UNIVERSITY OF WASHINGTON
DEPARTMENT OF
OCEANOGRAPHY

Technical Report No. 181

PROCESSING OF OCEANOGRAPHIC STATION DATA:
A COORDINATED COMPUTER-COMPATIBLE SYSTEM

by

EUGENE E. COLLIAS

Office of Naval Research
Contract Nonr-477(37)
Project NR 063 012
and
U.S. Atomic Energy Commission
Contract AT(45-1)-1725
RLO-1725-90

Reference M67-8
January 1968

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ABSTRACT

A coordinated computer-compatible system has been developed to eliminate most of the hand calculations involved in processing oceanographic data taken at a hydrographic (water-sampling) station. A special field-log form is used at the time the oceanographic station is occupied so that machine processing of the data is expedited. These data are first punched either on paper tape using a Friden Flexowriter or on Hollerith (IBM) cards and then submitted to a computer to make selected computations.

The computer program uses only uncorrected readings from the meter wheel, estimated wire length, reversing thermometers, salinity, oxygen, and other chemical determinations. The final results are printed, and other output options may be selected such as punched cards, magnetic tape, or both. Output formats for punched cards are essentially those used by the National Oceanographic Data Center. Many error checks and quality control evaluations are incorporated into the program.

The program is written in FORTRAN-II and FAP especially for the IBM-7094-7040 Direct Couple System. An average of 2.5 sec of computer time is required for a station of 12 sampling depths.
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1. INTRODUCTION

1.1. Purpose

The purpose of this comprehensive computer-compatible system for the processing of physical and chemical oceanographic station data is to eliminate most of the hand computations involved in reducing the observed values to a usable form for further analyses. From the actual physical and chemical readings obtained at an oceanographic station, the computer program is designed to calculate such quantities as corrected water temperature, salinity, density as sigma-\( \tau \), several values for representing oxygen concentration, relative humidity, wire-angle depth, and thermometric depth. The system has been designed with flexibility in mind. Inputs may appear in different forms, and outputs may be produced in several desired formats.

1.2. Background

Many attempts have been made to eliminate the need for hand computations of data taken at oceanographic stations where water samples are obtained (i.e., hydrographic stations). Prior to the development of high-speed electronic computers, reversing thermometer corrections were made by means of various nomograms as developed by Tully (1937) and by LaFond (1951), or by specially designed slide rules (Culbertson, 1955), or by hand calculator. Salinity values were derived by means of tables whether the determinations were performed by titration (Oxner, 1920) or by conductivity bridge or salinometer (Paquette, 1958). Values of density as sigma-\( \tau \) were computed by double interpolation from Knudsen's tables (Knudsen et al., 1901) or tables derived from this work. Oxygen saturation values were obtained from tables developed from the work of either Whipple and Whipple (1911) or Truesdale and Gameson (1957) or by nomograms derived from these works (Tully, 1949; Richards and Corwin, 1956). Because each of these quantities is based upon an explicit mathematical expression, it was easy to develop a program to perform the computations by means of a high-speed digital electronic computer.

Many groups (Dinger, 1964) have prepared computer programs to perform calculations of density and other values from reduced oceanographic station data. There have been some attempts to correct reversing
thermometers by electronic computer. But until recently there have been no attempts to design a system that would perform all of these computations from the basic observed (or raw) station data.

During the summer of 1963, a first attempt to develop such a comprehensive computer program was made and proved to be successful. Since then the program and system have been revised several times and a Friden Flexowriter has been incorporated into it.

1.3. The System

The system (Fig. 1.1) is designed so that after all the basic observed data have been recorded on the field log (section 2.1), the data are transcribed onto punched paper tape, using a Friden Flexowriter on board ship, as soon as practicable after the station is occupied. This procedure permits proofreading and a first screening for any errors or omissions shortly after the station is occupied. Any errors are corrected, and comments may be written on the tape after each station to explain any unusual events. Upon return to the home laboratory, the punched paper tape is converted to Hollerith cards using a suitable computer program (section 5.2). If no Flexowriter is available, the field logs must be carefully checked for errors, the data must be keypunched onto cards, and the cards must be verified.

After all cards from a cruise have been punched and verified, they are submitted to a proofreading program (section 5.4) for a further scan for errors and for the preparation of a thermometer deck (section 2.2.7). Any errors are corrected and additional comment cards are prepared if necessary. Then the corrected cards are processed by the main program SYNØP (section 4) for correction of thermometers and calculation of various parameters. The output from this program is in the form of a printed page giving all the computed results, plus punched-card output based on the NODC offshore format (National Oceanographic Data Center, 1962) and a magnetic tape if desired. The data are now ready for further analysis by the person or group that obtained the original data. After further checking of the data, computation of the actual sampling depths for samples deeper than 200 m, addition of any special chemistry
Fig. 1.1. Flow chart of the system.
values, computation of interpolated values, computations of dynamic heights, and the addition of any biological data, a data report is prepared for publication using a final computer program.

Details of the entire system are presented in the following sections of this report.

\[1\] Such as phosphate, nitrate, pH, silicates, etc.
2. INPUT

2.1. Field Log

Success with any system of processing oceanographic data demands that some type of a field log be properly prepared at the time of observation. Only then will the final results be a correct representation of the original data. It must be realized, however, that errors not obvious at the time of sampling may be present in the original data. Also, any inherent experimental errors will be present in the final output.

The field log used with this system (Fig. 2.1) is similar to field logs used by other institutions to record the basic physical and chemical data obtained at a hydrographic station. However, the number of digits placed in any data column and the location of the data fields are closely controlled. This field log permits direct transcription of the data onto punched paper tape with a Friden Flexowriter or onto punched Hollerith cards without further conversion or modification of the basic format. (See section 5 for more details.)

Five data areas are provided on the field log, of which three are used for machine coding\(^2\) and the other two are used for necessary information pertaining to work performed while the oceanographic station is being occupied. The first block of data, the master card information, is recorded on the upper two lines of the field log. The second type of data constitutes the parameter card and appears on the third line of the log. The information for the third set of data is recorded in the body of the log and is used to punch the detail-A cards. These three types of data cards plus three other types are necessary as input for the program SYNØP (section 4).

2.2. Format of Cards

2.2.1. Introduction: The basic input to the computer consists of punched Hollerith cards and wherever possible the information is coded as recommended by the National Oceanographic Data Center (1962). Card input was selected because of the ease of editing and correcting any errors.

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\(^2\)Small numbers are printed on the field log to indicate the column number on a Hollerith card into which the data are to be punched.
**Fig. 2.1.** Oceanographic field log for use with SYNOP (67 percent of original size).
Six types of card formats are used as input to the main program SYNØP. Three of the six formats are on special printed cards to aid in reading the data and for making corrections.

2.2.2. **Master card:** The master card (Fig. 2.2) contains information concerning when and where the station was occupied, the meteorological conditions at that time, and other pertinent information. Table 2.1 presents the format of this card. Only one master card is prepared for each station unless certain restrictions are exceeded as stated in section 4.2.

2.2.3. **Parameter card:** The parameter card (Fig. 2.3) states the constants necessary for the computer to make calculations of sampling depth, salinity, oxygen, and other values. Data for two casts can be punched into each card; hence several parameter cards may be needed for one station. The format and coding instructions are found in Table 2.2.

2.2.4. **Detail-A card:** The detail-A card (Fig. 2.4) contains observed data such as estimated depth, meter-wheel reading, uncorrected reversing thermometer readings, salinometer reading, oxygen-titration values, etc., for each sampling depth. One card for each depth is prepared as listed in Table 2.3.

2.2.5. **Comment card:** Frequently it is desirable to insert remarks as to what happened during a cast or station so that anyone working with the data will know the circumstances under which the station was occupied. Up to 20 comment cards per station may be punched according to the format in Table 2.4.

2.2.6. **Cruise parameter card:** One cruise parameter card is punched for each cruise, and it must be the first card of the data for each cruise. This card specifies the meter-wheel type used, the distance from the point of attaching the reversing bottles on the hydrographic wire to the surface of the water (referred to as distance above water), and the type of output options desired other than printed copy. The format is specified in Table 2.5.

2.2.7. **Thermometer-correction cards:** The thermometer-correction cards specify the serial number of the reversing thermometer, the type
Fig. 2.2. Master card.

Fig. 2.3. Parameter card.

Fig. 2.4. Detail-A card. (Combined Figs. 2.2, 2.3, and 2.4 are 80 percent of original size.)
(i.e., protected or unprotected), the pressure coefficient if unprotected, and the index correction at several readings of the main thermometer. A total of 15 index corrections per thermometer may be required with two cards per thermometer. A maximum of 300 thermometers is permitted. The format of these cards is given in Table 2.6.

2.3. Using the Flexowriter

The Friden Programmatic Flexowriter (Model SPD) provides a convenient method for completing the preliminary phases of machine data processing while aboard ship. By its use, the data obtained are transcribed onto tapes which, when corrected and combined into a single cruise tape, may be submitted to a computer for the preparation of punched cards.

Immediately upon the completion of the field log, the data are transcribed onto paper tape. The observer obtains a hard copy of the data and a full tape simultaneously. After all the data for one station have been typed, the operator proofreads the hard copy and makes any necessary corrections to the full tape. At the same time he scans the data for obvious errors and/or omissions and either corrects them or writes a comment at the end of the cast or station to explain any discrepancies or irregularities.

The transcription of the data from the field log is facilitated by the use of a number of program tapes for the Flexowriter. The master card program tape, the parameter card program tape, and several detail program tapes (i.e., one for each deep-sea reversing bottle or the detail-A card information) are prepared at the beginning of each cruise. To facilitate the preparation of these tapes a meta-master tape is used. This tape is prepared before the start of the cruise and provides all

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3The coding of the paper tape is the IBM 8-level BCD paper tape code.

4A hard copy is a typewritten page containing the data just typed onto the paper tape.

5The full tape contains the information just typed, plus column headings and control information for preparation of the condensed tape.
necessary Flexowriter and computer control information and headings. Instructions for using these tapes are available from the author upon request.

After the full tape for each station has been corrected, a condensed tape is prepared. This tape has no headings, all the spaces between data fields found on the hard copy are eliminated, and control characters for the tape-to-card program are inserted at the correct points.

An example of the hard copy obtained by the Flexowriter is shown in Fig. 2.5 and gives the same data as shown on the original field log of Fig. 2.1. The condensed version of these data is shown in Fig. 2.6. After the cruise has been completed and all condensed tapes have been prepared, a final punched tape is made by combining the condensed tapes into one continuous cruise tape without breaks between stations. This cruise tape is then submitted to a computer for preparation of punched cards.
OA CRUISE 78 STATION 017

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MW Factor 1000 Spec Chem Code 0 Time Zone 08 Card 1 of 1

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<td>078</td>
<td>013564</td>
<td>1108</td>
<td>083</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>0040</td>
<td>0140</td>
<td>12</td>
<td>oy6242</td>
<td>0988</td>
<td>083</td>
<td>014174</td>
<td>0981</td>
<td>080</td>
<td>014075</td>
<td>1135</td>
<td>083</td>
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<td></td>
<td></td>
<td></td>
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</tr>
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<td>0020</td>
<td>0160</td>
<td>13</td>
<td>oy182</td>
<td>0992</td>
<td>083</td>
<td>654333</td>
<td>0955</td>
<td>080</td>
<td>014079</td>
<td>1172</td>
<td>084</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0000</td>
<td>0180</td>
<td>14</td>
<td>654578</td>
<td>1007</td>
<td>072</td>
<td>654114</td>
<td>1009</td>
<td>083</td>
<td>014864</td>
<td>1195</td>
<td>088</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>0000</td>
<td>0194</td>
<td>00</td>
<td>01</td>
<td>oy6801</td>
<td>1006</td>
<td>085</td>
<td>654330</td>
<td>1002</td>
<td>081</td>
<td>60716</td>
<td>0654</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0010</td>
<td>0184</td>
<td>00</td>
<td>02</td>
<td>oy7566</td>
<td>1013</td>
<td>084</td>
<td>654119</td>
<td>1011</td>
<td>081</td>
<td>60783</td>
<td>0514</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0000</td>
<td>0194</td>
<td>00</td>
<td>03</td>
<td>oy6340</td>
<td>1015</td>
<td>083</td>
<td>oy6782</td>
<td>1012</td>
<td>083</td>
<td>60777</td>
<td>0509</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Fig. 2.5. Hard copy from Flexowriter (88 percent of original size).
Fig. 2.6. Condensed data from Flexowriter (actual size).
<table>
<thead>
<tr>
<th>Field No.</th>
<th>Card columns</th>
<th>Field width</th>
<th>Information</th>
<th>Decimal placement</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1-2</td>
<td>2</td>
<td>Country, indicating which nation is operating the ship or conducting the cruise</td>
<td>XX</td>
<td>Found in NODC table 1*</td>
</tr>
<tr>
<td>2</td>
<td>3-4</td>
<td>2</td>
<td>Ship code</td>
<td>XX</td>
<td>Supplied by NODC</td>
</tr>
<tr>
<td>3</td>
<td>5-9</td>
<td>5</td>
<td>Latitude to the nearest 0.1 minute whenever possible</td>
<td>XX*.XX.X'</td>
<td>If in the southern hemisphere, an 11-overpunch is put in col. 8</td>
</tr>
<tr>
<td>4</td>
<td>10-15</td>
<td>6</td>
<td>Longitude to the nearest 0.1 minute whenever possible</td>
<td>XXX*.XX.X'</td>
<td>If in the eastern hemisphere, an 11-overpunch is put in col. 14</td>
</tr>
<tr>
<td>5</td>
<td>16-18</td>
<td>3</td>
<td>Marsden square or a mnemonic area code</td>
<td>AAA</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>19-24</td>
<td>6</td>
<td>Year, month, and day based upon Greenwich mean time unless otherwise stated in col. 32-33</td>
<td>YYMMDD</td>
<td>Two digits each for year and month</td>
</tr>
<tr>
<td>7</td>
<td>25-27</td>
<td>3</td>
<td>Hour to the nearest tenth based upon Greenwich mean time unless otherwise stated</td>
<td>HH.H</td>
<td></td>
</tr>
<tr>
<td>8†</td>
<td>28-30</td>
<td>2</td>
<td>Predicted tide height in feet above mean higher high water or other datum</td>
<td>TT.T</td>
<td>If negative, an 11-overpunch is put in col. 28</td>
</tr>
<tr>
<td>9†</td>
<td>31</td>
<td>1</td>
<td>Tide stage: H = high stand, L = low stand, R = rising, F = falling</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>10†</td>
<td>32-33</td>
<td>2</td>
<td>Time zone on which hour (Field 7) is based</td>
<td>XX</td>
<td>00 = GMT</td>
</tr>
<tr>
<td>11</td>
<td>34-37</td>
<td>4</td>
<td>Sonic depth of water from surface to bottom in meters</td>
<td>XXXX</td>
<td></td>
</tr>
</tbody>
</table>

