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THE SACLANTCEN OCEANOGRAPHIC DATA BASE
VOL. II: ACCESS, INTERROGATION AND DISPLAY

by

RICHARD F.J. WINTERBURN

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NORTH ATLANTIC TREATY ORGANIZATION

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Richard F.J. Winterburn

15 June 1981

This memorandum has been prepared within the SACLANTCEN Underwater Research Division as part of Project 01.

O.F. Hastrup

O.F. HASTRUP
Division Chief

TABLE OF CONTENTS

List of Figures

List of Figures (Cont'd) Page

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Vol. II: ACCESS, INTERROGATION AND DISPLAY

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Richard F.J. Winterburn

ABSTRACT

An oceanographic data base established at SACLANTCEN on an 'in-house' UNIVAC 1106 computer system is described. Volume I discusses the design criteria used in setting up the data base, lists its structure and content, and explains how acquired data, either from outside institutions or from SACLANTCEN experiments are re-formatted and entered. Volume II describes how data are accessed, interrogated, and displayed, including the plotting of charts with coastlines and of contoured data.

INTRODUCTION

An oceanographic data base has been established using an in-house UNIVAC 1106 computer system. Volume I <1> describes the background to the establishment of the data base, discusses the design criteria used in setting it up, lists its structure and content, and explains how acquired data are reformatted and entered.

The present document, Volume II, goes on from that point by describing the methods and facilities developed to access, interrogate, and display the contents of the data base. The suite of programs described has been written to produce "standard" outputs of profile display, spatial and temporal distribution charts, and computations of mean profile and gradient. A simple interface, also described, may be included in any user's FORTRAN program to make the contents of the data base available for other purposes.

The executive programs are designed primarily to be used in demand mode from interactive graphics terminals. They call on a library of routines to select, display and analyse data from the base, using as far as possible fully conversational programming techniques. This almost entirely divorces the user from the data-base structure and also from the application programs; thus if one of the outputs described in this report is suitable for a users' needs he may produce it with no knowledge of any programming language or data management system. The only prerequisite is an appreciation of the oceanographic content and a basic knowledge of English.

The function and use of each of those routines is described in Ch. 5, together with examples of the output. A summary of the software requirements is given in Ch. 1, followed by a description of the more important supporting facilities. The successful development of the executive routines depends on efficient data-field definition and retrieval, and wellsupported graphic, cartographic, and interactive-terminal software; these are described in Chs. 2, 3 and 4, respectively.

1 SOFTWARE REQUIREMENTS

As the data base has been created for a number of well-defined applications its retrieval capabilities should closely reflect the output requirements of those applications. These may be summarized as follows:

- To make meso-scale and large-scale climatic studies of oceanographic features in SACLANTCEN's areas of interest.
- To provide an integrated environmental data system for the use of those SACLANTCEN projects that require pre-cruise appraisal and post-cruise analysis of oceanographic conditions.
- To allow research into the methodology for an historical oceanographic data base with a view to improving its statistical description for use as input to oceanographic forecasting and acoustic prediction models.
- To provide historical ocean-surface data to be used for intercomparison with remotely-sensed data and real-time surface data.

These applications therefore require the retrieval of data both in space and time and the description of data individually, summarily, and collectively.

2 DATA-RETRIEVAL FIELD DEFINITION

2.1 General

Every retrieval of data from the data base requires a clear field definition; this is done in conversational mode by a routine called CAMPO (see Sect 2.5).

As was described in detail in Vol. I <1>, the data are stored by means of a system of attribute keys and within every data record a dictionary area contains additional unique information about that particular profile, each item of which may be regarded as a key. These keys can be thought of as primary and secondary in the sense that

(a) Primary keys are those that provide direct access to a data record by virtue of its file name/element name,
Instrument – Marsden Square (MSQ) – One-degree Square (DSQ) – Month
(b) Secondary keys are those that are stored within the data record but may be used for data selection,
Position – Date – Time – Country – Ship – Cruise

These, however, may only be interrogated sequentially within one series of primary key combinations.

Data retrieval is therefore facilitated by the use of these keys, and may be conveniently divided into three distinct data-field definition criteria i.e. Spatial, Temporal, and Source.

2.2 Spatial Definition

Spatial definition is possible by using one of the four methods displayed graphically in Fig. 1.

2.2.1 Marsden area

This allows retrieval of data from a particular Marsden square or one of its 1° sub-squares (Fig. 2). It is the quickest, most direct of the four methods as no computation is required to create the data-file keys, whereas the other methods require additional input data and computation with which to create the keys.

2.2.2 Rectangular area

This allows retrieval within a given geographical area, whose limits are defined as shown in Fig. 3a.

These limits may be input directly as signed numerical values, or, they may be input interactively using the cursor of a graphic-display terminal. The latter method is defined as shown in Fig. 3b when input on a chart displayed on the terminal screen. From these cursor values the limits are computed as values of latitude and longitude, which then allows the computation of the MSQ/DSQ coverage.

2.2.3 Circular Area

This allows retrieval within a given circular area defined by the position at the centre and a range in nautical miles (Fig. 4). The geographic limits of the north, south, east and west extremities of this circle are computed, followed by the relevant MSQ/DSQ coverage.

2.2.4 Ground Track

This allows retrieval within an area defined as a swath along a computed ground track between two positions as defined in Fig. 5. The swath width is the total width in n.mi. From those input data the geographic extremities of the catchment area are computed, followed by the MSQ/DSQ coverage.

During the data-retrieval phase, the data are retrieved using the MSQ/DSQ coverage but only those data falling within the relevant area, be it rectangular, circular or a track swath, are extracted from the data base.

