Computers in Medical and University Libraries; A Review of the Situation in U.S. in 1964

米国の医学·大学図書館における電子計算機の利用状況（1964年現在）

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要　旨

図書館の利用者と，その欲する情報とをできる限り容易かつ経済的に結びつけるために，現在米国の医学や大学の図書館が，そのいろいろな仕事の面で試みている電子計算機の応用について概説し，最後に現在計算機の使用による文献調整活動中，最大の規模をもつ米国国立医学図書館の MEDLARS について述べている。

計算機はもとをたどればソロバンに迄遡るが，近代的な計算機としては，1944年頃ハーバード大学で開発された IBM 社の Automatic Sequence Controlled Calculator が最初である。本質的には数字で表わされたデータを計算する機械であるため，数学的に処理しうる仕事に対しては利用し易い。この種の計算機は図書館でも会計事務，給与計算，貸出の記録のようなものに使用し始め，未だにこの方面での利用が最大である。しかし最近では，より興味深い分野である非計数情報の蓄積と探索にも利用されるようになってきた。

図書館各部門での利用を見ると，発注・受入では会計的な面で既に以前から計算機を導入している大学事務局との接触が多いため，発注書その他を直接カードにパンチする例が増えて来ている。この場合，ワシントン大学の医学部図書館の場合のように，後で目録係や貸出係でも役に立つような情報をも含めてパンチすることが一般に行なわれている。これらの情報が訂正されたり，他のデータが加えられたりする目録では，さらに正確な情報が要求され，通常件名，分類記号などが追加される。またカード目録と冊子目録の両者の利点を活用しようとし，ハーバード，エール，コロンビア３校協同計画の場合は前者から，ワシントン大学の医学図書館の場合は後者から，共に両者を一つのプログラムで作り出そうと，その開発を進めている。また今迄高価につきすぎて不可能に近かった総合目録作成も，メンバー図書館の蔵書の記録を一つの計算機にのせることによって，協同でできるようになってきた。MEDLARS のテープが一般の図書館でも入手できるようになれば，このような総合目録の必要は益々強く感じられるようになろ

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う。ワシントン大学の医学図書館では，その所蔵資料中，米国国立医学図書館の所蔵していないものをMEDLARS と同じようにテープにして，両者を一度に探せるようにすることを計画している。逐次刊行物の記録を計算機にのせることは，この種の資料にその予算，館員の時間などの75%を費している科学図書館が，その開発に特別の関心を持っている。

カリフォルニア大学のラホラ地区の図書館やワシントン大学の医学部図書館などでその方法が開発されている。またこの開発されたプログラムはロスアンジェルスのカリフォルニア大学生物学・医学図書館，バンダービルト大学の医学図書館その他の図書館で利用されている。またニューヨークの医学図書館センターでは，同地区の主な医学図書館 80 館が所蔵する全ての逐次刊行物の総合目録を計算機にのせて作っている。その他にも，こういったユニオン・リストが幾つも作り出されている。貸出では，もともとその方法に種類が多いため，計算機を利用しての方法も数多い。最近大きな大学図書館で盛んに取り入れられる傾向がある。医学図書館での貸出は数も少く，大学図書館のように，日々これを利用するのは稀である。

ワシントン大学の医学図書館では，パンチした情報を1ケ月毎に計算機にかけて，夫々の帯出者の借りている資料中期限の切れているものを打出させ，学期末には全ての貸出記録を打出させるようにしている。

以上述べた計算機の利用例は図書館運営上必要な記録を取扱っているものに過ぎないが，これらが充分に行なわれてこそ，資料に含まれている情報を利用者が探す助けをするような意義の深い仕事にも計算機が使用されうるようになるであろう。例えば，科学者の要求する情報を，その要求範囲をさだめるキー・ワードと，資料の内容を表わすキー・ワードとの合致の有無により選び出して提供する「情報の選択的伝播」を行なう。索引作業の面での利用は，最も一般的なものは *BASIC* や *Chemical Titles* などで使われている KWIC 方式の索引である。変ったものとしては *Science Citation Index* のように，もとになった論文からそれを引用した論文をたどっていける索引がある。理論上は非常に有効な筈であるが，出版され出してから日が浅いので，実際の効果はまだ判らない。米国国立医学図書館の MEDLARS は世界の医学文献の索引である *Index Medicus* を印刷し，特定の主題の文献を周期的にリストする recurring bibliographies を出し，個々の人から要求される情報を探索する demand searches をも行なう現在世界で最も大きく最も完成された電子計算機を利用した索引で，GRACE と呼ばれる特殊の高速印刷機を利用し，種々の活字を使用している。また MEDLARS はそのテープを広く他の図書館でも利用できるように配布することによって，統制面での集中，利用面での分散といった利点を上手に一体としたシステムである。

情報を求める者と，その求める情報とをできるだけ無駄なく経済的に結びつけるという図書館の目的は皆同じであっても，その図書館の属する環境によって取られる方法は異ってくる。従って，アメリカの図書館で用いられている方法が，そのまま他の国の図書館にも当てはまるとは思われない。世界は日本の図書館員や生物学者達が，これらの問題をどのように解いてゆくかに注目している。 (Y. T.)

Introduction

Computers are electronic devices which have been developed, mostly within the past 20 years, to perform essentialy mathematical calculations very much faster (in the billionths of a second) than humans can perform them, with more accuracy than any human can hope to attain, and continually, without the fatigue or other physiological needs for stopping the work, which humans have.

It must not be thought, however, that the idea of computers is a new one. The earliest ones were probably the abacus, still in use in

Japan; while the earliest successful Western computer was probably that developed by the great German mathematician and librarian, Leibnitz, in the 17th century. The early computers were dependent upon mechanical devices —gear shafts, revolving parts, and hand-operated means of moving levers and other elements. Because these parts could not be fashioned with small enough tolerances to make the machines accurate, the results of the earlier machines were not always dependable. They were not completely useless, however. Robert Fletcher, the Assistant Librarian at the Library of the Surgeon-General's Office in Washington (now the National Library of Medicine) in the last quarter of the 19th century actually used a computer (which he called "an improved calculating engine") to work out tables on statistics of the soldiers in the American Civil War (1861–1865). And John Shaw Billings, the great Director of the same institution, suggested to his friend, Hollerith, an official of the U.S. Census Bureau, that he punch cards with holes in certain places to indicate certain amounts and types of data, and then "read" these cards by passing an electrical impulse through the holes. In the cases where holes existed in the cards, the impulse was able to pass right through, and this could be used to sort all the cards with holes in a certain place into a certain pile, which could then be counted. Where there were no holes in the card in that place—or no holes in the card at all—the cards were sorted out into still another stack. By the use of this method the 1880 census of the U.S. was tabulated and published in less than three years, when previously it had taken more than twice that length of time. Although not a computer device, such punched cards were the forerunners of modern data processing methods. One of their main differences was their inability to (1) store data and (2) to manipulate it in groups. These things modern computers are designed to do.

Essential for the development of any device is the need to have it and the means (both theoretical and technological) to bring it about. We have seen that the theoretical bases for at least simple computers had existed for many centuries before they came into active use; the need to calculate astronomical data and facts from other parts of the universe with large numbers of units of data had also been present for a long time. The missing ingredient was the technological knowledge which could translate the theory into practice. During the Second World War the overwhelming need for enormous amounts of mathematical calculations, the shortage of manpower, and the availability of money from the government to hire or draft scientists to develope the necessary technology resulted in the first large-scale attempt to build electronic devices to accomplish the tasks. The first such machine was worked out at Harvard about 1944; it was called the Automatic Sequence Controlled Calculator, and was a mixture of mechanical and electronic parts, and was constructed by the International Business Machines (IBM) from components they were already producing for other purposes.

