now undergoing evaluation have essentially nondirectional image characteristics. Hence, the reader has neither to sit bolt-upright before a viewing surface, nor must he view the images essentially head-on to obtain maximum brightness and discernibility.

The vertical-screen viewer has been installed in the Barker Engineering Library and is being evaluated there through responses to questionnaires given to users. The desk-top viewer will be used in conjunction with the Intrex installation being planned for the M.I.T. Center for Materials Science and Engineering.

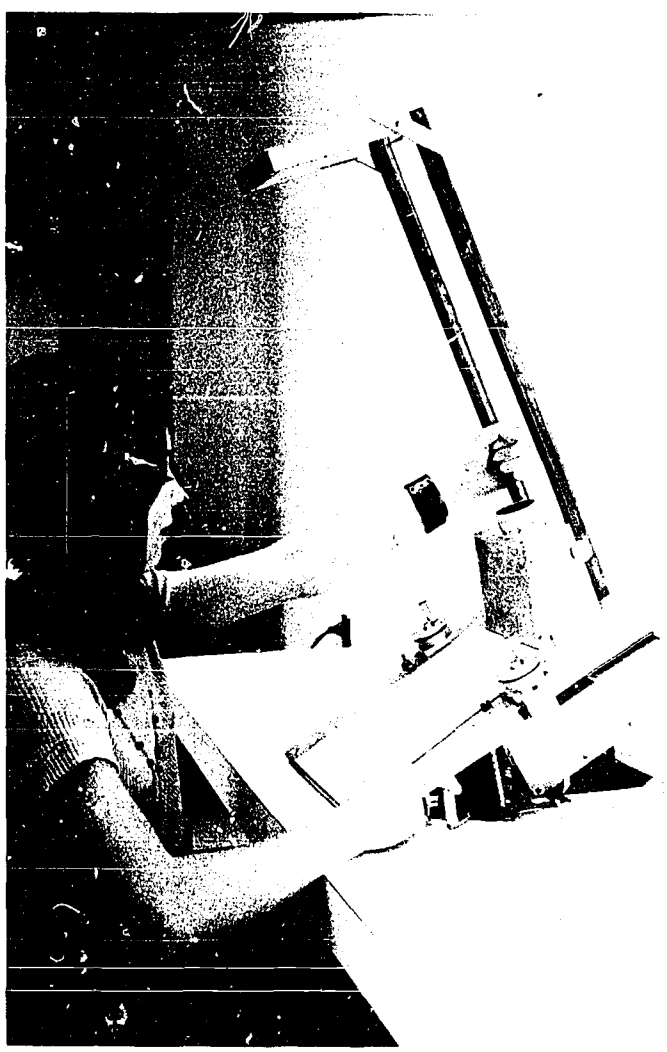

Fig. B-3 The desk-top version of the Electronic Systems Laboratory microfiche reader.

Fig. B-4 The arm-chair version of the Electronic Systems Labaratory microfiche reader.

C. AUGMENTED-CATALOG INPUTTING

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SUMMARY

A change from an off-line paper tape method to a direct on-line method of keyboarding catalog-record data has been implemented. This change was necessitated by discontinuance of the paper-tape to disk-storage converter facility at the Information Processing Center. Other alternative input methods that were examined, the decisions affecting implementation, and initial operational data, are discussed. We are also using, temporarily, an indirect paper-tape to magnetic-tape conversion method to process our backlog of paper tapes which were generated prior to on-line switchover. Paper tapes being created in a temporary back-up mode to the on-line method are also passed through the indirect paper-tape to magnetic-tape conversion process.

We have revised the specifications for three catalog-record fields containing corporate- and geographic-name elements. We are gathering and interpreting illustrative examples of our deep subject-indexing methodology. Section B of this report includes a discussion of staff indexer participation in the advisor-training program and a digest of the effect on the user interface of Intrex's bibliographic record-design and its access points.

As of 15 March 1971, 17,350 documents have been indexed and 14,100 catalog records have been completely processed into the computer-stored data base.

PROCESSING

General. The input group has initiated a periodic report to the text-access and software personnel informing them of the fiche numbers associated with those catalog records which are ready each month for inclusion in the data base. This procedure will allow the text-access facilities, which are limited to 1500 microfiche, and the related software to be updated to reflect the most recent documents in the Intrex system. This item is discussed further in Section F of this report.

We have introduced an additional step into our correction loop. This loop consists of a two-cycle process of manual proofreading followed by on-line editing of catalog records. Previously, no further manual proofreading was done after the second-edit step; we relied on visual verification that is a part of the edit process. We have since found

it necessary for a proofreader to check the hard-copy dialog transaction of the second editing. This correction procedure is a relatively quick process because of the small number of edit transactions at that stage (about 5 per file of 10 documents); it has helped to minimize the number of catalog-file rejections by the format processing program.

Our correction loop which ultimately ends with catalog records entering the stored data base was only recently resumed after a two-month halt because of hardware problems in the high-speed channel of the 7094 computer. At that time, catalog data had to pass through that channel on its way from paper-tape storage to disk storage. This problem is discussed below in connection with our change to on-line data input.

As of 15 March 1971,

17,350 documents were indexed

17,250 catalog records were reviewed

15,780 records were keyed

14,740 records were passed through the first proofreading and editing process

14,100 records were completely processed into the computer-stored data base.

On-line Data Inputting. We have changed from an off-line to an on-line method of keyboarding catalog-record data. Previously, catalog records were keyed onto punched paper tape with Friden Flexowriters. Each paper tape segment contained ten catalog records, called a file. At one-month intervals, the accumulated paper-tape files were passed through an optical paper-tape reader connected to a PDP-7 computer, a satellite of the central IBM 7094 computer. The PDP-7 then converted the Flexowriter codes to ASCII codes and transmitted the data over a high-speed cable to the central computer. It is this sequence of events, from initial keyboarding of data to its entry into the central-computer disk files that has been converted to direct on-line input. The two major processing steps after this point remain unchanged. These are: correction-loop processing, and formatting and merging the new records into the stored data base.

Change-over to on-line inputting was brought about by the plans of M.I.T.'s Information Processing Center to abandon their PDP-7. A study by C.W. Therrien of the Intrex Software Group showed alternative methods of catalog input and associated processing costs to be more expensive than our regular off-line paper-tape method. However, arrangements recently completed with the Information Processing Center permit on-line inputting at essentially no incremental cost to our project.

Three years ago (see the 15 September 1968 Semiannual Activity Report) a cost analysis of on-line keyboarding and paper-tape inputting showed the on-line method to be twice as expensive as the paper-tape method ($41.07 versus $23.46 for a file of ten catalog records.) The recent study of alternative input methods updated cost figures of the earlier study. In real cost, on-line inputting is still twice as expensive as the

paper-tape method ($43.02 versus $23.65 per file of ten catalog records). The double cost of on-line input is almost entirely the result of the need for additional computer processing. Seventy percent of that excess cost (about $14.00, or one-third of the total on-line cost) is attributable to computer-program swap time encountered within the computer while the typist is inputting data. The total on-line keyboarding cost would be reduced to $29.20 per file if program swapping were not involved. A configuration which buffers six lines of input data is possible to implement and would reduce swap time by a factor of six, thereby resulting in a total on-line keyboarding cost of about $31.50 per file.

Other major alternatives for input that were considered were paper-tape to magnetic-tape conversion and direct key-to-tape methods. The direct key-to-tape method was rejected because of incompatible magnetic tape, increased rental cost of key-to-tape devices, and the ability of most such devices to display only the last character typed, or its bit configuration, rather than the line currently being typed. We consider full-line display (and preferably several lines) important for keying our data which are mostly variable-length natural English text.

Paper-tape to magnetic-tape conversion is an indirect but feasible alternative. It is indirect because the 9-channel output magnetic tape from the paper-to-magnetic tape converter available to us must be processed through an IBM 360/65 computer to produce specially-formatted 7-channel tapes compatible with the IBM 7094. In addition Flexowriter-to-ASCII code conversion must be done on either the 360/65 or the 7094. The cost of paper-tape keyboarding plus conversion to magnetic tape and indirect processing for the 7094 computer is in the range of $26 to $28 per file. The indirectness of this data-transfer conversion is more of a disadvantage than its additional cost over the previous paper-tape to PDP-7 satellite computer method.

The plans and protocol to implement daily on-line keyboarding were developed over a four-week period and included trial input runs to familiarize typists with this mode and to identify operational problems. The difficulties encountered were minimal, primarily because of our extensive experience with on-line editing of catalog data. We wish to highlight major implementation decisions and experiences.

On-line data input is implemented as one function of generalized editing. Choice of a general text-editing program will affect the general data preparation process. Two such editing programs (designated QED and EDA) are available to us through the 7094 computer system. Their general features were studied in the total context of editing and QED was judged the more powerful for the following reasons: (1) switching from a strict input mode (called "append" in QED) to other edit modes, or the reverse, is less problematic because QED uses more explicit commands; (2) QED has both forward and backward line-pointer movement; (3) several sequential-edit commands can be combined onto one transaction line in QED. In addition, QED is currently used for on-line editing exclusive of data input and one of our two typists was thoroughly familiar with it.

Two IBM 2741 terminals previously available to all systems personnel are now reserved for exclusive use by our two typists. Differences between the Flexowriter and 2741 keyboards emphasize the interdependence of data-element coding and delimiting with the keyboard character set and the location of specific character keys. Typing experience resolved minor start-up difficulties with the location of equivalent keys. However, a few delimiters in the data are somewhat less than optimum now for keyboarding purposes either because of their specific location or the necessity for a case-mode change. The character-set differences posed other problems. An escape convention is now used to key four infrequently occurring graphic characters. Two frequently occurring graphics were dropped altogether by revising the specifications for three catalog fields; a confusing escape sequence for those particular graphics was avoided.

The transition to an on-line keyboard resulted in easier correction procedures for sensed errors. Two reserved characters used throughout the CTSS on-line system for "erasing" keyed characters or cancelling a complete line are used.

Two protective features were built into the protocol and instructions given to the typists which would prevent significant data loss in the event of a major computer failure. A typist is required to write out newly keyed data into a temporary-save file after each catalog record, or more often if a particular record is lengthy or difficult. Filename protection incorporates the typist's own name or initial into the names of the temporary-save file and completed file. It prevents one typist from accidentally deleting the files of another typist.

On-line inputting began on a regular basis on 13 January 1971. Start-up proceeded smoothly but three weeks of full-time operational experience is insufficient for a detailed review. We can note, however, that two major benefits to the entire processing cycle are now possible. On-line input realistically offers quicker turnaround and a reduction in elapsed processing time. A newly keyed file can be made available for proofreading the morning after it was created. However, we will continue correction-loop processing within a monthly cycle until more on-line input operational experience is gained. A second benefit is that the full power of the QED general editing program can be applied during initial keying so that we could expect cleaner records to enter the correction loop. One typist experienced in editing quickly found it advantageous, easy and natural to switch modes within QED during initial keyboarding to correct errors she detected on lines other than the current input-data line.

The only serious problem with on-line input in a production environment, other than its cost, is computer down time. For our time-sharing system there is exceedingly little interference between our daily daytime production mode and the regularly scheduled preventive-maintenance sessions on the computer; these cut into about 1 1/2 hours of our work week. Unscheduled down time caused by computer failures is more serious for production because of its unpredictability of occurrence. Its duration

depends upon the severity of the problem and may last anywhere from a minute to several days. We are currently exploring several potential methods of back-up and work scheduling during computer failures.

We are temporarily using our Flexowriters as a back-up mode to on-line input. The paper tapes created in this mode, and backlog paper tapes created before the switchover to on-line input are being passed through the indirect paper-tape to magnetic tape conversion process discussed earlier.

During our first three weeks of on-line input, 73 percent of all records keyed were keyed on-line. For on-line input, the average computer time, measured in terms of time consumed in the Central-Processor Unit, expended on input processing was 0.38 minute per catalog record. The ratio of computer time to console time was 0.013. These figures are comparable to the data obtained in the on-line input analysis three years ago.

