



Instrumentation

C. D. GULL

PRESSED BY GREAT masses of incoming materials and growing demands for a widening variety of services, federal libraries have been resorting to new and varied means in order to do better, or more cheaply, or with less manpower, the things which they would otherwise do less well, or even not at all. High among these is what might be called instrumentation, that is, the integrating of ideas, systems, and equipment in planning and carrying on their operations. New forms of recording information—such as microfilm, microprint, microcards, miniature printing; sound recordings on discs, tape, and wire; scientific and technical literature in report form—must be placed alongside the more traditional forms of records in books, journals, pamphlets, newspapers, maps, and manuscripts. Similarly, first the typewritten, and then the photostat, and today the microfilm copy, tend to replace interlibrary loans; tomorrow a telefacsimile may provide an even more rapid and perhaps as inexpensive a service. New methods of scanning the records are being devised to perform a more rapid and more precise and subtle job than the older “searching” of the card catalog.

While it is not clear that federal librarians can surmount all their difficulties through instrumentation alone, they are aware of their plight and active in their efforts to achieve success. As befits those who collect, preserve, and dispense the world’s knowledge, they are acquiring most of their new ideas, systems, and equipment outside the world of libraries, and by adapting them to their own needs are creating their own mechanisms of service.

Photography

Many of the basic features of instrumentation have been employed in federal libraries for many years, such as the telephone, typewriter, Mr. Gull is Technical Analyst of Documentation Incorporated, Washington, D.C.

printing press, mimeograph, pneumatic tubes, book carriers, adjustable shelving, and that outstanding library development, the unit catalog card and its accompanying cabinets. Libraries seem to have been a bit slow in adding photography to their activities, however, although they have used the services of the photographic laboratories of their agencies for many years. Perhaps the copyright laws and a feeling that scholarship should not be made easy have been partly responsible for this lag. The Photostat was introduced into the Library of Congress in 1912,¹ and served obvious uses in internal administration and in providing photocopies of materials in the Library's collections. In the twenties and thirties it reached a peak of usefulness in the work of "Project A" (extensive copying of records relating to American history in European and other archives) and of "Project B" (the construction of the National Union Catalog in its present form).² Except for a period in which there was a generous supply of WPA labor for typewriter operation, photography has continued to be the principal means of copying large catalogs for addition to the National Union Catalog. In recent years this work has been done on 16 mm. microfilm, and black and white drafts suitable for addition to the Catalog have been obtained by making enlargements with automatic equipment on rolls of paper five inches wide. The cards have had to be cut from the rolls and punched by hand, however, and the need for automatic equipment for this task, although blueprinted for several years, has not yet been met.

The Map Division of the Library of Congress has made ingenious use of microfilm and paper enlargements cut into cards in preparing its dictionary catalog of atlases.³ One of the obstacles to building this catalog was that there were about 1,300 cards of the 4 x 6-inch size. After microfilming these cards, with subject headings and some notes masked out, three enlargements of each card in the 3 x 5-inch dimension were produced, thus making possible an author, subject, and shelf-list record which could be interfiled with other printed, typed, and clipped cards of the same size. Several hundred thousand subject cards are being prepared in a similar fashion for the Cyrillic Subject Union Catalog at LC, in a project which may be finished in 1953.⁴

The microfilming of catalogs at the Library of Congress culminated in 1952 in the copying of the National Union Catalog for preservation purposes, a total of some 11,370,000 cards being photographed on more than 2,600 reels of film in eighty-seven working days. Prints of any or all reels are for sale at four dollars per 100-foot reel, and much

Instrumentation

valuable information has been obtained about the very difficult problem of publishing the Catalog.⁵

Bibliofilm Service, a nonprofit private agency sponsored by Science Service, undertook in 1937 to provide public photocopying for materials in the library of the United States Department of Agriculture and other federal libraries. This was one of the first agencies to employ microfilm on an extensive scale.^{6, 7} It has given way, as the need has become established and the fiscal and other arrangements could be made, to the Department's own laboratory. The latter furnishes a wide photocopying service in agriculture, chemistry, and technology, for which payment can be readily made, if desired, through the system of coupons maintained by the American Chemical Society. It has provided libraries, too, with the Rapid Selector and the Photo-Clerk, products of the active mind of Ralph R. Shaw, Librarian of the Department of Agriculture. Although advance notice has appeared,⁸ the final report on the current experiment with the Photo-Clerk in library operations unfortunately will not be released in time to supply information for this article. It can be said, however, that the Photo-Clerk is currently saving \$18,000 a year in typing costs in thirty operations at the Department of Agriculture Library.

A combined microfilm scanner and enlargement printer will be constructed for the Armed Forces Medical Library, where it has been found that the majority of requests for photocopies are for articles from a small group of about 250 journals. The new machine will speed up service, avoid excessive wear and tear on the bound volumes, and permit the use of the original articles by readers without interfering with photocopy needs. The microfilming of at least a ten-year file of the 250 journals is nearing completion. When photocopies are called for, the film will be placed in the new machine and scanned until the desired pages are located, at which point automatic exposure on paper rolls 8 inches wide and 825 feet long will be made, and the paper will be advanced simultaneously with the exposure. It is probable that this machine will be less expensive than a large Photostat machine.

Microcards, first proposed by Fremont Rider in 1944,⁹ are familiar to librarians as a new and valuable library material to contend with in acquisitions, catalog, reference, and circulation work. Until the Office of Naval Research and the Microcard Corporation entered into a contract in 1950 to prepare such cards from the collections of the Technical Information Division of the Library of Congress, microcards were largely used to provide copies of out-of-print items. The

new program changed the emphasis to that of publishing new materials, not for the sake of replacing other forms, but to reduce the loan problems of the Technical Information Division by giving cards away for retention. Microcards are laminated to the regular cards prepared by the Division, which bear usual catalog information and abstracts of the various reports. The Document Service Center at Dayton, Ohio, has experimented successfully with multilithing the text on the back of the developed microcard, thus eliminating the need to laminate two cards for a report. Since a single sheet of negative film is easier to work with than the strips of microfilm which have been used in preparing the microcards, the Library of Congress Photoduplication Service is testing the use of sheet film in the 3 x 5-inch size. While sheet film is readily duplicated on film or on opaque paper, this microfilm eliminates the possibility of including the cataloging and abstracting with the microfacsimile of the text matter, unless it is multilithed on the back of opaque paper.

