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## On-Line Serials Control at UCLA\*

The Biomedical Library at UCLA is the primary library for the UCLA Center for the Health Sciences, which includes the Schools of Medicine, Dentistry, Nursing and Public Health, the hospitals, clinics and institutes, and the Life Sciences Division. The center is one of the largest teaching and research centers of its type. In 1971 it retained 589 full-time and part-time faculty, 505 postdoctoral and full-time research appointees, and a support staff of more than 2,500 administrative, technical, clerical and other personnel.

An important ancillary division within the center is the Health Sciences Computer Facility (HSCF) which has as its primary goal the furtherance of biomedical research through the development of the mathematical and statistical methods and the data handling facilities required to enhance such research. One of the most significant products of the facility's interest in developing new uses for its computer is the Terminal Oriented Real-Time Operating System (TORTOS) which allows its user community remote access to the computer via terminals. The computer used by the facility is a large IBM machine, the 360 model 91.

Within the framework of its environment at the Center for the Health Sciences, the Biomedical Library carries out its objectives of supporting the teaching, research and service functions of the center. The library has approximately 6,500 regular users, chiefly faculty, students and research staff of the schools and departments mentioned. In addition, in the interest of the service

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function of the university, the library extends its services to affiliated hospitals and the local health sciences community. Through the extramurally supported Pacific Southwest Regional Medical Library Service and other projects, it provides a variety of subregional, regional, national and international services. One example of this service is the library's handling of some 3,000 interlibrary loan requests per month through the Regional Medical Library Program.

As is generally the case with libraries in the physical and life sciences fields, particularly in research-oriented institutions, journals and periodicals are the mainstay of the library services. In order to adequately cover the scope and range of materials required by the service function, the library maintains subscriptions to about 6,500 journals. The goal is to collect all important materials within scope which are published throughout the world.

Recognizing the potential of automation to handle the large quantities of data entailed by our periodical operations, we became one of the first libraries to enlist the use of the computer to manage our files of journal information when the initial efforts at systems design and programming were begun in 1963. By 1966 a machine-readable file had been prepared and initial listing and updating capabilities were operational. By the end of 1969 we had developed an integrated card and tape oriented batch process system to handle our check-in, claiming, and binding operations, and in that year published our first annual serials holdings list in conjunction with the Regional Medical Library operations.

A brief description of the batch processing system will provide the necessary background for a description of the on-line system which has now replaced it. The following figures provide an idea of the activity involved in the batch system: about 150 journals arrived each day to be checked in; every other week over 400 completed volumes were sent to the bindery to be bound; and as many as 100 computer-produced claim letters were processed weekly. New entries due to new subscriptions or changed titles averaged about 12 per week; other changes or additions to existing records averaged several hundred per week. In summary, each week at least 15 percent of the records in the file were altered or updated in some way.

All updates of the type just mentioned were made via punched cards sent into the computer once a week. In addition to the programmer who worked about half time at maintaining and supervising the system, two library assistants working exclusively at the coding, keypunching and other card handling aspects of the system were required to process the work. It should be pointed out that at least one of these two and probably both would in any case have been required to put the manual system into optimum condition and to process the claiming backlog of many years standing.

Against the computer and equipment costs of \$7,542, and the half time programmer salary of \$6,000, or a total of \$13,542 per year cost, about

\$15,950 of benefits resulting mainly from increased efficiencies of operation have been calculated in the areas of interlibrary loan, reference services, claiming and binding operations and acquisitions. We estimate that the batch system resulted in a net savings to the library of \$2,408 per year, the difference between the \$15,950 of benefits and the \$13,542 of costs.

## THE PRESENT ON-LINE SYSTEM

As indicated, the Health Sciences Computer Facility which serves the Center for the Health Sciences at UCLA has an innovative program for developing terminal-oriented facilities and services for its user community. When we became reasonably sure that the facility would be able to provide a general time-sharing system, allowing users to maintain relatively large data bases and allowing several hours per day of access to such a data base at a reasonable cost, we resolved to develop an experimental terminal-oriented system for complete serials control. Our immediate objective was to design an on-line serials control system which would allow us to eliminate all card handling and keep the data base current at all times in all respects. We thereby hoped to be able to reduce the heavy workload of coding and keypunching and to maintain the file on a daily basis. If these objectives could be accomplished we would then be in a position to address ourselves to the important long-range objective of determining the conditions necessary for a system of automated library operations generally.