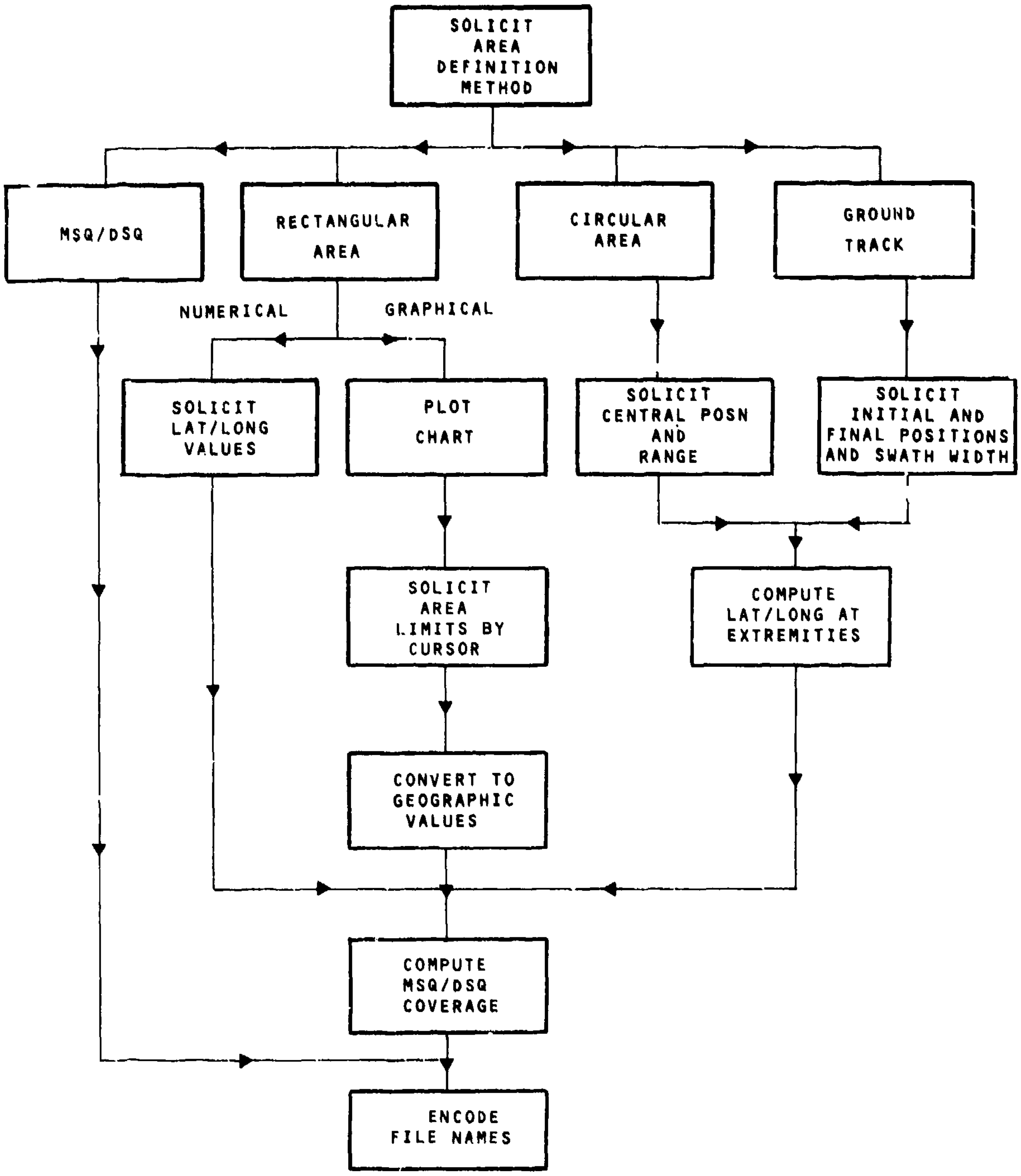

FIG. 1 SPATIAL RETRIEVAL METHODS

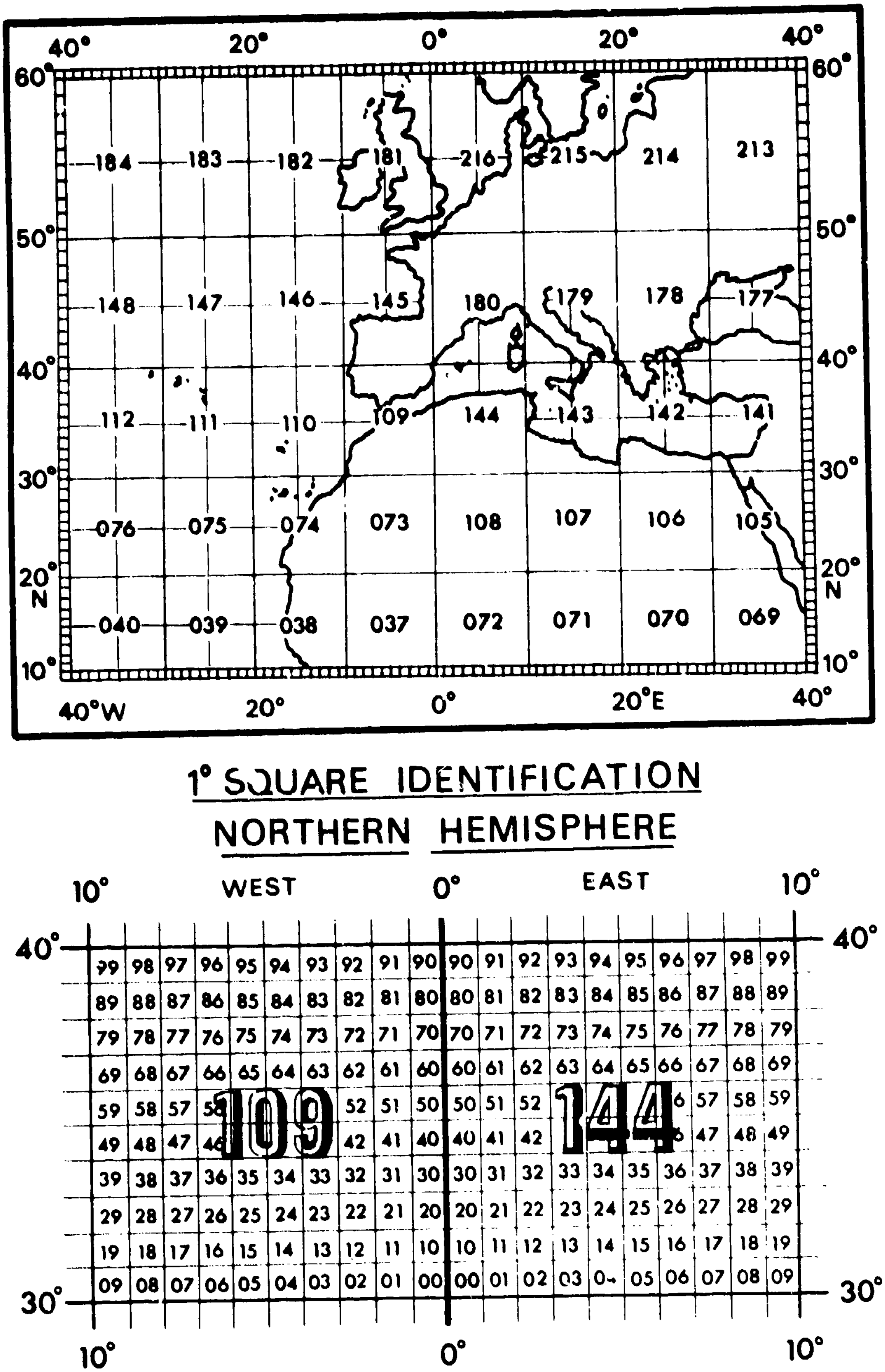

FIG. 2 MARSDEN SQUARE IDENTIFICATION

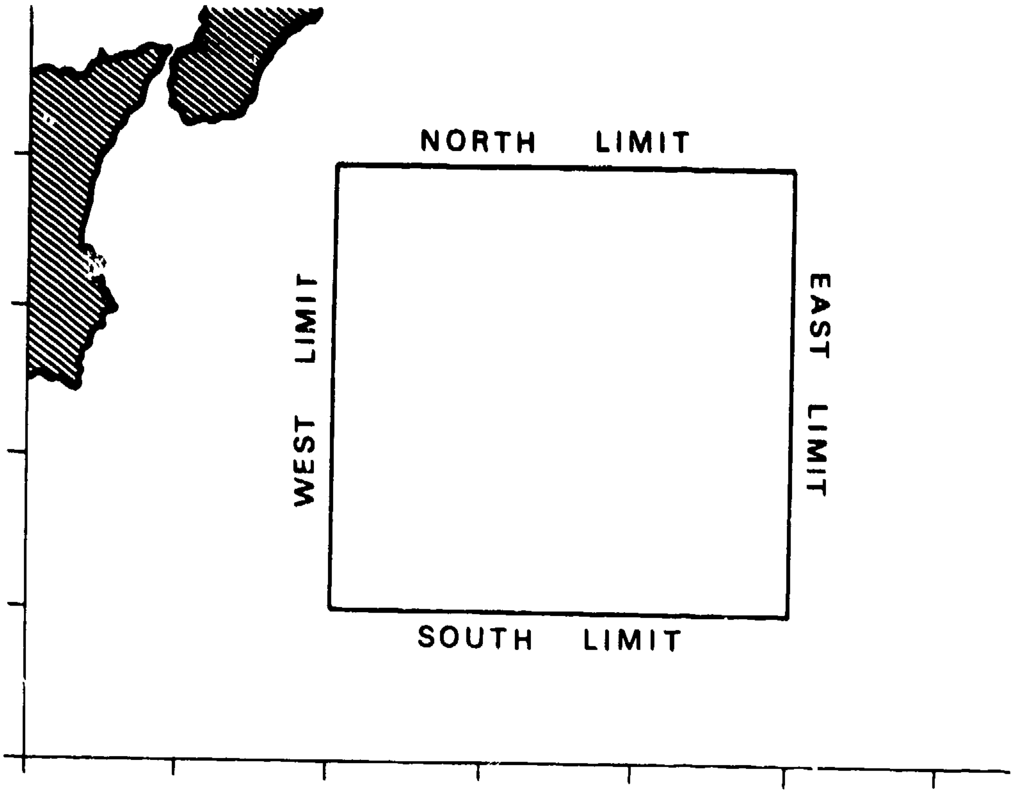

FIG. 3(a) RECTANGULAR AREA DEFINITION-DIRECT

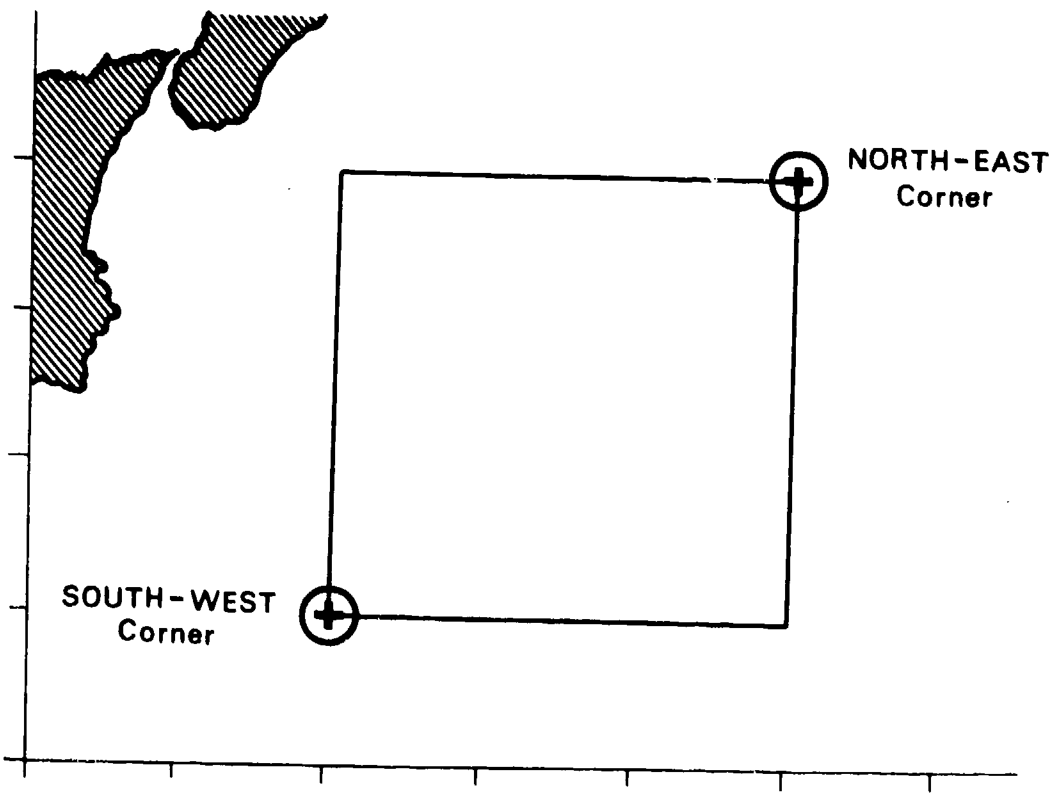

FIG. 3(b) RECTANGULAR AREA DEFINITION-INTERACTIVE

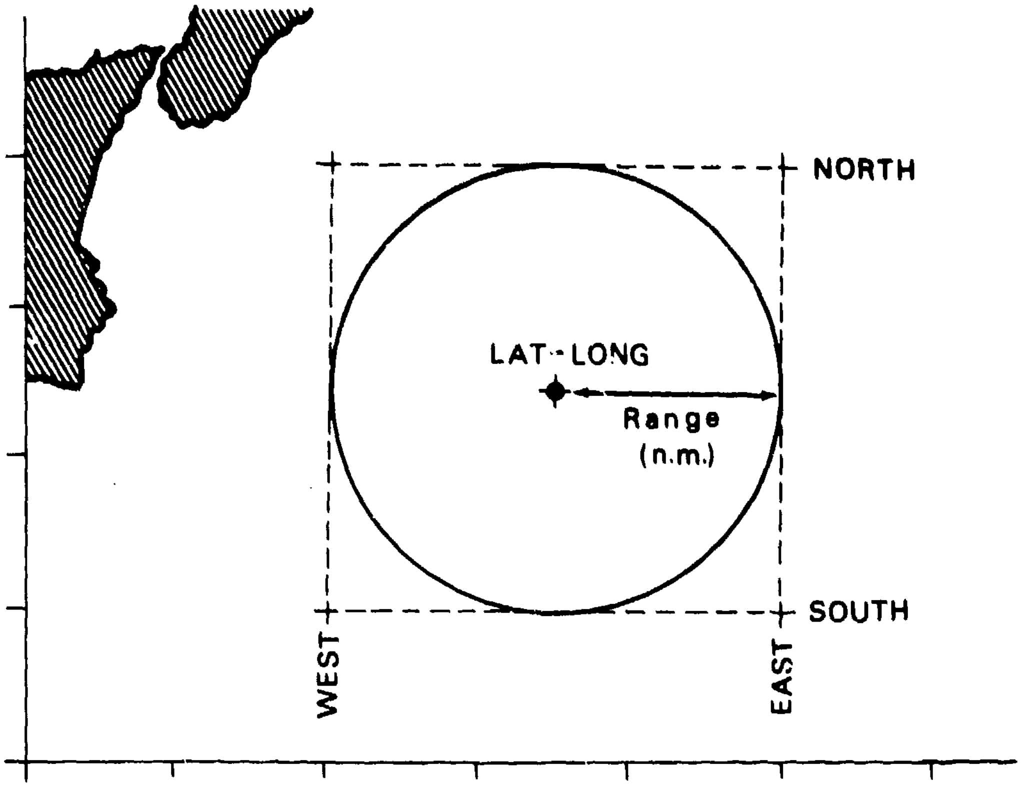

FIG. 4 CIRCULAR AREA DEFINITION

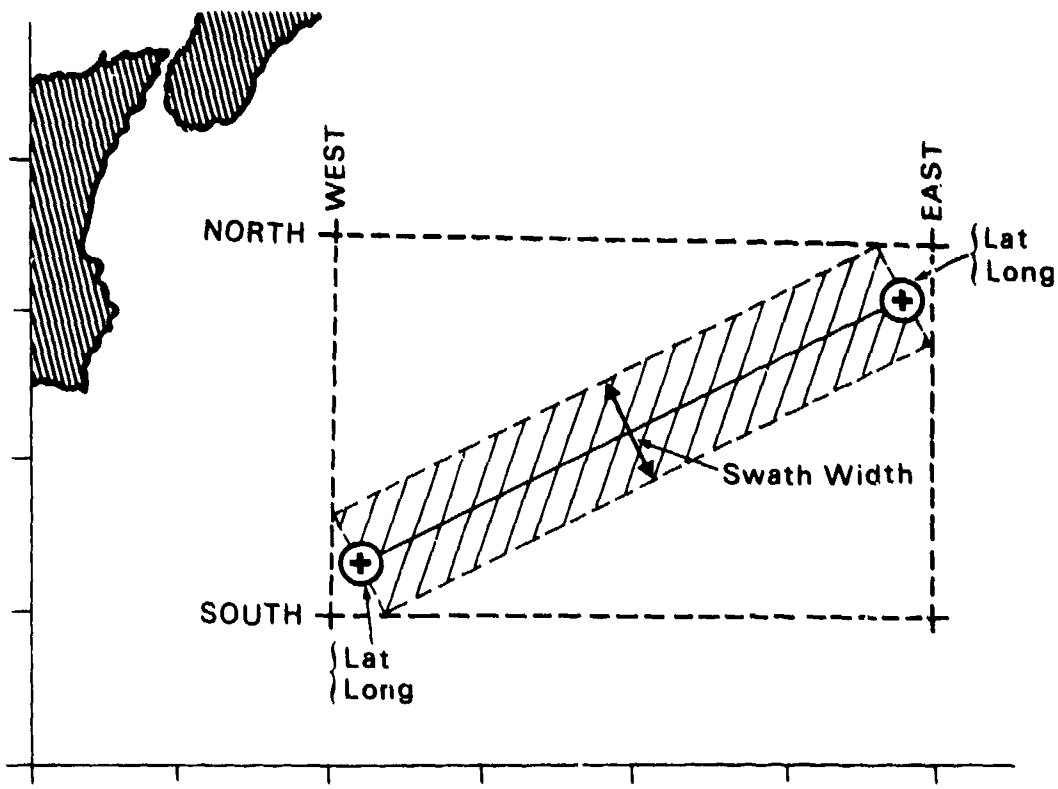

FIG. 5 GROUND TRACK DEFINITION

2.3 Temporal Definition

The month o observation is a direct key by which data may be retrieved without examining the record contents. Within the dictionary area, Year, Day and time of day are recorded and may be used for selection purposes; the standard field definition software, however, offers only Month and Year as a selection key.

2.4 Source Definition

Within this group are four parameters that may be defined for data retrieval

(a) Instrument (b) Ship (c) Country (d) Cruise (SACLANTCEN only).

Of which (a) is a direct key, (b) and (c) are dictionary items as described in <1>, and (d) is an in-house identifier used only for data recorded by SACLANTCEN.

2.5. Conversational Selection Routine (CAMPO)

This routine is called by each executive program to define the data selection within the fields described previously. It is totally conversational by requesting each data field to be defined, using a philosophy of:

HOW MANY? and WHICH?

a response of 999 to the HOW MANY? question signifies that all available data within the field are required, in which case the second question is skipped.
All responses are solicited by the SOE (>) character.
It should be noted that in all data descriptions within this memorandum, north latitude and east longitude should be input as positive, whereas south latitude and west longitude should be input as negative values.

The demands made by this routine are:

```
HOW MANY INSTRUMENTS DO YOU WISH TO SEARCH
ANSWER 1 TO 5 OR 999 FOR ALL
>
PLEASE LIST THE INSTRUMENT CODES, WHERE
1 FOR MBT * NON-SACLANTCEN
2 FOR XBT * NON-SACLANTCEN
3 FOR NC * NON-SACLANTCEN
4 FOR SACLANTCEN XBT DATA
5 FOR SACLANTCEN STD DATA
>
YOUR DATA AREA MAY BE DEFINED SPATIALLY
BY USING ONE OF THE FOLLOWING METHODS:
1 BY DEFINING A MARDSEN SQUARE/DEGREE SQUARE LIST
2 BY DEFINING NORTH, SOUTH, EAST AND WEST GEOGRAPHICAL LIMITS
3 BY INTERACTIVE MAP SELECTION (DEMAND MODE ONLY)
4 BY DISTANCE FROM A POSITION
  (I.E. WITHIN A CIRCLE OF RADIUS DISTANCE)
5 BY DEFINING IN A TRACK AND SWATH
>
```

If the response is 1:

```
A MAP OF THE ATLANTIC AND MEDITERRANEAN COASTLINES
WILL NOW BE PLOTTED.  WHEN THE CURSOR IS ENABLED,
INPUT THE SOUTH-WEST AND NORTH-EAST CORNERS
>
```

This will be followed by a report on the area selected and the MSQ/DSQ list will be computed.

If the response is 2:

```
PLEASE INPUT YOUR AREA LIMITS IN
DEGREES AND MINUTES OF LATITUDE AND
LONGITUDE IN THE ORDER TOP, BOTTOM, RIGHT AND LEFT
>
```

The MSQ/DSQ list will now be computed.

If the response is 3:

```
HOW MANY MARSDEN SQUARES DO YOU WISH TO SEARCH?
ANSWER EITHER 1 TO 23
OR 999 FOR ALL
>
PLEASE LIST THE MSQ NUMBERS
>
FOR MARSDEN SQUARE [repeated for each MSQ requested]
HOW MANY DEGREE SQUARES DO YOU WISH TO SEARCH?
ANSWER EITHER 1 TO 99
OR 999 FOR ALL
>
PLEASE LIST DEG. SQU. NUMBERS
>
```

If the response is 4:

```
PLEASE INPUT THE POSITION IN TERMS OF
LATITUDE AND LONGITUDE (DEGS AND MINS S AND W NEGATIVE)
FOLLOWED BY THE DISTANCE IN N.MI.
```

If the response is 5:

```
PLEASE INPUT THE TRACK AND POSITIONS
IN TERMS OF LATITUDE AND LONGITUDE
DEGREES (I) AND MINUTES (F)
SOUTH AND WEST NEGATIVE
FOLLOWED BY THE TOTAL SWATH WIDTH
IN N.MI.
>
MANY YEARS DO YOU WISH TO SEARCH?
ANSWER EITHER 1 TO 70
OR 999 FOR ALL AVAILABLE
>
PLEASE LIST THE YEARS (THE LAST TWO DIGITS E.G. 71 FOR 1971)
>
```

```
HOW MANY MONTHS DO YOU WISH TO SEARCH?
ANSWER EITHER 1 TO 11
OR 999 FOR ALL AVAILABLE
>
PLEASE LIST THE MONTHS (NUMERIC E.G. 1 FOR JANUARY)
>
IN HOW MANY COUNTRIES DO YOU WISH TO SEARCH?
ANSWER EITHER 1 TO 20
OR 999 FOR ALL AVAILABLE
>
PLEASE LIST THE COUNTRY CODES (E.G. 35 FOR FRANCE)
>
FOR HOW MANY SHIPS DO YOU WISH TO SEARCH?
ANSWER EITHER 1 TO 20
OR 999 FOR ALL AVAILABLE
>
PLEASE LIST THE SHIP CODES (ALPHA E.G. CA FOR CALYPSO)
>
```

3 CARTOGRAPHIC DATA

3.1 General

In the selection and display of oceanographic data it is obvious that cartography plays an important role in clarifying the spatial characteristics of the data.

For data selection, the interactive method (Sect. 2.2.2) requires a graphic-terminal display of coastline. For data display in mapping and horizontal contouring, again a plotted coastline is a valuable enhancement to the output. For these reasons a number of data sets have been created at SACLANTCEN by digitizing the coastline in particular areas of interest; these are described in Sect. 3.2 Horizontal distribution charts and contour plots are produced on the standard Mercator projection, which is the most widely used projection in navigation. This is briefly explained in Sect. 3.3, together with details of the geodetic spheroid options available.

3.2 Coastline Digitization

For a small-scale, low-resolution representation, the entire seaboard of the N. Atlantic Ocean has been digitized at a scale of 1:39 000 000, as shown in Fig. 6; this is used as a general-purpose coastline. As shown in Fig. 7, when a small part of this is selected for enlargment the low resolution of the digitization becomes apparent. For this reason two further data sets, see Figs. 9 and 10., have been created for areas of particular interest. These have been digitized at a much larger scale and the increased detail is apparent by comparing Fig. 7 with Fig. 8 which is the same area but plotted with data digitized at 1:9 000 000.

