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A STUDY WAS CONDUCTED TO PROVIDE GUIDANCE IN THE DEVELOPMENT OF THE EDUCATIONAL RESEARCH INFORMATION CENTER (ERIC) FOR THE U.S.J. OFFICE OF EDUCATION. THE STUDY CENTERED AROUND THREE TASKS--(1) TO DETERMINE PRESENT INFORMATION NEEDS AMONG PERSONS CONCERNED WITH EDUCATIONAL RESEARCH, (2) TO IDENTIFY THE TECHNOLOGY PROBABLY AVAILABLE TO MEET THESE NEEDS BY 1969, AND (3) TO PLAN AN ORDERLY TRANSITION FROM THE INITIAL ERIC POSTURE TO ONE WHICH WOULD SATISFY THE NEEDS IN THE MOST ECONOMICAL AND EFFECTIVE MANNER. CHAPTERS OF THE REPORT DISCUSSED--(1) DISSEMINATION OF INFORMATION, (2) THE CHANGING INFORMATION TECHNOLOGY, (3) ERIC AND THE FUTURE, (4) CURRENT AWARENESS, AND (5) DATA PROCESSING FOR CURRENT NEEDS. (EC)

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Submitted to:

U.S. OFFICE OF EDUCATION
Department of Health, Education and Welfare
Washington, D.C.

Contract OE-5-99-264

Final Report

TR-66-15-7

INFORMATION TRANSFER IN EDUCATIONAL RESEARCH

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April 8, 1966

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INTRODUCTION

This is the final report of a study performed by Informatics Inc. for the United States Office of Education, to provide guidance in the development of the Educational Research Information Center (ERIC). Individual chapters were delivered to USOE as they became available. The accompanying yellow pages (The Short Report) give the highlights of the study. The study centered around three tasks:

1) To determine present information needs among persons concerned with educational research.

2) To identify the technology available to satisfy those needs in the 1969 era.

3) To plan an orderly transition from the initial ERIC posture to one which would satisfy the needs in the most economic and effective manner

At the direction of the U.S. Office of Education, we reported in detail on six areas, which now form the chapters of this report:

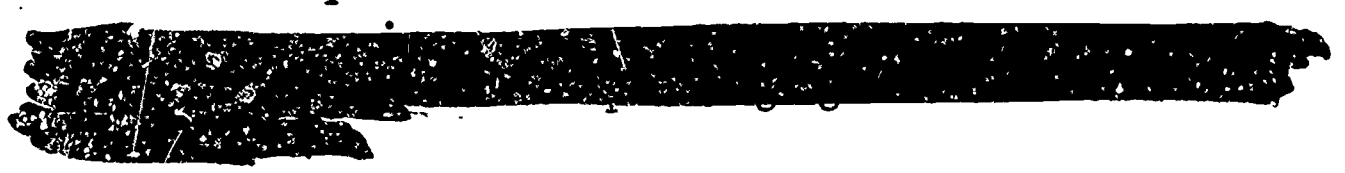
I. Dissemination of Information is mainly a description of the user population, its various kinds of information needs, and the means now used to satisfy those needs.

II. The Changing Information Technology describes technological trends which will affect patterns of information flow in the 1969 era.

III. ERIC and the Future contains our recommendations for the development of the system.

IV. Current Awareness discusses the need for a current awareness bulletin and recommendations for its format and distribution.

V. Data Processing for Current Needs describes the functions of ERIC with regard to needed equipment and techniques.



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The members of the Informatics Inc. study team wish to express our appreciation to the staff of the Bureau of Research Training and Dissemination, United States Office of Education, for their constant interest and cooperation. Dr. Lee Burchinal and Dr. Harold Haswell, Mr. Eugene Kennedy and Mr. James Eller have given us the benefit of their unique experience in dealing with problems of educational documentation.

We have gained valuable information from each of the persons we visited. It would be impossible to acknowledge individually the special contribution of each; the persons we have listed in Appendix A will however, recognize, as we do, their contributions.

Submitted to:

U.S. OFFICE OF EDUCATION
Department of Health, Education and Welfare
Washington, D. C.

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INFORMATION TRANSFER in EDUCATIONAL RESEARCH

The Short Report

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23 March 1966

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INFORMATION TRANSFER IN EDUCATIONAL RESEARCH

Few people will read the hundred-fifty page report of Contract OE-599-264, from which the few items in these pages were chosen. Only the persons who worked on the contract from start to finish will have read the additional hundreds of pages of technical notes and correspondence on which the report is based.

This accumulation of print, which inhibits rather than facilitates the transfer of information, is part of the problem we studied for the U. S. Office of Education.

USOE support of educational research will have increased one hundredfold in this decade.

The Office is presently creating an Educational Research Information Center (ERIC) and a supporting network of specialized information centers. ERIC is intended to make available the great volume of information flowing from educational research.

USOE directed Informatics to these questions:

What kinds of information do educational researchers and educators need?

How do they now obtain the needed information?

How can advanced technology improve the flow of research information?

How should ERIC evolve in order to use the technology effectively and economically?

The full report, Information Transfer in Educational Research treats in detail these and related questions.

During the study, we interviewed 154 people chosen from these groups:

a) University faculty with USOE research grants
b) Research staffs of state departments of education
c) USOE staff members
d) Information scientists and information system operators in government and private research organizations.

We deliberately avoided questionnaires, which would have answered only those questions which we had the foresight to pose. In semi-structured interviews, we uncovered major problems in information transfer which are not dealt with in existing systems. In some cases their solution will require unanticipated efforts on the part of ERIC; these efforts will complement rather than conflict with the work already done by USOE.

ERIC has chosen the following excellent options for handling documentary information:

a) The decision to make ERIC the coordinator of a decentralized network
b) The decision to create ERIC Clearinghouses in connection with research activity, rather than as mere archives
c) The subcontracting of secondary distribution.

The major problem we encountered was not a result of the "information explosion". It is not a problem awaiting computers and automation for its solution. It is the result of the accounting procedures which prevail in government research contracts.

Such contracts are seldom written to encourage exploitation of the large amount of previous work; they are written so that the researcher has a contractual obligation to add to the literature.

Among the researchers to whom we spoke, we found some who feel guilty when they take time to read, instead of doing work that will contribute to the final report — the item they have a contractual obligation to deliver.

At the time propqsals are submitted, the researcher implies that he has already laid out a course of action which will allow him to achieve his goal. He assumes that somehow he will get time to read. It is poor proposal writing to admit unfamiliarity with important literature extant at proposal writing time.

A major need for reading occurs soon after the research contract is received. Proposed promises of the work to be done suddenly seem shallow and uninformed to the researcher.

We urge the U. S. Office to change its research contract writing procedure so that the second four weeks of the contract be a time when information gathering is to be done as a direct charge. This is the period when material that could have been read years ago can now finally be absorbed.

The ERIC Centers form an integral part of this activity. These information centers can become the places where all the literature in a given area will have been read. A two or three day trip to such a center will allow the investigator to browse through the collection, and to obtain (though not necessarily heed) the opinion of the information men at the ERIC Center as to which reports are germane. The visit should be a funded part of each contract.

The visit to the information center serves a still more important purpose. Our study verified that those engaged in forefront research cannot wait for the published literature. Each investigator who visits the ERIC unit discloses the purpose and nature of his effort and has the opportunity to hear about related research in progress.

The problems of the state departments of education are very different from those of university researchers. University researchers accuse state department officials of not knowing what research is; the latter contend that the university researchers do not know what education is.

Research groups at the state departments are introspective. It is their task to know what is going on in their states. This is primarily a matter of statistical measurement, fiscal and student accounting. Research officers of the state departments are expected to know about research in their own states and about related developments elsewhere.

The information flow problem at the states is this: the states need aid in the dissemination of information.

ERIC's responsibility to make documentary information available is paralleled by the USOE Center for Educational Statistics' responsibility to make statistical data available.

The statistical data collected by the states is of great potential value to educational research. Much greater support must be given both to the Center for Statistics and to the respective state departments so that this great source of research data may be made available to the educational community. ERIC must enlarge its staff if the valuable information gathered by the states and coordinated by the Center for Statistics to be made available to the researchers who use the ERIC units.

QUALITY CONTROL

The present flow of information contains so much material that evaluation is more important than improved retrieval techniques. Many excellent reports go unread because the researcher has spent his always limited reading time in coping with the mass of literature — much of it consisting of poorly written reports of ill-conceived projects.

Periodical literature is subject to some measure of refereeship; report literature is almost entirely uncontrolled. Two types of evaluation are needed: one is to establish quality, the other is to ascertain type — such as review paper, forefront research paper, etc. Grading for quality control requires subject knowledge; this will require the staffing of ERIC units by subject experts respected by their colleagues. Quality control takes courage. Our cultural heritage makes us understandably afraid of literature suppression. But an unwillingness to evaluate is a very dangerous suppression; it results in a burial of information.

SELECTIVE DISSEMINATION

The essential purpose of an information system is to provide information

- To the person who needs it
- When he is ready to recognize the need.

We are a long way from being able to realize this goal.

Retrospective search during a visit to the ERIC unit is an example of the researcher recognizing the time of his need. The sending out of materials newly received at the ERIC units to those few who would be interested in just those reports is selective dissemination.

Fortunately, recent work, using computers, has shown that automatic selective dissemination can be provided. Interest profiles of the recipient are needed as well as subject profiles of the documents. A continuous useful matching of these profiles requires feedback from those served. We recommend a system where the following four types of feedback are received:

> Material sent was of sufficient interest to be read on day of receipt.
>
> Material sent is of interest and we intend to read it (this is the great bulk of material in everybody's office and is often unread).
>
> Material is of no interest; it was a waste of my time to open the envelope.
>
> This is the material I read that you didn't send me.

The first three items track the decline of previously known interests. The fourth item tracks the appearance of new interests. They all tend to prevent the flow of documents from becoming unmanageable or unpalatable.

Automatic selective dissemination works; the principal objection to it is its high cost. We urge the USOE to provide it.

ALMA MATERS FOR THE INVISIBLE COLLEGES:

Much of the communication among researchers takes place during the prepublication stage. Communication networks in the form of informal grapevines are created to circumvent the usual two-year delay between the inception of work and its formal publication. The groups thus formed have been labeled "Invisible Colleges."

We contend that the ERIC units should become the home of these groups.

As such, the ERIC units would facilitate information exchange by being a listening post, by holding very limited-attendance symposia, and by being the "registrar" for new members.

Serving these cliques will allow ERIC to acquire information needed by the rest of the world without hampering the operation of these informal groups.

RESEARCH IN PROGRESS:

National Science Foundation has demonstrated the usefulness of a research-in-progress bulletin. Such a bulletin describes the work of a research group prior to the issuance of its report literature.

The ERIC units, as a consequence of aggressive information acquisition, as a result of being visited at the beginning of new grants and of being the Alma Maters of the invisible colleges, are best equipped to provide proper reporting for a similar publication in educational research. The individual entries should include:

- Group identification
- Problem statement
- Major hypotheses
- Methodology
- Expected major findings.

ERIC units should issue the reports singly as they become available. USOE should issue annual edited cumulations.

AUDIOVISUAL MATERIALS:

In addition to print, the ERIC units should collect and evaluate audiovisual material. Critical reviews are even more important with film, since the material is not easily scanned. Those portions of research results which can only be presented effectively by non-print methods should not be slighted because of the bias towards report literature.

SIZE OF REPORTS:

Our study has shown us that long reports tend not to be read. The above is our short report; it contains almost none of our individual field observations and only a few of our thirty-seven recommendations.

The full report is available upon request.

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PART 1

TR-66-15-2

DISSEMINATION OF INFORMATION

Section 1

The Problem

Informatics was charged with three major tasks in the study that it performed for the U. S. Office of Education. The first of these was to determine the present information needs among a particular community concerned with educational research. The second was to identify the technology available to satisfy these needs in the 1969 era. The third task was to plan an orderly transition from the initial ERIC posture to one which would both satisfy the needs of the user community and economically use the most effective technology available.

Section 2

Survey Procedure

Two procedures were available to Informatics in its effort to discover current needs and practices of information transfer in the community. One technique, which would have allowed us to sample a large population, would have consisted of the mailing of questionnaires. This has been done in the past with varying degrees of success. We chose instead to use the informal semi-structured interview. We felt that in interviewing this particular community, the first things that we had to uncover were not answers, but questions. We were apprehensive that merely submitting questionnaires would only result in giving us answers to questions whose answers we already suspected. Thus, our visits and trips were scheduled to allow each interview to have an effect on the succeeding one.

Prior to our first series of interviews, we defined a tentative interview technique, to serve as a very flexible guide. The following is adapted from our notes at that time.

Upon meeting the interviewee, we would explain the purpose of our visit: to wit, the OE has set up ERIC to serve both the needs of its own staff and the information needs of the educational community at large. Informatics has been employed to assist ERIC in assessing the information needs of that community and in employing in the most effective way the rapidly growing technology of information handling. In cases where the persons we were interviewing did not know of the work ERIC has already done in providing abstracts and fiche, or in identifying centers of specialized information, we felt that it would be necessary to explain this.

Then, we would attempt to find out what we could about the questions outlined below. Bear in mind that we did not conduct a formal questioning session, so the questions below were not asked as baldly as they look on paper.

a) What kind of work are you doing? (Example: administration of research, research work itself, administering a school or school district, teaching in an experimental program, etc.)

b) What are your information needs?

c) How do you now meet these needs?

	Formal Channels	Informal
1) Printed materials, primary publications	books journals reports correspondence	preprints correspondence
Printed materials, secondary publications	abstracts indexes	reprints
2) Non-printed channels, like meetings, symposia, classes, etc.	formal papers seminars	author sessions informal discussion at meetings
3) Special services	libraries special information centers general information centers (like the Clearinghouse for Federal Scientific and Technical Information CFSTI)	

d) How much time do you spend on information problems?

e) Do you have information specialists (librarians, searchers, bibliographic aides, etc.) working with you?

f) What factors do you think affect your use/nonuse of the facilities like libraries, or tools like abstracts? Example: proximity, type of problem, etc.)

g) At what point in the research process do you do the information gathering? Are there different kinds of information gathering done at different times?

h) What is the relative value to you of current awareness versus retrospective search services?

i) To what extent do you rely on your own private files (or those of a small department or section over which you have control) for information needs? What services would enhance the value of these small files?

j) How do you see ERIC serving your needs?

1) To what extent should it try to centralize information and what kinds of information?

2) To what extent should it be essentially a referral agent or "switching mechanism?"

3) What should be the extent of its publishing services re abstracts, indexes? In what forms should these publications be cast in order to best serve your needs? Examples: State-of-the-art reports, demand bibliographies, etc., their scope and arrangement.

4) To what extent should ERIC attempt to provide specific information as differentiated from documents or referrals?

5) Should it attempt to provide assistance in the precataloging of materials in ways which would be used by other information centers — its satellites, for example?

6) How useful would be a system of "visiting information men," such as a specialist on information sources who would work at the early stages of research to put researchers in contact with others in other locations doing work in adjacent fields; or a technical editor who would assist in preparing input format for publications to come out of a contract; or a cleanup editor who, in addition to seeing that ensuing publications fit into the overall system in an optimal way, would also help prepare for capturing data not included in the final report but which the researcher thinks is of potential value to Office of Education or to other researchers?

7) Is it better to bring the "library" to the researcher, or the reverse? For example, would it be useful to assign a researcher on contract to do a stint of information gathering at the specialized centers which will be established or enhanced through cooperation in the ERIC system?

8) What are the problems of staffing such centers? How can staff be trained? What kind of persons can do the information work best and with what kind of training? Who should do the training?

9) How useful is the Selective Dissemination concept in education?

We started, of course, with a set of beliefs and prejudices. This formed the basis for the initial set of questions asked at the first installation. The absence of an interview form helped to quickly eradicate any sense of constraint among those whom we interviewed. Before an interview was more than one-quarter finished, a dialogue had started which enabled us to uncover unanticipated ideas, needs and demands. These new ideas then were added to or replaced some of the earlier questions so that in later interviews we were able to test whether we had come upon an isolated need of one researcher or whether we had uncovered a main stream in the education community.

By the end of our visits we had reached the point where we were testing ideas culled from earlier interviews, rather than merely those prominent in our initial set of assumptions. In general, the last group of interviews consisted of corroboration of ideas received earlier.

The personal interview technique limited the number of places visited. We do not claim any precisely measured statistical distribution. We did try, however, to avoid jumping to conclusions based upon interviews limited to only one part of the country or one type of audience. We visited groups in the North, South, West, and Midwest. We visited large universities and small colleges, as well as state departments of education as disparate in size as those of New York and Wyoming. We consulted groups with research support of one-half million dollars per year, and individuals whose support is only a few thousand dollars. In every way we tried to make sure that the survey covered the whole community rather than just a prestigious or expensive part of the community.

In all, we visited 22 states, 52 institutions, and spoke to 126 individuals.

Four types of populations were visited. These were:

a) University groups doing research in the field of education.

b) State departments of education and large city departments.

c) The U. S. Office of Education.

d) Information scientists-researchers and information system operators, in relevant areas.

Section 3

Information Needs and Patterns of Use

The need for educational research information is great and diverse. There are many kinds of information, and many kinds of need.

The potential users of ERIC services include:

a) Administrators
b) Teachers
c) Researchers
d) Other Government agencies
e) The public and its representatives
f) The mass media of communication

Users in categories d through f generally receive the needed information from people involved in a through c. Concentrating then on a through c, we find a spectrum of kinds of use, user, and needed format.

At one end of the spectrum is the administrator. His information needs are best exemplified by the public information officer (PIO) in a school system, who needs general descriptive materials to answer the bulk of requests put to him by the public, the lawmakers, and others. He has certain specific needs for highly detailed research information from time to time, but generally he is in no position to dig deeply into the literature, so at those times he needs to have a great deal of work done for him in the preparation of information.

The need for research materials by teachers (independently of their own research) will be largely for state-of-the-art summaries rather than detailed literature coverage.

The researcher on the other hand, will want some of the materials of value to the administrators and teachers, but in certain areas will also want full coverage of the literature, not only in terms of bibliographic coverage, but the availability of the original research reports themselves.

	Administrator PIO	Teacher	Researcher
Reason	Demands by public, news media, lawmakers, etc.	Needs information to help administer and implement programs.	Needs to know what is being done and by whom, to avoid duplication, make best use of time and effort. Incorporates ideas of others in his research.
Kind of Information	"Packets" of accurate, timely information on specific subjects, in good journalistic style easily assimilated.	Operational type information — professional rather than technical	Detailed research reports and data on some fields, general information on others.
Urgency and Reasons for Urgency	Matter of hours or minutes when political and fiscal events depend on being able to issue proper statements. Otherwise can tolerate some delay.	Rather urgent as result of needing to actually do the work.	Often felt as very urgent. Two weeks is too long.

Figure 3-1. Spectrum of Information Needs

The Administrator: Example – the PIO

The Public Information Officer as such is not often found at present in the educational field. In most state departments of education this function is served by the Director of Research who sometimes spends much more time in communicating than in research or research administration. Further, in many states, funds for research in education have been very limited, and the Director of Research has performed primarily statistical data collection and analysis. In some cases, true research in education in state departments has probably been non-existent until federal aid was made available.

Whatever his degree of involvement in research, the State Director of Research is the person to whom the lawmakers and their researchers turn for answers to a wide range of questions on education generally, on education in their own states particularly, and especially on matters of finance and distribution of educational funds.

It is to this person that many researchers turn when they need data to support their research efforts, but his capacity to respond is severely limited by inadequate staff size.

The large bodies of statistical data kept by most state departments of education are potentially very useful sources of research data. At present this material is not fully exploited for research, for several reasons:

a) Each state chooses for itself what statistics to collect.

b) There is little commonality in format and methodology.

c) Research sections at state level have little or no staff to service such requests.

d) Standard data processing programs are needed to make efficient use of data processing equipment where it is available

The Teacher QUA Teacher

The Teacher has need for general awareness of the developments in educational research; this need would best be served by adequate critical state-of-the-art summaries. He needs, of course, full text and search tools in his own area of specialization.

In addition, from time to time, he will be involved in experimental or developmental programs. On these he will need and presumably want the full text literature to be available to him.

He will need articles of generalized nature on a wide variety of subjects.

High level journalistic type format is appropriate for many of the teacher's needs, as for many of the PIO's needs.

He will at times need highly detailed technical articles pertaining to such things as a new methodology which he is using or evaluating for use in his classes.

The Researcher

The greatest variety of use patterns is to be found among researchers, and while this study has identified some gross characteristics, there is a need for extensive controlled studies before we will approach any scientific laws of use. In this respect, educational research is no different from research in the "natural" sciences, where large efforts are now being expended to evaluate the true relevance of the established media of information transfer.

Time Delay

Among those we interviewed, we found wide variance in willingness to wait for information. The university researchers appear, in general, to be far less patient with delays in obtaining information than do the people at the state departments of education. Many university researchers felt that a week's delay in obtaining research information negates the usefulness of the material. Indeed, most researchers indicated that promptness is of such importance that the formal literature cannot satisfy their needs — that they had to rely more on the grapevine — the "invisible colleges" as Derek Price called them.

Impatience for information finds a constructive outlet in the invisible colleges. This was demonstrated to us by the number of times that interviews were interrupted by telephone calls (often long distance) from colleagues who needed information.

The tolerance with which one can wait for information is generally greater in the state departments of education than at the university level. The research groups at the state departments of education seem to be burdened with such a large number of tasks that it is perfectly normal to go on to other bits of work while waiting for information. The exceptions to this generally arise in connection with their responsibilities to the legislature and to other government agencies. They are frequently pressed for exact information on a myriad of subjects, (perhaps most often related to fiscal and student accounting). The pressure here is a result of the fact that this is information for decision making.

Among both groups, it appears that the tests of an effective information system are:

- speed of response
- relevance of material delivered (both in subject and form)
- economy of operation.

To Sum Up :

We have identified three direct and three indirect users of educational research materials. We have concentrated on the direct users, namely:

The Administrator
The Teacher
The Researcher

Obviously, a person may combine these activities and their characteristic information use patterns.

Any system of information transfer which truly serves the wide range of researchers in the most effective way will also serve the other two groups. The reason for this is that researchers' information use patterns vary so widely as to include in some cases, patterns identical to the administrators and teachers. The emphasis will surely vary.

The researcher in a specialized field will not require a general and journalistic account of his own specialty but, outside of it, he is quite likely to have needs similar to the other groups.

The need therefore, is for a system which will serve directly at least these three general groups and the other groups indirectly. The service must be able to provide both bibliographic data and documents, but it must also provide substantive information, as distinguished from documents.

