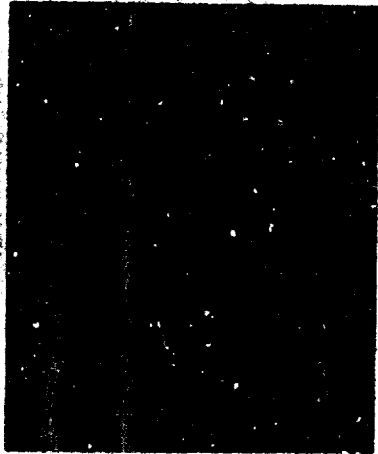Technical Report

AD 640 101

MECHANIZATION STUDY
OF THE U.S. ARMY
HARRY DIAMOND LABORATORIES
TECHNICAL INFORMATION OFFICE,
WASHINGTON, D.C.

BOOZ · ALLEN APPLIED RESEARCH INC.

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Technical Report

AD 640 101

MECHANIZATION STUDY
OF THE U.S. ARMY
HARRY DIAMOND LABORATORIES
TECHNICAL INFORMATION OFFICE,
WASHINGTON, D.C.

Submitted to

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Defense Documentation Center
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BOOZ·ALLEN APPLIED RESEARCH INC.

WASHINGTON

CLEVELAND

CHICAGO

LOS ANGELES

ABSTRACT

Mechanized library functions are performed on the IBM
7094 and 1410 computers using the Approach-By-Concept (ABC)
storage and retrieval syst n. At present, mechanization is applied
only to technical reports. The four outputs are accessions lists
with supplementary KWIC Index, catalog cards, the ABC Dictionary,
and current-awareness notifications. These notifications are provided
as a result of the Martin Company contract for analyses of current
open-source publications in selected subject areas. Because of
file organization problems encountered in the first-generation model
of the ABC system, a second-generation model was developed which
will become operational in the near future. Periodicals are presently
controlled with the aid of EAM techniques with a view to computerization
in the near future. The Library staff states that the program has
developed smoothly, with problem areas being worked out before
they become serious.

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I. SUMMARY

Mechanized library functions at the Harry Diamond Laboratories (HDL) use the Approach-By Concept (ABC) system. ABC is a computer-oriented storage and retrieval system designed to facilitate the organization of very specific and complex information for efficient and economical retrieval. At present, mechanization is applied only to technical reports. The four outputs are the accessions lists with supplementary KWIC Index, catalog cards, the ABC Dictionary, and current-awareness notifications. These notifications are provided as a result of the Martin Company contract for analyses of current open-source publications in selected subject areas.

Organization of HDL's Technical Information Office is illustrated in Appendix A. The Library subscribes to 700 periodicals. It has a collection of 18,655 books and 340,000 classified and unclassified reports with an annual increase of 2,400 and 14,200 respectively. Service is provided to the Laboratories' scientists, engineers and technicians, in person and by telephone or written request. The user relates directly to the ABC Dictionary for manual searching for desired items.

Ordinary library activities are aided by the use of EAM punched cards for the handling of periodical subscription lists and renewals,

-1-

check-in and circulation, with plans developed for addition of these

procedures to the computer. These cards are used by the Library

staff to simplify the subscription renewal and selective listing

procedures.

II. MECHANIZATION

1. CHRONOLOGY

In late 1960, idea for the ABC system was conceived in HDL's Technical Information Office when EAM equipment became available and computer installation was planned. This office also developed and tested the system.

In December 1962, the IBM 1410 was installed. Report acquisition, cataloging, storage, preparation and production of library catalog cards, accessions bulletins, and bibliographies were incorporated into the system. Preevaluation and processing of reports were performed by contractor analysts, and batches of 200 to 250 worksheets were sent to the machine room for keypunching.

In March 1963, conversion of punched cards to computer tape was completed for more than 6,000 titles. As of December 30, 1963, the ABC system was still being developed and tested. At least 10 programs remained to be written and tested.

In early 1965, an evaluation of the system was conducted for DoD, Research and Engineering. As a part of this evaluation, the second-generation ABC system was developed. Later in the year, a test on the retrieval program was initiated. Professors from

George Washington University are conducting this analysis.

2. TECHNICAL REPORT PROCESSES

Preparation of the accessions lists, document catalog cards, ABC Dictionary, and current awareness listings on the computer involve both the Library staff and the Research Operations Branch for input to the system.

(1) Input Procedures

1. Each document received on distribution is reviewed by the Research Operations Branch for its permanent value to HDL. They are grouped into three categories: category 1-- of permanent value to HDL, category 2-- hol 1 for a specific number of years, category 3-- not of value. Documents received as the result of a request are automatically cataloged.

2. Documents being retained in categories 1 and 2 are forwarded to the Library Cataloging Section.

3. Documents in category 3, not being retained as a part of the Library collection, are routed to individuals with possible interest in the report.

4.   Cataloging Section of the Library prepares worksheets
(see Appendix B-1) indicating bibliographic data or
descriptive cataloging information for reports in categories
1 and 2. This includes the shelf (accession) number,
report numbers, agency or source, contract number, title
and volume, personal authors, date, pages, copy numbers,
classification, codes, and group sequence number.
Subjects and tracings are added to reports of permanent
value.

5.   Documents in category 1 are returned to the Research
Operations Branch for addition of the concept analysis
statements. A KWIC title is used for category 2
documents.

6.   Worksheets are forwarded to the computer section
for preparation of the catalog cards and accessions listings.

7.   Concept statements are forwarded to the computer
section for updating of the ABC Dictionary tape.

8.   Abstract cards received from the Martin Company
contract, previously cataloged and processed, are filed
pending requests from users.

9.   Computer tape received as a part of the Martin
Company contract is forwarded to the computer section
for matching against the user profile tape.

(2)   Outputs

1.   Accessions Lists

The computer prepares two lists; one list contains
the HDL reports and the other covers all other classified
and unclassified reports. Samples of these outputs are not
shown because of their classification. The HDL listing
is by title, referring to document report number. The
other listing is arranged by the broad subject areas
assigned by the Cataloging Section, then by title referring
to the accession number. Following the breakdown by
subject area in category 1 and 2 reports, each confidential
listing has a KWIC title index.

2.   Catalog Cards

Three-by-five catalog cards (see Appendix B-2)
are prepared by the computer; one each for the shelf
list, source, report number, individual author (HDL only),
AD and other report numbers, contract number,

and, for category 1 reports, asterisk term and code (i.e., subject). These are filed in the regular card catalog for manual use by staff and users.

3. ABC Dictionary

The Dictionary (Appendix B-3) is printed from the updated master tape in a permuted concept arrangement. Copies of the Dictionary are maintained in the Library for manual reference by Library staff and users. This provides the searching tool and eliminates the necessity of a subject search on the computer. The user scans the Dictionary for the desired term or terms and proceeds to the asterisk term and code card file for specific documents. Under the second-generation system the Dictionary will include superimposed classification on the alphabetical arrangement of the ABC concepts.

4. Current Awareness Listings

This program is partially operated by a contractor. The contractor furnishes 3x5 abstract cards containing titles of periodical articles and report abstracts selected from abstracting literature and furnished on the basis of

subject categories (about 120) pertinent to the work of
HDL. The 3x5 cards were introduced in the summer of
1965. Before then, aperture cards with abstracts on
microfilm were provided. A computer tape was provided
with the aperture cards and is also furnished with the 3x5
cards. Individual users have indicated their interest in
broad subject categories. When a new input tape is run,
all entries in each category in which a given user is
interested are printed. This printout consists of selected
listings of current references that are circulated once
a month (see Appendix B-4 for sample of list) to
participants in the program. Some 500 different lists go
out each month.

The user selects references he thinks might be of
interest and reviews the abstract in the Library. If the
abstract is pertinent, the document is then withdrawn for
his use, or if it is not already available in the Library,
it is obtained. (Users are included in this program by
request.) The user may be an individual representing
himself or an Intelligence and Information Officer
representing a group of men.

3. PERIODICAL HANDLING PROCESSES

With a view to computerization in the near future, periodicals
are presently being recorded and controlled on EAM punched cards
(see Figure 1 for sample). There are three decks consisting of one
card for each title. Deck one is arranged alphabetically by title and
is used for the list of holdings. Deck two is arranged by expiration
date and includes the full renewal record. Deck three is arranged
by source record for renewal purposes. The current year's
subscriptions have been entered through a contractor agent rather than
direct to the source or publisher. Should this prove successful,
Deck three could be eliminated.

