GEOLOGICAL SURVEY CIRCULAR 815

Interactive Computer Methods for Generating Mineral-Resource Maps

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By James A. Calkins, Alan S. Crosby, Tod E. Huffman, Allen L. Clark, George T. Mason, Jr., *and* Robert J. Bascle

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By JAMES A. CALKINS, ALAN S. CROSBY, TOD E. HUFFMAN, ALLEN L. CLARK, GEORGE T. MASON, JR., and ROBERT J. BASCLE

ABSTRACT

Inasmuch as maps are a basic tool of geologists, the U.S. Geological Survey's CRIB (Computerized Resources Information Bank) was constructed so that the data it contains can be used to generate mineral-resource maps. However, by the standard methods used—batch processing and off-line plotting—the production of a finished map commonly takes 2–3 weeks.

To produce computer-generated maps more rapidly, cheaply, and easily, and also to provide an effective demonstration tool, we have devised two related methods for plotting maps as alternatives to conventional batch methods. These methods are: 1. Quick-Plot, an interactive program whose output appears on a CRT (cathode-ray-tube) device, and 2. The Interactive CAM (Cartographic Automatic Mapping system), which combines batch and interactive runs. The output of the Interactive CAM system is final compilation (not camera-ready) paper copy. Both methods are designed to use data from the CRIB file in conjunction with a map-plotting program.

Quick-Plot retrieves a user-selected subset of data from the CRIB file, immediately produces an image of the desired area on a CRT device, and plots data points according to a limited set of user-selected symbols. This method is useful for immediate evaluation of the map and for demonstrating how trial maps can be made quickly.

The Interactive CAM system links the output of an interactive CRIB retrieval to a modified version of the CAM program, which runs in the batch mode and stores plotting instructions on a disk, rather than on a tape. The disk can be accessed by a CRT, and, thus, the user can view and evaluate the map output on a CRT immediately after a batch run, without waiting 1-3 days for an off-line plot. The user can, therefore, do most of the layout and design work in a relatively short time by use of the CRT, before generating a plot tape and having the map plotted on an off-line plotter.

INTRODUCTION

Maps are a basic tool of economic geologists. Therefore, data in a computer file on geology and mineral resources should be arranged so they can be used to generate maps. To devise map-plotting applications for use with the CRIB (Computerized Resources Information Bank) has been a primary objective of the CRIB program since its inception (Calkins and others, 1973, p. 2, 8). The computer center of the USGS (U.S. Geological Survey) has been keenly aware of user needs in this regard and has provided a continuing program of evaluation, acquisition, and support of map-plotting devices and map-plotting program packages.

Maps discussed in this paper are standard geographic maps produced by computer methods. In particular, they are mineral-resource maps composed of base-map information and mineral-resource information. The base-map information includes geographic and political boundaries and other base-map features. The mineral-resource information consists of symbols showing the locations of mineral deposits in their correct geodetic positions, plus optional additional information (annotations) adjacent to each symbol. The mineral-resource data come from the CRIB file (Calkins and others, 1978; Keefer and Calkins, 1978), and the base-map data come from a map-plotting program and from auxiliary digitized files. The computer-generated geographic map is variously called a geographic-map plot, a map plot, or a point plot.

Many different combinations can be generated from a given set of mineral-resource data. By changing the kind and size of the symbol and by changing the annotations, a series of resource maps (called map overlays) can be produced to show different kinds of information in various combinations.

The basic operations performed in making computer-generated maps are equivalent to those of conventional mapmaking, except that the computer operations are automatic and thus have certain advantages and also certain inherent limitations. In conventional mapmaking, a mineral-resource map normally is made in two separate plates: a base-map plate containing the base-map information and a compilation plate containing the mineral-resource information. In computerized procedures, these two plates also can be created separately, but for most maps, both plates are produced simultaneously on a single map sheet. If only a base map is desired, no compilation plate need be produced.

The CRIB staff has been using CRIB data to plot maps since 1971 and has devised and extensively

tested map-plotting methods for other units of the USGS. For example:

1. We devised and experimented with the computer-generated base maps of the circum-Pacific area.
2. We demonstrated the feasibility of producing computer-generated base maps—in various projections, at various scales, and in acceptable registrations—on which to plot mineral-resource information.
3. We produced arctic polar projections and sinusoidal projections used as base maps on which to show oil and gas information.

Several map-plotting programs are stored in the program library of the Survey's computer center and are available to users by direct access. Those that are most highly used by the CRIB staff and that are discussed here are: the Quick-Plot map-graphic program (H858), the CAM (Cartographic Automatic Mapping) to Disk program (H876), the CRIB to CAM program (J499), the Plotcam program (J725), and the CAM program (U.S. Central Intelligence Agency, 1975).

The steady growth of the CRIB file during the past few years has been accompanied by an increasing use of the file for retrieving information and for producing mineral-resource maps. With the increased use has come an increased demand for more rapid turnaround in producing maps. In the batch-processing mode of the CAM program, several days, or even weeks, may be needed to create a new map, depending upon our familiarity with the particular projection to be used, the degree of refinement required, the nature of the resource data to be shown, and other factors. The preparation of "canned" computer routines for certain frequently used projections and scales has helped to alleviate this problem somewhat. Nevertheless, in the batch-processing mode of operation, the user is unable to see his result until the map is plotted on the CalComp[1] plotter. Usually, the turnaround time for each computer run is 2 days.

As a means of shortening the turnaround time, two separate programs were written to provide for interactive viewing of the mineral-resource map on a graphic display device—a cathode-ray tube. The first program, called Quick-Plot, was written by Tod Huffman. It permits the user to retrieve a subset of data of his choice from the CRIB file and immediately produce an X-Y map plot of the desired area on a graphic display terminal. This method is totally interactive, is useful for immediately evaluating the mineral locations of a given area, and is useful for demonstrating how trial maps can be produced quickly. The image is not suitable for use as a final map. The second method, called the Interactive CAM system, was written by Alan Crosby. It is an extension of the standard CAM map-plotting program, which produces full-size finished maps on true geographic projections. The Interactive CAM system also allows the user to select the data to be retrieved from the CRIB file. Immediately after the batch job has been processed through the computer, the user can view and evaluate the map image of the batch run on a graphic display terminal. Thus, the Interactive CAM system saves the user from waiting 1–3 days for an off-line plot in order to evaluate the map. The user can, therefore, do most of the design and layout work in a relatively short time, via the graphic display terminal, before generating a plot tape and before having the finished map plotted on the CalComp plotter.

These methods complement each other. The Quick-Plot program provides an immediate image suitable for a preliminary evaluation, but the image is not intended for publication. The Interactive CAM system provides a full-size final map on a true geographic projection. However, even final maps produced by the Interactive CAM system generally require additional hand-tailored work to complete a camera-ready compilation.

Users can quickly learn to use the map-plotting methods described here, but would benefit from having access to certain supplementary manuals and publications. The following manuals contain complete information on software and equipment referred to, but not discussed in depth, in this Circular. Complete references to these manuals are at the end of this Circular.

1. IBM Time-Sharing Option Command Language Reference Manual (International Business Machines Corporation, 1973).
2. Plot-10 Terminal Control System User's Manual (Tektronix, Inc., 1974a).
3. Users Manual for the Tektronix 4014 and 4014-1 Terminal (Tektronix, Inc., 1974b).
4. Users Manual for the Tektronix 4631 Hard Copy Unit (Tektronix, Inc., 1974c).
5. Programming CalComp Pen Plotters (California Computer Products, Inc., 1969).

[1] Any trade names in the Circular are used for descriptive purposes only and do not constitute endorsement by the USGS.

6. GIPSY Users Manual (Oklahoma University, Office of Information Systems Programs, 1975b).
7. GIPSY Programmer's Manual (Oklahoma University, Office of Information Systems Programs, 1975a).
8. CAM (Cartographic Automatic Mapping) Program Documentation (U.S. Central Intelligence Agency, 1975).

Selected terms in common use in computer sciences are defined in the glossary at the end of this Circular.

MAPMAKING BY CONVENTIONAL AND COMPUTER METHODS

GENERAL CONSIDERATIONS

A computer-generated map, in its final form, involves all the considerations and specialties associated with mapmaking in general, including cartography, the nature of map projections, layout and design, data content, and annotations.

In conventional procedures, the geologist takes an existing base map and compiles geologic and mineral-resource data on it. This procedure is somewhat restraining because the geologist is limited to those base maps that are available, which may or may not be the best base maps for the job. Ideally, the geologist using conventional compilation methods should be able to envision beforehand exactly what he wants to compile, because once compiled, the data cannot be changed, except by laboriously revising or by making a new compilation. However, new ideas often surface during compilation and demand a revision of the data already compiled. The time required for one compilation ranges from a few days to several months, depending upon the degree of organization of the raw data and the complexity of the map to be produced. Normally, therefore, time and cost limitations prohibit the geologist from making a large number of compilations.

By contrast, the computer-generated mineral-resource map offers the geologist a high degree of flexibility. The geologist can obtain a base map for any area of the world, on any of the commonly used projections, and at any scale desired. The base map can be produced separately, if desired, and can be used as the final base-map plate. The geologist can change the base-map scale or projection or the area covered at any time. The quantity and kinds of data shown on the map can be changed at any time. The geologist is not restricted to a limited number of hand-compiled maps. Before committing oneself to a final map, the geologist can produce many trial maps showing different kinds of information in various combinations. The geologist can then select the most meaningful combinations from the trial maps to use for one or more final maps.

Depending upon the needs of the job, a computer-generated mineral-resource map can be made quickly as a rough working copy only, or it can be refined to the point where the final product approaches the form of the final (camera-ready) compilation copy. Nearly always, however, some additional hand-tailored layout and design work is required to produce the final camera-ready compilation plate. A computer-generated mineral-resources map definitely is not intended to be the final camera-ready compilation plate. The machine is limited in symbols, print fonts, accessory annotations, and so forth, which require hand tailoring. Its main function is to provide overlays and working copy quickly and cheaply as an aid in the compilation process.

TIME AND COST COMPARISONS

In 1977, in order to obtain some estimates on the cost-effectiveness of computer-generated maps and of conventionally produced mineral-resource maps, the CRIB staff monitored the following task:

A resource specialist wished to generate 10 mineral-resource maps showing the deposit locations of certain mineral commodities for the State of California. These commodities were Cr, Hg, Cu, Mn, W, Zn, Ni, Au, Sn, and asbestos. The maps to be generated were to register to an existing base map—a Lambert projection at a scale of 1:1,000,000. In all, about 2,000 point locations were to be plotted. The resulting maps are considered to be "author's compilation copy," not final camera-ready copy.

Time and costs using computer methods.—The map-generating procedure can be divided into two

phases: 1. Design and 2. Map production. The time and costs for both phases are summarized below:

	Design and specification	Map production	Total
Costs			
Computer	$102.51	$ 80.00	$182.51
Plotter	77.00	110.00	187.00
Labor (programmer)	130.48	93.20	223.68
Total	$309.99	$283.20	$593.19
Time			
Computer (central processing unit)	5.85 min	7.00 min	12.85 min
Plotter	3.50 hr	5.00 hr	8.5 hr
Programmer	14 hr	10 hr	24 hr
Beginning to end	5 days	9 days	14 days

When computer methods were used, the work required 3 man-days of work at a total cost of $593.19.

Time and costs using conventional methods. – The time and costs for producing maps by conventional methods consist largely of labor (compilation) time and costs; compilation time can range from a few days to several months. However, if we assume the following optimum conditions, we can provide a rough estimate of time and costs:

1. All map materials are on hand at no cost (base map plus compilation sheets).
2. All resource data, including latitude and longitude coordinates, are organized before compilation begins, and are available.
3. Compilation is done by a technician earning $43.92/day.
4. Compilation proceeds at the rate of one point every 4 min, or 120 points per 8-hr day.

Using these assumptions, we estimate that the compilation of the 10 resource maps by conventional methods would require 17 days of compilation time at a labor cost of $746.64.

The comparison of the two methods for producing mineral-resource maps is summarized below:

	Cost	Labor
Computer method	$593.19	3 man-days
Conventional method	$746.64	17 man-days

DISCUSSION

For successive maps showing additional commodities or for plots at other map scales, the cost per map generated by computer methods would steadily decrease; by contrast, the costs per map for additional hand-compiled maps would be the same as for each of the original maps.

The number of point locations plotted has little effect on the cost of a computer-generated map but directly affects the cost of a hand-compiled map. For example, if 4,000 rather than 2,000 points had been plotted in the task described above, the costs of conventional compilation would have doubled, whereas the costs of computer methods would have been approximately the same.

In general, the cost-effectiveness of manual and computerized map compilation depends on one or more of the conditions listed below.

Manual compilation is efficient if:

- Few point locations (records) are to be compiled; that is, the file is small.
- Few variables (fields) at each location (record) are considered.
- Only a few maps are required.

Computerized compilation is efficient if:

- Many point locations (records) are to be compiled; that is, the file is large.
- Many variables (fields) at each location (record) are considered.
- A series of resource maps is required.

When the resource geologist needs a series of maps showing different kinds of information in various combinations for a large number of point locations, then the computer-generated map offers distinct advantages over the hand-compiled map.

QUICK-PLOT MAPS FROM THE CRIB FILE

By Tod E. Huffman

INTRODUCTION

Quick-Plot is one of the interactive-output programs of the CRIB (Computerized Resources Information Bank). Quick-Plot draws map displays on a graphic terminal showing the locations of user-selected mineral deposits; these locations are retrieved interactively from CRIB by using the GIPSY (General Information Processing System) program (Oklahoma University, Office of Information Systems Programs, 1975). Quick-Plot provides a visual means of making rapid appraisals of selected parts of the file in terms of types and distributions of mineral deposits existing in a geographic area. Quick-Plot is useful for preliminary evaluation of subsets of the master CRIB file and for demonstration purposes.

The principal output products from the CRIB system include finished compilation (not yet camera-ready) copies of maps produced by the

CAM (Cartographic Automatic Mapping) system using GIPSY batch retrievals from the CRIB file. If a finished full-size map is not required, the Quick-Plot interactive terminal retrieval and map plot may by itself satisfy a user request. Usually, however, the Quick-Plot map is used to preview specific CRIB retrievals before submitting the data to the CAM system for plotting on the CalComp plotter.

Basically, the graphic part of the Quick-Plot system provides a map display of any data that can be represented by single points whose latitude and longitude are known. When Quick-Plot is used to display mineral-commodity data from the CRIB file, the user can interactively:

1. Choose the geographic area within which mineral-deposit data are to be plotted.
2. Select data on different minerals (short for mineral commodities) to be plotted from the subfile of data previously retrieved from CRIB by GIPSY.
3. Assign symbols to the individual minerals to be plotted.
4. Select the scale of the map.
5. Indicate what worldwide coastlines and international boundaries or continental U.S. State and county boundaries should be shown.

The Quick-Plot system consists of three interactive user-controlled steps, as follows:

1. Retrieval of data from CRIB by use of the GIPSY program and copy of the retrieved data to a preallocated workfile.
2. An optional user edit of the data in the workfile; edit is under control of the IBM-TSO edit procedure.
3. Interactive map display using the Quick-Plot program (H858).

Steps 1 and 2 are the retrieval/edit function of the Quick-Plot program, and step 3 is the display function. Each of the two functions is initiated and fully controlled through a single TSO command procedure. The user merely invokes the proper command to enter the desired step. While in direct communication with the computer, the user guides and controls each step and is aided by user prompts and other messages from the computer.

The retrieval/edit and display functions may be performed as two distinct interactive operations, or the two functions may be combined into a single interactive session (fig. 1). If a Tektronix terminal is not readily available, the retrieval and editing can be performed on any type of terminal (interactive or batch), and the Quick-Plot graphic map display can be completed later when the Tektronix terminal is available. If the Tektronix is available, then the two functions can be combined into a single interactive session.

In step 1, selected data are retrieved from the CRIB file by using the appropriate commands of the GIPSY retrieval language (Oklahoma University, Office of Information Systems Programs, 1975b). Subsets of selected CRIB records are created until all selection criteria have been satisfied. A fixed-length output file is then automatically created when the user gives the GIPSY copy command. The required output data items from each selected CRIB mineral-deposit record are:

1. An identifier for the principal mineral commodity to be plotted.
2. Geographic latitude and longitude values.

Once the copy procedure is completed, the fixed-length output file is available for editing (step 2). Under control of the IBM-TSO data editor, the output file may be printed or records may be changed, added, or deleted as desired.

After editing is completed, the file is automatically prepared for plotting. This preparation consists of the conversion of latitude and longitude to units of angular measure (radians).

At this point, the mineral data are ready to be plotted on the Tektronix terminal (step 3). Depending upon the geographic distribution of the minerals and the degree of map boundary detail desired by the user, one of two TSO command procedures that control the display is selected. These procedures primarily differ only in the digital map boundary files that are available for plotting.

After the initial map plot is created, several options allow generation of hard-copy output, enlargement of specific areas within the display under user control, or the complete redefinition of the map display in terms of geographic boundaries and mineral data to be replotted.

The following operating instructions describe procedures for retrieving data from the CRIB file, editing that data, and creating a map plot on the Tektronix terminal.

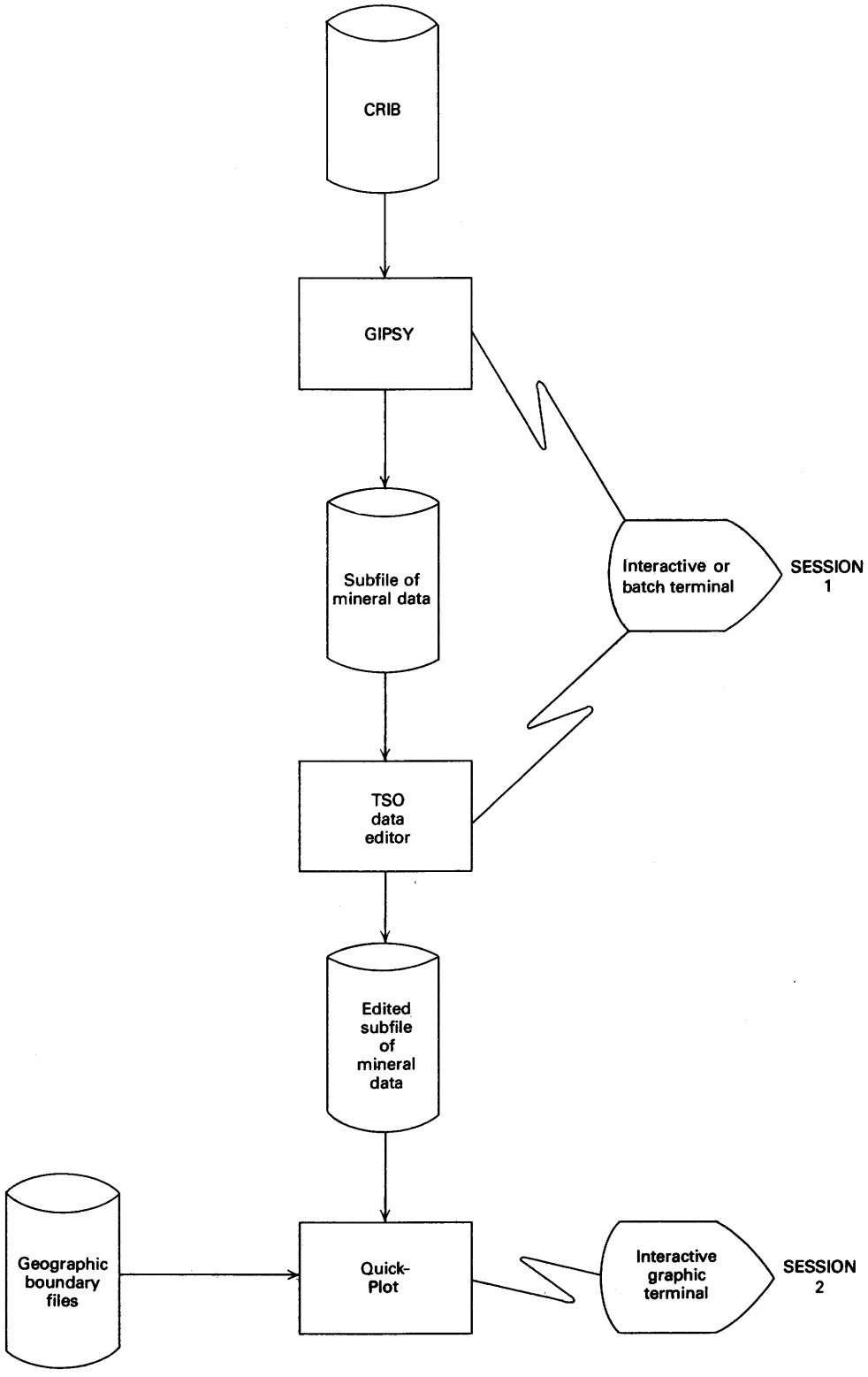

FIGURE 1. – Flow diagram of the Quick-Plot map-graphic system, separated into two terminal sessions.

OPERATING INSTRUCTIONS

In order to gain access to the Quick-Plot system, the user must sign on TSO:

System: LOGON (Tektronix 4010 or 4014 series terminal if plotting is to be done in the same session as the data retrieval)
System: USERID
System: READY

This section gives instructions for performing the three distinct steps of the entire Quick-Plot retrieval and display procedure. As mentioned in the "Introduction" to this section, these steps are:

1. GIPSY retrieval from the CRIB file using selection logic appropriate for the particular problem.
2. TSO edit of the CRIB data copied from the SRF (selected record file) to a preallocated dataset (WRK.DATA).
3. Execution of the command procedure that will create the Tektronix display of the edited CRIB data.

STEP 1: USE OF THE GYPSY PROGRAM TO RETRIEVE DATA FROM THE CRIB FILE

User : Execute GYP.CLIST
System: Responds with access to the GIPSY.
System: ? (Responds with question mark and turns control back to user.)
User : FORM
System: --------
User : CRIB
System: ?
User : SELECT
System: FULL OR TERM SEARCH?
User : FULL
System: A.
User : A40<CA> (All Canadian records.)
System: B.
User : C10<AGbb> (Any deposit containing silver. Two blank spaces are indicated by "bb.")
System: C.
User : A70 (Contains latitude value.)
System: D.
User : A80 (Contains longitude value.)
System: E.
User : Presses return key
System: LOGIC (Asks for logical relations desired among previously entered search parameters.)
User : A and B and C and D (Records must satisfy all conditions.)
System: SEARCH BEGINNING (At this time, GIPSY searches the CRIB file to retrieve all records meeting the stated criteria.)
System: SEARCHED XXX (System provides statistics on results of search. Number values indicated by "XXX.")
System: SELECTED XXX
System: VARIABLES SATISFIED
System: A XXX
System: B XXX
System: C XXX
System: D XXX
System: ITERATE?
User : NO

```
System: ?
User   : COPY                    (Reformat the SRF into the required fixed-length
                                  output record.)

System: --------
System: TERMINAL OR WORKFILE?
User   : W                       (Workfile-a preallocated output file called
                                  WRK.DATA.)
User   : 'AGbb' or C10 4         (Copy the mineral identifier AG or the first four
                                  characters of another mineral identifier from each
                                  qualifying record.)
User   : A70 9                   (Copy the first nine characters in the latitude field.)
User   : A80 10                  (Copy the first 10 characters in the longitude field.)
User   : /                       (To end input.)
System: ?
User   : END                     (To end the GIPSY session.)
```

At this point, step 1 is completed. The CRIB file has been searched, and qualified records have been reformatted and written to an output file called WRK.DATA. The WRK.DATA records contain the latitude and longitude of mineral deposits and contain the symbol for the primary mineral itself.

STEP 2. EDIT OF THE GIPSY COPY FILE

After step 1 has been completed, the terminal automatically enters the TSO edit mode. The GIPSY file, WRK.DATA, may now be edited by using the standard TSO edit commands summarized below.

To *list* the data: LIST
To *change* a record: TV
Down XX or Find " "
Change * " " " "
To *delete* a record: Delete *
To *add* a record: Insert " "

When the user is satisfied with the CRIB data, the data may be saved and the display part of the procedure may be initiated.

```
User   : SAVE
System: SAVED
User   : END
System: READY
```

STEP 3. CREATION OF DISPLAY ON A TEKTRONIX GRAPHIC TERMINAL

After mineral data have been selected, retrieved, and edited by using the GYP.CLIST procedure, they may be plotted on a Tektronix graphic terminal. In order to gain access to the plot software, the user must gain access to TSO and sign on his Tektronix graphic terminal. (If CRIB file retrieval and map plot are done in the same session, then the user can simply issue the selected plot procedure for execution.) Two TSO-command procedures–PREVIEW.CLIST and PRESTATE.CLIST–are available to control the interactive display. These procedures differ primarily in the map boundary files that are made available to the user. The user chooses the procedure that will best show the data and the required map boundary details, and then types in EXEC PREVIEW or EXEC PRESTATE.

The procedure named PREVIEW.CLIST is used for worldwide display. By use of this procedure, CAM WDBI (World Data Bank I) background map data are superimposed on the plotted CRIB data. Both coastline and international boundary information is included.

The procedure named PRESTATE.CLIST is used for display of CRIB data within the continental boundaries of the United States. In this procedure, the CENSUS/DIME State and county boundary files are available. The display may be of one or more States.

If the PREVIEW procedure is chosen for display, all files are allocated automatically, and the user selects his geographical display window by defining maximum and minimum latitude and longitude limits. If the PRESTATE procedure is chosen, then the user must select States to be displayed. States are selected by altering the command procedure so that only the necessary DIME boundary file members are allocated. Those State file members chosen by the user are concatenated as in the example on p. 9 of a PRESTATE procedure set up to display only the States of California and Arizona.