On-line data input now brings the general data-preparation process closer to the basic on-line nature of the experimental Intrex retrieval system. At some point, it will be of interest to do trial input runs at display terminals to investigate their efficiency and other effects on production-type work. ARDS terminals and the specially designed Intrex console are both available. The Intrex console also offers the potential for localized data editing with a cursor and function buttons.

DATA ELEMENTS AND CODING

We re-examined and partially revised the specifications for three catalog record fields containing corporate and geographic names. The data fields are author's affiliation (field 22), corporate author (field 23), and contract statement (field 40). Only the formatting and coding of the corporate and geographic names in those fields were affected; specifications for other data elements in those fields remain unchanged. The impetus for the revision was the impending change to on-line input and the need to avoid a confusing escape convention to key geographic name delimiters in those fields. The revision itself had broader benefits for both catalogers and typists. A cataloger's work with a cumbersome manual authority file of corporate names was reduced to a fraction of the time formerly spent, and a typist now has several less keystrokes and key escape conventions to make in each record.

Essentially, geographic names are no longer tagged in all three fields and, except for field 23, corporate names are no longer established. Whatever form or degree of completeness a corporate name has in the document at hand will be accepted, but the order of the organizational elements present will still proceed from largest to smallest to maintain some consistency in their display. Corporate names will continue to be established for field 23 (corporate author) because the elements from this field bear more directly on general bibliographic control and are more likely to be used in citing a document than similar elements assigned to the affiliation or contract fields.

Although there is no current inverted-file index to corporate and geographic names in the Intrex catalog, these revisions would not affect the creation of such an index along

the same lines as the current subject/title inverted file where access to records is provided by post coordination of individual words.

EVALUATIONS

At the beginning of this reporting period, the staff indexers initiated work on the gathering and interpreting of examples illustrative of the subject-indexing methods employed by Project Intrex. This continuing effort is directed toward complete documentation of our free-vocabulary, free phrase, in-depth indexing methodology.

The on-line user interface is influenced in many ways by the design and organization of the bibliographic records and the access points to those records. The results we have found to date with real system use, as affected by the experimental Intrex catalog-record design and its many access points, including deep subject indexing, are discussed in a paper prepared for the "Workshop on the User Interface for Interactive Search of Bibliographic Data Bases". A summary of that paper appears in Section B of this report.

D. COMPUTER SOFTWARE

Staff Members

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Dr. C.W. Therrien

SUMMARY

Extensive documentation of the Intrex software has been initiated. A large effort is being devoted to an Intrex report which will describe in detail the on-line retrieval programs and the programs used for data-base generation. In addition three internal reports were prepared on the buffer/controller software for the Intrex console. These reports will be included in a larger Intrex report to be issued later.

As the data base continues to grow, it has become expedient to find a means for decreasing the cost of adding new documents. A new procedure has been implemented.

Minor software changes were made in the retrieval system to respond with an informative message to requests for full text of older documents which, due to limitations in capacity of the text-access subsystem, have been removed and are retained off-line. Several other small software modifications were made to improve system performance and correct defects.

Software for the buffer/controller was modified to accommodate the additional 4-K words of core that were added to the 620i computer. The additional core capacity makes it possible to provide automatic switching to text-access mode on the Intrex console through use of the command "output text". This feature had previously existed only on the ARDS combined terminals.

Finally, a short-term effort was expended to aid a project sponsored by the Cambridge Project at the MIT Center for International Studies (CIS). The CIS project involves the indexing and retrieving of political documents. A goal of this effort was to develop a word concordance of 150 newspaper editorials as part of a larger effort to develop vocabularies suitable for indexing this type of material. Our part in the project was more than a success in that we not only developed the desired concordance, but also, through Intrex-like retrieval, uncovered relevant editorials not previously found by CIS personnel.

RETRIEVAL SYSTEM SOFTWARE DOCUMENTATION

The programming staff has devoted most of its time to writing comprehensive documentation of all of the software developed by Intrex. When completed, this report will discuss each of the 300 separate subroutines that comprise the Intrex retrieval system. Also included in this report will be documentation of the programs

used for data-base generation. To date, most of that part of the report which describes program details has been written. Other smaller portions that deal with an overview of the software and general programming-system architecture still remain to be completed.

RETRIEVAL SYSTEM UPDATE AND MAINTENANCE

The data base was increased by 7020 documents to a total of 14,100. Changes were implemented in the data-base generation process which reduced the computer cost associated with inputting to $2.65 per document. This is a substantial reduction from the previous figure of $3.50 per document.

The online directory to the microfiche collection has been updated to correct an accumulation of missing entries and errors.

Since there are now more microfiche than the storage-and-retrieval equipment can hold, a scheme has been implemented to give users the best possible service under this limitation. The earliest microfiche have been removed to make room for more recently acquired documents. If a user asks for text which is on a fiche no longer included in the online collection, the following message appears:

> "This document is not available at the console. You may obtain a copy of it from the Microfilm Service Area at the MIT Engineering Library (UN 4-6900, Ext. 3129)."

Presently, the first one-hundred fiche (out of a total of 1500) have been removed to make room for more recent documents.

Several other software improvements were implemented, as described below:

1. The online User Guide and dialog files were brought up to date and streamlined to remove outdated or misleading message text which had been confusing users.

2. The command delimiter and trim tables were updated and standardized. Thus the free format with regard to punctuation and delimiters between parts of a command was extended to include most Intrex commands (all except those where special treatment is needed).

3. The list-pointer table was expanded in size to allow more lists of documents to be named in a single user session. The current limit is now 38.

4. A central-error exit was included which takes control after most types of system errors (except "program stops"). This technique provides more informative error messages to be given before allowing the Intrex subsystem to take control. The core-image of an abortive session is saved and given a special name by the subsystem, thus allowing postmortems to be performed.

5. More efficient use of a portion of computer core known as "free storage" was provided by removing the command line buffer from free storage and placing it in a separate region of core.

6. Recognition of the QUIT command while in the "login" stage was enabled, thus offering to the user an opportunity for an immediate exit from the system during the login.

7. As a result of the close perusal given the various sections of software during documentation, many redundant or obsolete parameters and pieces of program code were eliminated.

In addition, a few new bugs were discovered in the retrieval system; these have been corrected. The extensive use that the system received at the hands of real users this fall and winter enabled the Intrex programmers to identify problems that had eluded detection in previous testing.

BUFFER/CONTROLLER SOFTWARE

The buffer/controller software has been modified to take advantage of the expansion of the 620i core memory from 4-K to 8-K words. This expansion made it possible to eliminate the core/drum overlay system forced on the 620i monitor software by inadequate core storage. Because of timing requirements, the overlay system was not workable with multiple Intrex CRT display consoles and its removal was undertaken in preparation for the second Intrex console currently being fabricated.

Elimination of the overlay system allowed the 620i software to be modified so that the automatic text-access mode of the Intrex console could behave like that of the combined ARDS/Text-Access display console; that is, the Intrex command "output text" now causes an automatic access to the full-text subsystem resulting in full-text display on the associated Tektronix 611 storage tube. The user may then continue using text-display function switches or return to catalog searching by typing the normal Intrex commands on the keyboard. No manual mode-changing is required. The Intrex console does, however, retain a text-access stand-alone mode for use when CTSS is not available and document fiche numbers are known to the user.

As a part of system software/hardware documentation efforts, the following internal reports were produced:

(1) A general system component and configuration description of the Intrex display system.

(2) A general functional description of the buffer/controller 620i software.

(3) A principles-of-operation manual for the magnetic-drum unit of the Intrex buffer/controller.

The latter manual contains detailed information and instruction useful to system programmers in programming the local storage-drum operations associated with the Intrex display consoles.

INDEXING AND RETRIEVAL OF POLITICAL DOCUMENTS

The versatility of the Intrex software system was demonstrated through assistance rendered to the staff of a project administered at the MIT Center for International

Studies (CIS) by the Cambridge Project. The stated purpose of the task brought to us was "the development of computer-based methods for identifying themes in political documents". This work is noteworthy because it highlights the ability of Intrex techniques to assist in the retrieval of documented information not specifically within the Intrex experimental scope.*

A goal of the CIS project was to develop a word concordance of 150 newspaper editorials as part of a larger effort to investigate appropriate vocabularies for indexing this type of material. The Intrex stemming algorithm was considered especially appropriate as a means for bringing together morphologically related words. Catalog and text records for these editorials were converted to Intrex format with each paragraph being taken as a subject term. These reformatted records were then run through the regular Intrex data-base-generation programs. The inverted file thus generated provided the desired concordance.

As a by-product of this effort it was possible to use the Intrex retrieval programs to search for editorials on particular subjects. Prior to the completion of the Intrex processing, a list of topics had been prepared, and a knowledgable person manually searched the text of the editorials to find those related to each topic. Intrex retrieval based on keywords from some of the topic statements was then tried. Most of the manually found editorials were retrieved along with only a few nonrelevant editorials. In addition there was a "discovery set", that is, a few editorials not found manually were retrieved by Intrex, and these were judged relevant by CIS personnel. Although in no sense statistically significant, the results are, perhaps, another indication of the efficacy of free-vocabulary indexing.

The principal investigators on the CIS project are Professors William E. Griffith and Rosemarie Rogers.

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*Previous work in the use of Intrex techniques for newspaper-story retrieval has been reported in a paper by J.F. Reintjes and R.S. Marcus, Computer-Aided Processing of the News, Proceedings of the Spring Joint Computer Conference, 1969.

E. DISPLAY CONSOLES

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Professor J.K. Foberge

Graduate Students

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Mr. Y. Chan

SUMMARY

The original design concept for the Intrex display consoles envisioned several cathode-ray-tube (CRT) display terminals interfaced to the main computer by means of a local buffer/controller that includes a small computer and a magnetic-drum memory. To date only one Intrex display console has been operating. Now a second terminal has been assembled and testing of it is well underway.

THE SECOND CONSOLE

The basic design of the first and second terminals is almost identical. However, improved integrated circuits have reduced the number of components and allowed more efficient packaging for the second display. A photograph of the new terminal is shown in Fig. E-1.

The new terminal consists of a CRT and keyboard, which can be placed on any available table or desk, with the electronics and logic circuitry located in a separate cabinet. The terminal was packaged so that it could be easily moved and also to facilitate maintenance. Other noteworthy features include a CRT with a non-glare faceplate for increased contrast and a solid-state keyboard which is expected to be more reliable than the photo-electric keyboard on the first terminal.

The use of more than one Intrex display terminal requires certain hardware and software modifications to the buffer/controller. The major hardware modification is the replacement of the present drum memory with one of increased capacity and separate read-write heads for each of the two display terminals. A Vermont Research Corporation 128-track drum with three sets of read-write heads will replace the current 32-track drum and is currently being installed. The buffer/controller software modifications are being designed and will be described in the next Semiannual Report.

Mr. Y. Chan, graduate student, is investigating methods for communicating between the display and the buffer/controller when separation distances are 2000 feet or more. Data are transmitted in both directions as bipolar pulses at approximately a 1-Megabit-per-second rate. This investigation is expected to result in a design for full-duplex transmission over a single coaxial table with repeaters located at intervals as required.

