PRODUCTION NOTE

University of Illinois at Urbana-Champaign Library
LIBRARIES AND DATA PROCESSING--WHERE DO WE STAND?


Introduction

As he begins this article, written by a systems engineer, the librarian might well ask "What is a systems engineer? What does he do? What business has he to write for a library publication about a library? Why is he even interested?" I am interested because probably in no other "industry" has so much been written about mechanization and so little been done about it as in the library field. The literature on the subject dates at least to 1936 and almost every article ends with the sure hope that librarians will find "...simpler, faster, and smarter ways to run their libraries"\(^1\) by utilizing data processing equipment.

After years of avoiding each other, librarians and manufacturers of EDPM equipment have met face to face in information retrieval. Yet even in this more glamorous subfield of library work, the marriage is barely consummated, because of the "... need to develop systems of handling the mass of bibliographic material which rest upon discovering and establishing our objectives, our plans, our standards, our methods and controls, within the laws of each situation. This may take twenty years and it may take one hundred, but it will come."\(^2\) We can help discover these objectives, methods, standards, and controls if we view the library as a system; the library "... is not only books, librarians, and readers, but is also a set of working patterns and techniques by which books flow in, through, out, and back to the library in orderly fashion. In a very real sense, the library is processes."\(^3\) A system engineer's job is to help his client study problem areas and advise him on the best set of processes--or system--to use to reach the client's goals.
Let us use this very practical definition of a "system" and not be sidetracked in a detailed discussion of the term. Therefore, in order to better understand the library world and its problems that data processing might help solve, let us rather proceed and (1) look at the library as a system, (2) restate the goals a library is trying to reach, (3) summarize some of the attempts that have been made to try to reach these goals (4) try to find some of the underlying principles for future mechanization and (5) attempt to determine if we can reach these goals and what advantages there might be for libraries, readers, and librarians.

Goals and Functions of the Library

A library, whatever its type, is responsible to serve a public efficiently and economically. The librarian wants to achieve the "... most economical physical effort of search and transport (of material) to the most adequate interpretation of his client's needs." 4

The trained librarian is the key person who can help match the reader with the information he seeks. No matter how sophisticated the system employed, the librarian is still the controller in "... traffic in time, space and material, controlled by verbal switchgear." 5

The resourceful librarian is in critically short supply. In a recent survey, a group of library schools reported that the ratio of vacancies to graduates was as high as "... 100 to 1; the lowest vacancy-graduate ratio was still 7 to 1. ... , ratios of 35, 40, and 50 to 1 were relatively common." 6

Because of the shortage, a second principal goal of the library profession is the elimination of drudgery and routine work so that trained librarians may be used effectively. "Let us be realistic--much of the work in libraries is clerical and repetitive, and the library user and evaluator is often struck more with the image of the librarian performing these duties than professional work. At the same time, most librarians are confronted by manpower shortages within their organizations." 1

With the elimination of drudgery, the librarian could help change the library to a more forceful enterprise. One librarian sums up her hopes this way: "... for so long we have contented ourselves with handing out how-to-do-it books, and trivia, that this will be no easy job. It will include some serious study of the people who don't use the library now, the reasons why they don't and how we can make the library a place they will use to their own best advantage. The next step may
be to study the new teaching methods and machines, to see how we can make them available to the general public. Remember, we decided long ago that books were not the only means we could use to spread ideas—that films and records were useful, and teaching machines may be the next logical step.\(^7\)

In short, the goal of the library is complete, fast, inexpensive service to its patrons based on the "scientific management of the printed record."\(^8\)

Libraries, we are told, "... are used for at least four distinct purposes—for research, for education, for general reading and as museums of literature."\(^9\)

Each of the different types of library (research, college, public, and museum) serves a special part of the population and has varying degrees of the same problems. Each thinks of itself as unique and different. The Librarian of Congress has reported that "... the problem in a large research library—as distinct from a small special library having material homogeneous in subject matter and a predictable clientele—is complicated by the tremendous bulk of material on a universality of subjects which the research library must collect. It is complicated further by the constant influx of new material on new subjects, and by the compelling requirement to retrieve information from an unpredictable variety of contexts and for an infinite diversity of needs—from that of the college student to the nuclear physicist."\(^10\)

The college library "... for research and higher education is a remarkably complex institution that services highly diverse requests for information at the same time it handles a large volume of relatively routine demands."\(^11\)

On the other hand, "a public library is a more or less representative collection of books provided from rate or tax funds, local or national, for the free use of the general public without distinction."\(^12\)

Because a library (research, college, or public)* is created to fill a special need, we sometimes fail to remember that the institution is a library and that the words "research," "college," or "public" merely mean that there are varying degrees of emphasis on the different functions within the library. All libraries perform the same basic functions:

"(1) acquire a basic collection which will anticipate the demands of the user so that there is little delay when information is needed,

*The museum library, while not discussed in this paper, can be considered as a research library in which the books do not circulate and hence might well utilize data processing equipment.
(2) index the material in depth so that the analysis will pinpoint the contents to be identified by someone searching for the information,
(3) store the material physically, so that it can be immediately accessible,
(4) cross question the requester to determine his wants in terms used in the systems organization of the library,
(5) of course, keep a record of the whereabouts of the books.

The basic duties of the librarian, then, are deciding what material to secure, acquiring it, cataloging it, and making it available to its patrons.

The writer of this paper is not a librarian and will make (or perhaps has made) statements about the library that will offend by their brashness or naivete experienced librarians. He apologizes for any overstatements or oversimplifications. They must be attributed to an overzealous evangelism that the librarian hold up the mirror and see not a traditional library but an information handling system which it also is. Let us look therefore at the library as a set of processes and discuss what some libraries have already done to mechanize these sub-systems.

Current Data Processing Activities in Libraries

Many libraries throughout the country are already using IBM equipment for one or more of the following library activities: (1) ordering and acquisition of books,* (2) technical processes (identifying the book), (3) catalogs and indexes, or (4) circulation control. Therefore, let us look at each of these areas and see what has been accomplished. First, we will discuss the functions to be performed in each area; second, describe how one library is doing this job; and third, briefly list other libraries performing the job in a variant way on data processing equipment.