All the originally planned facets of the system are now operational and the experiment is no longer an experiment. I will complete the brief analysis of the computer operation costs begun above for the on-line system, and devote the remainder of the paper to the system's operation. Compared with the former batch processing system, the computer charges for the on-line system have gone up from \$7,542 per year to \$14,280. The difference of \$6,738 is almost completely attributable to two factors: rental and usage charges of the cathode ray tube terminals and rental of on-line disk space. The largest category of computer charges is now for disk space, followed in order by the cost of the terminals, listing and paper charges, and finally the central processing unit charges.

The increase in computer costs is small, however, when compared with the very significant savings totaling \$17,425 which we have been able to achieve as a result of converting from the batch to the on-line system. Virtually all coding and keypunching have been eliminated; all data is entered and verified at the source on the terminal. Two full positions have been eliminated and the programmer analyst position reduced from half to quarter time, the latter partly because of decreased supervisory duties, and partly due to the fact that the on-line system runs more smoothly than the former batch system. Time previously used for bindery preparation, updating catalog

records and maintaining various public service files is now eliminated, representing additional important savings which have been used either to accommodate increase in workloads or for reallocation to other tasks. Increased staff productivity rests on two factors: improvements in tools (terminals and listings) for processing and handling information and improvement in morale, especially of nonprofessional staff members who now have greater responsibility and an expanded view of their contributions to the library's overall operation.

To summarize the cost aspects of going on-line, the savings in personnel are \$12,679 and the related savings in binding, cataloging and reference are \$4,746 for a total savings of \$17,425. Net savings is found by deducting the increased computer costs of \$6,738, resulting in \$10,687 per year. Combining this with the \$2,408 net savings reported above for the batch system, the total is \$13,095 of yearly savings over a completely manual operation. These are the measurable direct and indirect savings within the library, but perhaps in some ways more significant are the intangible benefits of better staff morale, greater user satisfaction, and the sharing of products with other institutions. More detail is contained in: "On-Line Serials Control System in a Large Biomedical Library, Part III: Comparison of On-Line and Batch Operations and Cost Analysis."<sup>1</sup>

### Lists and Other Products

The output products of the on-line system are, with minor differences, the same as those of the batch system; the major improvement is in the quality of the output. Because of the decrease in maintenance problems resulting from entry of data at the source, plus visual verification provided by the terminal, the accuracy of the entire operation has been greatly improved.

The principal product is the daily serials holdings list (fig. 1). It contains the usual data elements of title, call number, frequency of publication, location in the library, complete holdings statement of both bound and unbound issues, and history statement; in addition, certain less usual and very useful elements are included—dates on which missing issues were claimed, date on which the latest issue was received, and bindery notes for all volumes sent to the bindery.

Computer production of claim letters are, of course, a part of this system (fig. 2). Claims are initiated by the computer when an issue is skipped, and by a program which is run periodically to find lagging receipts. The claims assistant checks the selection on the terminal screen before allowing the letter to go out, but the largest part of the work is done automatically; the claims assistant processes more than eighty letters per week in about six hours.

A large amount of time, mostly in typing, has been saved in the bindery section. Briefly, the computer produces a bindery pickup list to aid in the

## AUSTRALIAN NATURAL HISTORY.

W1 AU842

B14-16 (1962-68/0)

U17N1-2 (1971)

CONTINUES AUSTRALIAN MUSEUM MAGAZINE.

LOAN DESK

QUARTERLY

LAST REC'D-10/20/71

## AUSTRALIAN NURSES' JOURNAL.

W1 AU847

B54-65 (1956-67)

U66N1-12 (1968).

U68N2-8;AUG. (1970)

AT BINDERY--66N7-12, ON SEP 18.

CLAIMED--68N1, IN SEP.

LOAN DESK

MONTHLY

LAST REC'D-10/30/70

Note: The location of the unbound issues, frequency and date of last receipt are on the right. Note also the "at the bindery" and "claimed" note on the second journal above.