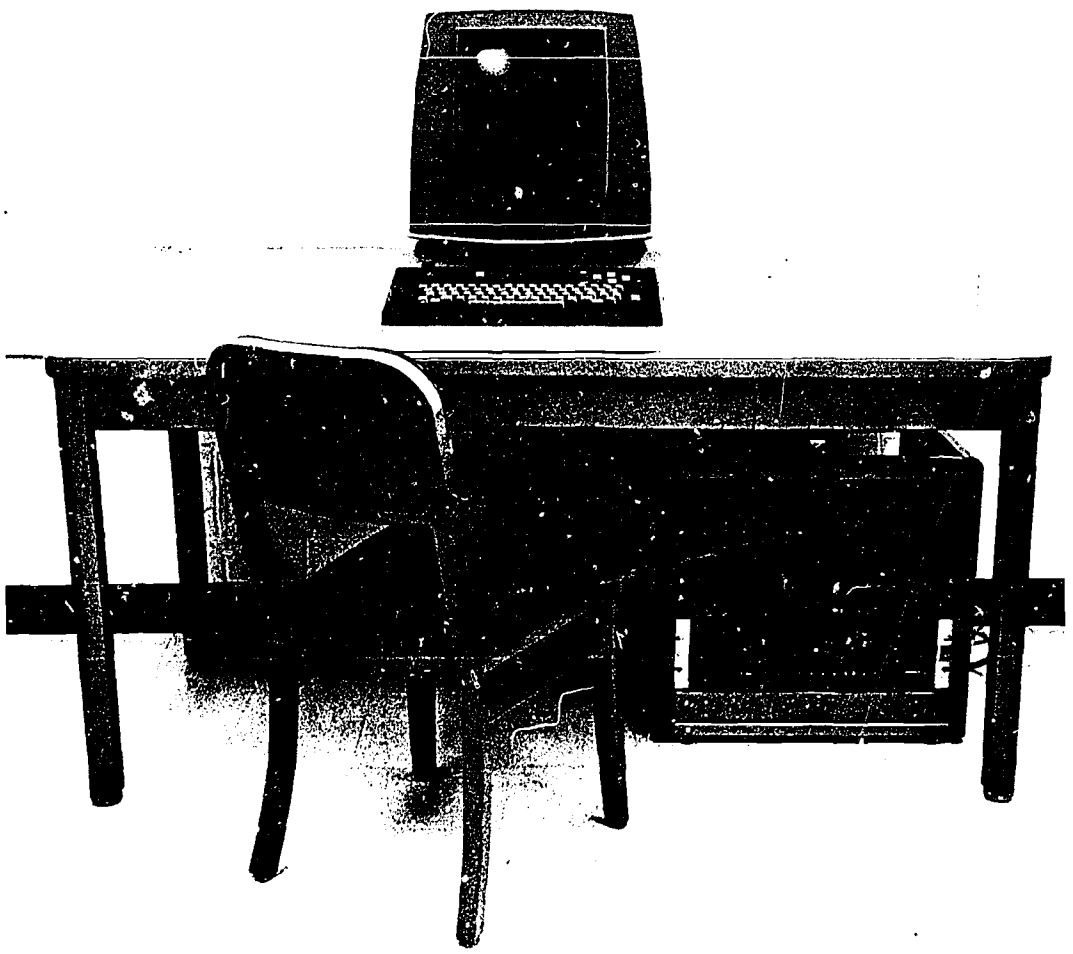

Fig. E-1 A second version of the Intrex display console.

F. FULL-TEXT STORAGE AND RETRIEVAL

Staff Members

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Mr. J.E. Kehr
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Professor J.K. Roberge

SUMMARY

The Advanced Remote Display Station (ARDS) catalog display and the soft-copy text display in the Engineering Library, which previously existed as separate terminals, have been merged into a combined ARDS/text-access unit similar to that described in the 15 September 1970 Semiannual Report. Experience gained from the daily operation of this combined terminal has resulted in several hardware modifications. The magnify and mode controls employed during text displays have been simplified to facilitate the display operation, particularly by those unfamiliar with the terminal.

The image quality of both the storage-tube displays and the film-copy terminal has been improved and made more stable by modifications to the scanner electronics.

The need for improved reliability has led to an extensive overhaul of the storage-and-retrieval devices by a representative of the manufacturer.

The Intrex document collection now exceeds the 1500-fiche storage capacity of the text-access system. Procedures have been adopted that provide automatic access to a 1500-fiche subset which include the most recent documents, and manual access to the remainder of the collection.

A storage-tube display is being constructed to provide text-access at the second Intrex console. Text requests from this display, as from the text display colocated with the first Intrex console, are transmitted via the display buffer/controller to the text-access central station. The design has been modified to make the display operation more consistent with the combined ARDS/Text terminals.

MAGNIFY MODE

The magnify option provides a 2X enlargement of a quarter-page sector of full text. In the initial design three separate push button actions were required to accomplish enlargement. The user initiated the magnify mode with the DISPLAY SECTOR button, selected 1 of 9 sector buttons, and transmitted the request by actuating the SEND button. To simplify matters, this sequence has been replaced by a single push button action where activating any one of the nine SECTOR buttons will transmit a request to magnify that sector. The SECTOR push buttons are lighted whenever the terminal is in the text mode and ready to receive a new request.

MODE CONTROL

The function of the mode-control push button on the combined ARDS/Text terminals has been changed. Previously, this, push button was used as a manual override of the logic which switched between the catalog and text modes and permitted operation as a stand-alone text display independently of the computer. In this mode the computer-generated fiche and frame numbers are replaced by numbers from the control-panel selector switches. The stand-along mode has proved useful for system testing, but normally is not employed by the user. Therefore, the stand-alone mode is now controlled by a switch in the electronics rack and is not accessible to the user, and the mode push button is being utilized for a somewhat different function.

As modified, the mode push button is lighted whenever the terminal is in the ARDS (or catalog) mode. Pushing the button causes the terminal to switch to the text mode and turns off the light. The terminal returns to the ARDS mode whenever a keyboard action is initiated or a computer message is received. The intent of this modification is to allow the user to switch manually between catalog and text modes without losing the fiche and frame numbers of the last text request.

MICROFICHE STORAGE

The Intrex document collection has recently exceeded the 1500-microfiche storage capacity of the text-access system. As a result, a new procedure combining manual and automatic means has been implemented for providing access to the complete set of documents. A 1500-fiche subset is stored in the automatic storage-and-retrieval devices and updated periodically to include the higher numbered fiche, thus providing automatic access to most recent documents. Duplicate fiche containing the early documents removed from the store can be obtained through the manually accessed file in the Engineering Library.

A spare set of microfiche and coded clips has been procured and are stored near the text-access retrieval units for quick replacement of damaged fiche.

SYSTEM PERFORMANCE

The daily operation of the Engineering Library terminal and information obtained from the user experiments have emphasized the need for improvements in the following areas of the full-text storage-and-retrieval system:

Stability of the image-intensity control
Image resolution
Retrieval-system reliability
Image centering

Both image-intensity control and resolution have been improved by a modification to the video-amplifier circuit. As described in the 15 March 1970 Semiannual Report,

the text-access system utilizes two microfiche retrieval units, each containing a photomultiplier tube (PMT) and video preamplifier. Differences between the two preamplifiers caused variation of the video bias-level control when alternating between the two preamplifiers. A circuit modification has been made which allows both PMT's to share a common preamplifier. Through careful selection of components, the gains and biases from both PMT's can be matched. This produces a more stable image intensity at the remote terminals and eliminates the need for frequent adjustment by the user.

Until recently, the scanner lens in one retrieval unit was set at an aperture of f/5.6 whereas the second unit's lens was set at f/4.0 to compensate for a lower PMT gain. After adjustment of the circuit components to match the PMT gains, both lenses were set at f/5.6 in order to provide optimum resolution and improved depth of field.

Further investigation of the 35-mm film-terminal characteristics showed that its video amplifier could be eliminated provided a compensating adjustment is made in the transmitter video gain. Because the storage-tube screens are essentially 2-level bright-dark devices, they are not affected by small changes in the video level. Therefore, the film-terminal amplifier was removed and the transmitter gain was adjusted to optimize film-terminal performance with a noticeable improvement in the image quality of the 35-mm film copies.

Many of the text-access malfunctions have occurred because of the microfiche storage-and-retrieval units. In order to improve system reliability, these units were recently overhauled by a representative from Image Systems, Inc. and critical mechanisms were realigned using special fixtures designed for that purpose. Several components have been redesigned since these units were acquired; replacement of some obsolete assemblies is being considered as a means for further improvement in system reliability.

The centering of page images on the display is a continuing problem. The page locations from one fiche to another currently vary up to 20 percent of the page dimensions and are sometimes skewed. The closed-loop edge finding technique, described in the 15 September 1968 Semiannual Report, corrects for horizontal variations, but vertical errors and skewing cause poor page alignment on the display. As a result of discussions with the MIT Microreproduction Laboratory, where the microfiche are produced, it was decided that most of the vertical variation and skewing occurs in making the contact-print duplicate from the master fiche. Revised techniques will be used to maintain the vertical position to within 0.025 inch of the nominal location and skewing to less than 0.025 inch away from the vertical. These tolerances represent less than 5 percent of the vertical-page size, and are expected to provide adequate page-centering on the display.

The push button control panel on the full-text display is located below the storage-tube screen. It consists of the following controls: FIRST PAGE, NEXT PAGE, PREVIOUS PAGE, SAME PAGE, LAST PAGE, SECTORS (1-9), and INTENSITY. Indicator lights are provided for SYSTEM DOWN, ERROR, and FICHE-NOT FOUND. The only new feature is the LAST PAGE pushbutton which allows the user to request the last page of a document by means of a single pushbutton action. This is expected to be useful for rapid access to reference lists at the ends of documents.

G. COST ANALYSIS

Staff Members

Dr. C. W. Therrien
Mr. J. E. Kehr
Professor J.F. Reintjes

SUMMARY

A start has been made on a cost analysis for operational Intrex-like retrieval systems. A preliminary study described a basic computer structure and estimated basic costs for a large-scale system consisting of a number of geographically distributed but otherwise identical centers of information retrieval. Follow-up research yielded data that supported some conclusions of the preliminary study and enabled refinement of others.

As part of the research topic, visits were made to two facilities that provide information-retrieval services on a relatively large scale. Because of similarities that exist between these systems and Intrex, we were able to obtain useful information in several areas that could apply to a large scale Intrex-like retrieval system.

COST-ANALYSIS STUDIES

A start has been made on a cost analysis for an operational Intrex-like retrieval system. Attention is first being focused on the catalog-retrieval part of the system. An initial configuration included a number of identical geographically distributed information retrieval centers. Each center would contain a computer in the $2 million price range, would provide an on-line collection of one million documents, and would service about thirty users simultaneously. No direct intercenter communication is postulated. Various data bases would be available on a scheduled basis. During non-peak hours the computer would be used for other tasks, not necessarily related to information retrieval, on a batch processing basis.

Subsequently, additional inputs were obtained that influence our consideration of the above system. First, review of some typical indexing statistics confirmed that one million documents may not be sufficient in some situations to service a large class of users. The Chemical Abstracts abstracting service reviews about 250,000 new journal articles each year, mostly in the field of chemistry. A catalog of one-million documents would thus suffice for a comprehensive coverage of the one field of chemistry for a period of about four years, but would not take care of others in a community of heterogenous interests. A data base of one-million documents, however, seems like a reasonable estimate of the number of documents that can be available on-line with

current technology.* New technology in areas such as optical-card storage may, of course, increase the feasible size of the data base. All of these considerations confirm that centers of information must have a segmented data base, segments of which are either: 1) duplicated for each center and available on a scheduled basis or 2) distributed geographically and made continuously available to each center by wire or microwave communication links. The design of a multicenter system with inter-center communication is currently being investigated both from technical and economic viewpoints.

A second point that arose from a close look at modern computing systems is that the performance/price ratio is higher than was previously expected. In particular it was found that one could purchase hardware suitable for on-line retrieval purposes for an amount between $1 million and $1.5 million. Such a configuration could service thirty or more simultaneous users and provide services for other time-sharing, batch processing, and real time operations during off-peak hours. With modular increases in hardware, a typical system can be upgraded to service up to sixty-four or more users simultaneously. A good estimate for the size of the community of users that such a system would serve is yet to be determined. The relation of system size to number of potential users in a community is very complex since it depends, among other things, on the number and location of the terminals, the size of the data base, and the mixture of interests in the community of users. As a very rough estimate, however, one might assume that each user requires 24 hours of service per year (two hours per month). If a system that can accommodate thirty simultaneous users were available for eight hours each day, the size of the community that it could service would be about 2600 persons. For systems with 64 and 128 simultaneous users, the size of the community would be 5500 and 11,000 respectively. The information available to the community must, of course, be consonant with user-community interests. This implies that unless all members of the community have interest in one field (such as chemistry), a number of different data bases must be made available, perhaps on a time-scheduled basis.