Modification of the PRESTATE procedure consists of entering the TSO data editor and adding or deleting ALLOC FI (allocate-file) statements, including the member names of the State boundaries to be displayed. The member names follow the standard FIPS (Federal Information Processing Standards) naming convention (U.S. Dept. Com-

```
00000010PROC 0
00000020TERM SECONDS(30)  INPUT(QUIT)
00000030TPRINT ' **** WELCOME TO THE MINERAL DISPLAY SYSTEM ****'
00000040TPRINT 'STEP #3, THE INTERACTIVE DISPLAY OF EDITED CRIB DATA WILL BEGIN:
00000050TPRINT '     THIS PROC LINKS DIME STATE BOUNDARY MEMBERS...'
00000051ALLOC FI(FT20F001) DA('VG9195J.DIME.DATA(CA)') SHR
00000052ALLOC FI(FT21F001) DA('VG9195J.DIME.DATA(AZ)') SHR
00000053CONCAT (FT20F001 FT21F001)
00000070ALLOC FI(FT06F001) DA(*)
00000090ALLOC FI(FT31F001) DA(WRK.DATA)
00000091ALLOC FI(FT30F001) DA(WRK1.DATA)
00000100LOAD 'SYS1.LOADLIB(H858)' FORTLIB EP(MAIN)
00000110TPRINT '*** LOAD DISPLAY PROGRAM - PRIOR TO INTERACTIVE SESSION'
00000120ALLOC FI(FT05F001) DA(*)
00000121 LOAD 'SYS1.LOADLIB(J732)' LIB('SYS1.PLOT10' 'SYS1.TEKTRON.LOAD') FORTLI
00000141 FREEALL
00000150END
//
```

merce, 1973). A list of the State codes used as member names in the partitioned data set VG9195J.DIME.DATA is shown in figure 2. As indicated within the example of PRESTATE procedure, State boundaries are allocated serially increasing file designations beginning at FT20F001 and ending at FT29F001. The CONCAT (concatenation) statement also must be modified to include only those boundary files being allocated. When using PRESTATE, the user is not required to define his geographic boundary limits because the allocation of specific State boundary files explicitly defines the geographic limits. Figure 3 is a flow chart of the TSO-command procedure from GYP through PREVIEW or PRESTATE.

On access to TSO and execution of the appropriate command procedure—PRESTATE or PREVIEW—the interactive display session will begin. The user is prompted for input on the characteristics of the map plot. Four groupings of input are requested:

1. Titling information for the display.
2. Physical-plot size in terms of terminal-screen height and width.
3. Geographic area of the map to be plotted.
4. Option selection for either total or selective display of data from the mineral input file.

After the appropriate command procedure is issued, the Tektronix screen will initially erase. Input entry will begin as follows:

System: START OF TAPE
System: OPTIONS? The bell will sound.
User : Respond by typing **1**. The bell will sound.
User : Respond by typing **C**.
System: INPUT TITLING INFORMATION—MAX. 56 CHARACTERS.
User : Respond by typing a character string to be used for titling the map plot.
System: DEFINE GRAPHIC DISPLAY AREA (MAX. 10×6 in) WHAT IS PLOT SCREEN WIDTH IN DECIMAL INCHES:
User : Respond by entering a number that is used to scale the plot size in inches; for example, **8.5** (max.=8.7).
System: WHAT IS PLOT SCREEN HEIGHT IN DECIMAL INCHES:
User : Respond with height; for example, **5.5** (max.=5.7). For the most realistic map portrayal, the ratio of plot height to plot width should be the same as the ratio of map latitude range to map longitude range.

If the PRESTATE.CLIST procedure is being executed, the next three prompts will not appear.

System: DEFINE GEOGRAPHIC AREA—INPUT E=1 or W=2 hemisphere
User : Respond with the quadrant for which mineral data are to be displayed.
System: INPUT N=1 OR S=2 hemisphere
User : Respond with the appropriate quadrant.
System: INPUT GEOGRAPHIC BOUNDARIES—NW LAT, NW LONG, SE LAT, SE LONG—IN DEC DEG (F5.1)
User : Respond with the coordinates of the four-cornered area for which data are to be displayed in the geographic order requested (decimal degrees, no embedded

```
lds 'vg9195j.dime.data' m
VG9195J.DIME.DATA
--RECFM-LRECL-BLKSIZE-DSORG
  FB     34     12988    PO
--VOLUMES--
  CCD921
DATA SET IS ON A 3330 AND HAS ROOM FOR A MAXIMUM OF      5,730 RECORDS.
THERE ARE    190 TRACKS ALLOCATED AND    175 TRACKS USED FOR THIS DATA SET

                    --MEMBERS--
                  AL                NC
                  AR                ND
                  AZ                NE
                  CA                NH
                  CO                NJ
                  CT                NM
                  DC                NV
                  DE                NY
                  FL                OH
                  GA                OK
                  IA                OR
                  ID                PA
                  IL                RI
                  IN                SC
                  KS                SD
                  KY                TN
                  LA                TX
                  MA                US
                  MD                UT
                  ME                VA
                  MI                VT
                  MN                WA
                  MO                WI
                  MS                WV
                  MT                WY
                                   READY
```

FIGURE 2 – List of State codes used as member names in the partitioned data set VG9195J.DIME.DATA.

blanks). For example,

0 4 8 . 0 1 2 0 . 0 0 2 8 . 0 0 4 2 . 0
NW NW SE SE
LAT LONG LAT LONG

System: DO YOU WANT TO DISPLAY ALL MINERALS WITHIN THE AREA (TYPE IN 1) OR DO YOU WANT TO SELECT MINERALS TO BE DISPLAYED (TYPE IN 2):

User : Respond with either 1 or 2. If 1 is entered, then locations of *all* the mineral deposits for which data are in the edited CRIB COPY file will be displayed (if the deposits are within the geographic limits as previously defined by the user); all deposit locations will be marked by the default symbol ◊ . If a 2 is entered, then the user will be required to list those minerals for which he wants information displayed and to designate a particular symbol to be associated with each mineral.

If the user enters 2, then:

System: ENTER MINERAL NAMES (2 CHAR) AND SYMBOL (1 CHAR)–
○=1; △=2; +=3; X=4; ◊=5
TO END INPUT, TYPE IN SYMBOL=∅ [zero]:

User : Respond with mineral symbol name and code for type of symbol to be used for portrayal; for example, CU3.

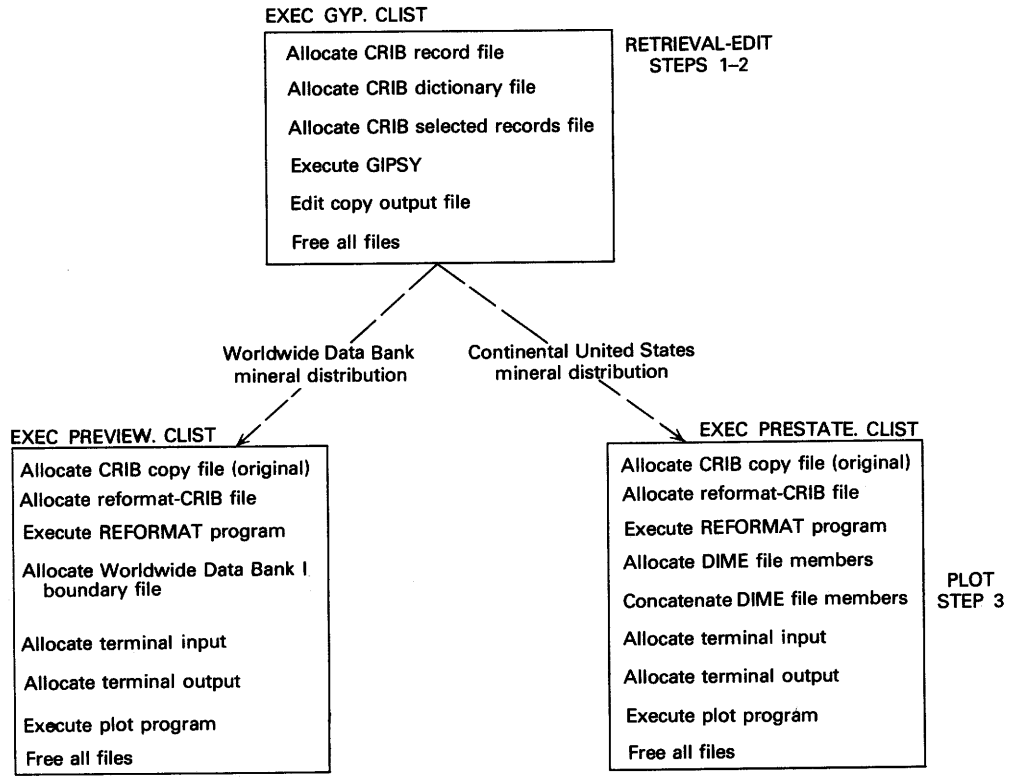

FIGURE 3.–Flow chart of the Quick-Plot TSO-command procedure from GYP through PREVIEW or PRESTATE (Steps 1-3).

The system will echo each item of input as:

System: MINERAL: CU SYMBOL: 3
User : ZN5
System: MINERAL: ZN SYMBOL: 5

This sequence continues until the user types in the symbol Ø to halt input and signal readiness to continue to the next prompt.

User : bbØ Two blanks followed by a zero will terminate input of minerals and symbology. At this point in the interactive problem definition, the system searches the digital boundary file(s) for maximum and minimum latitude and longitude values so as to size the total map-plot area to the previously defined screen height and width. This search procedure is only performed when executing PRESTATE.CLIST which accesses the DIME files. The system search is not required in PREVIEW.CLIST because the geographic boundaries are defined by the user.

System: DIGITAL OUTLINE FILE SEARCHED FOR SCALE FACTORS. This is an informative message and does not require user response. At this point in processing, the system searches the edited CRIB copy file to determine (1) whether any of the mineral deposits described in the file are outside the user-defined geographic area or (2) whether information on all the minerals designated by the user is actually contained within the input file and can be displayed. Any discrepancies are listed on the screen. At this point in processing, several options are available.

System: TYPE 1 TO CONTINUE. TYPE 2 TO SELECT OTHER MINERALS FOR DISPLAY FROM THE CRIB FILE. TYPE 3 TO REDEFINE THE ENTIRE PROBLEM. TYPE 4 TO END SESSION.

User : If the user types 1, the screen erases and map plotting is initiated. If the user types 2, the program returns for redefinition of minerals for which information is to be

displayed. If the user types 3, the program returns to the beginning of problem definition, and the user may then completely redefine the display parameters. If the user types 4, the map-plot session is ended, and the terminal returns to the TSO idle mode.

Depending upon the option selected (except 4), the screen will eventually erase, and the map plot will be initiated.

After the entire map plot is created, several options are listed at the lower right corner of the plot area.

System: * ENTER S TO END SESSION,
* ENTER W TO WINDOW:
(FIRST MIN LAT/LON THEN MAX)
* ENTER H FOR HARDCOPY AND WINDOWING,
* ENTER R TO DEFINE ANOTHER PLOT.

At this point in processing, the crosshair cursor will appear on the face of the screen.

User : If the user types S, the cursor will move to the lower left of the screen, and READY will appear. The display session has ended.

If the user wishes an area within the current map plot to be enlarged, he must first position the crosshair cursor (by using the two thumbwheels on the lower right of the console) according to the instructions for windowing printed at the lower right corner of the plot. Screen coordinates for the minimum latitude and longitude of the area of interest must be designated as step 1, and maximum coordinates must be designated as step 2. The user first positions the cursor to the minimum position and enters W. At this point, the cursor will disappear for an instant and then reappear. The user then repositions the cursor to the maximum latitude and longitude position and again enters W. At this point, the screen will erase, and plotting of an enlarged map of the selected area will begin.

To obtain an image of the screen plus windowing, follow the same procedure of positioning the cursor but enter H, rather than W.

If the user types R, the cursor will move to the upper left corner of the screen, the program will then request a complete redefinition of the map plot, and another completely new display will be created. This recycling back to the beginning may continue as long as desired.

EXAMPLE

The following example illustrates how Quick-Plot can be used to retrieve data and produce map plots of mineral data from the CRIB file. The retrieval was made by using the GIPSY program on the USGS IBM-370 computer at Reston, Va. Both data retrieval and map plots were made in interactive time-share runs. The map images were plotted on a Tektronix graphic display terminal. Some map illustrations in this Circular are unretouched direct copy, obtained through an attachment that makes a paper (hard) copy of the screen image; other illustrations are photographs of the screen. Detailed descriptions of the command stream, computer statements, and user-generated statements are contained in the preceding section on "Operating Instructions."

Request: Produce a preliminary map on a graphic terminal showing copper deposits and gold deposits currently available in the CRIB file that have a recorded production within the States of California and Arizona.

GIPSY RETRIEVAL

After a phone connection is made between the user's terminal and the computer, the user engages in a controlled "conversation" with the computer. The user translates the request into a set of logical components, called search statements, and indicates the logical relationship among the search statements. The GIPSY program searches the CRIB file and retrieves records according to the logic specified by the user. A copy of this "conversation," which constitutes step 1 of the session, is shown in figure 4.

The mineral-deposit records that pass all selection criteria are copied into a fixed-length output file containing an identifier of the major mineral commodity and the latitude and longitude of each deposit.

At this point, the user may enter step 2 and edit the data in the output file, or the user may go directly to step 3. Editing methods are briefly

described in the section on "Step 2. Edit of the GIPSY Copy File" (p. 8). Complete information is contained in the IBM Time-Sharing Option reference manual (International Business Machines Corp., 1973).

QUICK-PLOT MAP DISPLAY

The locations of copper and gold deposits in California and Arizona are now available and ready for display by means of step 3 of the Quick-Plot program. The user issues the PREVIEW command. Then in the first part of the map plot session, four kinds of input on the characteristics of the map plot are requested:

1. Map titling information.
2. Physical plot size.
3. Geographic area.
4. Mineral selection.

The user chooses to have a small-scale map produced initially in this example. Continental and international boundaries are shown, and both the copper- and gold-deposit locations are indicated by dots. The input statements and the resulting map are shown in figure 5.

For a more detailed display of the individual copper- and gold-deposit locations retrieved from CRIB, the characteristics of the map plot are redefined in order to produce a larger scale map of California and Arizona. State and county boundaries are shown. Different symbols are used to distinguish between copper and gold deposits. The interactive statements and resulting map are shown in figure 6.

A section of the large-scale map (fig. 6) containing overlapping symbols is enlarged to show the exact number and location of deposits. To define the area to be enlarged, the user moves a crosshair cursor on the screen over the display of figure 6. Another map plot (fig. 7) is then created at a larger scale; it shows the locations at the county level of copper and gold deposits in northern California. On figure 7, the user can see details that are obscured on the primary map.

PROGRAM DOCUMENTATION MATERIALS

SYSTEM DESCRIPTION

Quick-Plot is written in fortran using the Tektronix Plot-10 terminal control system preview software. Plot-10 consists of a series of functional subroutines allowing graphic display on the 4010 and 4014 series Tektronix display terminals (Tektronix, 1974a, b, 1977). Quick-Plot operates via TSO on the IBM-370 computer.

The Tektronix terminal consists of a storage tube and keyboard and is capable of both alphanumeric and graphic display under program control. The 4010-series terminal has a screen size of 5×7 inches. A later model—the 4014-series terminal—has a screen size of 11×15 inches.

A flow diagram showing the functional components of the Quick-Plot map-graphic system is shown in figure 8. Source listings and command procedures are shown in the pages following figure 8.

```
exec gyp.clist
**** WELCOME TO THE MINERAL DISPLAY SYSTEM ****
THIS COMMAND PROCEDURE PERFORMS STEPS #1 AND #2 OF THE
   3 STEP PROCESS:
THE THREE STEPS ARE:
    (1) GIPSY QUERY, RETRIEVAL, AND COPY OF CRIB DATA
    (2) USER EDIT OF SELECTED CRIB DATA
    (3) INTERACTIVE DISPLAY OF EDITED CRIB DATA

STEP #1, THE GIPSY CRIB RETRIEVAL WILL NOW BEGIN:

 G I P S Y - UNIVERSITY OF OKLAHOMA                    11:11 A.M. THURS
DAY  SEPTEMBER   7,1978

?
form
-------
crib

?
select
-------
     FULL OR TERM SEARCH?
full
A. a50< 04 >
       STATE CODE.............
B. a50< 06 >
       STATE CODE.............
C. a40< us >
       COUNTRY CODE.................
D.
LOGIC (a or b) and c
    SEARCH
LOGIC
11:12:37.5 SEARCH BEGINNING

11:12:47.5 SEARCH COMPLETED
 SEARCHED     115
 SELECTED     115     SUBSET     1
 VARIABLES SATISFIED
     A         33
     B         82
     C        115

ITERATE?
yes
```

FIGURE 4. – An example of an interactive search of the CRIB file (step 1 of Quick-Plot) showing GIPSY search and copy statements generated statements, computer

```
A. major< cu >
       MAJOR PRODUCTS..
B. major< au >
       MAJOR PRODUCTS..
C. yes
       YES
D. a70
       LATITUDE
E. a80
       LONGITUDE
F.
LOGIC (a or b) and (c and d and e)
    SEARCH
LOGIC

11:16:46.8 SEARCH BEGINNING


11:16:49.2 SEARCH COMPLETED
 SEARCHED     115
 SELECTED     115     SUBSET     2
VARIABLES SATISFIED
    A          32
    B          83
    C         115
    D         115
    E         115

ITERATE?
no

?
copy
-------
TERMINAL OR WORKFILE?
w
major 4
a70 9
a80 10
/

?
end
-------
 G I P S Y - UNIVERSITY OF OKLAHOMA                    11:17 A.M.  THURS
DAY SEPTEMBER    7,1978

THE RETRIEVAL IS COMPLETED - NOW EDIT DATA...
DATA SET WRK.DATA NOT LINE NUMBERED, USING NONUM
EDIT
```

for retrieving records currently available in the CRIB file on copper and gold in California and Arizona. Search consists of user-responses, and messages.

```
START OF TAPE
OPTIONS?1
C
INPUT TITLING INFORMATION - MAX 56 CHARACTERS :
COPPER AND GOLD: CALIF. AND ARIZ.
DEFINE GRAPHIC DISPLAY AREA (MAX 10X6 IN.) --
WHAT IS PLOT SCREEN WIDTH IN DECIMAL INCHES :
8.5
WHAT IS PLOT SCREEN HEIGHT IN DECIMAL INCHES :
5.5
DEFINE GEOGRAPHIC AREA --
INPUT E=1 OR W=2 HEMISPHERE
2
INPUT N=1 OR S=2 HEMISPHERE
1
INPUT GEOGRAPHIC BOUNDARIES --
NW LAT. NW LONG. SE LAT. SE LONG -- IN DEC DEG.(F5.1)
060.0130.0020.0060.0
DO YOU WANT TO DISPLAY ALL MINERALS WITHIN THE AREA
(TYPE IN 1) OR DO YOU WANT TO SELECT MINERALS TO BE
DISPLAYED (TYPE IN 2) :
1
```

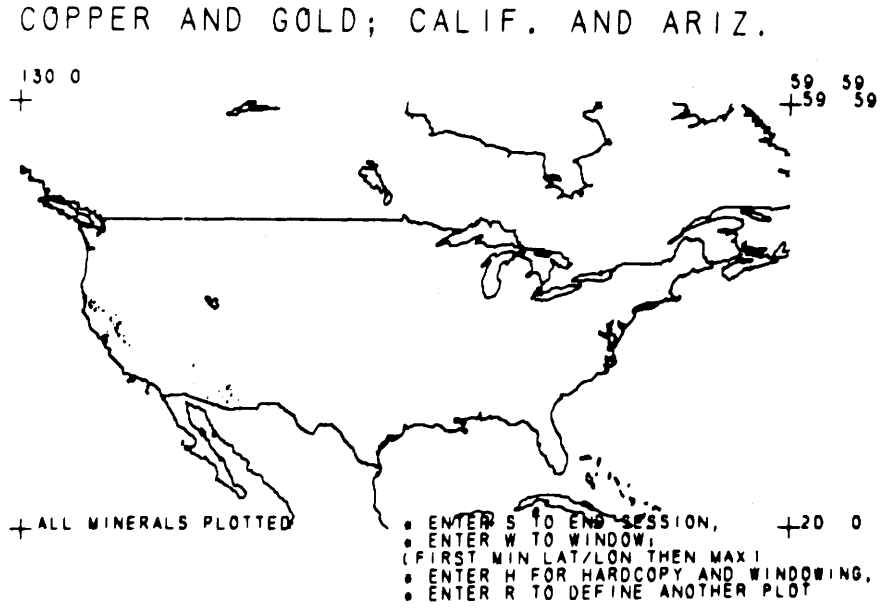

FIGURE 5.—An initial small-scale map of the United States produced by the Quick-Plot program on a graphic display terminal to show locations of copper and gold deposits in California and Arizona for which information is currently available in the CRIB file. The input information used to generate the map is also shown.

```
START OF TAPE
OPTIONS?1
C
INPUT TITLING INFORMATION  - MAX 56 CHARACTERS :
COPPER AND GOLD: CALIF. AND ARIZ.
DEFINE GRAPHIC DISPLAY AREA (MAX 10X6 IN.) --
WHAT IS PLOT SCREEN WIDTH IN DECIMAL INCHES :
7.4
WHAT IS PLOT SCREEN HEIGHT IN DECIMAL INCHES :
5.5
DO YOU WANT TO DISPLAY ALL MINERALS WITHIN THE AREA
(TYPE IN 1) OR DO YOU WANT TO SELECT MINERALS TO BE
DISPLAYED (TYPE IN 2) :
2
ENTER MINERAL NAMES (2 CHAR) AND SYMBOL (1 CHAR) --
TO END INPUT, TYPE IN SYMBOL=0 :
CU3
MINERAL:  CU SYMBOL:  3
AU4
MINERAL:  AU SYMBOL:  4
110
DIGITAL OUTLINE FILE SEARCHED FOR SCALE FACTORS
TYPE 1 TO CONTINUE, OR 2 FOR HARDCOPY AND CONTINUE
1
```

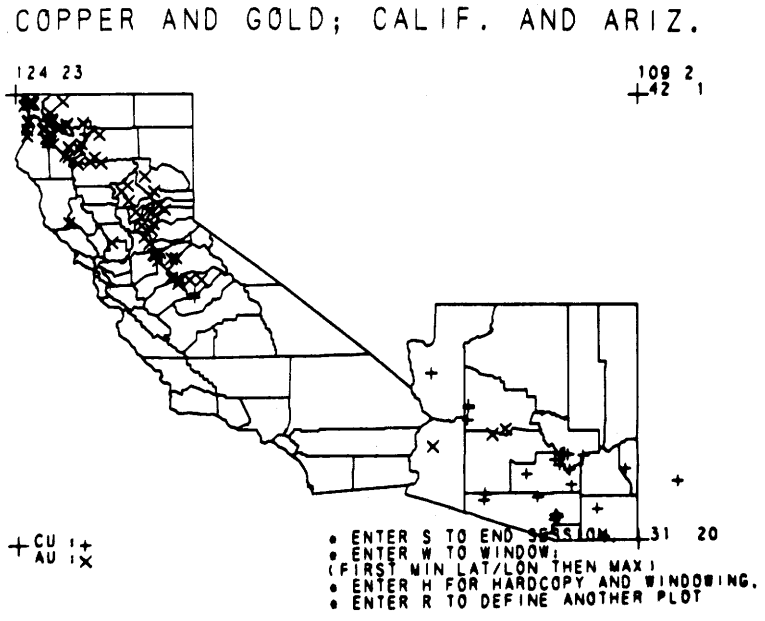

FIGURE 6.–A part of figure 5 enlarged by the Quick-Plot program on a graphic display terminal and showing the area of California and Arizona only. The input information used to generate the map is also shown.