Fig. 1. Serials Holdings List

selection of volumes to be picked up from the shelves for binding, later produces bindery slips (fig. 3) containing the bindery information for the volume, and then runs off the packing list just before the volumes are sent to the bindery.

Other products of the system include specially formatted lists of the file for use by the interlibrary loan department, serials, bindery and catalog departments, as well as a daily receipts list for record-keeping purposes and reorder letters (figs. 4, 5, 6). Upon demand, lists may be produced which utilize certain data elements. In this way a list can be made of journals by subject, language, country or other selection criteria.

To test potential use of the terminal by reference staff and patrons, a terminal was installed in the reference area for six months and a set of directions assembled to go with it as well as a scheme for reporting usage. The most significant resulting observations are the following: (1) There was a wide range of adaptability in users to the terminal. Many people found it intriguing or "fun," others were quite perplexed and found it difficult to use. (2) The consensus of the reference staff was that until additional data bases become available to be tied to our serials data base, the usefulness of this type of tool is limited. Specifically, the user wants displays of journal articles, together with authors' names and perhaps abstracts. (3) Several users frequently need access to the serials record at the same time; implementing this would mean additional terminals and additional costs. (4) Finally, since terminals are still

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CENTER FOR THE HEALTH SCIENCES  
UNIVERSITY OF CALIFORNIA  
LOS ANGELES, CALIFORNIA 90024

FEBRUARY 22, 1971

GENTLEMEN

ACCORDING TO OUR RECORDS WE HAVE NOT YET RECEIVED THE FOLLOWING WHICH COMES TO US ON OUR REGULAR SUBSCRIPTION

CANADIAN JOURNAL OF MICROBIOLOGY.  
VOL 16 ISSUE 7 (1970)

PLEASE CHECK REPORT (IF REPORTING ON MORE THAN ONE ISSUE, WRITE NUMBER OR DATE BESIDE REPORT OR CLARIFY UNDER REMARKS.

WILL SEND IMMEDIATELY:  
WILL SEND WHEN PUBLISHED (ABOUT:            WEEKS, MONTHS)  
OUT OF PRINT:  
TEMPORARILY SUSPENDED, VOLUME, NUMBER, DATE OF LAST ISSUE:  
PUBLICATION TO BE RESUMED ON:  
CEASED PUBLICATION: VOLUME, NUMBER, DATE OF FINAL ISSUE:

REMARKS:

WE WOULD GREATLY APPRECIATE YOUR SENDING THIS MATERIAL IN ORDER THAT WE MAY COMPLETE OUR FILE.

OUR MAILING ADDRESS IS

BIOMEDICAL LIBRARY (SERIALS CLAIMS)  
UNIVERSITY OF CALIFORNIA  
CENTER FOR HEALTH SCIENCES  
LOS ANGELES, CALIFORNIA 90024

PLEASE NOTIFY US WHAT ACTION YOU ARE TAKING AND PLEASE RETURN THIS LETTER WITH YOUR REPLY. OUR REFERENCE IS 1868800.

SINCERELY YOURS,

CLAIMING ASSISTANT  
BIOMEDICAL LIBRARY

Fig. 2. Claim Letter

	YEAR	VOL.	ISSUE	SER NUM	PTS/VOL	FREQUENCY	LOCATION
ENTOMOLOGISCHE ZEITSCHRIFT. W1 EN971	71	81	1-24	2728500	01	SEMI-MO	INCOMPLETES
ENVIRONMENTAL HEALTH (LONDON) W1 EN996E	71	79	1-12	2733900	01	MONTHLY	INCOMPLETES
EUROPEAN JOURNAL OF BIOCHEMISTRY W1 EU726	71/2	24	1-3	2782500	01	IRREGULAR	READING ROOM

