Deciduous Forest Biome
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F I N D

Freshwater Institute Numeric Database

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ABSTRACT

A series of programs for data management are described. The storage structure of data in the database and the retrieval capabilities of the system are presented. The system is designed to assist in the storage and retrieval of scientific data. The programs are written in IBM 360 Assembler Language.

KEYWORDS

Data Management, Management Information System, Database, Data Storage and Retrieval.

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INTRODUCTION

FIND - Freshwater Institute Numeric Database - is an information system for data management. It allows scientific investigators easily accessible storage of their data, facilitates interchange of data among investigators, makes possible modeling and analysis using data from multiple sources, and permits rapid interrogation concerning what data are available. All of these functions are important when dealing with a highly complex, interdisciplinary study such as that at Lake George.

Data are stored internally on the computer on disk pack units. In this form large amounts of data may be stored efficiently in a small space and are easily and rapidly manipulated by computer programs. Punched cards, stored externally to the computer, serve as a back-up in the event of accidents affecting storage in the computer or its peripheral devices.

The prime function of the FIND system is to produce auxiliary data sets of interest to the user. These data sets may be used as input for computer assisted analysis programs, as input for modeling routines, and for model validation. In addition to producing auxiliary data sets, the FIND system provides for elementary operations (listing and punching) on the data sets.

While efficient computing concepts and procedures are important, the prime consideration in the development of FIND has been the individual needs of research investigators. Since, at this time, many of the investigators are not experienced with

computer systems, site data processing personnel will be responsible for the actual operation of FIND. Investigators will only be responsible for presenting their data in machine compatible form, usually punched cards, along with an abstract describing the data. As in the past, data processing personnel will aid investigators in the preparation of their data, but it still is the primary responsibility of the investigator.

This report gives a general overview of the FIND system. The intent of this report is to inform investigators about computer storage and retrieval procedures without having them become unduly concerned with computer specifics. A subsequent report will provide program listings, job control language statements, system command words, and telecommunications procedures. This subsequent report will contain the necessary information so that investigators may retrieve data without the intervention of data processing personnel.

FIND SYSTEM

The FIND system consists of two parts:

1. physical storage of data, internal to the computer, hereafter called the database;
2. a series of programs that operate on the database to: store data in compact form, retrieve data, execute analysis programs, and issue status reports containing a summary of available data.

Data Storage

A record of data stored in the computer consists of the actual data and identifiers giving supplemental information about the data. We have called these identifiers classification states. These classification states enumerate the how, what, when and where identifications of data.

These classifications may be made by either direct recording or by locational significance. While each data set will usually have different classification states, the following examples are typical.

Examples:

1. Diatoms have been counted (3 species) at different stations (2), depths (4), and time of the year. Classification states are:

   a) Species - coded 1,2,3 for instance

   b) Station - coded 1,2

   c) Depths - actual depth

   d) Date - actual date

   The record would be

   Station, Depth, Date, Species, Data-Count

i.e. 1 3.0 6/17/69 1 100

2. Locational significance could be used by having all three species on one record. The first count would be for species 1, the second for species 2, and so on. The record would now be

   Station, Depth, Date, Data Count, Data Count, Data Count
   Species 1 Species 2 Species 3

i.e. 1 3.0 6/17/69 100 50 75

In addition there are two more classification states that will always be present. These are

   (i) password -- identifies the originator of the data, and

   (ii) identification (ID) code -- a numeric code that identifies the specific data.

For example,

   Password - SMITH

   ID code - 1 hourly incoming solar radiation
   2 air temperature readings

The password and ID code, in addition to providing information, control access to data files. The password and ID code must be correct before the data files may be read.

Classification states are quite important because they are information used by the retrieval program. The more detailed the classification states are, the finer the resolution that is possible in the retrieval program. If it is desired to have all the solar radiation values for the months of June and July between the hours of 1100 and 1300 (on 24 hour clock) the classification states associated with solar radiation must include time of day and date.

FIND PROGRAMS

The FIND programs, written in IBM Assembler Language, are designed to run in either batch or remote terminal mode. Batch mode refers to submitting programs on punched cards, through the input devices located at the Rensselaer Computing Center. The remote terminal feature will allow investigators both on and off the Rensselaer campus to easily access the database. All that is needed for remote terminal mode is either a teletype or an IBM telecommunications device (2741).

The remote terminal mode will operate under the ALPHA system at Rensselaer. The ALPHA system is a procedure for telecommunications. All the programs may be executed from the terminal. When run in ALPHA conversational mode, the programs will request input directly at the terminal. The output may be directed to whatever output device the user desires. Punched output will always be produced at the card punch in the Rensselaer Computer Center. Printed output may either be on the terminal or on the high speed printer in the Rensselaer Computer Center. When dealing with large data

sets, it is wise to have the data printed on the high speed printer because telecommunication devices are quite slow in printing. When run in ALPHA remote entry mode all of the input is entered at once and the program run at some later time. After the program has been run the output is saved; the user may then enter the ALPHA system and direct the printing of his output as in conversational mode.

The main difference between conversational and remote mode is that conversational mode requires the user to wait at the terminal for his program to execute; while remote mode does not require this waiting, the user must enter the ALPHA system twice, once to submit his program and once to retrieve his output. It should be noted that while the waiting time for execution is less in conversational mode it still may be substantial depending on the load on the computer.

The output printed at the Rensselaer Computing Center will be delivered, by courier to the investigators. A more detailed description of the telecommunications procedures will appear in a subsequent report.

Table 1 presents a summary of the FIND programs and a short description of their purpose.

Maintenance Routines - NEW, PURGE

These routines load new data to the database and change, add, and delete existing data records. These routines are sometimes known as "housekeeping" routines. Their function is to keep the database updated with the most current data available from the

investigators.

The operations of these programs will be the responsibility of the site data processing personnel, only. Investigators need only supply the data needed for the updating of their data file; they need not be concerned with the programming considerations in maintaining the database.

These maintenance programs will not be available to investigators in either the batch or remote modes. The prime reason for this is to avoid inadvertent "wiping" of a data set. While the system has been designed as failsafe as possible through a series of back-up magnetic tapes, the "wiping out" of a data set is a serious problem and would cause much extra work in reloading the data file. Retrieval programs accessible to the investigators operate in a read-only mode, e.g. they can only read the database and not modify it.