Although this machine seems primitive today, compared to the ones which are now in common use, it ought to be noted that only twenty years have intervened since its development. It is appropriate, therefore, to consider the great strides which have been made in so short a period of time and to note what changes they have brought into the lives of all Americans, and especially of librarians.

As was noted earlier, computers are essentially mathematical calculators. Their primary purpose is the storage and manipulation of numeric data, and any other use is a by-product, and in a sense a translation of this non-numeric data into numeric information, its manipulation on mathematical principles, and the re-translation into non-numeric form. As can be expected in such a situation, the closer the work performed is to arithmetic operations, the easier it is to handle it in computers; the further away from mathematics, the more complicated becomes the task of handling it.

It follows from what has just been said that the earliest uses of computers, outside of pure mathematical calculations, had to do with such quasi-mathematical jobs as are found in busi-

ness operations; for example, keeping an inventory of stock in a warehouse, billing customers for purchases, recording bank transactions, and the like. Indeed, it was the sale and use of computers for such purposes that allowed the computer manufacturers to amass enough capital to produce continually better machines, and to do recearch on computers as machines capable of doing certain non-mathematical jobs with comparative ease.[1) 2) 3)]

In the library scene, the same sequence of events occurred as in the business world. Computers were first used in mathematical and quasi-mathematical jobs, such as fiscal accounts for books purchased, payrolls, circulation records, and the like. This is still the area of greatest use of computers in library operations today, and the most successful because it comes closer to the purposes for which the machines were designed than other operations. In the past few years, however, a concerted effort has been begun on the solution of the problems of greater interest to libraries: the storage and retrieval of non-numeric information in computers. This application is still new and its results as yet spotty and uncertain.

Library Applications of Computer Technology

In the following parts of this paper, it is proposed to take up the various kinds of medical and university library activities in order and to describe methods which have been worked out to use computers as aids in these activities (See Figure 1). Finally, the work of the National Library of Medicine in its MEDLARS program will be discussed in some detail, both because it is the largest and most important computer-based bibliographical control system and because its results are available to medical libraries all over the world through the publication of the *Index Medicus* and its ability to perform demand searches for individuals anywhere. It is particularly appropriate to discuss it in this paper, also, because there is a strong likelihood that some of the work necessary to store and retrieve Japanese medical literature for MEDLARS will be undertaken at Keio University in the near future. For general and more detailed accounts of computers in library scene, the items referred to at the end of the paper will be found helpful.

Acquisitions Work

In medical libraries the work of the acquisitions librarians and clerks consists in (a) choosing the books, journals, pamphlets, etc., which are to be added to the collection, (b) preparing the necessary records; that is, those which have to do with the receipt, cost, payment, and other fiscal questions relating to the items acquired, and (c) seeing that whatever information necessary for cataloging and classifying the work which has been located in the above process is passed on to the catalogers for use in their segment of the job of bringing the book and the reader together. The portion of this, listed above in (b), is the one which has traditionally and for the longest period of time been machine handled. Partly, this has been because many medical libraries are divisions of larger organizations which possess "business machines"—such as universities or hospitals. The accounting departments of these institutions have been using punched card data processing equipment for at least 30 years.[4)] (Examples are Columbia University and Presbyterian Hospital, New York City, and the University of Missouri) This is understandable, since the fiscal accounts for a library are not very different from the fiscal accounts of other departments.

For the most part, however, these fiscal accounts were kept in the institution's business office and the librarian in the medical school or hospital library had very little actual contact with either the details of how they were accomplished or the evidences of their existence. The librarian prepared an order form manually, often using a multi-copy form, with one copy going to the bookstore from which the book was ordered and another to the business office to encumber the funds to pay for the book. In the business office a punched card with the accounting information was made; when the book was received in the medical library and approved by the librarian, the business office was notified, and it issued the check to pay for

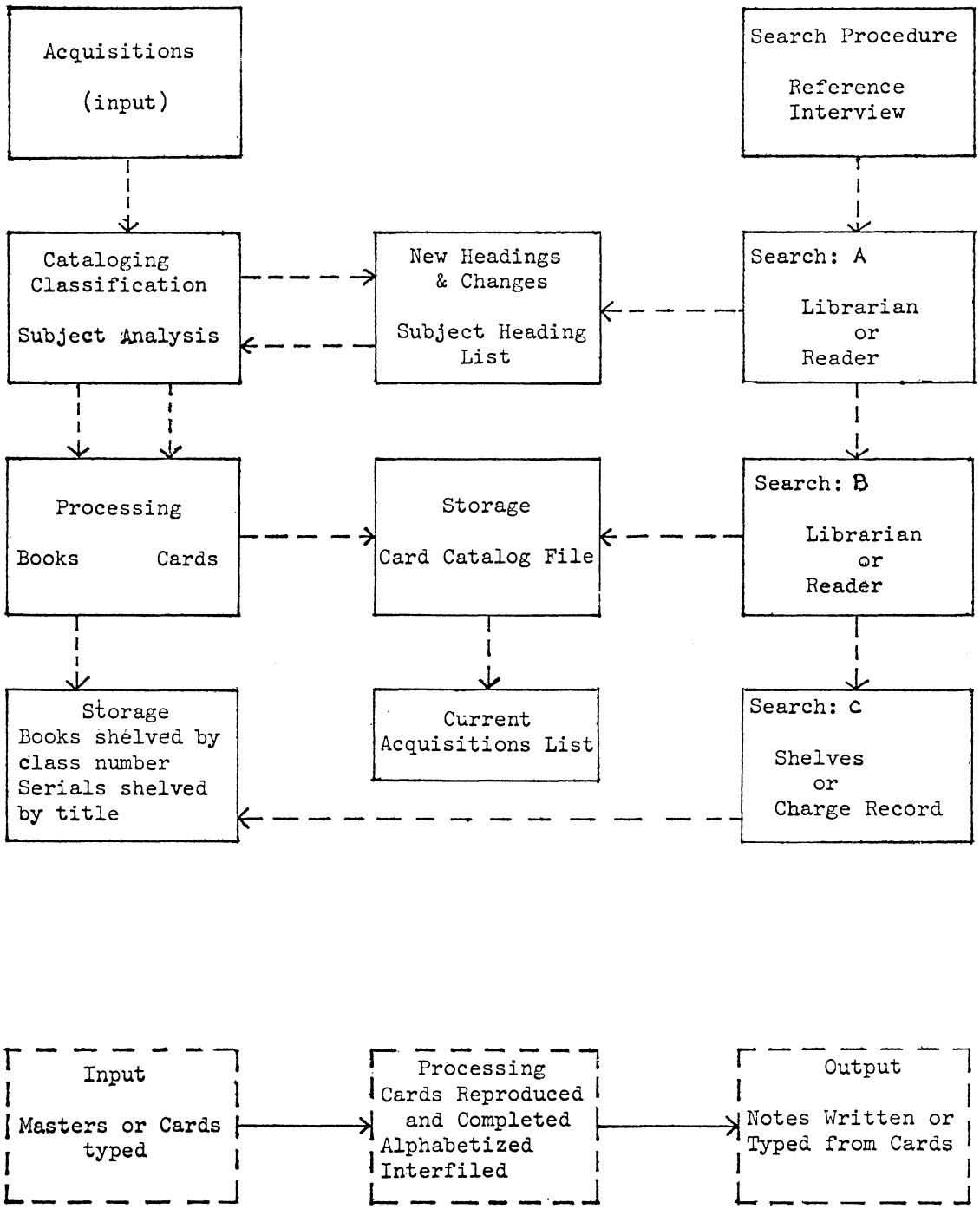

Figure 1. Standard Library Procedures

the book, using the punched card to write the check and make the necessary changes in the library budget accounts. A monthly budget statement was then sent to the medical library by the business office. The medical librarians were completely outside this picture for many years; some librarians had been in situations like this for ten or more years without ever seeing the machines or learning how they worked.