As a part of our study, visits were made to two facilities which operate retrieval systems with a much larger data base and total number of users than Intrex. The facilities visited were the National Library of Medicine, Bethesda, Maryland and National Aeronautics and Space Administration, Washington, D.C. The purpose of our visits was to acquire some detailed information about the structure of these "operational" retrieval systems and, if possible, obtain cost data for the various parts of the systems.

The two facilities visited are similar to Intrex and to each other in several ways. The retrieval programs are used on-line as part of a larger computer system. Control of the programs is via a command language, and many similar functions are

*Large files systems such as the IBM 3330 disk or Control Data 821 data file (disk) could accommodate a catalog of 1 million documents if the size of the catalog record is limited to 600 characters per entry.

available to the user in each system. Document retrieval is by means of an inverted file, although neither of the systems visited uses a free vocabulary to construct the file.

Because of the similarities several useful items of information were acquired that could apply to a large-scale Intrex-like system. In particular, we obtained data on communication costs for remote terminals, statistics on indexing and the catalog-input process, and information about general system configuration. One of the systems had its computer very nearly dedicated to information retrieval and we were able to appreciate some of the advantages and disadvantages of their particular system architecture on the IBM 360/50. Neither of the systems visited had on-line text access so no information was obtainable about that aspect of the retrieval process.

III. MODEL LIBRARY PROJECT

A. STATUS OF THE PROJECT

Mr. C. H. Stevens

The fall semester has given Model Library Project personnel their first opportunity to test some techniques for assisting users with traditional library facilities and with those that are the result of the new technology. The results of those tests have been generally encouraging.

Response to the availability of point-of-use instructional aids has been good. Users voluntarily try these devices and, from the comments they have given us, we can infer that minor changes to the scripts and slides will make the instructions given even more valuable. Acceptance of Library Pathfinders has been excellent both at M.I.T. and at other schools. A cooperative program is emerging that could assist research libraries at colleges and universities and in government and industry as well. User preference studies for fiche versus hard copy have not produced significant results; there has been too little use of the microfiche collection to permit us to observe trends. Steps are underway to improve the collection, provide more fiche readers, and advertise availability of fiche in order to obtain a level of usage commensurate with the costs of operation and of the studies we wish to make.

It is our desire to have other librarians see Project Intrex and the Model Library Project in the Barker Engineering Library and to benefit from their reactions to what they observe. We are beginning to invite small groups of librarians to visit the Barker Engineering Library this spring and summer for this purpose.

B. POINT-OF-USE INSTRUCTION

Mr. C. H. Stevens
Miss M. P. Canfield
Mr. J. J. Gardner

The point-of-use instruction program is in the stage of initial user tests within the Barker Engineering Library while production of additional units continues. The programs currently in use have been placed in close proximity to the reference tools which they discuss and notebooks have been provided for user reactions to each program. As we place additional programs in the library, using varying formats and content approaches, we hope to be able to discover the positive and negative aspects of each. There are currently four programs in actual operation; two awaiting equipment delivery; two for which scripts are being prepared; and one in an exploratory stage.

The introduction to the Barker Engineering Library's subject card catalog consists of a synchronized sound-filmstrip (running time 2 minutes and 50 seconds) installed in a LaBelle Sentinel sound-filmstrip projector (Fig. III-1). The unit is outfitted with standard monaural headphone; the controls are pre-set; and the program is activated by depressing a single button. The machine shuts down automatically at the program's conclusion. The controls have been placed behind a steel plate and the projector is locked to avoid tampering.

The program introducing the Barker Engineering Library's author-title card catalog is also a synchronized sound-filmstrip and the equipment is the same as that used for the subject catalog (Fig. III-2). The program runs for 3 minutes and 30 seconds.

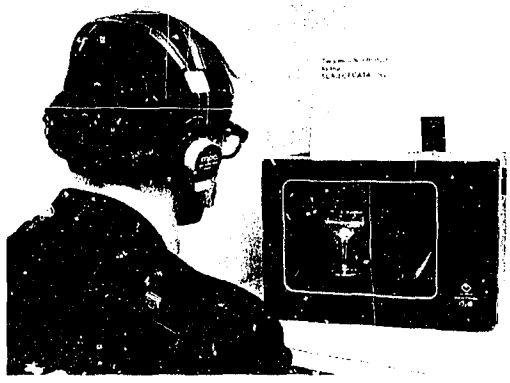


Fig. III-1 Labelle Sentinel sound-filmstrip projector used for subject card catalog instruction program in Barker Engineering Library.

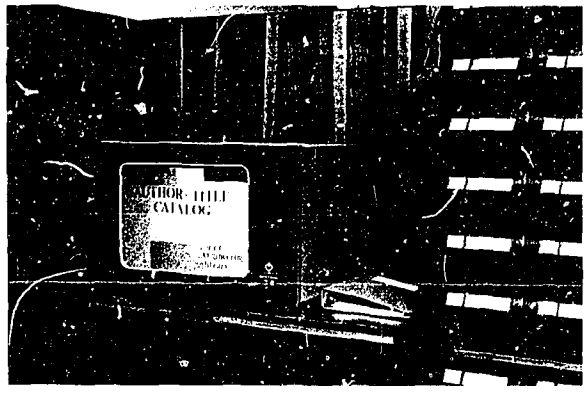


Fig. III-2 Labelle Sentinel sound-filmstrip projector used for author-title card catalog instruction program in Barker Engineering Library.

The third program which has been in use within the library for an extended period is a five-minute introduction to NASA STAR. It is a synchronized sound-slide presentation, a format which has the rather considerable advantage over filmstrip of being easy to edit and update.

This presentation utilizes a projection unit designed and fabricated by the Model Library staff and Laurence Associates of Boston. The design requirement was that it combine a rear projection screen, carousel slide projector, and synchronized audio playback unit in a cabinet small enough to fit onto existing shelves and tables in the Barker Engineering Library. The present unit meets this design requirement, utilizing a Kodak Carousel 850 Projector, LaBelle Plamatic audio unit, front-silvered mirror, and 5" x 7" rear projection screen, (Figs. III-3 and III-4). A companion unit is currently being redesigned by the M.I.T. Audio-Visual Department into an even smaller unit.

Fig. III-3 Sound-slide projection unit used for NASA STAR instruction program in Barker Engineering Library.

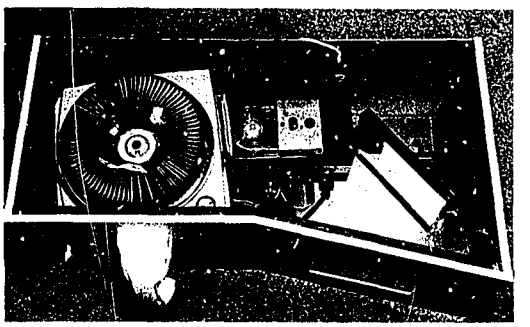


Fig. III-4 Interior view of sound-slide projection unit. Clockwise from hand set the components are: Kodak 850 Carousel slide projector, Labelle Plamatic audio unit, silvered front mirror and 5" x 7" rear-projection screen.

The program automatically begins when a hand phone is lifted from its cradle and shuts down automatically at the program's conclusion - ready for the next user.

A presentation on Science Abstracts: Series B. Electrical and Electronics Abstracts is in 16 mm sound-filmstrip format and will be shown via a LaBelle Courier 16. This unit is smaller than the Sentinel, will easily fit on a standard library bookshelf, and will be activated by depressing a single button. Delivery of this unit is expected by 1 April 1971.

A three-minute introduction to Engineering Index is in synchronized sound-slide format and will be installed in the unit currently being redesigned by M.I.T.'s Audio-Visual Department. This unit will include a LaBelle Plamatic for audio and will incorporate a Buhl right angle lens in the Kodak Carousel projector. The use of the Buhl lens will decrease the size of the unit, making it more readily adaptable to typically crowded library environments.

In an effort to determine user preference between audio-visual and audio format we will test two audio presentations.

An audio program instructing the listener in the use of NASA STAR has been completed and placed with NASA STAR in M.I.T.'s Aeronautics and Astronautics Library, a branch of the Barker Engineering Library. The program runs for approximately four minutes and refers to copies of sample pages from STAR contained in a notebook adjacent to the unit. The equipment was designed and fabricated by M.I.T.'s Audio-Visual Department and consists of a cabinet containing a SONY cassette player/recorder utilizing a newly available continuous loop cassette. The listener lifts a Cousino hand phone off its cradle to activate the program and it shuts down automatically at its conclusion. The unit measures 12" deep x 10" wide x 12" high. (Figure III-5)

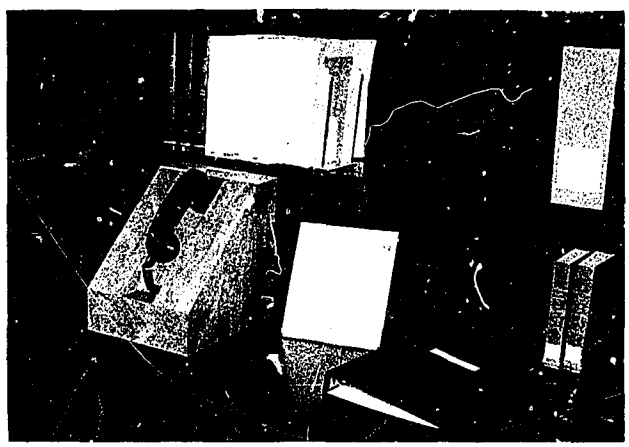


Fig. III-5 Audio unit used for NASA STAR program in the Aeronautics and Astronautics branch of the Barker Engineering Library.

An audio presentation is also being prepared for Science Citation Index. It will be presented in equipment identical to that used for the NASA STAR program and will be tested in the Barker Engineering Library.

The remaining program currently being produced is a synchronized sound-slide introduction to the Intrex console. This is being done at the suggestion of several Barker Engineering Library users and will be a brief program intended to overcome the more common misconceptions about the Intrex augmented catalog and text-access systems. The program will instruct the user on how to get into the system and how to do simple searches. Our judgment is that complex or in-depth questions about the system are best answered on a personal, individualized basis and through the experience of actually using the system.

In dealing with library users' specific problems in utilizing specific library reference tools, we have realized that we are approaching a second-level problem. The initial or first-level problem is to make the library user aware of the existence of these tools. A point-of-use introduction to NASA STAR is helpful to a user only if he knows that STAR exists as a potential source of information. In an attempt to approach this problem, we are exploring the possibility of producing a videotape introduction to the Barker Engineering Library indicating, as briefly as possible, the various kinds of information sources and services available. A decision on whether to proceed with this project will be made in the coming weeks.

The user response to the three programs which have been operational for a significant length of time has been, for the most part, favorable. Comments are made — at the user's option — in a notebook placed with each unit and replies to each comment are typed on the opposite facing page. Additional reactions have been offered by the staff of the Barker Engineering Library. The reactions have indicated some interesting pitfalls which we had not anticipated and which will help us not only in revising the existing programs but also in planning new programs.

The comments on the subject catalog program fall into these six categories:

1.	Uncritically favorable	13	31%
2.	Favorable with reservations	11	26%
3.	Favorable to the concept but unfavorable to specific program	10	24%
4.	Totally unfavorable	2	5%
5.	Irrelevant	3	7%
6.	Equipment problems	3	7%

The comments falling into catagories 2 and 3 total 21. Of these, 12 indicated the program was too elementary — that the user knew everything or almost everything

that was presented. Seven suggested adding more information and two were bothered by the inclusion of non-instructional, "light" material. Some typical comments from these categories were:

> "Enlarge it to include more information. Good start. Thank you."
>
> "Now that I've heard it, I know that I shouldn't have bothered — it's all old hat (to me anyway)."
>
> "This is a good approach to teaching library skills, but I think the material presented is already common knowledge to college students or professors."
>
> "Great idea — a bit elementary in approach — perhaps it should elaborate more on location within library — i.e., where to find..."
>
> "Not bad. Kind of elementary, but I like talking to pretty librarians better."
>
> "Can't see how anyone could be here and not know what you tell."

