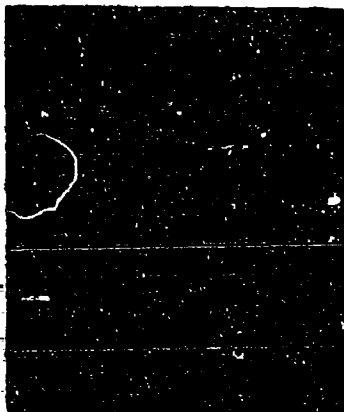


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Technical Report

AD 640 109

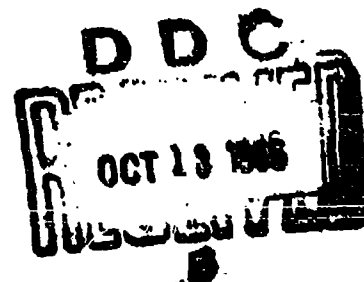
MECHANIZATION STUDY
OF THE TECHNICAL LIBRARY
AIR FORCE CAMBRIDGE
RESEARCH LABORATORY,
L. G. HANSCOM FIELD, MASSACHUSETTS

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Technical Report

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MECHANIZATION STUDY
OF THE TECHNICAL LIBRARY
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September 1966

~~BOOZ • ALLEN APPLIED RESEARCH INC.~~

AMERICAN
LIBRARY
OF CONGRESS
SERIALS ACQUISITION
5101 MARSHALL BLVD
BETHESDA, MD 20814

ABSTRACT

The Technical Library has developed a unique semimechanized process for the production of catalog cards, charge cards, card pockets, and accessions lists, and a machine-readable punched paper tape record for a future computer-produced book catalog. This system was originally based on a special purpose digital processor, called the Crossfiler, which multiplies catalog card records, inputed on punched paper tape and supplies entry headings for each of the copies. Actual printing is done on a Flexowriter. The Library recently began employing the PDP-1 computer to perform this task and has phased out the Crossfiler. A periodical control system is being developed utilizing the Laboratory's IBM 7044 computer. The library plans to convert its paper tape records to magnetic tape for computer production of a book catalog and computer-run retrospective searches.

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I. SUMMARY

I. SUMMARY

The Technical Library of the Air Force Cambridge Research Laboratory (AFCRL) has developed a unique, semimechanized process for the production of catalog cards, charge cards, card pockets, accession lists, and a machine-readable punched paper tape of bibliographic records for a future computer-produced book catalog. This system, originally based on a special purpose digital processor called the Crossfiler, was designed by the Ittek Corporation. The system, now run using a PDP-1 computer, multiplies catalog card records provided by an input punched tape. The resultant output from a Crossfiler program generated on the PDP-1 computer is an "expanded" punched tape with as many identical records as there are cards to be reproduced. The program detects card headings on the single input record, and begins each of the identical output tape records with the appropriate segregated heading. The cards are then reproduced from the output tape on a Flexowriter. A significant feature of the system is its use of natural language, with nonprinting characters to define information fields

Records for periodical control are prepared on a punched paper tape which is used to produce a 5 by 8 inch check-in card for each title,

a bindery list, a list for ordering, a title list for reference, a list arranged by country of origin, and titles listing for reference.

Titles in the periodicals collection are currently being keypunched on EAM cards for use by the Laboratory's IBM 7044 computer in the production of a titles listing, including changed titles, "see also's", and an indication of whether or not bound.

The collection of the Technical Library currently consists of approximately 49,386 book titles (182,541 volumes and bound journals), 3,200 periodical subscriptions, and 170,000 technical reports, with an annual growth rate of 2,500 book titles (11,000 volumes), and 9,350 reports. The technical report collection is supplemented by microfilm and microcards of AEC, NASA, and DDC reports.

The Library collection is essentially a reference collection with circulation limited to the scientific staff at AFCRL. The emphasis has been on acquisition of both old and new materials with the users playing a minor role in the selection process. The general public is permitted access to the library but this use is limited to reference. Interlibrary loan is not encouraged, but is performed as required. Copies of periodical articles and documents are provided as requested. Translations are handled by the staff when the capability exists; otherwise, translations are prepared by contractors. Because of the distance of the

Library from much of the Laboratory's staff, most requests are received by telephone. Users are requested to come to the Library to use reference documents.

The organizational structure of the Library is illustrated in Appendix A.

II. MECHANIZATION

II. MECHANIZATION

1. CHRONOLOGY

In 1959, as a result of a growing backlog exceeding 15,000 volumes and general dissatisfaction with the system, the Library employed the Itek Corporation to study mechanized techniques as they might be applied to the Library's problems. This study was one in a series which had been performed for the Library by various consultants since 1956. The prime objectives of the study were to:

"Examine the methods currently used by the AFCRL Research Library to control monographs, serials, and technical documents.

Investigate the feasibility of a total system of mechanized processing routines.

Achieve compatibility of the Research Library with machine systems in other information processing centers."

Two stipulations were made in the Itek contract -- that the main card catalog would be maintained; and that the use of American Library Association cataloging rules and the Library of Congress card format would be continued.

Development of the mechanized process for serials control, including ordering, receiving, recording, binding, and records keeping, also began.

By 1963, Itek had established that the production of a catalog card was "a critical point in the work flow,"¹ particularly when it was necessary to order Library of Congress (LC) card sets.² To simplify and speed up this process, Itek designed and built the Crossfiler for the Library. This device was put into operation in the first half of 1963. A Polaroid camera (MP-3) was also introduced and used to photograph National Union Catalog entries in order to eliminate manual transcription cataloging information. Except in special cases, the ordering of LC cards was discontinued.

In November 1964, the Library was forced to give up the clerical help engaged in the operations associated with the Crossfiler. The Library then contracted these operations to Inforonics Corporation and the Crossfiler was moved to the contractor's facilities. This arrangement is still in effect and the card generation program is now run on the contractor's PDP-1 computer with the Crossfiler as "backup" to the system.

Inforonics was also awarded a contract to modify their Editor I machine for library use. This device operates in conjunction with a

Flexowriter to simplify the correction of punched tape errors.

In 1965 the conversion of holdings records for the mechanized serials control system began using EAM equipment for serials holdings and Flexowriter equipment for currently received journals. The latter system is temporary until all serial holdings can be converted. Full development of the serials system on the IBM 7044 is expected to be completed sometime in 1967.

Publication of the first book catalog using the 7044 computer is expected by December 1966. The British National Bibliography format with Dewey classification will be used in the catalog and it will contain an author and title index. Demand bibliographies will also be prepared by the 7044. In preparation for this, punched paper tape records of the books that have been received and cataloged are being converted to magnetic tape records. Approximately 8,000 records have already been converted.