The microcard program also provides an opportunity to observe, on a large scale, for the first time, the reaction of users to opaque microfacsimiles, since microcard readers were made available to participants in the experiment on a purchase or monthly rental basis. A backlog of requests for materials out on loan was cleared up very rapidly by supplying microcards, beginning in January 1951. One inquiry conducted by the Technical Information Division indicates that scientists and engineers are somewhat better pleased with the microcard program than librarians and documentalists. Dwight Gray, Chief of the Division, who has provided a full account in *American Documentation*,¹⁰ wrote in January 1953: "There continues to be an increase in the number of our customers, scientists, engineers, librarians and documentalists, who specifically request microcards rather than reports on loan."¹¹ At that date over 600,000 microcards had been distributed, representing 13,000 different reports.

Reflex photography and a dye transfer process are now being employed as an office procedure in some federal libraries, in situations in which one copy, or at most two or three, is needed. The Contoura affords a very simple light source for exposing the paper; and Eastman Kodak, Remington Rand, American Photocopy Equipment Company, and the United States Microfilm Corporation sell developers—all being of their own manufacture except that of the last named firm, which is imported from Germany. The negative and the positive sheets issue from the developer in a few seconds, and they are peeled apart and

Instrumentation

the reverse-reading negative discarded. The positive copy is only slightly damp and dries in a short time. The Copyright Office uses the APECO cylindrical printer for exposing the paper and the APECO Autostat to develop the dye transfer paper; the District of Columbia Public Library uses the Contoura for exposing, and conventional wet chemicals for developing reflex paper.

Completely dry methods of photography are now competing with the older method using wet chemicals. Ozalid, one of the oldest of these, in which diazo dyes are developed by ammonia vapor, has not received wide use in federal libraries because it is limited to copying loose sheets of paper. It is available at the Library of Congress as an alternative to the more familiar blueprint process.

Thermo-Fax is a reflex process dependent on the reflection of heat rays from the characters of the text to be copied. In effect, a light colored substance is burned away from the surface, leaving a copy of the text visible in the dark layer underneath. Since the heat rays are not reflected adequately by certain dyes, this process cannot be employed with all library materials. It is in use at the Library of Congress and the libraries of the State Department for copying correspondence and bibliographies, and in the library of the Weather Bureau in preparing overdue notices.

Xerography can be used as a lens or reflex process, and makes use of the ability of certain metals, notably selenium, to acquire a different electrical charge under exposure to light. Finely powdered carbon and resinous materials adhere to the outline of the original text when the powdered mixture is "flowed" over the exposed plate, and they can be transferred to a sheet of paper by passing the sheet and the plate together under a charged wire. The powder is then fixed on the paper by heating for a few seconds, which melts the resinous materials. Soon after the introduction of Xerox equipment it was discovered that a copy made on a paper offset master provided the lithographic effect, which has led to a joint promotion of Xerox and multi-lith equipment by the Haloid Company, Rochester, New York, and the Addressograph-Multigraph Corporation, Cleveland, Ohio. The combination is used at the Naval Research Laboratory Library and the Library of Congress. Thermo-Fax and Xerography have been described by G. Miles Conrad¹² in *American Documentation*, and James G. Hodgson¹³ has compiled a pamphlet entitled *The Use of Xerography in Libraries*.

Several trends are discernible for photography in the federal library-

ies. One is a continuing increase in the size of central laboratory facilities, caused by the growing business provided by the library and its patrons. This condition is exemplified in the Library of Congress, where the Photoduplication Service has a staff of sixty-one persons and a large laboratory of the most modern equipment, purchased on the strength of a self-sustaining business which operates upon a revolving-fund established by the Rockefeller Foundation in 1938.^{14, 15} An opposite trend is seen in the growing use of equipment, exemplified by the Contoura, Photo-Clerk, and dye-transfer printing, which can be used at or near the desk of the person who needs photocopies and wishes to avoid the delays associated with remoteness, authorization, accounting, and backlogs of work, which are inevitably encountered in any centralized installation. Dry photography is here to stay and will accelerate the tendency to photocopying at the user's desk, while at the same time its great convenience will lead to continuing improvements, with the quality of wet photography as the goal. Already one man is working to give dry photography the flexibility of wet photography plus the rapid reproductive capacity of the printing press; he is William Huebner,¹⁶ and he described his photronic onset to the Library of Congress Staff Forum in the fall of 1951.

Punched Cards

In 1940 the Library of Congress installed punched card equipment, produced by the International Business Machines Corporation, to care for the accounting and billing operations of the Card Division. Since then it has been employed for the records for payrolls, leaves, appropriations, budgets, book purchases, war and defense bonds, and book charging, as well as many other specialized uses. The Tabulating Office staff numbers fourteen, and is one of the most heavily burdened of the Library.

The availability of nearly the entire range of IBM equipment in one installation led the Library to study the possibility of preparing catalogs, bibliographies, and indexes from punched cards. While an internal telephone directory and a couple of catalogs of books available to colleges and universities through the Surplus Books for Veterans project were made from punched cards on the IBM tabulator, limitations of typography, of card capacity, and of the time required to arrange and rearrange large numbers of cards, led to the adoption of other methods, principally the cumulative catalog technique described later in this article. An experiment on a larger scale, the in-

Instrumentation

dexes of the *Bibliography of Agriculture* for 1949, which were produced on the IBM tabulator, ended with the same conclusion.

Two Library of Congress publications, however, continue to be prepared from IBM punched cards, i.e., the *List of Subject Headings* of the Technical Information Division and *Serial Titles Newly Received* (1951-52) of the Serial Record Section of the Order Division. The first derives from cards treated on a specially built punch, which are used to operate two specially wired, card-operated typewriters providing upper and lower case characters, Arabic numerals, and all the punctuation marks and symbols of the conventional typewriter. This installation uses equipment which is not commercially available to achieve a satisfactory typography, but at the price of an increase in the difficulty of punching and a slower rate of printing.