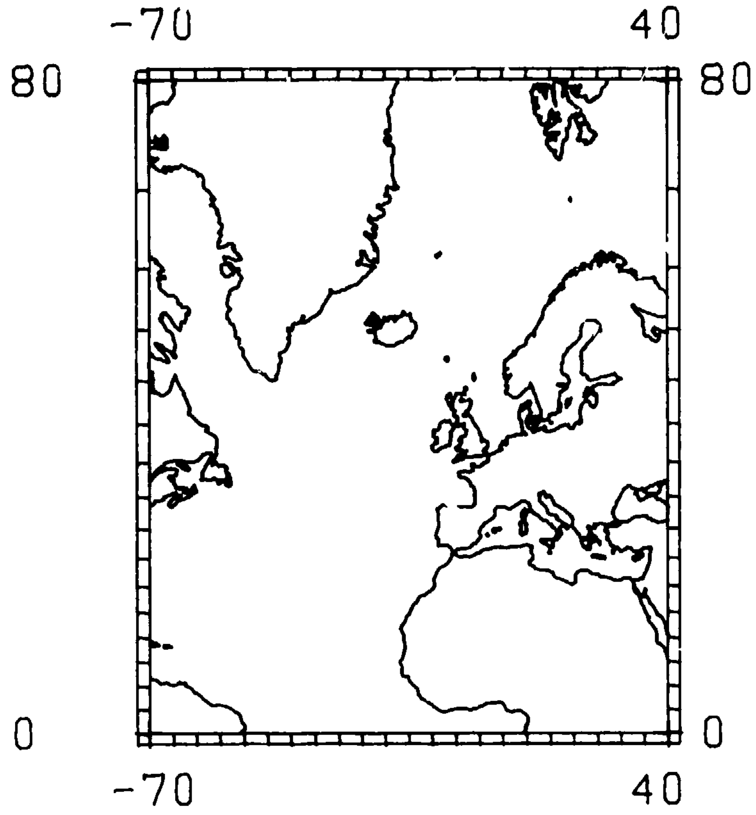

FIG. 6 N. ATLANTIC OCEAN DIGITISED COASTLINE

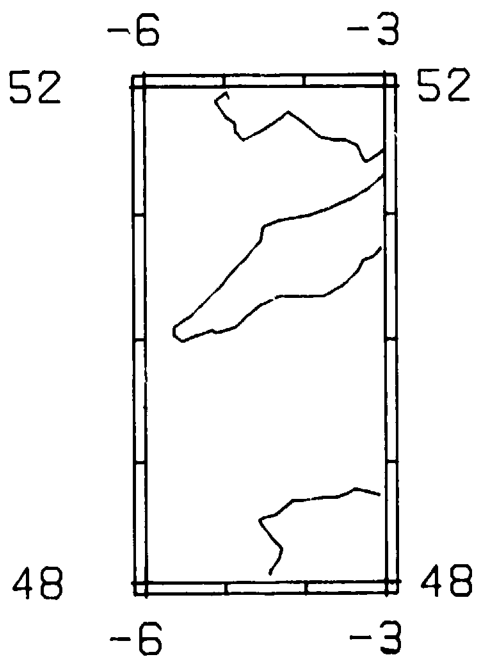

FIG. 7 PART OF N. ATLANTIC OCEAN

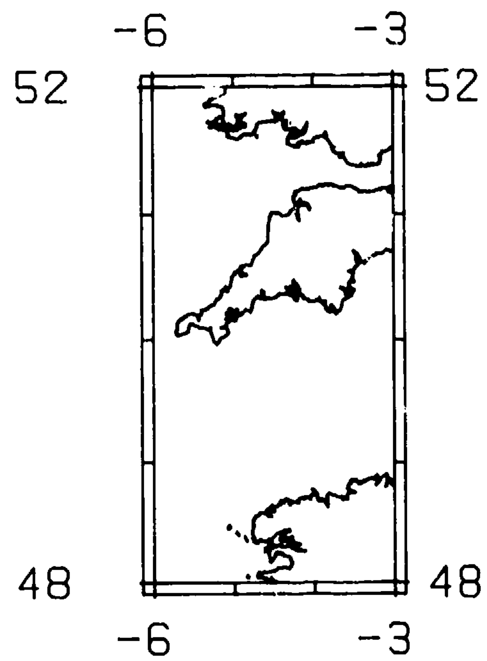

FIG. 8 PART OF S.W. APPROACHES

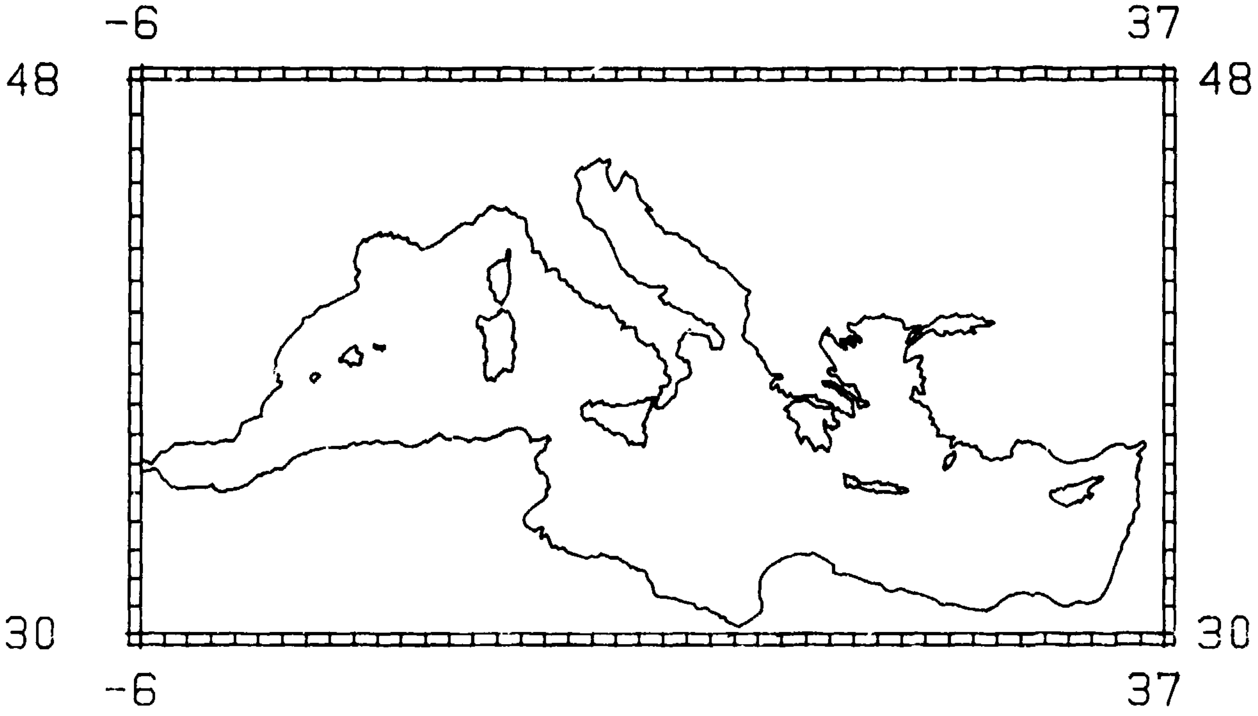

FIG. 9 MEDITERRANEAN DIGITISED COASTLINE

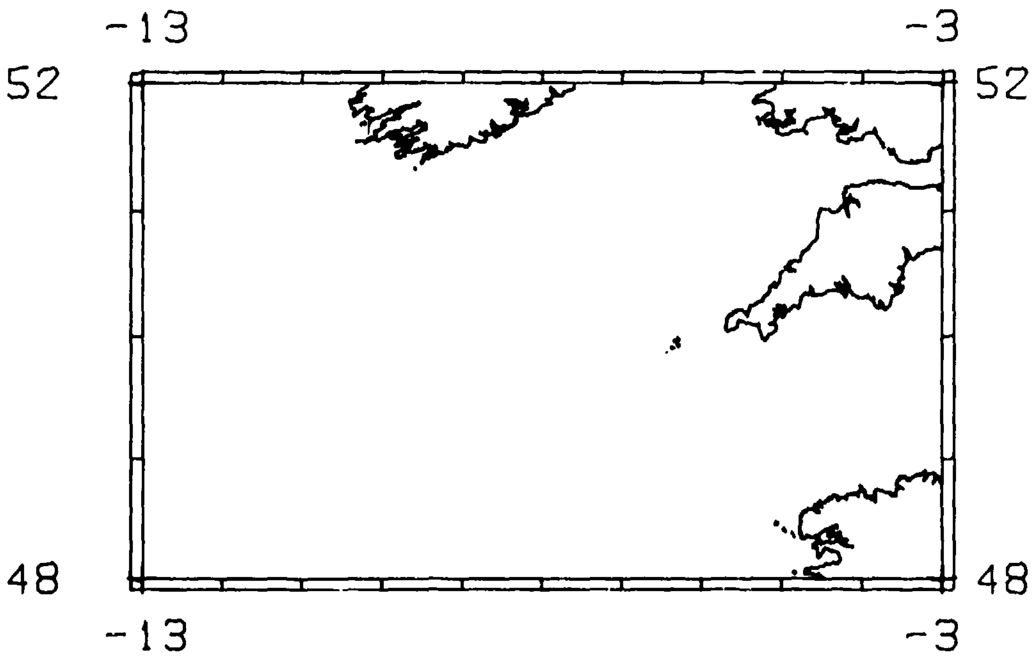

FIG. 10 S.W. APPROACHES DIGITISED COASTLINE

These data sets are selected and accessed by routines COAST and COSTA respectively, the former soliciting the input parameters required by the latter, as follows:

```
PLEASE INDICATE FROM WHICH COASTLINE DATA SET
YOU WISH TO PLOT:
-1 NO COASTLINE
1 MEDITERRANEAN (1:12M)
2 S.W. APPROACHES TO ENGLISH CHANNEL (1:9M)
3 ATLANTIC OCEAN (1:39M)
>
```

If the response is positive then

```
PLEASE SELECT THE LINE WIDTH TO BE USED:
1 THIN LINE
2 THICK LINE
3 DASHED LINE
>
```

3.3 Chart Projection and Geodetic Data

All charts produced by this suite of programs use the standard Mercator projection, which is satisfactory within the latitudes of our areas of research. At higher latitudes, however, a conical projection is more appropriate.

Pearson <2> defines the full numerical solution and gives an excellent overview of the advantages and disadvantages of these and other projections. The mapping programs however make use of a "graphical" solution by computing the projection dimensions through Meridional parts, which is the normal navigation computation as used by Hydrographic Offices <3>.

The Meridional parts are computed by using routine MERPAR, which allows a choice of spheroidal constants to define the reference ellipsoid between the two most widely used Geoids, viz. the International, or Hayfords, 1910 and the World Geodetic System (WGS) 1972, the primary constants for which are defined by the semi-major axis α and the flattening f,

where $f = \frac{\alpha - \beta}{\alpha}$, in which β = semi-minor axis.

The relevant constants being:

<u>International</u>
α = 6378388.0 metres
f = 1/297

<u>WGS</u>

α = 6378135.0 metres
f = 1/298.26

4 SUPPORTING SOFTWARE

4.1 Data Retrieval

An in-house-developed data management system <4>, known as the Mini-Filing System (MFS), is used for all data retrieval and allows direct access to individual data records. The routines of this processor, which are used by the FINDBT routine to extract individual profiles are not documented here. The FINDBT routine is therefore the interface between all the executive programs and the data base by using the MFS routines

OPRDF
REDES
REDATA
CLOS
SETMD

4.2 Graphics

An in-house-developed graphics system <5> is used to create device-independent files of plot instructions. i.e. the files may be subsequently output to either Calcomp plotter or Tektronix screen. The "calcomp-like" calls of this system are used in many routines of the SMODS package but are not documented here. This package is available world-wide as it is now included in the UNIVAC users' library.

4.3 Contouring

A complete package of contouring and three-dimensional plotting routines <6> has been implemented at SACLANTCEN. This extremely powerful package (CCP) allows gridding, smoothing and contouring of irregularly spaced data. It has been adapted and used by the CONTOUR and SECTION executive programs through routines

INSIDE
ZGRID
SMOOTH
GETLEV
CONSEG
DATAPT

5 DISPLAY AND ANALYSIS SOFTWARE

5.1 General

The application software consists of six executive routines that call on a library of 44 sub-routines and also on the previously mentioned UNI*TEKX, MFS and CCP packages. The main programs, written in FORTRAN V are known as

DISPLAY
MAP
MEAN
CONTOUR
SECTION
SIGMAT

and are described in App. A. The function of each of the subroutines is described in App. B and the links between executive programs and sub-programs are illustrated graphically with each main program in Figs. A.1, A.3, A.5, A.7, A.9, and A.11.

Each executive routine is described in terms of function, execution, input-data format, and output-data examples. It will become apparent that, as far as possible, conversational mode programming is employed, almost all the input being solicited by plain-language (English) requests. In addition all responses are checked by the I/O routines for "reasonableness" i.e. invalid responses are rejected and the particular request is repeated but borderline cases can pass as good input data.

CONCLUSIONS

The use of a suite of interactive programs to access, interrogate and display data of the SACLANTCEN Oceanographic Data Base has been described.

These programs produce "standardised" outputs of profile display, horizontal and vertical distribution, mean profile computation and density displays.

A simple interface has been developed that allows any FORTRAN program to access the data within the data base.

As the data base is expanded and its application increased, further reports will be produced to update this users' description.

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6. TAYLOR, J., RICHARDS, P. and HALSTEAD, R. Computer routines for surface generation and display. Ottawa, Department of Mines and Energy, 1971. (Marine Sciences Branch, Manuscript Report Series: 16).

A P P E N D I C E S

APPENDIX A

EXECUTIVE PROGRAMS

A.1 Display Program

Function: To display either graphically and/or numerically, single or multiple profiles of temperature, salinity or sound speed as a function of depth; or to compute for any profile, values of potential temperature, <A.1>, sigma-t <A.2>, density <A.2>, potential density, sound speed <A.5>, and Brunt-Väisälä frequency <A.4>.

Execution:

```
@XQT SMODS*SYSTEM.DISPLAY
```

Subroutines: (see Fig. A.1)

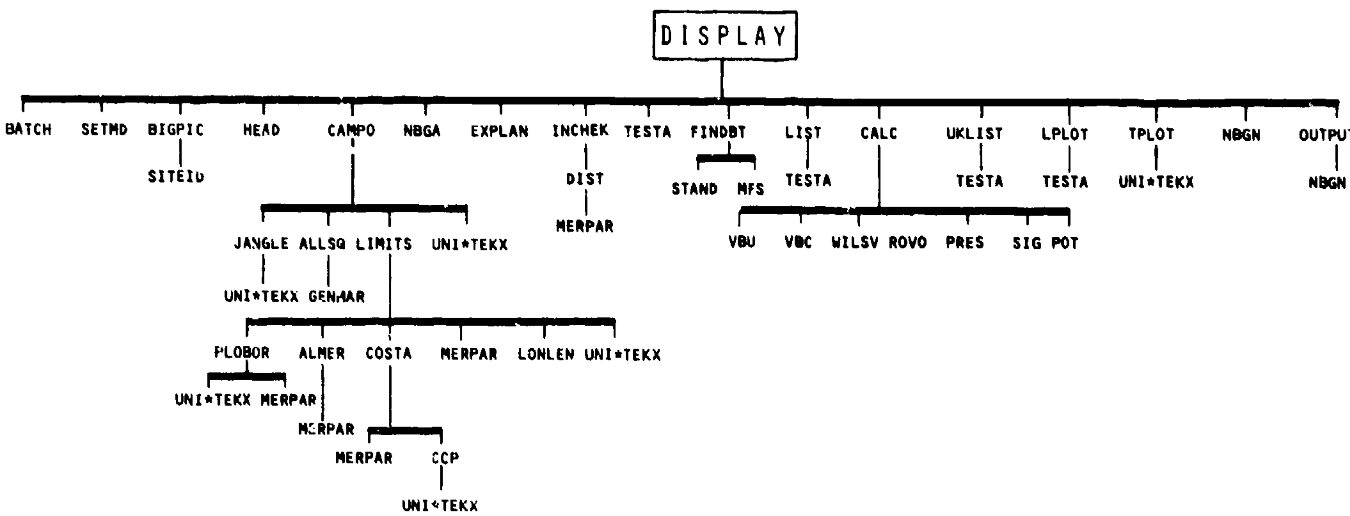

FIG. A.1 ROUTINES OF EXECUTIVE PROGRAM — DISPLAY

Input Data

Field Definition via subroutine CAMPO (see Sect. 2.5 of main text) followed by:

```
WHICH TYPE OF OUTPUT DO YOU REQUIRE?
TYPE 1 LISTING ONLY
TYPE 2 CALCOMP/TEKTRONIX PLOT ONLY
TYPE 3 LISTING AND CALC/TEKT PLOT
TYPE 4 COPY TO MT
TYPE 5 COPY ON DISK VIA MFS
>
```

If a listing is required

```
WHICH STYLE OF LISTING DO YOU REQUIRE?
STYLE 1 HEADING ONLY
STYLE 2 HEADING PLUS OBSERVED LEVELS
STYLE 3 HEADING PLUS STANDARD LEVELS
STYLE 4 HEADING. OBS. AND STAND. LEVELS
STYLE 5 COMPUTATIONAL LISTING AT OBSERVED LEVELS
STYLE 6 COMPUTATIONAL LISTING AT STANDARD LEVELS
```

<u>NOTE</u>: If run in batch mode or on the Tektronix 4014 the print output has a character plot of each trace.

If a plot is required:

```
WHICH PARAMETER DO YOU WISH TO PLOT?
TYPE 1 FOR DEPTH vs TEMPERATURE
TYPE 2 FOR DEPTH vs SALINITY
TYPE 3 FOR DEPTH vs SOUND SPEED
>
WHICH TYPE OF PLOT DO YOU REQUIRE?
TYPE 1 SINGLE PROFILE OF EACH STATION
TYPE 2 MULTIPLE PROFILES (ENVELOPE)
>
PLEASE TYPE MIN AND MAX PARAMETER AXIS VALUES
>
PLEASE TYPE MIN AND MAX DEPTH AXIS VALUES
>
PLEASE TYPE SCALE FACTOR OF PLOT
WHERE 1.0 GIVES A PLOT 5 INS BY 8 INS.
>
```

If a copy on M.T. is required

```
PLEASE ENSURE A TAPE HANDLER
IS AVAILABLE TO BE
ASSIGNED TO YOUR RUN
IF ALL OK TYPE "GO"
>
```

If a copy on disk via MFS is required:

```
PLEASE TYPE
QUALIFIER FILENAME (12 CHARS. EACH)
IN WHICH RECORDS SHOULD BE WRITTEN
>
```

The input-data solicitation is terminated by:

```
THIS CONCLUDES YOUR OUTPUT OPTIONS
IF ALL OK TYPE 999
ELSE TYPE-999
>
```

If the print option has been specified and the run is being executed in demand mode the following request is made

DO YOU WANT YOUR OUTPUT SENT TO THE LINEPRINTER?

If the response is positive, the data is buffered into a temporary mass-storage file using the name 21, which must be output before the

@FIN control statement.

If the response is negative, the output is directed to the terminal screen and, if needed, a hard copy may be taken with the 4631 unit.