2. DESCRIPTION OF PROCESSES

Besides the production of catalog cards, emphasis in mechanization at AFCRL Library has also been placed on the creation of a machine-readable book record file. This cataloging system is described in Paragraph (1) below.

In addition, the mechanized serials control system is developing steadily. Present procedures are described in Paragraph (3) of this section.

(1) Input Procedure--Book Processing

A description of the AFCRL mechanized control system is detailed in the following paragraphs and summarized in block diagrams (Figures 1 and 2).

1. Books are requested by users or selected by the Library staff from the usual selection sources. Order cards are prepared and categorized. Special orders and requested items receive highest priority; non-request items are ordered as funds and time permit.
2. Before an order is placed, a search is made of the public catalog, the acquisition-on-order and received file, the file of LC cards on order, and the "dead" file (a card file of temporary records of the uncataloged backlog).
3. For most orders, a search is made in the National Union Catalog or the British National Bibliography. A photograph of the item's entry, which forms the basis of later cataloging, is taken with a Polaroid MP-3 camera.

FIGURE 1
Book Processing

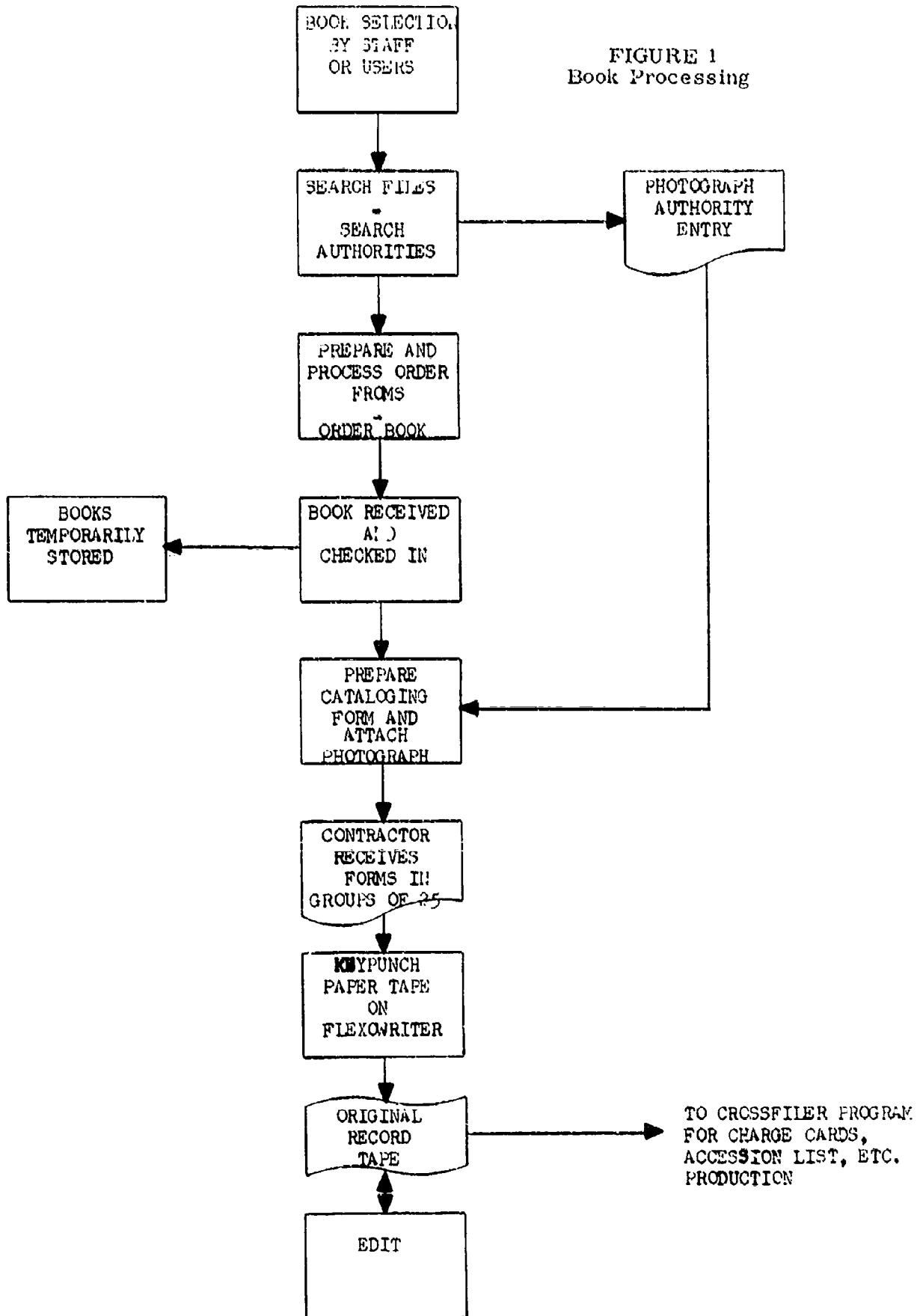
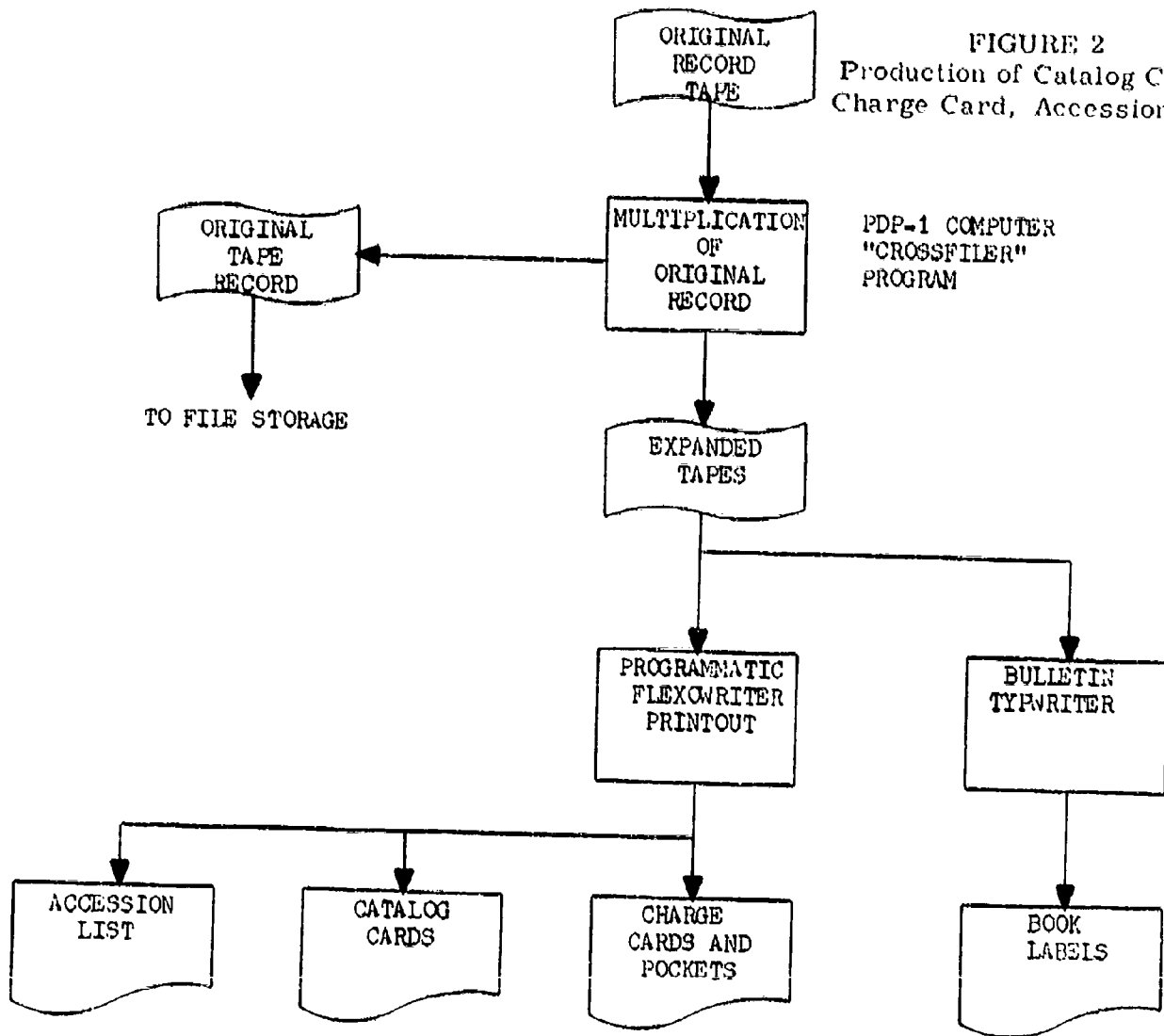