The Cardatype and a conventional punch are utilized to compile *Serial Titles Newly Received*,¹⁷ and with them typography is sacrificed to the commercial availability of the equipment, for the Cardatype does not provide lower-case letters. Both of the publications named above take advantage of those characteristics of punched card equipment which appear to be the most useful for libraries, i.e., storage of information, interfiling of new matter, and repetitive preparation of text for expanded or cumulative editions. They are not employed for the control and recovery of subject information, which is one of the principal uses in nonfederal libraries and private installations, especially with marginally punched and notched cards.

Although marginally punched cards, under various trade names such as Keysort, Rocket, Pathfinder, and E-Z Sort, are widely used in industry¹⁸ and in a number of college and university libraries,¹⁹ they apparently have not been widely adopted in federal libraries. They are employed in circulation work in the Armed Forces Medical Library and in acquisitions work in the District of Columbia Public Library. The Research and Development Board, in the Department of Defense, and the Technical Information Division of the Library of Congress, have experimented with Keysort cards. Kathrine O. Murra is planning a McBee Keysort record of a rapidly growing file of information on international organizations in the General Reference and Bibliography Division of the Library of Congress, and the cards are designed to make it possible to lay them out in page form if it should be desirable to publish the file as a book or pamphlet. A Zator installation is in use elsewhere in the Reference Department. The Zator system²⁰⁻²² provides 36 positions across the top of a 5 x 8-inch

card and another 36 positions along the bottom. Through the use of Boolean algebra these edges are notched in superimposed random codes, and the desired cards can be retrieved from the file by placing them in a simple electric vibrator, provided with removable needles, which sorts at a rate of approximately 800 cards per minute. This installation employs about 415 descriptors (index terms) for the first 10,000 cards or 10,000 items of information. From one to thirteen descriptors can be used for each card, and a four-position random code pattern has been found satisfactory in recovery operations. At this stage in the specialized requirements of the project employing the Zator system, "it is thought feasible if the research project employs ten or more research analysts upon a special program in which the requirements for information retrieval cannot be efficiently handled by traditional library techniques because the activity is group research with recurring requests for large amounts of information showing numerous interactions and interrelations among the data."

The Rapid Selector

The Rapid Selector is another example of the difficulty of classifying information where it can be recovered most usefully. One of its basic ideas was developed by Emanuel Goldberg, a Zeiss-Ikon employee, and patented in this country December 29, 1931, as a statistical machine.²³ In the later 1930's it was independently reinvented by Vannevar Bush when he was connected with the Massachusetts Institute of Technology.²⁴ After World War II interest in it was revived, but the model made there was found to have been dismantled.

In the words of John C. Green, Director of the Office of Technical Services of the Department of Commerce, "The Department of Commerce is particularly eager to see the dream of mechanization of scientific information approach reality because it serves U.S. manufacturing industries through the collection, compilation and distribution of valuable technical information."²⁵ A contract for the construction of a selector was let by the Office of Technical Services to the Engineering Research Associates, Inc., of Arlington, Virginia,^{26, 27} and technical responsibility was entrusted to Ralph R. Shaw, Librarian of the Department of Agriculture. Later, support was secured from the Atomic Energy Commission through the efforts of Mortimer Taube. Shaw has recently received U.S. Patent No. 2,594,358 for the present design of the Rapid Selector.²⁸

Briefly, catalog entries or entries and abstracts, or other text, are

Instrumentation

photographed on one-half of 35 mm. microfilm, with subject coding to correspond on the other half. The coding consists of patterns of small opaque dots. When a reel of film is searched, a pattern of dots complementary to those being sought is inserted in the Selector, and the film is run through the machine at a rate of 500 feet, representing 120,000 coded subjects, per minute. Whenever the desired pattern is encountered, it is detected by photoelectric cells, and a flash photograph is taken of the corresponding entry and abstract on fresh film. This film can be developed for use in a microfilm reader, or enlarged on paper for use with the unaided eye. Improvements have been made in the coding patterns by adopting binary and other more flexible numbering systems, in the keyboard for recording the codes, and in the flash camera mechanisms, which were not fast enough in the original design.²⁹

Cataloging

Photography, punched cards, and the Rapid Selector were the principal advances in instrumentation which were available or foreseeable when serious consideration was given to finding new techniques for those central activities, descriptive and subject cataloging, upon which all the public services draw so heavily. In this area the possibility of basing new mechanical applications and methods upon a better understanding of the mental processes behind cataloging seemed particularly promising.

While the Library of Congress experimented with multilithed temporary cards in the years just prior to World War II, it has continued to rely upon typesetting machines and the flatbed press to produce its printed catalog cards; but for a decade it has used Standard rotary fluid process duplicators to prepare preliminary cataloging cards. These cards are used in a process which was adopted to keep track of the thousands of books which are always in process of cataloging at any given time. A minimum of eighteen cards is made for each title, and as the title progresses to full cataloging, a copy of the card is used as follows: (1) to show location in the Descriptive Cataloging Division; (2) to show location in the Subject Cataloging Division; (3) to show location on the shelves; (4) as a temporary shelf-list record; (5) as a temporary author card in the main catalog. The first three cards are filed in succession in the Process Information File, from which telephone reference service is supplied during the regular working hours of 8:30 to 5:15, Monday through Friday. All cards are

replaced eventually by printed cards. Other copies are used to advise reference workers of new materials, and some are distributed outside the Library.

The trend was not only toward a better control of incoming materials during cataloging, but toward simpler cataloging, and therefore, it was hoped, speedier and more economical cataloging. It was furthered by a trip across the country in 1943, to visit many of the country's principal catalogers, by Herman H. Henkle, then Director of the Processing Department, and Lucile M. Morsch, Chief of the Descriptive Cataloging Division. The results of this trip were incorporated in a pamphlet called *Studies of Descriptive Cataloging*,³⁰ in the writing of which Seymour Lubetzky played a principal part. After receiving the report of the Advisory Committee appointed to investigate the subject,³¹ Luther H. Evans, Librarian of Congress, directed Morsch to prepare the Library's *Rules for Descriptive Cataloging*,³² which was published in 1949. The concurrent choice of Clara Beetle of the Descriptive Cataloging Division to edit the second edition of *A.L.A. Cataloging Rules for Author and Title Entries*, and its publication in 1949,³³ ended one phase of the dissatisfaction with the preliminary second American edition of the *A.L.A. Cataloging Rules* in 1941;³⁴ but it was recognized that rules for the descriptive cataloging of sound recordings, motion pictures, manuscripts, prints and photographs, and books for the blind were lacking, and that the rules for corporate entry, as distinct from those for personal authors, were in need of revision. The continuing work on these rules is described in the annual report of the Librarian of Congress for 1952.³⁵ Lubetzky is currently working on the rules of corporate entry.

