Mechanical and Electronic

Aids for Bibliography

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BIBLIOGRAPHIC WORK consists of a complex of operations, some of which appear susceptible to mechanization and some of which do not. The systems pattern in bibliographic work appears to consist of nine processes, each in turn, including a range of operations. The basic processes which form parts of any bibliographic system are:

    I. Planning the bibliography
    II. Searching to locate items that may be pertinent
    III. Copying citations that may be pertinent
    IV. Locating copies of the items cited
    V. Verifying the references
    VI. Analyzing the articles to determine whether they are pertinent (and in some cases annotating or abstracting)
    VII. Organizing the citations into the most suitable form
    VIII. Editing the manuscript and preparing it for reproduction
    IX. Reproducing the bibliography.

The operations under these processes are approximately as follows:

I. Planning the bibliography
    A. Determining the scope of the bibliography: i.e., defining the subject of the search, the period to be covered, the geographic areas and languages to be covered, the types of material to be covered, the inclusiveness, i.e., completeness of listing, exclusion or inclusion of various aspects or treatments of the subject, etc.
    B. Determining the sources to be searched.
    C. Determining the headings under which the search will be made.
    D. Estimating the time required and scheduling the operation.

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II. Searching
  A. Consulting the sources under the subjects indicated, and selecting possible references according to criteria set in I.
  B. Modifying the list of sources and of headings as indicated.

III. Copying the citations that appear to be pertinent.

IV. Locating copies of citations noted
  A. In sponsoring library
    1. Getting call numbers
    2. Preparing request slips and/or
    3. Getting from shelves.
  B. Elsewhere
    1. Locating copies, and
    2. Borrowing or visiting other collections.

V. Verifying the citation—comparing citation with publication for accuracy and completeness.

VI. Analyzing the article to determine whether it is actually pertinent to the search being made. This step frequently includes annotation, or abstracting, to indicate the material in the citation that is pertinent to the particular search being made. (Additional searching by checking literature cited)

VII. Organizing material: i.e., determining, based upon I, the most suitable form of organization and putting it into that form by classifying the citations, arranging them in chronological or other order, or by writing a review article, indexing the bibliography, etc.

VIII. Editing, including revision and mechanical editing. The revision consists primarily of an overview of the whole of the report to make sure that it does in fact achieve the objectives set forth under the plan prepared as step I, and that it is consistent. Editing consists of preparation of the copy for reproduction and taking care of the mechanical consistency of the citations or report, and preparation of the copy in final form, proofread and ready for reproduction.

IX. Reproducing, including the preparation of the list in final form, whether that be achieved by typing, near printing, or other means.

Some of these steps, such as IV and V, may be omitted in preparation of nonselective booklists, but such lists represent a very low order of bibliographical work, a task which is more nearly clerical than professional, since the judgment factor is at a minimum.

Having outlined the operations involved, it is now feasible to ex-

amine the possibilities for mechanization of each of these operations, the mechanical and electronic devices available or foreseeable, and the operations and levels of operation at which these are, or may be, applicable. Before this is done, however, it is necessary to note that while there are only a very few potentially applicable electronic devices available or foreseeable, there is a wide range of mechanical devices, of various levels of sophistication, now in use for bibliographical work. The electronic devices are, as summarized before,[1-3] the computers, the Rapid Selector, the Hollerith card machines of the Samain or Luhn type, and even more experimental devices such as the electronic reading pencil and the various new devices for direct reading, encoding, and reproducing of alphabetical information.

Many of the mechanical devices are so familiar that they tend to escape general identification as mechanical devices. These range from the lead pencil to the card catalog, the book catalog, the bibliographical tool, and the book. More generally recognized mechanical devices are the typewriter, the mimeograph, the multilith machine, and the photographic devices. Electromechanical devices, such as the card- or tape-operated electric typewriter, machines of the Hollerith type, selector actuated addressing devices of various types, and electronic equipment, are uncommon enough in libraries to be generally recognized as machines.

Having this general outline of bibliographic work and of electronic and mechanical aids, it will be useful to examine the bibliographic operations step by step, in terms of their relative importance in the system of bibliographical work and in terms of the degree to which mechanization appears feasible, and to discuss the types of mechanical devices that appear applicable.