Of the two comments which were totally unfavorable, one complained that the machine was "cold and metallic," the other that it was an "inane waste of money."

The equipment problems category reflects some minor synchronization problems we had immediately after the unit was installed. Since that period of a few days the unit has been reliable, requiring virtually no service.

The category breakdown of the comments on the author-title catalog program was as follows:

1.	Uncritically favorable	12	34%
2.	Favorable with reservations	12	34%
3.	Favorable to the concept but unfavorable to specific program	1	3%
4.	Totally unfavorable	3	9%
5.	Irrelevant	2	6%
6.	Equipment problems	5	14%

Of the 13 comments within categories 2 and 3: six suggested adding additional information; five were related to environment (e.g., need for stool to sit on); one indicated the program was too elementary; and one found the non-instructive introductory material disconcerting.

Comments included:

"Good, but don't lay the wit on so heavy."

"It was good but you need a place to sit."

"Too fast."

"Good idea, but how about one which overviews the whole library."

The three totally unfavorable comments were that "real people could do a much better job;" that it was "too expensive;" and "this is inane."

The equipment problems were similar to those encountered in the subject catalog program, and like those, were resolved a few days after installation.

The comments on the NASA STAR sound-slide program are categorized as follows:

1.	Uncritically favorable	5	21%
2.	Favorable with reservations	10	42%
3.	Favorable to the concept unfavorable to specific program	0	0%
4.	Totally unfavorable	5	21%
5.	Irrelevant	1	4%
6.	Equipment problems	3	12%

Of the ten comments in category two: seven thought the program went too fast; two would like to have had sample issues integrated with the program; and one thought the screen illumination was too bright.

Comments included in category two were:

"Very well done. Indexes should be at hand. I am one of that minority who would rather have a written guide that I could read at my own pace and order."

"Good but would prefer a slightly longer time stop on pictures."

"Very good — a little too fast in some parts."

"In general, pretty good and clear. At times, slides change too quickly."

Of the five totally unfavorable comments, four were directed towards the introduction to the program which is as follows:

> Library users have always been forced to play by the establishment's rules. The rules for Scientific and Technical Aerospace Reports, known as STAR, have been made by NASA and are complicated enough to make you question the viability of our institutions. But — power to the people — that's what this three-minute tape will give by explaining how to use STAR. Either this or anarchy in the stacks. So, Right On!

The four comments indicated a negative reaction to our use of political rhetoric. Obviously these users took the language more seriously than we had intended.

The programs for Science Abstract, Series B, Electrical and Electronics Abstracts and Engineering Index were delayed for both audio and visual editing, primarily in the introductory or non-instructive areas. These changes were made at the request of staff members of the Barker Engineering Library and revolved around analogies considered offensive to women. The introduction to Science Abstracts made an analogy between using Science Abstracts and taking a drive with a woman driver. The Engineering Index script (reprinted in the last semiannual report) compared locating correct subject headings to being at a "college mixer, sifting through a multitude of entries to find the few chicks, or even the one chick, with the best potential."

The criticism of the NASA STAR; Science Abstracts and Engineering Index scripts indicates a need for sensitivity to the current social and political movements. This seems especially true at a university, but is probably an important factor in any environment. We included light, irrelevant material in the initial programs in the hope it would relax the user and add life to potentially dull subjects. This approach may be valid, but avoidance of controversial subjects seems advisable.

The audio NASA STAR program has not been in use long enough for us to receive significant feedback.

In addition to the revision of the Science Abstracts and Engineering Index scripts, the comments on the programs have directed us towards considering revising the NASA STAR audio-visual program and increasing the time allowed for viewing selected slides.

The problem of helping users to avoid viewing the catalog presentations when they already know how to use the catalogs is being approached by indicating explicitly on signs at the projectors that the material is introductory and directed towards the newcomer to the library. We feel that this is the person who can be most helped by this kind of presentation and that individualized, complex problems in using the card catalogs are best solved by librarians. The range that these problems can fall within is so large that a presentation covering them all would be prohibitively long.

The remaining programs to be completed are being done in a straight-forward, business-like manner, eschewing attempts at humor or lightness. We will try to determine if users actually prefer this to the lighter presentations.

With the assistance of Mrs. Susan Brown, psychologist, we are developing questionnaires based on the comments we have received in the notebooks. We will measure reactions of users to the equipment, the tone of the productions, the content of the productions, the timing of the productions, and the concept of point-of-use instruction. We will also determine whether users are viewing the programs out of actual need or curiosity and whether these factors affect their opinions of the programs.

We will continue to share our work through the loan of programs to interested institutions. We will offer copies of the catalog programs in slide and 1/4" audio tape format, and we will offer both sound-slide and sound-filmstrip programs for NASA STAR, Science Abstracts: Section B., and Engineering Index. We will also loan copies of the audio NASA STAR program. As additional programs are completed we will continue to provide copies for loan.

We also plan to offer copies of the programs, in various formats, for permanent retention. Charges made would be to cover our duplication costs only.

C. PATHFINDERS

Mr. C H. Stevens
Miss M. P. Canfield
Mr. J. J. Gardner
Mrs. E. King
Miss K. C. Todd

In addition to the eighty-two Pathfinders listed in the last semiannual report, a total of forty-five have been completed dealing with topics in civil engineering, computer technology, electrical engineering, humanities and social sciences, information science, materials science and engineering, and pollution. Placement of Pathfinder titles within these categories is arbitrary and based on local considerations. The titles are:

Civil Engineering

Asphalt
Plates
Portland Cement Concrete
Shells
Soil Cements
Systems Analysis
Urban Mass Transportation

Computer Technology

Magnetic Disk/Drum Storage
Magnetic Tape Drive
Magnetic Tape Storage

Electrical Engineering

Integrated Circuits
Lasers/Masers
Magnetohydrodynamics
Microwaves
Stroboscopic Photography
Telecommunication

Humanities and Social Sciences

Black American Novels-20th Century
Encaustic Painting
Etruscan Language
History of the English Bible
New England Transcendentalism
Sleep Deprivation (1960-1970)

Information Science

Information Retrieval
Information Transmission
Scientific Information Transfer

Materials Science and Engineering

Ferroelectrics
Ferromagnetism
Fiber Composite Materials
Mössbauer Effect
Particle Optics
Raman Effect
Superconductivity

Pollution

Air Pollution - Atmospheric Monitoring
Air Pollution - Automotive Exhaust Emissions
Air Pollution - Electrostatic Precipitators
Air Pollution - Filtration
Air Pollution - Nitrogen Oxides
Air Pollution - Standards/Legislation - U.S.
Wastewater Treatment - Activated Sludge Process
Wastewater Treatment - Electrodialysis
Wastewater Treatment - Foam Fractionation
Wastewater Treatment - Sedimentation
Water Pollution - Mercury
Water Pollution - Monitoring Water Quality
Water Pollution - Radioactive Materials

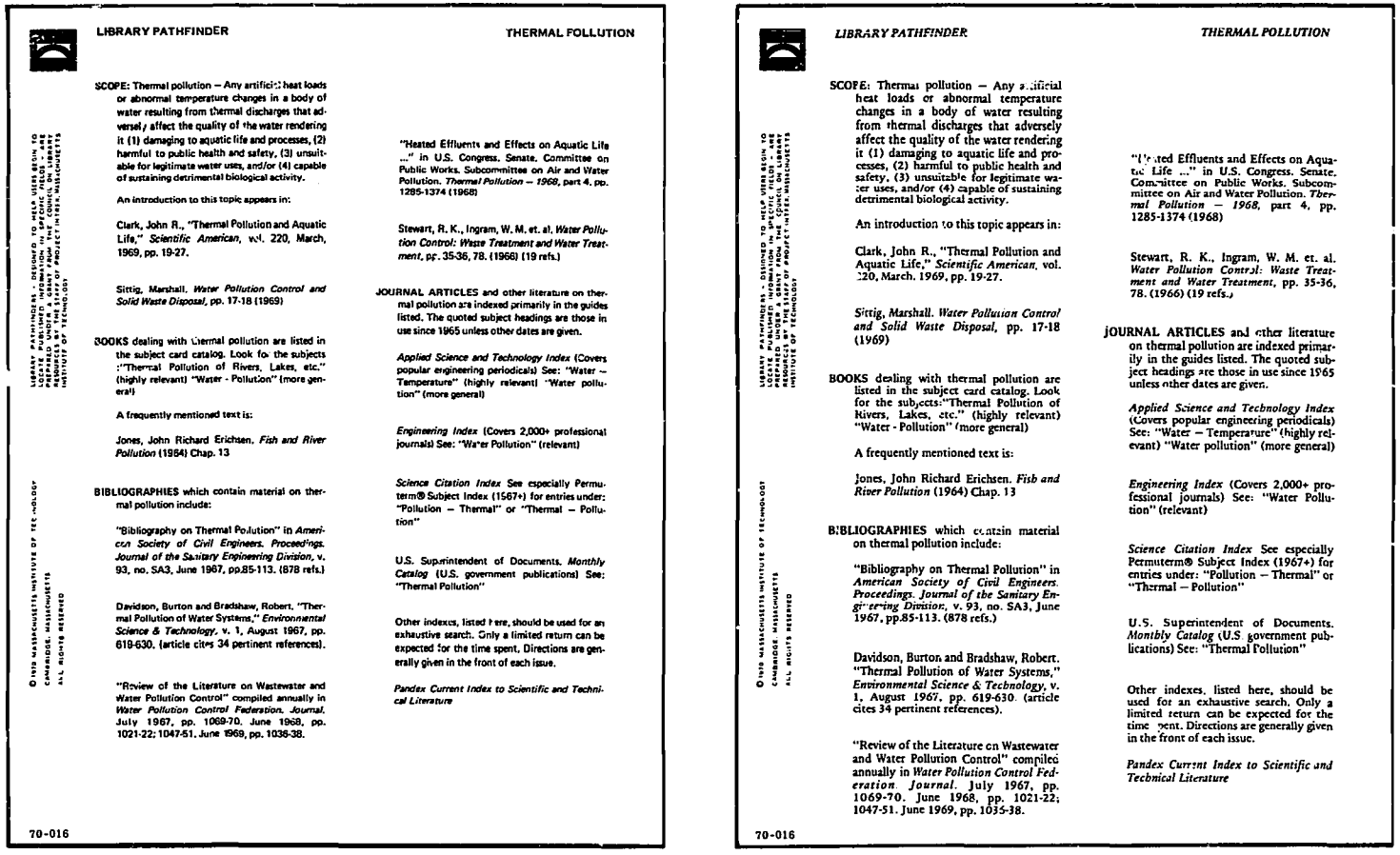
In addition to Pathfinders prepared by the Model Library staff, this list includes compilations contributed by the Tufts University Library staff and edited titles originally compiled as assignments by students enrolled in the Literature of Science and Technology course at Simmons College School of Library Science.

The Pathfinders on "Black American Novels-20th Century" and "New England Transcendentalism" were compiled by the Model Library staff to demonstrate the adaptability of the Pathfinder concept to fields other than science and technology. These two Pathfinders have been used as samples for the social science and humanities literature specialists whom we have contacted with the proposal that they prepare Pathfinders in their subject areas of interest.