FIGURE 1
Punched Card Used for Handling Periodicals

As soon as a renewal or a new subscription is entered, a punched card is produced for each issue of each volume expected throughout the year. These are arranged by month, then alphabetically by title. When the issue is received, the punched card is pulled manually and inserted into a pocket in the back of the copy. This then becomes the circulation record. Any remaining cards at the end of the month are used as the basis for claiming. Seven hundred titles are received yearly; 28 weekly, 21 semimonthly, 11 biweekly, and the rest monthly.

III. PROGRAM SYSTEM DATA

The presently operating system is known as the first-generation ABC system. Appendix C discusses the development of a second-generation system and how it differs from its first-generation counterpart.

The overall planned system for Library automation is shown in Figure 2. The functions of each of the blocks of the planned system are as indicated. However, at the present time, only five of the indicated functions are operational; descriptive cataloging, subject analysis, ABC Dictionary updating, subject card catalog updating, and automatic dissemination. In more general terms, the first four functions are more conveniently grouped together as only two functions, namely, cataloging and ABC Dictionary updating. The fifth function is an unsophisticated Current Awareness program that will be developed further. The following discussion deals only with these operational portions of the ABC system.

1. DESCRIPTION OF FILES

Appendix D (Figures D-1 through D-8) illustrates the format for the files discussed below.
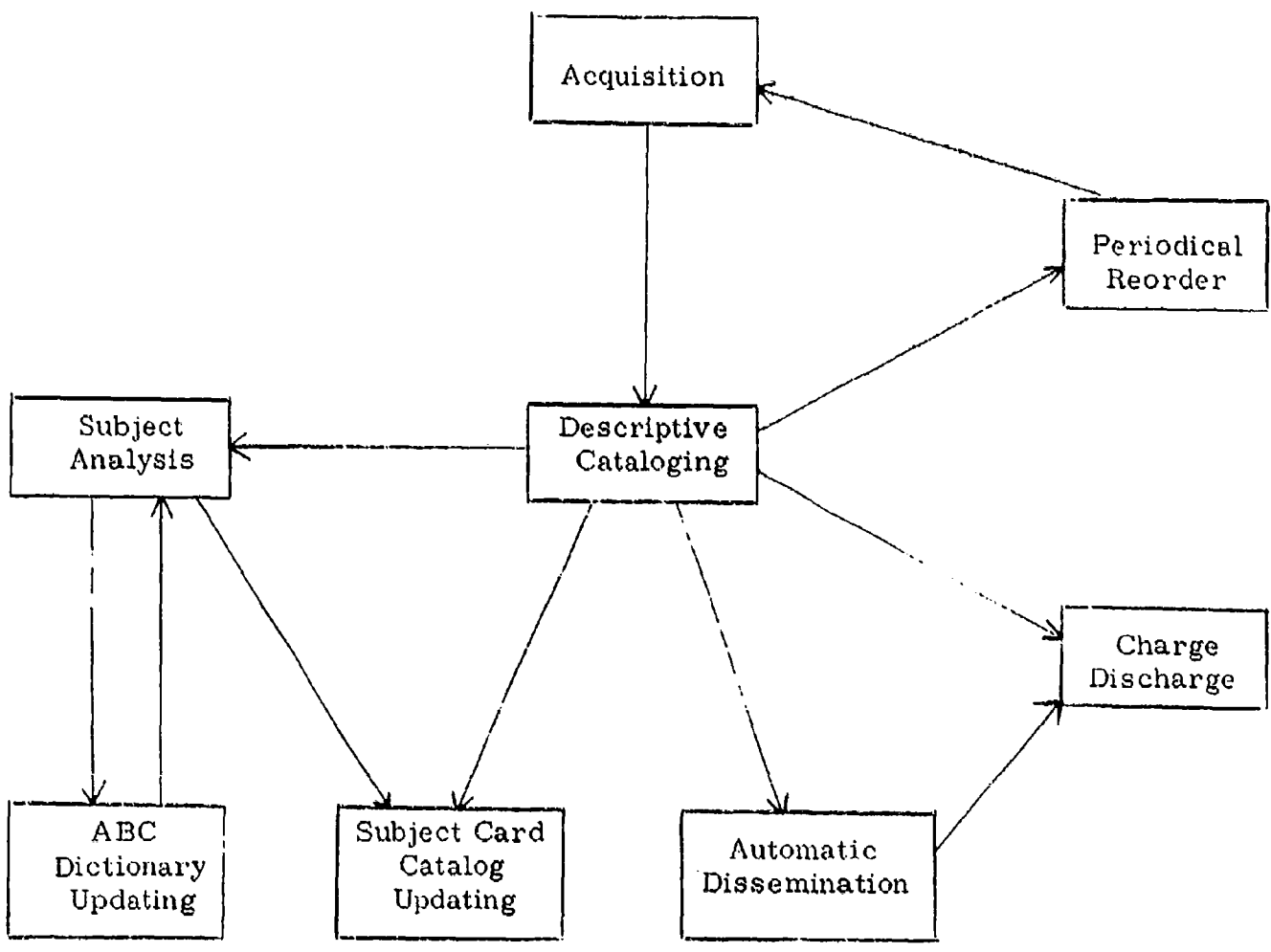
FIGURE 2
Functional Block Diagram of ABC System

(1)   Cataloging System Files

Four permanent storage files and four intermediate working

files form the basis of the cataloging system. The files contain

the concepts that described the basic documents; they are used

to produce accessions bulletins and catalog cards.

The following storage files are used:

1.   Cumulative Catalog Update Card File

This is a cumulative file of 80/80 images of all

cards used to update the catalog system.

2.   Cumulative Catalog File

This is a variable length file of bibliographic and

descriptive information. Each record is a multiple of 48

characters in length. Each group of 48 characters comprises

a two-digit "card code", 45 characters of data, and one

blank. The card codes and types of data are discussed

in the description of the cataloging system routines.

More than one record may refer to a single document. These

records contain the same information, permuted so that each

of the "card" types appears as the leading group of 48

characters in the record, simplifying multiple
catalog card prints.

3. Partial Subject File

This is a variable length file of bibliographic and
descriptive information, similar in format to the Cumulative
Catalog File. In this file, however, permuted records for
a single document are excluded. One record exists for
each asterisk term included in the concept under which the
document has been cataloged. The term and its code
appear as the first 48-character group in the record.
One record is included that has the shelf number first, for
each category 1 report that has not yet been assigned an
asterisk term and code (subject entry).

4. Cumulative Rotated Title File

This is a file of 132-character records containing the
document title and shelf number. Each record is set up
in KWIC format.

The following intermediate files are output files from
the programs indicated.

1. Drive 1 from BULLETIN PRINT

   - Input to sort and print catalog cards

   - Input to file of all catalog information

2. Drive 4 from BULLETIN PRINT

   - Input to print accessions list in KWIC format

   - Input to update Cumulative Rotated Title File

3. Drive 5 from BULLETIN PRINT

   - Input to sort and update Partial Subject File

4. Drive 2 from PRINT BE-PIP

   - Used for subsequent printouts

(2) ABC Dictionary Updating System Files

Three permanent storage files and four intermediate
working files are required to maintain the ABC authority.
Additions, changes, and deletions are made to the Dictionary,
and a listing is made for use in both indexing and searching.

The storage files are as follows:

5. ABC Dictionary File

This is a file of 84-character records containing
all concepts and codes.

6.   Valid Asterisk Terms File

This is a file of 80-character records; each record contains 37-character asterisk terms and 6-character codes. All valid asterisk terms from the Dictionary are included.

7.   Reports Subject File

This file is similar in format and content to storage file 3, differing only in that zero cards (shelf number) are omitted.

The following intermediate files are output files from the programs indicated.

5.   Drive 4 from DICTIONARY UPDATE

- Input to sort and delete and replace asterisk terms, contains all deletions and their replacements

6.   Drive 2 from PRINT BE-PIP

- Used for subsequent printouts

7.   Drive 3 from DELETE AND REPLACE

- Input to sort and change Reports Subject File

8. Drive 3 from COMPARE AND CHANGE

    - Input to sort and change Reports Subject File

2. DESCRIPTION OF ROUTINES

It is emphasized that the presently operating versions of cataloging and ABC Dictionary updating are not the same as those planned for implementation in the future since several refinements for simpler operation as well as for more readable outputs will be incorporated into the final system.