Reading Patterns

In one of the earliest visits we received an important clue from a well-read and highly enlightened principal investigator. He pointed to the soft leather chair in his office, commented on how excellent it would be for reading and then he observed that it doesn't get used. The man complained that he felt guilty when reading instead of carrying on the project work. He noted that when his assistants read he had to suppress the feeling that they were wasting time. This attitude, though not universal among the groups visited, was fairly common. Though there were principal investigators who spent much of their time keeping up with the literature in their field, there were others who spent almost no time in this activity. Attitudes toward reading differed violently. Our initial informant was almost apologetic about his attitude. Another informant was quite brutal; it was his opinion that "Big readers don't accomplish much — they are merely the characters who go over big at the cocktail parties." This wasn't the bitter lament of a loser. The man was a successful researcher. Most researchers found that most of the reading time in a project was assigned to the graduate students rather than being done by the principal investigators. The principal investigator collected his information from informal sources. Graduate students and research assistants were assigned the lesser task of being alert to the literature.

The lack of use of the literature was highlighted on our visit to the depository of the State Library in Sacramento, California. There we discovered that most of the cooperative research reports deposited by the U.S. Office of Education had been off the shelves only for cataloging. Though it is true that the more logical place for researchers and students to have attacked the literature would be at the two major branches of the University of California, one would have expected a greater use of this particular depository.

The library most often used by the busy researcher was his own collection. The main library was more likely to be used by the student population.

Size and Format of Reports

The major problem with many reports arises from a laudable effort to present all the facts. This may stem from a desire to give value in pages for dollars spent, but also from the tradition that enough data, methodology, and hypotheses must be presented so that an independent researcher can duplicate the experiment. Unfortunately this type of heavy report does not easily get read, and abstracts and title listings hardly do justice to the topic. Thus there seems to be a great need for the short report – the 20-page reduction of the 250-page document. Groups like the New York City Board of Education, whose very functioning depends upon their public image, have adopted the practice of turning out both reports.

The small report does not merely point to the larger one, in the manner of the "executive summary" found in some magazines. Such summaries are often so simplified as to be insulting. Rather there is need for a short report form of real use to the fellow researcher who is not concerned with duplicating the experiment, but needs more than an abstract.

Another need is for a kind of high-level journalism which brings the most significant facts of the research effort into non-technical form, both informative and attractive.

We saw several examples of this on our visits. One, produced by the Division of Surveys and Field Services of George Peabody College, is based on a survey report on the Duval County schools.

The survey report is itself attractively printed, and its completeness is appropriate for the researcher or student of the problem. Its size, format and cost would make it inappropriate for general distribution.

Recognizing the importance of public awareness, the Division has drawn highlights from the full report, and has produced an illustrated booklet of 56 pages.

The other appears in the Alumni Bulletin of the University of Illinois College of Education (May 1965).

It is a highly interesting journalistic account of the SOCRATES technique of programmed instruction.

We were told by many researchers and administrators that they consider it necessary to devise dramatically better ways to bring to the general public the meaning of research in education and the resulting developments in the educational system.

Quality Control

One of the most frequently mentioned demands on the part of the research community was a demand for a thinning of the literature that was presented to them. This demand stemmed from a fear of over-dissemination. The demand took various forms. The most violent form called for a suppression of the literature before publication, the most gentle called for a review score to be attached to each piece of literature.

Our informants several times referred to the need for literature "birth control" or "euthanasia", an analogy posed as early as 1947 by a geneticist,* who, after demonstrating the baleful effects of book "over-population" urged that"...we must conceive of the library as a dynamic circulatory system, through which books pass on their way from the publisher to the incinerator."

In our interviews, we often heard the claim that evaluation of research results is more important than dissemination of the initial papers. Different techniques were proposed for the evaluation. Certain techniques called for review articles; other techniques demanded an actual scoring of the material in much the same way that movies are reviewed by the New York Daily News, i.e., anywhere from zero to four stars (****) being assigned to a paper. One variant of this technique called for three different scores to be assigned to the paper — one given by the author, the second by the sponsor and the third by an independent reviewer.

Other techniques of evaluation recognized that there are different types of quality; that the encyclopedic report may be junk to the well-seasoned researcher in the field, but may be just the type of material

*Garrett Hardin — "The Doctrine of Sufferance in the Library." College and Research Libraries, April 1947.

that is needed by someone first entering the field. Recognition is also given to the fact that quality is not a constant attribute of an article. Some reports are of exceedingly high interest when they are fresh and of almost no interest after they've reached a certain age. This type of quality labeling can be useful both to the man trying to retain current awareness in his field and to the new entrant into the field.

The large number of reports that give no new significant information clutter up the file. It is these reports that are mainly responsible for the demand for "book-burning". All such demands were usually tempered by the fear of the charges involved in literature destruction. These fears centered around:

a) How do you really know this is junk?
b) Who is to be given this terrible responsibility?

Thus people felt more at ease with an evaluation of the material than with the destruction of it.

Several researchers indicated that they would favor an approach like the one used in Buros, Mental Measurements Yearbook, which brings together current information, but also has several evaluative articles on particular areas of research. These are written independently by experts, and it is felt that this fact has a salutary effect on review writing.

Need for Data

Quite often the type of material required is not so much that which appears in journal publications as it is the actual data collected in the course of the research. Many groups that we visited had large collections of data that had been acquired on previous contracts. This data often formed a corpus for future research. By now, however, it had become evident in many cases that there would never be time for the people who had collected it to ever work with it. At this point, most researchers seemed more willing to make the data available to others who would have use for it. Unfortunately the availability of such data seldom came to the attention of those who needed it until after they had duplicated it.

The other type of data, which seemed badly needed by some of the research community, was the data collected in the field by the school systems. As yet, there was no effective way for this statistical type of data to flow to the research community. Although this information is currently gathered by the U. S. Office, there was no convenient way of retrieving it at the time this study was made.

Microform

We questioned most of the groups about their use of microform. This question was of much importance to us. The U. S. Office had already determined to use microfiche as one of its major modes of dissemination. Some of the interviewees were delighted with the space compression that can be achieved by microfiche. In general, however, their experience with attempting to read microform had been so frustrating as to raise serious questions about the usefulness of any material disseminated in such a manner.

It should be noted that many researchers used microfilm years ago, at a time when standards were comparatively low. Many to whom we spoke have not used any microform in recent years and some were not aware of microfiche.

It is extremely important for the U.S. Office to establish feedback procedures. The use of microfiche is dictated by the desire for economy in both distribution and storage. If achieved at the price of the material not being read, it will be false economy.

Use of Military Document Literature

Some of our informants felt that much literature which came out as a result of research supported by military and space agencies has substantial usefulness to the educational researcher. In one conference, great chagrin was expressed at the amount of this literature which is classified, which researchers felt had no business being so.

In one instance, the charge was made outright that security classification appears to be used deliberately to restrict publicity about contract opportunities. Others are less sure that it is deliberate, but are nonetheless unhappy, and urge that ERIC act as a liaison between DoD and the civilian educational researchers to review the classified literature, and obtain faster downgrading where it is called for.

Use of Other Government Documents

In education, as in nearly every other field, the product line of U.S. Government Printing Office is very great. Its service is slow and its marketing efforts almost non-existent. While it is outside the scope of ERIC to remedy this, it might be possible to provide liaison

for the research community, obtaining faster services from GPO as well as directly from originating agencies.

TV, Video Tape

Closed-circuit TV and video tape are used to a degree in the communication of scientific-technical information. Notable efforts have been made in programs for continuing education for medical practitioners.

The technical content in such efforts is presumably not new findings in research, but rather newly proven accepted technique. This can be characterized as "professional" rather than research information. We have not found these techniques being used this way for professional needs of the educators. The possibilities are numerous and promising, especially in a period of vast expansion in program implementation which requires a great deal of transfer of professional information.

Further, the technique of closed-circuit TV conference has many of the desirable features of informal personal communication.

The Consultant as Communicator

In a number of research centers and departments of education, we were told of the value of consultants in the information transfer process. These organizations had had experience in the use of consultants; in one instance our informant had served in this capacity for the department of education in a large eastern seaboard state.

The principle value of using consultants seems to be that they can put people in touch with current and recent developments in a way that seems to surpass any other. They pick up information in the process of giving information. Depending on the receptiveness of the group and the ability and willingness of the consultant to project, he is able to infuse ideas with life in a way that the printed word can seldom do. In visting the many centers of research and school systems, we sensed the fact that on a single campus or in a single city there are people who have common or at least contiguous areas of research interest who are not in effective communication with one another. In some instances, the presence of an outsider seeking information on dissemination of research information brought together people from the fields of education, journalism, psychology, linguistics, and the mass media, in what we believe was a mutually useful focus of interests.

Our conversations lead us to believe that, already on a small scale, a significant transfer of ideas occurs in the field of education through the use of the itinerant consultant.

Section 4

Communication Lines

It was initially expected that the communities identified would have the following characteristics: that the universities would be creators of a research product; that the state departments of education would be primarily concerned with the consumption of this product; and that the U. S. Office of Education's main concern would be with the management of research.

These ideas were to disappear during the course of the study. The expected complementarity between universities and state departments of education did not materialize. Though the universities were engaged in research by the operational definition assumed by the project, i.e., that research in education was any project labeled "research" and supported by the U. S. Office of Education, there was a tremendous skepticism in most of the state departments as to whether the groups at the universities had the least bit of concern with the problems that state department people knew to be the problems of education. A similar antipathy existed in the universities where there was often a doubt as to whether there really is a research group in any state department of education.

Certainly both statements are hyperboles, but elements of truth exist in each, as a result of each group's definition of the word "research." Though some of the state departments are concerned with research in the very same way that the universities are, most of the former's research groups are concerned with the very introspective problem of understanding conditions in their own states. Their function is to do the research that enables them to understand their own school circumstances and to respond to the demands placed upon them by

their commissioners. The research groups at the universities are not so much concerned with what the current situation is, as with the implications of experiments. In general, there seemed to be comparatively poor communication between the state departments and the universities. Of course, there were exceptions.

The principal lines of communication for the researcher are those with his fellow researchers and with the experimental schools with which they deal.

The major communication for the state departments is the flow of statistical data from individual schools.

The natural point of contact in the U. S. Office of Education is different for each of these groups.

Not surprisingly, the state departments appear to concentrate their efforts on liaison with the USOE's statistically-oriented people. University researchers on the other hand concentrate on contacts with persons in USOE who are empowered to award contracts for research in the university's field of subject interest.

Section 5

Contract Research and Information Needs

A major portion of the community to whom this study was directed was primarily project oriented. In this community there are three specific times when a large amount of information is needed from the outside world. These times are:

a) At the proposal writing stage.
b) During the very beginning of the project.
c) At the time of writing the final report.

The motivations for reading during each period is dramatically different. At the proposal writing stage, it is necessary to uncover information which will keep one from submitting proposals aimed at duplicating work already performed elsewhere. In connection with this, there is a need for awareness of contract awards to groups whose interests are similar, and a need for rapid notification of final publications that result from these contracts.

Also, at proposal writing time, there is need for information which will aid the researcher in defining the subject profile of the work.

This profile, contained explicitly or implicitly in the proposal, can be used to create a bibliography of value to the researcher upon award of the contract. It could also be of use to an unsuccessful bidder in determining wherein his proposal was inadequate. It would appear likely that this feedback would help raise the general quality of proposal effort, while saving time lost on unsuccessful proposals.

The reading at the beginning of the project is concerned with finding information which will allow the project to be conducted in a manner as informed and as intelligent as initially promised by the proposal.

The reading at final report time is concerned with discovering whether any of the conclusions reported on were already deduced by earlier research teams. This last bit of reading could not have been done easily at an earlier stage, since the conclusions would not have been well enough identified to have been sought.

There is occasional pressure for reading in the middle of the project when new ideas are uncovered. In general, however, the pressure experienced by the project manager throughout the whole project is to deliver a product whose method of creation has already been outlined in the proposal. Indeed, a strain exists between the scholarly instinct to be completely informed and the managerial instinct to waste little time on items which do not have a high probability of contributing to the final report. One almost has a feeling that what is needed is not so much a list of what is to be read, as a list of what would be a waste of time to read. The present large amount of literature leaves the conscientious scholar in a position of having missed pertinent documents, not because he is lazy, but because he wastes time on those which have little of significance to contribute.

In performing under contract, both state department and university research groups experience hidden or unpredicted costs connected with information: the states primarily in collection and dissemination, the university researchers in acquisition and assimilation of the information.

Some research grants from USOE are too small to allow any time for problem re-definition, and in such cases the grantee does most of the reading prior to the award.

We have been impressed by the effect that the accounting system has on the information habits of the research groups. Since information gathering and handling is seldom a direct charge in a research

project, there is a strong tendency on the part of many project managers to slight information activities which might not contribute directly to the final report. On the other hand, the writing of the final report is a direct charge in almost all of the contracts. Thus, all groups devoted a great deal of effort to fulfilling this contractural obligation.

A similar situation existed until a few years ago in contracts let by the Department of Defense. As a result of congressional concern with the handling of information resources, DoD now requires routinely the identification of costs for information searching, and maintenance of information services as a direct charge.

The amount of reading a researcher does appears to be significantly related to the size of the school with which he is associated. In the large, well-known university departments, researchers supplement their reading by fairly heavy reliance on the invisible college. In some of the smaller schools, we found a great reliance on the literature, with researchers spending as much as 45 hours per week keeping up with the literature. At these schools, secondary publications (abstracts, indexes, bibliographies, etc.) were utilized fully, as were reviews of current research.

In general, researchers at small schools use the literature rather than availing themselves of the "invisible colleges." Since their contracts were smaller, one is tempted to conclude that the present system provides information to the winners and not to the losers. If one defines being a winner by either the measure of size of the contract or by virtue of being a member of an invisible college, one finds that the problem for researchers at less prestigious schools is to become a member of one of these informal dissemination groups.

Section 6

Personnel for Information Dissemination

As in other subject areas, so also in education there is a decided shortage of information personnel. We believe that much information work, especially in the documentation of research, is being duplicated because there is no real coordination of such efforts.

Cooperation in Making Best Use of Personnel

The persons we consulted appear to be overwhelmingly in favor of more cooperative processing of research literature. No one wants to duplicate functions unnecessarily. To be sure, there is some concern about letting go of functions and of data bases. A small number of informants have expressed apprehension about giving too strong a hand to any one group, as for example, to a regional ERIC. But even these persons were strongly in favor of a program to assure proper documentation and dissemination without the present unnecessary duplications.

Types of Information Personnel

The following types of skills are at present used in documentation and dissemination of research:

- Abstractors
- Bibliographers
- Data Processing Operators
- Editors
- Librarians
- Literature Analysts
- Literature Searchers
- Research Assistants
- Statistical Analysts
- Systems Analysts
- Translators

It has become apparent that there is a need for several kinds of communicators – skilled in both the written and non-written modes.

One of these is the person who can upon request take a body of technical literature, ferret out the needed information and present it in a form useful to the person who needs it. In some applications, this person will need deep subject background in addition to writing skills. In other instances, what is called for is a high level of journalistic effort.

We have sought and received many suggestions as to how to staff information functions in the field of education. For the long term need, it is apparent that the educational community needs to cooperate with schools of modern language, mathematics, journalism and librarianship to begin creating the cadre having subject knowledge and communication skills that will be needed.

This could be done in a number of ways, including:

a) Cooperative programs among departments in colleges and among colleges.

b) Graduate internships and fellowships.

c) Special institutes for continuing professional development.

The last named is especially recommended in terms of short-term needs for information personnel, in view of these facts:

a) Many educational information operations are going to expand rapidly as a result of federal aid to education. Their personnel requirements will rise in a period when there is already a severe shortage of trained information personnel.

b) Rapid changes in information technology are rendering obsolete many techniques now being used; information technicians need constant updating of their skills.

c) The quality of service rendered by ERIC units and cooperating agencies will depend greatly on the skills of their operators and users. There is need for a combination of subject knowledge and technical knowledge relating to techniques of information handling.

In our visits, we described the information technology being used and planned at ERIC. In many instances we were asked for further information relating to the state of information technology. The extent of interest in information technology among the researchers we contacted leads us to the conviction that there is need for a continuing program of education in this area, for the researchers who will use the information system as well as for its operators.

We found on some campuses people who have both interest and competence in the various subject areas mentioned above, but they, being spread out among various departments, and being totally engrossed in their own research and teaching, had not been aware of each others' interest in the overall development of information science and technology. We believe that the proper catalyst could draw these people together to provide for research in yet unsolved problems of information transfer in education, and to teach the cadre of information personnel which will be needed.

Section 7

Needs Specific To State Departments of Education Research

The research operations in the state departments of education differed dramatically from the research groups at the universities. The obligations placed upon these groups by the organizations that support them are almost totally different. Where the university research groups have a responsibility to derive new knowledge, the state departments have a responsibility to be alert to all knowledge within a particular area. Monies are given to state departments to be alert to what is happening within the state. Money is not necessarily given to the state departments to disseminate this information.

The university, by contrast, is not generally supported specifically to obtain overall information about a given school system,* but is supported in disseminating the results of its own research.

In reality most of the state departments of education performed the function of being information men to the commissioners of education and to the state legislatures. It is not their function to experiment; it is their function to be knowledgeable.

Indeed, the difference in function between research groups of the state departments and the research community in the universities is such that on several occasions we were told by university researchers that there is no such thing as research in state departments of education. We were also told by some research persons in state departments that the universities do not have any idea what education is.

*Exceptions are found in cases where school districts or states contract with university research departments for specific studies of school systems.

The state research groups need statistical information. They generally have provided techniques for supplying this information from their respective states. They are working with the U. S. Office in an attempt to create an overall system so that information is available to all the states. At the time of the survey such a system had not as yet been implemented.

The one large city department of education research group that was visited formed a contrast to both the states and to the universities. Here the major concern seemed to be with neither research nor statistics, but with the evaluation of programs already deemed worthy enough to be implemented on a pilot basis within the school system. Dissemination was excellent within the school system itself.

Dissemination

Dissemination of research information to the local school districts will be one of the main problems that must be solved by the U.S. Office. Dissemination to the state departments of education and their further dissemination to the local schools seems like the natural hierarchal flow. Unfortunately, we were unable to find any assurance that research information would flow from the states to the local schools. Certain states are already equipped to facilitate such a flow of information; others are aggressively setting out to become so, but are held back by severe budgetary limitations. Indeed some state research groups consider this dissemination one of their main functions, and have begun with research bulletins concerning work done within the state. Other states, however, are not organized to disseminate the research information to their school districts and information sent through their state departments of education runs the risk of being relegated to the shelves. Bypassing the state departments to avoid this difficulty would offend political sensibilities. Dissemination of research information to the individual school districts will probably require federal funding to enable the state departments of education to perform the job.

None of the above considerations takes into account the need of the non-public schools for information. Presumably our traditional separation of the church and state has been effective in making for very weak lines of communication between the state departments of education and the private school system.

Selective Dissemination

We found at the state departments of education the same enthusiasm for selective dissemination shown by university groups. Selective dissemination for the states will be more difficult, however, because their range of information needs is broader, while the amount of time for satisfying those needs is not as large.

ERIC Units

Research persons at the state departments expressed a great deal of enthusiasm about the concept of ERIC units, and look to the establishment of such units as a means by which they may obtain needed information services. We came away with the impression that the state departments would be able to work more productively with ERIC units than with university research groups directly.

Computer Needs

Many of the state departments of education are obtaining computers. The needs of these states are quite similar. The cost of providing programming for these computers is both time consuming and expensive. Cooperative programs are needed to allow the state departments to exchange either computer programs or the information which would allow these programs to be recreated with less time and money expended.

Section 8

Regional Emphases

While our samples make generalizations dangerous, we wish to note two apparent regional emphases.

In the Northwest, we found especially strong interest in communication among educators and researchers. Aware, as are others, that the research literature is not read, they are concerned with more effective transmission of important conclusions. They emphasized the need for studies in the technique of holding conferences. (Other groups had emphasized use of radio and closed circuit TV for research uses generally.) While recognizing that people-to-people communication is more effective for many uses than the printed word, they were dismayed by its slowness and expense.

We found an equally striking concern with dissemination amon, educators and researchers in the South. The difference is that their concern emphasizes strongly the need to convey information about education to the populace at large.

They are keenly aware that unless they are able to enlist the interest and understanding of the populace at large, they will be unable to raise the standards of their school systems.

The educator and educational administrator wish to convey information flowing from educational research and from developmental programs. The problem is that their time and resources are extremely limited, and it is both time consuming and expensive to translate research documents into media effective in communicating to the lay audience.

Section 9

Current USCE Information Needs

The United States Office of Education is of course one of the main users of recorded information, for purposes of its own research, as well as for decision making, especially in the award and administration of research contracts. The important difference is that information flows with relative ease to USOE, since groups seeking support are anxious to apprise the office of their past efforts and the expected results of present work. In addition, people at USOE can supplement this with information from the files of the Science Information Exchange, the National Referral Center and other government information agencies.

With special regard to the award and administration of research contracts, the time of most need for information in the USOE would appear to be when proposals have to be evaluated. These are done with the aid of outside committees who have the responsibility for advising the office and these have need for research literature which affects whether the proposal should be granted.

As with other groups, USOE staff members do not have enough time to read all pertinent materials. Selective dissemination is as much a requirement at the U. S. Office as it is anywhere else.

For example, USOE personnel have a far greater need than do university researches for publications of the federal government itself, such as congressional hearings, laws, etc.

Within the District, there is of course no shortage of libraries and information resources. Serious inconvenience is caused by dispersion of USOE personnel in a number of locations, which makes impossible the best use of library facilities. One researcher and several administrators to whom we talked indicated that they would make for more frequent use of the HEW library except that it is some blocks away, and telephone contact does not really suffice. Rather than take frequent time-consuming trips to the library, they often do without the information.

Such dispersion is not easily overcome, especially in periods of great expansion.

Further, the people in the USOE are on the firing line, subject to many interruptions and frequent calls for information from all quarters. Their use of formal channels of information, such as the HEW Library, is at the mercy of such time pressures.

Just as researchers and state department of education officials need information gathering and analysis assistance, so also do the members of the USOE staff.

We suggested for the ERIC units a system similar to that of the Supreme Court.

The Supreme Court Justices are aided by the brightest graduates from the law schools, who rightly look upon their limited term appointments as law clerks as a great honor and opportunity. So too, the ERIC units and Central ERIC should be served by people who, upon gaining their graduate degrees, are given appointments to the information staff. In the ERIC units these graduates will be under the supervision of the advanced subject specialists in charge. At USOE, they could be supervised by Central ERIC, and could serve the information needs of all USOE, through use of the ERIC central files, contact with ERIC units, and also through the many other information resources available.

Because of the unique responsibilities of the USOE for the development of national educational resources, we must expect its information needs to grow commensurately with the increase in the educational system.

Section 10

Use of Libraries

We found among our informants very few who use libraries much in person, though some use library services through student assistants. Reasons most frequently given were:

a) By the time the information is published, it is "old hat."

b) It takes too long to get anything if you get it through the library.

c) Library is not attuned to needs of researcher; librarians are not subject-knowledgeable.

d) Library policies cause excessive inconvenience.

e) The library does not provide for subject approach in sufficient depth.

f) The library is inconveniently located, or its hours do not coincide with the times when the potential user is able to use its facilities.

g) The arrangement (classification scheme) of the library is inconvenient. (Some go so far as to say "incomprehensible.")