Another step towards simplification is found in Processing Department Memorandum No. 60, April 20, 1949, under which the Library of Congress is establishing the names of personal authors on the basis of "no conflict" with other names in its Official Catalog. This policy appreciably reduces the labor necessary to fix personal names.

Subject cataloging, too, has received its share of attention in recent years, and the first practical treatise in English on devising subject headings is one of the results; this is David J. Haykin's *Subject Headings, a Practical Guide*,³⁶ written while he served as Chief of the Subject Cataloging Division at the Library of Congress. In his present capacity as Consultant in Classification and Subject Cataloging, Haykin has begun the preparation of a code of rules governing the assignment of subject headings.³⁷

Instrumentation

The past decade has seen the Library of Congress continue the publication of its very comprehensive list *Subject Headings Used in the Dictionary Catalogs of the Library of Congress*, with the fourth edition in 1943 and the fifth in 1948, plus cumulative supplements to date, all from the Government Printing Office. Music was treated last year, with the publication of *Music Subject Headings*.³⁸ The Technical Information Division has brought out three editions of its *List of Subject Headings*, already mentioned in the discussion of punched cards. This is a consistent attempt to use uninverted headings; and with the unification of the technical information services of the Department of Defense under the direction of the Armed Forces Technical Information Agency, it has become the principal authority for subject cataloging of government-sponsored scientific and technical reports.

The Library of Congress has made a successful effort in recent years to keep all of its classification schedules in print, and those for many of the more rapidly changing subjects have been made available in revised editions, of which one embodies development of Class K, Law.³⁹ Since 1930 the Library has maintained a Decimal Classification Section in the Subject Cataloging Division, to apply Dewey decimal classification numbers to printed catalog cards for books which are of particular interest to the public libraries of this country, and it has provided space for the editorial staff of the *Dewey Decimal Classification*. While these activities represent real services to the library world, the Library has never supplied a manual on its classification schedules and their use, and such a publication should be of great utility to the several hundred libraries which use the LC classification for their collections. Leo E. LaMontagne is now delving into the history of the LC classification, and it is very much to be hoped that he will be asked to follow it up with a treatise.

Activity in other federal libraries which has affected the trends in cataloging includes production of the following:

The *Army Medical Library Classification, Medicine*.⁴⁰ The American Library Association survey made in 1944 recommended, "The best classification scheme that could be devised for the Library would be one which combined the notation of the Library of Congress system with the basic plan of the Cunningham classification."⁴¹ This recommendation was followed, and the letters QS through QZ, and W, which were unused in the LC classification, were used in developing the new classification. Medical libraries which wish to adopt the LC

notation now have a choice of the older R schedule or the newer QS-QZ and W schedules for medicine.

*Subject Headings Used in the Catalogs of the U.S. Atomic Energy Commission.*⁴² This list is the authority for subject cataloging in sixty-five libraries of the Commission and its contractors, and can be used for the many AEC reports in other libraries. Other subject headings lists from federal libraries are reported on in the *Journal of Cataloging and Classification*.⁴³

TIP cards and abstract bulletin. From 1947 into 1953 the Technical Information Division of the Library of Congress prepared catalog cards with abstracts and tracings, its abstract bulletin, the *Technical Information Pilot*, and indexes to the abstract bulletin, all from one original typing on cards. In doing so it used photographic reduction, multilithing, and the cumulative catalog technique.⁴⁴

The catalog cards of the National Advisory Committee on Aeronautics. Since 1947 the Division of Research Information has provided catalog cards for each report on sheets placed in every report, from which the cards can be cut for use in libraries. In addition to the descriptive information, these cards provide an abstract, and subject and author-title tracings. The tracings are on the right margin, as is true with the *TIP* cards.

The Veterans Administration Library Service presents a picture of instrumentation centered on cataloging, but involving new selection and acquisitions techniques as well. The Administration is currently operating a thirty-year-old library system, involving approximately 450 separate libraries, hospitals, and regional offices throughout the country. Some of the libraries provide recreational and educational reading for the patients, and others offer reference and research service to the medical and hospital staffs. One of the truly dramatic features is the projected book, which can be read on the ceiling by seriously disabled patients.

The year 1945 appeared to offer a splendid opportunity to establish a program of centralized book procurement and cataloging. In 1946 the Library Service secured authorization to perform its own book procurement, and in 1947 a system of centralized cataloging was placed in effect, to supply catalog cards to all the general and medical libraries in the various installations.

The field librarians retain responsibility for book selection. In order to provide specialized book-reviewing information, to guide in book selection, and to supplement existing trade media, the Book Review

Instrumentation

Division in Washington keeps them continuously advised of new publications, with emphasis on the suitability or unsuitability for use in hospitals. The field librarians select the material needed in the local libraries and forward requests weekly to Washington, in accordance with the quarterly budgetary allocations.

On receipt of such requests the Technical Processes Division in Washington groups orders from several stations for the same book, for rapid and efficient handling of purchase orders. These are written from IBM punched cards containing all essential information, such as dealer's name and address, author, title, list price, and discount. The books are shipped from the dealers directly to the hospitals or regional offices; but the covering vouchers are returned to Washington, where payment is made on the basis of signed receipts from the station librarians.

The cataloging of all titles so ordered is performed centrally in Washington, without reference to the books themselves. Cataloging information is obtained by searching standard sources of bibliographical information, and through use of catalog cards of the Library of Congress and the Armed Forces Medical Library. Traditionalists may view this kind of cataloging with alarm, but the results are convincingly satisfactory.

Catalog cards are reproduced on Elliott stencil addressing equipment. The bibliographical information pertaining to each title is typed in capitals on a special stencil, which provides a field allowing nine lines of thirty-two characters each. Separate stencils repeating the entry information are cut for each of the subject headings and added entries, as well as for the book-charging card and book pocket. Cards are thus reproduced with and without headings on the addressing machines in the quantities required by current ordering, and a limited stock of catalog cards, book cards, and pockets is established to take care of future orders. Because there is normally a delay in supplying books from the dealers, the cards and pockets usually arrive at the field stations in advance of the corresponding books.