FIGURE 2
Production of Catalog Card
Charge Card, Accession L



In a few cases, as for example when an item is selected from "Publisher's Weekly", LC cards may be ordered prior to ordering the item. In every case, as much cataloging information as practicable is obtained before the order is placed. Appendix B-1 describes the exceptional use of hand-typed or LC cards.

4. Purchase orders are prepared and processed according to Air Force procurement regulations.

5. After a book is received and checked in, a blank worksheet is inserted in the book. Attached to the worksheet are a photograph or LC card and other information regarding cataloging of the item.

6. Books with worksheets are sent to the processing section for cataloging.

7. The cataloger fills in the worksheet and delivers it to a cataloging coordinator for further processing. An example of a completed worksheet is shown in Appendix B-2. Information fields are defined by non-printing characters on the worksheets; e. g. , 8 C (8 carriage returns), and T (tabulation) as shown in the left margin of

the worksheet. Later these characters are transcribed on punched paper tape along with the card information, and are used by the Crossfiler program to determine correct format. A description of the "machine-readable natural format," as Itek labeled this system, is presented in Appendix C. The technique of setting off and identifying areas of information, widely used in teletype communications, eliminates the need for special codes or confusing symbols. Its use, however, becomes cumbersome as the number of information fields increases.

8. The Tape Library Call Number, a processing control code, is assigned by the coordinator who reviews the worksheet for accuracy and consistency.

9. The worksheets, grouped in batches of 25, are collected twice weekly by the contractor (presently Inforonics). Twenty-five was selected as a maximum number of worksheets to be processed at one time in order to avoid tape punching errors. The processing rate is set by contract at no more than 350 titles per month. While worksheets are being processed, the books are temporarily stored.

10. At the contractor's facility, worksheets are transcribed on punched tape using a Flexowriter. Attached to the Flexowriter is a device designated the "Editor I". Designed and built by Inforonics, the Editor is a small, digital data processor with a two-character memory buffer, a high-speed tape reader, and a tape punch. The Flexowriter may be connected through the buffer, permitting a two-character delay between the pressing of the key and the punching of the character. Thus if the word data were punched on tape, the letters d and a would be keyed but would be stored in the Editor without any corresponding action to the tape. When the t is keyed, the d would then be taken out of storage and punched on the tape. This delay permits an operator to correct character errors that are detected immediately. A full description of the Editor is contained in Chapter 3.

11. The tape is then printed out on continuous feed paper for a visual error check. In the past, the Editor was also used to assist in error correction. However, with experienced operators, this application offered no speed advantage.

12. The tape is next applied as input to the PDP-1 computer. The Crossfiler program generates a new "expanded" tape which contains a series of identical records forming a card set, each with a different heading. There are five types of cards in a set: a unit card, a full title card, a subject card, an added entries card, and a tape library call number card. The last named card bears a code identifying the item type, year cataloged, month, cataloging accessions number, cataloger code, search note, e. g., M64 2 232 ef indicates a monograph cataloged in 1964-February, No. 232, cataloged by code e, searched in code f.

The program scans the original record for a predetermined identifying non-printing code and then returns to the beginning of the record in preparation for copying. These codes in the original record identify headings for each of the entries on the output expanded tape. The operation is as follows:

- (1) The first record on the input tape is read and punched on the output tape.
- (2) The input tape is rewound to the beginning of the first record and step (1) is repeated. The result on the output tape is two identical records which represent two corresponding unit cards.

- (3) The input tape is again rewound to the beginning. The record is then scanned with no output until the non-printing characters representing the title are detected. The title is then read and punched, forming the beginning of the third entry on the output tape. The input tape is rewound once again and the entire record is read and punched.
- (4) The process described in (3) is iterated until each of the desired card headings has been detected and punched on the output tape as the leading entry of a duplicate record. At this point, the next successive record on the input tape is read and the entire process repeated. The same input tape is used on the PDP-1 to produce tapes for the accession list, charge cards, and book labels from three auxiliary PDP-1 programs.

(2) Outputs--Book Processing

1. When the card sets for 25 items are punched on the expanded tape, the tape is removed from the Crossfiler and applied to a Programmatic Flexowriter. Continuous pinfeed card stock is loaded into the Flexowriter and the program is started. Information from the tape is automatically typed on the cards. An average tape takes 3 to 4 hours to type out. Catalog cards are now being created on pinfeed continuous rolls of card stock and cut automatically on a die cutter as completed. Appendix D-1 illustrates a typical card prepared by the program and an LC card for comparison.

2. The book accession tape is then loaded into the Flexowriter, and the daily accession list is printed out on continuous form paper. An example of an accessions list is illustrated in Appendix D-2.