Flow diagrams of the cataloging system and the ABC Dictionary Updating System are shown in Figures 2 and 3. It should be noted that each rectangular block in these flow diagrams indicates a separate computer program (routine). The circular symbols are tapes, with the drive numbers on which they are mounted indicated as "DR x" as appropriate.

(1) Routines for Cataloging System

As input to the cataloging system, IBM cards are punched in a format designed especially for this application. These cards are punched from a worksheet (Appendix B-1) on which each line represents a single IBM punched card. In this format, the shelf number of each item (card columns 1-8) is repeated

on each punched card, as is the group sequence number in columns 74 to 79 (broad-subject-category).[*] Thus, the cards for a given item to be cataloged are easily sorted together on these numbers.

However, in order to (a) identify what portion of an entry is signified by a given card, and (b) properly sequence the cards within a given type of card, e.g., a title card, two additional numbers are added to each punched card. These are the card numbers contained in columns 10 and 11. The first (column 10) is a card-type code indicating the type of information in the data field as follows:

Card Type	Data
0	Shelf Number
1	Report Number
2	Corporate Author
3	Contract or Project Number
4	Title

---

* Only the first three positions are currently used. These represent a broad subject category, which is used at present only to organize the periodical accessions bulletins into subject categories. Thus, the primary method of sorting inputs is by this subject category, the secondary method of sorting is by the shelf number, and the tertiary method of sorting is by the two-digit card numbers (columns 10 and 11).

Card Type	Data
5	Personal Author
6	Miscellaneous (date, pages, classification, etc.)
7	Subject
8	Tracings

The second digit (column 11) merely provides for proper sequencing of cards within a similar type (column 10) entry. The data that are subsequently used for printing are all (except for shelf number) punched in columns 12 to 62.

The present cataloging system produces two-part accessions bulletins, catalog cards, and appropriate files of information on magnetic tape (See Figure 3 for flow diagram). The two-part accessions bulletins are composed of (1) a bibliographic listing (in broad-subject-category order) which is printed by the Bulletin Print program, and (2) a KWIC rotated title list that is prepared from a tape output from the Bulletin Print program by the BE-PIP (Bell Permutation Index Program) 7090 program; the BE-PIP program was supplied by the IBM SHARE system from the original author, the Bell Laboratories.

The catalog cards are printed from a tape prepared by the
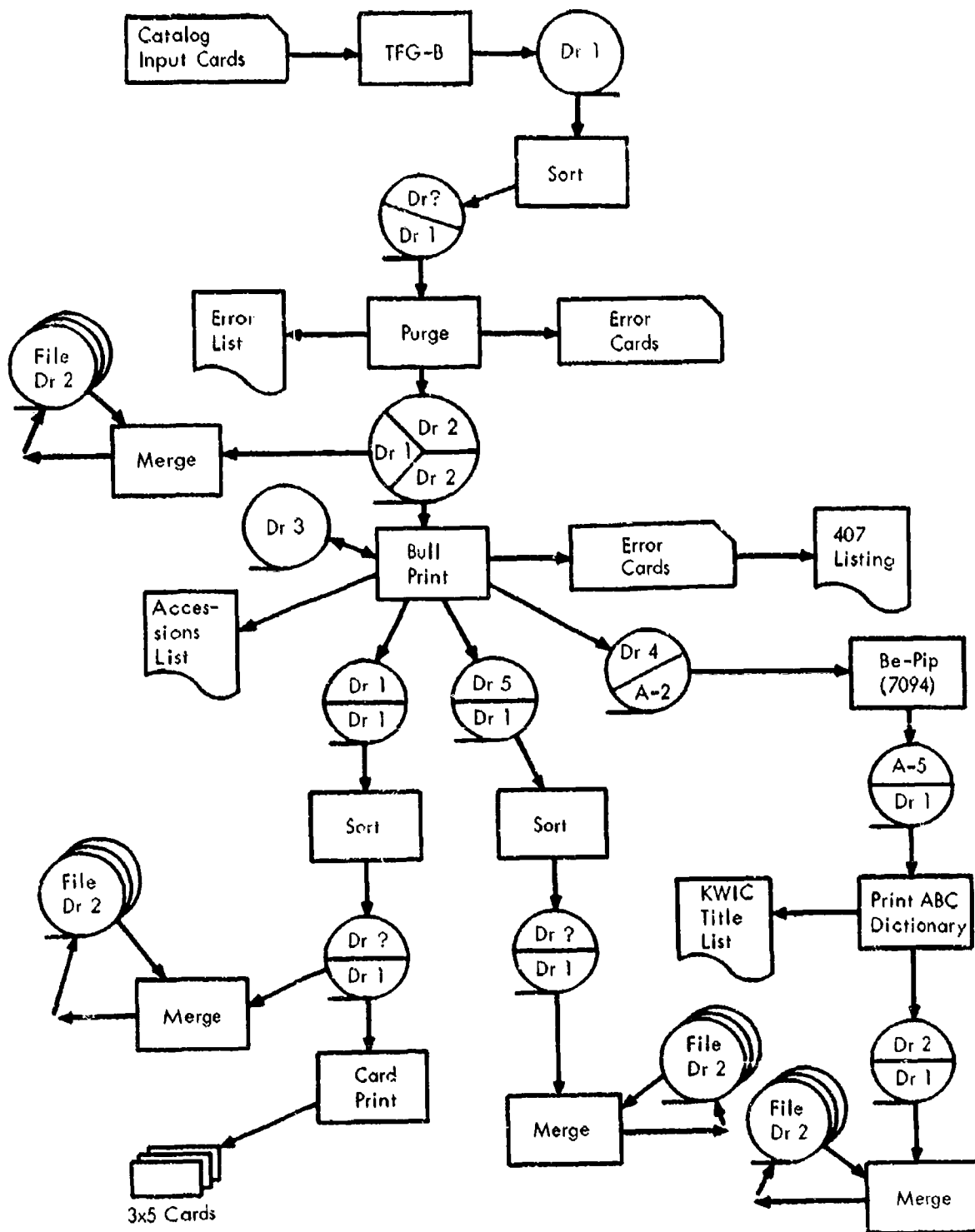
FIGURE 3
Flow Diagram of Cataloging System

Bulletin Print program only after this tape has been sorted
into approximate filing order for ease in placing the cards in the
catalog drawers. The tape files maintained are useful for
such operations as subject card catalog updating and the
possible printing of additional catalogs and lists (such as the
recently provided list of corporate authors and contract and
project numbers).

The following 13 routines pertain to cataloging and produc-
ing accessions bulletins.

1.   TFG-B (1410)

An IBM utility routine for card-to-tape operations.
In this instance, images of catalog updating cards are
recorded on tape.

2.   Sort (1410)

Card images are sorted into sequence by subject
category number, shelf number, and card sequence
number.

3.   Purge (410)

Card images are scanned for detectable errors,
which are punched onto cards, listed, and deleted
from the tape to be corrected and reintroduced into the
system in the next run.

4.   Merge (1410)

All valid card images remaining are merged into
the Cumulative Catalog Update Card File (storage file 1).

5.   Bulletin Print (1410)

All valid card images are input to this program,
which prints the bibliographic data in an accessions bulletin.
Three output tapes are generated to become inputs to
subsequent programs. All card images relating to a
single document are assembled into a single record. Other
records are created containing the same data but per-
muted so that each card image appears once as the first
card of a record (intermediate file 1). These records
are written on tape (Drive 1) to be sorted before
printing catalog cards. Titles and shelf numbers are
output to the tape in Drive 4 (intermediate file 2) for input

to the Bell BE-PIP program, which produces a rotated
title list. The tape on Drive 5 (intermediate file 3) is
used to maintain the Partial Subject File which, in turn,
is used for updating the subject card catalog with the
ABC Dictionary Updating System.

6.   Sort (1410)

The Drive 1 output from the Bulletin Print program
(intermediate file 1) is sorted by card type and by the
alphanumeric information contained in the first three cards
of the record.

7.   Card Print (1410)

This program simply prints catalog cards in
approximate filing sequence.

8.   Merge (1410)

All records used for printing catalog cards are
merged into a Cumulative Catalog File (storage file 2).

9.   Sort (1410)

The output from BULLETIN PRINT on Drive 5 is
sorted by subject code if available or by shelf number.

10. Merge (1410)

These sorted records are merged into the Partial
Subject File (storage file 3) for subsequent use in
updating the subject card catalog with the ABC
Dictionary Updating System.