In the past few years, however, a new spirit has been growing up in library administration. Instead of considering each job done in the library as a separate little world of its own, attempts have been made to view the work of the entire library as a single system. The relations and interrelations of the various parts have been studied, sometimes by the librarians themselves, and sometimes by outside analysts hired by the library or by the parent organization in the hope of saving money and getting more service at a smaller costs. In such studies it was usually found that duplication of effort was widespread among the parts of the library —the same information would be sought by several different departments, without one realizing the other was doing the same thing, and that records for the same items were being made and handled by a number of people. As a result, more attention is being paid to systems analysis in American medical libraries, and the acquisitions librarian and the business office, and the acquisitions, cataloging, and circulation librarians are more and more being welded into one continuous group.

In library after library today, the acquisitions librarian has been brought into the picture of the electronic accounting for books and journals obtained for the collection. Where such systems are used, it is common for the acquisitions librarian who has selected a book or journal for purchase to prepare a work sheet with the necessary bibliographic and fiscal information on it, and then give it to a key-punch operator who makes a punched card or set of cards with that information on it. These punched cards are essentially the same suggested by Billings to Hollerith and used for the 1880 census, as already described. The key punch machine operates very much as a typewriter, with the clerk sitting at a keyboard and hitting keys which have letters and numbers and certain symbols (like dollar signs) on them. The main difference, so far as the clerk is concerned, is that the result of her labors is a card with holes at various spots to indicate certain letters or numbers or symbols; though the latest key-punches also simultaneously print out the characters in readable form on the top of the card. (See Appendix A)

In the system being developed at the Washington University School of Medicine Library,[5] these key-punched cards are then used to provide a whole spectrum of other records, without the necessity of re-typing or re-punching or re-recording the information. This is a typical use of machines in the Western world, where people are very expensive and in short supply and machines comparatively cheap and easy to get. It follows that many of the attempts to mechanize library procedures in the West revolve around substituting machines for people; this would not be a worthy objective in a country where people were cheaper than machines, of course. The single input, added to, changed, and rearranged, which results in a number of different outputs without the intervention of people, is, therefore, the ideal of machine methods in American libraries.

Not only does the acquisitions librarian come into the data processing picture when the book is first ordered, but she sends to the accounting department further punched cards with further information about the book at various time. When the book is received, she sends a punched card to inform the business office of this fact; when the bill comes, she informs the fiscal accounts department of the exact cost of the book so it can pay for it; and at the end of the month or year the machine store is processed to provide information on the amounts she has spent that month or year, the names and addresses of the dealers to whom the money has been paid, and a list of all the books she has ordered which have either not been received or (if received) no bill has come for them so that they have not been paid for. All

of this is easily possible, because the information has been transferred from the punched cards sent in by the acquisitions librarian to a magnetic tape file to be processed by a computer. By the use of a series of commands to the computer (called a program), the computer is made to print out the information requested at very high speeds, much faster than any human being could extract the records by hand, to say nothing of performing the mathematical calculations or the printing. As mentioned above, also, the computer can re-arrange the information it has in its store, or print only certain parts of it, or do mathematical calculations on the information and give the results—all from a single record and a series of programs.

The work we have just described can be made into a diagram like Figure 2.

A number of libraries are using systems very much like this, such as the Pennsylvania State University,[6] the IBM Library, and the University of Missouri, as well as Washington University School of Medicine, mentioned above. Although each one has developed certain differences and certain similarities in its system, the fundamental ideal of multiple outputs from single inputs, based on the conservation of human energy, is the same for all the systems.

The work of a library, of course, consists of a series of jobs, and this means that to be economical, the information and records developed in one job must be used in as many different jobs as is possible. The alternative is to do over again the same work each time the information or record is needed. It follows from this that the information obtained by the acquisitions librarian is very often passed on to the other members of the staff for their use in their jobs; most frequently in providing New Acquisitions Lists, cataloging information, and lists of works by subject or author or other characteristic needed by a reader in his individual work. Again, each person working with the record may add to it or change it without redoing the whole work. This can be diagrammed as in Figure 3.