3. The charge card list is loaded into the Flexowriter to produce charge cards on continuous pre-printed card stock forms.

All outputs are returned to the Library, the original tape is stored and the expanded tape discarded. The catalog cards (approximately seven in a set) are manually filed in the central catalog file. The daily accessions list is placed on the circulation desk for use by the Library staff and users. Charge cards, with pockets, are inserted in the appropriate books.

(3) Input Procedures--Serials

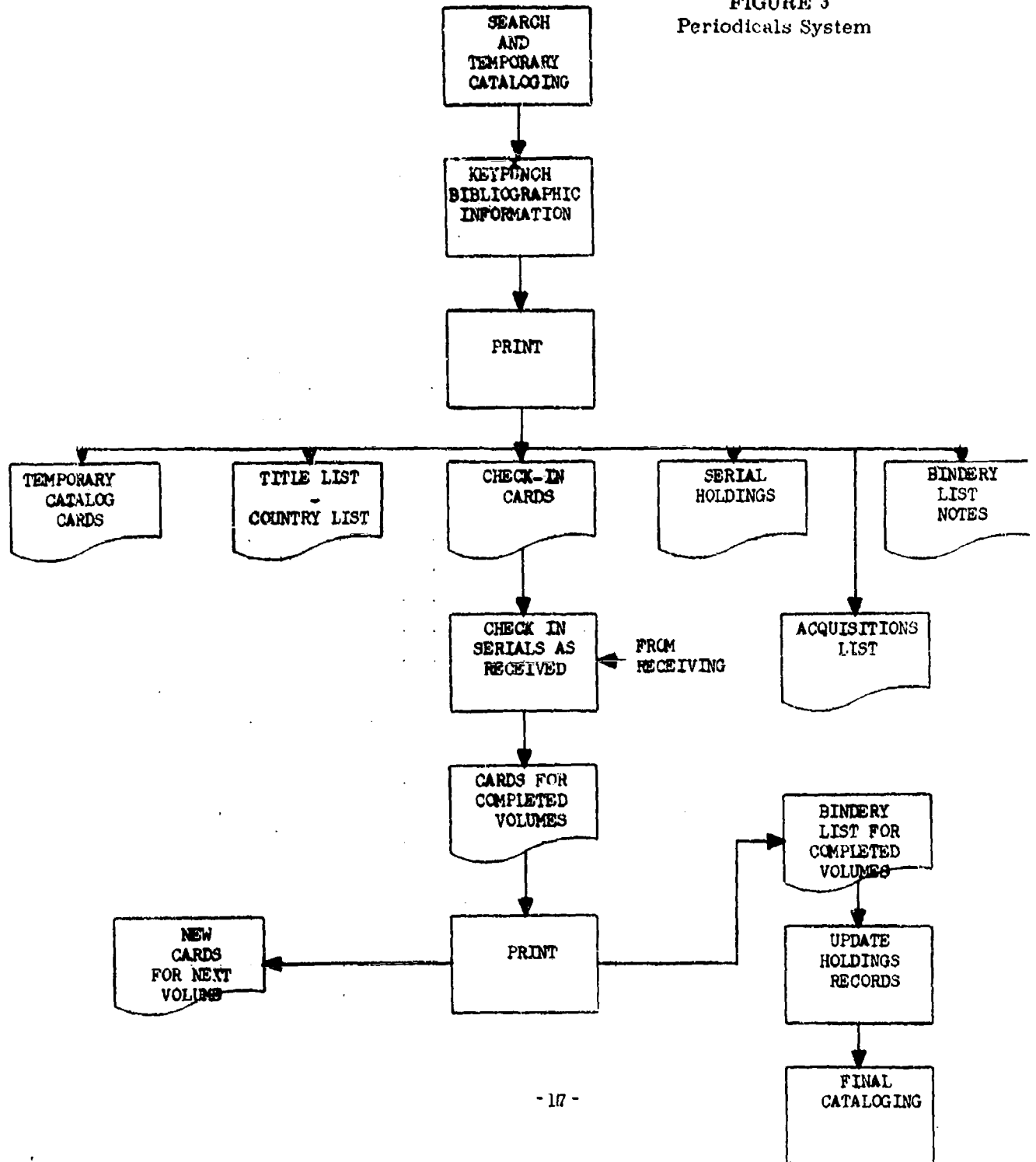
Purchase requests for new periodical titles are always ordered in complete sets including all volumes from one to the current volume. The periodicals system is described in the following paragraphs and summarized in a flow diagram (Figure 3).

1. A subscription request, based on a user's request or selection by the Library staff, is generated.

2. A search routine similar to the one for monographs is initiated, and temporary cataloging is performed.

3. A punched paper tape of the new periodicals' bibliographic information is prepared on a Flexowriter. (This information is also now being punched on EAM cards as part of the development of the mechanized process.)
Approximately 10 EAM cards are required for complete entries, including an extra title card for check-in purposes.
Sample worksheets used in preparing the EAM cards are included in Appendix E.

FIGURE 3
Periodicals System



(4) Outputs--Serials Processing

The punched paper tape is used to print out the following on the Flexowriter:

- . Temporary catalog cards
- . Title list (partly done on EAM, partly on Flexowriter)
- . Country list
- . Serial holdings (now printed using EAM cards)
- . Circulation cards
- . Check-in cards
- . Bindery list
- . Acquisitions list

The check-in cards are used to record issues as they are received for a period of 1 year. At the end of the period, new cards are prepared and the completed cards are used to prepare periodicals for binding and final cataloging of completed bound volumes.

The system described above will be replaced by the mechanized process now being developed. With this process, the records will be recorded on EAM cards which will be used to create outputs from the AFCRL computer.

(5) Future Plans

The Library is in the process of converting the paper tape files of book records to magnetic tape. When this is completed, demand bibliographies will be prepared by the AFCL's 7044 computer using three standard alphabetic sort programs. A book catalog will also be produced using the same sort programs.

III. EQUIPMENT, COSTS, AND EVALUATION

III EQUIPMENT, COSTS, EVALUATION

(Note: Data relating to the program systems was not made available during the survey and is therefore not included in this report.)

1. EQUIPMENT

PDP-1	Computer (contractor's) 8 K memory, Programs in DECAL, Tape Units are Model DEC 555, Microtape. Printer--typewriter (console) output.
IBM 7044	Computer with 32 K core memory. Programs are written in Fortran language.
Model 729V	Tape units
Model 1403-3	Printer

Crossfiler (manufactured for AFCRL by the Itek Corporation)

"Editor I" (manufactured by Inforonics, Inc.)

Crossfiler. The Crossfiler is a solid-state, digital data processor designed and built by the Itek Corporation for the AFCRL Library. It is capable of catalog card set generation on punched paper tape and tape duplication.