(continued)
<table>
<thead>
<tr>
<th>Field No.</th>
<th>Card columns</th>
<th>Field width</th>
<th>Information</th>
<th>Decimal placement</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>38-39</td>
<td>2</td>
<td>Maximum sampling depth in hundreds of meters</td>
<td>XX</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>40-41</td>
<td>2</td>
<td>Additional observations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>42-43</td>
<td>2</td>
<td>Water color as determined by the Forel-Uhl scale</td>
<td>XX</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>44-45</td>
<td>2</td>
<td>Transparency of the water based upon a Secchi disk reading recorded to the nearest meter</td>
<td>XX</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>46-47</td>
<td>2</td>
<td>Wave direction</td>
<td>XX</td>
<td>Coding in NODC table 36*</td>
</tr>
<tr>
<td>17</td>
<td>48</td>
<td>1</td>
<td>Wave height or amount if direction is blank</td>
<td>X</td>
<td>Coding in NODC table 38*</td>
</tr>
<tr>
<td>18</td>
<td>49-50</td>
<td>1</td>
<td>Wave period</td>
<td>X</td>
<td>Coding in NODC table 39*</td>
</tr>
<tr>
<td>19</td>
<td>50-51</td>
<td>2</td>
<td>Direction from which the wind is blowing</td>
<td>XX</td>
<td>Coding in NODC table 36*</td>
</tr>
<tr>
<td>20</td>
<td>52-53</td>
<td>2</td>
<td>Wind speed in knots</td>
<td>XX</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>54-56</td>
<td>3</td>
<td>Barometric pressure in millibars to the nearest tens, units, and tenths only (i.e., leave off the 9 for 900 plus or the 10 for 1000 plus)</td>
<td>XX.X</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>57-59</td>
<td>3</td>
<td>Dry bulb air temperature as determined by a psychrometer, in degrees Celsius</td>
<td>XX.X</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>60-62</td>
<td>3</td>
<td>Wet bulb air temperature as determined by a psychrometer, reported in degrees Celsius</td>
<td>XX.X</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>63-64</td>
<td>2</td>
<td>Weather code (if present weather code is used put the letter X in col. 63)</td>
<td>XX</td>
<td>Coding in NODC table 64*</td>
</tr>
</tbody>
</table>

(continued)
<table>
<thead>
<tr>
<th>Field No.</th>
<th>Card columns</th>
<th>Field width</th>
<th>Information</th>
<th>Decimal placement</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>65</td>
<td>1</td>
<td>Cloud type (if clear, leave blank)</td>
<td>X</td>
<td>Coding in NODC table 68*</td>
</tr>
<tr>
<td>26</td>
<td>66</td>
<td>1</td>
<td>Cloud amount in octas of cloud cover</td>
<td>X</td>
<td>Coding in NODC table 69*</td>
</tr>
<tr>
<td>27</td>
<td>67</td>
<td>1</td>
<td>Visibility</td>
<td>X</td>
<td>Coding in NODC table 70*</td>
</tr>
<tr>
<td>28</td>
<td>68-73</td>
<td>6</td>
<td>Special observations</td>
<td>AAAAAA</td>
<td>Coded by observer</td>
</tr>
<tr>
<td>29†</td>
<td>74-76</td>
<td>3</td>
<td>Cruise number</td>
<td>AAA</td>
<td>Alphameric field</td>
</tr>
<tr>
<td>30†</td>
<td>77-79</td>
<td>3</td>
<td>Station number</td>
<td>AAA</td>
<td>Alphameric field</td>
</tr>
<tr>
<td>31†</td>
<td>80</td>
<td>1</td>
<td>Always the letter &quot;J&quot;</td>
<td>A</td>
<td></td>
</tr>
</tbody>
</table>

*Tables are found in NODC Pub M-2 (1962).
†Deviations from NODC format.
# TABLE 2.2
## PARAMETER CARD FORMAT

<table>
<thead>
<tr>
<th>Field No.</th>
<th>Card columns</th>
<th>Field width</th>
<th>Information</th>
<th>Decimal placement</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1-2</td>
<td>2</td>
<td>Country code or left blank</td>
<td>AA</td>
<td>Ignored by computer programs</td>
</tr>
<tr>
<td>2</td>
<td>3-4</td>
<td>2</td>
<td>Ship code</td>
<td>AA</td>
<td>Duplicated from master card</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
<td>1</td>
<td>Cast number</td>
<td>I</td>
<td>An integer from 1 to 9, must not be 0 or blank</td>
</tr>
<tr>
<td>4</td>
<td>6-9</td>
<td>4</td>
<td>Messenger time of cast in local time</td>
<td>XXXX</td>
<td>Used by SYNØP when chemical analyses changed in middle of cast</td>
</tr>
<tr>
<td>5</td>
<td>10-13</td>
<td>4</td>
<td>Last applicable depth for chemical analysis</td>
<td>XXXX</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>14-15</td>
<td>2</td>
<td>Wire angle</td>
<td>XX</td>
<td>Left blank if not measured</td>
</tr>
<tr>
<td>7</td>
<td>16-19</td>
<td>4</td>
<td>Final &quot;down&quot; reading on meter wheel</td>
<td>XXXX</td>
<td>Actual reading of meter wheel when cast is down</td>
</tr>
<tr>
<td>8</td>
<td>20-21</td>
<td>2</td>
<td>Salinometer number (valid numbers in existing program are 2, 4, 11, and 22, but must be changed by any other used to conform with his own salinometers)</td>
<td>XX</td>
<td>If salinity is entered onto detail-A cards, code is 88; if chlorinity was determined by titration, code is 99</td>
</tr>
</tbody>
</table>

(continued)
### TABLE 2.2 (continued)

<table>
<thead>
<tr>
<th>Field No.</th>
<th>Card columns</th>
<th>Field width</th>
<th>Information</th>
<th>Decimal placement</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>22-25</td>
<td>4</td>
<td>Oxygen titer—average number of milliliters of sodium thiosulfate required to standardize against 10.00 ml of 0.0100 N potassium biiodate</td>
<td>XX.XX</td>
<td>Code as 0000 if oxygen values in detail-A cards are in mg atoms/liter, or 0001 if entered as ml/liter, or left blank if no oxygens determined.</td>
</tr>
<tr>
<td>10-16</td>
<td>26-46</td>
<td>21</td>
<td>Same as Fields 3-9 for another cast</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>47-64</td>
<td>18</td>
<td>Not used</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>65-68</td>
<td>4</td>
<td>Meter-wheel factor (actual diameter of meter wheel divided by theoretical diameter)</td>
<td>X.XXX X</td>
<td>Must be numeric and not blank</td>
</tr>
<tr>
<td>19</td>
<td>69</td>
<td>1</td>
<td>Special chemistry</td>
<td>X</td>
<td>0 = no special chemistry 1 = phosphate samples only 2 = frozen samples collected 3 = phosphates and frozen samples</td>
</tr>
<tr>
<td>20</td>
<td>70-71</td>
<td>2</td>
<td>Time zone on which messenger time is based</td>
<td>XX</td>
<td>Negative zone indicated by minus overpunch in col. 71</td>
</tr>
<tr>
<td>21</td>
<td>72-73</td>
<td>2</td>
<td>Parameter card number X of Y for this station</td>
<td>XY</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>74-76</td>
<td>3</td>
<td>Cruise number</td>
<td>XXX</td>
<td>Duplicated from master card</td>
</tr>
<tr>
<td>23</td>
<td>77-79</td>
<td>3</td>
<td>Station number</td>
<td>XXX</td>
<td>Duplicated from master card</td>
</tr>
<tr>
<td>24</td>
<td>80</td>
<td>1</td>
<td>Always the letter &quot;K&quot;</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>
### TABLE 2.3
DETAIL-A CARD FORMAT

<table>
<thead>
<tr>
<th>Field No.</th>
<th>Card columns</th>
<th>Field width</th>
<th>Information</th>
<th>Decimal placement</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1-2</td>
<td>2</td>
<td>Country code or blank</td>
<td>XX</td>
<td>Ignored by computer programs</td>
</tr>
<tr>
<td>2</td>
<td>3-4</td>
<td>2</td>
<td>Ship code</td>
<td>XX</td>
<td>Duplicated from master card</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
<td>1</td>
<td>Cast number</td>
<td>X</td>
<td>Must agree with that on parameter card</td>
</tr>
<tr>
<td>4</td>
<td>6-9</td>
<td>4</td>
<td>Meter-wheel reading</td>
<td>XXXX</td>
<td>Must be numeric</td>
</tr>
<tr>
<td>5</td>
<td>10-13</td>
<td>4</td>
<td>Estimated depth</td>
<td>XXXX</td>
<td>Must be numeric</td>
</tr>
<tr>
<td>6</td>
<td>14-15</td>
<td>2</td>
<td>Slippage—difference between down and up readings of meter wheel</td>
<td>XX</td>
<td>Numeric or blank</td>
</tr>
<tr>
<td>7</td>
<td>16-17</td>
<td>2</td>
<td>Deep-sea reversing bottle number</td>
<td>AA</td>
<td>May be alphabetic or numeric</td>
</tr>
<tr>
<td>8-10</td>
<td>18-30</td>
<td>13</td>
<td>Left reversing thermometer data:</td>
<td>AAAAAA</td>
<td>Alphameric but no blanks permitted</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>18-23 Serial number of thermometer</td>
<td>XX.XX</td>
<td>Malfunction coded as 8888</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>24-27 Main thermometer reading</td>
<td>XX.X</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>28-30 Auxiliary thermometer reading</td>
<td>XX.X</td>
<td></td>
</tr>
<tr>
<td>11-13</td>
<td>31-43</td>
<td>13</td>
<td>Middle reversing thermometer data:</td>
<td>AAAAAA</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>31-36 Serial number</td>
<td>XX.XX</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>37-40 Main thermometer reading</td>
<td>XX.XX</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>41-43 Auxiliary thermometer reading</td>
<td>XX.X</td>
<td></td>
</tr>
</tbody>
</table>

(continued)
### TABLE 2.3 (continued)