Procedural delays and difficulties have interfered with full implementation of computer processing of Pathfinder text mentioned in the last semiannual report. After some successful tests of the input of Pathfinders to the computer and the successful output of one Pathfinder, we were unable to proceed with a larger sample because of changes in the input-output configuration of the peripheral equipment we were using. Specifically, the conversion to and from punched paper tape and magnetic tape became a bottleneck. Some temporary solutions emerged and were discarded because they were unreliable for day-to-day operations. New efforts to make this type of operation practical are in progress because greater flexibility of format is possible, correction and updating will be less costly than manual methods, the results are more readable and therefore more useful than typescript. Photographic reductions of the Pathfinder prepared by computer in two fonts are shown in Figure III-6. We remain optimistic about the possibility of computer generated Pathfinder masters for future titles. Project T.I.P. (Technical Information Project) personnel have performed the tasks related to computer production of Pathfinders; their assistance is gratefully acknowledged.

Librarians in cooperating libraries have questioned Project Intrex about the cost of producing Pathfinders adapted from the master copy furnished to them for users in their own libraries. Since the master is on "camera-ready" stock, the costs involved are those for finding and adding call numbers to the master, for preparing a printing plate, and printing it on stock drilled for a standard notebook. These costs may vary from one location to another but the figures we offer here are adequate for estimates and planning.

A.	Catalog search for local call numbers and recording of these call numbers. This task takes less time as more Pathfinders are done if a handlist of recurring titles and call-numbers is kept. Library assistant - paraprofessional: Twenty minutes at $5.00/hour.	$ 1.65
B.	Typing of library name and call numbers on the two sheets of the master Pathfinder. Skilled typist: Twenty minutes at $3.30/hour.	$ 1.10



LIBRARY PATHFINDER

THERMAL POLLUTION

LIBRARY PATHFINDERS - DESIGNED TO HELP USERS BEGIN TO LOCATE PUBLISHED INFORMATION IN SPECIFIC FIELDS. ARE PREPARED UNDER A GRANT FROM THE COUNCIL ON LIBRARY RESOURCES BY THE STAFF OF PROJECT INTREX, MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

SCOPE: Thermal pollution – Any artificial heat loads or abnormal temperature changes in a body of water resulting from thermal discharges that adversely affect the quality of the water rendering it (1) damaging to aquatic life and processes, (2) harmful to public health and safety, (3) unsuitable for legitimate water uses, and/or (4) capable of sustaining detrimental biological activity.

An introduction to this topic appears in:

Clark, John R., "Thermal Pollution and Aquatic Life," *Scientific American*, vol. 220, March, 1969, pp. 19-27.

Sittig, Marshall. *Water Pollution Control and Solid Waste Disposal*, pp. 17-18 (1969)

BOOKS dealing with thermal pollution are listed in the subject card catalog. Look for the subjects :"Thermal Pollution of Rivers, Lakes, etc." (highly relevant) "Water - Pollution" (more general)

A frequently mentioned text is:

Jones, John Richard Erichsen, *Fish and River Pollution* (1964) Chap. 13

BIBLIOGRAPHIES which contain material on thermal pollution include:

"Bibliography on Thermal Pollution" in *American Society of Civil Engineers. Proceedings. Journal of the Sanitary Engineering Division*, v. 93, no. SA3, June 1967, pp.85-113. (878 refs.)

Davidson, Burton and Bradshaw, Robert. "Thermal Pollution of Water Systems," *Environmental Science & Technology*, v. 1, August 1967, pp. 619-630. (article cites 34 pertinent references).

"Review of the Literature on Wastewater and Water Pollution Control" compiled annually in *Water Pollution Control Federation. Journal*. July 1967, pp. 1069-70. June 1968, pp. 1021-22; 1047-51. June 1969, pp. 1036-38.

"Heated Effluents and Effects on Aquatic Life ..." in U.S. Congress. Senate. Committee on Public Works. Subcommittee on Air and Water Pollution. *Thermal Pollution – 1968*, part 4, pp. 1285-1374 (1968)

Stewart, R. K., Ingram, W. M. et. al. *Water Pollution Control: Waste Treatment and Water Treatment*, pp. 35-36, 78. (1966) (19 refs.)

JOURNAL ARTICLES and other literature on thermal pollution are indexed primarily in the guides listed. The quoted subject headings are those in use since 1965 unless other dates are given.

Applied Science and Technology Index (Covers popular engineering periodicals) See: "Water – Temperature" (highly relevant) "Water pollution" (more general)

Engineering Index (Covers 2,000+ professional journals) See: "Water Pollution" (relevant)

Science Citation Index See especially Permuterm® Subject Index (1967+) for entries under: "Pollution – Thermal" or "Thermal – Pollution"

U.S. Superintendent of Documents. *Monthly Catalog* (U.S. government publications) See: "Thermal Pollution"

Other indexes, listed here, should be used for an exhaustive search. Only a limited return can be expected for the time spent. Directions are generally given in the front of each issue.

Pandex Current Index to Scientific and Technical Literature

70-016

LIBRARY PATHFINDER

THERMAL POLLUTION

LIBRARY PATHFINDERS - DESIGNED TO HELP USERS BEGIN TO LOCATE PUBLISHED INFORMATION IN SPECIFIC FIELDS. ARE PREPARED UNDER A GRANT FROM THE COUNCIL ON LIBRARY RESOURCES BY THE STAFF OF PROJECT INTREX, MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

SCOPE: Thermal pollution – Any artificial heat loads or abnormal temperature changes in a body of water resulting from thermal discharges that adversely affect the quality of the water rendering it (1) damaging to aquatic life and processes, (2) harmful to public health and safety, (3) unsuitable for legitimate water uses, and/or (4) capable of sustaining detrimental biological activity.

An introduction to this topic appears in:

Clark, John R., "Thermal Pollution and Aquatic Life," *Scientific American*, vol. 220, March, 1969, pp. 19-27.

Sittig, Marshall. Water Pollution Control and Solid Waste Disposal, pp. 17-18 (1969)

BOOKS dealing with thermal pollution are listed in the subject card catalog. Look for the subjects:"Thermal Pollution of Rivers, Lakes, etc." (highly relevant) "Water - Pollution" (more general)

A frequently mentioned text is:

Jones, John Richard Erichsen. *Fish and River Pollution* (1964) Chap. 13

BIBLIOGRAPHIES which contain material on thermal pollution include:

"Bibliography on Thermal Pollution" in *American Society of Civil Engineers. Proceedings. Journal of the Sanitary Engineering Division*, v. 93, no. SA3, June 1967, pp.85-113. (878 refs.)

Davidson, Burton and Bradshaw, Robert. "Thermal Pollution of Water Systems," *Environmental Science & Technology*, v. 1, August 1967, pp. 619-630. (article cites 34 pertinent references).

"Review of the Literature on Wastewater and Water Pollution Control" compiled annually in *Water Pollution Control Federation. Journal*. July 1967, pp. 1069-70. June 1968, pp. 1021-22; 1047-51. June 1969, pp. 1036-38.

"Heated Effluents and Effects on Aquatic Life ..." in U.S. Congress. Senate. Committee on Public Works. Subcommittee on Air and Water Pollution. *Thermal Pollution – 1968*, part 4, pp. 1285-1374 (1968)

Stewart, R. K., Ingram, W. M. et. al. *Water Pollution Control: Waste Treatment and Water Treatment*, pp. 35-36, 78. (1966) (19 refs.)

JOURNAL ARTICLES and other literature on thermal pollution are indexed primarily in the guides listed. The quoted subject headings are those in use since 1965 unless other dates are given.

Applied Science and Technology Index (Covers popular engineering periodicals) See: "Water – Temperature" (highly relevant) "Water pollution" (more general)

Engineering Index (Covers 2,000+ professional journals) See: "Water Pollution" (relevant)

Science Citation Index See especially Permuterm® Subject Index (1967+) for entries under: "Pollution – Thermal" or "Thermal – Pollution"

U.S. Superintendent of Documents. *Monthly Catalog* (U.S government publications) See: "Thermal Pollution"

Other indexes, listed here, should be used for an exhaustive search. Only a limited return can be expected for the time spent. Directions are generally given in the front of each issue.

Pandex Current Index to Scientific and Technical Literature

70-016

Fig. III-6 Pathfinder "Thermal Pollution" produced by computer output in sans serif font "Univers" (left) and serif font "Journal Roman" (right).

C. Printing 100 copies from photo-offset plate on drilled, high quality, fifty-pound offset paper stock, 2 sides. $10.75

Printing 100 copies from photodirect plastic or paper plate on drilled, economy, fifty-pound stock, 2 sides. $ 4.20

Printing 100 copies from electrostatic plate on drilled, economy, fifty-pound stock, 2 sides. $ 2.60

Quantities less than 100 copies of one title will reduce printing costs very slightly or not at all. However, storage of copies not used promptly may be expensive and unwieldy. In this case a shorter print run and more frequent printing may be beneficial. Use of heavier paper stock including cover stock or ledger stock will increase printing costs but the durability of the Pathfinder is also improved.

Assembling the total costs from the three components (search, typing, printing), it can be seen that the lowest cost for 100 copies is $5.35; the highest is $13.50. Within this range the large variables are the plate method used and paper stock selected. The combination of photodirect process plate and a high quality paper stock plus fixed charges for search and typing would result in a total cost of about $8.00 for 100 copies.

Recovery of the printing increment of the production costs may be achieved by offering them to the user for a fee smaller than the cost to him of photocopying a pirated copy — perhaps ten cents.

If printing is eschewed for any reason, the library can make Pathfinders available to the user by photocopying the master on legal-size paper and charging the user for two Xerox-type prints. In the experimental use of Pathfinders in the Barker Engineering Library they have been furnished free to users to obtain the widest base for study of user reactions.

Further development of the cooperative program of Pathfinder compilation has occurred during this reporting period. Our goals have been to increase the number of Pathfinders produced and broaden the scope of Pathfinders to include topics in the social sciences and humanities as well as science and engineering. We aim to achieve these goals while maintaining established standards of quality and utility.

We have continued the cooperative Pathfinder program with Mr. James Matarazzo and the Simmons science-technology students which was described in the last semiannual report. During this reporting period twenty-two student compilations on topics in electrical engineering, materials science, and pollution were edited by the Model Library staff and subsequently printed. These titles, together with the 15 previously reported, account for 37 of the 127 Pathfinders currently available. It is projected that 56 additional science-technology Pathfinders will be prepared at Simmons this semester.

The Simmons instructors in the Literature of the Social Sciences have also been contacted and they have indicated their interest in joining the cooperative program.

Final commitments in terms of numbers of student compilations to be submitted for publication are pending because the Pathfinder assignments will be optional.

In an attempt to expand the cooperative program, the Model Library staff wrote to faculty members at 49 institutions offering a graduate program in library science. Of the 114 faculty contacted, 36 responded favorably with an interest in having their students participate in the cooperative program. At the time of writing we have received firm commitments from 12 of these instructors that student compilations will be prepared and submitted. We expect to receive commitments from many of the remaining 24 instructors by the time this report is printed and distributed. On the basis of our correspondence thus far it is projected that we will receive between 250 and 300 Pathfinders to consider for publication this semester. See Figure III-7 for details.

In addition to involving library school faculty and students in the expansion of the Pathfinder program, our efforts with professional librarians have met with limited success. We have accepted eleven Pathfinders for publication from five libraries, and we have been notified that seven additional compilations are in progress. See Figure III-8 for details.

We have had responses from 7 other libraries indicating that they will be working on compiling Pathfinders during this semester. Included in this group are Lehigh University, University of Houston, and Bath University of Technology. We will continue to pursue this avenue of approach with the full realization that, at many university and special libraries, the lack of available staff time for special projects of this sort precludes production of Pathfinders in large numbers. In our contacts with cooperating institutions we have presented our role in the cooperative program of Pathfinder compilations as being threefold: (1) to act as a clearinghouse to supply and/or record potential topics selected by the cooperating institutions; (2) to edit and prepare submitted compilation for publication as oversize printed masters; and (3) to act as a central distribution point in supplying oversize printed masters without call numbers to cooperating institutions. To facilitate the Model Library Project's function as a clearinghouse for Pathfinder topics, the staff has prepared a reserve file of topics available for compilation in mathematics, the physical sciences, engineering, the social sciences, fine arts, and the humanities. The staff, all of whom have different subject backgrounds, prepared lists of potential topics in their respective fields. The criteria were that the topics be of current research interest within their disciplines, that they have the degree of specificity required for meaningful Pathfinder compilation, and that they be represented by bodies of literature.