The use of mechanical equipment at one central point to order books for 450 libraries eliminates the necessity of maintaining duplicate files of order records throughout the library system, and enables a small staff to operate a procurement program spending over \$700,000 a year for books and magazines. By cataloging without reference to the books, a staff of three professional catalogers and fifteen clerks and clerk-typists performs the cataloging, and supplies the catalog

cards for all books purchased for the 450 libraries, a total of 250,000 copies of 14,000 titles annually. Studies of this operation indicate that it is at least 50 per cent cheaper to catalog in Washington than in the field, and the field librarians' time is free for direct service to the patients and hospital staff.^{45, 46}

Catalogs in Book Form

The Library of Congress has pioneered in producing catalogs in book form from catalog cards as the original copy. The Union Catalog Division's files contain photostats, made as early as 1928, of typed cards laid out in columns to make up a page.

By 1940 a group of forward looking librarians headed by William Warner Bishop, then Librarian of the University of Michigan, realized that the idea of depository catalogs consisting of Library of Congress printed cards had run into a practical snag simply because so many cards had been printed and deposited in forty years that the recipients could not afford to house and file the incoming ones. Yet the need of the information contained in such a bibliographical and cataloging tool was greater than ever. Photo-offset lithography, which had grown apace during the same years, seemed to offer the best solution for converting an author file of Library of Congress cards into a catalog in book form. The Association of Research Libraries obtained the permission of Archibald MacLeish, then Librarian of Congress, to copy the cards, and secured Edwards Brothers, Publishers, of Ann Arbor, Michigan, to undertake the photo-offset lithography and binding. James M. Boyland oversaw the arrangement of the cards in Ann Arbor, and John W. Cronin, of the Library of Congress, read each of the more than 100,000 pages in Washington, before printing, to check on the order of the entries. The result was *A Catalog of Books Represented by Printed Catalog Cards in the Library of Congress to July 31, 1942*,⁴⁷ in 167 volumes of about 600 pages each. Subsequently there was issued a *Supplement through December 31, 1947*,⁴⁸ in 42 volumes. The basic set and the supplement, popularly known as the Edwards Catalog, immediately joined the ranks of the other great printed library catalogs, principally those of the British Museum in London and the Bibliothèque Nationale in Paris.

There were technical difficulties with these volumes which caused a considerable waste of paper. The cards had been printed for card catalogs with wide margins at the top and left edges for headings and call numbers, and the lines were spaced out for aesthetic effect. Henkle

Instrumentation

and Cronin presented this problem to the Government Printing Office; and Philip L. Cole, then Director of Planning Service, and R. C. Smith suggested that the lines of type could be rearranged as the cards were printed daily, and invented the Card Aligning Device⁴⁹ on which the cards could be placed in page form. With the lines closed up and with narrow margins at the top and left edges, it was possible to lay out an average of thirty-nine cards per page, compared to eighteen in the Edwards Catalog, with a slight increase in the size of the type as well. Monthly issues and quarterly cumulations in author arrangement were published during 1947 in developing the technique experimentally, and in 1948 *The Library of Congress Cumulative Catalog* became the continuation of the Edwards Catalog and its Supplement.

Further experimentation led to *The Library of Congress Subject Catalog* in 1950, at which time the *Cumulative Catalog* became *The Library of Congress Author Catalog*. In 1950 a newly available low-tack Scotch tape was adopted for holding the cards in place for the camera; and it became possible to discontinue the preparation of multiple sets of cards, one for each cumulation, which had been necessary because the high-tack Scotch tape damaged the cards when an attempt was made to strip them from the cardboard for subsequent use. The technique of preparing these catalogs is described in detail in *American Documentation*.⁵⁰ The inherent flexibility of the technique is silently acknowledged in the announcement that, commencing in 1953, separate parts will be available for maps and atlases, films, and music and phonorecords, all as component parts of a general *LC Catalog*.⁵¹

The cumulative catalog technique is not dependent upon printed cards and the rearrangement of slugs of type, but is equally satisfactory with typed cards. Several Library of Congress publications, such as the *Monthly Checklist of State Publications*, the *Monthly Checklist of Russian Accessions*, the *Technical Information Pilot*, and certain parts of the *Catalog of Copyright Entries*, are laid out on the Card Aligning Device, on aluminum mounting boards, or on drafting boards. Paul Howard, Librarian of the Department of the Interior, also has designed a mounting board which is used for an accessions list in his library, and it has been adopted by Clickner in the Municipal Reference Library of the Census Bureau.

The Armed Forces Medical Library has utilized the cumulative catalog technique for its *Current List of Medical Literature* and

has, since April 1948, sold its catalog cards through the Library of Congress and permitted their reproduction in book form as a supplement to the *LC Catalog*. The volumes for 1948 and 1949 were in author order only; the 1951 one was in two substantially equal parts, author and subject, and presumably this will be true of subsequent volumes. All are prepared on the Card Aligning Device.

Nearly everything that might be written about the current rejuvenation of the Armed Forces Medical Library, which dates from World War II, is concerned with instrumentation in its broadest sense. The scope of the Library has been re-examined and new acquisitions policies adopted.⁵² As we have seen, a new classification has been devised and accepted; and descriptive and subject cataloging processes have undergone a thorough overhauling.^{53, 54} The reference services have been affected only through the acquisitions and cataloging operations, because neither punched cards nor the Rapid Selector is yet a satisfactory substitute for reference workers.