<table>
<thead>
<tr>
<th>Field No.</th>
<th>Card columns</th>
<th>Field width</th>
<th>Information</th>
<th>Decimal placement</th>
<th>Remarks</th>
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</thead>
<tbody>
<tr>
<td>14-16</td>
<td>44-56</td>
<td>13</td>
<td>Right reversing thermometer data:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>44-49 Serial number</td>
<td>AAAA</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>50-53 Main thermometer reading</td>
<td>XX.XX</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>54-56 Auxiliary reading</td>
<td>XX.X</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>57-61</td>
<td>5</td>
<td>Salinometer reading in ohms</td>
<td>XXX.XX</td>
<td>Actual salinity or titration value may be entered</td>
</tr>
<tr>
<td>18</td>
<td>62-65</td>
<td>4</td>
<td>Milliliters of sodium thiosulfate used to titrate sample</td>
<td>XX.XX</td>
<td>Blank if no oxygen sample; oxygen may be entered as mg atoms/liter or ml/liter if coded in parameter card</td>
</tr>
<tr>
<td>19</td>
<td>66-69</td>
<td>4</td>
<td>Special chemistry bottle number</td>
<td>AAAA</td>
<td>Alphameric field</td>
</tr>
<tr>
<td>20</td>
<td>70-73</td>
<td>4</td>
<td>Not used at present</td>
<td>blank</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>74-76</td>
<td>3</td>
<td>Cruise designator</td>
<td>AAA</td>
<td>Duplicated from master card</td>
</tr>
<tr>
<td>22</td>
<td>77-79</td>
<td>3</td>
<td>Station number</td>
<td>AAA</td>
<td>Duplicated from master card</td>
</tr>
<tr>
<td>23</td>
<td>80</td>
<td>1</td>
<td>Always the letter &quot;L&quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Field No.</td>
<td>Card columns</td>
<td>Field width</td>
<td>Information</td>
<td>Decimal placement</td>
<td>Remarks</td>
</tr>
<tr>
<td>-----------</td>
<td>--------------</td>
<td>-------------</td>
<td>------------------------------------</td>
<td>-------------------</td>
<td>----------------------------------------------</td>
</tr>
<tr>
<td>1</td>
<td>1-2</td>
<td>2</td>
<td>Country code or left blank</td>
<td>XX</td>
<td>Ignored by computer programs</td>
</tr>
<tr>
<td>2</td>
<td>3-4</td>
<td>2</td>
<td>Ship code</td>
<td>XX</td>
<td>Duplicated from master card</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
<td>1</td>
<td>Cast number</td>
<td>X</td>
<td>Must not be 0 or blank</td>
</tr>
<tr>
<td>4</td>
<td>6-71</td>
<td>66</td>
<td>The comment</td>
<td></td>
<td>Any legal Hollerith code permitted</td>
</tr>
<tr>
<td>5</td>
<td>72-73</td>
<td>2</td>
<td>Not used</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>74-76</td>
<td>3</td>
<td>Cruise designator</td>
<td>AAA</td>
<td>Duplicated from master card</td>
</tr>
<tr>
<td>7</td>
<td>77-79</td>
<td>3</td>
<td>Station number</td>
<td>AAA</td>
<td>Duplicated from master card</td>
</tr>
<tr>
<td>8</td>
<td>80</td>
<td>1</td>
<td>Always the letter &quot;N&quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Field No.</td>
<td>Card columns</td>
<td>Field width</td>
<td>Information</td>
<td>Decimal placement</td>
<td>Remarks</td>
</tr>
<tr>
<td>-----------</td>
<td>--------------</td>
<td>-------------</td>
<td>-------------</td>
<td>-------------------</td>
<td>---------</td>
</tr>
<tr>
<td>1</td>
<td>1-2</td>
<td>2</td>
<td>Country code or blank</td>
<td>AA</td>
<td>Ignored by computer programs</td>
</tr>
<tr>
<td>2</td>
<td>3-4</td>
<td>2</td>
<td>Ship code</td>
<td>AA</td>
<td>Must be same on all cards for the cruise</td>
</tr>
<tr>
<td>3</td>
<td>5-12</td>
<td>8</td>
<td>Not used</td>
<td>XX</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>13-14</td>
<td>2</td>
<td>Distance from hydro-platform to water surface in meters</td>
<td>X</td>
<td>1 = reading increases as wire is paid out  2 = reading decreases as wire is paid out</td>
</tr>
<tr>
<td>5</td>
<td>15</td>
<td>1</td>
<td>Meter-wheel use</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>16-18</td>
<td>3</td>
<td>YES if detail and auxiliary cards are to be punched</td>
<td>AAA</td>
<td>Leave blank if this option is not wanted</td>
</tr>
<tr>
<td>7</td>
<td>19-21</td>
<td>3</td>
<td>YES if auxiliary tape is to be written</td>
<td>AAA</td>
<td>Leave blank if this option is not wanted</td>
</tr>
<tr>
<td>8</td>
<td>22-24</td>
<td>3</td>
<td>YES if special chemistry bottle numbers are to be punched in output detail cards col. 70-73</td>
<td>AAA</td>
<td>Leave blank if this option is not wanted</td>
</tr>
<tr>
<td>9</td>
<td>25-79</td>
<td>55</td>
<td>Leave blank</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>80</td>
<td>1</td>
<td>Always the letter &quot;M&quot;</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### TABLE 2.6
THERMOMETER CORRECTION CARD FORMAT

<table>
<thead>
<tr>
<th>Field No.</th>
<th>Card columns</th>
<th>Field width</th>
<th>Information</th>
<th>Decimal place-ment</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Card type one</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Not used</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2-7</td>
<td>6</td>
<td>Serial number of deep-sea reversing thermometer</td>
<td>AAAAAAAAA</td>
<td>Must be six digits or letters</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>1</td>
<td>Type of thermometer</td>
<td>A</td>
<td>P = protected</td>
</tr>
<tr>
<td>4</td>
<td>9-11</td>
<td>3</td>
<td>( V_0 ) — Volume of small bulb in °C</td>
<td>XXX</td>
<td>U = unprotected</td>
</tr>
<tr>
<td>5</td>
<td>12-15</td>
<td>4</td>
<td>( K ) — the relative expansion of glass and mercury as specified by manufacturer</td>
<td>XXXX</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>16-20</td>
<td>5</td>
<td>( Q ) — the pressure coefficient of an unprotected thermometer</td>
<td>.XXXXX</td>
<td></td>
</tr>
<tr>
<td>7-16</td>
<td>21-70</td>
<td></td>
<td>Ten correction terms as</td>
<td></td>
<td></td>
</tr>
<tr>
<td>21-22</td>
<td></td>
<td></td>
<td>Temperature in °C</td>
<td>XX</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td></td>
<td></td>
<td>Sign or correction term</td>
<td>+ -</td>
<td></td>
</tr>
<tr>
<td>24-25</td>
<td></td>
<td></td>
<td>Correction term in hundredths °C</td>
<td>XX</td>
<td></td>
</tr>
<tr>
<td>etc.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>71-74</td>
<td>3</td>
<td>Left blank</td>
<td></td>
<td>Ignored by program</td>
</tr>
<tr>
<td>18</td>
<td>75-76</td>
<td>2</td>
<td>Month calibrated</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>77-78</td>
<td>2</td>
<td>Year calibrated</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>79-80</td>
<td>2</td>
<td>Left blank</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(continued)
TABLE 2.6 (continued)

<table>
<thead>
<tr>
<th>Field No.</th>
<th>Card columns</th>
<th>Field width</th>
<th>Information</th>
<th>Decimal placement</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>B. Card type two — continuation card</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Not used</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2-7</td>
<td>6</td>
<td>Serial number of thermometer</td>
<td>AAAAAA</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>1</td>
<td>Not used</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>9-11</td>
<td>3</td>
<td>999</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>12-20</td>
<td>9</td>
<td>Not used</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6-10</td>
<td>21-45</td>
<td>25</td>
<td>Correction terms</td>
<td></td>
<td>Five more terms as Fields 7-16 of card number one</td>
</tr>
<tr>
<td>11</td>
<td>46-80</td>
<td>35</td>
<td>Not used</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3. OUTPUT

3.1. The Printed Page

The output of the main program SYNPOP (section 4) may be in several forms. The printed page is always obtained, with the punched-card output, or auxiliary tape, or both, being selected by setting options in the cruise parameter card (section 2.2.6). The printed page (Fig. 3.1) contains four areas of information. The first area is the station header data, which includes all the information on the master card arranged in a convenient manner. This arrangement may be in one of two formats depending on whether tide height and stage were included on the master card (i.e., if columns 28-33 of the master card were punched). The difference in these formats is simply the inclusion of tide height and time zone on which the station time is based. The second area is a transcription of the parameter card (section 2.2.3) and includes the calculated oxygen titer (section 4.3). This portion is repeated once for each card. Comment cards are written immediately after the parameter card data; the detail-A data are listed in the fourth area. The number of lines for each reversing bottle may vary from one to seven depending upon the number of thermometers and whether the protected thermometers agreed within 0.06°C or closer. If they did not meet this test, one line for each thermometer or combination of thermometers is printed and one card for each thermometer or combination will be punched. By printing and/or punching all related data for each thermometer, it is possible for the observer to select the best fit when there is a disagreement in temperature. At the end of each printed page any comments made by the program (such as missing thermometers or incorrect thermometer numbers, errors in the data that SYNPOP has picked up, etc.) are printed. Each station begins a new page.

The arrangement of the printout of depths within a station is by cast and in order of the maximum sampling depth on each cast. If two casts have the same maximum sampling depth, they are printed in sequence by cast number.

3.2. Punched Cards

3.2.1. Output detail cards: Punched cards may or may not be obtained depending upon the option set in the cruise parameter card
### OBSERVED VALUES OA 078-017

| REV | BOTTLE LEFT | MIDDLE | RIGHT | WIRE THICK | WIRE L-Z | TOTH L-Z | CALL LENGTH | DEPTH | FROM ACCEPTED | AVG | DEPTH | CURVE | DEPTH | T | SAL | SIGMA-T | PL/L | MA/L | AP/L | SATN | NO | PUA | NO3 | SIO3 |
|-----|-------------|--------|--------|------------|----------|----------|-------------|--------|---------------|-----|--------|--------|--------|---|-----|---------|-----|------|-----|------|----|------|-----|
| 01  | 7.68        | 7.67   | 0      | 0          | 7.68     | 27.62    | 21.54       | 6.65   | 0.394         | 0.011| 98.28  | 3.41  | 21.54  | 27.62| 21.54| 6.65| 0.394| 0.011| 98.28 |
| 02  | 7.81        | 7.85   | 5      | 5          | 7.83     | 27.61    | 21.54       | 6.65   | 0.394         | 0.012| 99.84  | 3.33  | 21.54  | 27.61| 21.54| 6.65| 0.394| 0.012| 99.84 |
| 03  | 8.51        | 8.50   | 10     | 10         | 8.50     | 29.49    | 22.91       | 5.34   | 0.477         | 0.111| 81.12  | 3.34  | 22.91  | 29.49| 22.91| 5.34| 0.477| 0.111| 81.12 |
| 04  | 8.49        | 8.50   | 15     | 15         | 8.49     | 29.49    | 22.91       | 5.34   | 0.477         | 0.111| 81.12  | 3.34  | 22.91  | 29.49| 22.91| 5.34| 0.477| 0.111| 81.12 |
| 05  | 8.52        | 8.51   | 20     | 20         | 8.52     | 29.71    | 23.08       | 4.94   | 0.441         | 0.146| 75.24  | 3.45  | 23.08  | 29.71| 23.08| 4.94| 0.441| 0.146| 75.24 |
| 06  | 8.67        | 8.67   | 30     | 30         | 8.67     | 29.87    | 23.18       | 4.80   | 0.429         | 0.155| 74.76  | 3.50  | 23.18  | 29.87| 23.18| 4.80| 0.429| 0.155| 74.76 |
| 07  | 8.70        | 8.29   | 45     | 40         | 8.70     | 29.96    | 23.26       | 4.65   | 0.415         | 0.167| 72.83  | 3.56  | 23.26  | 29.96| 23.26| 4.65| 0.415| 0.167| 72.83 |
| 08  | 8.65        | 8.94   | 60     | 60         | 8.94     | 30.06    | 23.71       | 4.66   | 0.417         | 0.163| 72.12  | 3.61  | 23.71  | 30.06| 23.71| 4.66| 0.417| 0.163| 72.12 |
| 09  | 9.12        | 9.15   | 80     | 79         | 9.13     | 30.21    | 23.38       | 4.37   | 0.390         | 0.176| 68.76  | 3.38  | 23.38  | 30.21| 23.38| 4.37| 0.390| 0.176| 68.76 |
| 10  | 9.63        | 9.63   | 114    | 113        | 9.63     | 30.42    | 23.47       | 3.74   | 0.334         | 0.235| 59.62  | 3.47  | 23.47  | 30.42| 23.47| 3.74| 0.334| 0.235| 59.62 |
| 11  | 9.76        | 9.79   | 119    | 118        | 9.76     | 30.51    | 23.52       | 3.54   | 0.312         | 0.255| 55.62  | 3.52  | 23.52  | 30.51| 23.52| 3.54| 0.312| 0.255| 55.62 |
| 12  | 9.86        | 9.85   | 135    | 134        | 9.86     | 30.98    | 23.58       | 3.34   | 0.299         | 0.267| 51.62  | 3.58  | 23.58  | 30.98| 23.58| 3.34| 0.299| 0.267| 51.62 |
| 13  | 9.94        | 9.57   | 154    | 154        | 9.94     | 30.65    | 23.59       | 3.21   | 0.289         | 0.250| 48.62  | 3.59  | 23.59  | 30.65| 23.59| 3.21| 0.289| 0.250| 48.62 |
| 14  | 10.14       | 10.14  | 170    | 169        | 10.14    | 30.76    | 23.61       | 3.22   | 0.270         | 0.245| 45.62  | 3.61  | 23.61  | 30.76| 23.61| 3.22| 0.270| 0.245| 45.62 |

**Fig. 3.1.** Printed output from SYNOP (49 percent of original size).
(section 2.2.6) or by deletion under program control (section 4.3). The "output detail cards" are in essentially the same format as that used by NODC and are shown in Fig. 3.2 and explained in Table 3.1.