The maintenance section of the database consists of two programs: NEW and PURGE. NEW takes data and adds them to the database, while PURGE removes the indicated data. A typical addition operation is flowcharted in Figure 1. The data are taken by an external procedure which reformats the data to database form (adding classification states where needed) and then sorts the data -- keying on classification states -- onto a temporary storage area. Typical classification states added are investigator, password and ID code. Program NEW takes the data, adds them to the correct position in the database, and creates a new back-up tape. The data are added to the database sequentially by classification states. For example,

1. A new set of data, SMITH-2, would be added after SMITH-1.

Table 1

Summary of FIND Programs

Program	Description
NEW	Adds new data to the database. This program inserts data in the correct position sorted by classification states.
PURGE	Removes data from the database and consolidates the database.
SEEK	Searches the database for specified records and stores the retrieved records on a temporary file.
LIST	Produces a listing of SEEK's temporary file.
PUNCH	Produces punched card output of SEEK's temporary file.
ADLIB	A series of programs to store, retrieve, and list data set abstracts.

Figure 1

Addition Operation

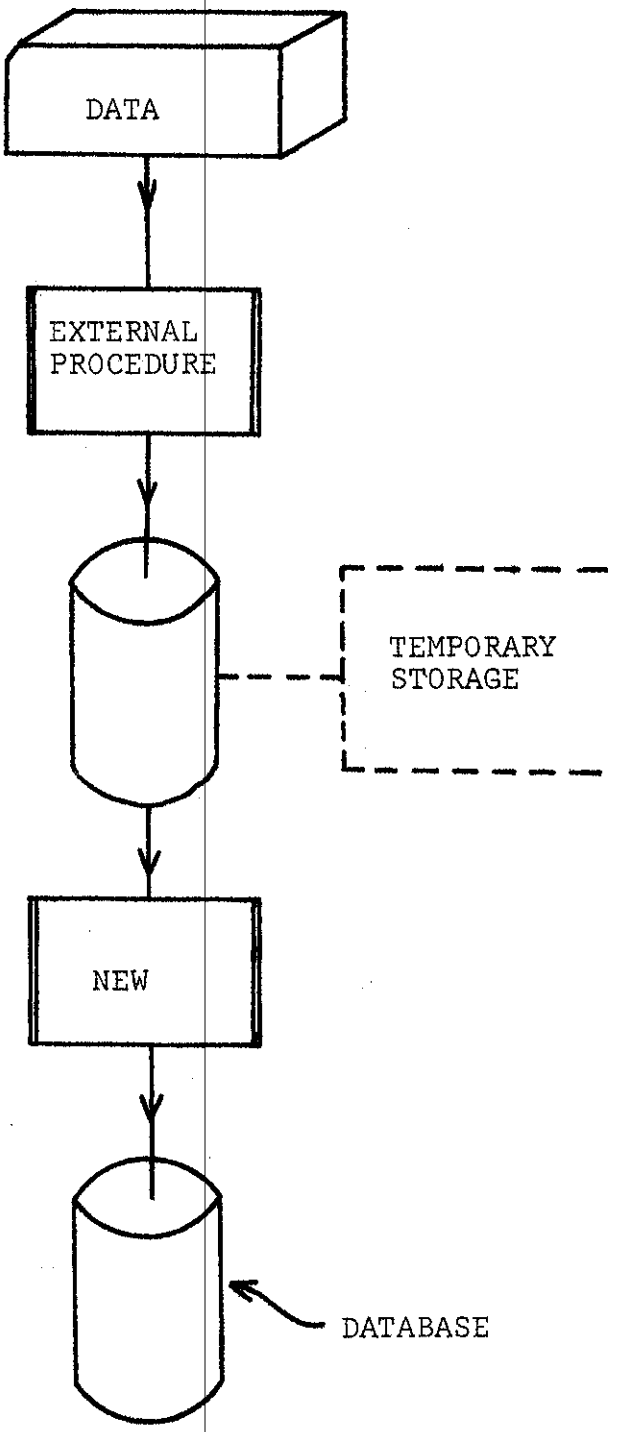
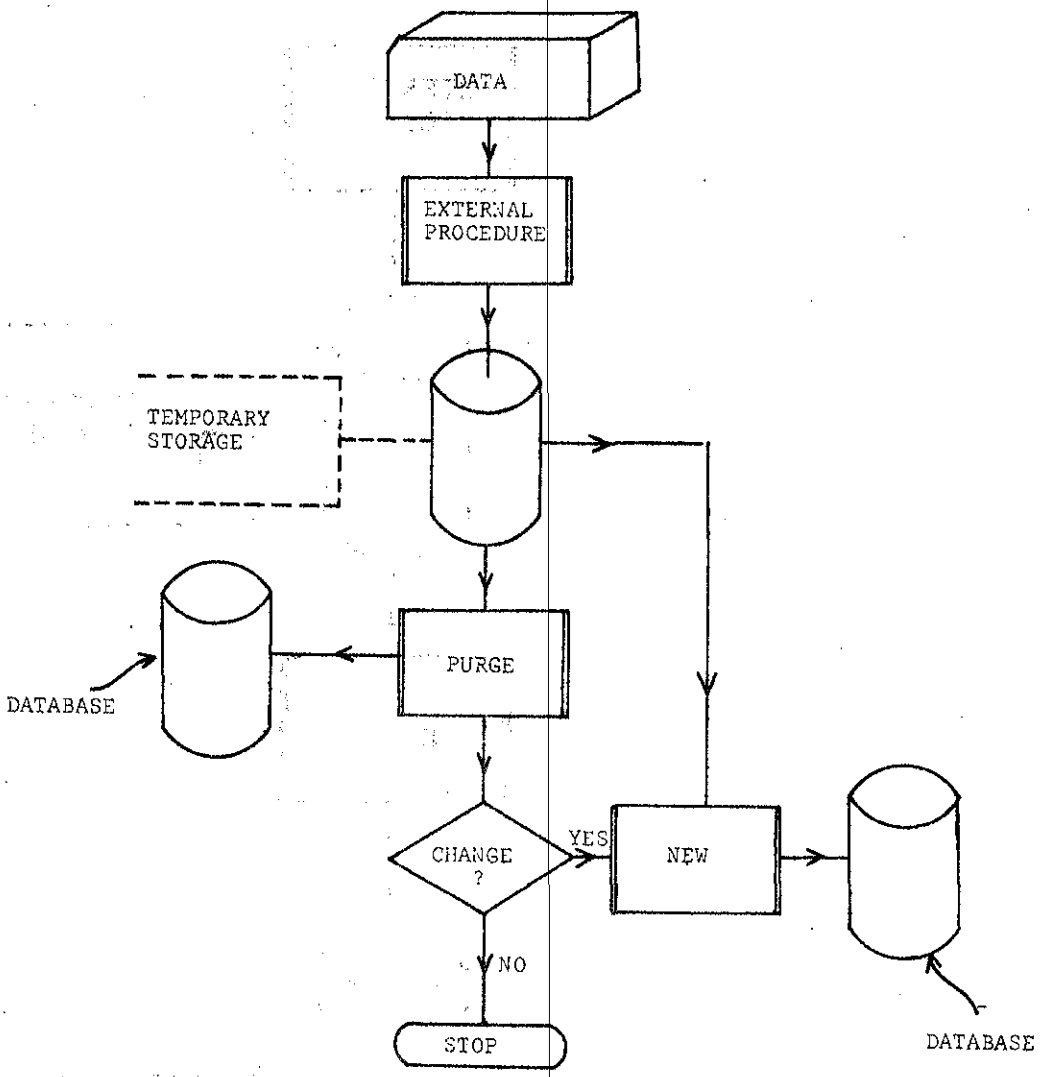