The reorganization of the Armed Forces Medical Library revealed that that mainstay of other years, the *Index-Catalogue of the Surgeon General's Library*, was hopelessly out of date and losing ground every year, due partly to the nature of the cataloging processes and partly to the delays and expense of letterpress publication, but even more to the traditional policy of publishing the full alphabet in one series before starting that in the following series. The *Armed Forces Medical Library Catalog* in two parts—author and subject—is solving the problem for books, both current and retrospective, as recataloging progresses through the Library's collections. The *Current List of Medical Literature* has taken over the treatment of current periodical literature. There remain over a million periodical articles for which copy was prepared but never published in the *Index-Catalogue*. A most desirable development would be for the Armed Forces Medical Library to compile selections from them as speedily as possible.⁵⁵⁻⁵⁷

The *Current List* has, commencing with Volume 19, July 1950, contained three parts, viz., a register section, which is a listing of tables of contents of the various issues of periodicals; an author index with six columns per page; and a subject index, of three columns per page. The indexes are now cumulated in June and December each year. All entries are typed and stamped with serial numbers before they are separated as cards for the three parts, after which they are arranged and laid down on the Card Aligning Device. The indexes are true indexes—they refer from authors or headings to the titles by number,

Instrumentation

and do not repeat the information as is done in a subject catalog. The subject heading authority list for the *Current List* has undergone an interesting development, including a rapid compilation of the list by making use of some IBM punched cards already available through the Medical Indexing Project at the Johns Hopkins University.⁵⁸⁻⁶⁰ Unfortunately for the present article the final report of this Project, a contract let by the Armed Forces Medical Library and under the direction of Sanford V. Larkey, will not be available for summarizing here, but preliminary information is found in the Army Medical Library's Annual Report,^{61, 62} and in an article by Larkey.⁶³

The Department of Agriculture Library makes use of a modification of the cumulative catalog technique in preparing the monthly *Bibliography of Agriculture*, which, with about 96,000 entries each year for books and periodical articles, is of about the same size as the *Current List*. Entries are typed on slips and arranged in ten broad classes, after which they are numbered and affixed to sheets. No machine is used. The index slips for authors and subjects bear the same numbers as their entries, but only the author slips are laid out for the camera. The subject slips are recopied on long strips, which are then mounted for the camera. The indexes for Volume 13, 1949, were prepared on IBM punched cards, but this technique was abandoned because the typography was unsuitable for high reduction, although the method lessened the workload at the end of each volume.⁶⁴

The principal federal libraries—the Library of Congress, the Department of Agriculture Library, and the Armed Forces Medical Library—have made a complete conversion from letterpress to photo-offset lithography in recent years for their chief book catalogs and periodical indexes, all of which are based on the principle of laying out pages from cards or slips mounted on cardboards for the camera. These techniques have rendered it possible to provide author and subject records to some 280,000 books and periodical articles annually, with the distinct advantages of usable arrangements and timeliness. Since the coverage of the volumes is international rather than national, the collective achievement has no parallel elsewhere.

Storage

A new type of storage shelving, manufactured by Remington Rand, Inc., has been installed in the libraries of the Naval Research Laboratory and the National War College in Washington, in response to the changing character of published scientific and technical literature,

C. D. GULL

which is turning to reports in pamphlet form and away from monographic and serial publications. The shelving, basically similar to nonfreestanding bookstacks, can be used in single- or multiple-tier installations. The shelves can be inserted anywhere vertically on one-inch centers. They are equipped individually with backs about five inches high and are slotted to receive dividers on three-inch centers. These dividers are $4\frac{5}{8}$ inches high and serve to keep the flexible pamphlets from sliding over the shelves, as well as to make it easier to see titles and identification numbers on their backs. The new shelving is more economical of floor space than the filing cabinets widely used for storing such materials, because the shelving can be carried up to the limit of 7 feet 6 inches, which is not practical with filing cabinets. The following comparison shows the economy of divided shelves:

<i>Containers</i>	<i>Average number of reports per square foot of floor space</i>
16 four-drawer files in $87\frac{3}{4}$ sq. ft.	1344
16 five-drawer files in $87\frac{3}{4}$ sq. ft.	1680
4 tiers of divided shelves, each 9 ft. long, in 81 sq. ft.	2940

The libraries in the Navy Department which have surplus reports are fortunate in being able to remove them from their shelves for storage in the nearest Navy Record Center.

The District of Columbia Public Library has standardized all the shelving in its system; it is using bracket shelving made to specifications drawn by Alvan C. Chaney, and the shelving has been built by Sjöström and the Alexandria Woodworking Company, of Philadelphia, Pennsylvania, and the Georgia Showcase Company, of Montgomery, Alabama. This Library is also using a book truck designed by Chaney; shelves are mounted on a dolly measuring 22 inches by 36 inches, and slant inwards so that two rows of books can be placed on one. Since one man can move up to 600 books on a single truck, these vehicles are especially good for large-scale moves.

An interesting phase of storage stems from the work of William J. Barrow, document restorer of Richmond, Virginia, whose laminating device has been used in the Library of Congress since 1947 for the preservation of letters, maps, sheet music, and similar materials. The sheets are protected by laminating them with cellulose acetate and tissue under heat and pressure, after treatment to eliminate the chem-

Instrumentation

ical causes of deterioration. Barrow also discovered that the ink could be transferred in a similar manner from seriously deteriorated paper to rag paper and preserved there by lamination. The Library of Congress has arranged to have a number of volumes treated in this manner annually, raising the interesting question, "Will an ink-lifted first edition become a first edition once removed?"^{65, 66}

A very small percentage of library collections is now recorded on microfilm or is found on single sheets for rapid scanning from conveyor belts. Most of the information is in bound volumes or in serial issues in pamphlet form. In recognition of this condition, Taube pressed for the development of flatbed scanning for facsimile communication, to replace, for library use, the more conventional rotary scanning in which the original is wrapped around a cylinder. The result is RCA's flatbed facsimile scanner and receiver, which has been tested by the library system of the Atomic Energy Commission at Oak Ridge, Tennessee. There are now a scanner and receiver in the Loan Division at the Library of Congress, undergoing daily testing.⁶⁷⁻⁶⁹

In further recognition that such devices are still in the experimental stages, the Technical Information Division of the Library of Congress has subscribed to unattended teletype (TWX) service, since it found that most of its customers were doing so. With this equipment the Division receives requests at any hour of the day, and replies with reference data or asks for further information. Stimulated by the experience of the Midwest Inter-Library Center and other libraries using teletype, the Library of Congress has installed that system for its regular divisions in the Secretary's Office.⁷⁰

