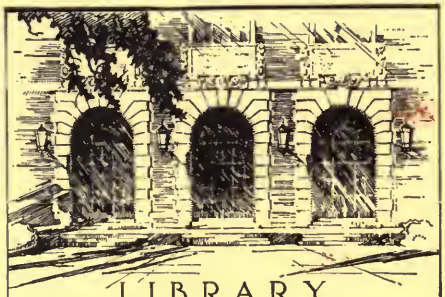
PROCEEDINGS OF THE 1963 CLINIC ON LIBRARY APPLICATIONS OF DATA PROCESSING

Graduate School of Library Science
University of Illinois



UNIVERSITY OF ILLINOIS GRADUATE SCHOOL
OF LIBRARY SCIENCE

PROCEEDINGS OF THE 1963 CLINIC ON LIBRARY APPLICATIONS OF DATA PROCESSING

Held at the Illini Union on the
Urbana Campus of the University
of Illinois, April 28-May 1, 1963

Edited by

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FOREWORD

Starting from the proposition that it is the proper function of a library school to give leadership to the profession, the Faculty of the University of Illinois Graduate School of Library Science have from time to time attempted to identify major challenge problems of our age and to formulate appropriate responses to them. It is ever more clear that a major problem—perhaps the major challenge of the profession in our generation—is that posed by the mounting volume of publication in combination with the increased use of a complex technological society for factual information.

In a sense all of librarianship bears on this problem. But more specifically this is the province of documentation and its special tools of high-speed machines. To help meet this challenge problem, the University of Illinois Graduate School of Library Science set up a graduate course on "Information Storage and Retrieval" which was offered for the first time in the fall of 1962. Then in the spring of 1963 a Clinic on Library Application of Data Processing was held in Urbana, the papers of which constitute this volume. Other parts of the School's response will be forthcoming.

As can be quickly seen—and as was planned from the beginning—the Library School's role in this area is seen as half-way between the theoretical work being done by those at the frontier and the needs of the practitioners in the field. It would be unfortunate if there were no one doing the difficult and necessary exploration of new ideas and of possible solutions; it would be equally unfortunate if there were no one next in line to interpret this work and to pass on its results to those who will have to apply them in practice. The enthusiastic response of those who came to this Clinic would bear out the correctness of the position.

In accordance with this plan, it was decided to use the clinic device as the focus for a meeting of librarians on the subject of data processing. That is to say, libraries were selected of various types, which were thought to have had sufficient relevant experience to make their findings of value to others. An appropriate person in each instance was then invited to present in effect a case report of that library's experience. In addition there were three general papers, that by Adkinson on current trends, that by Heiliger and Schultheiss on flow charting, and that by Kraft on possible applications of IBM machines.

It should be explained that three papers, those by Henderson, Parker, and Taine were preprinted and distributed in advance to those attending the Clinic. In each case a discussant was named to comment upon the paper in question. The original paper in each case is here reprinted and a summary of the discussant's remarks; in one instance, the original author's rejoinder to the discussant is also given.

The papers in this collection speak for themselves. There are, however, three observations I should like to add. One is that those of us who planned this Clinic were surprised at the great response it drew. We had almost twice as many applications for attendance as could be honored, although we emphasized that the papers would be technical in nature and likely to be of interest only to those already engaged in or seriously concerned with data processing. Our conclusion is that the use of data processing equipment in libraries is already well upon us and is not to be thought of as something yet to come.

A second observation is that few of these papers deal in any way with information retrieval, and not all deal with information storage. What we really have here are case reports on the use of data processing machines for the mechanization of library routines. And this is a natural first long step which will be needed in most cases before there can be any practical day-to-day use of the equipment for more sophisticated purposes. In short, the great need at the present time is not for training in search strategy, for example, but for instruction in writing computer programs for library operations.

Finally, the discussions at the Clinic (which are not recorded or even digested here) were certainly a major part of the educational value of the Clinic for the registrants. Equipment salesmen, computer men, librarians with varying experiences—all debated the merits and demerits of various technical devices, approaches, and proposals, and they probably learned as much from each other as from the formal papers. What this seems to say is that an annual meeting on this subject would not be too much to keep up with new developments and new lessons of practical experience. And so, the Faculty of the Graduate School of Library Science have agreed that a second Clinic on Library Applications of Data Processing will be held in the spring of 1964—from Sunday, April 26, to Wednesday, April 29. We hope that it will prove as profitable to those who attend it as this first one.

The Committee responsible for planning the Clinic consisted of Professor Frances B. Jenkins, Chairman; Professor Harold Goldstein; and this writer. As a group we wish to thank our colleagues on the Faculty of the School for their advice, assistance, support, and encouragement. Mrs. Christina Vestling handled the arrangements for the clinic with her usual efficiency and aplomb. Mr. Hugh Davison and his staff in the Division of University Extension (which co-sponsored the Clinic) gave us every assistance we requested. The

International Business Machines Corporation was most generous in providing a dozen of its most appropriate machines with supporting staff, literature, demonstrations, and technical advice. The preparation of these papers for publication was done by R. Joanne Fields and Jean Somers, Assistant to the Editor, Graduate School of Library Science. And finally we doff our respective caps both to the speakers who gave so well of themselves for the sake of others and to the Clinic registrants whose receptive attitude made it a pleasure to serve them.

Herbert Goldhor

Urbana, Ill.
July, 1963

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TRENDS IN LIBRARY APPLICATIONS OF DATA PROCESSING

Burton W. Adkinson

"Enough has probably been written on the principles of the punched card method and its application to library routines."[1] This statement may seem a peculiar one with which to introduce my paper, but its particular interest in connection with trends in library applications of data processing is that it was made twenty-one years ago by E. Carl Pratt in an article on circulation control at the library of the University of Florida. When one considers the flood of material on library applications with which we have been deluged since 1942, it is easy to see that many other workers in the field have not shared the opinion expressed by Pratt.

This conclusion is evident from the fact that even a rigidly restricted selection of literature on the application of mechanized techniques to library operations can produce a very sizable listing of items. One such literature search conducted recently by the National Science Foundation's Office of Science Information Service yielded a 27-page pamphlet entitled Bibliography of Mechanized Library Processes.[2] The bibliography includes material on acquisitions, circulation control, handling of serials, selection of document copies, and intercommunication between libraries. It deliberately excludes material on information retrieval—that is, the use of a machine system for making subject searches. And I shall deliberately have relatively little to say here concerning information retrieval. The bibliography* does include the application of punched card techniques and of computers to library processes such as accessions, circulation control, cataloging, and the handling of periodicals. In time, it covers items from 1934 to the latest issues of library journals.

The purpose of compiling the bibliography was to see whether or not one might detect trends as reflected in the literature. The

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*In this publication the bibliography referred to above appears as Appendix 1.

titles of the 155 items which are included do not immediately and obviously depict trends, but by injecting observations which do not generally appear in the literature, we can venture guesses of possible trends.

First, let me review the nature of the applications of mechanization in library processes. As the sections in the bibliography indicate, these applications occur with acquisition, circulation control, serials handling, and cataloging. In addition, mechanized equipment has been used to facilitate the publication of announcement media and the selection of replicas of documents. Finally, a number of libraries are proposing to do subject searches by mechanized means and to provide selective dissemination of documents to users on the basis of interest profiles. A number of specialized information centers in government and industry already use computers and electric accounting machines for making subject searches. Over fifty of these are described in some detail in Nonconventional Technical Information Systems in Current Use, No. 3,[3] a recent NSF publication. However, none of these applications is in any of the libraries reporting at this clinic.

What Is the Problem?

To begin with, we might note the trends that the literature indicates with respect to which aspects of library operations can and should be mechanized. Early publications generally reflect experience in mechanizing some limited aspect of library operations, such as book acquisition at the Library of Congress,[4] serials handling at Massachusetts Institute of Technology,[5] and circulation control at the University of Florida,[1] Montclair, New Jersey,[6] and the University of Texas.[7] Later, when the potentialities of data processing equipment were better appreciated, its use for making subject searches was emphasized. Much that has been published on this aspect is replete with consideration of coordinate indexing, uniterms, descriptors, inverted files, Boolean algebra, and the like. Implicit in much of this material is the idea that subject searches made by reference librarians are the most important function of a library. Yet, for the systems listed in Nonconventional Technical Information Systems in Current Use, 50 per cent of those using punched card equipment answer fewer than one query per day; of those using computers, 50 per cent handle fewer than three queries per day. Making such searches is, of course, only a part of the job done by libraries.

More recently there has been a trend toward recognizing that a library performs many services which can best be approached from a systems point of view. Thus machine records produced in one

operation, acquisitions, for example, can be used in others such as cataloging, circulation control, announcement, selective dissemination, or information retrieval. Examples of activities using this approach are National Reactor Testing Station,[8] Lockheed Missiles,[9] Douglas Aircraft,[10] and Sandia Corporation.[11] Certainly this systems or total systems approach is good. It should reduce redundant effort and result in better coordination of library functions. Consequently, libraries contemplating mechanization have been returning to first principles and studying in detail the basic input record for each item in the library. This record contains not only information required for cataloging, but also that used for accounting, circulation control, future disposal or reclassification (in a security sense), where it might be filed on microfilm or magnetic tape, and other items pertaining to distribution, dissemination, and storage. Ordering information can also be included after the fact. Ordering, itself, generally requires a separate record because of the incompleteness of the information that may be available at the time of ordering. It is necessary to think through carefully exactly what items of information will be useful or necessary before one considers how any specific processes might be mechanized.

However desirable it is to understand the complete problem before working on any aspect of it, care also should be taken that such study does not become a fetish. Integrated Data Processing (IDP) has long been the goal of commercial concerns. The desire may be, for example, to produce a record on an employee once, and then use this record in payroll, personnel, security, training, and various other functions, and thereby to eliminate duplication in records. But this, for various practical reasons, still is a long term goal in most mechanized business data processing applications. Librarians should be wary that they do not attempt to do too much at first while overlooking other immediate and practical objectives.

Proper Use of Mechanized Equipment

The logical next topic, then, is the proper use of mechanized equipment including computers. First, let us see what is being done with machines.

A careful examination of the many applications described in the literature makes it apparent that, much of the time, these machines are being used simply as printing devices. They are "supertypewriters" and mostly are employed for relatively little else. Most of the applications involve recording the basic information on a punched card so that book catalogs, accession lists, overdue document lists,

lists of items being procured, lists of items still at the bindery, etc., can be readily prepared and distributed to whoever needs the information. All of these operations can be performed, and long have been performed, by clerical personnel using typewriters.

However, I do not mean necessarily to imply that this is an improper use of punched card equipment or even of computers. By using the term "supertypewriter," I mean to emphasize only that mechanized equipment, used in this way, allows a librarian to do many things that would be impractical to accomplish with clerks and ordinary typewriters, but they are not new and different kinds of tasks. The speed, ease, and economy that mechanization of library processes permits are very important and may justify its use. The flexibility, relative freedom from error, and other by-products are bonus items that may even make the use of machines positively enjoyable.

Although this relatively low-level use of mechanized equipment is sometimes looked at disparagingly, to the librarian it is extremely useful and significant. I think that this important fact often has not been given sufficient attention. In their zeal to apply machines in very sophisticated operations (such as information retrieval), systems designers perhaps have overlooked good opportunities to render less dramatic but very real services to libraries. Some of the most successful applications either have been these low-level applications (e.g., list making), or they include them. Sometimes it has been only fortuitous that it happened this way. One group that I know of designed an information retrieval system for articles in periodicals with coordinate indexing, and other techniques. Quite incidentally they noted that a clerk was spending considerable time typing lists of periodicals to be ordered. It was a simple matter to transfer this somewhat trivial operation to the computer group. I suspect that this part of their mechanization has, at least until recently, saved more time and effort for the library staff than has the more glamorous information retrieval system.

To repeat, I think that these relatively routine, simple activities are more important now than some of the "Cloud Nine" ventures that perhaps can be accomplished successfully sometime in the future. It may very well be that the word computer itself—and the unfortunate connotation of "giant brains"—has caused us to expect too much from computers. The French seem to have avoided this difficulty to some extent. They generally refer to what we call a "computer" as an "ordinateur"—a term chosen deliberately so that these devices would not be identified entirely by their ability to compute.

I have already emphasized that present library applications of computers are indeed useful even though of a rather low intellectual level. However, we must not ignore what needs to be done to go further. A crude analogy is that these present day applications represent

the crawling stage of development. Other applications which are now developing can be thought of as standing or even walking phases. We must always be looking forward to the running stage. It is for this reason that the NSF Office of Science Information Service supports basic research in information sciences.

Investigations into the nature of language and how it represents and conveys information are very important from a long-range point of view. We feel that such experimentation is a fundamental part of the solution of the science communication problem. It is encouraging that some of this highly esoteric work is beginning to be applied to specific problems. An example is the use of syntactic analysis developed by the University of Pennsylvania. However, there is a wide gap between what is now being done and the ultimate use of this basic research. We are interested in the whole spectrum of applications although the emphasis at this clinic is concentrated at one end of the scale.

Closing the Gap

The gap I refer to is that which exists between what I shall call "computer people" and librarians. The former now generally refer to themselves as "systems" analysts and designers. Yet librarians are "systems" people too, albeit concerned with a different kind of systems analysis and design. The materials, tools, techniques, and funds available to librarians over a period of years often cause them to approach problems much differently than computer people would. The computer field has evolved with quite a different set of materials, tools, and techniques, and usually with a different attitude towards cost.

There seems to be relatively little communication between the two groups; however, the gap is closing. Each is learning to use the other's language; they are becoming familiar with each other's jargon. Each is learning the how and why of the other's approach to problems. This is a two-way street. On the one hand, computer people are learning somewhat to their amazement (and the librarians' amusement) that, as one "machine" man put it recently, "every mark, every space, every position, every word on a Library of Congress catalog card means something!" On the other hand, librarians are finding it extremely useful to analyze their procedures in the detail that a mechanized system requires, to determine exactly what is done, precisely how it is done, and just why it is done. Many library procedures have been improved as a result of such study even when no actual mechanization is involved.

I referred earlier to applications of mechanized equipment to routine library processes. However, the analysis required to determine what processes could and should be mechanized, and how to do this, is indeed a highly complex activity. The library processes problem is often deceptive to computer systems people. More than one has started on such an analysis assignment with the preconception that it is quite a simple problem and, some months later, has come to realize that he is just then beginning to understand the problem—that it is indeed highly complex.

I presume that librarians and computer people will continue to share the work of analyzing library systems and of designing new systems. It seems to me, however, that librarians must assume a larger and larger share of this work. It is dangerous to be too dependent upon computer people. It takes a long time to train one really to appreciate the problems. Since his primary obligation is not to the library, librarians may lose him, and this fact can seriously affect the entire operations. I have seen it happen when too much of the systems know-how was with the computer person rather than the librarian with whom he was working. The librarian has to live with the system; the computer person does not. There's no royal road to mechanization, but librarians would do well to see to it that systems know-how stays on their side of the fence.

Future Challenges

Finally, I would like to review some of the major problems facing us in the mechanization of library processes.

First, and perhaps foremost, is the need for rethinking what must be done. Most of the items in the bibliography are concerned with mechanizing existing processes. The real challenge perhaps lies less in determining better ways of performing existing services than in extending these services to solve the fundamental problem—that is, the most effective communication of information. This development may well result in processes much different from those now in use. I am not sure, for example, that we are making good use of information on one-half-mile long reels of magnetic tape which move through computing devices at seven miles per hour. It sometimes seems foolish to use this device to print out, of all things, 3" × 5" catalog cards. Yet this practice is now being carried on. Further, when large capacity random access devices become practical, will we be really prepared to use them? I think that this possibility is more likely because librarians think in terms of large random access files. A card catalog is such a file. Finally, are we prepared to

readjust our thinking if costs of mechanized operations drop to 1/10 or 1/100 of their present figures?

An example of a specific problem which we face is that of filing rules. These filing rules have been developed for humans who can be expected to have knowledge and intelligence to understand and use them. They are not designed for use by computers. Studies indicate that it is essentially impossible to get computers to use these rules.[12] It appears that some compromise may be needed to permit retaining the intellectual benefits of filing rules and yet take advantage of the computer's ability to perform routine operations at high speed.

A third challenge of mechanization lies in getting useful, valid information on information needs and uses. Obtaining data of this kind is not now practical in libraries; however, these data can come rather easily as a by-product in mechanized systems. It will take a sizable effort to be able to gather the right kind of such information and to make good use of it. Yet the effort needs to be made. One example might be in book selection. Now a librarian will often select according to the way in which he remembers that the users wanted information when he was "on the desk." Better data on use and requests unfilled could help him in his selection. Perhaps the machine could do routine selection where there is adequate precedent. Incidentally, one of the earliest uses of EAM equipment,[6] begun in 1941, was concerned with gathering statistics and their use in analyzing library requirements in Montclair, New Jersey.

Let us go back to Pratt, who in 1942 observed that "perhaps enough has already been written on the principles of the punch card method and its application to library routines," and then cited four references. Analysis of the 155 items listed in the bibliography[2] indicates that the cumulative amount of literature has doubled about every four years for the last twenty-five years. There is no indication yet that it will slacken.

In summary, I am tempted to liken the evolving situation I have been discussing to that of the ambitious camel's progressive entry into the tent in the famous old parable. I hesitate to do so only because, in that case, it was assumed that admitting any part of the beast necessarily was bad and that the more of him that got in, the worse things were bound to become. With the computer "camel," however, as I have shown, his "nose" of the mechanization of various clerical-type routines already is proving immensely valuable in library operations. It is up to people and groups like us to see to it that his further invasion of the librarian's professional "tent" is accomplished in an intelligent, effective manner that will bring greater and greater benefits rather than disaster.

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AUTOMATION IN THE PUBLIC LIBRARIES OF LAKE COUNTY, INDIANA

Lorin R. Burns

Four years ago Lake County Public Library had the rare opportunity of planning, organizing, and developing a county system along the lines of regional library operation. No restrictions were placed on method, nor was traditional operation required.

Prior to this time, nine small libraries spread over approximately 125 square miles had contracted for service from a nearby municipal library. As a general rule, the standard of service was rather poor, with but a token book stock, dilapidated buildings, a staff with no training nor any future prospect of such, and from twelve to twenty hours of service a week. Naturally, the communities wanted better library service. To obtain better service it became necessary to discontinue contract service and to establish a separate system.

After the initial break was accomplished, libraries of all types throughout the United States were contacted in an effort to obtain procedures, systems, and ideas on how to approach the problem of giving the best possible service while operating within a relatively small budget. From this beginning, and other probing techniques, we have developed our present system; it is from these ideas, which have further germinated, that our unique and increasingly effective system of operation has been developed.

What has been accomplished in four years has far from exhausted the potential, but a number of interesting results have already been achieved.

Each one of our libraries, situated in small but distinct population centers, is conceived and treated as an individual community library, in so far as responsibility for community service is concerned. There is no large central library with its usual function. Rather, a very small administrative and technical processing center takes care of general administration, acquisitions, book processing, registration, and circulation control among and for the community libraries.

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Co-ordinating sections with their respective expert professional personnel in the areas of children's work, reference, and adult education are utilized to plan, co-ordinate, and instruct in their various spheres of activity.

The entire holdings of the library system are considered a single collection. Much, of course, is duplicated in each library; however, little used but necessary books or very expensive items can be purchased in single copies and can be utilized by the entire system. This is not only an economy reflected in the book budget, but it is highly effective in the conservation and best use of the all too little shelf space, a universal library problem.

All libraries in our system are connected through a closed circuit teletype (TTY) so that immediate and recorded communication is at all times possible. Not only is this method of communication highly effective over a wide geographical area, but it is also surprisingly inexpensive. TTY is used to accomplish circulation control, registration, administrative directives, monthly status reports, panic button pushing, informational and reference requests, as well as a dozen other daily uses. Daily courier service throughout the system is, of course, a necessary supplement.

Machine processing, which is a vital part of our operation, is accomplished efficiently and economically through the use of IBM equipment. The adaptation of these machines to library operations is, of course, not new with us. Others saw the adaptive potential and pioneered in the use of electronic machines in library operations several years ago. The principles they outlined were simple and easily adaptable; however, we early recognized that an IBM machine has no greater validity for a library than has a pencil. Both are simply tools for the accomplishment of a library operation, and like all tools they are only as effective as the individuals using them.

For many years librarians have been experimenting with time- and labor-saving methods, with amateur zeal and with condign results. They have tried to reduce costs, to reduce the number of personnel required properly to provide service for rapidly expanding populations and with the best will in the world, but unfortunately without utilizing the very willing, highly trained professional help and facilities available to them. In most cases, they simply were not aware that such help existed.

We are all aware, some of us very vitally, that there is a serious shortage of trained librarians, scholars, and knowledgeable technicians in the United States. Recruitment can do a great deal, possibly, but it is certainly not the immediate answer in a modern, rapidly expanding, technological society. One possible alleviation to the shortage of librarians, which is simply a shift in another direction, is through the utilization of "centralized librarianship"—if you want to use this

term in connection with modern equipment, data processing machinery, and co-ordination of lesser trained library personnel under the controlled supervision of professional specialists.

Once this basic concept of utilizing certain types of machinery for library procedures is accepted, then the experimentation and evolution of library techniques can be assured and the realization and accomplishment of their potential can be explored and achieved. Much of the traditional training of librarians can be utilized more effectively, and service to the public in the collection, storage, assimilation, and distribution of ideas can be streamlined and made much more efficient and much more economical. This type of service can be accomplished with a cadre of trained, skilled, and educated librarians.

However much this degree of efficiency is to be anticipated, it is not what we have at the moment. As a consequence the profession as a whole is in somewhat low repute. The entire complex of librarianship as it has traditionally been understood—if not willingly accepted—is not going to be too greatly changed insofar as the general public is concerned. The service librarian at the desk is still going to be a vital link in any method of library operation. But behind the scenes the selection and supplying of the books, which contain the ideas which the librarian at the desk must draw upon to help library users, is going to be vastly changed. As knowledge increases, the cataloging situation is going to be more and more important insofar as the users of the library are concerned—whether they be children in school or young people in college or the average adult citizen who should, and we hope will, use the library. The cataloging situation can be made simple and relatively inexpensive. This is an aim which we have attempted. It is not very difficult to catalog books for a public library; what is more difficult is to encourage people to use the catalog properly.

Through the planned and intelligent use of punched card equipment it is possible to employ staff members who have little or no formal library training or experience. With proper supervision these individuals can prepare and maintain a union catalog for all libraries within a system, prepare cost analysis reports and purchase orders, process books, and maintain registration statistics. Also, they may conduct reader or survey analysis and other computations as they are needed, usually at a greatly reduced cost.

It is, of course, necessary for both the technical and professional people to work in close harmony, and to insure proper functioning it is necessary to establish certain requirements. One of our first applications of this revised program is in the selection of personnel for operation of the IBM machines. We made the same mistake many new IBM installations make in using inexperienced machine operators.

It is desirable to have machine operators with a background of literature—but because this combination is often difficult to locate, high competence in machine operation is of greater importance than a literary background.

As a result of our experience, we have established what we consider to be minimum standards for our machine room supervisor. We require graduation from an accredited IBM operator's school, two years of college, a knowledge of library operations, and a minimum of two years of actual experience on the machines. Keypunch and other machine operators must have relative education and experience.

The use of IBM machines in libraries is comparatively new. However, the concept of electronic data processing—which has been used successfully in business administration for about fifty years—is not. The use of electronic data processing in the libraries is largely a matter of applying proven systems and techniques to library requirements.

The IBM equipment at Lake County Public Library consists of one #082 Sorter, one #026 Keypunch, one #403 Tabulator-Printer Unit, and one #087 Collator. We have four full-time employees, and we process in the neighborhood of 2,000 books a month. We also order on the average of 1,400 books a month, not including standing orders and gifts, and do other routine and repetitive work, such as registrations and catalogs for all the libraries in our system.

Three people other than the Director are authorized to order material. They are the Children's Librarian, the Reference Librarian, and the Supervisor of Circulation Control. When the ordering of a particular book is desired, the person ordering the book indicates the number of copies desired and, when possible, pre-codes and classifies the book. This notation is done on the margin of the original document in which the review or listing was found. This document is given to technical processing personnel, who check our main entry file to ascertain that we do not already have copies available or to determine the number of copies already in the system. The open order file is checked to insure that no duplicate orders are prepared. Without further checking at the order source, the source document is then converted into punched card form.

The keypunch, which has a keyboard similar to that of a typewriter, is the basic machine for all punched card operation. This machine will automatically duplicate or reproduce, automatically skip from one column to another, print the punched information on the top border of the card, and feed blank cards into the machine. The speed of the cardpunch, as with any electric typewriter, is entirely dependent upon the speed of the operator. The faster the operator types, the faster the machine operates.

The keypunch operator prepares one card for each copy of the book being ordered, and in the instance where there is no main entry, a new main entry card is prepared. If there is a main entry card, it is pulled and the number of copies changed to reflect the additional copies to be ordered.

Incidentally, contrary to popular belief, the keypunch is basically simple to operate, and we have trained typists to become operationally competent and skillful in its use.

The main entry card is returned to its file. The locator cards are sorted into author-title sequence, using the Sorter, the machine which will mechanically place cards in one position sequence at the rate of 400 to 450 cards per minute.

After the locator cards are in sequence, the purchase order listing is prepared on the Tabulator-Printer Unit. This machine is controlled and operated by means of a control panel which, when properly wired, will direct the machine to add, subtract, and print information contained in the punched cards at the rate of some 150 lines of print per minute.

On the purchase order we list only the first card of each author-title group, the total number of copies of each book being ordered, the cost per book, and the total cost per title. At the bottom of the last page of the printed order, we indicate the total number of books being ordered and the total amount of the order.

Using the Collator, the cards are then merged into the open order file, where they are held until the books are received. The Collator performs many card filing and selection operations. It can simultaneously feed two sets of numerically punched cards, merging the matched cards and selecting the unmatched cards. During this process, the machine can also check the sequence of the primary file of cards.

Upon receipt of the books from the jobber, we select from the open order file the card matching each book. We check off the books from the purchase order and send any follow-up letters required. The cards are then run through the Tabulator-Printer Unit, and the book plate, identification stamp, and book card are prepared from them.

The cards and the books are then processed in the manner usual to most other libraries—pockets are put in, plates pasted, etc., with one exception: we continue to use the same punched IBM card for other operations. The books are then dispatched to the proper library and the IBM card filed in the locator file in the Library Center.

As required, we prepare for each library in our system a catalog of the entire collection. The main entry cards, which were prepared when the books were ordered, are run through the Tabulator-Printer Unit and in three passes of our main entry files, we prepare a subject catalog, an author catalog, and a title catalog.

All the libraries in the Lake County Library system share in a growing book collection, which is being built to provide a basic collection sufficient to serve a quarter of a million population. A union catalog in book form, in single or multiple copies as required, is furnished to each participating library; the closed circuit teletype communication provides the necessary means of sharing the common collection as reflected in the union catalog. In addition, as the need arises, due largely to the increase in circulation as a result of the construction of new libraries (four in 1962), we make up a local community library three-part catalog.

It is necessary to accept some compromises, as is expected, in the development of a system for handling a great volume of data. One compromise is to employ only brief entry information and, when necessary, to refer to the complete cataloging available in co-operatively produced bibliographies. Another compromise is to consider the catalog to be simply an updated report of material available in the library system.

This does not mean we have the perfect solution to the preparation of our catalog. The type of catalog librarians are now utilizing is the result of many experiments over the years, and librarians will need to continue such experiments until even better results are obtained.

The first catalog in the Lake County Public Library contained only the new books added to the system since the conception of a centralized system; it was difficult to read, expensive to produce, and incomplete. Last year we developed the system which we are currently using to prepare the catalog. First, we completed a physical inventory of all holdings; then we completed a catalog of these holdings. This was a long and expensive operation involving six months of labor. But it was a point, when reached, from which we could not retreat.

When the Lake County Public Library began functioning as a separate unit in 1959, we were faced with the problem of immediate operation. Consequently, we ignored the fact that approximately 30,000 uncataloged volumes were already on the shelves of our libraries and started our routine of operation.

In 1962 we decided that we were at a point at which it would be feasible and of urgent necessity to backtrack and to pick up the material we had previously not checked for classification, nor included in our printed catalog. This seemed to be an almost frustratingly insurmountable task to begin with, but as we talked about it, the way in which it could be accomplished became relatively simple. The resolution necessitated a complete understanding throughout by all permanent personnel, a great number of temporary personnel (in our case—volunteer), and overtime shifts worked by technical processing

personnel. The entire operation came off exceedingly well, largely because of adequate presentation to those involved and exact scheduling by the IBM section.

We reproduced our central locator file and sent each library duplicate cards of all IBM-processed material assigned to that library. We prepared two report forms: one to indicate IBM-processed material that for some reason was not matched with a corresponding IBM card, and one to reflect older material that was not IBM-processed.

We closed all libraries for one week and conducted a physical inventory of the holdings in each library, including those out on circulation. When the inventory was completed, the IBM cards were broken down into two groups, matched and unmatched, and were returned to the library center with the corresponding report forms.

At the Library Center we checked all the matching cards against our locator files. We then destroyed the inventory cards which matched the material in the libraries. We sorted down the unmatched IBM cards from the libraries and checked them against the list of IBM-processed material which had no IBM card. The correct location code was then placed in the locator card and the cards were returned to the file.

This operation left us with the report of unprocessed material. The reports were keypunched onto IBM cards, which were sorted and matched against the main entry cards to insure that we had a main entry card for all material in the system. The cards were then placed in our locator file. All of the locator cards were then matched against the main entry to ascertain that we had a complete record of the material available in our system.

This operation took six months to accomplish, but from the effort expended, we now have a union catalog reflecting all the material in our system. Although our catalog is still being refined, even in its crude state, it is invaluable to our operation. The principal refinement needed is that of co-ordinated abbreviations.

If a request is received in a library which does not have the book, the catalog is checked to see if the book is in our system. If it is, the request is placed on teletype. Library Center will check the locator file to determine the location of the book and will notify libraries in possession of the book as to the desired loan. The book is dispatched by courier to the requesting library. Our courier is on a rigid time schedule, visiting each library at least once a day to pick up and deliver books, fines, correspondence, records, films, etc. As a result of this combination, we serve our patrons as rapidly as possible at a minimum cost.

In addition to preparing purchase orders, processing books, and preparing a catalog, the technical processing section also prepares new borrowers' cards and compiles community statistical information.

When a patron expresses a desire for a library card, he is asked to fill out an application card, which is forwarded to the Library Center where it is converted to a punched card. After the library cards are prepared, the punched cards are placed in the registration file for future use.

At the present time our community librarians are manually charging out books. Using our book card and library card, we can easily convert to a photographic charging system when our circulation justifies the cost.

When a book is overdue, the librarian teletypes the patron's registration number to the Library Center. We pull the corresponding card from the file and prepare overdue notices. The card is then returned to the registration file. One great advantage of using punched card registrations is the mass of community information which can be accumulated and used to determine locations of new libraries, types of material required in the area, information for book selection, and so on.

By comparison with the costs of operating a manually operated system, the costs of maintaining the IBM portion of this system are relatively small. There are some attachments on the Lake County Public Library's machines that might not be necessary elsewhere. On the other hand, attachments are available which are not used at our library, but which other libraries might want for additional operations, such as statistical studies on subject use and borrowers. Such costs are not detailed here because they are not incurred in the basic procedure. At the present time, twenty-eight man-hours per day, or about 5,600 man-hours per year, are expended for the IBM processing operations. Personnel costs are variable for each area; consequently, these cost figures can be used only as a rough guide.

Libraries with a newly instituted IBM system, but without previous IBM machine experience, will probably have to plan for a greater number of hours for the initial data processing operations. Like all systems, a routine of operation and a solidification of procedures is necessary for efficient expenditure of time and money. The monthly and annual expenditures for our IBM installation are:

Item	Monthly	Annual
Personnel Cost	$663.95	$7,967.40
Card Punch	63.95	767.40
Sorter	60.90	730.80
Collator	162.40	1,948.80
Tabulator-Printer	405.18	4,862.16
Card Stock	11.00	132.00
Paper Stock	10.00	120.00

Custom Forms	30.00	360.00
Teletype	461.85	5,542.20
Teletype Paper	23.76	285.12
Total	$1,892.99	$22,715.88

Varying local situations create differences in policies and procedures, and librarians will need to determine for themselves the changes they must make to suit their own circumstances. Because this system is proving successful at Lake County Public Library, other libraries may find it equally well suited to their needs. However, IBM machines afford great flexibility, and this way is not the only possible way.

The advantages of using modern data processing machinery are many. The elimination of typed book cards is a saving in time as well as in supply and personnel costs. The elimination of clerical positions for the manual ordering of books is equally advantageous in that it does away with a costly operation and at the same time makes books available more quickly. The preparation and maintenance of catalogs for fourteen libraries certainly constitute a factor for consideration.

THE BOOK CATALOGS OF THE LOS ANGELES COUNTY PUBLIC LIBRARY

John D. Henderson

The decision to issue our catalog in book form was made after a study of mechanization indicated that this format could best meet the needs of the field staff and the public served by the County Library system. It was seen that catalog production by data processing techniques could be achieved for all branches at a low cost per unit in comparison with the expense of maintaining traditional card catalogs at the service outlets. To present the setting in which economy and mechanization proved to be so important, some background information is in order.

The Los Angeles County Public Library serves an area of 3,300 square miles, now populated by two and a quarter million people, predicted to reach four and one half million by 1980. Forty-one cities, from 15,000 to 100,000 population, are included in this service area with a combined population of more than one million. The balance of the residents live in the unincorporated territory. There are ninety-three service outlets grouped in eight regions with a center programmed for each housing 100,000 volumes and accomodating 150 readers. The satellite branches within the regions have collections ranging from 5,000 to 35,000 volumes. These are supplemented by seven bookmobiles. The Library also has sixteen branches in county institutions, such as jails, hospitals, road camps, and other facilities.

The Library serves in round figures 800,000 readers with a book collection of 2,000,000 volumes embracing 200,000 titles; approximately 10,000 titles (7,500 purchased, 2,500 gifts) and 250,000 volumes are added to the collection annually.

John D. Henderson is former Librarian, County of Los Angeles Public Library, Los Angeles.

Centralized Administration

From its founding in 1912, the County Library was a highly centralized organization with all professional administrative activities directed from Headquarters. Until just a few years ago, most of the branches were small, with modest book collections. A policy of buying a relatively large number of titles with a small number of copies was established at the outset. The practice was to "exchange" or "revolve" the collections at the branches at intervals of about six months. This practice provided patrons with a large variety of titles, but not necessarily the ones wanted at any given time. A request system was developed by which any book included in the Library's book stock could be obtained by a patron. Folders of book jackets publicizing the new books and published annotated lists of current accessions were distributed to the branches; however, there was a growing awareness on the part of the staff and the administration and the public that something better was needed to inform readers of the Library's resources. Each branch had an official shelflist covering local holdings, but its use was limited to the staff.

In 1951, when our studies of the printed catalog's possibilities began, there were card catalogs in twenty-six branches; a number of these were no longer major outlets because of population shifts; and the lack of catalogs at the remaining branches was a source of frustration to patrons and staff. The only complete record of the entire collection was in the Central Card Catalog which, because of its location, was of value primarily to the headquarters staff. Without references to Central, there was no way of determining what books were in the system beyond the branch collection; and the request service, although an asset, was not the feature that the Library had hoped to make it for the borrower.

Impact of Population—Reorganization

The decisive decade for the County Library began in 1951. Population expansion was then well under way; the accelerated urbanization of the County plus the increasingly sophisticated demands of our readers placed unprecedented pressures for a metropolitan quality service upon a library system that was still basically rural in structure and operation. It was clear that reorganization was called for with the greatest possible expansion in all elements of the program: books, personnel, and buildings. First attention was given to the book collection and the administrative structure of the Library.

Following a study of libraries serving more than one million population, a reorganization along regional lines was instituted by which over-all administration, book buying, cataloging, and processing were continued at Central. Eight geographic regions were established with a ninth for service to institutions. Each region includes a population of almost 300,000 and is directed by a Regional Librarian; in each there are from ten to sixteen community branches. Book evaluation by subject specialists is carried on at Central, with public service and book selection the chief responsibilities of the Regional Librarians. The Regional Librarian is in touch with the title and subject requests filled by the local branches as well as those that are referred to the region and those that the regions must forward to Central.

It was clear that the request system should continue but primarily on a regional basis. The regional headquarters facilities were designed and equipped to serve as the first backstop and resource for the local branches.

The catalog in book form received attention early in our studies of the organization and service. Since we are a young library in the process of maturing and strengthening a book collection to serve a large number of service outlets, it was seen that our need was urgent for a basic, convenient bibliographic tool to be used throughout the system by readers and the staff, at once simple, complete, and (comparatively speaking) economical. These were the features of the book catalog; it provided staff and readers with a full perspective of the book collection and it implemented our philosophy of service. After our adoption of the new format, title requests were filled out accurately and our subject holdings were readily determined. Book retrieval was expedited; with our resources thus arrayed in full scope and depth, a new dimension was added to our service.

Production Program

The accompanying flow chart shows that the production of the catalog was in two phases, preparatory and operational. See Figure 1.