A. PICKUP LIST (Packing list looks the same except last four columns are omitted.)

.....  
03/21/72 VOLS THIS TITLE: 1

ARCHIVES OF PHYSICAL  
MEDICINE AND REHABILITATION

BIOMED.  
W1  
AR469  
V. 52  
NO. 7-12  
1971

B. BINDERY SLIP.

52  
JUL.-DEC.  
1971

1222500  
CLOTH COLOR - BLACK  
COVERS - BIND FRONT  
ADS - LAST COPY ONLY  
INDEX - BIND IN BACK  
.....

Fig. 3. Bindery Products

relatively expensive, it is difficult to justify them on a cost basis unless constant and highly productive use is made of them. The daily lists have proved to be a much more acceptable method of getting the information to the user than the terminal. The data on the current day's list is virtually as current as that which could be obtained from the terminal; in addition, two-, three-, and four-day old lists left in the reference area provide a multiple access which is impossible with one terminal. To conclude, unless the cost for terminals decreases or larger and more varied files become available containing so much data as to be impractical to list often, a terminal for public use of this type is not practical. The great usefulness is for the input process and for various technical processing procedures for which the serials staff are responsible.

Parentetically, the reliability of the computer system is a very important factor in determining the usefulness of any terminal system. The test mentioned above was done during the latter half of 1970 when the computer facility was having certain difficulties with both its software and hardware. Although this was an annoyance at the time, we believe the basic conclusions mentioned above would have been the same even with a more acceptable computer system. Since that time the reliability of the system has greatly improved.

0003600 ACCMA BULLETIN. (ALAMEDA-CONTRA  
COSTA MEDICAL ASSOCIATION). W1 AL182  
(GIFT)

000600 ADM. REVISTA DE LA ASOCIACION DENTAL-  
MEXICANA. W1 A389 (GIFT) ORG123

A. List used in bindery dept.

0006900 1 MTC-12 FREQ- 1 RT/LOC-B S  
A.E.T.F.A.T.-INDEX. Z 5356 S7 All3  
B(1953-56).B(1959-67)U(1968)U(1969)  
U(1970)

0023400 1 MTC-12 FREQ- 1 RT/LOC-B RFR  
AMA DRUG EVALUATIONS. QV 740 A254  
B(1971)

B. List used in serials dept.  
(list used in interlibrary  
loans and cataloging have  
a similar format).

Fig. 4. Internal Lists

BIOMEDICAL LIBRARY  
CENTER FOR THE HEALTH SCIENCES  
UNIVERSITY OF CALIFORNIA  
LOS ANGELES, CALIFORNIA 90024

FEBRUARY 12, 1972

CALIFORNIA DEPT. OF FISH AND GAME  
1416 NINTH ST., 12TH FLOOR  
SACRAMENTO, CALIF. 95814

GENTLEMEN:

PLEASE CONSIDER THIS A FORMAL PURCHASE ORDER FOR THE FOLLOWING:

ANNOTATED BIBLIOGRAPHY OF RESEARCH IN ECONOMICALLY IMPORTANT  
SPECIES OF CALIFORNIA FISH AND GAME. SUPPLEMENT.

ISSUE 7

PLEASE INVOICE US IN TRIPPLICATE.

IF THIS PUBLICATION IS NO LONGER AVAILABLE, OR WILL BE  
AVAILABLE AT SOME FUTURE DATE, PLEASE LET US KNOW AS SOON  
AS POSSIBLE.

OUR REFERENCE IS 1075800-9

PLEASE RETURN THIS LETTER WITH YOUR REPLY.

THANK YOU FOR YOUR ASSISTANCE IN BRINGING OUR RECORDS UP TO DATE.

SINCERELY YOURS,

Fig. 5. Reorder Letter

TITLE	CALL NUM.	YEAR	VOL.	ISSUE	FREQUENCY	LOCATION
AMERICAN JOURNAL OF MEDICINE.	W1 AM4926 COP.2	1972	52	1	MONTHLY	READING ROOM
AMERICAN JOURNAL OF OPHTHALMOLOGY.	W1 AM4959	1972	73	1	MONTHLY	READING ROOM
AMERICAN JOURNAL OF OPHTHALMOLOGY.	W1 AM4959 COP.2	1972	73	1	MONTHLY	READING ROOM
AMERICAN MEDICAL ASSOCIATION JOURNAL.	W1 AM554	1972	219	4	WEEKLY	READING ROOM
AMERICAN PSYCHOLOGIST.	W1 AM6744	1972	27	1	MONTHLY	READING ROOM
ANTIOQUIA MEDICA.	W1 AN875	1971	21	6	10 PER YR	LOAN DESK

Fig. 6. Daily Receipts List

## Hardware and Software

The system was originally designed to work from IBM 2260 cathode ray tube (CRT) terminals with a display area of eighty characters across by twelve lines down. Selection of terminal was made on the basis that the IBM 2260 was available and supported by the computer facility. Plans are currently underway to allow general use of the system with other types of CRT terminals, although there are two major constraints: (1) unless a great deal of reprogramming was done, the screen size would have to be eighty characters across to accommodate the displays which the programs sets up; and (2) the data transfer rate would have to be fairly rapid since most displays entail several hundred characters.