11. BE-PIP (7094, Bell)

The Drive 4 output from BULLETIN PRINT is
input to this program which is unchanged as received
from the IBM SHARE system. The program rotates
and searches the data and produces 120-character print
images in KWIC style; that is,titles appear in a sequence
in which key words appear alphabetically. These print
images are written as the second file of output tape on
Drive A-5 (intermediate file 5). All other outputs of this
program are discarded.

12. Print ABC (1410)

This program prints the second file of the tape
producing the rotated title listing and writes the same
information on another tape in 132-character records, as
the first file.

This listing becomes the second half of the accessions bulletin.

13. **Merge (1410)**

The above records are merged into a Cumulative Rotated Title File (storage file 4).

(2) **Routines for ABC Dictionary Updating System**

The ABC Dictionary Updating System (Figure 4) provides the means for adding new terms to this open-ended Dictionary, for changing terms in the Dictionary, and for deleting terms. Since a deletion would be made only to combine several entries having similar meanings, reports cataloged under the deleted entry must be automatically recataloged to the other entry having the same meaning.

14. **ABC Dictionary Update (1410)**

This program accepts changes to the ABC Dictionary in the form of additions (new concepts to be added), changes to existing entries (rewording or changing asterisk terms) or deletion/replacements (deletion of a concept and replacing all references to it with references
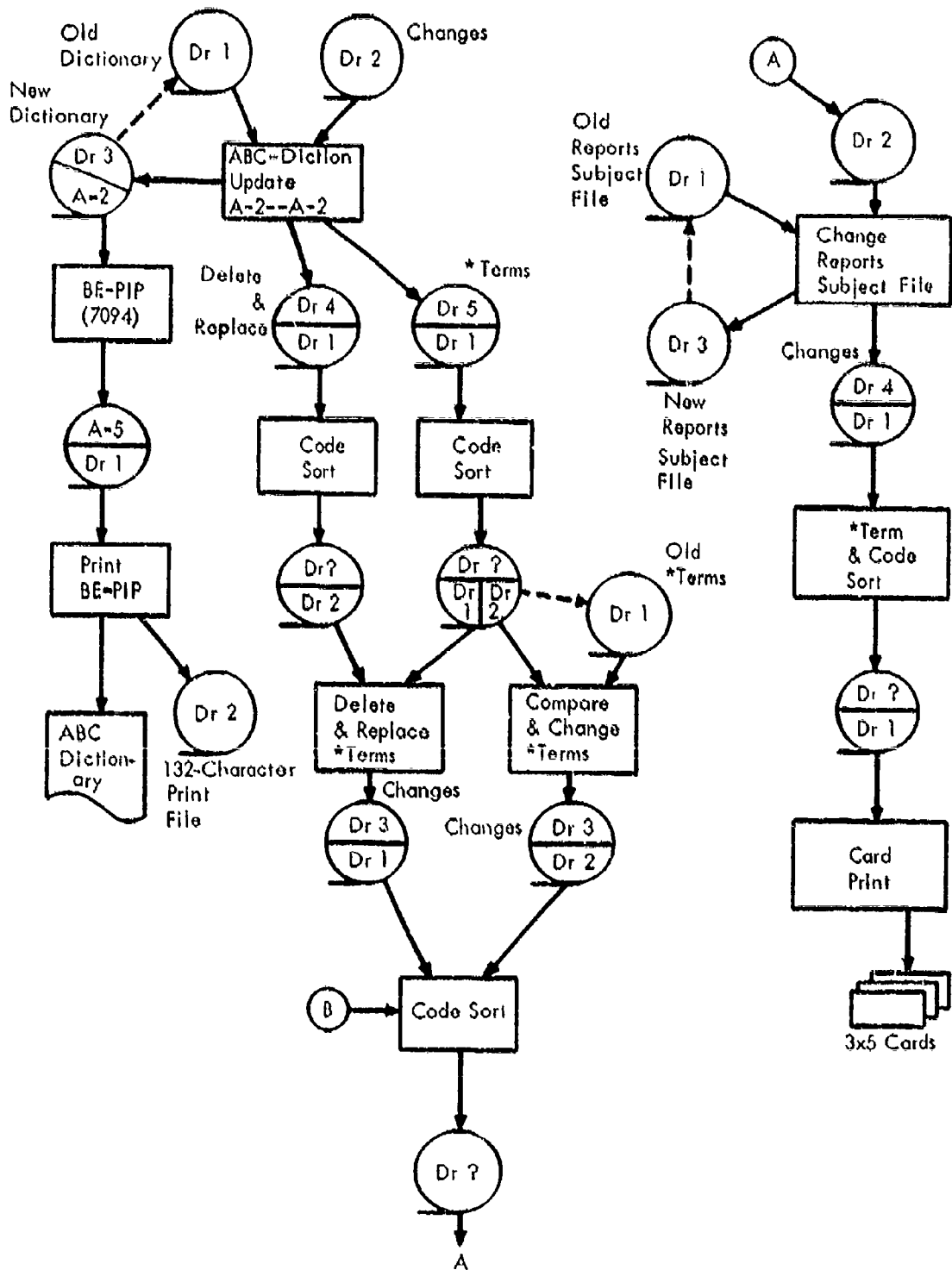
FIGURE 4
Flow Diagram of ABC Dictionary Updating System

to another concept already contained in the Dictionary). The most recent version of the Dictionary tape (storage file 5) and a tape of update card images (Cards 1 and 2) are inputs to this program. The program produces a new Dictionary with the required changes. In addition, it produces two files (intermediate file 5 and storage file 6) that are used to carry those changes into the Reports Subject File.

15. BE-PIP (7094, Bell)

This program, as described above (Program 11) produces a Rotated concept File from the new Dictionary tape.

16. Print BE-PIP (1410)

This program prints the ABC Dictionary in rotated title format, from the second file on the tape produced by Program 15. In addition, it produces a new tape from which additional copies of the Dictionary may be printed more rapidly.

17.   Code Sort (1410)

The Deletions and Replacements File (intermediate
file 5) is sorted by the "new" subject code.

18.   Code Sort (1410)

The Valid Asterisk Term File (storage file 6) is
sorted by subject code.

19.   Delete and Replace Asterisk Terms (1410)

Both of the above sorted files are input to this
program. For each deletion record encountered, its
"new" subject code is used to search the Valid Asterisk
Term File, and one record is produced on the output
tape for each valid term found (intermediate file 6).

20.   Compare and Change Asterisk Terms (1410)

The Valid Asterisk Term File is compared to the
Valid Asterisk Term File saved from the previous updating
run. Terms in the "new" file that differ from terms in
the old file are written into an output file (intermediate
file 7).

21. Code Sort (1410)

Changes from Program 19 and 20 are sorted
together by "old" code.

22. Change Reports Subject File (1410)

Changes are now incorporated into the Subject File
(storate file 7). The format of this file is identical to
that of the Partial Subject File (storage file 3) except
that zero cards (shelf number) are excluded. "Old"
subject codes on the change tape are matched against
subject codes in the Subject File. When a match is made,
the "new" code and asterisk term is substituted and a
"new" Subject File is produced. A file (Drive 4) is
produced in the same format, but it contains only items
to which changes have been made, rather than the entire
Subject File. Entries on the change tape for which no
reference is found in the Subject File are listed on a
separate output error tape.

The Subject File produced by this program must
be sorted by subject code before further use.

23.   Asterisk Term and Code Sort (1410)

The output file from Program 22, containing only changed entries, is sorted by asterisk term and code.

24.   Card Print (1410)

This is the same as Program 7. New catalog cards reflecting changes are printed for filing.

IV. EQUIPMENT, COSTS, AND EVALUATION

1. ## EQUIPMENT

IBM 7094		The 7094 is running two shifts, but not at full capacity.
	7094	with 32K core memory
10	729	Mod IV Tapes, 5 on Channel A, 5 on Channel B; 2 on Channel A and 2 on Channel B are switchable to Channel 1 of 1410.
	407	printer
	711	low-speed card reader
IBM 1410		The 1410 is overloaded, primarily with various printing jobs.
	1410	with 40K core memory
2	729	Mod IV tapes, 1 on Channel 1, 1 on Channel 2
	1402	card reader/punch
	1403	printer with 132-character positions; Channel 2

2. ## COSTS

The following costs are taken from the results of the performance test conducted by HDL's Technical Information Office in early 1965. These figures take into consideration the money that was spent to organize the test collection in accordance with the ABC storage and retrieval method.