Not surprisingly, use of libraries for browsing was found to be quite dependent on physical proximity.

Certain researchers were heavy users of the library. These were people who had learned to trust the library services that most librarians are both trained to give and eager to supply. In general, though, it was the graduate students who rely on the technical literature while the principal researcher is supplied much of his information through the informal sources. Thus, the graduate students became very important information men in the research projects. Indeed, a definition of "old fogey" appeared. The "old fogey" among researchers was a man who at one time knew the literature very well. He presumably had mastered

it during his graduate student days and his early years as a researcher. As he began aggressively to pursue his own field of research, his reading dimished and his lab work and informal contacts increased. Eventually he reached the stage where the literature that he quoted was two generations behind that quoted by his graduate students. At this point, he had become an "old fogey."

The hopefully symbiotic relationship between researcher and his graduate students may have the overall effect of successfully blending formal (especially written) modes with informal.

Section 11

Personal and Project Libraries

The "library" of real use is the one in the office of the user. Many researchers have elaborate filing systems for papers and abstracts. The materials they use are the ones they personally collect. It is quite conceivable that the major contribution that could be offered would be a means by which these personal or project libraries could be maintained in a more effective and less time-consuming way.

Some researchers reported that they had underestimated the amount of cost for acquiring books and other literature, with two results:

a) They were unable to secure all the materials they felt should have been obtained;

b) They transferred funds from labor charges to pay for books.

Section 12

Information Centers

One of the most urgent needs that was expressed during the course of the studies is for informal communication. Many times researchers are in a position where they need to discuss their problems with someone knowledgeable with the field and its literature. A simple document retrieval system fails to provide this. A library system staffed by the non-subject oriented librarian type fails to provide the researcher with someone whom he trusts in his own subject area. Thus the concept that evolved during our visit was that of an information exchange center rather than a document center. This image in its final form took the appearance of something which could be called an "alma mater for the invisible college".

The center would be staffed by people who would be completely knowledgeable in the literature of its field as a result of their involvement in its abstracting and indexing. The center, being associated with one of the more important research groups, would also bring to its documentary task subject knowledge. As each researcher visited the center he would have the following advantages: he would be able to discuss the literature with a colleague; he would be able to obtain an opinion after describing his own project, of what the colleague thought was important or unimportant in the already existing literature; he would be able to browse through the documents rather than through indexes or abstracts. (Time and time again it was pointed out that the actual browsing through a document is far more effective in choosing one's reading than merely using abstracts.)

When the researcher left, he would leave a fair amount of information about the work that he was going to perform. Thus, later visitors to the information center could be informed of work in progress as well as published material.

Indeed, the men who run such an information center would fill an interesting function. Though required to become adept in library science, they start with the stature of colleagues rather than that with the lower stature usually assigned to the librarian. They are essentially subject oriented, but their major contribution is to be knowledgeable and evaluative rather than "creative". Indeed, they must be gossips who enjoy describing another's work rather than self-centered types who can only give due credit to what they themselves have done. For the information center to be truly effective it must be more a salon than the traditional library.

The salon atmosphere gets to be increasingly important when one runs into the problems of conventions. Most educators, like others who attend conventions, seem to go for the conversations in the lobbies and the hotel rooms, rather than to listen to poorly delivered papers, which they could have read at far less expense only a few days after the conference. The difficulty with the convention is that quite often meetings are haphazard. Attendees don't get to talk to those to whom they wish to talk. The other difficulty, of course, is the frequency with which unstructured dialogue occurs. The unstructured communication often turns out to be pointless and a waste of time.

The information center provides a place where periodically all those working in a field can come together for a semi-structured, unreferenced presentation of their latest results delivered to an audience small enough to permit uninhibited discussions. The recent high popularity of the closed meeting highlights the importance attached to the small select group. Those few in the information field who have tried the small round table semi-structured meeting have found both papers and the discussions worth a dozen conferences of the traditional type.

Today's researcher finds that he needs to tour the laboratories of his colleagues in order to first fulfill part of the initiation rites of the invisible college and then to make sure that he maintains current awareness. The information center, which met the approval of so many of the researchers

would not completely eradicate the need for travel to other laboratories. It would however, eliminate a large number of the later trips. One would only have to make visits when one had received information at the center that there really was something at another laboratory which was of high immediate interest.

The information man at the center would provide still another avenue of entrance to the invisible college.

It became evident during the study that we are about to emerge from a period where the most effective form of communication is that of "gifted print". This is especially evident in the field of education. Audio-visual centers exist at many of the colleges. It became apparent that much which had been recorded on film presented the type of information which film presents so much more effectively than print. Unfortunately film catalogs offer a poor criterion for determining whether one will feel satisfied after having spent fifteen minutes looking at a particular reel. The type of critical view that is needed is the one presented by the movie reviewer who has been forced to sit through the film from beginning to end. But whereas the movie reviewer need only satisfy his own aesthetic criteria, the user of audiovisual research devices is concerned with whether the film is to the point. The information center requires audiovisual collection and storage, review and criticism. Prohibitive costs prevent reproducing the film at every location; the ERIC Unit is a logical and economic depository for the films in its field.

At one point during the survey the concept of reciprocal visits came into play. There is no doubt that the researcher should visit the information center at early parts of the contract. It seemed also desirable that the center's information man visit the research group at the end of its project. Here the information flow would be reversed. The temporary center of information would be the project; thus rather than being able to talk only to the project leaders, the information man would also be able

to draw information from others associated with the project. A far truer picture could be gathered from these informal discussions, especially about such things as negative results, than is ever presented in the formal printed report. Even more importantly, the information man would have an opportunity to be informed about that large amount of data so often gathered in a project, but which is never used. We must report that the concept of being visited instead of visiting was not unanimously welcomed. The majority of researchers was pleased with both concepts. There were some however, who felt that the final visit would be an imposition.

Section 13

Selective Dissemination

Most of the educators and educational researchers we spoke to were unfamiliar with the concept of automatic selective dissemination. When we described the concept of material disseminated on the basis of their own individual needs, most of them became quite enthusiastic. None of this enthusiasm had a chance to be banked by the statement of cost. We deliberately excluded the concept of money cost in testing out the desirability of an SDI system. We were far more interested in knowing whether the researchers were willing to pay for this dissemination in a coin that seemed to be of far greater value to them than contract monies, i.e., the coin of their own time.

The coin was to be paid in the form of feedback to the dissemination system. The feedback is necessary in order to keep the initial profile current. We asked the researchers whether they would give us the following four types of feedback. The first three were associated with materials that were sent them.

1. Material which was of such great interest to them that it was read when received
2. Material which they were glad we had sent and which they intended to read, but would not be able to read on the first day. They all recognized this material as the type of thing which cluttered up their office for sometime as long as two years – material they always mean to read
3. Material which they regarded as junk mail, the type of material which they felt had wasted their time and their secretary's time in handling
4. Items that they had read which hadn't been sent to them by the selective dissemination system

No technique for the mechanization of these procedures was discussed. The first three items evolved as an attempt to keep track of

changes of interest in those things initially mentioned in their profile. The fourth item was primarily intended to keep track of new interests. In all, it was generally agreed that selective dissemination required constant monitoring of interest lest it become just a deluge of material.

Few objections were made to the concept of selective dissemination. The objections were essentially

a) A fear of an overwhelming deluge of material.

b) A fear that if you ever removed an interest in your profile, you would never receive another document in that area or that if later you become again interested in the field you would have lost pertinent materials announced in the interim.

c) A fear that such a system would be too expensive to implement. (This last fear was expressed within the U. S. Office itself.)

Section 14

Literature Search

In the educational field we have no direct analogy to the computerized search facilities of NASA, CFSTI, DDC, AEC, and the like. However, we believe the experience in other fields is pertinent to the assessment of any proposed service for education.

We believe the following should be observed in postulating search services:

- Many researchers served by such search facilities either do not now have available to them adequate library services (including search) or else do not effectively use them.
- Effective search service is a direct function of good rapport between the researcher and the operators of the system.

The results of good rapport are:

- Clear definition of scope and strategy.
- Frequent corrective feedback during the search.
- A product tailored to the specific need, both in content and form.

Some believe that the elimination of the human intermediary in the search through direct access by the researcher to the data base may eventually change this. For now, it is certain that the human intermediary is a critical point in the use of literature search services. Personal contact between user and operator of a literature search system is extremely important.

To Sum Up

Two of three segments of our community use abstracts to one extent or another. As we have pointed out elsewhere, there is almost a complete lack of agreement as to what constitutes a useful and acceptable abstract. This should be the subject of much further study, preferably in controlled experiments.

Section 15

Information Tools

Handbooks, Guides to the Literature

Several researchers expressed the need for a guide to the literature of educational research. The model which one researcher pointed to is Basic Reference Sources by Louis Shores. This is of course, a very general introduction and reference guide for all fields, and is used in the teaching of librarians. The approach is the significant thing. Our informant, although not a librarian, had, as a matter of fact, studied under Shores and considered that his approach to the exploitation of research literature was something that strengthened graduate education. This researcher, a university professor, stresses a comprehensive training in use of literature, especially for graduate students, and believes that a Shores-type book for the field of education would be extremely useful. The idea was heartily approved by others who were asked about it. We have suggested that in order to keep it current in a fast changing field, it should be issued in looseleaf form, much as the law reporter services are published.

Current Awareness Bulletins

With researchers and educators consulted during the course of this study, we discussed many possible techniques for improving the dissemination of research information. With few exceptions, our informants expressed the need for some form of "current awareness bulletin." The term has various meanings, however, according to the following aspects:

a) How current is "current?"

b) In what depth does the bulletin report?

c) What is the scope? Does it include:

1) Brief description of current research and development, with information on who is doing it, where, under what funding, etc.

2) Reports of research results and progress in implementation.

3) Current sources of information including individuals (who knows - and what), institutions and organizations active in particular fields, published sources (e.g., new guides to literature and methodology).

4) Announcements of new publications.

5) Review of current literature.

6) Abstracts or other secondary publication.

7) Organizational developments in professional societies, academic institutions, research centers and support agencies.

8) Legislation proposed or enacted having effect on the field.

We have many examples of publications which serve the current awareness function in each of these modes and in many combinations. There are two which National Science Foundation provides on a continuing basis which we think especially relevant to needs in education. They are:

a) Current Research and Development in Scientific Documentation, which meets needs described above under (1).

b) Scientific Information Notes, which reports on (2) through (8).

There are a number of analogies between the field of scientific documentation which these publications serve, and education.

a) There is no practical limit to the ultimate subject scope in either case. Current awareness in both fields means knowledge of developments in information transfer regardless of subject matter.

b) The fields are immensely dynamic at present and show no signs of leveling off.

c) There are severe shortages of skilled persons in both fields, which adds to the desirability of the effective application of personnel.

d) They, like other fields caught in the avalanche of print, are without adequate switching mechanisms.

The NSF publications have been well received by the community for which they are published. The educators, in answer to our queries, have indicated that they need similar coverage in the educational field, and use those research announcement publications which serve part of the field. Almost without exception, they have expressed need for the kind of coverage found in Current Research and Development.

However, within recent weeks, we have received announcement of a new service of the Clearinghouse for Federal Scientific and Technical Information, (CFSTI) which promises to meet this need to some extent by listing federal research contract awards.

There are important differences however:

a) The CFSTI service will cover only federally supported research.

b) It will list currently and will not cumulate.

c) There is as yet no indication of whether research will be subject-classified.

Nonetheless, we believe it in the interest of ERIC to pursue fully with CFSTI the use of United States Government Research and Development Reports (USGRDR) listings as a basic input to any

comprehensive current research publication for education. Arrangements could be made for advance release of materials to the group responsible for the more specialized bulletin.

The study team believes that a bulletin similar in format and scope to Scientific Information Notes is even more urgently needed and desired by the educational community.

The keys to the usefulness of such a publication are its selectivity and its succinctness. The busy researcher, practioner, or administrator, by reading such a publication, can at least keep up with gross trends and be alerted to those developments which he ought to investigate in greater depth.

We would propose as an alternative approach, the kind of publication epitomized by the Foreign Policy Associations' Intercom.

Each issue of Intercom is devoted to a specific topic, within the journal's general area of interest. (The current issue deals with Films on Foreign Affairs). Characteristically, each issue begins with some short background articles. Where appropriate, reviews of prevailing ideas (or techniques) and trends will follow. There will be a directory of organizations interested in the subject, research and publication centers, standard reference works, and the like.

Intercom is to a degree both a current awareness tool and a reference tool, since its presentation in depth, of background and information sources does not go out of date until the topic is again surveyed. The timetable of current usefulness of Intercom is, in our experience, about like that of Consumers Reports which investigates given products in depth.

In between coverages, it remains (despite being months old or even 1 - 2 years old) an excellent fund of data.

A third example is one which combines aspects of technical journal and current awareness tools - International Science and Technology. This limited circulation journal combines excellently written state of the art summaries, with other of the features listed above. It does not contain abstracts, since its subject coverage is so vast, but in each issue is a section entitled "To Dig Deeper" - which gives a highly select bibliography of readings and notes on institutional sources of information. The great popularity of the magazine especially among applied scientists in industry attests to the effectiveness of its mix of contents, as well as to its stylistic and technical excellence.

Abstracts and Indexes

Among the points of interest in the interviews was the use of secondary publications. Some of the groups rely very heavily on abstracts, indexes and bibliographies. Others made little use of these secondary publications because of the time lag involved in their publication. In general, the secondary literature was the material that the graduate student rather than the principal investigator was assigned to peruse.

We asked the researchers what type of abstract they preferred, suggesting three choices:

a) An extended title of one or two sentences.
b) A one or two paragraph abstract.
c) A digest or summary rather than an abstract.

The third differed from the first two choices in that the first two choices allowed one to determine what not to read, while the third presented an alternative to reading the initial article. Much to our surprise and to the surprise of those we interviewed, preference for each of these three choices was equally divided. Those who had desired the digest were those seeking an escape from the tremendous verbosity of most reports. Those who rejected the third choice doubted the ability of any other person to pick out the items that they themselves were interested in.

The main objection to the published abstracts centered around the delay in publication. Indeed, there was general agreement that the time to receive the abstract was before appearance of the journal article. Such early publication could alert those who had an urgent need for information to contact the initial author. A side effect would be the result on refereeship. The fear of suppressing worthwhile material would be eased if referees knew that anyone who wanted the information badly enough was alerted to the fact that it could be obtained from the contributor of a rejected article. The fact that the article had not been published would present a caveat rather than a prohibition.

Some researchers felt that the published abstracts have little utility because the data base is too broad. One of the attractions of ERIC was the narrowing of the data base from which abstracts would be chosen.

The same objections of time delay were attached to indexes as had been attached to abstracts.

The number of bibliographies that have been published have become so great that one researcher called for a bibliography of bibliographies in education.

ERIC - Disseminated Abstracts

In some places we visited, ERIC's abstracts and fiche had been received. Sometimes our mention of these brought forth interest on the part of one or more persons in the group, and they learned only then that these tools were already in house. The idea of such abstracts and fiche was often accepted with interest, even enthusiasm. The fact that they had not known of their existence in the same building is indicative of the fact that the information transfer value of these items of themselves is doubtful. These services are new, and no marketing effort has been done. This surely is a significant factor. The format of the ERIC abstracts is, in our opinion, uninteresting, and the fact that they arrive as a loose pile of sheets hardly makes for ease of use.

We believe that it is too early to say what their eventual degree of use will be. We think that given an acceptable format, they will enjoy the same use as other abstracts. The thing we seriously question is whether general distribution of any abstracts is really of much ultimate value of itself. We know for example, that indexes and abstracts generally distributed to libraries, information centers et cetera, have disappointing rates of use unless there is a strong marketing effort on the part of an intermediary, usually a librarian. Most librarians, in our experience, are too pressed with other duties to have time for this kind of marketing. Further, in all candor, there is for the librarian little pay-off professionally for such effort.

Therefore, we recommend that ERIC-produced abstracts be used for selective dissemination and as a base for demand searches, rather than being sent out wholesale in the manner in which the PL 89-10 materials were sent. If any units are to receive the entire corpus, strong marketing effort should accompany the distribution.

Fiche should receive the same treatment – being made available upon specific request; perhaps through the contractor now providing hard copy.

As in any materials distribution effort, ERIC should establish measures of usefulness and of use, and distributions should constantly be tailored to need and use.

Factors Affecting Use of Abstracts and Indexes

Our informants indicate little or no interest in indexes of periodical literature, as a current awareness tool. There were some expressions of feeble interest in Education Index as a retrospective tool, but its use is apparently limited to:

a) "Quick and dirty" literature search when you are quite unfamiliar with a specific topic and need a quick look at what is being done. If it is a field in which the researcher has done any amount of work, he is inclined to regard such indexes with disdain.

b) Use as a didactic tool, specially for upper division and beginning graduate students.

The principle reasons for non-use often given are:

a) Lack of depth and precision of indexing.

b) Time lapse between original publication and the receipt of the index.

Experience in research libraries and specialized information centers shows however, that periodical indexes are used extensively and with a high degree of acceptance by researchers under the following conditions:

a) At an early stage in a research problem, when the researcher has not imposed upon the study a particular methodology or critical limits of scope.

b) When someone brings to his attention a wide array of indexes in related fields. The researcher is seldom aware of the diversity and volume of publishing related to a given subject, or of the intensity of interest in the subject by researchers in abutting specialties.

c) When he has assistance in the initial screening, much of which is mechanical and time-consuming.

d) When there is a relatively small delay between identification of desired articles and their delivery to him.

Abstracts

Abstracts are of use to the working researcher, and to a lesser degree to the practitioner. To the administrator of either research or teaching, abstracts are of use indirectly, since these people assign searching to their staff, and glean the results. To the teacher, abstracts are a didactic tool in addition to their use for his own study. To the general administrator in education, abstracts appear to be almost as useless as the mass of primary publication. This is because his effectiveness, while surely a function of his knowledge, does not depend on literature per se. He needs not literature, nor abstracts, but very specific information. The research scholar or scientist can seek out the whole range of concepts, writings and techniques, and gradually develop an approach to the best answer. The administrator must come up with a decision on a pressing schedule. He is no more prone to look for the answers in abstracts than he is to go into the library to do a literature search. He will look in his files, and finding nothing, will call his colleague in whose specialized knowledge he has confidence.

PART 2

TR-66-15-1

THE CHANGING INFORMATION TECHNOLOGY

This is Interim Report No. 1, prepared for Contract OE-5-99-264, dated 23 June 1965. It represents a projection of emerging trends in information technology with reference to the needs of the Educational Research Information Center (ERIC).

This is not a report on the survey conducted on the question of information needs of the educational community, which shall be dealt with in future reports.

Section 1

INTRODUCTION

In January 1966, we are predicting the information technology of 1969. The study on which we base our forecast has made abundantly clear that the useful technology of 1969 will include the automatic processes which had been developed already in 1965, but had not been widely implemented because they were not then economically beneficial.

The most significant changes in the period 1966-69 will result from developments which will make economic these "state-of-the-art" techniques.

The changes already occurring, which affect the feasibility of "far-out" developments are:

The current revolution in printing technology.

The emergence of the public utility concept of computers.

The ubiquitousness of computers.

The general appearance of the automated retrieval center.

This report, based on visits to many information-research centers and on literature review, discusses salient aspects of the predicted change.

Section 2

THE CHANGES AFFECTING ECONOMICS

2.1 THE CURRENT REVOLUTION IN PRINTING TECHNOLOGY

In 1954 Bafour obtained his initial patents for computer controlled publication. Although this early advance was made in Fance, the full impact of computer processing was to have its effect in the United States and the United Kingdom. For some years now certain publishing groups have placed their about-to-be-printed texts in computer readable form. This transformation occurred because these publishing houses hoped to save money during the printing process. Examples were available even three years ago of publishing houses which had found this process economically feasible. The Los Angeles Times places 160,000 words on paper tape each day. None of this is done for archival purposes. The main purpose is to conserve the cost of expensive human justification and hyphenation. The Los Angeles Times process drives a hot lead system.

The high quality Time-Life books have been produced by a photo composition process that is driven by paper tape. These tapes have been saved although only for research purposes.

McGraw-Hill is also utilizing this technique.

The U. S. Government Printing Office is acquiring high speed composition equipment that will be driven from magnetic tape. The National Library of Medicine acquired less ambitious equipment in the process of establishing its MEDLARS system at an earlier date.

We believe that segments of the publishing portion of our economy will be using computer readable text by 1969, and feel that any group entering into a publishing endeavor would be best off following such a plan. We are not sure whether the future lies with photo composition

devices or with hot lead devices. We are convinced that the near future involves full text input to the printing process.

The significance of this revolution to the field of documentation lies in a new capability that is offered. Many people have experimented with various automatic documentary techniques for information search, retrieval, et cetera, during the last decade. All these techniques have fallen before the lack of economic feasibility for handling full texts. Re-keyboarding of texts costs one cent (1) per word. The total cost of handling any large collection by such techniques was prohibitive in both money and time.

By 1969 we will have reached the stage where neither the monetary nor the temporal considerations of handling full text need be an impediment to the other aspects of the technology that will be discussed below.

2.2 THE EMERGENCE OF THE PUBLIC UTILITY CONCEPT OF COMPUTERS

Another economic barrier to computer solutions of documentation problems has been the tremendous cost of computers which would be adequate to the task. Now, after seven years of much heralded man-machine relationship, the public utility phase of computer availability has appeared as a commercial reality. The use of a large, powerful computer system for just a few short and possibly unpredictable intervals during a work day is no longer prohibitively expensive. Nor does such capability require that the user either be near the computing capability or be willing to send a messenger to its location.

Project MAC at MIT pioneered by placing consoles not only all over the Boston area, but even down to Washington and now to Chicago. These consoles allow one to use the powerful MIT computing capability as if it were next to the console itself. In a less dramatic but economically more sigificant way, the Teleregister Corporation placed inexpensive

consoles at the desks of many stock brokers so that they could get immediate response to queries from their clients. Today we find IBM and General Electric in a nationwide competition to supply similar services to occasional customers through the public utility concept of plugging in to the computing capability when and if needed. Both companies have been so swamped by over-eager use of their system that small groups are popping up over the country in an attempt to get into this new field.

Thus we see that a lack of need for a giant computing system over one or two shifts per day no longer presents an economic barrier to the use of such a system.