Book Ordering and Acquisition

To understand what functions must be performed in each area, let us construct slightly different flow charts which are general and inclusive, designed to show similarities among libraries, not their minor differences. For ordering and acquisitions, the chart of this subsystem (Exhibit I) shows a fairly standard order procedure; it differs from an industrial application only in that the material is books rather than machinery. With data processing equipment, much of the drudgery of the

*I use the term "book" in this paper to refer to all books, periodicals, pamphlets, etc. that the library acquires.
ORDERING

EXHIBIT I
operation can be eliminated. An authority of the library must first answer the basic, searching question "Should we have this item?" and from that point on, the procedure is basically clerical: checking to see if the library has the book or if it is on order, checking that there is enough money in the appropriate fund to purchase the item, and initiating the order process.

From a source document all the information about the book is recorded; these cards can write the order, serve as an "on-order" record, update records of money available to spend, check for overdue items, and, if desired, write the check to pay the bill. One special variation from standard order procedure is that the cards are often used to print an order to the Library of Congress for a set of catalog cards for the book.

An outstanding example of this procedure is being used by the Public Libraries of Lake County in Crown Point, Indiana. This county-wide network of libraries has a collection of about 70,000 books and serves a population of 132,000 people. Installed equipment is a key punch, a sorter, and an accounting machine. The library ordering committee checks items in the book review sections of trade journals which may be purchased. Next the classification information is added and a "main entry" card is punched.

These cards are then checked against "in stock" books and "on order" cards to be sure no second order is placed for the same book. They are then sorted by jobber and combined with jobbers' name and address cards to print the book order; when a book is received, it is checked to ascertain that it is the desired one and the card representing the item is removed from the "on order" file and authorization given to pay the bill. Finally, the card is filed in a tub file for inventory control as the books move from one branch to another.

Library authorities say the installation is economically justified because they formerly paid $25,000 yearly to a neighboring library to do this book processing for them.

Another book order procedure on an 858 Cardatype was installed in January, 1957, at the University of Missouri by Dr. Ralph Parker for "all ordering, paying, and accounting for library materials." The machine prints the purchase order, produces an accounts payable card, and updates all funds for the amount of money spent from each.

A similar 858 operation at the University of Florida for library purchase order writing, Library of Congress card ordering, and inter-department library expense accounting was installed about two years ago.

A special part of book ordering is record keeping for serials and periodicals. The details of this operation done
manually "...will make even the most tradition-bound humanist look for mechanical help." The library must be sure it receives every item in the series, but the manual work is staggering because "in most university libraries the largest item in the book budget is for serials and continuations; yet this is the account about which librarians know the least." This operation, usually described in library literature as "series acquisition," is, from a systems point of view, the same operation as the purchase of a book except that multiple cards (one for each issue to be received) are punched when the periodical is ordered and removed from the "on-order" file when the issue is received.

The file (whether manual or electronic) must be reviewed continually to see if items are delivered promptly. At the IBM San Jose Library, periodicals are checked in by writing on a mark sense card. After a reproducer reads these cards and punches information into the card that was previously marked on it, the card is also the source document to write a claim to the publisher that an item was not received.

In summary, then, book ordering and acquisition on data processing equipment is a comparatively routine application. Similar to many other commercial order writing procedures, the "pay-off" is in the later use and reuse of the same basic record.

Technical Processes (Identifying the Book)

After a book is received and before it can be put to use, it must: (1) be identified as the property of the library, (2) be indexed or classified for future retrieval, and (3) notice must be given that the book has been received. Exhibits II and III show a flow chart of these operations.

Of these three operations, two are routine. To identify the book as a library possession, the same card used in the ordering procedure can be used to print book cards to be inserted in the book, as is done at Crown Point. Rather than letter on the spine of the book, it is possible to print stickers with identifying information. This operation is done at the technical library of National Reactor Testing Service in Idaho Falls, Idaho.

Printing lists of new books is also a simple matter as is notification to a person who may have requested a book.

The indexing or classifying of the book for future retrieval is far from routine. The librarian must somehow attach words, numbers, or symbols that will be used to retrieve the book. Later we will discuss future possibilities in this area. For the moment, we are concerned only with the present. It is presumptuous to tell librarians that most libraries classify
ACQUISITION

EXHIBIT II
their holdings under the Dewey Decimal System or the Library of Congress system; but it is important to our later discussion to review briefly this card catalog procedure.

Many libraries purchase from the Library of Congress or the H. W. Wilson Company catalog cards (Exhibit IV) that already have book information and suggested classifications printed on them. The librarian almost invariably verifies each item on the card. He is usually especially critical of two items: the recommended classification numbers and recommended subject headings. For example, on the Exhibit IV sample card, it is suggested that the book be filed under 301.243 in the Dewey System or HD45.L5 in the Library of Congress system and a card placed in the library's card catalog under the heading "Automatic control" as well as one under the author and the co-author. The librarian may decide, for example, that 301.243 is too specific and file the book under a more general category, or he may decide on more headings (for example "Automation" or "Systems design"). Most libraries have a master list of headings to which they refer for selecting or verifying these headings. The librarian then types headings on these cards so that there is one headed with author name, one headed with book title, and one or more with subject headings. These are filed in the card catalog and used to retrieve the book.

Printed cards are not available for many books. Some libraries, like IBM's own in the Data Systems Division at Kingston, New York, print their own. In this operation, the book or pamphlet is marked by the cataloger for the keypuncher who produces a series of cards that are used to print catalog cards. "In addition to these six main subjects, descriptors representing a more complete and detailed subject analysis are keypunched at this time solely for storage, so that our retrieval terms will be as complete as possible when we are ready to move into computer-controlled information retrieval."17

Thus the library continues its current operations and prudently plans for the future at the same time. A similar approach is planned at the Yale Medical Library where the cataloger fills out a form by specifying information to appear on the catalog card and also adding descriptions that will be used at a later date.

As we have shown, there is much that can be mechanized in this operation in printing identification information and notification listings. But, under present operations, little can be done in the cataloging operation—the librarian's intellectual work of checking the information on the card against the book and adapting suggested cataloging procedure to fit his own system.
Lilley, Samuel.
224 p. illus. 22 cm.
Includes bibliography.