The programs are all written in PL/1 and both the programs and the data file have been designed for use on a large time-sharing computer system such as exists at the Health Sciences Computer Facility. The on-line programs presently run in a 100K region which is dynamically rolled in and out of memory onto drum storage space by the operating system. All programs which run the terminal are linked together into one large program so that they are immediately available for use at all times. Taken together, the amount of memory required for these programs greatly exceeds 100K, but by using overlay programming techniques only a small amount of programming code is in memory at any one time. Considering the overhead required for the terminal system, however, it would appear that 100K, or perhaps 80K at the least, defines the practical size of memory required to run such a system.

The machine files are set up in one physical file of about 930 tracks on an IBM 2314 disk pack. This is about 7 million characters of storage and is less than one-fourth the capacity of one disk pack of this type. All journal records are in alphabetical order and arranged by the unique access-serial number assigned to them when cataloged. Thus the tracks which contain the master file of data may be thought of in much the same way as a block of records in a sequentially organized tape file. However, with a block of records

on tape no updating of that tape can be made without copying it onto another tape; with the disk file the potential exists for in-place updating. This capability, of course, lies at the heart of the on-line file maintenance system.

Not all tracks on the disk file contain the master serials file data, however. Certain tracks have been formatted for storage of the retrieval data, others for bindery, claiming and daily receipts data, and so on. There are nine special purpose logical files in all which are maintained in a dynamic fashion by the programs, all contained on the 930 tracks allocated to the serials' control system.

The master file of serials consists of the 6,500 current journal records, one for each title, together with about 5,500 ceased, on-order and cross-reference records. The record format is somewhat similar to MARC II in concept, containing an average of about eight tagged variable length fields and normally two fixed length fields. The records average about 400 characters in length. When the records are blocked together on the disk tracks, a slack of about 600 characters is left at the end of each track. Thus, during daily operations at the terminal causing the length of various records to change, extra space is available as needed from this slack area. Once or twice per month the whole file is regenerated on disk to evenly redistribute the slack area. A more detailed account of the file maintenance concepts is contained in "On-Line Serials Control System in a Large Biomedical Library, Part I: Description of the System."<sup>2</sup>

### Retrieval Features

The system utilizes an inverted file for its primary retrieval technique. About sixty tracks of the disk have been reserved for storage of the inverted file data, which index all title words of significance, and all subjects, languages, and countries to the appropriate records in the master file. This is about 7 percent of the total of the 930 tracks which are allocated to the serials system.

The file is set up as follows. A program reads each master file record and breaks out all words in the title. The program discards some twenty commonly occurring articles and other insignificant words, and also truncates all words containing over fourteen characters. At the same time, the program processes all the subject, language and country codes. To each of these resulting retrieval elements it adds the journal's serial number. The program then sorts the entries found for all the titles by term and by serial number. The last step consists of removing all duplicated terms but one, while saving the serial numbers which provide the link back to the master record in a string and storing the result on the disk space reserved for this purpose. This whole procedure is repeated perhaps once monthly since dynamic updating of this file is not provided for in the present system.

The operator who uses the terminal to retrieve a journal may key in one or more words of the title of the desired journal. Over 50 percent of all resulting terms in the inverted file have only one title linked to them, so an operator with some experience can very often key only one word to retrieve a unique title. Tests have determined that the correct title is reached about 80 percent of the time if an average of three title words are entered. When a unique title is not reached, the operator normally has a list of from two to six titles displayed which have satisfied the keyed search criterion; normally the correct title is among the list and it is a simple matter to pick it out.