Summary of Trends

Instrumentation has played an ever-increasing role in federal libraries, and it will assume even greater importance in the coming years, for the reasons mentioned at the beginning of this paper. Until now, however, there has been little organized research to discover what can be accomplished by it. One of the most encouraging trends is to be seen in the contract let by the Armed Services Technical Information Agency to Documentation, Incorporated, to study classification systems and lists of subject headings already in use in the Department of Defense, and to recommend a method of controlling subject information which the Agency can use in unifying and directing the technical information services in the Department. The experimental approach required in this contract has already resulted in the

Uniterm system of coordinate indexing, which appears to hold great promise for more satisfactory subject control.⁷¹⁻⁷⁴

The Rapid Selector, Zator installations, and certain mechanical and marginal punched card installations, have one characteristic in common: the complete record must be searched every time a question or a combination of questions is to be answered. Obviously such a search is feasible in a large collection only if the operations are kept at high speed. Years ago, before such machines were conceived of, federal librarians adopted classification of materials on the shelves and subject headings for their catalogs in an attempt to overcome the problem of inspecting all the shelves or of reading all the way through a catalog; but neither classification schedules nor subject headings offer mutually exclusive pigeon holes or concepts, so that it is necessary to search in many places to locate answers. In serious investigation there is always the haunting fear that too few places were searched. The development of coordinate indexing has sharply defined the distinction between systems requiring full and partial searches, for it offers the chance to hunt all the information on one or more subjects without surveying the complete record.

Looking to the future, acquisitions work will certainly benefit from improved communications, and from wider application of the policy of having materials for the United States government collected by the Publications Procurement Officers of the State Department. Catalogers and classifiers will continue to seek improvements in recording devices, perhaps such as RCA's pencil-sized facsimile scanner, and for better methods of author and subject control. Reference workers will go on pressing for better copying methods, more adequate collections and procedures for collecting, better communication between libraries, and faster and easier recovery of stored information, in the amounts and directions they need, whether it be simple or complex. Thus, we can expect to see further work towards Memexes and Rapid Selectors, but we should not overlook the difficulties and probable delays in realizing the millenium.⁷⁵⁻⁷⁸

References

1. U.S. Library of Congress: *Report of the Librarian of Congress . . . 1912*. Washington, D.C., U.S. Government Printing Office, 1912, p. 114.
2. U.S. Library of Congress: *Reports of the Librarian of Congress, 1928-34*. Washington, D.C., U.S. Government Printing Office, 1928-1934.

Instrumentation

3. Cole, Maud D., and Steinbinder, Helen: The Formation of a Dictionary Catalog of Atlases in the Library of Congress Map Division. *D.C. Libraries*, 23:3-5, Jan. 1952.
4. U.S. Library of Congress: *Annual Report of the Librarian of Congress . . . 1952*. Washington, D.C., U.S. Government Printing Office, 1952, p. 76.
5. *Ibid.*, pp. 74-75.
6. Davis, W.: Microphotographic Duplication in the Service of Science. *Science*, 83:402-404, May 1, 1936.
7. Davis, W.: Next Steps in Microfilm. *Saturday Review of Literature*, 28: 13-14+, June 9, 1945.
8. Shaw, R. R.: Photo-Clerical Experiment. *A.L.A. Bulletin*, 46:39-40, Feb. 1952.
9. Rider, F.: *The Scholar and Future of the Research Library*. New York, Hadham Press, 1944.
10. Gray, D. E.: Practical Experience in Microfacsimile Publication. *American Documentation*, 3:58-61, Jan. 1952.
11. Gray, D. E.: Letter dated Jan. 30, 1953.
12. Conrad, G. M.: Thermo-Fax, Stenafax and Xerox. *American Documentation*, 2:95-97, April 1951.
13. Hodgson, J. G.: *The Use of Xerography in Libraries*. Fort Collins, Colo., Colorado A. & M. College Library, 1952.
14. U.S. Library of Congress, *op. cit.*, ref. 4, chart facing p. 96, p. 103.
15. U.S. Library of Congress: *Annual Report of the Librarian of Congress . . . 1938*. Washington, D.C., U.S. Government Printing Office, 1939.
16. Huebner, W. C.: The Photronic Reproducer. *American Documentation*, 2: 238-240, Oct. 1951.
17. Keller, A. H.: *A Plan for the Development of a Union Catalog of Serials by Punched Card Methods*. Washington, D.C., Library of Congress, 1950.
18. Casey, R. S., and Perry, J. W., eds.: *Punched Cards; Their Application to Science and Industry*. New York, Reinhold, 1951.
19. McGaw, H. F.: *Marginal Punched Cards in College and Research Libraries*. Washington, D.C., Scarecrow Press, 1952, pp. 174-176.
20. New Filing System Developed for Special Collections. *Library Journal*, 73:794-797, May 15, 1948.
21. McGaw, *op. cit.*, pp. 196-198.
22. Mooers, C. N.: Zatocoding Applied to Mechanical Organization of Knowledge. *American Documentation*, 2:20-32, Jan. 1951.
23. U.S. Patent No. 1,838,389, Statistical Machine, granted Dec. 29, 1931, to Emanuel Goldberg.
24. *The Rapid Selector*, July 1940. Cambridge, Mass., Research Corp., 1940.
25. Green, J. C.: Letter dated Feb. 13, 1953.
26. *Report for the Microfilm Rapid Selector*. Contract Cac-47-24 with Department of Commerce, Office of Technical Services. St. Paul, Minn., Engineering Research Associates, Inc., June 20, 1949.
27. Green, J. C.: The Rapid Selector—An Automatic Library. *Military Engineer*, 41:350-352, Sept.-Oct. 1949.
28. Rapid Selector Patented. *Library Journal*, 78:310, Feb. 15, 1953.