2.3 THE UBIQUITOUSNESS OF COMPUTERS

Apart from the public utility concept, the past two years has seen a general acceptance of computing equipment as being the sort of thing that most enterprises have available. The ubiquitousness of computers testifies to the change of attitude towards these devices. From 1950 to 1955 advanced thinking generally accepted these devices as being phenomenally powerful calculating machines. They were used by mathmeticians. From 1955 to 1960 advanced thinking was concerned with robotology. Automatic "this" and automatic "that" were the vogue. The machines were the concern of the cyberneticist. From 1960 to 1965 advanced thinking was concerned with man-machine relationship. (A properly-attuned people would interact with the computer.) The machine was the concern of the computer oriented scientist. During the period 1966 to 1970 the computer is to appear everywhere. It has reached a new high of being only a machine. It will be available to everyone.

During our survey we found computers at almost every university we visited. We found computer systems, some of them quite advanced, at many of the State Departments of Education we visited.

The rapid development of these systems indicates that there will be no economic barrier to convenient computer installations in the users' organizations. The installations will probably proceed apace, and will be used on a shared-time basis.

2.4 THE GENERAL APPEARANCE OF THE AUTOMATED RETRIEVAL CENTER

Many large information processing services have appeared in the past decade. DDC is a prototype of such a service. NASA has been providing an excellent retrieval capability in both decentralized and centralized form over the past three years. The National Agricultural Library, responding to national concern, began to automate its Pesticides Library last year. The National Library of Medicine has done pioneering work in order to keep its century-old system responsive to the pressures of today. Even the Library of Congress which because of its large and successful operation, has the most to fear from "upsetting the apple cart", called for bids during the first week of January of this year, for automation of its bibliographical processes.

There is no lack of prototype systems to test the various aspects of the new technology. Indeed the present fear of both COSATI and the National Science Foundation is that there will be such a proliferation as to create a system less effective than could otherwise be achieved. These fears center around concerns of optimization rather than concerns of economic feasibility.

2.5 SUMMARY

In the preceding we have tried to point to the rapid evaporation of certain economic and prototype impediments to a more automatic technology. Although these considerations are of major importance, there remains the even more important consideration as to whether a more automatic technology is technically capable of satisfying the needs better than

existing conventional techniques. If comparison between conventional and automatic technology results only in a "draw" we must ask whether the change appears to be warranted on the basis of economic advantage.

Section 3

CONCEPTS AND TECHNIQUES

3.1 THE INFORMATION SYSTEM – ACTIVE VERSUS PASSIVE

With regard to the dissemination function, the information system – a library for example – operates in one of two modes: active or passive. Most systems do both.

A library is operating as a passive disseminator when the user asks for a book. It is an active disseminator when the librarian sends a book to a user because he knows that it will be of interest, even though the user has not even yet heard of the book.

Active, selective dissemination is a very old idea, but one which is extremely expensive when done in conventional ways. The advent of automatic information technology – especially the general purpose computer – made large scale selective dissemination economically feasible for the first time.

3.2 SELECTIVE DISSEMINATION

At the present time, many organizations use programs of selective dissemination of information (SDI). Most of these are doing so under conditions which make it unnecessary that the system demonstrate its economic value immediately. (IBM because it has a vested interest; certain scientific installations because of the high order of urgency in their work.)

This is not to say that automatic SDI is economically unjustifiable; quite the contrary – it is probably a truism that <u>given the same task</u> – general SDI is for all practical purposes <u>only</u> economically possible using computer techniques.

Computerized SDI is efficient. The question we must ask is – "Is it effective?" (in terms of our goals). For ERIC this question will have to be answered at a later point – on the basis of further study and experimentation. We wish at this time to point out some of the outstanding developments and findings in the work done thus far.

Example: NASA and SDI

NASA delivers to certain information centers every fortnight, copies of the tapes used to produce the abstracts appearing in Scientific and Technical Aerospace Reports (STAR) and the International Aerospace Abstracts (IAA).

These tapes are searched for profiles which match the profiles of researchers served by the information center. Where a document profile matches a researcher's profile, the abstract is printed out and sent to him. He then decides whether he wants the full text of the document. Feedback mechanisms reflect changes in researcher's profiles.

Some doubts have been raised about the effectiveness of SDI. These usually center on the difficulties in measuring (1) Accuracy of profile, (2) Effectiveness of feedback mechanism, (3) Relevance and recall.

3.2.1 Accuracy of Profile

We consider that at least four types of feedback are needed in order to first correct the initial profile and then have it track the changing interest. These four types of feedback are:

1) What document was the man sent which interested him sufficiently so that he read it immediately?

2) What documents were not read, but are of the class which the recipient feels interests him? These are the documents that sit waiting to be read for as much as two years. Though the recipient does not actually read

these, he would feel the system inadequate if he had not received them.

3) What documents were sent that the recipient regarded as "junk mail"? These are the documents that he feels waste his time, threaten to inundate the recipient with uninteresting matter and thus to bury and hide that very important material in group 1. Even with the recipient who has no self-control, there is danger from the material in group 2.

4) What material did the recipient read that the system did not send him?

With the above four groups, one can even create a fifth group of newly emerging material which might be of interest to the recipient and should be dangled before him. This is to find out in which one of the three classes the new material falls.

The measure of these depends largely on:)

3.2.2 Effectiveness of Feedback Mechanisms

We have doubt about the ability to get feedback from users about information in categories 1 through 3. We have grave doubt about the ability to get feedback about the material in category 4, except in situations where there is an excellent rapport directly between user and operator of the system. This condition is, of course, ideal but not to be expected because (a) many researchers, competent insofar as their subject matter command, are insufficiently motivated and/or trained as far as making effective use of information sources, (b) the depressed state of information personnel training and staffing precludes any wide-scale use of information system operators in this way.

The two conditions combine to make difficult the kind of mutual respect between user and operator which is necessary for good feedback.

Nevertheless, those whom we interviewed in the field of education assured us of their willingness to supply such information in order to receive selectively disseminated material. Thus, we will hazard a guess that experiments in selective dissemination, the high success of the present IBM internal dissemination and the eagerness of the clientele we interviewed make for a controllable large scale selective dissemination and off-the-shelf capability by 1969.

3.2.3 Relevance and Recall

Experiments are being conducted to develop measures of relevance and recall which are better than those used by the Cranfield Project which have been severely attacked. The effectiveness of SDI, like that of all indexing systems, hinges upon those factors which create good indexing. We have not yet created adequate tools for measuring it; we do not yet even know what good indexing is.

A possible way out of the morass is not to index at all, and to use full text for identification of a profile match. Results of experiments in this direction indicate that computer dissemination based on full text is at least as effective as with human dissemination.

Another possibility is the development of better criteria through experiments utilizing full text -- now economically possible.

Selective dissemination is very expensive. Present disappointments have not come from technical failure, but from the cost of running such an operation. Suggestions have been made that these costs can be cut by disseminating to groups instead of disseminating to individuals. It is our belief that such dissemination would not have met the needs of those to whom we spoke. Feasibility of selective dissemination is not so much based on some absolute economic test. Rather the feasibility depends on the genuine need for the information and the determination that those who need the information are to get it.

3.3. INDEXING

3.3.1 Motivation for Automatic Indexing

Modern retrieval or dissemination can be done on two different types of material. One type is full text. Work of this nature has only been experimental up to now, due to the tremendous burden of full text retrieval from the point of view of input costs and due to the lack of adequate storage mechanisms. Most retrieval and dissemination have been done on text to which index terms have been assigned by human indexers. To a large extent, the present success or lack of success of our system can be attributed to this. Indexing has been so important that there has been much experimenting in attempts to determine whether it can be performed automatically. The motivation behind these experiments have been three-fold. There has been a motivation of robotology which for our purposes can be disregarded. There has been a motivation due to an attempt to find a more complete way of indexing, to produce indexes which are better than those prepared by people, and which can be performed on larger bodies of text. The third motivation is based on the belief that people who are willing to be indexers are not the type of people who are capable of indexing intelligently. Thus, the third motivation has been centered not so much out of belief that humans cannot index well, but that humans will not index well.

In any absolute sense, this idea is patently absurd. There are highly intelligent and capable people who derive satisfaction from indexing, and who do it well. But the skills are not easily learned. As Panizzi said,

> "Moreover, catalogers have to learn their business and it takes time to teach them."

Furthermore, it is undeniable that many competent indexers and catalogers do tire of the work and move into either subject

specialization or "output" (reference) services. The competent indexer or cataloger is ideally suited from certain points of view to do "output" work, being familiar with the overall subject structure and language of the system. Mechanized aid to the indexers should help alleviate the shortage of output personnel, assuming that people can be transferred (or deferred) from one to the other function.

3.3.2 Automatic Indexing Trends

Other types of automatic indexing are dependent to a greater or lesser degree on the availability of computer readable text. Some feel that one can put into the title, significant paragraphs and major headings and achieve some form of indexing. Others insist upon full text.

The state-of-the-art in automatic indexing, has been recently surveyed by Mary Elizabeth Stevens (National Bureau of Standards). This study spells out developments in the following areas:

1) Indexes compiled by or with the aid of machines.
2) Keyword techriques (e.g., KWIC).
3) Experiments in automatic assignment.
4) Automatic classification.
5) Associative indexing.

We have no doubt that there are many ways to effectively use indexes based on computer-manipulated full text. We do not believe that completely automatic indexing is as effective as human indexing. Completely satisfactory automatic indexing may be a chimera, even given a great deal of further research in the supporting logical and linguistic processes. However, we do not believe that it need be as good as human indexing in order to be useful. The key to its use lies in aiding human indexing and query.

Computer technology is a long way from doing all the things which competent human indexers can do. But it can do some, usually less demanding tasks, and thus free the human for higher-order work. This is especially important in this time, because not only can we not find enough indexers, we cannot find people to train indexers.

Automatic indexing can offer certain logical controls, aiding the indexer in what might be called the "housekeeping" tasks – those which lessen the inconsistencies in the structure of his subject array. He can utilize the product of computer indexing as raw material.

3.3.3 Full Text – Its Advantages

Discussion with researchers who are working with full text technique has elicited what they believe to be certain superiorities in the method:

1) It does not try to anticipate the needs of a later date.
2) It does not rely on choosing labels which will satisfy particular requests.
3) The retriever can manipulate the text himself. (This could be especially helpful in on-line operation, allowing a browsing function.)

3.3.4 Summary

Full-text operations developed thus far are very promising. We believe, however, that by 1969, this technology will be emerging from the experimental stage into "state-of-the-art", rather than "off-the-shelf".

To the extent that the capability is available, it will be without doubt expensive, and rationed just as computer time is rationed in the Project MAC Operation now. Open shop operation for the individual researcher would be, under these conditions, very wasteful. The information system operator is not, under present conditions, used effectively.

The solution, however, is not to turn over his function and the powerful new tools for the job to the researcher. The solution is to change the role of the information man in the research community.

TO SUM UP: The most effective indexing in 1969 will be neither human nor machine – it will be machine-aided human indexing.

3.4 SOME GENERAL SYSTEM ASPECTS OF BIBLIOGRAPHIC PROCESSES

Some doubt remains in our minds as to the appropriate time for indexing to take place. One of the noticeable facts during this study and others, especially the APA study, has been the extreme lag between the initiation of the work and the publication of its results. The added lag in secondary publication (e.g., abstract bulletins) is even more aggravating. Thus, the work by Buckland of Inforonics and the proposed system of Atherton of the American Institute of Physics, were of extreme interest to us. Their efforts are concerned with full text manipulations before printing with the aim of avoiding all delay in secondary publication. One must be skeptical and wonder whether this will cause a delay in primary publications. We have no doubt about the capabilities of pre-indexing and pre-cataloging publication information at that particular time. It can be done today. No doubt, some will do it in 1969. The question arises whether those who publish the educational information would be willing to pay the added expense of indexing and cataloging. Certainly if this decision were in the hands of the U. S. Office of Education, we would heartily urge that it follow the advanced thinking of the American Institute of Physics.

3.5 RETROSPECTIVE SEARCH

Retrospective search using computer aids is a reality today. It is performed more than adequately at NASA, at National Library of Medicine, at DDC and at other installations. Today's retrospective

computer search characteristically produces a demand bibliography, using programs now available for yesterday's computers.

Thus, CFSS, developed by IBM (San Jose) can be run on 1410, and provides demand bibliographies with abstracts under conditions of search for more complex than mere Boolean "and-ing" and "or-ing", and having aspects of role usage.

Interestingly, the operators of the Knowledge Availability Center (Pittsburgh) who use the input and programs supplied by NASA perform all retrospective search manually; they are convinced that they cannot get a product from retrospective machine search which will satisfy their quality standards.

Without in any way disparaging the enormous improvement in literature search quality made in recent years by DDC, it should certainly be said that the product is far from being what can be done manually, even by intelligent clerical assistants, let alone by a highly trained librarian. The volume which is done is the decisive factor.

As with indexing, 1969 offers computer-aided human search.

The question for 1969 is not whether the computers-aided retrospective search can be performed so much as how it should be performed and who should perform it.

At present the request for literature search, either manual or computer, must be formulated by a highly skilled person in order to be effective.

3.5.1 "On-Line" Search

Among those who favor the use of the computer directly by the researcher, in an on-line mode, the hope is that a creative dialectic between computer and researcher can be made available without the human intermediary. If such is possible, it probably will be done, if for no other reason than the fact that as a society, we incline to invest resources in technology rather than in human beings, the latter being less predictable. It would take a great deal of money and other resources to educate enough humans to operate effectively in the way described, and when so educated, there is no guarantee that they would remain available to do so.

On-line, interactive bibliographic systems are now being developed.

Such systems, when developed, will be available for use by the researcher directly, or by an intermediary.

3.5.2 Some Examples

At MIT, Project MAC provides a beginning toward this kind of interactive device.

Project INTREX will push for extension of MAC-type operation for more general use. INTREX is described in a separate report, as a prototype which illustrates a great number of the concepts, tools and techniques that mark the state-of-the art and experimental development in information technology.

Based upon discussions with users of the MAC system, we offer the following general comments:

This application of the "no-intermediary" principle appears to have a high degree of appeal to its users.

We are not sure whether the user of such a system will be the researcher himself or his colleague who is familiar with the workings of the system.

Examples of this user-colleague relationship exist today. Reading files are examined on the 7090 at Pittsburgh after telephone requests from colleagues as far removed as California. Our informant was very satisfied with the adequacy of the service he had received from such an intermediary.

The dialog will aid the researcher by allowing him to narrow down his bibliographic search to really pertinent citations. Conversely, it offers him a technique for examining a larger corpus of choices. Among the important side benefits of such operation will be the fact that the requestor's interest profile can be automatically updated for SDI use.

It is too early in the game to predict the patterns of use which will emerge. It is very likely that there will be highly individual patterns of use and non-use of this system, as there is of conventional libraries.

3.5.3 Use Patterns

Of at least equal importance for progress in theoretical information science, is the fact that the computer-aided system can make available an enormous and constantly growing corpus of data on patterns of information use.

By 1969 it will be possible to retain computer data that reflects the use of the information systems. Though such retention of data is presently postulated as a by-product of the system, it may turn out to be of more important long-range value than the immediate aids that the system will provide to the research unit.

3.5.4 Fact Retrieval

The experiments which lead in this direction are characterized as "fact retrieval" and "fragment retrieval". (A recent article develops the notion of a "concept library".)

Primitive systems have been put into operation. They await more complex syntactic and semantic computer capabilities before they can operate in a smooth manner. However, even in their present rough manner they promise capabilities and usefulness as a browsing Their experimental use, as well as any practical use, has been inhibited by the absence of sufficiently large storage mechanisms. Information has had to be kept on either inadequate disc memories of today or on frustratingly slow magnetic tapes. Delivery of the trillion-bit (10^{12}) memory is promised for 1969. Even a memory of that size will be inadequate to store the graphic data of interest, but will certainly be sufficient for non-graphic data of any ERIC unit. The cost, however, is likely to be prohibitive.

Thus, 1969 will not bring the availability for ERIC's uses, of a generalized "fact" or "concept" type retrieval.

3.6 AUTOMATIC ABSTRACTING

We obtained from our respondents among the research personnel a wide range of responses of our questions regarding abstracts. Two kinds of spectra emerge:

1) From heavy reliance to no reliance on abstracts.
2) From:

"Abstracts tell me what to read"

to

"The only use of abstracts is to tell me what I don't want to read."

(It is probably not a trivial matter to understand the difference, operationally, between the two attitudes).

We find an almost total lack of agreement as to what constitutes a usable abstract. This fact alone dissuades us from expecting by 1969 any automatic abstracting of real value to ERIC.

The programs now in development lack entirely the ability to paraphrase. There is likewise no sign of concept recognition capability being a reality in the next few years.

The best that can be expected along these lines by 1969 is some form of machine-aided human abstracting. Even this would depend on a more adequate definition of a useful abstract.

3.7 TECHNOLOGY FOR MOST-USED PATTERNS OF INFORMATION-GETTING

The subject of information use patterns is more basic than the subject of technology. How we are to do something is hardly a question until we know what we are to do. In this report, we are, however, limiting our discussion of use patterns to those which have technological implications.

We have dealt with some advanced systems, including several which are very popular as research subjects, but which offer little hope of use in the near future.

We would do well to take stock at this point – to ask ourselves what we are trying to do. We are trying, of course, to facilitate the transfer and use of useful ideas. When we choose a technology for this purpose, we would do well to invest in proportion to the degree that a tool will facilitate information transfer.

Research is dependent upon both formal and informal modes of communication. Among the members of an "invisible college" – peer group of researchers in a given specialty – the informal modes are extremely important. For some purposes, face-to-face conversation is the most effective and efficient mode. However obvious this may seem, many researchers have emphasized this to us in our interviews. Frequently they have gone on to say that next to personal conversation with someone who knows the answer (or where to get it) the single most valuable tool is the telephone. They are, of course, deterred from long distance calling except in cases of real urgency.

3.7.1 Telephone Use

The research community has a mechanism for long distance communication. The telephone would be a great boon to the transfer of research information. Its use should be formally postulated in an information system.

3.7.2 Videophone

Jules Mersel visited Bell Laboratories recently, where Videophone was available. His description of it has interesting implications for long distance communication of research information:

> "I spoke to an individual in another part of the research laboratories. Visual communication was excellent. One could tell the reaction of the other individual very, very easily in the form of frowns, smiles, consternation, agreement. I asked that individual to hold up a document.

> It was a typewritten page or a printed page. I was able to identify that it contained names and telephone numbers, by its form. This was a deduction, however, since nothing could be read. I held up my own notebook and it could be identified as a book, but no more identification was able to come from it, not even the identification as to whether the writing was written or printed. Thus, the Videophone will provide an important people communication link that may be used in the research information dissemination program. In itself, it has much, much too narrow a band width to hope to provide document transmission or examination from a distance."

We postulate the use of videophone networks by researchers in the 1969 era.

During the course of our study, we have been very much concerned with the question of whether to move information to researchers or vice-versa. The videophone has some good qualities of both methods. Two-way television has similar features, and is being implemented or planned in some of the locations we visited.

Videophone and television are highly adequate for person-to-person communication, but inadequate for transmission of the printed page.

3.7.3 Long Distance Xerox

One of the important forms of long-range fast communication which came up during the course of our study, was long distance xerox. We were unable to determine when such a system will be available or its cost. We have no doubt about the need for such a system; we merely lack the capability to predict with any sense of assurance that this will be off-the-shelf technology both in capability and in cost in 1969. We hope that it will be available to take care of the need for rapid transmission of the printed page.

3.7.4 Audio-Visual

It is very evident that the whole area of A/V is high in the list of presently-available but under-utilized technology.

The film libraries we observed at some universities are impressive. At University of Southern California, there is a pre-cataloging effort under way to speed the dissemination of films.

There is no doubt that film and video tape are superior media for certain kinds of information transfer. An adequate system for the 1969 era will serve the user needs for these, as well as for audio recordings.

3.7.5 Print Readers

Thus far, we have dealt with the change in economic factors attendant on the ready availability of machinable text, even when prepared by keyboard operations.

The potential for development of generalized optical print readers opens opportunities of another order of magnitude.

The advance in character recognition in recent years has been great. A recent demonstration on handwritten numbers, for example, showed a 90% accuracy. Optical sensing of type font is of course much more accurate, but readers for all or most fonts need yet to be developed. We believe this to be technically feasible by 1969.

When available, print readers will eliminate the need for keyboarding for input to indexing, abstracting and SDI systems. There are two likely effects:

1) Economic – great expansions of possible services as a result in economies in clerical operations.
2) Technical and theoretical – probable spur to development of automatic natural language operations, indexing, abstracting, etc.

3.7.6 Consoles

Consoles are of course available today for manipulation of natural text. We expect to see a large growth in their utilization for editing, and for bibliographic efforts of all kinds. Hopefully the increased use will result in decrease in costs.

3.7.7 Information Networks

Information networks have been proposed many times to the federal community. These really are not a new manifestation but a constantly improving communication system among information sources. The communication means discussed in this report will be incorporated into presently evolving national networks.

PART 3

TR-66-15-4

ERIC
AND THE FUTURE

Section 1

Background Information

It is the purpose of this report to sketch an orderly transition from wherever the U. S. Office of Education found itself in the spring of 1966 to what is feasible and desirable for 1969. Feasibility was to be based upon what had been found out about the state of information technology (Report No. 1). Desirability was to be based upon what had been found out about the needs of the educational research community as reported in Interim Reports No. 2 and No. 3.

It was entirely possible that we would look upon the present ERIC situation as deplorable. The very term "orderly transition" was aimed at indicating that the U. S. Office, due to a need to act, had taken necessary but undesirable actions and were now to receive enlightened corrective information.

As citizens we are happy that the course taken by the U. S. Office out of its need to act can be seen with hindsight as having been eminently wise. The orderly transition that we propose turns out to be an augmentation of the Office's course rather than a violent revision.

Early in the history of ERIC the U.S. Office rejected the concept of an electronic kludge and substituted the concept of information centers. As a computer firm we are not adverse to electronic techniques; indeed, there are places where we suggest it. However, we applaud the fact that the U. S. Office chose to identify information needs first, and put minor emphasis on the technology required to satisfy the needs. The danger always remains, whether it be with traditional libraries or with the new technology, that people will insist on satisfying that which they know how to satisfy rather than that which needs their help.

Section 2

Informatics' Approach to the Problem

It is very easy to become confused about the problem that is to be solved. It is primarily an information problem. From a traditional library point of view one could assume that the problem is concerned with documents. From a modern computer point of view one could become equally well confused with thoughts about electronic stores, switching networks, and displays. However, when looking upon the needs of the clientele it became evident that neither of these was the problem.

The problem essentially centered around placing information in front of those who needed it about three seconds before they were ready to recognize the need. We recognized this as an unobtainable goal. It requires an even deeper knowledge of people than is presently demanded. We chose the above goal in analogy to the problem of travel. The real answer to one who wants to get from one place to another is teleportation. Teleportation is not feasible, but when we recognize that the ideal is to get from one place to another in zero time, we no longer get confused into spending too much time on the width of railroad, or the speed of jet planes. We concern ourselves with reducing the amount of time in which an individual can come from his truly initial departure point such as home, to his final arrival point, such as the office he must visit. Magnificent improvements such as an increase in the speed of airplanes fall into their proper perspective when one notes that the time from home to the airport and from airport to office remain the greatest element.