<u>Output Data:</u> (see Fig. A.2)

INS	CON	ODOM	MSQ/DSQ	CTY	SHIP	LAT	LONG	D/M/Y	GMT	DEPTH	DFLAG
3	1	11	180/24	35	PT	42 26.5N	04 11.0E	02/07/57	0730	1420.0	
3	2	11	180/24	35	PT	42 34.0N	04 18.0E	03/07/57	0500	1600.0	
3	3	11	180/24	35	PT	42 16.0N	04 35.0E	03/07/57	0830	2200.0	
3	4	11	180/24	35	PT	42 19.5N	04 53.0E	03/07/57	1236	1800.0	
3	5	11	180/24	35	PT	42 36.5N	04 50.0E	03/07/57	1606	1460.0	
3	6	11	180/24	35	PT	42 55.4N	04 44.0E	03/07/57	1924	120.0	
3	1	11	180/25	35	PT	42 58.1N	05 31.3E	03/07/57	0730	1240.0	
3	2	11	180/25	35	PT	42 54.7N	05 57.3E	04/07/57	1906	2080.0	
3	3	11	180/25	35	PT	42 39.5N	05 41.0E	04/07/57	1424	2270.0	
3	4	11	180/25	35	PT	42 42.0N	05 14.0E	04/07/57	0618	1920.0	
3	5	11	180/25	35	CA	42 52.0N	05 26.0E	11/07/55	1400	1900.0	

11 PROFILES HAVE BEEN SELECTED

FIG. A.2(a) DISPLAY — DESCRIPTIVE AREA PRINTOUT

INS	CON	ODOM	MSQ/DSQ	CTY	SHIP	LAT	LONG	D/M/Y	GMT	DEPTH	DFLAG
3	2	11	180/25	35	PT	42 54.7N	05 57.3E	04/07/57	1906	2080.0	

DEPTH	TEMP	SAL	SV	TYP
.0	24.50	37.67	1536.6	6
5.0	24.50	37.67	1536.7	3
10.0	22.30	37.76	1531.5	6
10.0	22.30	37.76	1531.5	3
20.0	17.74	37.93	1519.6	6
20.0	17.74	37.93	1519.6	3
30.0	15.16	38.00	1512.1	6
30.0	15.16	38.00	1512.1	3
40.0	14.32	38.02	1509.6	3
50.0	14.26	38.04	1509.6	6
50.0	14.26	38.04	1509.6	3
75.0	13.88	38.13	1508.9	6
75.0	13.88	38.13	1508.9	3
100.0	13.64	38.02	1508.4	6
100.0	13.64	38.02	1508.4	3
125.0	13.42	38.08	1508.2	6
150.0	13.24	38.13	1508.1	6
200.0	13.03	38.22	1508.3	6
200.0	13.03	38.22	1508.3	3
250.0	13.13	38.29	1509.5	6
300.0	13.19	38.35	1510.6	6
300.0	13.19	38.35	1510.6	3
400.0	13.21	38.41	1512.4	6
400.0	13.21	38.41	1512.4	3
500.0	13.22	38.46	1514.2	6
500.0	13.22	38.46	1514.2	3
600.0	13.18	38.45	1515.7	6
600.0	13.18	38.45	1515.7	3
700.0	13.14	38.43	1517.2	6
700.0	13.14	38.43	1517.2	3
800.0	13.11	38.41	1518.7	6
800.0	13.11	38.41	1518.7	3
900.0	13.08	38.39	1520.3	6
900.0	13.08	38.39	1520.3	3
1000.0	13.06	38.38	1521.8	6
1000.0	13.06	38.38	1521.8	3
1100.0	13.11	38.42	1523.7	6
1100.0	13.11	38.42	1523.7	3
1200.0	13.14	38.45	1525.5	6
1200.0	13.14	38.45	1525.5	3
1300.0	13.08	38.45	1527.0	6
1300.0	13.08	38.45	1527.0	3
1400.0	13.01	38.44	1528.4	6
1400.0	13.01	38.44	1528.4	3
1500.0	12.96	38.44	1529.9	6
1500.0	12.96	38.44	1529.9	3
1750.0	13.00	38.40	1534.2	6
1800.0	13.04	38.38	1535.1	3

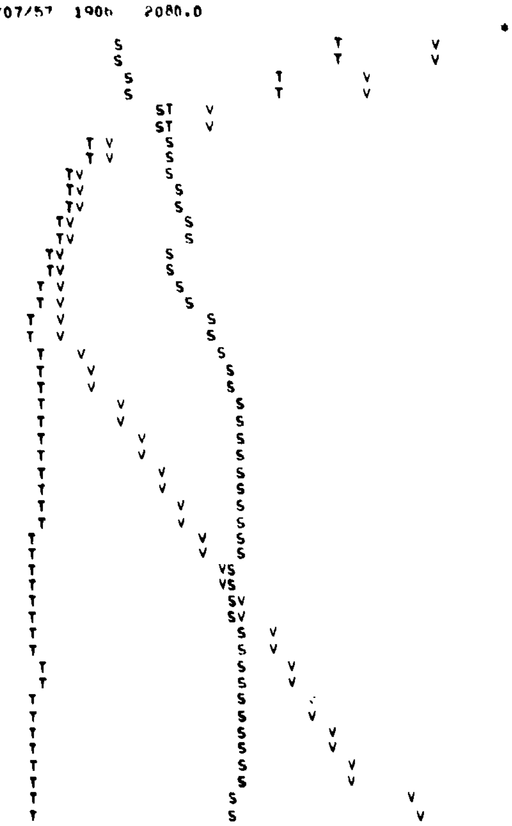

FIG. A.2(b) DISPLAY — PRINTOUT OF ALL DEPTH LEVELS

```
EXPLANATION OF COLUMN HEADINGS
******************************

DEPTH       (M)
TEMP        (C) IN SITU
SALIN       (PPT)
POT TEMP    (C) VIA FOFONOFF
SV COMP     (M/S) VIA WILSON (2ND EQ)
SIGMA T     VIA USNOO
POT DENS       "
DENSITY        "
   BRUNT-VAISALA CALCULATIONS
VBFDU       FREQ(C/HR) UNCORRECTED FOR C**2
VBFDC          "       CORRECTED     "   "
VBPDU       PERIOD (S) UNCORRECTED   "   "
VBPDC          "       CORRECTED     "   "
VBFPD       FREQ. CORR. FOR C**2 AND USING
            POTENTIAL DENSITY GRADIENT
VBPPD       PERIOD CORR. FOR C**2 AND USING
            POTENTIAL DENSITY GRADIENT

****************************************
```

INS	CON	ODOM	MSQ/DSQ	CTY	SHIP	LAT	LONG	D/M/Y	GMT	DEPTH	DFLAG
3	5	11	180/24	35	PT	42 36.5N	04 50.0E	03/07/57	1606	1460.0	

DEPTH	TEMP	SALIN	POT.TEMP	SV COMP	SIGMA.T	POT.DENS	DENSITY
.00	23.120	37.840	23.120	1533.52	26.0713	26.0713	26.0716
10.00	21.640	37.910	21.638	1530.04	26.5487	26.5493	26.5927
20.00	18.360	38.050	18.356	1521.51	27.5335	27.5345	27.6220
30.00	16.140	38.160	16.135	1515.30	28.1619	28.1631	28.2955
50.00	13.370	38.330	13.363	1507.10	28.9125	28.9140	29.1369
75.00	13.120	38.410	13.109	1506.79	29.0270	29.0293	29.3637
100.00	13.110	38.440	13.095	1507.20	29.0524	29.0554	29.5011
125.00	13.130	38.450	13.112	1507.69	29.0559	29.0598	29.6166
150.00	13.150	38.450	13.128	1508.16	29.0517	29.0564	29.7243
200.00	13.160	38.460	13.131	1509.03	29.0574	29.0636	29.9536
250.00	13.130	38.450	13.093	1509.74	29.0559	29.0636	30.1757
300.00	13.100	38.440	13.056	1510.45	29.0545	29.0637	30.3978
400.00	13.070	38.430	13.011	1511.98	29.0530	29.0653	30.8426
500.00	13.040	38.420	12.966	1513.51	29.0515	29.0669	31.2867
600.00	13.000	38.400	12.911	1515.00	29.0443	29.0628	31.7246
700.00	12.970	38.400	12.866	1516.55	29.0505	29.0721	32.1750
800.00	12.950	38.390	12.831	1518.12	29.0469	29.0716	32.6149
900.00	12.930	38.390	12.795	1519.71	29.0511	29.0789	33.0618
1000.00	12.940	38.400	12.790	1521.41	29.0567	29.0878	33.5089
1100.00	12.960	38.410	12.794	1523.15	29.0604	29.0947	33.9530
1200.00	12.990	38.420	12.808	1524.92	29.0619	29.0996	34.3939

	VBFDU	VBFDC	VBPDU	VBPDC	VBFPD	VBPPD
5.000	.022	.021	4.699	4.905	.021	4.907
15.000	.031	.031	3.345	3.417	.031	3.419
25.000	.025	.024	4.137	4.278	.024	4.282
40.000	.020	.019	5.236	5.534	.019	5.542
62.500	.009	.007	11.278	15.771	.007	15.817
87.500	.007	.003	14.492	32.955	.003	33.233
112.500	.007	.001	15.808	78.327	.001	81.469
137.500	.006	-.001	16.371	-97.593	-.001	-91.992
175.000	.007	.001	15.867	84.782	.001	89.430
225.000	.006	.000	16.124	236.552	.000	953.781
275.000	.006	.000	16.130	232.055	.000	1068.370
350.000	.006	.001	16.118	183.496	.000	268.742
450.000	.006	.001	16.134	182.658	.000	269.184
550.000	.006	-.000	16.252	-235.389	-.001	-167.581
650.000	.007	.001	16.027	101.724	.001	111.173
750.000	.006	.000	16.222	296.506	-.000	-489.960
850.000	.007	.001	16.098	113.250	.001	125.845
950.000	.007	.001	16.097	107.419	.001	113.722
1050.000	.006	.001	16.156	122.135	.001	129.281
1150.000	.006	.001	16.217	145.544	.001	153.632

FIG. A.2(c) DISPLAY — COMPUTATIONAL LISTING AT STANDARD LEVELS

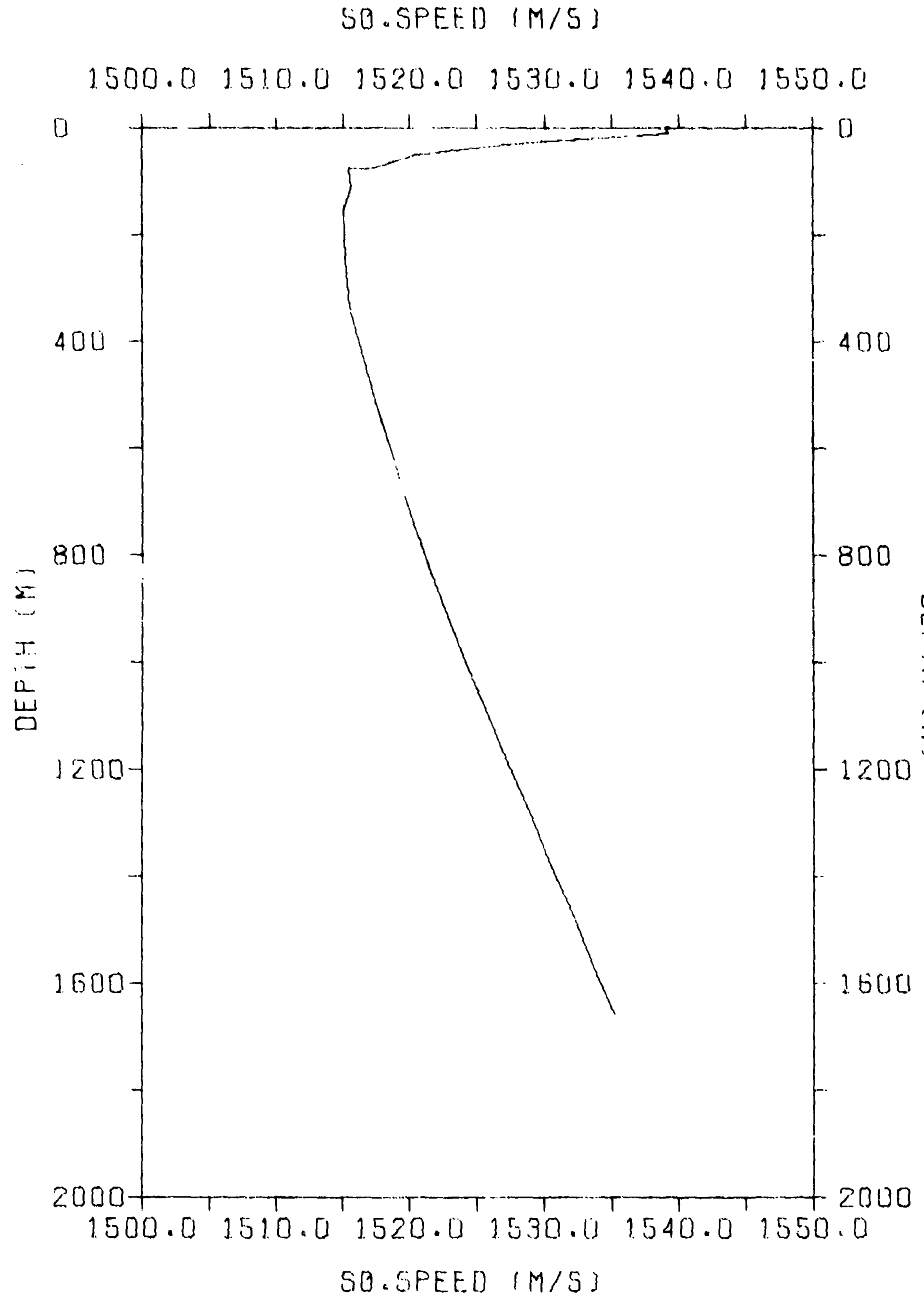

FIG. A.2(d) DISPLAY — SINGLE PROFILE PLOT

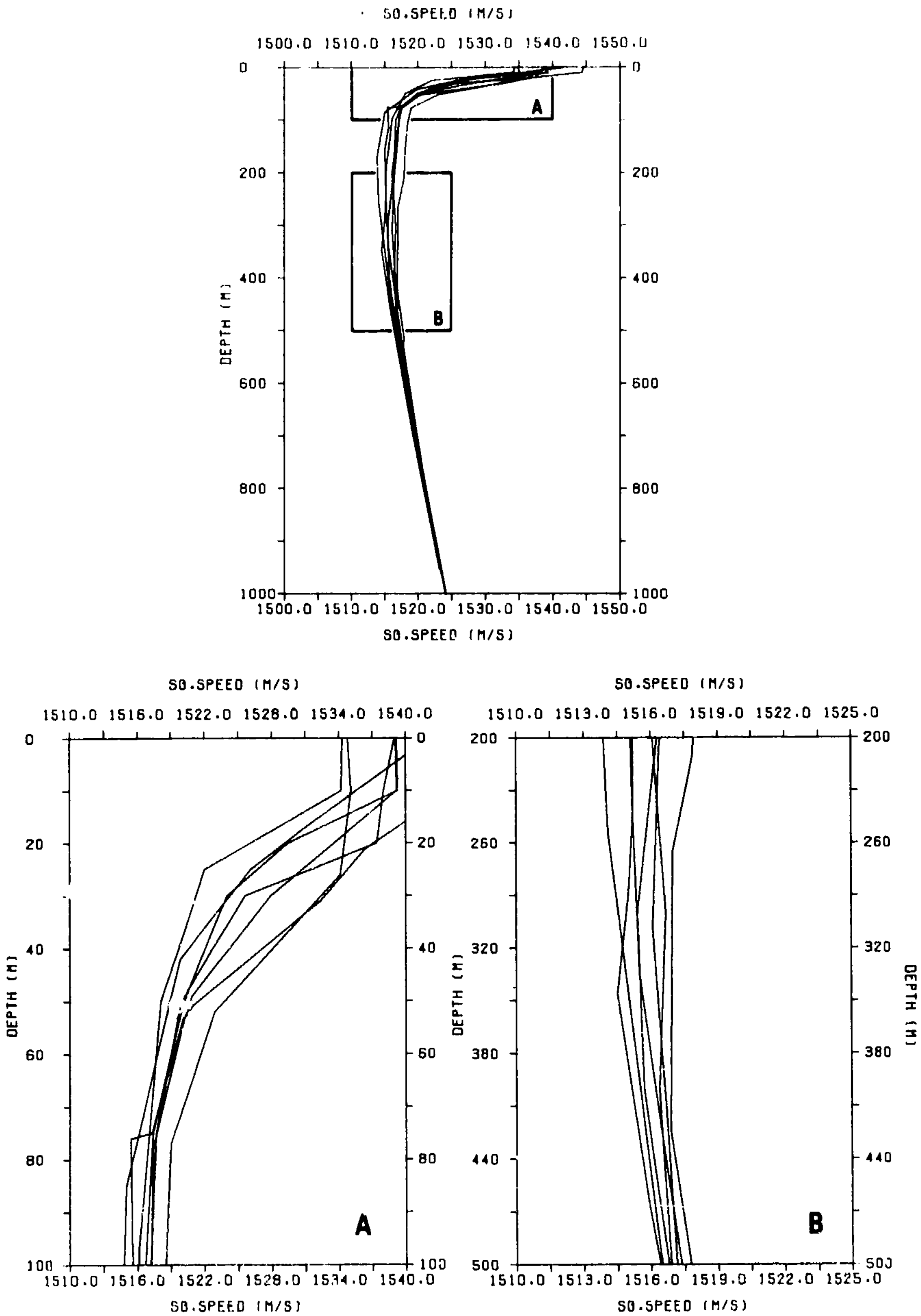

FIG. A.2(e) DISPLAY — MULTIPLE PROFILE PLOT

A.2 MAP Program

Function: To plot a Mercator chart including intermediate lines of latitude and longitude, intermediate border tick marks, a coastline and, if, required select and plot data from the data base.