3.2.2. **Auxiliary output card:** The auxiliary output card is used to supply information in preparing the header information in the final data report presentation, but this information does not appear on the master card. The format of this card is described in Table 3.2.

### 3.3. Auxiliary Output Tape

When the auxiliary output tape option is set on the cruise parameter card (section 2.2.6), the tape produced is in card-image form and consists of one auxiliary card, the required number of detail cards, and a final card image with the letter X in column 80 for each station. At the end of all the data, a card image with the letter Z in column 80 and an end-of-file mark are generated. The auxiliary card format is identical to that described in Table 3.2 but the detail cards differ from that stated in Table 3.1 as follows:

<table>
<thead>
<tr>
<th>Field No.</th>
<th>Card columns</th>
<th>Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>28-31</td>
<td>Wire-angle depth for all samples rather than corrected sampling depth</td>
</tr>
<tr>
<td>21</td>
<td>66-69</td>
<td>Wire length rather than silicate or a blank</td>
</tr>
<tr>
<td>22</td>
<td>70-73</td>
<td>Thermometric depth rather than special chemistry bottle number</td>
</tr>
</tbody>
</table>
Fig. 3.2. Output detail card (actual size).
<table>
<thead>
<tr>
<th>Field No.</th>
<th>Card columns</th>
<th>Field width</th>
<th>Information</th>
<th>Decimal placement</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1-2</td>
<td>2</td>
<td>Cast number</td>
<td>XX</td>
<td>XX Duplicated from master card</td>
</tr>
<tr>
<td>2</td>
<td>3-4</td>
<td>2</td>
<td>Ship code</td>
<td>XX</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>5-9</td>
<td>5</td>
<td>Latitude to nearest 0.1 minute</td>
<td>XX-XX.X</td>
<td>South latitude indicated by X-overpunch in col. 8</td>
</tr>
<tr>
<td>4</td>
<td>10-15</td>
<td>6</td>
<td>Longitude to nearest 0.1 minute</td>
<td>XXX-XX.X</td>
<td>East longitude indicated by X-overpunch in col. 14</td>
</tr>
<tr>
<td>5</td>
<td>16-18</td>
<td>3</td>
<td>Marsden square or area code</td>
<td>AAA</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>19-24</td>
<td>6</td>
<td>Date</td>
<td>YYMMDD</td>
<td>Duplicated from master card</td>
</tr>
<tr>
<td>7</td>
<td>25-27</td>
<td>3</td>
<td>Time of cast in GMT</td>
<td>XXX</td>
<td>See section 4.3</td>
</tr>
<tr>
<td>8</td>
<td>28-31</td>
<td>4</td>
<td>Corrected depth of sample in meters</td>
<td>XXXXX</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>32</td>
<td>1</td>
<td>Error code established by NODC</td>
<td>X</td>
<td>Left blank by program SYNØP</td>
</tr>
<tr>
<td>10</td>
<td>33-36</td>
<td>4</td>
<td>Temperature of water in °C</td>
<td>XX.XX</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>37</td>
<td>1</td>
<td>Error code established by NODC</td>
<td>X</td>
<td>Left blank by program SYNØP</td>
</tr>
<tr>
<td>12</td>
<td>38-42</td>
<td>5</td>
<td>Salinity in parts per thousand</td>
<td>XX.XXX</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>43-46</td>
<td>4</td>
<td>Density as sigma-t</td>
<td>XX.XX</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>47-49</td>
<td>3</td>
<td>Percentage oxygen saturation</td>
<td>XXX</td>
<td>Change from NODC format</td>
</tr>
</tbody>
</table>

(continued)
<table>
<thead>
<tr>
<th>Field No.</th>
<th>Card columns</th>
<th>Field width</th>
<th>Information</th>
<th>Decimal placement</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>50</td>
<td>1</td>
<td>Not used at present</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>51-53</td>
<td>3</td>
<td>Oxygen concentration in ml/liter</td>
<td>X.XX</td>
<td>If more than 10 ml/liter, put 12-overpunch in col. 51</td>
</tr>
<tr>
<td>17</td>
<td>54-56</td>
<td>3</td>
<td>Phosphate in μg-atoms/liter</td>
<td>X.XX</td>
<td>Inserted by hand</td>
</tr>
<tr>
<td>18</td>
<td>57-59</td>
<td>3</td>
<td>Oxygen concentration in mg-atoms/liter</td>
<td>XXX</td>
<td>Deviation from NODC format</td>
</tr>
<tr>
<td>19</td>
<td>60-62</td>
<td>3</td>
<td>Apparent oxygen utilization</td>
<td>XXX</td>
<td>Deviation from NODC format (see section 4.3)</td>
</tr>
<tr>
<td>20</td>
<td>63-65</td>
<td>3</td>
<td>Nitrate-nitrogen in μg-atoms/liter</td>
<td>XX.X</td>
<td>Inserted by hand</td>
</tr>
<tr>
<td>21</td>
<td>66-68</td>
<td>3</td>
<td>Silicate-silicion in μg-atoms/liter</td>
<td>XXX</td>
<td>Inserted by hand</td>
</tr>
<tr>
<td>22</td>
<td>69-73</td>
<td>5</td>
<td>Option: special chemistry bottle number or blank</td>
<td>XXXXX</td>
<td>Set by option in cruise parameter card (section 2.2.6)</td>
</tr>
<tr>
<td>23</td>
<td>74-76</td>
<td>3</td>
<td>Cruise designator</td>
<td>AAA</td>
<td>Duplicated from master card</td>
</tr>
<tr>
<td>24</td>
<td>77-79</td>
<td>3</td>
<td>Station number</td>
<td>AAA</td>
<td>Duplicated from master card</td>
</tr>
<tr>
<td>25</td>
<td>80</td>
<td>1</td>
<td>Always blank</td>
<td>B</td>
<td></td>
</tr>
</tbody>
</table>
### TABLE 3.2
AUXILIARY OUTPUT CARD FORMAT

<table>
<thead>
<tr>
<th>Field No.</th>
<th>Card columns</th>
<th>Field width</th>
<th>Information</th>
<th>Decimal placement</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1-3</td>
<td>3</td>
<td>Blank</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>4-5</td>
<td>2</td>
<td>Relative humidity in percent</td>
<td>XX</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>6-9</td>
<td>4</td>
<td>Blank</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>10-27</td>
<td>18</td>
<td>Wire angle of casts in increasing order, nine values in two column fields</td>
<td>XX.XX. etc.</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>28-69</td>
<td>42</td>
<td>Blank</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>70-71</td>
<td>2</td>
<td>Maximum sampling depth</td>
<td>XX</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>72-73</td>
<td>2</td>
<td>Blank</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>74-76</td>
<td>3</td>
<td>Cruise designator</td>
<td>XXX</td>
<td>Duplicated from master card</td>
</tr>
<tr>
<td>9</td>
<td>77-79</td>
<td>3</td>
<td>Station number</td>
<td>XXX</td>
<td>Duplicated from master card</td>
</tr>
<tr>
<td>10</td>
<td>80</td>
<td>1</td>
<td>Always the letter &quot;K&quot;</td>
<td>A</td>
<td></td>
</tr>
</tbody>
</table>
4. THE PROGRAM "SYNØP"

4.1. General Information

The oceanographic station data processing program (SYNØP) uses for input the master cards, parameter cards, and detail-A cards for the various stations, plus the other three cards described in section 2.2. Output is provided in several formats as described in section 3. The main program was written in FORTRAN-II for the IBM 7094 computer and occupies 12,614 memory locations. The associated subroutines require another 12,960 locations, and the common storage area occupies 2108 cells for a total of 27,682 cells. In addition to these storage requirements, the computer monitor program requires at least another 2000 locations so that a 32K memory is necessary if the program is used as presented in this report. For a computer with a smaller memory, the program may be rewritten as a two- or three-pass program or many of the options may be eliminated. Seven subroutines are required as listed in Table 4.1. Sense lights 1 and 2 are used in the program as logical switches. Sense switches are not used, nor are the divide check and overflow indicators used.

4.2. Restrictions

Restrictions imposed by storage requirements are: (1) the thermometer correction deck is limited to 300 thermometers with a maximum of 15 index corrections each, (2) a station may have no more than (a) nine casts, or (b) 40 detail-A cards, or (c) 20 comment cards. If a station exceeds these limits, it may be processed by duplicating the master card and splitting the casts in an appropriate manner.

4.3. Main Program

Basically, the main program of SYNØP sets up a table of thermometer corrections, sets output options, and then processes the oceanographic stations one at a time until an end-of-data card is found. A summary of the data submitted for the run is printed before control of the computer is returned to monitor. A flow chart describing the main features of SYNØP is shown in Fig. 4.1. Many of the various tests and branches are
1.2

NO

4

CORRECT THERMOMETERS WHEN ALL UNPROTECTED APPEAR. IF THERE IS A ~Sa~5~~~ depth and paint the temperature.

2

WRITE MASTER INFORMATION

CHECK DEPTHS

COMPUTE WIRE LENGTH, WIRE ANGLE DEPTH AND THEIR AVERAGE FOR EACH DEPTH

CALL THERMOMETERS TO COMPUTE TEMPERATURES, THERMOMETRIC DEPTHS

IS THERE A MASTER CARD?

YES

BLANK OUT MASTER CARD VARIABLES

IS THIS THE LAST CARD?

YES

READ AND STORE MASTER CARD INFORMATION

NO

READ AND STORE PARAMETER CARD, COMMENT CARD, AND DETAIL CARD INFORMATION

WRITE COMMENTS AND COLUMN HEADINGS

FOR EACH THERMOMETER COMBINATION, DO NECESSARY CONVERSIONS, WRITE IN VARIOUS FORMAT, AND PUNCH OR WRITE TAPE IF OPTIONS ARE SET

TEST FOR ERROR CONDITIONS FOUND IN THIS STATION AND WRITE MESSAGES

CORRECT THERMOMETERS WHEN ALL UNPROTECTED APPEAR, IF THERE IS A PROTECTED WITHIN 10 M. COMPUTE THERMOMETRIC DEPTH AND PRINT IT

1.1

IS THIS MASTER CARD NEXT?

YES

READ AND STORE MASTER CARD INFORMATION

NO

BACKSPACE INPUT TAPE

Determine order of cast output, pacing control characters, maximum sampling depth and special chemistry option

IF OPTIONS ARE SET, PUNCH AUXILIARY CARD, WRITE AUXILIARY TAPE

PRINT SUMMARY TABLE

CALL EXIT

Fig. 4.1. Flow chart of SYNØP.
not indicated but can be determined by consulting the program listing (Appendix 3). The order in which the cards are presented to the computer is given in section 5.5.

The program SYNØP begins by initializing selected memory locations and then calls upon subroutine THERMØ to read, set up, and print the thermometer-correction table. A cruise parameter card (section 2.2.6) is read to set the output options and to set the necessary constants for the depth calculations. If the cruise parameter card is missing and if the ship code on the first data card is "TT" the correct constants for depth calculation will be set by the program, but only the printed output will be obtained. If the ship code is not "TT" error message number 3 will be printed.7,8

The master card for each station is processed first, conversions of selected fields are made, and the relative humidity ($R_h$) is computed from the dry bulb reading ($t_d$) and wet bulb reading ($t_w$) by equations (4.1) to (4.5).

$$T_{d} = 1 + t_{d}/273.2$$

$$T_{w} = 1 + t_{w}/273.2$$

$$T_1 = \exp(25.22)(1/T_{d} - 1/T_{w})$$

$$T_2 = \exp(25.22)(1/T_{d} - 1)$$

$$R_h = [T_{d}/T_{w}]^{5.31} T_1 - 10.16(2.02 + 0.927T_{d})$$

$$\times (T_2)(T_{d} - T_{w})T_{d}^{5.31}100$$

If no master card is present, SYNØP will expect a parameter card to be next in order. If this is not the case, error messages will be set and that station will be bypassed.

---

6 "TT" refers to the RV Thomas G. Thompson.