The Crossfiler performs the first function by detecting headings that will be used for each card in a set from a punched paper tape record of a catalog card. After each heading is punched out on a

secondary tape, it is followed by a reproduction of the complete card record. Thus, from one card record input, the Crossfiler punches out the representation of a complete set of cards with appropriate headings formatted at the top of each card in the set.

To perform the second function, the Crossfiler reads the input tape and simultaneously punches out a duplicate.

The Crossfiler consists of:

- (1) An optical bidirectional paper tape reader with a reading speed of 110 characters per second.
- (2) A mechanical paper tape punch with a punching speed of 110 characters per second.
- (3) Processor digital logic.

The Crossfiler has no memory. It generates outputs by scanning, detecting, and punching detected information, then reversing the input tape to the record beginning to reread and repunch the complete record.

Editor I. The Editor I is a small digital data processor that has a two-character memory buffer, a character counter, and a high-speed tape reader and punch. It has two significant capabilities:

A Flexowriter may be connected through the buffer, permitting a two-character delay between the pressing of the key and the punching of the character. Thus, if the word

data was to be punched on the tape, the d and a would be keyed but would be stored in the Editor without any corresponding action to the tape. When the t is keyed, the d would then be taken out of storage and punched on the tape. This delay permits an operator to correct character errors that are immediately detected.

For editing, a paper tape may be mounted on the high-speed reader and the location of a previously noted error typed in the unit's console. The Editor will then advance at 500 words per minute to the error position, meanwhile copying the correct material on a new tape. When it reaches the error it will stop and permit the operator to enter the correct information from the Flexowriter keyboard. It can then be instructed to proceed to the next error.

The control console has three sets of keys:

Set 1 - Copy, Insert, Delete, Justify

Set 2 - Line, Word, Character, Sentence, Paragraph,
Record

Set 3 - 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 20, 30

The selection Copy 9 Line, would cause, for example, 9 lines of the old tape to be reproduced followed by a stop for the operator to insert new or corrected information.

2. COSTS

Original system development by Itek	\$85,000
Crossfiler development	\$26,000
Current costs of book processing, including record typing, proof- reading, Crossfile operations, card production, and labeling	\$5.50 per book

Input typing of 1 group of 25 records (good typist)	1-1/2 to 2 hours
Proofreading 1 group of 25 records (poor typist)	4 hours 45 minutes times 2 people
Computer system development and system design	\$7,500 (approximately)
System programming	\$7,500

The following cost comparisons were extracted from Reference 3.

(These represent cost calculations made in 1963 based on full use of the Crossfiler and computer charges that were in effect at that time. Computer charges are now substantially less than those indicated below. The Library states that computer costs are now approximately the Crossfiler operating costs and that this has led to the change to computer operations.)

COST ANALYSIS OF CROSSFILER PRODUCED CARD SETS*

Percentage of total Crossfiler processing capacity	100%	50%	25%	12.5%	6.25%
Total number cards produced in 1 year	806,400	403,200	201,600	100,800	50,400
Total number of card sets produced in 1 year	115,200	57,600	28,800	14,400	7,200
Machine cost per card	.3	.6¢	1.2¢	2.4¢	4.8¢
Final cost of machine produced cards	12.3	12.6¢	13.2¢	14.4¢	16.8¢
Final cost of machine produced card sets	82.7¢	86.7¢	90.9¢	99.3¢	\$1.16

* Figured on using a Crossfiler exclusively for card set production. Based on a \$25,000 machine cost and 10 year depreciation.

COMPARISON OF COMPUTER AND CROSSFILER PROCESSING TIMES AND COSTS FOR CATALOG CARD SET TAPE PRODUCTION

	Crossfiler	Computer*
Input reading speed	110 characters per second (cps)	200 cps
Output punching speed (paper tape)	110 cps	66 cps**
Average processing time required to produce one tape representation of a catalog card set	1 min (or 60 per hour)	1.5 min (or 40 per hour)
Total annual processing capacity	115,200 card sets (based on a 240 day work year)	Not computed; see below
Cost per card set	82.5¢ (see Chart 2)	\$2.70 (based on a service rate of \$75 per hour) (1963 basis)

* Figures are for Digital Equipment Corporation's Standard 4-K PDP-1, with disc memory.

**High speed printing equipment is available and used with many computers, but these devices are capable of printing in upper-case letters only.

3. FACILITY'S EVALUATION OF SYSTEM

The Library would prefer to have the Crossfiler located within its facility, but manpower restrictions do not permit this. Operation of the equipment within the Library by contractor personnel is also not permitted.

Mechanized processing was applied first to books because of the large backlog. Next in precedence were serials. Since the document

collection receives the least use, it will be the last area to be mechanized. The low rate of document usage is said by the Library to be due to the theoretical and experimental nature of the AFCRL's work which does not relate to documented information. The Library would prefer to depend upon DDC for document service rather than build up its own capability.

One of the main factors leading to mechanization was the positive attitude of management which made funds available for mechanization studies resulting in the awarding of the Itek contract.

In the Library's view, the chief reason for the success of the mechanization process was the decision by the contractor to utilize the LC card format and natural language.

There has been a continuing problem in obtaining complete acceptance of the value of mechanized processing techniques by all members of the Library's staff.

The first major output from the stored catalog card tapes will be an author subject book catalog which will be distributed to the 15 widely separated main laboratories.

It is believed that mechanized processes are primarily useful in assisting with clerical functions. Manual information retrieval is

best accomplished by specialists. However, it is recognized that this technique leads to a dependence upon certain individuals who become expert in particular fields and these people may leave the employment of the Library.

The choice of developing the Crossfiler instead of purchasing a computer for the Library was made because of the relatively lower cost of the Crossfiler at the time (\$25, 000 compared with \$100, 000).

A substantial amount of time is spent by the present contractor in proofreading and error correction because of a requirement for perfect records. Some thought is now being given to rationalizing this perfection requirement in view of the inherent redundancy of natural language.

The use of the non-printing symbols (machine-readable natural format) to set off information fields becomes more unwieldy as complexity of the information per record increases. Future development will probably use a simpler format, such as paragraph numbering. For a discussion of information field coding techniques, see reference 4.

Errors in tape preparation are due almost entirely to operator fatigue. Optimum performance is achieved by limiting typing periods to between 1 and 2 hours.

Operation of the Crossfiler to date has been satisfactory, but mechanical problems generally require the presence of an operator. Since the machine was built as a prototype model only and costs of computer operation have fallen considerably since 1959, the Crossfiler has been gradually phased out as computer programs have been developed. One of the important improvements from this changeover is the capability for handling a larger range of formats.