Since the tabulating or punched card is the basic control in data processing and production of the book catalog, our first challenge was to develop a format that would be flexible enough to permit for future refinement and yet conform to the limitations of mechanization. At this point, it should be explained that the punched card in microcosm and in its own language encompasses everything that appears ultimately in the printed catalog. For economy, the same basic design had to be used for all divisions of the catalog. After the design of the

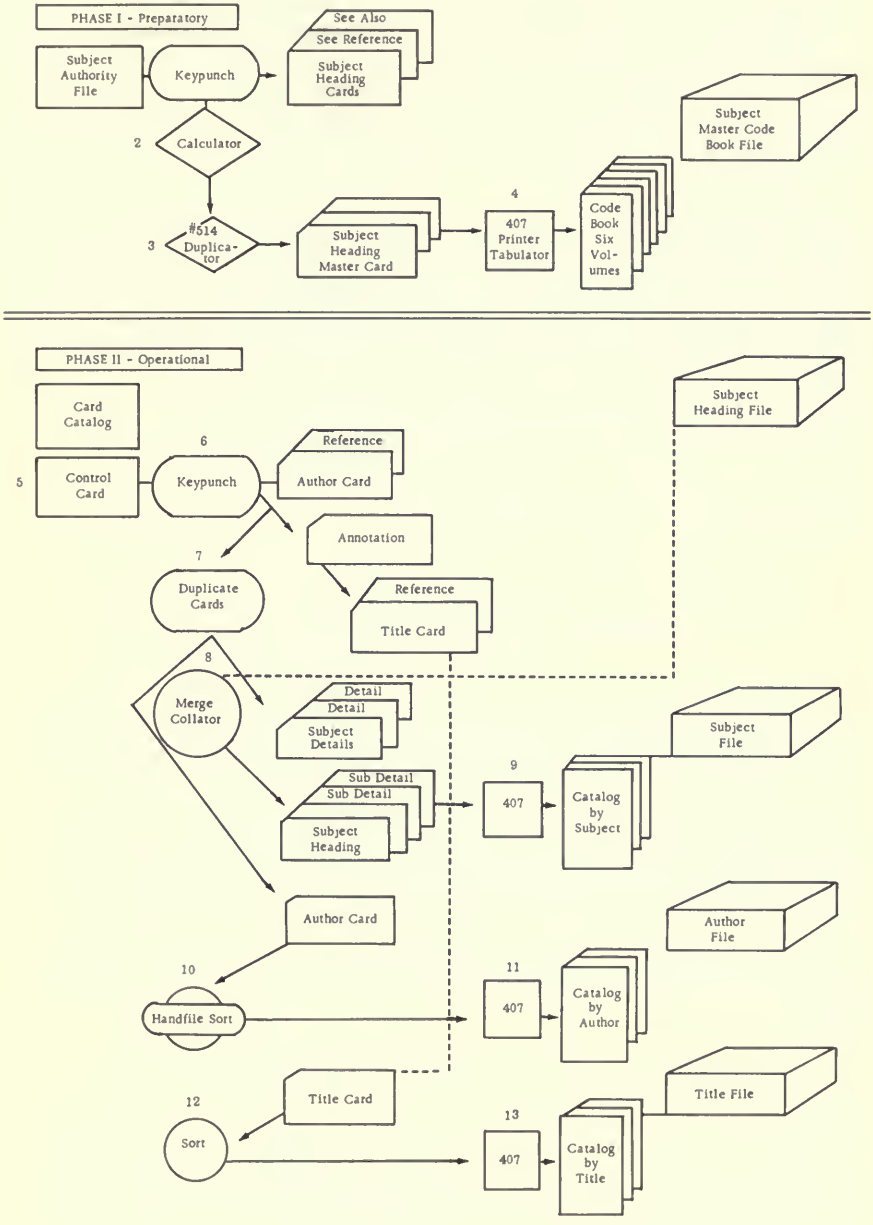

Figure 1
Catalog Production Flow Chart

card was completed, an electroplate of the layout was cut for the printing in quantity of the initial and subsequent card stock.

Preparatory to the first phase, it was necessary to revise the Central Card Catalog; this involved weeding obsolete entries, correlating subject headings, revising see references, and clearing a multitude of details in the 432,000 cards comprising our basic bibliographical tool.

Decisions then had to be made concerning the amount of bibliographical detail to include in the new format since the catalog was being designed to serve readers and staff at the branches. Simplicity was our aim. Following a survey of branch personnel and patrons, items determined to be essential were classification number, author (full name and all cross references), full title, edition (other than first), date of publication, volumes (when more than one), and a brief annotation to be prepared by a subject specialist. It was decided to issue the adult and juvenile catalogs in four major divisions each: (1) Author, (2) Title, (3) Subject, and (4) Subject-Fiction, with a separate volume for foreign publications. Cumulative supplements were scheduled at regular intervals.

From Catalog Cards to Tabulating Cards

To convert to the book format and to mass produce the catalog, the following procedures, techniques, and equipment were employed. Central's revised catalog cards, subject headings, and see references were punched into standard key punch tabulating cards which were merged into proper sequence through automatic sorting and manual filing. The various card decks for the appropriate divisions of the catalog—author, title, subject—were then processed through an IBM #407 printer-tabulator which "read" the cards and converted the information into printed text on a continuous form multilith master. After final proofreading, page masters were run on #1250 multilith presses to produce the printed pages, which were then bound into volumes.

Later editions and the cumulative catalog supplements were produced by the same method. Maintenance of the card decks involved filing of the appropriately punched tabulating cards representing added titles and the pulling of cards when titles were withdrawn from the collection. Each edition of the catalog was built upon the preceding edition with certain refinements and minor changes being made as necessary.

The author division was an alphabetic listing including the essential bibliographic data noted above. The title division was

briefer—a straight alphabetic listing by title with only author and class number for non-fiction. More sophisticated was the subject division; it included the subject specialists' annotations, see and see also references, and analytics for series and anthologies.

Each card contains ten rows of eighty printed numbers, plus space for two more rows. Information is placed on the card by punching out the appropriate numbers. Two punches in a column are required to designate each letter and one for each digit. Each card, when fed into the IBM #407 tabulator, produces one line of text. The punched card is "read" by electronic devices as it passes over wire brush "fingers," which activate a printer mechanism. Figure 1 shows the steps followed in converting catalog cards to punched cards.

The steps involved are:

1. From the Central Subject Authority File are punched:
   Subject master cards
   See reference cards
   See also cards
2. Subject codes are calculated and punched into cards.
3. All cards are reproduced; one set is used in Step 8, the other set is used to prepare the Subject Master Code Book.
4. Subject cards are processed by the 407 printer-tabulator to prepare Subject Master Code Book.
5. Information is retrieved from the card catalog to prepare control cards manually.
6. From data on the control cards are punched author, author reference cards, annotations, title, and title reference cards.
7. Information cards from Step 6 are reproduced on the #514 duplicator up to Subject Code Field to produce detail cards for each subject required for the Subject Division of the Catalog.
8. Collator merges the subject detail cards from Step 7 behind the subject heading cards (from Step 3) into the following sequence:
   Subject heading
   Author-title entry
      Annotation
   See reference
   See also reference
9. All cards from Step 8 are processed by the 407 to produce multilith masters of the text of the Subject Division of the Catalog.
10. Added author reference cards are interfiled into the author card file.

11. All cards from Step 10 are processed by the 407 to produce multilith masters of the text of the Author Division of the Catalog.
12. Title cards are placed in alphabetical order by sorter.
13. All cards from Step 12 are processed by the 407 to produce multilith masters of the text of the Title Division of the Catalog.

Basic Design of Tabulating Card

As used by the Library in production of the author and subject divisions of the Catalog, the card is divided into six fields, with the first field of fifty-four numbers (or columns) being used to punch the author's name (last name first), followed by the title of the book, edition, copyright date, and any necessary volume information. The second field, consisting of eleven columns, is for the classification number or to indicate "periodical" or "document." The third field consists of six columns and was originally "free." It later was used to indicate the year of purchase. The subject code number appears in the fourth field consisting of seven columns. The fifth and sixth fields, consisting of columns seventy-nine and eighty are used for the card sequence number.

Except for classification number, all catalog text is reproduced from data punched in the first field of fifty-four spaces. If this field does not accomodate the required information, a second or "overflow" card, and if necessary more, continues the entry.

In the subject division of the Catalog, indentation of printed text is governed by placement of the initial letter (or punches) on the cards. Subject headings begin with the twelfth space, annotations start on the ninth, and "See" and "See also" references commence with the fifteenth space. It should be noted, however, that in each instance title-author and author-title entries are preceded in the text by classification number. Sequence of the text is determined by the wiring of the control board, which is discussed later. This in effect moves the text fourteen spaces to the right. See Figure 4.

Subject Heading Code Numbers

In Figure 4 it will be seen that each card has a seven-digit code number 8118240, columns seventy-two through seventy-eight, and the same number will be seen in Figures 2 and 3. This is the identifying

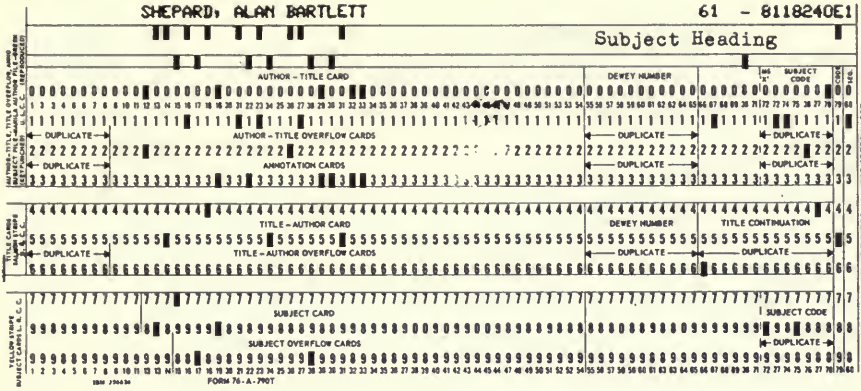

Figure 2
Subject Heading Card

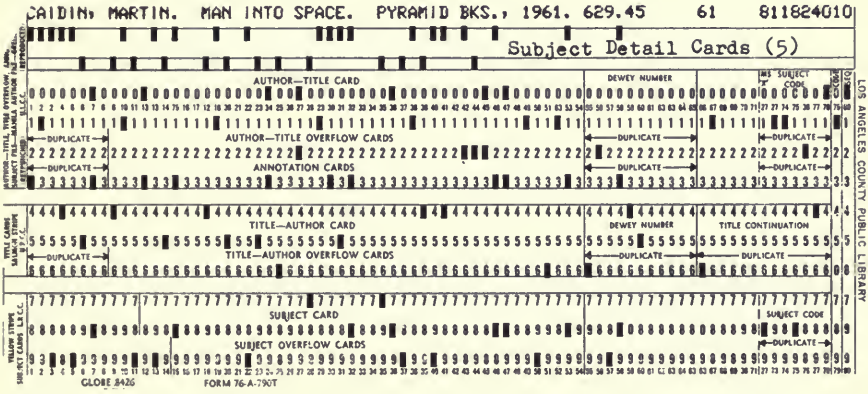

Figure 3
Subject Detail Card

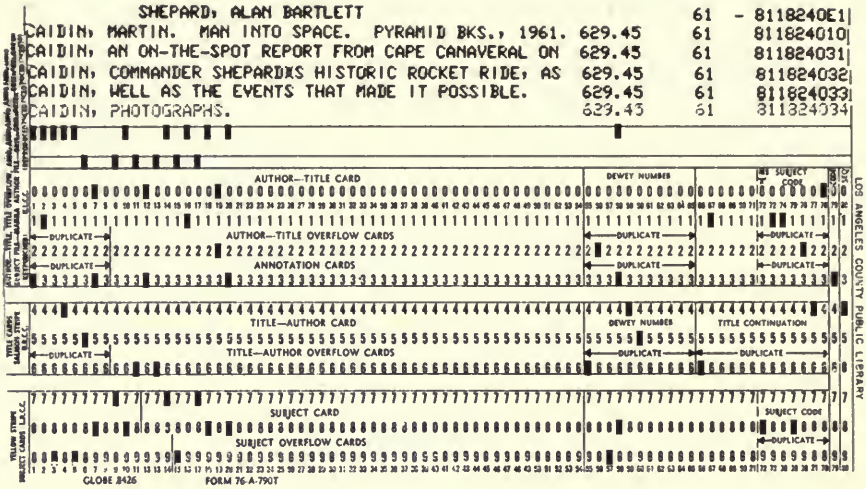

Figure 4
Example of Entry in Subject Division of Catalog,
Showing Subject Heading, Author-Title Entry, and Annotation

code number assigned to the subject "Alan Bartlett Shepard." Each of the subject headings included in the subject division of the catalog, whether for fiction or non-fiction, is assigned a specific subject code number.

Subject heading code numbers were necessary because of the complexity and bulk of the material to go into the subject division of the Catalog. There were 71,650 initial subject headings; these have increased to 86,333.

Phase I - Subject Heading Master Code Book

The first step in the preparatory phase of catalog production via data processing techniques was the keypunching of subject headings on tabulating cards (See step 1 of Figure 1). Preceding this, however, all entries in the Central Subject Authority File were verified against the Central Card Catalog to ascertain that the headings were up to date and in suitable form. An X punch was made in column seventy of the first card of each "see" reference to allow for the counting of headings and to control the spacing before and after each heading as they are used in the final preparation of the subject catalog.

The second step (see Figure 1) was the processing of the tabulator cards containing the subject headings by an electronic calculator which assigned a seven digit code number to each subject heading (in alphabetical order), and punched this number into the tabulating card. Provision was made for future expansion of subject headings by spacing 240 number units between the assigned code numbers.

The third step was the automatic duplication of the entire deck of calculator processed subject heading cards. This operation was performed by an IBM #514 duplicator. After this process, the Library had two complete sets of subject heading cards in alphabetical order, with a permanent number assigned to each subject heading. Additional subject headings could be added later, still in alphabetical order, within the 240 unit gap between code numbers.

One deck of the cards was reserved for the direct production later of the subject catalog. The other deck of subject heading master cards was (in step 4 of Figure 1) processed through an IBM # 407 tabulator which printed the text (code number and subject heading) on continuous form paper. The printed sheets were separated into pages, numbered and bound into six volumes to provide a master subject heading Code Book to complete the preparatory phase of catalog production. As required, additional subject headings are written into the Code Book in alphabetical order.

Phase II - Control Cards

The manual typing of "control cards" (Figure 5) was the initial step in the operational phase (Step 5 of Figure 1). One control card was prepared for each title, or about 120,000 in setting up the operations and 80,000 additional cards were taken from the Central Card Catalog and the master subject heading Code Book. In the upper left-hand corner appeared the classification number, then the author's surname, full forenames, title of the book, edition, the publisher's name in abbreviated form, and the copyright date, followed by any necessary volume information. The annotation on the card was given in note position, with the subject tracings below and preceded by the subject code numbers. Tracings for added entries, joint authors, and partial titles followed. Cards were kept in alphabetical order.

Subject detail cards were then keypunched from the control cards; they included the author-title entry, plus the annotations. (See Step 6 of Figure 1). One complete set of the cards was punched for each subject heading, thus bringing together all titles under a given subject. In punching a group of cards for a set, the first eight columns were always duplicated on the second and succeeding "overflow" cards

329.45 Caidin, Martin
Man into space. Drawings by Fred L. Wolff.
New York, Pyramid Bks., c1961.
192 p. illus., ports. 18 cm. (Pyramid books, PR35)
"Glossary of space terms": p. 189-192.

1. Project Mercury. 2. Shepard, Alan Bartlett
I. Title.

Figure 5

Catalog Card

629.45
Caidin, Martin. Man into space. Pyramid Bks., 1961.

An on-the-spot report from Cape Canaveral on Commander Shepard's historic rocket ride, as well as the events that made it possible. Photographs.

7294780 1. Project Mercury
8118240 2. Shepard, Alan Bartlett
8352940 3. Space flight

1-8, C

Control Card

for the author-title, annotation, and title-author entries to identify and keep the sets together. Punching of the tabulating cards was identical for each set of cards, except for the code number. Repetitive data was reproduced automatically on the key punch machine. In the second and succeeding sets of cards an X was overpunched in column seventy-two to identify cards destined subsequently to be merged (by the collator) into the subject detail files. (See Step 8 of Figure 1.)

After the subject detail cards were completed, the entire group was run through an IBM #514 duplicator and one set of green striped cards was automatically duplicated from the first set (which had no X punch in column seventy-two) to produce the file of author entries for the author division of the catalog (Step 7 of Figure 1).

Subject detail cards (consisting of all entries under each subject heading, including author-title entries and annotations) were sorted numerically by subject code and merged by an IBM collator behind the proper subject heading cards. The collator is designed to interfile two groups of cards, each of which is arranged in correct sequence. This operation was referred to (Step 8 of Figure 1) as "merging" and resulted in the subject detail cards being placed in proper relation to the subject heading cards; these are controlled by the subject heading code numbers. After merging, the tabulator cards were ready for final processing to produce the subject division of the catalog (Figure 4).

The complete deck of cards for the subject catalog was then processed through the IBM 407 tabulator which printed the proof copy on continuous-form short run multilith masters. The page masters were then run on two #1250 multilith presses to produce the text for the subject division of the catalog (Step 9 of Figure 1).

The author cards which had been punched (Step 6 of Figure 1) along with the subject heading cards were in alphabetical order (Step 10). Added entries and author reference cards were hand-sorted and interfiled into proper sequence. The author card deck was then processed through the 407 to produce the text of the author division of the catalog (Step 11 of Figure 1). See Figure 6.

Title Cards Punched Separately

Although the basic design of the tabulator punch cards used for the title division of the catalog was the same as for other entry cards, the punching fields differed because of the order of the entries and it was necessary for these cards to be punched separately. The first field of fifty-four columns is for the title, followed by the word "by" and the initials and the last name of the author. The second field of

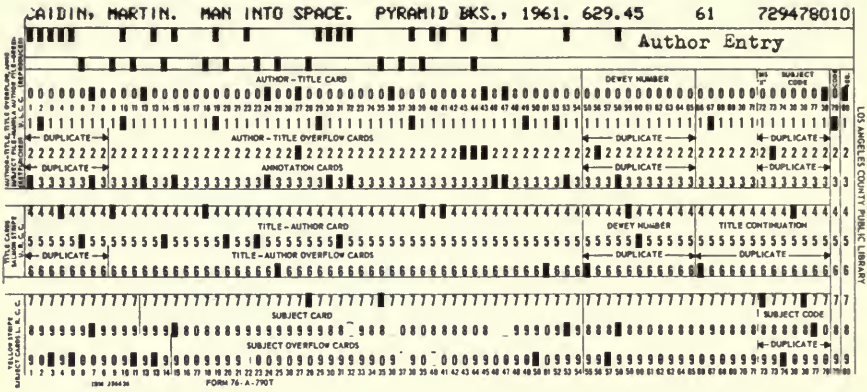

Figure 6
Catalog Author Entry: Line of Text
as Produced by the Author Entry Tabulating Card

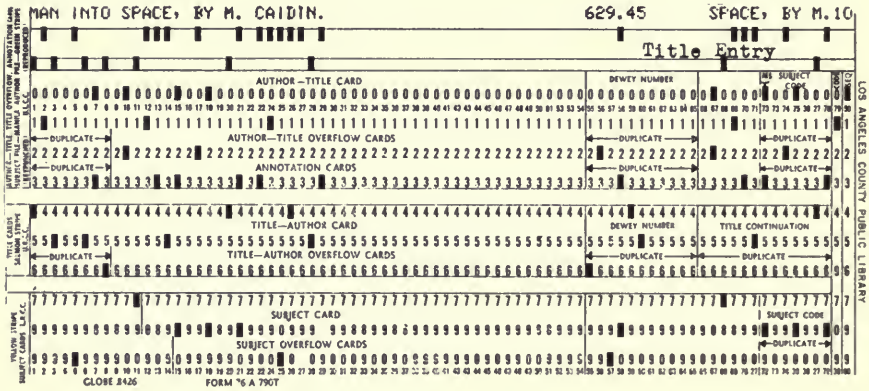

Figure 7
Catalog Title Entry: Line of Text
as Produced by the Title Entry Tabulating Card

eleven columns is for the classification number; the third field of thirteen columns consists of the duplication of the ninth through the twenty-first letter of the title, upon which the alphabetical sort of the IBM sorter machine was used. The fourth field, consisting of columns seventy-nine and eighty is used for sequence numbers. The title cards were punched during Step 6 but set aside temporarily. When ready for processing, punched title entry cards were placed in alphabetical order by the IBM sorter with some final filing done manually (Step 12 of Figure 1). The final step in the automated production of the catalog was the processing of the title entry cards by the 407 tabulator. See Figure 7.

Control Panel Directs #407

The "brain" of the IBM #407 is its control panel. A single panel, measuring about twenty by twenty-two inches, was utilized for the production of all divisions of the catalog, and with use of selector switches produced the master subject code books, proofs, and the final multilith master stencils. The 407 is a tabulator adapted to printing, with the tabulator cards activating printing wheels to produce text at the rate of 150 lines per minute.

The panel is wired through selector switches to allow for the proof-run showing the code number, the X-punches, and the acquisition and sequence numbers, since data punched in different fields on the cards may be shown by the class selectors in one run or be omitted in another, or be moved automatically to various positions on the printed form. An example of this is the classification number, which is punched in columns fifty-five through sixty-five and, by the use of selector switches, appears on the left side of all printed forms. The panel is also wired through switches to print six lines of text per inch in the Children's Catalog, for easier reading by youngsters, and eight lines of text per inch in the Adult Catalog. The double spacing allowed before and after the subject headings in the catalogs is controlled by wiring in the panel through which electrical impulses are sensed by the X-punch in column seventy of the subject heading card. The word "continued" is wired into the control panel to show on the multilith master if a break is necessary at the end of a page in a "see also" reference.

When subject entries carry over from one page to the next, the subject heading is printed at the top of the second and succeeding pages by "overflow skipping." When one master is filled to the determined length and the next master advances, the subject heading in use is printed at the top of the continued listing. This overflow skipping is caused by sensing a punch in a specific position of the tape.

Continuous-form paper for proofreading and continuous form masters for the multilithing of pages are used on the IBM 407. The continuous forms carry marginal punches at half-inch intervals on each side. Pin-feed devices geared to the machine platen carry the forms into position to receive the printing.

The first or preparatory phase of catalog production was completed with the issuance of the first full edition of the Catalog in 1954. Since that time, all processes have been included within the steps indicated in the operational phase on the flow chart—i.e., continuing maintenance following the original edition. This has consisted of adding title, author, and subject entries to the appropriate division of the Catalog, and the elimination of data concerning titles that have been withdrawn from the book collection, and the up-dating of continuations. Except for the automatic duplication of tabulating cards by the key punch machine and the reruns of the card decks for supplements and new editions on the 407, the maintenance operations have been performed manually.

The Catalog has been kept up to date through the publication of monthly cumulative supplements which are incorporated into the bound volumes on an 18-month cycle.

TABLE 1
STATISTICAL DATA ON THE PRINTED CATALOG

	First Edition: 1952-1954			Current Edition		
	No. of Entries	Bound Volumes	Subject Headings	No. of Entries	Bound Volumes	Subject Headings
ADULT						
Author	86,000(est.)	5		151,132	12	
Title		3			8	
Subject		11	66,400		26	78,200
Subject Fiction	22,000	3	2,800	29,506	5	3,512
JUVENILE	12,000	3	2,450	14,092	5	4,621
FOREIGN	5,000	1		6,414	1	
Total	125,000	26	71,650	201,144	57	86,333

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Discussion

Bruce Stallard*

A catalog in book form seems well adapted to a county library where, as in the case of the Los Angeles County Public Library, a large number of branch libraries with book collections differing in size are dispersed over a broad region. Here the total resources of the Library would not be immediately available at any one outlet. Mr. Henderson has indicated that a book catalog containing the total collection available within the region was decided upon as a desired means of providing a more complete service.

One cannot inspect the Los Angeles County Book Catalog and not become aware of the effort that was made to meet the needs of all potential users. It is complete in all types of references, analytics, series, and other entries. Annotations, often several lines in length, are a special feature of the volumes making up the subject catalog. Subject headings have been adapted to machine processing and appear in straight alphabetic order more frequently than is found in the usual card catalog where chronology and other factors often break up alphabetical arrangement. For example, "BIBLE. N.T." appears ahead of "BIBLE. O.T." Users not versed in filing rules for the dictionary catalog no doubt appreciate this arrangement.

Mr. Henderson has outlined in detail how the tabulating card was divided into fields of a determined number of columns. He has described how each field was set aside for a specific purpose and has

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explained that certain columns were punched for control purposes in machine processing.

Techniques of card design allow permissible variation in the choice of location for punched data, providing the same type of data is always placed in the same location on the card. At another time, different columns (or fields) might have been used to achieve like results.

The success and useful length of life of any data processing application depends upon how carefully it is planned before it goes into operation. When used as a basis for the preparation of a punched-card catalog, the conventional card catalog should be revised if it is not in good order. It is especially important to make any necessary corrections and alterations in subject headings before they are assigned code numbers for machine processing.

The type of entries to be used in the book catalog must be decided upon and the maximum length of each part of the entry must be determined before the number of columns for a given field can be assigned. Standard arrangement of data on the card is required for machine processing. The punching of specific data is restricted to the number of columns that were set aside during initial planning. Once fields of fixed length have been punched, a change to accommodate a longer entry cannot be made without making over all cards that have been punched. It is cheaper to first spend enough time to resolve all present and future problems that may be encountered or anticipated than to find that the job must be done over again at a later date at even greater expense. For example, the number of digits to be used for the coding of subject headings should allow for future expansion. Los Angeles County chose a seven digit code which allowed a predetermined 240 units between headings. This provided for the future addition of 240 new subject headings between each of the headings being used at the time the catalog was planned. When initial planning was started about ten years ago, Los Angeles County had a book collection of about 800,000 volumes. Since that time the Library has grown to 2,000,000 volumes. Fortunately, the 240 units of expansion originally provided in the seven digit code has permitted this amount of growth.

With an estimated ten punched cards per title,[1] the Library, now with over 200,000 titles, would have some 2,000,000 punched cards in its files. Cards for titles newly purchased are kept in separate files for the printing of cumulative supplements. They are manually merged into the main decks when a new edition of the complete catalog is due.

"Large scale file processing" would perhaps be a better term than data processing for the printing of this large catalog. With a rated speed of 150 lines per minute, the IBM 407 would need a mini-

mum of six weeks or more to handle approximately 2,000,000 cards for a single printing on multilith masters. With two machines at work, running time would be reduced but it would still remain a massive printing job for this type of equipment. The accounting machine was designed for various business applications and not primarily for speed of printing. It has the capability of accumulating and printing totals and possesses other features that are not necessary in the printing of a book catalog. A higher rate of speed would be desirable in a printing job of this size.

The job is not finished when it leaves the accounting machine. Additional time is needed to produce by multilith the number of extra copies required for distribution. Multiple copies for each page of the catalog must be collated and bound into the appropriate volumes making up the complete set: The complete set of fifty-seven volumes would contain thousands of pages and would take time to assemble. The 1958-59 cost of producing one full set of the volumes has been placed at $690.90.[2] This was considered more economical than maintaining card catalogs in each of the many branch libraries. From the standpoint of both economy and service, it would seem that the book catalog is well established at Los Angeles County.

In the business world, the usual step from unit record equipment is to a computer. Even a computer with a peak printing speed of 600 lines per minute would require roughly one and one-half to two weeks to prepare multilith masters for the Los Angeles County catalog. An advantage claimed for the computer is that when data are stored on magnetic tape, large files of punched cards are no longer necessary to maintain, thus creating a saving in this part of the operation.

A number of libraries now have book catalogs produced from punched cards but none has reported a comparable experience with magnetic tape. Results of projects now underway at the Illinois State Library[3] and the Undergraduate Library of the University of Illinois in Chicago[4] will be of interest when results are reported.

The rapid growth in computer installations is evident in the prediction that there will be 20,000 computers in operation in the nation by the end of 1963.[5] However, computers, as we know them today, are expensive pieces of equipment and rental rates at service bureaus are correspondingly high. Reels of tape are fairly inexpensive but the tape handling units used with today's computers are quite expensive and figure prominently in over-all cost. The cost of four tape units amounts to approximately one half the total cost of one of the more common medium-scale computer installations. Random access of high capacity is also expensive. There is a need for a more economical means of storage and input if many libraries are to find a place in their budgets for full use of a computer. As in the case of

the accounting machine, computers are designed for other capabilities as well as for printing. For a printing job the size of the Los Angeles County Book Catalog, the printing speed of the lower priced medium-scale computer could stand improvement.

As greater numbers of computers are placed in service, more used equipment will become available. It may also follow that marketing competition will bring improvements and reduced costs. Of even greater importance is the scientific revolution which is growing increasingly evident as time goes on. Technological achievements that may come in the next few years are difficult to predict, but the rapidity of new developments may very well exceed present expectations. The field of data processing may be due for some important developments in the not too distant future with more economical and widespread use as a result.

Those who contemplate the preparation of a book catalog at this time might be ill advised to make too many compromises for the sake of immediate economy. Librarians today need to alert themselves and be ready to take advantage of new developments as they become available.

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PRESENT AND FUTURE APPLICATION OF DATA PROCESSING EQUIPMENT FOR SCHOOL LIBRARIES

James W. Jacobs

I am awed by the many scientific achievements which have been developed or perfected during the last forty years—the radio, jet aircraft, talking pictures, rockets, and television are but a few which flash to mind. In spite of our modern hardware and our continuing to reach new horizons of success, back home in the local library things are pretty much the way they were forty years ago, in that a library patron today, as in yesteryear, goes through somewhat the same exercise to locate information.

Modern society, with all of its many (and sometimes perplexing) technological aids, has developed in spite of the printed word being excruciatingly difficult to locate. And to make matters even worse, once the word is located and used, the same pain must be endured by the next searcher, and then the next searcher, and so on!

My assignment is to present the ways in which the Montgomery County (Maryland) Public Schools are using or plan to use data processing equipment to enhance the library program. Montgomery County is one of twenty-three counties in Maryland and is contiguous to and north of the District of Columbia. According to the last census report, Montgomery County is the highest average income county in the United States and also has the reputation for being the best educated county in the fifty states. There are about 90,000 residents with college backgrounds, and approximately 10,000 with some type of doctorate degree. Our county population is now close to 360,000; in 1950 it was about 164,000. The public schools enroll more than 94,000—the projected enrollment for 1966 is 110,000—whereas in 1948 when I joined the system it was about 20,000. There are 131 existing schools—100 elementary, 30 secondary, 1 junior college—with five additional schools to be occupied in September 1963. During the past ten years we have added 70,000 children and 3,500 teachers.

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Our school budget this year is around $65 million. We have opened a new classroom each school day for the past four years. We have libraries in all schools, with one or more librarian in each secondary school and a full or part-time librarian in each elementary library. Our pupil growth is approximately 5,500 per year which necessitates an increase, including turnover, of about 750 new classroom teachers per year. This means four new classroom teachers every day just to stay even.

The Office of Instructional Materials, with which I work, has been assigned the general responsibility for coordinating the instructional materials program for the county schools. Our office is organized into several sections: (1) the office of the director, (2) the instructional materials center, (3) a central processing center, (4) a textbook depository, (5) a library or field services section, (6) a curriculum laboratory, and (7) a production section.

Our office is constantly searching for a better and more efficient modus operandi. Since we believe there is an easier and perhaps more efficient way to get the job done, we are reaching out to take full advantage of machines and technology. Since 1948, our system has had data processing equipment. We started out with an IBM 402, a sorter, a reproducer, a collator, and two keypunch units. We later added a second 402 and a 602A calculating punch. We have now the series 1401 with all necessary companion equipment.

We have developed the expected uses for this equipment. The more sophisticated the equipment has become, the more sophisticated the program. Currently we are making use of our equipment in the following ways: (1) payrolls and related records, (2) accounting, (3) testing and research, (4) federal aid, (5) pupil accounting, (6) secondary school scheduling related records, and (7) miscellaneous (including personnel data and Montgomery Junior Colleges).

These, of course, are not unusual nor unexpected in relationship to the capabilities of our hardware. Additional uses being planned include: (1) ranking of high school graduation classes by school and by type of diploma within school, (2) attendance accounting—secondary level, (3) catalog of approved textbooks—elementary and secondary, (4) inventory of textbooks—elementary and secondary, (5) catalog of audio-visual materials, (6) purchasing—preparation of bid lists, (7) purchasing—purchase order preparation, (8) purchasing—textbook order forms, (9) cafeteria—statements of income and expense, (10) cafeteria—analysis of income and expense, (11) enrollment projections, and (12) location and assignment of substitutes.

Several of these programs enter into frontier uses of this type of equipment. Our school system has no desire to be the first to the frontier; we are simply interested in capitalizing on what we have available as hardware in order to release staff time to accomplish things for which the hardware would not be appropriate.

One of the primary assignments of my office is to effect a better coordinated materials program. Coordination is more readily accomplished if information is easily available and rapidly accessible. Here are some ways by which coordination is being secured in our library program.

The school library program in Montgomery County two years ago would have been termed traditional. The library was larger than a classroom facility, rectangular in layout, with a work-room and office at one end and usually a small conference room at the other—often with two entrances, one marked IN, the other marked OUT. The work-room was adequate in size to take care of the repetitive chores of processing and mending but not large enough to accommodate special individualized library work of teachers or students. Tables and chairs, row on row, were in sufficient quantity to seat generally ten per cent of the rated capacity of the building. Schedules for using the library quarters were developed with a class of two coming in each period of the day for group assignments, etc., or at the elementary level by special arrangement. There were, of course, many of the traditional good uses made of the library but my point is that it was a fairly structured operation, largely restricted to printed media, due to tradition, physical quarters, and collection limitations. Some of our libraries, however, in spite of these restrictions were not following the traditional program. Some schools had added to their collection other than printed materials—they included in the card catalog information on such material, and in some instances the library staff assumed responsibility for the school materials program and worked with the full range of printed, visual, and auditory media.

What has happened during the last two years is that this new approach, as some few schools were finding challenging and successful, has flamed into a burning interest on the part of the full county library staff. Today, we are witnessing our library program seek a new level of service to the instructional program, the student enrollment, and the professional teaching staff. Many, if not most of our libraries, although in the same general quarters, are re-thinking and making new uses of what is at hand. The materials program is being co-ordinated in or from the library wherever and whenever possible. Many materials—new to the library collection--are housed in the library, space permitting. All materials are not necessarily housed in the library, but the library is rapidly becoming an information center for the complete materials program. With minor physical changes, provisions are being made for students as well as teachers to use materials on an individual basis through the use of special study cubicles or carrels. Opportunities for previewing and listening are available, and the use of the collection to help in the preparation of teacher-made/student-made transparencies, slides, or tapes is possible.

In the planning of new facilities, we are making an effort in the initial construction to develop a facility which promotes this new approach and which should permit the library staff to have an even better chance of success. We want each library to be the materials center of its school. We want a variety of instructional materials readily accessible to students and teachers for both individual and group learning situations. The program of requirements for one of our new secondary schools includes a reading room for 100 students (but not all at tables and chairs), staff work space, a research area, an area for independent study, storage space and preparation areas for audio-visual and other instructional materials, student typing space, and a conference area.

Realizing that our library program has broadened its scope of service, includes a multi-media collection, and serves as a materials information center, it is incumbent upon each person working with the program to seek new and more sophisticated methods and procedures for implementing the added responsibilities. Some of the activities, each at a different stage of development, which we think will help get the job done a little better and a little easier, are these:

(1) We recently issued to each school a color-banded card file for materials contained in our county IMC (Instructional Materials Center), which includes approximately 8,000 items. The next step is to translate all titles to punched cards in order for multi-media listings to be made on request. This, we feel, will lend itself to resolving the question each teacher faces when planning a lesson—what materials are available?

(2) We have just about completed the county's first comprehensive listing of secondary textbooks. This project came about as a result of the lack of a current inventory of useable copies of each title in every school. Realizing that a depository operates more effectively with information of this kind it was decided the quickest method of taking and maintaining a textbook inventory would be to make use of the punched card. Since a list was required, problems and needs were fused with the result being a punched card textbook list by title, including considerable explanatory data concerning each title and a means for taking periodic inventory, all accomplished by one-time effort.

(3) Our curriculum laboratory makes a sincere effort to keep the administrative and supervisory staff abreast of current periodicals and other pertinent or new material. This is rapidly becoming a losing battle. We need some way of getting bare bones to the prospective user in order for staff

members contacted to request a meatier portion perhaps or the document itself. We should be able to develop a system whereby articles are listed by title or keyed to some index, placed on punched cards, printed out, and distributed for informational purpose. So much comes so fast, volume-handling techniques are a dire necessity!

(4) The central processing center in its first 20 months of operation has processed about 175,000 volumes. The efficiency of the operation now in terms of what we were experiencing some months ago is vastly improved. However, we still find ourselves doing many chores in a repetitive and time-consuming fashion. From the time the tile order is initiated by an individual school library through the entire processing operation until the book arrives in the library for use requires considerable coordination and fusion of work. We feel strongly that a machine program can be developed which will provide the initial order on a sensitized or punched card. The complete ordering and financial accounting cycle can then be geared to a machine, saving hundreds of manhours as well as expediting the operation. Our purpose in developing machine procedures is to reduce the span of time from the initiation of the order to the shelving of the book. We think this can be as short as three weeks—we now take six on the average. Once the title is on a punched card, we then have the capability of sorting for a variety of purposes: by title, by publisher, by jobber, by elementary or secondary school level, by basic or supplementary. We spend many hours developing lists of titles or bringing up-to-date—if this can be accomplished by available hardware, we would certainly be remiss not to take advantage of the equipment.

(5) One persistent problem in the field of instructional materials is that of the review, evaluation, and selection of teaching materials. We are now in the first stage of establishing a comprehensive program which we hope will be helpful in the solution of this problem. In cooperation with the Office of Curriculum Development, our office has published a brochure on the review, evaluation, and selection of instructional materials for the school system. This directive provides information to each staff person concerning procedures for this phase of the total instructional program. In brief, the responsibility for seeing that review and evaluation takes place in its proper perspective is the responsibility of the Office of Instructional Materials. Selection is accomplished by staff members who are

involved in the actual teaching program. Materials are reviewed and evaluated and then recommendations are forwarded to our office. Obviously, in a system as large as that of Montgomery County the amount of materials reviewed, evaluated, and recommended for use is staggering. We expect to publish, with some frequency, broadly inclusive lists of materials which may be considered for purchase by individual schools. It appears obvious that developing a punched card system for handling these many items of instructional materials is necessary.

(6) Another element of a comprehensive program is that of reviewing library book material. Our system receives new titles from many publishers. This large monthly influx of new materials is important to our library program and should be rapidly reviewed with reviews quickly consolidated and made available to all librarians. We expect soon to translate to punched cards not only pertinent title information but a brief annotation as well. The data when printed out will then be forwarded to all librarians for their constructive use in the acquisition program.

(7) Although not a school system--initiated use of data processing equipment, our Montgomery County Public Library system is now publishing its catalog through the use of punched cards. Monthly acquisitions are listed in separate lists, subject, author, and title, and distributed from the central library to all branches. These listings show not only regular bibliographic information but each separate location or branch which houses the title. Annually, a complete up-to-date catalog will be issued. This new approach to developing the library catalog is a definite advantage to our school system as we place the appropriate lists in each of our schools, and thus provide a further opportunity to coordinate services of the school and the public library program. As a member of the Public Library Advisory Board, I am proud to include this use of data processing equipment in my report.

DEVELOPMENT OF AUTOMATIC SYSTEMS AT THE UNIVERSITY OF MISSOURI LIBRARY

Ralph H. Parker

Mechanization in some degree has existed in libraries for many years. The typewriter, or possibly the book truck, represented the first phase; duplicating, book charging, and even punched card tabulating machines have followed. But before there can be said to be automation, the idea of system—the interrelating of separate entities so that they operate as a single organism—must be added. A duplicating machine operated by turning a crank is mechanized but is not automatic, nor does adding an electric motor make it automatic. Adding a counting device which will stop the machine when a predetermined number of copies has been duplicated creates a low level of automation. Addition of a device to cause the machine to stop when the paper is exhausted constitutes an essential element of a truly automatic system. Once started, the machine will run until either of two conditions causes it to stop! Various components of the machine are working together as a system.

Development in the last fifteen years of a systematic approach to office management and record handling may well be spoken of as a paper revolution. For want of a better term, let us call this procedure "integrated data processing," the term used by computer manufacturers to include the total cycle of input and processing of information and the output of results. Before 1945 most planning was in terms of applications: using a typewriter to prepare an invoice, an adding machine to obtain the total, a posting machine to maintain the ledgers, and the typewriter again to address monthly statements.