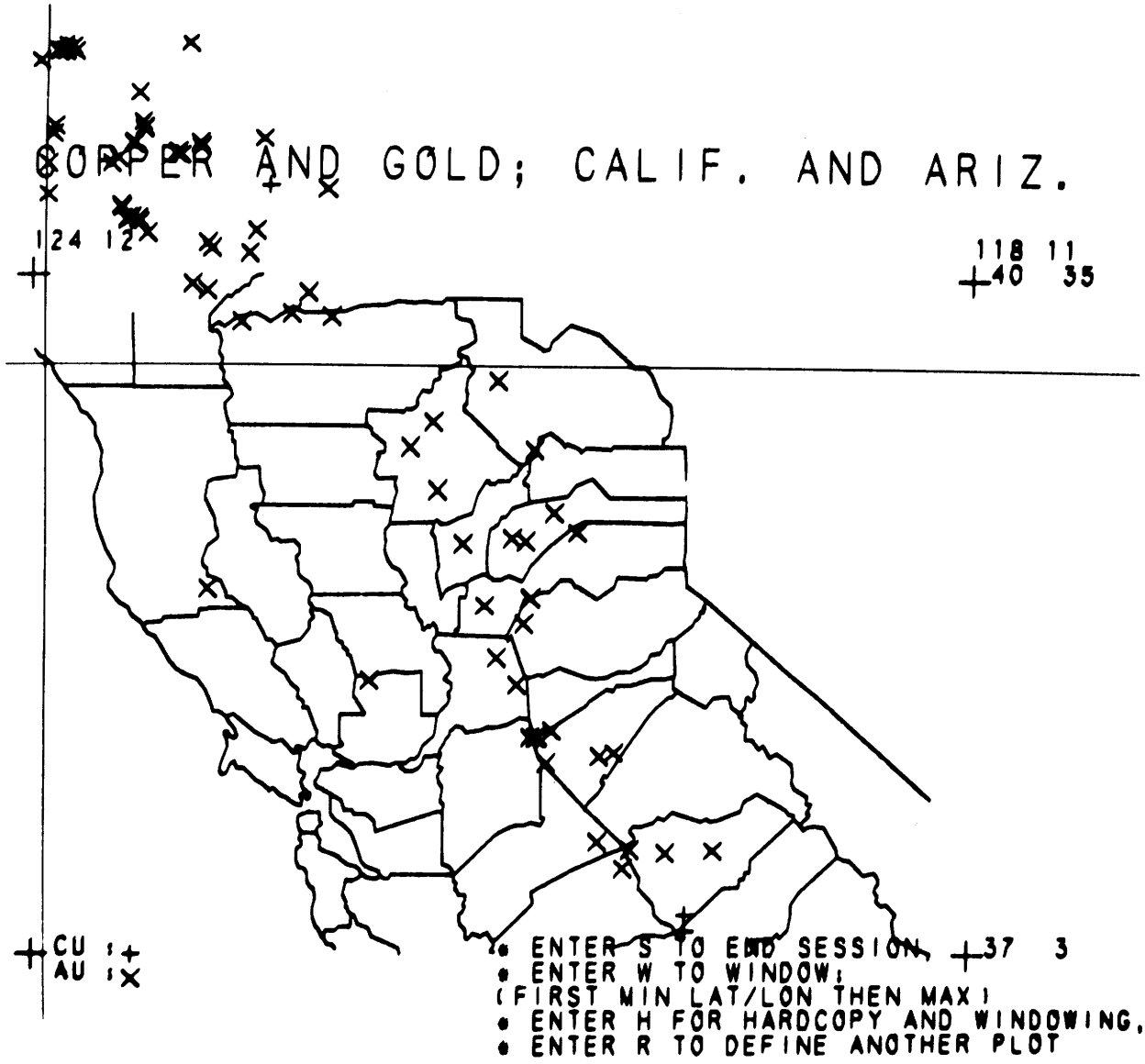

FIGURE 7.—A part of figure 6 enlarged by the Quick-Plot program on a graphic display terminal to show locations of copper and gold deposits in northern California. Some symbols that were overlapping are now distinct.

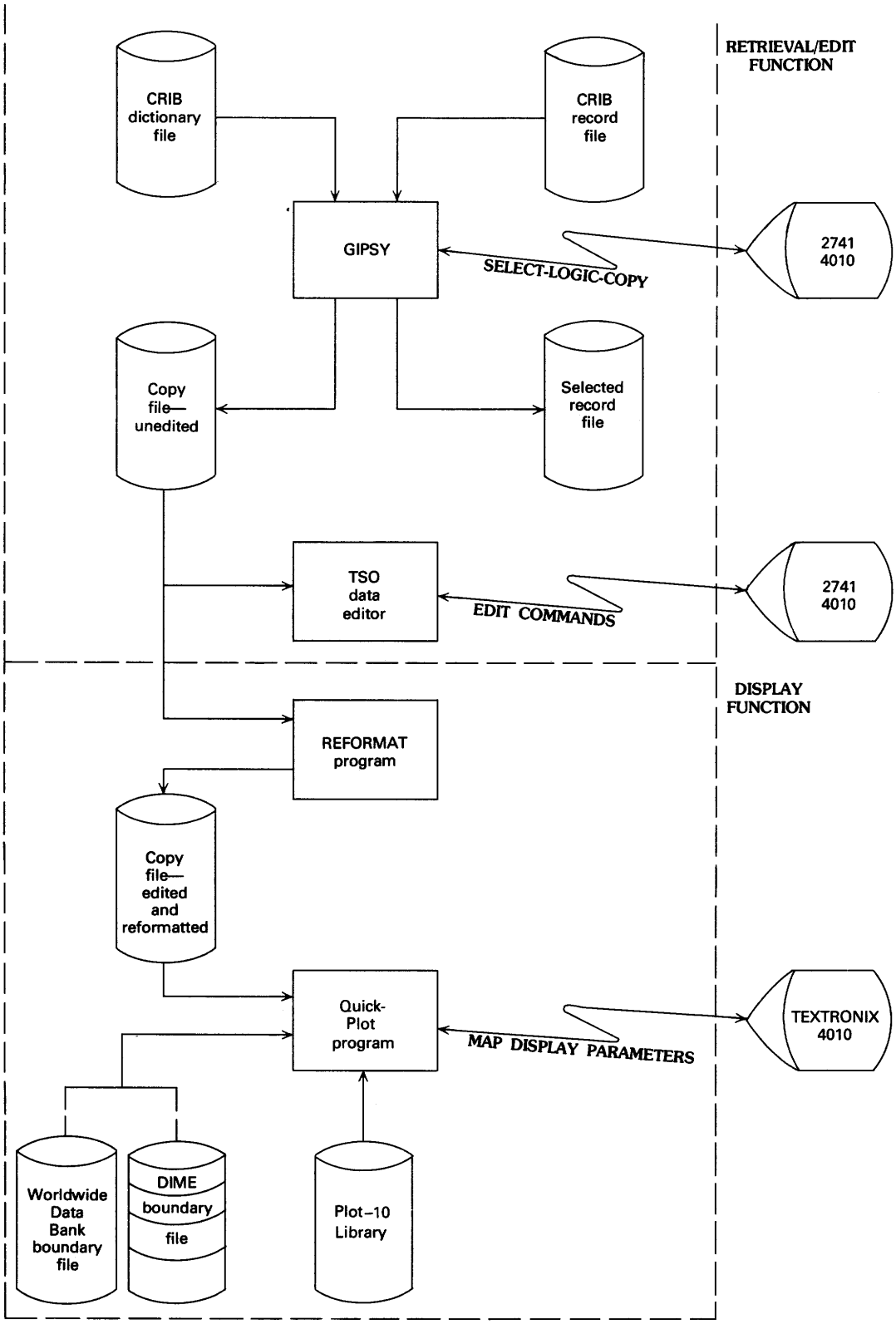

FIGURE 8. – Flow diagram showing the functional components of the Quick-Plot map-graphic display system.

QUICK-PLOT PROGRAM (H858)

```
      DIMENSION IBUF(1000),X(2),Y(2),XCOR(4),YCOR(4),ANNOT(8)          00000010
      DIMENSION ITEM(10),ISYMB(10)                                     00000020
      REAL*8 HEAD(7),XIN                                               00000030
      INTEGER*2 IR                                                     00000040
      COMMON /PARAM/ IHEMNS,IHEMEW                                     00000050
       CALL PLOTS(IBUF,1000,11)                                        00000060
C      MOVE PEN 0.5 IN AND REDEFINE ORIGIN                             00000070
 1025  CALL PLOT(1.0,1.0,-3)                                           00000080
      WRITE(6,826)                                                     00000090
  826 FORMAT(1X,'INPUT TITLING INFORMATION - MAX 56 CHARACTERS :')      00000100
      READ(5,827) HEAD                                                 00000110
  827 FORMAT(7A8)                                                      00000120
      WRITE(6,828)                                                     00000130
  828 FORMAT(1X,'DEFINE GRAPHIC DISPLAY AREA (MAX 10X6 IN.) --')       00000140
      WRITE(6,403)                                                     00000150
  403 FORMAT(1X,'WHAT IS PLOT SCREEN WIDTH IN DECIMAL INCHES :')       00000160
      READ(5,404) XLIM                                                 00000170
  404 FORMAT(F3.1)                                                     00000180
      WRITE(6,405)                                                     00000190
  405 FORMAT(1X,'WHAT IS PLOT SCREEN HEIGHT IN DECIMAL INCHES :')      00000200
      READ(5,404) YLIM                                                 00000210
      WRITE(6,829)                                                     00000220
  829 FORMAT(1X,'DEFINE GEOGRAPHIC AREA --')                           00000230
       WRITE(6,400)                                                    00000240
 400   FORMAT(1X,'INPUT E=1 OR W=2 HEMISPHERE')                        00000250
      READ(5,401) IHEMEW                                               00000260
 401   FORMAT(I1)                                                      00000270
        WRITE(6,402)                                                  00000280
  402   FORMAT(1X,'INPUT N=1 OR S=2 HEMISPHERE')                       00000290
      READ(5,401) IHEMNS                                               00000300
      WRITE(6,2000)                                                    00000310
 2000 FORMAT(1X,'INPUT GEOGRAPHIC BOUNDARIES --')                      00000320
      WRITE(6,2001)                                                    00000330
 2001 FORMAT(1X,'NW LAT, NW LONG, SE LAT, SE LONG -- IN DEC DEG.(F5.1)')00000340
      READ(5,2002) DLAT1,DLON1,DLAT2,DLON2                             00000350
```

```
 2002 FORMAT(4F5.1)                                                        00000360
      WRITE(6,830)                                                         00000370
  830 FORMAT(1X,'DO YOU WANT TO DISPLAY ALL MINERALS WITHIN THE AREA ')    00000380
      WRITE(6,831)                                                         00000390
  831 FORMAT(1X,'(TYPE IN 1) OR DO YOU WANT TO SELECT MINERALS TO BE ')    00000400
      WRITE(6,832)                                                         00000410
  832 FORMAT(1X,'DISPLAYED (TYPE IN 2) :')                                 00000420
      READ(5,834) ICHOS                                                    00000430
  834 FORMAT(I1)                                                           00000440
      IF(ICHOS .NE. 2) GO TO 503                                           00000450
      NUM = 0                                                              00000460
      WRITE(6,407)                                                         00000470
  407 FORMAT(1X,'ENTER MINERAL NAMES (2 CHAR) AND SYMBOL (1 CHAR) --')     00000480
      WRITE(6,835)                                                         00000490
  835 FORMAT(1X,'TO END INPUT, TYPE IN SYMBOL=0 :')                        00000500
      DO 500 I = 1,10                                                      00000510
      READ(5,408)           ITEM(I), ISYMB(I)                              00000520
  502 FORMAT(1X,'ONLY 10 ITEMS/SYMBOLS ALLOWED-PROCESSING CONTINUED')      0000062
  503 CONTINUE                                                             0000063
      RAD = 0.0174533                                                      0000064
C     COMPUTE XY MIN/MAX ACCORDING TO QUADRANT                             0000065
      IF(IHEMEW.EQ.2) GO TO 4001                                           00000660
      XMAX = DLON2 * RAD                                                   00000670
      XMIN = DLON1 * RAD                                                   00000680
  408 FORMAT(A2,I1    )                                                    00000530
      IF (ISYMB(I) .EQ. 0) GO TO 503                                       00000540
      WRITE(6,409) ITEM(I), ISYMB(I)                                       00000550
  409 FORMAT(1X,'MINERAL:',2X,A2,1X,'SYMBOL:',2X,I1)                       00000560
      NUM = NUM+1                                                          00000570
      IF (I.EQ. 10) GO TO 501                                              00000580
  500 CONTINUE                                                             00000590
      GO TO 503                                                            00000600
  501 WRITE(6,502)                                                         00000610
```

```
      GO TO 4003                                                                00000681
4001  XMAX = DLON1 * RAD                                                        00000690
      XMIN = DLON2 * RAD                                                        00000700
 4003 IF(IHEMNS.EQ.1) GO TO 4002                                                00000710
      YMAX = DLAT2 * RAD                                                        00000720
      YMIN = DLAT1 * RAD                                                        00000730
      GO TO 4004                                                                00000731
4002  YMAX = DLAT1 * RAD                                                        00000740
      YMIN = DLAT2 * RAD                                                        00000750
 4004 CONTINUE                                                                  00000751
  300  FORMAT(5X,8F08.3)                                                         00000760
       DELX = XMAX-XMIN                                                         00000770
       DELY = YMAX-YMIN                                                         00000780
       XS = XLIM/DELX                                                           00000790
       YS = YLIM/DELY                                                           00000800
      IF (ICHOS .EQ. 1) GO TO 836                                               00000810
      DO 600 J= 1,NUM                                                           00000820
  660 READ(30,510,END=680) Y(1),X(1),IMIN                                       00000830
      IF(IMIN.EQ. ITEM(J)) GO TO 620                                            00000840
      GO TO 660                                                                 00000850
  620 IF(X(1).LT.XMIN.OR.X(1).GT.XMAX) GO TO 640                                00000860
      IF(Y(1).LT.YMIN.OR.Y(1).GT.YMAX) GO TO 640                                00000870
      GO TO 670                                                                 00000880
  640 WRITE(6,650) IMIN                                                         00000890
  650 FORMAT(1X,'---MINERAL',2X,A2,1X,'IN CRIB FILE OUTSIDE OF AREA')           00000900
      GO TO 670                                                                 00000910
  680 WRITE(6,621) ITEM(J)                                                      00000920
  621 FORMAT(1X,'***MINERAL',2X,A2,1X,'NOT IN CRIB FILE')                       00000930
C     IF MINERAL NOT IN CRIB FILE DO NOT PLOT; SET FLAG = 0                     00000940
      ISYMB(J) = 0                                                              00000950
  670 REWIND 30                                                                 00000960
  600 CONTINUE                                                                  00000970
      WRITE(6,690)                                                              00000980
  690 FORMAT(1X,'TYPE 1 TO CONTINUE, OR 2 FOR HARDCOPY AND CONTINUE')           00000990
```

```
      READ(5,691) IGO                                                    00001000
  691 FORMAT(I1)                                                         00001010
      IF (IGO .EQ. 2) CALL HDCOPY                                        00001020
 3000 CONTINUE                                                           00001140
      CALL PLOT(XX,YY,3)                                                 00001150
      CALL PLOT(XX,YY,2)                                                 00001160
      LNO1 = LNO                                                         00001170
 3001 CONTINUE                                                           00001180
      READ(20,END=100) LNO,IR,FLAT,FLON,KNT                              00001190
      CALL QUAD (FLAT,FLON,IYN)                                          00001200
      IF (IYN.EQ.1) GO TO 3001                                           00001210
      IF(FLON.GT.XMAX.OR.FLON.LT.XMIN) GO TO 3003                        00001220
      IF(FLAT.GT.YMAX.OR.FLAT.LT.YMIN) GO TO 3003                        00001230
      YY = FLAT                                                          00001240
      XX =  FLON                                                         00001250
      CALL CNVRT(XX,YY                ,XS,YS,XMIN,YMIN,XMAX,YMAX)        00001260
C     CHECK  IF PEN UP OR DOWN                                           00001270
      IF (IPU.EQ.1) GO TO 3005                                           00001280
  836 CALL ERASE                                                         00001030
C     SET PEN INDICATOR                                                  00001040
  111 IPU = 0                                                            00001050
  110 READ(20,END=100) LNO,IR,FLAT,FLON,KNT                              00001060
      CALL QUAD (FLAT,FLON,IYN)                                          00001070
      IF (IYN.EQ.1) GO TO 110                                            00001080
      IF(FLON.GT.XMAX.OR.FLON.LT.XMIN) GO TO 110                         00001090
      IF(FLAT.GT.YMAX.OR.FLAT.LT.YMIN) GO TO 110                         00001100
      YY = FLAT                                                          00001110
      XX =  FLON                                                         00001120
      CALL CNVRT(XX,YY                ,XS,YS,XMIN,YMIN,XMAX,YMAX)        00001130
```

```
      IF (LNO.NE.LN01) GO TO 3000                                          00001290
      CALL PLOT(XX,YY,2)                                                   00001300
      GO TO 3001                                                           00001310
C     COORDS OUTSIDE MAPPED AREA - RAISE PEN                               00001320
 3003 IF (IPU.EQ.1) GO TO 3001                                             00001330
      CALL PLOT(XX,YY,3)                                                   00001340
      IPU = 1                                                              00001350
      GO TO 3001                                                           00001360
C     COORDS HAVE AGAIN ENTERED AREA - LOWER PEN AND PLOT                  00001370
 3005 CALL PLOT(XX,YY,3)                                                   00001380
      CALL PLOT(XX,YY,2)                                                   00001390
      IPU = 0                                                              00001400
      GO TO 3001                                                           00001410
  100  CONTINUE                                                            00001420
      XCOR(1) = XMIN                                                       00001430
      IF(IHEMEW.EQ.1) XCOR(1) = XMAX                                       00001440
      YCOR(1) = YMIN                                                       00001450
      IF(IHEMNS.EQ.2) YCOR(1) = YMAX                                       00001460
      XCOR(2) = XMIN                                                       00001470
      IF(IHEMEW.EQ.1) XCOR(2) = XMAX                                       00001480
      YCOR(2) = YMAX                                                       00001490
      IF(IHEMNS.EQ.2) YCOR(2) = YMIN                                       00001500
      XCOR(3) = XMAX                                                       00001510
      IF(IHEMEW.EQ.1) XCOR(3) = XMIN                                       00001520
      YCOR(3) = YMAX                                                       00001530
      IF(IHEMNS.EQ.2) YCOR(3) = YMIN                                       00001540
      XCOR(4) = XMAX                                                       00001550
      IF(IHEMEW.EQ.1) XCOR(4) = XMIN                                       00001560
      YCOR(4) = YMIN                                                       00001570
      IF(IHEMNS.EQ.2) YCOR(4) = YMAX                                       00001580
C     DRAW CORNER TICS                                                     00001590
      DO 800 J=1,4                                                         00001600
      CALL CNVRT(XCOR(J),YCOR(J)              ,XS,YS,XMIN,YMIN,XMAX,       00001610
```

```
     *YMAX)                                                                    00001620
      CALL SYMBOL(XCOR(J),YCOR(J),0.25,3,0.0,-1)                               00001630
  800 CONTINUE                                                                 00001640
C     ANNOT(8):XULLO,YULLO,XURLO,YURLO,XURLT,YURLT,XLRLT,YLRLT                 00001650
      ANNOT(1) = XCOR(1)                                                       00001660
      ANNOT(2) = YCOR(2) + 0.20                                                00001670
      ANNOT(3) = XCOR(3)                                                       00001680
      ANNOT(4) = ANNOT(2)                                                      00001690
      ANNOT(5) = XCOR(2) + 0.14                                                00001700
      ANNOT(6) = YCOR(3)                                                       00001710
      ANNOT(7) = ANNOT(5)                                                      00001720
      ANNOT(8) = YCOR(4)                                                       00001730
      DO 840 I=1,7,2                                                           00001740
      J = I+1                                                                  00001750
      IF (J.EQ.2) XIN=XMIN                                                     00001760
      IF(J.EQ.2.AND.IHEMEW.EQ.1) XIN = XMAX                                    00001770
      IF (J.EQ.4) XIN=XMAX                                                     00001780
      IF(J.EQ.4.AND.IHEMEW.EQ.1) XIN = XMIN                                    00001790
      IF (J.EQ.6) XIN=YMAX                                                     00001800
      IF(J.EQ.6.AND.IHEMNS.EQ.2) XIN = YMIN                                    00001810
      IF (J.EQ.8) XIN=YMIN                                                     00001820
      IF(J.EQ.8.AND.IHEMNS.EQ.2) XIN = YMAX                                    00001830
      CALL RTDMS (XIN,IXD,IXM)                                                 00001840
      XD = IXD                                                                 00001850
      XM = IXM                                                                 00001860
      CALL NUMBER(ANNOT(I),ANNOT(J),0.14,XD,0.0,-1)                            00001870
      ANNOT(I) = ANNOT(I) + 0.56                                               00001880
      CALL NUMBER(ANNOT(I),ANNOT(J),0.14,XM,0.0,-1)                            00001890
  840 CONTINUE                                                                 00001900
      ANNOT(2) = ANNOT(2) + 0.60                                               00001910
C     PLOT TITLING                                                             00001920
      CALL SYMBOL(0.0,ANNOT(2),0.25,HEAD,0.0,56)                               00001930
```

```
C       READ MINERAL FILE,CHECK MIN CODE & GET SYMBOL,ID,SCALE,XY                00001940
  540   READ(30,510,END=520) Y(1),X(1),IMIN                                      00001950
  510   FORMAT(2F7.5,2X,A2,56X)                                                  00001960
        IF (ICHOS .EQ. 1) GO TO 512                                              00001970
        DO 511 J=1,NUM                                                           00001980
        IF (IMIN.EQ.ITEM(J)) GO TO 512                                           00001990
  511   CONTINUE                                                                 00002000
C       IF CRIB MINERAL NOT IN USER AREA DO NOT PLOT                             00002010
        GO TO 540                                                                00002020
  512   CALL CNVRT(X(1),Y(1)                    ,XS,YS,XMIN,YMIN,XMAX,YMAX)    00002030
        IF (ICHOS .EQ. 1) CALL SYMBOL(X(1),Y(1),0.005,1,0.0,-1)                  00002040
        IF(ICHOS .NE. 1) CALL SYMBOL(X(1),Y(1),0.14,ISYMB(J),0.0,-1)             00002050
        GO TO 540                                                                00002060
  520   CONTINUE                                                                 00002070
C       PRINT LEGEND AT LOWER LEFT                                               00002080
        XLEG = 0.20                                                              00002090
        YLEG = 0.0                                                               00002100
        IF (ICHOS .EQ. 1) GO TO 837                                              00002110
        DO 820 J=1,NUM                                                           00002120
C       IF MINERAL INVALID (=0  ) THEN DO NOT PLOT                               00002130
        IF (ISYMB(J).EQ. 0) GO TO 820                                            00002140
        CALL SYMBOL(XLEG,YLEG,0.14,ITEM(J),0.0,2)                                00002150
        XLEG = XLEG + 0.40                                                       00002160
        CALL SYMBOL(XLEG,YLEG,0.14,':',0.0,1)                                    00002170
        XLEG = XLEG + 0.20                                                       00002180
        CALL SYMBOL(XLEG,YLEG,0.14,ISYMB(J),0.0,-1)                              00002190
        XLEG = XLEG - 0.60                                                       00002200
        YLEG = YLEG - 0.20                                                       00002210
        IF(YLEG .EQ. -1.0) GO TO 821                                             00002220
        GO TO 820                                                                00002230
  821   XLEG = XLEG + 0.80                                                       00002240
        YLEG = 0.0                                                               00002250
                                                                                 00002260
```

```
  820 CONTINUE
  837 IF(ICHOS.EQ.1) CALL SYMBOL(XLEG,YLEG,0.14,                          00002270
     *'ALL MINERALS PLOTTED',0.0,20)                                     00002280
C      COMPUTE XCOORD FOR USER INFO THEN PLOT OPTIONS                    00002290
       XMID = (XMAX-XMIN)/2.0 + XMIN                                     00002300
       CALL CNVRT(XMID,Y(1)                ,XS,YS,XMIN,YMIN,XMAX,YMAX)   00002310
       CALL SYMBOL(XMID,0.0,0.14,'* ENTER S TO END SESSION,',0.0,25)     00002320
       CALL SYMBOL(XMID,-0.20,0.14,'* ENTER W TO WINDOW:',0.0,20)        00002330
       CALL SYMBOL(XMID,-0.40,0.14,'(FIRST MIN LAT/LON THEN MAX)',0.0,   00002340
      *28)                                                               00002350
       CALL SYMBOL(XMID,-0.60,0.14,                                      00002360
      *'* ENTER H FOR HARDCOPY AND WINDOWING,',0.0,37)                   00002370
       CALL SYMBOL(XMID,-0.80,0.14,                                      00002380
      *'* ENTER R TO DEFINE ANOTHER PLOT',0.0,32)                        00002390
       CALL VCURSR(ICHAR,XX,YY)                                          00002400
C      VCURSR COORD REL SCREEN WINDOW SO SUBT 1.0 IN. FOR ORIGIN SHIFT   00002410
       XX = XX-1.0                                                       00002420
       YY = YY-1.0                                                       00002430
C      STRIKE S TO TERMINATE                                             00002440
       IF (ICHAR.EQ.83) GO TO 901                                        00002450
       IF (ICHAR.EQ.72) CALL HDCOPY                                      00002460
C      IF R-FLAG THEN DUMP BUFFER AND DEFINE ANOTHER PLOT                00002470
       IF (ICHAR.EQ. 82) GO TO 1020                                      00002480
       CALL BCKXY(XX,YY,DELX,DELY,XMIN,YMIN,XMAX,YMAX,XLIM,YLIM)         00002490
       CALL VCURSR(ICHAR,XXX,YYY)                                        00002500
       XXX = XXX-1.0                                                     00002510
       YYY = YYY-1.0                                                     00002520
       IF (ICHAR.EQ. 83) GO TO 901                                       00002530
       CALL BCKXY(XXX,YYY,DELX,DELY,XMIN,YMIN,XMAX,YMAX,XLIM,YLIM)       00002540
       XMIN = XX                                                         00002550
       YMIN = YY                                                         00002560
       XMAX = XXX                                                        00002570
```

```
      YMAX = YYY                                                          00002580
      CALL ERASE                                                          00002590
C     WITH NEW XMIN/YMIN AND XMAX,YMAX CREATE NEW PLOT                    00002600
      REWIND 20                                                           00002610
      REWIND 30                                                           00002620
      DELX = XMAX-XMIN                                                    00002630
      DELY = YMAX-YMIN                                                    00002640
      XS = XLIM/DELX                                                      00002650
      YS = YLIM/DELY                                                      00002660
      GO TO 111                                                           00002670
C     MOVE CURSOR TO 0.0, ERASE SCREEN, AND REDEFINE PLOT                 00002680
 1020 CALL PLOT (-1.0,-1.0,-3)                                            00002690
      CALL ERASE                                                          00002700
      CALL ANMODE                                                         00002710
      CALL HOME                                                           00002720
      REWIND 20                                                           00002730
      REWIND 30                                                           00002740
      GO TO 1025                                                          00002750
 901   CALL PLOT(0.,0.,999)                                              00002760
  200  FORMAT(1X,'END OF JOB')                                            00002770
       STOP                                                               00002780
       END                                                                00002790
      SUBROUTINE BCKXY(X,Y,DELX,DELY,XMIN,YMIN,XMAX,YMAX,XLIM,YLIM)       00002800
C     SUBROUTINE TO CONVERT SCREEN COORDS IN XY TO RADIANS                00002810
      COMMON /PARAM/ IHEMNS,IHEMEW                                        00002820
      IF(IHEMNS.EQ.1) Y= YMIN + ((Y/YLIM)*DELY)                           00002830
      IF(IHEMEW.EQ.2) X= XMAX - ((X/XLIM)*DELX)                           00002840
      IF(IHEMNS.EQ.2) Y= YMAX - ((Y/YLIM)*DELY)                           00002850
      IF(IHEMEW.EQ.1) X= XMIN + ((X/XLIM)*DELX)                           00002860
      RETURN                                                              00002870
      END                                                                 00002880
       SUBROUTINE CNVRT(XM,YM                ,XS,YS,XMIN,YMIN,XMAX,YMAX)  00002890
       COMMON /PARAM/ IHEMNS,IHEMEW                                       00002900
        IF (IHEMNS.EQ.1) YM = (YM-YMIN) * YS                              00002910
```

```
      IF (IHEMNS.EQ.2) YM = (YMAX-YM) * YS                                00002920
      IF (IHEMEW.EQ.1) XM = (XM-XMIN) * XS                                00002930
      IF (IHEMEW.EQ.2) XM = (XMAX-XM) * XS                                00002940
      RETURN                                                              00002950
      END                                                                 00002960
     SUBROUTINE RTDMS (PHI,IDEG,IMIN)                                     00002970
     IMPLICIT REAL*8 (A-H,O-Z)                                            00002980
     RHO = 206264.806247D0                                                00002990
     SEC =  DABS(PHI)*RHO                                                 00003000
     IDEG = SEC/3.6D3                                                     00003010
     IMIN = (SEC-IDEG*3.6D3)/6.0D1                                        00003020
     IF(PHI.LT.0.D0.AND.IDEG.GT.0) IDEG = -IDEG                           00003030
     IF(PHI.LT.0.D0.AND.IDEG.EQ.0.AND.IMIN.GT.0) IMIN = -IMIN             00003040
     RETURN                                                               00003050
     END                                                                  00003060
     SUBROUTINE QUAD (FLAT,FLON,IYN)                                      00003070
C    PROCESS ONLY THOSE WDB ENTRIES WITHIN QUADRANT                       00003080
C    IHEMEW=1=E,IHEMEW=2=W,IHEMNS=1=N,IHEMNS=2=S                          00003090
C    IYN=1 MEANS OUT OF QUADRANT                                          00003100
     COMMON /PARAM/ IHEMNS,IHEMEW                                         00003110
     IYN = 0                                                              00003120
     IF(IHEMEW.EQ.2.AND.FLON.GT.0.0) GO TO 10                             00003130
     IF(IHEMNS.EQ.2.AND.FLAT.GT.0.0) GO TO 10                             00003140
     IF(IHEMEW.EQ.1.AND.FLON.LT.0.0) GO TO 10                             00003150
     IF(IHEMNS.EQ.1.AND.FLAT.LT.0.0) GO TO 10                             00003160
     IF(IHEMEW.EQ.2) FLON = -FLON                                         00003170
     IF(IHEMNS.EQ.2) FLAT = -FLAT                                         00003180
     RETURN                                                               00003190
  10 IYN = 1                                                              00003200
     RETURN                                                               00003210
     END                                                                  00003220
```

```
      IMPLICIT REAL*8 (A-H,O-Z)                                          00000010
  200 READ(31,20,END=100) SYM,XDL,XML,XSL,XDLN,XMLN,XSLN                 00000020
   20 FORMAT(    A2,2X,3(F2.0,1X),F3.0,2(1X,F2.0))                       00000021
      XDL = (XDL+((XML+(XSL/60.0))/60.0))                                00000040
      XDLN = (XDLN+((XMLN+(XSLN/60.0))/60.0))                            00000050
      XDL = XDL/57.29577951                                              00000060
      XDLN = XDLN/57.29577951                                            00000070
      WRITE(30,30) XDL,XDLN,SYM                                          00000080
   30 FORMAT(    2F7.5,2X,A2,62X)                                        00000090
      GO TO 200                                                          00000100
  100 CONTINUE                                                           00000110
      WRITE(6,101)                                                       00000120
  101 FORMAT(1X,'THE CRIB MINERAL POSITIONS HAVE BEEN CONVERTED')        00000130
      STOP                                                               00000140
      END                                                                00000150
```

```
00000010ALLOC FI(SYSDICT) DA('RIF.DICT1.CRIBD1') SHR
00000020ALLOC FI(SYSREC) DA('RIF.W0001.CRIB1') SHR
00000030ALLOC FI(SYSGWRK) DA('RIF.K0022.TSOSAVE') SHR
00000040ALLOC FI(SYSWRKO) DA('VG9195J.WRK.DATA') SHR
00000050ALLOC FI(SYSPCH) DA(*)
00000060TPRINT '**** WELCOME TO THE MINERAL DISPLAY SYSTEM****'
00000070TPRINT 'THIS COMMAND PROCEDURE PERFORMS STEPS #1 AND #2 OF THE'
00000080TPRINT '   3 STEP PROCESS:'
00000090TPRINT 'THE THREE STEPS ARE:'
00000100TPRINT '    (1) GIPSY QUERY, RETRIEVAL, AND COPY OF CRIB DATA'
00000110TPRINT '    ( 2) USER EDIT OF SELECTED CRIB DATA'
00000120TPRINT '    (3) INTERACTIVE DISPLAY OF EDITED CRIB DATA'
00000130TPRINT '      '
00000140TPRINT 'STEP #1, THE GIPSY CRIB RETRIEVAL WILL NOW BEGIN:'
00000150TPRINT '      '
00000160CALL 'SYS1.GIPLIB(TSO2741)'
00000170FREE FI(SYSGWRK,SYSWRKO,SYSDICT,SYSREC,SYSPCH)
00000180TPRINT '      '
00000190TPRINT 'THE RETRIEVAL IS COMPLETED - NOW EDIT DATA...'
00000200TPRINT '      '
00000210EDIT WRK DATA OLD NONUM
00000230END
//
```

```
00000010PROC 0
00000020TERM SECOND(30) INPUT(QUIT)
00000030TPRINT '**** WELCOME TO THE MINERAL DISPLAY SYSTEM ****'
00000040TPRINT 'THIS PROC LINKS TO WDB I BOUNDARY FILE'
00000050ALLOC FI(FT06F001) DA(*)
00000060ALLOC FI(FT31F001) DA(WRK.DATA)
00000070ALLOC FI(FT30F001) DA(WRK1.DATA)
00000080 LOAD 'SYS1.LOADLIB(H858)' FORTLIB EP(MAIN)
00000090ALLOC FI(FT20F001) DA('VG5207A.WDBICOST.DATA') SHR
00000100ALLOC FI(FT21F001) DA('VG5207A.WDBIBNDS.DATA') SHR
00000110CONCAT (FT20F001 FT21F001)
00000120ALLOC FI(FT05F001) DA(*)
00000130 LOAD 'SYS1.LOADLIB(J729)' LIB('SYS1.PLOT10' 'SYS1.TEKTRON.LOAD') FORTLI
00000140FREEALL
00000150END
//
```

```
00000010PROC 0
00000020TERM SECONDS(30)  INPUT(QUIT)
00000030TPRINT ' **** WELCOME TO THE MINERAL DISPLAY SYSTEM ****'
00000040TPRINT 'STEP #3, THE INTERACTIVE DISPLAY OF EDITED CRIB DATA WILL BEGIN:
00000050TPRINT '     THIS PROC LINKS DIME STATE BOUNDARY MEMBERS...'
00000051ALLOC FI(FT20F001) DA('VG9195J.DIME.DATA(UT)') SHR
00000070ALLOC FI(FT06F001) DA(*)
00000090ALLOC FI(FT21F001) DA(WRK.DATA)
00000091ALLOC FI(FT20F001) DA(WRK1.DATA)
00000100LOAD 'SYS1.LOADLIB(H858)' FORTLIB EP(MAIN)
00000110TPRINT '*** LOAD DISPLAY PROGRAM - PRIOR TO INTERACTIVE SESSION'
00000120ALLOC FI(FT05F001) DA(*)
00000121 LOAD 'SYS1.LOADLIB(J732)' LIB('SYS1.PLOT10' 'SYS1.TEKTRON.LOAD') FORTLI
00000141 FREEALL
00000150END
//
```