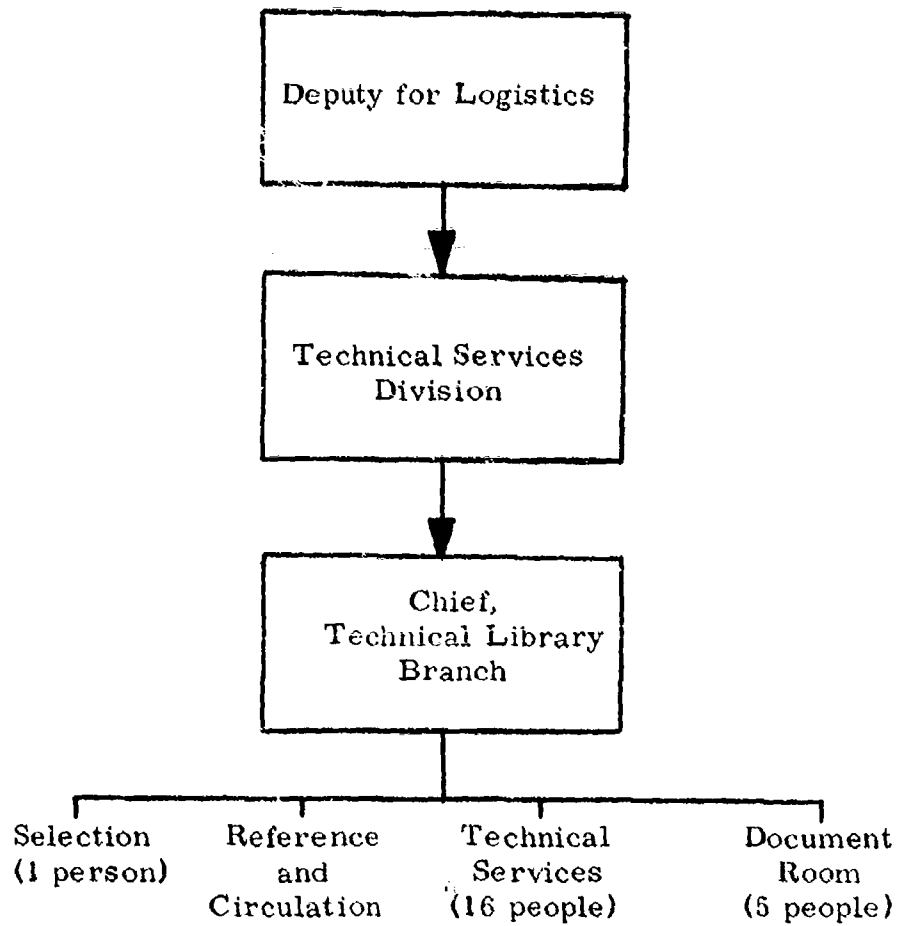
While an upper/lower case print capability has been considered essential in the production of catalog cards, the Library is willing to tolerate an all upper case print for its bookform bibliography. When a practical upper/lower case print chain is available for the IBM 7044, the Library will probably introduce its use. In the meantime, it will continue printing catalog cards on the Flexowriter from computer-produced paper tape.

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3. "The Recording of Library of Congress Bibliographical Data in Machine Form," by Lawrence F. Buckland, LC Card Number 65-18647, Revised February 1965, Inforonics, Inc., Maynard, Massachusetts.
4. "Monograph Cataloging Manual," by the AFCRL Research Library Branch, dated June 1964.
5. "Automated Routines in Technical Services," Patricia T. Sievers and Paul J. Fasana, AD 435615, AFCRL Report Number 64-70, dated February 1964.

APPENDIX A
ORGANIZATION CHART

AIR FORCE CAMBRIDGE RESEARCH LABORATORY



APPENDIX B
BOOK PROCESSING INPUT FORMS

Vertical text on the left margin, likely bleed-through from the reverse side of the page.

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Use of LC or Hand-Typed Cards
(Extracted from Bibliographic Reference 4)

APPENDIX B: Use of LC or Hand-typed Cards

Because of space and printout restrictions on machine generated card sets, certain types of books are best represented in the public catalog with Library of Congress or hand typed cards. Use of such cards in preference to Crossfiler cards is restricted to:

1. Books with voluminous notes which must be transcribed.
2. Books which have complicated signs and symbols not easily described or translated into English (e.g., chemical formulas, etc.).

Books falling into either of the above categories are treated as follows:

- a) It is brought to the attention of the Cataloging Coordinator who indicates use of an LC or hand typed card for main entry in place of a machine generated main entry for public catalog.
- b) The cataloger prepares a worksheet with a brief entry for the machine system. A brief entry contains call number, author (or main entry) brief title, imprint, collation, subjects and added entries. Generally, notes will be excluded.
- c) The cataloger completely prepares the main entry card which will be used in place of the machine generated card. This means that if a hand-typed card is being used, the cataloger types the entire card; if an LC card is used, the cataloger types the call number, etc. The card is attached to the worksheet and a note instructing the Processing Unit is posted on the worksheet.
- d) The item is processed through the machine room in the usual fashion; a complete card set is made and forwarded with the worksheet.
- e) The Processing Unit replaces the machine main entry card with the hand-typed card. The tape library call number is posted on the hand-typed card. The card set is otherwise processed in the normal fashion.

APPENDIX B(2)

ST 24 80	Vol. N. 57815 K34
ST R1	Main Entry ①
ST R2	Title ②
ST R1 encl or.	Imprint ③
ST R1 CFT	Citation ④
encl	Notes X
ST R1 CFT / CFT	Subject ⑤
ST R1 encl or.	All Ent. X
encl	Series
encl	M64 a 61 ea

① ~~by, Deamond, eds~~
 ② Techniques for electron microscopy. With a pref. by V. E. Coslett.
 ③ ~~Wash~~ ④ 201 p. illus. 1964

⑤
 1 Electron microscope 1 Title
 QT1907.K8 578.15 62-1279 J
 Library of Congress 10

APPENDIX C

MACHINE-READABLE NATURAL FORMAT AND BOUNDARY CODES

APPENDIX C

MACHINE-READABLE NATURAL FORMAT AND BOUNDARY CODES

To insure proper handling of information by a mechanized data processor, the information must be in a format which the processor recognizes. If all of the information is to be handled in the same fashion the problem is relatively simple, but it becomes increasingly complex if certain portions of the information must be treated differently than other portions. These separate parts are classed as "information fields" and the data processor must recognize the distinctions between fields.

On punched cards, fields are defined by the location of punches. On punched paper tape, fields can be identified by special symbols such as "\$", which may, for example, set off the author line of a catalog card. Still another method is to count characters and define fields relative to the count.