Since conversion from one data system to another is a monumental undertaking, few organizations dare to make immediate complete changes. Most first convert existing applications into subsystems which will eventually be part of the new over-all system. This evolutionary approach has been followed by the University of Missouri Library. The sections which follow will describe briefly

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the applications of punched card and similar equipment in this library and will attempt to show how they have been developed into sub-systems. It is appropriate at this time to point out that the automation program is limited to records and does not include physical handling of books, for example.

Catalog Statistics

In 1949 it became obvious that the operating statistics kept by the Catalog Department did not provide the facts necessary for management of the library. The variance between the record of acquisitions by the Order Department and the statistics of cataloging made both suspect. It was not possible to ascertain the form or language or source of the material acquired. No one could answer the question, "How many titles were cataloged last year without the aid of Library of Congress cards?"

To answer such questions and to keep all the statistics which had been kept in the past, it was decided to utilize a mark sensing IBM card to be inserted in each volume as it begins the processing operation. It was also decided that the cards would be consecutively numbered and provided with the accession number to assist in maintaining a processing control. As a volume passes from station to station the appropriate items are recorded by marking the card. These include: source, branch, form, type of addition (that is, new title, new addition, added volume, added copy, etc.), type of cataloging, type of cards used, and the basic language of the publication. Upon completion of cataloging, the card is removed from the book. From time to time the cards are processed, and from them all of the cataloging statistics are compiled.

Since accession numbers are assigned essentially in chronological order, it is possible to analyze uncataloged arrearage in terms of length of delay. This elementary form of processing control has been expanded in another operation which will be described later.

Such an application of punched cards can hardly be called a system or even a sub-system. It is not at this time related directly to any other segment of the Library's operations, but plans for eventual integration of this application into the total system will be described later.

Subscription Records

That financial records of periodical subscriptions and standing orders for serials are difficult and vexatious cannot be denied. This fact together with the recurring nature of the operation makes them a natural for adaptation to data processing equipment. Preparation of basic records for conversion to punched card operation was begun at the University of Missouri Library in 1950. Had the records been in such condition that the cards could be punched directly the conversion could have taken place within two or three months. In actuality, the records were not completely transformed for about five years.

The basic problem revolves around the fact that many manually kept records are ambiguous, and it is necessary to make interpretations at the time any activity occurs. Since machines will accept only yes and no answers, it is necessary for records of each title to be absolutely complete and definite.

Before beginning to punch subscription record cards, it was necessary to define the items which would be needed. Because of limitations of card capacity and the cost of maintaining records, it was necessary to eliminate a number of items which might have been desirable, such as language, country of origin, and frequency of publication. Those eventually included were: title, a subscription number for machine control operations, estimated cost, the actual expenditure, codes for the address to which the serial should be sent, for the supplier, for the mode of payment (that is, advance payment of subscription, billed on receipt, received on membership, gift, etc.), renewal period in years, the expiration date, and finally the account to be charged. By 1952 enough items had been coded and cards punched for renewal subscriptions to American periodicals to be placed by machine.

As the operation continued and expanded, situations arose which had not been anticipated and which necessitated a few changes in the content of the cards and a number of changes in the program. For example, it was originally assumed that an item number assigned to each subscription, which would be used in alphabetization of entries on the machines, would be adequate for both bibliographic and fiscal purposes. It soon became apparent that this was not the case. For accounting purposes it was desirable to have all publications received on any one society membership coded with the same subscription number even though the titles might be scattered throughout the alphabet. To prepare lists for use of faculty and library staff it was necessary to establish a title code for each publication.

Similarly it appeared logical that, for purposes of encumbering funds, the actual expenditure for the previous year could be used. We

did not know that perhaps half the publications commonly called continuations have no charges in any one fiscal year. It was necessary to modify the program so that in these cases the estimate for the previous year would simply be carried forward. This, at the time, seemed to be a solution, but we had not taken into account the failure of some suppliers to send invoices for subscriptions until long after they had expired. Another program modification was required.

Ordering and Accounting

By early 1955, even before all of the subscription and standing order records had been converted, it was becoming evident that the utilization of punched card equipment should be extended to all ordering and accounting work. A study was begun which resulted in a punched card installation in the Library itself. Although the equipment was ordered in December 1955, it was not installed until January 1957. Since our fiscal year began July 1, we had six months in which to develop procedures, to train personnel, and to convert records to the new system.

The serials records procedures which had been in use for a number of years were reviewed and further improvements were made. Forms were developed which would articulate closely with the records of one-time orders.

It is neither necessary nor desirable at this point to describe in detail the ordering procedure which is used at the University of Missouri Library. Basically it consists of purchase orders prepared on the Cardatype machine from IBM cards which have in turn been prepared from data supplied on book purchase requests which have been checked and approved by the Order Department. The documents prepared, in addition to purchase orders, include Library of Congress card orders and a slip which is filed in the public card catalog indicating that the book is on order.

Regular orders are prepared weekly, usually on Wednesday. All related documents, except the punched cards which were used to prepare the orders, are sent to the Order Department for processing and for mailing by late Friday afternoon. At the same time the IBM section has prepared a ledger statement for the week. Thus should any account become overdrawn it is possible to cancel items before the order is actually mailed.

The book fund is subdivided into approximately 150 sub-accounts on which balances are maintained. Incoming invoices are processed through the IBM section so that any variations in cost from preliminary estimate are taken into account and the corrections entered in the ledger.

The nature of punched cards is such that it becomes possible to maintain more active control over deliveries and to claim undelivered books and invoices, with minimum human effort. These same potentialities for control extend also to books being cataloged. The IBM card which had been created to record the invoice payment is filed in a "Paid but not cataloged" file. The IBM card which had been used to create the original purchase order, together with the catalog statistics card mentioned earlier, is inserted in the volume as it enters the processing track. The two cards travel together until the book has left the processing division. Each month they are collected and sorted; the statistics cards are retained for compilation of cataloging statistics and the order cards are matched by collator against the "Paid but not cataloged" cards. Since the payment record card shows the date on which the invoice was paid (not too much different from the date of receipt), it is possible to maintain effective control over the cataloging process.

The greatest unexpected dividend from the new ordering and accounting system was the ability to maintain an active desiderata file. The University of Missouri Library, like most research libraries, had many titles in desiderata files but nothing much happened to them. If a book ordered from a second hand catalog was undelivered because of prior sale and if it appeared desirable that it should be pursued further, an inquiry would be sent to some likely dealer. If the dealer should offer the book, well and good; but if he did not, the card probably remained in the file inactive from then on.

Often the professor who originally requested the item would, on seeing it in a catalog again, reorder it; we repeated the process of bibliographic verification and placed a new order unaware that it was still in the desiderata file. This situation led us to recognition of the fact that, although automating operations does eliminate intellectual activity, it also makes possible the effective storage and retrieval of the results of such activity, thus eliminating duplication of personal effort.

Want list procedures therefore evolved quite naturally. With only a few exceptions, undelivered items are merely transferred from the order procedure to the desiderata procedure. All necessary information is already stored in the punched cards which had been used to prepare the original purchase order. They are now used to prepare requests for quotation and are subject to the same systematic control as is applied to outstanding purchase orders.

Immediately after cancellation of an order with a dealer, the IBM section prepares request for quotation forms. The Quotation Section (actually the secretary to the Director of the Acquisition Division, supervising a student assistant) sends one copy to a prospective supplier or uses the copy to prepare an advertisement for one of the media which we use. Another copy with the legend "Recommended

for purchase," is filed in the public card catalog replacing the "On order" slip which had been there. The third slip becomes the permanent desiderata record in the Quotation Section.

Whenever a volume is offered, the information is passed to the ordering section of the Order Department which puts it back into the order procedure if the price is deemed satisfactory. Everyone concerned has been instructed that, in checking book purchase requests, one for an item already in the quotation procedure should be sent immediately to the Quotation Section. If the request is based upon another potential source, it is possible to complete the purchase order with little delay, since the bibliographic verification is done and the IBM cards for preparing the purchase order are already punched.

Circulation Records

In May 1958, the University of Missouri Library began using IBM records for circulation control. The application was considered an interim solution to the circulation record problem. It involves a call slip composed of an IBM card with a tissue and carbon overlay. The borrower fills out this call slip for each volume to be borrowed. The tissue overlay is inserted in the book pocket, the card itself is manually filed in a classed file after having certain information punched into it. For loans to students, the information consists only of the date of loan and the date due. For loans to faculty and graduate students, who are permitted indefinite loan periods, the call number, the author's name, and the borrower's identification number are also punched.

The collator is used to pull the cards for overdue books each week. Notices are prepared manually. Graduate student loans are pulled each semester, and lists of books on loan are prepared on the Cardatype for mailing to the borrower in advance of the close of the semester. Similar lists are prepared once each year for members of the faculty.

Because we are on the threshold of installing a completely automatic book charging system, let me jump forward to a description of it and then return to other matters which are already in operation.

It has been our hope for many years that a data collection system economically feasible for the control of book circulation would become available. The system installed in the Montclair, New Jersey, Public Library in 1942 performed the functions desired, but involved

equipment too expensive to make the system economically advantageous. Furthermore, it was satisfactory for the central library but could not be applied to branch operations.

The system which we are planning to install will consist of a transmitter at each point where books may be issued, connected to a central punch in the IBM section. Each borrower will carry a badge into which will be punched his identification number. Each book will be equipped with an IBM card which shows the call number, accession number, and abbreviated author and title. The lending operation will be completed by inserting the book card and the badge into the transmitting unit and depressing a key to indicate the type of loan. A transaction card will be created showing the borrower identification, the book identification, the station from which the loan was made, the time of the transaction, and the date due. Returns will be recorded similarly except that it will be necessary to use only the punched book card.

The circulation file will be maintained by machine, up-dating all loans and returns once each day. Machines will also be used for selecting overdue records and preparing notices, and for preparing lists of books placed on reserve by individual professors, etc., as desired.

The most serious objective usually raised to this system is the enormity of the task of creating the punched book cards. There is an alternative to a complete and instantaneous conversion; we propose to follow that alternative. It is well known that many books in the library are used only infrequently. We need not be concerned with them if we could but identify them.

By making a book card for each book as it is circulated for a period of time prior to the initiation of the data collection system and by making a book card for each new book added to the collection, it would be possible to have cards prepared for that segment of the collection which supports a large proportion of home use circulation.

At the University of Missouri, we are planning to insert book cards in all of the books which are now in the Library of Congress classification system. As will be explained, we are now in process of reclassifying our books from Dewey to Library of Congress. In the less than three years after we started using the Library of Congress system, the circulation of books in that system represents more than one-fourth of our total home use loans. Reserve loans are, by our priorities in reclassification, much more nearly completely Library of Congress. After we have proceeded somewhat further in the reclassification of sections of the Dewey books which create other problems, we propose to reclassify books on the basis of observed use.

The present limited record system will be used parallel to the new automatic system until the reclassification project is complete.

Of course if a library were not involved in reclassification it could simply make a temporary record of the loan and create the new type book card while the book was on loan. Upon its return the new book card would be removed from a special file, used to discharge the book, and then be placed in the card pocket.

We hope that eventually the circulation system will be connected either directly or indirectly with a computer. When this is done there will be no card sorting or collating; overdue notices can be prepared automatically, and fines and charges for lost books can be billed automatically. The computer can be programmed to refuse a loan to an individual who is delinquent. When the return of a book is being recorded, should it be wanted for reserve, the operator will be signaled. But these benefits are still in the future.

Catalog Production

Let us return to here and now. As a part of the pre-automation planning it became apparent that much professional effort was being wasted in our cataloging procedures. We were using a modified Dewey classification system which resulted in one out of each four books falling into a classification not consistent with the printed schedules. This situation became critical when, in 1957, the University administration decided that the library would be expanded and made truly a research library, with the result that the book fund was more than doubled in a single year. Our installation of punched card equipment which had just been completed made it possible to handle the ordering and accounting with only minor difficulty, but in 1957-58 we were able to catalog fewer than two-thirds of the volumes acquired. Naturally the volumes which were uncataloged were the more difficult ones.

Analysis of the situation indicated that the solution might well lie in the adoption of the Library of Congress classification and in utilizing it essentially without modification. We would thus undertake to eliminate the duplication of cataloging effort. There were many ramifications of this idea. One was that the catalogers were to handle only books which required original cataloging. The processing of titles for which there were printed cards would become essentially routine. In setting up this factory type operation, the Catalog Department was divided so that the department itself was concerned only with the creation of copy for books not yet cataloged by anyone else.

The Catalog Maintenance Department was established to handle those aspects of the cataloging process which involve the editing and creation of the card catalog itself. Into this department flowed the

copy from the catalogers, printed cards, proof slips, or photographic reproductions from the printed book catalogs of the Library of Congress. All these items were to be transformed into our own card catalog by the Catalog Maintenance Department through creation of the necessary structure of cross references, guide cards, and the like.

The Library had never maintained an official catalog but had a subject authority file which was used extensively. In the new quarters into which the Library moved in 1961, the processing division was adjacent to the public card catalog. It was decided that the authority file could be combined with the subject section of the public card catalog, if the subject catalog were separated from the author-title section.

We therefore decided that for the books in Library of Congress classification the subjects would be filed in a separate catalog while the author and added entry cards would continue to be filed in the old dictionary catalog. For each subject, there would be a guide card which would also be the authority card. Subject headings would not be typed at the top of the cards. It thus become possible to file cards for all subjects which had been previously used, without prior checking. If there is no guide, the card is given to a supervisor who prepares the guide card and the necessary cross references.

Let us look now at the actual preparation of catalog cards. Copy is obtained from four sources. First are the printed cards ordered from the Library of Congress. Second are proof slips from the Library of Congress. The University of Missouri Library had discontinued its depository catalog when the printed book catalogs appeared; but a decision was made in 1960 to order proof slips beginning in January 1961, and to file them, not by main entry, but by LC card number. The maintenance of the file would thus be much less expensive and would serve our purpose of providing copy equally well. The third source of copy is from the printed book catalogs of the Library of Congress, of value mostly when cards are out of print. Fourth is locally prepared catalog copy.

Because of the card work involved in the reclassification project, we were particularly interested in the possibility of using the Xerox Model 914 for direct card reproduction. On the basis of preliminary estimates, we decided that it would be more economical to select the cleanest card, usually the shelf list card, obliterate the old call number with white opaquing compound, and retype the new call number, and then to reproduce a complete set of cards, rather than to erase the numbers from all the old cards and retype them. The procedure would be feasible only if the Xerox method would work satisfactorily.

A long period of trial and experimentation followed. We found that by using card stock approximately 15 cm. × 26.5 cm., cut with the

grain running crosswise of the card, cards could be reproduced satisfactorily. The copies to be duplicated were mounted on a blank card, using rubber cement. The card could be used about a dozen times without new application of cement.

At the same time we were considering the use of Flexowriters in preparing cards for which there was no copy that could be photographed. From their delivery in the summer of 1962 until February 1963, the machines were used in a manner similar to that of a number of other libraries. A preliminary copy of the card was typed and a by-product tape produced. After correcting the tape for proof errors, it was used to duplicate the number of cards necessary for a set. Headings were added manually.

It was apparent that production could be increased greatly if a procedure could be developed for automatically producing in a single operation complete sets of cards with all headings typed. Experiments in programming for the more completely automatic procedure demonstrated that the undertaking was feasible. The system now in use involves three basic steps. The first is typing the complete unit card, including all tracings, accession number, etc. and the creation of a by-product tape with the same information. The card is then proofread for accuracy.

The second step involves superimposing a program from a master instruction tape for the creation of the set of cards. This operation is performed simultaneously with correcting any errors which may have been discovered on proofreading the content of the card, and results in two tapes: one includes the instructions for the typing of each card required for the set; the second includes the content of the card plus certain additional codes which articulate it with the instruction tape.

The third step is the production of the complete set of cards. Using continuous card stock, the machine will run until the complete set is made; the operator merely changes the tape, depresses the Start key, and starts on the next set. Typing at the rate of approximately one card per minute can be maintained throughout an entire day. Two operators, performing the three steps, can produce more than 650 cards in an 8-hour day.

We have not yet programmed all of the possible variations in card format, so that the Xerox machine is still being used to reproduce certain types of cards for which we are typing original copy. We have not yet, for example, begun making cards which involve serial publications. This as well as other variations will be done in due course.

On the basis of preliminary estimates of time required, we decided that we would not utilize the Flexowriters for creation of cards if more than thirteen are required for a set. With our system of

auxiliary catalogs, this means that only cards with four or fewer tracings would be put into the Flexowriter system. Those with more tracings continue to be duplicated by Xerox, but further studies may cause us to change the division point.

In analyzing card production operations, we have found that the greatest losses occur from non-continuous processes. The time consumed in shifting from the typewriter, which prepares the original copy, to the Xerox machine, from the Xerox machine to the card cutter, and from the card cutter back to the typist who manually adds the headings is at least as great as the time used by the productive portion of the cycle. The virtue of the Flexowriter system, despite the fact that each card is produced by typing a letter at a time, is that the cards when typed are complete and ready for filing.

Conversion to Computer

The punched card equipment, at the time it was installed in 1957, was considered adequate for a book budget of $250,000 per year and an annual acquisition rate of approximately 30,000 volumes. Since that time the rate of acquisition has almost doubled. The equipment is still performing well but is at a peak of utilization. Analysis of our needs has led to the conclusion that the next expansion should be in the installation of a small scale computer in the Library itself. This is now being discussed with the University administration, and it appears likely that such an installation will be approved within another year.

The next step in the development of a truly automated record system will be the conversion of present operations from punched cards to the computer. This will not be a radical change. Outside of the machine room itself, the members of the Library staff will hardly be aware of a change at all. Punched cards will continue to be used, since they are the primary form of data input for a computer system.

I have indicated earlier the effects of a computer on our circulation control system. It will also make possible the accomplishment of a number of other objectives which could perhaps have been performed with our punched card equipment, but would have required considerable expansion of human effort.

A number of years ago we published and distributed to the faculty and other interested persons a book containing the titles of serials currently received by the Library. To this we had hoped to add holdings records, so that we would in effect have our own small union list. The holdings records thus prepared would have been a supplementary and off-line operation and would not have been connected with normal

acquisitions procedures. With the computer we can record current receipts in the computer memory, thus eliminating other serial checking records. The publication of complete serials holdings for distribution to the faculty will become a by-product of regular operation.

We have also felt the need for establishing a binding schedule and record control system, using punched card equipment. This has not been done, largely because of problems arising from the reclassification program. It should be included in any computer programming.

We are now ready to begin tying together a number of aspects of our serials operations into an integrated whole. The programming which is used to create the record of current serials receipts and later the bound volume record will also include the cataloging statistical information for the particular title. Thus for serials a single record will be available for controlling the renewal and payment records, the receipt of current issues, binding of volumes, and finally the statistical analysis of the Library's acquisitions.

Computer Compiled Book Catalog

At this point we are ready for the near final step to an integrated automated record system, the computer compiled book catalog which would replace the card catalog. The system we would use is not far different from that described by the Chicago branch of the University of Illinois. Perhaps by the time we are ready to undertake it there will be improvements in equipment to make the format of the catalog more acceptable to librarians. When this day arrives we plan to reproduce the catalog for those books in the Library of Congress classification. Books remaining in the Dewey classification will continue to be represented by the card catalog.

Many of the problems of conversion have already been anticipated in the way the card catalogs have been set up. The subject catalog, as it stands, could be transformed into a book catalog almost without change. The Flexowriter procedures which are utilized for the creation of tapes would be equally usable as the input medium for the computer catalog. Many of our specific decisions have been made on the premise that eventually this will occur.

How long will it take? It has been almost fourteen years since the first step was taken. We are talking now of beginning computer catalog production by the middle of 1965; but the installation of our circulation system, which we think is almost here, is already nearly two years behind the original schedule. Pioneering is a slow business. The trip from St. Louis to Columbia over the Boonslick Trail 150

years ago took considerably longer than the trip today over the same route, which is now called Interstate 70.

Discussion

Ralph E. McCoy*

My remarks on Ralph Parker's paper are those of a newcomer to the world of automation, appraising the work of an old pro. Ralph Parker has been talking and writing about the library use of punched cards and computers when many of us were still charging out books by a pencil with an attached date stamp. While his library at the University of Missouri was installing electronic equipment to handle book ordering and accounting, most of us were solving our technical problems by adding another sheet of carbon paper.

Today there is a rush to climb on the bandwagon of automation, and our library has recently joined this parade. I expect that before long library schools will permit their doctoral candidates to substitute a machine language, say "FORTRAN," for the traditional French or German.

Dr. Parker begins his discussion with the appropriate point that automation must be preceded by the idea of system—the inter-relating of separate entities so that they operate as a single organism. Such an analysis of tasks to be performed, whether made by a stop watch, by statistics, by flow charts, or by a combination of these devices, will force us to re-examine procedures and may well save us from devising a more efficient method of doing something that need not be done at all. The very act of work analysis will reveal flaws and duplication of effort that have crept into our technical processes through piecemeal development.

Dr. Parker speaks of two ways of approaching automation of a library: by revolution or by evolution. Few libraries can afford the turmoil of revolution, or can close down long enough to retool. We must settle for the slower and perhaps tortuous evolutionary development of sub-systems. The point that Parker makes here and that has been graphically revealed in Mr. Heiliger's project, at the Chicago

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campus of the University of Illinois, is that some awareness of the total implication of automation for library routines must precede the creation of these sub-systems. Otherwise, a library might be faced with costly modifications later in attempting to join together the various sub-systems into a continuous assembly line production. Can the bibliographical information acquired in the book ordering process, for example, and stored on punched cards and perhaps on magnetic tape, be utilized by catalogers in establishing entries? Can the cataloging and classification process be translated to punched card for a printed catalog? Can a portion of this information, in turn, activate a record that can serve as the basis for book circulation? And, finally, can meaningful statistical data be extracted at any point in these processes?

I should like to point out that the lure of automation can result in over-mechanization, in devising expensive and complex methods for doing what really are simple jobs, best performed manually. I think the study of circulation control systems made by Fry and Associates brings out this fact very clearly.[1] When a brief news item on our automated circulation system appeared recently in Library Journal, I received more than a score of letters of inquiry, many from small libraries where the simplest kind of hand processing circulation system should be adequate.

One of the considerations in determining the desirability and extent of automation, of course, is the present and projected volume of work and its concentration in both space and time. A further consideration is the relationship of the library's operation to the business and institutional research facilities of the total university. The library may be a sub-system of a university-wide system of automation, just as it may have its own sub-systems.

On our campus we have a Data Processing and Computing Center with strong support from the university administration for campus-wide automation. We are also fortunate in having a Systems and Procedures Office that has worked closely and sympathetically with the Library in automation planning. A library that must assume the entire burden of developing and maintaining a system may find the cost prohibitive.

Speaking of costs, and we generally are in our library, we have been cautioned by our systems people that automation will not necessarily produce an immediate savings in dollars. It may merely shift the burden of cost from one campus agency to another. In the case of our circulation system, for example, we expect the cost of mailing overdue notices to be shifted from the library to the bursar's office. Greater accuracy, the potential for handling increased work loads, and convenience to the library's public may be more appropriate arguments for automation than reduced budgets.

Business records of libraries are natural subjects for automation, especially where they relate to the general business and accounting procedures of the University. It is in this area that the University of Missouri began its automation efforts, which Dr. Parker indicates took some fourteen years to perfect. At Southern Illinois we have used punched cards for some ten years to handle financial accounts, subscriptions, and the ordering of books, commodities, and services.

I would like to make some specific comments on Dr. Parker's system of business records, in the light of our experience. Our IBM cards for subscriptions include an "item number" by which titles are alphabetized; a code number to designate source, that is, whether it is from dealer or direct, by membership or by gift; and a code for the location of the journal in the library. Most of our subscriptions have a December 31 expiration date, and most are paid for in advance. Serials that are "billed on receipt" are classed as continuations, not periodicals, and are paid for from book funds. The encumbering problem for continuations, their irregularity of issue, and the length of the entries for so many of them have discouraged us from trying to put them on punched cards. For example, we have not discovered a way to get the IBM system to re-encumber automatically for future receipts of a series at the time it records payment for one of them. We do not punch in subscription prices on cards used for the print-out of our public list, because it is irrelevant and because a price change would necessitate punching a new card for each title affected.

The University of Missouri makes use of purchase orders prepared on the Cardatype machine from IBM cards which have, in turn, been prepared from data on book order requests. The multiple order receipts created by Cardatype serve much the same function as the multiple order cards that in our library are created from a Multilith master. It is difficult for me to assess here which is faster, or more economical. We place orders daily, rather than weekly as in the case of Missouri. We find we cannot rely on the weekly punched card ledger sheets supplied by our data processing office to prevent over-encumbering an account, but must manually record orders placed between runnings of these ledgers. Perhaps here is a reason for the library to have control over equipment scheduling.

Our monthly IBM ledgers are easy to check for orders requiring claims or cancellations. The order number shows when an order was placed, but the date showing when an item was cataloged is not too useful for control purposes. A long time-lag between receipt and cataloging, revealed by the ledger, means that the item has been in the precatalog stacks, rather than on someone's desk awaiting cataloging. If cataloging were on a relatively current basis, the "date cataloged" would be more useful as a control device.

Parker notes that one of the multiple order forms goes to the public catalog when an item is ordered from a secondhand dealer catalog. We spare ourselves the bother and expense of preparing a purchase order on such an item until we have actually verified by letter, telegram, or cable that the item is still available. Only if it is available and is being held for us do we prepare a purchase order. This saves initiating an IBM cancellation and withdrawing a card from the public catalog.

One of the most interesting features of the Missouri system is the creation of a desiderata record intended to eliminate a second bibliographic verification. However, we question the advisability of scattering such records throughout the public catalog as opposed to keeping them together in the order department.

Incidentally, our multiple order system provides the following cards, nine in all, each in a different color and with appropriate preprinted instructions. Two cards go to the vendor (one to be returned with the book); one card goes immediately into the public catalog as evidence that the title is ordered; one card goes to the subject librarian; one card goes to the Library of Congress to order a set of catalog cards; one card (in sheet form) goes to Data Processing for the encumbrance record. When the book arrives, an "invoice copy" initiates payment; one card becomes the cataloger's work card; another card bearing the pre-catalog serial number is used to replace the order card in the public catalog and to serve as a temporary author card; and the card it replaces is used to notify the faculty member that the book he ordered has arrived.

The completely automated book circulation system that Dr. Parker plans for the future is quite similar to that now being developed at Southern Illinois University. Let me comment on some of the similarities and differences. In both systems a transaction card will be created at the circulation desk by the insertion of the borrower's card and a prepunched master book card permanently located in the pocket of each book. Our installation at the central circulation desk calls for six #357 IBM units, each with manual input facilities, three keypunch units, and other necessary components. Only the variable date due will be manually punched at the time of the transaction. The Missouri system includes an abbreviated author and title and an accession number as well as call number. By limiting our punching and print-out to call number only we are able to use a short IBM card that will not protrude above the top of the book. In both systems it should be noted that there is little carry-over from this card to a full scale book catalog. It seems to me that in a research library, unlike a public library, there would be limited value in the preparation of a book catalog with abridged bibliographical information.

A university library imposes a requirement in circulation records not generally demanded by a public library. The university

library must know at all times who has a given book so that, if necessary, the book may be recalled before it is due. A daily print-out of book charges, arranged by call number and giving borrower's number and due date, will give us this information. Copies of this record, available in the various reference rooms, will eliminate calls to a central desk.

In order to speed the job of discharging returned books, we shall prepare two transaction cards at the time the book is borrowed. One is sent immediately to Data Processing for conversion to magnetic tape and serves as the record of the charge and the basis for sending out an overdue notice; the other card is a "date due" card which goes into the book pocket along with the master card when the book is given to the borrower. Prompt discharging can be accomplished merely by pulling the "date due" card and sending the book to the shelves. This card then goes to Data Processing to up-date the circulation record.

The task of preparing master book cards for a half-million volumes was not as enormous as we had anticipated--largely because of a speed-up device, a simple code sheet, designed by Science Research Associates, that could be marked by a pencil. Each sheet, containing the coding for eight books, is then put through a machine that converts the information to tape. The tape, in turn, activates the punching of the master book cards. The code sheets can be marked much faster than a card can be punched by hand, and the process eliminates the training of keypunch operators and the tying up of equipment for many months. Our problems have related largely to the original design of the code sheets to provide for a variety of book notations in the library. The Dewey classification lends itself very well to the scheme, much better than the Superintendent of Documents' classification which we use for federal documents. Still unsolved are the handling of bound volumes of unclassified periodicals and the devising of a simple system for flagging a returned book for which there is a class or personal reserve.

One of the arguments for using the IBM circulation system in our library was that the entire volume of circulation was concentrated at one point in the main library. I doubt whether this particular system would lend itself to a library with many branches or separate circulation points. It would be very costly to install the expensive input and card punch equipment at every station.

The entire cataloging operation at the University of Missouri appears to have been developed carefully and reappraised frequently. It is complicated by the reclassification project and by an increased level of book buying in recent years. We are particularly interested in the mechanics of using the 914 Xerox for direct card reproduction. I hope also that we can learn more about the use of the Flexowriter and compare it with our own use of Multilith stencils.

I do not see the operation of the Flexowriter as a sub-system in the preparation of a completely automated book catalog. Perhaps it is the procedures only and not the equipment that would be utilized in the conversion. In order to achieve a continuous flow, how would the catalog production be joined at one end with the order process, and at the other end with the circulation process? All the efficiency and speed achieved in photo-copying of LC cards, it seems, would be lost in the manual operation of typing or key-punching. I am sure that both Missouri and the University of Illinois at Chicago have given thought to these matters. The possibility of a machine printed book catalog, capable of being maintained by machine filing and available in multiple copies, is one of the most exciting prospects in the future of libraries.

Dr. Parker speaks of the possible installation of a computer in the library itself at the University of Missouri. One of the advantages that we saw in automated business records and circulation at Southern Illinois was the shifting of a clerical burden to another agency—a central data processing office that would do the detailed work of filing, typing, bookkeeping, mailing overdue notices, compiling hold-up lists, and performing many other related chores. This would eliminate bulky files in the library and the need for staff to maintain them. We are counting on this service from a central campus agency being prompt and reliable. If it is not, we may be sorry that we converted to this system. It is also possible for machines to make errors or, to state it properly, for the men that run them to make errors. We received quite a shock last fall to learn from the computer that for the first time since the Korean war enrollment at SIU had leveled off. This situation was changed, however, within a few days when Data Processing located a box of enrollment cards that had not been fed through the machine.

One of the advantages of tying into a university-wide automation system is the potential to analyze library usage—to correlate reading patterns with grade averages, with subject majors, with high school records, with dropouts, with IQ or other test scores, all of which will be recorded and stored on tape. It will also be possible to gather frequency-of-use data on certain classes of books or to make quantitative studies of book holdings, useful for the many questionnaires we are called upon to complete. The Decatur Public Library has made many analyses from the punched card records of its circulation.

I think the application of automation to the operation of a library should be pushed with vigor, not only because it can make a real contribution, but as a matter of self defense—to protect us from the pressures of university administrators, equipment dealers, and data processing zealots who wish to push us into the never-never-land of information retrieval.

At a recent conference on our campus, an outside consultant gave the impression to our top administrators that a complete system of information retrieval for university libraries was just around the corner and that only the backwardness of librarians plus a few bugs in the equipment stood in the way.

I was glad to note that a more reasonable claim was proposed by Dr. John R. Pierce of the Bell Telephone Laboratories, speaking at the recent dedication of the John Crerar Library. He said: "It is clear that if our objectives are modest, we can put machines to profitable use in libraries today. We can use machines to reduce cost, to minimize clerical drudgery, to offer better service; in short, to help improve the whole process of information communication."[2]

But, he warned that until the computer can be made to "think" and to separate materials, library users " . . . would smother under the flood of information and misinformation it would produce . . . . What the person who consults the library needs is not everything about a subject, but the best information about it or about the part of it in which he is interested."[3] And only human beings, he concluded, can make this judgment.

I believe that librarians should combine an alert and eager interest in the future of automation with a healthy skepticism to the panacea of automation. Data processing experts and librarians have much to learn from each other.

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TECHNIQUES OF FLOW-CHARTING

Louis A. Schultheiss

INTRODUCTION, by Edward Heiliger

Automation of libraries must come about through close cooperation between librarians and "machine people." Each must understand something of the other's specialty. For a starter, a good common language is provided by flow charts, which are simple work-flow charts written in yes-no terms. They can be quickly understood by the "machine people," and the technique of making them can be learned by a librarian in a very short time.

Because each member of the library staff knows his own work better than does anyone else, he is, therefore, better qualified to do the flow charting of his work. In flow charting the library's work, all of the staff take part and contribute to the process of preparing for automation. Staff members lose some of their fears in the process and take pride in their contribution to the joint effort. This grass-roots approach develops interest in the whole problem and makes the next step easier. The staff member benefits by learning to think of his work in terms of logical alternatives. He discovers that the old routines were illogical in many ways and that many changes are needed, automation or no. Reasons for work conflict are uncovered and outmoded routines left over from previous changes are discovered.

One by-product has been a new kind of staff manual, consisting of flow charts. An uninitiated staff member seems to be able to understand the workings of a new department much more quickly by reading flow charts than by reading text. It is also easier to see each department's relation to the whole library by studying the whole library's charting.

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It is evident that data processing will be most effective when all of the library's work is tied into one system and when that system is planned before the implementation of any part of the work is begun. Flow charting is an essential part of planning the system and is the first step that must be taken. The paper by Mr. Schultheiss includes a description of the flow charting method and this can be a guide for those interested in using this approach. A complete set of the charts developed in the University of Illinois study can be found in the book published on the project.[1] --E. H.

"Flow-charting" is a very broad term used to describe a number of charting and diagramming operations, many of them not peculiar to data processing. Decision flow charting and work flow charting and diagramming have been used in other fields for many years, although the concept seems to be a relatively new one among librarians.

Since this conference is made up primarily of librarians, I will concentrate on decision flow charting, with a few examples of other types, and will show samples of both early and recent work at the University of Illinois Undergraduate Division Library at Navy Pier, Chicago, during the past three years.

All librarians know about procedure manuals, instruction sheets, and other means of maintaining uniformity of procedures and of instructing new personnel. The primary difficulty with these (other than the fact that they always seem to be out of date) is that they give only broad steps, on an action basis, and cannot show HOW to make the value judgments and decisions that must be made if the procedure is to be carried out intelligently.

Flow charts, on the other hand, combine both physical actions and decision making in one logical flow. The type of operation (action, decision requirement, hold, etc.) is indicated by the shape of the box surrounding the written inscription. The choice of box shapes and sizes may become very elaborate and representational, and may be transcribed in a variety of formats; the Head of our Data Processing Department has often jokingly remarked that by using flow charts and magnetic tape reels we have rediscovered the pictogram and the scroll and are calling this progress.

For work at Navy Pier, however, choices were limited to a small number of the shapes provided by the IBM Diagramming Template:

1. Circles are used to indicate the start or the end of a complete process.

2. Diamonds are used to indicate the entrance of material from another flow sequence, or its exit to another sequence.
3. Rectangles are used to indicate some sort of action.
4. Hexagons are used to indicate holding operations of all kinds.
5. Round-ended boxes are used to indicate questions and decision requirements.

The size chosen at any particular time depends entirely on the length of the inscription to be contained, and the aesthetic whim of the person doing the diagramming.

Decision flow charts are so constructed that all questions are answerable by a "yes" or a "no," and there must be both a "yes" and a "no" answer to each question. If there is not, there is no question because there is no choice. And there can be no "maybe" answers in flow charting. If there are several choices possible at a particular point, the most likely choice is posed as the first question; if the answer to that question is "no," the next most likely choice is posed, and so on down the line until a "yes" answer is reached or until only one choice remains and is no longer a matter of question.

Before going on to the actual techniques of decision flow charting or to an examination of samples of actual working charts, here are a few basic rules:

1. Flows cannot come to a dead end. It is important that no procedure be left dangling; material must either exit to another flow or come to a complete and indicated stop without further requirement for action.
2. There must be two alternatives at each decision point. As already indicated, one must be a "yes" and the other a "no." Two of one kind or a total of more than two are logical impossibilities.
3. Wording must be sufficiently precise for both questions and actions to be clearly understood. It is entirely possible that the wording of inscriptions will be more difficult in some cases than the delineation of the procedural flow itself.
4. The flow chart, to be valuable, must be an accurate picture of the way the work is really done, rather than of the way the supervisor would like to have it done:
   (1) Decisions must be made at the points indicated on the charts.
   (2) Actions must be charted in the sequence in which they are actually performed.
   (3) Actions and decisions must be indicated as being performed by the persons actually doing them.

There are many ways of constructing preliminary flow charts. Perhaps one of the easiest is to indicate each action, decision, or other operation on a separate slip of paper and then to arrange the slips on a corkboard or to tape them onto a large surface. This will eliminate a great deal of tearing up and starting over, as few people are able to visualize a flow chart in the beginning or to estimate properly the amount of space it will take. The staff at Navy Pier began with small slips of paper, grease pencils, cellophane tape, and a poster typewriter; the slips were taped to large sheets of jute board, and grease pencil lines were eventually drawn onto the boards to connect the various steps (see Example 1). For purposes of crowding as much as possible onto one 8-1/2"× 11" sheet, the slips used in this example are much smaller than those we actually used. "P" slips are about right, with boards of about 30"× 36" inches.

After steps in a given process have been written on slips, boxed, and arranged on the backing board, flows are traced through to be sure that they are mechanically correct; i.e., have no dead ends, have the proper number and variety of choices, etc. When this has been accomplished, it is usually well to review the work thus far with another staff member who has some knowledge of the procedure under examination. This may not lead to continuing friendships, but it does increase the chances of accuracy. Then, after errors have been corrected and missing steps inserted, the entire chart is ready for transfer to some more permanent and manageable form. Do not be too upset if the first few charts cannot be corrected at all, or if another member of the staff walks up and immediately sees the answer to the problem that has been stumping you for the past half-hour; this is something of a new technique to most librarians, and it also requires the ability to stand off and see a familiar routine as if it were being observed for the first time.

There are at least two common ways of transcribing flow charts to paper: from top to bottom, and from left to right. In the beginning, the staff at Navy Pier were taught to chart from top to bottom. This technique is the one used by IBM and works very well on short flows. The other method of transcribing, from left to right, is used by the Burroughs Company and is the method now used for new work within the Technical Services Division at Navy Pier, though we continue to use the IBM template. The primary reason for the change was simply one of convenience; these charts are used a great deal for training and instructional purposes, and it is easier to connect distant portions of the same routine by lines rather than by exit symbols. Such entrance and exit symbols seem to be difficult for the clerical mind to understand, and they always seem to feel that something else is going on between the point of exit and the point of re-appearance. So we attach additional sheets to the right side of the first page and

accordion-fold the whole thing when we are finished; by doing this, we can keep both the flow chart and the accompanying procedures write-up in the same notebook and both can be consulted without having to turn the notebook at a 90° angle. Examples 2 and 3 are illustrations of transcription. Example 2 is an elaboration of Example 1, reading from top-to-bottom; and Example 3 is the same as Example 2, but is transcribed from left to right.