The problem of information transfer does not center around books, documents, conferences, or computers. The problem centers around anything which prevents the individual from getting the information that he needs at precisely the time that he needs it. In our study we

attempted to identify some of the items which prevent this information transfer from occurring. The suggestions that are made to the U. S. Office are motivated by our belief that these augmented functions of ERIC will reduce the items which block information transfer.

Section 3

The Accounting Nature of the Problem

Much to our surprise the major impediment to information transfer in university research contracts came not so much from the information explosion, but rather from the accounting system used in government grants and contracts. Contracts are written in such a way that the acquisition of information from other groups is hidden as a non-specified item. Time spent acquiring information is time spent on obtaining information not specifically promised in the original proposed statement of work. Attempts to get the information on overhead or to read it on overhead are invariably opposed by the administrative people in the organization. Thus, information transfer runs into a frictional opposition from both the project manager and the administrative group.

The solution is simple. It calls for the U. S. Office to change the format of its contracts. Reading and acquiring information should become a listed direct charge. Indeed, as much attention should be paid to seeing that this proposed portion of the work is fulfilled as is paid to seeing that the final report is delivered.

In Report No. 2 we note the times in a contract when reading is liable to be heaviest; these are shortly after the grant is made. The proposal as written implies that the principal investigator has all the needed information already in his hand to allow him to conduct the research. After the contract is received the proposal manager is then faced with the problem of how he is going to carry out the efforts he so glibly proposed to do. It is during this second four weeks of the contract when sufficient time has been applied to discover the hidden difficulties that there is the greatest need for reading. It is our suggestion that the second four week

period be devoted by the research team to reading as a direct charge for which no apologies need be made.

We feel very strongly that ERIC Units will form the proper information centers. We believe that contracts should be funded in such a way that the principal investigators or their managing lieutenants be funded for travel to the appropriate ERIC Unit. They will find a complete collection of documents there. More than that, they will find people who have read all of the documents and can give them at least their own evaluation as to what is worth reading and what is not worth the time. They, of course, will select those items which they feel will be worthwhile. Of equal importance, their visits will inform people of the ERIC Unit about what their groups will be doing. Other visits will have left information which will allow the ERIC Unit to inform the visiting project manager of yet unreported work being done at other research groups. Thus, the project becomes informed of both the documentary and non-documentary information necessary for its operation.

Section 4

Journal Literature

Publications competing for attention take the forms of books, periodical articles, and reports.

The report literature can be more fresh and immediate, since it is unrefereed and there is less delay in publishing. Journal articles are generally more concise, and have usually been subjected to some critical review, but there is greater delay.

During our study we found the need for short and long reports. We urge the U. S. Office of Education to make provision in its research contracts so that reports in the form of journal articles become an end product of the contract as well as the standard report to USOE. It is conceivable that there are cases in which the journal article would carry the substance of the report, in which case an additional report would be unnecessary.

There is no guarantee that the article will be accepted by a journal, but in that form it will likely be of value in the ERIC collection.

Section 5

Central ERIC

The Central ERIC Unit forms three important functions. The first of these functions is that it acts as a collecting agency for the more noteworthy of the reports abstracted and indexed at the specialized ERIC Units.

Another function performed by Central ERIC will be that of providing communication among the various ERIC Units. The third function which must be provided by ERIC Central is to act as a coordinator for the various ERIC Units.

Section 6

ERIC Units

The heart of the educational research information problem solution is the provision of ERIC Clearinghouses. These clearinghouses must be information centers rather than merely document processing centers. The task of establishing clearinghouses will center initially around acquiring, indexing, and abstracting documents. The clearinghouse must however, become, in the eyes of its clientele, the center of all information, both published and unpublished. In order for this to be achieved, the center will require constant feedback from its users.

The center will be formed out of the initial set of assumptions; each center must continually ascertain which services have been useful to particular clients and which services are a nuisance. The decision will be a function of the user. Funds must be provided to the center in order for it to obtain this feedback.

The literature service provided by the ERIC Units must be combined with the ERIC Units' concern for understanding the user habits. The ERIC Units should have the goal of anticipating the needs of its users. It should be able to offer the right information at the correct time. This can only be achieved by knowing its clientele exceedingly well.

The prime example of an information service which operates in the above manner is the Senate Law Library located in the Capitol Building. Here the library is comparatively small and concerned only with the laws of the United States. Such a field however, is not larger than the concern of the various ERIC Units. The clientele is very small. There are only 100 prime clients. The goal of the library when we saw it, was to have the proper book waiting when a page arrived from the floor. This

was achieved by knowing who was going to speak on what law. Books were selected ahead of time with slips inserted in the correct page. Thus, when a request came for information it was satisfied immediately.

The users of the ERIC Units are not as prestigious as the members of the United States Senate. Nonetheless they form a small group whose needs can be known.

Great rapport must be established between the center and its users. With the tremendous amount of literature that is continually accumulating, help is needed in knowing what not to read. The average researcher has only a limited budget of time which can be spent reading. The time he spends reading one item is time that cannot be spent reading another. Thus, the user must learn from experience to trust the recommendations of the people at the ERIC Units. In our time, characteristically the researcher distrusts the judgment of the librarian. The ERIC Units must be staffed by people so subject oriented as to warrant the researchers' initial tentative trust and to earn his permanent trust.

It is quite difficult to obtain good indexers and abstractors for clearinghouses. The task requires special capability and knowledge of library techniques. The rewards for this type of work usually do not increase dramatically with the passage of time. The work is interesting when first encountered. It allows one to be paid for reading and keeping up with one's field. We strongly urge that the role of abstractor at the ERIC Units be considered a role endowed with great honor. We have in mind similar roles played by the foremost graduates of law schools vying for the honor of being clerks to Supreme Court Justices for a period of two years. The position of abstractor should be considered as a post-graduate position of prestige. It is a learning position. It takes place at the center of information flow. It allows one to communicate with all the researchers in one's field before the abstractor has made his own

reputation. It allows one to become familiar with all the freshly written literature in the field.

Review articles are needed to give proper perspective. ERIC Units should be staffed by those people who have had the requirement of being familiar with all work being done in their field. It should be the duty of the ERIC Units not only to abstract and index, but also to create the review articles in their own fields.

Although the ERIC Units will send out title listings and abstracts, they remain the most complete collection of information in their field. Their stacks should remain available to visitors. The venerable urge to browse is highly justified. The browser gets a better description from thumbing the documents than just from reading abstracts. This open stack capability must be maintained. The clearinghouse that is communicated with only by mail will lose much of its usefulness.

The ERIC Centers must have funding for marketing their wares. The wonderful services that can be made available will be useless unless the potential users are familiar with them. Thus, funds must be provided for the ERIC Units for frequent dissemination of information describing their services.

The ERIC Unit forms one of the two most important libraries for a researcher in his field. The other important library – the most important one – is the researcher's own individual library. The ERIC Unit has the responsibility to serve this particular library. Serving the individual library is possibly the most effective aid that can be given.

Section 7

Alma Maters for Invisible Colleges

Report No. 2 commented frequently on the informal information exchanges that have been set up by researchers in their fields. The ERIC Units should become part of this informal exchange. All the members in the cliques who exchange information will need the documentary and pre-documentary services offered by the ERIC Units.

Extensive efforts should be made by the ERIC Units to facilitate the information exchange which caused the formation of these invisible colleges. The ERIC Units can do this through the collection of reports, the exchange of current information at the time that the units are visited, and through the introduction of new members to the groups. Since the ERIC Units will in all probability serve the needs of many such groups, they should attempt to facilitate inter-group communication as well. The level of such communication would be at a different pitch from that exchanged within a group. It is essentially the responsibility of the personnel at the ERIC Units to distinguish the differences in needs visible between the two kinds of communication – inter- and extra-group.

Section 8

SE Education of Users

Libraries already offer services most people do not know about. Those few who told us that they use the services of the trained research librarian are exceedingly delighted with them. We assume that one of the main reasons most people who need information fail to use these services, is that they do not know what services exist or what they can do. The ERIC Unit runs the same danger; its services may not be utilized because the client does not know the services exist or how to use them. The ERIC Units should provide tutorials aimed at teaching its clients how to use services that are provided. The combination of such tutorials with other publicity and with feedback should help to identify those services which are to be kept by ERIC Units, and those which should be discarded for lack of use.

Section 9

Visits at the End of Research Contracts

There are two important types of information flow required in the operation of the research contract. The first occurs when the researcher obtains the information to do the study; the second when he completes the study and defines his findings.

Report literature, in presenting all possible ramifications, tends to hide the important kernals of thought. This is in part due to the absence of a dialog.

We have recommended that the ERIC unit be visited by the researcher at the beginning of a contract, at which time the unit will be the principal supplier of information. We believe that at the end of the contract, the information man from the unit should visit the research site.

In each situation, we have recommended moving the individual to the information, rather than the reverse, because of the browsing value this will have. We believe that the individual can best express a problem in dialog with the information source. This will entail stack browsing and file examination as well as person-to-person communication.

In discussing this idea with researchers, we were interested to know if they would consider such visits an imposition. A few did, but most did not. An important point is that proprietary information need not be disturbed; only the research group need know of it. Also, files may be purged before the visit. Thus there need be no invasion of privacy in these visits.

Section 10

The Role of the State Departments of Education

The research groups in the state departments of education would be able to use the ERIC Centers in the same way that researchers can. The state department's research group differs, however, from the average university researcher. People from the state departments of education will be concerned with many of the ERIC units, rather than just one or two Units. It is quite likely that people at the state departments of education will use the Central ERIC Unit, since it offers both convenience of having to deal with only one location and the additional advantage of having a smaller and higher quality collection of material. Thus, use of the Central ERIC Unit will save the very busy state department research personnel from having to go through too much material that is of low quality or has little relevance to their needs.

An additional problem is presented by the need to pass information on to the practitioners. The state departments of education form logical switching mechanisms. We recommend that they be the channel for transmission of research information from the U.S. Office of Education to the practitioners. To bypass the state department would probably be as ineffective as it would be politically undesirable.

In order to help the state departments disseminate information to the various practitioners, it will be necessary to take additional steps.

We suggest that materials be selectively packaged according to a set of most common interest patterns. This will require continual analysis of teacher interests.

Section 11

Conferences

Most researchers do not attend conferences to hear papers. Papers published at conferences could be obtained in other ways. Researchers attend conferences for people-to-people communication, but satisfactory contacts at large conferences are a haphazard matter.

The ERIC Units as alma maters of the invisible colleges will have established the identity of the participants in particular types of research. Periodic symposia should be held in these areas.

Each symposium should consist of a limited group, small enough to sit around a large table in the same room. The symposium should be semi-structured, i.e., each research group should deliver a previously unrefereed talk on the subject matter of the sumposium. This talk should be followed by an open discussion. Thus we picture the formal part of the meeting as being semi-structured. A totally unstructured part of the meeting can occur in the evening.

This type of symposium and the visits to the ERIC Units may eliminate the need for some visits to other research groups. Attention would center on those whose work is of immediate interest.

Section 12

Quality Control

ERIC Units have the responsibility for the quality of items included in their collections. Two points of critical judgment are already built into the system. The first is the selectivity involved in initial choice of materials included in the collection at the ERIC Unit. The second is in choice of items deemed of sufficient importance to become part of the collection of Central ERIC.

We recommend further critical analysis and quality rating. We were frequently told during our study that the evaluation of research results is more important than dissemination of all results. Persons at ERIC Units will have to be well qualified to evaluate the literature.

They will have visited many of the important research groups and will have been visited by many others as well. They will know what literature is duplicative of work already reported. All that is required is that they have the courage to evaluate.

We recommend two kinds of criteria:

a) Type of report vis-a-vis the kind of need it is likely to satisfy, i.e., encyclopedic, review, bibliographic or forefront research.

b) Absolute quality, as for example of scoring of 0 to 3, in ascending order of value. This could be achieved by a combined scoring by the reviewers at the ERIC Unit, the author, and the agency sponsoring the study, where this applies.

Section 13

Selective Dissemination

We strongly urge the creation of a selective dissemination system as part of the ERIC network. The university researchers and state education department staffs to whom we talked are very much in favor of such a system. Experience in other such systems indicates a high probability of success.

Selective dissemination, in order to be effective, will require constant feedback between the automatic system and the user. Without this feedback, the service would be little more useful to the recipient than fourth class mail. We would run the danger of burying him with the avalanche of material which doesn't fit his needs. Such material would hide and bury the things which are really pertinent to his present needs.

These are five steps in selective dissemination:

a) Obtaining the profile of user interests.

b) Indexing of document.

c) Comparison of user profile with document profile.

d) When significant match is found, sending a copy of the document (or surrogate) to the user.

e) Obtaining corrective feedback and thereby continually correcting the user profile to reflect changes of interest.

The danger of such a system lies in overloading the recipient with useless materials. Hence the need for continual feedback. We recommend the following kinds of feedback:

a) Indication that the item received is of sufficient interest that it was read on the day it was received.

b) Indication that an item is of interest, and recipient intends to read it. This is the kind of item that constitutes the great mass of materials in most researchers' offices. Some of it is eventually read; much of it eventually falls too low on the researcher's list of priorities and doesn't ever get read.

c) Indication that the recipient considers the item junk.

d) Indication of interests not being served by the system — in effect what he is reading that the system did not send him. This will probably be the most difficult kind of feedback to obtain.

Selective dissemination will not replace retrospective search. To be effective it must be offered together with retrospective search service. The reason for this is illustrated in this example:

The researcher is registered as being interested in subjects X, Y, and Z. For a time, he loses interest in subject X and reflects this in his interest profile. A year or two later he becomes again interested, but now lacks the notification of items received by the system in the interim. If he cannot at that time obtain retrospective search he will be reluctant to ever again indicate a lessening of interest in a field. He will become a hoarder of everything remotely of interest, and this of course, defeats the whole idea of the system.

Timing

Large amounts of material sent out at one time results in most of it being filed without actually being read. Certain groups that we visited, such as the State of Utah Department of Education, carefully send out information about the research projects they report on, one project at a time. We feel that the information sent out by the ERIC system should again be carefully parceled out so that no more than two items are sent to any

recipient on the same day. Any saving in postage and of handling by sending large amounts of material is not worthwhile, since the end result is that the material is not read.

Section 14

Data

Almost every research group that we visited had large amounts of unreported data left over from earlier research grants. This data usually was incidental material compiled during the course of research. Time was never available to properly exploit the data, thus it never received notice in the journal publications. If referred to at all in the report literature, it would not have been alluded to under a topic which would have allowed it to be found easily.

Usually the data was retained with the intention of working on it some day. Even when it became obvious that the material would not be worked on because of other interesting projects that now were demanding the time of the researcher, it was not thrown away — it was far too valuable for that.

Most of the researchers to whom we spoke seemed perfectly willing to allow others to use the material. We are sure that they would want a credit, but they seemed to be perfectly willing to allow others to exploit rather than have to duplicate this material.

We do not suggest making the ERIC Units depositories for such data. We do feel, however, that the information men at the ERIC Units should become aware of the unreported-on data at the termination of each contract. This awareness probably can be achieved during the course of the final visit, the visit made by the information men to the research group. The information men would visit the research group long enough to be able to find out about all of the side ramifications of the project.

ERIC Units will be visited at the beginning of projects when the investigator describes his project to the information man. The information man may be able to point out that much of the data that he intended to collect laboriously is already available at a colleague's installation. The decision as to whether to deliver this data of course, would rest with the colleague rather than with the ERIC Unit. We think that in most cases the material would be delivered.

Section 15

Catalogs

The ERIC system should provide catalogs of its holdings, by the subject field of each unit. These catalogs should contain abstracts, and be periodically revised. The question arises as to the desirability of providing abstract cards for individual items, in the manner of Library of Congress catalog cards, or the abstract cards of Engineering Index. This may prove an expense not warranted by a high value to the potential user.

Section 16

Microfiche Versus Hard Copy

Most of the people to whom we spoke had had difficulty using microfilm or microfiche. The attraction of microfiche is the inexpensiveness of reproduction and the small amount of storage required. These features are sufficently persuasive so that ERIC intends to make all material available on microfiche. We suggest, in view of the past complaints about microform, that ERIC maintain an inspection of the use of microfiche by the people for whom it is intended. If the material is not used, but merely stored (while hard copy receives greater usage) an even greater conservation of storage could be achieved by not sending it – even more money could be saved by not creating it.

Experiments are called for – experiments that deal with better microfiche readers and experiments that deal with microfiche readers in the individuals' own offices. The ability to pull material from the files and read it in one's own office would tend to increase use of the microfiche itself. This conjecture should be tested.

Section 17

Audiovisual

The ERIC Units should maintain audiovisual libraries in their fields of expertise. These libraries should be as complete as their printed libraries. The ERIC Units have an even greater responsibility for the evaluation of the audiovisual material than they do for the printed material. This increased responsibility is due to the difficulty in scanning audiovisual material. Thus, the information men at the ERIC Units should be reviewers of audiovisual material. They have a responsibility to recommend films to the different research groups and noting what can best be ignored, considering the needs of those groups.

Section 18

Contract Awards

One of the requests of the research community was to be kept informed of contract awards and of the publication of final reports. We feel that this indeed is a matter of interest to the community and that this knowledge is to the advantage of the U. S. Office of Education. We, therefore, heartily urge that there be a publication announcing contract awards, publication of final reports, and the receipt of solicited and unsolicited proposals.

Section 19

Computer Technology

Our study indicated that the main problem faced in disseminating research information was not a function of the existence or lack of existence of computers. Thus, we feel that the major problem will be solved without actually invoking the computer technology. We do feel, however, that the solutions that we have proposed can be much more efficiently effective through the use of computers. We recommend that the U. S. Office provide computer programs for selective dissemination, retrospective search, catalogs, etc., to those ERIC Units which will have computers available to them. A great deal of effort, time and money can be saved by central production of such programs. This can be achieved by programming an ERIC problem-oriented lang e which then can be translated to the various computer installations.

The specifics of what can be done are presented in far more detail in Reports No. 1 and No. 6.

Section 20

Charges for Services

It is much too easy to ask for everything if there is no cost involved. There are collectors who would ask for everything though they would never use it. We heartily recommend that there be a charge for all ERIC-supplied services. This charge should be applied to research contracts with U. S. Office of Education as well as to individuals. The charge hopefully will aid the U. S. Office in getting feedback as to which of its services are really desired and which have been provided for no real reason at all.

Section 21

DETAILED RECOMMENDATIONS

1. ERIC should continue to be a decentralized system, with specialized information units coordinated by central ERIC. Central ERIC should be the communication link among the ERIC units.

2. Central ERIC should maintain continuous inspection of all facilities operated under contract to it, to assure their effectiveness.

3. Studies should be performed to ascertain in an objective manner the relative effectiveness of various media for transfer of educational information. ERIC's techniques should reflect findings of such studies, as for example, its use of microform should be tied to findings as to how much use is made of this medium.

4. A charge should be made for all services of the ERIC system, to ensure that the services are filling a real need. Such charges should be legitimate uses of contract monies.

5. ERIC units should become information exchange centers rather than merely document clearinghouses.

6. ERIC units should have among their tasks, exchange of information within and among the existing informal networks, or "invisible colleges" — for which the units should become alma maters.

7. The ERIC units should hold yearly symposia. These symposia should be small — should have a very limited attendance. The symposia should not overlap.

8. Acquiring of literature and reading should become a listed direct charge in every research contract of U.S. Office of Education.

9. Every research contract should be priced to include travel to the appropriate ERIC unit, especially in the early period of information gathering.

10. Information personnel from the ERIC unit should visit a research group at the end of its contract, to obtain information of an informal nature, as the researcher did at the beginning of the contract.

11. ERIC units should be responsible for seeing that their potential users are aware of their services. The unit staff should be responsible for educating users in the documentary techniques they provide.

12. ERIC units should be cognizant of unreported data available at each of the research units in its network.

13. The units must strive to anticipate the needs of their users.

14. Each ERIC unit should maintain reference assistance for on-site and remote query.

15. ERIC units should maintain an open-stack facility and desk space for its authorized visitors.

16. ERIC units should have the responsibility of aiding the users in identification and acquisition of materials for project libraries, through the use of the microduplication facility.

17. ERIC units should evaluate the reports they receive. There are two different evaluations to be made. One is to identify the innate quality of the report, i.e., is it excellent, good, mediocre or poor. The other is to establish the nature of the report.

18. The position of abstractors at the ERIC units should be offered as great rewards to be filled for a year or two by post-graduates who are in the process of becoming familiar with the literature of the field.

19. Review articles in the field covered by an ERIC unit are to be written by people at the ERIC unit when possible, or on contract, but always by recognized and respected subject experts.

20. A strong emphasis should be placed upon supplying critical review of research.

21. ERIC files should be periodically purged of obsolete materials.

22. Funds must be provided to ERIC units to allow them to obtain feedback from users.

23. The U.S. Office should make an active effort to collect the queries asked by researchers at the different ERIC units. This will allow it to analyze the information in order to perfect its information dissemination system.

24. Audiovisual material should constitute part of the collection of the ERIC units where members of the ERIC units have a responsibility for both reviewing all their audiovisual material and recommending appropriate films to the proper audiences.

25. We recommend an automatic dissemination system which sends information to users, based upon their interest profiles. Feedback must continually be obtained from people by the selective dissemination system, in order to keep profiles current. Personal contact between users and operators should be facilitated in every way possible.

26. The state departments of education should be encouraged to use the Central ERIC Facility rather than the ERIC units.

27. The state departments of education should act as switching centers for information coming from research groups and being forwarded to the states' school systems and thence to the teachers.

28. Representative teacher-interest profiles should be created so that information sent to state departments of education can be disseminated selectively to teachers whose interests are thereby represented.

29. The U.S. Office of Education should publish research in progress announcements through the ERIC units.

30. Research results and related materials should be sent out by the ERIC system in a spaced-out manner to ensure a high probability of their being used.

31. These announcements should be compiled into a research in progress volume.

32. The U.S. Office of Education should print periodic abstract bulletins covering materials in the ERIC files.

33. The U.S. Office of Education should require production of journal type articles as a final product of research contracts and grants. This may supplement or in some cases substitute for report literature.

34. ERIC should investigate the desirability of providing catalog cards of its holdings to researchers or research groups, in the manner now done by Engineering Index.

35. The U.S. Office of Education should provide bulletins announcing contract awards, publication of final reports, and receipt of proposals.

36. Central ERIC, as well as the ERIC units, should include among its staff, post-graduate interns, who would be chosen from the most highly recommended graduates in education and related fields. These would serve as information persons for the USOE needs, gaining for themselves invaluable knowledge of information resources, and providing a much-needed service.

37. U.S. Office of Education should provide centrally produced computer programs for the ERIC units. These programs should be used for retrospective search, selective dissemination, cataloging, etc.