7 Error messages are listed in Appendix 12.

8 This feature must be changed by the user to fit his requirements.
Because the parameter, detail-A, and comment cards may appear in any order within the station, they are all read for a given station before any major computations are performed. The cast numbers on the parameter cards are checked against those in the detail cards and if a cast number is missing, error message number 4 is set and the entire station is bypassed. Otherwise, the cast time is converted to Greenwich mean time (GMT) in hours and the oxygen titer factor \( O_f \) is computed by equation (4.6) using the oxygen titer \( O_e \) listed for each cast (Table 2.2, Fields 9 and 16).

\[
O_f = 0.504/O_e \quad (4.6)
\]

The program SYNØP assumes that the Winkler method as described by Thompson and Robinson (1939) was used for the oxygen determination and that 250-ml sample bottles were used. If the messenger time of any cast is numerically less than the messenger time of the first cast, 24.0 hr are added to it, since the date on all casts will be the same. Data from the parameter cards are stored by cast number. At this point, the station header information is printed if a master card is present. A test is made to determine if tide and time-zone information is present; if so, the station heading is slightly modified as stated in section 3.1.

After a complete station is read into memory, each estimated depth listed in the detail-A cards is checked for correctness by Algorithm 1.

**Algorithm 1**

**Checking for Error in Wire Length**

(a) If the meter-wheel type (Table 2.5, Field 5) is 1, the meter-wheel reading \( M_p \) plus the estimated depth \( L_e \) plus the distance from the hydrographic platform to the water surface must equal the final down reading, or:

(b) If the meter-wheel type is 2, the meter-wheel reading minus the estimated depth minus the distance from the hydrographic platform to the water surface must equal the final down reading.

Each depth that does not meet this test is flagged with an asterisk (*) and error message number 17 is set. Next, the true wire length \( L_t \),
wire-angle length ($L_w$), and the average of these two values ($L_d$) are computed from equations (4.7), (4.8), and (4.9), respectively.

$$L_t = (L_e + S)(M_r)$$  \hspace{1cm} (4.7)

$$L_w = L_t \cos \theta$$  \hspace{1cm} (4.8)

$$L_d = (L_t + L_w)(0.5)$$  \hspace{1cm} (4.9)

where $\theta$ is the wire angle and $S$ is the slippage (Table 2.3, Field 6).

After the depths have been checked, subroutine THERM\# is called once for each station to compute the corrected water temperature and thermometric depths. Details of this subroutine are presented in section 4.4. After control is returned to the main program, salinity and oxygen computations are performed. Valid salinometer numbers in the current program are 2, 4, 11, and 22, but these must be modified by any other user. If the salinometer number listed in the parameter card (Table 2.2, Fields 8 and 16) is coded 88, the input is converted directly to salinity. If the salinometer number is blank and there are salinities to be computed on that cast, the salinometer number from the previous computations is used, if it is a valid number, and error message number 12 is set. Salinities by salinometer are computed according to equations (4.10) and (4.11).

$$R = r + \Delta r$$  \hspace{1cm} (4.10)

$$S = A + BR + CR^2$$  \hspace{1cm} (4.11)

where $r$ is the salinometer reading and $\Delta r$ is a resistance correction dependent upon the value of $r$.

If oxygen values are to be computed on a cast and the corresponding titer value is missing, no oxygens are computed and error message number 13 is set. Normally oxygen values are entered as burette readings ($O_b$) and computed by equation (4.12) in terms of milligram atoms per liter ($O_a$) and by equation (4.13) in terms of milliliters per liter ($O_m$) by equation (4.13).

$$O_a = O_f O_b$$  \hspace{1cm} (4.12)

$$O_m = 11.159 O_a$$  \hspace{1cm} (4.13)
However, oxygen values may be entered directly as either milligram atoms per liter or as milliliters per liter by appropriate coding of the oxygen titer in the parameter card (Table 2.2, Fields 9 and 16).

If both temperature and salinity data are present for a given depth, the density as sigma-\(t\) (\(\sigma_t\)) is computed by equations (4.14) through (4.18).

\[
\Sigma_t = -\{T[T(T + 275.04) - 2236.8396] + 4482.8332\} \\
\quad \div [503.57(T + 67.26)] \tag{4.14}
\]

\[
A_t = 1 - \{T[T(1.0843 \times 10^3 T - 9.8185 \times 10^{-2}) + 4.7867]\} \\
\quad \times 10^{-3} \tag{4.15}
\]

\[
B_t = \{T[T(1.667 \times 10^{-2}T - 0.8164) + 18.030]\} \times 10^{-6} \tag{4.16}
\]

\[
\sigma_0 = \{S[S(6.768 \times 10^{-6}S - 4.82496 \times 10^{-4}) + 0.81487658]\} \\
\quad - 9.344586 \times 10^{-2} \tag{4.17}
\]

and

\[
\sigma_t = \Sigma_t + A_t \sigma_0 + B_t \sigma_0^2 + 0.1324 A_t - (0.1324)^2 B_t \tag{4.18}
\]

where \(S\) is the salinity for the given depth and \(T\) is the specified temperature. If more than one temperature is returned by subroutine THERMO, a sigma-\(t\) value will be calculated for each temperature.

Finally, if temperature, salinity, and oxygen values are present for a given depth, the percent saturation of oxygen (\(O_p\)) and apparent oxygen utilization (AOU) are computed according to equations (4.19) through (4.21) (based upon the work of Truesdale and Gameson, 1957).

\[
C' = 0.88506 - 0.02464T + 0.0004821T^2 - 0.000004038T^3 \\
- S(0.005256 - 0.000160T + 0.000002338T^2) \tag{4.19}
\]

where \(C'\) is the solubility of oxygen at a given temperature (\(T\)) and salinity (\(S\)) and at atmospheric pressure.
The next section of SYNØP sets printer control characters in an attempt to print an entire cast on one page. If two casts can be printed on one page without continuing onto another page, they will be. The number of lines to be printed per station is determined by Algorithm 2.

**ALGORITHM 2**

**NUMBER OF LINES TO BE PRINTED**

Number of lines = 10 lines per station for header information
+ 11 lines per cast for cast information
+ 2.2 lines per depth
+ 1.1 lines per comment card.

If the total number of lines exceeds 59, the station will be printed on two or more pages.

This algorithm may occasionally fail if many of the correction temperatures fall outside the acceptable limits. Then the maximum sampling depth is found and the auxiliary card (see section 3.2.2) is prepared for punching. The station data are printed one cast at a time, as stated in section 3.1. The parameter card information and any comment cards for the cast are printed first, followed by column headings for the oceanographic information. The information from each depth is printed and the process is repeated for all casts of the station. Any error messages pertaining to the station are printed along with a list of thermometer numbers that could not be found in the thermometer deck. If there are any depths at which only unprotected thermometers were placed, the program will calculate depths if there are protected thermometers within 10 m of this bottle. This information is printed out at the end of the error messages. If cards are punched or an auxiliary tape is to be prepared or both, this is done at the same time the printed output is written.

After all the stations have been processed, a summary table is printed and the proper ending is put on the auxiliary tape.
4.4. **Subroutine THERMØ**

Subroutine THERMØ is used to store and print the thermometer correction table, to correct the reversing thermometer readings, and to compute the thermometric depths if unprotected thermometers were present. The first time THERMØ is called by SYNØP, the thermometer correction table is entered into storage. The first card of the table is used to identify the thermometer table and the set of data with which it is to be used. The last card of the table must be blank to signal the end of the thermometer corrections. Any errors in the thermometer deck arrangement will cause error message 2 to be printed. The program will be terminated and control will be returned to monitor.

After all the data for a given station have been read by SYNØP, control is transferred to THERMØ. Subroutine THERMØ begins by examining each of the three thermometer positions (left, middle, and right) to determine if the thermometers present were of the protected or unprotected type, or if a malfunction occurred. A value of $N$ is assigned for each position as follows:

- $N = 0$ for thermometer absent or malfunctioned
- $N = 1$ for protected type
- $N = 2$ for unprotected type

A value of NBASE is calculated by equation (4.22), which will have a value from 0 to 26 and represents one of the 27 combinations of thermometers listed in Table 4.2.

$$N_{BASE} = 9N_l + 3N_m + N_r$$

where $N_l$ is the value of $N$ for the left thermometer, $N_m$ for the middle thermometer, and $N_r$ for the right thermometer.

The equations used by THERMØ to correct the reversing thermometers are those developed by Sverdrup (1947). For the protected thermometer the equation is

$$T_w = T' + I + \frac{(T' - t)(T' + V_o)}{K - (T' - t) - (T' + V_o)}$$

(4.23)
and for the unprotected thermometer the equation is

\[
T_u = T' + I + \frac{(T \omega - t)(T' + V_o)}{K - (T \omega - t)}
\]  

(4.24)

The thermometric depth \(Z\) is calculated as

\[
Z = \frac{(T_u - T \omega)}{(Q \rho_m)}
\]  

(4.25)

where \(T \omega\) is the "true" water temperature, \(T'\) is the uncorrected reading of the main thermometer, \(t\) is the reading of the auxiliary thermometer, \(I\) is the index correction, \(V_o\) is the volume of the small bulb, \(K\) is a constant depending upon the type of glass used in the thermometer, \(Q\) is the pressure coefficient of the unprotected thermometer, and \(\rho_m\) is the mean integrated density of the water from surface to the depth in question.

For this subroutine the \(\rho_m\) values used were based upon the data taken off the coast of Washington and Oregon and are presented in Table 4.3. This table is valid only for this area and must be changed for other areas of the world. This is accomplished by changing the \textit{in situ} density table.

The nature of the data returned to the main program SYNOP by subroutine THERMO depends upon the case represented by the value of NBASE. Each of the 27 cases is treated separately as follows:

**Case 0:** In this case there are no reversing thermometers or all thermometers have malfunctioned. No temperatures are computed.

**Cases 1, 3, 9:** One protected thermometer is present, so only one corrected temperature is returned.

**Cases 4, 10, and 12:** The two protected thermometers are corrected and the results are rounded to the nearest 0.01°C. If the difference between the two temperatures is less than or equal to 0.06°C, the average value is returned; otherwise, each value is returned to be used in separate calculations of sigma-\(t\), AOU, and oxygen saturation values.

**Case 13:** All three protected thermometers are corrected and the results are rounded to the nearest 0.01°C. One, two, three, or six temperatures \([T_\alpha(x)]\) are returned to the main program depending upon the values of the corrected temperatures \((T_u, T_m, \text{and } T_r)\) as follows:
(1) \[ |T_L - T_m| \leq 0.06 \]
\[ |T_L - T_r| \leq 0.06 \]
\[ |T_m - T_r| \leq 0.6 \]
\[ T_\alpha(1) = \frac{(T_L + T_m + T_r)}{3} \]

(2) \[ |T_L - T_m| \leq 0.06 \]
\[ |T_L - T_r| > 0.06 \]
\[ |T_m - T_r| > 0.06 \]
\[ T_\alpha(1) = \frac{(T_L + T_m)}{2} \]
\[ T_\alpha(2) = T_r \]

(3) \[ |T_L - T_m| > 0.06 \]
\[ |T_L - T_r| > 0.06 \]
\[ |T_m - T_r| > 0.06 \]
\[ T_\alpha(1) = T_L \]
\[ T_\alpha(2) = T_m \]
\[ T_\alpha(3) = T_r \]

(4) \[ |T_L - T_m| \leq 0.06 \]
\[ |T_L - T_r| > 0.06 \]
\[ |T_m - T_r| \leq 0.06 \]
\[ T_\alpha(1) = \frac{(T_L + T_m)}{2} \]
\[ T_\alpha(2) = \frac{(T_m + T_r)}{2} \]
\[ T_\alpha(3) = T_L \]
\[ T_\alpha(4) = T_m \]
\[ T_\alpha(5) = T_r \]
\[ T_\alpha(6) = \frac{(T_L + T_m + T_r)}{3} \]

Cases 5, 7, 11, 15, 19, and 21: The protected thermometer is corrected, the unprotected thermometer is corrected, and the thermometric depth is computed. All three values are returned.

Cases 14, 16, and 22: If the corrected temperatures from the two protected thermometers agree within 0.06°C, the average value is used to correct the unprotected thermometer and to obtain the thermometric depth. Otherwise, the unprotected thermometer is corrected for each protected thermometer and a corresponding thermometric depth is computed. These values and each value of the protected thermometer are returned.
Cases 17, 23, and 25: The protected thermometer is corrected, and then the unprotected thermometers are corrected and the two thermometric depths are computed and returned to the main program.

Cases 2, 6, 8, 20, 24, and 26: Each of these types involves only unprotected thermometers, and since a "true" water temperature is needed to correct an unprotected thermometer, THERMO simply returns to the main program, without any computations. After all possible temperatures for the station have been computed, the main program SYNOPSIS tests to see if a thermometric depth can be computed for these cases. In order to have a thermometric depth computed, there must be a "true" water temperature within 10 m and on the same cast. The program checks for these conditions for only two depths on either side of the one in question. For this reason, it is best to have the detail-A cards separated by cast and in order of depth within each cast.