Figure 2

Change/Delete Operation



2. Suppose SMITH-1 has classification states only as station and date. If the stations are currently coded as 1 and 7, and data are added which are coded as SMITH-1, station 4, NEW will then add station 4 between 1 and 7.

Change/Delete operations are flowcharted in Figure 2. Once again, data are reformatted to database format by an external procedure. The classification states specified by the data are deleted from the data base by program PURGE. If data are not to be changed (only deleted) PURGE then consolidates the database and creates a backup tape. If the data are to be changed, NEW takes the data and inserts them in the database in the same fashion as an addition operation.

An external procedure has been used because of the variety in form and type of data being collected. By having an external procedure written when the data are initially loaded, the system has a great deal of flexibility regarding kinds of data it can handle. Investigators are not bound by any rigid format structure imposed by the database.

Retrieval Routine - SEEK

The retrieval section of the database consists primarily of the program, SEEK. SEEK will locate on a given file those data records that correspond to the classification states desired. These records are then stored on a numbered work file. This numbered work file is also available for retrieval by the SEEK program. Several searches may be made with the results stored in several numbered work spaces.

A special feature, FILESCAN, a hardware feature of 2311 and some 2314 disk pack units is utilized in the retrieval program. A pattern record corresponding to the data record desired to be found is formed. FILESCAN then compares this pattern record, on a

machine level, with the actual data records on the database. Those records found matching the pattern record are read off the database, and placed in temporary storage.

These work spaces may be operated on by the use of "and/or" statements. Such statements have the effect of merging files with similar classification states. For example,

Suppose there are two data sets stored on the database with the following classification states

STROSS-1	Station 1,4,7	Date 1969-1971	Depth 0.5-15.0	Time Incubation on 24 hour clock	Data PMax

SMITH-1	Date 1969-72	Time on 24 hour clock	Data total incoming solar radiation

The object is to match the PMax values with the observed solar radiation values. The steps in retrieval are as follows:

1. Retrieve STROSS-1 Station 1; assign to work file 1
2. Retrieve STROSS-1 Station 4; assign to work file 2
3. Retrieve STROSS-1 Station 7; assign to work file 3
4. Retrieve SMITH-1; assign to work file 4
5. "AND" work file 1 and 4, By Time; assign to work file 1
6. "AND" work file 2 and 4, By Time; assign to work file 2
7. "AND" work file 3 and 4, By Time; assign to work file 3
8. "OR" work file 1,2,3; assign to 1

Step:

5. Work file 1 now contains PMax values at station 1 (all times and depths) and solar radiation values matched by incubation time (STROSS-1) and time (SMITH-1)
6. Work file 2 now contains PMax values at Station 4 matched by time with solar radiation.
7. Work file 3 now contains PMax values at Station 7 matched by time with solar radiation.
8. Combines the matched sets to finally obtain on one file: PMax values matched with solar radiation for stations 1, 4, and 7.

With each retrieval, a status message is given informing the user of the number of records retrieved and where the retrieved data are stored.

User Programs

The work files created by the retrieval section may now be used in analysis programs. There are two commands intrinsic to the database - LIST and PUNCH. LIST will produce a listing of the specified work file. PUNCH will produce punched output. As was noted earlier the printed and card output will be produced at the Rensselaer Computer Center. Small data sets may be listed on a remote terminal.

These work files may also be used as direct input to analysis programs. They are stored in the computer as files accessible by a normal data file declaration statement. Once the retrieval program and associated analysis programs are completed the work files are removed and no longer available. If it is thought that more analysis is to be done with the data in a work file, it is wise to punch the data so that another retrieval need not be made.

There are many analysis programs available for investigators' use. Several computer plot routines may be used, one of which will plot day of the year as an independent variable. The Biomedical Statistical Computing routines are also available. The routines include regression analysis, analysis of variance, multivariate analysis, and data description and tabulation. There are also specialized programs dealing with cluster analysis and ordination, time series analysis, and nonlinear estimation procedures. Also available are SPSS and SSP packages from IBM. Programs are also available from the ORNL Numerical Analysis Library.

ADLIB

A companion system, called ADLIB, for storage and retrieval of data set abstracts has also been developed. The system is similar in purpose to the ORLOOK system at IBP/Eastern Deciduous Forest Biome Headquarters. ADLIB is completely integrated with the FIND system so that once a user examines the abstract file and determines that data sets of interest exist, he may enter the FIND system and immediately retrieve the specific data of interest. The abstracts stored under ADLIB are the same as those described by "Documentation and Submission of Data Sets" (Brooks and Sayrs) EDFB Memo Report #72-38, and shown in Figure 3.

The programs are designed to operate in ALPHA conversational mode. Through the use of command words, the user may request a search of the abstract file. At this time the search may only be made an author, subject category, and/or keywords. When the search is completed ADLIB returns the abstract numbers of the abstracts meeting the specification. These abstracts may then be printed at the remote terminal.