38. The U.S. Office should continue research in the field of information science as it pertains specifically to the field of education.

39. The U.S. Office of Education should cooperate with other government agencies, professional societies, and academic institutions, in improving and expanding education in library and information science at all levels. Among the ways in which this should be done are:

- Cooperative programs among departments in colleges and among colleges.
- Graduate internships and fellowships.
- Special institutes for continuing professional development.

PART 4

TR-66-15-3

CURRENT AWARENESS

Section 1

THE CURRENT AWARENESS BULLETIN

One aspect of information transfer was considered important enough to warrant a separate item in the statement of work for this study: the need for "current awareness."

This part of the study was stimulated by the National Science Foundation's publication Current Research and Development in Scientific Documentation.

Attached figures are reproduced sample pages from the bulletin, as follows:

Title page
Text
Glossary
List of Acronyms
Index of Individuals and Organizations
Geographical Index of Organizations
Equipment Index

The purpose of such a publication is to alert members of the research and development community in a given field to work by others, without waiting for the publication of formal reports. We wished to find out if members of the educational community feel the need for this kind of publication.

We discussed the NSF bulletin with all of the research groups we visited. It is, of course, familiar to all who are involved in advanced work in documentation and other areas of information science.

With only three exceptions, there was an enthusiastic response, calling for a similar publication for educational research. Our informants pointed out to us similar publications in fields which overlap with educational research, highlighting the same need which the NSF bulletin was designed to satisfy.

1.1 FREQUENCY

Current Research and Development in Scientific Documentation was initially intended for publication every six months. In the early days, when it was small, that schedule was met. For the 13th edition, with 486 pages, it was not possible to come near meeting the schedule.

The nature of each entry is intended to convey the facts which will:

a) Inform people of the nature of research being done, before publication of research reports.

b) Allow new groups entering a field to discover where similar research is being performed.

c) Allow established groups to note the entry of a new group into a field.

The bulletin consists of statements submitted by principal investigators. These statements are of an uneven nature. Some investigators are too humble and report too little; other investigators puff, while still others submit the same information year after year. An accurate, useful publication will require more than the filling of forms by the investigators. It will require careful reporting on the part of those responsible for publication, and careful editing.

The responsibility for such reporting should be assigned to the ERIC Units. These units working through the U. S. Office of Education, should have the greatest competence in noting where research in education is being performed. They are also in the best position to know what is worth reporting.

1.2 SCOPE

During the early history of the National Science Foundation publication it was the practice to accept almost all offerings. This practice was a consequence of the policy of omitting no research group. As the years rolled on, being listed became prestigious; eagerness to be listed is partially the cause for today's large volume. We suspect that greater refereeship is required to eliminate the reports from those who wish to cloak themselves in the mantle of a research group without actually being engaged in research. Thus, one of the major responsibilities of the ERIC Units would be selecting those groups whose work would be reported.

The ERIC Units should also eliminate reports of intended research which over the years remains intended -- never being actually performed.

1.3 ORGANIZATION

The invisible colleges are the embodiment of research groupings. The ERIC current awareness bulletin should, therefore, be organized along those lines. In many instances this will result in broad, interdisciplinary categories.

The ERIC Units, as potential alma maters for the invisible colleges, will be able to define the boundaries of the different groups. A worthwhile service will be offered to those who have not already established their clique relationships by including their work among the descriptions of others in the same clique.

We feel that the research in progress publication should contain:

a) Problem statement
b) Major hypothesis
c) Methodology
d) Expected major findings

1.4 FORMAT AND FREQUENCY

The research in progress bulletin should be current. Reasons of economy prevent too frequent a publication. The repetitive nature of most entries would also keep the material from being read. Further, our study indicates that thick publications are not read; small ones might be. Therefore, we recommend the following two-step action:

a) The ERIC Units should have the responsibility of noting new research contracts. They would then acquire the information needed for the research and development publication. They would send out this information as an individual sheet shortly after the new research effort started. This will provide information much faster than could be done by a periodic publication. It will also reduce the need for a thick document.

b) Individual project descriptions should be compiled and edited in an annual cumulation. This will provide information in one place, and prevent the fliers from becoming unmanageable. The annual cumulation might at some future time become the basis for a much needed annual review of educational research, with critical summaries.

NSF-64-17

CURRENT RESEARCH AND DEVELOPMENT in SCIENTIFIC DOCUMENTATION No. 13

National Science Foundation
Office of Science Information Service
November 1964

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(2) Barnett, Michael P. and Kelley, K. L. "Computer Editing of Verbal Tests. Part I. The EST System," *American Documentation*, vol. 14, no. 2, April 1963, pp. 99–108.

1.3 AMERICAN INSTITUTE OF CHEMICAL ENGINEERS

345 West 47th Street, New York 17, N.Y.

B. E. HOLM, *Chairman, Information Systems Committee*

The experiment with publishing indexing information and abstracts in the American Institute of Chemical Engineers' publications, and also in *Petroleum Refiner*, is continuing, with no change reported since the previous statement (Ed.).

A continuing analysis of the information requirements of chemical engineers is being made, and needed extensions to the program are being developed.

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Reference:

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Several editors of the American Institute of Physics (AIP) journals are using the same method of analysis to obtain statements from authors which describe the basic concepts of research in their papers (1). These statements will provide assistance to the indexers of research papers. Future plans include a continuation of efforts to improve indexes to physics research literature based on analyses of data collected from the survey of research physicists and statements of authors of research papers.

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A new technique developed by Vance Weaver Composition, Inc., was used to prepare several indexes from one typing operation (9). An index entry is typed once on a Listomatic card and additional copies of the Listomatic card are made by Xerography. The cards are then arranged in order, and the index copy prepared by means of sequential-card camera techniques. A sample "Combinded Index" was produced by this method in December 1962.

A comprehensive study of the 1961 issues of *Physics Abstracts* is underway. Quantitative data are being collected in machine-readable form on various items of information. These include the number of articles in the journals of each country for each field of physics, the time lapse between primary journal publication and secondary publication, the language of each article, the availability of translations of articles in cover-to-cover translation journals, and the number of authors per paper. This work developed from a smaller study cited in earlier reports.

Evaluation of the usefulness of an experimental citation index to the literature of physics is in progress. Another study will be made to determine the relationship between citing and cited papers.

Several guides to the literature of physics have been published and cited in earlier reports, or are in preparation (2) (3). These publications are being widely distributed to graduate students, teachers, librarians, and physicists.

The above-mentioned projects are supported by the National Science Foundation.

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(1) "Aid to Indexing," *Journal of the Optical Society of America*, vol. 53, no. 5, May 1963, p. 654.

(2) *Annual Physics Book List.* New York, N.Y.: American Institute of Physics, 1962. Available from OTS, PB 164 183, Xerox $2.60.

(3) *Check List for an Undergraduate Physics Library*, (R–142). New York, N.Y.: American Institute of Physics, October, 1962.

(4) *Current Physics Articles*, Experimental Issue, vol. 0, no. 0. New York, N.Y.: American Institute of Physics, 1963, 43p.

(5) Atherton, Pauline. *Aid-To-Indexing Forms.* New York, N.Y.: American Institute of Physics, September, 1963, 14 p. plus appendix. Available from AIP as Report No. AIP/DRP 63–2. Also available from OTS, PB 164 181, Xerox $2.60.

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An experimental issue of a current-awareness journal was prepared and distributed (4). This journal, in which experimental work is continuing, was designed to include several features known to be requirements for an adequate reference retrieval system (e.g., indication of type of research reported).

A new technique developed by Vance Weaver Composition, Inc., was used to prepare several indexes from one typing operation (9). An index entry is typed once on a Listomatic card and additional copies of the Listomatic card are made by Xerography. The cards are then arranged in order, and the index copy prepared by means of sequential-card camera techniques. A sample "Combinded Index" was produced by this method in December 1962.

A comprehensive study of the 1961 issues of *Physics Abstracts* is underway. Quantitative data are being collected in machine-readable form on various items of information. These include the number of articles in the journals of each country for each field of physics, the time lapse between primary journal publication and secondary publication, the language of each article, the availability of translations of articles in cover-to-cover translation journals, and the number of authors per paper. This work developed from a smaller study cited in earlier reports.

Evaluation of the usefulness of an experimental citation index to the literature of physics is in progress. Another study will be made to determine the relationship between citing and cited papers.

Several guides to the literature of physics have been published and cited in earlier reports, or are in preparation (2) (3). These publications are being widely distributed to graduate students, teachers, librarians, and physicists.

The above-mentioned projects are supported by the National Science Foundation.

References:

(1) "Aid to Indexing," *Journal of the Optical Society of America*, vol. 53, no. 5, May 1963, p. 654.

(2) *Annual Physics Book List.* New York, N.Y.: American Institute of Physics, 1962. Available from OTS, PB 164 183, Xerox $2.60.

(3) *Check List for an Undergraduate Physics Library*, (R–142). New York, N.Y.: American Institute of Physics, October, 1962.

(4) *Current Physics Articles*, Experimental Issue, vol. 0, no. 0. New York, N.Y.: American Institute of Physics, 1963, 43p.

(5) Atherton, Pauline. *Aid-To-Indexing Forms.* New York, N.Y.: American Institute of Physics, September, 1963, 14 p. plus appendix. Available from AIP as Report No. AIP/DRP 63–2. Also available from OTS, PB 164 181, Xerox $2.60.

methods developed with examples of documentation literature concerning the use of nuclides (individual isotopes) in applied biology, insofar as these are not included in *Nuclear Science Abstracts*.

Results include: (a) development of an abstracting scheme, termed a "position abstract"; (b) analysis of about 3,000 publications according to this scheme; (c) setting up of an appropriate thesaurus with 1,000 descriptors and 700 synonyms; and (d) definition and translation of the descriptors in English.

A Flexowriter SPID Programmatic tape typewriter, peek-a-boo cards, edge-punched cards, and ancillary equipment were used in this study.

This project was sponsored by the European Community for Atomic Energy Center for Scientific Information Processing, Automatic Documentation Section, under Euratom Contracts, Nos. 003–60–5–CETD and 028–62–5–CETD, covering the period May 1, 1960 to April 30, 1962, and May 1, 1962 to April 30, 1963, respectively.

Additional work is being sponsored by the Deutsche Forschungsgemeinschaft [German Research Association] on projects to: (a) investigate the possibilities of coordination among several documentation centers using different punched-tape equipment; (b) conduct tests on examples of documentation literature on plant nourishment; and (c) develop a thesaurus in Russian, Polish, French, and English.

Results have included the collection and systematization of about 5,000 keywords, and the establishment of a conversion program between the Flexowriter and the BIMA.

Reference:

(1) Rothkirch-Trach, Karl-Christoph Graf von. *Das Positionsreferat [Position Abstracts]*, Report No. EUR 258.d. Prepared under Euratom Contract No. 028–62–5–CETD. Brussels, Belgium: Euratom, March 1963, 18 p.

3.3 BIRKBECK COLLEGE (UNIVERSITY OF LONDON)

Department of Computer Science,[1] Malet Street, London, W.C.1., England
MICHAEL LEVISON, *Principal Investigator*

Research into the techniques of machine translation and the mechanization of certain aspects of literary studies has continued. The most significant progress has been made in the latter area.

During the past few years, literary scholars in the University have become increasingly aware of potential applications of computers. This has led to a heavy demand for assistance in the preparation of word-indexes and concordances. More than a quarter of a million words, including texts in Greek, Anglo-Saxon, Spanish, and English, have been processed using a Ferranti Mercury computer, and valuable experience has been gained in this type of operation.

Statistical criteria of authorship have been under investigation. In cooperation with Rev. A. Q. Morton of Culross, a large number of samples of Greek prose have been examined, and some interesting results obtained. These have been applied to the question of the authorship of the Pauline Epistles.

The application of computing techniques to literary studies has recently been extended to a new class of problems, namely, those connected with the reconstruction of manuscripts from fragments. Preliminary results are very promising and indicate that the computer should be of great value in this field.

An important event of the past year was the installation at the College of a large data-processing computer. This machine, the ICT 1400, a prototype not in general production, was contributed by International Computers and Tabulators, Ltd., and commissioned with the aid of a grant from the Nuffield Foundation. The additional computing facilities will permit a considerable increase in the scope and extent of the department's activities in the field of linguistics.

[1] Formerly Department of Numerical Automation.

BUNKER-RAMO CORPORATION[1] 3.4

Canoga Park, Calif.
JULES MERSEL, *Principal Investigator*

I. Translation Error Detector (TED)

(Gerhard Reitz, *Project Manager;* H. P. Edmundson, L. Ertel, P. L. Garvin, C. A. Montgomery, and S. B. Smith)

A computer program, TED, which detects and classifies certain types of discrepancies between professional human translation and Thompson Ramo Wooldridge's machine translation has been coded and run. Output from this program is being analzed and employed in a study for contemplated general revisions of the present TRW MT technique. The program provides for the extraction of all errors of a particular kind. A second program which is currently being coded extracts all Russian sentences which contain a particular Russian lexical item under investigation along with the corresponding English sentences.

This research is supported by the National Science Foundation.

II. Semantic Research Technique

(Jules Mersel, *Project Manager;* Steven B. Smith, *Associate Project Manager;* L. Ertel, Paul L. Garvin, C. A. Montgomery, and G. Reitz)

A semantic research technique was recently developed and employed. This technique makes possible the construction of semantic classes of words which

[1] Formerly Thompson Ramo Wooldridge Inc.

"The Verbal Loop Hypothesis:
Journal of Verbal Learning and

"The Verbal Loop Hypothesis:
ed in the *American Journal of*

Glossary

This glossary is not intended to be inclusive for the field of scientific documentation but rather is intended to serve as an aid to understanding some of the specialized terminology used in project descriptions in this issue of the report series. In all instances the definitions are presented essentially as provided by the project investigators. Each definition is followed by section-article numbers which denote the descriptive statement(s) in which the term is used.

CLIQUE—A group of objects each of which is directly associated with every other. (2.99)

COLLATING INFORMATION RETRIEVAL SYSTEM—An information retrieval system in which the main data store consists of composites formed from input documents. An input document is compared against the data file to add information to existing composites or to select composites which will be merged with the input document to form one or more new composites. The input documents are retained in secondary files. (2.113)

COMPOSITIONAL GRAMMAR—The compositional grammar is a mapping scheme which associates to every set of strings A (over a finite set of symbols W which contain the symbol *) a set of strings K(A) in the following way: (1) ACK(A); (2) if $a_1 \ldots$, $b_1 \ldots$, $c_1 \ldots$, $d_1 \ldots$, are infinite sequences of strings, the members of which (except a finite number of the first ones) equal the identity symbol, then it holds: if $a_1b_1 \ldots$, $a_1d_1 \ldots$, $c_1b_1 \ldots \in K(A)$, then also $c_1d_1 \ldots \in K(A)$.

Let V be a finite set of symbols, $*_\epsilon VW = VU[*]$. The set of strings C over V is called a compositional language, if there exists a finite set of strings A over W such that the set of strings C is obtained from the strings of the set K(A) by leaving out the symbol C. (5.3.22)

CORRELATING—A particular kind of combination which consists of giving the results of other operations a temporal order. (5.4.36)

DIFFERENTIATION—A change of state whose results are the *differentiata*, which are taken as the indivisible elements in the analysis of mental activity. They can be described in terms of the change in the organ which produces them, or by indicating the opposite differentiatum, or by indicating the conditions under which we carry out this particular change of state. Examples of differentiata are "light," "dark," "hot," and "cold." (5.4.36)

EMIC—An emic unit is one that is structurally relevant within the language. (5.3.33)

Index of Individuals and Organizations

The statements have been assigned consecutive numbers within the various sections. The "Section—Article" column below denotes the numbers of the section and article from which the indexed entry was taken. The letter *r* indicates an author in the list of references following statements.

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Equipment Index

Part I consists of an alphabetical index to all equipment, devices, and storage media mentioned in the statements. Part II classifies equipment according to some of the general categories of use. The numbers following the index entries denote the section and article in which reference to the specific equipment is made.

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PART 5

TR-66-15-6

DATA PROCESSING FOR CURRENT NEEDS

Section 1

INTRODUCTION

The goals of the Educational Research Information Center as currently being defined and developed in the U. S. Office of Education will encompass a wide range of activity which demand immediate consideration of data processing solution. Inasmuch as application of computers and data processing equipment to the problem is only one of several important computer applications in the Office of Education, the requirements for ERIC should be evaluated in the context of the overall requirements in the Office of Education. Consideration should be given to the possibilities an integrated systems approach to the data processing needs of the office as a whole. The advantages (and disadvantages) of joint computer usage in a central facility should be evaluated in a thorough systems study of the problem.

Basically, there are two possibilities:

1) The development of a computing facility for ERIC.
2) The use of a centralized facility for use by ERIC and by others.

This report, however, does not presume to make a judgment on this basic issue. It is primarily concerned with a discussion of the data processing needs of ERIC. It considers a somewhat larger area than the ERIC functions, as currently outlined, however. The approach is that of considering the problem from the standpoint of an aggragate of closely associated functions for which data processing techniques are particularly suitable. Many of these functions are currently being performed or are in the process of being developed by ERIC. Others are performed elsewhere in the Office of Education and yet others, not at all. This report does not

address itself to organizational or administrative matters and therefore, it should be understood that there is no intention to comment on the roles of the various organizational divisions in the office. Accordingly, it seems appropriate to refer to the unit(s) which would coordinate the functions considered herein as a "National Center". This term is understood to constitute an organization with a similar but somewhat broader mandate than ERIC.

The term "field unit" is used herein, and is equivalent in all important respects to the term ERIC satellite, ERIC clearinghouse, or ERIC unit.

1.1 DEVELOPMENT OF THE NATIONAL CENTER

The state-of-the-art in information systems is quite advanced and the technology is subject to advantageous exploitation by the Office of Education.

In many respects the Office is fortunate that it will be in a position to design a data processing system initially and not have to evolve from a manual system. Since this will not consist of simply automating existing procedures, the pitfall of perpetuating the inadequacies of a long established system may be avoided.

However, the development of an adequate system which will satisfy the critical information needs of the educational research community is one which will require careful analysis and system design. It is recognized that implementation of an effective capability may not be accomplished immediately. During the interim period prior to the implementation of what may be regarded as a satisfactory information system, those needs may not be neglected. Accordingly, the efforts towards these ends should be channeled in two parallel and concurrent undertakings.

1) Satisfaction of the information needs of the educational community by the methods which are immediately available and realizable in the immediate future.

2) Immediate initiation of a system study to determine an approporiate solution to the data processing requirements of the "National Center" and of the Office of Education.

The emphasis of this report is on the effort described in 1 above, but the assumption is made that the system study is also undertaken so that an orderly transition to the expended capability as called for by the urgency of the problem will be possible.

1.2 EQUIPMENT CONSIDERATIONS

The total experience in business and scientific data processing is immense. For the development of a system circa 1968 therefore, the designer falls heir to a wealth of technology of such scope that a shopping-list approach to the problem of equipment acquisitions is possible.

In the area of computer development, in particular, the requirements of the problem for the national center are so well within the state-of-the-art that it is not necessary to think in terms of advanced developments but rather on the somewhat simpler scale of most computation for the money.

The possible use of optical sensing equipment, however, presents the possibility of using equipment which is on the forefront of technological development, and therefore on the fringes of technical acceptance. In the area of software development also, new techniques and tools currently being developed give promise to provide further leverage and power in program production.

The emphasis of this interim report is not directed toward offering recommendations concerning equipment acquisition, since we believe this should result from a thorough system study with the benefit of

all possible input to the problem. In particular, an intimate knowledge of all constraints – organizational, personnel, fiscal, and policy – is an absolute requirement.

1.3 SERVICES OF THE NATIONAL CENTER

The functional relationships of the national center are depicted in Figure 1-1. The organization of this chart illustrates the importance of a computerized data base. It is noted that the services listed are no more extensive than those provided by several other information centers. The particular services shown have been chosen arbitrarily for purposes of illustration for discussion of data processing requirements.

The imposing of the functional services of the national center upon a realistic time scale is an important output of the system study which is recommended. Although premature, an attempt at such an analysis is shown in Figure 1-2. This chart suggests a particular chronology of events for development of data processing capability and is used as a basis for the discussions to follow.

The assumption is made that the parallel efforts described in Section 1.1 are undertaken. The period during which an interim capability is developed is designated as Phase 1. Phase 2 refers to the time period after installation of an integrated computing facility. The emphasis of this interim report is on the Phase 1 period.