1. Automation.

HD45.L5 1957a
*801.243 388.45 57-2617 $
Library of Congress

EXHIBIT IV
Catalogs and Indexes

Once the book is on the shelf, the reader must be able to locate it by some index system. The most common method is the card catalog, which already has been described. In addition to providing card catalogs, however, many libraries use master book cards to publish printed catalogs in loose leaf or book form which are "... basically listings of library holdings, arranged in various sequences and providing a diversity of bibliographic data."18

The Los Angeles Public Library pioneered in this application in August 1952. With 10-18 branches in each of four regions, it uses the catalogs as an easy means of keeping readers updated as to current holdings. The library has reported that "... the form appeals to them (their patrons), for they are accustomed to consulting dictionaries, encyclopedias, and telephone books and find them easier to use than cards."19

"Even in the branches where there are card catalogs, the children prefer the book catalogs which are divided, list all children's books together, and provide subject headings adapted to a child's reading level."20

Catalogs are produced at Lake County Library and other institutions throughout the country. A similar type catalog of interest to librarians is a union catalog in which Lake County lists its combined holdings, especially in serials. The Universities of Idaho and Washington State and the National Reactor Testing Station in Idaho Falls are engaging in such a project.

In the technical processes, then, data processing equipment can be used to reduce the amount of writing and copying of information by using the same basic machine record over and over again. If desired, the library can even manufacture its own catalog cards, but data processing cannot, as yet, by itself, solve the all-important problem of classification of the book. (See the section, Future of Data Processing in Libraries.)

Circulation Control

After the book is placed on the shelf, it is available for use. A patron desiring information enters the library and either with or without the help of the librarian consults an index or catalog for a specific book, or he may merely browse, a pleasure not to be denied the prospective reader even in a technical library. The book is brought to a record keeping station when it is ascertained that the borrower is eligible to remove this book. A suitable record is made of the transaction and the borrower leaves the library, leaving behind a record to be added to the records already on hand. Thus begins the most repetitive, unproductive, and necessary job in the library. (See Exhibit V). In 1956, for example, the circulation of public libraries alone was
CIRCULATION CONTROL #1

Reader Wants to Check Out A Book

Desires Special Information? Y

Looks in Card Catalog

Satisfactory Leads? Y

Consults Librarian

Any Leads in Other Indicies? Y

Available Outside Library

Order Fm. Other Library

Borrower Rejected

N

Search for Item

Item Available? Y

Bring Item To Check Out Desk

Permissible for Borr. to Use this Library Y

Make Record that Borr. has this Item

N

Make Record Borrower Wishes This Item

EXHIBIT V
CIRCULATION CONTROL #2

EXHIBIT V
estimated at about 490,000,000. "Records of books on loan from a library are essentially simple, consisting of an identification of the book, the borrower, the date borrowed and the date due, and in large systems the unit from which borrowed."\(^{21}\)

When the borrower returns the book, this record must be cancelled. If the book is overdue, a fine is sometimes collected. Any necessary reprocessing is done to prepare the book for circulation again and it is reshelved, after checking to see if there is any other patron waiting for the book.

The record file, meanwhile, must be searched at appropriate intervals to determine if any books are overdue and appropriate action taken.

Almost all circulation control systems, both manual and mechanized, are of two basic types—book card and transaction card.

**Transaction Card.**—In a transaction card system, the borrower's identification and book identification are assigned a transaction number. When the book is returned, the transaction number is somehow marked off or cancelled. If the book is not returned, the transaction number is then used to look up the detailed information about the loan. The system of the Detroit Public Library is typical of this type of operation. The patron fills out a slip with book and borrower information, and the clerk writes the transaction number on this slip and inserts a punched transaction card in the book. When the book is returned, the transaction card is removed and placed with cards for books due on the same return date. On each date due, these cards are matched against a duplicate card file which contains a duplicate card for all the transactions for that day and the missing numbers are found. Assistants then look up the slips with the missing transaction numbers and send a photographed copy as an overdue notice. This application has been installed for seventeen years. The punched card equipment processes a circulation of 5,000,000 items yearly.

Many variations of this system are installed throughout the country. Some, like Brooklyn College, use a punch card as the call slip. The patron fills out the punch card call slip, and it is marked with a transaction number as before. A transaction card with the same number is inserted in the book and, after the transaction number and call number of the book are punched in the card, the same procedure is followed. When an overdue book is found, however, the borrower information is already written on the punched card and there is no need to look up any additional information. Since the classification number of the book is also punched in the cards, the whereabouts of a
book is known at any time because the cards are filed in classification number order.

Similar operations are installed in several other libraries. In Phoenix, Arizona, and in Long Beach, California, the book and borrower information is obtained by photographing the book card and the borrowers card along with the transaction card before it is inserted in the book.

Regardless of the variations, however, the basic principle is the same. Each time a book is checked out, a record is made of borrower and book borrowed. A number is assigned to this transaction and a transaction card created. A second card, with the same number, is created and inserted in the book so that when the volume is returned, this card "cancels" the first one when it is matched with it. The book is ready to be returned to the shelf for the next user; this is the most important virtue of the system--no card needs to be reinserted in the book.

**Book Card System.** --A book card system is built on the principle that each book has in it a card called a "book card" (either manual or punched) which, in effect, represents the book when it is out of the library. The borrower's identification is somehow added to this card which already contains the book information and thus the record is complete. When the book is returned, the card is put back in the book and the loan is discharged. If the borrower identification and date due are punched into the book card, the library then has a complete file of machine processable documents that can be kept in one single master file by book number rather than in many separate date-due sequences in a manual operation. Under a manual system, when a book is returned, it must be inspected for "date due" and then the book card removed from that section of the file and reinserted in the book. This process, called "slipping" the book, is a most odious one to librarians. When a punched card is used as a book card, it can be used only once, of course, and so must be reproduced somehow and a new card put in the book.