Table 2 presents a brief summary of the ADLIB command words. A more complete discussion of the ADLIB system may be found in "ADLIB-Abstract Data Librarian" (Nagy, Kohberger, Wilkinson) IBP Memo Report #72-62.

Figure 3

DATA SET DOCUMENTATION FORM

⟨ DATATITL ⟩ _____

_____

⟨ INVESTIG ⟩ _____

_____

⟨ MENTOR ⟩ _____

⟨ SITE ⟩ ☐ Coweeta ☐ Lake George ☐ Lake Wingra ☐ Oak Ridge ☐ Triangle ☐ other _____

⟨ PROCESS ⟩

☐ Terrestrial Primary Production ☐ Terrestrial Secondary Production ☐ Terrestrial Decomposition ☐ Terrestrial Mineral Cycling ☐ Land-Water Interaction ☐ Hydrology ☐ Meterology ☐ Aquatic Primary Production ☐ Aquatic Secondary Production ☐ Aquatic Decomposition ☐ Aquatic Mineral Cycling

⟨ KEYWORDS ⟩ _____

_____

_____

⟨ PARMLIST ⟩ _____

_____

_____

⟨ TAXON ⟩ _____

_____

⟨ DATATYPE ⟩ ☐ Raw ☐ Reduced ☐ Summarized ☐ Literature ☐ Derived ☐ other _____

⟨ GEOGDESC ⟩ _____

⟨ SPONSOR ⟩ _____

⟨ DISSEM ⟩ ☐ This data set may be sent on request to anyone. ☐ This data set may be sent on request to anyone participating in IBP. ☐ This data set may be sent on request to anyone in the EDF Biome. ☐ This data set may be sent on request to anyone at the _____ site in the EDF Biome. ☐ This data set may be sent only with the author's permission. ☐ The data sharing agreement must be signed by the requestor before this data set is sent. ☐ The data sharing agreement need not be signed.

⟨ DS NAME ⟩ _____

⟨ DATA ABS ⟩ _____

_____

_____

_____

_____

_____

⟨ EXPDESIG ⟩ _____

_____

_____

TX-4492 (7-72)

⟨EXP METH⟩

⟨DATADATE⟩

⟨ERORBNDS⟩

⟨FLD DESC⟩

⟨MEDIA⟩

⟨MISSDATA⟩

⟨NULLDATA⟩

⟨AVAIL⟩

⟨ADD DESC⟩

⟨ADDAVAIL⟩

⟨SUP DOCU⟩

⟨COMMENT⟩

⟨D SOURCE⟩

Table 2

ADLIB Command Words

Word	Description
HELP	Describes all command words and the format and inputs needed for their use.
PRINT	Will print selected data set abstracts or if desired the entire file.
INPUT	Program recognizes that data set abstracts are to be added to the abstract file.
SEARCH	Program accepts categories and words for which it must search the data set abstracts. The categories available for search are: 1. author 2. subject category 3. keywords
END	Program recognizes the user has completed his job and wishes to stop program execution.
FIND	Program links to FIND system.

Appendix 1

Example

The example considered is the data of Dr. Raymond Stross. The data consists of maximum hourly productivity measured in mg. C per hour. The data as originally received appears in Figure 1.A, along with a legend describing the various fields on the data cards. The data are identified by:

1. Cruise Number - the number of the cruise at which the data was collected.
2. Station - the station in the lake where the data was collected.
3. Profile - the identifier of the replication of the data around the station (for further information see Stross IBP Memo Report).
4. "1" - the sample was incubated in situ
   "2" - the sample was incubated in vitro
5. Depth at which the sample was collected.

This data was then operated on by the transformation program shown in Figure 2.A. This program adds classification states and reformats the data. The classification states added are:

1. Julian date
2. month
3. year
4. time of incubation
5. ID code

The transformation program then stored the reformatted records on a temporary file which was taken by the data base programs and the data added to the database. A portion of the

data as on the database is shown in Figure 3.A The numbers at the top of the listing are the word numbers in the database record. Table 1.A explains the contents of each word.

A sample retrieval is shown in Figure 4.A. The data desired to be retrieved consisted of all data for cruise 2 (coded as 20) at station 1 and profile A (coded 10.1 on the database). The command words for the retrieval are shown as well as a listing of the retrieved records.

Figure 1.A

EXAMPLE OF ORIGINAL INPUT DATA
DATA OF DR. RAYMOND G. STROSS

CRUISE	STATION	PROFILE	S-V	DEPTH	P-COUNT
10	10	A	V	0.5	12.8
10	10	A	V	0.5	15.9
10	10	A	V	2.0	11.8
10	10	A	V	2.0	12.1
10	10	A	V	5.0	13.5
10	10	A	V	5.0	14.8
10	10	A	V	10.0	27.2
10	10	A	V	10.0	28.7
10	10	A	V	15.0	18.2
10	10	A	V	15.0	13.3
10	10	B	V	0.5	12.3
10	10	B	V	0.5	13.7
10	10	B	V	2.0	13.8
10	10	B	V	2.0	13.8
10	10	B	V	5.0	16.1
10	10	B	V	5.0	16.6
10	10	B	V	10.0	19.4
10	10	B	V	10.0	22.9
10	10	B	V	15.0	5.4
10	10	B	V	15.0	4.5
10	10	C	V	0.5	11.5
10	10	C	V	0.5	12.5
10	10	C	V	2.0	13.7
10	10	C	V	2.0	14.1
10	10	C	V	5.0	9.5
10	10	C	V	5.0	9.3
10	10	C	V	10.0	9.6
10	10	C	V	10.0	10.3
10	10	C	V	15.0	6.8
10	10	C	V	15.0	6.6
10	40	A	V	0.5	10.4
10	40	A	V	0.5	9.1
10	40	A	V	2.0	9.6
10	40	A	V	2.0	7.9
10	40	A	V	5.0	11.4
10	40	A	V	5.0	12.0
10	40	A	V	10.0	13.5
10	40	A	V	10.0	11.6
10	40	A	V	15.0	15.8
10	40	A	V	15.0	15.9
10	40	B	V	0.5	8.0
10	40	B	V	0.5	7.4
10	40	B	V	2.0	6.1
10	40	B	V	2.0	7.0
10	40	B	V	5.0	9.0
10	40	B	V	5.0	6.6
10	40	B	V	10.0	11.5
10	40	B	V	10.0	9.8
10	40	B	V	15.0	17.8
10	40	B	V	15.0	13.3
10	40	C	V	0.5	5.2
10	40	C	V	0.5	7.5
10	40	C	V	2.0	6.2
10	40	C	V	2.0	6.0