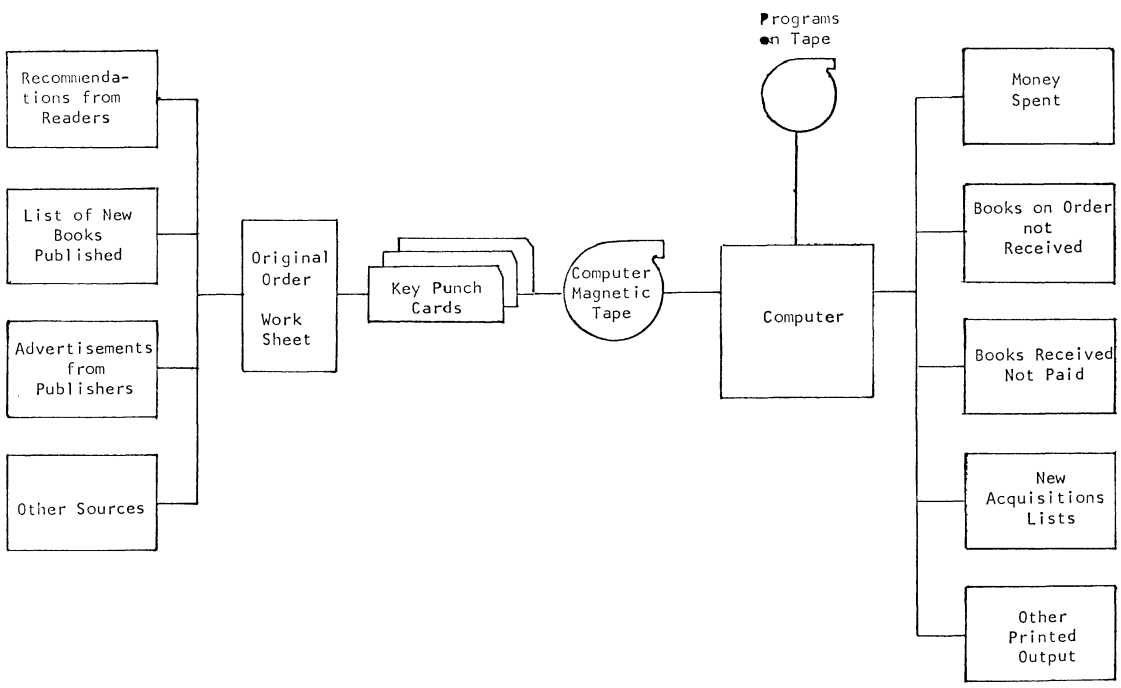

Figure 2. Acquisitions Work

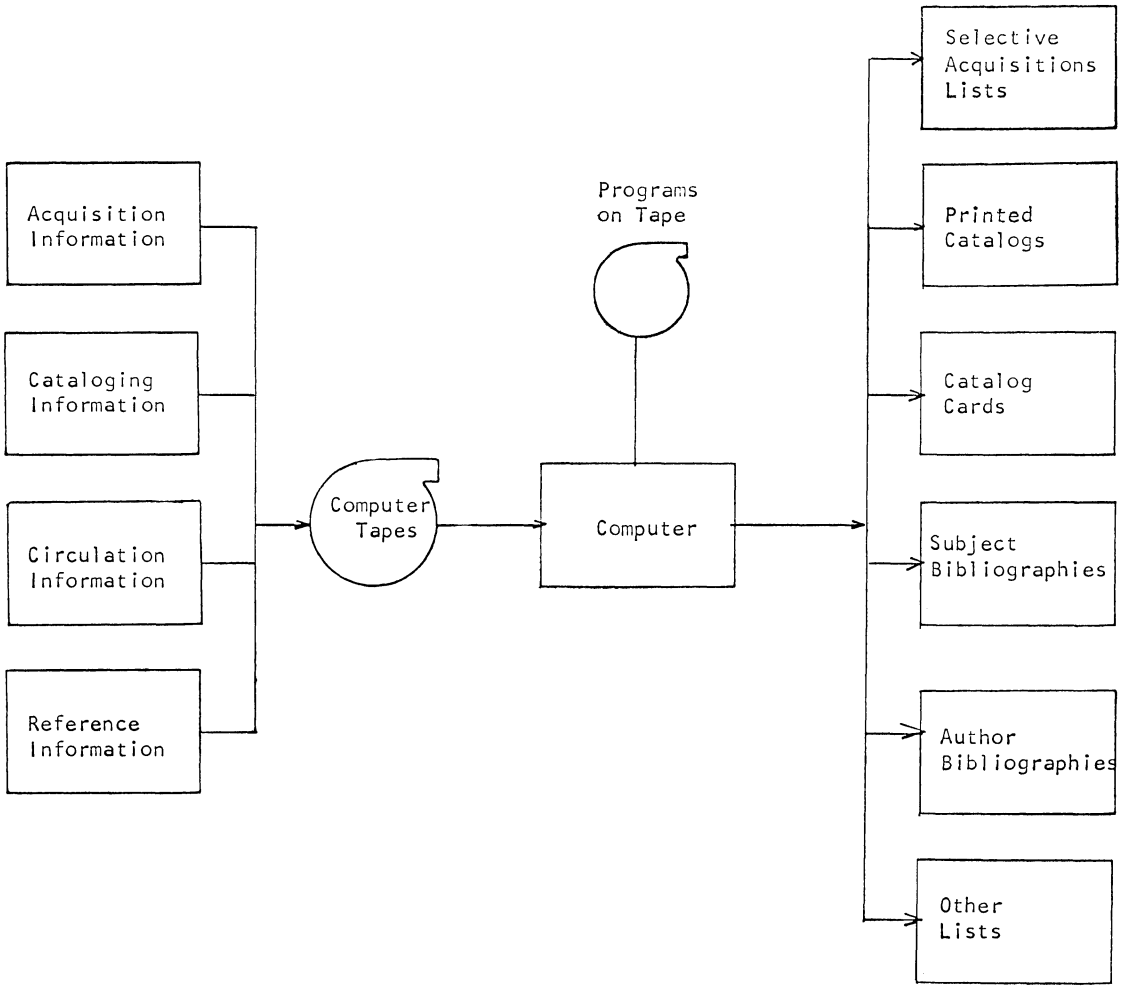

Figure 3. Multiple Output

Cataloging

Cataloging follows logically from acquisitions work. To acquire material in a library and then just stack it in bins or shelve it on shelves without regard to some logical order and without giving the reader a method of finding the particular book he wants (or all the books on a particular subject or by a particular author) is a waste of money and frustrating to the readers. All libraries from time immemorial have, therefore, made some attempt to list and arrange their holdings in some logical order. This was true of the clay tablets in the libraries of Ninevah, the papyrus rolls in the ancient Egyptian libraries, the leather scrolls in the Dead Sea caves, the Japanese and Chinese pagoda libraries (I am told), where the sutras were arranged in order, followed by the commentaries on them, and in the medieval monastery libraries of Europe, as well as in the modern library today.

The modern system of cataloging consists of two parts: (a) a description of the book, giving the author's name, the title of the work, and certain publishing data, as well as data about the book as a physical object (size, whether illustrated or not, e.g.), and the subject or sub-

jects which are contained in the book, and (b) a finding device for shelving the book, most commonly consisting of a notation of the main subject of the book (its classification) plus an indication of the author of the book. We thus have, in traditional cataloging, an author entry, several subject entries, and a classification device for shelving.

In computer-based cataloging, the cataloger begins to compile this information by using the information which had been located during the acquisitions process. This is usually the author, the title, the publisher, and the date. This information may be amended, changed, or added to by the cataloger, who, unlike the acquisitions librarian, has the book in hand when making the record, and so may be able to determine facts from it not found in the publisher's advertisement or the list of new books used by the acquisitions librarian. The use of the computer makes it possible to amend parts of the record without changing any of the other parts, which the cataloger finds are exactly as described by the acquisitions librarian. The most common additions, of course, are the subject headings and the classification shelving symbols.

A number of libraries have begun to use computers to produce their catalogs, notably the Florida Atlantic University,[7][8] a new school starting from the beginning; the Harvard-Yale-Columbia Medical Schools,[9] which are attempting to use one computer and one system of cataloging for all of them; the Toronto (Canada) University Library—all of these worked together on a machine which would print both upper and lower case letters, marks for non-English languages, and certain other printing symbols needed for catalogs—the University of Missouri Library, and other institutions.

Typewriters are available which not only print when their keys are struck, but which punch holes in a strip of paper, a paper tape, at the same time. Each key punches a unique pattern of holes in the tape, so that one pattern stands for the letter "A", another for the number "2", and so on. These paper tapes may then be used to cause other specially constructed typewriters to print the information from the tapes as many times as one wishes. These same tapes can also be used to operate other machines, including computers. They are similar to punched cards in this respect. A system using these tape typewriters in part produced the INDEX MEDICUS from 1960 to 1963.[10]

The main university library of Washington University is using these specially constructed typewriters (called "Flexowriters" and made by the Friden Company) to produce catalog cards, to produce a punched card for each book which will eventually be used to provide information for a computer when the book is checkd out by a reader, and to produce typed classification number labels to be pasted on each book. The librarians in the main library plan that one day they will also use the tapes to operate a computer to produce special lists of books for individuals.

All of this is done from a single typing operation. A typist types all the information about a book, including the classification number and the subject headings, one time. At this time the paper tape is also punched by the special attachment on the typewriter, and then by proper operation of equipment, all the catalog cards are produced, with each added entry typed in its proper place at the top of the card. Later, the tape is taken to other machines to produce the book labels and other things mentioned.

Up to the beginning of the 19th century, the traditional catalog in American and European libraries was a printed volume in which the books in the library's collection were listed either by author, by title, by subject, or by a combination of these. The advantages of such a catalog were many: it could be produced in multiple copies and people could have catalogs of their libraries in their offices and homes, a person could see at a glance all the books on a particular subject or by a particular author, and the comparison of the characteristics of various books (say, the date of publication) was easy. On the other hand, of course, book catalogs had disadvantages. By the time a

volume of catalog had been printed, the library had usually acquired a number of other books, which were too late in arriving to be included in the printed catalog; thus, the catalog was never a complete list of all the works in the library, and all sorts of supplements and additional lists had to be produced and used. With the advent of the computer, however, it became possible to interfile the information about newly acquired books with the old ones on the computer tapes and print out the whole group of items at any time that seemed desirable. The computer, therefore, made possible the advantages of both the book catalog and the card catalog which had supplanted it; and the result was that the whole question of the comparative value of the two forms came up for discussion again.[11)12)]

Because the answer to this question has not yet been completely settled, many libraries today are experimenting with both forms of catalog: the printed and the card catalog. This, however, makes for some problems, in that the form of cataloging designed for cards is somewhat different from that for book catalogs—due to the very facts mentioned above, and especially to the fact that a number of titles can be listed on a page under a single rubric (author or subject), while in a card catalog the rubric must be repeated on each card. To store all the information in the computer tapes and then bring forth one set of formats for a printed catalog and another for a card catalog requires a series of quite complicated programs (that is, set of commands to the computer), and no library has yet finished its work on this. At the present (January 1965), for example, the Washington University School of Medicine Library is programming its computer to produce a Selected Acquisitions List (see Appendix B) and the printed book catalog, and is only just beginning to work on the programs necessary to produce the cards for its card catalog. In the meantime, it continues to produce its catalog cards from the same information fed into the computer, but by manual means (xeroxing a master card and adding subject headings and other extra data to each card individually). It is hoped that by the time this Festschrift to Director Hashimoto is published, the problem of producing catalog cards will be solved or close to solution.