INTERACTIVE CARTOGRAPHIC AUTOMATIC MAPPING (CAM) SYSTEM

By ALAN S. CROSBY

INTRODUCTION

The Interactive CAM (Cartographic Automatic Mapping) system is an enhanced version of the standard CAM program (U.S. Central Intelligence Agency, 1975). The Interactive CAM system was devised to shorten the map-creation time primarily through the use of interactive methods, which simplify the data-input procedures and allow the user to view the result on a graphic-display terminal immediately after each job run. Interactive CAM is used to plot on base maps information from mineral-deposit records stored in the CRIB (Computerized Resources Information Bank) of the USGS (Calkins and others, 1973, 1978; Keefer and Calkins, 1978). The user may make a base map only (base-map plate), may plot mineral-location data only (compilation plate), or may have both base-map and mineral-location data combined on a single map. Usually both base-map and mineral information are plotted on the same map.

The mapmaking procedures of the Interactive CAM system are discussed in the following pages. First, the whole process is briefly described and two examples are given. More detailed operating instructions and program documentation follow. Some of the details of the interactive conversation between man and machine have been omitted from the examples in order to make them simpler and clearer.

EXAMPLE 1

SEARCHING THE CRIB FILE

The first step in making a map that shows mineral data on a base map is to conduct an interactive search of the CRIB file for the data on mineral deposits of interest. Because the CRIB file operates under the GIPSY (General Information Processing System), the search is done in the GIPSY retrieval language (Oklahoma University, Office of Information Systems Programs, 1975a, b). The search procedures are similar to those used for Quick-Plot. Example 1 in the Interactive CAM system is the same example used to illustrate the Quick-Plot program (p. 14-18, figs. 4-7).

The object of example 1 is to plot on a base map the locations of productive copper and gold deposits in California and Arizona. By means of a set of logical statements, the user will instruct the GIPSY program to select from the CRIB file records containing latitude and longitude coordinates on those mineral deposits in Arizona and California that have produced copper or gold as major products. These logical statements are shown below.

```
FORM
  CRIB
SELECT
  A. A50<04>
  B. A50<06>
  C. A40<US>
  LOGIC (A or B) and C
ITERATE
  A. MAJOR<CU>
  B. MAJOR<AU>
  C. YES
  D. A70
  E. A80
  LOGIC (A or B) and (C and D and E)
```

GIPSY will make a list of the records meeting these criteria and will pause for further instructions.

SAVING THE INFORMATION ON MINERAL-DEPOSIT LOCATIONS

The chemical symbol and coordinates from each mineral-deposit record on the list are extracted (copied) from the CRIB file and passed along to other programs in the Interactive CAM system. The commands below instruct GIPSY to extract the records.

```
COPY
  '02'
  MAJOR 2
  '!'
  A70 9
  A80 10
  END
```

GIPSY copies the mineral-deposit information to disk and passes control over to the CRIB to CAM program, which automatically reformats the information into a format acceptable to CAM.

COMBINING BASE-MAP INFORMATION AND MINERAL-LOCATION INFORMATION

Next, the base map is defined by preparing CAM control statements. In a batch run, the CAM to Disk program of the Interactive CAM system prepares a base map according to these control statements, overlays the mineral-location data just copied by CRIB to CAM, and stores the resulting map in digital form on disk.

VIEWING THE MAP ON A GRAPHIC DISPLAY TERMINAL

The Plotcam program of the Interactive CAM system uses the base-map and mineral-location data stored on disk to draw the map on a graphic-display terminal (fig. 9). Figure 9 is a draft map that is reviewed interactively by using Plotcam (see the section below, "Viewing a Part of the Map"). If the map requires modification, the CAM control statements are corrected, and the CAM to Disk run is repeated. This process continues until a good draft of the map is obtained. When a satisfactory map is obtained, the previous batch-job run is repeated, this time writing the digitized information on tape. The tape is used to plot the final map on an off-line plotter. The final map plotted on an off-line plotter is shown in reduced form in figure 10.

VIEWING A PART OF THE MAP

The screen of the graphic-display terminal measures only 15 in. by 11 in., and a typical map plotted on an off-line plotter is three times as large. When the map is reduced to fit the terminal display screen, some of the fine detail is lost. However,

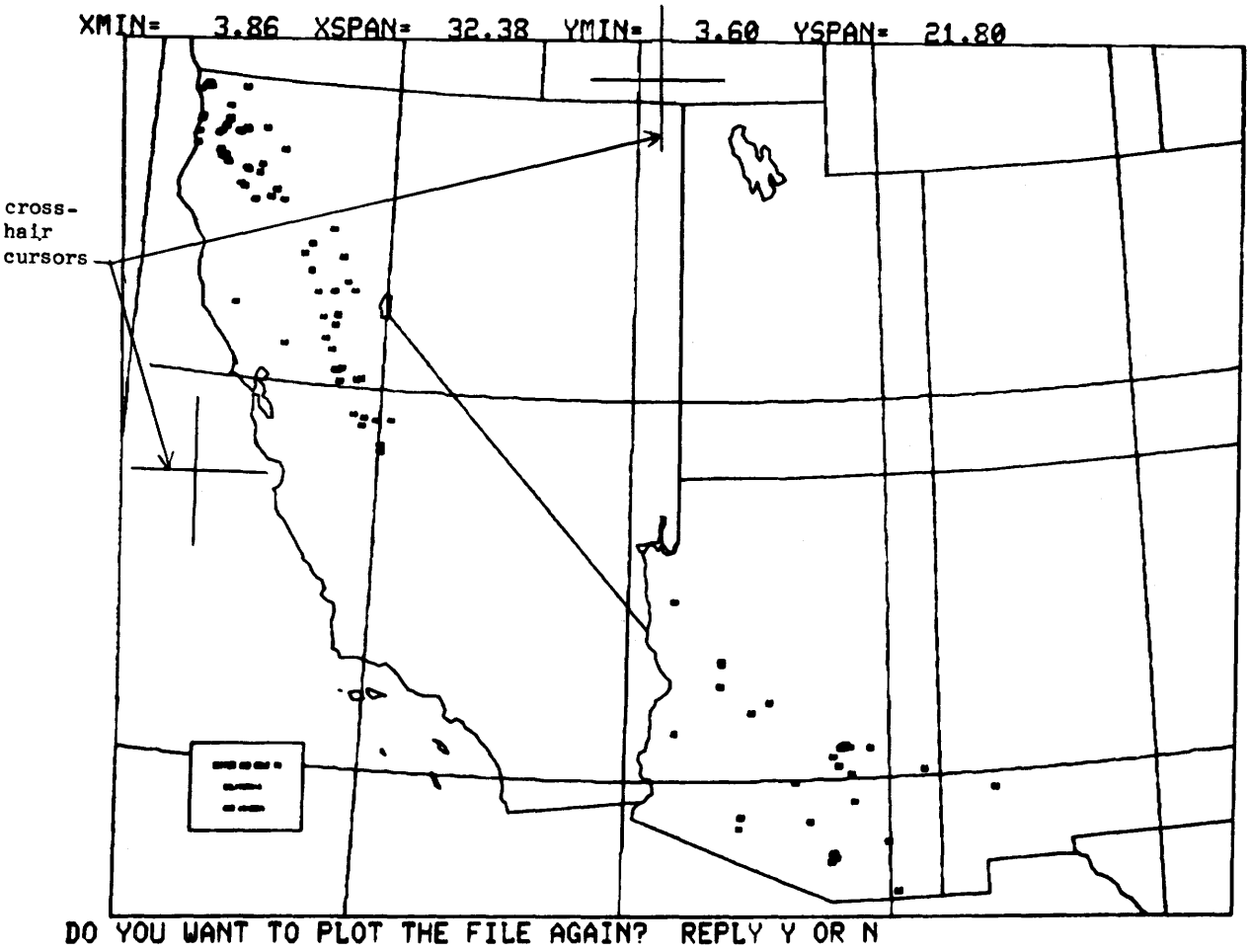

FIGURE 9.—Map of the southwestern United States produced by the Plotcam program of the Interactive CAM system on a graphic display terminal and showing locations of copper and gold deposits in California and Arizona. Positions of user-controlled crosshair cursors define the part of the map to be enlarged and redrawn as shown in figure 11.

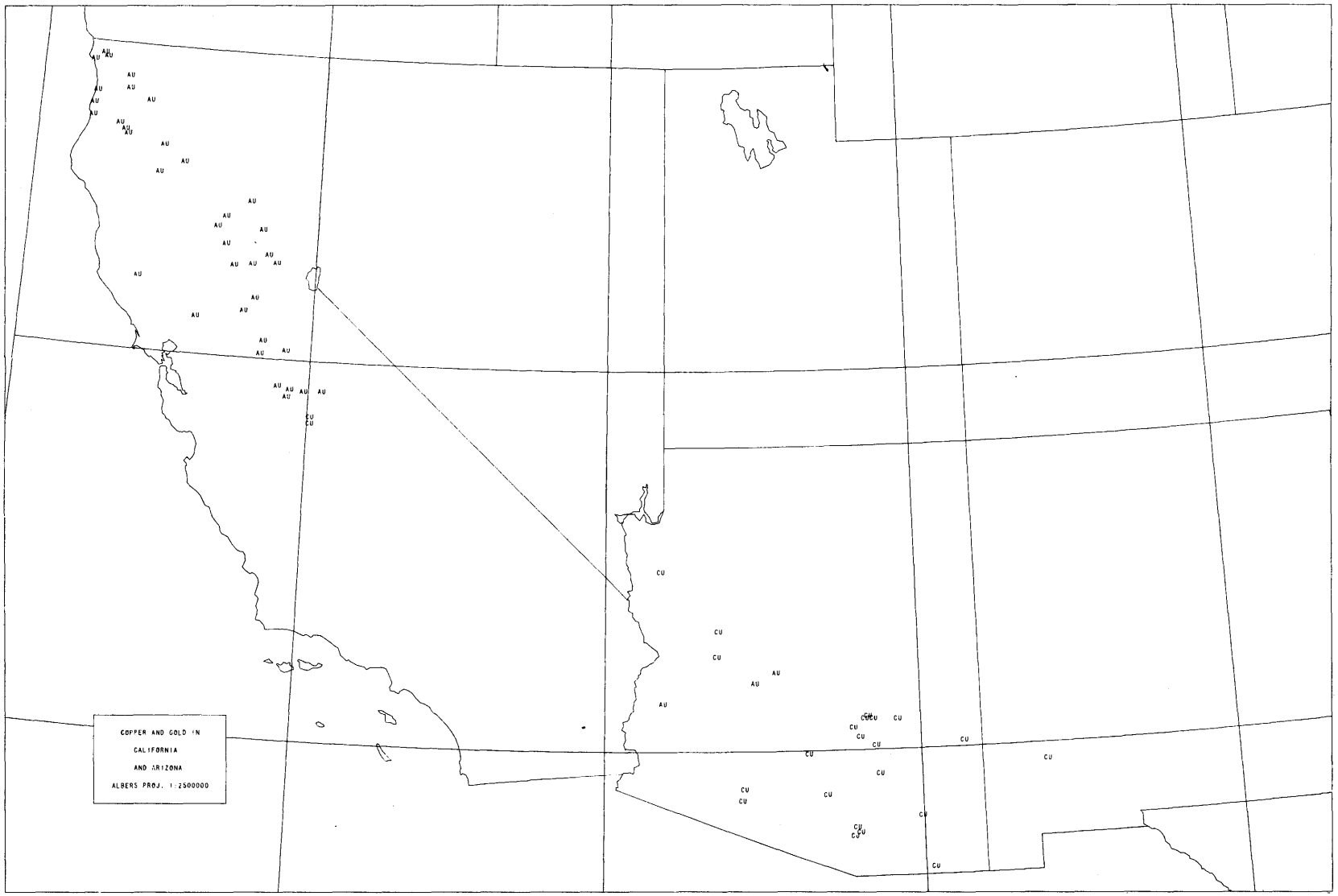

FIGURE 10. – Reduced copy of final computer-generated map produced by the CAM to Disk program H876 on an off-line plotter to show locations of copper and gold deposits in California and Arizona from data currently available in the CRIB file. The plotter produced the map at the scale of 1:2,500,000; it has been reduced for publication.

Plotcam can be instructed to draw an enlargement of any part of the map. The user defines the area to be redrawn at a larger scale by marking the lower-left and upper-right corners of the desired area. The marking is accomplished by moving two fine lines (cursor lines), which appear on the screen, until their intersection defines a crosshair (crosshair cursor) at each corner of the desired area. Plotcam erases the current image and then searches through the digital surrogate of the map and draws only the digital information within the area of interest. The enlargement is drawn quickly in front of the user.

The ability to enlarge parts of the map aids in the layout and design of the final map. For example, where symbols are dense and overlap, an enlargement is needed to show greater detail. The positions of the crosshair cursors for redrawing a part of the map are shown in figure 9, and the enlargement of that part of the map is shown in figure 11.

As another example, the title box shown on the original map (fig. 9) is illegible. In order to check the layout and design, the title box was redrawn to occupy the entire screen as shown in figure 12.

EXAMPLE 2

Example 2 of the complete Interactive CAM process begins with the GIPSY query shown in figure 13; the query will select and copy records on those United States copper mines contributed to the CRIB file by Dennis Cox. After the selected data are put into CAM format and are stored on

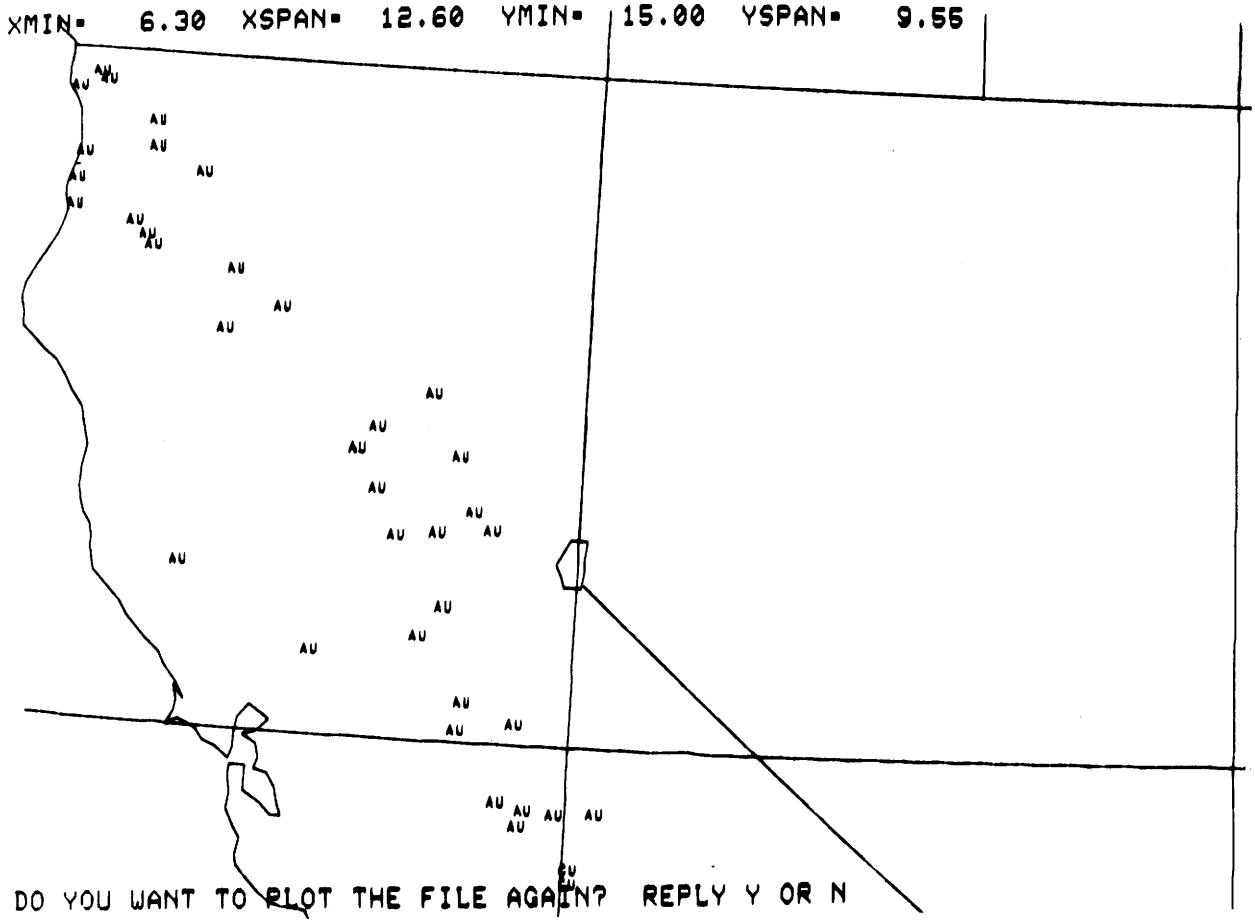

FIGURE 11.—The northwestern part of figure 9, enlarged and redrawn by the Plotcam program of the Interactive CAM system on a graphic display terminal. Formerly overlapping symbols in California are now distinct.

disk by the CRIB to CAM program, they can be combined with a base map by the CAM to Disk program. The resulting map drawn by Plotcam is shown in figure 14. The same map has been enlarged and redrawn to show only the western half of the United States in figure 15.