10	40	C	V	5.0	7.1
10	40	C	V	5.0	5.3
10	40	C	V	10.0	13.0
10	40	C	V	10.0	11.2
10	40	C	V	15.0	9.9
10	40	C	V	15.0	13.4
20	10	A	V	0.5	17.7
20	10	A	V	0.5	23.8
20	10	A	V	2.0	22.3
20	10	A	V	2.0	23.9
20	10	A	V	5.0	23.1
20	10	A	V	5.0	25.6
20	10	A	V	10.0	15.6
20	10	A	V	10.0	25.9
20	10	A	V	15.0	9.8
20	10	A	V	15.0	18.6
20	10	B	V	0.5	19.5
20	10	B	V	0.5	16.4
20	10	B	V	2.0	26.1
20	10	B	V	2.0	21.7
20	10	B	V	5.0	30.5
20	10	B	V	5.0	31.2
20	10	B	V	10.0	46.1
20	10	B	V	10.0	40.4
20	10	B	V	15.0	20.2
20	10	B	V	15.0	22.0
20	10	C	V	0.5	18.3
20	10	C	V	0.5	21.4
20	10	C	V	2.0	17.3
20	10	C	V	2.0	24.4
20	10	C	V	5.0	23.4
20	10	C	V	5.0	23.5
20	10	C	V	10.0	18.9
20	10	C	V	10.0	22.0
20	10	C	V	15.0	19.1
20	10	C	V	15.0	22.5
20	40	A	V	0.5	9.5
20	40	A	V	0.5	10.7
20	40	A	V	2.0	16.0
20	40	A	V	2.0	10.6
20	40	A	V	5.0	13.1
20	40	A	V	5.0	13.6
20	40	A	V	10.0	19.0
20	40	A	V	10.0	11.2
20	40	A	V	15.0	14.0
20	40	A	V	15.0	8.7
20	40	B	V	0.5	11.4
20	40	B	V	0.5	10.1
20	40	B	V	2.0	9.2
20	40	B	V	2.0	12.0
20	40	B	V	5.0	8.7
20	40	B	V	5.0	8.4
20	40	B	V	10.0	11.9
20	40	B	V	10.0	8.5
20	40	B	V	15.0	8.8
20	40	B	V	15.0	9.2
20	40	C	V	0.5	10.3
20	40	C	V	0.5	9.3
20	40	C	V	2.0	7.2
20	40	C	V	2.0	15.0