Examples 4, 5, and 6 indicate three generations in the flow charting of the same procedure. The first operation was done for the Information Systems Section of General Electric in the spring of 1960, and was laid out in very broad steps (Example 4). Example 5 is a portion of the same procedure, as revised in July of 1961. Examples 6-A and 6-B are a revision of the same procedure as it is carried out at the present time.

Example 7 is a bit different. In this case we have a diagram of proposed system flow for a circulation system. If the system outlined in Example 7 is put into operation, the "people flow" or decision flow, will go something like what is shown in Examples 8-A and 8-B.

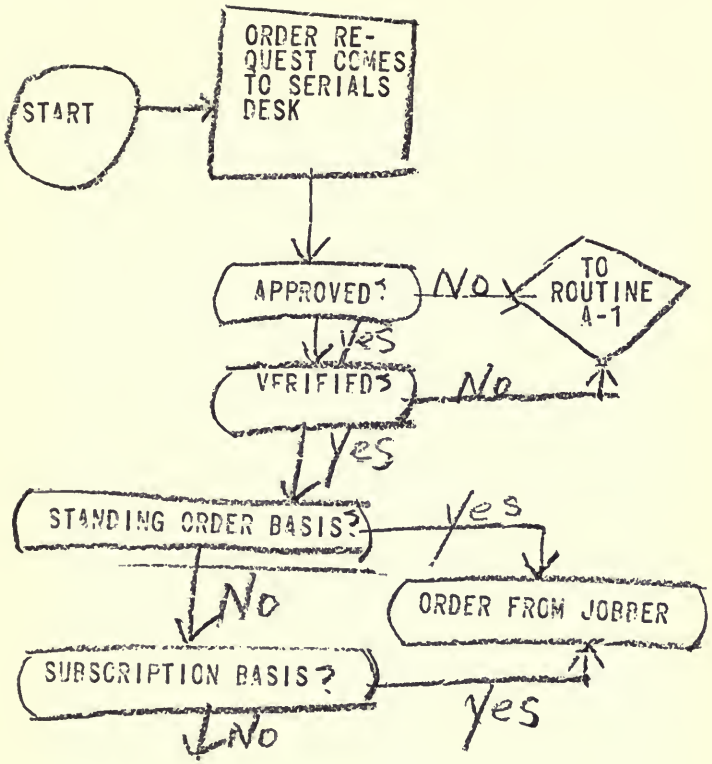
Example 9 is an illustration of the Burroughs Company's flow charting, and shows some differences in symbols and technique.

Example 10 is somewhat more pictorial than the ones we have seen so far, and is a very sweeping description of the conversion of catalog data contained on punched cards to magnetic tape and to a book catalog.

The final example, Example 11, is of a completely different sort. This one is an example of a block diagram, and contains one block for each computer operation. After completion, diagrams of this type are coded into the language of the computer, punched into cards, and are put into the computer itself.

REFERENCES

1. Schultheiss, Louis A., et. al. Advanced Data Processing in the University Library. New York, Scarecrow Press, 1962.


START
ORDER REQUEST COMES TO SERIALS DESK
APPROVED?
No
TO ROUTINE A-1
Yes
VERIFIED?
No
Yes
STANDING ORDER BASIS?
Yes
No
ORDER FROM JOBBER
SUBSCRIPTION BASIS?
Yes
No

EXAMPLE 1

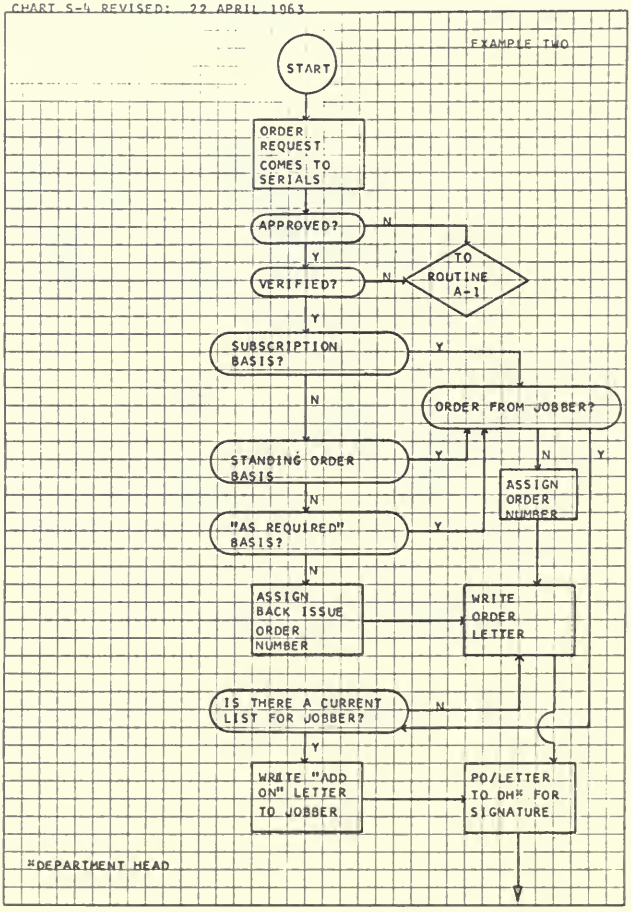


CHART S-4 REVISED: 22 APRIL 1963
EXAMPLE TWO
START
ORDER REQUEST COMES TO SERIALS
APPROVED?
N
Y
VERIFIED?
N
TO ROUTINE A-1
Y
SUBSCRIPTION BASIS?
Y
N
ORDER FROM JOBBER?
STANDING ORDER BASIS
Y
N
Y
ASSIGN ORDER NUMBER
"AS REQUIRED" BASIS?
Y
N
ASSIGN BACK ISSUE ORDER NUMBER
WRITE ORDER LETTER
IS THERE A CURRENT LIST FOR JOBBER?
N
Y
WRITE "ADD ON" LETTER TO JOBBER
PO/LETTER TO DH* FOR SIGNATURE
*DEPARTMENT HEAD

EXAMPLE 2

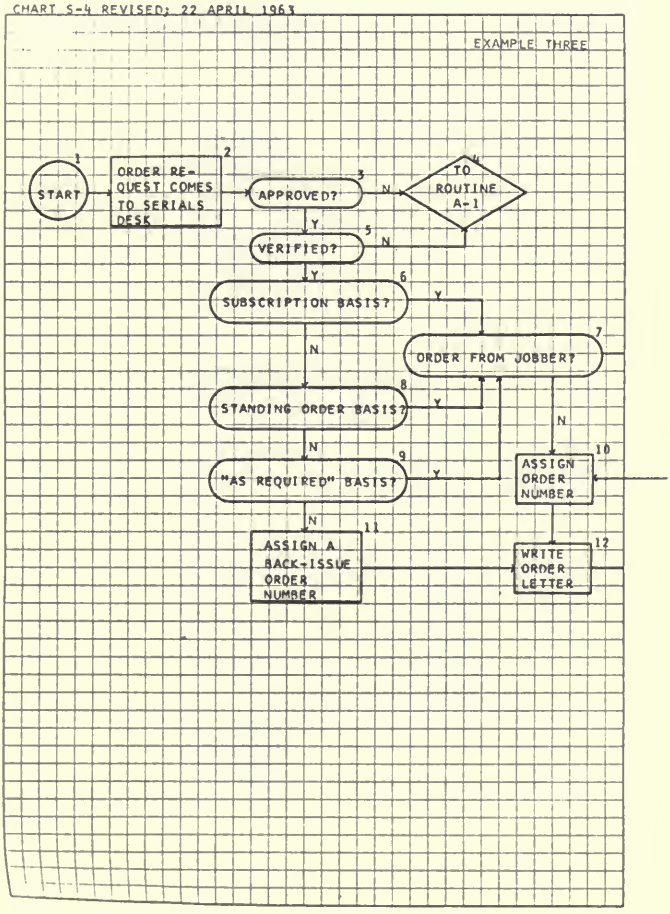
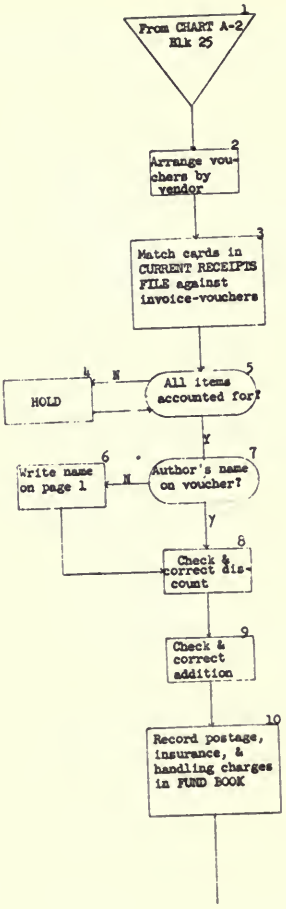


CHART S-4 REVISED: 22 APRIL 1963
EXAMPLE THREE
1
START
2
ORDER RE-QUEST COMES TO SERIALS DESK
3
APPROVED?
N
4
TO ROUTINE A-1
Y
5
VERIFIED?
N
Y
6
SUBSCRIPTION BASIS?
Y
N
7
ORDER FROM JOBBER?
8
STANDING ORDER BASIS?
Y
N
9
"AS REQUIRED" BASIS?
Y
N
10
ASSIGN ORDER NUMBER
11
ASSIGN A BACK-ISSUE ORDER NUMBER
12
WRITE ORDER LETTER

EXAMPLE 3


1
From CHART A-2
Blk 25
2
Arrange vouchers by vendor
3
Match cards in CURRENT RECEIPTS FILE against invoice-vouchers
4
HOLD
N
5
All items accounted for?
Y
6
Write name on page 1
N
7
Author's name on voucher?
Y
8
Check & correct discount
9
Check & correct addition
10
Record postage, insurance, & handling charges in FUND BOOK

EXAMPLE 4

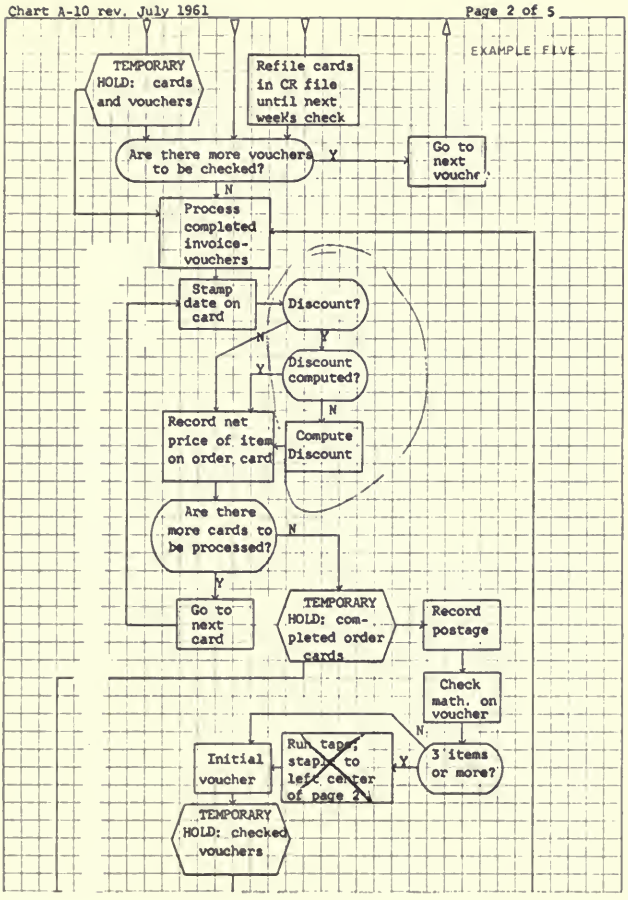
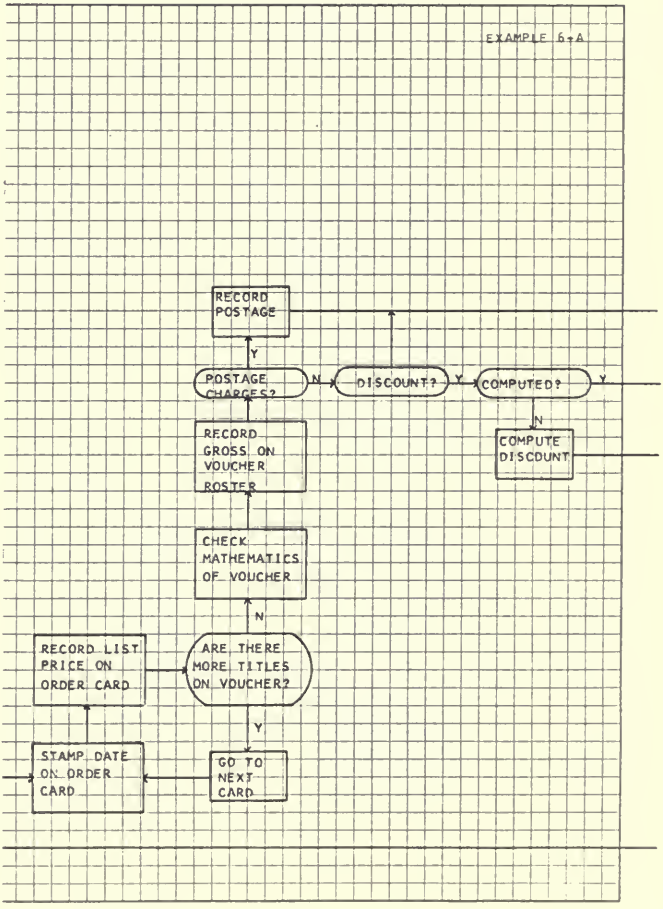
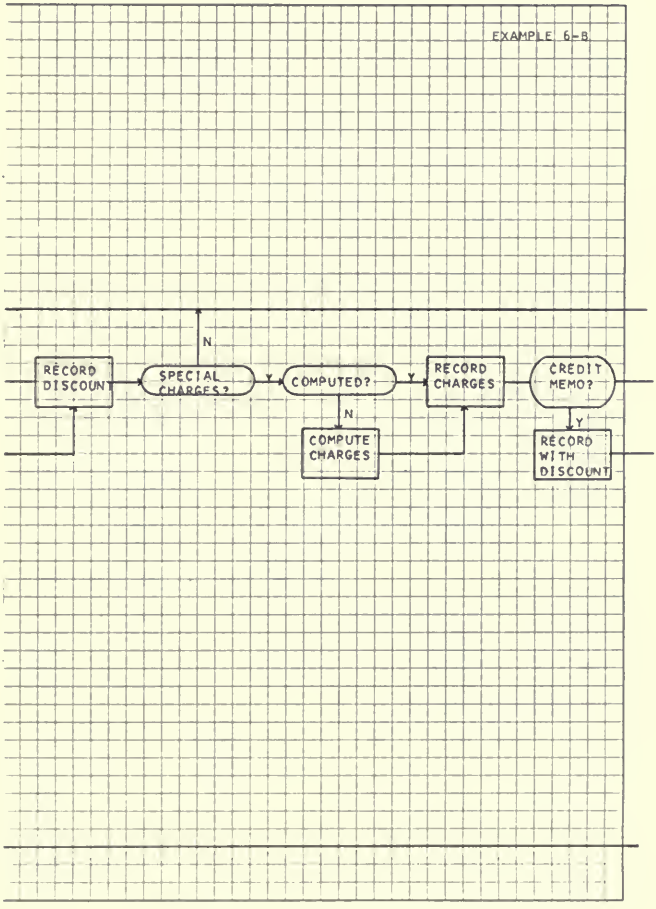


Chart A-10 rev. July 1961
Page 2 of 5
EXAMPLE FIVE
TEMPORARY HOLD: cards and vouchers
Refile cards in CR file until next week's check
Are there more vouchers to be checked?
Y
Go to next voucher
N
Process completed invoice-vouchers
Stamp date on card
Discount?
N
Y
Discount computed?
Y
N
Record net price of item on order card
Compute Discount
Are there more cards to be processed?
N
Y
Go to next card
TEMPORARY HOLD: completed order cards
Record postage
Check math. on voucher
N
Initial voucher
Run tape; staple to left center of page 2
Y
3 items or more?
TEMPORARY HOLD: checked vouchers

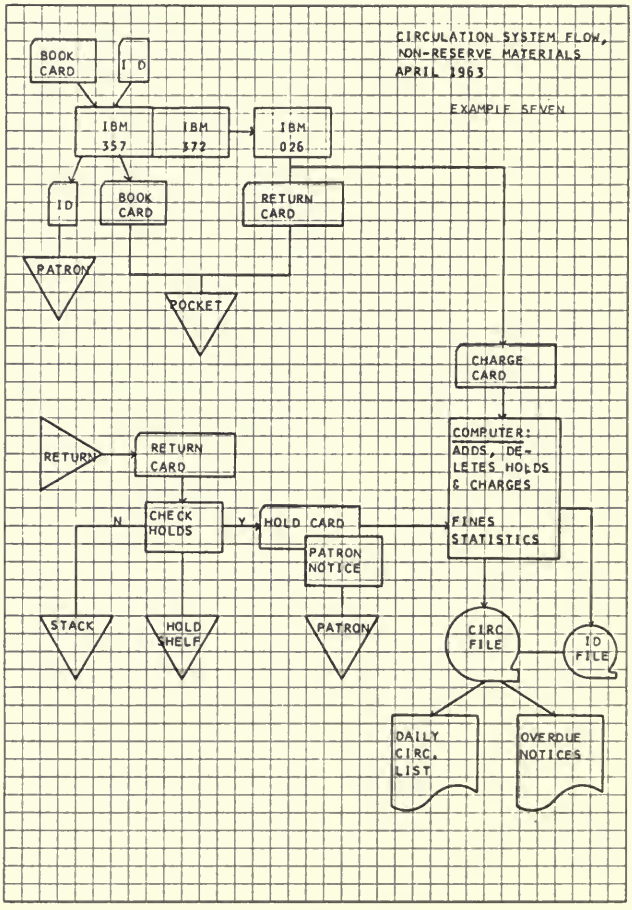
EXAMPLE 5


EXAMPLE 6-A
RECORD POSTAGE
Y
POSTAGE CHARGES?
N
DISCOUNT?
Y
COMPUTED?
Y
N
COMPUTE DISCOUNT
RECORD GROSS ON VOUCHER ROSTER
CHECK MATHEMATICS OF VOUCHER
N
RECORD LIST PRICE ON ORDER CARD
ARE THERE MORE TITLES ON VOUCHER?
Y
STAMP DATE ON ORDER CARD
GO TO NEXT CARD

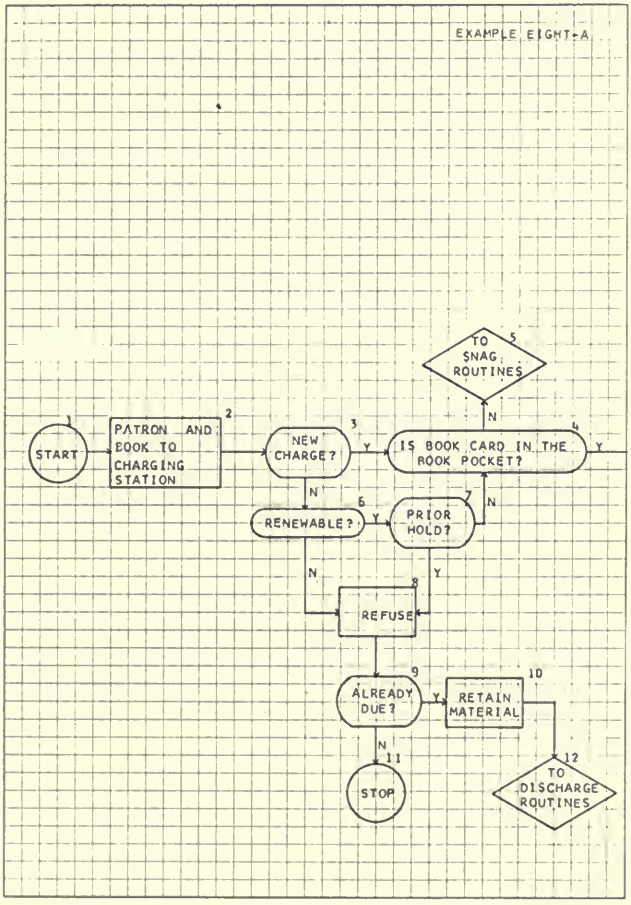
EXAMPLE 6-A


EXAMPLE 6-B
RECORD DISCOUNT
SPECIAL CHARGES?
N
Y
COMPUTED?
Y
N
COMPUTE CHARGES
RECORD CHARGES
CREDIT MEMO?
Y
RECORD WITH DISCOUNT

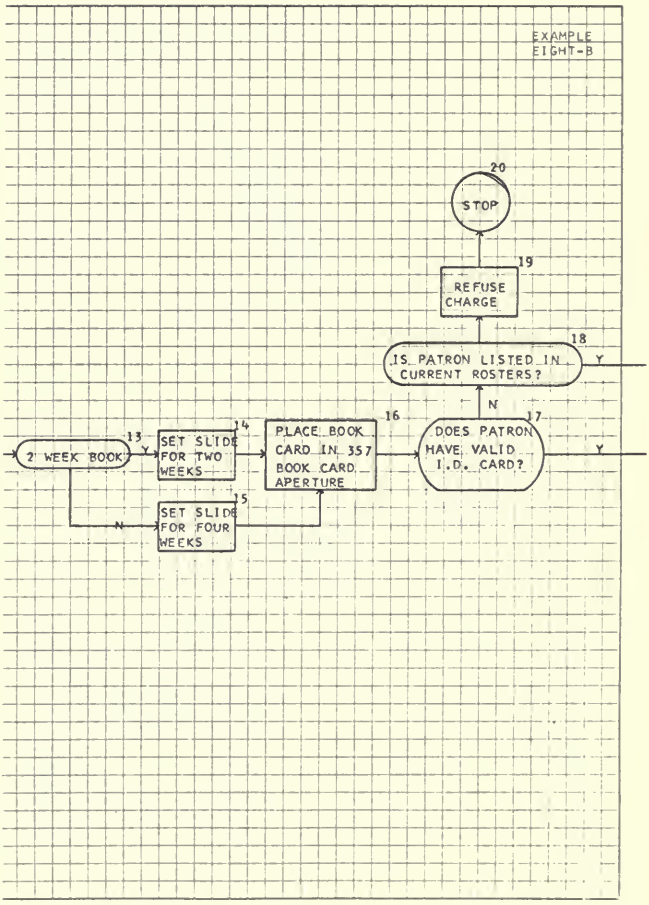
EXAMPLE 6-B


CIRCULATION SYSTEM FLOW,
NON-RESERVE MATERIALS
APRIL 1963
EXAMPLE SEVEN
BOOK CARD
I D
IBM 357
IBM 372
IBM 026
ID
BOOK CARD
RETURN CARD
PATRON
POCKET
CHARGE CARD
RETURN
RETURN CARD
COMPUTER: ADDS, DELETES HOLDS & CHARGES
N
CHECK HOLDS
Y
HOLD CARD
PATRON NOTICE
FINES STATISTICS
STACK
HOLD SHELF
PATRON
CIRC FILE
ID FILE
DAILY CIRC. LIST
OVERDUE NOTICES

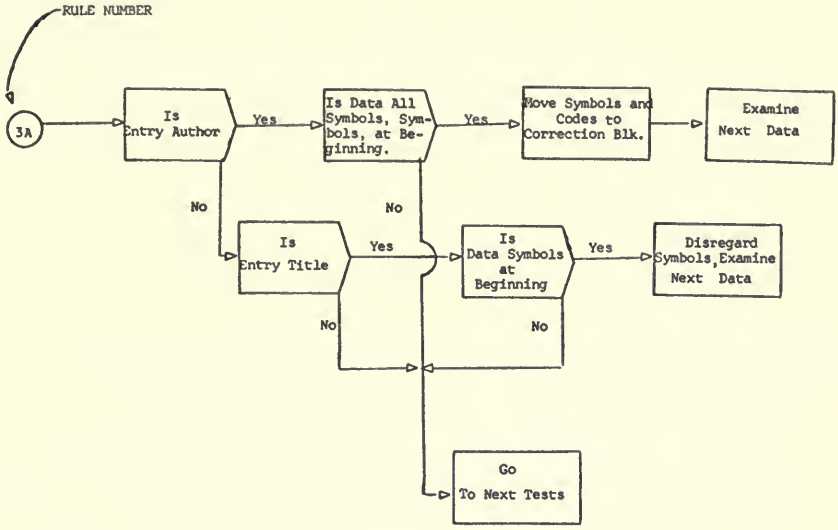
EXAMPLE 7


EXAMPLE EIGHT-A
1
START
2
PATRON AND BOOK TO CHARGING STATION
3
NEW CHARGE?
Y
4
IS BOOK CARD IN THE BOOK POCKET?
Y
5
TO SNAG ROUTINES
N
N
6
RENEWABLE?
Y
7
PRIOR HOLD?
N
N
Y
8
REFUSE
9
ALREADY DUE?
Y
10
RETAIN MATERIAL
12
TO DISCHARGE ROUTINES
N
11
STOP

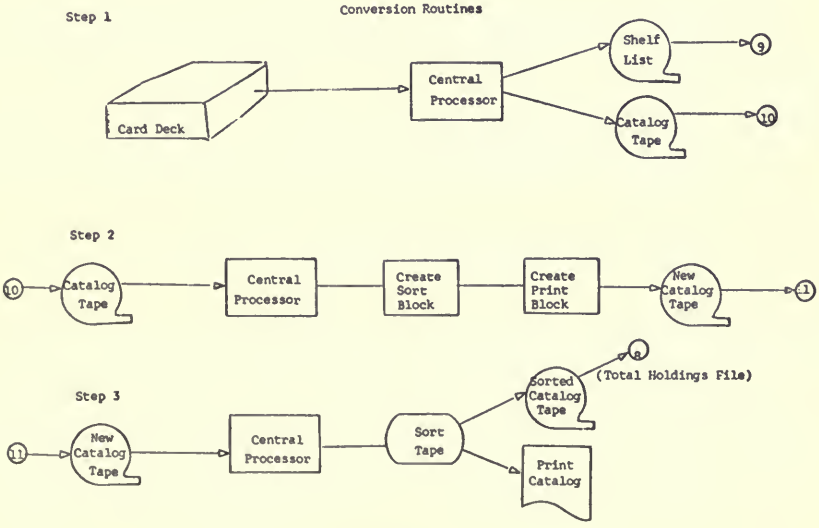
EXAMPLE 8-A


EXAMPLE
EIGHT-B
20
STOP
19
REFUSE CHARGE
18
IS PATRON LISTED IN CURRENT ROSTERS?
Y
N
16
17
DOES PATRON HAVE VALID I.D. CARD?
Y
13
2 WEEK BOOK
Y
14
SET SLIDE FOR TWO WEEKS
PLACE BOOK CARD IN 357 BOOK CARD APERTURE
N
15
SET SLIDE FOR FOUR WEEKS

EXAMPLE 8-B

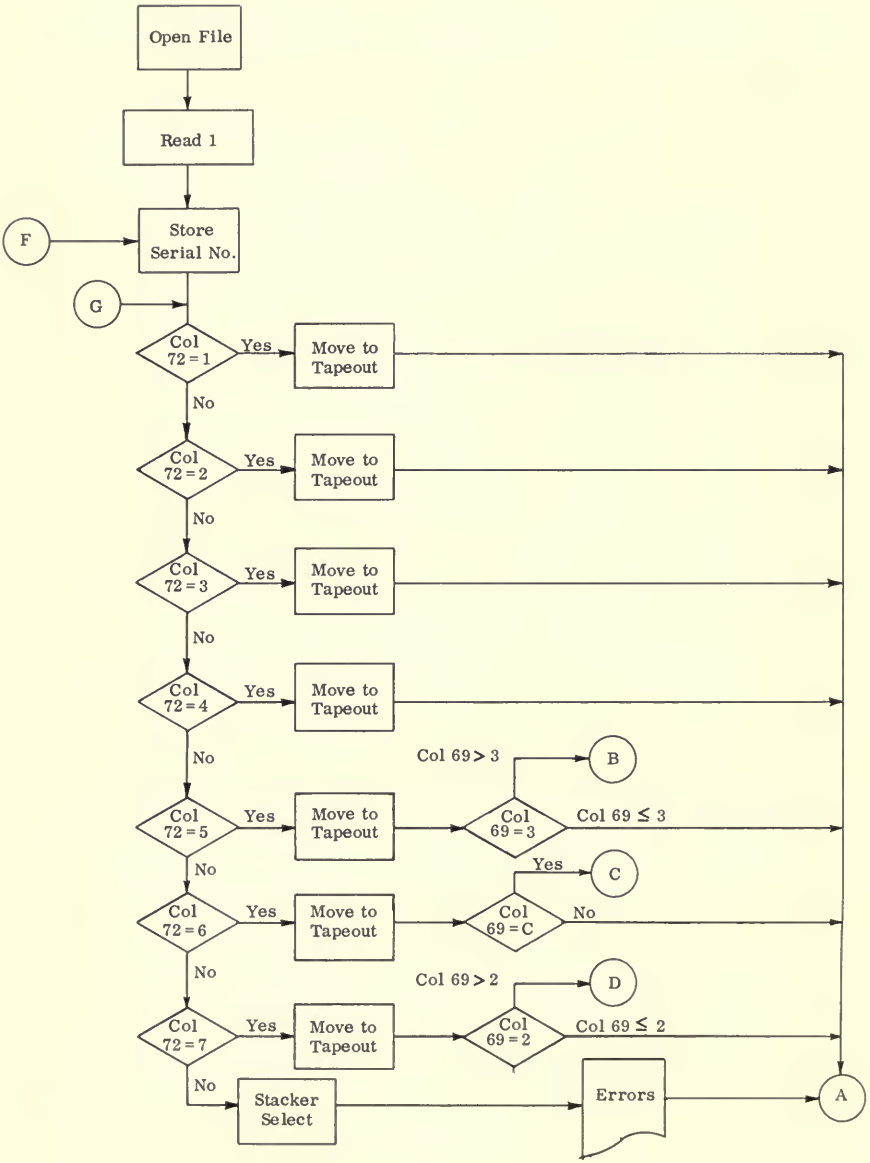


EXAMPLE 9



EXAMPLE 10

File Creation



EXAMPLE 11

IBM ADVANCED SYSTEMS DEVELOPMENT LIBRARY IN TRANSITION

Marjorie Griffin

The IBM Advanced Systems Development and Research Library in San Jose became a pioneer in mechanization for the sake of expediency. It was organized conventionally in 1952, with its main purpose to give dynamic information service to the personnel in the Research Laboratory. Then, during 1955-56, an expansion program within the company increased employees from 80 to 1,000, and locations from 1 to 16 buildings. The demands of the new users on the small staff created a need for faster processing and greater control of library material. As a result of this demand, the second function of the library was introduced: experimentation in the mechanization of library routines to speed the flow of processing. We decided to mechanize those routines which would immediately minimize our problems of backlogs and of control of dissemination of library material. We used the IBM machines which were then available, including a keypunch, a sorter, a collator, and an accounting machine—the IBM 407. The underlying philosophy throughout this development was to provide greater service with as much economy as possible.

Routing of Periodicals

Accordingly, the procedure of routing periodicals to personnel in different buildings received first emphasis. The objective was to reduce time spent in typing the routing slips, by making machine-preprinted routing lists on a monthly basis, to which names of personnel could be easily added or deleted. To accomplish this objective, we took the following steps:

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1. The periodicals were arranged in alphabetical order and assigned a four-digit code number from the IBM 10,000 Division Code for Proper Names, with 99 unused numbers left between titles. For example, Bell Lab. Record was number 2,100, and Bell System Technical Journal was 2,200. This identified each periodical numerically, for machine purposes, and permitted the addition of new titles in alphabetical order.

2. Routing slips for each periodical were analyzed to determine what information on them remained the same (and were machine usable) for every issue, and what varied and thus would have to be added by the periodical assistant at every routing. Only the date of the issue and the date the periodical is sent on routing had to be added.

3. To simplify the addition and deletion of users from a routing slip, all bibliographic periodical information was placed on one card (header), and employee information was punched on another (detail). A detail card was made for every person on the routing list. These card sets were linked by code and copy numbers of the periodical. Figures 1 and 2 show a card set (header and detail cards) and the routing slip printed from them.

4. The routing slip was designed in a double form: one half to be used as the circulation card, while the periodical was out on routing, and the other half to be attached to the periodical as a mailing slip. An IBM 407 control panel was wired to print the same information on both halves of the form from a single deck of cards (Fig. 3).

The advantages of this system over the manual one were: (1) It was easily updated; (2) The correct number of copies of the routing slip were made for the number of copies of the periodical received; (3) It saved time in processing--only the date of issue and the date of routing had to be added manually for correctly routing each periodical; (4) The exact reproduction onto the circulation card portion of the slip of the names on the mailing slip portion permitted tracing the issue if needed; and (5) Upon return of the issue, the mailing slip was destroyed and its other half could become the permanent circulation card. After seven years of usage this successful system remains substantially the same.

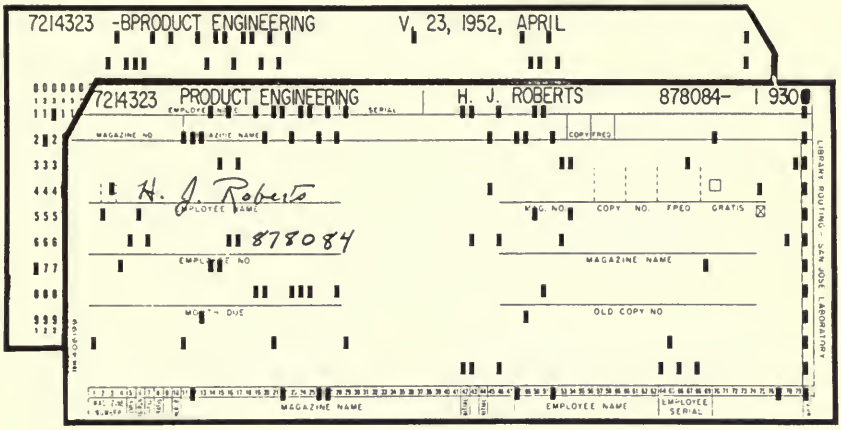

Figure 1
Routing Card

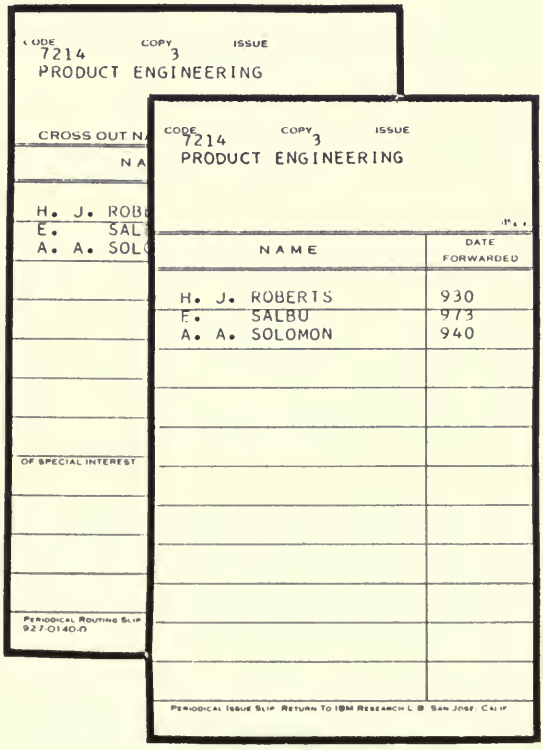

Figure 2
Routing Slip

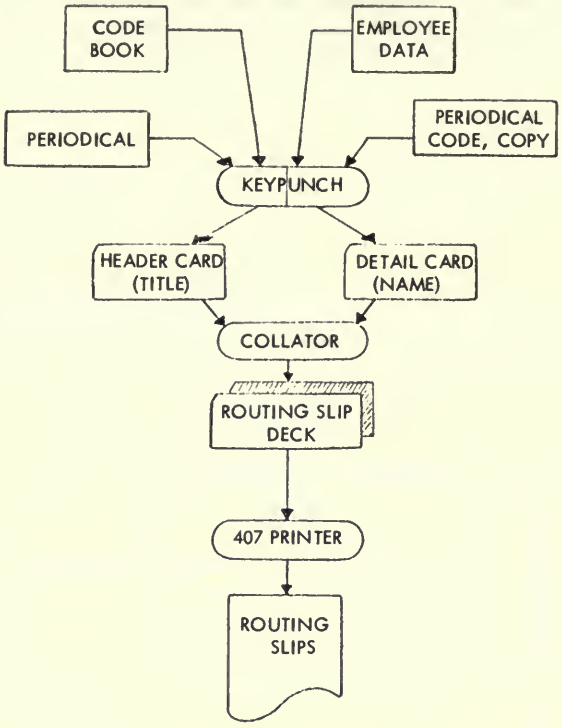

Figure 3
Routing

Circulation

The next routine to receive attention was circulation. In order to keep tighter control of books and pamphlets, we needed to inform borrowers regularly of all material charged to them and to inform a terminating employee on a demand basis of all material charged to him. To achieve these goals we took the following steps:

1. We identified the information we would need to know for machine-producing these notifications. This was:
   a. for the employee—his name, department, serial number, and the date he borrowed the material.

b. for the material—author, title, volume, part, call number, copy, and year of publication.

2. We punched a master deck of requisite bibliographic information for each item from the shelf list onto one IBM punched card. This meant compressing the information from a Library of Congress card into 80 columns or characters. Fixed fields were assigned to each kind of information.

3. We decided upon a type of circulation card that would be used for a single transaction and then placed in an inactive file, to be used later for statistical purposes.

4. We designed a circulation card which would incorporate bibliographic information from the master deck and still leave room for the borrower information to be punched. Compromises had to be made in this compression, and we decided not to punch the title, but to type it on the card for visual reference.

5. The circulation system was set up as follows. When an item was charged out, the borrower wrote his name, serial number, department, and the date on the card. This information was keypunched into the card, and the card was duplicated with the exception of the borrower information. The two cards were placed in the circulation file. When the item was returned, both circulation cards were pulled from the file. The card containing the borrower information was placed in an inactive file, from which circulation statistics could later be obtained. The other card was placed in the book pocket, ready for the next transaction.

6. At the request of some of the library users, overdue notices were designed as single sheets, one item per sheet. This sheet could be trimmed to provide a 3"× 5" record of a book borrowed. We tried to send these notices once a month.

7. To print the overdue notices, the completed circulation cards were merged with the master deck so that the title would be printed. This required a rearrangement of the active circulation file for processing.

This system helped us meet some of our original goals of tighter control. It gave us these advantages over the manual system: (1) We could prepare overdue notices more quickly than by typing them, even though we fell short of our goal of monthly reminders. (2) We could easily gather a variety of statistics for periodic reports to management. (3) We could print lists of loans to terminating employees, on demand.