We have, though, encouraged cooperating institutions — both libraries and library schools — to select their own topics and tailor them for use in their own libraries. We have suggested that, for maximum return on the investment of compilation time, it would be best for such locally selected topics to reflect (1) curriculum- and research-related areas of interest (which implies an identifiable body of Pathfinder users),

Library School	Number of Pathfinder Topics Selected for Compilation (X = Exact number unknown)	General Subject Disciplines Represented
Simmons College	56	Science; Engineering
	X	Social Sciences
	X	Social Sciences
Case Western Reserve University	50	Social Sciences
	26	Medicine
	2	Information Science
Drexel University	X	Science; Engineering
Emory University	X	English Literature
Florida State University	35	Social Sciences
Kent State University	X	Humanities
McGill University	9	Science
Rosary College (Illinois)	40	Humanities
University of British Columbia	13	Science
University of Denver	33	Social Sciences
University of Illinois	18	Science; Engineering

Fig. III-7 Library schools compiling Pathfinders in the cooperative program.

Library	Number of Pathfinders: Accepted	Number of Pathfinders: In Progress	General Subject Disciplines Represented
Duke University School of Engineering Library	3	2	Engineering
Tufts University Library	4		Art; Social Sciences
Johns Hopkins University Applied Physics Laboratory Library	3		Physics
Yale University Engineering and Applied Science Library		2	Physics
Commonwealth of Massachusetts Department of Education Educational Reference Center	1	3	Education

Fig. III-8 Libraries compiling Pathfinders in the cooperative program.

(2) the subject concentrations and strengths of library collections and staff, and (3) for library schools, the subject areas that best represent course emphasis and students' backgrounds and interests.

However, when a cooperating institution requests that the Model Library staff supply topics for Pathfinder compilation, we ask to be appraised of the subject areas of interest. With this information we are better prepared to select from our reserve file topics that will be relevant to local compilers' interests.

In addition to the reserve file of topics available for compilation, the Model Library staff also maintains records of topics for which compilations are either in progress or have been completed.

Before cooperating institutions begin work on Pathfinders, we ask them to inform us of the topics that have actually been selected — either locally or from lists supplied by us. We then check the selections against our records of topics in progress and topics completed. We do this not to restrict or unduly influence compilers' choices but primarily to prevent duplicate compilations by any of the cooperating institutions.

In our correspondence with cooperating institutions, we have indicated that a compiler may find it necessary to modify a topic whether it be one selected locally or one supplied by the Model Library staff. This procedure usually takes the form of narrowing or delimiting the topic, and we stress that the compiler should feel free to exercise a professional judgment. Our experience as compilers has demonstrated that the need for such a step becomes obvious only when one actually begins searching the literature.

We have distributed to all cooperating institutions a summary of the guidelines and procedures which the Model Library staff has followed in compiling Pathfinders. Because the guidelines were developed with engineering Pathfinders foremost in mind, we have emphasized that the format described should be adapted for compilations in the social sciences and humanities. Our judgment is that adaptation consists primarily of tailoring the sections used in a Pathfinder to reflect the forms in which the literature of a discipline appears. We have indicated that compilers working in the social sciences and humanities should feel free to adapt the Pathfinder format according to the dictates of their disciplines.

We have recently begun to print Pathfinders with a credit statement on the bottom of the verso. This credit identifies both the compiler and the institution at which the Pathfinder was prepared.

Pathfinder revision continues to be a concern. We have added to our file of potential revisions not only suggestions obtained through feedback from Pathfinder users but also information which the Model Library staff becomes aware of in the course of compilation work and as new materials are received in the Barker Engineering Library. In addition, we have initiated a Pathfinder review program with the National Referral Center in the Science and Technology Reference Division of the Library of Congress. Finished Pathfinders are being submitted, on a continuing basis, to both referral specialists and science reference librarians for review. Their comments concerning infor-

mation sources and suggestions of additional citations are being incorporated into the revision file and will be utilized when our revision plans are made final.

The methods of publicizing Pathfinders have continued along the lines previously reported which include posters in departmental office and laboratory areas, notices printed in the Engineeing Library Bulletin, Pathfinder card entries under the pertinent subject headings in the Barker Engineering Library Subject Catalog, and notebooks of samples of available Pathfinders located at the library's public service desks. In addition, Pathfinders have been incorporated into orientation programs and subject seminars conducted by the Barker Engineering Library staff. Some professors, too, have distributed explanatory Pathfinder material to their classes and have recommended that their students use specific titles as bibliographic aids when compiling course-required papers.

Response to the Pathfinder idea from librarians and others who have encountered it outside M.I.T. has been enthusiastic and encouraging. Some samples of recently received unsolicited comments follow:

National Referral Center - Library of Congress
John A. Feulner, Senior Referral Specialist

"They are, indeed, a marvelous idea. One wonders why nobody has thought of such a tool and put it into practice decades ago. I am most impressed by the whole concept.... Truly this new tool should prove most useful: telling people where to look and at the same time giving them something concrete. Actually, anybody, who can read, should be able to use and profit from the pathfinders."

Bath University Maurice Line, Director

"The more I see your Pathfinders, the more I like them. They seem to me to be right on the ball, and have the advantage that every librarian can build up his own package to suit his own requirements.... I am sold on the idea, and I shall want my own staff to start producing such things as soon as they possibly can."

California Institute of Technology Harald Ostvold, Librarian

"You have ingeniously reduced the guides to a level of simplicity that should encourage use by students, if that can be done at all."

Colorado State University
Marjorie Rhoades, Engineering Science Librarian

"Your Pathfinders are indeed a welcome innovation. The approach you have taken to the perennial problem should be very fruitful.... I certainly plan to adapt this technique for local use."

Air University Library Robert Lane, Chief of Reader Services

"Needless to say, I find them very intelligently done, and feel the format is exceedingly well worked out."

International Business Machines, Inc.
Eugene Jackson, Director, Information Retrieval and Library Services

> "I have been impressed by the potential of your Pathfinders.... In addition to the expected use in an industrial firm for briefing new employees or staff entering a new field of specialization, I see these as being crucially useful in developing countries that have to "make do" with basic collections including material in languages other than their native tongue."

The primary distribution point for Pathfinders continues to be the Barker Engineering Library circulation desk. During the period August, 1970 through January, 1971, 480 Pathfinders were distributed on request to library users for personal use and retention. As previously reported, each of these Pathfinders had attached to it a self-addressed reply card on which the user was asked to record comments.

Twenty-five cards have been returned with 28 comments. These comments can be categorized as follows:

Uncritically favorable	16
Favorable with reservations	4
Suggested additions of material	5
Unfavorable	1
Additional topics suggested for compilation	2

Of the four comments that were "favorable with reservations," one suggested revising the scope note, one suggested that we list by name, prominent researchers in the topic field, one advised increasing Pathfinder publicity, and one thought that Pathfinder topics were too narrow. The one unfavorable comment indicated that the user had not found information on "computer utilities" in the Pathfinder on Time-Sharing.

We had anticipated a low rate of return of the Pathfinder comment cards. Therefore, in addition to supplying the comment cards, we have used — and will continue to use during the next reporting period — another mechanism to obtain feedback from users.

Individuals who take Pathfinders are requested (but not required) to sign their name and address on a list maintained at the circulation desk. This list is subsequently used as a source for mailing a follow-up questionnaire (Fig. III-9) to determine user reaction to Pathfinders. During the period September, 1970 through January, 1971, 105 questionnaries were sent and 71 (68%) were returned.

1. How did you learn about Pathfinders?
   ___ Engineering Library Subject Catalog
   ___ Referred by Professor
   ___ Engineering Library Bulletin
   ___ Posters
   ___ Sample notebooks in Engineering Library
   ___ Other (specify) _____

2. Why did you take them?
   ___ Thesis research
   ___ Course paper research
   ___ Personal interest
   ___ Other (specify) _____

3A. Have you used them?
   ___ Yes ___ No

B. If yes, which sections did you use?
   ___ Subject catalog headings
   ___ Frequently mentioned texts
   ___ Handbooks, encyclopedias, and dictionaries
   ___ Bibliographies
   ___ Journal abstracts and indexes
   ___ Journal titles
   ___ State-of-the-art reviews and conference proceedings
   ___ Technical report indexes

4. How helpful have the Pathfinders been?
   ___ Very helpful
   ___ Fairly helpful
   ___ Not helpful

5. Can you suggest ways to improve Pathfinders?

6. Can you suggest additional topics?

Name: _____
Extension: _____

Fig. III-9 Questionnaire sent to individual Pathfinder users.

The responses to question #1 were as follows:

#1. How did you learn about Pathfinders?	Responses*	
	No.	%
Engineering Library subject catalog	27	(38%)
Referred by Professor	14	(20%)
Engineering Library Bulletin	9	(13%)
Posters	5	(7%)
Sample notebooks in Engineering Library	13	(18%)
Librarian	7	(10%)
Other	4	(6%)

(*N = 71; eight respondents checked two answers)

The largest group of respondents (38%) were introduced to Pathfinders through the color-coded cards entered in the Barker Engineering Library Subject Catalog under relevant headings. However, a significant combined percentage of respondents (40%) learned about Pathfinders from professors whom the Model Library staff had contacted directly, from announcements in the biweekly Engineering Library Bulletin, and from posters selectively located in departmental areas. This suggests to us that the subject catalog consititutes as good a Pathfinder mechanism as any for reaching presumably regular library users; yet, the promotion of Pathfinders by means external to the library is a mechanism which has as much potential for reaching another identifiable group within the M.I.T. community. Conceivably, this latter group includes persons who do not have preestablished library habits and are, therefore, most in need of assistance when they have subject literature requirements.

The responses to question #2 indicated the reasons Pathfinders were taken to be as follows:

#2. Why did you take them?	Responses*	
	No.	%
Thesis research	14	(20%)
Course paper research	34	(48%)
Personal interest	21	(30%)
Project research	8	(11%)
Non-MIT company research	2	(3%)
Other	3	(4%)

(*N = 71; eleven respondents checked two answers)

The percent of responses (30%) indicating that Pathfinders were taken for personal (i.e., non-research, non-curriculum) interests was higher than expected. We do not know how much the curiosity factor influenced these responses.

The percent of responses (20%) indicating an interest in Pathfinders in connection with thesis research was lower than expected. This may be a reflection of a common

"searching" practice among thesis writers of consulting, almost exclusively, specific materials recommended by departmental advisors and/or subject collections scattered throughout departmental offices.

The high percent of Pathfinder interest (48%) relative to course paper research reinforces our opinion concerning the value of having instructors distribute to students introductory material indicating the availability of specific Pathfinders relevant to course content.

The responses to questions #3A and #3B concerning the Pathfinder sections actually used were as follows:

#3A. Have you used them	Responses*	
	No.	%
Yes	60	(85%)
No	10	(14%)
Not yet	1	(1%)

(*N = 71)

#3B. If yes, which sections did you use	Responses*	
	No.	%
Subject catalog headings	16	(27%)
Frequently mentioned texts	36	(60%)
Handbooks, encyclopedias, dictionaries	13	(22%)
Bibliographies	13	(22%)
Journal abstracts and indexes	24	(40%)
Journal titles	17	(28%)
State-of-the-art reviews and conference proceedings	18	(30%)
Technical report indexes	17	(28%)

(*N = 60)

The responses to these questions indicate that the majority of Pathfinders taken (85%) were actually used — the curiosity factor notwithstanding. In addition, the indications are that all sections constituting the Pathfinder format are used with sufficient frequency to warrant continued inclusion. Concerning the Pathfinder sections, there has not been any negative user reaction to the sequence in which they are arranged.