Figure 2.A

```
G LEVEL  20                    MAIN                    DATE = 72210          19/41/06

C                                                                                    00000100
C                                                                                    00000200
C     FINDIN  ADDS STROSS' DATA TO DATABASE                                          00000300
C                                                                                    00000400
C     AUTHOR  J.NAGY, FWI                                                            00000500
C                                                                                    00000600
      DIMENSION ARRAY(16,7,3,2,4),NZERO(9),TIMEDA(4)                                 00000700
      DATA NA/'A'/,NB/'B'/,NC/'C'/                                                   00000800
      CALL TIME(ARRAY)                                                               00000900
      IO=1                                                                           00001000
      LCRUS=0                                                                        00001100
      INDEX=0                                                                        00001200
      NPSWD=512                                                                      00001300
      DO 1 I=1,9                                                                     00001400
    1 NZERO(I)=-100                                                                  00001500
  500 READ(5,100,END=999)CRUS,STA,LOC,SV,DEP,PCOUNT                                  00001600
  100 FORMAT(F3.0,F2.0,A1,F1.0,F4.1,F5.2)                                            00001700
      IF (LCRUS.NE.CRUS) INDEX=INDEX+1                                               00001800
      LCRUS=CRUS                                                                     00001900
      LSTA=STA                                                                       00002000
      IF(STA.GT.9) LSTA=LSTA/10.
      LSV=SV                                                                         00002100
      IF (LOC.EQ.NA) LLOC=1                                                          00002200
      IF (LOC.EQ.NB) LLOC=2                                                          00002300
      IF (LOC.EQ.NC) LLOC=3                                                          00002400
      DO 2 I=1,4
    2 TIMEDA(I)=ARRAY(INDEX,LSTA,LLOC,LSV,I)
      CRUS=CRUS*10                                                                   00002700
      IF (STA.LT.10) STA=STA*10                                                      00002800
      STA=STA+LLOC*.1                                                                00002900
      WRITE(8,102)NPSWD,STA,TIMEDA(3),DEP,TIMEDA(4),TIMEDA(1),TIMEDA(2),00003300
     $ID,CRUS,SV,PCOUNT,(NZERO(I),I=1,9)                                             00003400
  102 FORMAT(20A4)                                                                   00003500
      WRITE(6,101)NPSWD,STA,TIMEDA(3),DEP,TIMEDA(4),TIMEDA(1),TIMEDA(2),00003000
     $ID,CRUS,SV,PCOUNT                                                              00003100
  101 FORMAT(' ',Z8,6F8.3,I1,3F8.3)
      GO TO 500                                                                      00003600
  999 STOP                                                                           00003700
      END                                                                            00003800
```

```
G LEVEL  20                    TIME                DATE = 72210          19/41/06

      SUBROUTINE TIME(A)                                                  00001000
      DIMENSION A(16,7,3,2,4)
C                                                                         00000100
C     THIS SUBROUTINE GETS A LOOKUP TABLE
C          FROM CRUISE NUMBER IT FINDS- JULIAN DATE
C          MONTH,YEAR, AND TIME OF INCUBATION
C                                                                         00000900
      DO 1 I=1,16                                                         00001100
      DO 1 J=1,7                                                          00001200
      DO 1 K=1,3                                                          00001300
      DO 1 L=1,2                                                          00001400
      DO 1 M=1,4                                                          00001500
1     A(I,J,K,L,M)=0                                                      00001600
      DO 2 I=1,7                                                          00001700
      DO 2 J=1,3                                                          00001800
      DO 2 K=1,2                                                          00001900
      A(1,I,J,K,1)=7.                                                     00002000
      A(1,I,J,K,2)=69.                                                    00002100
      A(1,I,J,K,3)=69.191                                                 00002200
      A(2,I,J,K,1)=9.                                                     00002300
      A(2,I,J,K,2)=69.                                                    00002400
      A(2,I,J,K,3)=69.270                                                 00002500
      A(3,I,J,K,1)=12.                                                    00002600
      A(3,I,J,K,2)=69.                                                    00002700
      A(3,I,J,K,3)=69.354                                                 00002800
      A(4,I,J,K,1)=3.                                                     00002900
      A(4,I,J,K,2)=70.                                                    00003000
      A(4,I,J,K,3)=70.080                                                 00003100
      A(5,I,J,K,1)=5.                                                     00003200
      A(5,I,J,K,2)=70.                                                    00003300
      A(5,I,J,K,3)=70.133                                                 00003400
      A(6,I,J,K,1)=6.                                                     00003500
      A(6,I,J,K,2)=70.                                                    00003600
      A(6,I,J,K,3)=70.170                                                 00003700
      A(7,I,J,K,1)=7.                                                     00003800
      A(7,I,J,K,2)=70.                                                    00003900
      A(7,I,J,K,3)=70.182                                                 00004000
      A(8,I,J,K,1)=7.                                                     00004100
      A(8,I,J,K,2)=70.                                                    00004200
      A(8,I,J,K,3)=70.196                                                 00004300
      A(9,I,J,K,1)=7.                                                     00004400
      A(9,I,J,K,2)=70.                                                    00004500
      A(9,I,J,K,3)=70.198                                                 00004600
      A(10,I,J,K,1)=7.                                                    00004700
      A(10,I,J,K,2)=70.                                                   00004800
      A(10,I,J,K,3)=70.210                                                00004900
      A(11,I,J,K,1)=8.                                                    00005000
      A(11,I,J,K,2)=70.                                                   00005100
      A(11,I,J,K,3)=70.224                                                00005200
      A(12,I,J,K,1)=9.                                                    00005300
      A(12,I,J,K,2)=70.                                                   00005400
      A(12,I,J,K,3)=70.269                                                00005500
      A(13,I,J,K,1)=5.                                                    00005600
      A(13,I,J,K,2)=71.                                                   00005700
      A(13,I,J,K,3)=71.124                                                00005800
      A(14,I,J,K,1)=6.                                                    00005900
      A(14,I,J,K,2)=71.                                                   00006000
      A(14,I,J,K,3)=71.160                                                00006100
```

```
G LEVEL  20                    TIME                    DATE = 72210          19/41/06

      A(15,1,J,K,1)=6.                                                        00006200
      A(15,1,J,K,2)=71.                                                       00006300
      A(15,1,J,K,3)=71.181                                                    00006400
      A(16,1,J,K,1)=7.                                                        00006500
      A(16,1,J,K,2)=71.                                                       00006600
      A(16,1,J,K,2)=71.202                                                    00006700
2     CONTINUE                                                                00006800
      DO 3 I=1,3                                                              00006900
      DO 3 J=1,2                                                              00007000
      A(1,1,I,J,4)=1300.                                                      00007100
      A(1,4,I,J,4)=1400.                                                      00007200
      A(2,4,I,J,4)=1400.                                                      00007300
      A(2,7,I,J,4)=1100                                                       00007400
      A(4,1,I,J,4)=2000.                                                      00007500
      A(4,2,I,J,4)=2100                                                       00007600
      A(4,3,I,J,4)=2100                                                       00007700
      A(4,6,I,J,4)=1200.                                                      00007800
      A(5,1,I,J,4)=1600.                                                      00007900
      A(5,4,I,J,4)=1700.                                                      00008000
      A(5,7,I,J,4)=1200.                                                      00008100
      A(13,1,I,J,4)=1545.                                                     00008200
      A(13,4,I,J,4)=1630.                                                     00008300
      A(13,7,I,J,4)=2115.                                                     00008400
3     CONTINUE                                                                00008500
      DO 4 I=1,2                                                              00008600
      A(2,1,1,I,4)=1500.                                                      00008700
      A(2,1,2,I,4)=1600.                                                      00008800
      A(2,1,3,I,4)=1700.                                                      00008900
4     CONTINUE                                                                00009000
      DO 5 I=1,7                                                              00009100
      DO 5 J=1,3                                                              00009200
      DO 5 K=1,2                                                              00009300
      A(3,I,J,K,4)=1200.                                                      00009400
      A(9,I,J,K,4)=1530.                                                      00009500
5     CONTINUE                                                                00009600
      DO 6 I=1,7                                                              00009700
      DO 6 J=1,2                                                              00009800
      A(14,I,1,J,4)=1300.                                                     00009900
      A(14,I,2,J,4)=1630.                                                     00010000
      A(15,I,1,J,4)=1410.                                                     00010100
      A(15,I,2,J,4)=1715.                                                     00010200
      A(16,I,1,J,4)=1325.                                                     00010300
      A(16,I,2,J,4)=1630.                                                     00010400
6     CONTINUE                                                                00010500
      DO 7 I=1,7                                                              00010600
      DO 7 J=1,3                                                              00010700
      A(7,I,J,1,4)=1000.                                                      00010800
7     CONTINUE                                                                00010900
      DO 8 I=1,3                                                              00011000
      A(6,1,I,2,4)=1200.                                                      00011100
      A(6,4,I,2,4)=1400.                                                      00011200
      A(6,7,I,2,4)=1000.                                                      00011300
      A(7,1,I,2,4)=1400.                                                      00011400
      A(7,4,I,2,4)=1100.                                                      00011500
      A(7,7,I,2,4)=1030.                                                      00011600
      A(8,1,I,1,4)=900.                                                       00011700
      A(8,4,I,1,4)=1000.                                                      00011800
      A(8,7,I,1,4)=800.                                                       00011900
```

```
G LEVEL  20                    TIME                    DATE = 72210          19/41/06

      A(8,1,1,2,4)=1200.                                                      00012000
      A(8,4,1,2,4)=1400.                                                      00012100
      A(8,7,1,2,4)=1000.                                                      00012200
      A(10,1,1,1,4)=900.                                                      00012300
      A(10,4,1,1,4)=1000.                                                     00012400
      A(10,7,1,1,4)=830.                                                      00012500
      A(10,1,1,2,4)=1200.                                                     00012600
      A(10,4,1,2,4)=1300.                                                     00012700
      A(10,7,1,2,4)=900.                                                      00012800
      A(11,1,1,1,4)=910.                                                      00012900
      A(11,4,1,1,4)=1005.                                                     00013000
      A(11,7,1,1,4)=830.                                                      00013100
      A(11,1,1,2,4)=1135.                                                     00013200
      A(11,4,1,2,4)=1330.                                                     00013300
      A(11,7,1,2,4)=1045.                                                     00013400
      A(12,1,1,1,4)=1210.                                                     00013500
      A(12,4,1,1,4)=1210.                                                     00013600
      A(12,7,1,1,4)=1000.                                                     00013700
      A(12,1,1,2,4)=1420.                                                     00013800
      A(12,4,1,2,4)=1515.                                                     00014000
      A(12,7,1,2,4)=1200.                                                     00014100
8     CONTINUE                                                                00014200
      A(6,1,1,1,4)=900.                                                       00014300
      A(6,4,1,1,4)=900.                                                       00014400
      A(6,7,1,1,4)=800.                                                       00014500
      RETURN                                                                  00014600
      END                                                                     00014700
```