Execution:

@XQT SMODS*SYSTEM.MAP

Subroutines: (see Fig. A.3)

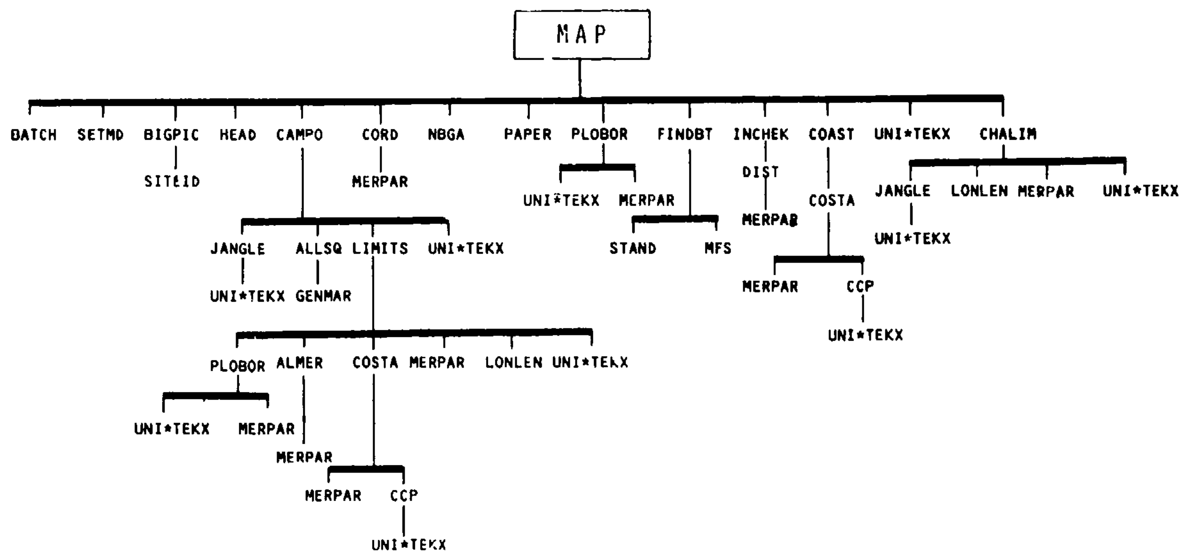

FIG. A.3 ROUTINES OF EXECUTIVE PROGRAM — MAP

Input Data: first define the chart, then the data

```
PLEASE INPUT A TITLE (UP TO 80 CHARS.)
>
PLEASE INPUT YOUR CHART LIMITS
IN TERMS OF DEGREES OF LATITUDE AND LONGITUDE
IN THE ORDER TOP, BOTTOM, RIGHT, LEFT
(SOUTH AND WEST NEGATIVE)
>
WHAT IS THE CHART'S STANDARD PARALLEL ?
(DEGREES AND MINUTES -- NORMALLY THE MID LATITUDE)
>
AT WHAT NATURAL SCALE?
(F WHERE 1/F IS THE SCALE)
>
```

```
WHICH SPHEROIDAL CONSTANTS DO YOU WISH TO USE?
THOSE FOR THE INTERNATIONAL TYPE 1
THOSE FOR THE WGS 72 TYPE 2
>
DO YOU WANT TO PLOT ANY INTERMEDIATE
PARALLELS OF LATITUDE?
ANSWER Y FOR YES OR N FOR NO
>
```

If the response is yes:

```
HOW MANY?
>
PLEASE LIST THEM AS DEGREES MINUTES
(SOUTH NEGATIVE)
>
TICK MARKS ON THE LATITUDE SCALE?
Y FOR YES OR N FOR NO
>
```

If the response is yes:

```
TICK INTERVAL IN DEGS. AND MINS?
>
DO YOU WANT TO PLOT ANY INTERMEDIATE
MERIDIANS OF LONGITUDE?
ANSWER Y FOR YES OR N FOR NO
>
```

If the response is yes:

```
HOW MANY?
>
PLEASE LIST THEM AS DEGREES, MINUTES
(WEST NEGATIVE)
>
TICK MARKS ON THE LONGITUDE SCALE?
Y FOR YES OR N FOR NO
>
```

If the response is yes :

```
TICK INTERVAL IN DEGS. MINS?
>
DO YOU WISH TO SELECT AND PLOT
DATA FROM THE DATA BASE?
Y FOR YES OR N FOR NO
```

If the response is Y then the CAMPO subroutine is entered to conversationally define the data field limits (see Sect. 2.5of main text), after which the plot is created; if the response is N, the plot is created immediately.

<u>Output Data</u> (see Fig. A.4)

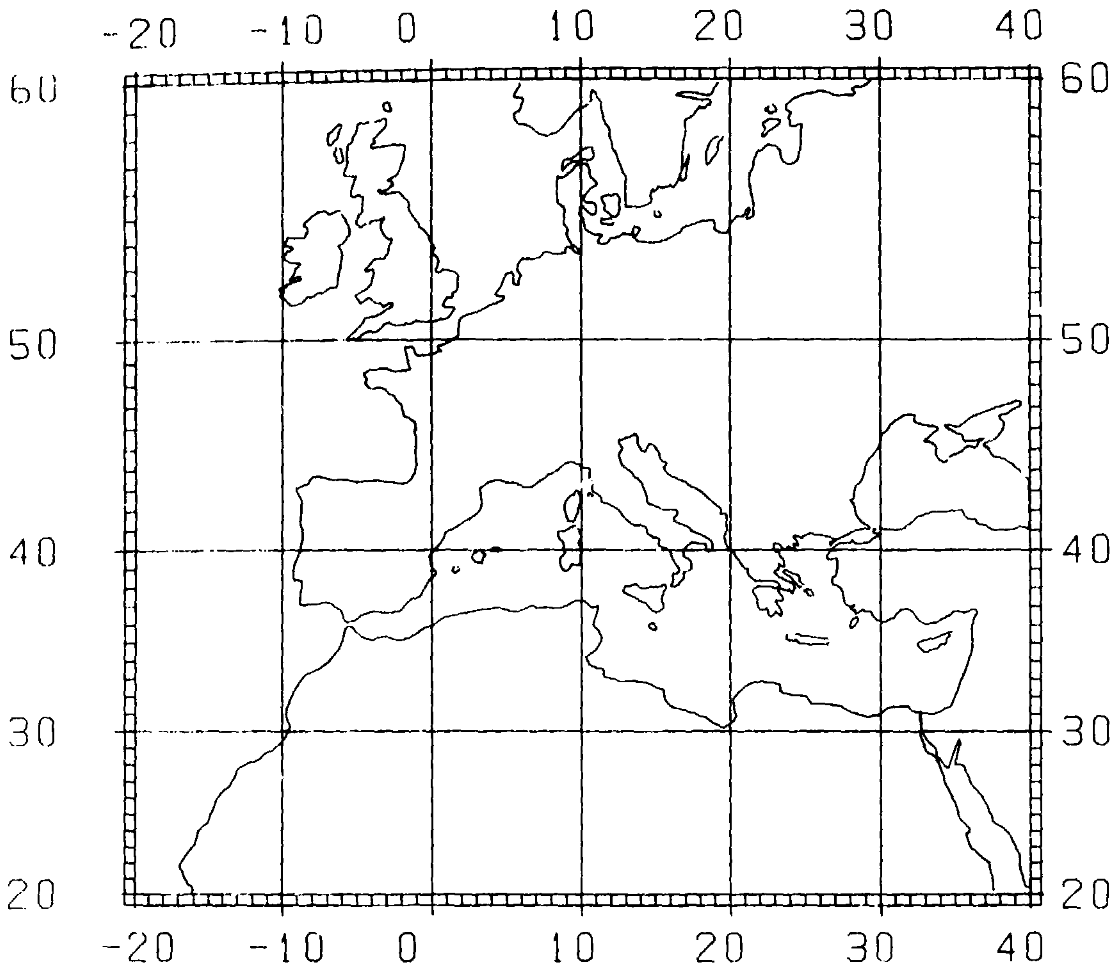

FIG. A.4(a) MAP — MERCATOR CHART SKELETON

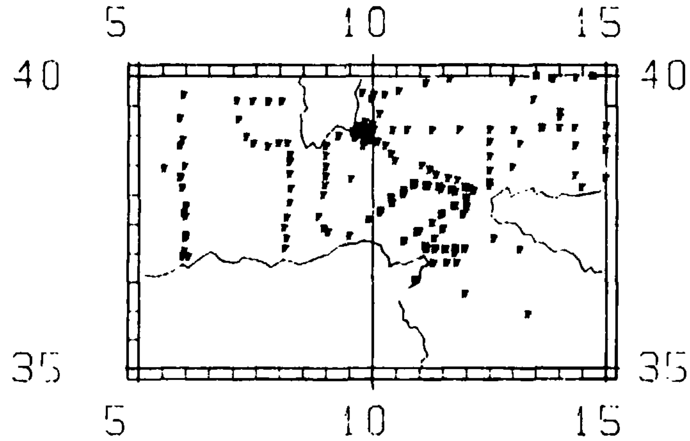

FIG. A.4(b) MAP — MERCATOR CHART WITH DATA POINTS

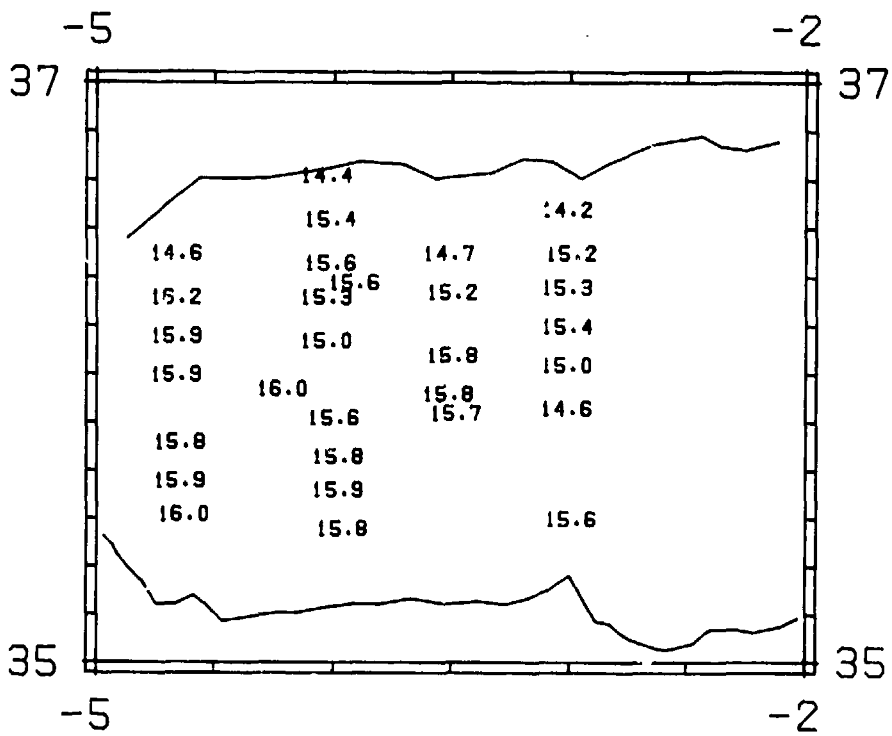

FIG. A.4(c) MAP — MERCATOR CHART WITH SST VALUES

A.3 Mean Program

Function: To compute over a user-defined temporal and spatial field, the mean, maximum, minimum, standard deviation, gradient, and number of observations of sound speed at US National Oceanographic Data Center standard depth levels <A.3>.

Execution:

@XQT SMODS*SYSTEM.MEAN

Subroutines: (see Fig. A.5)

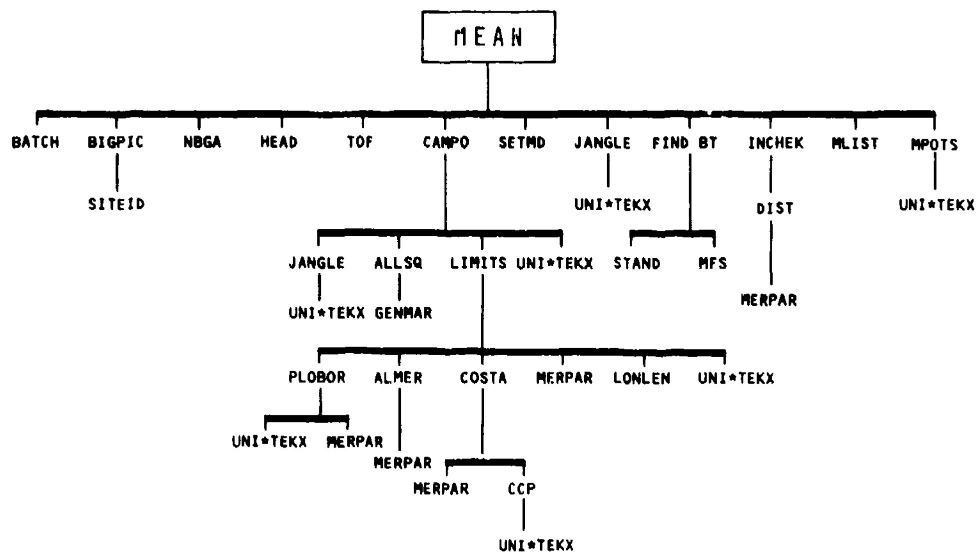

FIG. A.5 ROUTINES OF EXECUTIVE PROGRAM — MEAN

Input Data:

```
PLEASE INPUT THE PLOT WINDOW AS FOLLOWS
MIN AND MAX OF THE VELOCITY SCALE (M/S)
MIN AND MAX OF THE DEPTH SCALE (M)
>
PLEASE INPUT THE CUT-OUT DEPTH AND PLOT SCALE WHERE THE CUT-OUT DEPTH
IS THE MINIMUM DEPTH A CAST MUST REACH TO BE INCLUDED IN THE ANALYSIS.
THE SCALE WHERE 1.0 PRODUCES A PLOT 8 IN. BY 5 IN.
>
```

The CAMPO routine is now entered to define the data-field limits (see Sect. 2.5 of main text).

Output Data: (see Fig. A.6)

SOUND VELOCITY CHARACTERISTICS

****

DEPTH	NO	MIN	MAX	MEAN	ST.DEV	GRAD
0	14	1522.6	1536.6	1529.7	3.90	
						-28.43
10	14	1519.1	1531.5	1526.8	3.54	
						-66.86
20	14	1515.0	1524.9	1520.1	2.32	
						-50.43
30	14	1511.5	1520.2	1515.1	2.46	
						-30.04
50	14	1506.3	1513.7	1509.1	2.30	
						-7.54
75	14	1506.5	1508.9	1507.2	.78	
						-.37
100	13	1506.7	1508.4	1507.1	.48	
						1.55
150	12	1507.5	1508.2	1507.9	.25	
						1.55
200	12	1508.2	1509.2	1508.7	.34	
						1.65
300	12	1509.9	1511.1	1510.3	.36	
						1.61
400	12	1511.5	1512.7	1511.9	.40	
						1.58
500	11	1513.1	1514.2	1513.5	.37	

FIG. A.6(a) MEAN — PRINTOUT OF MEAN PROFILE

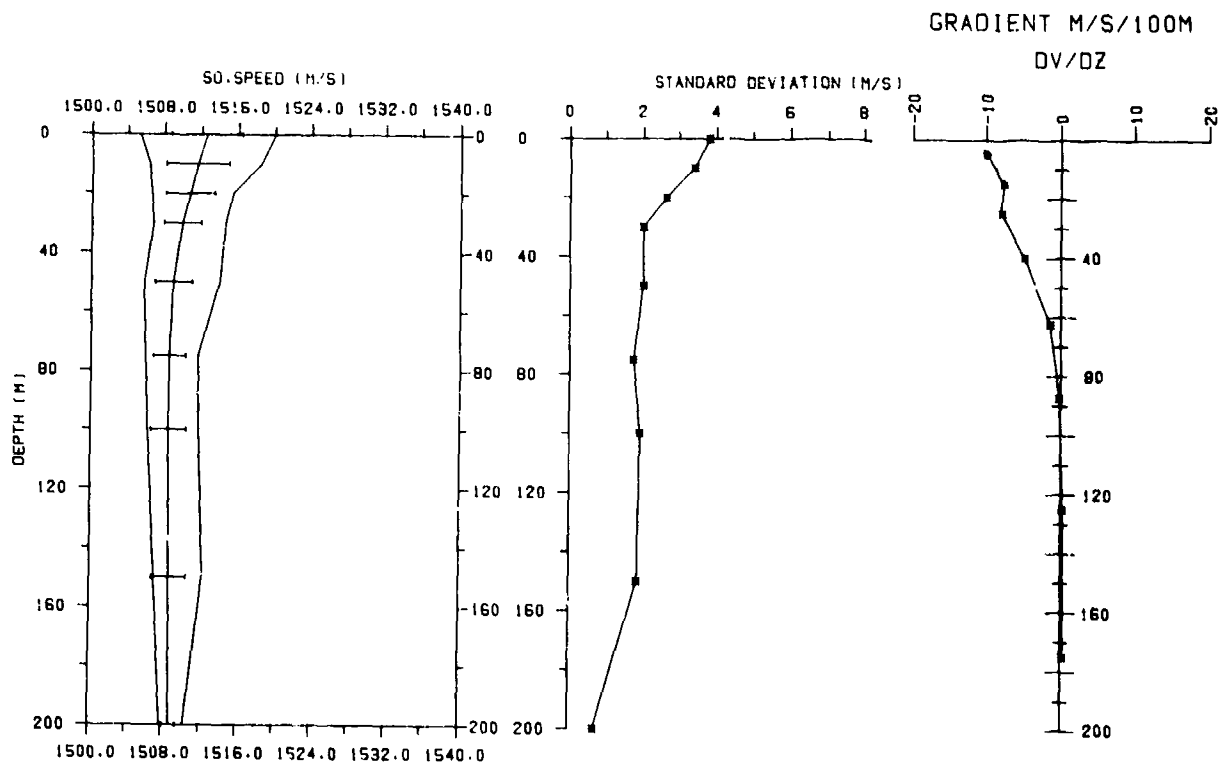

FIG. A.6(b) MEAN — PLOT OF MEAN PROFILE, STANDARD DEVIATION AND AVERAGE GRADIENT

A.4 CONTOUR Program

Function: From depth, temperature, salinity or sound speed data, compute and plot contours of one parameter at a fixed value of another on a Mercator projection.