CONCLUSIONS

The CAM to Disk and Plotcam programs of the Interactive CAM system can be used to display information from most files containing latitude and longitude information, if the latitude and longitude can be extracted and converted to the CAM format (U.S. Central Intelligence Agency, 1975, p. 2–18). At present, CRIB to CAM performs these tasks only for the CRIB file, but the same techniques used in CRIB to CAM could also be used to extract coordinates from other GIPSY files.

The programs of the Interactive CAM system are available for general use. Details on their construction and operation are contained in the following sections.

Sometimes tools designed for specific tasks are found to have a wider use. Although they were designed to speed up the reviewing of a draft map, the programs of the Interactive CAM system can also be used to produce a final compilation. The programs are used for CAM training; students learn by watching the map-drawing process. The programs can also be used to display information for a group of viewers.

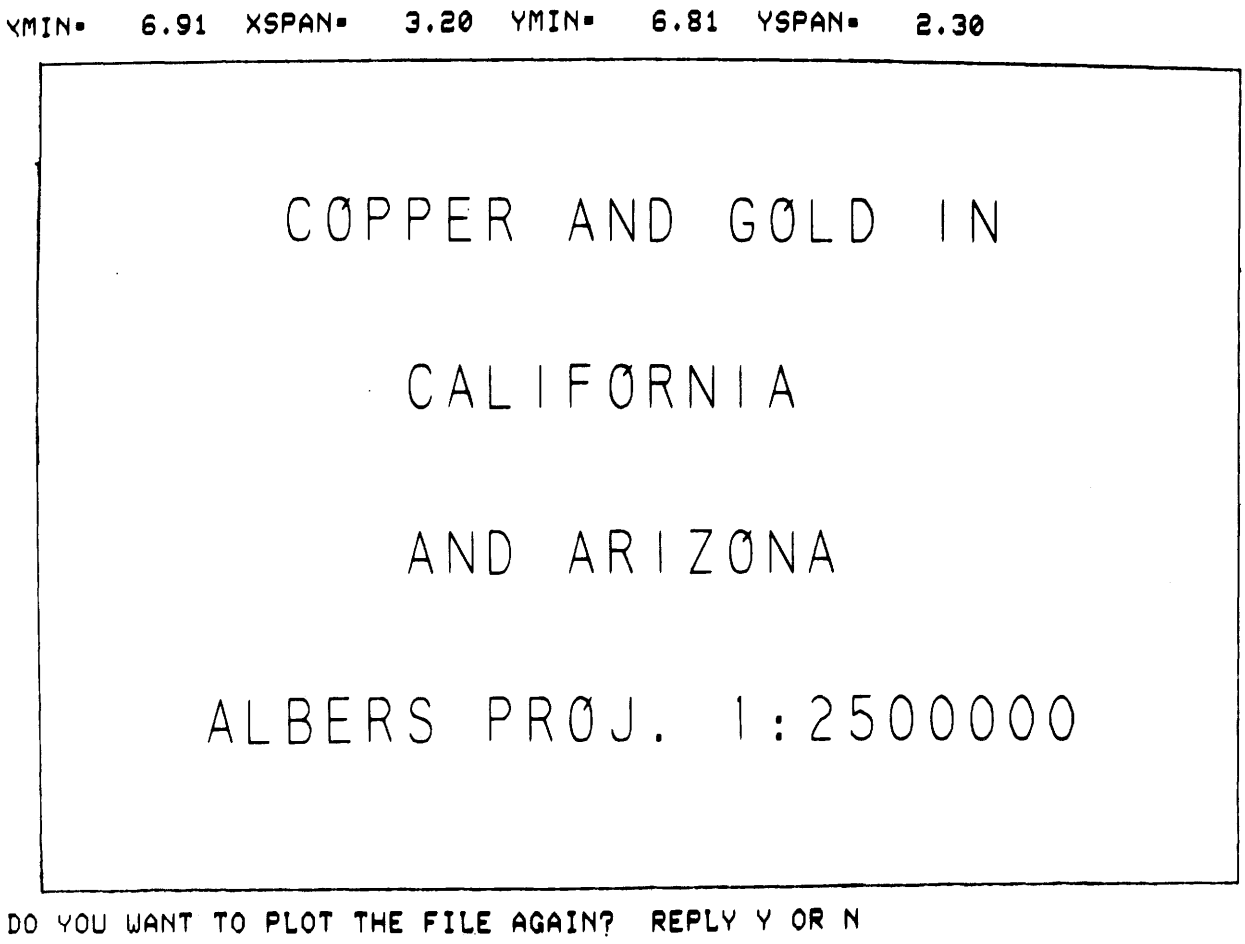

FIGURE 12.–The title box of figure 9, enlarged and redrawn by the Plotcam program of the Interactive CAM system on a graphic display terminal. This enlargement allowed an immediate check of spelling and the placement of textual material.

```
     QUERY:  Find all the records on
copper mines in the United States
contributed to the CRIB file by Dennis Cox.
The records must contain latitude and
longitude coordinates in order to be
plotted by the Interactive CAM system.

     SEARCH METHOD:  Look for United States
(A40<US>) records reported by Cox
(G2<COX>) to have copper as the major
element (MAJOR<CU>).  Deposit must have
produced some copper (YES), and record
must contain latitude (A70) and longitude
(A80) information.

System:  READY
  User:  exec crib
System:  LINK CRIB FILE AND INTERACTIVE CAM
System:  G I P S Y - UNIVERSITY OF OKLAHOMA
System:  ?
  User:  form
System:  -----
  User:  crib
System:  ?
  User:  select
System:  -----
System:                FULL OR TERM SEARCH?
  User:  f
System:  A.
  User:  a40<us>
System:                COUNTRY CODE
System:  B.
  User:  g2<cox>
System:                NAME
System:  C.
  User:  major<cu>
System:                MAJOR PRODUCT
System:  D.
  User:  yes
System:                YES
System:  E.
  User:  a70
System:                LATITUDE
System:  F.
  User:  a80
System:                LONGITUDE
System:  G.
 (User touches the carriage-return key.)
System:  LOGIC
  User:  a and b and c and d and e and f
System:  LOGIC
 (User touches the carriage-return key.)
System:  17:50:20.4      SEARCH BEGINNING
         17:51:27.3      SEARCH COMPLETED
     *    *    *    *    *    *    *
System:  ITERATE?
  User:  n
System:  ?
  User:  copy
System:  -----
System:  TERMINAL OR WORKFILE?
  User:  w
  User:  '02'
  User:  major 2
  User:  '!'
  User:  a70 9
  User:  a80 10
  User:  /
System:  ?
  User:  end
System:  -----
System:  G I P S Y - UNIVERSITY OF OKLAHOMA
System:  RECORDS READ:  ***
System:  READY
```

FIGURE 13.—An example of an interactive search of the CRIB file showing GIPSY search and copy statements for retrieving records on copper mines in the United States, contributed to the CRIB file by Dennis Cox.

CRIB TO CAM PROGRAM (J499)

INTRODUCTION

The CRIB to CAM program reformats CRIB mineral information into a form CAM can use. It is activated by the TSO-command procedure, CRIB, which begins by activating GIPSY. A search of CRIB is conducted in the GIPSY retrieval language (Oklahoma University, Office of Information Systems Programs, 1975a, b) for records on mineral deposits. The records are copied out of the CRIB file, and CRIB to CAM reformats them and stores them on disk (fig. 16).

OPERATING INSTRUCTIONS

ACTIVATING THE CRIB TO CAM PROCESS

The TSO command to activate the CRIB to CAM process is: EXEC CRIB 'GIPFILE (name of a CRIB file) MEMBER (name of a storage area)', where "name of a CRIB file" is the full name of the CRIB file to be searched. If GIPFILE is omitted, then the standard CRIB file will be searched. The "name of a storage area" is the name (chosen by the user) of a member in a partitioned data set, called LAT.LONG.DATA in this paper, where the results of the run will be stored. If the name of the storage area is omitted, the name NONAME will be used. The command can have several forms, for example:

```
EXEC CRIB
EXEC CRIB 'MEMBER(PERU)'
EXEC CRIB 'GIPFILE(CRIB7)
  MEMBER(STORE7)'
```

When the command EXEC CRIB is issued, control is passed to the GIPSY program.

THE GIPSY SEARCH AND COPY OUTPUT

When GIPSY gains control, conduct the search for information on the deposits in which you are interested. Then, copy the data elements and the latitude and longitude from the selected records by using the copy command. This command can have three formats.

Format 1:

```
COPY
'nnn!' (inserted literal)
A70 9 (latitude field)
A80 10 (longitude field)
/
```

where "nnn" is a three-digit code for the symbol to

be plotted.

Example:

```
COPY
'-1116!'
A70 9
A80 10
/
```

The copy command in this example will cause the delta symbol to be plotted for each record selected at the latitude and longitude specified in the record. One delta symbol will be plotted for each record copied from the GIPSY file.

Format 2:

```
COPY
'nn text!'
A70 9
A80 10
/
```

where "nn" is a number from 01 to 40. It gives the length of the "text," which is a character string to be plotted.

Example:

```
COPY
'06copper!'
A70 9
A80 10
/
```

The copy command in this example will cause the word "copper" to be plotted at the latitude and longitude contained in each record. The word "copper" will appear once for each record copied from the GIPSY file.

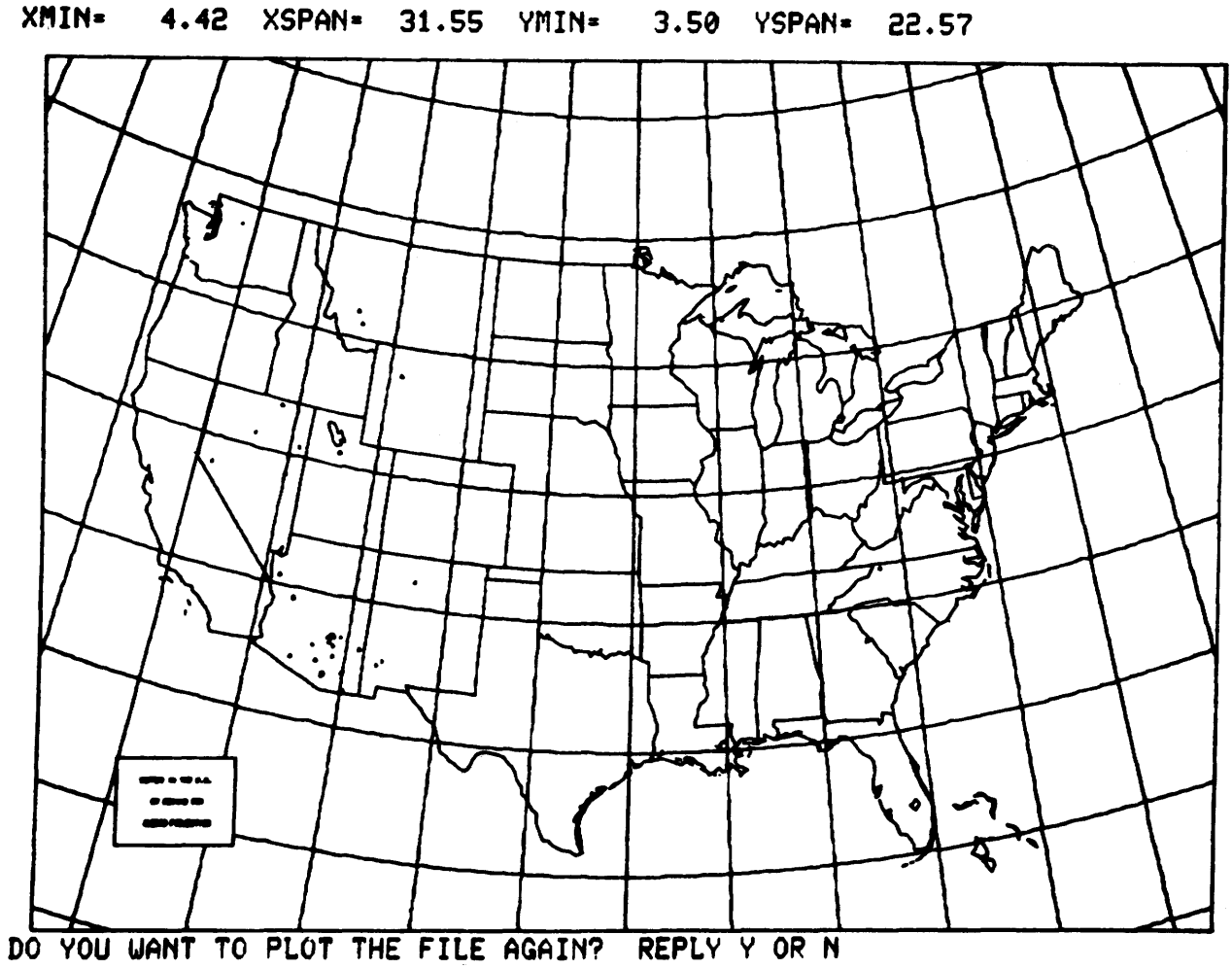

FIGURE 14. – Map of the United States produced by the Plotcam program of the Interactive CAM system on a graphic display terminal and showing copper mines, as reported by Dennis Cox.

Format 3:

```
COPY
'nn'
Label-1 L1
   .
   .
   .
Label-n Ln
'!'
A70 9
A80 10
/
```

where "nn" is the sum of L1, . . . Ln; it should not exceed 40.

"Label" is a data element, the contents of which are to be plotted.

"L" is the number of characters to be plotted from a data element. The sum of all lengths, L should not exceed 40.

Example:

```
COPY
'40'
A10 24
C10 16
'!'
A70 9
A80 10
/
```

The copy command in this example will cause the name of the mineral deposit, A10, and the chemical symbols for the commodities present, C10, to be plotted at the latitude and longitude specified in

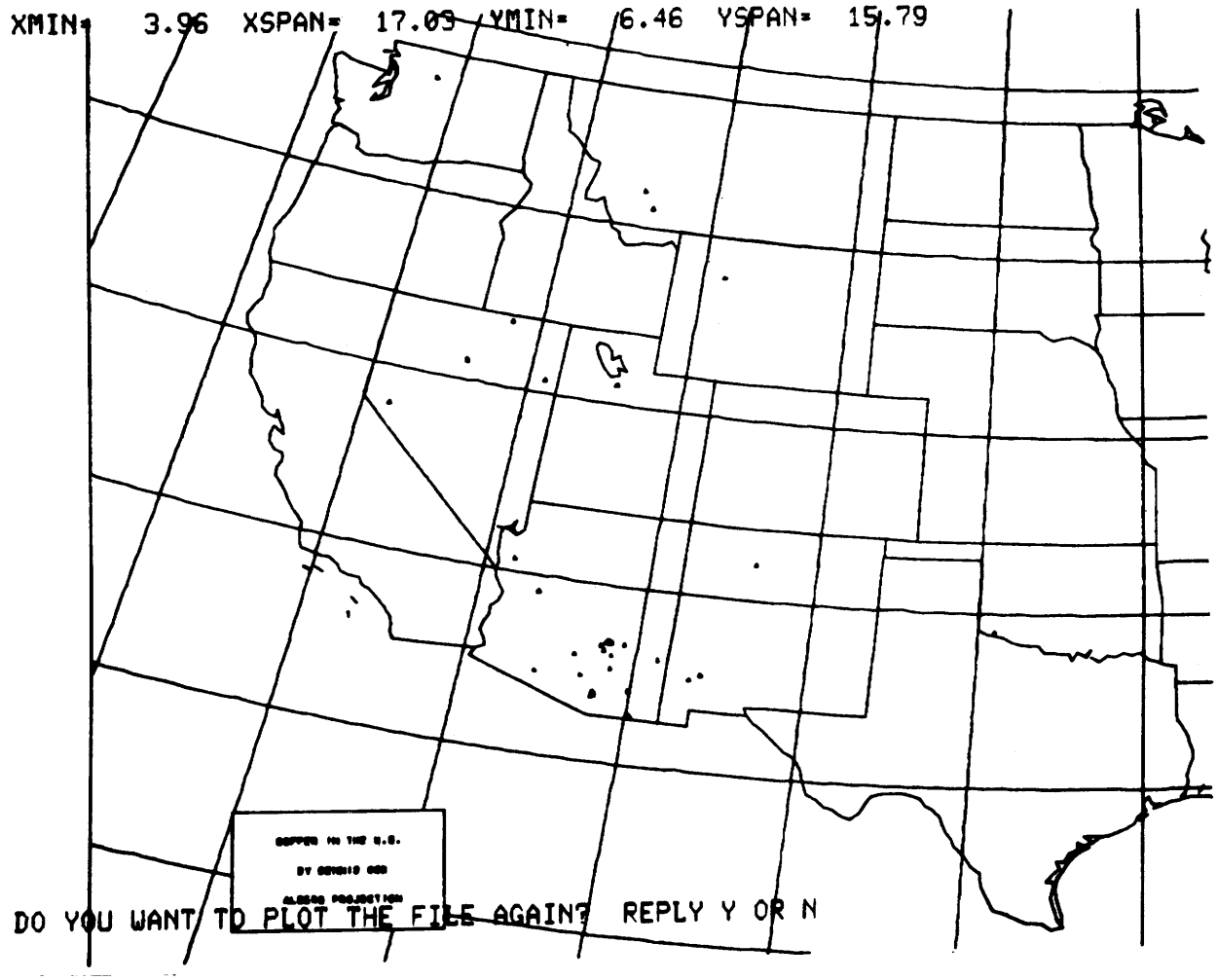

FIGURE 15.–Part of figure 14, enlarged and redrawn by the Plotcam program of the Interactive CAM system to show only the western half of the United States.

the record. Because the data being plotted are coming from the record, what is plotted will vary from record to record. A word of caution: if the mineral deposits are too close to each other, the data from one may be plotted on top of the data from another.

An example of a complete GIPSY search and copy output is shown in figure 17.

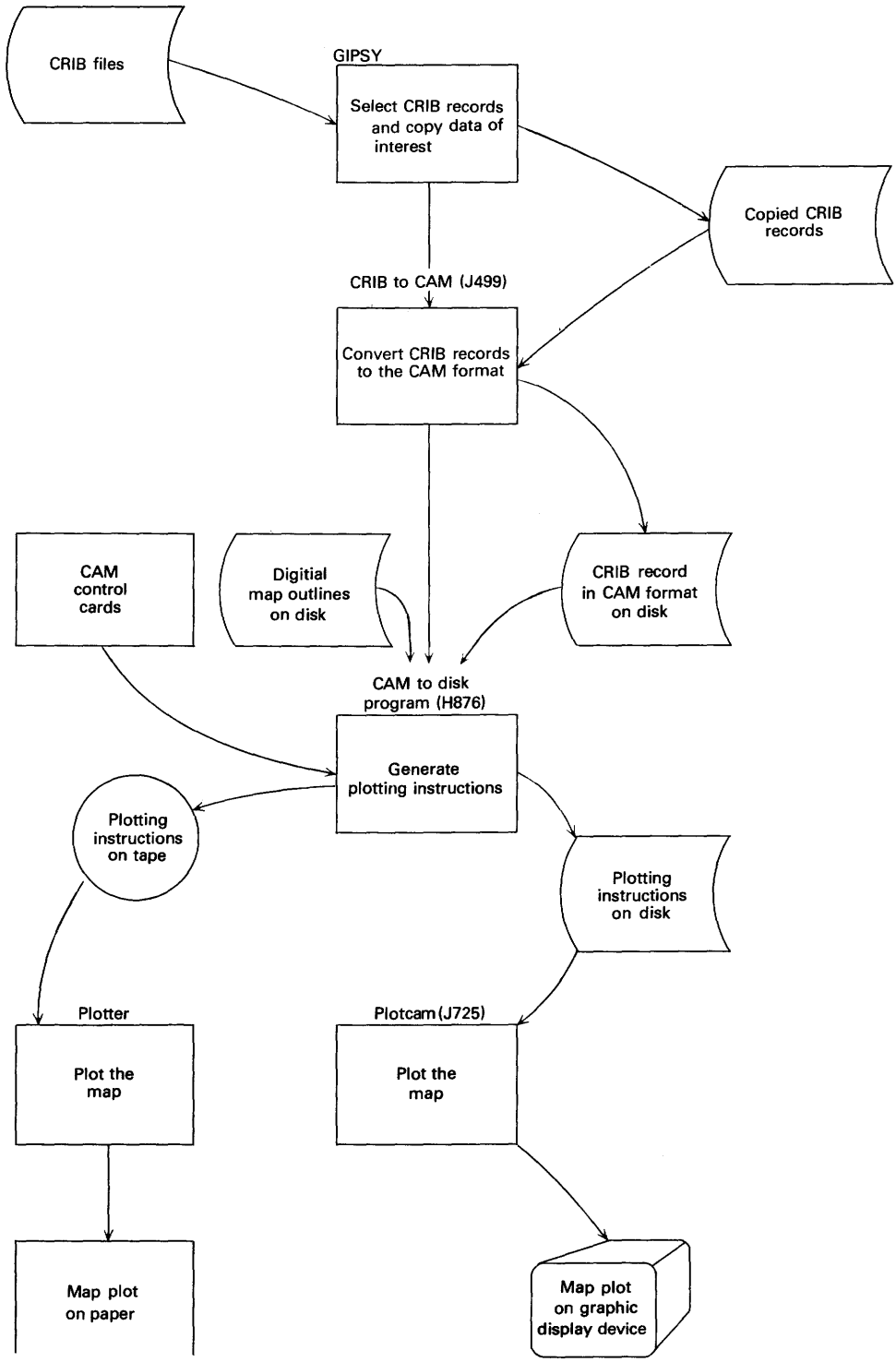

FIGURE 16.–Flow diagram showing the Interactive CAM system.

```
System:  READY
  User:  exec crib 'gipfile(crib.data.set) member(copper)'
System:  LINK CRIB FILE AND INTERACTIVE CAM
System:  G I P S Y - UNIVERSITY OF OKLAHOMA
System:  ?
  User:  form
System:  -----
  User:  crib
System:  ?
  User:  select
System:  -----
System:              FULL OR TERM SEARCH?
  User:  f
System:  A.
  User:  c10<cu>
System:              COMMODITIES PRESENT:
System:  B.
 (User touches the carriage-return key.)
System:  LOGIC
  User:  a
System:              SEARCH
System:  LOGIC
 (User touches the carriage-return key.)
System:  16:49:51.3     SEARCH BEGINNING
         16:50:00.0     SEARCH COMPLETED
           SEARCHED          405
           SELECTED          122    SUBSET     1
           VARIABLES SATISFIED
               A             122
System:  ITERATE?
  User:  n
System:  ?
  User:  copy
System:  -----
System:  TERMINAL OR WORKFILE?
  User:  w
  User:  '08 copper!'
  User:  a70 9
  User:  a80 10
  User:  /
System:  ?
  User:  end
System:  -----
System:  G I P S Y - UNIVERSITY OF OKLAHOMA
System:  RECORDS READ:       122
System:  READY
  User:  list 'lat.long.data (copper)' nonum
08 COPPER                          432727N1142153W
08 COPPER                          432542N1142102W
08 COPPER                          432636N1141932W
08 COPPER                          432634N1141838W
08 COPPER                          432652N1141751W
08 COPPER                          432708N1141749W
08 COPPER                          433314N1141234W
08 COPPER                          434150N1141723W
08 COPPER                          434039N1141720W
08 COPPER                          433847N1141446W
08 COPPER                          434119N1141823W
08 COPPER                          433049N1142710W
08 COPPER                          434002N1141632W
                                   99
                                   99
```

FIGURE 17.–Example of a terminal session using CRIB to CAM. Shown are the statements resulting from a GIPSY search of the CRIB file and a listing of part of the reformatted output.