A very complete circulation control system based on this principle is in operation at IBM's Yorktown Heights Laboratory. A 1401 Computer, rather than unit record equipment, is used; the more powerful machine gives more powerful results. A borrower removes the book card and signs his name and man number. This number and a date due code are punched into the card. Rather than being merged into a card file, these cards are held and added to the outstanding file (kept on magnetic tape) every two weeks when, as a byproduct, new book cards are produced for all outstanding loans so they can be inserted when the books are returned. At the same time it is necessary to search for overdues. This is done by feeding into the machine at the same time the book cards that were manufactured two weeks ago and have not been
reinserted in books; that is, the books they represent are still out. If the machine finds a book past due and the card still in the file, it writes a record on a tape as overdue. Although this might conclude a simpler process, the machine also prepares two listings—one a listing of books by borrower of books outstanding and the second a list by author of all books outstanding. A master name and address tape is merged in also, and overdue book notices are printed.

One of the oldest and most interesting book card systems has been installed in the Montclair, New Jersey, Public Library since February 1942. In this system, the book card is a stub punch card; the borrower has a stub punch card as an identification card. When the book is checked out, both cards are inserted in a special desk machine, (cable connected to a reproducer), which punches a full size card with complete record of book and borrower information. When the book is returned, the book card is inserted in the machine to produce a full size card that indicates the book has been returned. It is matched against the "checked out" card to cancel the record. This procedure eliminates "slipping" of the book, provides positive borrower identification, uses a completely machinable document, and provides for complete statistical analysis. In circulation control, then, the librarian wants a quick, accurate record of the whereabouts of books not on the shelf, with a minimum number of operations, and a good control of overdue items.

To many librarians, the above system description will seem generalized and simplified. It is purposely so in order to attempt to point out the similarities among libraries rather than the differences. The examples are purposely chosen from a wide variety of types and sizes of libraries to show the likeness of processes in these seemingly disparate institutions. Librarians must think in terms of likenesses, not differences, if they are to gain the real rewards of data processing.

Problems

In general, the reluctance of librarians to use data processing equipment can probably be traced to a traditional fear of machines coupled with a lack of education and a scarcity of money.

This attitude is shown repetitively in the literature of the field. One librarian summed up the situation with these words: "Much of librarians' writing on this subject (data processing) is more descriptive than analytical and, often, more naive than sophisticated. There is a real need of "bridging" literature; that is, articles that relate the concepts and practices of professional management literature to library situations."

Many librarians, however, equate data processing with
information retrieval and fail to realize or even visualize other benefits they might receive from mechanization.

There has been little education offered to overcome this lack of faith in machines, even simple ones. A recent survey of 107 college and university libraries in Illinois showed that adding machines were used in only five per cent of the ordering departments and "over three-fourths of the libraries in the sample had no special equipment for charging out materials. . . ."23 Little has been done to give the librarian the opportunity that the businessman and the scientist have had to learn about data processing.

We have failed to make librarians realize that data processing machines are adaptable to almost any business, including libraries. For those who believe that data processing in a library "... represents the natural extension of conventional techniques and equipment to more unusual problems,"24 there are many who feel that they need a whole special line of equipment, "... special-purpose devices better suited to the work but less expensive than the general-purpose machines now employed."25 Their lack of knowledge makes them naturally suspicious and cautious.

However, existing machines have been utilized in information retrieval, but most of this work has been done in special libraries so that many librarians are left far behind and perplexed. "The first cause of misunderstanding lies in the fact that most of the actual work in information retrieval has been done in scientific fields, about which many of us (librarians) are profoundly ignorant, having received a highly humanistic education."26 Many librarians are, accordingly, complacent to sit and hope that the "master" plan for libraries is formulated and presented in one piece.

Meanwhile some librarians have pioneered, but the problem of misunderstanding is "... not mitigated by an attitude of aggressive sophistication on the part of a younger generation reared on computer tape to whom the new techniques are child's play and who would rather sweep their elders aside than try to instruct them, especially if the latter are resistant to instruction."27

Librarians do try, however, to keep up but because they "... do not have research and development departments (they), ... tend to borrow and adapt innovations from the outside, and the changes are digested piecemeal."28

The piecemeal approach, of course, produces piecemeal results. Librarians, then, tend to see their libraries as a group of activities: circulation control, finance, cataloging, registration, periodical renewal, etc., that have only one thing
in common—they concern a book. We have, however, already seen in a previous section how all the various library jobs can be performed, but is it possible today for a library to develop a complete, total system, the real "... set of working patterns and techniques by which books flow in, through, out, and back to the library in orderly fashion?" The answer is yes.

**Today's "Total System"**

There are libraries in America today that approach, within the limits of today's technology, a total system (ordering, acquisition, purchase, printed catalogs, registration, circulation control, and circulation statistics). IBM's ASDD and Research Library in San Jose could be taken as an example of this attempt. The National Reactor Testing Station Technical Library, of a different size and purpose, also hopes to achieve this goal.

However, time does not permit the recounting of various case histories; let us look at a single pioneering library, associated neither with an equipment manufacturer nor the government, that has proven how much can be accomplished in a "total system" approach and what is lacking to make the results even better.

The Decatur, Illinois Public Library, a medium-sized library of 165,000 volumes with an annual circulation of 540,000, has a small punch card installation (026, 077, 082, 402, and 514). Their operations are based on the creation of a unit card punched from the book review or brochure that prompts the library to order the book. This card is then used to write the book order, represent the "on order" item, pay the invoice, update the encumbrance account to which it is charged, print list of new books received, prepare shelf list and printed catalog, and make the book cards for circulation control.

In addition, the library uses the same equipment to keep an accurate budget, write its payroll, and make accurate registration records. Many important one-time jobs are also performed—salary surveys, a skills inventory of library employees, a counting of registered patrons by precinct to help locate the new branch—are but a few of these bonus jobs.

The library feels that the data processing department (a supervisor and key punch operator) is economically justified by its use in "... three areas where it was felt that the manual methods then in use were slow, expensive, and too general: circulation statistics, registration of patrons, and budgetary control. Previously circulation statistics required 264 hours each month to compile at a cost of $7,448.32 yearly. The registration was often over-estimated and in the final analysis told the library planner nothing about its patrons except name, address, and telephone number. The budgetary accounting took at least five
days to summarize and prepare for each board meeting, not to men-
tion the hours of ledger accounting maintained by hand. These
figures were not detailed enough to give accurate cost studies
whenever needed by the library administration especially at
budget time."30 A further saving was the elimination of "... 433 hours clerical time monthly by transferring book ordering,
payment and accounting functions to Data Processing."31

The Decatur Circulation Control system deserves special
mention because it indicates what can be done today with existing
equipment to approximate results desired with tomorrow's more
specialized equipment. In this "book card" system, each book has
a packet of eight cards (duplicates of the master book card).
When a book is checked out, a card is removed, stamped with
borrower's number, punched with date due, and filed in a master
file. When the book is returned, a second card is removed and
used to match against the first to clear the record. The book
can meanwhile be returned to the shelf. In effect, this ap-
proximates the Montclair system but does not require any special,
expensive equipment. Checking through the chart of library
functions, we can easily see that there are two major improve-
ments that ought to be made in this system: (1) the circulation
control process should be simplified, and (2) the "mechanical"
part of cataloging or indexing should be mechanized.