However, unsuspected weaknesses were discovered while the system was in operation. Weaknesses found were: (1) Typing the title on the circulation card took too much time; (2) To print overdue

notices, the master deck had to be sorted and merged with circulation —a laborious card-handling operation; and (3) A single-sheet overdue notice for every item was costly in printing, and time-consuming in handling. Therefore, we changed the procedure as follows:

1. From the master card, the bibliographic information is now reproduced by an IBM 519 onto a redesigned circulation card (Fig. 4).

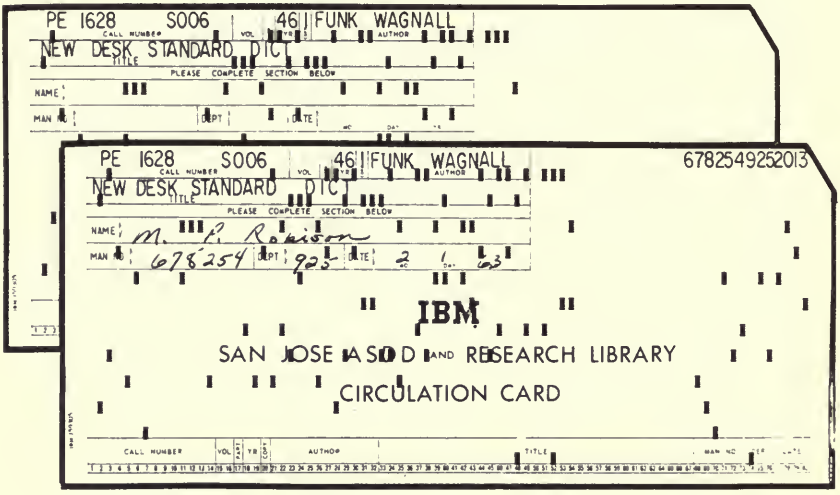

Figure 4
Circulation Card

2. This redesigned circulation card includes a truncated title which allows us to use the circulation file to print overdues and termination lists without merging it with the master deck. The title no longer has to be typed for visual reference.

3. A second duplicate of the completed circulation card is now made at the time the borrower information is punched. This duplicate is filed by the employee's serial number, and termination listings can be made directly from this file.

4. Overdue notices, now called inventory control lists, are also printed from this file, which is kept up-to-date daily. The file is merged with a personnel deck to print borrower's name at the top of the inventory.

5. The individual inventory control lists are printed on single sheets, so that the borrower can see at a glance what is charged to him (Fig. 5).

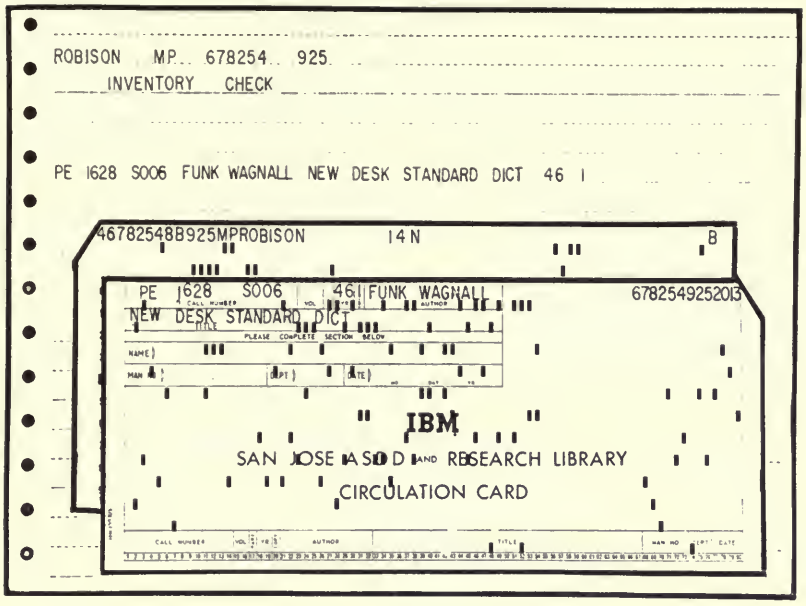

Figure 5
Inventory Control

Author and Title Book Catalogs

By 1957, in this rapidly developing location, several small libraries had been started to accommodate the engineers in scattered buildings. Book catalogs seemed the solution to the problem of keeping up-to-date and comprehensive catalogs in every library in this complex.

We decided to make this catalog a finding list, rather than a complete catalog with full bibliographic entry. The Research Library already had, for the circulation procedure, a master deck of punched cards prepared from shelf list cards. These could be used to prepare a short-entry type of finding list (Fig. 6). In addition to being partially prepared, this was by far the cheapest way to process the information, allowing faster punching, and faster printing, and producing smaller catalogs.

The system was designed as follows. Each individual library maintained its own card catalog and supplemented this by using the book catalogs which were reprinted monthly. The assistant in each

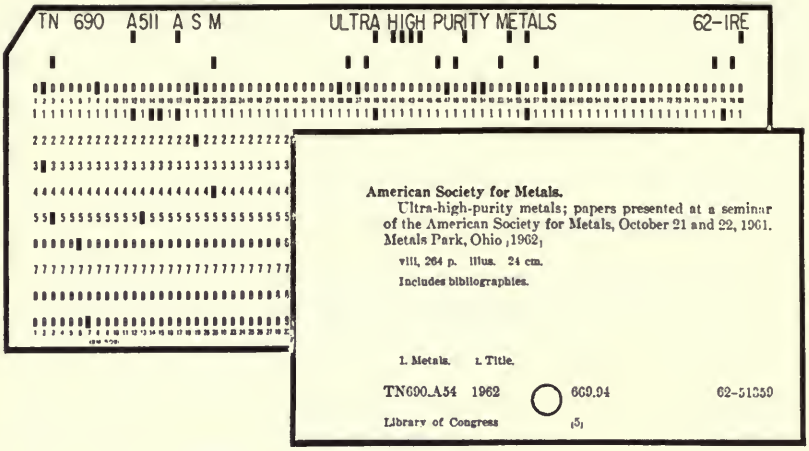

Figure 6
Master Card

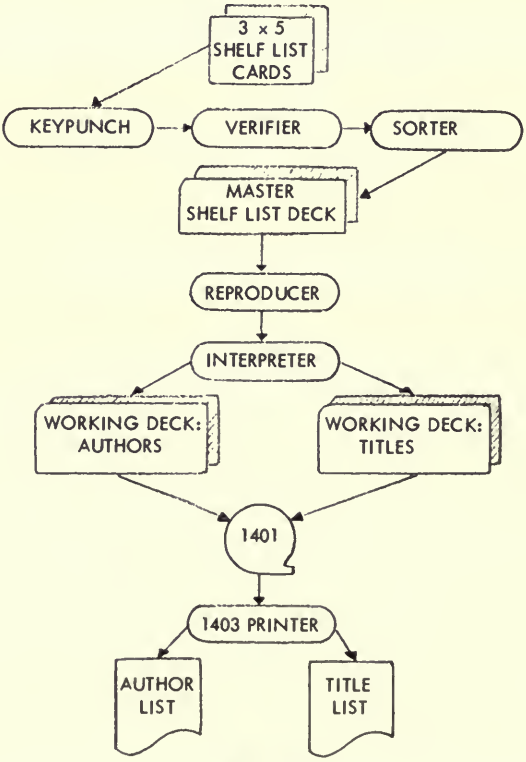

Figure 7
Author-Title Catalog

library forwarded her shelf list cards to the Research Library for processing. Three book catalogs were made—for authors, titles, and subjects.

The production of the author and title catalogs followed these steps (Fig. 7):

1. Two columns were designated on the master card to identify location of book; e.g., RE was Research, PD was Product Development, etc.
2. Each master card was reproduced twice. One set of master cards became the author deck, the second the title deck, and the original remained the master source deck (Fig. 8). The author deck was alphabetically sorted on the author field; the title deck on the title field.

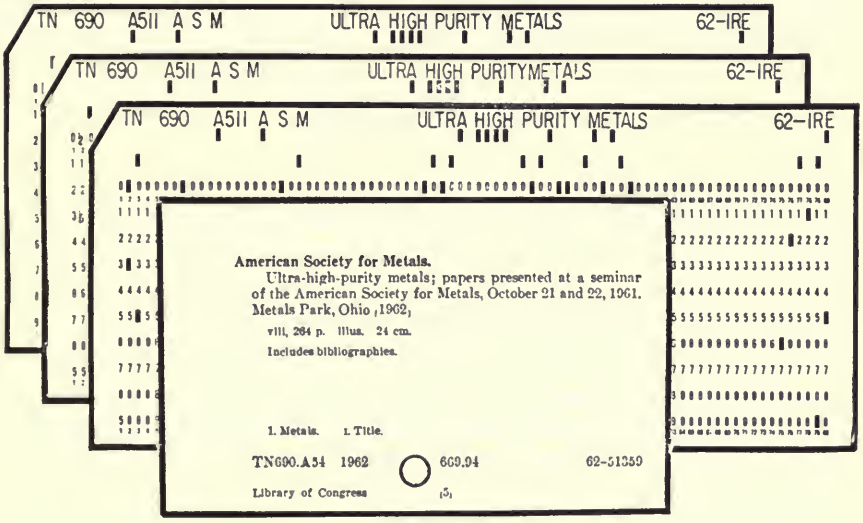

Figure 8
Author-Title Catalog

3. Two panels on the IBM 407 were wired to rearrange the information on the cards when printing the catalogs, with the titles first in one case, and the authors in the other. The complete entry remained the same; only the order of entry differed.
4. For updating these catalogs, the cards made for the additions were sorted into their respective sequences and merged with their main decks on a collator. The new decks were then reprinted.

We learned that it was necessary to establish an authority file for abbreviations in the titles and corporate entries. In manual filing one can poke a card into its correct place, but a machine will only sort the card as it is punched, and a collator will only merge like names into sequence. A major improvement was made in our catalog procedure when we normalized the language used in the titles and corporate entries.

When we improved the processing procedure for the title and author catalogs, we were able to take advantage of the greater capabilities of the IBM 1401, which had become available in our laboratory. We transferred the author and title decks to magnetic tape, and now, instead of using a sorter and collator for updating, we merge new additions directly into the existing files on the tape. The IBM 1401 sorts the decks into their correct sequence, and the IBM 1403 prints the new catalogs. The total process is accomplished in less than 15 minutes—a saving of two days of sorting, merging, and printing.

Subject Book Catalog

The subject catalog was a more complicated procedure to initiate. It required establishing the subject-heading code dictionary, as well as adding to the master card the number assigned to each book's Library of Congress subject heading. To compile the dictionary (1) each Library of Congress subject heading we had used, and each see and see also reference was punched on an IBM card; (2) the deck was sorted into alphabetical order; (3) to each subject heading and see and see also reference a five digit code number was assigned, leaving 99 numbers between entries for interfiling future subjects. From this deck, the subject code dictionary was printed by an IBM 407.

The subject headings on Library of Congress shelf list cards were numbered from the new dictionary, and our next problem was to find space for these numbers on the already-full master cards. Rather than compress the titles to accommodate the extra data, we transferred information from the single master card into two cards, one containing the title, and call number, date, location and subject-heading code, and the other the author and the same common information. This two-card-per-entry deck allowed us to print subject catalogs, but these catalogs required two lines of print per entry, and lost in readability and usefulness. This handicap proved severe enough that we revived the single entry card for the subject catalog deck. We reduced the title field on the master card, but only by six columns, so that the title was still identifiable. This left a field into

which we could put the subject-heading code number when we made the entry card from the master card. Fortunately, we were still a small enough library that such experimentation was possible (Fig. 9).

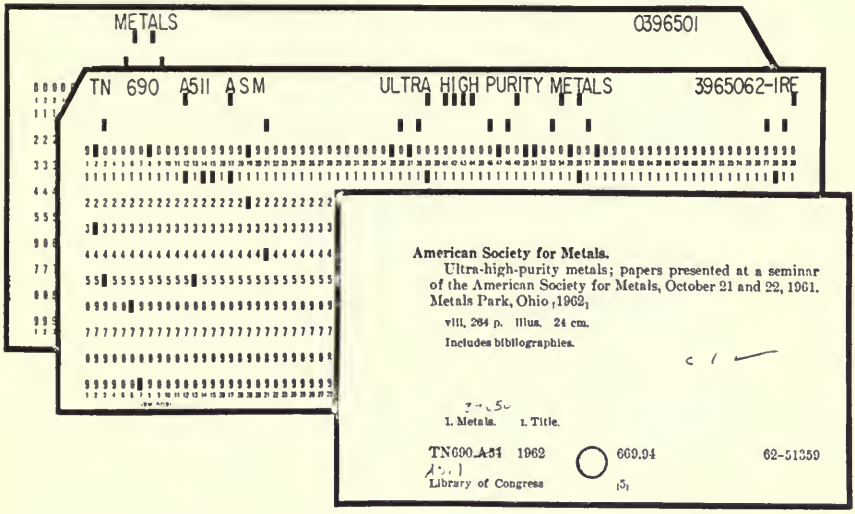

Figure 9
Subject Catalog

The subject card is produced from the master card as follows (Fig. 10). The subject card is made at the same time that the master card is keypunched, unlike the author and title cards which are reproduced on the IBM 519. By using the alternate programming on the keypunch, we automatically duplicate the bibliographic information from the master into the subject card, until we come to the fixed field for the subject code. The code is then punched, and the remainder of the information duplicated. This single subject card format produces a smaller and more readable book catalog.

At present, a program is being written for the IBM 1401 which will arrange the entries first by subject and then by alphabetical author sequence under the subject. This will save days of processing time, for this computer sorts in blocks and will print the catalog at 600 lines per minute, instead of the 150 lines per minute of the IBM 407.

In analyzing the book catalogs system we found that although weaknesses had grown from too many compromises, advantages remained over a manual system. Advantages found were: (1) A complete card catalog in every library was not required. (2) Therefore,

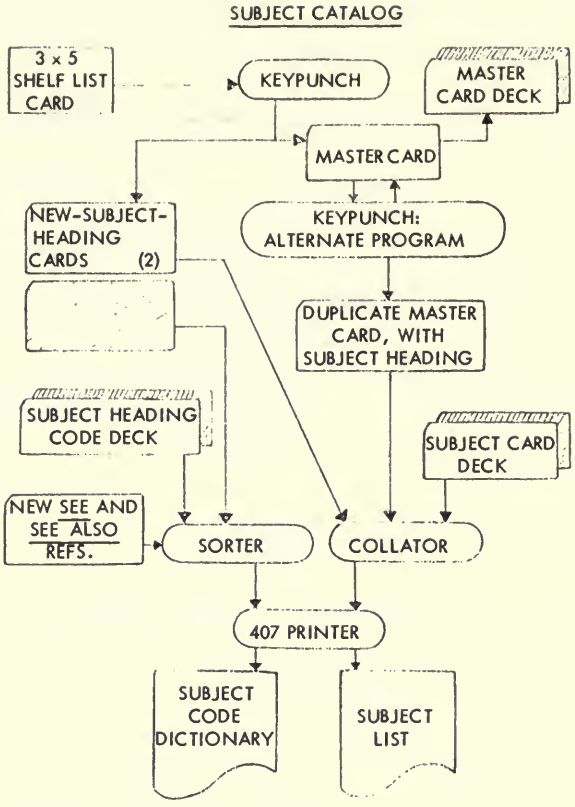

Figure 10
Subject Catalog

many sets of duplicate cards did not have to be typed. (3) The branch assistants were able to locate books in other branches without telephoning. (4) Users preferred to scan a page of text rather than use a card catalog. (5) Once organized, the system was simple to update. (6) Because complete lists were readily available, there was less duplication in ordering material. (7) Users and librarians alike enjoyed having portable catalogs that could be carried to the shelves.

Ordering

The next system to be analyzed for mechanization was ordering. There were two specific purposes in mind: (1) We wanted to be able to trace the progress and standing of an order—at any time, and (2) We were frequently asked by management and accounting for many and varied statistics on orders.

A 3" × 5" order card for library users had not provided sufficient room for the information added by the order librarian, which would trace the progress of the order; and in addition, statistics could only be obtained by hand counting. Accordingly, we listed the information we would need to know for a multiple-purpose order card which would contain all data about an order and which could be quickly processed to give us the statistics we needed.

This was: (1) Book information--author, title, series, publisher, year, edition; (2) Additional report and pamphlet information—issuing agency, code number, verification, and source; (3) Requester information—employee's name, serial number, department, division, and the date of the request; (3) Library information—number of copies received, call number or Library of Congress number; and (5) Purchasing information—whether item was received or not, gift or purchase, price, agent, and dates of order, receipt and payment.

Benefits we aimed to accomplish were: (1) To keep a single-card, complete record of each order; (2) To obtain statistics on total number of orders by year, month, division, department, employee, and subject; (3) To obtain total costs; (4) To be able to follow-up back orders with minimum effort; (5) To assist the Accounts Payable Department with invoice approval; (6) To have our "order-received" cards provide a complete shelf list; and (7) To obtain accession listing from the punched "orders-received" cards.

When these goals had been determined, we designed the order card. To assist the users, we attached two carbon copies to the main card. The requester took the first so that he would have a copy of his order. The other was sent to him by the library when the requested item was ordered. This was his justification for complaint if the item was not received within ten days. Its progress could be checked easily on the order card.

By punching the information from this card onto other cards, we could manipulate the data to print lists in any order we chose. All the ends we planned to accomplish with this system have been achieved with one exception: again we compromised on the title, and have omitted it from listings. With the success of the system, we have established an interlibrary loan procedure using similar techniques and cards.

Information Retrieval

While these procedures were being developed, another area of our library was receiving experimental attention, that of subject searching. To speed our answers to the queries of engineers, we now have an information retrieval system on the IBM 7090, which stores information from 33,000 documents. However, this retrieval system has evolved from its beginning on the IBM 101, through the RAMAC 305, and the IBM 704. Each time we have converted the system to be able to utilize the greater capabilities of the machines, as they have become available in our laboratory.

The documents in the system include reports, pamphlets, bibliographies, and selected periodical articles. Keywords from the title, abstract, summary, first and last paragraphs, and paragraph headings are manually selected from the documents. This technique of indexing was chosen because of the speed of input it allows, and because we felt it would be more efficient to have the intellectual structuring (which is what classifying is) occur at the time of the search. This took advantage of the searcher's knowledge of his subject field and its vocabulary, and his ability to pinpoint the terminology that would produce a tailor-made individual bibliography. Even in 1959 we were thinking in terms of eventual machine indexing and wanted to begin with a system that would be compatible with it.

Material is processed as follows for the IBM 7090 system (Fig. 11):

1. The documents are sent to the library machine room where a document number is assigned.
2. Two card sets are punched directly from each document. One contains the index terms, hereafter called the descriptor cards, and the other the bibliographic information, called the document cards. The machine number links the two sets together.
    a. The document card set contains the machine number, the author, title, date, and library call number.
    b. Each descriptor card contains only the machine number and a single descriptor.
3. From these sets of cards stem by-products:
    a. The document cards are printed on the IBM 407 to make the master reproduction copy for the Daily News—our medium for getting word to the laboratory personnel of material received in the library.
    b. The first document card in a set is reproduced and interpreted to produce the circulation cards.

c. Document cards are reproduced and interpreted for two files, author and report number, used manually for quick reference.

4. The document and descriptor cards are sent to the Computation Laboratory where the information on them is transferred to two tapes for the 7090. The information retrieval program compiles bibliographies by searching these tapes, tying document to descriptor by means of their common machine number. By-products also result from this process:

a. At the time of updating, the descriptor tape is printed to produce the vocabulary listing for visual reference in framing a search.

b. The descriptor and document cards are combined by the IBM 7090, and a listing is printed of all titles under each single descriptor. The chief use of this lengthy listing is for browsing under single terms.

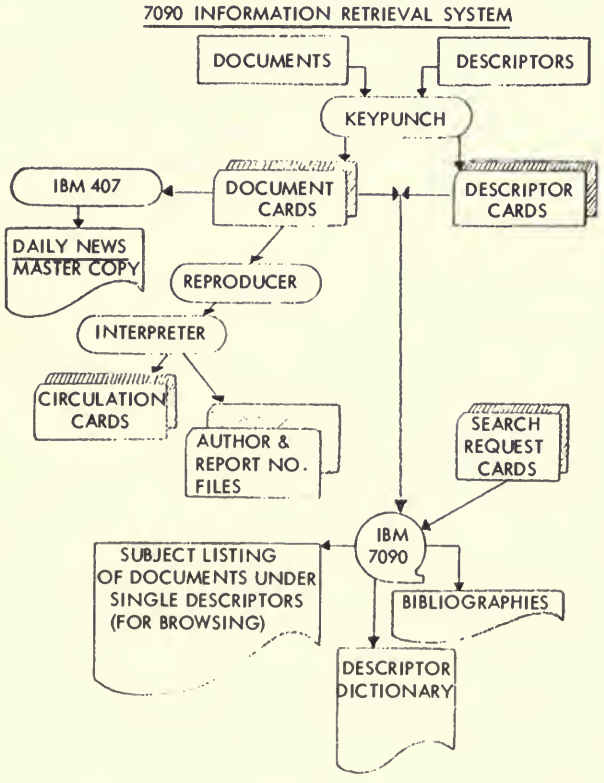

Figure 11
7090 Information Retrieval System

When a requester initiates a search, a librarian fills out a search worksheet giving the requester's name, department, extension, and date; and then the descriptors and the logic to be used in the search. The logical connectives accepted by this program are AND, OR, and NOT. This worksheet is sent to the keypuncher who punches search request cards. The program will permit six requests per pass of the descriptor tapes through the 7090 reading station. The machine numbers located on this pass are looked up on the document tape to obtain the complete reference. The resultant bibliography lists title, author, call number, and date for each item.

The machine searching program allows us great freedom in manipulating and combining the single descriptor terms to construct tailor-made searches. We can specify a precise inquiry by the ability of the program to combine terms with the logical connectives, and we can make a generic search by masking the grammatical endings of the descriptors.

The advantages of this information retrieval system are several: (1) It is a time saver—we can run a search in about two minutes which, by manually searching the published indexes, would take up to several days. (2) We can locate more current information, for published indexes are at least three months late, and we update biweekly. (3) The users find the printed listing easy to use and the reading of them analogous to browsing. (4) We can expand or further delimit a topic by making a second search on descriptors located in a pertinent document from the first search.

New Goals

Each of the previous procedures was mechanized to circumvent an immediate problem, usually to secure a particular benefit. Through our experience in using the machines and through discovering our early systems' limitations, we became aware that the many machine produced records needed should stem from one complete entry and that the comprehensive and interdependent system should be planned in advance before any of it is mechanized. We know, too, that hindsight gives a perspective not discernible while developing a system.

Fortunately, we have been given another challenge—to plan a new library for a major move in January 1964. Benefiting from the experience gained from mechanizing the present library procedures, the new library organization is being based on a total systems concept, with no piecemeal approaches. Each of the present mechanized procedures has been studied in detail to determine data required for efficiently manipulating and retrieving information and each procedure has been analyzed, step by step, for the integrated system.

Whereas in our piecemeal approach, we implemented procedures in a practical but illogical progression with the ordering procedure at the end of the library mechanization, in this rebirth we plan a logical, systematic flow in which all procedures will originate from a basic initial request, whether for an interlibrary loan or to order a book, pamphlet, or periodical. This information will be checked for completeness and for accuracy and then stored in computer memory. Through different programs we will instruct the computer to manipulate these data.

The single record of complete, accurate information on every item will be the basis of all future operations on that item. Around this one source record, and the ability of the computer to withdraw sections of information from it, we are planning services in addition to those now in effect. To assist in accomplishing our objectives we shall use such devices as remote station typewriter input, mechanized format-correction of bibliographic entries, and remote terminal displays to facilitate on-line information availability.

We expect the system to do the following new operations automatically: (1) Print orders to vendors, (2) Print claims for periodicals, (3) Print the Daily News, (4) Print lists of recent accessions to match an employee's personal interest profile, (5) Print bindery information, (6) Produce index terms for documents from title and text input, (7) Print union lists of periodicals, (8) Print routing slips for periodicals, (9) Print a check-in card for each periodical issue, (10) Print call number labels for book spines and card pockets, (11) Print circulation cards, (12) Print book catalogs, (13) Print overdue or inventory notices, and (14) Handle circulation transactions.

Since the library staff will be freed from these clerical tasks, they will be able to render more intellectual service; for no matter how much we accomplish in library automation, there is always need for intrinsic intellectual effort.

ELECTRONIC DATA PROCESSING APPLICATIONS TO TECHNICAL PROCESSING AND CIRCULATION ACTIVITIES IN A TECHNICAL LIBRARY

Hillis L. Griffin

The National Reactor Testing Station Technical Library, like many other special and research libraries, constantly strives to provide the highest level of service to its users. In support of this objective, the technical processing and circulation activities of the library must be prepared to fill user requests promptly and to anticipate user requirements.

One way to meet these standards might be through the addition of more clerical personnel handling an increased load of book purchasing, journal subscription and renewal activities, frequent recall of overdue materials in circulation, and timely announcement of new books and journals which are added to the collection. In 1958 the NRTS Technical Library decided instead to explore the benefits which electronic data processing procedures might bring to the library operation. Since that time new procedures utilizing punched cards have been implemented in the acquisitions, accounting, cataloging, and circulation activities of the library.

This paper will describe applications which have been used successfully at the National Reactor Testing Station Technical Library near Idaho Falls, Idaho. This library, located at the Station fifty miles west of Idaho Falls, is operated for the United States Atomic Energy Commission by Phillips Petroleum Company's Atomic Energy Division, to serve the literature needs of several hundred scientists, engineers, and other technical personnel employed by the Atomic Energy Commission and its contractors at the NRTS. Now twelve years old, the library is staffed by three professional librarians, three group leaders, and thirteen staff members. Its collections include approximately 15,000 volumes, 350,000 technical reports, and 800 journal titles.

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The NRTS is a large area of sagebrush-covered arid land, comparable in size to the state of Rhode Island. Various operational areas located about the site are served by the central library and branch libraries, as is the headquarters of the Idaho Operations Office of the Atomic Energy Commission located in Idaho Falls. Many of the library users have their major contact with the library by telephone as they request that books, journals, and reports be sent to them. Automatic answering telephones in the library provide round-the-clock auxiliary telephone service for many of these requests.

Punched cards are now utilized in many library functions. Books are purchased with order slips printed from punched cards. Notices for overdue materials are also printed from punched cards. Lists of new titles added to the library are machine printed for reproduction and distributed about the site each month, and cumulative listings of these titles are easily and frequently prepared from an always up-to-date deck of IBM cards. Electronic data processing applications have assumed a major role in the successful operation of the NRTS Technical Library since the initial application over three years ago. Many conventional library activities have been converted to punched card operations with direct benefit to the library and to the users which it serves.

Printed Lists of Journal Holdings

A union lists of the library's journal holdings used by research and engineering people at their scattered locations, as well as by the library staff, was the first item to be produced from punched cards instead of typewriter. New titles and back runs were being added frequently, and prompt revision of our list of journals was essential if it were to remain timely. We could not afford time to retype a complete revised list for each printing. A system was needed which would require only the new and revised material to be prepared, enable obsolete items to be deleted, and leave unchanged listings intact. Punched cards fully met this requirement.

Each line of the listing is punched on a separate IBM card. The cards, properly sorted and fed into an IBM printer, produce copy either directly on Multilith masters for offset printing, or on blank paper for later photo-production of multilith plates, or for use in the library as is.

Initial preparation of the list involves surveying the entire library collection and typing, on working cards ruled to coincide with the spacing of the information on the punched cards, each title held and the date of the first volume of each title. Information for each

entry consists of the title, volume numbers held, and the year of issue of the first volume in the run. Cross-references are provided for title changes referring to the latest title. Inclusive volumes under former titles are shown as a note after the latest title. Cross-references are also provided for foreign journals published in translation under variant titles, and volume numbers are shown for both publications if volume numbering of the translated journal differs from that of the original. The location of each set is also shown on the list together with the extent of the holdings at each location for runs which are not complete. The complete volumes are shown as well as those which are only partially complete.

Once the file of punched cards has been set up, it is easy to maintain and use. While it is possible to incorporate other information in the entry, e.g., language of publication, frequency, etc., we felt that this information could be readily obtained from other sources when it was needed. As a result, our initial conversion to punched cards took no more time than would be involved in typing a similar list for publication. Once the conversion to punched cards has been accomplished, later listings can be prepared quickly by machine in a matter of minutes.

This system has worked well, and the resulting union list of journal holdings is very useful. Trips to the stack area by circulation personnel to see whether we hold a title or a particular volume are eliminated. The reference section of the library has found it helpful in determining which citations can be supplied directly from our shelves. Branch librarians have better access to the entire library collection of journals. Scientific and technical personnel, each of whom has a copy of the list, are aided in their research by being able to ascertain quickly if a given reference is held by the library.

Book Lists and Printed Catalog

Our next application of punched cards was in the preparation of monthly lists of new books added to our collections, and periodic cumulations of these lists. This application was designed to be the initial phase of an integrated system for book ordering and ultimately for the preparation of a printed book catalog.

Since we regard the monthly lists and the printed book catalog as finding media (what is in the library, and where), entries are not bibliographically complete. The following information for each title is punched into the IBM cards: complete author and title, date of publication, and call number. Subject headings and branch locations are punched as alpha-numeric codes. Incidental information (e.g., series notes, edition, etc.) is included as a parenthetical note after the title. Information such as publisher, pagination, or contents note

is found in the shelf list which continues to be maintained in conventional form. As many cards as are necessary are used to provide full author and title information.

As the books are cataloged, the cataloger types a 3" × 5" working card for each title, showing author, title, notes, call number, and branch location. A six digit alpha-numeric title number for use with the printed catalog will also be assigned when the printed catalog system becomes fully operational. The working card is so ruled that the type spacing for author and title is identical with the space assigned for this information in the IBM card. The space reserved for the author on the working card, for example, will accomodate twenty-seven typed characters, just as the field allotted for author on the IBM card contains twenty-seven columns. Once each month these working cards are sorted by author and keypunched. The monthly list of new additions to the library is printed from these cards. This print-out, originally accomplished on the IBM 407 accounting machine, is now being done on the IBM 1401. Cumulations are prepared at timely intervals by sorting and collating the cards which have been used to print the monthly lists. Cards for the printed book catalog will be duplicated automatically from a single main entry set of cards punched for the monthly list.

At the time we embarked on this program, we were faced with two problems. Our original problem of publishing the monthly list quickly and easily was solved by the introduction of punched cards. As we looked at our card catalog, however, it was quite apparent that this catalog would not lend itself to conversion as it stood. Subject headings had proliferated; there were no cross-references and no subject authority file. Before we would be able to assign subject codes for subject headings, it appeared that we should work to reduce the number of subject headings in the catalog by consolidation. Cross-references would have to be supplied. This job is still in progress. When it is completed the library will gain, as a by-product of the coding operation, a printed subject authority file. The printed subject authority file will offer the primary benefit of utility. It will be readily available on the cataloger's desk and can be quickly reprinted as often as necessary. Inasmuch as the cataloger must use it as the basis for assigning subject codes to each book cataloged, it serves as an automatic verification that each subject heading assigned is currently being used in the catalog.

Any conversion job is a task of monumental proportions. We are well aware that conversion of our catalog to punched cards will be a difficult job. We presently plan to issue initially an author catalog and a title catalog. In this manner we can utilize the cards which have accumulated during the past two years from production of the monthly book list. Keypunching of all prior entries will be completed with the omission of subject codes. As the subject headings are

brought into order and each heading and cross-reference has a code number assigned to it, we can then proceed to code the subject headings assigned to each title. From the master author deck we will duplicate the trailer card (containing the call number and space for five subject heading codes) for each title. These cards will then be sorted by call number to place them in shelf list order. Working from our shelf list we will then proceed to punch the appropriate codes for subjects into the trailer card for each title. These cards will then be merged into the author file to replace the corresponding uncoded trailer cards. The author file will then be duplicated to obtain the subject file.

We feel that the division of the present catalog into a divided catalog will bring many advantages. It will be easier to use than a conventional dictionary catalog, for we can look for authors in the author catalog without the distraction of title and subject entries. We think that the author catalog will have great usefulness to our staff members for verification of entries, searching book orders, and location of books for borrower requests. The librarian is generally concerned with the author entry and probably the title entry secondarily, but the scientist is very often looking to see what we have on a particular subject. To him the subject catalog will probably be the most important. It will be readily available to him whenever he needs it, either at his own desk or a short distance away within his division. Together with the author and title catalogs, we look to this extension and improvement of the library catalog to increase the usefulness of our collections.

Book Purchasing With Punched Cards

Book purchasing procedures in many special libraries differ considerably from those found in public and university libraries, for the special library must generally adapt its procedures to those used by the company for its other purchasing activities. Our book ordering system was devised to work within the framework of established purchasing, receiving, and finance procedures within our company and at the same time to enable the library to process orders and check in materials quickly and accurately.

Punched cards are used to print order slips on the IBM 1401 using preprinted forms. The basic slip is the traditional 3" × 5" size. These slips are arranged three across the form and five copies deep with interleaved carbon. The back sheet is of heavier stock in a distinctive color. One printing operation produces fifteen copies of the slips for each copy of each title ordered. Fortunately, not all of these

copies stay in the library! They are distributed as follows: Library-8 slips, (1) Public catalog (this card is in a distinctive color and of heavier stock than most of the slips), (2) Purchase order file, (3) File by invoice number, (4) File by author, (5) Purchasing department, (6) Warehouse (receiving section), (7) Finance department, and (8) Extra copy (most libraries would use this copy to order L.C. cards); and Dealer - 7 slips, (1) Purchase order to publisher, (2) Report to library, (3) Dealer file copy, and (4-7) Invoice copies (returned to the library with the book and marked with selling price).

Since each slip serves throughout the entire ordering-billing cycle, they carry an individual invoice number for the entire process. This number is assigned to each title as it is ordered, and an order for multiple copies of a single title will have a separate invoice number for each copy ordered. Only one item is ordered against any invoice number. These numbers appear on all records involved in the transaction and facilitate several operations. Warehouse personnel match the number on the invoice sent in the book with the one on the copy of the form which they received when the book was ordered. Library personnel use it in pulling slips from the files when the item is received. The invoice number makes it much easier to resolve any problems with the dealer because it ties down the item in question very clearly. It is essential, too, in pulling IBM cards from the on-order file for processing invoice slips for payment.

A 3" × 5" search card is prepared for each book to be ordered. These cards are printed in continuous strips for easy handling in the typewriter. Like the working card used in preparation of punched cards for the monthly book list, the search cards are arranged in fields corresponding to those on the punched cards. They are spaced so that the number of typed characters which will fit into the spaces on the card are equal to the number of characters which may be punched in the same field of the punched card. After the card has been cleared for ordering, the information is punched into the appropriate fields on the IBM cards.

At the time the book ordering system was initially installed, an IBM 407 accounting machine was used to print the order slips. The system is presently operating on an IBM 1401 to secure greater flexibility in the preparation of input cards and in the print-out and output cards which result. As the order slips are printed on the IBM 1401, a new deck of cards is punched simultaneously. This deck is identical to the input deck with the exceptions that the invoice numbers, dealer code, and order date are added to all cards and the purchase order number is added to the trailer card.

A "load card," which precedes the data deck, loads certain constant information to the computer for use in various parts of the program. This load card contains the current date, last invoice number

used, the amount committed to date against the purchase order being used, the purchase order number, and the dealer name and his invoice code letters. At the end of each computer run a new load card is punched automatically, and it is necessary only to add the current date to this card to begin the next order run.

Invoices removed from the books received from the basis for clearing the IBM cards from the on-order file at monthly intervals. The cost of each item and the invoice number is punched into finder cards, and these finder cards are used to pull the IBM cards for materials received from the outstanding orders deck. Price information is transferred to the trailer card for each item received, and these cards are used to prepare the monthly list of clearings and finance summaries. The finance summaries are prepared in two formats. One, printed in invoice number order, accompanies our check to the dealer and gives him the detailed listing of the invoices being paid by the check. The second listing, arranged by purchase order and account number, is used by the finance section to debit the various accounts for materials received against them.

The orders-outstanding file may be used at any time for expediting materials which have not been received. A printed listing of outstanding items may be sent to the dealer for his action in noting the current status of the order. The library, too, has some indication of when the material may be expected when the dealer returns the list. Such a listing is easy to secure since the information has already been keypunched, and since the deck, maintained in invoice number order, is automatically in chronological sequence.

The book ordering and book catalog punched card formats were originally designed to be very similar in nature. We had hoped to be able to punch the cards once in ordering the book and then use these cards later in preparation of the printed catalog merely by pulling the card containing non-bibliographic information from the purchasing set of cards and by using the remaining bibliographic cards, with the addition of a trailer card showing call number, in the printed book catalog. Our experience indicates, however, that it is much easier to repunch the cards for the book catalog than to use the cards which were made to order the material. This takes advantage of the economies of monthly batch processing. We found, too, that since a large percentage of our materials are ordered before publication dates, we obtained little agreement in form of entry between the way a book was ordered and the way it was cataloged.

This book ordering system has been very satisfactory in operation. From one set of cards we get records for all of our essential files, and it is impossible to receive and pay for duplicate material in error. We are able to handle a large number of orders quickly and easily. We also benefit from a considerable saving in clerical time

in initiating the order, in file maintenance, and in all of the attendant housekeeping procedures.

Journal Renewal

The IBM 1401 data processing system gives us the means to cope quickly and easily with the problems of journal renewal. From one basic deck of punched cards we are able to send renewal notices to those for whom we order journals, requesting that they authorize renewal of the subscription for the coming year. From this same deck we write the renewal orders. Then, when the first issue of the journal subscriptions should have been received, we are able to take the same deck of punched cards and write letters to each subscriber asking that he certify that the subscription is being received in good order. A job which was formerly measured in months is now accomplished in a few hours.

The journal renewal system consists of three phases. In the first phase we generate renewal notices for subscriptions due to expire four months hence. These renewal notices are sent to the person for whom the subscription has been ordered, or, in the case of library subscriptions, they are used to check the current status of receipt of the journal prior to renewing. As each letter is written on the IBM 1401, the subscription card is removed from the file. When the authorization is returned to the library, the IBM card is replaced in the subscription deck to await the second phase of the operation. The only way that the subscription can be renewed is for the authorization to be returned to us by the subscriber or, in the case of a library subscription, for the material to be arriving in good order.

The actual renewal order is written in the second phase of the operation. Renewals are written automatically for subscriptions expiring three months hence or earlier to the vendor to whom we are directing renewal orders for each particular title. As the renewal order is being written, the subscription period and the inclusive volumes being ordered are updated automatically and a new subscription card is punched. The printed output from the IBM 1401 in this operation consists of sheets showing the titles which are to be renewed, the new period of subscription, volume numbers, address to which the subscription is to be sent, estimated cost, and the account which is to be debited for each subscription. These sheets are covered by a purchase order and constitute our renewal instructions to the vendor. The updated subscription cards which are punched as part of the renewal procedure are interpreted and merged into the subscription deck replacing the subscription cards from which the renewal orders

were written. A printout of the entire deck at this time, using a switched option of the renewal program, indicates the current status of all subscriptions on order.