The Harvard-Yale-Columbia program, on the other hand, started with the idea of producing catalog cards from the store of information in its computer, and is just beginning to work on the problems of the book catalog. Both this group and the Washington University School of Medicine group are continually exchanging the information and technical details each evolves, and it is hoped that each one will be able to use the information or insights developed by the other.

The matter of cooperation is, of course, vital in so new a field. It would be very wasteful of effort if each group attempt to solve the same problems; if each considered its work a secret not to be divulged to others; or if each tried to develope its own machines. The Harvard-Yale-Columbia project and the two additional universities, at Florida and Toronto (Canada), for example, were able to bring down the cost of purchasing a printing mechanism for their computers by working together to pay for the development costs involved. Now other libraries are enabled to obtain this printing device, needed for cataloging books in a scholarly library in the United States, at much less than the original price.

The Harvard-Yale-Columbia project is an example of another advantage which the libraries of the past have wished for, but been unable to get manually, except at great cost—the union catalog, which lists the books in a number of libraries in one single place. By pooling the catalog of each library in a single computer, a query about a specific book or about books under a specific subject or by a specific author in the computer store of information will bring forth a list of all the books desired, no matter which cooperating library owns them. Thus, Harvard will have access to information at Yale and Columbia; Colombia to that at Harvard and Yale; and Yale to the other two as well as at its own library, by means of direct inquiry machines in each

library.

This same idea will undoubtedly be taken over by many other libraries when the computer tapes from the MEDLAS project of the National Library of Medicine (described below) will be available to medical libraries generally. The Washington University School of Medicine Library, for example, plans to add to the MEDLARS tapes the catalog information for the books it has, which are not listed in Washington, and to annotate the tapes to show which of the Washington books it has in its own collection. Then, when a request for all the books on a certain subject (for example) is placed in the computer, the resulting list obtained from the computer will contain all the books in the library in St. Louis, plus those in the National Library of Medicine. It might even be possible to consider in the future that each medical library in the United States would send information about its holdings to MEDLARS for storage and retrieval. If this were done, might cut down on the number of requests for interlibrary loans sent to Washington, since the local library might find a copy of the desired work was owned by a library closer to it than the National Library of Medicine. This would speed service to the local physician and research worker and strengthen the local library.

Serials

A serial is defined as any publication which appears at intervals of not more than one calendar year and is meant to be continued indefinitely. The most common form of serials is the journal or periodical or magazine, which comes out with some regularity and whose issues are made into volumes containing a certain number of issues of the journal. In scientific libraries serials may account for 75% of the total budget, personnel, and time of the staff; and therefore any method which is devised for handling them easily, quickly, and cheaply is of great importance in the running of the library and in making the information needed by the physician, student, or research worker available promptly. For this reason, it is not surprising that many libraries have attempted to develope systems for recording the receipt of these journals, for claiming any which fail to be received when they are due, for binding the volumes when all the issues have been received, and for making records available to readers and staff to show what issues of what periodicals are owned by the library.

As soon as computers became generally available for American university libraries, several places attempted to develope systems which would continually up-date the records of the holdings of serials in their collections, as each issue was received, and would issue printed lists of these holdings on a regular schedule, so that readers could take with them a list of all the serials which the particular library owned. Again, such a system was possible because the computer is capable not only of storing information, but of having that information added to, deleted, or changed without too much difficulty.

Almost the same type of system for mechanizing the serial record was worked out simultaneously by several libraries, notably the one at the University of California at La Jolla (San Diego), described by Voigt and Vdovin[13)14)15)] and the one at the Washington University School of Medicine Library in St. Louis.[16)] Essentially, this system consists of programming the computer to produce a punched card for every journal which is expected to be received within a specified time (usually a month). These cards are sent to the Serials Department of the library and filed, When an issue of the journal is received, the card is pulled from the file and returned to the computer, which changes the record of the holdings of that journal title to show that the library now has that particular issue. The computer is also programmed to produce a list of all the journals received, showing from whom each title is obtained and how much it costs; as well as lists of each dealer from whom the library obtains its material and the particular journal titles obtained from him. At the end of the month, moreover, the computer prints out a list of all the journals which have received their last issue of the volume,

so that the serials librarian can gather them up to send them to be bound. Cards for journals which remain in the library's file at the end of the month indicate issues which were expected to be received that month, but were not. Periodically, this file is examined by the serials librarian and claim requests are sent to the supplier of the journal for the issue which has not been received.

In this serial system a list of all the journals received that day is produced; this list is cumulated weekly into a monthly list, and then the entire file of holdings is printed each month. Once every six months this list is published in permanent form (by mimeographing, multilithing, or printing) from forms coming off the computer directly. Between this semiannual listing of all the titles and issues held by the library, another list of titles received, arranged by language and by subject, is produced. Both kinds of lists (holdings lists and subject and language lists) are distributed free to all departments of the school, while other libraries may usually purchase them for the cost of printing.

As was noted above, several libraries developed a somewhat similar system almost simultaneously. Since then a substantial group of libraries, both medical and university ones, have adopted or adapted this system to their own collections. The setting up of the first records on the computer are the most difficult and time-consuming portions of the entire system, and many libraries are finding that it is taking more time than they envisioned to prepare the records for the thousands of journal titles they receive. In retrospect, this should not surprise anyone, because the manual systems, from which the computer records must be made, themselves took many years to compile; but somehow libraries have not always realized the investment which it is necessary to make in personnel and time (as well as key-punching equipment and supplies) to transfer the old record to the new one. Another difficulty encountered in some large libraries is that the printed record of all their holdings has turned out to be extremely bulky, and a number of them are now considering breaking down their printed record into two parts: one, containing journals no longer received regularly, which might be published at long intervals (maybe once every two to three years); and the other, containing the journals which are being received at the moment, and whose holdings are therefore changing day by day.

In serials, as in other parts of the newer library technology, cooperation of a number of institutions in working out the details and in passing around the newer methods devised has been a strong factor. For example, it is estimated that it cost the Washington University School of Medicine Library about $17,000 to develope its serials system; but other libraries can now purchase the descriptions and the programs for about $36, and some dozen or so other schools have already done so, including the University of California at Los Angeles Biomedical Library, the Vanderbilt University Medical Library, Ohio State University, Louisville University Medical Library, and University of British Columbia. These libraries can then modify the original plan at much less expense than if they had to devise the entire system anew. In addition, an informal group of librarians working with computers on serial and other problems has been formed, and this group passes around at irregular intervals news and notes on new developments of the members of the group, long before these facts appear in the published information. This follows the trend in scientific information dispersal today, in that many pre-prints and many letters among friends working in the same field make information available before the facts are presented formally at a scientific meeting or in the scientific press.

One outstanding example of joint work on computer-based serial records by a number of libraries is that of the Medical Library Center of New York, founded by all the medical schools and a number of the larger hospitals in New York City. At this place the serial records of some 80 or more libraries in the Metropolitan New York area are being put on computer tapes for a union catalog of medical journals; it will

thus be possible for libraries to borrow materials from one another with ease and dispatch, and it will show which journals are held by many libraries and which journals are not available anywhere in the area. The list of journals indexed in *Index Medicus* has been checked against this computer list, and all titles not in New York will be obtained by one or another of the libraries in the group, if this is at all possible.