The "total system" is hampered in two areas, cataloging
and circulation control, by a lack of cooperation and a lack of
a machine. Both must be provided in the future.

Future of Data Processing in Libraries

The future of data processing in libraries should be con-
sidered in two parts, data processing within a library and data
processing among libraries.

Data Processing Within a Library

First, what can a library do for itself, now and in the
future, with data processing equipment? We have shown in earlier
sections that purchasing, registration, sheaf catalogs, encum-
brance accounting, etc. are all straightforward applications.
The problem areas are cataloging and circulation control. What
can be done?

Cataloging is really the art of placing "... a book
where you think it will be most useful; and always have a reason
for placing it there."32 The reason for putting a book in a
certain place is usually that books of that type have always been
placed there. "Readers like to have the books on the same sub-
ject together, as they much prefer examining the books to search-
ing a list or a catalog."33 In the simplest cataloging or index-
ing operation, the cataloger decides under what subject classifi-
cation (and corresponding index number) the book belongs. Index
cards purchased from the Library of Congress or the H. W. Wilson Company have complete information about the book and suggested classification numbers. The cataloger need only order a set of these cards, put on them the subject headings under which he wants them filed, and place them in the card catalog.

This sounds as though it should be a reasonably mechanical process: the cataloger assigns the words (subject headings) under which the document may be retrieved; "... cataloging in the sense in which it is practiced in all libraries is a form of information retrieval."34 What are the snags that make cataloging a major problem and indicate that the problems will be more serious under a more complicated information retrieval system?

In an individual library, the cataloger may assign any classifications or descriptors that seem appropriate. "Whatever rules or principles were applied in choosing or devising headings in the past, it is clear that they were often based on no more than the limited personal experience of the cataloger."35

Not only was material placed according to somewhat limited experience but the classifications were and are and probably will be subject to human whim and change. "Underlying all types of subject analysis—descriptors, uniterms, subject headings, telegraphic abstracting, etc.—is the fundamental problem of selection of significant concepts and characteristics from a document to be recorded as reference points for use in future retrieval operations... Pertinency is therefore in the eyes of the beholder and is relevant to the state of knowledge at any given time."36

Sometimes the cataloger does not even have the Library of Congress suggested classification number. Much material that does not have a high "... degree of formality of publication..."37 is particularly trying. "... acquisition of reports is often a hazardous, nerve wracking business. Many reports are not available through the normal commercial channels like books and journals. The various government agencies under whose contracts most of these reports are prepared have many different policies and procedures for making these reports available. And too often the bibliographic control is so haphazard and sketchy that it is extremely difficult to identify a document and its sources. In fact all too frequently the very existence of a report remains unknown because no bibliographic record exists. All in all, the small reports library is an expensive operation requiring much professional administration."38

For the immediate future then, libraries are trapped into being very "personal" enterprises. Each is indexed by its own standards, understandable to its staff and, to a far lesser degree, its patrons. "Not until the indexing device can read directly in the document or until the recorded information can go beyond the index heading, will new concepts be created which the indexer did not put there in the first place."39
The individual library must be content to be an almost self-contained entity with little communication with the outside world. Therefore, the user must use different retrieval systems for each library he visits.

The second major problem within the library, circulation control, is the most repetitious in library work. Herbert Goldhor, Director of the University of Illinois Library School, has said that because "... in the country as a whole, public libraries loan some 400,000,000 volumes annually. If we estimate conservatively and in round figures that it costs five cents to charge and discharge a book, the total cost of public library circulation is about $20,000,000 a year or roughly one-third of the total expenditures for current operations of all public libraries." No other library chore has inspired so much experimentation with so few real results. Most circulation control systems are still manual; the Council on Library Resources in its 1961 Study of Circulation Control Systems recommended to libraries that they continue with the manual systems even though "... 98 per cent of the operations are manual. The remaining 2 per cent is performed on a typewriter during the preparation of overdues. It would appear that there are many opportunities available to reduce the required staff time and to lower the operating costs through simplification and mechanization."

The task is also the most fruitless chore in the library because, aside from statistics, the only loans in which the librarian is interested are those in which the book is not returned on time; Goldhor estimates that of every 100 books borrowed, 95 will be returned on time.

He hopes that "... a fresh look at the problem in the light of modern technological resources will bring forth innovations to reduce the work and cost of recording book loans to the very low level that their actual use and value justify."

To summarize, Goldhor says the ideal circulation control system should:

1. be economical to install and to operate
2. be easy to understand
3. reduce errors to a minimum
4. save time for clerk and patron
5. require few operations
6. prevent falsifying of records
7. lend itself to all kinds of agencies
8. allow centralization of as many operations as possible
9. be inconspicuous
10. easily identify overdue items and borrowers who have them
11. allow renewals and reserves
12. count number of items circulated in various categories
13. record a use of each book.
In a total systems concept for a library, we should add one more criterion—that this subsystem fit well with the other parts of the system. It appears that the ideal circulation system then would be some easy inexpensive way of combining information about book and borrower into a machinable record and cancelling that record automatically when the book is returned.

Many libraries try to attain this goal in ingenious ways; Decatur punches multiple cards and stores them in the book itself for later use; in an English library, a key punch is situated at the door and the operator punches two cards as the patron leaves; one card is kept in the library as an "out" record and one placed in the book as a record to cancel the loan when the book is returned. The Christ Church City Council Library in New Zealand has a Powers-Samas punch that automatically produces two cards in a similar operation; the process involves reproducing the borrower's number from a punched stub card he carries as an identification card and gang punching the date due information and punching manually the book number.