One month after the initial issue of the renewal subscription should have been received, the third phase of the system comes into operation. Letters are sent automatically to each subscriber asking for verification that the subscription is being received. The beginning date of the subscription is the testing medium. As these acknowledgements are returned to the library by the subscribers, we can clear our records and assure ourselves that the subscriptions are properly entered.

We have found that this system has served our needs very well. Whereas we formerly spent three months each summer preparing to renew our journal subscriptions, the entire job can now be done in about 45 minutes on the IBM 1401, including preparation of updated records. Average time to write a renewal for one title for one subscriber is about two seconds, including preparation of the updated record and searching through subscriptions not due for renewal. Another feature of the system which has been valuable is the fact that it is impossible to enter a renewal without proper authorization. We are also assured that subscriptions expiring at odd intervals during the year will be properly renewed at the right time.

Circulation Procedures

The circulation control system at the NRTS Technical Library is a conventional two-card system, i.e., one file maintained by call number and one by borrower. Our book circulation system functions more as a perpetual inventory system than as a true circulation system. It is anticipated that this system will soon be converted into a true circulation system, utilizing magnetic tape on the IBM 1401. Circulation of technical reports has been handled completely by machine for over a year, using an IBM 085 collator with the alphabetic collating device in a system similar to that used for books, journals, and assigned materials.

The present library circulation file on punched cards consists of book, journal, and assigned materials and is filed in borrower order. This file is used to provide an annual inventory of books in circulation, since we have no fixed loan period for books. The file is also used to process journal overdue notices at periodic intervals and to provide lists of materials charged to any given employee upon request.

The basic circulation card for the system shows the call number or report number, copy number, title (and author for books), date on which the material was charged out, and the identification number of the employee to whom the book is charged.

For inventory purposes the borrower circulation file is used to print a list of all items charged to each borrower on preprinted forms using the IBM 1401. This system was originally designed for the IBM 407 and operated very well on that machine. Follow-up for inventories which are not returned within a given time is accomplished automatically, and letters are written with the IBM 1401 asking that the materials be returned. This program makes follow-up very easy, eliminating the need of manual letter writing or telephoning.

For the recall of journals the entire file is loaded into the IBM 1401 and scanned card by card. When a card for an overdue journal is recognized, the borrower's name is printed on the inventory sheet, a message is printed telling him that the journal is overdue, and the overdue journals which he has checked out are listed below on the sheet.

Our circulation systems for books, journals, and reports have served us very well and have enabled us to undertake jobs which would otherwise have been impossible. We anticipate that the conversion of all these systems to magnetic tape will enhance their usefulness.

Miscellaneous Operations

The Report Section of the library has made use of punched cards in many operations. Circulation activities have already been mentioned. In addition, the Report Section utilizes punched cards in the production of a biweekly announcement bulletin of new reports received by the library. Punched cards are also used in other internal operations of the Report Section.

Once data has been captured on punched cards, it is relatively easy to produce other reports from them to meet special needs. The flexibility of the IBM 1401 makes it especially easy to accomplish jobs such as the following. One of the site contractors was effecting a sizeable reduction in staff assigned to the NRTS. We modified our inventory program to print inventories for only those borrowers employed by this contractor. One pass of the circulation deck through the IBM 1401 produced printed inventory sheets for them. The whole job including program modification and processing took less than one hour. It saved untold hours of manual checking and typing which might have been required if our circulation system had not been on punched cards.

Statistics are easily gathered as a by-product of operating runs. Inventory runs, for example, tell us how many active borrowers we have and how many books are in circulation, both as a total and by types of material. As the monthly lists and cumulations of new material added to the library are printed, we secure as a by-product statistics indicating the total number of titles which we have added during this period. It is easy to determine book ordering activity at any time. We could, if we wished, determine the number of books ordered, received, and on order at any time; complete financial figures are always available to us. We have been well pleased with the operation of our systems to date and look forward to the time when all will become fully operational. We anticipate that other library operations will be converted to punched cards when the need arises.

Equipment and Training

Experience with the initial IBM application convinced the staff that punched cards could expedite operations. It showed also that an important advantage is lost when library personnel have to copy information onto sheets or cards for keypunching at another location by keypunch operators unfamiliar with the library system and its requirements. It appeared that important benefits would result if personnel were to punch cards directly from the document, to the greatest possible extent.

To this end, an IBM model 026 printing keypunch was leased. With this machine the operator can see printed what she has punched and thus develop confidence. All members of the staff learned to operate the keypunch. Individuals who handled the various routines in the library did the keypunching involved in their areas of work. A training program was instituted, with the assistance of our local IBM Data Processing Division representative, for the entire staff. This had many benefits. No one felt "left out," and staff members not directly associated with certain operations could assist with keypunching duties whenever temporary work, overloads, or illness made it impossible for the assigned staff member to handle the job.

While the staff members can be trained successfully, they may not all become outstanding keypunch operators from the viewpoint of production work. A slow typist will probably not be a fast and efficient keypunch operator, for manual dexterity is an important aspect in keypunching, as in typing. But the staff member who is trained as a keypunch operator knows the rest of the routine, and probably knows and appreciates why certain information must be entered in a specific manner. Knowing this, she will be less prone to let errors slip by.

If the work load justifies, it is probably better to secure a full time keypunch operator to handle all keypunch work for the entire section. This demands a skilled and flexible operator. Jobs which require continual but intermittent use of one keypunch would probably not be given to the full time keypunch operator. Circulation is an "on demand" type of job which cannot be worked into a fixed schedule. The circulation attendant does the punching for circulation cards. But many jobs can be scheduled for the full time keypunch operator in the section. In the NRTS library, for example, preparation of cards in the Report Section is a full time job for one member. Book orders, cards for the monthly book lists and printed catalog, journal renewal changes and additions, and many of the other jobs in the Section can all be channeled to the full time operator. This allows the staff members who are presently doing keypunching in addition to their regular duties to devote more time to the duties for which they are more skilled and better trained.

As other systems were installed, it became apparent that one keypunch could not handle the load of work entering the system, especially with the Report Section located some distance from the library. We obtained two more 026 keypunches, both with the alternate program device and one with the interspersed master card gang punch feature. This IMGP feature permits simple gang punching on the spot, without carrying cards to the data processing section and waiting for time to become available on the IBM 514 reproducing punch. Our aim was to be as self sufficient as possible and to do as much of our work as possible on our own machine. At this time we also secured a model 085 collator with the alphabetic collating feature, and an IBM model 082 sorter, capable of sorting 650 cards per minute. This sorter is equipped with a card counting device and the sort suppress feature.

We chose the IBM 085 collator in preference to the 087 collator, although the 087 will sort a few more columns of alphabetic information and allows greater flexibility in the columns which may be used for alphabetic collating. The alphabetic collating feature on the 085 can be used only in certain positions, and this forced us to design our cards to place any information to be collated in a position on the card which would be compatible with the collator columns so equipped. We had the device set up for columns 1-16. Cards with alphabetic data in other columns can be handled by reproducing the data into columns 1-16 and then reproducing the deck back into the original format. Our systems are so designed, however, that this is not necessary for any of the work which we do. In addition, the 085 is a much more flexible machine than the 087, allowing a greater variety of jobs to be handled.

When we were making our initial applications, the only printer available to us was the IBM 407 accounting machine. This was a basic 407 with no additional selectors or special features. It did a

fine job within its limitations and enabled us to get systems into operation which were of real benefit.

It was only one year ago that the IBM 1401 data processing system became available to us, for it was at that time that it was installed in the headquarters building in Idaho Falls, fifty-five miles distant from our location at the NRTS. We felt that the advantages which we could obtain from the machine far outweighed the inconvenience of transporting trays of cards from the NRTS to the headquarters building for processing. This machine was a basic IBM 1401 with 4K core, but with only a limited number of special features. Although this machine has its limitations, it vastly extended our capabilities over the IBM 407 and made possible jobs which would not have been physically or economically possible on the IBM 407. A new IBM 1401 system using magnetic tape has recently replaced the machine which has been used by the library, and a number of applications have been awaiting the installation of this equipment.

Probably the greatest problem for the librarian desiring to utilize punched card procedures is his lack of background in electronic data processing equipment, procedures, and capabilities. The IBM Data Processing Division representatives are extremely helpful, but there is need for the librarian to become well versed in the principles of electronic data processing. Only in this way can he relate the capabilities of the various types of equipment to the operations which he desires to accomplish.

It is, of course, highly desireable to have all necessary equipment available in the library to handle all of the jobs which are to be done. The convenience which this offers to the smooth functioning of the system cannot be denied. Nevertheless, it is possible to accomplish a great deal with only a keypunch in the library if machine service can be obtained locally. Many universities and colleges now have computing centers or are introducing electronic data processing equipment in their accounting operations. City and county governments are using this equipment, and various industrial firms and business have such equipment available. It is possible, in many communities, to secure these services from a local service bureau or tabulating center. The major problem which will be encountered will probably be a lack of alphabetic collating ability, since most data processing jobs are set up for numeric collating.

Electronic data processing can play an important role in many activities of the library. It enables routine jobs to be performed quickly and accurately, leaving more time for trained people to give to tasks which need human attention. In the NRTS Technical Library it works well, enabling the staff to better serve the scientists and engineers at the station.

BIBLIOGRAPHIC DATA PROCESSING AT THE NATIONAL LIBRARY OF MEDICINE

Seymour I. Taine

Almost sixteen years ago I was graduated from what would be described in the parlance of TV as "another" library school. The curriculum to which I was exposed was probably little different from what the sister schools throughout the United States were dispensing at that time: cataloging and classification, book selection, library administration, history of libraries and books, etc. When, after commencement, I went out into the world and began applying the knowledge I had acquired at library school, I cataloged and I classified and I performed all of the other conventional functions in a manner little different from the professional routine which my colleagues had been following for decades.

Few people anywhere were talking about computers and data processing as we know them today, for the very good reason that the entire subject field was in process of being created. About this time, too, one heard nothing about such phenomena as "information explosions," "data storage and retrieval," or "coordinate indexing," because the coiners of these now popular expressions had still to mint them. All of us were—with few exceptions—blissfully unaware of the profound social and professional revolution on whose brink we stood. I for one, with my well-established, personal lack of "mechanical aptitude," never dreamed that it would be my professional destiny to become involved so heavily with the gadgetry and jargon of data processing.

There were, however, some organizations including a handful of libraries, that were already deeply involved, if not with electronic data processing, with the growing information handling problem. Among these pioneers was the Army Medical Library, previously known as the Library of the Surgeon General of the U. S. Army, and which, since 1956, has been called the National Library of Medicine. Having mentioned the topic of my presentation, I wish to make clear

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that in this paper I shall not be describing data processing activities carried on throughout the National Library of Medicine. Instead, I shall be restricting my discussion to the application of these new techniques to the Library's indexing program, where they have been given most attention to date.

This constraint is really not as narrow as it sounds. When an application is carefully selected and designed, data processing may become a powerful adjunct to librarianship as it has already become in business and technology. Although the amplitude of appropriate applications will vary with the organization or the library, the computer system will remain merely a foundation upon which specific library programs may be superimposed. In the case of the National Library of Medicine, we have chosen to begin utilizing these new tools in the indexing program; tomorrow we may decide to tackle the serial record or the preparation of the catalog; in the more distant future we may decide to take on the devising of a system for the total control of the Library collection, including inventory, circulation, interlibrary loan, and perhaps even miniaturization.

Fifteen years ago, a Committee of Consultants for the Study of Indexes to Medical Literature Published by the Army Medical Library —an activity in which the Library had been engaged for about seventy years—was appointed. A parallel research project was set up at Johns Hopkins University's Welch Medical Library, which included among its charges the study of the possibility of using machine methods. It is interesting to note retrospectively, the names of some of the eminent Committee and Project members. Among the librarians who served on the Committee were Verner Clapp, Ralph Shaw, and Mortimer Taube. Eugene Garfield, now the Director of the Institute for Scientific Information, started his career with the Research Project; while he was with the Project, more than ten years ago, Dr. Garfield devised a method of preparing printed indexes through the use of punched card equipment.

As a result of the Committee's activities, certain decisions were made in 1950 that radically affected the Library's publications program. The venerable Index-Catalogue, which had been published for three quarters of a century by the traditional letter-press method, was suspended. In its place were issued two separate publications, the annual Printed Catalog and the monthly Current List of Medical Literature, both prepared by the then novel method of shingling individual 3" × 5" slips or cards into columnar or page formats. Elsewhere in the Library during the same period, new photoduplication equipment and techniques such as xerography and home-grown "Photoclerk" devices were also being utilized.

Index Mechanization Project

Serious limitations in the method of preparing the Current List of Medical Literature began to be noted and attention was devoted to exploring ways of improving the ongoing system. In 1956, following the establishment of the National Library of Medicine in the Public Health Service, the search was intensified. By the end of 1957 a preliminary plan had been devised, and financial support was sought to mount a research project to study and implement new methods of index preparation. The Council on Library Resources responded with a grant of $73,800 to cover the work to be performed during the fiscal years 1959 and 1960. Early in the course of the NLM Index Mechanization Project's existence, in April 1959, the Library also contracted with an expert in the field of biomedical applications of computers to "conduct a study to investigate the feasibility of using electronic digital computers for the publication of the Index Medicus and also as a basis for the construction of an efficient reference and bibliographic service." These are some of the more immediate antecedents to our mechanization and computer systems.

The present system used in the publication of the Index Medicus, Cumulated Index Medicus, and Bibliography of Medical Reviews emerged from the Project in 1960. A detailed report on the Library's experience in conducting the Index Mechanization Project was published in January 1961 in the Bulletin of The Medical Library Association[1] and, after about 4,000 copies were distributed, it was recently officially declared "out of print." Since the contents of this report are available, I shall restrict myself here to a summary of the mechanized index preparation system that evolved from the Project, draw some conclusions based on our experience that may be of interest, and move on to a more detailed discussion of the computer system now under development by the Library.

The primary objective of the Project was to improve the printed index composition methods by introducing mechanized techniques and, by so doing, to enhance the currency and expand the coverage of the publication. A second aim that was not fated to be accomplished successfully at that time pertained to the feasibility of using the basic publication system also as a bibliographic storage and retrieval system. It was concluded " . . . that a retrieval system could not be successfully grafted on to a publication system, which deals in large measure with the problems of composition. . . . In the context of a very large system, it would be more suitable to start with the design of a retrieval system, and then to proceed with the publication. . . ." This is, in fact, the most significant lesson we learned from the Project, and we hope to put it to good use in the design of MEDLARS.

Since January 1960, the Library has been publishing the monthly issues of the new Index Medicus by means of the new system which utilizes punched paper tape typewriters, punched card tabulating equipment, and the Listomatic Camera. At the heart of the system lie two major factors: one, the choice of basic format, the other, the employment of a high-speed precision camera (the Listomatic Camera) which photographs text imprinted along the top two-thirds of an inch of a punched card.

The format of the Index Medicus is based on the unit citation, in contrast to the fragmented citation used in its predecessor publication, the Current List of Medical Literature. A typical unit entry consists of the following elements: the names of all authors cited in the original publication, the title of the article either in the original English or in English translation, the abbreviated journal title, the volume number, inclusive pagination, date of issue, and a symbol indicating the language of the article if other than English.

With the Listomatic Camera, one, two, or three lines of copy, precisely positioned along the top of a punched card, are photographed at the rate of 230 cards (up to 690 lines) per minute. A special punch is "read" by the camera informing it as to the number of lines on the card to which the aperture must be adjusted. Other portions of the card can be punched for other purposes, e.g., the provision of various sorting indicia.

The following characteristics are basic to the system. The great majority of unit citations can be compressed into entries of three lines or less. The unit citations can be mechanically and repetitively transferred to punched cards. The punched cards can then be coded to allow rapid arrangement by machine. The arranged cards can then be quickly passed through the camera, and the negative film can be cut into column lengths and assembled in page form for the direct production of a lithographic printing plate.

The preparation of the Index Medicus proceeds as follows. First the individual journal article is analyzed for its subject content. The analyst assigns appropriate subject headings, following a subject-heading authority list to assure consistency. Foreign language titles are translated. The information is recorded on a simple "data sheet" which is clipped to the beginning page of the journal article to which it refers.

The data sheet, together with the journal itself, is next passed on to a subprofessional assistant who, working with a code dictionary, assigns codes for the main subject headings and certain other data. The purpose of this operation is to convert the indexer's contribution into a form suitable for mechanical processing.

From here the encoded data sheet and journal are sent to the "input-typing station" where a typist, operating a Model AA Justowriter recorder, types the unit citation in its full form and, in the

process, produces a perforated paper tape together with a readable proof copy. After the proofreading, the tape, clipped to the journal, moves on to the "key-punch station," and a set of cards is punched for each article. A typical situation would perhaps call for five cards: three subject cards, each punched with its individual subject-heading code, and two author cards, each punched for the name of a particular author. Additional punches indicate language, year of publication, and the number of lines to be photographed on the card. At this point the issue of the journal is released and added to the Library's collections; the perforated paper tape and the corresponding set of cards are sent to the "output-typing station."

The "output typist" inserts the perforated tape in the reading element of a Model JU Justowriter reproducer and the punched cards in a special card-holding platen of the machine; the machine automatically imprints the text of the unit citation across the top of each of the cards. After a final inspection the processed cards are stored until the end of the collection period each month. The cards for the month are sorted and arranged by multiple passes through the IBM 083 sorter which handles the cards at the rate of 1,000 per minute.

Three auxiliary master sets of cards are required. The first set contains all subject headings as they appear in the authority list. The second set contains the entire cross-reference structure of "See" and "See also" references. The third set is a special Listomatic "program set." The latter, consisting of about eight cards for each page of the Index, furnishes instructions for a special device on the collator which counts the varying number of lines on the cards until the maximum number per column is reached and merges column-spacer cards, page indicators, and running-head indicators. These "non-entry" sets, punched and imprinted in advance, can be used over and over in the preparation of successive issues.

By means of the IBM 087 collator, the arranged entries are checked against the master subject-heading set. Subject headings needed for the issue are selected, while other subject headings are rejected. The selected subject headings are then checked against the master cross-reference set. Cross references needed are selected, and cross-references to headings not appearing in the particular issue are rejected; the selected subject headings and cross-references are merged and incorporated with the main file of previously arranged entry cards. The entire file—entries, main headings, and cross-references—is now in the desired order for publication; after this file has been merged with the Listomatic program set, the material is ready for the camera.

The entire file is photographed by the Listomatic Camera on 400-foot rolls of film which, after having been processed, are cut into column lengths and "stripped" into page form. The time required for

all these operations, beginning with the arrangement of the entries, is ten working days for an issue of about 50,000 entries. The publication is printed by offset reproduction from the page negatives.

The National Library of Medicine publishes twelve regular monthly issues of the Index Medicus, each containing only new material. At the end of the year the entries in the twelve issues are mechanically consolidated into one alphabet by the same procedure as that just described. The entire file of cards again passes through the Listomatic Camera. The cumulation requires about six weeks of machine time. The "manuscript" of the cumulated Index, on film, is turned over to the American Medical Association which publishes it as the annual Cumulated Index Medicus.

After administering the new system for almost one year, we attempted a fairly detailed appraisal of its effectiveness for inclusion in the Index Mechanization Project Report. Now, let us see how the system appears to me after more than three years' experience with it.

There is no doubt in my mind that the new mechanical composition system was a distinct improvement over the older Current List shingling method. Thanks to the Listomatic system, we have been able to realize a significant increase in coverage of the medical literature from an average annual level in the neighborhood of 110,000 articles to 125,000 in the first year of operation, 140,000 in 1961, and about 146,000 items in 1962. While providing more rapid, current publication, relative unit costs have also gone down. As you can see, we have been quite pleased with the new system. But how about others?

One of the objectives of the Index Mechanization Project was "To provide a demonstration of methods that might aid scientific indexes in general, and assist in similar enterprises in other fields." The project succeeded in the objective of demonstrating the potential usefulness of such a system, but no significant trend towards emulation developed. Although we at the NLM have sporadically run a number of publications for other government organizations (inspired largely by the availability of our Camera) and commercial service bureaus have executed another handful of bibliographic products, on the whole, these applications have generally been half-hearted. This relative scarcity of any imitators is a highly significant aspect of the system.

This is probably as it should be. Now that the Index Mechanization Project has gone into history we are able to look back and to realize that those were years of general transition between an era of primitive, non-automated operational systems and increasing experimentation and investigation on the one hand, and the beginning of the exploitation of more sophisticated data processing techniques which we are witnessing today. The vast majority of libraries and other information-oriented agencies will be moving rather directly, abruptly, and traumatically from the Stone Age into the Space Age; the transition

stage that our present system represents will, therefore, probably not play a major role in future developments in library technology. In our own case, however, the more gradual transformation has been of inestimable benefit.

MEDLARS

Now let us turn our attention to discussing the NLM's present MEDLARS Project, and I shall attempt to recount the highlights of its history, objectives, and system characteristics. MEDLARS stands for Medical Literature Analysis and Retrieval System.

In the Fall and Winter of 1960, it became clear to the Library that a new program was needed to meet the bibliographical needs of the medical community. The following general objectives for the Library's indexing program emerged:

> Increased coverage of the current substantive medical literature of the world up to totality.
>
> More rapid processing to accelerate the availability of the information contained in the system.
>
> Provision of broader accessibility to the bibliographic items by analyzing to a greater depth and along additional avenues of approach such as language and geographic origins of the document.
>
> The capture and delivery of pinpointed and prescribed segments of the total file in a variety of patterns of selection and arrangement.

Underlying these aims is the fundamental principle of exploiting a single inputting of information to produce a multiplicity of output products. The object is to utilize the initial screening, identification, analysis, description, and processing required in the normal course of bibliographic activity, so as to provide variations as well as replicas of the original citations for different purposes. This is scarcely a revolutionary concept to librarians accustomed to the unit catalog card entry. In MEDLARS, the digitalized information about authors, titles, subject headings, and other bibliographical data may well be considered a supercharged analog of the unit card.

To achieve these goals, the Library again attempted to create an integrated bibliographical system possessing a publication and retrieval capability, both of a high order of sophistication and magnitude. One of the conclusions reached in the course of the earlier Index Mechanization Project was the inadequacy of punched cards as the medium for a system as complex and large as this. Since a more

powerful system was required, it was natural for the Library to investigate the feasibility of utilizing an electronic digital computer as the keystone of the new project.

At the beginning of 1961, systems specifications for MEDLARS were written and distributed to appropriate organizations active in related fields of operation. Accompanying the "specs" were invitations to submit proposals for a "planned approach to the development, testing, and implementation of an effective capacity within the Library for the storage, retrieval and publication of typed information from medical . . . literature." Among the specific primary objectives of MEDLARS were the following:

1. Improve the quality of and enlarge the Index Medicus, at the same time reducing the through-put time required to prepare the monthly edition for printing to five working days.
2. Provide for machine compilation of bibliographic listings in a variety of rather broadly defined subject areas within the general field of medicine. Examples of the scope of this type of service might be such topics as "diseases of the cardiovascular system" or "cancer." These listings would be made available on a recurring, periodically scheduled basis, essentially as a current awareness type service.
3. Make possible the addition to the Index Medicus, and other MEDLARS products, of citations representing monographs and serial titles, as well as journal articles and research project reports.
4. Make possible the prompt and efficient servicing of relatively complex demand requests for bibliographic information.
5. Increase the depth of indexing per article, both by adding more specific terms to the subject heading authority list and by increasing the number of terms used by the indexer in the analysis of the item.
6. Increase the coverage of the literature from an annual indexing of about 145,000 items to about 250,000 by the end of the decade.
7. Reduce the duplication of literature-screening activities now being carried on by many organizations.
8. Keep statistics and perform analyses of the MEDLARS operations, to provide useful system intelligence.
9. Provide for future expansion to add other objectives not entirely clearly defined or feasible in the earlier phases of the project.

The last point refers to certain secondary objectives which are scheduled for somewhat later implementation. The Library has

underplayed these future applications for fear of jeopardizing the successful implementation of the primary objectives that we have just described. It is interesting to note the history of the secondary objectives starting with the brief mention in the original MEDLARS letter of invitation of "other functions of the Library, where feasible (that) may be integrated into the system at a future date" down to the present where the Library now has deemed it necessary to commit actual resources to the serious study of these concepts. For the moment, it should be emphasized that these "blue sky" projects are not an integral part of the MEDLARS that is scheduled for implementation in 1964. Included in these secondary objectives are the following:

1. The storage and retrieval of graphic text images in addition to the bibliographic citations that are already in the basic MEDLARS.
2. A decentralized national network of mechanized search centers utilizing the MEDLARS input data centrally processed at the National Library of Medicine.
3. Conversion of the Library's entire Serial Record File to the computer in order to facilitate the control of posting, claiming, and general information relating to the medical serial literature entering the collection.

Other potential applications are being uncovered in the course of the present investigation.

About seventy-five firms ultimately received the "bid packages" and, before the deadline was reached on April 24, 1961, twenty-five proposals had been received in the Library. These proposals varied considerably in their method of presentation, size, appearance, lucidity of expression, imagination, and comprehension. The Information Systems Operation of General Electric Company's Defense Systems Department, located near the Library in Bethesda, was finally selected and, on August 14, 1961, the MEDLARS project was officially launched.

Primarily for purposes of more effective management control, the entire MEDLARS project was broken down into three major phases: Preliminary Design, Detailed Design, and Implementation.

The first phase consisted of the study and analysis of the Library's stated requirements and objectives in parallel with the development of an embryonic system concept. Estimates of projected work loads and request demands played an important part in this stage as did investigations of suitable equipment for use in the different subsystems of MEDLARS.

Phase I was completed by the end of January 1962, and Phase II, the Detailed Design, commenced on February 1, 1962. This part of

the Project covered the design and engineering of the system merely outlined during Phase I, to the level of detail necessary to transform it into an operational reality. During this phase, which ran until the summer of 1963, a tremendous effort was required. The detailed procurement specifications for every item of equipment had to be written for use in their purchase or development. All the major and minor computer programs had to be written and tested. Plans had to be developed for the training of the entire present staff complement in the Bibliographic Services Division and for the considerable number of additional personnel, including several top level key people required to fill the various new positions created by the new system. Detailed planning for the preparation of the computer site to provide additional mechanical facilities was also essential for the operation of the equipment configuration.

Before the completion of Phase II, the third and final implementation stage was kicked off. Phase III actually got underway officially at the end of January 1963. During the Implementation Phase, the equipment will be procured, installed, and tested. On March 14 the computer was delivered to the Library and installed in a specially prepared area. The training of all the members of the NLM staff will be completed with the desired objective achieved of having developed the in-house capability of operating and even further expanding the new system.

It would be useful at this point to give some idea of the quantitative loads that the system is being designed to handle. In 1964, the first year of operation, about seventy journal issues, representing about 650 articles plus approximately twenty monographs will enter the system daily; by 1969 this is expected to rise to about 100 periodical issues daily or approximately 1,000 indexed articles plus an additional seventy monographs. Ten demand requests per day are anticipated initially; ninety, later. About fifty recurring bibliographies are provided for. From the output viewpoint, the load in terms of characters composed is expected to be about 100,000 daily at the outset for demand bibliographies alone; close to a million characters per day by 1969. The Index Medicus will add a load of almost 9 million characters each month, rising to twelve and a half million in five years; an additional annual load of more than a hundred million characters will stem from the Cumulated Index Medicus in 1964, and about 150 million characters five years later. These figures do not include an average of about 800,000 characters per week that will be required for the composition of the recurring bibliographies.

To get a better idea of how MEDLARS will operate, it will be helpful to understand the nature of the unit record which is like the life blood of the entire system. Each of the major functional components of MEDLARS interprets the elements of the unit record according to its own requirements. The indexer begins the construction of

the unit record by deriving and posting subject and other tags, translating or transliterating the article title, and supplying descriptive indexing data. The typist reduces the alpha-numeric form in which the information arrives at her station to the digitalized codes that are machine usable. To the computer, the record represents a processing load for compression, for storage, for search, and for output processing. At the output end of the system, the unit records manifest themselves in the sheer quantity of characters they comprise and the manifold forms of entry which they are capable of assuming. To the user, hopefully, the unit record is the bibliographic pot of gold at the end of the rainbow. The following elements constitute the unit record: (1) names of authors, (2) title of article in English, (3) title of article in vernacular, (4) journal title abbreviation, (5) volume and page information, (6) date of issue, (7) language, (8) subject tags, (9) geographical tags, (10) form tags, (11) check tags, (12) date of entry.

Most of the elements, singly or in combination, with the exception of the title of the article itself and volume and page information, are susceptible to search.

Now we might turn our attention to the subsystem components of MEDLARS. The operations of the system can be divided logically into three parts, as follows: Input and conversion subsystem, Manipulation subsystem, and Output subsystem.

Input and Conversion Subsystem

The Input and Conversion Subsystem performs two basic functions: (1) It prepares the information to be read into the computer, and (2) It converts this information into computer language.

As journals are received by the Library, they are sorted and distributed to a staff of indexers. Book material will be distributed to a staff of catalogers who will perform somewhat similar functions. The analysts select the articles containing pertinent information and prepare a data sheet for each article containing those elements of the unit record that are appropriate to the particular citation. They translate titles of foreign material and analyze the information contained in the material by posting one or more of the headings listed in the Library's Medical Subject Headings. Pertinent check tags are also noted on the data sheet. Check tags are search access points other than subject headings, such as form or geographic headings, not contained in Medical Subject Headings. Another interesting innovation is the provision for the analyst to suggest new terms for consideration as ultimate additions to the subject heading list. These unofficial terms are called "provisional headings." The result will be a unit record for each article, monograph, book, or serial title which consists of a citation plus associated headings.

The data sheets and associated journals are used by a staff of input typists, and the data are converted to a form which can be fed into the computer. These operators type on machines that simultaneously produce typewritten copy and punched paper tape. There is an average of about ten articles per journal piece indexed. For each piece, the journal information is typed only once and is sequentially followed by the other unit record elements for all articles in the journal.

The proofreading staff checks the typed copy prepared by the input typists and indicates necessary corrections. A separate "correction" paper tape containing all the correction and control information is then prepared and reproofed. A complete unit record, any element of a unit record, or individual words can be added, deleted, or changed. The original reel of paper tape containing many unit records and the correction tape are then read into the computer. Any errors detected by the computer programming are printed out on the computer printer.

In addition to preparing unit records for entry into the computer, the Input and Conversion Subsystem also processes requests for the retrieval of certain selected parts of the stored information. These requests will be of two broad types: those calling for the preparation of periodically printed publications, such as Index Medicus, and those calling for the retrieval of bibliographic reference information to satisfy requests received by the Library from its consumers, that is, recurring bibliographies and demand bibliographies, respectively.

A search request is completely defined by the following items:

1. Retrieval criteria
2. Limits on the number of unit records to be printed
3. Manner in which specificity of retrieval criteria may be expanded or contracted
4. Arrangement in which unit records retrieved are to be printed
5. Selection of specific elements of unit records to be printed
6. Format of the total printed output, i.e., the physical arrangement of words on the page
7. Typography of the printed output

Those elements of the unit record that may be examined during a search in order to determine whether the unit record qualifies for retrieval include author name (s), journal title abbreviation, language, appended subject headings, geographical headings, form (article, monograph, etc.) headings, and date of acquisition of entry. Such elements may be used singly or in any combination of logical products and sums to specify the retrieval criteria of a single search request.

As requests for bibliographic information are received by the Library, they will be sorted and distributed to a staff of bibliographic specialists called Searchers. These Searchers translate the requests into the language and format required by the system. In the same manner that analysts select those subject headings that adequately classify an entry, the bibliographic Searchers select the headings that identify the entry for retrieval. The retrieval criteria elements are listed and organized into the form of logical expressions following the rules of Boolean algebra.

The demand bibliographic requests are typed by the input typists in the same manner as are the citations from medical literature. The typed copy is proofread, corrections made, and the paper tape read into the computer. The information retrieved by the computer to satisfy these search requests is screened by the Searchers to make sure that it satisfies the original requests before being transmitted to the requestor.

In 1963, the existing mechanized system will continue to publish Index Medicus and associated publications. The unit records generated will, however, be fed into the computer's file for use in meeting future demand bibliographic requests. During the transition period, output information will continue to be sorted and collated, and photographed by the Listomatic Camera. When MEDLARS finally and completely supersedes the existing system, it will have a tremendous store of references on hand to call upon in filling individual demand bibliographic requests.

Manipulation Subsystem

The Manipulation Subsystem revolves around the high-speed digital computer. It accepts the unit records on paper tape, checks them for the presence and correctness of those elements for which such checks are possible, does some pre-processing to facilitate and speed the subsequent processing, and stores the unit records on magnetic tape. In response to search requests, it searches its cumulation of unit records for those that qualify for retrieval, edits them, and composes them for output on magnetic tape.

In the performance of the tasks, the Manipulation Subsystem will utilize computing equipment consisting of the Minneapolis-Honeywell 800 computer and associated tabulating equipment.

The journal article records; other data are stored on reels of magnetic tape. These tape files are prepared, updated, and used by various computer programs which manipulate the files to provide the desired outputs.

A highlight of the Manipulation Subsystem is the use of two separate citation files. In one file, the Compressed Citation File, the citations are carried essentially in coded form to enable demand searches to be made faster and more efficiently. In the other file, the Processed Citation File, the citations have been enlarged to provide the complete form of entry required for Index Medicus and other recurring bibliographic publications in a more efficient manner.

Output Subsystem

The Output Subsystem transforms the magnetic-tape product of the Manipulation Subsystem into the specific form desired.

Two basic output techniques will be available in MEDLARS. For routine man-machine communication, some of the recurring bibliographies and most of the demand searches, a high-speed computer printer will provide single font copy in continuous paper, or on 3" × 5" card forms. The Index Medicus, Cumulated Index Medicus, Bibliography of Medical Reviews, most of the recurring bibliographies and a small number of demand searches will, however, be printed out in a more interesting manner.

During the preliminary design phase, considerable effort went into the study of the publication composition requirements of the system. To satisfy these quantitative and qualitative requirements it was necessary to combine relatively high speed with equally superior levels of typographic quality. The investigations of equipment possessing this kind of capability led to a dead end, and the decision was reached to attempt to develop a satisfactory machine for this specific purpose.

Following the appraisal of competitive bid proposals, a subcontract was awarded to Photon, Inc. in August 1962 for the delivery to the Library of a Graphic Arts Composing Equipment (GRACE) that will be capable of transforming the magnetic tape output of the Manipulation Subsystem into exposed film from which, after processing, a printer will be able to produce the Index Medicus and related publications. GRACE accepts electrical signals from a magnetic-tape transport operating fully under her control. These signals arrive in bursts of coded characters which represent a full line of legible type across the multi-columnar page. This type is made up of a combination of 226 different alphanumeric symbols which are set on film or paper at a rate in excess of 440 characters per second.

Once a month, for the publication of Index Medicus, the unit records in storage will be expanded, sorted, edited, and rewritten on magnetic tape. Once a year the material will be merged for the annual

Cumulated Index Medicus; even with the help of GRACE the annual Cumulated Index Medicus is estimated to require about two weeks for composition.

The demand search requests will be processed by a staff of search specialists and converted to a form suitable for input to the computer on paper tape. The tape will be read into the computer, which will then search its files for the citations that meet the request's specific requirements.

For the recurring bibliographies, the search specialists will periodically prepare the search and output format parameters for entry into the computer. As new citations thereafter enter the computer, they will be tagged with the recurring bibliography identification for future, periodic retrieval.

All of these functions will be performed speedily. The monthly issue of Index Medicus will require but five days for completion of the film "manuscript," and recurring bibliographies will be processed in one or two days. Demand bibliographies will be produced in a similar period, except for priority requests which will be given same-day service.

One of the keystones of the entire system is the subject heading authority list, Medical Subject Headings. In preparation for the first issue of the new Index Medicus the 1st Edition of Medical Subject Headings was carefully compiled in 1959. This list was published and used as the basis for all 1960-62 issues of Index Medicus and Cumulated Index Medicus that have appeared. To prepare for the computerized retrieval system, the full scale revision of this list was initiated. The huge task of converting 4,400 main headings and sixty-seven standard topical subheadings contained in the 1959 list into a 5,700 main heading system with no topical subheadings was completed in October 1962 and published in January 1963. The cross-reference structure was augmented by a completely categorized arrangement of the main headings in addition to the purely alphabetically-ordered listing.

An innovation in the updating and publication arrangements for Medical Subject Headings is the provision for the revision of the lists to be made annually hereafter and for the entire alphabetical and categorized listings to be published as a second part of the regular January issue of Index Medicus. All subscribers to the Index Medicus will thus automatically receive the authority list, as they did this year, and have it available for reference in the use of the index.

Another important change in the subject approach revolves around the increased depth of indexing to which I earlier referred. In the past, the Index Medicus subject section included an average of about two entries per article. For the retrieval system, this level appears to be entirely inadequate and the goal has been raised to an average of eight to ten subject tags per item. However, some simple

arithmetic quickly indicated that it would be impracticable to publish all of the citations under these additional headings in the Index Medicus. The solution that was finally adopted was a compromise between the conflicting requirements of the publication and retrieval systems. The publication average was upped 50 per cent, from an average of two to three subject entries and the remainder of the selected headings, designated as "non-IM tags," are retained in the computer system for search purposes. It should be made absolutely clear that each heading per se is not "IM" or "non-IM"; rather, the indexer, on the basis of the individual article in hand, decides on the disposition and treatment of the subject tags.

When MEDLARS becomes operational early in 1964, the National Library of Medicine expects to realize substantial advantages over the present, limited mechanized system. This does not mean that all of the Library's functions in this area will be mechanized. Certain tasks, such as indexing, cataloging, preparation of search requests, and proofreading will be performed by people while machines will perform such operations as storage, retrieval, and composition of bibliographic citations.

In the development of a computer information retrieval system such as MEDLARS, there is a natural tendency to stress the data processing aspects at the expense of these humanly performed functions. Since it is indisputable that the mechanized portion of the system requires a tremendous effort to engineer, it becomes necessary to exercise care and discipline to avoid relegating the other parts to a kind of second-class status. This could be fatal. Difficult and complex as the data processing problems that confront us are, I have the conviction that the success or failure of MEDLARS will be more directly related to the non-mechanized elements.

Discussion

Ralph T. Esterquest

The impact of MEDLARS on the medical library world is not that of the familiar metaphor--the pebble dropped in the pond, casting concentric ripples that reach many points on the shore. The impact

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Mr. Esterquest is Librarian, Harvard Medical Library.

is no pebble for sure. It is a mighty rock. The waves it will cause will surge and splash for a long time to come.

MEDLARS is the great bibliographic break-through of our generation.

Let me first remind you of certain characteristics of medical libraries—especially medical school libraries—that seem relevant to our subject.

1. The materials of a medical library are subject to a rapid rate of obsolescence. The heavily-used item is this year's book and this month's periodical.

2. Periodicals seem more important than books. Although books are indeed used, the emphasis is definitely on the periodical article. The typical medical library will, this year, place on its shelves almost as many new periodical volumes as monograph volumes.