As is apparent from the list of operations, bibliographic work is a complex of intellectual and mechanical operations. The intellectual operations are clearly paramount, and no degree of mechanization available or foreseeable appears to offer promise as a substitute for the basic intellectual operations involved. The most that can be hoped for is that equipment may be used to reduce the human effort expended on the mechanical operations, thus freeing time for more of the intellectual effort. It should be noted, however, that in practically all fields scientific management has reduced the amount and types of work that require intellectual effort—for example, in the machine shop, before the days of prescheduled and predesigned operations, every operation required independent judgment, and many steps required pooled judgment through conference with the foreman and

others. Similarly, if and when bibliographic work becomes more systematized and if and when mechanical devices (particularly photographic devices) become as common as the lead pencil or the mechanical typewriter, many operations which are now performed in intimate relationship with the intellectual part of the work will be isolated and will be handled mechanically. Even after that has been carried out to the greatest extent conceivable, there will still be a core of intellectual work which is not susceptible to mechanization.

I. Planning the bibliography

In the first process, planning the bibliography, the determination of scope hardly seems susceptible to machine treatment.

II. Searching

A large part of the searching operation, process II, is clearly susceptible to mechanization. This part is now a mechanical process consisting of such activities as locomotion to reference tools, handling sources, and turning pages. Reading citations and comparing them with the general criteria, likewise, is either mechanical or, at least, is an operation that can be and has been expressed in machine language and performed by machines.

This is the part of the bibliographic system that has been the source of much loose speculation on the mechanization of bibliography (and of libraries), as well as the subject of much constructive work. Book catalogs, card catalogs, conventional bibliographies, selective addressing machines, notched cards of the McBee and Zator types, punched-card machines, electronic computers, and the Rapid Selector have all been used to varying extents to perform this function. This function is merely the mechanical act of selecting in accordance with predetermined criteria.

A second part of this process, the modification of the list of sources and of subject headings, is normally performed as part of the selecting operation. This is an intellectual process, and no way of wiring machines to modify or extend their criteria appears likely to supplant mature judgment. This is not a good field for mechanization because it is a nonrepetitive operation and one which may not be completely logical. It will, in the present or foreseeable state of the art, continue to be done by human intelligence. The only difference apparent at this stage is that this operation will be separated from the search operation, where the search is mechanized, and modification of the list of sources and the list of headings will become a part of process

VI, analysis after which one or more of additional searching cycles will be added.

III. Copying

Copying, which is limited to physical transcription of the citation or data, or both, has not been automatized to any appreciable extent. While this is always a purely mechanical operation, of all the machines proposed or available only the selective addressing devices and the Rapid Selector provide for copying the citation directly and automatically as part of the searching process. Notched cards and punched cards can carry the citation in legible form (as do printed bibliographies) but copying must be performed as a separate operation. Insertion of microfilm frames into notched cards and punched cards affords storage of as much as a full page of text, but copying this frame has not been made automatic. Of all the devices now known, the Rapid Selector is the only one that provides for automatic copying of the data as part of the search process.

Introduction of the Photoclerk has indicated that the copying of citations from catalogs, bibliographic sources, and even pages of books can be mechanized when there is enough volume of copying to justify mechanization. Since the volume required to justify such simple photographic devices as this is quite small and the machine can be used for many other routines as well, it appears likely that a good deal of the work of copying citations from bibliographic sources will be mechanized. This is of particular value in copying citations in non-Roman alphabets and those in English in highly technical subject fields. In addition to reduction in cost this method offers increased accuracy, since it is difficult to transpose numbers or otherwise garble citations in copying photographically.

IV. Locating copies of the items cited

A. Location of the original book or article, and obtaining it when it is in the library in which the search is being made, is a relatively simple routine. It could be mechanized, and in a relatively small number of cases parts of it are mechanized by such devices as book lifts, book conveyors, and book trucks.

The operations involved are:

1. Getting and recording the call number. This could be mechanized beyond the use of the card catalog, but in the present state of mechanical and electronic devices it is difficult to postulate any set

of conditions under which the more sophisticated devices could compete in this operation with manual use of the author card catalog.

2. Preparation of call slips (when the bibliographer does not go directly to the shelves). Here again we have a very simple operation which could be mechanized. However, the time required to write a call slip is so short and the number written at any one time, i.e., the number of items a bibliographer could examine within a reasonable period, is so small, that again, it is difficult to visualize any mechanism that could economically vie with the lead pencil or the typewriter. In a limited number of cases, in which large numbers of call slips are required and in which the photographic copy can be used in lieu of the conventionally ordered call slip, it might well be possible to do this job with the Photoclerk, but it appears that this would be the exception rather than the rule.