After all thermometers have been corrected on the station, control is returned to the main program.
<table>
<thead>
<tr>
<th>Subroutine name</th>
<th>UWMS* number</th>
<th>Memory locations</th>
<th>Programming language(s)</th>
<th>Description in:</th>
</tr>
</thead>
<tbody>
<tr>
<td>THERMØ</td>
<td>0980</td>
<td>12,725</td>
<td>FORTRAN-II</td>
<td>Section 4.4 &amp; Appendix 4</td>
</tr>
<tr>
<td>BIDE</td>
<td>0950</td>
<td>97</td>
<td>FAP</td>
<td>Appendix 5</td>
</tr>
<tr>
<td>DEBI</td>
<td>0948</td>
<td>115</td>
<td>FAP</td>
<td>Appendix 6</td>
</tr>
<tr>
<td>RDBUF</td>
<td>0933</td>
<td>8</td>
<td>FAP</td>
<td>Appendix 7</td>
</tr>
<tr>
<td>EXØR</td>
<td>0945</td>
<td>4</td>
<td>FAP</td>
<td>Appendix 8</td>
</tr>
<tr>
<td>BLANK</td>
<td>0941</td>
<td>6</td>
<td>FAP</td>
<td>Appendix 9</td>
</tr>
<tr>
<td>XRND</td>
<td>0944</td>
<td>5</td>
<td>FAP</td>
<td>Appendix 10</td>
</tr>
</tbody>
</table>

*UWMS = University of Washington, Department of Oceanography, Applied Mathematics Section.
TABLE 4.2
POSSIBLE ARRANGEMENTS OF THREE REVERSING THERMOMETERS

<table>
<thead>
<tr>
<th>Thermometer combinations</th>
<th>Value of $N_{BASE}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left</td>
<td>Middle</td>
</tr>
<tr>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>*</td>
<td>P</td>
</tr>
<tr>
<td>*</td>
<td>P</td>
</tr>
<tr>
<td>*</td>
<td>P</td>
</tr>
<tr>
<td>*</td>
<td>U</td>
</tr>
<tr>
<td>*</td>
<td>U</td>
</tr>
<tr>
<td>*</td>
<td>U</td>
</tr>
<tr>
<td>P</td>
<td>*</td>
</tr>
<tr>
<td>P</td>
<td>*</td>
</tr>
<tr>
<td>P</td>
<td>*</td>
</tr>
<tr>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td>P</td>
<td>U</td>
</tr>
<tr>
<td>P</td>
<td>U</td>
</tr>
<tr>
<td>P</td>
<td>U</td>
</tr>
<tr>
<td>U</td>
<td>*</td>
</tr>
<tr>
<td>U</td>
<td>*</td>
</tr>
<tr>
<td>U</td>
<td>*</td>
</tr>
<tr>
<td>U</td>
<td>P</td>
</tr>
<tr>
<td>U</td>
<td>P</td>
</tr>
<tr>
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<td>P</td>
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<td>U</td>
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<td>U</td>
</tr>
</tbody>
</table>

* = absent or malfunction
U = unprotected
P = protected
TABLE 4.3
MEAN INTEGRATED DENSITIES ($\rho_m$) FOR THE NORTHEAST PACIFIC OCEAN

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>$\rho_m$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1.0242</td>
</tr>
<tr>
<td>100</td>
<td>1.0253</td>
</tr>
<tr>
<td>200</td>
<td>1.0261</td>
</tr>
<tr>
<td>300</td>
<td>1.0267</td>
</tr>
<tr>
<td>500</td>
<td>1.0275</td>
</tr>
<tr>
<td>700</td>
<td>1.0282</td>
</tr>
<tr>
<td>1,000</td>
<td>1.0291</td>
</tr>
<tr>
<td>1,500</td>
<td>1.0305</td>
</tr>
<tr>
<td>2,000</td>
<td>1.0318</td>
</tr>
<tr>
<td>2,500</td>
<td>1.0330</td>
</tr>
<tr>
<td>3,000</td>
<td>1.0344</td>
</tr>
<tr>
<td>3,500</td>
<td>1.0355</td>
</tr>
<tr>
<td>4,000</td>
<td>1.0366</td>
</tr>
<tr>
<td>10,000</td>
<td>1.0510</td>
</tr>
</tbody>
</table>
5. USE OF THE SYSTEM

5.1. Field Use

Proper preparation of the field log (section 2.1 and Fig. 2.1) while aboard ship will considerably reduce the amount of handwork involved in processing the oceanographic data collected at a station. This requires some extra care by the observer; he must be neat and print all values legibly. When numbers are recorded in the various fields, it is necessary to fill in as many digits as are called for in that field. This means that some numbers must be prefixed by one or more zeros. Thus, a depth of 5 m will be recorded as 0005 not 5, and a temperature of 7.86°C will be recorded as 0786 not 786. The required number of digits in each field is listed in Tables 2.1, 2.2, and 2.3. Also note that, by data processing convention, the number zero is represented by 0 and the letter "0" by Ø; this is contrary to the standard military and radiotelegraphic usage of these symbols.

At the completion of each station, the scientist in charge of that station must go over the field log, fill in any missing information, perform any necessary conversion of units, and check to see that all entries have been made. The time to obtain any missing information is while the events are fresh in the observer's mind. A delay of only one hour may create a problem in reconstruction of events. It is good practice to have one person of the scientific party assigned to make a final check of all field logs. Any pertinent remarks must be written down at this time even if it requires using the reverse side of the log for a longer explanation.

If a Flexowriter is aboard ship, the full tape (section 2.3) is prepared at this time. After the final oceanographic station has been completed, the condensed cruise tape is prepared. Thus by the time the ship has arrived in port the oceanographic data are ready for processing.

5.2. Paper Tape-to-Card Conversion

After the cruise tape (section 2.3) has been prepared, the information is converted to punched cards by use of the IBM 1401 computer. The program reads the tape and converts the data into master, parameter, and
detail-A cards. Because the condensed tape does not have all the information for the detail-A cards, this information is derived from the appropriate master card and transferred to the proper card column. A listing of this program is given in Appendix 1.

Only one type of printed card may be punched by the IBM 1401, so all of the output is put onto detail-A cards. The output deck is then sorted on column 80 and the master and parameter cards are reproduced onto the appropriate printed format. Finally the deck is reassembled by sorting by station number and cruise number if more than one cruise was processed. The order of the cards in this sort is master card first, followed by the parameter cards, detail-A cards, and any comment cards. The deck may be rearranged at this time if so desired.

5.3. Keypunching the Input Cards

If for some reason the data were not punched onto paper tape, the data must be keypunched onto the appropriate card format. When this is done, it is desirable to have the cards verified to reduce the number of errors due to keypunching.

5.4. Proofread Program

After the data cards have been prepared according to section 5.2 or 5.3, the data are submitted to the proofread program. This program was written for the Burroughs B5500, coded in ALGOL, and is listed in Appendix 2.

The first section of the program reads the thermometer master deck, stores all thermometer numbers in a table in memory, and writes all the card images onto a scratch file. Then the data for one complete station are read and stored one card column per word. The data cards are checked in separate routines depending upon the type of card (i.e., master, etc.). Each error as listed in Table 5.1 is flagged with a special code, and cards with errors are printed along with appropriate error indicators. At the end of each station, all cast numbers from parameter cards and detail cards are compared, and indications of any mismatches are printed. When all stations have been processed, the thermometer file is read and cards are punched for those thermometer numbers that appear in the data.
Separate listings are made for both valid and invalid thermometer numbers, showing the number of times each thermometer was used and the first station on which it was used.

The deck makeup for submitting this program to the Burroughs B5500 is as follows:

1. Control cards:
   - ?COMPILE card
   - ?DATA card
2. Source deck for PRUF
3. ?DATA THERMOMSTRCD
4. Thermometer master deck (section 2.2.7)
5. ?DATA CRUISEDATA
6. Data cards for one station
7. Repeat (6) as often as necessary
8. ?END card

The printed output will consist of a page containing a list of the error codes and their explanations. If there are any errors, each card in error will generate two lines of printout; the first one is a card image and the second is the error indicator. The error list is followed by a listing of valid thermometers, and then the list of invalid thermometers. The last line of print contains the beginning and ending times for processing the data, and the I/O channel times. The punched output will be a copy of the thermometer corrections used by this set of data.

5.5. Submitting SYNØP to the Computer

The method of submitting SYNØP to the computer will vary with computer systems but basically the procedure is similar. The method described in this section is specifically for the IBM 7040-7094 Direct Couple System (DCS). The DCS requires an estimate of both the number of lines to be written (sum of lines printed, punched, and put onto tape) and of the maximum 7094 computer time to be used.

The computer time estimate is obtained by dividing the total number of cards submitted by 300, adding two, and rounding to the next highest minute. The line estimate is obtained as follows:
(A) For the printed page, add:
(1) the number of stations multiplied by 10, to
(2) the total number of cast times 11, to
(3) the total number of sampling depths times 2.2, to
(4) the total number of comment times 1.1.

(B) For punched cards (if option is set), add
(1) the number of stations times 1.1, to
(2) the total number of sampling depths times 1.3.

(C) For magnetic tape output (if option is set), use the
same count as for punched cards.

(D) If source program decks are used rather than binary
program decks, multiply the number of source cards by 2.

(E) Sum the values obtained in (A), (B), (C), and (D), add
1000, and round to the next highest thousand.

After the line count and time estimate have been calculated, the various
control and program cards are arranged in the order as given in Table 5.2.
This completed card deck is then ready for submission to the computer.

5.6. Correcting the Output of SYNOP

After the printed output is obtained, the scientist preparing the
data scans for errors as listed at the bottom of each station. Any
thermometer values that differed by more than 0.06°C must be reconciled
as well as other possible errors. If the sampling depth was greater
than 200 m, the L - Z curves are plotted in the usual manner (LaFond,
1951), and the accepted sampling depths are determined and posted in the
proper column of the printout. If any special chemistry determinations
were performed, the results are posted in the proper column.

Next the output cards are corrected as necessary. Further checks
are made on these cards and the results of the various parameters are
plotted to check internal consistency and for spacial consistency. When
all obvious errors are corrected, the output cards are ready for use by
any interested party. These data may be used to compute values of various
parameters at standard depths, for dynamic height calculation, etc. Finally
the data may be put into report form by the use of various mechanical
printers such as the IBM 407 accounting machine or by special computer
programs.
TABLE 5.1
EDITS MADE AND ERRORS FLAGGED BY PROOFREAD PROGRAM

On all cards
Col. 80 must be J, K, L, or N
Col. 74-79 must be nonblank

For master cards
Col. 1-8 must be nonblank
Col. 10-14 must be nonblank
Col. 16-277 must be nonblank

For parameter cards
Col. 1-2 must be either blank or numeric
Col. 5-37 must be either blank or numeric
Col. 5-25 must be all blank or all nonblank
Col. 26-46 must be all blank or all nonblank
Col. 65-73 must be nonblank except for col. 69

For detail-A cards
Col. 5 must be 1 through 9
Col. 6-15 must be nonblank
Col. 16-17 may not both be blank

Thermometer numbers must be valid
If \( T \neq 8888 \) or blank, then \( t \) must be nonblank
Cast number must appear in a parameter card
TABLE 5.2
ORDER OF CARDS TO BE SUBMITTED TO COMPUTER FOR SYNØP

(1) Control cards
   (a) $JØB card
   (b) $ID card
   (c) $IØBASE card
   (d) $EXECUTE FMS card
   (e) *XEQ

(2) SYNØP source or binary cards

(3) THERMØ source or binary cards

(4) SUBRØUTINES as listed in Table 4.1

(5) *DATA card

(6) Cruise parameter card (section 2.2.6) (one per cruise)

(7) Data cards for one station
   (a) Master cards
   (b) Parameter cards
   (c) Detail-A cards
   (d) Remarks cards

(8) Repeat (6-7) as often as needed

(9) $EØF
ACKNOWLEDGMENTS

The author wishes to acknowledge the assistance of Monique Rona and Marsha M. Wallin who originally wrote the programs SYNØP and THERMØ. Later changes and modifications in these two programs were prepared by Linda Green Olund. The subroutines BIDE and DEBI were written by Paavo Kovala. The RDBUF program was prepared by personnel of the University of Washington Computer Center.

Many constructive suggestions were made by Cuthbert Love and William Walker, who were in the Department of Oceanography Data Analysis Section. Mr. Walker prepared all the programing associated with the use of the Flexowriter.

The tape-to-card program (Appendix 1) was written by Mr. M. M. Marshall.

The proofread program (Appendix 2) was originally written by Mr. Walker and modified for the Burrows 5500 by Hella MacIntosh.

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National Oceanographic Data Center

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Sverdrup, H. U.