3. Many users of a medical library want information in a hurry. It's not that he's a surgeon, elbow-deep in a chest operation, calling for a book to read up on what to do next. But frequently, in a teaching hospital, an unanticipated observation at eleven in the morning suggests a highly useful consultation at two o'clock, and a bit of reading meanwhile can increase substantially the effectiveness of such a conference, or teaching situation.

Add to these characteristics the literature explosion. The total number of medical periodicals is increasing all the time. There were 3,900 in the World Medical Periodicals list in 1953; 5,800 in the 1961 edition. The medical scientist is badgered by a public that wants him to find a cure for cancer. He's given $100 million by Congress and told to get busy and take care of heart disease. The medical scientist tries to cope with the literature and puts the heat on the librarian. "Do something!" he cries.

At least the National Library of Medicine is doing something. MEDLARS.

The NLM has had a long history of publishing indexes and catalogs, and has a tradition of leadership in bibliographic control. The quality of this national leadership has never been better than it is today. Medical librarians are not surprised to see their National Library undertake MEDLARS.

This exciting project is notable on many counts. One important count is MEDLARS' dual purpose: the publication of an index; and the compilation of tailor-made bibliographies. In respect to index publishing, MEDLARS a) greatly speeds up the time schedule for compilation; b) increases accuracy; c) increases the depth or thoroughness of subject analysis; d) greatly increases coverage, from 130,000 articles annually (now) to 250,000 in 1969; and e) increases scope by the inclusion of catalog entries of monographs as well as periodical articles. In respect to the compilation of demand

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Fig. 2

bibliographies, MEDLARS draws upon a vast store of bibliographic information, selects relevant items through the sophisticated manipulation of thousands of subject and other tags, and prints out its tailor-made product at great speed.

It is important to remember about MEDLARS, however, that its end product is not a nugget of scientific information, it is a bibliographic citation.

A basic principle of MEDLARS is that the input item is a "unit record," or unit citation. This is analogous to the familiar unit card in cataloging. It's as though thousands upon thousands of unit cards—everyone different—were thrown haphazardly into a vast tub, and then, because each unit card had many different, and invisible, and magic handles, you the magician can pull out any group or combination you could name. Out they pop, all in perfect order—exactly as you wished it, when you rubbed your Aladdin's lamp.

In order that you may see how well-ordered the unit citations actually will be when out-put by MEDLARS, Fig. 1 shows a sample page of the new Index Medicus (as of January 1964). The subject index (Fig. 2) is the main section, followed in each monthly issue by the author index. The typographic excellence of these pages testify to the sophistication of the MEDLARS hardware, specifically GRACE (Graphic Arts Composing Equipment).

An important aspect of MEDLARS is the attention that has been given and is being given to the subject heading apparatus. Only a short time ago, the National Library of Medicine developed a revised up-to-date subject heading list. Many medical libraries adopted this list and have been using it as a major part of their subject authority list. Now, with MEDLARS on the scene, extensive further revision has been undertaken, topical sub-headings have been eliminated, and many new, more specific headings have been added. One reason given for these wholesale changes has to do with the fact that, in recent monthly issues of Index Medicus, the number of citations under some subject headings had become too great for easy scanning; thus new, more specific headings were created to break up the long list. Wouldn't more sub-divisions have been a better answer? Has this something to do with the searching technique of MEDLARS? I should hope that Mr. Taine would tell us why the new Medical Subject Heading list (MESH) has taken the form it has. In medical libraries where the NLM list is used in cataloging, major revisions can be an expensive nuisance.

In connection with the subject heading list, it should be pointed out that MEDLARS provides an automatic mechanism for testing provisional subject tags, for recording how useful they are, for incorporating selected ones into the main body of MESH, and then for publishing regular, up-dated cumulated lists. Perhaps Mr. Taine would like to explain how this works.

It is significant that MEDLARS will permit a great increase in the number of subject tags that can and will be tied to each unit citation. From the present two subject headings, it is expected that the average citation will, under MEDLARS, get eight to ten tags, or descriptors. However, only three (on the average) will be coded for out-put for the printed Index Medicus. Why not all ten? The monthly issues would be just too big to handle—to say nothing of the annual cumulation. The other subject tags, that is, those that do not appear as headings in Index Medicus, are in the computer store as coded tags for retrieval in the case of the demand bibliographies.

Because the imagination is captured by the MEDLARS' capabilities for compiling Index Medicus, one tends to overlook the importance of the other half of the program: the demand bibliographies. It is this aspect that opens new horizons and has great potentialities. Incidentally, it is worth pointing out that the plan for starting the indexing input as of January 1963—one year ahead of the first MEDLARS-produced Index Medicus—serves not only to provide a year for testing the system, it also serves to build a one year's store of citations (i.e., 1963) for its obvious usefulness in the out-put of demand bibliographies.

The National Library of Medicine now responds to mail requests for literature citations on many subjects. Its Reference Department does some manual compiling of bibliographies, as staff resources permit. With MEDLARS, these special bibliography requests can be answered by in-putting properly coded paper tape search requests, whereupon the computer will grind out the desired citation list, using fast print-out techniques. This kind of automation holds great promise. But also, it is likely to be the first place where the MEDLARS load capacity will be reached and exceeded.

Out of anticipation of this problem, the National Library of Medicine has announced, somewhat tentatively, a plan for decentralization, specifically a plan for placing in selected, geographically-distributed medical libraries duplicate magnetic tapes, that is, the computer store of citations. Assuming for the moment that such regional libraries could make full use of these tapes for producing demand bibliographies locally, the scheme would have a number of other obvious advantages:

1. Reduce the load at the national center, that is at the NLM.
2. Provide for faster processing of requests.
3. Improve the quality of the search by permitting a face-to-face exchange between the individual making the request and the search-specialist.
4. Increase experience in the use of MEDLARS and increase knowledge of its capabilities.
5. Lead to the discovery of new applications; the more operators, the greater the probability of new ideas being generated.

It is apparent that the possibilities here are enormous. Literature-searching is a time-consuming activity in medical libraries. Often it is carried on by top-flight research men and women, whose time ought to be saved by the automated screening process that decentralized MEDLARS could theoretically provide. But there are more problems to a decentralized MEDLARS than meet the eye. In the first place, MEDLARS in Bethesda is centered in a Honeywell 800 computer. The computers locally available to my library happen not to be Honeywell machines and cannot read Honeywell's tape. And even if Honeywell's tape were to be converted, there is still non-compatibility at the systems or operational level. I should like to hope that Mr. Taine would tell us more about this very serious problem.

But let us assume that this problem of non-compatibility can be resolved, and there is evidence that it will be. In this event, the impact of MEDLARS will be enormous. It will be, for librarianship, one of our most pleasant dreams come true, since it will embody a principle which we have for a long time embraced, namely: Let the intellectual labor (of indexing, cataloging, analyzing) be done just once—centrally; and then let our out-post libraries exploit the product in the form of the endless variations which individual requests and needs require. Let the NLM staff, with its subject and language specialists, index the 250,000 journal articles and catalog the current American and foreign medical imprints, and let the rest of us, relieved of this one-time task, concentrate our attention on making use of their product on behalf of our readers.

The availability of published periodical indexes has made home-made periodical indexing in individual libraries unnecessary for a long time. MEDLARS may now eliminate the need for cataloging many books in our individual medical libraries. Is this perhaps the beginning of the end of the card catalog as we have known it up to now?

My remarks, so far, have tended to sing the virtues of MEDLARS. I have admitted that I am enthusiastic about this project. But I am here presumably as a critic, and a critic ought to criticize.

Let me discharge my responsibility now by raising a few questions. These are questions that some medical librarians are asking about MEDLARS, and I address them to Mr. Taine with the expectation that he will clarify these points for all of us.

Question 1. The reels of magnetic tape, which are the memory store, have a finite capacity. We are told that, in the case of the "Compressed Tape" (for demand searches) six reels are required to hold one year's citations. Thirty reels are needed for five years. Since it takes the computer at least five minutes to search one reel, it follows that a complete search of five years of citations would take two and one-half hours. How then can MEDLARS undertake to compile more than two or three demand-search bibliographies in a working day? And when does the over-worked computer do its other tasks?

Answer by Taine. The demand search capability of MEDLARS was planned to permit up to about 100 searches daily. These searches are not run in the computer individually; rather, depending on the number of parameters contained in the individual requests, they are "batched" and many, perhaps all of the daily work load will be run simultaneously. Of the eight hours of computer time available in a single shift operation, it is anticipated that the demand search requirements will be met in about 85 minutes when this peak is reached in 1969; initially, the time required on the computer will be close to 45 minutes.

Question 2. If the distribution of duplicate tapes to regional libraries is a part of the MEDLARS plan, why was the Honeywell 800 computer selected for MEDLARS, when other types are so much more prevalent and available in the academic communities where medical libraries are located, and when the Honeywell tapes, being non-compatible cannot be used on these other computers?

Answer by Taine. At the inception of the MEDLARS Project, a firm decision was made to divide the aims of the system into two parts. First priority was given to the successful attainment of the primary objectives, essentially the development of an in-house computer search and publication capability. It was recognized that useful, even essential, secondary objectives would also be generated but that it would be desirable to wait until the complex requirements of the primary objectives first be accomplished. This, incidentally, has proven to be a wise course of action.

The selection of the computer to be used by MEDLARS, therefore, had to be primarily based on these requirements and secondarily on those of the vaguer and more distant goals. Since no computer exists that is ideal for all purposes and, an "average" need is not possible to establish, the computer selection had to be based on the most urgent needs of the system. Following a very careful study of available configurations, the Honeywell 800 was finally chosen.

It should also be pointed out that Honeywell is not alone among the computer manufacturers in being incompatible with other computers. In fact, there is even a considerable degree of incompatibility between different computers from the same company. However, this is not a serious obstacle to the effective distribution of duplicate MEDLARS tapes to outside computer centers. The conversion of M-H 800 magnetic tapes to other tape formats is economically and technically feasible at the present time.

Question 3. Why is MEDLARS, and the resulting Index Medicus, greatly extending its coverage to include many more medical journals (14,000 journal issues now; 25,000 by 1969), when it is strongly suspected that these additional journals are of an inconsequential nature? Does not this effort to "increase coverage" really amount to a cluttering up of the columns of Index Medicus with thousands of citations to low-quality articles?

Answer by Taine. If objective techniques actually did exist to permit one to distinguish the "junk" from the "worthwhile," a major contribution to bibliographic control would have been achieved. These desirable characteristics do not, however, exist and until such a universally acceptible yardstick comes into being, there appears to be no alternative to admitting virtually the entire literature corpus into the system. Although a sizeable quantity of inferior material will thereby be indexed, it is also true that there are still very large numbers of truly valuable items, yet unindexed, that will be included as a result. Subsequently, other refining techniques can be used to screen out the undesirable material if the specific search warrants such an approach.

Question 4. The subject scope of MEDLARS and Index Medicus is much narrower than that of most medical school libraries, which need to provide materials in chemistry, biology, physics, psychology, etc.--subjects which are out of scope for MEDLARS. Why doesn't MEDLARS extend its subject scope instead of trying to increase coverage to embrace further strictly medical journals?

Answer by Taine. This is a dilemma that most, if not all, scientific information services, must face today. As a result of the prevalent trend towards increased interdisciplinary relationships, the traditional boundaries between subject fields have become rather tenuous. An exhaustive literature search is therefore not likely to be successful if it is based on the use of a single bibliographic aid or on the multiple tools in the same discipline. The size of the total literature does not permit each disciplinary index or abstracting service the luxury of duplicating the peripheral material. As the index stretches to encompass these fringe items, it quickly finds itself in the untenable position of attempting to be a universal bibliography. MEDLARS, therefore, strives to first cover the medical and paramedical literature. We look to the future for the real solution to this problem, perhaps in the form of an integrated scientific information system in which the efforts and contributions of various individual disciplinary services are combined.

APPLICATION OF IBM EQUIPMENT TO LIBRARY MECHANIZATION, KEYWORD-IN-CONTEXT (KWIC) INDEXING AND THE SELECTIVE DISSEMINATION OF INFORMATION (SDI)

Donald H. Kraft

Fundamentals of Data Processing

Data processing equipment is being used to assist the librarian in many clerical tasks relating to acquisition, indexing, cataloging, circulation control of books and serials, and accounting functions. This is resulting in better service to the user, fewer clerical tasks for the librarian, and more time for the librarian to perform professional duties. Descriptions of these applications and their economics have been published.[1-9]

There are certain basic principles which are common to all successful IBM data processing installations. These fundamentals permeate virtually all uses of IBM equipment, and deviations from them may result in serious difficulties. They represent decades of experience and hold true, regardless of whether one is designing a system for production control in a factory or encumbrance accounting for a library. It would be well to review some of them here and see how they apply to library data processing.

1. Information is recorded once in an IBM card, which is then available, as required, to give desired results by machine processing. Once the information is keypunched and key-verified for accuracy, it is available for multiple uses. For example, at the time a book is ordered, cards are punched with the author's name, title of book, and publisher information. These cards can be used many times to write the purchase order, to prepare an outstanding order list, to order Library of Congress cards, to write the check and remittance voucher, to prepare a list of new acquisitions,

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to print catalog cards or a book catalog, to print a shelf list, to prepare Keyword-In-Context (KWIC) Indexes, etc. With a manual system, it is not uncommon to find this information typed and re-typed six to ten times. The savings in time, accuracy, and cost are obvious.

2. Use of Pre-Punched Data. To take advantage of the fact that much information processed is of a repetitive nature, data is "pre-punched" into cards as much as possible. Master files of publisher information, such as name and address, can be kept. When a book is ordered, the appropriate publisher card is removed from the master file, duplicated automatically on a keypunch or reproducer machine, and then returned to its place in the file. An alternate approach is to prepare multiple cards for each publisher. These are used as needed, and the file is replenished when a signal card (designated by a different color or corner cut or special identifying punch) is reached. Removing pre-punched cards from a file is normally faster and less expensive than punching and verifying the same data.
3. The Total Systems Concept. When a system is analyzed for conversion to automated data processing, one must be careful not to impose illogical boundaries between applications. An area, such as book ordering, should be analyzed for the effects that transactions in this area have on other phases of the library operation.

If a data processing system is to be most effective, long-range goals and aspirations should be established in the beginning. The system should be designed to do what the librarian wants it to do, not necessarily to do what is now being accomplished. For example, if encumbrance accounting for books, supplies, equipment, etc. is too difficult and expensive to do manually on a current basis, it does not follow that the same holds true with an IBM system. On the contrary, it can be one of the easiest of results to obtain.

In the November 1962 issue of Illinois Libraries, Howe and Weidner[7] describe a very straightforward approach to encumbrance accounting using data processing equipment. They follow through by adding catalog information to the IBM encumbrance card. This card "can then be used for book stock statistics and a more accurate sampling of book stock for insurance purposes. This encumbrance card, with the added information, becomes the master book card or shelf-list card for circulation control, sheaf catalogs, etc."

Take a fresh approach to problems. Do not be tempted to carry over vestigial procedures into a mechanized system just because

"things were always done that way." It is usually quite wasteful to use machines to perform tasks in the same manner as they are done manually. To do so without good reason would be just as foolish as to direct airline pilots to fly from city to city following automobile highways.

An illustration of this point is in order. In some manual systems, two cards are filed for each book that is charged out. One is filed in call number sequence, so that the library knows where each book is at all times. The other is filed by due date. Not only is multiple filing double work, but problems are created when books are renewed in absentia and when they are returned. Using a punched card approach, it is not necessary to have a double file. Cards need be filed only in call number sequence. Of course, the due date is punched into the card also, by use of an IBM 357 Data Collection System or some other means. The collator can be used to select automatically the overdue cards from this file, which is in call number sequence. The IBM 085 collator can search this file at the rate of 26,400 cards per hour, and the IBM 088 collator can search it at the rate of 78,000 cards per hour. These machine speeds free the librarian of the difficulties which are imposed upon them by the limitations of human searching capabilities.

When long-range goals are known, applications may be undertaken with a future connection in mind. Equipment selection at this point may proceed with a more intelligent appreciation of present goals and future needs.

4. Use Flow Charts. A flow chart is indispensable for analyzing a proposed procedure. It cuts to the logical essence of a system. Short-cuts as well as bottlenecks come to light during the flow charting process. An outstanding example of flow charting of a library operation was done at the University of Illinois, Chicago Undergraduate Division Library by L. A. Schultheiss and others.

   The flow chart in Appendix F (taken from Page 226 of Advanced Data Processing in the University Library) illustrates part of a charge-out procedure.

5. Establish Controls. Proper use of controls insures that the results obtained by data processing procedures are accurate. They also provide an audit trail, whereby proof of a report can be verified to satisfy management or an auditor.

Controls can be exercised by the use of checking features built into the equipment. For example, suppose one is using a collator to

merge current book transaction cards into a file of outstanding book transaction cards, which is arranged in call number sequence. The current transaction cards are first arranged into call number sequence by use of an IBM sorter. Since it is always possible that someone inserted some cards incorrectly into the outstanding transaction card file, while performing a manual exception routine, it is best to check the sequence of this file. The comparing circuitry of the collator can be used quite easily, while performing the merging operation, to check that the cards are in proper call number sequence. In most cases, this type of checking can be performed at no loss of time, since it is done simultaneously with other functions of the machine.

Other controls can be designed into the system. They, too, would take advantage of the capabilities of data processing equipment. For instance, card punching can be checked by use of the IBM 056 Card Verifier. Recognized accounting procedural controls can be designed into the system. An obvious check that would be used if expenses were distributed among many accounts is that the total of all the accounts is equal to the total of all the individual expenses. An IBM 402 or 407 Accounting Machine can do this while printing the distribution.

6. Step-By-Step Conversion. Although the entire mechanized system will have been flow charted, it is wise to plan to convert only one or two applications at a time to data processing equipment. Some operations are logically discrete and, as such, can be tackled separately. Problems will arise which were not anticipated, and they will be easier to solve one at a time.

   Moreover, improvements will be made to the original procedures during these early stages. For example, experience gained during the conversion of the book ordering job will make easier the conversion of later applications.

   An application should be converted, tested, and operating smoothly before the next job is tackled. In some cases, however, several applications are so closely interwoven that it is best to convert them together.

7. Pre-Test the System's Components. Portions of a system can be pre-tested by wiring the necessary control panels for the unit record equipment (or programming the computer), punching cards that would be representative of those encountered in actual operation, and finally, processing the data. The results of these "dry runs" would be analyzed to make certain that they give the information desired in the required time.

Whenever possible, it is wise to continue the manual operation parallel with the newly converted machine procedure for a short period of time. This not only provides insurance that your operations will continue to function in the event you encounter difficulties, but also provides valuable comparisons between the two systems.

8. Become Familiar with the Equipment. It is necessary that the librarian have at least a basic knowledge of what each machine in the system can do. The more one knows about them, the more one can take advantage of their power and flexibility. It is easier for a librarian to learn the capabilities of the machines than it is for a systems engineer to learn the inner workings of a library.

Librarians who are planning to mechanize their procedures will want to become knowledgeable about the new equipment, so that they can exert more control over its proper use. In order to help the librarian understand the equipment, IBM offers free courses at all of its branch office locations. These courses are taught at both the survey or conceptual level as well as at the detailed operating level. They cover unit record equipment and computers.

Once the machines are installed and performing the tasks for which they were acquired, it is usual to find many additional one-time (as well as repetitive) jobs that can be efficiently done on them. IBM machines are quite flexible. But it is up to the professional librarian to spot these additional applications.

9. Batch Processing. Unless a random access computer storage device (such as the IBM 1311 Disk File) is available, the machine processing of data is done most efficiently in batches rather than as single transactions. This reduces machine setup time considerably. The workload is usually cycled through a period of time in order to collect enough material to form a batch. For example, book ordering may be done once a week, while check writing may be done once a month. Over-due notices may be scheduled for processing one day a week. On the other hand, the filing of circulation transaction cards may be done by the collator on a daily basis.
10. Management by Exception. Characteristic of most management personnel is an ability to strike through detail to the core of a problem. A data processing system can assist library management by selecting only items requiring review. Attention is focused on the exceptional rather than the commonplace. This principle is illustrated in the records

department. It is not necessary to examine each card in a file to determine which serials did not arrive this month, nor is it necessary to examine each card for renewal date. Data processing equipment can do this searching at machine speeds and print an action report on those items of current interest.

The principle of management by exception would be employed in designing a budgetary accounting system. For example, special reports could be printed to highlight those departmental accounts which are close to their authorized limits.

KWIC, A Computer-Produced Index

The task of organizing large bodies of information so that particular facts can be found quickly when needed is a pressing problem of our times. A simple way to organize information is to use the actual words contained in documents as index terms. Through mechanization this can be done very easily by listing the words in alphabetical order, as in a dictionary. A refinement over this simple alphabetical listing is to include, with each index word, the words by which it is surrounded—that is, to list each index word "in context." A further refinement is to exclude from the index non-informative words, such as prepositions, articles, and the like. The Keyword-In-Context (KWIC) program does just these things—that is, it excludes words which the program has designated as non-informative, and it lists alphabetically all the remaining words (Keywords), with each Keyword surrounded by the words with which it appears in the original material.[10,11]

The technique was developed as a computer application in IBM's Research Laboratories by H. P. Luhn. It has been used to index various types of information. The first KWIC index produced on a large scale was "Chemical Titles," prepared in 1960 by the Chemical Abstracts Service of the American Chemical Society in Columbus, Ohio, under the leadership of Dr. G. M. Dyson. "Chemical Titles" is prepared on an IBM 1401. Each issue indexes some 2,800 titles and 5,900 authors, this material being keypunched directly from the title pages of about 600 journals of chemistry. The entire index is prepared by two keypunch operators, an editor, and an office services man.[12] The IBM 1401 produces the index in 3-1/2 hours.

A KWIC index may be useful either as a direct lead to literature or as a catalog to a more elaborate abstract or document file. Some of the compilations in which the KWIC indexing method has been used are listed below along with the name of an organization which uses it.

1. Section indexes to procedure manuals (Trans-Canada Airlines).
2. A current index to the laws passed in the fifty states (American Bar Foundation, Chicago, Illinois).
3. Cumulative indexes to computer program abstracts (IBM Corporation).
4. Indexes to special collections of publications (Chemical Abstracts, Columbus, Ohio).
5. Indexes to research and development projects (Lockheed Aircraft).
6. Indexes to correspondence files (IBM Corporation).
7. Special bibliographies (Bell Telephone Laboratory, Murray Hill, New Jersey).
8. Indexes to internal technical reports (North American Aviation).
9. Programs of professional meetings where many papers are presented (American Institute of Chemical Engineers—1962 annual meeting).
10. Concordances (American Medical Association, Chicago, Illinois).
11. Cumulative Index to a periodical (Communications of Association of Computing Machinery, March, 1963).

A KWIC index can be only as good as the titles that go into it. There are as many index entries for each title as there are Keywords in the title. Thus, the paper entitled, "Design of a Chemical Reactor by Dynamic Simulation" will be indexed five times: once for each of the Keywords—"design, chemical, reactor, dynamic, simulation." Words of little significance, such as articles, prepositions, and conjunctions are not treated as Keywords. All other words will be indexed.

The librarian may supplement the title with descriptors or a sub-title. These words will be indexed in context, too. "See Also" references may be used. For instance, one may insert punched cards with the information:

- ATOMIC ENERGY see also NUCLEAR, RADIATION.
- ANTI-TRUST see also CLAYTON, COMPETITION, MONOPOLY, ROBINSON-PATMAN, SHERMAN.

into the deck of title cards. They will be listed in the appropriate places by the computer.

Several papers have been written in the area of determining whether titles are, in general, well-written or not.[13,14,15] The conclusions in the areas of law and medicine are that approximately 90 per cent of the titles can be well indexed by their own words. Since

KWIC indexes are being produced regularly in the physical and biological sciences, one may assume that, in general, these titles contain good indexing words. If titles in less precise areas, such as the social sciences, are not as descriptive, they can still be used for KWIC indexing. It merely means that searching a KWIC index of them will be less efficient. Professor Kenneth Janda of the Political Science Department of Northwestern University has produced several KWIC indexes in the field of political science.

The Keywords are alphabetically positioned near the center of a line, which includes several words that precede and follow the Keyword. An equal (=) sign appears at the end of each title. In addition to the Keyword, each line of the KWIC index contains the remainder of the title up to a total of sixty characters and spaces; this residue may, at times, include the whole title. The computer makes it possible to provide additional words of context by "wrapping the title around." Thus, if the Keyword is the last word in a title, the title begins again after the appearance of the equal sign. The additional information aids in indicating the nature of the work and facilitates selection of relevant titles.

To locate those papers in which you might be interested, scan vertically down the alphabetically arranged Keyword column. When a significant word is found, glance horizontally at the nearby contextual words to see if the specific meaning is appropriate to your interests. If so, note the reference number on the right and refer to the bibliographic section, which is arranged in reference number sequence. There will be found the complete bibliographic reference. Synonyms of subject words of interest should also be looked up in the index.

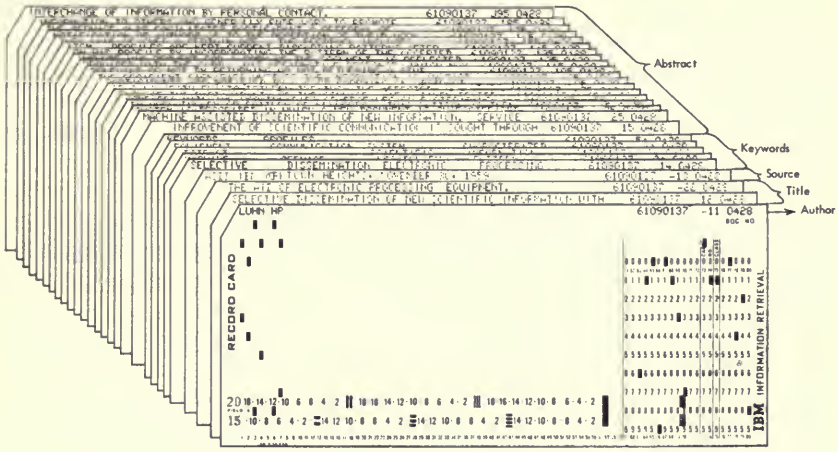
An author index is provided. It also gives access to the bibliography through use of appropriate reference numbers. The reference number, which is used to tie the three sections of a KWIC index together, may be assigned by the librarian using any combination of letters and numbers up to twelve in all. An optional feature of the KWIC program is the automatic assignment of an identification code, which is generated by the computer from the author's name, year of publication, and the title words. As an illustration of this code, the IBM 1401 KWIC program (Program No. 1401-CR-02X) would assign the following reference to this paper:

KRAFDH - 64 - AOI

KRAF are the first four letters and DH are the initials of the author's name. The year of publication is 1964. AOI are the first letters of the first three words in the title.

Appendix E illustrates the three sections of a typical KWIC index; (a) the Keyword-In-Context index; (b) the bibliography; and (c) the author index.

KWIC indexes are produced quickly, at low cost, and with a small expenditure of manpower. The input to the KWIC computer program consists of punched cards containing the author's name, the title, and publication date. The indexing may be enriched by adding punched cards with additional descriptors. An abstract may be included, if desired.



The data are most usually obtained from the title page of the journal to be indexed. As an illustration of the economics of this type of input, consider the value to an organization if a single monthly index of all the major articles in the top 100 journals in the library could be produced easily. Assume that there are twenty articles per journal--a total of 2,000 articles per month. An average of 4-1/2 cards are needed per article to record the author's name, title of the article, and reference data. This totals 9,000 cards. A keypunch operator, working directly from the table of contents, can punch 900 cards per day. Therefore, ten days are required for key-punching, and ten days for key-verifying of the cards. These 9,000 cards are then read into a computer (IBM 1401, for example). Less than three hours would be required for the IBM 1401 to generate and print the Keyword-In-Context index, the author index, and the bibliographic section. These can be placed in a binder and kept in the library for reference.

If desired, the KWIC index could have been printed directly by the IBM 1401 on multilith masters for reproduction and distribution to interested parties. An alternate procedure would be to photograph the IBM 1401 output and print multiple copies by offset.

The approximate monthly cost of producing the KWIC index of 2,000 articles can be estimated as follows:

IBM Type 026 Card Punch	$ 30.	(1/2 month's rental)
IBM Type 056 Verifier	25.	(1/2 month's rental)
3 hours of 1401 Time @ $75/hr.	225.	(Prices vary from $50-$100/hr.)
Key Punch Operator	300.	(Varies with experience and geographic area)
	$580.	(Does not include federal and state taxes)

If an IBM 1401 is available in another department of the organization, it is most likely that the $225 estimate would be reduced considerably. Since the key punch and verifier are used only ten days a month on this project, only one-half month's rental is charged above to the cost of the index.

The cost per article indexed is only 29¢. This compares with the cost of manually indexing an article, which averages $4. A key point to note is that in most cases there is no manpower available to do the indexing any other way. Since each title will average six Keywords, the cost per index entry is 5¢(29¢/6).

Studies have been made to demonstrate the efficacy and quality of KWIC indexing.[12,16] For example, Dr. G. Jahoda (of Esso Research and Engineering Company Library) reports with reference to internal reports that two-thirds of the queries asked at their reference desk could be answered by referral to author, title, or source of publication listing.[17]

Selective Dissemination of Information

A major problem of our time is that of keeping well informed. Scientists, engineers, professors, managers, and executives all need current information about technological discoveries, new research, competition, customers, financial data, economic conditions, etc.

There are hundreds of pieces of information appearing daily in The Wall Street Journal, Barron's National Business and Financial Weekly, Forbes Magazine of Business and Finance, Harvard Business Review, trade papers, technical journals, laboratory reports, etc., that might be of interest to any person in a decision-making capacity. For example, there are more than 150 publications which contain articles that might interest an IBM data processing salesman. It is a Herculean task to attempt to screen this mass of information.

In a small library it is possible for a conscientious librarian to know the principle interests of some of the borrowers and to notify these people when certain books arrive, which deal with their interests. It is impossible to expect the librarian to extend this personal service

to include articles in journals, newspapers, trade organs, etc. And the problem is compounded to a second degree of impossibility if one were to expect the librarian to cover this vast literature for hundreds of persons whose interests are different and changing.

One solution to the problem has been produced by IBM research—it is called "Selective Dissemination of Information" or SDI.[18,19] SDI is like an electronic traffic director of information, analyzing and routing it to those who have a need to know. This is a tool with which one can match or compare his particular interests against the flood of paper. Through the use of this technique, one automatically receives only the specific information that he really wants. SDI provides the librarian with the means to extend himself almost infinitely in his ability to service his users' information needs promptly.

Let us examine the thought processes of an individual standing before a shelf of publications in a library and study his browsing procedure. First he examines the titles in a table of contents. If one looks interesting, the browser opens the publication to the first page of the article and looks for an abstract. If there is one, he reads it. If the abstract interests him, he probably reads the article. In the event there is no abstract, the reader probably looks for a section entitled "summary" or "conclusions." In the absence of these, he most likely reads the first and last paragraphs of the article in an attempt to discover if the article is worth his time to read it. In short, the browser is searching for something to assist him in making a judgment about the article—"Should I read it or not?"

Analyzing more deeply the processes described above, we ask the question, "what makes a title look interesting to a researcher?" Since the title is usually a short sentence, the answer is that certain of the words in the title jump out of the page at the reader; they are his "hot-buttons." They are a subset of the set of all words which can be used to describe his interests. He recognizes these words as meaningful and significant. This same analysis would hold true of the abstract. Once again words pop out of the page, if the abstract is about an article of interest to the reader.

Searching for meaningful words and matching them with people's interests is the process the computer is to simulate.

Those people who have a current awareness need should furnish lists of words which characterize their various interests. These are the same "hot-button" words which the reader looks for when he browses. These lists of words are called "interest profiles," and they are stored in the computer. Abstracts (title, author, source, index terms, abstract) of articles are fed into the computer. The computer next compares each interest profile word by word with the index words of the article. When a sufficient number of words match between a profile and the index term of an article, the abstract is printed by the computer and sent to the appropriate user.

In this way a person can browse electronically through vast amounts of literature. When this technique is applied to many people, it is called Selective Dissemination of Information (SDI).[20]

In order to understand SDI, it is necessary to discuss it as an operational system as opposed to a generalized concept. For this reason the balance of the paper will be a description of a specific SDI system using a program which was written for the IBM 1401 Data Processing System.[21] It should be noted that SDI systems have been in operation for over four years in servicing IBM research and development personnel. At the time of this writing, there are in excess of a dozen SDI systems in the country. Some are fully operational, while others are still in the pilot operation stage.[22] The number of SDI systems is expected to grow many-fold as operational experience becomes more widely known.

The first step in an SDI system is to interview the users of the system to obtain their interest profiles. This list of words (up to sixty in length) will vary from person to person, depending upon his current information needs. A user may have more than one profile.

The logic of the system permits the user to have two different types of profile terms:

a. Exact Term - i.e. ", SIMULATE". This WILL match on "SIMULATE" only. It will NOT match on "SIMULATES" or "SIMULATING." An exact term is designated by a comma (,) prefix.

b. Root Term - Ex. 1 - "%SIMULAT". This WILL match on "SIMULATE" and also "SIMULATION," "SIMULATES," and "SIMULATING." A root term is designated by a percent sign (%) prefix.

Ex. 2 - "%70". This WILL match on: 704, 7040, 7044, 709, 7090, 7094, 705, 7080, etc.

Each profile has a "hit level" associated with it. This is a positive 2-digit number, which is a measure of desired similarity between the profile and documents being compared with it. When the sum of the weights of the profile terms which match the document terms equals or exceeds the hit level, a notice is sent to the user.

The Exact Terms and Root Terms have "weights" assigned to them. Thus if a user assigned the weight of 3 to one of this profile words, it would have three times the importance of a word with the weight of 1. Weights may range from -9 to +9.

Plus weights may be used to increase the importance of a word. For example, with a hit level of 4, a word weighted "+3" would require only one additional matching word before a notice is sent. If a weight of "+4" were used, a notice would be sent if the word occurs in the abstract.

LIST S. D. I. PROFILE DATE FEBRUARY 20, 1964

LOC.	DEPT.	SER.	PROF.	NAME	LOCATION	SECURITY ABCDE	HIT LEVEL
963	328	353485	T	DONALD H KRAFT	MWRO-CHICAGO-7TH FL	11	03

KEYWORD TYPES , - EXACT TERM % - ROOT TERM

TYPE	WT.	PROFILE TERM
%	3	□CHEMICAL-ABSTRACTS
,	-2	*IB
,	3	#LIBRARY
%	2	ABSTRACT
,	1	APERTURE
,	1	CIRCULATION
%	2	CLASSIF
%	1	DISSEMINAT
%	1	DOCUMENT
,	1	IMAGE
%	1	INDEX
,	3	INFORMATION-RETRIEVAL
%	2	KEYWORD
,	3	KWIC
%	2	LAW
,	1	LEGAL
%	2	LIBRAR
,	-9	MICR
,	1	MICROFILM
,	1	OPTICAL
%	1	PATENT
,	1	READER
%	2	RETRIEV
%	1	SCAN
,	3	SDI
%	1	SEARCH
,	1	SERIALS
,	-2	SHARE
%	1	STOR
,	1	TECHNICAL
%	1	TEXT
%	1	TRANSLAT
,	-9	1282
,	-9	1418
,	-9	1428

Exhibit A

The use of minus weights is an effective way to reflect the fact that a term is usually found in documents of little interest, and additional matching terms will be required. Weighting a term -9 would for most abstracts be the same as stating that abstracts containing this word are not wanted.

Example 1: , 2 SIMULATE - If this word occurs in an abstract, the hit level is reduced by two. If the hit level were two, a notice would be sent.

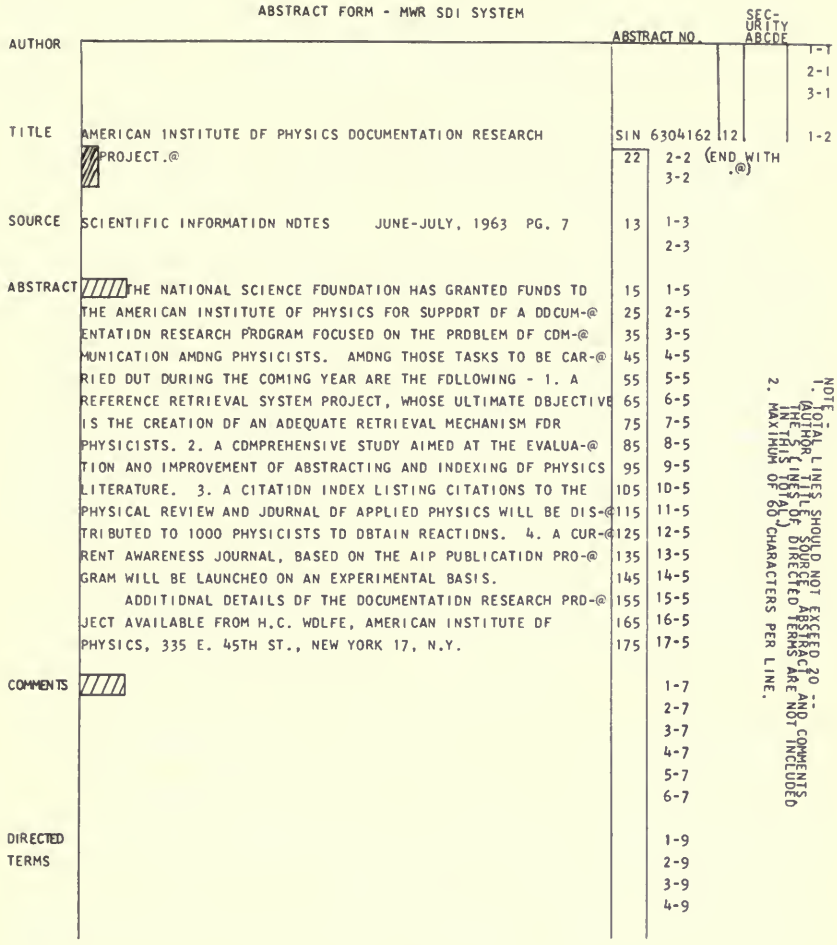
Example 2: , -1 *HBR - Every time an article from the Harvard Business Review is encountered the hit level is increased by one. Since the weight is subtracted, a hit level of three would be increased to four. Thus articles from this publication will require more matching words than other publications.

It is important to note that the user chooses his own profile and hit level. He is free to modify them at any time. A list of profiles covering many interests may be given to each new subscriber to assist him in determining the words for his own profile. The author's profile is given as an example in Exhibit A.

The second ingredient in an SDI system is the article itself. The publications which are in the SDI system are assigned to those specialists who normally would read them. Based upon their broad range of experience, these specialists select the articles which are most significant. In the course of reading or scanning the article, they may mark sentences or paragraphs which are of high information content. The specialist may write a comment or evaluation of the article. It should be noted that this selectivity of input need not be done in this fashion. It may be desirable in some cases (research laboratories) to include all articles from each journal which is in the system. Additional sources of input may include trip reports, important letters, etc.