All expenditures have been reduced to unit cost, i.e., cost per title, and wherever feasible, an indication of the time involved in the individual operation is given.

For the selection of the test collection
and the preparation and standardization
of the concepts for 3,650 accepted titles,
the total cost was $10,674.60 and the
unit cost was $2.91

For the input into the computer memory,
an average of six punched cards per
title was required. At a unit cost of
$0.07, the cost per title was   0.42

For the printout of three different
catalog cards and one bibliographic
listing of the collection, a total
of 24 lines per title at $1/minute
(1410) machine rental, the cost per
title was   0.11

For the KWIC title list (a nonessential
tool for the customary reference service),
about five lines were permuted at $8/min.
by way of the 7094 computer and printed
at $1/minute by the 1410 computer with
a per title cost of   0.06

For permuting 4,000 concepts with the 7094
computer, the total cost was $150, and
the cost per title was   0.04

For the printing of the ABC Dictionary
with the 1410 computer, the cost of an
average of six lines per title amounted to   0.01

                                        TOTAL $3.55

NOTE: Additional cards create a cost increase
      of up to $0.02.

In the expenditures, only the cost of printing one Dictionary
was included. Every additional accumulation requires another
printing of the same title, at a title cost of $0.01. Therefore, if the
average title added to the collection will be published in a second
accumulation during the first year and then be included in the yearly
accumulations in its second and third year, the cost of three
accumulations must be added, an increase of $0.03 per title.

3.   **FACILITY'S EVALUATION OF SYSTEM**

Owing to the fact that a programmer was trained and used in
the Technical Information Office, many of the problems that might
exist between programmers and Library staff were nonexistent.

As far as the Library staff is concerned, the program has
developed smoothly, with changes being worked out before they
become serious problems. Formats for input are satisfactory, and
the outputs have proved very useful. The Research Operations Branch
feels that the only problems that exist are concerned with the feasi-
bility of new ideas and whether these can be incorporated into the
programs.

Advantages to the system at the present time seem to be in the
natural language used for analysis, organization, and retrieval and
in the browsing convenience to the user.

The primary objective of a performance test conducted early in 1965, was to spot deficiences in the existing system and to develop the second-generation ABC model. In the test, a reasonable recall potential was provided for by requiring a test collection in depth; that is, the scope of the subject area was narrowed (and therefore deepened) to solid state devices, circuits, and applications. This subject area allowed for a conventional subject card with multiple entries and abstracts, thus enabling evaluators to check on the completeness of the retrieval and to determine the recall ratio. Results of the controlled performance test of 36 freely styled questions were a relevance ratio of 88.4 ± 2.6 percent and a recall ratio of 24.7 ± 5.2 percent. The recall ratio was computed on the basis of all pertinent, relevant documents in the collection and was the proportion of the total of the +, =, and - rated items to the total of the relevant documents.

The second-generation model is characterized by descriptors of unlimited length, the introduction of facets or microschedules which produce logical organization of documents under important keywords, and a decrease in the number of verbalized concepts (or statements). Type of document, level-of-difficulty descriptions, and operating parameters of equipments (a feature of the ABC method) are transferred to card catalogs.

This second-generation system is based on experience gained in the test; on the analysis of difficulties that scientists, subject specialists, and librarians encountered as they used the first-generation system; and on a previously conceived ideal storage and retrieval system.

A retrieval test is currently being conducted at HDL. Scientists at HDL make out questions, obtain answers, and then evaluate their own results. George Washington University professors check these results. In this test, the relevance ratio is usually about 87 percent and recall ratio is 10 percent below maximum. It is expected that these percentages will deteriorate with a larger collection.

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Technical Information Office Collections and Services, 15 May 1964,
    Harry Diamond Laboratories.