But all of these valiant attempts only approximate the real goal. If patrons are registered on punch cards, they can be given a punch card as borrower's identification. The book card can easily be a stub card. All that is needed is a device to combine those two items into a full-size card. The ideal circulation control machine should be a small, compact, portable, almost noiseless device into which the book card and the borrower's card would be placed to produce a full-size card with the combined information.

This system has been envisioned by a group of librarians as an important part of the "Special Library of the Future." "The books are charged by means of a punched card system. When a book is borrowed, the borrower's card and the book card are placed side by side in a small control machine at the desk. At the press of a button, a charge card, which duplicates the borrower's pattern and the book's pattern, side by side, is mechanically produced on a machine in the workroom. The book card is replaced immediately in the book pocket."43

The processing of this record could be done on a wide variety of equipment ranging from a small punch card installation to all types of random access machines. Regardless of the size, however, there must be an easy, cheap accurate way of recording book and borrower information. Tomorrow, as some librarians suggest, we may be able to automatically record the book information by mechanically reading the spine of the book and combining this information with a borrower's request written in magnetic ink but, for the time being, we must content ourselves with a more attainable goal—the source recorder. Some libraries might prefer to use this recorder to reproduce the book card and permit the borrower to merely sign this new card so that if the book becomes overdue, his name and address are readily accessible.
Such a machine would provide the missing link and, except for indexing, give the library a complete system. Some of the important advantages would be the repeated use of the punch card record already used multiple times, satisfaction of the above criteria, and especially the production of a complete set of statistics. Much has already been written in library literature about the uses Montclair found for the "... amazing wealth of sociological, educational, and professional information, certainly more conclusive evidence than is usually gathered together in strenuous and costly 'surveys'." Most libraries, however, keep only the barest statistics today, enough for their self-defense but not enough for real self-analysis.

In summary then, for the foreseeable future, it appears that there is little likelihood of improving the indexing effort of the individual library but that with a source-recorder desk set, the library can have an otherwise complete total system.

But what of improved operations among libraries?

Data Processing Among Libraries

If libraries could save considerable time by mechanizing the circulation control operation, what could they do about the great duplication of effort in cataloging? In a recent study, it is pointed out that for a university library, it cost roughly $2.00 to select, $2.00 to order, and from $6.00 to $10.00 to catalog a book that cost $6.00. Similar figures were discovered recently at the University of Illinois. "Difficult as it is to believe, a new title costing $5.00 costs $18.51 at UIC by the time it gets to the shelf, and a gift book costs the UIC library over $13.00 to accept, check, and catalog."45

Verner Clapp, President of the Council on Library Resources, has noted that while cataloging expense is getting prohibitive "... if such input were available from central sources, the situation might change rapidly."46

Cataloging could be streamlined by the preparation of a machine processible record which would contain all of the information now contained on LC cards and be available as the book starts its path through the library.

Such a process would:
(1) give libraries a more correct record then the one from which they ordered.
(2) allow them to print their own catalog cards as well as use the record for all the other purposes discussed above.
(3) allow use of LC card number as a universal means for identifying the book.

Surely if libraries are ever to share their wealth of books with each other, there must be some way of quickly identifying a particular book. For all their current complex indexing schemes,
libraries do not have a simple way of identifying a volume without a lengthy description of author, title, date, volume, etc. The Library of Congress card offers the best solution; it consists of a year number and a consecutive number within that year. If it were modified to be sure there was a new number assigned for special editions, etc., it could well become a universal "part number" for the book.

(4) permit libraries to keep fewer "less used" items because, with this positive identification, books could easily be described by only a few digits.

Robert Kingery, Chief of Preparation Division in the New York Public Library, has written: "In many and perhaps most libraries, few books need to endure physically for more than a few years. Yet a varying number of copies of every book needs to be available if not for eternity, then certainly for a very long time in some libraries... It may take us a long time to face the reality that it doesn't pay for lots of libraries to acquire, store and conserve material against the chance that it might be needed one day. A few could do the job, the rest might call for electrostatic copies when needed, and only then."47

Before, however, we transmit facsimiles of books, we must be able to do simpler "... transmittal of information about the library's resources..."48 That need could very well be met by the installation of a tele-processing network linking the libraries of the world. It could begin by joining the smaller libraries with the larger ones to borrow less common books. "It is hard to explain in the day of television and jet flight why it should average eight days for a public library to locate and borrow a book from another library in the same state..."49

Teletype networks have long interested librarians; a seven-station network currently connects the public libraries of Lake County, Indiana. As early as 1950, Milwaukee and Racine, Wisconsin, communicated over a private wire. The University of California, the Midwest Inter-Library Center in Chicago, and a group of Michigan libraries have all expressed interest in this form of speedy communication.

It is not hard to envision how, in the future, such a tele-processing network would be used not only to transmit book requests, but also to send book orders, receive cataloging information, and even to receive advance notice of publication of books, including descriptors that tell about the book.

Even though the use of a tele-processing network and a common ID number would begin to bring integrated data processing to the library world, they still would not provide the basic remedy for all the duplication of effort in cataloging. To do this, either all the libraries must convert to one system of cataloging or there must be some central system of cataloging which libraries adapt to their own use.
"... the intellectual problem cannot be solved without a national or international processing agency. Into this would be funnelled all the recorded material currently produced. The rate of processing would have to match the channel capacity, and expand as the volume expands. It would not be sufficient merely to gather into one place a complete store of recorded knowledge. The bigger the pile the more intractable it might become. What would be needed is some new, immensely richer system of associating stored records."50

Such an agency would undoubtedly be a federal one of some type because it is "... unthinkable that any program of centralized cataloging would be considered which, if not conducted under the auspices of the Library of Congress, would at least be based upon that institution's present services."51 A report currently being prepared by the Library of Congress may have some interesting comments on its own feeling of obligation in this area.