The method selected by the Itek Corporation for use in catalog card production system designed for the AFCRL Library is based on the use of special, non-printing symbols. These are carriage returns (CR), tabulate shifts (T), and spaces (S). Appendix C-3 illustrates a catalog card using these symbols to designate the end of information

APPENDIX C(2)

fields. The worksheet example in Appendix B-2 illustrates how these symbols are presented to the paper tape punch operator.

The following pages describing the use of the formatting symbols were extracted from Reference 5.

At least 5CR's
from previous card

Abriding symbol Permuting bar

669.95 CR	American Society for Testing Materials. CR
A5 T	T Symposium on advances in electron metal-
T	lography; presented at the sixty-first annual CR
T	meeting, Boston, Mass., June 24, 1958, Amer-
T	ican Society for Testing Materials. CR
T	Philadelphia [c1958]. CR
T	T 120p. CS illus., diags., tables. CR ; includes CR
T	bibliographical references. CR CR
T	T Metallography. CS Electron microscope. CS ASTM CR
T	Special technical publication no. 245.

At least 5CR's
to next card

Crossfiled machine-interpretable natural format showing typing manipulations used as boundary codes

The following section outlines cataloging procedures used in the AFCRL Library for monograph cataloging and gives examples of the various types of catalog card formats possible within the machine system.

The following is a printout of the format with identification of major paragraphs:

I	526.99
II	D18 Dahlgren, Per Johan. Sveriges sjokarta; av Per Dahlgren och Herman Richter. Lund, Ohlssons, 1944. 413p. illus., maps. English summary, p. 348-361.
III	
IV	CARTOGRAPHY--SWEDEN--HISTORY. HYDROGRAPHIC SURVEYING. Richter, Herman [jt auth]. Stockholm. Statens sjohistoriska museum. Handlingar 1, ser., M63h776eb

- I. Call number paragraph
- II. Title page paragraph
- III. Collation and notes paragraph
- IV. Subject and tracing paragraph

1. Code Characteristics.

The format is structured by two devices to identify the nature of the data: (1) sequential position, and (2) boundary markers.

1a Sequential position.

- i. Paragraphs. The sequence of the five paragraphs (indicated above by Roman numerals) has a fixed significance. Each paragraph is defined to correlate with a corresponding block of bibliographic information usually found on conventional catalog cards.
- ii. Statements. Statements are defined fields within a paragraph. The sequence of statements is fixed.
- iii. Phrases. Phrases are particular elements within a statement. The sequence of phrases is not necessarily fixed.

2. Paragraph Identification

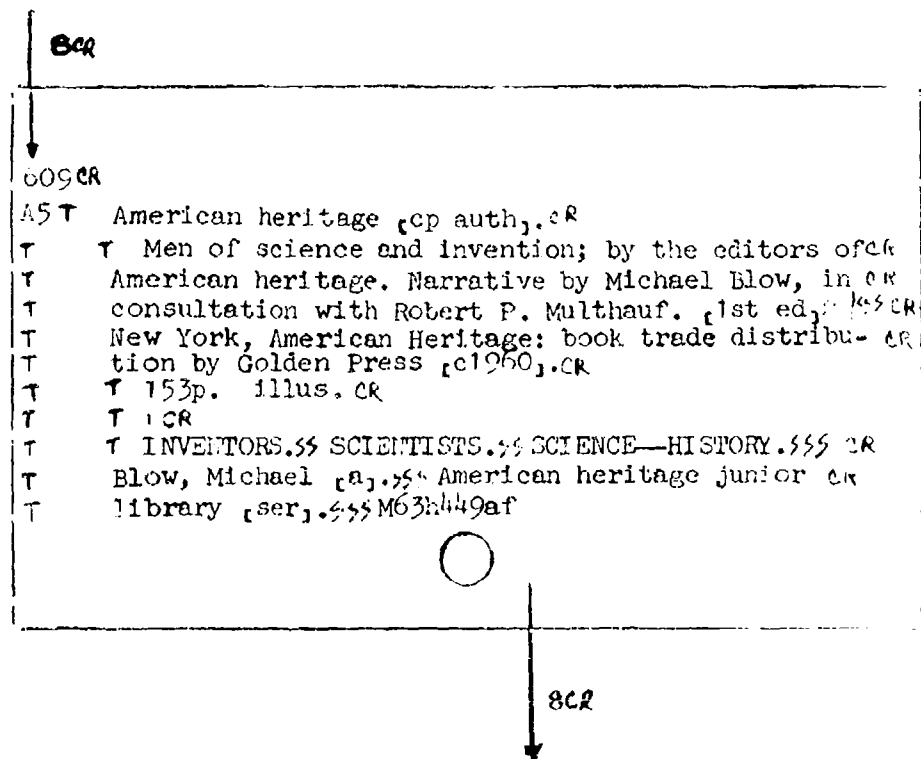
The following is a brief identification of the assignment of bibliographic data to the four paragraphs used in the format, showing paragraph and statement sequence:

- (1.) Call number paragraph
 - a. Call number
 - b. Main entry
- (2.) Descriptive paragraph
 - a. Title and title page transcription
 - b. Imprint
- (3.) Collation and notes paragraph
 - a. Collation statement
 - b. Notes
- (4.) Tracing paragraph
 - a. Subject statement
 - b. Added entries
 - c. Series
 - d. Tape library call number

2a Boundary codes. Cards, paragraphs, statements, and phrases are separated and distinguished by combinations of carriage returns, tabs and spaces. These conventional typing operations serve as normal punctuation in the printout and as machine interpretable boundary codes in the punched tape record. The boundary combinations are reserved for these uses exclusively:

- i. Cards. Cards are introduced (or separated) by a sequence of at least five carriage returns.
- ii. Paragraphs. Paragraphs are separated by a sequence of one carriage return and two tabs. (CRTT)
- iii. Statements. Statements are separated by a sequence of three spaces. (sss)
- iv. Phrases. Phrases are separated by a sequence of two spaces. (ss)

Following is a printout of the encoding format showing the boundary markers used to define cards, paragraphs, statements, and phrases. (CR-carriage return, T-tab, S-space.)



3. Tracing and Non-Tracing Modes

Each statement in the format is designed to be used in either a "tracing" or "non-tracing" mode. A tracing is automatically made for every phrase in a tracing mode statement. No tracings are made from statements in the non-tracing mode statement. Statements in the Crossfiler tracing mode are:

- (1) Short title
- (2) Subject
- (3) Added entries
- (4) Series
- (5) Tape library call number

Statements in the Crossfiler non-tracing mode are:

- (1) Call number
- (2) Main entry
- (3) Imprint
- (4) Collation
- (5) Notes

3a Null occurrence. Not all statements in the format are applicable to every book cataloged. When a data block is left blank, the cataloger circles the "null" sign. A null occurrence in the following statements is indicated by typing a "bar" symbol in place of data:

- i. Main author (Statement 2, Paragraph 2: used for documents only)
- ii. Alternate series

Note that the "bar" symbol is preceded by the introductory boundary code and followed by the closing boundary code.