PROGRAM LISTING OF CRIB TO CAM (J499)

```
//VG901745 JOB (934000231,J499),'ALANCROSBY', COMPILE AND LINK J499
// CLASS=A
//S1 EXEC PLIXLIB,PROG=J499
//PLI.SYSCIN DD *
 J499:  PROC OPTIONS(MAIN);
                                /*  CONVERTS LOCATIONS COPIED OUT OF A
                                    GIPSY FILE INTO THE CAM FORMAT MBFMT */
             DCL      /* SETS ISA AT EXECUTION TIME TO 5K    */
 PLIXOPT CHAR (7) VAR INIT('ISA(4K)') STATIC EXTERNAL;
             DCL                /*  USED TO COUNT THE NUMBER OF RECORDS  */
 COUNT  FIXED BINARY (31)       /*  READ BY THIS PROGRAM                 */
       INIT (0);
             DCL                /*  OUTPUT RECORD IN CAM MBFMT FORMAT    */
 1 CAM_RECORD,
   2 COUNT_BLK1   CHAR(59),     /*  1-59   FORMAT VARIES                 */
   2 LATD  CHAR(2),             /* 60-61   LATITUDE, DEGREES             */
   2 LATM  CHAR(2),             /* 62-63   LATITUDE, MINUTES             */
   2 LATS  CHAR(2),             /* 64-65   LATITUDE, SECONDS             */
   2 ALAT  CHAR(1),             /* 66-66   S FOR SOUTH, OR N FOR NORTH*/
   2 LONGD CHAR(3),             /* 67-69   LONGITUDE, DEGRESS            */
   2 LONGM CHAR(2),             /* 70-71   LONGITUDE, MINUTES            */
   2 LONGS CHAR(2),             /* 72-73   LONGITUDE, SECONDS            */
   2 ALONG CHAR(1),             /* 74-74   E FOR EAST, OR W FOR WEST  */
   2 FILLER CHAR(6) INIT (' '); /* 75-80   BLANK                         */
             DCL                /*  INPUT RECORD IS PRODUCED BY THE GIPSY*/
 IN  CHAR (74);                 /*  COPY COMMAND.  THE FORMAT OF THE
                                    RECORD IS:
                                    Y, ,LATITUDE,LONGITUDE
                                    Y -1 AND A 3 DIGIT SYMBOL CODE  OR
                                      C,D
                                       C 2 DIGITS GIVING THE LENGTH OF D
                                       D UP TO 40 CHARACTERS TO BE PLOTTED
                                      A DELIMITER
                                    LATITUDE IN THE FORM   DD-MM-SS, S/N
                                    LONGITUDE IN THE FORM DDD-MM-SS, E/W */
  %SKIP(5);
    ON ENDFILE (DD1) GO TO  A100;
```

```
/* MAIN LOOP */
   DO WHILE ('1'B);
     READ FILE (DD1) INTO (IN);
     COUNT = COUNT + 1;
     K = INDEX (IN,' ');
     IF K = 0                    /* WAS THERE A " " ? */
      THEN                       /* NO */
       DO;
         PUT EDIT ('INPUT RECORDS ARE NOT IN THE CORRECT FORMAT.  ',
                   'THE DELIMITER " " IS MISSING.  RUN WAS STOPPED.')
                  (COL(1),A,A);
         GO TO A100;             /* STOP THE RUN */
       END;
     COUNT_BLK1 = SUBSTR (IN,1,K - 1);
     L = K + 1;
     LATD = SUBSTR(IN,L,2);
     L = L + 3;
     LATM = SUBSTR(IN,L,2);
     L = L + 3;
     LATS = SUBSTR(IN,L,2);
     L = L + 2;
     ALAT = SUBSTR(IN,L,1);
     L = L + 1;
     LONGD = SUBSTR(IN,L,3);
     L = L+ 4;
     LONGM = SUBSTR(IN,L,2);
     L = L + 3;
     LONGS = SUBSTR(IN,L,2);
     L = L + 2;
     ALONG = SUBSTR(IN,L,1);
%SKIP(5);
/*    IF THE DEGRESS, MINUTES, OR SECONDS PORTION OF LONGITUDE OR
   LATITUDE ARE BLANK, THEN SET THEM TO ZERO.                        */
%SKIP(5);
     IF LATD = '  ' THEN LATD = '00';
     IF LATM = '  ' THEN LATM = '00';
     IF LATS = '  ' THEN LATS = '00';
```

```
      IF LONGD = '   ' THEN LONGD = '000';
      IF LONGM = '  ' THEN LONGM = '00';
      IF LONGS = '  ' THEN LONGS = '00';
      WRITE FILE (DD2) FROM (CAM_RECORD);
 /* END MAIN LOOP */
    END;
 A100:
    CLOSE FILE (DD1);
                          /*  WRITE EOF RECORDS FOR CAM       */
    CAM_RECORD = ' ';
    LATD = '99';
      WRITE FILE (DD2) FROM (CAM_RECORD);
      WRITE FILE (DD2) FROM (CAM_RECORD);
    CLOSE FILE (DD2);
    PUT EDIT ('RECORDS READ:',COUNT)
             (COL(1),A,P'ZZZZZ9');
 END J499;
//
```

```
00010 PROC 0 GIPFILE( CRIB.DATA.SET  ) MEMBER(NONAME)
00020 PRINTT '                    LINK CRIB FILE AND INTERACTIVE CAM'
00025 ATTRIB A RECFM(F,B) LRECL(74) BLKSIZE(13024)
00030 DELETE (S4)
00035 ALLOC FI(SYSDIR) DA('GIPSY.INDEX.DATA ') SHR
00040 ALLOC FI(SYSDICT) DA(' GIPSY.DICTIONARY ')  SHR
00050 ALLOC FI(SYSREC) DA('&GIPFILE.') SHR
00060 ALLOC FI(SYSGWRK) DA(' GIPSY.SAVE.AREA  ') OLD
00070 ALLOC FI(SORTLIB) DA('SYS1.SM01SORT') SHR
00080 ALLOC FI(SORTWK01)  SPACE(20) BLOCK(13030) NEW
00090 ALLOC FI(SORTWK02)  SPACE(20) BLOCK(13030) NEW
00100 ALLOC FI(SORTWK03)  SPACE(20) BLOCK(13030) NEW
00110 ALLOC FI(SORTMSG) DA(*)
00120 ALLOC FI(SYSWRK0) DA(S4) SPACE(50) TRACK USING(A) MOD
00130 ALLOC FI(DD1) DA(S4) OLD
00140 ALLOC FI(DD2) DA(' LAT.LONG.DATA (&MEMBER.)') SHR
00150 CALL 'SYS1.GIPLIB(TS02741)'
00160 CALL 'SYS1.LOADLIB(J499)'
00170 DELETE (S4)
00180 FREE FILE(SYSGWRK,SORTLIB,SORTWK01,SORTWK02,SORTWK03,SORTMSG,SYSWRK0)
00190 FREE FILE(SYSDICT,SYSREC,SYSPCH,DD1,DD2,SYSDIR)
00200 FREE ATTRLIST(A)
```

CAM TO DISK (H876) AND PLOTCAM (J725)

INTRODUCTION

CAM to Disk is CAM Version 4.0 modified to store the plotting instructions on a disk file, rather than on tape. The CAM to Disk program H876 is run in the batch mode to prepare the plot. The plotting instructions are saved in a disk-data set. When H876 is finished, these plotting instructions are used by the Plotcam program (J725), running under TSO (Time Sharing Option of IBM System/370 Operating System), to draw the plot on a Tektronix graphic display terminal.

The advantage of using CAM to Disk and Plotcam instead of the standard CAM is in the time saved from the point the CAM-control cards are prepared until the plot is made. A comparison of the turnaround times of the two versions of CAM is shown in figure 18. CAM takes longer to run than H876 because a tape must be used; jobs requiring tapes are delayed from running until the tape is

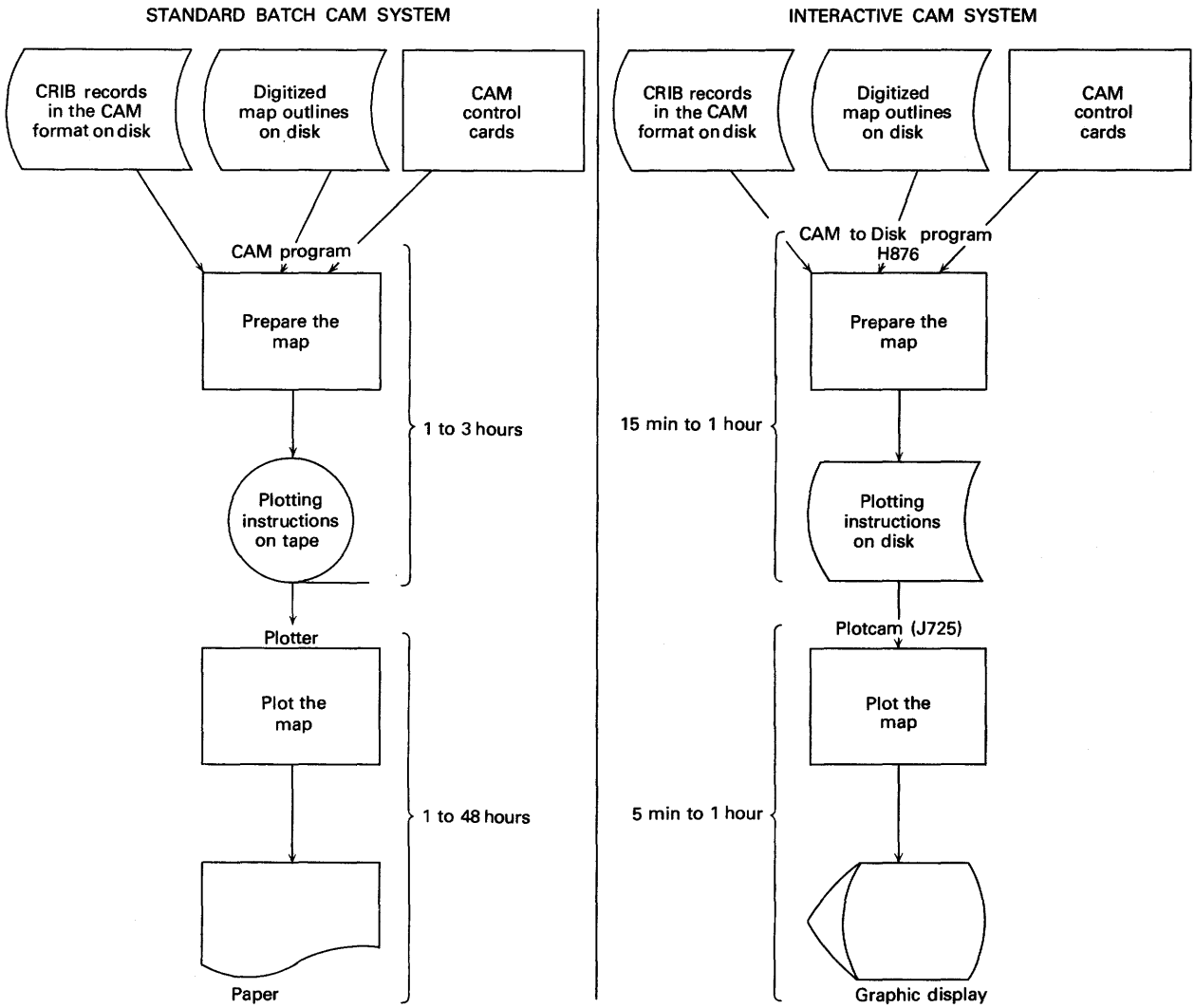

FIGURE 18. – Comparison of turnaround times of the standard batch CAM and the Interactive CAM systems.

mounted. The delay may take hours. Once H876 has been run, the plot may be reviewed in a few minutes, whereas the plot tape produced by CAM must wait for plotting on an off-line plotter. If the backlog of tapes to be plotted is large, the delay may be measured in days.

OPERATING INSTRUCTIONS

CAM-CONTROL CARDS AND DATA DEFINITION (DD) STATEMENTS

In the example shown in figure 17, the data have been copied from the CRIB file, converted to CAM format, and stored in the member "copper" of the data set LAT.LONG.DATA. These data may be plotted by using the conventional CAM or CAM to Disk programs. The CAM control-card SYMPT provides the link. It has the form:

SYMPT 2, nn

where "nn" is a two-digit number used in the DD (data definition) name of the input DD statement that points to the mineral data to be plotted. The DD name has the format of a Fortran DD name. If nn were 77, the DD name would be FT77F001.

To establish the link, choose an unused Fortran DD name. Take the two-digit part of the DD name and put it in a SYMPT statement. Add the SYMPT statement to the CAM control statements. Prepare a DD statement in which the DD name contains the same two-digit number. The data set named in this DD statement will contain the data copied from the CRIB file. An example of a CAM run using 77 as the two-digit number in the Fortran DD name is shown below (see Example of a CAM to Disk Run).

The DD statement FT22F001 is used to define the output data set that will contain the plotting instructions for Plotcam. In the example below, the partitioned data set PLOT.DATA.SET has been allocated for the purpose of saving plots from the CAM to Disk program H876. The running time of H876 and the subsequent plotting time on the display can be reduced by changing field 3 (the plotting increment) of the PLOTTER card from the usual .01 to .11. The change will instruct H876 to issue fewer plotting instructions. Place the CAM-control cards after the FT07F001 DD statement in the H876 deck.

In the example below, the DD statement FT14F001 has been set to the dummy condition. If the plotting instructions are to be saved on tape for plotting on a mechanical plotter, change this DD statement to provide the tape.

EXAMPLE OF A CAM TO DISK RUN

```
//VG901743 JOB (000000000,H876,5,25),
  'ALANCROSBY',H876 CRIB LINK,
// CLASS=D
//S1 EXEC PGM=H876,REGION=354K,
  TIME=5
//STEPLIB DD DSN=SYS1.LOADLIB,
  DISP=SHR
//FT06F001 DD SYSOUT=A
//FT08F001 DD DSN=VG5207A.
  WDBICOST.DATA,DISP=SHR
//FT11F001 DD DSN=VG5207A.
  WDBIBNDS.DATA.DISP=SHR
//FT14F001 DD DUMMY
//FT21F001 DD DSN=VG5207A.
  DAHLUS.DATA,DISP=SHR
//FT22F001 DD DSN=PLOT.DATA.SET
  (name of plot),DISP=SHR
//FT77F001 DD DSN=LAT.LONG.DATA
  (COPPER),DISP=SHR
//FT07F001 DD *
PLOTTER 14.,1.,.11,8.,1.,10.,,10.
CEAGEN 6378206.4,6356583.8,,29.,30.,,45.,30.
CETPOT 40.,,,-095.
CONFAC 39.37
MAPBOUND 15.,,,60.,,,-140.,,,-050.
MAPSAL 7500000.
XYLIM 20.,15.
SAVE
XYLIM 15.,10.
SAVE
OPENBOX 1.,-13.,-8.,-10.,-6.,1.
1        COPPER IN THE U.S.
-12.75    -6.5
1         Dennis Cox
-12.75    -7.
1         ALBERS PROJECTION
-12.75    -7.5
SAVE
BOX 40.,,,-95.,,,15.,10.
LGRID 5.,5.,.1,.1,15.,,,60.,,,-140.,,,-050.
LINEPT 21.,6.
SYMPT 2,77
SPLATE
//
```

PLOTTING ON THE TEKTRONIX DISPLAY TERMINAL

After H876 is run, the plot will be available for review on the Tektronix display terminal under the control of the Plotcam program (J725). Sign on to TSO in the usual manner. When the sign-on processing with TSO has been completed and the

message "READY" appears, enter the following command:

EXEC CAM 'PLOT(name of plot)'.

The name of the plot will be the name of the member chosen to contain the plot when the H876 run was made.

During a short delay, TSO will allocate files for the use of Plotcam. When Plotcam has been given control, it will issue messages to solicit guidance in the preparation of the plot. The reply to most messages is "Y" for yes or "N" for no. These messages are explained in the section, "Plotcam User-Prompt Messages."

IMAGE RELATIONSHIPS

Each of the plotting instructions issued by the CAM to Disk program H876 of the Interactive CAM system has a dimension in the X direction and a dimension in the Y direction. These dimensions are the distances in inches to the lower left corner of the plotter. The values of Xmin, Xspan, Ymin, and Yspan are also in inches. When the Plotcam program is processing the plotting instructions issued by H876, it will discard all X values that are less than Xmin and all Y values less than Ymin. It will discard all X values greater than the sum of Xmin and Xspan and will discard all Y values greater than the sum of Ymin and Yspan. The remaining values will be scaled to fit the display screen, which is 11 in.by 15 in.

The top of figure 19 shows an image on a hypothetical off-line plotter. The distance between the lines of the grid is 10 in. For this example, Xmin and Ymin have been set at 10 in. The span of X is 50 in., and the span of Y is 40 in. The bottom of figure 19 shows the same image as it would be displayed by Plotcam on the Tektronix display terminal. Notice that vertical lines, A, H, I, J, and K do not appear on the display, and neither do horizontal lines A and G. They have been discarded because they are outside the values that have been specified to Plotcam. On the upper image, the area of interest has been divided into five segments in the X direction and four in the Y direction. The screen of the display has also been divided into five equal segments in the X direction and four equal segments in the Y direction. This example illustrates what will happen to every image: the part of the image within the span of X and Y will be scaled to fit the display screen.

PLOTCAM USER-PROMPT MESSAGES

During the interactive map-plotting session, the user is led through a sequence of processing steps in which the Plotcam program issues prompts to the user, and the user answers by choosing one of the available options. These user-prompt messages are explained below. The order of appearance of these messages is shown in figure 20. By studying figure 20, one can see in advance where a particular sequence of messages and replies is leading.

DO YOU WANT TO USE CURSOR TO SELECT AREA TO BE PLOTTED? REPLY Y OR N

This is the first message issued by the Plotcam program. It is issued immediately after the program is entered and at the end of each plot. Its appearance at the end of each plot allows the user to make a new plot, if desired, of a smaller area within the area of the first plot.

Y-The screen will be erased, and the crosshair cursors will appear. Position the cursors to define the lower left point of the area to be plotted. Enter the letter "C" and press the return key. The crosshair cursors will disappear for a moment and then reappear. Position them to define the upper right point of the area to be plotted. Enter the letter "C" and press the return key. The screen will be erased and the next message will appear.

N-The program will go on to the next message.

USE DEFAULT WINDOW SIZE? REPLY Y OR N

This message appears if the cursor is not being used to control the plot. In answer to this and succeeding messages, the values to be plotted in the X and Y directions can be specified. The unit of measurement used by CAM and Plotcam is inches. Plotcam will ignore all values outside the range specified below, and it will scale the values inside the range to fit the display screen.

Y-Plotcam will use the default values of X and Y. The minimum value of X will be 0; the maximum, 47.60 in. The minimum value of Y will be 0; the maximum, 35 in. The screen will be erased, these values will be displayed at the top of the screen, and the map will be plotted.

N-The values of X and Y that are to be plotted will be solicited by a series of messages.

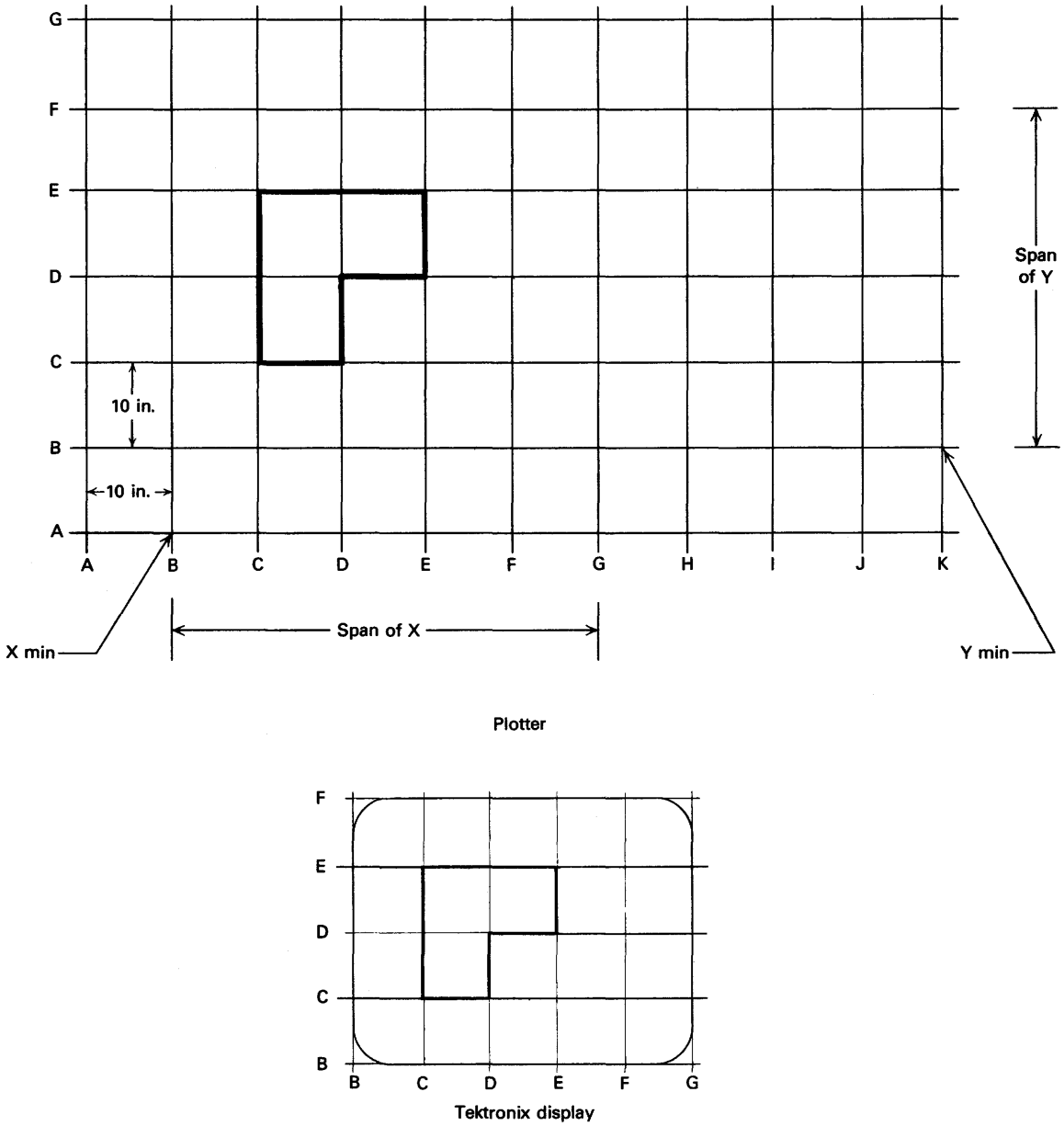

FIGURE 19.—Image relationships between off-line plotter and Tektronix graphic display terminal.

SET X SO THAT THE RATIO OF Y/X = 11/15? REPLY Y OR N

Plotcam will take the points defined by the cursor and scale the plot to fit the screen. If the plot that results does not have the same ratio of height to width as does the Tektronix display screen, the plot will be distorted.

Y-Before the map is plotted, the span of X will be adjusted, if necessary, so that the ratio of the span of Y to the span of X will be 11/15. The display screen will be erased and the map will be plotted.

N-No adjustment will be made to the span of X. The display screen will be erased and the map will be plotted.

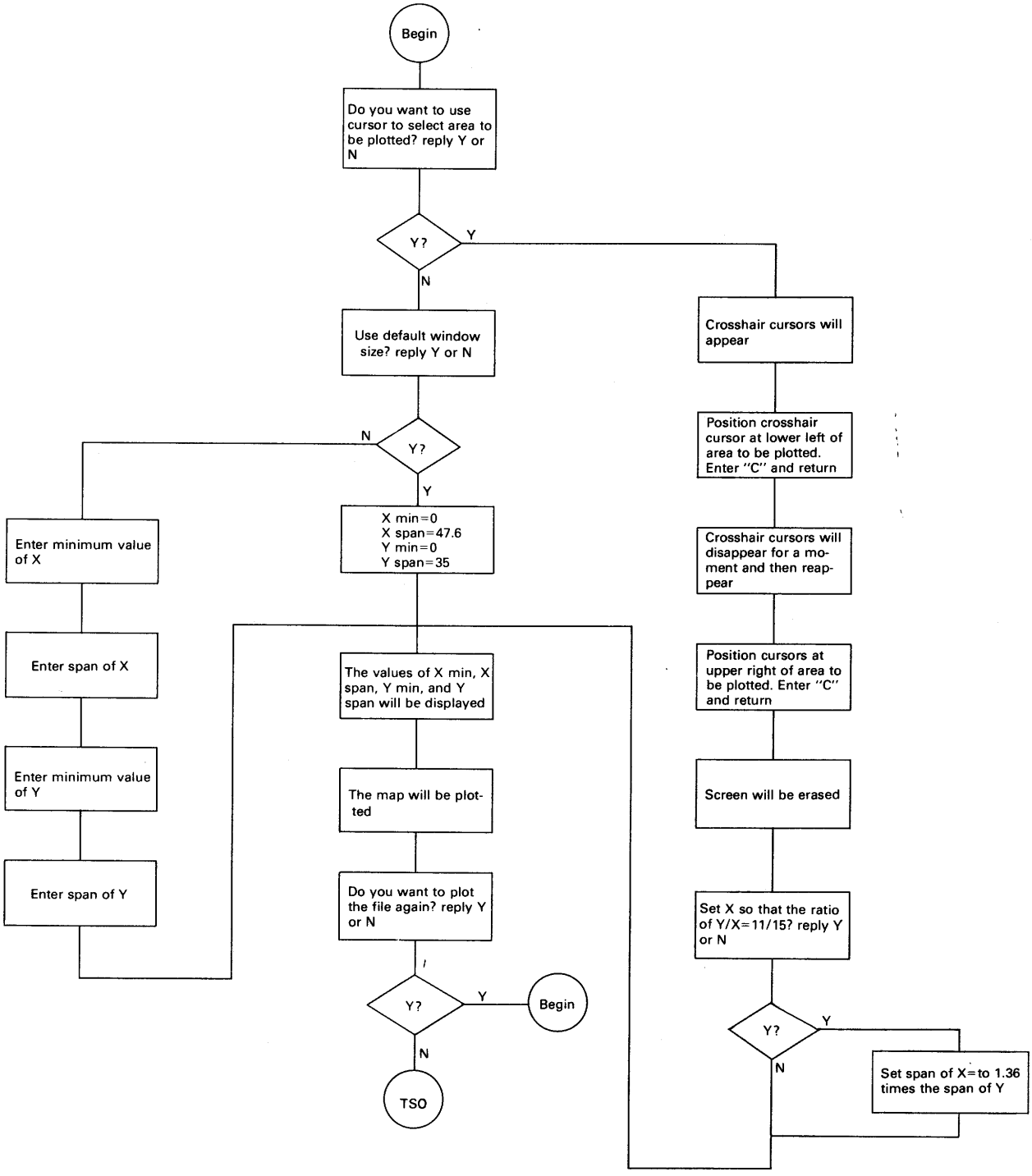

FIGURE 20. – Flow diagram showing order of appearance of Plotcam user-prompt messages.