When more than one term is required to find the desired title, the terms may be entered one at a time, waiting for a response each time, or more likely, the terminal operator will key in several terms at once so the program need not keep displaying intermediate results. In either case Boolean anding is performed automatically as long as title words are entered. If the operator should wish to search by subject, language or country, a similar sequence takes place except that the program does not automatically assume Boolean anding, but rather gives the operator the choice of AND, OR, or AND NOT.

In addition to retrieval by use of the inverted file, the operator may, of course, use the seven-digit accessions number if it is available. This method is slightly faster because it guarantees a single response every time. Most of the bindery and claiming operations entail using a computer-generated list which has the serial number printed on it, so this method of retrieval is often used in these instances.

The following points should summarize some of the more important aspects of the retrieval scheme: (1) the method of setting up and using the inverted file described above has proven to satisfy the retrieval requirement from a design point of view. It is not particularly expensive nor difficult to maintain. It is easy to use and is sufficiently accurate to be readily understood and accepted by operators of the terminals. (2) Certain features of the concept have useful side effects. For example, transliteration of a title can be accomplished by simply transliterating the easiest word, keying it in and letting the computer display the journal or journals found. The operator should recognize the correct title and can proceed to copy the rest of the transliteration of the title. (3) Since the words may be truncated when keyed in by the terminal operator, it is often a simple matter to key in merely a few letters of a word to retrieve the correct title. (4) Also, related to the transliteration problem, a particularly obscure journal may be retrieved by merely keying in its language or country rather than the title. Finally, any misspelling in a title is soon discovered when this method is used for retrieval. Further discussion of the retrieval aspects of the system is given in "On-Line Serials Control System in a Large Biomedical Library, Part II: Retrieval Features."<sup>3</sup>

## Terminal Operations

As indicated above, the on-line system has a complete complement of check-in, bindery, and claiming modules. In addition, there are programs to change all fields of a record and to add or delete whole records. There is also a set of system control routines which are used by the systems staff to display and monitor the files in the system. Several special purpose file updating capabilities are provided for the programmer's use in this set of routines.

At the present time there are two terminals; their combined usage of approximately seven hours per day is broken down as follows: (1) four hours checking in an average of about 150 journals, (2) one hour each for bindery, claiming, new entry and other miscellaneous use. Additional time should be allowed for development work by the systems staff and for giving demonstrations. Scheduling the workload would probably become a problem if only one terminal were available since computer downtime, both scheduled and unscheduled, averages perhaps an hour a day, and since the various terminal operations are often done by different members of the staff on different floors of the library. We have not, of course, hired special operators for the terminal. Members of the staff use the terminal as a tool just as they use the telephone or typewriter. The operation of the terminal is relatively straightforward and only a short time is needed for operator training. For new personnel, use of the terminal is a minor aspect of their normal job training. Library interns, for instance, become reasonably competent at the check-in aspects after one day of working with the check-in person. The great advantage of a CRT-type terminal is that normally all response codes to a given frame can be displayed: the beginning operator merely takes cues from the displayed message to proceed to the next message, and so on.

The serials control system described above has been fully operational for many months. Although it is fairly large and complex, it has proved to be quite manageable, and, most important, meets our library needs in the area of serials control. Most heartening is the fact that the system has shown definite cost advantages. The computer facility is admittedly subsidized to a certain extent by the federal government on the basis that it is a research facility, but even with somewhat higher computer costs, we believe the system could justify itself.

Finally, although no further developmental work is now being done on the system, we do have plans for future improvements including the addition of an invoicing module, redesign of the file format to save disk space, and generalization of the system to be able to use a terminal other than the IBM 2260. These and other improvements will be predicated on two considerations: (1) improving the cost-benefit ratio of the system within the library, and (2) making the system more easily adaptable for other libraries.

## REFERENCES

1. Fayollat, James. "On-Line Serials Control in a Large Biomedical Library, Part III: Comparison of On-line and Batch Operations and Cost Analysis."
2. \_\_\_\_\_. "On-Line Serials Control in a Large Biomedical Library, Part I: Description of the System."
3. \_\_\_\_\_. "On-Line Serials Control in a Large Biomedical Library, Part II: Retrieval Features."

These papers were all recently submitted to the *Journal* of the Society for Information Science for consideration for publication.