APPENDIX A

ORGANIZATION OF TECHNICAL INFORMATION OFFICE

HARRY DIAMOND LABORATORIES

ORGANIZATION OF TECHNICAL INFORMATION OFFICE

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                    ┌─────────────────────┐
                    │    Office of the    │
                    │  Associate Director │
                    └──────────┬──────────┘
                               │
                    ┌──────────┴──────────┐
                    │ Technical Information│
                    │       Office        │
                    └──────────┬──────────┘
                               │
            ┌──────────────────┴──────────────────┐
   ┌────────┴────────┐                    ┌────────┴────────┐
   │   Collections   │                    │     Research    │
   │     Branch      │                    │    Operations   │
   │    (Library)    │                    │      Branch     │
   └────────┬────────┘                    └─────────────────┘
            │
   ┌────────┼────────────────────┐
┌──┴───────┐ ┌───────────┐ ┌──────┴──────┐
│Acquisitions│ │Descriptive│ │ Circulation │
│  Section   │ │Cataloging │ │     and     │
└────────────┘ └───────────┘ │    Ready    │
                             │  Reference  │
                             └─────────────┘
```
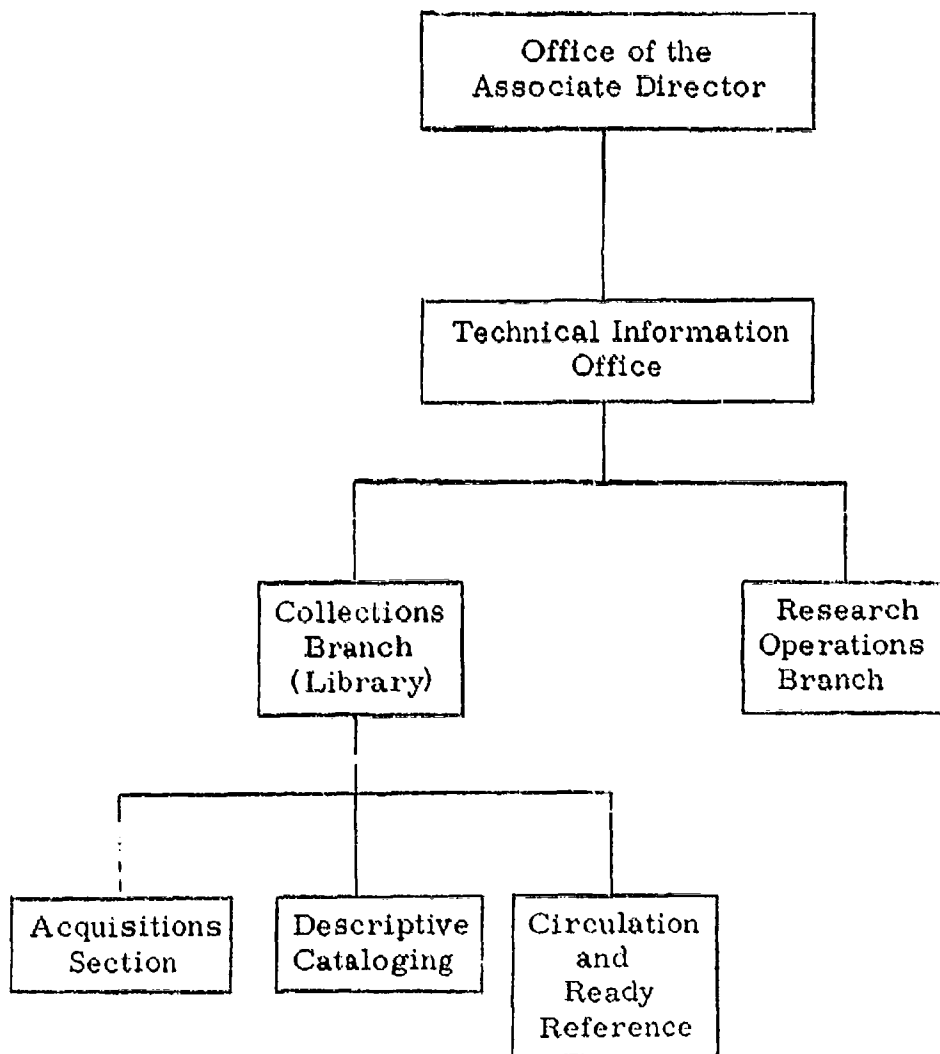
APPENDIX B

SAMPLE OF WORKSHEET AND OUTPUTS

B-1

LIBRARY CATALOGING WORKSHEET

B-2

COMPLETE SET OF CATALOG CARDS

SAMPLE OF SECOND-GENERATION ABC DICTIONARY

* * * AMPLIFIER -- GENERAL * * *

* * * AMPLIFIER -- GAIN CONTROL * * *

ALYSIS OF PHASE DISTORTION* DUE TO AGC IN F8 T, .ISTOR AMPLIFIER *   AN AERU
       WIDE-FREQUENCY RANGE GAIN-CONTROL* FOR TRANSISTOR AMPLIVIER WITHOUT VARYING DC BIAS *   AGOL

- - - AMPLIFIER -- MULTISTAGE - - -

          NOMOGRAPH FOR DESIGN OF RC-COUPLED TRANSISTOR AMPLIFIER* *   ACOT
   FREQUENCY-RESPONSE OF TRANSISTOR TRANSFORMER-COUPLED AF AMPLIFIER* *   AFMO
MATRIX OF ONE-ARM OF WIEN-BRIDGE APPLIED AS SELECTIVE RC AMPLIFIER* *   DERIVATION OF THE ADGC
               DESIGN OF RESISTANCE-COUPLED TRANSISTOR AMPLIFIER* F4-5, GAIN-P60 *   ACKS
               TRANSISTOR RC-COUPLED HIGH-FREQUENCY AMPLIFIER* F8, GAIN-P12 *   AEOH
                       THREE-STAGE CASCADED AMPLIFIER* FOX, F8X.32-BANDWIDTH, GAIN-P34 *   AEOZ
MAXIMUM GAIN BANDWIDTH PRODUCT FOR 2-TERMINAL TRANSISTOR AMPLIFIER* INTERSTAGE *   AFAN
OF TRANSISTORIZED DISTRIBUTED- AND CASCADED- AMPLIFIER* AMPLIFIER* */SIS AND GAIN-BANDWIDTH COMPARISON ACOL

- - - AMPLIFIER -- DISTORTION - - -

ALYSIS OF PHASE DISTORTION* DUE TO AGC IN F8 TRANSISTOR AMPLIFIER *   AN AERU
    PREDISTORTION METHOD OF MULTI- TUNNEL-DIODE-AMPLIFIER* AMPLIFIER* DESIGN *   ADAC

- - - AMPLIFIER -- FEEDBACK IN AMPLIFIERS - - -

          HALL-EFFECT MULTIPLIER* USING FEEDBACK AMPLIFIER TO REDUCE PHASE-SHIFT-DISTORTION * AAVL
      TEMPERATURE-STABILIZATION* OF TRANSISTOR AMPLIFIER WITH ZENER-DIODE FEEDBACK-NETWORK * AFOS

- - - AMPLIFIER -- MINIATURIZATION - - -

R, GAIN, AND STABILITY, IN MICROELECTRONIC* SMALL SIGNAL AMPLIFIER *   RELATIONSHIP OF POWE AFTL
          DESIGN AND FABRICATION OF BANDPASS AMPLIFIER* USING INTEGRATED-CIRCUITS *   ADEY

* * * AMPLIFIER -- THEORY AND DESIGN * * *

- - - AMPLIFIER -- ANALYSIS AND SYNTHESIS - - -

   ANALYSIS AND DESIGN OF P2X.25 COMPENSATED TRANSISTOR AMPLIFIER* *   AFCE
MPARISON, AND DESIGN OF BROAD-BANDED, LOW-PASS TRANSISTOR AMPLIFIER* *   ANALYSIS, CO AFMF
               GENERAL SYNTHESIS OF TUNNEL-DIODE AMPLIFIER* AND SENSITIVITY-MINIMIZATION *   AFZW

- - - AMPLIFIER -- DESIGN - - -

   ANALYSIS AND DESIGN OF P2X.25 COMPENSATED TRANSISTOR AMPLIFIER* *   AFCE
       DESIGN ANALYSIS OF SINGLE-TUNED TRANSISTOR BANDPASS AMPLIFIER* *   AFMI
   ND GRAPHIC DESIGN FOR SERIES TUNED NEGATIVE-RESISTANCE* AMPLIFIER* *   ANALYTIC A AEHC
MPARISON, AND DESIGN OF BROAD-BANDED, LOW-PASS TRANSISTOR AMPLIFIER* *   ANALYSIS, CO AFMF

* * * AMPLIFIER -- APPLICATIONS * * *

          MINIATURIZED ELECTROCARDIOGRAM* CARRIER AMPLIFIER *   AFSI
               AN EXPERIMENTAL TUNNEL-DIODE AMPLIFIER* FOR F7-8 APPLICATION *   AFOY
                       TRANSISTOR-RELAY AMPLIFIER* FOR ANALOG-COMPUTER *   ACPC
      FREQUENCY-CONVERSION MAGNETIC REPEATER AMPLIFIER* FOR LOW-LEVEL SUBMARINE   ACOT
                                             TELEGRAPH-CABLES
          CONSTANT TEMPERATURE ONE-TRANSISTOR AMPLIFIER FOR SELENIUM PHOTOVOLTAIC-CELLS*   AEMK
                                             VP2X.6-OUTPUT *
   POWER-SUPPLY, CHOPPING OSCILLATOR AND TUNED AMPLIFIER FOR SENSITIVE PHOTOMULTIPLIER* *   AEQY
                       HYBRID DC AMPLIFIER FOR THERMOCOUPLE* AND RESISTANCE   AFFO
                                             THERMOMETER, ALSO FOR OTHER PURPOSES *
               TRANSISTOR FERRITE-CORE AMPLIFIER PROVIDES BASIC LOGIC-CIRCUIT FOR   AFWE