3. Getting books from the shelves. This could be mechanized. There is nothing novel about the idea of a completely mechanical stack, and such a stack could be built according to any one of several known operating principles without any great amount of research or development of work. Mechanisms do exist which will select one ledger from a group of ledgers in a safe, bring it out to the work space and return it to its proper place in the safe when work on it is completed. The only question then is not whether we can mechanize the bookstack further, but whether it is worth while. If this is ever tested it will probably be most feasible to try it first in a storage type stack rather than a stack in which browsing is permitted. But whether it is to be done must be determined by studies of the capital investment involved (amortized over a reasonable period) plus operating costs, as compared with the cost of obtaining books from the shelves, returning them to the shelves, and keeping the stacks in order by the present methods. It might be possible in mechanizing the stacks to reduce aisle space and to eliminate floors so as to obtain more storage per cubic foot, and that, too, should be taken into consideration in designing the automatic stack and in comparing it with conventional stacks and conventional book retrieval methods. However, the necessary economic studies have never been made, and until they are we will not know whether mechanization of the bookstack is desirable.

B. Getting books from other libraries. The additional operations involved when the books needed are not in the library in which the search is being made are: (1) locating copies and (2) the interlibrary loan procedure or visits to other libraries.

1. The steps involved in locating copies are not too different from those involved in determining a call number except that different reference tools are used. This could be mechanized, but the same question arises as that in relation to mechanization of the finding of call numbers.

2. Interlibrary lending has been mechanized to some extent by the substitution of photographic copies, the use of simpler wrapping devices, and, to a slight degree, the provision of standard interlibrary forms. Basically, there are two methods for satisfying requests from a distance. The conventional method is lending of the book or other physical object. A variant on this method, which has been proposed and discussed but has not been put into practice in any appreciable degree, is the substitution of a reduced facsimile edition for lending of books. Under this proposal microcards, or microprints, would be sent in lieu of lending. Since both of these are edition processes rather than single copy processes, this proposal would involve stocking of duplicate sets of the materials to be lent and that would involve considerable costs. Also, the facilities for reading these types of materials are still limited, so there would need to be consideration not only of what items were to be stocked but of what users could accept and use this type of substitute material. The second method for handling requests from a distance, suitable particularly for short-run requests, is the whole range of single-copy copying services, including microfilm, photoprints, reduced photoprints pasted on cards (after the fashion of microcards but prepared automatically, directly on 35-mm. paper, one copy at a time, and automatically pasted on cards), ozalid, and many others.

A newer method that has been proposed is the use of facsimile transmission, and this has been tried out by the Atomic Energy Commission. To date, the systems for facsimile transmission that have evolved have been too slow to promise any advantage over conventional photoprint services, in other than most exceptional cases in which speed in obtaining an occasional page may be more important than its cost.

V. Verifying the references

This consists of checking the citation with the original to make sure that the citation is correct. Presumably, by the use of some of the newer alphabetic reading mechanisms, this could be mechanized. However, the devices for reading alphabetic material electronically are new, imperfect, and exceedingly limited in range at the present

time, and it appears unlikely that these will be of much use for some time to come for other than specially prepared alphabets in specially adapted order.

VI. Analyzing the articles to determine whether they are pertinent (and in some cases annotating and abstracting)

This operation involves reading of the articles in the light of the criteria established under I to determine whether they contribute to the basic purpose of the search. If they do, it then requires brief statement of the contribution. This step does not appear susceptible to an appreciable amount of mechanization. Theoretically, the electronic reading pencil, which has been described in the references cited, could be used to copy pertinent words for a crude form of annotation, but this device is not perfected as yet.

The analysis of the article usually involves additional searching by checking the literature cited when pertinent material is found in an article and when literature cited appears relevant. This is a supplementary searching operation and requires repetition of the steps III, IV, and V.

VII. Organization of the material

This includes judgment as to the most suitable form of organization as well as putting the material into that form. Here again judgment enters so deeply into every part of this series of operations that mechanization does not appear very likely.

VIII. Editing

Operations included as editorial work include reviewing for consistency of treatment of the bibliography as a whole and adequacy of the bibliography as a whole as well as copy editing to make sure of consistency in form. Little of this, if any, is subject to mechanization at the present time.