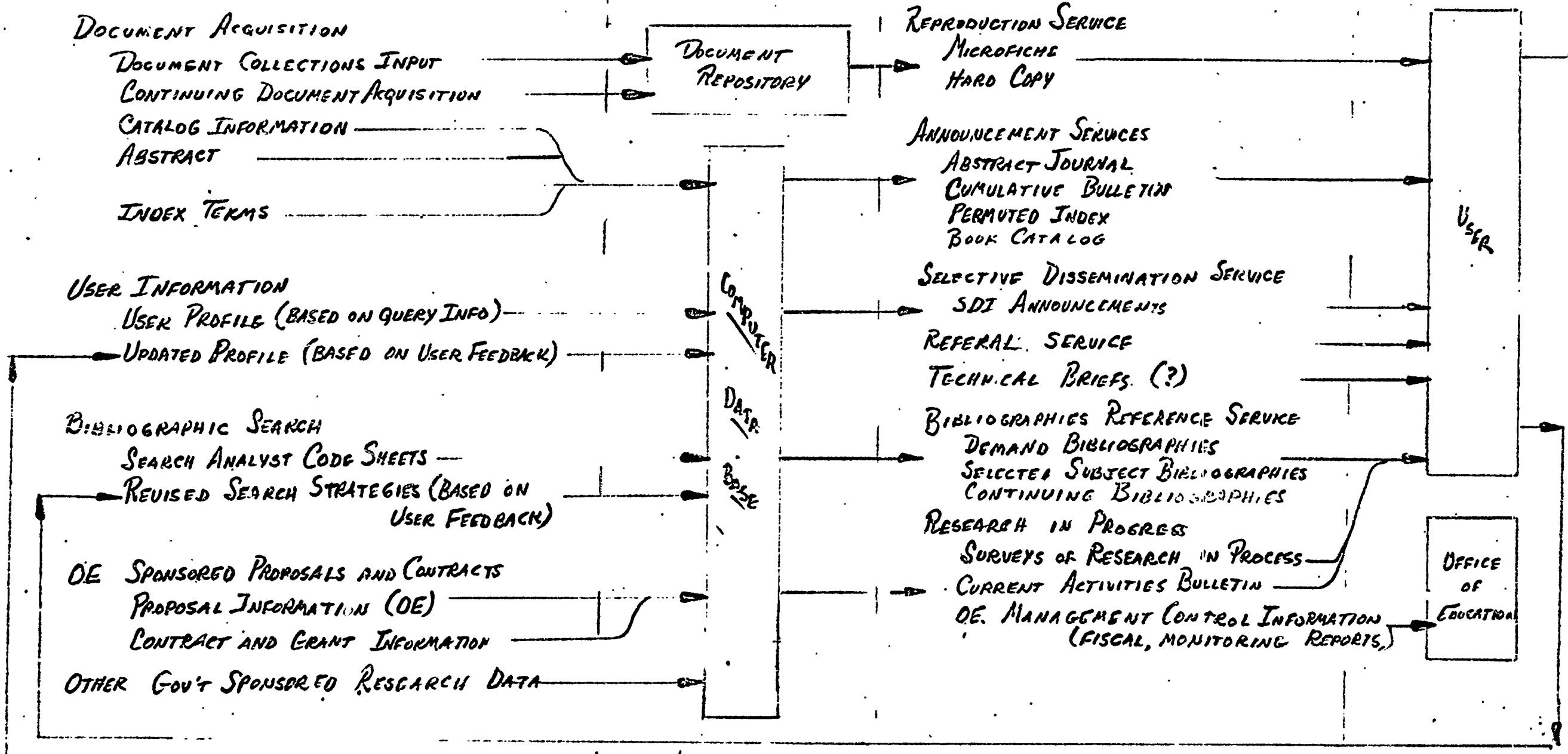

Fig. 1-1. Functional Relationships of the National Center

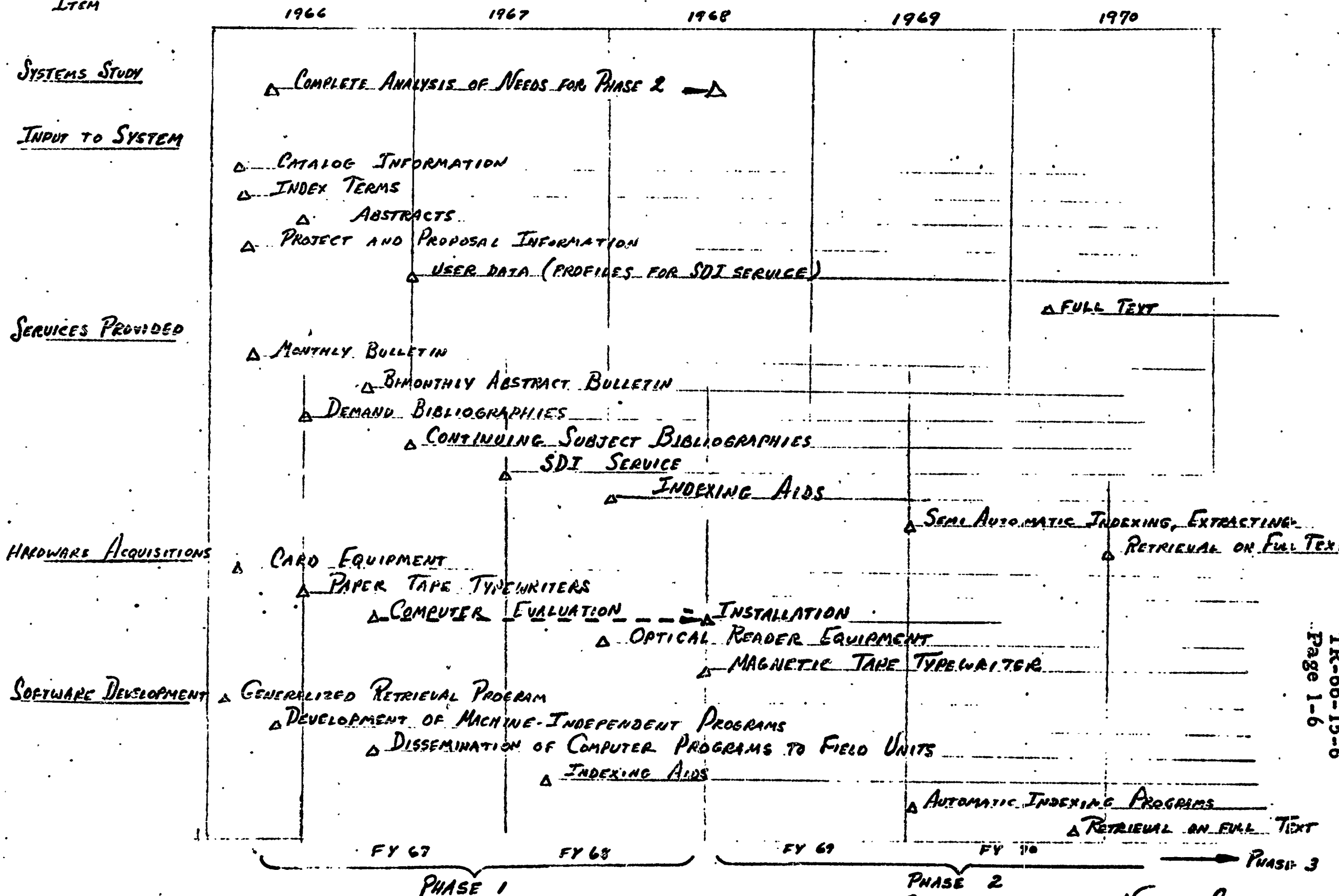

FIG 1-2. ILLUSTRATION OF TIME-PHASING OF DATA PROCESSING CAPABILITIES FOR THE NATIONAL CENTER

Section 2

THE FUNCTIONS OF THE NATIONAL CENTER

The current philosophy of ERIC favors decentralization. The establishment of regional information centers is intended to relieve the national information center of many of the information gathering functions, as well as the processing ones, such as indexing and abstracting. Many of the dissemination functions are also expected to be performed from the field units. In pursuing this course, the national center will be able to concentrate its resources in the areas of greatest need which is that of coordinating the efforts of the field units as they are being started and the development of a computerized central facility.

Currently, ERIC has segregated the dissemination function as a separate function performed by the ERIC Reproduction Service. This solution has further simplified the task of the central activity and is regarded as satisfactory for the interim period until a fully operational system is defined.

However, the necessity of providing the necessary publications to serve the "current awareness" needs together with the requirements posed by other specialized services, demands that a considerable capability be developed immediately.

The nature of these functional requirements was indicated in Figures 1-1 and 1-2 and further discussions are found in the paragraphs to follow.

2.1 ANNOUNCEMENT BULLETIN AND BIBLIOGRAPHIES SERVICE

A basic service to be undertaken is the publication on a continuing basis of a bulletin designed to make the user aware of currently

completed reports. Initially this bulletin will contain only an index according to title grouped according to subject headings and will be published monthly. At a later time the scope of this activity will increase to include the preparation of a complete abstract bulletin with citations and organized according to each of several indexes. It is also anticipated that the frequency of the publication will be increased to bi-monthly.

Cumulative indexes will be prepared quarterly with the same information as the announcement bulletins. The fourth quarterly cumulative index will list the items for the entire year.

The announcement bulletin will carry the cataloging information such as title, author, abstract, index terms, etc. It will also carry an alphabetic listing of the index terms for the document and the traditional author and organization indexes. In addition to the combined announcement-abstract bulletin, the center will issue continuing bibliographies in particular fields of continuing interest. These bibliographies are essentially a repeat of the abstract portion of the announcement bulletin. The items are chosen through various Boolean combinations. The selection process is similar to that used for demand bibliographies. The choice of criteria, however, should be performed only by those with subject knowledge. The continuing bibliographies, since they are expected to have a wide distribution, would undergo the same printing process that the announcement bulletin receives. On occasion the center will issue special bibliographies. These may occasionally result in the initiation of a continuing bibliography.

The center will quite naturally have early cognizance of a large amount of activity in a new field or an unusually large increase in activity in an already established field. Upon such notice, a special bibliography of the work in that field will serve to call attention to this unusual amount of interest to all users. The bibliography will perform the function of giving current awareness to those interested in the full literature of the field receiving this burst of activity.

2.1.1 Demand Bibliographies

A bibliography service will provide the capability for preparation of selective bibliographies, using a computer search program. The search will be made on the currently updated master file.

The bibliographies are prepared on the basis of user requests as interpreted and defined by the search analysts at the national center. The search analyst prepares input to the search program in terms of logical search equations prepared on search coding sheets. These sheets are keypunched into a deck suitable for computer entry. Input of the demand bibliographies are batched for the day (or other suitable interval) and are processed by the search program against the master file. The user should specify in his request the size of the bibliography he wishes within bounds (e.g., 1 - 20, 21 - 50, 50 - 100, 100+), in order to help the search analyst select the appropriate search strategy.

The output of this program is a listing of the references which satisfy the logical equations. The design of the search program should be sufficiently flexible to permit retrieval of not only document references but also references concerning research programs in process. One of the input parameters to the search process would specify which of these types of information is desired.

2.1.2 Audit of Bibliographies

The finished computer items will be referred to the search analyst who processed the request so that he can verify that it satisfies the requirements. In case the results are insufficient (e.g., if the size of the bibliography is not within the requested limits), the search strategy may be modified and resubmitted.

The audit of the bibliography results should not be expected to yield much information regarding the accuracy or relevancy of the results,

however. Feedback from the requestor must be the primary source of determining relevancy, and every effort should be made to induce a response from the requestor.

2.1.3 Continuing Bibliographies

The programs required for continuing publications are almost identical to those required for the demand bibliographies. The differences between the two bibliographies arise in their reasons for creation rather than in their mode of collection. Continuing bibliographies will permit selection of cut-off dates to eliminate documents that were written before an arbitrarily chosen date. It is also presumed that the large population interested in the continuing bibliography will cause that bibliography to be printed using the full printing technology that is devoted to the announcement journal. Demand bibliographies on the other hand will be more individually responsive, and will probably be output on high speed printers.

2.2 SELECTIVE DISSEMINATION

Under the usual operation of document retrieval, the requestor searches the file of items already within the library. He formulates his request in index terms in the form of logical equations. Selective dissemination is somewhat different in that the requestor indicates the nature of the documents in which he has an interest; he then expects to be made aware of any documents that enter the collection and that fall into this classification. Effective selective dissemination is one of the necessary devices in providing current awareness.

The mechanical operations of selective dissemination are similar to those of document retrieval. In document retrieval, one places specific index terms against the whole store of the library. In selective dissemination, one places the whole spectrum of an individual's interest against the store of recently acquired documents. The difficulty, of course, is determining this

profile of interest. One can, of course, ask the individual what he wants to receive. Presumably, an intelligently worded query could unearth the synoptic interest of the client; such criteria are more satisfactorily provided by observation, however.

The query technique of establishing profiles must be pursued in the initial process of first establishing a profile. Though it is fairly sound to conclude that he who does not use a library is not really interested in documents, a policy cannot be formulated from such conclusions. Such a policy could probably result in most potential recipients being excluded from the distribution list.

Reasonably sound dissemination profiles can be created through observation of the behavior patterns of the recipients of the material. The behavior patterns can be observed through document requests. The index terms of the requested articles form excellent material for updating the selective dissemination profiles. A computer can be used to examine the index terms of those articles requested versus those articles whose announcement has been selectively disseminated but which were not requested. This information gives a clear picture of what the reader is interested in.

The initial answers to a query system include a large amount of information about what the client feels he should be interested in. The second source of information comes from the articles cited by requested documentation. These citations give an opportunity to widen the dissemination spectrum of an individual profile.

The observations concerning requests provide a capability of narrowing the profile. Observations of the index terms of the articles cited offer an opportunity for widening the profile.

It is apparent that the effectiveness of a program of SDI depends upon the input of user information into the computer store which may be modified and updated on a continuing basis.

Important conclusions about quality can be inferred from the reaction of recipients of the new material. A failure to read the material provides some indication. Actual comments, if the material is read, provide even better criteria. An attempt should be made to experiment with this feedback information to provide better guides to the recipients for future retrieval.

Section 3

EQUIPMENT CONSIDERATIONS

The emphasis of this report is methodological. Therefore, recommendations concerning equipment selection for the operation of the national center are limited to a presentation of alternatives which at this time are candidates.

The emphasis of effort in the immediate future should be channelled and concentrated in the area of system study and design. A principle output of this effort is an equipment evaluation to determine the equipment acquisitions for a system configuration which is deemed adequate to provide the necessary capability.

It is recommended that data processing equipment acquisitions for the interim provisional system should be kept at a minimum and be limited to the necessary input and conversion equipment necessary for computer entry of the input. Lease arrangements for equipment of this sort will permit a flexible attitude toward the eventual hardware configuration.

A postulated phasing of hardware and software development was depicted in Figure 1-2. It is noted that the steps shown are intended to be illustrative, not definitive and therefore, do not constitute recommendations. The scope of our study does not permit such a position, nor do we have sufficient information to make the necessary determinations.

It is possible to comment, however, on the likely applicability of various types of equipment and to make limited judgment concerning the appropriateness of the possible uses.

The discussion to follow treats the data processing equipment under three headings:

1) Digital computers
2) Input equipment
3) Output equipment

Excluded from the latter type are reproduction and publication equipment and microform devices which are not considered as a part of the data processing topic.

The purpose of the discussion is:

1) To provide statements concerning the factors which should be considered as a basis for selection.
2) To indicate whether the technology is within the state-of-the-art.
3) To relate the potential usefulness of the equipment under discussion to the overall system operation to be developed.

3.1 COMPUTER EQUIPMENT

The tools which are used for document retrieval in the large information centers are for the most part not designed uniquely for this application. Exceptions to this are the various types of specialized input equipment designed for input of textual information, or the Graphic Arts Composing Equipment (GRACE) used by MEDLARS at the National Library of Medicine. From a commercial standpoint, manufacturers have usually found it advisable to offer a conventional capability which is attractive to a larger number of potential buyers, rather than a specialized device for which development amortization is spread over a narrower base.

Performance characteristics of currently marketed digital computers have advanced to the point that we would expect the most powerful machines to overpower the problem. It is noted that development of the so-called third generation computer equipment (typified by the IBM

System/360, RCA Spectra 70 of CDC 6800) represents an advance of an order of magnitude beyond its predecessors. The problem resolves to a selection of computing capability which is in the most favorable position on cost/performance curve for applications of this sort.

The foregoing remarks do not discount the possibility that the advances in computer technology may permit computer uses not possible before. The speed advantages and greatly increased computer storage capacity together with advanced telecommunication equipment give promise for new applications such as on-line query systems which could retrieve on the basis of a full text data base. This usage is of interest only in a post phase-two time period, however.

3.1.1 Computer Evaluation

The current computer capabilities available to the Office of Education at the Department of Health, Education, and Welfare computing facilities, while adequate for immediate requirements can only be judged as inadequate for the Office of Education's long-range needs. Once again, it must be pointed out that this report makes no comment on the advisability of joint usage of computing facilities for users in the Department; or of the advisability of joint usage by the functions currently performed by the National Center for Educational Statistics and those proposed for ERIC. Such determination should be the subject of a systems engineering study and is beyond the scope of this report. The assumption is made, however, that the performance of the functions outlined in this report should be delineated and made sufficiently independent so as to avoid a compromise of the vital mission of this undertaking.

It is therefore assumed that at some point in time, the requirements of the Office will be evaluated. If a determination is made that acquistion of computers and other data processing equipment is called for, a computer evaluation study should then be undertaken. The steps for such a study are well known.

In summary, a study of the types of computer tasks to be performed is made. From this analysis test problems are designed. A usual practice is to submit the test problems to manufacturers for solution. Results of such analyses are subject to many possible sources of error (e.g., misinterpretation of the problems, varying programming techniques, assumptions tinted by sales optimism, etc.). It is therefore recommended that such studies be undertaken either in-house or by an independent contractor. The performance characteristics derived from such studies usually emphasize the capability of the central processor. It is important, however, not to neglect such considerations as input-output capabilities and peripheral equipment compatibilities. The latter is particularly important as it affects the degree of interchange of information between the national center and the field units. Another aspect of particular significance is the amount of software support (programming assistance and program packages provided by the manufacturer) to be expected.

3.1.2 Instruction Repertoire Characteristics

The characteristics of this type of computer problem pose no particularly unusual requirements. The typical repertoire of the commercial general purpose computer is largely adequate. For the type of processing required, the instruction repertoire should feature the following:

1) Bit, character, and variable field manipulation
2) Table searching capability
3) Flexible addressing (e.g., literal, direct, indirect)
4) A strong set of logical commands

Although analysis of instruction repertoire is meaningful, it is likely that other considerations will prove more important. For example, a doubling of computer memory access speed would far outweigh an improvement in the logical design of the instruction repertoire.

3.1.3 Compatibility With Field Units

The choice of computer equipment could be made on the basis of selecting equipment which is compatible with the computer equipment at the computer installations in the field. Present indications suggest that computer uniformity among the field units or even a high degree of computer compatibility is out of the question.

Although hardware compatibility is not possible on all levels, it is important to stress compatibility and standardization in the areas of formats, data code usages; e.g., ASCII, and to establish at least a few equipments of nearly universal use (e.g., card equipment, microfiche readers, and, perhaps, standard font typewriters for printer reader use). The problem of compatibility is discussed in greater detail in Section 4.2.

3.2 CONVERSION OF INPUT

Perhaps the most significant and immediate equipment problem is the selection of input equipment. For this function, a number of alternatives are worth consideration.

Included in this class of equipment are punched card equipment (reader, and punch), and, paper tape equipments (reader and punch) associated with typewriter keyboards for converting documents information into forms acceptable for computer processing. Another kind of typewriter input uses magnetic tape as the storage medium.

Apart from the selection of the input method and input media (i.e., card, paper tape, or magnetic tape), the possibility for direct input (on-line) from several terminals is a possibility.

3.2.1 Punch Card Equipment

The use of punch card machines is particularly compatible with the use of computer equipment. Such equipment approximates

most closely the common denominator which is most likely (perhaps certain) to be at each data processing installation in the field units.

However, in the applications of primary interest, which is the input of textual data, this equipment has severe limitations. These are:

- The limited character set is insufficient.
- Need for the variable length records would require that too many cards be punched for each input document. (3-5 cards)
- The physical storage requirement and the cost factor is higher than for competitive methods.

For the volume of input anticipated, such equipment is much more expensive than other media.

From the standpoint of computer input of limited data, e.g., preparation of programs, input of search equations for demand bibliography, card input is appropriate, and is likely to remain the industry standard into the next decade.

An important advantage of such equipment is that the information contained on cards can be readily rearranged by a physical reordering of the cards. This may be done automatically by EAM equipment (e.g., when cards are sorted), or, manually, as when a programmer rearranges the routines in his program, inserts or deletes cards, etc.

3.2.2 Paper Tape Typewriters

The paper tape typewriter is composed of a number of elements. It has (1) a keyboard similar to a conventional typewriter keyboard, (2) a printing unit for printing characters either by manual keyboard action or under control of a (3) paper tape reader, which is capable of reading a perforated tape, and a (4) tape perforator (punch).

The primary advantage of such equipment is in providing to the input function the convenience of the ordinary typewriter. Use of paper tape is not highly regarded by the computer programmer, since it is in many respects an awkward medium, and somewhat unreliable. For textual input, however, it is much cheaper than the use of cards (approximately twice as cheap) and is much more compact physically. A typical punched card contains 80 characters of data while a punched paper tape record may contain thousands of characters.

The paper tape typewriter is recommended as the appropriate input device for textual information for the interim Phase I period until more satisfactory equipment can be used for the input functions.

The use of typewriters as input console terminals in an on-line system is also a possibility which has considerable merit. This is discussed in a section to follow.

3.2.3 Magnetic Tape Typewriters

This equipment, although much more expensive, incorporates many advanced features including automatic programmed tape search and electronic correction of mistakes. Storage is on magnetic tapes cartridges and it is possible to combine the stored information at different tape stations and merge material stored at these stations.

This equipment would be particularly effective for editing and proof-reading. The storage and recall capability could be used for indexing since it would be possible to store the thesaurus at a tape station. The preferred terms could be recalled and their respective place in the hierarchal authority list could be printed out for the benefit of the indexer. Since the bulk of the indexing function is to take place at field units, however, this application would have limited use.

Before selection of paper-tape typewriter equipment, the possibility of using magnetic tape typewriters should also be investigated to see if they could be justified on an economic or other basis. One of the potential problems to be resolved is the method of conversion from the magnetic tape cartridge to a form suitable for computer entry (e.g., via the conventional tape drive equipment).

3.2.4 Optical Character Readers

The primary input of document information, currently, is in the form of the ERIC resume. However, since the transcription to a form suitable for computer entry represents a substantial effort, every effort should be made to capture newly generated information directly in machine processable form. Although it is recognized that initially the transcription will provide a form of editing and quality control to assure that standards are maintained, as uniform procedures are developed it will be more appropriate to perform these functions as a separate activity. Print-reader equipment for the purpose of entering the document information into the computer data base presents a possibility of substantial savings.

Optical readers are becoming a practical reality in several important data processing applications. Advances in optical sensing systems have changed the industry attitude from one of expecting unreliable performance to that of solid respect.

This technology is one which might be termed as "emergent". The readers now in use are largely high price, limited font and low capacity. Equipment currently being developed however, has the capability of recognizing multiple fonts at speeds in excess of 1000 characters per second.

The volume of input in the immediate future (Phase I) does not justify use of such equipment. However, within two or three years a

combination of factors may cause this solution to the input problem to be increasingly attractive. Some of these factors are:

1) Improved capability and decreased cost of optical scanners.

2) Field units will be a position to use standard fonts, which will result in consistency of procedures. Standardized procedures will result in uniformity of input.

3) Increased volume of input.

4) The system design resulting from system studies may be developed to effectively utilize this capability.

The appearance on the market of relatively low cost, reliable, multiple-font page readers is expected by 1968. Such equipment can be justified on a differential cost basis if the volume is sufficient. The national center is in a good position in the initial phase of development to require standardization to the extent of prescribing the use of machine readable font (not necessarily limited to one, however) by those preparing the input form.

For the interim transition period the use of standard equipment, a combination of punched card equipment and paper typewriters can effectively handle the input requirement.

3.2.5 On-Line Terminal Operator System

A system approach to the input problem is the use of input terminals corresponding to the various functional stations which are directly on-line to an electronic computer. The console terminals for on-line systems are often assumed to be extremely expensive equipments with sophisticated display and feedback characteristics. It is also possible however, as is assumed here, to use a simple keyboard device similar to a typewriter.

There is frequently a concern among potential users of such terminals that they are tying up an expensive computer as they type in at slow human reaction speeds. This is not necessarily the case. In effect, the terminal will present a character to the computer which will accept it at microsecond speeds and then revert to other activity (programs) until the next character is ready.

The system is ordinarily centered about a relatively small computer, which contains a specialized set of programs. These programs contain the control and functional logic for various text processing activities. Such systems are currently used for other applications.* The advantage is that the unit records are compiled as they are entered and do not require a later computer run. The input function could be effectively segregated in this one system. The resulting unit records could then be transferred periodically and merged with the master file.