Execution:

@XQT SMODS*SYSTEM.CONTOUR

Subroutines: (see Fig. A.7)

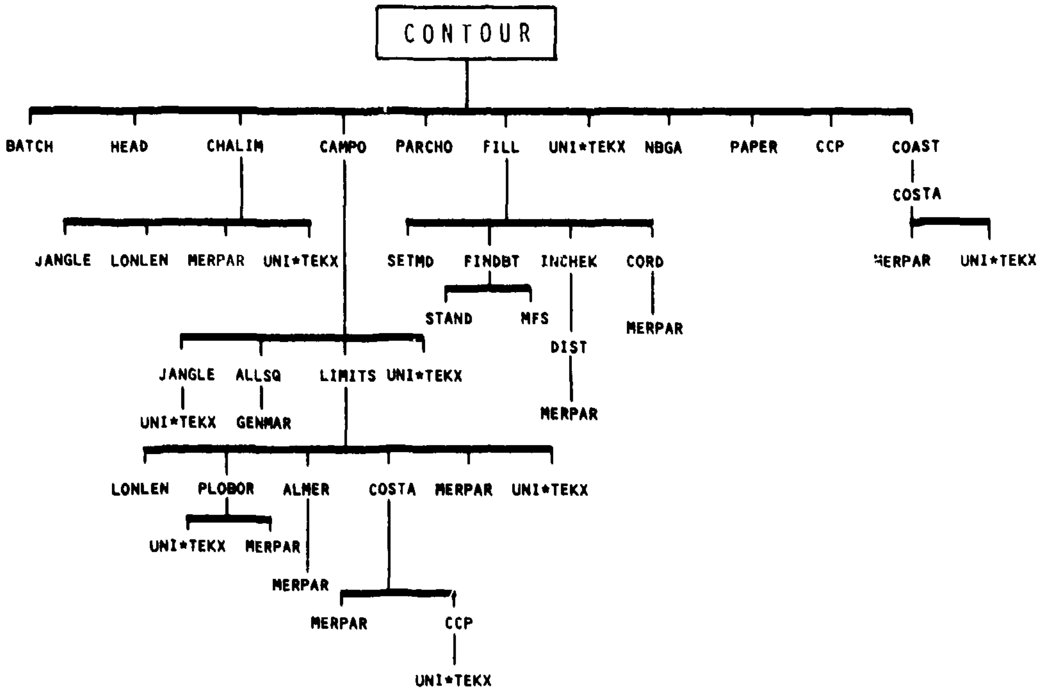

FIG. A.7 ROUTINES OF EXECUTIVE PROGRAM — CONTOUR

Input Data:

The CHALIM routine (see Sect. B.7 of App. B) is entered first to define the Mercator chart, followed by:

```
PLEASE INPUT THE FIXED AND VARIABLE PARAMETERS TO BE CONTOURED
BY THE FOLLOWING KEY:
1 FOR DEPTH
2 FOR TEMPERATURE
3 FOR SALINITY
4 FOR SOUND SPEED

>
```

(e.g. 1 2 would indicate contours of temperature at a fixed depth or 3 1 would indicate contours of depth of a fixed value of salinity)

```
INPUT THE LEVEL AT WHICH TO BE CONTOURED
(I.E. OF THE FIXED PARAMETER E.G. 0 (ZERO) METRES)
>
```

At this point the CAMPO subroutine is entered to define the data field (see Sect. 2.5 of main text) followed by a report of the number of data points which have been extracted:

```
DATA EXTRACTION COMPLETE
(  ) DATA POINTS TO BE CONTOURED

DO YOU WANT THE DATA POINTS TO BE PLOTTED?
ANSWER Y FOR YES
     OR N FOR NO
>
PLEASE INPUT
THE CONTOUR INTERVAL
CONTOUR LABELLING CODE BY :
     1 TO 3 (for number of digits required after decimal)
or  -1 FOR NO DECIMAL (I.E. INTEGER PART ONLY)
or  -3 FOR NO LABEL
>
THE LINE-TYPE CODE BY :
     1 THIN LINE
     2 THICK LINE
     3 DOTTED LINE
>
```

At this point the plot will be generated, followed by a request for continuation or run termination as follows :

```
PLEASE INPUT THE DATA CONTROL KEYS (1 OR 0)
WHERE KEY 1 ** NEW TITLE
      KEY 2 ** NEW DATA FIELD (TIME/SPACE)
      KEY 3 ** NEW CONTOUR LEVELS
      KEY 4 ** NEW CHART LIMITS
      KEY 5 ** NEW CONTOUR PARAMETERS
>
```

At this point the user will be requested to input only those data parameters that need to be changed.

A response of

    0 0 0 0 0

will terminate the run

An example of the use of these keys is as follows:

A response of

    1 0 1 0 1

indicates that the user wishes to redefine the plot title, the contour interval and/or line type and/or label type, and the contour parameters. In such a case only those questions necessary to input the new values will be asked. The remaining data fields will remain the same as defined by the previous plot generation.

Output Data: (see Fig. A.8)

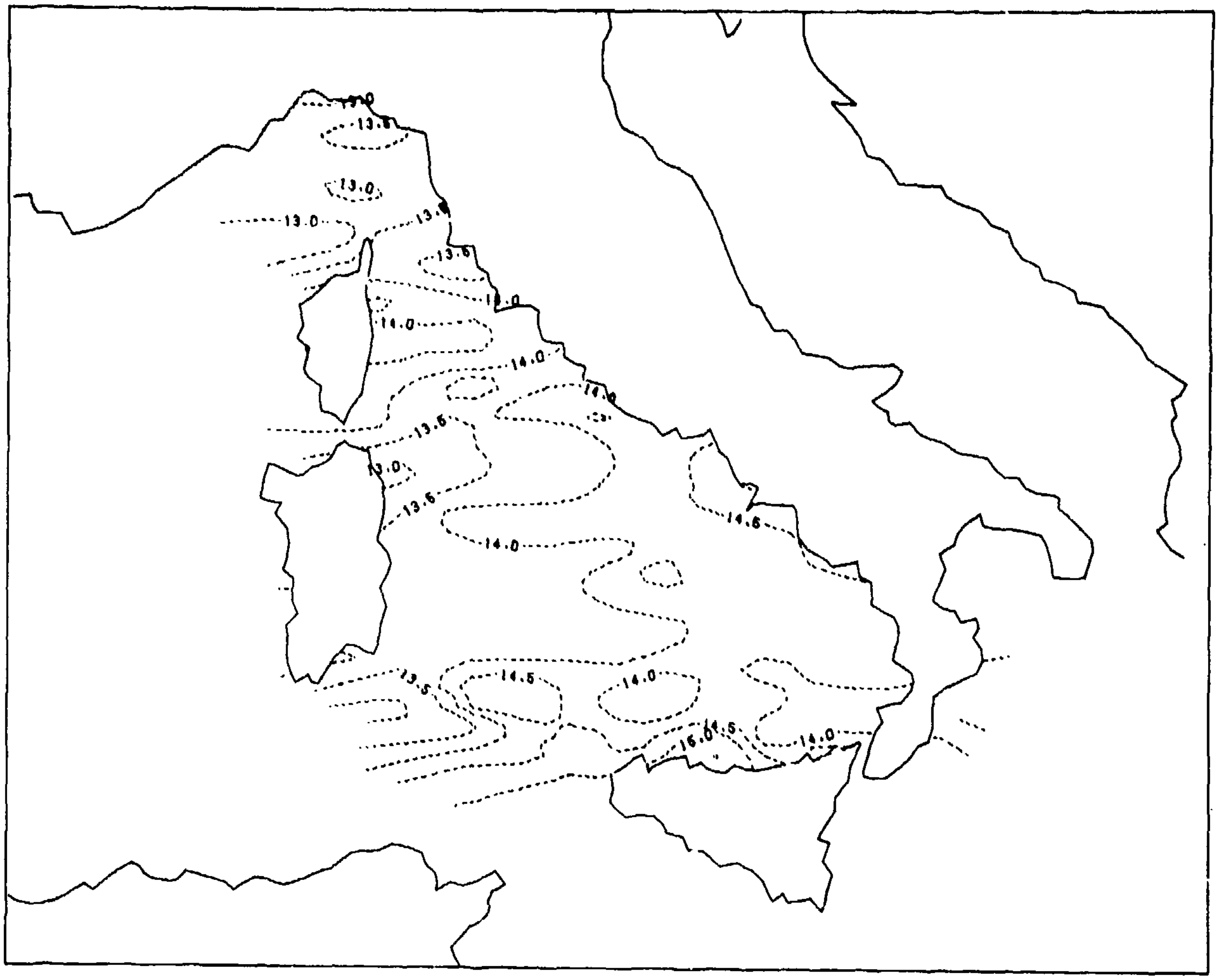

FIG. A.8 CONTOUR — SEA SURFACE TEMPERATURE

A.5 SECTION Program

Function : To compute and plot temperature, salinity, or sound speed data as a function of depth as a cross-section between two input geographical positions. The plot displays the cross-section in terms of distance in nautical miles from the initial position against depth in metres, either as contour lines of the selected parameter or as data points or both.

Execution:

```
@XQT SMODS*SYSTEM.SECTION
```

Subroutines: (see Fig. A.9)

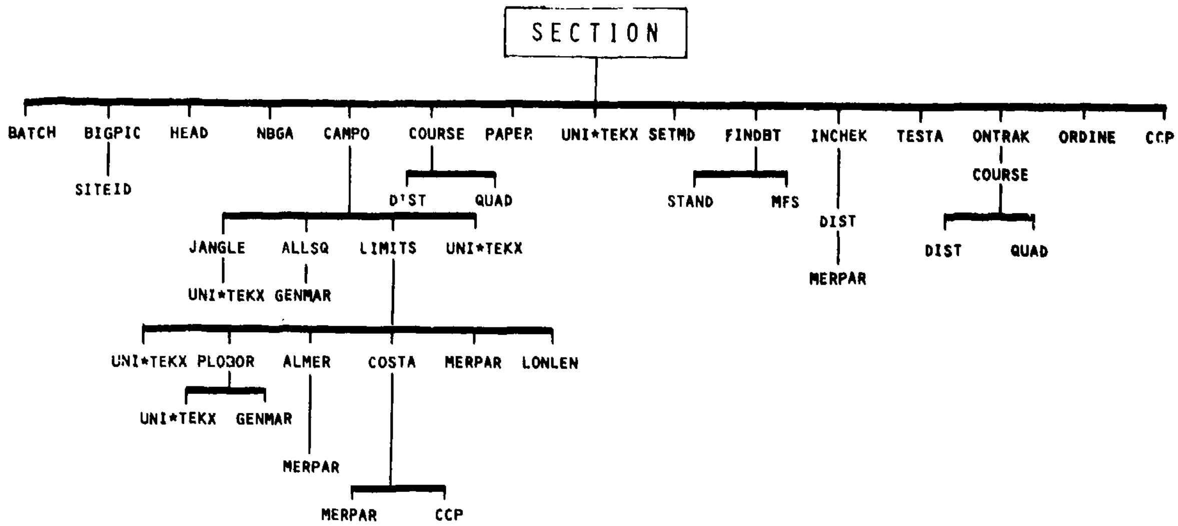

FIG. A.9 ROUTINES OF EXECUTIVE PROGRAM -- SECTION

Input Data:

```
TITLE OF PLOT (< 80 CHARS)
>
```

At this point the CAMPO subroutine is entered to define the data field (see Sect. 2.5 of main text)

Followed by:

```
WHICH PARAMETER TO SECTION?
RESPOND WITH  1 FOR TEMPERATURE
              2 FOR SALINITY
              3 FOR SOUND SPEED
>
TRACK POSITIONS IN LAT AND LONG?
(DEGS AND MINS S AND W NEGATIVE)
>
LANE WIDTH IN N.MILES?(SWATH)
>
```

This is followed by plot information:

```
PLEASE INPUT MIN AND MAX DEPTH (METRES)
       RANGE TICK INTERVAL (N.MI.)
       PLOT SIZE (X,Y, IN INCHES)
       CONTOUR GRID SIZE (NX,NY)
>
PLOT OF DATA POINTS  - D
   CONTOURS          - C
   OR BOTH           - B
>
```

If response is D or B

```
POINT LABEL CODE AS POSITIVE
NUMBER OF FIGURES AFTER DECIMAL
     OR
     - 1  NO DECIMAL PART
     - 2  NO LABEL
     - 3  NO DATA POINT
>
```

If response is C or B

```
CONTOUR INTERVAL,LABEL CODE,LINE TYPE
>
```

At this point the plot is generated.

Note: The data field selected using the CAMPO subroutine defines the catchment area of the data base. However, this executive program also checks for proximity to the track and range along the track. This range is computed as shown in Fig. A.10, by projecting the position of the observation on to the track, and computing the distance (d) off the track and the range (R) from the initial position.

If d is less than (SWATH/2) the observation is included. After all the data has been examined, the water depths of included data are sorted by the ORDINE routine (see App. B) into increasing values of R (range along track), such that the bathymetric profile may be plotted. The parameter isovalues are extracted and the contour matrix is generated, where the abscissa is range (R) and the ordinate is depth.

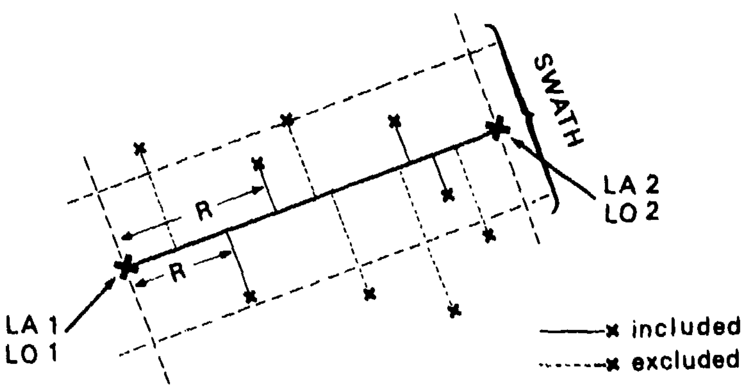

FIG. A.10 RANGE CALCULATION FOR PROGRAM SECTION

Output-Data: (see Fig. A.11)

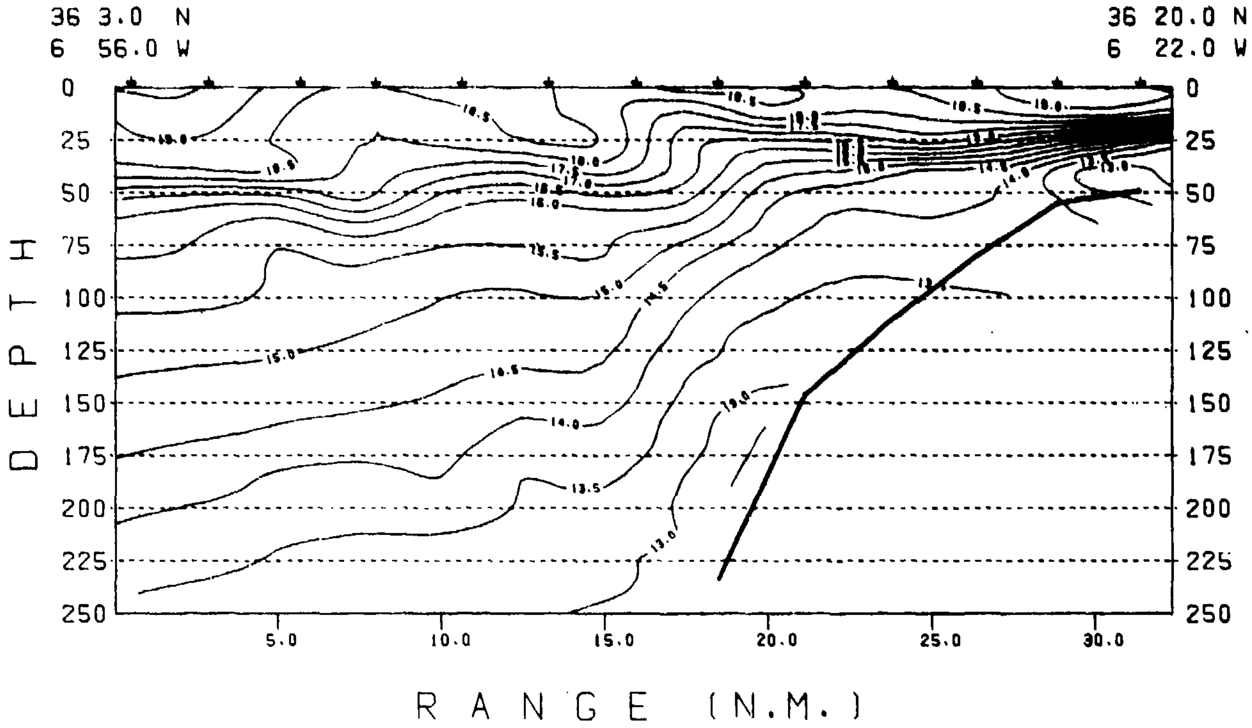

FIG. A.11(a) SECTION — ISOPLETHS OF TEMPERATURE

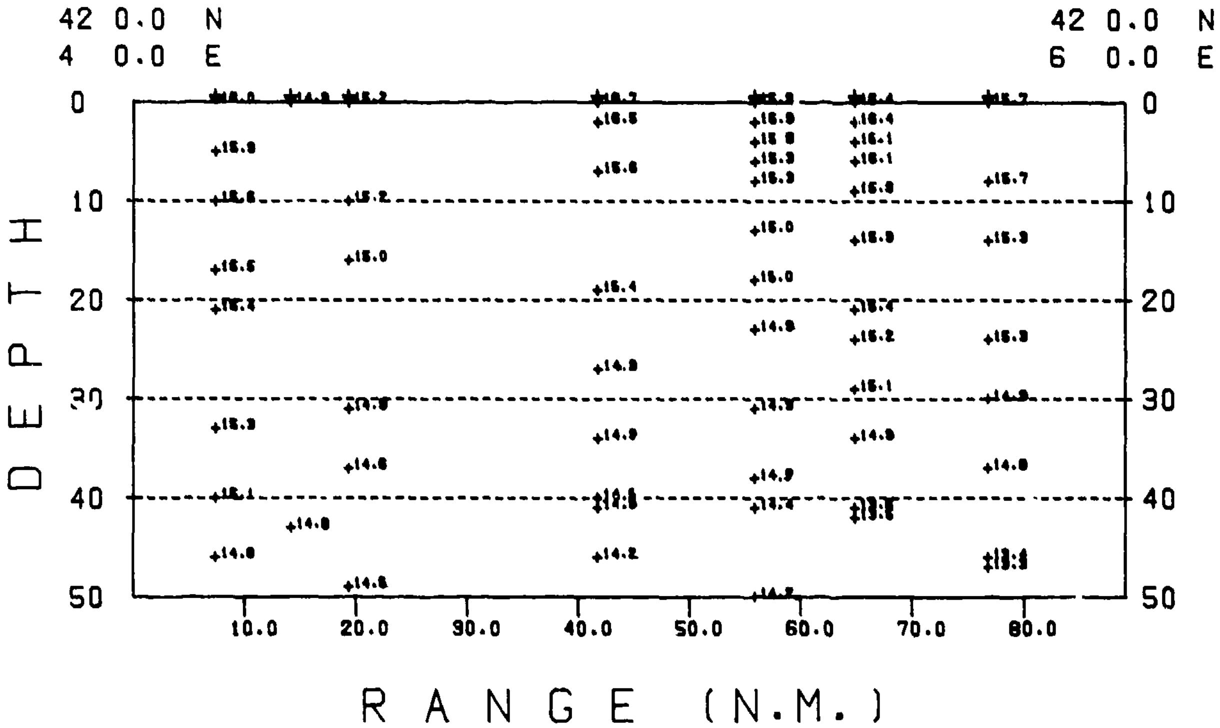

FIG. A.11(b) SECTION -- ISOVALUES OF TEMPERATURE

A.6 SIGMAT Program

Function: To plot or printout, within user-defined limits of temperature and salinity, values or isopleths of sigma-t. The plot may be superimposed with user-selected data points from the data base.