The problems in establishing such a center are not small. First, how would the library get all the books? Although two copies of all books copyrighted in the United States must be sent to the Library of Congress, they are not required to catalog all of these. In 1943, Ralph Ellsworth suggested a remedy of "... having the libraries send information to the national library when orders were placed, and also send a microfilm negative of the title page and verso and a table of contents, or even the book itself, if L.C. lacked the book. Acceptance of the cataloging and willingness to pay a fair share of the cataloging costs by the contributing libraries were stated obligations. The assumption of the plan was that the elimination of duplicated cataloging among American libraries would provide sufficient funds for the cataloging of all books by the Library of Congress."52 A department of defense librarian has added an interesting proposal, the enactment and extension of which should help the L.C. with its cataloging by requiring that the originating library do the cataloging because the "activities originating reports should know best what is important in a report and consequently should be in a position to do the best job."53 This concept might be extended to have all material not from a trade publisher handled in a similar way. Probably the most interesting advance in pre-cataloging was the "Cataloging-in-Source" experiment conducted in 1958 by the Library of Congress and 157 government agencies and trade publishers.

The purpose was to determine if it was feasible to catalog a book before it was actually published. Publishers would send the book while still in proof, the Library of Congress would catalog the book and send the information to the publisher so that the actual L.C. card could be printed in the book itself. Implementation of the plan could mean that "every published book in the country would be cataloged by the Library of Congress early enough that in all advertisements and publisher's catalogs and in all
bibliographies and reviews it would be properly entered, and late enough that a perfect catalog card would be printed in the same location in every book. All catalog codes in the world would agree and all libraries agree to accept them in full. Catalog cards would be machine-copied from the book either to catalog cards or to offset masters, and everyone having any contact with that book forever would use this information as provided. The report on the experiment concludes that the "... high cost of the proposed program to both publishers and the Library of Congress, disruptions of publishing schedules, the high degree of unreliability of catalog entries based on texts not in their final form, and the low degree of utility which would result from the copying of these entries because of the variations in their format as printed, their unreliability, and the need for adapting them to the requirements of individual libraries" made the plan unworkable.

It would seem that several of these objections are internal matters at the Library of Congress, but surely an estimated cost to the Library of Congress of $750,000 and an increase in $30-$40 in cost of producing each book would be a small price to pay for bibliographical standardization and elimination of duplicate cataloging.

In order to make this basic record of the book more useful, however, it should be in a machine-processible form and include not only bibliographical material, but also an abstract and descriptors for later use in an IR system. It would supersede the record now keypunched as the original record in libraries. Libraries could then order books and receive them completely cataloged, with a complete machine processible record.

If a book processing operation, an abstracting service, a bibliographical record and data processing were combined, the library could order a book and receive it, ready to put on the shelf, with catalog cards and a machine-processible record of the book as well--on cards or tape--containing the traditional bibliographical information, and an abstract and descriptors ready for use in an information retrieval system now or at a later date. The abstract and descriptors might possibly come from another source if there were some way to tie them together--a universal part number like Library of Congress card number.

The key to this whole procedure is data processing; for the libraries to cooperate and to use central cataloging, it must be accurate, fast, and reproducible. Data processing provides the answer. Assuming that such a service did exist, would the end product be acceptable to librarians? "... it is obvious that no program of centralized processing can be fully utilized as long as librarians deem it necessary to review and revise the classification numbers assigned. ..."

A 1957 survey of nine large university libraries showed that "about two-thirds of all changes on LC cards are in descriptive or subject cataloging, averaging one change for every two
About 47 per cent of the cards were used with no changes but "the libraries using the service of the Library of Congress fall short to the extent that they have failed, in the years since the Library of Congress began printing and distributing its cards, to adapt their own cataloging and classification policies to enable them to make full use of any centralized cataloging service."

To utilize a centralized service, libraries would have to accept its classification of materials on most items. This would mean they would have some books under an old classification and similar books under a new classification. Already "cataloging and classification demand a large part of the library budget and there are few administrators who feel that they can further increase the cost for a period long enough to reclassify a library. Some rather large libraries have undertaken reclassification in spite of the cost involved. . . . A surprisingly large number of small libraries have been reclassified in recent years."

The librarian at the Yale Medical School, however, has pointed out how quickly a collection, even a technical one, turns over so that reclassification might not be as serious a problem as some librarians deem it. He states that because primarily recent books are used by the patron, "if tapes or cards were set aside for six years, 51 per cent of the used section of the catalogue would be in the machine" and that it would be "... quite feasible for carrying out the dual operation of making a card catalogue and a catalogue in the form of machinable information," for that period. Many librarians "... who formerly believed fervently in cataloging and classification tailored to their own particular institutions, have even come to agree that a ready-to-wear product may be preferable."

Even to reap these benefits, it is highly unlikely that many libraries will reclassify. If they do not, however, they might still gain the benefits in two ways. First, they could begin to use the new system and not move old books and insert a "see also" under the old headings. Secondly, they could provide the central processing center a list of rules specifying how they want their cards and records prepared. A library has a reference list of headings that it uses and a policy on pseudonyms, corporate authors, and other bibliographical guide lines. Most of these rules could be handled by the computer. If a heading is not used in a particular library, the processor would substitute the appropriate one; if the classification (420.19, for example) were too specific, it would create the more general one appropriate to the library (420, perhaps). With the best catalogers doing the job for all libraries and a computer to translate and modify cataloging, libraries would get the best cataloging available.

Librarians argue that it will never be possible for all libraries to use one classification scheme. To be sure, each of the
two major systems has its own advantages and disadvantages and like
the ALA rules for cataloging, is subject to modification, but that
is not the point. What librarians really mean to say is that at
least one system must exist but they merely wish to modify it for
their own local use. In the beginning, they had no choice but to
use their own resources to catalog books; then the Library of Con-
gress began to sell catalog cards and they began to use them in
ever-increasing numbers. The Library of Congress "... sold
42,386,314 catalog cards in 1962, compared with 35,678,496 the
previous year. The card sales were boosted by an experiment to
distribute sets of printed cards to wholesale bookdealers and pub-
lishers to accompany books purchased by libraries. This new mar-
et alone bought 4,880,000 cards."61 As information retrieval
becomes more important, the classification effort will decrease
but probably never disappear.

Book processing companies already exist that secure the
book, mark it, procure catalog cards, catalog the book (if desired),
and send the processed book and indexing records to the Library.
An accurate record of books published each week appears in
Publishers' Weekly and monthly in the Cumulative Book Index.
There are also, of course, throughout the country numerous ab-
stracting services.