Thompson, T. G., and R. J. Robinson

Truesdale, G. A., and A. L. H. Gameson
Tully, John P.

Tully, John P.

Whipple, G. C., and H. C. Whipple
APPENDIX 1  Program to convert Flexowriter paper tape to cards
DATA TAPE PUNCH 1

UNIVERSITY OF WASHINGTON
DEPARTMENT OF OCEANOGRAPHY
SEATTLE, WASHINGTON 98105

PROGRAMMED BY M. M. MARSHALL

PUNCHES DETAIL-A, MASTER AND PARAMETER CARDS FROM FLEXOWRITER TAPE.

SWITCHES ALL OFF.

BOARD EOL IS WIRED TO EOR.

HALTS 888 READY PAPER TAPE READER.

999 END OF JOB.

TO START ANOTHER TAPE

TURN SWITCH G ON AND

PRESS START.

0103 START B READY
0104 GO RT (P1, INPUT
0105 RT (P1, INPUT
0106 RT (P1, INPUT
0107 B READY
0108 RT (P1, INPUT
0109 B MASTER
0112 RTMR B READY
0113 RT (P1, INPUT
0114    RT    (PI.INPUT
0115    SBR    NOP 3
0116    B    PARAM
0117    NOP    NOP 000
0120    RIDE    R    READY
0121    RT    (PI.INPUT
0122    B    DETAIL
0201    MASTER    SW    101,134
0202    SW    142,174
0203    MLC    INPUT 26,127
0204    MLC    INPUT 30,137
0205    MLC    INPUT 56,167
0206    MLC    INPUT 63,180
0207    MLC    104,SAVE1
0208    MLC    179,SAVE2
0209    P
0210    CS    180
0211    B    RTMR
0213    PARAM    SW    105,126
0214    SW    163,180
0215    MLC    SAVE1,104
0216    MLC    SAVE2,179
0217    MLC    INPUT 20,125
0218    C    NOP 3,ZAP
0219    BU    FORMB
0222    FORMA    B    READY
0223    RT    (PI.INPUT
0224    MLC    INPUT 8,173
0225    MLC    INPUT 9,180
0226    P
0227    CS    180
0228    B    RIDE
0301    FORMB    MLC    INPUT 41,146
0304    B    READY
0305    RT    (PI.INPUT
0306    MLC    INPUT 8,173
0307    MLC    INPUT 9,180
0308    P
0309    CS    180
0310    B    RIDE
0312    DETAIL    MLC    SAVE1,104
0313    MLC    SAVE2,179
0314    SW    103,180
0315 MLC INPUT 64,169
0316 MLC INPUT 65,180
0317 P
0318 CS 180
0319 B READY
0320 RT (P1, INPUT
0321 SBR NOP 3
0322 C NOP 3, ZIP
0323 BU DETAIL
0324 B READY
0325 RT (P1, INPUT
0321 SBR NOP 3
0322 C NOP 3, ZIP
0323 BU PARAM
0324 B READY
0325 RT (P1, INPUT
0321 SBR NOP 3
0322 C NOP 3, ZIP
0323 BU MASTER
0324 CS 180
0325 P
0311 EOJ H 999,999
0312 8SS START, G
0313 B EOJ
0316 READY SBR OUT 3
0317 CS GMWM-1
0318 CS
0319 CHAIN2A
0320 BIN BIN OUT, 2
0321 H 888, 888
0322 B BIN
0323 OUT B 0
0324 SAVE1 DCW =2
0325 SAVE2 DCW =6
0326 ZIP DCW -Z01-
0327 ZAP DCW -Z22-
0328 ORG 1000
0329 INPUT DA 1X2999
0330 GMWM DCW -)
99999 END START
APPENDIX 2 Proofread program

Program to proofread detail-A, master, and parameter cards and prepare a thermometer deck
BEGIN COMMENT

PROOFREAD

UWMS=1070

UNIVERSITY OF WASHINGTON
DEPARTMENT OF OCEANOGRAPHY
SEATTLE, WASHINGTON 98105

ORIGINATED BY: JACK BECK SEPTEMBER 1966
PROGRAMMED BY: H. MACINTOSH OCTOBER 1966

WRITTEN IN ALGOL FOR BURROUGHS 5500

BASED ON PROGRAM UWMS=1038 (1401)

THIS PROGRAM READS CRUISE DATA AND CHECKS VARIOUS COLUMNS
FOR ERRONEOUS CODES AND PUNCHES. CARDS WITH ERRORS ARE
PRINTED AND THE ERRORS ARE FLAGGED.

INTEGER I,J,CARDCNT,TCOUNT,PCST,DCST,LINECOUNT,P ћ U ;
INTEGER GDCOUNT,NGCOUNT,PTA,ITA J ;
INTEGER ARRAY GDTALLY[O:1200], NGTALLY[0:1200], THFLAG[0:1800] ;
ALPHA STATION, LASTSTATION ;
ALPHA THERMOMETER ;
SAVE ALPHA ARRAY THLIST[O:800], COLL[O:800], CAH[0:1000,0:1800], TH[0:14],
ER[COL[0:800], PCST[COL[0:800], GCAST[COL[0:1200] ;
ALPHA ARRAY NGLIST[0:1200], NGSTAT[0:1200], GLLIST[0:1200], GDSTAT[0:1200] ;

BOOLEAN ERH5W, NEW, NEWD ;
FILE IN THERMOMSTRCD (2,10) ;
FILE IN CRUISEDATA (2,10) ;
FILE THERMOTAPE DISK SERIAL [2,1800] (2,10,30) ;
FILE OUT THERMOPUNCH (0,10) ;
FILE OUT PUNCHOUT (4,17) ;

FORMAT TITLE ("COUNTRY SHIP CST COLS 16-30",X3,
"COLUMNS 31-43 COLUMNS 44-56 COLUMNS 57 THRU73",X3,
"CRUISE STATION CNTRL"// )

FORMAT THERMOFMT (A1,A6,A1,A3,11A6,28) ;
FORMAT DATAFMT (8A1) ;
FORMAT LINEFMT (X4,2A1,X6,2A1,X4,2A1,X3,10A1,X3,15A1,X3,13A1,X3,13A1,
X3,17A1,X4,3A1,X4,3A1,X6,2A1) ;

FORMAT PCSTFMT("PARAMETER CAST NUMBER ",A1," NOT ON DETAIL CARDS FOR ",
"CRUISE AND STATION ",J1,A1,"=",J1,NEW // ) ;
FORMAT DCSTFMT("DETAIL CAST NUMBER ",A1," NOT ON PARAMETER CARDS FOR ",
"CRUISE AND STATION ",J1,A1,"=",J1,NEW // ) ;

FORMAT THLISTFMT (A10,T10,A10) ;
FORMAT NGTITL E("INVALID THERMOMETERS "// ) ;
FORMAT OKTITL E("VALID THERMOMETERS USED IN THIS RUN "// ) ;
FORMAT THTITL E (" THERMO COUNT STATION"// ) ;
FORMAT TIMEFMT ("BEG(NEW) PRTIC;218",BEG(NEW) I/O",218) ;
FORMAT EXPLAIN ("ERROR CODES AND THEIR EXPLANATIONS!" //
"* - THIS COLUMN SHOULD NOT BE BLANK " /
"# = CONTROL PUNCH INVALID: NOT J,K,L OR 4" /
"* = CAST NUMBER INVALID: NOT 1-9" /
"% = PARAMETER CARD FOR THIS CAST EITHER" ,
"OUT OF ORDER OR MISSING " /
"",",","," - THIS COLUMN SHOULD NOT BE ALPHA " /
"+ - INVALID THERMOMETER NUMBER" /
"* - SALINITY ≥ 800 OR OXYGEN ≥ 30" /

LIST THCARD (THEO) ,THERMOMETER , FOR I = 1 STEP 1 UNTIL 14U IN TH(I) ;
LIST DATACD (FOR I = 1 STEP 1 UNTIL 80 DU COL(I) ) ;
LIST LINTLIN (FOR J = 1 STEP 1 UNTIL 80 DU CARD(I,J)) ;
LIST LINEPK (FOR J = 1 STEP 1 UNTIL 80 DU ERRCOL(J)) ;
LIST THLISTOUT (GDLIST[J], GDTALLY[J], GLSTAT[J] ) ;
LIST NGLISTOUT (NGLIST[J], NGTALLY[J], NGSTAT[J] ) ;

COMMENT THIS PROCEDURE READS THERMO MASTER DECK, WRITES IT ON DISK, AND CREATES A TABLE OF ALL THERMO NUMBERS IN THE DECKS.

PROCEDURE PROCESS THERMOMASTERS ;
BEGIN
LABEL THENU ;
FOR THCOUNT = 1 STEP 1 WHILE TRUE DO
THEN READ REAL (THERMOMSTRC{THERMOMT,THCARD}) [THEAD] ;
WRITE (THERMOtape THERMOMT,THCARD) ;
THLIST[THCOUNT] = THERMOMETER ;
END;
THEN THENWNU(THERMOtape) ;
CLOSE (THERMOMSTRC, RELEASE ) ;
WHEN (1) ;
END;

COMMENT THIS PROCEDURE PROCESSES MASTER CARDS ONLY ;

PROCEDURE PROCSSMASTERCARD ;
BEGIN
FOR J = 1 STEP 1 UNTIL 8 > 10 STEP 1 UNTIL 14, 16 STEP 1 UNTIL 27
DO IF CARD[1,J] = " " THEN
BEGIN ERRSW = TRUE ;
ERRCOL(J) = "*"
END;
END PROCESSING MASTER CARD ;

COMMENT THIS PROCEDURE HANDLES ALL PARAMETER CARDS ;

PROCEDURE PROCSSPARAMCARD ;
BEGIN
BOOLEAN NONBLANKS ;
FOR J = 1,2,5 STEP 1 UNTIL /3 DO
IF CARD[I,J] = " " AND CARD[I,J] > "9" THEN
BEGIN ERRSW = TRUE ;
ERRCOL(J) = "*"

END PROCESSES THERMOMASTERS;
END;
NONBLANKS = FALSE;
FOR J + 5 STEP 1 UNTIL 25 DO
  IF CARD[I,J] = " " THEN NONBLANKS = TRUE;
IF NONBLANKS THEN
  BEGIN FOR J + 5 STEP 1 UNTIL 25 DO
    IF CARD[I,J] = " " THEN
      BEGIN ERSW = TRUE;
      ERRCOL[J] = "*"
      END;
  PCST = PCST+1;
  PCASTNO[PCST] = CARD[I,5];
END;
NONBLANKS = FALSE;
FOR J + 26 STEP 1 UNTIL 46 DO
  IF CARD[I,J] = " " THEN NONBLANKS = TRUE;
IF NONBLANKS THEN
  BEGIN FOR J + 26 STEP 1 UNTIL 46 DO
    IF CARD[I,J] = " " THEN
      BEGIN ERSW = TRUE;
      ERRCOL[J] = "*"
      END;
  PCST = PCST+1;
  PCASTNO[PCST] = CARD[I,26];
END;
FOR J + 65 STEP 1 UNTIL 68, 70 STEP 1 UNTIL 73 DO
  IF CARD[I,J] = " " THEN
    BEGIN ERSW = TRUE;
    ERRCOL[J] = "*"
    END;
END PROCE$$ING PARAMETER CARD;

COMMENT THIS PROCEDURE HANDLES ALL DETAIL CARDS;