29. Wise, C. S., and Perry, J. W.: Multiple Coding and the Rapid Selector. *American Documentation*, 1:76-83, April 1950.
30. U.S. Library of Congress. Processing Department: *Studies of Descriptive Cataloging*. Washington, D.C., U.S. Government Printing Office, 1946.
31. U.S. Library of Congress. Advisory Committee on Descriptive Cataloging: *Report . . . to the Librarian of Congress*. Washington, D.C., Library of Congress, 1946.
32. U.S. Library of Congress. Descriptive Cataloging Division: *Rules for Descriptive Cataloging*. Washington, D.C., U.S. Government Printing Office, 1949.
33. American Library Association. Cataloging and Classification Division: *A.L.A. Cataloging Rules for Author and Title Entries*. Ed. 2. Chicago, The Association, 1949.
34. American Library Association. Catalog Code Revision Committee: *A.L.A. Catalog Rules, Author and Title Entries*. Preliminary American 2nd Ed. Chicago, The Association, 1941.
35. U.S. Library of Congress, *op. cit.*, ref. 4, pp. 33-36.
36. Haykin, D. J.: *Subject Headings, a Practical Guide*. Washington, D.C., U.S. Government Printing Office, 1951.
37. Subject Heading Code in Preparation. *Journal of Cataloging and Classification*, 8:130, Dec. 1952.
38. U.S. Library of Congress. Subject Cataloging Division: *Music Subject Headings Used on Printed Catalog Cards of the Library of Congress*. Washington, D.C., U.S. Government Printing Office, 1952.
39. U.S. Library of Congress, *op. cit.*, ref. 4, p. 71.
40. U.S. Army Medical Library: *Classification, Medicine*. Washington, D.C., U.S. Government Printing Office, 1951.
41. *Ibid.*, p. 3.
42. Greene, A. G.: *Subject Headings Used in the Catalogs of the U.S. Atomic Energy Commission*. Oak Ridge, Tenn., Reference Branch, Technical Information Service, 1951.
43. Bibliography of Subject Headings Lists 1938-1952. *Journal of Cataloging and Classification*, 8:159-170, Dec. 1952.
44. Taube, M.: The Planning and Preparation of the *Technical Information Pilot* and Its Cumulative Index. *College and Research Libraries*, 9:202-206, July 1948.
45. Mohrhardt, F.: VA Libraries Reach from Ocean to Ocean. *Library Journal*, 76:1098-1103, July 1951.
46. Logsdon, R. H.: V.A. Speeds Cataloging Procedures. *Library Journal*, 73: 166-168, Feb. 1, 1948.
47. *A Catalog of Books Represented by Library of Congress Printed Cards Issued to July 31, 1942*. Ann Arbor, Mich., Edwards Bros., 1942-46, 167v.
48. *A Catalog of Books Represented by Library of Congress Printed Cards. Supplement, Cards Issued August 1, 1942-December 31, 1947*. Ann Arbor, Mich., J. W. Edwards, 1948, 42v.
49. U.S. Patent No. 2,527,532, Card Aligning Device, granted Oct. 31, 1950, to Philip L. Cole.
50. Gull, C. D.: The Cumulative Catalog Technique at the Library of Congress. *American Documentation*, 2:131-141, August 1951.

Instrumentation

51. *Library of Congress Information Bulletin*, 12:12-13, Jan. 26, 1953; 12:18, Feb. 16, 1953.
52. U.S. Army Medical Library: *Policy on Scope and Coverage*. Washington, D.C., U.S. Government Printing Office, 1951.
53. Rogers, F. B.: Cataloging and Classification at the Army Medical Library. *Bulletin of the Medical Library Association*, 39:28-33, Jan. 1951.
54. MacDonald, M. R.: Cataloging at the Armed Forces Medical Library, 1945-1952. Will appear in *Journal of Cataloging and Classification*, Vol. 9, no. 2.
55. The Army Medical Library's New Publication Program. *D.C. Libraries*, 21:53-55, April 1950.
56. Rogers, F. B., and Adams, S.: The Army Medical Library's Publication Program. *Texas Reports on Biology and Medicine*, 8:271-300, Summer 1950.
57. U.S. Army Medical Library: *Army Medical Library Annual Report . . . 1951*. Washington, D.C., The Library, 1952, p. 51.
58. U.S. Army Medical Library: *Army Medical Library Annual Report . . . 1950*. Washington, D.C., The Library, 1951, pp. 53-55.
59. U.S. Army Medical Library, *op. cit.*, ref. 57, pp. 47-50.
60. Taine, S. I.: Subject Heading Authority List of the Current List of Medical Literature. *Bulletin of the Medical Library Association*, 41:41-43, Jan. 1953.
61. U.S. Army Medical Library, *op. cit.*, ref. 58, p. 8.
62. U.S. Army Medical Library, *op. cit.*, ref. 57, p. 9.
63. Larkey, S. V.: The Welch Medical Library Indexing Project. *Bulletin of the Medical Library Association*, 41:32-40, Jan. 1953.
64. Schindler, Margaret C.: The Preparation of the Bibliography of Agriculture, 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. 226-235.
65. *Library of Congress Information Bulletin*, pp. 7-8, April 26-May 2, 1949; 9:13-14, July 24, 1950; 10:8, Oct. 15, 1951.
66. U.S. Library of Congress: *Annual Report of the Librarian of Congress . . . 1950*. Washington, D.C., U.S. Government Printing Office, 1950, pp. 132, 167-168.
67. Radio Corporation of America. RCA Victor Division: *Report on Remote Facsimile Duplicator Equipment*. Camden, N. J., 1951.
68. Velie, L.: A Million Words a Minute. *Collier's*, 122:13-14+, Oct. 30, 1948.
69. Radio Corporation of America. Department of Information: *RCA Ultrafax, a High Speed Radio Communication System*. New York, The Corporation, 1948.
70. WA333. *Special Libraries*, 43:322, Oct. 1952.
71. Taube, M.: Specificity in Subject Headings and Coordinate Indexing. *Library Trends*, 1:219-223, Oct. 1952.
72. Taube, M.: *The Coordinate Indexing of Scientific Fields*. (Documentation Studies No. 2) Washington, D.C., Documentation Inc., 1952.
73. Taube, M., et al.: Unit Terms in Coordinate Indexing. *American Documentation*, 3:213-218, Oct. 1952.
74. Taube, M.: *Coordinate Indexing Without Machines*. (Documentation Studies No. 1) Washington, D.C., Documentation Inc., 1952.
75. 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, Ill., University of Illinois Press, 1951, pp. 57-71.

C. D. GULL

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

77. Bristol, R. P.: Control of Subject Information; Can It Be Mechanized? *College and Research Libraries*, 11:222-227, July 1950.

78. Bristol, R. P.: Can Analysis of Information Be Mechanized? *College and Research Libraries*, 13:131-135, April 1952.