Figure 3.A

Data As On The Database

1	2	3	4	5	6	7	8	9	10	11
********	10.100	69.191	0.500	1300	7	69	*	10	2	12.790
********	10.100	69.191	0.500	1300	7	69	*	10	2	15.910
********	10.100	69.191	2.000	1300	7	69	*	10	2	11.840
********	10.100	69.191	2.000	1300	7	69	*	10	2	12.150
********	10.100	69.191	5.000	1300	7	69	*	10	2	13.470
********	10.100	69.191	5.000	1300	7	69	*	10	2	14.810
********	10.100	69.191	10.000	1300	7	69	*	10	2	27.160
********	10.100	69.191	10.000	1300	7	69	*	10	2	28.680
********	10.100	69.191	15.000	1300	7	69	*	10	2	18.230
********	10.100	69.191	15.000	1300	7	69	*	10	2	13.280
********	10.200	69.191	0.500	1300	7	69	*	10	2	12.330
********	10.200	69.191	0.500	1300	7	69	*	10	2	13.700
********	10.200	69.191	2.000	1300	7	69	*	10	2	13.780
********	10.200	69.191	2.000	1300	7	69	*	10	2	13.770
********	10.200	69.191	5.000	1300	7	69	*	10	2	16.120
********	10.200	69.191	5.000	1300	7	69	*	10	2	16.640
********	10.200	69.191	10.000	1300	7	69	*	10	2	19.440
********	10.200	69.191	10.000	1300	7	69	*	10	2	22.900
********	10.200	69.191	15.000	1300	7	69	*	10	2	5.420
********	10.200	69.191	15.000	1300	7	69	*	10	2	4.530
********	10.300	69.191	0.500	1300	7	69	*	10	2	11.460
********	10.300	69.191	0.500	1300	7	69	*	10	2	12.530
********	10.300	69.191	2.000	1300	7	69	*	10	2	13.660
********	10.300	69.191	2.000	1300	7	69	*	10	2	14.080
********	10.300	69.191	5.000	1300	7	69	*	10	2	9.530
********	10.300	69.191	5.000	1300	7	69	*	10	2	9.340
********	10.300	69.191	10.000	1300	7	69	*	10	2	9.640
********	10.300	69.191	10.000	1300	7	69	*	10	2	10.280
********	10.300	69.191	15.000	1300	7	69	*	10	2	6.820
********	10.300	69.191	15.000	1300	7	69	*	10	2	6.630
********	40.100	69.191	0.500	1400	7	69	*	10	2	10.400
********	40.100	69.191	0.500	1400	7	69	*	10	2	9.150
********	40.100	69.191	2.000	1400	7	69	*	10	2	9.600
********	40.100	69.191	2.000	1400	7	69	*	10	2	7.890
********	40.100	69.191	5.000	1400	7	69	*	10	2	11.380
********	40.100	69.191	5.000	1400	7	69	*	10	2	11.970
********	40.100	69.191	10.000	1400	7	69	*	10	2	13.530
********	40.100	69.191	10.000	1400	7	69	*	10	2	11.620
********	40.100	69.191	15.000	1400	7	69	*	10	2	15.850
********	40.100	69.191	15.000	1400	7	69	*	10	2	15.890
********	40.200	69.191	0.500	1400	7	69	*	10	2	7.980
********	40.200	69.191	0.500	1400	7	69	*	10	2	7.420
********	40.200	69.191	2.000	1400	7	69	*	10	2	6.130
********	40.200	69.191	2.000	1400	7	69	*	10	2	6.970
********	40.200	69.191	5.000	1400	7	69	*	10	2	8.960
********	40.200	69.191	5.000	1400	7	69	*	10	2	6.590
********	40.200	69.191	10.000	1400	7	69	*	10	2	11.490
********	40.200	69.191	10.000	1400	7	69	*	10	2	9.790
********	40.200	69.191	15.000	1400	7	69	*	10	2	17.790
********	40.200	69.191	15.000	1400	7	69	*	10	2	13.330
********	40.300	69.191	0.500	1400	7	69	*	10	2	5.240
********	40.300	69.191	0.500	1400	7	69	*	10	2	7.460
********	40.300	69.191	2.000	1400	7	69	*	10	2	6.210
********	40.300	69.191	2.000	1400	7	69	*	10	2	6.000
********	40.300	69.191	5.000	1400	7	69	*	10	2	7.100
********	40.300	69.191	5.000	1400	7	69	*	10	2	5.300
********	40.300	69.191	10.000	1400	7	69	*	10	2	13.000
********	40.300	69.191	10.000	1400	7	69	*	10	2	11.170