This approach also provides the possibility of connecting remote terminals into the system as well. The system configuration is highly conjectural and it should be pointed out that the terminals shown are intended to illustrate the types of functions which could be performed. It is likely in actual practice that many of the functions would be performed at the same station. It is also possible that for those functions representing high volume input, several duplicate stations would be required.

Although the current implementations of such systems are limited in number, the emphasis on on-line computation, and man/machine relationships is increasing dramatically. It is expected that by the start of Phase 2, many such systems will be marketed. The primary advantage is in the area of on-line recall, review, and editing of the input. Another possibility would be the use of on-line terminals in conjunction with optical reader equipment, thus limiting the input problem of the national center to one largely of quality control.

*For example, the IBM 1440/1460 Administrative Terminal System and the Scientific Terminal System for the same configuration.

There are at least two applications for such a system in the Office of Education. (Figure 3-1)

1) Input of ERIC resumes

2) Input of management control information for control of USOE sponsored proposals and contracts.

Although the idea of such a system is conceptually appealing, it should be studied closely from the standpoint of differential costs. The basic difference in this system is that the input is immediate and the unit records are composed as details of input, rather than batched as paper tape or card deck input. It is therefore possible to separate functions among the various stations with greater flexibility. It is also possible to request output of selected data or "recall" current input. This is particularly important for the editing and proof-reading activities.

3.3 OUTPUT EQUIPMENT

Printing will be the main form of communication between the national center and its users. Some communication will be oral. Eventually communication may be achieved through client use of the on-line terminal devices.

Until recently, quality printing was not associated with computers. The imagination of the computing industry was occupied by the newer tasks of extremely fast computation and high data transfer rates.

This is no longer so. The computing industry has been concerned with adding quality to an already achieved fast output. The printing industry is adding the speed and reliability of computer controls to techniques for printing.

3.3.1 Computer-Driven Printers

The original computer printers were of two types. Some early computers produced paper tape or magnetic tape which was used to drive typewriters.

INPUTS PROCESSING SUB-SYSTEM

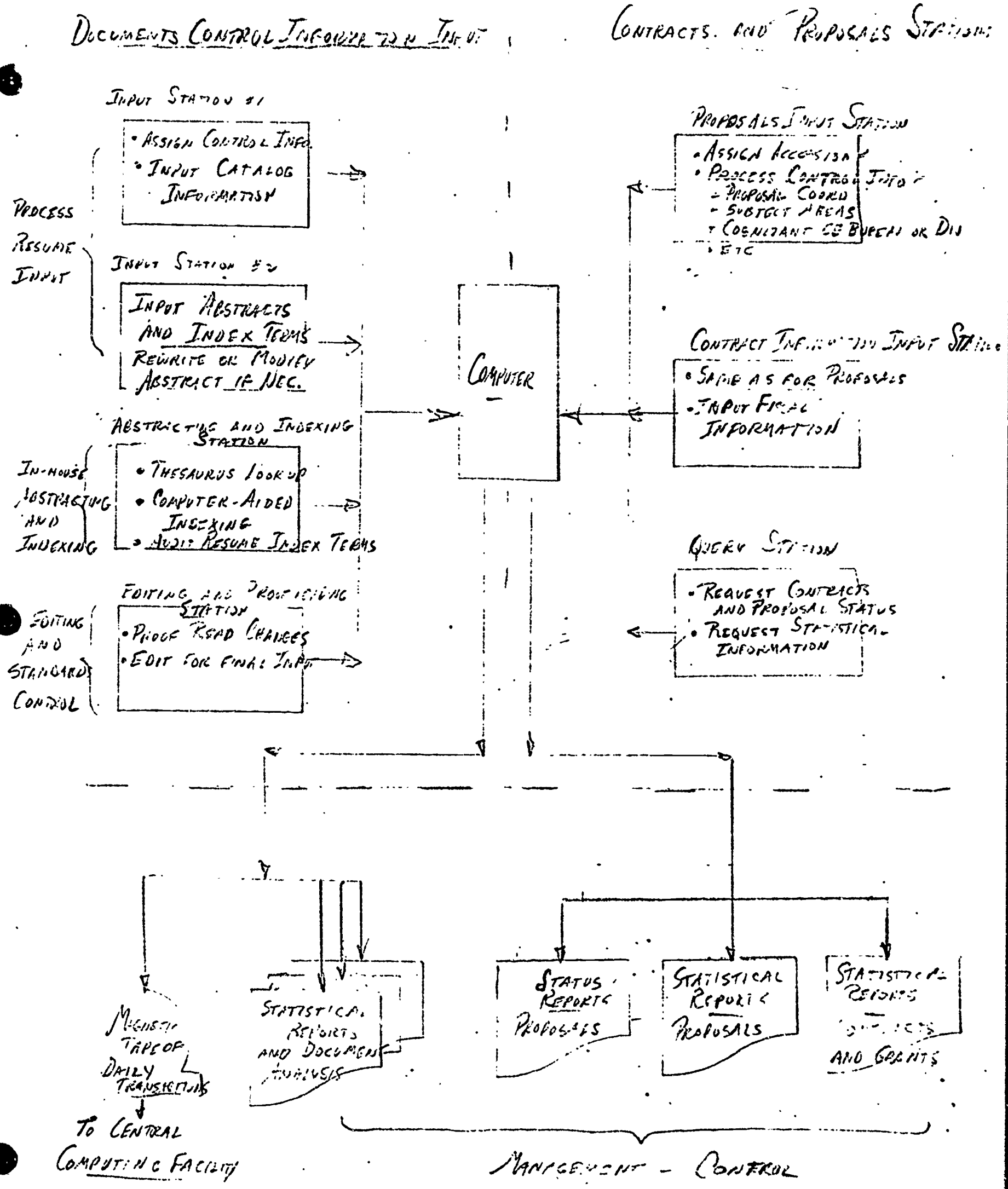

FIG. 3-1. ILLUSTRATION OF USE OF ON-LINE TERMINAL SYSTEM FOR DOCUMENT CONTROL INPUT, AND PROPOSALS AND CONTRACTS INFORMATION

The initial line printer had a limited set of characters. Added charges were imposed if one wished the ability to use the alphabet in all positions on the line. The quality of output was decidedly inferior to that which could be obtained by a typewriter.

The quality of line printer output remained poor for many years. Any attempt to improve the quality was quickly undermined by the need for greater speed to keep up with computer output.

In the past five years the desire for quality has overtaken the desire for speed. IBM reduced the output speed of its printer and dramatically enhanced the quality of the output.

The IBM 1403 produced better quality than the earlier line printers. Until recently it retained the line printer defect of having too few characters. The capital letters of the alphabet, the numerals and a few special characters were all that could be printed. By slowing down the 1403 printer it is possible to have 120 different characters. Thus upper case, lower case, and a much larger number of special characters are available as well as the digits. The appearance of the output is comparable to what can be expected from a good typewriter. It is thus possible to obtain high speed and upper and lower case representation of the output.

3.3.2 Use of Computer Printers

The quality available through the use of computer printers is such as to detract from the apparent quality of the information content. Years of training have taught us to judge books by the cover and by the craftsmanship of the printing art. Thus, the quality of computer output is psychologically acceptable only when the recipient views the output in another frame of reference. Computer output is acceptable if it comes

in response to a specific request. It even retains a hint of the personal relationships implied in a handwritten letter when the subject matter is specific to the user. Thus, one can see computer output as being a normal mode of operation for demand bibliographies or selective dissemination lists or for the individual catalogs that are tailored to the specific recipient.

One of the machines that has lent itself to computer control has been the Photon. This printer possesses a character set of 1,440 different characters. Though all 1,440 characters are of the same type size, twelve different lenses are used to determine the output type size. Any one of these lenses can be replaced by a prism to achieve either superscript or subscript printing. The Photon can be directed to operate automatically in any one of four different justification modes. Hyphenation must be performed before the information is presented to the printer. The quality of Photon output is demonstrated by its use in the production of Time-Life magazine books.

The Photon is slow. An overall speed of five characters per second is all that is obtained when using the full character capability. Special Photons entitled ZIP or GRACE have resulted from the Medlars Program. Here, increased speed has been achieved at the cost of a drastic reduction in the number of characters that had initially been made available.

Merganthaler has also produced paper tape drive photo-composition equipment. Their technique utilizes 18 different fonts of 88 characters. Special converters are needed to transform the ordinary computer output to output acceptable by the Mergenthaler Linofilm.

The Government Printing Office has a photocomposition printer under development. This printer is to operate from computer provided magnetic tape. It was initially specified to operate at 2,000 characters per per second, essentially the same speed as can be achieved with the

120-character IBM 1403. This GPO printer presents a two-fold possibility for the National Center. One possibility is to deliver magnetic tapes to GPO for processing on their printer. The other possibility is to acquire such a printer for use of the center.

3.3.3 Computer Controlled Printing

Computer-controlled printing provides many advantages. Since information must be placed in computer storage for ease of retrieval and dissemination, computer-controlled printing assures that the same information is announced. Extra error in the type setting process is avoided. Incorrect computer storage is brought to light.

The most important gain that is achieved from computer-controlled printing is the ease of updating future publications. Not only is new information published, but old information may be republished in the form of complete catalogs or also in answer to requests for demand and special bibliographies. Material once prepared for computer output need only be selected and rearranged. The major effort is not continually repeated.

Section 4

SOFTWARE CONSIDERATIONS

Computer solutions have been designed for the type of problems which are found, and their characteristics are well known. Unfortunately, the development of separate information retrieval computer programs at the many field units could result in a sizeable duplication of effort. It seems obvious that, in the aggregate, a better solution would be to expend these same programming efforts in a concerted effort to improve retrieval capabilities and to produce a powerful set of programming tools. It is an attractive concept but much more difficult of realization that these programs and programming tools could be made available to all participating computer installations.

With the presence of so many diverse computer equipments, so many different sizes and types of computer processors, disparate system configurations, etc., the problem of software (program) compatibility is exceedingly critical. Fortunately, there are a number of increasingly promising computer program developments which provide assistance in this area.

The sections to follow contain discussions of the types and characteristics of programs needed, and present the various approaches to the problem of software compatibility. Also included are discussions of computer languages and a brief description of metalinguistic techniques.

A large number of computer programs must be written to satisfy the full needs of the national center. These programs will have many portions in common. This is not surprising since many of these programs are intended for similar retrieval tasks.

The ease with which the programs can be designed is dependent on the identification of common modules. These modules will be used time and again in the various programs. Effective management of the programming task is far easier once modular construction has been decided. Each member of the programming staff provides modules whose interfaces with other modules are well defined, whose purpose is explicitly stated. The failure to produce any module, though it affects all programs in which the module is used, is easily identified and corrected.

Another virture of the modular construction of programs is the ease of program improvement. Any one module can be replaced by a more effective module if the interfaces are kept the same. Such improvements affect the entire set of programs rather than just one program. New programs can be easily designed. The large number of tested modules forms a convenient set of building blocks for new programs.

Modular programs can be more easily transferred to a new generation of computers. Since the building blocks have been defined in the form of modules, a more convenient level of definition exists than either the level of the full program or the level of the different instructions within the program. It becomes easy to identify those modules which should be preserved and those modules which are so completely equipment-oriented that they should be replaced.

4.1 CHARACTERISTICS OF INFORMATION RETRIEVAL PROGRAMS

Information retrieval is characterized as a request/response process. The requirement of this type problem is to obtain information based on a partial description of the desired data. Another characteristic associated with the problem is the dynamic nature of the data. Data ordering, file updating, and sorting is frequently required.

4.2 COMPATIBILITY CONSIDERATIONS

The development of computer programs for information retrieval is an important segment of software development as a whole. The parallel development of many such systems at computer installations provides an excellent environment for future advances in retrieval capability. Unfortunately, there is also the prospect that a great deal of duplicating effort will be entailed in the development of such systems for the varying types of computer, types of computer languages and system configurations.

In the aggregate, there would seem to be a great deal to be gained by a channeling of such efforts to avoid unnecessary duplicate investment of effort, and in arrangements for shared software, reciprocal arrangements for undertaking such developments, et cetera.

4.2.1 Methods of Compatibility

In general, there are several approaches to the compatibility problem – the most obvious level of uniformity could be obtained by selection of the same type of computer environment. For obvious reasons, this approach is not feasible. Not only is it impossible to impose such a standard selection of computer hardware; it would be inadvisable to do even if possible.

The subject of conversion techniques has received a great deal of attention recently as computer users are faced increasingly with the problem of conversion of programs to a new equipment line. This problem has been intensified by the advent of the third generation computer equipment, and in particular, the IBM System/360. The attention accorded this problem by IBM and other manufacturers is particularly evident, and great emphasis has been given to the development of conversion aids. It is not simply altruism which impels this interest on the part of the manufacturers, since a significant proportion of computer users could simply

not afford to convert from one computer to another if, in so doing, they would lose the software inventory of programs written over a period of years.

Some of these conversion techniques are reported by the SHARE System/360 Conversion Committee.

Unfortunately, these efforts are usually directed to aid the users of manufacturer to adapt to new equipment of a particular line. The problem of running computer programs on competitive equipment is much more difficult.*

A more promising approach is the compatability of higher order languages. In the area of higher order languages, compatability means the ability to take the source language program written for machine "A" and recompile it for machine "B" using the machine "B" compiler. The resultant program must be capable of operating on machine "B" and producing the correct results. Reprogramming must not be required, with the exception of the equipment configuration specifications. For the user's viewpoint, this is the desired compatability he understands.

This approach would be adequate if all the field units used the same compiler language. Unfortunately, this is not the case. Furthermore, although the hardware should not be a function of higher order language compatibility, in fact few compilers are completely machine-independent. Even in the case where similar languages do exist, minor differences in the language exist. An article in the August, 1964 issue of DATAMATION entitled "The Various FORTRANS", analyzed the FORTRAN compilers of 23 computers. Incompatabilities were found to exist in the number of legal statements, allowable number range, operational interpretation of the statements and the character set used.

*A limited number of programs are available (e.g., the Honeywell Liberator program which permits the running of 1401 programs on Honeywell equipment) which are designed for a particular conversion.

4.3 COMPUTER LANGUAGES

In the context of computer discussion, a language is defined by a set of symbols and a prescribed set of rules governing the manner and sequence in which the symbols may be combined. These languages are members of a class of formal systems of expression similar to the equations of mathematics. By providing a powerful notation, they allow a programmer to concentrate on a method of problem solution, rather than on the problems associated with organization of machine instructions.

Current efforts to develop programming tools to provide more direct rapport between the programmer and the computer give promise of decisive increase in programming effectiveness. In some instances the necessity of assistance from the programmer professsional will be obviated and the programming function may be assumed by the application analyst.

In the area of computer languages, a number of important trends can be identified which are likely to endure through the next decade and beyond. These developments have important implications to the national center. These are introduced below and discussed in greater detail in following subsections:

- There has been a growing trend toward greater usage of higher order compiler languages as opposed to the machine-oriented assembly languages.
- Efforts are underway to combine the most powerful features of current compiler languages into what might be termed a universal language.
- Attempts to achieve economy of effort with respect to compiler writing are underway with use of metalinguistic techniques.

4.3.1 Symbolic Assembly Languages

Symbolic assembly languages are currently the most universally used computer languages. In general, such a language provides a means

by which the instructions for a particular machine may be written symbolically. That is, locations in memory may be assigned alphanumeric names, and the machine instructions may be referred to by mnemonic symbols. Every useful machine instruction is assigned its mnemonic symbol. Numbers may be written in decimal notation. The advantage of writing programs in an assembly language is that the programmer can maintain almost complete control over every detail of the operation. The disadvantage of using an assembly language is that every detail of the operation must be specified. As a result, the process of programming in an assembly language is time-consuming and the programs produced are difficult to read or interpret because the statements can seldom be grouped into sequences which are very meaningful to human beings.

4.3.2 Compiler Languages

The programming costs in computer systems are consuming an ever increasing portion of overall implementation costs. Therefore, ease of programming is often regarded as more important than program efficiency. The most efficient translation from problem statement to computer program in terms of programmer effort is by means of higher order languages. It is important to maintain the distinction between the language and the language processor. The language processor is the routine which translates it into basic internal machine language, or object language. This distinction must be kept in mind although the language/language processor pair must frequently be discussed at the same time. Before proceeding to a discussion of existing language/language processor pairs, language processors in general will be briefly considered. An important type of language processor is the compiler.

The compiler accepts an entire program and translates it completely into internal machine language. Sometimes intermediate languages are used with two or more translation steps. The translation is preserved for execution at any subsequent time.

The use of compiler languages is generally less efficient in terms of program efficiency than programs produced with machine languages directly. Machine language programs generally occupy less m ory and require less computer time for their execution. As a rule, the more general-purpose the programming language, the more inefficient it becomes both from the standpoint of the computer time (required by the language processor) and the efficiency of the machine language produced. On the other hand, programming languages are extremely valuable because of the ease with which programs can be constructed, checked out, and maintained.

Although the goal of a univeral language is still nurtured by many, there will continue to be a multiplicity of higher order languages. PL/1 (formerly NPL and MPPL) being developed by IBM for the System/360 may become a de facto standard because of the vast impetus that will be provided in the installation of System/360 equipment. PL/1 comes close to serving as a universal language, since it incorporates FORTRAN, ALGOL, and COBOL features, as well as being intended for use by the systems programmer. It has features for handling executive and interrupt functions and is appropriate for real-time programming.

4.3.3 Comparison of Compiler Languages

Comparative evaluations between compiler languages are difficult since there are not completely valid bases for comparison. The basic difficulty in investigating language efficiency is that recognized languages exist in many forms. Even where an agreed definition of a compiler language exists, the compiler programs which implement the program translation are not standard.

Other variables which tend to confuse evaluation efforts are the variations in the operating systems and the types of users. In the case of compiler languages, one of the important variables, in addition to the choice of language and the writer, is the operating system. The operating system

consists of a set of support programs designed to control the computer as it proceeds sequentially through a string of jobs. In some cases, the supposed advantages (or disadvantages) of a language actually reflect the power of the operating system under which the compiler and compiled program operate. Examples of operating systems are the FORTRAN Monitor and NELOS (used in conjunction with NELIAC).

4.4 METALINGUISTIC TECHNIQUES

The development of meta-assemblers and metacompilers give promise for decisive improvement in programming effort effectiveness. These tools provide leverage for the production of software translations at a cost an order of magnitude less.

A meta-assembly program provides the capability to produce code for any conventional (Von Neumann) digital computer. This is done by specifying the characteristics of the computer in terms of the instruction repertoire and instruction formats.

Although the primary purpose of the meta-assembler is for program assembly, it has other powerful uses as well. With the meta-assembly program, the user can define his own pseudo-operations (macros) and can thus tailor his language to his needs.

Another important feature is its ability to produce code for computers other than the computer on which the meta-assembler is running. The systems programmer describes to the meta-assembler both the source language and the instruction format of the target computer. The meta-assembler can produce from the same source language, object code to run on any of several machines.

In case of changeover from one computer system to another, it is possible by these means for the user to prepare his programs even before his new computer is delivered, using his currently available system.

This type of programming tool has important implications for the translating of program libraries from one assembly language to another. In any situation where conservation of program inventories is an important consideration, this tool could find important application.

The use of a meta-assembler as a translating tool among various ERIC computer installations in order to effect software sharing is an attractive possibility. The procedure would involve the following basic steps:

1) The programs would be prepared in a computer-independent language (either a currently defined compiler language or one to be defined).

2) The characteristics of the target computer would be input together with the source language program.

3) The meta-assembly program would then assemble the program and produce an object program for the target computer.

4) The assembled program would then be in a form which would be executable at any subsequent time on the target computer.

Appendix A

PERSONAL CONTACTS ON USOE TRIPS

Number of persons visited:	154
Number of states visited:	22
Number of institutions visited:	61

GEOGRAPHICAL LIST OF ORGANIZATIONS AND INSTITUTIONS VISITED

Alabama

Redstone Scientific Information Center
Huntsville, Alabama

Air University Library
Montgomery, Alabama

California

University of California
School of Education
Berkeley, California

University of California
Department of Agricultural Economics
Davis, California

University of California
Los Angeles, California

State Library
Sacramento, California

State Department of Education
Sacramento, California

San Francisco State University
San Francisco, California

IBM
San Jose, California

San Jose State College
San Jose, California

American Bibliographical Center
Santa Barbara, California

Colorado

University of Colorado
Boulder, Colorado

University of Denver
Denver, Colorado

State Department of Education
Research Group
Denver, Colorado

Florida

Florida State Department of Education
Tallahassee, Florida

Florida State University
Department of Educational Research and Testing
Tallahassee, Florida

Georgia

University of Georgia
Athens, Georgia

Illinois

University of Chicago
Graduate School of Library Science
Chicago, Illinois

Office of the Superintendent of Public Instruction
Department of Statistics
Springfield, Illinois

University of Illinois
Training Reseach Laboratory
Urbana, Illinois

University of Illinois
Institute of Communications Research
Urbana, Illinois

Maryland

Atomic Energy Commission
Gaithersburg, Maryland

National Library of Medicine
Bethesda, Maryland

Massachusetts

Massachusetts State Department of Education
Boston, Massachusetts

Harvard University
Cambridge, Massachusetts

Inforonics
Maynard, Massachusetts

Minnesota

University of Minnesota
Communication Research
School of Journalism
Minnespolis, Minnesota

Minnesota State Department of Education
Division of Research
St. Paul, Minnesota

New Jersey

Rutgers — The State University
Graduate School of Library Science
Brunswick, New Jersey

New York

New York Department of Education
New York, New York

New York State Department of Education
Albany, New York

Bell Laboratories
Murray Hill, New York

American Institute of Physics
New York, New York

Columbia University
Bureau of Applied Social Research
New York, New York

Conover-Nast Publications
New York, New York

Yeshiva University
New York, New York

IBM Research Center
Yorktown Heights, New York

Ohio

Western Reserve University
Cleveland, Ohio

Oregon

University of Oregon
Educational Research Center
Eugene, Oregon

Pennsylvania

University of Pittsburgh
Health Law Center
Pittsburgh, Pennsylvania

University of Pittsburgh
Knowledge Availability Systems Center
Pittsburgh, Pennsylvania

University of Pittsburgh
Learning Research and Development Laboratory
Pittsburgh, Pennsylvania

South Carolina

University of South Carolina
Department of Education
Columbia, South Carolina

Tennessee

George Peabody College for Teachers
Division of Surveys and Field Studies
Nashville, Tennessee

Texas

University of Texas
School of Education
Austin, Texas

University of Texas
Linguistics Research Center
Austin, Texas

University of Texas
School of Library Science
Austin, Texas

Utah

State Department of Public Instruction
Salt Lake City, Utah

Washington

Office of the State Superintendent of Public Instruction
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Madison, Wisconsin

Wyoming

State Department Education
Cheyenne, Wyoming

Washington D. C.

United States Office of Education
Department of Health, Education and Welfare
Washington, D. C.

American Educational Research Association (AERA)
National Education Association
Washington, D. C.

EDUCOM
Washington, D. C.

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Washington, D. C.

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