ENTER MINIMUM VALUE OF X

This is a request to define the minimum value of X that is to be plotted. All values less than this will be ignored. Enter the number in the format nnn.nn. Always supply the decimal point.

ENTER SPAN OF X

This is a request to define the span of the plot in the X direction. It is the difference of the minimum value of X and the maximum value of X. Values that exceed the sum of the minimum value of X and the span of X will be ignored. Enter the number in the format nnn.nn. Always supply the decimal point.

ENTER MINIMUM VALUE OF Y

This is a request to define the minimum value of Y that is to be plotted. All values less than this will be ignored. Enter the number in the format nnn.nn. Always supply the decimal point.

ENTER SPAN OF Y

This is a request to define the span of the plot in the Y direction. It is the difference of the minimum value of Y and the maximum value of Y. Values that exceed the sum of the minimum value of Y and the maximum value of Y will be ignored. Enter the number in the format nnn.nn. Always supply the decimal point.

This is the end of the sequence beginning with "Enter minimum value of X." The display screen will be erased and the map will be plotted.

DO YOU WANT TO PLOT THE FILE AGAIN? REPLY Y OR N

This message will appear after the map has been plotted. It is the only message that can be used to terminate the session.

Y-The map will remain on the screen, control will pass to the beginning of the program, and you will be given the opportunity to control the plotting process by replying to the same sequence of messages as before.

N-This is the signal to end the session. The map will remain on the screen. There will be a slight delay as control is passed to TSO. When this transfer of control has been completed, the message, READY, will appear on the screen.

The exit reply is "E."

The reply to each message issued by Plotcam determines what Plotcam will do next. The reply "E" is used to instruct Plotcam to start over or to quit. When Plotcam receives an "E" in reply to a request for guidance, it will display the message, "DO YOU WANT TO PLOT THE FILE AGAIN? REPLY Y OR N." Reply "N" to end the session or "Y" to continue it.

PROGRAM DOCUMENTATION MATERIALS

The progam documentation materials presented below provide technical information on CAM to Disk (program H876) and its companion program Plotcam (J725).

The link-edit flow chart for program H876 is shown in figure 21. The logic flow diagrams (fig. 22) show the output flow for CAM to Disk (program H876) in comparison to that for the standard CAM program. The logic flow is similar for both programs except that CAM to Disk provides for the program results to be directed to disk storage as well as to tape. Either output device, or both, may be utilized.

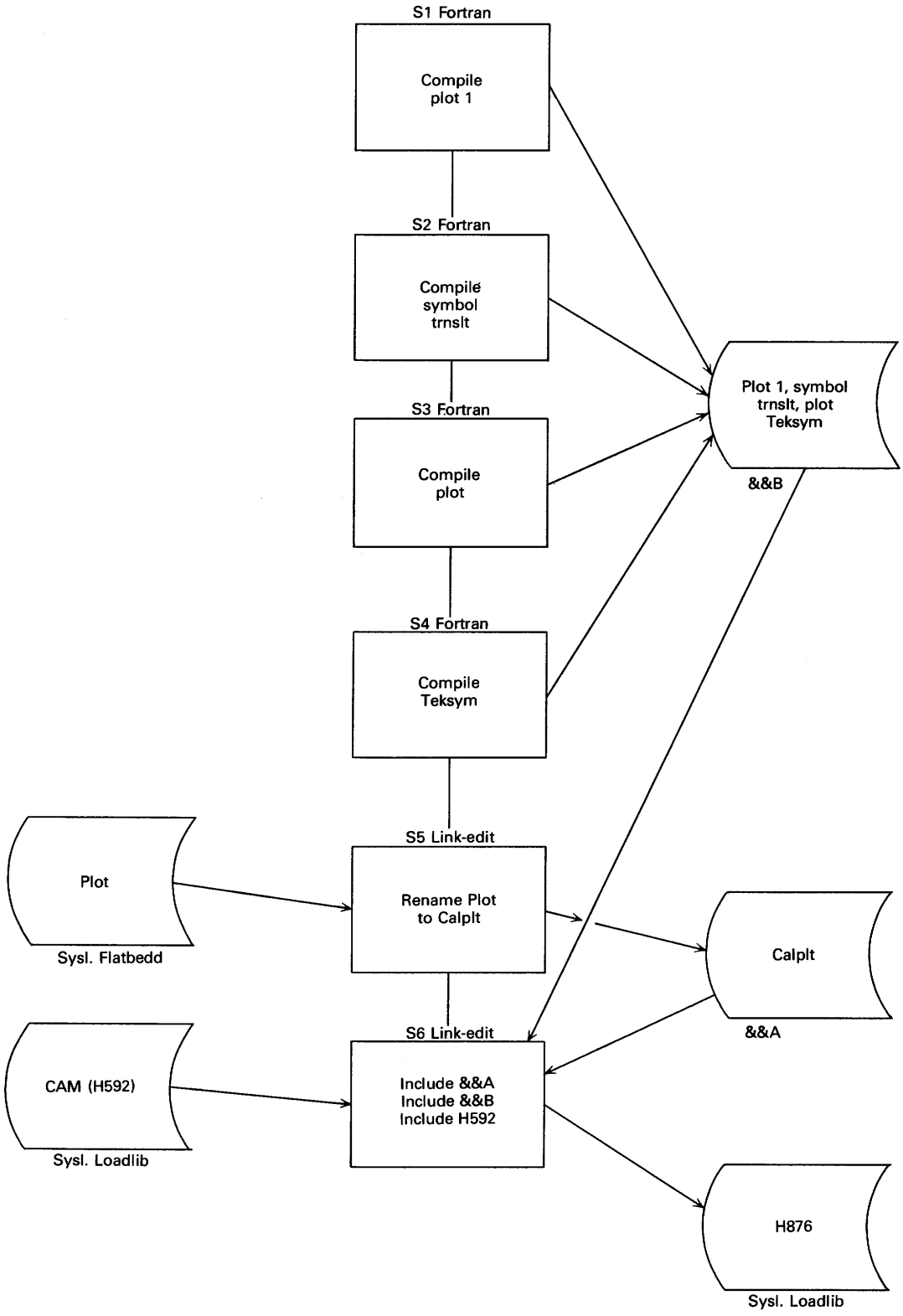

FIGURE 21. – Link-edit flow chart for CAM to Disk program H876.

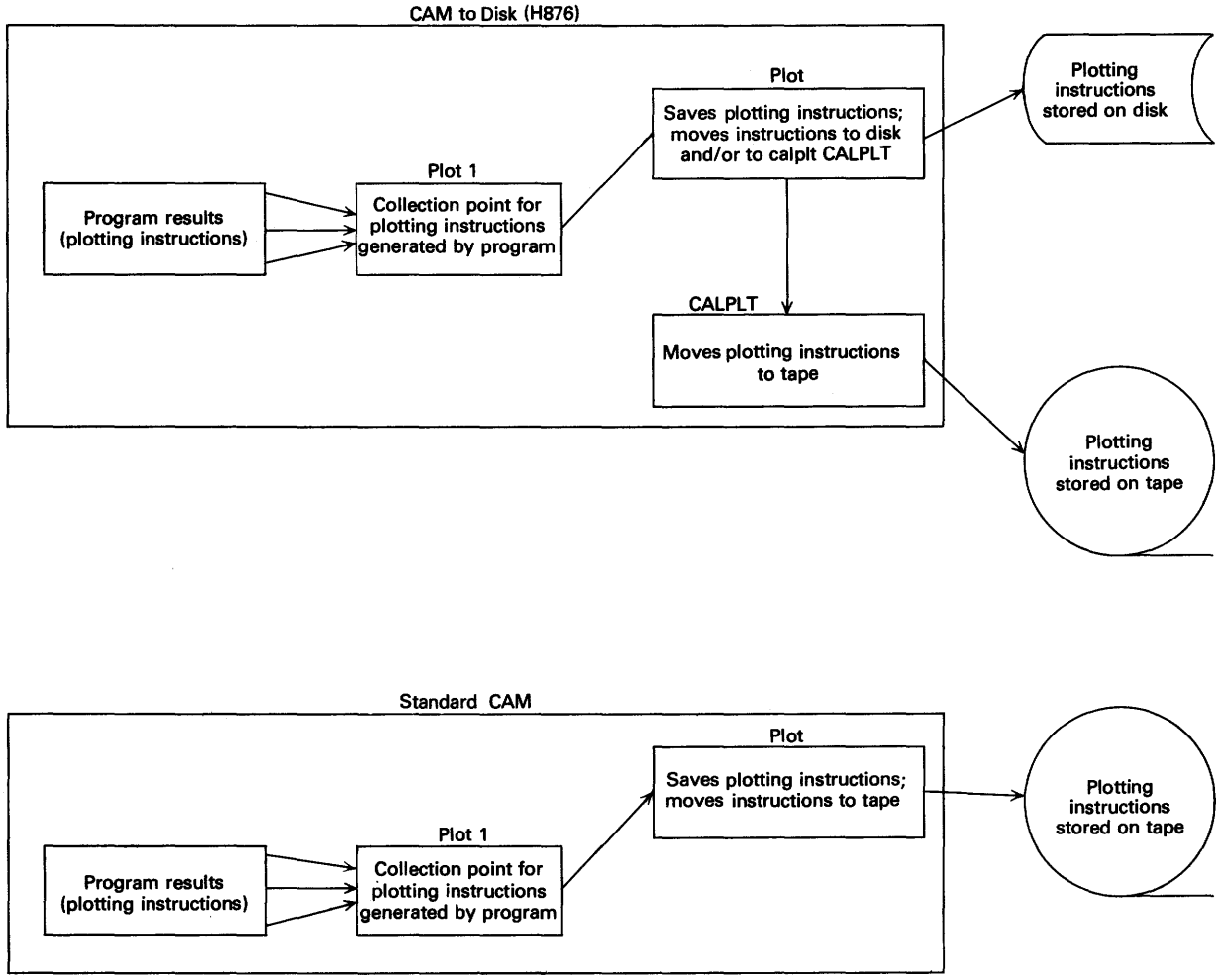

FIGURE 22.–Logic flow chart for CAM to Disk program H876.

```
//VC90173C JOB (934000231,H876,9,25),'ALANCROSBY', LINK H876
// CLASS=B
//S1 EXEC FORTGC
//FORT.SYSLIN DD DSN=&&B,
//        UNIT=SYSDK,
//        DISP=(NEW,PASS),
//        DCB=(RECFM=FB,LRECL=80,BLKSIZE=400),
//        SPACE=(TRK,(10,10))
C                                PLOT1
C                                WRITTEN BY ALAN CROSBY
C                                REPLACES THE MODULE IN CAM OF THE SAME
C                                NAME.
      SUBROUTINE PLOT1(X,Y,N)
      CALL PLOT(X,Y,N)
      RETURN
      END
//S2 EXEC FORTGC
//FORT.SYSLIN DD DSN=&&B,DISP=(MOD,PASS)
C    SYMBOL
C    WRITTEN BY ALAN CROSBY
C    REPLACES THE MODULE IN CAM OF THE SAME NAME.
      SUBROUTINE SYMBOL(XPAGE,YPAGE,HEIGHT,IBCD,ANGLE,NCHAR)
      DIMENSION IBCD(2)
      IF (NCHAR.EQ.-1) CALL TRNSLT(IBCD(1))
C    TEKSYM IS THE OLD CALCOMP SYMBOL ROUTINE THAT DRAWS CHARACTERS
C    INSTEAD OF ISSUING A CODE FOR THE PLOTTER TO TRANSLATE.
      CALL TEKSYM(XPAGE,YPAGE,HEIGHT,IBCD,ANGLE,NCHAR)
      RETURN
      END
      SUBROUTINE TRNSLT(J)
C    WRITTEN BY ALAN CROSBY
C      THIS PROGRAM WILL TRANSLATE OLD CALCOMP SYMBOL CODES TO THE
C      NEW, ASCII, SYMBOL CODES.
C      J CONTAINS THE OLD CODES:  0 TO 127
      DIMENSION J(2),ICODES(128)
      DATA ICODES/0,1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,
     *            21,22,23,24,25,26,27,28,29,30,31,25,90,127,123,91,108,
     *            80,125,77,93,92,78,107,96,75,97,112,113,114,115,116,
     *            117,118,119,120,121,122,94,76,126,110,111,124,65,66,
     *            67,68,69,70,71,72,73,81,82,83,84,85,86,87,88,89,98,99,
     *            100,101,102,103,104,105,53,55,54,18,24,32,33,34,35,36,
     *            37,38,25,40,41,42,43,25,25,25,25,48,49,50,51,52,53,54,
     *            55,56,57,25,25,60,61,63,62/
C      THE VARIABLE I WILL NOW POINT TO THE PROPER ASCII CODE IN THE
C      TABLE.
      I = J(1) + 1
C                PICK UP THE ASCII CODE.
      J(1) = ICODES(I)
      RETURN
      END
//S3 EXEC FORTGC
//FORT.SYSLIN DD DSN=&&B,DISP=(MOD,PASS)
C                              PLOT
C                              WRITTEN BY ALAN CROSBY
C                              REPLACES CALCOMP SUBROUTINE CALLED PLOT.
C                              SAVES PLOTTING INSTRUCTIONS ISSUED BY
C                              CALCOMP.  CALLS CALCOMP SUBROUTINE PLOT
C                              WHICH HAS BEEN RENAMED CALPLT.
C
C
C
```

```
      SUBROUTINE PLOT(X,Y,N)
      WRITE(22,1) X,Y,N
    1 FORMAT(2F10.6,I5)
      CALL CALPLT (X,Y,N)
      RETURN
      END
//S4 EXEC FORTGC
//FORT.SYSLIN DD DSN=&&B,DISP=(MOD,PASS)
C      SYMBOL         94218     9.4.9      07/70        BCD VERSION          28420000
C SUBROUTINE SYMBOL COPYRIGHT 1970 CALIF. COMPUTER PRODUCTS                   28420001
C MODIFIED FOR IBM-360              FORTRAN IV                                28420002
C SYMBOL  V7006     06/10/70          PRODUCT NUMBER 94218                    28420003
      SUBROUTINE TEKSYM(XPAGE,YPAGE,HEIGHT,IBCD,ANGLE,NCHAR)                  28420004
      DIMENSION JCHAR(10),XA(32),YA(32)                          ,IBCD(2)     28420005
      DIMENSION NXY(2), XB(32),YB(32)                                         28420006
      DIMENSION ITAB( 750),JTAB(128)                                          28420007
      DIMENSION ITAB 1(150)                                                   28420008
      DIMENSION ITAB 2(150)                                                   28420009
      DIMENSION ITAB 3(150)                                                   28420010
      DIMENSION ITAB 4(150)                                                   28420011
      DIMENSION ITAB 5(150)                                                   28420012
C                                                                             28420013
      EQUIVALENCE (ITAB(   1),ITAB 1(1))                                      28420014
      EQUIVALENCE (ITAB( 151),ITAB 2(1))                                      28420015
      EQUIVALENCE (ITAB( 301),ITAB 3(1))                                      28420016
      EQUIVALENCE (ITAB( 451),ITAB 4(1))                                      28420017
      EQUIVALENCE (ITAB( 601),ITAB 5(1))                                      28420018
C                                                                             28420019
      DATA XA(1),YA(1),XB(1),YB(1) /0.0,0.0,0.0,0.0/                          28420020
      DATA OLDTH/999./                                                        28420021
      DATA ASPCT,TALIC,RSPAC,SPCT/.8,0.0,1.0,.8/                              28420022
C                                                                             28420023
C                                                                             28420024
C                                                                             28420025
C                                                                             28420026
      DATA JTAB/                                                              28420027
     9  18433,  26633,  14357,  16411,  16418,  16425,  16432,               28420028
     9  14391,  20541,  16454,  38989,  28767,  14444,  10354,               28420029
     9  24694,   4226,   4228,  67718,   6311,  16554,  10418,               28420030
     9  53431,  16593,  16601,   4321,  35043,   4340,  28918,               28420031
     9  20740,   6414,  16657,  35089,  26914,  26927,  24892,               28420032
     9  24904,  41300,  41303,  31083,  14714,  47489,  22936,               28420033
     9  33187,  43443,  31176,  25047,  72163,  86499,  10765,               28420034
     9  29202,  12832,  12836,   8746,   8750,   8752,   4660,               28420035
     9  23094,  14913,  16968,  23120,  10843,  10848,  10853,               28420036
     9  10856,   2056,  10861,  37490,  37508,  27286,  15011,               28420037
     9  12964,  41642,  12990,   4804,  31060,  10950,   6688,               28420038
     9  17033,  10955,   4804,  47824,  19175,  15088,   6903,               28420039
     9  11002,   8957,  49921,  21273,  49955,  25403,  25415,               28420040
     9  50003,  23403,  17158,  27510,   7043,   4274,   4998,               28420041
     9  45960,   9118,  21410,   6907,  11180,  11185,  11190,               28420042
     9   9147,  43967,  15228,  29652,   4995,   6695,  37858,               28420043
     9  43780,   7156,  31735,  44038,   9243,  39967,  46130,               28420044
     9  17480,  60496,  46189,  23414,  23683,  66702,  13486,               28420045
     9  11444,  27833/                                                       28420046
C                                                                             28420047
C                                                                             28420048
C                                                                             28420049
C                                                                             28420050
      DATA ITAB 1/                                                            28420051
     9 210131,  19463, 400787, 217056, 210131, 117776,  10343, 302474,       28420052
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9 409907, 217056, 210131,  10634, 217056, 210131,1015821, 407520,  28420053
9 203981, 413664,  19847,1015815, 210131,  13511, 406739,1016013,  28420054
9 216077, 406739,1016007, 209939, 412679,1016199, 210029,1015827,  28420055
9 412679, 401376, 308429,  20448, 412877, 204768, 210323,1016112,  28420056
9 114707,1015920, 108551,1015914, 305543,1016106, 312288, 210323,  28420057
91016019, 204768, 400403,1015821, 407520,  7373,  19859, 209927,  28420058
9 400589, 217056, 203981, 216074, 403667,1016007, 409616, 204768,  28420059
9 209991, 564551, 351239,  22710, 251156, 279792, 179215, 179438,  28420060
9 275721, 237735,  8160, 337256, 433639, 565833, 602669, 378194,  28420061
9 348533, 449014, 579156, 138580, 531596, 537568, 540816,1015956,  28420062
9 544851, 609749, 476755, 280852, 251062, 120885,  19466,  41063,  28420063
9 171240, 271627,1016135, 350710, 579156, 607792, 507215, 507463,  28420064
9 152084,1016334, 146400, 207320, 152084,1016153, 344032, 143884,  28420065
9  38533,  7190, 269590,1016150, 338280, 433639, 565834, 613344,  28420066
9 678535, 924735, 687209, 106631, 204008, 272685, 386460, 457183,  28420067
9 556606, 586901, 415188, 511505, 540141, 471435, 142484, 335380,  28420068
9 147633, 248113, 376238, 507408,1016340, 511410, 380213, 252085,  28420069
9 151711, 228606, 291094, 315731, 313616, 272616/                  28420070
 DATA ITAB 2/                                                      28420071
9 203911, 556511, 457116, 416116, 347506, 409994, 434631, 531562,  28420072
9 257202, 178412, 307597, 474683, 474605, 569452, 257210,  90298,  28420073
9 257498, 518715, 518618, 405853, 337888, 485755, 322778, 155765,  28420074
9 115854, 209195, 372172, 539185, 579096, 486368, 118323, 123098,  28420075
9 255119, 144556, 241965, 376243, 516667,1016223, 138349, 583648,  28420076
9 124121, 472621, 254169, 189560,  88115,  49230, 144589, 276853,  28420077
9 311630, 374221, 539183, 643702, 614969, 517243, 191738, 287027,  28420078
9 109875, 345486, 472620, 540111, 409878, 220311,  88116,  51280,  28420079
9 146639, 278934, 482839, 585150, 391517, 388568, 514548, 475533,  28420080
9 340172, 144495, 115860, 220440, 353721, 452147, 118752, 585147,  28420081
9 321753, 154740, 116879, 210220, 437803, 124091, 224506, 254059,  28420082
9 254363, 519737, 579975,  9256, 105639, 237833, 274669,  50194,  28420083
9  20533, 121014, 251156,1016150, 338280, 433639, 565834, 613344,  28420084
9 663190, 842613, 938897, 901935, 671535, 899981, 927592, 827015,  28420085
9 588927, 348263, 564531, 316789, 380211,1015952, 541664, 374061,  28420086
9 306539, 374297, 152079,1016332, 144352, 146964, 156779, 352811,  28420087
9 110239, 294151, 663199, 293983, 597500, 486715, 256217, 256315,  28420088
9 388334, 242955, 359751, 241834,1016159, 523531, 405472, 290203,  28420089
91016159, 335123, 413664, 273803,1016091, 421856/                  28420090
 DATA ITAB 3/                                                      28420091
9 359751,  85205, 214099, 609355, 618464, 601179, 359707, 421215,  28420092
9 335115, 404807,  40287, 630287, 146516, 446963, 575055, 603690,  28420093
9 500135,  72799, 425470, 585273, 548309, 414298, 586238, 425279,  28420094
9 227484, 125014,  82028, 141512, 302471, 500266, 603207, 302472,  28420095
9 469517, 575029, 550364, 424255,  97351, 597063,  86516,  86111,  28420096
9 589402, 586238, 425279, 227484, 125014,  82028, 141512, 302471,  28420097
9 500266, 603729, 378439, 622164,  86111,  73031, 359751, 236778,  28420098
9 338247, 605263,1016135, 351772, 489855, 261277, 126072, 532039,  28420099
91016020, 115791,  77930, 172295, 400840, 535084, 570959, 111754,  28420100
9 205095, 368072, 535085, 588895,  72786, 622560, 597238,  97351,  28420101
9 564263,  64839, 654951,  97351, 621977,1016103, 368072, 535084,  28420102
9 606806, 584220, 489855, 326878, 159866,  88144, 110730, 205095,  28420103
9  72799, 425470, 585273, 548309, 413780, 302439, 467466, 569936,  28420104
9 612922, 553438, 392511, 227484, 125014,  82028, 141512, 303072,  28420105
9 407111,  72799, 425470, 585273, 548309, 413780, 414279, 310621,  28420106
9 359711, 292143,1016137, 335111, 271689, 400799,1016095, 270304,  28420107
9 111755, 207306, 537133, 572945, 510132, 152695, 124058, 225756,  28420108
9 551480, 605263,1016135, 352224, 153097,1015945, 546033, 345428,  28420109
9 250097,1016135, 236778, 338247, 299233,  52883/                  28420110
 DATA ITAB 4/                                                      28420111
9 672351,  72780, 108712, 269703, 500266, 602703, 574931, 186519,  28420112
9 124027, 160958, 294303, 522781, 585031, 359519, 621695, 111754,  28420113
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     9 205095, 368072, 535085, 588831, 171359, 499359, 597087,1016415,  28420114
     9  72767, 348487, 348799,  97887,  73287, 540111, 409878, 220311,  28420115
     9  88116,  51280, 146639, 278934, 482839, 612980, 641616, 539740,  28420116
     9  97471, 192604,1016415,  73696, 499178, 600647, 499017, 335111,  28420117
     9 271689,1016109, 310609, 547384, 585245, 522655, 326846, 128327,  28420118
     9 359677, 127166, 294303, 521786, 582166, 479570, 211083, 107623,  28420119
     9 564438, 318807, 449013, 577104, 604715, 533960, 367911, 204906,  28420120
     9  78816, 351706, 556191, 499199,  81487, 588959, 152790, 318807,  28420121
     9 449013, 577104, 604715, 533960, 367911, 204906,  77906, 185686,  28420122
     9 513587, 607820, 567784, 433415, 172138,  78934, 125084, 227647,  28420123
     9 425470, 585823, 622011, 385333, 246989, 171084, 108712, 269703,  28420124
     9 500266, 602703, 574931, 186519, 124027, 160958, 294303, 522781,  28420125
     9 585273, 548342, 216177,  80972, 108712, 269671, 467466, 569936,  28420126
     9 615996, 522655, 294078, 127066,  87155, 181584, 509524,  81487,  28420127
 91016235, 521184, 614488,1016060, 175663, 542231, 542191, 407886,  28420128
     9 277745, 249110, 352665, 484887, 582202, 520605, 357628, 190616,  28420129
     9 119921, 145580, 239945, 402922, 535831, 324927/                  28420130
      DATA ITAB 5/                                                      28420131
     9 261373, 285779, 610272, 605263, 286013, 326911, 259351,1016247,  28420132
     9 488927, 425373, 450528,1016800,1016800,1016800,1016800,1016800,  28420133
 91016800,1016800,1016800,1016800,1016800,1016800,1016800,1016800,  28420134
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 91016800,1016800,1016800,1016800,1016800,1016800,1016800,1016800,  28420148
 91016800,1016800,1016800,1016800,1016800,1016800,1016800,1016800,  28420149
 91016800,1016800,1016800,1016800,1016800,1016800/                  28420150
      ISH3 = 2**24                                                      28420151
      ISH2 = 2**16                                                      28420152
      ISH1 = 2**8                                                       28420153
      IF(HEIGHT) 500,5,5                                                28420154
    5 IPEN = 3                                                          28420155
      NT = NCHAR                                                        28420156
      IF (NT) 10,10,30                                                  28420157
   10 J = 4                                                             28420158
      IF (NT  + 1) 11,12,40                                             28420159
   11 IPEN = 2                                                          28420160
   12 JCHAR(J) = IBCD(1)                                                28420161
      KTAB = 1                                                          28420162
      IF (JCHAR(J)-14) 15,15,50                                         28420163
   15 DIV = 12.                                                         28420164
      ASPCT = 1.0                                                       28420165
      GO TO 60                                                          28420166
   30 J = 1                                                             28420167
   40 KTAB = 1                                                          28420168
   50 DIV = 24.0001                                                     28420169
   60 TH = ANGLE                                                        28420170
      HT = HEIGHT                                                       28420171
      FCT = HT/DIV                                                      28420172
      DIV = RSPAC*(DIV+6.0)                                             28420173
      IF (TH-OLDTH) 80,70,80                                            28420174
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 70   IF (FCT-OLDFC)   90,100,90                                        28420175
 80   OLDTH = TH                                                        28420176
      TH = TH*0.0174533                                                 28420177
      SINC = SIN(TH)                                                    28420178
      CINC = COS(TH)                                                    28420179
 90   OLDFC  = FCT                                                      28420180
      XA2    = FCT*CINC                                                 28420181
      YA2    = FCT*SINC                                                 28420182
      XB2 = XA2 * ASPCT                                                 28420183
      YB2 = YA2 * ASPCT                                                 28420184
      DO 95 I=2,32                                                      28420185
      I1 = I-1                                                          28420186
      XB(I) = XB2 + XB(I1)                                              28420187
      YB(I) = YB2 + YB(I1)                                              28420188
      XA(I) = XA2+XA(I1)                                                28420189
 95   YA(I) = YA2+YA(I1)                                                28420190
100   XT= XPAGE                                                         28420191
      YT= YPAGE                                                         28420192
      IF(XT-998.9) 101,101,102                                          28420193
 101  XO=XT+YA(8)-TALIC*XB(8)                                           28420194
      X= XT                                                             28420195
 102  IF(YT-998.9) 103,103,104                                          28420196
 103  YO =YT-XA(8)-TALIC*YB(8)                                          28420197
      Y=YT                                                              28420198
 104  IND = 1                                                           28420199
      NCHR = 0                                                          28420200
      IF (NT) 110,140,140                                               28420201
110   IF (JCHAR(J)-14) 120,120,150                                      28420202
 120  XO = XO-(XB(7)-YA( 7))                                            28420203
      YO = YO-(XA( 7)+YB(7))                                            28420204
      ASPCT = SPCT                                                      28420205
      GO TO 150                                                         28420206
130   IPEN = 3                                                          28420207
      J = J+1                                                           28420208
      IF (J-5) 150,135,135                                              28420209
135   J = 1                                                             28420210
      IND = IND+1                                                       28420211
 140  JCHAR(1) = IBCD(IND)/ISH3                                         28420212
      IF (JCHAR(1)) 144,148,148                                         28420213
 144  JCHAR(1) = JCHAR(1) + ISH1-1                                      28420214
 148  L     = IBCD(IND) - JCHAR(1)*ISH3                                 28420215
      IF (L-ISH3) 149,1480,149                                          28420216
1480  L=0                                                               28420217
      JCHAR(1)=JCHAR(1)+1                                               28420218
 149  CONTINUE                                                          28420219
      JCHAR(2) = L    /ISH2                                             28420220
      JCHAR(3) = L    /256-JCHAR(2)*ISH1                                28420221
      JCHAR(4) = L     - JCHAR(3)*256-JCHAR(2)*ISH2                     28420222
 150  JCH = JCHAR(J)                                                    28420223
      IF (JCH-128) 153,152,152                                          28420224
 152  JCH = JCH- 128                                                    28420225
 153  ICHAR = JCH + KTAB                                                28420226
      IF (JCH - 17) 154,202,154                                         28420227
 154  IF (JCH - 21) 155,205,155                                         28420228
 155  IF (JCH - 25) 156,220,156                                         28420229
 156  IF (JCH - 46) 157,220,157                                         28420230
 157  IF (JCH - 47) 158,220,158                                         28420231
 158  ICHAR = JTAB (ICHAR)                                              28420232
      INUM = ICHAR/2048                                                 28420233
      L = ICHAR-(INUM*2048)+1                                           28420234
      ILOC = L/2                                                        28420235
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      L = L-2*ILOC                                                      28420236
      K = 0                                                             28420237
  160 NXY(2) = ITAB (ILOC)/1024                                         28420238
      NXY(1) = ITAB (ILOC) - NXY(2) *1024                               28420239
      ILOC = ILOC + 1                                                   28420240
      L = 2-L                                                           28420241
  165 NX = NXY(L)/32 +1                                                 28420242
      NY = NXY(L) - NX*32 +33                                           28420243
      L = L-1                                                           28420244
      IF (NX-32) 170,180,180                                            28420245
  170 XT= XO+ XB(NX)-YA(NY) + TALIC*XB(NY)                              28420246
      YT= YO+ YB(NX)+XA(NY) + TALIC*YB(NY)                              28420247
      CALL PLOT(XT,YT,IPEN)                                             28420248
      IPEN = 2                                                          28420249
      GO TO 190                                                         28420250
  180 IPEN = 3                                                          28420251
  190 K = K+1                                                           28420252
      IF (K-INUM) 200,210,210                                           28420253
  200 IF (L) 165,160,165                                                28420254
  210 XO = XO + XB2*DIV                                                 28420255
      YO = YO + YB2*DIV                                                 28420256
  220 NCHR = NCHR+1                                                     28420257
      IF (NCHR-NT) 130,300,300                                          28420258
  202 XO = XO - XB2*DIV                                                 28420259
      YO = YO - YB2*DIV                                                 28420260
      GO TO 220                                                         28420261
  205 X = X + YA2*24.*12./7.                                            28420262
      Y = Y - XA2*24.*12./7.                                            28420263
      XO = X                                                            28420264
      YO = Y                                                            28420265
      GO TO 220                                                         28420266
  300 RETURN                                                            28420267
  500 IF (ABS(XPAGE) - 998.9) 510,515,515                               28420268
C.....ASPCT = WIDTH/HEIGHT                                              28420269
  510 ASPCT =0.8*XPAGE                                                  28420270
      SPCT = ASPCT                                                      28420271
      OLDFC = 999.0                                                     28420272
  515 IF (ABS(YPAGE)- 998.9) 520,525,525                                28420273
C.....TALIC = CHANGE OF SLANT OF LETTERS                                28420274
  520 TALIC = YPAGE                                                     28420275
  525 IF (ABS(ANGLE)- 998.9) 530,550,550                                28420276
C.....RSPAC = CHARACTER SPACING, SPACE                                  28420277
  530 RSPAC = ANGLE                                                     28420278
  550 RETURN                                                            28420279
      END                                                               28420280
//S5 EXEC PGM=IEWLF128,PARM='XREF,LET,LIST,SIZE=(300K,100K),NCAL',
//  TIME=6,REGION=310K
//SYSPRINT DD SYSOUT=A
//SYSUT1 DD UNIT=SYSDK,SPACE=(1024,(200,30))
//SYSLIN DD  DDNAME=SYSIN
//DD1    DD DSN=SYS1.FLATBEDD(PLOT),DISP=SHR
//SYSLMOD DD DSN=&&A,
//        UNIT=SYSDK,
//        DISP=(NEW,PASS),
//        DCB=(BLKSIZE=13030),
//        SPACE=(TRK,(8,8,2))
//SYSIN DD *
 CHANGE PLOT(CALPLT)
  INCLUDE DD1(PLOT)
 NAME CALPLT(R)
//  EXEC PGM=IEWLF128,PARM='XREF,LET,LIST,OVLY,SIZE=(300K,100K)',
```