The responses to question #4 concerning the Pathfinders' utility were as follows:

#4. How helpful have the Pathfinders been	Responses*	
	No.	
Very helpful	26	(43%)
Fairly helpful	28	(47%)
Not helpful	6	(10%)

(*N = 60)

	USER'S REASON FOR TAKING PATHFINDER									
	Thesis Research		Course Paper Research		Personal Interests		Other		Project Research	
	No.	%	No.	%	No.	%	No.	%	No.	%
Very helpful	3	(23%)	18	(60%)	6	(33%)	1	(50%)	3	(50%)
Fairly helpful	8	(62%)	9	(30%)	12	(67%)	1	(50%)	2	(33%)
Not helpful	2	(15%)	3	(10%)	0		0		1	(17%)
Total	13		30		18		2		6	

Fig. III-10 Correlation between user's reason for taking Pathfinder and user's judgment of utility. (9 respondents took Pathfinders for two reasons)

	NUMBER OF PATHFINDER SECTIONS USED							
	8	7	6	5	4	3	2	1
	No. %	No. %	No. %	No. %	No. %	No. %	No. %	No. %
Very helpful	3 (100%)	0	0	1 (50%)	3 (36%)	2 (25%)	11(58%)	6 (32%)
Fairly helpful	0	0	1(100%)	1 (50%)	5 (64%)	6 (75%)	7(37%)	8 (42%)
Not helpful	0	0	0	0	0	0	1 (5%)	5 (26%)
Total	3	0	1	2	8	8	19	19

Fig. III-11 Correlation between number of sections used and user's judgment of utility.

These responses indicate to us — in a general way, at least — that, for the majority of respondents (90%), the Pathfinders are fulfilling their stated objective"... to help library users begin to find information...." Upon analysis, the 10% "not helpful" responses are really not disturbing. One negative respondent indicated that he had, in fact, not used the Pathfinders much but he did"... see high potential for them." For the most part, the remainder of the negative responses represent the reactions of users who selected Pathfinders not pertinent to their subjects or who expected Pathfinders to be more of a bibliography.

With the assistance of Mrs. Susan F. Brown, Project Intrex psychologist, a completely new and refined questionnaire for obtaining user feedback is currently being prepared. It is expected that this question concerning users' subjective measures of Pathfinders' utility will be broadened to include more gradations of opinion.

On the basis of questionnaire responses, correlations have been obtained concerning users' judgments of Pathfinder utility in terms of both the reasons for which Pathfinders were taken (Fig. III-10) and the number of Pathfinder sections used (Fig. III-11).

The comments made by respondents on improving Pathfinders did not indicate to us any major areas of weakness. The suggestions can be categorized as follows:

#5. Can you suggest ways to improve Pathfinders?	Responses*	
	No.	%
No suggestions	40	(56%)
Addition of type of material	9	(13%)
Improve layout	4	(6%)
Publicize	4	(6%)
Update Pathfinders	3	(4%)
Finer subject breakdown of material	3	(4%)
Specific additions suggested	1	(1%)
Identify outstanding researchers	1	(1%)
Irrelevant suggestions	8	(11%)

(*N = 71; two respondents made two suggestions)

During the next reporting period the main efforts of the Model Library staff regarding Pathfinders will be concentrated on:

(1) increasing the number of available Pathfinders through the development of the cooperative compilation program;
(2) increasing the distribution of printed masters to cooperating institutions for use in their own libraries; and
(3) increasing user feedback concerning Pathfinders by means of the refined questionnaire now in preparation.

D. USER PREFERENCE STUDY

Mr. C. H. Stevens
Mr. J.J. Gardner
Mr. J. M. Kyed

With a substantial period of operation carefully recorded in the Barker Engineering Library Microfilm Service Area there is no evidence for changing the widely held view that a majority of library users have a strong preference for hard copy over film copy whenever they are equally available. But the "majority" may not be quite as large or quite as insistent as it has been in the past. As the collection of fiche has become more comprehensive and the fiche readers more available, there has been a small but significant increase in the use of these materials. Since the number of requests for copies of fiche and for hard copies from fiche has been small, the concentration of effort has been on building the collection and on improvement of the access options available to the user.

The collection now has nearly 30,000 fiches. During the last six months the additions have included a collection of manufacturers' catalogs representing over 400 companies, significantly long runs of thirty-four journal titles, several thousand M.I.T. theses in engineering, and all of the materials indexed for the Intrex augmented catalog experiments. Taken together, the new acquisitions double the collection held at the time of the last semiannual progress report. It is reasonable to expect that this larger collection will have wider use since the patron will have greater expectancy of obtaining the desired item. The emphasis on collection will continue during the next six months. During this period the thesis filming project will be concluded for all titles from 1946 - 1969. A large percentage of M.I.T. 1970 engineering theses will also be complete by September. Purchases of available journals, society papers, conference reports, and monographs on fiche will continue and a program of filming other heavily used current journal issues will begin.

To improve user access to the fiche two new types of microfiche readers have been added to those already available and reported earlier. One of the readers, designed for library, office, dormitory, or classroom use, by the Electronic Systems Laboratory at M.I.T. under a contract from the United States Office of Education features a motor-driven fiche carrier with remote control operation and projection of the film image on a wall screen. Installation of this unit in the Barker Engineering Library occurred in January 1971 and the users who have tried it are pleased with both the image quality and the simplicity of operation. Since the image is large and bright there has been no complaint about eye fatigue by our users. The second new reader is the widely-advertised, eight-pound portable microfiche viewer made by DASA in Andover, Massachusetts. This reader, also developed under Office of Education sponsorship, has just become available to us in quantity and first experiments in loaning units to readers will occur about the

time this report is distributed. The opportunity exists with the receipt of the portable readers to test the view that use of fiche increases in proportion to the easy availability of readers for fiche.

A program of displays and demonstrations calling attention of casual library users to the advantages of microfiche began during the opening of classes in late September. Increased awareness to the growing collection is, we believe, a key to increased utilization and therefore the effort to promote use by alerting patrons to the collections and how to use them will continue. Two of the displays used for microfiche publicity are reproduced in Figure III-12.

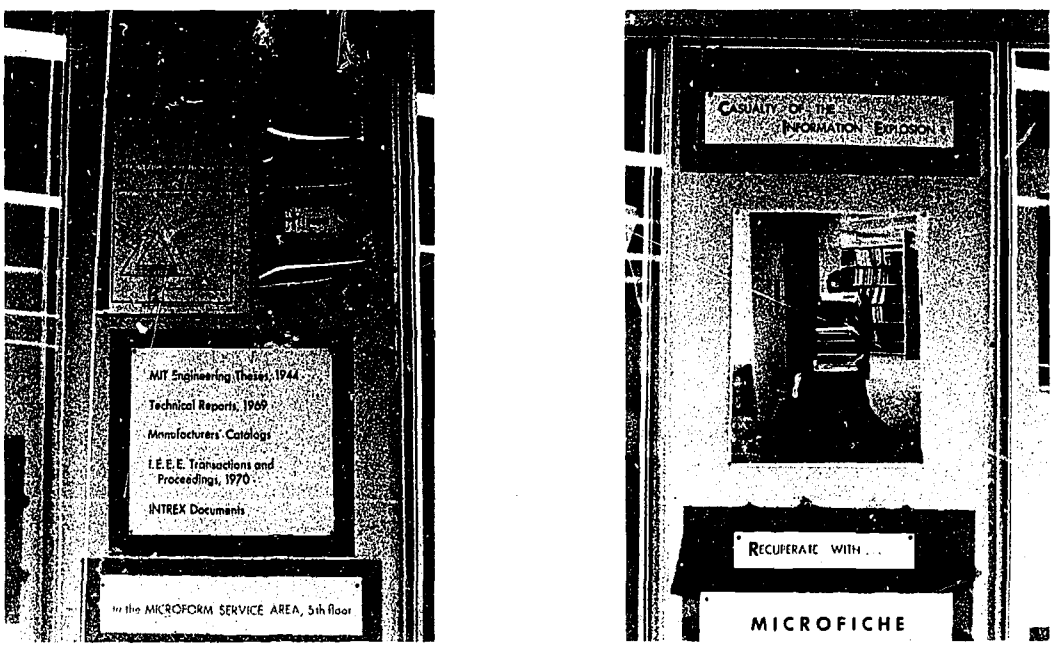


Fig. III-12 Bulletin board displays used to draw attention to microfiche services.

IV. PROJECT INTREX STAFF

A. PROJECT OFFICE

Professor Carl F.J. Overhage, Director

Mr. Charles H. Stevens

B. ELECTRONIC SYSTEMS LABORATORY

Professor J. Francis Reintjes
Mr. Alan R. Benenfeld
Mr. Larry E. Bergmann
Mr. Joseph Bosco
Mrs. Susan Brown
Professor Lynwood S. Bryant
Mr. Dennis W. Buckley
Mr. Peter Campoli
Mr. Yiu T. Chan
Miss Margaret A. Flaherty
Mr. Robert Goldschmidt
Mr. Daniel J. Griffin
Mr. Charles E. Hurlburt
Miss Margaret A. Jackson
Mr. James E. Kehr
Mr. Donald R. Knudson
Mr. Peter Kugel
Mr. Stephen G. Kuyamjian
Miss Linda A. Langille
Miss Lucy T. Lee
Mr. Richard S. Marcus
Mr. Patrick L. Martin
Miss Mary M. McMillin
Miss Virginia A. Miethe
Mr. Michael K. Molnar
Professor James K. Roberge
Mr. John O. Silvey
Miss Frances Spigai
Mr. Jean R. Ward

C. BARKER ENGINEERING LIBRARY

Miss Rebecca L. Taggart, Head
Mrs. Marjorie Chryssostomidis
Miss Barbara C. Darling
Mrs. Kate Herzog
Miss Carol L. Keator
Mr. James M. Kyed
Miss Helen Magedson
Miss Susan Nutter
Miss Mary Pensyl
Mr. David C. Van Hoy

D. MODEL LIBRARY PROGRAM

Mr. Jeffrey J. Gardner
Miss Marie P. Canfield
Mrs. Elizabeth King
Miss Katherine C. Todd

V. CURRENT PUBLICATIONS

A. REPORTS

None

B. BOOK CHAPTERS, JOURNAL ARTICLES AND CONFERENCE PAPERS

Marcus, R. S., Benenfeld, A. R., and Kugel, P., "The User Interface for the Intrex Retrieval System." Presented at the Workshop on the User Interface for Interactive Search of Bibliographic Data Bases, Palo Alto, California, January 14-15, 1971. Proceedings to be published by AFIPS Press.

Lovins, J. B., "Error Evaluation for Stemming Algorithms as Clustering Algorithms." Journal of the American Society for Information Science, Vol. 22, No. 1, January, 1971, pp 28-40.

Stevens, C. H., "Specialized Microform Applications in an Academic Library." Presented at the University of Denver, Denver, Colorado, December 7, 1970. (To be published in the Proceedings.)

Overhage, Carl F. J., "Directions for the Future." Presented at Collaborative Library Systems Development Conference, New York, N. Y., November 10, 1970. (To be published in Conference Proceedings.)

C. THESES

None

D. MISCELLANEOUS PRESENTATIONS

Stevens, C. H., "Project Intrex and Engineering Library Services." Presented at Boston University, Boston, Massachusetts, January 12, 1971.

Stevens, C. H., "Project Intrex at Midstream." Presented at the University of Illinois, Urbana, Illinois, November 20, 1970.

Stevens, C. H., "The Sky is Not the Limit." Presented at Honeywell Corporation Executive Seminar, Concord, Massachusetts, November 16, 1970.

Stevens, C. H., "Science and Technology Information Services in the Academic Library." Presented at North Carolina Central University, Durham, North Carolina, October 21, 1970.

VI. PAST PUBLICATIONS — October, 1969 through 15 September 1970.

A. REPORTS

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