                                             SWITCHING-EQUIPMENT* *
A DETAILED DESCRIPTION OF   SIGN OF A
   MINIATURIZED ELECTROCARD   AM* TRANSISTORIZED CARRIER AMPLIFIER SYSTEM *   AFUM
                       SIX-CHANNEL DC-COUPLED AMPLIFIER* USED AS GALVANOMETER-DRIVER UP TO   ACOX
                                             F4 *
          STABLE TRANSISTOR AMPLITUDE COMPRESSION AMPLIFIER* USED AS MULTICHANNEL DISTRIBUTOR * AFEI
EXPERIMENTAL EVALUATION
OF THE PHASE-SENSITIVE 5-STAGE TRANSISTOR HOMODYNE-TYPE AC AMPLIFIER USED IN THE HOLMES-JOHNSON AND LAROCHE AFHX
                                             RADIATION DETECTORS* *

* * * AMPLIFIER -- CHARACTERISTICS * * *

          EFFECT OF FET* ON LOW NOISE HIGH IMPEDANCE AMPLIFIER *   AGAU
RELATIONSHIP OF POWER,
   GAIN, AND STABILITY, IN MICROELECTRONIC* SMALL SIGNAL AMPLIFIER *   AFTL
A BASIS FOR THE ANALYSIS OF HARMONIC
   DISTORTION* IN BALANCED AND UNBALANCED CLASS-AB PUSH-PULL AMPLIFIER *   AFIL
ANALYSIS, COMPARISON,
   AND DESIGN OF BROAD-BANDED, LOW-PASS TRANSISTOR AMPLIFIER* *   AFMF
SOME COMMENTS ON THE   FLUENCE
   OF STABILITY C OISE-FIGURE FOR NEGATIVE-CONDUCTANCE AMPLIFIER* *   ANZZ
   DESIGN CONFIGUR. ND PARAMETERS OF NEGATIVE FEEDBACK AMPLIFIER WITH ADJUSTABLE TO INFINITY INPUT- AAUZ
                                             IMPEDANCE* INDEPENDENT OF OUTPUT LOAD AND
                                             CERTAIN OTHER PARAMETERS *
                       TRANSISTOR AMPLIFIER* 2.6-INPUT F-1-5-BANDWIDTH FOR HIGH-   AAPB

SAMPLE OF CURRENT AWARENESS LISTING

CATEGORY NO.	PROCESSING NO.	SOURCE	DATE	DESCRIPTORS
0170	051512	JETAS	1261	21617 58360 76083 84017

REFRIGERATION FOR SPACE-BORNE CRYOGENIC NAVIGATION SYSTEMS. JPL A1

0170	051520	KGNASA	0362	17029 31910 32792 52773 54947

OPTIMAL FILTERING AND LINEAR PREDICTION APPLIED TO A MIDCOURSE NAVIGATION SYSTEM FOR THE CIRCUMLUNAR MISSION. JPL A1

0170	051525	NCCIT	1161	32782 56637 54947 60735 81939

MONTE CARLO SIMULATION OF THE MIDCOURSE GUIDANCE FOR LUNAR FLIGHTS. JPL A1

0170	052321	KIRAND	0262	20105 17086 19155 73241

COMMUNICATION SATELLITES ESSENTIAL COMMAND AND CONTROL PURPOSES IN THE MID-SIXTIES. AD 328-237

0170	052342	KGNASA	1060	20225 24392 24894 27012 41434 75765

A HOMING MISSILE CONTROL SYSTEM TO REDUCE THE EFFECTS OF RADOME DIFFRACTION. AD 222 495

0170	052605	KIPHILC	0859	06260 11954 58360 72601 81527

PRESSAR, THE APPLICATION OF SIDE-LOOKING RADAR TO BOMBING-NAVIGATION SYSTEMS IS DISCUSSED. AD 312 017

0170	052609	RIRCA	0859	11354 28870 58360 72601 81527 58327

ELECTROFAX RECORDING SYSTEM FOR SIDE-LOOKING RADAR. AD 313 710

0170	053637	JEIRE	0661	50503 59549 84069 90518 20105

LOGARITHMIC NAVIGATION FOR PRECISE GUIDANCE OF SPACE VEHICLES. IAA 9-61

0170	053906	KIAEROS	0661	32790 61969 84099

ATTITUDE REFERENCE AS ESTABLISHED BY A HORIZON SCANNER. AD 261 140

0170	054096	KIRAND	1061	20105 19155 61969 70143 70141

AN ORBITAL CONTROL PROCESS FOR A 24-HOUR COMMUNICATION SATELLITE. TECH. PUB. ANN UN. 5-62

0170	054795	KIGCA	0661	03168 67431 84099

PHASE CURVES AND ALBEDOS OF TERRESTRIAL PLANETS. AD 261 165

0170	054797	KIGCA	0861	07468 19702 49642 52728 84099

INVESTIGATION OF PHYSICAL PHENOMENA FOR SPACE NAVIGATION. AD 261 166

0170	054799	KIGCA	0761	19702 47622 84099 83466

INTERPLANETARY NAVIGATION STUDIES. DIAMETERS OF TERRESTRIAL PLANETS - WITH APPENDIX IN THE OUTER PLANETS -. AD 261 167

APPENDIX C

DEVELOPMENT OF SECOND - GENERATION ABC SYSTEM

DEVELOPMENT OF SECOND - GENERATION ABC SYSTEM

Problems were encountered in the first-generation model of the

ABC System (see Figure C-1). It was recognized that certain disruptions

introduced by automatic alphabetization had to be eliminated, and

concepts that rapidly accumulated in the ABC Dictionary under broad

and significant content words -- amplifiers, antennae, diodes, lasers,

oscillators, plasma, transistors, etc. -- should be organized for

rapid and easy location.

Therefore, as a part of the performance test requested by DoD,

work was undertaken to prepare a practical, flexible scheme for group-

ing in subdivisions the information under the different important keywords,

to prepare a program capable of listing the same concept under at least

three of the logical subdivisions of such a special superposed scheme

whenever desirable, and to automate all clerical functions, such as

the reproduction of the required numbers of concepts, the filing of the

concepts into the various subdivisions, and the printing of the organized

sections and subsections of the ABC Dictionary.

Subgroups of subject schemes (miscroschedules) for 30 different

keywords have been introduced. The number of subdivisions in one

given scheme is limited to 676 because of the two-letter code used for

identifying them in the machine program. These codes

FIGURE C-1

FIRST GENERATION ABC DICTIONARY (SAMPLE)