917.98	
H3	Hart, Robert G
	McKay's guide to Alaska. 561 55 McKay [1959].
	330p. illus. CA
r	f 1 CR
r	ALASKA—DESCRIPTION & TRAVEL—GUIDE—BOOKS.
M6	4a35ef

○

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A null occurrence in the following statements is passed over without mechanical notice:

- (1) Main entry (Author only)
- (2) Notes
- (3) Added entries
- (4) Series

It is assumed that there will always be data in the following statements:

- (1) Call number
- (2) Title
- (3) Imprint
- (4) Collation
- (5) Subject
- (6) Tape library call number

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3b Permuting Device. A device is provided to permute tracings (i.e., pull an additional but partial tracing) in the tracing mode statement. This device is not used in monograph cataloging. The following example is provided only to show how it is used.

The "bar" symbol is typed immediately before that portion of the tracing to be pulled. The tracing pulled includes everything following the bar to the end of the phrase. The first letter of the phrase is capitalized. The bar itself, being a non-ringing symbol, appears in printout as a space. In the following example, a bar has been typed immediately before the word "metal" in the title statement. The cards show the two headings that are pulled. The permuting device can be used more than once in a phrase.

Example:

Iodide metals and metal iodides.

546.734
R6 Rolsten, Robert F
Iodide metals and metal iodides. Wiley
{c1961}.
441p. illus., bibl.

IODIDES. METALS, Electrochemical Society
series {ser}, M64a113df

Metal iodides.

546.734
R6 Rolsten, Robert F
Iodide metals and metal iodides. Wiley
{c1961}.
441p. illus., bibl.

IODIDES. METALS, Electrochemical Society
series {ser}, M64a113df

APPENDIX D

OUTPUTS - BOOK PROCESSING

APPENDIX D

Brandt, Conrad.

A documentary history of Chinese communism, by Conrad Brandt, Benjamin Schwartz and John K. Fairbank. Cambridge, Harvard University Press, 1952.

552 p. 24 cm. (Russian Research Center studies, 6.)

1. Communism--China. I. Schwartz, Benjamin Isadore, 1916-
(Series: Harvard University. Russian Research Center. Russian
Research Center studies, 6)

A 62-0396

Harvard Univ. Library
for Library of Congress (10)

951.05
B76

Brandt, Conrad.

A documentary history of Chinese communism; by Conrad Brandt, Benjamin Schwartz and John K. Fairbank. Cambridge, Harvard University Press, 1952.

552p. Russian Research Center studies [6].

Communism--China. Schwartz, Benjamin Isadore, 1916- Harvard University. Russian Research Center. Russian Research Center studies, 6.

LC Card and Crossfiler-produced Catalog Card

0438

CURRENT ACQUISITIONS LIST
(9 March 1964)
M64-301-325

539.721.082
F8
Fulton, Thomas.
Elementary particle physics
and field theory;

530.150.82
P27
Parker, Eugene Newman.
Astrophysics and the
many-body problem;

530.1
S57
1960
Smith, Clarence Joseph.
A degree physics.

510.82
C23
v.1
1912a
Leathem, John Gaston.
Volume and surface in
physics.

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510.82	
C23	
v.1	
1912a	
Leathem, John Gaston.	
Volume and surface integrals	
used in physics.	
DATE	ISSUED TO

Charge Card

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APPENDIX E
SERIALS PROCESSING INPUT FORMS

APPENDIX E(2)
cc: 75-78

REGULAR PROGRAM
Creation of Class Card 2
Holdings Card

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	

21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	
B																													

50	51	52	53	54	55	56	57	58

59	60	61	62	63	64	65	66	67	68	69	70	71
			SKIP									

72	73	74	75	76	77	78	79	80
	21					00		

ALTERNATE PROGRAM--Creation
of Class Card 2 continuation cards
*Note that last card in set is
numbered 9.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
								SKIP												

21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	

50	51	52	53	54	55	56	57	58

59	60	61	62	63	64	65	66	67	68	69	70	71	72	73
														SKIP

74	75	76	77	78	79	80

cc: 1-20 Class number or shelf location. Leave spaces as shown. If field not completed skip to cc 21.

21-58: Bound holdings only, only volume numbers listed. Use years for volumes where no volume nos. given. End list of bound holdings with a dollar sign \$. If there are notes to be added separate each note with period and space. End entire field with 2 dollar signs--\$\$

59-71 Skip

72 Title Status
1-Active 2-Dead
4 Continuation

73: Card Class--always a 2 in this column

74 Card Number--always a 1 in this column.

75-78 Use Serial number shown in upper right corner above.

79-80 For later expansion. Always a 00 in conversion.

Alternate Program

1-20 Skip

21-58 Continue holdings information. Follow same rules for ending this field as outlined above.

59-71 Skip

72-73 Auto dup of card above

74 Assign next sequential card number. Last card to be used punch 9 in this column.

75-80 Auto. dup. previous card.

1. ORIGINATOR'S NAME AND ADDRESS BOOZ ALLEN APPLIED RESEARCH, INC. 4733 Bethesda Avenue Bethesda, Maryland 20014		2. SECURITY CLASSIFICATION Unclassified	
3. REPORT TITLE Mechanization Study of the Technical Library, Air Force Cambridge Research Laboratory, L. G. Hanscom Field, Mass.			
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Final Report of on-site survey			
5. AUTHOR (Last name, first name, initial) G. A. Kershaw, D. Crowder, J. E. Davis, E. G. Loges, E. Merendini, S. M. Thomas			
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10. AVAILABILITY LIMITATION NOTICES Distribution of this Document is unlimited			
11. SUPPLEMENTARY NOTES None		12. SPONSORING MILITARY ACTIVITY Defense Supply Agency Defense Documentation Center Cameron Station, Virginia	
13. ABSTRACT <p>The Technical Library has developed a unique semimechanized process for the production of catalog cards, charge cards, card pockets, and accessions lists, and a machine-readable punched paper tape record for a future computer-produced book catalog. This system was originally based on a special purpose digital processor, called the Crossfiler, which multiplies catalog card records, inputted on punched paper tape and supplies entry headings for each of the copies. Actual printing is done on a Flexowriter. The Library recently began employing the PDP-1 computer to perform this task and has phased out the Crossfiler. A periodical control system is being developed utilizing the Laboratory's IBM 7044 computer. The library plans to convert its paper tape records to magnetic tape for computer production of a book catalog and computer-run retrospective searches.</p>			

Security Classification

KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
<p>Digital Computer Digital Systems Information Systems Libraries</p>						

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