The ideal service could, of course, be provided by one cen-
tral government agency; it is unlikely, however, that they would
ever provide the physical book but would provide only the principal
classifying operation as they do now. A commercial book supplier
might well perform the remainder of the operation.

Information retrieval may some day free that classifier
from this chore; however, no matter how comprehensive the informa-
tion retrieval system used, the book usually needs to be placed
on the shelf with other books on a similar subject. As informa-
tion retrieval increases in accuracy, it will matter much less
where the book is on the shelf for the specialist who can retrieve
specialized information, but it will still be helpful to askers
of less detailed questions and browsers to have the books classi-
fied under a conventional scheme.

Absolute acceptance of one of these classification systems
would mean that, at last, a "... mass production would be
carried through from manufacture to library consumer... "62

If it is done nationally, the librarian will get a better
product, save money, and have a uniformity much to be desired.
Librarians apparently look forward eagerly to the day of true
information retrieval but are they really planning for it? Surely
no one believes that each library will abstract and index its
entire collection individually. The library will of necessity
have to rely on a central indexing service; there are not enough
catalogers to catalog in depth at each location, and, secondly,
it would be prohibitive in cost.
If libraries find it difficult to agree on a single, fairly simple, and in the long run, imprecise category under which to file a book, how will they ever accept detailed, complex retrieval indexes that demand complete agreement for their use?

The probable future history of events will be that libraries will sort out the simpler reader's requests from the more difficult ones; they will answer the easier ones from standard references and submit the others to a specialized information center. Here too, specialized vocabularies are growing up; each will have a prescribed set of search words and will require translation from one discipline to the other. Ideally, of course, there probably would be one gigantic technical information center but this is too much to hope for. Truly technical libraries can never be satisfied with one-dimensional indexing but even they might accept a standard classification number just to give the book a home on the shelf for basic identification. Already we are being warned that libraries cannot communicate. "If an immediate choice of computer languages is not forthcoming, chaos is the inevitable result, with automated library routines in the same hopeless position as library cataloging was 80 years ago." One way to prevent this total chaos is to give each book a positive identification universally used as a basic catalog number so that regardless of the individual IR systems that are developed (or have already been developed), there will be basic order and communication among the libraries of the land. Standardization among libraries is an old cry; data processing can give the impetus that is necessary to make it a reality--the day when the machine-processible document "... will be produced as part of the composing process (of the book), and that machine editing, indexing and subject analysis will be upon us."64

Reaching Our Goals

The day of the machine-processed document will be upon us sooner than we think. Fifteen years ago there were no computers; today they can read their own output, recognize hand-written information, and perform complicated indexing jobs. Why should the librarian be concerned? Why not merely wait until there is a "master system" which the librarian installs and then has an automated library?

A master plan for an industry must grow from the ground up. Look, for example, at the mechanization revolutionizing the banking world today. It came about because bankers began to campaign for an automatic means of handling checks and the demand was met.

An individual library can begin now by using a small installation or even a service bureau to begin preparing the basic file it will need, the shelf list or master file of books. This must be done to begin any kind of mechanization. Next, the library can build a registration file and use it for many reports and statistical studies.
The librarian need not fear he is a guinea pig if he begins this activity because, in the foreseeable future, he will not be able to avoid the creation of this file. If he decides later that the format of the cards is not quite what he wants, it is easy to change them automatically and speedily by running them through a reproducer or a computer.

With this file, the librarian can print book catalogs, new book lists, "cull" lists, borrower interest lists, and many other useful reports. The book file is the heart of the matter. Once it has been constructed, he has made the big step toward mechanization.

After a shelf list or master book file is developed, it is then easy to combine the lists from various libraries into union catalogs. As a by-product of building this file, the library can mechanize its ordering procedure and also be prepared to expand to circulation control--all projects to help relieve librarians of clerical chores.

In the midst of the information explosion that is fostering information retrieval and advanced techniques, the librarian still has not solved a far simpler problem--the "... scientific management of the printed record,"65 the operation of their business, utilizing the simpler forms of data processing.

Librarians do, indeed, run big businesses. There were, according to the American Library and Book Trade Annual, 13,676 libraries with a total income of $463,749,000 in 1959:

<table>
<thead>
<tr>
<th>Type</th>
<th>Number</th>
<th>Income-1959</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public</td>
<td>7,204</td>
<td>$ 298,263,000</td>
</tr>
<tr>
<td>College/University</td>
<td>1,450</td>
<td>112,555,000</td>
</tr>
<tr>
<td>Special</td>
<td>2,384</td>
<td>52,931,000</td>
</tr>
<tr>
<td>Other</td>
<td>2,638</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>13,676</strong></td>
<td><strong>$ 463,749,000</strong></td>
</tr>
</tbody>
</table>

The same publication reports these average expenditures for public libraries:

<table>
<thead>
<tr>
<th>Function</th>
<th>Percent of Budget</th>
</tr>
</thead>
<tbody>
<tr>
<td>Library staff</td>
<td>61.0%</td>
</tr>
<tr>
<td>Building staff</td>
<td>6.7</td>
</tr>
<tr>
<td>Books</td>
<td>15.3</td>
</tr>
<tr>
<td>Audiovisual</td>
<td>1.4</td>
</tr>
<tr>
<td>Binding &amp; mending</td>
<td>2.1</td>
</tr>
<tr>
<td>Other</td>
<td>14.5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>100.0%</td>
</tr>
</tbody>
</table>
Over 60 per cent of its budget is spent for personnel to prepare and circulate publications; by using data processing equipment, the library can materially reduce the non-professional activities that many professional librarians now perform. Librarians should be used to help readers, not perform clerical chores.

Data processing will lighten their load and broaden their horizons. "If (management techniques are) applied to the entire book-processing operations, systems and procedures should result that would permit librarians to devote more time to the purely professional requirements of their jobs. To accomplish this objective will require the best professional talent available. Such talent should not be wasted on mechanical and procedural operations."6

The writer, as I have said earlier, is not a librarian. As a Systems Engineer, he has attempted to look at a library as a system or an informative management procedure in which, as librarians themselves say, "If full advantage is to be taken of opportunities for improved information flow in a library, there must be a corresponding improvement in the methods of handling routine technical operations. These operations include the selection, acquisitions and financial processes, and circulation and overdue routines."67 The time to begin is now.
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