Execution:

@XQT SMODS*SYSTEM.SIGMAT

Subroutines: (see Fig. A.12)

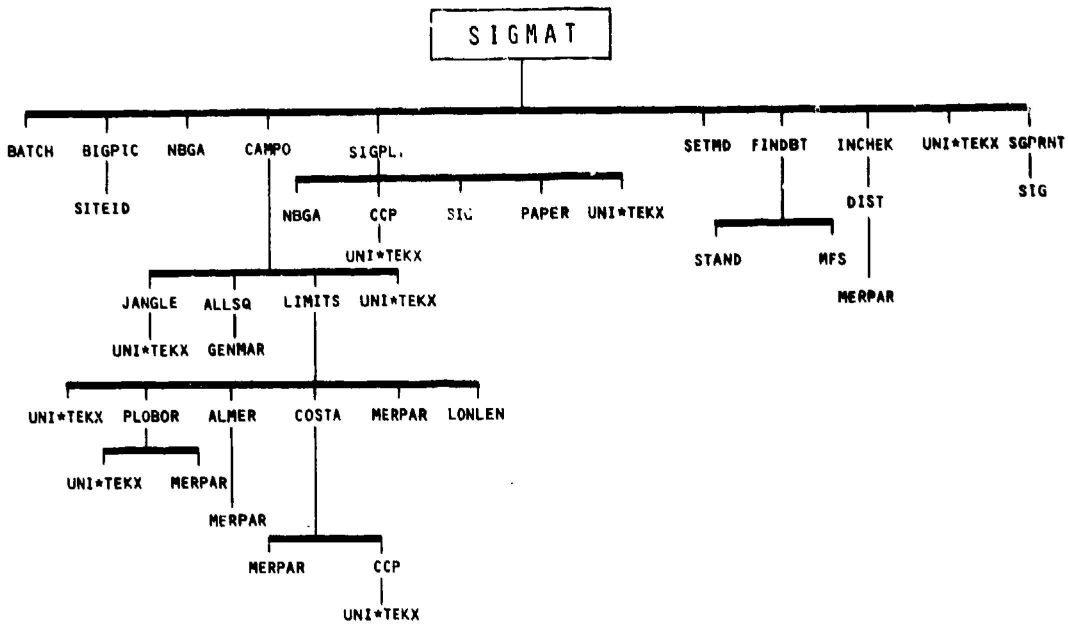

FIG. A.12 ROUTINES OF EXECUTIVE PROGRAM — SIGMAT

Input Data

```
DO YOU WANT OUTPUT AS A LISTING TYPE L
     OR PLOT TYPE P ?
>
```

If response is L:

```
PLEASE INPUT   MIN TEMP
               MAX TEMP
               TEMP INCREMENT
               MIN SAL
               MAX SAL
               SAL INCREMENT
>
```

If response is P:

```
PLEASE INPUT    MIN AND MAX TEMP. VALUES
                MIN AND MAX SAL.  VALUES
>
PLEASE INPUT    LENGTH (IN INCHES)
                OF TEMPERATURE AXIS
                OF SALINITY AXIS
>
PLEASE INPUT    SIGMAT INTERVAL
                HEAVY LINE INTERVAL
                NO OF DIGITS ON CONTOUR LABEL
                OR -1 NO DECIMAL PART
                   -2 NO LABEL
>
DO YOU WISH TO SELECT AND PLOT DATA FROM THE O.C. DATA BASE
Y  OR  N
>
```

If the response is Y the CAMPO subroutine is entered (see Sect. 2.5 of the main text) to define the data field.

<u>Output Data</u>: (see Fig. A.13)

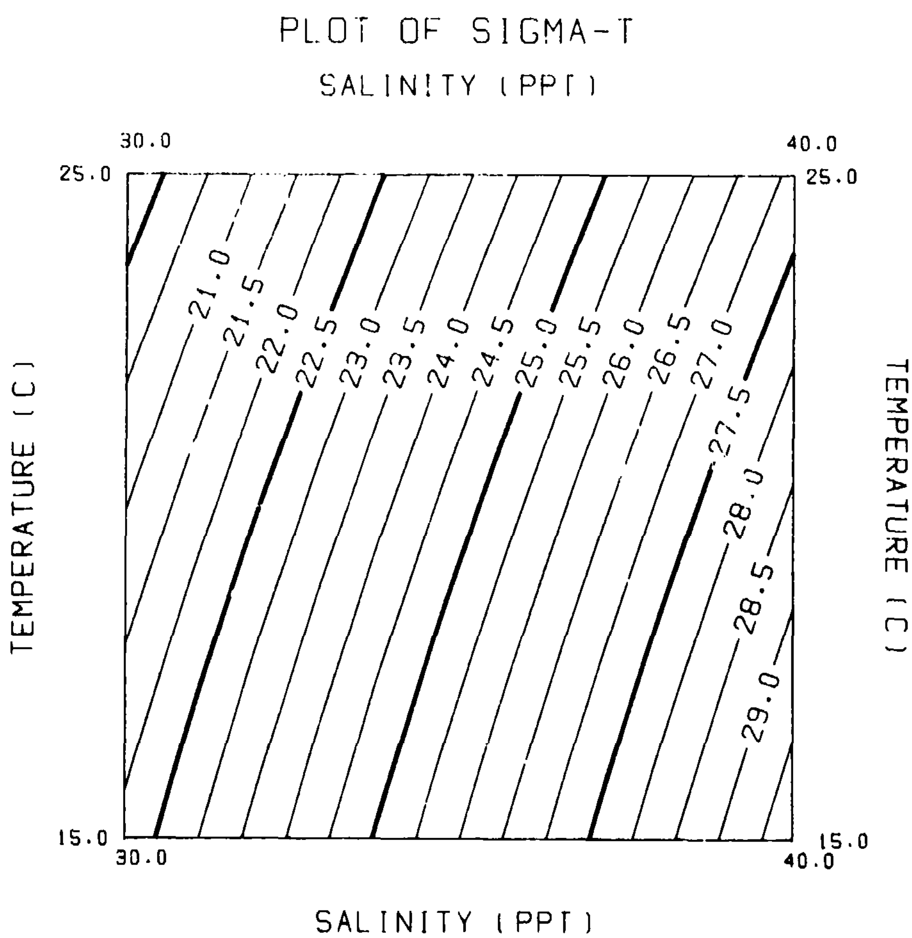

FIG. A.13(a) SIGMAT — ISOPLETHS OF SIGMA-t

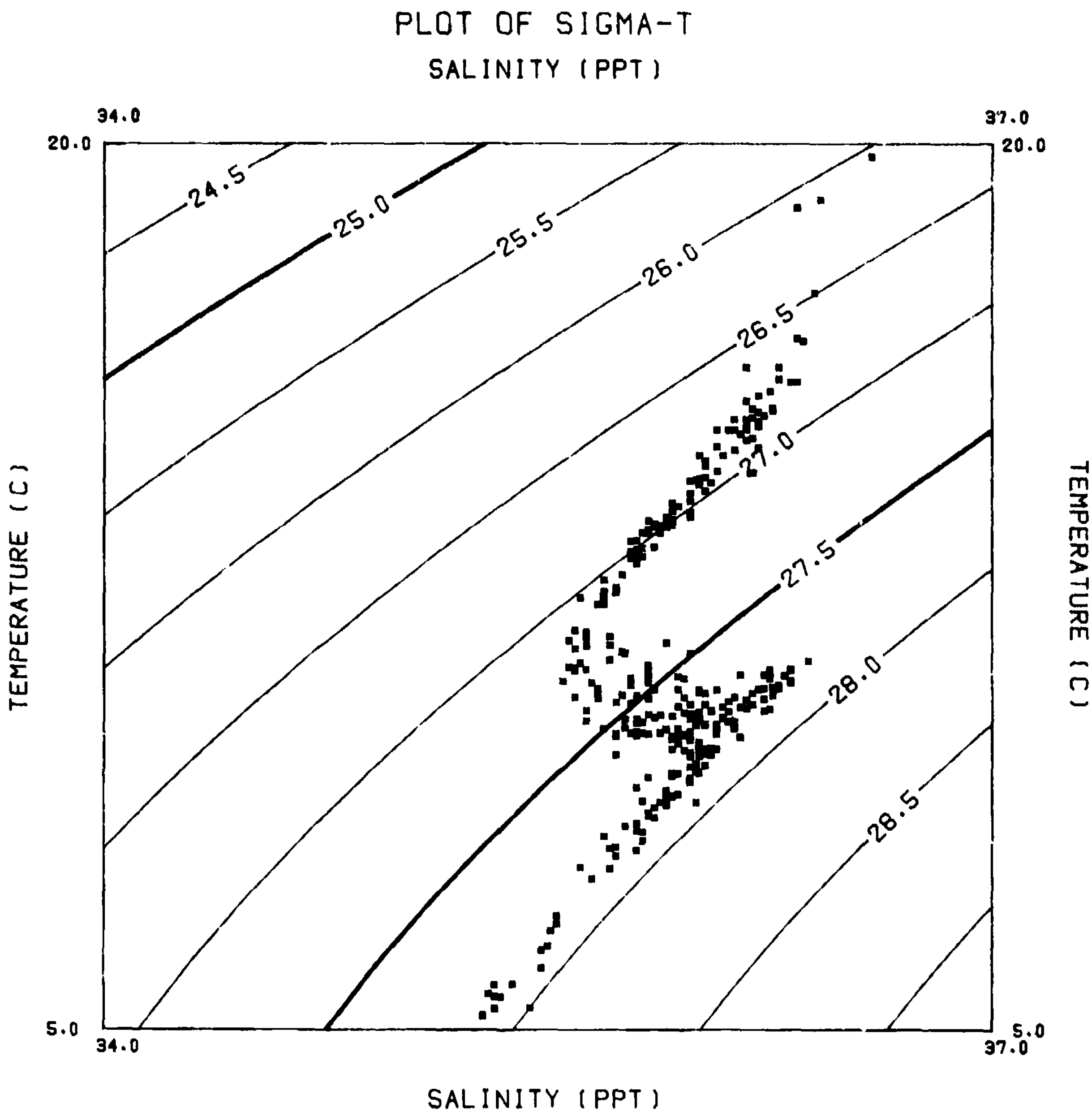

FIG. A.13(b) SIGMAT — ISOPLETHS OF SIGMA-t OVERLAID WITH DATA POINTS

REFERENCES

A.1 FOFONOFF, N.P. Physical properties of sea water. In: HILL, M.N., ed., The Sea; Ideas and Observations on Progress in the Study of the Seas. Vol. 1: Physical oceanography. New York, N.Y., Wiley, 1962: p. 17.

A.2 SVERDRUP, H.U., JOHNSON, M.W. and FLEMING, R.H. The Oceans, their physics, chemistry, and general biology. Englewood Cliffs, N.J., 1942.

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APPENDIX B
SUBROUTINE LIBRARY

B.1 General

Each of the subroutines used by the system, with the exception of those of the UNI*TEKX, MFS and CCP packages, will be briefly described by function, access and, where applicable, source reference.

They may also be used independently by other FIELDDATA software, and collected by the EXEC 8 instruction

LIB SMODS*LIBRARY

Data are passed to and from these routines either by formal and actual parameter lists or by access to one or more of a series of named COMMOM blocks.

These are:

```
/CONT/IHD(28),IDET(5,2500),NDET
/CONTRO/IOU,ITY,MODE,MULT,IST,IPRNT,INDOUT,KBAT
/FIELD/IOMCT(7),IDO,MSCT(25),IMQ,IDQCT(25,100),IDQ(25),
IYRCT(80),IYR,MNCT(11),IMN,ILAN,NLAN(20),IVES,NVES(20),MS
/POSIZ/ALAT,ALO,AMN,ALN,NV,NY,TIM,XD
/RAGGIO/KLAT,CLAM,KLON,CLOM,RAY,KAREA
/DAREA/UP,DOWN,RIGHT,ALEFT
/WINDOW/MIV,MAV,MID,MAD,FAX,IPAR
/BASE/SMP,W,FAC,XL,YL
/CHART/ND,NM,SD,SM,ED,EM,WD,WM,SCD,SCM,NSC
/GRID/IPALS,MERS,IPAL(20),PAM,(20),MER(20),AMER(20),
LAY,LATIKD,LATIKM,LOY,LOTIKD,LOTIKM
/DP/IDP(26),MT
/POINT/XP(2501),YP(2501),ZP(2501),MX,MY,FLV
/BLANK/XB(1484),YB(1484),NB
```

In all subroutine descriptions, standard FORTRAN naming conventions are applied: the first letter of the symbolic name of a formal parameter or constituent parameters of a common block is any of the six letters I,J,K,L,M or N, the routine requires integer-type data, if any other character is used then real-type data are required. Automatic-type conversion however allows for conversion of integer values to real values without affecting a computation, whereas the converse may produce a rounding-off error and should be avoided.

B.2 ALMER

Computes the latitude for a given value of meridional parts on the International Speroid.

CALL ALMER (A,B),

where A is the input value of meridional parts,

B is the computed latitude.

This routine requires the MERPAR subroutine.

B.3 ALLSQ

Computes those Marsden Square and one degree square references in and on the border of a rectangle defined by its north, south, east and west geographical limits

    CALL ALLSQ

This routine requires input data passed through COMMON blocks FIELD and DAREA where the area limits are input in DAREA and the MSQ,DSQ output is put into FIELD.

This routine requires the GENMAR subroutine.

B.4 BIGPIC

Identifies the terminal type by identification of the terminal site ID.

    CALL BIGPIC (ID),

where ID is the returned terminal type

as 1 = Batch Run
2 = UNIVAC DCT 500
3 = Tektronix Model 4014
4 = Tektronix Model 4010
5 = UNIVAC UNISCOPE 100
6 = Tektronix Model 4025.

This routine requires the UNI*TEKX subroutine (not described here).

B.5 CALC

Computes sound speed <B.10>, potential temperature <B.5>, density <B.7>, potential density, dynamic height anomaly <B.7>, specific volume anomaly, and Brunt-Väisälä frequency <B.9>.

    CALL CALC (INST),

where INST is the instrument code as defined in Sect. 2.5 of the main text.

This routine requires:

(a) Common blocks CONT, CONTRO, POSIZ and FIELD
(b) routines PRES, WILSV, SIG, ROVO, POT, VBC and VBU
(c) UNI*TEKX.

Output is to the unit with the name held as the current value of parameter IPRNT of block CONTRO.

B.6 CAMPO

Defines, by conversational demand, the data selection field limits (see Sect. 2.5 of the main text)

    CALL CAMPO

This routine requires:

(a) COMMON blocks FIELD, CHART, GRID, RAGGIO, DAREA and BASE
(b) UNI*TEKX.

B.7 CHALIM

Defines, by conversational demand, the limits, meridians, parallels, standard parallel and natural scale of a Mercator chart; uses these data to compute the chart-control parameters output by COMMON block BASE.

```
CALL CHALIM
```

This routine requires:

(a) COMMON blocks CONTRO, CHART, GRID, BASE, FIELD
(b) routines JANGLE, LONLEN, MERPAR
(c) UNI*TEKX.

On return, BASE will hold:

SMP = Meridional parts of southern border

W = Longitude in minutes of western border(West negative)

FAC = Mercator Projection scaling factor to be applied to all N-S, E-W differences

XL,YL = the chart size in inches.

B.8 COAST

Define, by conversational demand, the input parameters for routine COSTA.

```
CALL COAST
```

This routine requires:

(a) COMMON block BASE
(b) routine COSTA.