Computers have been used to compile union lists of journals in other places also. Two examples which come to mind immediately are the one issued from the libraries in Cleveland, Ohio, and the one now being undertaken by the Higher Education Coordinating Council of the St. Louis, Missouri, area, though there are undoubtedly others which could be cited.

One method of bringing the information about newer developments in the field of the librarians is by meetings: symposia, conferences, and the like. Another is by courses given at schools and universities, and by the Committee on Continuing Education of the Medical Library Association, which for three years now has presented one-day courses for its members on the principles and methods of using punched cards and computers. As new librarians emerge from library schools trained in this technology and older librarians are brought up-to-date on them, it may be expected that librarians in medical and general university libraries will all soon have some familiarity with the theory of computers in library tasks, and will be able to discriminate between those methods which are well adapted to computer handling and those which are best done by some other method.

Circulation

Libraries purchase books and journals, and catalog them, and make the records of them as a means to an end—the use of the works by their readers. Two such uses are common in all American medical libraries—circulation, so that the reader may use the book or journal outside the confines of the library, and reference service, which is the demand search and retrieval for information needed by an individual. Many computer-based systems for preserving the records of the circulation process have been worked out by libraries, but reference work, so far, has generally been the least successful use of the machines to date. It might also be pointed out that circulation systems are more varied than most other systems in libraries; each library can have its own method of handling this facet of its work and the small degree of standardization of circulation routines can be seen in the review of the many systems published by Fry and his associates for the Library Technology Project of the American Library Association.[17]

As a result of this, the variation in methods of machine-handling of circulation records is also great. Because most medical libraries are small and, therefore, the circulation is comparatively small, the routine use of large-scale computers is unusual. University libraries, on the other hand, with their thousands of students, faculty members, and administrative staffs are more and more coming to use a system which automatically registers in a computer somewhere else than at the Loan Desk of the library the details of the circulation transaction: the name of the book, its call number, the name or number (or both) of the borrower, and the date the book was taken from the library. The computer is used to print out at intervals (daily, several times weekly, or weekly, for example) all the books which have been borrowed from the library, together with information about the borrower and the date the book is due back. Periodically, lists of overdue books, arranged under the name and address of the borrower, are printed and sent to the delinquent person as a reminder to return the book. When a book is returned to the library, the computer is notified of this, and by a series of commands erases that portion of its record which refers to the particular book. If a book is renewed, the computer will change the date in its file from the old date to the new date. When a book is borrowed by one reader and then requested by another one before the work is returned, the computer can be programmed to make a symbol next to the circulation record

for that book to show that it should not be placed back on the shelf, but that instead the file of "reserved books" be searched, so the new requestor can be notified that the book is now available to him.[18]

The system described above is used only in the largest libraries, as previously noted. Other, simpler, systems are used in smaller installations. For example, the Washington University School of Medicine Library manages its circulation by imprinting information about the borrower and the item borrowed on a card which is then key-punched to show electronically the book or journal borrowed, the identification of the borrower, and the date when the item is expected to be returned to the library.[19] At the end of the month, the entire file is transferred to computer tape, to which is added a file of names and addresses of borrowers. The computer is then programmed to sort the items circulated by borrower's number, and then to print first the borrower's name and address, next a letter saying the works listed in the letter are overdue, and finally to give all the books and journals borrowed by that person which were due back before that day, but were not returned. At the end of the semester, a list of all the items circulated, both those overdue and those just borrowed, is printed for each borrower, so that he may be able to check his files before going home for vacation or leaving the medical center permanently. (See Appendix C) If the circulation of this library ever grows to a point where this procedure is unable to handle the work easily, it may be necessary to adopt one of the more complex procedures described above.

Storage and Retrieval of Information

The problems discussed up to this point in the paper can be considered as "housekeeping" or "record keeping" problems. They are a necessary part of the work of the library, if the users are to be able to find the material which they need. But they are merely means to the end—the use of the material; and any library which neglects to aid its users in obtaining the information within the books and journals it is recording is performing labor for the sake of labor only. The most advanced libraries give the best informational services; how useful this is can be shown by the fact that in libraries in commercial companies (such as pharmaceutical firms), a large amount of money is invested every year in providing the scientists, and others needing the information, with the facts necessary to make their work more successful and the profits of the company larger.

Only now that the problems of record keeping by computers have been in operation for some time, has it become possible to work on providing individualized information services to the scientists. One of the most common, frequently called "Selective Dissemination of Information," requires the scientist to define the subject of his interests in some detail, from a list of subject indicia provided to him or, alternatively, by making up a list of key words which describe his interests. This list of words is then matched by the computer against the words in the title or summary of an article, and when a certain number of words within the two sets agree, then a notice of the article or its summary, or even the article itself, is sent to the scientist. By asking the scientist to report back which papers so selected actually were of interest to him and which were not, the computer's commands can be changed to define even more thoroughly the subject interests of the scientist.

Indexing by Computers

Still another form of providing information to the individual has been the use of a computer to produce an index to the literature. The most common and easiest has been named "Keyword in Context" (KWIC Index), and has consisted of instructing the computer to print each title of each article by permutations, with one after the other of the important words printed first. An example might be an article with the title, "Insulin treatment of diabetes mellitus in rats." This would be indexed by the computer thus:

Insulin treatment of diabetes mellitus

in rats .....p. 23
Treatment of diabetes mellitus in rats, insulin .....p. 23
Diabetes mellitus in rats, insulin treatment of.....p. 23
Rats, insulin treatment of diabetes mellitus in .....p. 23

after which the titles would be alphabetized and listed. A number of variations on this method have been evolved, but essentially this is the method used by BASIC, the index to *Biological Abstracts*, *Chemical Titles*, and other abstracting tools which need to have a quickly and cheaply prepared index before the more detailed subject index can be compiled and printed. It is interesting to note that a comparison of this method with indexing done by humans (at the National Library of Medicine) showed a high correlation between terms.[20] Further work on validating this is proceeding.

Still a further method of providing information to users through an index has just begun to have some impact on medical library service. For some years a theory has been growing up that it would be useful to be able to go forward in time in scientific bibliography, rather than always to go backward. All previous bibliographies and indexes have referred to works earlier than the one taken as the source; nowhere was it possible to find one which allowed a person who knew of an early, classic contribution to a subject to find out who had worked on the same subject since that time. By the use of computers, *Science Citation Index* has now provided a list which shows the articles published at a certain time and all the articles since then which have cited that key article. Because this service is new and quite expensive, not enough experience has been generated yet to see how much use will be made of the new technique, but in theory it seems to hold great promise.

MEDLARS

We have alluded in several places in this paper to the work of MEDLARS (Medical Literature Analysis and Retrieval System), produced at the National Library of Medicine in Bethesda, Maryland. This system uses a combination of humans and machines to produce: (1) the printed *Index Medicus*, an index to a large number of journals from all over the world, (2) recurring bibliographies; that is, lists of references on a particular subject or series of subjects which are sent to an individual or an organization regularly for a fee, and (3) demand searches; that is, lists of references which answer a specific question asked by an individual. Eventually, also, the National Library of Medicine hopes to make the MEDLARS tapes available to other libraries in the United States and overseas for local use. It is probable that Tokyo will be chosen as one such center.