PROGRAM LISTING OF PROGRAM H876 AND JCL FOR LINK EDITING—Continued

```
//  TIME=6,
//  REGION=310K
//SYSLIB   DD  DSN=SYS1.FLATBEDD,DISP=SHR
//         DD  DSN=SYS1.FORTLIB,DISP=SHR
//         DD  DSN=XTENT.LIB,DISP=SHR
//SYSPRINT DD SYSOUT=A
//SYSUT1 DD UNIT=SYSDK,SPACE=(1024,(200,30))
//SYSLIN DD DSN=&&B,DISP=(OLD,DELETE)
//    DD DDNAME=SYSIN
//DD1  DD DSN=SYS1.LOADLIB,DISP=SHR
//DD2  DD DSN=&&A,DISP=(OLD,DELETE)
//SYSLMOD DD DSN=SYS1.LOADLIB,DISP=SHR
//SYSIN DD *
 INCLUDE DD2(CALPLT)
 INCLUDE DD1(H592)
 ENTRY MAIN
  NAME H876(R)
//
```

```
//VG9017B  JOB (934000231,H876),'ALANCROSBY', C&L J725
// CLASS=D
/*ROUTE  PUNCH LOCAL    RE1
//S1 EXEC FORTGC
//FORT.SYSLIN DD DSN=&&A,
//        UNIT=SYSDK,
//        DISP=(NEW,PASS),
//        DCB=(RECFM=FBS,LRECL=80,BLKSIZE=400),
//        SPACE=(TRK,(10,10,2))
C                                       PLOTCAM4
C                                         BY
C                                       ALAN CROSBY
C                                          USGS
C                                          CCD
C
C
C     PLOTCAM READS PLOTTING  INSTUCTIONS THAT HAVE BEEN PREPARED BY CAM
C AND STORED ON A DISK DATA SET.  THE INSTRUCTIONS ARE IN THE FORM:
C X, Y, PEN  CODE.  PLOTCAM USES THE PLOTTING INSTRUCTIONS TO DRAW A
C PLOT ON A TEKTRONIX GRAPHICS DISPLAY DEVICE.
C
C
      REAL NO
      DATA YES/'Y'/,NO/'N'/,END/'E'/
C                         INITIALIZE SOFTWARE AND ERASE SCREEN
      CALL INITT(120)
C                                       SOLICIT OPTIONS
  100 CALL HOME
      CALL ANMODE
      WRITE(6,3)
    3 FORMAT('  ')
      WRITE(6,1)
    1 FORMAT(1X,'DO YOU WANT TO USE CURSOR TO SELECT AREA TO BE PLOTTED?
     C   REPLY Y OR N')
      READ(5,5) ANS
    5 FORMAT(A1)
      IF (ANS.EQ.END) GOTO 1000
      IF(ANS.EQ.YES) GOTO 150
      CALL OPKEY(XMIN,XSPAN,YMIN,YSPAN,ANS)
      IF (ANS.EQ.END) GOTO 1000
      GOTO 300
  150 CALL OPCURS(XMIN,XSPAN,YMIN,YSPAN,ANS)
      IF (ANS.EQ.END) GOTO 1000
      GOTO 300
  300 CALL NEWPAG
      CALL ANMODE
      WRITE(6,10) XMIN,XSPAN,YMIN,YSPAN
   10 FORMAT(1X,'XMIN= ',F6.2,'  XSPAN= ',F6.2,'  YMIN= ',F6.2,
     C'  YSPAN= ',F6.2)
C                                       PLOT THE DATA
      CALL VWINDO  (XMIN,XSPAN,YMIN,YSPAN)
  500 READ(23,2,END=1000) X,Y,NPEN
    2 FORMAT(2F10.6,I5)
C                                       PEN UP?
      IF (NPEN.EQ.2)  GOTO 600
C                                       PEN DOWN?
      IF (NPEN.EQ.3)  GOTO 700
      IF (NPEN.EQ.3)  GOTO 700
C                                       TEST FOR EOF SIGNAL
      IF (NPEN.EQ.999) GOTO 1000
C                                     IGNORE NEGATIVE PEN POSITIONING CODES
```

```
      IF (NPEN.LT.0) GOTO 500
C
C                                          ERROR, NPEN NE 999, 2, OR 3; SKIP IT
      GOTO 500
C                                          NPEN=2, DRAW A LINE.
  600 CALL DRAWA(X,Y)
      GOTO 500
C                                          NPEN=3, MOVE CURSOR.
  700 CALL MOVEA(X,Y)
      GOTO 500
 1000 CALL BELL
C      MOVE CURSOR TO 2ND LINE FROM THE BOTTOM OF THE SCREEN.
      CALL  MOVABS(0,30)
      CALL ANMODE
      WRITE(6,11)
   11 FORMAT(1X,'DO YOU WANT TO PLOT THE FILE AGAIN?  REPLY Y OR N')
      REWIND 23
      READ(5,5) ANS
      IF(ANS.EQ.NO) GOTO 2000
      GOTO 100
 2000 CALL FINITT(0,0)
      END
      SUBROUTINE OPKEY(XMIN,XSPAN,YMIN,YSPAN,ANS)
      REAL NO
      DATA YES/'Y'/,NO/'N'/,END/'E'/
      CALL NEWPAG
      WRITE(6,4)
    4 FORMAT(1X,'USE DEFAULT WINDOW SIZE?  REPLY Y OR N')
      READ(5,5) ANS
    5 FORMAT(A1)
      IF (ANS.EQ.END) GOTO 300
      IF(ANS.EQ.YES) GOTO 200
      CALL NEWPAG
      WRITE(6,6)
    6 FORMAT(1X,'ENTER MINIMUM VALUE OF X')
      CALL GETNUM(XMIN,ANS)
      IF (ANS.EQ.END) GOTO 300
      WRITE(6,7)
    7 FORMAT(1X,'ENTER SPAN OF X')
      CALL GETNUM(XSPAN,ANS)
      IF (ANS.EQ.END) GOTO 300
      WRITE(6,8)
    8 FORMAT(1X,'ENTER MINIMUM VALUE OF Y')
      CALL GETNUM(YMIN,ANS)
      IF (ANS.EQ.END) GOTO 300
      WRITE(6,9)
    9 FORMAT(1X,'ENTER SPAN OF Y')
      CALL GETNUM(YSPAN,ANS)
      GOTO 300
C                  SET DEFAULT WINDOW SIZE
  200 XMIN=0.
      XSPAN=47.6
      YMIN=0.
      YSPAN=35.
      GOTO 300
  300 RETURN
      END
      SUBROUTINE OPCURS(XMIN,XSPAN,YMIN,YSPAN,ANS)
      REAL NO
      DATA YES/'Y'/,NO/'N'/,ELO/Z00000065/,EUP/Z00000045/,END/'E'/
C             SOLICIT DEFINITION OF AREA TO BE PLOTTED.
```

```
      CALL BELL
      CALL ANMODE
      CALL VCURSR (ANS,XL,YL)
C     'E' IS SIGNAL TO STOP CURRENT PLOT
      IF (ANS.EQ.EUP) GO TO 900
      IF (ANS.EQ.ELO) GOTO 900
      XMIN=XL
      YMIN=YL
      CALL BELL
      CALL ANMODE
      CALL VCURSR (ANS,XR,YR)
C     'E' IS SIGNAL TO STOP CURRENT PLOT
      IF (ANS.EQ.EUP) GO TO 900
      IF (ANS.EQ.ELO) GOTO 900
      XSPAN=XR-XMIN
      YSPAN=YR-YMIN
      CALL NEWPAG
      CALL ANMODE
      WRITE(6,1)
    1 FORMAT(1X,'SET X SO THAT THE RATIO OF Y/X = 11/15?  REPLY Y OR N')
      READ(5,2) ANS
    2 FORMAT(A1)
      IF (ANS.EQ.END) GOTO 1000
      IF (ANS.EQ.NO) GOTO 1000
      XSPAN=1.36*YSPAN
      GO TO 1000
900   ANS = END
 1000 RETURN
      END
C*****************************************************************************00000010
C                                                                             00000020
C                                                                             00000030
C                              GETNUM                                         00000040
C                                                                             00000050
C                             WRITTEN BY                                      00000060
C                                                                             00000070
C                             ALAN CROSBY                                     00000080
C                                                                             00000090
C                              USGS, CCD                                      00000100
C                                                                             00000110
      SUBROUTINE GETNUM(X,ANS)
      DIMENSION A(6)
      DATA END/'E'/
      CALL ANMODE                                                           00000130
      WRITE(6,1)                                                            00000140
1     FORMAT(1X,'ENTER NUMBER IN THE FORMAT NNN.NN')                        00000150
      CALL REREAD
      READ(5,4) A
4     FORMAT (6A1)
      IF (A(1).NE.END) GO TO 500
      ANS = A(1)
      GO TO 1000
C             THE FOLLOWING STATEMENT IN COMBINATION WITH REREAD
C             ALLOWS AN INPUT MESSAGE TO BE READ MORE THAN ONCE
C             SO IT MAY BE TRANSLATED USING DIFFERENT FORMAT
C             STATEMENTS.
500   READ(99,2) X
2     FORMAT(F6.2)                                                          00000170
      WRITE(6,3)X                                                           00000172
3     FORMAT(1X,F6.2)                                                       00000173
1000  RETURN
```

```
      END                                                              00000190
//S3 EXEC PGM=IEWLF128,PARM='XREF,LET,LIST,SIZE=(300K,100),DCBS',
// REGION=310K
//SYSLIB DD DSN=SYS1.TEKTRON.LOAD,DISP=SHR
//        DD DSN=SYS1.FORTLIB,DISP=SHR
//         DD DSN=XTENT.LIB,DISP=SHR
//SYSPRINT DD SYSOUT=A
//SYSUT1 DD UNIT=SYSDK,SPACE=(1024,(200,30))
//SYSLIN DD DDNAME=SYSIN
//DD1 DD DSN=&&A,DISP=(OLD,DELETE)
//SYSLMOD DD DSN=SYS1.LOADLIB,DISP=SHR
//SYSIN DD *
 INCLUDE DD1
 ENTRY MAIN
 NAME J725(R)
//
```

FILE FORMATS FOR CAM TO DISK PROGRAM H876

CAM to Disk uses the same input- and output-file formats as the standard version of CAM. These formats are described by the U.S. Central Intelligence Agency (1975). The plotting instructions prepared by CAM to Disk are output via the DD statement FT22F001. The plotting-instructions record has the following format:

Position	Contents
1–10	a value in the X direction (f10.6)
11–20	a value in the Y direction (f10.6)
21–25	a CalComp pen-movement code

THE SYMBOL PROBLEM

The newer versions of the CalComp software do not draw symbols. When a symbol is needed, a code for the symbol is recorded on the plot tape. When the tape is plotted, the CalComp plotter recognizes the symbol code and draws the symbol. This method of generating symbols had to be circumvented in CAM to Disk because the plotting instructions were being passed to Tektronix software, rather than to a CalComp plotter.

Nancy Wright had a copy of the old CalComp subroutine Symbol; it draws symbols instead of passing codes. I renamed it Teksym and included it in the CAM to Disk program.

The table of available symbols in Teksym does not agree with the latest symbols in the CalComp software. I wrote Trnslt to translate to the codes presently in use. I wrote Symbol to gain control from CAM, translate codes if necessary, and pass control to Teksym.

TSO COMMAND PROCEDURE CAM.CLIST

```
00020 PROC 0 PLOT (NONAME)
00030 PRINT '          »»»»»»»»»WELCOME TO
  INTERACTIVE CAM««««'
00060 FREE FI (FT05F001,FT06F001,
  FT23F001)
00070 ALLOC FI (FT05F001) DA(*)
00080 ALLOC FI (FT06F001) DA(*)
00090 ALLOC FI (FT23F001) DA('PLOT.
  DATA.SET(&PLOT.)') SHR
00100 CALL 'SYS1.LOADLIB (J725)'
00110 FREE FI (FT05F001,FT06F001,FT23F001)
00120 END
```

FILE FORMATS FOR PLOTCAM PROGRAM J725

The plotting instructions to Plotcam prepared by CAM to Disk are input via the DD statement FT23F001 and have the following format:

Position	Contents
1–10	a value in the X direction (fl0.6)
11–20	a value in the Y direction (fl0.6)
21–25	a CalComp pen-movement code

The output of the Plotcam program is the map drawn on the terminal.

GLOSSARY

Alphanumeric information (alphanumeric, alphameric)–Information consisting of any combination of digits 0-9, letters A-Z, and special characters such as /, $, or ?.

Assumed decimal point (implied decimal point)–A decimal point whose position is known, even though it is not physically entered (punched) into a numeric field.

Batch processing (batch job)–The sequential processing of records, programs, or jobs as a group (batch), one group at a time. Batch processing is in contrast to "interactive processing," during which each unit of data is processed immediately at the time of presentation–as in the airline reservation system.

CAM–The Cartographic Automatic Mapping System devised by the U.S. Central Intelligence Agency to convert digitized data into geographic coordinates and to draw maps automatically.

Catalog–A predefined direct-access storage area containing names and addresses of cataloged procedures and data sets.

Cataloged procedure–A job-control-language generator operating in a manner similar to a variable in an algebraic equation.

CLIST – The suffix of the name of a data set that contains a time-sharing option (TSO) command procedure. Name derived from catalog list.

Command – In the sense used in this Circular, a command is an instruction issued by the terminal user in a given command-language structure, such as GIPSY or TSO command language.

Command procedure – See TSO command procedure.

COPY – One of the GIPSY retrieval-language commands available to the user. Provides fixed-length record output from variable-length GIPSY records.

CRIB – Computerized Resources Information Bank – a computer file on mineral resources. It is operational but has not yet attained complete coverage. See Calkins and others (1973, 1978) and Keefer and Calkins (1978).

CRT – A cathode ray tube. Some CRT's display graphical information; others display alphanumeric information.

Data Definition (DD) statement – A particular JCL (job-control language) statement. Describes a given data set associated with the job.

Data item (data element, information item) – The smallest unit of information to which reference is made, for example "country," "State." A set of related data items constitutes a record.

Data set – A self-contained group of records.

Direct access – The process of finding information in storage directly by using an index, rather than by starting the search at the beginning of storage and searching sequentially until the information is found. A tape is a sequential-access device. A disk is a direct-access device.

Disk (disk pack) – A storage device consisting of a circular metal plate (disk) coated with magnetic material on both sides and mounted on a rotating shaft. Read-write heads service both sides of the disk. Stacked disks constitute a disk pack.

Field (data item, information item) – A specified category of data. The basic unit of a record. See also data item.

File – A collection of related records treated as a unit; for example, the records file and dictionary file of CRIB. Also in the general sense, a collection of related files; for example, the CRIB file, which actually consists of three files.

File maintenance – Modification of file content; for example, insertions, deletions, transfers, and corrections.

Fixed-field-length format (fixed-length fields, fixed fields) – An arrangement in which the fields in a record are set to a specified length.

Fixed-field records – Records of predefined length and loosely used to mean that both record length and field length are set to specified lengths.

Floating decimal – A decimal point without a predetermined fixed position within a numeric field. In a six-position number field, for example, the decimal may be in any of the six positions, depending upon the size of the number.

Format – A logical arrangement. A predefined arrangement of characters, fields, print lines, and so forth.

GIPSY – General Information Processing System. The retrieval and file-management program written by people at the University of Oklahoma.

Hardware – The physical, tangible components of a computer system, such as: a tape drive, central processor, or disk.

Interactive processing – The user is communicating with the computer system in a "conversational" manner from a terminal by sending instructions (commands, parameters, data) to the system. The system executes the instructions and sends the reply (result) back to the terminal. Each entry is processed immediately at the time of presentation. Interactive processing is in contrast to batch processing in which the time of processing of a given statement (or job) depends upon the number and length of statements (or jobs) in front of it.

Job (job run) – A collection of related programs, files, and instructions executed as a single unit of work by the computer.

Job control language (JCL) – The language of the operating system of the computer. The user provides the necessary information in the JCL so that the computer system can run the job. JCL includes such items as the name and address of the data file to be processed, the name of the program to be executed, what to do with the results, and so forth.

Job deck – A deck of punched cards which constitutes a job.

Label – As used in GIPSY, a set of one to seven alphanumeric characters used to identify a data item or field to GIPSY program.

Literal – In GIPSY, a set of characters inserted into output records written by the copy command.

Off line–Pertaining to devices not connected to the computer.

On line (on-line processing)–Essentially equivalent to "interactive." Also, describes a device having direct entry into the computer.

Operating system–The set of management programs that handles the flow of jobs through a computer, including: job scheduling, input and output control, and so forth.

Parameter statements (search variables)–A list of the data elements the computer is to search for during a retrieval. In general, any convention one uses to control a computer process by providing information (parameters).

Partitioned data set–A data set divided into individually addressable subsets (partitions). Each partition is called a "member," and has a "member name."

Program–A set of instructions that tells the computer how to solve a problem.

Record (records)–A group of data items (fields) treated as a unit.

Retrieval operation–The actions connected with the recovery of information stored in a computer storage device.

Software–Programs.

Subroutine–A program that is subordinate to a main program (routine). A subroutine performs specific taks whenever the main program calls upon it to do so.

Tektronix graphic terminal–A CRT (cathode-ray-tube) computer terminal that is made by Tektronix, Inc., and that is capable of drawing lines, symbols, and alphanumeric characters. The Tektronix graphic terminal was used to devise and implement Quick-Plot and Interactive CAM systems.

Track address–A number identifying the location where information is stored on disk. A disk contains concentric circles (tracks) where information is recorded. Each track has an address.

TSO–Time sharing option. One of the time-sharing systems of the IBM 360/370 series computers.

TSO command procedure (TSO procedure)–A predefined set of TSO command statements by which the computer performs a sequential series of processing tasks automatically. Thus, by invoking just one command, the user has a complete set of related, at times complex, tasks done for him. It performs in the time-sharing mode a function similar to that performed by JCL in the batch mode.

Utility programs–Programs used to peform certain standard functions, called housekeeping functions; for example, update, transfer data from one device to another, sort programs, and so forth.

Variable fields (variable-length fields)–Fields having no predefined lengths.

Variable format (variable-length format)–A field or record of no predefined length.

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