B.9 CORD

Converts a latitude and longitude to X/Y coordinates in inches, given the necessary control data (in COMMON block BASE).

```
CALL CORD (A,B,C,D),
```

where A = Latitude (degrees)
B = Longitude (degrees)
C = X value (converted longitude)
D = Y value (converted latitude).

This routine requires:

(a) COMMON block BASE
(b) routine MERPAR.

B.10 COSTA

Plots, within input chart limits, the coastline selected from a choice of data files of digitized coordinates (see Sect. 3.2 of the main text).

CALL COSTA (I,J),

where I = 1 for Mediterranean
= 2 for Southwestern Approaches to the English Channel
= 3 for North Atlantic.
J = 1 for thin line
= 2 for thick line
= 3 for dashed line.

This routine requires:

(a) COMMON block BASE
(b) routines ERTRAN (UNIVAC FORTRAN V LIBRARY) and MERPAR
(c) UNI*TEKX.

B.11 DIST

Compute the distance and course between two geographic positions using the principles of Mercator and Parallel Sailing <B.2>. This can be used over only relatively short distances, (< 600 n.mi) otherwise the great circle distance and incremented course should be used.

CALL DIST (A,B,C,D,DIST,ANGLE),

where A,B is the starting position in degrees of latitude and longitude
C,D is the final position expressed in degrees of latitude and longitude

DIST is the computed distance in nautical miles

ANGLE is the course relative to north
(i.e. + or -180°).

This routine requires the MERPAR subroutine.

B.12 EXPLAN

Prints out an explanation (parameters and units) of the computational output of the CALC subroutine.

CALL EXPLAN

This routine requires COMMON block CONTRO; an example is shown in Fig. A.2d of App. A.

B.13 FILL

Uses the data field defined by CAMPO and the data provided by FINDBT, to fill the data matrix contoured by the CONTOUR program (see App. A.4).

CALL FILL (IP)

where IP is output as the current number of points in the data matrix.

This routine requires

(a) COMMON blocks CONT, BASE, FIELD, RAGGIO, DAREA and POINT
(b) routines FINDBT, CORD
(c) MFS.

B.14 FINDBT

The interface to the O.C. Data Base: loads into core a profile defined by the parameters INST, MSQ, DSQ, MON and NUMBER <B.1>.

```
CALL FINDBT (I,J,K,L,M, (1), (2)),
```

where I = Instrument Code
J = Marsden Square Number
K = 1° Square Number
L = Month
M = Consecutive Element No.,

followed by two error returns:

(1) when no element of this name is available i.e. no such data exist within this I,J,K,L combination

(2) when no file of this name is available i.e. there are no data within the combination I,J,K, (see Sect. 3.3 of Vol. I <B.1>).

This routine requires:

(a) COMMON block CONT
(b) routine STAND
(c) MFS.

The data, if retrieved successfully, are loaded into COMMON area CONT.

B.15 GENMAR

Computes the Marsden Square (MSQ) and 1° square (DSQ) reference of a geographical position (see Figs.2, 3 of main text).

```
CALL GENMAR (A,B,K,L),
```

where A the latitude in degrees } input
B the longitude in degrees } input
K [illegible] MSQ } Output
L [illegible] DSQ } Output

B.16 HEAD

Prints a line [illegible]nter-output identification for any batch run.

```
CALL H[illegible]
```

This routine requires COMMON block CONTRO.

B.17 HEADER

Prints the header (or dictionary) data of the data base.

CALL HEADER (INST,ICON),

where INST is the Instrument Code
ICON is the Consecutive Number of the profile within one INST/MSQ/DSQ/MONTH group. (Normally a loop control variable).

Output is to the unit with the current value of parameters IPRNT.
This routine requires COMMON blocks CONT, CONTRO, FIELD and POSIZ.

B.18 INCHEK

Checks whether a profile is within certain of the data fields selected by S/R CAMPO.

CALL INCHEK ($(1)),

where control is returned normally if a profile lies within the fields of spatial definition, year, country, and ship; in addition the routine checks the " doubtful " flag for inclusion or otherwise. If any one of these field limits is violated, control is returned through label $(1).

This routine requires COMMON blocks CONT, CONTRO, FIELD, RAGGIO and DAREA.

B.19 JANGLE

Rings the terminal bell.

CALL JANGLE (N),
where N = number of rings required.

This routine requires UNI*TEKX.

B.20 LIMITS

Allows the user to delineate a sub-area of the Atlantic Ocean by interactive use of the Tektronix cursor. Returns the limits of the selected area, together with a computed natural scale and mid-latitude required to plot the area within the limits of the Tektronix small screen (i.e. models 4002, 4010, 4012).

CALL LIMITS

This routine requires
(a) COMMON blocks BASE, CHART, GRID, DAREA
(b) routines LONLEN, MERPAR, PLOBOR, COSTA, ALMER
(c) UNI*TEKX.

On entry into this routine the following message is output:

A MAP OF THE ATLANTIC OCEAN WILL NOW BE PLOTTED FOR YOU
TO INTERACTIVELY.
INPUT YOUR DATA AREA.
WHEN THE CURSOR IS ENABLED, INPUT THE SOUTH-WEST AND NORTH-EAST
CORNERS.

At this point, the coastline is plotted and the cursor enabled. If the input positions for the corners are not of the right order of magnitude or are input in an incorrect order, an error message is output and the input is re-solicited.

B.21 LIST

Prints a station of the data base, with the option to print observed and/or standard depth levels. Does not produce a character plot (see S/R LPLOT).

CALL LIST (INST, ICON),

where INST = Instrument Code
ICON = Consecutive number of the profile within one INST/MSQ/DSQ/MONTH group

This routine requires

(a) COMMON blocks CONT, CONTRO, FIELD and POSIZ
(b) routine TESTA.

Output is to the unit assigned with the current value of variable IPRNT of /CONTRO/.

B.22 LONLEN

Computes the length in metres of 1' longitude at a given latitude; including an option of reference ellipsoid (see Sect. 3.3 of main text).

CALL LONLEN (A,Z,I),

where A = latitude in degrees
Z = computed length of 1' longitude (metres) at lat A.
I = 1 for International Spheroid
2 for WGS72.

B.23 LPLOT

Prints a station of the data base (as S/R LIST), including a character plot of each component parameter profile (Fig. A.1b of App. A)

CALL LPLOT (INST,ICON),

where INST = Instrument Code (I)
ICON = Consecutive number of the profile within one INST/MSQ/DSQ/MONTH group

B.24 MERPAR

Computes the meridional parts of a given latitude, with the option of reference ellipsoid.

CALL MERPAR (A,Z,I),

where A = Latitude in degrees
      Z = Meridional parts
      I = 1 = International spheroid
          2 = WGS72.

B.25 MLIST

Prints the results of the executive MEAN program (see App. A.3).

```
CALL MLIST (B,IA)
```

where B = output array dimensioned for five output parameters at up to 26 standard levels.
      IA = Array of standard depth levels.

This routine requires COMMON blocks CONTRO, DP.
Output is to the unit assigned with the current value of parameter IPRNT of /CONTRO/; an example is shown as Fig. A.6 of App. A.

B.26 MPLOTS

Plots the output of program MEAN (see App. A.3).

```
CALL MPLOTS (TITLE)
```

where TITLE is a character string shorter than 81 FIELDDATA characters.

This routine requires common blocks WINDOW and DP.
An example of the output is shown as Fig. A.56 of App. A.

B.27 NBGA

Checks whether a variable has the value of either Y or N (for Yes or No) or whether it has another value.

```
CALL NBGA (CHAR, $)
```

Returns normally if CHAR has the value Y or N; returns through label $ if any other value. It is designed essentially to " idiot-proof " the conversational software.

B.28 NBGN

Checks whether a numerical value lies within a certain range.

```
CALL NBGN (ALOW,HIGH,VAL, $)
```

where ALOW is lowest permissible value
      HIGH is highest permissible value
      VAL is the value being tested.

The routine returns control normally if:

$$ALOW \leq VAL \leq HIGH$$

otherwise it returns through label $.

B.29 NDIG

Determines the number of digits in an integer value; used in character spacing on graphic displays. This is a FORTRAN Function and is therefore accessed by:

```
(Variable) = NDIG(I),
```

where I = the value being plotted.

B.30 ORDINE

Sorts a variable number of paired integer and real values into ascending order of magnitude of the real values, using the "bubble " sorting method (Knuth <B.3>).

```
CALL ORDINE (A,I,N),
```

where A is a real array
I is an integer array
N is the number of pairs of values
(i.e. arrays are dimensional A(N),I(N)).

B.31 OUTPUT

Sets up the control variables to direct the output of executive program DISPLAY. The conversational demands are those explained in App. A.1.

```
CALL OUTPUT
```

This routine requires

(a) COMMON blocks CONTRO, WINDOW, FIELD
(b) UNI*TEKX.

B.32 PAPER

A Calcomp 960 drum plotter is employed at SACLANTCEN. A real-time program schedules plots generated by user programs on to the plotter in a range of fixed paper sizes <B.4>. Given a plot size in inches, this routine computes the smallest permissible sheet size and its orientation, onto which the plot will fit.

```
CALL PAPER (X,Y,IP, $),
```

where :

X,Y are the abscissa and ordinate lengths in inches
IP is the plot size in the range 1 to 12
$ is an error return label if the plot size is greater than the maximum possible sheet size.

B.33 PARCHO

Solicits information of required contour parameter and level for the CONTOUR executive program.

```
CALL PARCHO
```

This routine requires COMMON block POINT.

B.34 PLOBOR

Plots a Mercator chart border, with intermediate lines of latitude and longitude labelled in terms of degrees and minutes E or W, N or S. In addition plots tick marks on either or both scales as required (see Fig. A.4a of App. A)

CALL PLOBOR

This routine requires:

(a) COMMON blocks CHART, BASE, GRID
(b) routines NDIG, MERPAR
(c) UNI*TEKX.

B.35 POT

Computes potential temperature from in-situ pressure, temperature and salinity, using Fofonoff's equation <B.5>.

V = POT (P,T,S),

where P = pressure in decibars
T = temperature in °C
S = salinity ‰
and V = potential temperature °C.

B.36 PRES

Converts depth to pressure at a latitude, using Leroy's 1968 <B.6> simplified formula.

V = PRES (D, ALAT),
where D = depth in metres (F)
ALAT = latitude in degrees
and V = pressure in kg/cm^2 (F).

B.37 QUAD

Given two positions, computes the course from the first to the second as

(a) a signed angle from 0° to 90° which by inspection may be converted to cardinal notation, (see Fig. B.1)

(b) the course expressed in three-figure notation. e.g. if α = 45° the cardinal notation is S65°W and the three-figure notation is 245°; conversely if α = -65° the cardinal notation is S65°E and the three-figure-notation is 115°.

CALL QUAD (A1, 01 ,A2, 02, C90, C360),

where A1,01 are the latitude and longitude of position 1
A2,02 are the latitude and longitude of position 2
(S and W negative)
C90 is the signed cardinal angle from P1 to P2
C360 is the 360° angle.

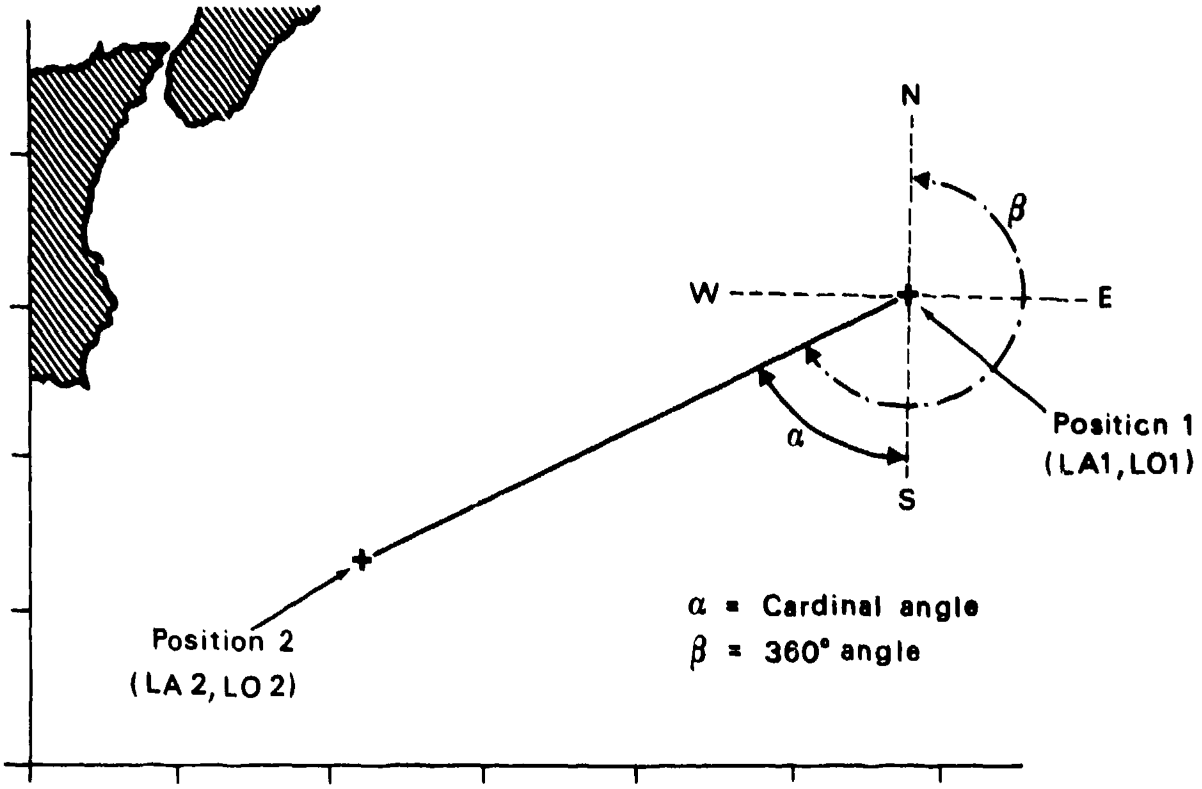

FIG. B.1 CARDINAL ANGLE TO THREE-FIGURE NOTATION

B.38 RADIAL

Given a circle of radius R on the earth's surface centred at position ATL, OTL, computes the geographical limits of the enclosing square (see Fig. 5 of main text).

    CALL RADIAL (ATL, OTL, RAD),

where ATL, OTL is the position of the centre (latitude, longitude)
RAD is the radius (n.mi).

Computed results are stored in COMMON area DAREA, which is therefore required.

B.39 ROVO

Computes density and specific volume from sigma-t,pressure, temperature, and salinity <B.7>.

    CALL ROVO (SG, P, T, S, RHO, SVO),

where SG is sigma-t in (g/cm^3 - 1)/1000
P is pressure in decibars
T is temperature in °C
S salinity in ‰
RHO is density in g/cm^3
SVO is specific volume (1/RHO).

B.40 SIG

Computes sigma-t from temperature and salinity <B.7>.

    V = SIG (T, S),

where T = temperature in °C
S = salinity in %
giving V the sigma-t in (g/cm^3-1)/1000.

B.44 STAND

Interpolates significant point data to US National Oceanographic Data Center standard depths <B.8> using linear interpolation.

In addition, each observed depth is labelled with a 3, each interpolated depth is labelled with a 6.

    CALL STAND (INS),

where INS is the Instrument Type Code (Sect. 2.5 of the main text).

This routine requires COMMON block CONT.

The computed results are merged with the input observed profile in area CONT.

B.42 TESTA

Re-formats the data-base dictionary into correct units.

CALL TESTA(INST),

where INST is the Instrument Type Code (Sect. 2.5 of main text).

This routine requires COMMON blocks CONT and POSIZ. The reformatted variables are output in area POSIZ.

B.43 TPLOT

Plots single or multiple profiles of temperature, salinity, or sound speed as a function of depth.

CALL TPLOT (INST)

where INST is the Instrument Type Code (Sect. 2.5 of main text).

This routine requires

(a) COMMON blocks CONT,CONTRO and WINDOW
(b) UNI*TEKX.

The plot is selfscaled within the input values held in WINDOW, and the axes labelled accordingly. Single profile plotting initiates and closes a plot file (see Sect. 4.2 of main text) each time the routine is called, whereas multiple profile plotting only initiates on the first entry and closes on the last. Examples of the output are shown as Figs. A.2e and A.2f of App. A.

B.44 UKLIST

A modified version of routine LIST to output United Kingdom Hydrographic Office formatted meteorological data <see Sect. 3.3 of Vol. I <B.1>).

CALL UKLIST (INST,ICON),

where INST = Instrument Type Code (Sect. 2.5 of the main text)
ICON = Consecutive number of the profile within one INST/MSQ/DSQ/MONTH group (normally a loop control variable).

This routine requires :

(a) COMMON blocks CONTRO, CONT and POSIZ
(b) routine TESTA.

Output is written to the data file or unit having the name assigned with the current value of variable IPRNT of CONTRO; an example is shown as Fig. A.2c of App. A.

B.45 VBC

A function to compute Brunt-Väisälä frequency <B.9>.

V = VBU (DG,G)

where DG = density gradient
G = gravity,

giving V in cycles/hour.

B.46 WILSV

Computes the speed of sound in water using Wilson's 2nd equation <B.10>.

V = WILSV (T,S,P),

where T = temperature (°C)
S = salinity (%)
P = pressure kg/cm^2,

giving V = sound speed (m/s).

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