The method employed is to have human indexers note on specially designed sheets of paper the subject or subjects of the article being indexed, for which purpose they use the list of subject headings (MeSH: Medical Subject Headings) devised by the library for this purpose. The indexers also denote which of the large number of headings chosen are to be printed in the *Index Medicus* and which additional headings are to be stored in the computer, but not published routinely. These sheets of paper are then sent to typists who use specially constructed machines which produce the typed citation and also a punched paper tape, much as in the system of cataloging described earlier. This punched paper tape is then fed into the computer which processes the information according to the programs developed for MEDLARS. Other programs then bring forth from the computer the necessary elements for the printed index, the recurring bibliographies, or the demand searches. Further details on this can be located in a pamphlet published by the National Library of Medicine, "The MEDLARS Story."[21]

MEDLARS is significant for a number of reasons. It is the largest, most complete, and most successful computer-based index in existence. It has ingeneously devised a system where the usefulness of human minds and the speed and control of the machines have both been incorporated into the whole. It has made possible with one input a whole series of out-

puts; and because of the importance of the indexing, it has had to give great attention to the problems of subject indicia and the training of the indexers and searchers using the indexed materials. For its printing problems, it developed a new mechanism (GRACE; Graphic Arts Composing Equipment) capable of printing many different fonts of type and many different alphabets directly from the computer and at high speeds. In its plans for decentralization of its tapes, also, the MEDLARS system has successfully united the advantages of centralized control and decentralized use, which allows for local needs and flexible uses without sacrificing the advantages of unified rules.

MEDLARS has been criticized because it is an index to the literature, not to the data directly. In essence MEDLARS says, "The information you want is in this article or series of articles," rather than, "Here is the information you want." There are many reasons why the National Library of Medicine chose to do this, not the least of which was that the first is easier to do than the second, and if it had waited to develope an index of data, it might still be struggling for a solution. But another reason is the historical tradition of the Library which, since the days of its founding, has considered it one of its prime obligations to provide medical scientists throughout the world with bibliographic indexes. MEDLARS is thus the lineal descendant of the *Index Catalogue of the Surgeon General's Office*, the old *Index Medicus*, the *Quarterly Cumulative Index Medicus*, and the *Current List of Medical Literature*. In has turned out to be one of the most exciting of the uses of computers in the storage and retrieval of information up to this time, and all librarians look to it with hope for the future.

Conclusion

The work described in this paper shows some of the directions which American medical and university libraries have been taking in their attempt to use mechanical and electronic means to reach the goals of all libraries: the bringing together of the inquirer and the information he needs in the easiest and most economical manner possible.

Although all libraries have the same goals, they do not all follow the same pathways to these goals—nor should they. The background of the society in which the library exists, the state of the technology of the time and the place, the absence or presence of the people needed, and the difference in the historical traditions of different groups all dictate the manner in which the search for the best path to the end desired is undertaken.

Since this is so, a description of work in American libraries cannot logically be taken as a prescription for work in other countries. The world looks forward with great interest to seeing what solution to these problems the Japanese librarians and biomedical scientists will bring forth; solutions which will better serve the Japanese culture and the Japanese, perhaps, than the ones described here. In this development the work of the Japan Library School and of Director Hashimoto in training and preparing those who will undertake this will have had a profound effect.

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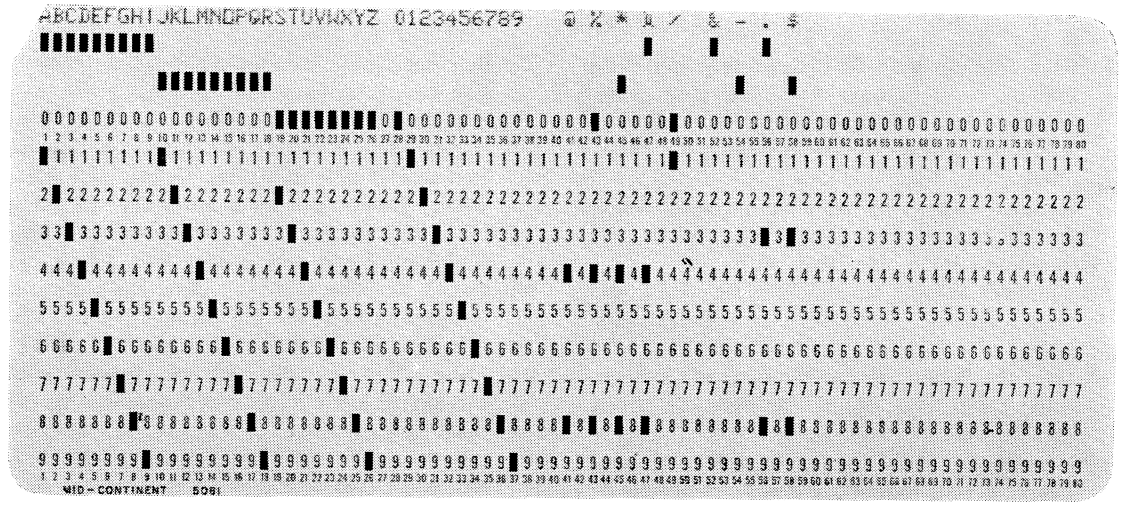
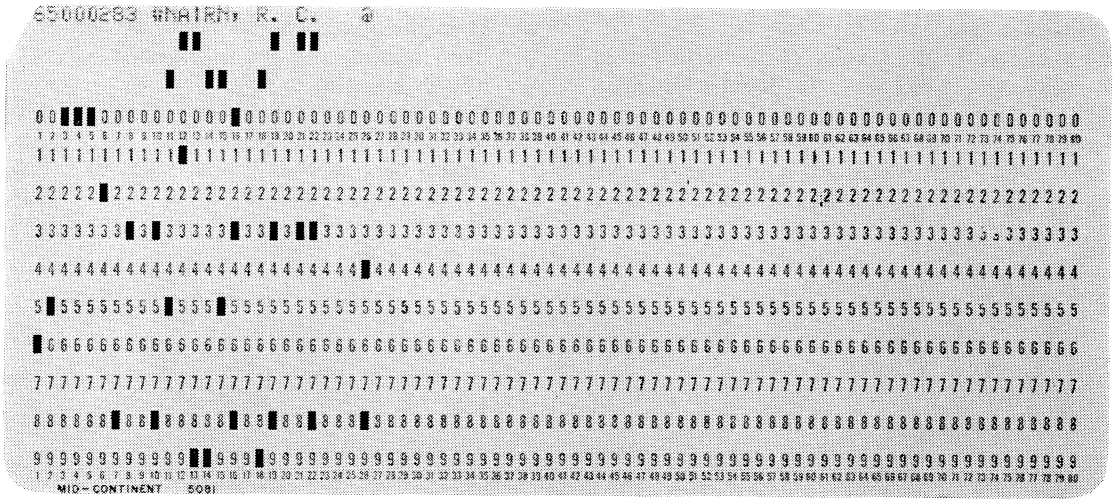
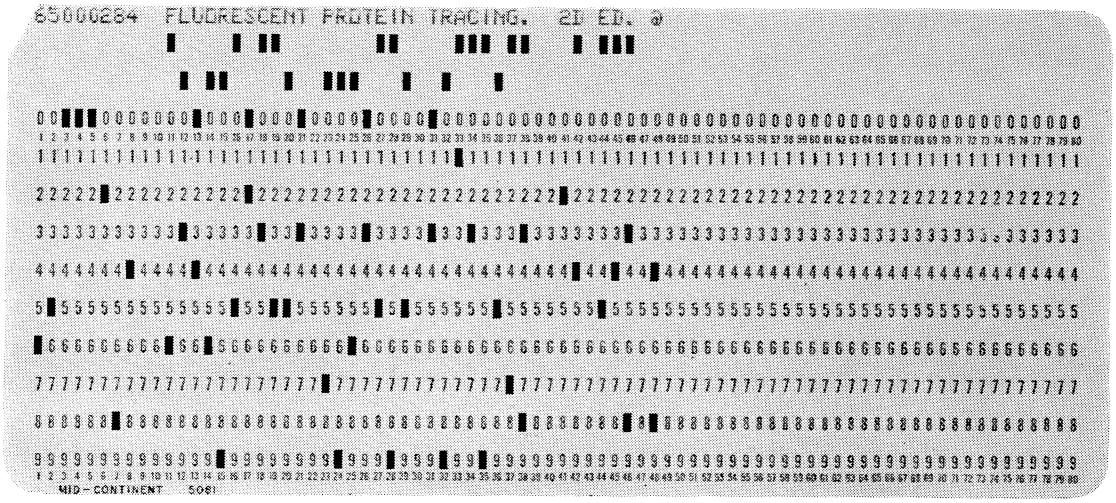
APPENDIX A.