********	40.300	69.191	15.000	1400	7	69	*	10	2	9.950
********	40.300	69.191	15.000	1400	7	69	*	10	2	13.420
********	10.100	69.270	0.500	1500	9	69	*	20	2	17.700
********	10.100	69.270	0.500	1500	9	69	*	20	2	23.760
********	10.100	69.270	2.000	1500	9	69	*	20	2	22.250
********	10.100	69.270	2.000	1500	9	69	*	20	2	23.890
********	10.100	69.270	5.000	1500	9	69	*	20	2	23.120
********	10.100	69.270	5.000	1500	9	69	*	20	2	25.570
********	10.100	69.270	10.000	1500	9	69	*	20	2	15.650
********	10.100	69.270	10.000	1500	9	69	*	20	2	25.860
********	10.100	69.270	15.000	1500	9	69	*	20	2	9.830
********	10.100	69.270	15.000	1500	9	69	*	20	2	18.640
********	10.200	69.270	0.500	1600	9	69	*	20	2	19.550
********	10.200	69.270	0.500	1600	9	69	*	20	2	16.390
********	10.200	69.270	2.000	1600	9	69	*	20	2	26.090
********	10.200	69.270	2.000	1600	9	69	*	20	2	21.730
********	10.200	69.270	5.000	1600	9	69	*	20	2	30.520
********	10.200	69.270	5.000	1600	9	69	*	20	2	31.230
********	10.200	69.270	10.000	1600	9	69	*	20	2	46.150
********	10.200	69.270	10.000	1600	9	69	*	20	2	40.390
********	10.200	69.270	15.000	1600	9	69	*	20	2	20.230
********	10.200	69.270	15.000	1600	9	69	*	20	2	21.990
********	10.300	69.270	0.500	1700	9	69	*	20	2	18.270
********	10.300	69.270	0.500	1700	9	69	*	20	2	21.380
********	10.300	69.270	2.000	1700	9	69	*	20	2	17.290
********	10.300	69.270	2.000	1700	9	69	*	20	2	24.370
********	10.300	69.270	5.000	1700	9	69	*	20	2	23.370
********	10.300	69.270	5.000	1700	9	69	*	20	2	23.490
********	10.300	69.270	10.000	1700	9	69	*	20	2	18.920
********	10.300	69.270	10.000	1700	9	69	*	20	2	22.010
********	10.300	69.270	15.000	1700	9	69	*	20	2	19.100
********	10.300	69.270	15.000	1700	9	69	*	20	2	22.500
********	40.100	69.270	0.500	1400	9	69	*	20	2	9.510
********	40.100	69.270	0.500	1400	9	69	*	20	2	10.720
********	40.100	69.270	2.000	1400	9	69	*	20	2	16.000
********	40.100	69.270	2.000	1400	9	69	*	20	2	10.650
********	40.100	69.270	5.000	1400	9	69	*	20	2	13.130
********	40.100	69.270	5.000	1400	9	69	*	20	2	13.560
********	40.100	69.270	10.000	1400	9	69	*	20	2	19.030
********	40.100	69.270	10.000	1400	9	69	*	20	2	11.180
********	40.100	69.270	15.000	1400	9	69	*	20	2	13.970
********	40.100	69.270	15.000	1400	9	69	*	20	2	8.710
********	40.200	69.270	0.500	1400	9	69	*	20	2	11.400
********	40.200	69.270	0.500	1400	9	69	*	20	2	10.080
********	40.200	69.270	2.000	1400	9	69	*	20	2	9.230
********	40.200	69.270	2.000	1400	9	69	*	20	2	11.960
********	40.200	69.270	5.000	1400	9	69	*	20	2	8.680
********	40.200	69.270	5.000	1400	9	69	*	20	2	8.370
********	40.200	69.270	10.000	1400	9	69	*	20	2	11.920
********	40.200	69.270	10.000	1400	9	69	*	20	2	8.530
********	40.200	69.270	15.000	1400	9	69	*	20	2	8.800
********	40.200	69.270	15.000	1400	9	69	*	20	2	9.160
********	40.300	69.270	0.500	1400	9	69	*	20	2	10.280
********	40.300	69.270	0.500	1400	9	69	*	20	2	9.250
********	40.300	69.270	2.000	1400	9	69	*	20	2	7.200
********	40.300	69.270	2.000	1400	9	69	*	20	2	14.960
********	40.300	69.270	5.000	1400	9	69	*	20	2	11.840
********	40.300	69.270	5.000	1400	9	69	*	20	2	10.860
********	40.300	69.270	10.000	1400	9	69	*	20	2	14.510
********	40.300	69.270	10.000	1400	9	69	*	20	2	13.010

Table 1.A

Word	Explanation
1	Contains the password needed for accessing the data. It is shown here as a *, not as the password.
2	The station and profile. 10.100 signifies station 1, profile A (Note B=.200 and C=.300)
3	Julian date of the sample. 69.191 signifies the 191st. consequative day of 1969.
4	Depth of the sample. 2.0 signifies 2.0 meters.
5	Time of incubation on a 24 hour clock.
6	Month the sample was collected 7 signifies July. (January = 1, etc
7	Year the sample was collected.
8	ID code, intentially printed as a *.
9	Cruise number 10 means cruise 1
10	situ-vitro code
11	Maximum hourly productivity (mg C per hour)

Figure 4.A

```
ARE YØU FAMILIAR WITH ADLIB RETRIEVAL SYSTEM? (YES/NØ)

1Z INPUT?
YES
1Z INPUT?
ØFIND
1Z FILEIN?
ASSIGN 5,FT05F001
FILE IS NØW ASSIGNED
1Z FILEIN?
SCAN 0,5
1Z FILEIN?
PASSWØRD STRØSS
1Z FILEIN?
CRUISE 20
1Z FILEIN?
STATIØN 10.1

1Z FILEIN?
GØ
0010 RECØRDS WERE FØUND MEETING CRITERIA
1Z FILEIN?
DELETE 5
FILE IS NØ LØNGER ASSIGNED
SPACE FØR DCB HAS BEEN FREED
1Z FILEIN?
EXEC STRØSS



QUICK LISTING ØF STRØSS'S RETRIEVED DATA


CRUISE STATIØN   DATE   DEPTH S/V PCØUNT
------ -------- ------ ----- --- ------

  2.     1.01   69.270   0.5   2. 17.70
  2.     1.01   69.270   0.5   2. 23.76
  2.     1.01   69.270   2.0   2. 22.25
  2.     1.01   69.270   2.0   2. 23.89
  2.     1.01   69.270   5.0   2. 23.12
  2.     1.01   69.270   5.0   2. 25.57
  2.     1.01   69.270  10.0   2. 15.65
  2.     1.01   69.270  10.0   2. 25.86
  2.     1.01   69.270  15.0   2.  9.83
  2.     1.01   69.270  15.0   2. 18.64
```