```
RUBY MASER* AMPLIFIER* GAIN-14, F7-BANDWIDTH =                                                    AEAT
DERIVATION OF POWER-GAIN IN TUNNEL-DIODE* AMPLIFIER* =                                            AFGV
MINIATURIZED ELECTROCARDIOGRAM* CARRIER AMPLIFIER =                                               A^SI
EFFECT OF FET* IN LOW NOISE HIGH IMPEDANCE AMPLIFIER =                                            AGAU
ALYSIS OF PHASE DISTORTION* DUE TO AGC IN F8 TRANSISTOR AMPLIFIER =                         AN    AERU
-FREQUENCY COMPENSATION* OF DRIFT-TRANSISTOR AND OF TUBE AMPLIFIER*                       HIGH    AOXX
R, GAIN, AND STABILITY, IN MICROELECTRONIC* SMALL SIGNAL AMPLIFIER*     RELATIONSHIP OF POWE      AFTL
TORTION* IN BALANCED AND UNBALANCED CLASS-AB PUSH-PULL AMPLIFIER*     ANALYSIS OF HARMONIC DIS    AFIL
TITY* EQUATION FOR DIFFERENT TYPES OF TRANSISTOR VOLTAGE AMPLIFIER*   DISCUSSION OF THERMAL STABI AFHS
PLIFICATION AND GAIN OF FORWARD AND REFLECTED WAVE LASER* AMPLIFIER*    THEORETICAL ANALYSIS OF AM AEUG
EL-DIODES* =                                 NEGATIVE-RESISTANCE AMPLIFIER*                        AFCH
PERFORMANCE OF PARAMETRIC-DIODES* IN AMPLIFIER AND BISTABEL PULSE-CIRCUITS USING TUNN             AFOJ
TUNNEL-DIODE* EQUIVALENT-CIRCUIT, AMPLIFIER AND FREQUENCY MULTIPLIER-CIRCUITS =                   AFDT
INSTABILITY IN THE NEMAG* AMPLIFIER AND GENERATOR =                                               ADZW
DESIGN AND ANALYSIS OF F8 NEGATIVE-RESISTANCE* AMPLIFIER AND OSCILLATOR USING TUNNEL-DIODE* =     ABHF
HIGH-FREQUENCY-TRANSISTOR F9, PN2 AS OSCILLATOR OR AMPLIFIER AT TWICE THE CUTOFF-FREQUENCY =      AAHS
FREE-RUNNING AND PULSE AMPLIFIER AVALANCHE SWITCH-CIRCUITS =                                      AFHX
ENT OF TRANSISTOR* PARAMETERS AND EQUIVALENT-CIRCUIT FOR AMPLIFIER DESIGN =         MEASUREM      ADLV
PUT = CONSTANT TEMPERATURE ONE-TRANSISTOR AMPLIFIER FOR SE PHOTOVOLTAIC-CELLS* VP2X.6-OUT         AERK
POWER-SUPPLY, CHOPPING OSCILLATOR AND TUNED AMPLIFIER FOR SENSITIVE PHOTOMULTIPLIER* =            AEQY
HYBRID DC AMPLIFIER FOR THERMOCOUPLE* AND RESISTANCE THERM                                        AFFB
OMETER* =                    LIMITER* AMPLIFIER OPERATING AT F7X.8 WITH A DYNAMIC-RAN             AGFU
GE OF 80-DB =            BIAS OF TUNNEL-DIODE* USED AS SWITCH OR AMPLIFIER OR OSCILLATOR =         AAXS
HING-EQUIPMENT* =        TRANSISTOR FERRITE-CORE AMPLIFIER PROVIDES BASIC LOGIC-CIRCUIT FOR SWITC AFUE
MINIATURIZED ELECTROCARDIOGRAM* TRANSISTORIZED CARRIER AMPLIFIER SYSTEM =                         AFVH
HALL-EFFECT MULTIPLIER* USING FEEDBACK AMPLIFIER TO REDUCE PHASE-SHIFT-DISTORTION =               AAVL
INDUSTRIAL PREPAREDNESS-STJOY* FOR DEVICE 7, F9X.7 AMPLIFIER TRANSISTOR=                          AFFY
PHASE-SENSITIVE 5-STAGE TRANSISTOR HOMODYNE-TYPE AC AMPLIFIER USED IN RADIATION DETECTOR* =       AFHX
EXCITATION OF 8-INCH RUBY LASER* AMPLIFIER USING ELLIPTICLA XE FLASH- LAMPS  T300                 ADIX
DESIGN ANALYSIS OF HIGH INPUT IMPEDANCE AMPLIFIER USING FET* AND MPN BIPOLAR-TRANSISTOR           AGOH
STABLE DC OPERATING-POINT OF TRANSISTOR AMPLIFIER USING ZENER-DIODES =                            AFAY
PEDANCE* INDEPENDENT OF OUTPUT-LOAD = FEEDBACK AMPLIFIER WITH ADJUSTABLE TO INFINITY INPUT-IM     AAUQ
TEMPERATURE-STABILIZATION* OF TRANSISTOR AMPLIFIER WITH ZENER-DIODE FEEDBACK-NETWORK =            AF3S
WIDE-FREQUENCY RANGE GAIN-CONTROL* FOR TRANSISTOR AMPLIFIER* WITHOUT VARYING DC BIAS =            AGDL
DESIGN OF A COMMON-EMITTER DISTRIBUTED AMPLIFIER* F0 TO F9 =                                      ADFI
DESIGN OF RESISTANCE-COUPLED TRANSISTOR AMPLIFIER* F4-5, GAIN-P60 =                               ADKS
TRANSISTOR RC-COUPLED HIGH-FREQUENCY AMPLIFIER* F8, GAIN-P12 =                                    AEDH
ONE-STAGE HIGH-GAIN TRANSISTOR AMPLIFIER* F8, GAIN-P8.5 =                                         AEDG
THREE-STAGE CASCADED AMPLIFIER* F8X, F8X.32-BANDWIDTH, GAIN-P34 =                                 AEDI
```

(alphabetically arranged) for each subsection into which they
are to be inserted are added to the respective keywords of a
concept.

The second-generation system will insure the following
computer operations: 1) alphabetization by keywords; 2) recognition
of the different codes attached to them; 3) reproduction of the required
number of concepts; 4) arrangement of the concepts by the code
symbols; 5) insertion of the headings ahead of the subdivisions
(corresponding to the code) from a second tape; and 6) printout of
the subheadings and concepts in order and eliminating the codes from
the printout.

Two additional format changes were designed to improve the
appearance and usefulness of the Dictionary. First of all, the length
restriction of the individual concept to one line was eliminated. A
new program will accommodate concepts of any length. Second,
the concepts are printed in a different arrangement, with double
printing to produce a bolder typeface for the headings.

Although the secondary organization of the concepts around the
key term are mainly accomplished by superposed subject schemes,
refinement of rules for concepting will continue. Something other
than the rule that an overall concept must be prepared to tie

together the various different concepts assigned to one paper is
needed. In addition, considerable attention will be given to the
standardization not only of the terminology but also of the syntax
as soon as practical results are available through research on
generative grammar and automatic translation methods.

Another major objective of the second-generation ABC method
is the reduction of the Dictionary to the smallest possible size by
moving some information to the card catalog. The major items
in this operation are parameters and descriptive information.

APPENDIX D

FILE FORMATS

FILE FORMATS

FIGURE D-1

Storage File 2   Cumulative Catalog File

Storage File 3   Partial Subject File

Storage File 7   Reports Subject File

Intermediate File 1   Drive 1 from BULLETIN PRINT Program

Intermediate File 3   Drive 5 from BULLETIN PRINT Program

ID	Data	ID	Data	ID	Data	Data
1	48	49	96	97		
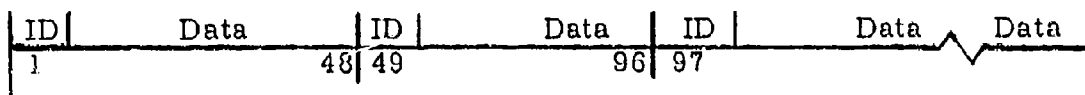
These records are of variable lengths. Each subunit is 48
characters long. ID is two characters; the first is the card type
code indicating the type information in the data field (see page 17
in Program Systems Data) and the second digit is for sequencing
continuation cards of a given type. Data are 45 characters followed
by one blank.

FIGURE D-2

Storage File 4   Cumulative Rotated Title File

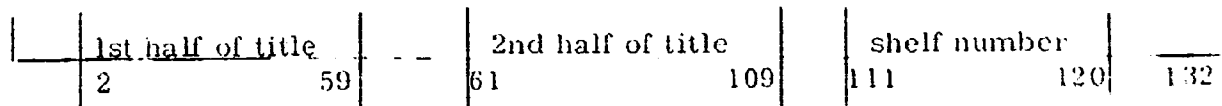Intermediate File 5   Drive 2 from PRINT BE-PIP Program
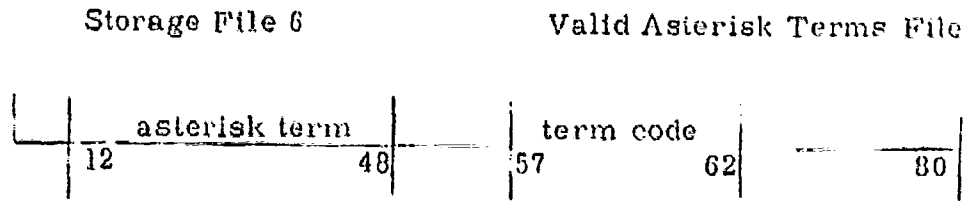
1st half of title	2nd half of title	shelf number	
2 59	61 109	111 120	132

FIGURE D-3

Storage File 6   Valid Asterisk Terms File

| | asterisk term | | | term code | | | 80 |
| 12 | 48 | 57 | 62 | |

FIGURE D-4

Intermediate File 5   Delete and Replace File

| new term code | | old term code | |
| 57 | 62 | 64 | 69 | 80 |

FIGURE D-5

Intermediate File 6   Changes (Delete and Replace)

| asterisk term | | old term code | | new term code | |
| 12 | 48 | 57 | 62 | 64 | 69 | 80 |
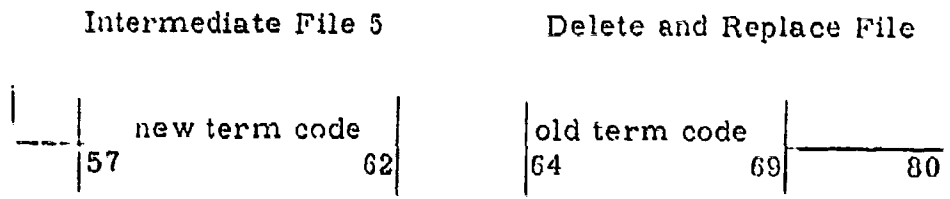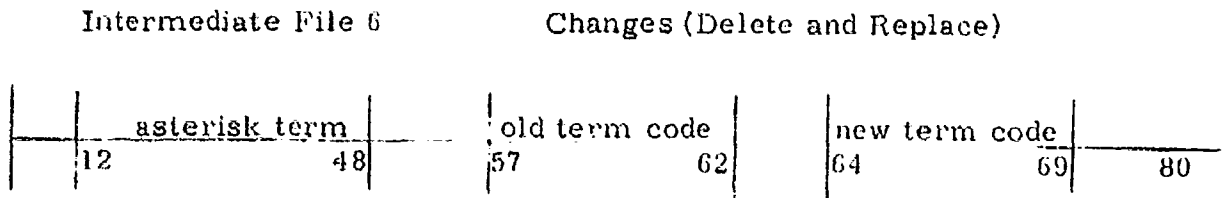
FIGURE D-6

Storage File 5   ABC Dictionary File

Intermediate File 2   Drive 4 from BULLETIN PRINT Program

ID			code			data				
1	2	3	7	17		19	65		84	

The above format pertains specifically to storage file 5.
However, the format for intermediate file 2 is the same except that
"shelf number" replaces "code".

The first character of ID is either T for title or A for author.
The second character is a sequence number. Column three contains
a period to indicate the last record of a set.

FIGURE D-7

Intermediate File 7   Compare and Change Asterisk Term

	asterisk term			old code			new code			
	12	48		57	62		64	69	80	

FIGURE D-8
Dictionary Update Cards

Card 1

change or
add card

T or A	Sequence No.		Code		Data	
1	2	3	7 17		19 65	80

Card 2

Delete
and Replace
Card

D		old code		new code		
1		7 17		19 29	80	

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Final Report of on-site survey

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13. ABSTRACT

Mechanized library functions are performed on the IBM 7094 and 1410 computers using the Approach-By-Concept (ABC) storage and retrieval system. At present, mechanization is applied only to technical reports. The four outputs are accessions lists with supplementary KWIC Index, catalog cards, the ABC Dictionary, and current-awareness notifications. These notifications are provided as a result of the Martin Company contract for analyses of current open-source publications in selected subject areas. Because of file organization problems encountered in the first-generation model of the ABC system, a second-generation model was developed which will become operational in the near future. Periodicals are presently controlled with the aid of EAM techniques with a view to computerization in the near future. The Library staff states that the program has developed smoothly, with problem areas being worked out before they became serious.

14	KEY WORDS	LINK A		LINK B		LINK C	
		ROLE	WT	ROLE	WT	ROLE	WT
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There is no limitation on the length of the abstract. However, the suggested length is from 150 to 225 words.

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