IX. Reproducing

Reproduction is a purely mechanical operation, regardless of whether the reproduction takes the form of cards to be filed in the catalog or typewritten, mimeographed, multilithed, offset, printed, or otherwise reproduced lists; and the whole gamut of printing, near-print, and office copying equipment is, of course, applicable, as are the devices for mounting cards for photographing and similar office tools.

Having reviewed, step by step, the work of preparing a bibliog-

raphy it appears that operations which are not susceptible to mechanization outnumber those which are. This does not mean that mechanization will not be used. In fact, as noted, it invariably is used to some extent even if it is of as low an order of mechanization as standard typewriting or writing. However, the use of sophisticated mechanical and electronic devices appears to offer promise primarily in the areas of searching, copying, obtaining copies, and reproducing.

The mechanical devices currently available for economic use in libraries are few and simple. None of the electronic devices now on the market appear to offer any likelihood of widespread adoption or adaptation to library purposes for the present or for the immediate future. Mechanical or electronic devices are costly by most libraries' standards and are economically usable only where there is enough volume of productive work to keep them busy for a material portion of each day. Very few libraries can supply the necessary work load for economical operation of any mechanical device that costs as much as $10,000, yet many of the devices that have been suggested for library or bibliographic operations cost that much or more per year. The libraries in the country that have as many as five full-time people working on bibliographical work day in and day out are few. Furthermore, large-scale machine operation bespeaks large-scale preparation for machine operation. That again indicates that the widespread application of Univacs, Memexes, Rapid Selectors, and Electronic Punched Card installations to libraries in general is far in the future, unless technological change simplifies and cheapens these and thus makes possible their use with limited collections. The present day field for these sophisticated electronic and electromechanical devices would appear to be limited to custom-made apparatus for the few library applications that would appear to justify such equipment. If these devices can be simplified and brought down in cost, then it might be possible to use them in libraries on a wider scale; or if library operations in general should become much larger than they are now, they might justify larger investments in equipment.

As has been pointed out before, much of the mechanical equipment now available is too slow for the handling of very large files, and is too costly for handling small files. Depending upon the type of search, it is even doubtful whether the fastest electronic machine that we can postulate will ever be able to search for a series of author entries as rapidly or as economically as that can be done in a conventional card catalog. It should be remembered that the preparatory work of descriptive cataloging would have to be done pretty much the same way

in either case. The only costs and times that would be different would be those for construction of the card catalog, preparation and filing of cards, maintenance of the card catalog, and the finding of citations in a card catalog of a million or more cards, as compared with those for construction of the machine, introduction of the same information (represented by the catalogers revised draft) into the mechanism, operation and maintenance of the mechanism, and reproduction of the data as required.

Nevertheless, there are many operations in which the more sophisticated types of mechanisms appear desirable and promising. When large files have to be maintained and when they have to be searched repeatedly for subject information, great reduction in space requirements and in searching time and in copying time may be achieved by mechanization. In a number of cases these savings may well be great enough to more than offset the cost of the equipment. As machines are developed to meet the need in these limited cases, the product will become available to others, thus providing a secondary mechanization of libraries which cannot justify machines of their own, and helping to keep the machines busy enough to make them pay their way. Furthermore, as development work on these machines progresses, they will inevitably be simplified and reduced in cost, so that eventually they will be inexpensive enough for general application. However, progress will be aided by recognizing the areas of potential usefulness of the machine and by planning for the concomitant intellectual processes without which machines cannot, according to the analysis above, serve any useful bibliographic purpose.

References

1. Shaw, R. R.: Machines and the Bibliographical Problems of the Twentieth Century. *In* Ridenour, L. N., *et al.*: *Bibliography in an Age of Science.* (Phineas L. Windsor Lectures in Librarianship No. 2) Urbana, University of Illinois Press, 1951, pp. 37-71.

2. Shaw, R. R.: Management, Machines, and the Bibliographic Problems of the Twentieth Century. *In* Shera, J. H., and Egan, Margaret E., eds.: *Bibliographic Organization.* (University of Chicago Studies in Library Science) Chicago, University of Chicago Press, 1951, pp. 200-255.

3. Shaw, R. R.: From Fright to Frankenstein. *D.C. Libraries,* 24:6-10, Jan. 1953.