The articles are abstracted ("extracted" is more precise) into less than 200 words. These abstracts may be written by specialists, librarians, professional abstractors, etc. However, very satisfactory indicative abstracts can be written by girls with no training in the technical field covered. The abstracts may be prepared by these girls, using IBM 826's. An IBM 826 is an electric typewriter connected to a key-punching machine. As the girls type the abstracts, they simultaneously punch them into IBM cards.

One girl can scan an article and type the abstract (extract) for 25 articles in a work day. Each abstract contains the author's name, the title of the article, the publication source and date, as well as the abstract itself and comments. (See Exhibit B)



ABSTRACT FORM - MWR SDI SYSTEM

		ABSTRACT NO.	SEC-URITY ABCDE	
AUTHOR				1-1 2-1 3-1
TITLE	AMERICAN INSTITUTE OF PHYSICS DOCUMENTATION RESEARCH PROJECT.@	SIN 6304162 22	12	1-2 2-2 (END WITH .@) 3-2
SOURCE	SCIENTIFIC INFORMATION NOTES JUNE-JULY, 1963 PG. 7	13		1-3 2-3
ABSTRACT	THE NATIONAL SCIENCE FOUNDATION HAS GRANTED FUNDS TO THE AMERICAN INSTITUTE OF PHYSICS FOR SUPPORT OF A DOCUM-@ ENTATION RESEARCH PROGRAM FOCUSED ON THE PROBLEM OF COM-@ MUNICATION AMONG PHYSICISTS. AMONG THOSE TASKS TO BE CAR-@ RIED OUT DURING THE COMING YEAR ARE THE FOLLOWING - 1. A REFERENCE RETRIEVAL SYSTEM PROJECT, WHOSE ULTIMATE OBJECTIVE IS THE CREATION OF AN ADEQUATE RETRIEVAL MECHANISM FOR PHYSICISTS. 2. A COMPREHENSIVE STUDY AIMED AT THE EVALUA-@ TION AND IMPROVEMENT OF ABSTRACTING AND INDEXING OF PHYSICS LITERATURE. 3. A CITATION INDEX LISTING CITATIONS TO THE PHYSICAL REVIEW AND JOURNAL OF APPLIED PHYSICS WILL BE DIS-@ TRIBUTED TO 1000 PHYSICISTS TO OBTAIN REACTIONS. 4. A CUR-@ RENT AWARENESS JOURNAL, BASED ON THE AIP PUBLICATION PRO-@ GRAM WILL BE LAUNCHED ON AN EXPERIMENTAL BASIS. ADDITIONAL DETAILS OF THE DOCUMENTATION RESEARCH PRO-@ JECT AVAILABLE FROM H.C. WOLFE, AMERICAN INSTITUTE OF PHYSICS, 335 E. 45TH ST., NEW YORK 17, N.Y.	15 25 35 45 55 65 75 85 95 105 115 125 135 145 155 165 175		1-5 2-5 3-5 4-5 5-5 6-5 7-5 8-5 9-5 10-5 11-5 12-5 13-5 14-5 15-5 16-5 17-5
COMMENTS				1-7 2-7 3-7 4-7 5-7 6-7
DIRECTED TERMS				1-9 2-9 3-9 4-9

NOTE - 1. TOTAL LINES SHOULD NOT EXCEED 20 -- AND COMMENTS (AUTHOR, TITLE, SOURCE) DIRECTED TERMS ARE NOT INCLUDED IN THIS TOTAL.
2. MAXIMUM OF 60 CHARACTERS PER LINE.

Exhibit B

The abstracts written by the girls, following the "Abstracting Guidelines" (Exhibit C), have been well received. Numerous comments were made to the effect that an abstract was of interest; but it was not necessary to see the article since the abstract covered it so well. Success has been encountered with ex-secretaries (having only a high school or business school education) abstracting marketing and technical literature in the Chicago SDI Development Program; this confirms the results obtained by IBM Research Labs which have been using secretaries to abstract highly technical literature for their SDI system.[23, 24, 25]

Exhibit C

ABSTRACTING GUIDELINES

1. All abstracts MUST include the following:

   A. Author's name and company affiliation, if available.
   B. Title.
   C. Source of Publication.
   D. Date of Publication.
   E. The abstract itself.
   F. Number of pages.
   G. Comments, if available.

2. Use sentences or phrases underlined by industry representative (selector).

3. Include company names and machine model numbers where they play a significant role.

4. There are 20 total lines available in each abstract. Since the 1401 S.D.I. Program matches interest profiles against documents on the basis of the words in the abstract, it is most important that the abstractor uses as many relevant words as possible to assure an abstract with good content and coverage. Try to use as many of the allotted 20 lines as is feasible.

5. Usually the most important material is located in a section of the article designated by one of the following:

   a. Boldface (heavy type); b. "Abstract"; c. "Summary";
   d. "Conclusion"; e. First paragraph; f. Last paragraph.

6. A quick way to enrich the abstract with Keywords at minimal use of space is to make use of a statement such as:

   "Article discusses . . . "

   Then state the topics by use of short, concise phrases, single words, or paragraph headings.

7. Try not to use words in the abstract that are already in the title.

8. If abstract exceeds 20 lines total, then reduce size by editing out modifying words (adjectives, adverbs) and other unimportant phrases and clauses. This will make the content more meaningful.

9. If the article is short, and the abstract includes the entire article, then indicate this by stating: "Entire article."

10. Indent paragraphs for better print-out appearance.

11. If the article is contained in a journal, attach a paper clip to the first page of the article to be abstracted. This will aid the S.D.I. Department in locating that particular abstract in the future.

12. Please return document with abstract to Department 328, MWRO.

The punched cards containing the abstracts are automatically indexed by the SDI program on the IBM 1401. The indexing can be done in either of two ways: (1) Keywords may be selected from the abstract, title, and author's name if they do not match a word on an exclusion list of common words stored on magnetic tape; (2) Keywords may be selected from the abstract, title, and author's name if they match a word in a dictionary stored on magnetic tape and are not on an exclusion list of common words. Provision is made for human indexing also. Subject headings, descriptors, etc. may be added to enrich the indexing. Using the dictionary approach combined with the exclusion list of 264 words, an average of 22 keywords are chosen per item. The exclusion list technique alone indexes an item by an average of 41 keywords.

The indexed abstracts are then written on magnetic tape. Using an IBM 1401 with 8,000 positions of memory and 729 II tape drives, the following times (including card reading, auto-indexing, tape reading and writing) were observed for the auto-indexing run: with an exclusion list of 264 common words, 16 seconds per abstract, and with a dictionary of 2,200 words and also an exclusion list of 264 words, 60 seconds per abstract.

Keywords from the abstracts are then compared with the users' interest profiles. In those cases where enough keywords match (the sum of their weights is equal to, or greater than, the hit level), document notices are printed on continuous forms in mailing sequence. A typical run for 875 users' profiles and 42 abstracts required 2-1/2 hours on the IBM 1401, or about 10-1/2 seconds to process one user's profile against 42 abstracts. Statistics on the words which matched and the documents which were disseminated are obtained by the program and stored on magnetic tape for control and evaluation purposes.

The forms are sent to the mail room where they are separated by a bursting machine and distributed to the appropriate offices. Because of the importance of the information contained in the SDI notices, most users give priority to them. It takes less than a minute to read the abstract and punch the reply card. The user indicates his responses to the notices by punching out with his pencil a pre-scored (Port-A-Punch) position in the reply card. With the reply card, the user may request a copy of the entire article or simply indicate whether or not the article was of interest to him. There is space for the user to write comments. This feedback provides a measurement of the system's effectiveness. (See Exhibit D).

A very important innovation in this program is that the abstract words which matched in the profile are printed above the abstract. An examination of Exhibit D (See SDI notice) and Exhibit A (author's profile) shows that the notice was printed because the abstract contained the words RETRIEVAL, INDEX, DOCUMENTATION, ABSTRACTING, and the sum of their weights is 6, which exceeds the hit level of 3.

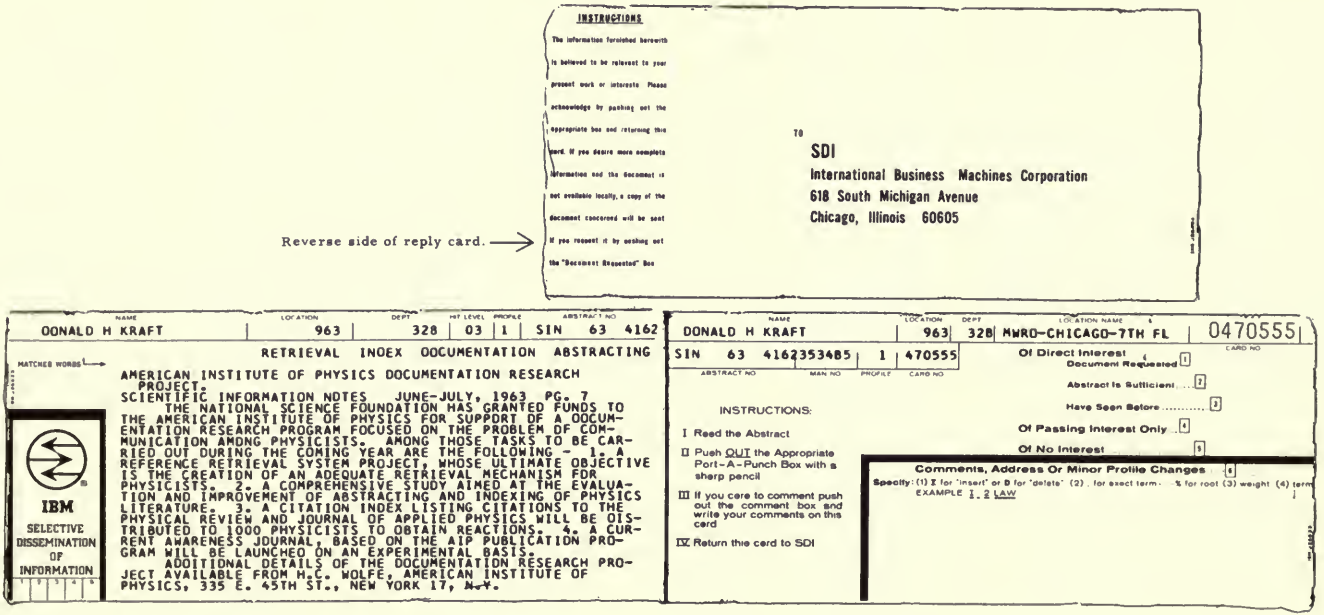


Exhibit D
SDI notice consisting of an abstract and a reply card

By adjusting his hit level upward or downward, the user can control the amount of information he receives. Further control can be had by varying the weights of the profile terms. The user also can exert control over the sources of publication. For example, consider a profile with hit level 4 including these words:

-1 *HBR
+1 *CE
-9 *EN

This would increase the hit level to 5 for all articles from Harvard Business Review; decrease the hit level to 3 for all articles from Control Engineering; and it would virtually eliminate the chance of getting any articles from Electronic News—by raising the hit level to 13.

It has been estimated that some 10,000 articles a month are screened by the SDI specialists. From these, approximately 800-900 are abstracted and enter the system. The "average" user will get SDI notices concerning 110 of them—or about 1 per cent of the total.

An analysis of users' replies indicated that two-thirds of the notices were "of interest" and one-third of "no interest" (25). Considering that a "typical" user received an average of five SDI notices per day, the noise level of 34 per cent was tolerable, since it required less than one minute to read an SDI abstract and punch out the reply card. The author's profile was revised five times, and it ultimately resulted in 86 per cent of the notices received being "of interest" and only 14 per cent of "no interest."

It is difficult to say how much "noise" a person can live with, but experience indicates that 1/3 noise is not too high. Constant upgrading of profiles is a necessity if the noise in the system is to be kept to a minimum.

No measure was taken of the pertinent documents which may have been missed by an individual due to the absence of certain words in his profile or in the keywords of the abstract. Such losses were not considered serious, since the users received so much more information than they ever had before. Actually 89 per cent of the "of interest" notices had not been seen before by the users.

Efficient dissemination, when a document first appears, reduces the retrieval problem later. SDI is a kind of "retrieval-in-advance"—a current awareness program, that helps users keep abreast of new information. It is a technique that makes it possible to build a communications system for an entire organization.

The cost of an SDI system is determined by the number of interest profiles, the number of documents entering the system, type of abstracts used, and the type of computer used. One estimate,

based on 2,000 profiles, 50 documents per day, use of an IBM 1401 computer and non-professional abstractors, was approximately $7 a month per user profile.

Since the library, whether special, public, school, or otherwise, is the normal repository of published material, it is not unreasonable to imagine it as the center of this new activity. For example, an SDI system, with professors and students doing the abstracting, would serve the information needs of a campus. Each person enrolled in the system would receive abstracts of articles of interest to him, regardless of their source. The economics professor would receive relevant articles from sociology, as well as economic journals. The history professor would be exposed to material from political science journals. The University President would receive abstracts from management science journals, Fortune, Wall Street Journal, etc.

Exhibit E

CHART D-1, Sheet 1
Charge Out Procedures

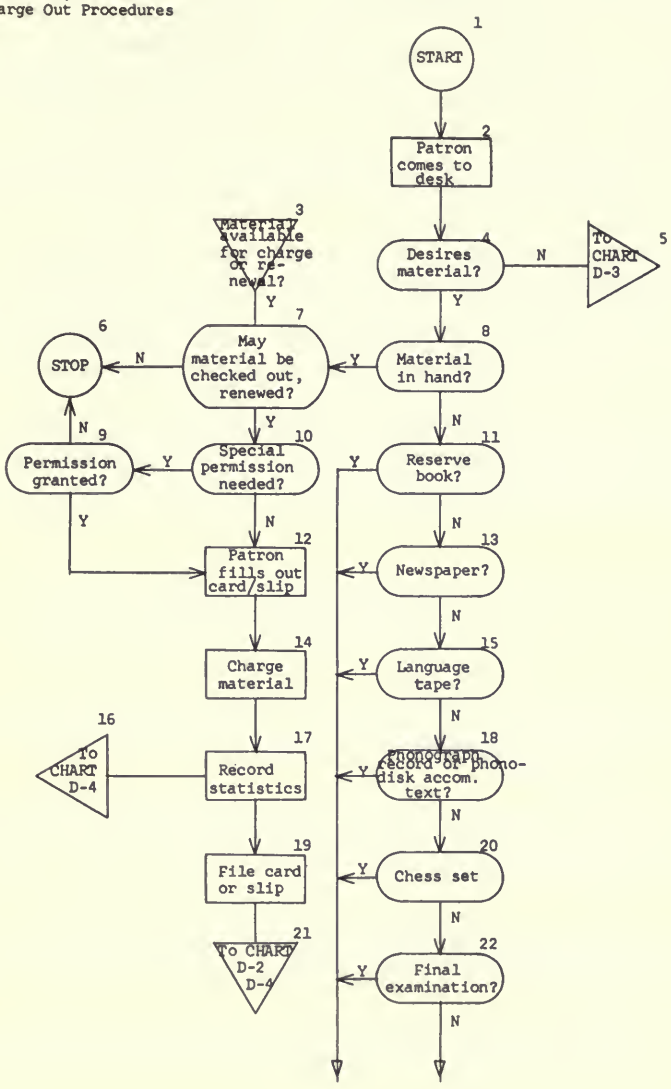


Exhibit F

Could not the public library take on the role of actively keeping a segment of the community informed? Users of a library-managed SDI system would pay a monthly membership fee to cover the expenses of the system. Heads of local industries and businesses would be enrolled in this current awareness program. These people would be eager to hear about a solution to their information problem.

Computer time is available from service bureaus, data centers, and local industries who are not utilizing their computers fully. Some larger libraries could economically justify their own computer, for both housekeeping tasks and SDI.

Abstracting in volume is not the problem it may seem to be. Many journals print their own abstracts. The local librarian can call upon a host of potential abstractors to aid in this project—for example, qualified students, handicapped persons, housewives, retired senior citizens, etc. A short special training period is all that is necessary to prepare a person to write SDI-type abstracts.

This new role of the library, that of an active disseminator of information, is one that ought to be given serious consideration. It offers the librarian an unusual opportunity to give better and extended service.

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APPENDIX I
BIBLIOGRAPHY ON MECHANIZED LIBRARY PROCESSES

Compiled by Edward Mack McCormick

This bibliography contains 155 English-language items of literature on the mechanization of library processes. These processes include acquisitions, circulation control, handling of serials, selection of document copies, and intercommunication between libraries. Mechanized information retrieval is not included, i.e., subject searching by machine. Further, the common uses of data processing by libraries for such functions as payroll and accounting are not included.

Mechanized equipment includes punched-card accounting machines, computers, automatic typewriters, or automatic selection devices. All these devices involve machine-usable file media such as punched cards, magnetic tape, and punched paper tape. Thus ordinary typewriters and reproduction devices are not included. The use of edge-notched cards is also not included.

There is a table of contents on the following page.

The compilor collected this material in April 1963, for the Office of Science Information Service, National Science Foundation, Washington 25, D. C.

Organization of Bibliography

The bibliography itself is divided into eleven sections. In addition, two indexes are included.

Sections

Indexes

In the eleven sections the items are arranged in inverse chronological order. This facilitates examination of each section for the new items; items at the end of each section are generally only of historical interest. The items are numbered in one sequence in the eleven sections. The library location index refers only to single systems described individually in the items in the bibliography. Items which contain information on several systems are not included in this index. Thus, the systems described in sections 1 and 11 are not included but those in sections 3 through 10 are included.

1. Libraries and Automation

This section is concerned with general considerations in the automation of libraries. The items are primarily concerned with defining the library problem as related to automation or with the nature of the library of the future.

The items pertaining to the general library automation problem include items 5, 15, 16, 21, and 32. Item 32 is the often referenced article by Bush which includes the Memex concept. Professional implications for librarians are considered in 6, 11, and 20. The Patent Office as a special library is considered in 22 and 23.

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35. Fair, Ethel M. "Inventions and Books—What of the Future?" Library Journal, 61:47-51, Jan. 15, 1936.

2. Machine Usable Records

Mechanization of library processes requires information in machine usable form. Many of the items in the sections referring to specific processes include this, i.e., sections 3 through 8. However, the items in this section pertain to general aspects of putting information into punched cards. Converting information into punched paper tape is included in section 9.

36. International Business Machines Corporation. General Information Manual: Mechanized Library Procedures (E20-8094). White Plains, N. Y., IBM Corp., Data Processing Division, 1962.

37. Davies, John. Library Studies No. 1 Methods of Punching Cards. Winchester, Hampshire, England, IBM British Laboratories, 1962.

38. International Business Machines Corporation. Reference Manual: Index Organization for Information Retrieval (C20-8062). White Plains, N. Y., IBM Corp., Data Processing Division, 1961.

39. Grems, Mandalay. "A Card Format for Reference Files in Information Processing," Communications of the ACM, 4:10, February 1961.

40. Luhn, Hans P. General Rules for Creating Machinable Records for Libraries and Special Reference Files. Yorktown Heights, N. Y., IBM Corp., Advanced Systems Development Division, 1960.

3. Acquisitions

The following items pertain to the use of mechanized equipment for the acquisitions process. In many ways this process is most closely related to the normal commercial application of data processing equipment. It will be noted that the oldest item in this bibliography, item 47, is in this section.

41. Juhlin, Alton P. "The Use of IBM Equipment in Order Procedures at Southern Illinois Library," Illinois Libraries, 44:587-592, November 1962.

42. Fetterman, Lois. "Mechanization of Magazine Orders," National Association of Secondary-School Principals Bulletin, 43:120-122, November 1959.

43. Young, H. H. "Use of Punched Cards in the Serials Acquisitions Department of the University of Texas," SLA Texas Chapter Bulletin, 11:1-3, 1959.

44. Butcher, S. J. "The Acquisition of Books," Library Association Record, 54:259-262, August 1952.

45. Keller, Alton H. "Book Records on Punched Cards," Library Journal, 71:1785-1786, Dec. 15, 1946.

46. Moffitt, Alexander. "Punched Card Records in Serials Acquisition," College and Research Libraries, 7:10-13, January 1946.

47. International Business Machines Corporation. Purchase Analysis Procedure—Boston Public Library. New York, IBM Corporation, 1934.

4. Circulation

Circulation control is a process often mechanized. Items 61 and 62, each published eleven years ago, report on 5 and 10 years experience with mechanized circulation systems.

48. International Business Machines Corporation. General Information Manual. IBM 357 Data Collection System (E20-8028). White Plains, N. Y., IBM Corp., n.d.

49. "Automated Circulation Procedures at Southern Illinois University," Library Journal, 88:1133, March 15, 1963.

50. Black, Donald V. and Cox, James R. IBM Circulation Control at the University of California Library, Los Angeles, A Preliminary Report. Los Angeles, University of California, March 1963.

51. McCord, John G. W. "A Data Processing System for Circulation Control at the Illinois State Library," Illinois Libraries, 44:603-607, November 1962.

52. Riggle, Stella-Margaret. "Automatic Journal Routing Using IBM Punched Cards," Special Libraries, 53:537-540, November 1962.

53. Williams, H. L., Jr. Library Periodicals Ordering Information and Routing: Operating Manual for Library Personnel. Albuquerque, N.M., Sandia Corporation, Aug. 31, 1962.

54. Birnbaum, Henry. General Information Manual. IBM Circulation Control at Brooklyn College Library (E20-0072). White Plains, N. Y., IBM Corp., Data Processing Division, 1960.

55. Stevenson, Chris G. "Control and Inventory of Classified Documents," Special Libraries, 51:499-500, November 1960.

56. Richardson, Wm. H. "Circulation Control," Special Libraries, 51:493-496, November 1960.

57. Booser, Ronald J. "Use of Data Processing Equipment for the Control and Circulation of Magazines," Special Libraries, 51:297-300, July-August 1960.

58. Waldron, Rodney K. "Will Circulation Librarians Become Obsolete?" Library Journal, 84:386-388, Feb. 1, 1959.

59. Duer, Margaret D. and Lewis, Clark S. "How We Use IBM," Library Journal, 78:1288-1289, August 1953.

60. Monkevich, Edward. "Public Library Mechanizes Book Loans," The Punched Card, 1:140-142, 1952-1953.

61. Klausner, Margaret H. "IBM Circulation Control," Library Journal, 77:2165-2168, Dec. 15, 1952.

62. Quigley, Margery C. "Ten Years of IBM," Library Journal, 78:1152-1157, July 1952.

63. Leyland, E. "Mechanized Book Issuing," Library Association Record, 52:112-115, April 1950.

64. Quigley, Margery. "Business Machines in a Public Library," American City, 60:101-102, 1945.

65. Pratt, E. Carl. "International Business Machines Use in Circulation Department, University of Florida Library," Library Journal, 67:302-303, April 1, 1942.

66. Quigley, Margery. "Library Facts from International Business Machine Cards," Library Journal, 66:1065-1067, Dec. 15, 1941.

67. Parker, Ralph H. "The Punched Card Method in Circulation Work," Library Journal, 61:903-905, Dec. 1, 1936.

5. Serials

In addition to the items in this section, there are items in other sections which are also pertinent to the serials handling process. For example, items 42, 43, and 46 report on acquisitions of serials; items 52, 53, and 57 are concerned with the routing of serials.

68. Vdovin, George, Voigt, Melvin J., Newman, David, and Perry, Clay. "Computer Processing of Serial Records," Library Resources and Technical Services, 7:71-80, Winter 1963.

69. "Computer Used in Operation of a University Library," Library Journal, 87:3015, Sept. 15, 1962.

70. University of California, San Diego. Report on Serials Computer Project: University Library and UCSD Computer Center. La Jolla, California, University of California, San Diego, July 1962.

71. McCann, Anne. "Applications of Machines to Library Techniques: Periodicals," American Documentation, 12:260-266, October 1961.

72. Anthony, L. J., and Hailstone, J. E. "Use of Punched Cards in Preparation of Lists of Periodicals," Aslib Proceedings, 12:348-360, October 1960.

73. Nicholson, Natalie, and Thurston, William. "Serials and Journals in the MIT Library," American Documentation, 9:304-307, October 1958.

6. Catalogs

Most of the items in this section report on individual experience in the generation of book catalogs. In addition, section 11 also includes survey information on book catalogs in items 142 and 143. Some of the items in section 7 also include automated book catalog production, for example items 98 and 106. Some systems in section 7 are also used for the production of 3" × 5" catalog cards, for example, 96, 101, and 106.

Note that items 76, 77, and 79 are concerned with the problem of mechanizing library filing procedures.

74. Wilkinson, W. A. "A Machine-Produced Book Catalog: Why, How, and What Next?" Special Libraries, 53:137-143, March 1963.

75. Richmond, Phyllis A. "A Short Title Catalog Made with IBM Tabulating Equipment," Library Resources and Technical Services, 7:81-90, Winter 1963.

76. Culbertson, Don S., Schultheiss, Louis A., Sieve, Arion and Boone, Donald. An Investigation into the Application of Data Processing to Library Filing Rules. Chicago, University of Chicago, Chicago Undergraduate Division, Dec. 5, 1962.

77. Gull, C. Dake. Automatic Authorship: The Impact of Electronics upon Cataloging Rules (Working Paper for International Conference on Cataloging Principles, Paris, October 9-18, 1961), Washington, General Electric Company, Information Systems Operation, October 1961.

78. Vertanes, Charles A. "Automation Raps at the Door of the Library Catalog," Special Libraries, 52:237-242, May-June 1961.

79. Gull, C. Dake. "How Will Electronic Information Systems Affect Cataloging Rules?" Library Resources and Technical Services, 5:135-139, Spring 1961.

80. Hewiston, Theodore. "The Book Catalog of the Los Angeles County Public Library: Its Function and Use," Library Resources and Technical Services, 4:228-232, Summer 1960.

81. MacQuarrie, Catherine, and Martin, Beryl L. "Book Catalog of the Los Angeles County Public Library: How it is Being Made," Library Resources and Technical Services, 4:208-227, Summer 1960.

82. Warheit, I. Albert. "Catalogs from Punch Cards," American Documentation, 10:254, July 1959.

83. MacQuarrie, Catherine. "IBM Book Catalog," Library Journal, 82:630-634, March 1, 1957.

84. Martin, Adella Fern. IBM Catalog for the King County Public Library (Unpublished Master's Thesis). Cleveland, Western Reserve University, Library School, 1953.

85. Alvord, Dorothy. "King County Public Library Does it with IBM," Pacific Northwest Library Association Quarterly, 16:123-132, April 1952.

86. Callander, T. E. "Machine Reproduction of Catalogue Entries," Library Association Record, 52:115-118, April 1950.

7. Other and Combined Processes

Most of the items in this section pertain to libraries which appear to be mechanizing two or more of the above processes. Further, they sometimes include other processes such as announcement, automatic dissemination, or information retrieval which are outside the scope of this bibliography. Also included are three items, 110, 111, and 113, reporting experience in mechanizing subject heading lists and indexes.

87. International Business Machines Corporation. Application Brief, Circulation Control and Related Applications at Decatur Public Library, Decatur, Illinois (K20-0106). White Plains, N. Y., IBM Corp., Data Processing Division, n.d.

88. Dean, Crowell. "Integrating a Library Machine System," Special Libraries Association Rio Grande Chapter Bulletin, 6:5-7, April 1963.

89. General Electric Company. The Medlars Story. Wasington, General Electric Co., Information Systems Operation, March 1963.

90. International Business Machines Corporation. IBM Advanced Systems Development and Research Library Procedure Manual. San Jose, Calif., IBM Corp., Advanced Systems Development Division, 1959 and subsequently including March 19, 1963.

91. Lockheed Georgia Company. Mechanization of Library Procedures (Project 163). Marietta, Ga., Lockheed Georgia Co., 1962.

92. Schultheiss, Louis, Culbertson, Don, and Heiliger, Edward M. Advanced Data Processing in the University Library. New York, The Scarecrow Press, Inc., 1962.

93. U. S. Atomic Energy Commission. "The Literature of Nuclear Science, Its Management and Use," In Proceedings of September 1-13, 1962, Conference (TID 7647). Oak Ridge, Tenn., U. S. Atomic Energy Commission, December 1962, pp. 164-206.

94. Howe, Mary T., and Weidner, Mary K. "Data Processing in the Decatur Public Library," Illinois Libraries, 44:593-597, November 1962.

95. Heiliger, Edward M. "Application of Advanced Data Processing Techniques to University Library Procedures," Special Libraries, 53:472-475, October 1962.

96. Carroll, Kenneth D., and Summit, Robert K. MATICO: Machine Applications to Technical Information Center Operations (Report 5-13-62-1). Sunnyvale, Calif., Lockheed Missiles and Space Company, September 1962.

97. "'Building Block' Approach Core of New Processing System for New Books, Technical Reports in Kingston Engineering Library," IBM Data System News, 1:4, Aug. 16, 1962.

98. Griffin, Hillis L. "The National Reactor Testing Station Technical Library," Pacific Northwest Library Association Quarterly, 26:199-204, July 1962.

99. Roach, John P., Jr. SATIRE: Computer Applications of Semiautomatic Technical Information Retrieval (SP-857). Paramus, N. J., System Development Corporation, July 26, 1962.

100. Parker, Ralph H. "Automatic Records System at the University of Missouri Library," College and Research Libraries, 23:231-232+, May 1962.

101. Koriagin, Gretchen W., and Bunnow, L. R. Mechanized Information Retrieval System for Douglas Aircraft Company, Inc.; Status Report (SM-39167) Santa Monica, Douglas Aircraft Company, Inc., January 1962.

102. Roach, John, Jr. SATIRE: The Technical Librarian's EAM Application of Semi-automatic Technical Information Retrieval (SP-595). Paramus, N. J., System Development Corporation, Dec. 28, 1961.

103. Howe, Mary T., and Weidner, Mary K. "Mechanization in Public Libraries; Data Processing Department in the Decatur Public Library," UNESCO Bulletin for Libraries, 15:317-321+, November 1961.

104. General Electric Company. A Final Report of Improving Information Flow in a University Library (Prepared under contract with the University of Illinois, Chicago Undergraduate Division). Washington, General Electric Company, Information Systems Operation, July 1961.

105. Turner, Lester D., and Kennedy, James H. System of Automatic Processing and Indexing of Reports (UCRL-6510). Livermore, Calif., University of California Radiation Laboratory, July 12, 1961.

106. Durkin, Robert E., and White, Herbert S. "Simultaneous Preparation of Library Catalogs for Manual and Machine Applications," Special Libraries, 52:231-237, May-June 1961.

107. National Library of Medicine. The National Library of Medicine Index Mechanization Project. Washington, National Library of Medicine, 1961. Also published in Bulletin of the Medical Library Association, 49:1-96, January 1961.

108. The Library of Congress. Mechanization of Services and Functions in the Library of Congress. Washington, The Library of Congress, 1960.

109. Ashley, Edwin M. "Clerical Automation," Library Journal, 82:1725-1729, July 1957.

110. Garfield, Eugene. "The Preparation of Printed Indexes by Automatic Punched-Card Techniques," American Documentation, 6:68-76, April 1955.

111. Garfield, Eugene. "Preparation of Subject Heading Lists by Automatic Punched-Card Techniques," Journal of Documentation, 10:1-10, March 1954.

112. Pike, J. R. "A Future for Mechanization," Library Association Record, 56:47-49, February 1954.

113. Garfield, Eugene. Preparation of Printed Indexes by Automatic Punched-Card Equipment—A Manual of Procedures. Baltimore, Johns Hopkins University, Medical Indexing Project, 1953.

114. Baatz, Wilmer H., and Stevens, M. E. "Machines at Work," Library Journal, 78:1277-1281, August 1953.

8. Document Replica Selection

Devices for finding replicas of documents (when each document is identified by a number which is known to the searcher) have been considered extensively in the literature. Only a few are included here. However, item 116 contains an extensive bibliography of 311 items which should be examined by those interested in this topic. There is no intent here to include all the work reported on microreproduction or the aspects of document selection associated with information retrieval devices or systems.

115. McMurray, James P. "The Bureau of Ships Rapid Selector System," American Documentation, 13:66-68, January 1962.

116. Bagg, Thomas C., and Stevens, Mary E. Information Selection Systems Retrieving Replica Copies: A State-of-the-Art Report (NBS Technical Note 157). Washington, Government Printing Office, Dec. 31, 1961.

117. Ball, Howard R. "The Rapid Selector—BuShips' Newest Information Retrieval Device," Navy Management Review, 5:10-11, April 1960.

118. Melcher, Daniel. "Primer in Machine Information Storage and Retrieval," Library Journal, 85:909-912, March 1, 1960.

119. Bowder, K., et. al. Technical Investigation of Elements of a Mechanized Library (EW-6680). Boston, AVCO Corporation, January 1960.

120. Williams, Gordon. "FLIP: Film Library Instantaneous Presentation," Library Resources and Technical Services, 2:278-281, Fall 1958.

9. Automatic Typewriter Uses

The previous items in this bibliography pertain generally to the use of punched cards in the mechanization of library processes. However, it is also possible to use punched paper tape equipment either as systems by themselves or in conjunction with other equipment such as computers. All items in this section except 123 are individual systems. In item 123 the general use of punched paper tape as a common media for information interchange is considered. Of course, some other libraries which use computers also use punched paper tape input. Examples are items 89, 96, 101 and 107 in section 7.

121. Bowron, A. W. "Automatic Typing in Book Processing Toronto Public Library," Canadian Library, 19:10-11, July 1962.

122. "Electronic Tape-activated Typewriter Used for Automatic Catalog Card Processing," Law Library Journal, 53:508, November 1960.

123. Mooers, Calvin N. "The Tape Typewriter Plan: A Method for Cooperation in Documentation," Aslib Proceedings, 12:277-291, August 1960.

124. Johnson, Noel W. "Automated Catalog Card Reproduction," Library Journal, 85:725-726, Feb. 15, 1960.

125. Luckett, George R. "Partial Library Automation with the Flexowriter Writing Machine," Library Resources and Technical Services, 1:207-210, Fall 1957.

126. Witty, Francis J. "Flexowriter and Catalog Card Reproduction: Perfect Solution for Short Runs?" District of Columbia Libraries, 28:2-4, July 1957.

127. Becker, Joseph. Short Run Methods of Catalog Card Duplication; A Preliminary Survey, (Unpublished master's dissertation). Washington, The Catholic University of America, Department of Library Science, 1955.

10. Interlibrary Communication

Another area for possible mechanization is that involved in the communication of information between libraries. This included facsimile, interchange of data on communication lines, or, as in item 129 simply the use of Telautograph. Although item 131 refers generally to intra-library communication, the same techniques are applicable to interlibrary communication.

128. Roach, John P., Jr. SATIRE: Remote Communications Subsystem: A Feasibility Study (SP 1130). Paramus, N. J., System Development Corporation, March 18, 1963.

129. Kennedy, R. A. "Long-Distance, Longhand Library Records," Sci-Tech News, 14:37-38+, Summer 1960.

130. King, Ellis F. "Electronic Transmission for Inter-library Loans," American Documentation, 11:32-39, January 1960.

131. International Business Machines Corporation. General Information Manual. IBM Tele-Processing in Circulation Control at Public Libraries (E20-8040 and E20-0077). White Plains, N. Y., IBM Corporation 1959 and 1960.

132. Bristol R. P. Card Turner Problems; Preliminary Investigation of the Feasibility of Long-distance Consultation of Card Catalogs. Charlottesville, Virginia, University of Virginia, Alderman Library, 1958.

133. Bacon, F. R. et. al. Final Report to Council on Library Resources. Application of a Telereference System to Divisional Library Card Catalogs. A Feasibility Analysis. Ann Arbor, University of Michigan, Engineering Research Institute, May 1958.

134. Adams, Scott. "Library Communications System," Library Trends, 5:206-215, October 1956.

135. Adams, Scott. "Facsimile for Federal Libraries," Special Libraries, 44:169-172, May-June 1953.

11. Bibliographies and Surveys

The two recent bibliographies, items 137 and 139, are large; the latter contains 1550 items. Although oriented primarily toward information retrieval, each contains items on mechanization of library processes. Item 149 has relatively little on library processes. Item 138 contains information on 87 operational information systems. The last section of it includes systems for producing bibliographies and indexes. Items 146, 147, and 151 provide thorough surveys of mechanized library processes. Although outdated, item 151 includes a good system for classifying these applications.

136. Kraft, Donald H. "Data Processing Equipment for Library Use in Clerical Tasks and Dissemination of Information," Illinois Libraries, 44:587-592, November 1962.

137. Balz, Charles F., and Stanwood, Richard. Literature on Information Retrieval and Machine Translation. Owego, N. Y., IBM Corporation, Federal Systems Division, November 1962.

138. National Science Foundation. Nonconventional Technical Information Systems in Current Use, No. 3. Washington, National Science Foundation, October 1962.

139. Spangler, Marshall. General Bibliography on Information Storage and Retrieval, Revised. Phoenix, General Electric Company, Oct. 1, 1962.

140. Heller, Elmer W., and Hobbs, Charles D. A Survey of Information Retrieval Equipment (SP-642). Santa Monica, System Development Corporation, Dec. 15, 1961.

141. Davis, H. D. Analysis of the Periodical Literature Dealing with Automation in Scientific and Technical Libraries (Unpublished master's thesis). Atlanta, Ga., Atlanta University, 1961.

142. Griffin, Marjorie. "Printed Book Catalogs," Revue de la Documentation, 28:8-17, February 1961.

143. Griffin, Marjorie. "Printed Book Catalogs," Special Libraries, 51:496-499, November 1960.

144. Davies, John. "Punched Cards in the Library and Information Fields," Aslib Proceedings, 12:101-108, March 1960.

145. Beckwith, Herbert Henry. Applications of Automatic Punched Card and Digital Machines in Libraries (Unpublished master's thesis). Chapel Hill, N. C., University of North Carolina, 1959.

146. Dewey, Harry. "Punched Card Catalogs-Theory and Technique," American Documentation, 10:36-50, January 1959.

147. Berry, Madeline M. "Application of Punched Cards to Library Routines," In Robert S. Casey, ed. et. al. Punched Cards: Their Application to Science and Industry, 2d Edition, New York, Reinhold Publishing Corporation, 1958, pp. 279-302.

148. Voigt, Melvin J. "Trend Toward Mechanization in Libraries," Library Trends, 5:193-204, October 1956.

149. Loftus, Helen E., and Kent, Allen. "Automation in the Library - An Annotated Bibliography," American Documentation, 7:110-126, April 1956.

150. Gull, C. Dake. "Instrumentation," Library Trends, 2:103-126, July 1953.

151. Parker, Ralph H. Library Applications of Punched Cards: A Description of Mechanical Systems. Chicago, American Library Association, 1952.

152. Coblans, Herbert. "Some Notes on American Practice in Documentation," Journal of Documentation, 6:206-212, December 1950.

153. Blasingame, Ralph U. Application of IBM's in Libraries (Unpublished master's thesis). New York, Columbia University, School of Library Service, 1949.

154. Stokes, Katherine. "Library Applications of Punched Card Systems," Special Libraries, 38:204-208, September 1947.

155. Gull, C. Dake. "A Summary of Applications of Punched Cards as They Affect Special Libraries," Special Libraries, 38:208-212, September 1947.

A. AUTHOR INDEX

B. Library Location Index