ABCDEFGHIJKLMNOPQRSTUVWXYZ 0123456789 @ % * ¤ / & - . $
MID-CONTINENT 5081


85000283 ¤NAIRN, R. C. ¤
MID-CONTINENT 5081


85000284 FLUORESCENT PROTEIN TRACING, 2D ED. ¤
MID-CONTINENT 5081

APPENDIX B

CARDIOVASCULAR SYSTEM

1964

VIAMONTE, MANUEL, ED. PROGRESS IN ANGIOGRAPHY. SPRINGFIELD, THOMAS, 1964. 562 P.
WG 500 V613P

DERMATOLOGY

1964

MACKENNA, ROBERT MERTTINS BIRD. DERMATOLOGY. BALTIMORE, WILLIAMS AND WILKINS, 1964. 279 P.
WR 100 M155C

ENDOCRINOLOGY

1964

BAJUSZ, EORS, ED. MAJOR PROBLEMS IN NEUROENDOCRINOLOGY, AN INTERNATIONAL SYMPOSIUM. BALTIMORE, WILLIAMS AND WILKINS, 1964. 471 P.
WK 102 B165M

NABARRO, J. D. N. CORTICOSTEROID THERAPY - USES AND ABUSES. ROYAL COLLEGE OF PHYSICIANS OF EDINBURGH, 1964. 46 P.
P 18
PAM

PINCUS, GREGORY. THE HORMONES. NEW YORK, ACADEMIC PRESS, 1964. V. 5.
WK 100 P647H

ZARROW, M. X. EXPERIMENTAL ENDOCRINOLOGY, A SOURCEBOOK OF BASIC TECHNIQUES. NEW YORK, ACADEMIC PRESS, 1964. 519 P.
WK 25 Z38E

1962

CONFERENCE ON THE THYMUS, MINNEAPOLIS, 1962. THE THYMUS IN IMMUNOBIOLOGY, STRUCTURE, FUNCTION, AND ROLE IN DISEASE. NEW YORK, HARPER, 1964. 778 P.
WK 400 C748T

GASTROINTESTINAL SYSTEM

1964

DAVID, HEINZ. SUBMICROSCOPIC ORTHO- AND PATHO-MORPHOLOGY OF THE LIVER. NEW YORK, PERGAMON PRESS, 1964. 2 V.
WI 702 D249S
OV RES

PUESTOW, CHARLES BERNARD. SURGERY OF THE BILIARY TRACT, PANCREAS AND SPLEEN. 3D ED. CHICAGO, YEAR BOOK, 1964. 389 P.
WI 700 P977S

SCHWARTZ, SEYMOUR I. SURGICAL DISEASES OF THE LIVER. NEW YORK, BLAKISTON, 1964. 387 P.
WI 700 S399S

HISTORY OF MEDICINE AND SCIENCE

1964

MCLEAVE, HUGH. A TIME TO HEAL, THE LIFE OF IAN AIRD, THE SURGEON. LONDON, HEINEMANN, 1964. 277 P.
WZ 100 A298M

NEWERLA, GERHARD J. MEDICAL HISTORY IN PHILATELY. MILWAUKEE, AMERICAN TOPICAL ASSOC., 1964. 1 V.
WZ 340 N547M

WRIGHT-ST. CLAIR, REX E. DOCTORS MONRO, A MEDICAL SAGA. LONDON, WELLCOME HISTORICAL MEDICAL LIBRARY, 1964. 190 P.
WZ 112 M753W

1963

BIRKS, J. B., ED. NORTH DAKOTA MEDICINE, SKETCHES AND ABSTRACTS. NEW YORK, BENJAMIN, 1964. 364 P.
WZ 100 R975B

APPENDIX C.

WASHINGTON UNIVERSITY

SCHOOL OF MEDICINE LIBRARY

DEAR DOCTOR, BORROWERS NO. 01445

THE LIBRARYS RECORDS INDICATE THAT THE ITEMS ON THE LIST BELOW ARE CHARGED OUT IN YOUR NAME. WOULD YOU KINDLY RETURN THOSE ITEMS FOR WHICH YOU HAVE NO FURTHER NEED, AND INDICATE, BY CHECKING THE APPROPRIATE ITEMS WHICH YOU WOULD LIKE TO HAVE RENEWED.

THIS LISTING HAS BEEN PREPARED FROM PUNCHED CARDS, AND, OF NECESSITY, TITLES AND OTHER DATA DESCRIBING THE JOURNALS AND BOOKS HAVE BEEN ABBREVIATED. PLEASE NOTE THE FOLLOWING GENERAL AREAS WHICH WILL ENABLE YOU QUICKLY TO IDENTIFY THE ITEM.

ABBREVIATED JOURNAL TITLE/ BOOK TITLE	CUTTER (BOOK) NUMBER		VOL.NO. JOURNAL/ BOOK	ISSUE DATE/ COPYRIGHT	DATE DUE
AMER J MED SCI			195	1938	12/12/63
J INFECT DIS			29	1921	12/31/63
J LAB CLIN MED			44	1954	12/31/63
MEDICINE			29	1950	12/26/63
PSEUDOM AERUG INF	F721P	FORKNER		1960	01/02/64
RES IN BURNS	I61R	INT CONG		1960	11/07/63

SHOULD YOU HAVE ANY QUESTIONS REGARDING ANY OF THE ITEMS ON THE LIST, PLEASE CALL STATION 458.

SINCERELY YOURS,

ISABELLE T. ANDERSON
ASST. LIBRARIAN FOR
PUBLIC SERVICES

Homage to Director Hashimoto

The work of the Japan Library School at Keio University has been an outstanding example of what can be accomplished when men of good will and understanding come together to attempt to solve a common problem: in this case, how to preserve the best traditions of the past of one culture and people, at the same time adding the best of another culture and people.

Japan has had a tradition of scholarship and study which reaches back at least into the 3rd century of the western era, when Chinese methods of writing were adopted for the entirely different language structure of Japanese. Its pagodas have been the repositories of both the ancient Chinese classics and the substantial additions of the Japanese thinkers, who made the knowledge borrowed subtly different and refined. After the Meiji Revolution, also, the advances in technology which had allowed the Island Kingdom to be outstripped by western countries were quickly assimilated by the Japanese people, and then added to and made greater by the Japanese themselves.

In the field of librarianship this acceptance of newer technologies began with the founding of the Japan Library School soon after World War II, and it is greatly to the credit of both the American Library Association, which founded it, and the officials of Keio University, which accepted it, that from the beginning it was planned so that gradually the foreigners would leave the school and the Japanese be free to develope it in the way which best fitted the needs and the traditions of their country. In this transition, the work of Director Hashimoto has been the keystone; without his understanding of and sympathy with both the old and the new, without his desire to obtain the best of both worlds, without his ability to bring about the ends he had in mind, the concept of the Japan Library School would have faltered or been turned aside. Now, as he approaches his 70th birthday, it gives me, who spent six months watching his masterful handling of this complex situation, great pleasure and pride to contribute to the celebration of his Koki this small example of great respect.

Estelle Brodman, Ph. D.