PROCEDURE PROCESSDETAILCARD;
BEGIN BOOLEAN GOOD ; ALPHA TAB, LEFTNU, MIDDLENO, RIGHTNU ;
LABEL CKLT, CKMI0, CKWIT ;
GOOD = FALSE;
IF CARD[I,5] < "1" OR CARD[I,5] > "9" THEN
  BEGIN ERSW = TRUE;
  ERRCOL[5] = "*
END ELSE
  BEGIN FOR P + 1 STEP 1 UNTIL PCST DO
    IF CARD[I,5] = PCASTNO[P] THEN GOOD = TRUE;
    IF NOT GOOD THEN
      BEGIN ERSW = TRUE;
      ERRCOL[5] = "*"
      END;
  NEWD = TRUE;
  FOR D + 1 STEP 1 UNTIL DCST DO
    IF DCASTNO[D] = CARD[I,5] THEN NEWD = FALSE;
    IF NEWD THEN
      BEGIN DCST = DCST + 1;
      DCASTNO[DCST] = CARD[I,5]
END;
END;
GOOD + FALSE;
IF MIDDLEN0 <> "" THEN
BEGIN FOR J + 1 STEP 1 UNTIL GDCOUNT DO
IF MIDDLEN0 = GDLIST[J]
THEN BEGIN GOOD + TRUE;
GDTALLY[J] + GDTALLY[J] + 1;
GO TO CKMID;
END;
FOR J + 1 STEP 1 UNTIL THCOUNT DO
IF MIDDLEN0 = THLIST[J]
THEN BEGIN GOOD + TRUE;
GDCOUNT + GDCOUNT + 1;
GDLIST[GDCOUNT] + MIDDLEN0;
GDTALLY[GDCOUNT] + 1;
GSTAT[GDCOUNT] + LASTSTATION;
THFLAG[J] + 99;
GO TO CKMID;
END;
END;
CKMID: IF NOT GOOD THEN
BEGIN ERRSW + TRUE; NEW + TRUE;
IF NGCOUNT > 0
THEN FOR J + 1 STEP 1 UNTIL NGCOUNT DO
IF MIDDLEN0 = NGLIST[J]
THEN BEGIN NEW + FALSE;
NGTALLY[J] + NGTALLY[J] + 1;
END;
IF NEW
THEN BEGIN NGCOUNT + NGCOUNT + 1;
NGLIST[NGCOUNT] + MIDDLEN0;
NSTAT[NGCOUNT] + LASTSTATION;
NGTALLY[NGCOUNT] + 1;
END;
ERRCOL[31] + "*"
END;
& CARD[I,43][42:42:16];
IF TA <> "8888" AND TA <> "" AND TB = "" THEN
BEGIN ERRSW + THUF;
END;
GOOD + FALSE;
IF RIGHTNO # "" THEN
BEGIN FOR J + 1 STEP 1 UNTIL GDCOUNT DO
IF RIGHTNO = GDLIST[J]
THEN BEGIN GOOD = TRUE;
GOTALLY[J] = GOTALLY[J] + 1;
GO TO CRKRT;
END;
FOR J + 1 STEP 1 UNTIL THCOUNT DO
IF RIGHTNO = THLIST[J]
THEN BEGIN GOOD = TRUE;
GDCOUNT = GDCOUNT + 1;
GDLIST[GDCOUNT] = RIGHTNO;
GOTALLY[GDCOUNT] = 1;
GDSTAT[GDCOUNT] = LASTSTATION;
THFLAG[J] = 99;
GO TO CRKRT;
END;
CRKRT: IF NOT GOOD THEN
BEGIN ERRSW = TRUE; NEW = TRUE;
ERRCOL[44] = ";
IF NGCOUNT > 0 THEN FOR J + 1 STEP 1 UNTIL NGCOUNT DO
IF RIGHTNO = NGLIST[J]
THEN BEGIN NEW = FALSE;
NGTALLY[J] = NGTALLY[J] + 1;
END;
IF NEW THEN BEGIN NGCOUNT = NGCOUNT + 1;
NGLIST[NGCOUNT] = RIGHTNO;
NGSTAT[NGCOUNT] = LASTSTATION;
NGTALLY[NGCOUNT] = 1;
END;
END;
IF TA # "BRBB" AND TA # "" AND TB = "" THEN BEGIN ERRSW = TRUE;
ERRCOL[54] = ERRCOL[55] = ERRCOL[56] = "*
END;
END;
IF CARD[I,57] # "?" AND CARD[I,57] # "" THEN BEGIN ERRSW = TRUE;
ERRCOL[57] = "!
END;
IF CARD[I,62] # "?" AND CARD[I,62] # "" THEN BEGIN ERRSW = TRUE;
ERRCOL[62] = "!
END;
END PROCESSING THIS DETAIL CARD;

COMMENT THIS PROCEDURE HANDLES ALL COMMENT CARDS;
PROCEDURE PROCESSCOMMENTCARD;
BEGIN
  BOOLEAN GOOD;
  GOOD + FALSE;
  IF CARD[I,5] <"1" OR CARD[I,5] >"9" THEN
  BEGIN
    ERRS + TRUE;
    ERRCOL[5] + "9"
  END
  ELSE
  BEGIN FOR P + 1 STEP 1 UNTIL PCST DO
  IF CARD[I,5] = PCASTNO[P] THEN GOOD + TRUE;
  IF NOT GOOD THEN
  BEGIN ERRS + TRUE;
    ERRCOL[5] + "8"
  END
  END;
END PROCESSING THIS COMMENT CARD;

COMMENT THIS PROCEDURE HANDLES CARDS WITH ERRORS;

PROCEDURE PROCESSBADCARD;
BEGIN
  IF LINECOUNT = 17 THEN
  BEGIN
    LINECOUNT + 0;
    WRITE(PRINTOUT[PAGE]); WRITE(PRINTOUT,TITLE);
  END;
  WRITE(PRINTOUT,LINFMT,LINEIN);
  WRITE(PRINTOUT,DBL,LINFMT,LINERK);
  LINECOUNT + LINECOUNT +1;
END PROCESSING ERROR CARD;

COMMENT THIS PROCEDURE EDITS THE LIST OF CAST NUMBERS;

PROCEDURE EDITCASTLIST;
BEGIN
  BOOLEAN PCASTOK,DCASTOK;
  PCASTOK + DCASTOK + FALSE;
  FOR P + 1 STEP 1 UNTIL PCST DO
  BEGIN FOR D + 1 STEP 1 UNTIL DCST DO
  IF PCASTNO[P] = DCASTNO[D] THEN PCASTOK + TRUE;
  IF NOT PCASTOK THEN
  BEGIN
    WRITE(PRINTOUT,PCSTFMT,PCASTNO[P]);
    FOR J + 74 STEP 1 UNTIL 79 DO CARD[O,J];
  END;
  LINECOUNT + LINECOUNT +1;
  END;
  PCASTOK + FALSE;
END;
FOR D + 1 STEP 1 UNTIL DCST DO
BEGIN FOR P + 1 STEP 1 UNTIL PCST DO
  IF DCASTNO[D] = PCASTNO[P] THEN DCASTOK + TRUE;
  IF NOT DCASTOK THEN
  BEGIN
    WRITE(PRINTOUT,DCSTFMT,DCASTNO[D]);
    FOR J + 74 STEP 1 UNTIL 79 DO CARD[O,J];
67

LINECOUNT + LINECOUNT + 1
END;
OCASTOK + FALSE;
END;
END CASTLIST EDIT;

COMMENT THIS PROCEDURE HANDLES ALL CARDS FOR ONE STATION;

PROCEDURE PROCESSLASTSTATION;
BEGIN
PCSI + DCSI + 0;
FOR J + 0 STEP 1 UNTIL CARDCNT UU
BEGIN FOR J + 1 STEP 1 UNTIL 80 UU ERRCOL[J] + " " ;
FOR J + 74 STEP 1 UNTIL 79 UU
IF CARD[J] = " " THEN
BEGIN ERRSW + TRUE ;
ERRCOL[UO] + "*"
END;
IF CARD[UO] = "M" THEN PROCESSMASTERCARD ELSE
IF CARD[UO] = "K" THEN PROCESSPARAMCARD ELSE
IF CARD[UO] = "L" THEN PROCESSDETAILCARD ELSE
IF CARD[UO] = "N" THEN PROCESSCOMMENTCARD ELSE
BEGIN ERRSW + TRUE ;
ERRCOL[UO] + "*"
END;
IF ERRSW THEN BEGIN PROCESSSBASECARD ; ERRSW + FALSE END;
END;
ENDCASTLIST;
END PROCESSING THIS STATION;

COMMENT THIS PROCEDURE LIST OUT ALL THERMOMETER NUMBERS
USED, HOW OFTEN, AND ON WHAT STATION FIRST USED;

PROCEDURE NEWWRAPITUP;
BEGIN
BOOLEAN FOUND ;
LABEL THLIST;
WHILE (PRINTOUT[PAGE]) ; WRITE(PRINTOUT,DRTITLE) ;
WRITE (PRINTOUT,THTITLE) ;
FOR THCOUNT + 1 STEP 1 WHILE TRUE UU
BEGIN READ (THERMOTHERP,E, THERMOMT, THCARD ) [THLIST] ;
FOUND + FALSE ;
IF THFLAG[THCOUNT] # 0 THEN BEGIN FOR J + 1 STEP 1 WHILE NOT FOUND UU
IF THLIST[THCOUNT] = GDLIST[J] THEN BEGIN WRITE (PRINTOUT, THLISTFMT, THLISTOUT) ;
WRITE (THERMO,PUNCH,THERMOMT, THCARD) ;
FOUND + TRUE ;
END ;
END;
ELSE IF TH[2] = "999" AND THFLAG[THCOUNT -1] # 0 THEN WRITE (THERMO,PUNCH, THERMOMT, THCARD) ;
END ;
PROCEDURE PROCESSDATA;
BEGIN BOOLEAN FIRSTCARD, LASTCARD;
LABEL ENDOFDATA;
FIRSTCARD + TRUE; LASTCARD + FALSE;
CARDCNT + PCST + DCST + 0; LINECOUNT + 17;
NGCOUNT + GDCOUNT + 0;
WHILE TRUE DO
BEGIN READ (CRUISEDATA, DATAFMT, DATAAD) [ENDOFDATA];
STATION + COL[1][7][2][14][2][16][75][18][42][16][76][24][42][16][77][30][42][16][78][36][42][16][79][42][42][16];
ERRSW + FALSE;
IF NOT FIRSTCARD AND STATION ≠ LASTSTATION THEN
BEGIN CARD + CARD + 1;
PROCESSLASTSTATION;
CARD + 0;
END;
FOR J + 1 STEP 1 UNTIL 80 DO CARD[CARDCNT,J] + COL[J];
CARDCNT + CARDCNT + 1;
LASTSTATION + STATION;
FIRSTCARD + FALSE;
END PROCESSING ONE DATA CARD;
ENDOFDATA: CARDCNT + CARDCNT = 1;
PROCESSLASTSTATION;
NOWWRAPITUP;
END PROCESSING ALL DATA CARDS;

COMMENT THIS IS THE PROGRAM IN ITS PURE DISTILLED FORM;

PTA + TIME(2); ITA + TIME(3);
WRITE (PRINTOUT, EXPLAIN);
PROCESSSTHROMMasters;
PROCESSDATA;
WRITE (PRINTOUT, TIMEFMT, PTA, TIME(2), ITA, TIME(3));
END.
APPENDIX 3 The main program SYNØP
CSYNO

SYNOPTIC PROGRAM

UWMS-0980-C

CSYNO

UNIVERSITY OF WASHINGTON
DEPARTMENT OF OCEANOGRAPHY
SEATTLE, WASHINGTON 98105

CSYNO

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REVISION C BY: LINDA S. GREEN

CSYNO

WRITTEN IN FORTRAN II, VERSION 2, FOR IBM 709/7090/7094

CSYNO


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SUBROUTINES USED BY THIS PROGRAM ARE THERMO (REV.B AND REV.C),
BIDE (UWMS-0950), DEBI (0948), RDBUF (0933), BLANK (0941), AND
XRNQ (0944).

CSYNO

THE FIRST CARD OF THE DATA DECK IS A TITLE FOR THE THERMOMETER
TABLE; THIS IS FOLLOWED BY THE THERMOMETER DECK. A BLANK CARD
MUST BE BETWEEN THE THERMOMETER TABLE AND THE OBSERVED DATA.

CSYNO

THE FORMAT FOR THE CRUISE PARAMETER CARD IS AS FOLLOWS:

CSYNO

<table>
<thead>
<tr>
<th>COL. 3-4</th>
<th>SHIP CODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>COL. 13-14</td>
<td>DISTANCE FROM METER WHEEL TO WATER (METERS)</td>
</tr>
<tr>
<td>COL. 15</td>
<td>METER WHEEL TYPE CODE</td>
</tr>
<tr>
<td>COL. 16-18</td>
<td>YES IF PUNCHING IS DESIRED, OTHERWISE BLANK</td>
</tr>
<tr>
<td>COL. 19-21</td>
<td>YES IF TAPE IT3 (8) IS TO BE WRITTEN, OTHERWIDE BLANK</td>
</tr>
<tr>
<td>COL. 22-24</td>
<td>YES IF SPECIAL CHEMISTRY BOTTLE NUMBERS ARE TO BE PUNCHED IN COL. 70-73 OF DETAIL CARDS, OTHERWISE BLANK</td>
</tr>
<tr>
<td>COL. 80</td>
<td>M</td>
</tr>
</tbody>
</table>

CSYNO


DIMENSION DELR(892), A(2), d(2), C(2), MEST(9), ZLAST(9), AN(9), LSTE(40)

1* WHEEL(9), SAL(9), TITER(9), FACTOR(9), SPCM(9), ZONE(9), ZTRUP(40),
2* NO(9), NO2(9), CRU(9), STAP(9), JCA(9), RES(9), WSIGN(9), PAGE(9),
3* LGMT(9), OFAC(9), FLKG(9), ICAST(40), WEL(40), EST(40), SLIP(40),
4* REV(40), BOTNO(3, 40), CAPT(3, 40), TI(3, 40), OOH(40), OXY(40), CHEM(40),
5* CRUD(40), STAD(40), AN(9), FLG(40), ZTRUE(40), ZANG(40), ZAVE(40),
6* SALW(40), SALP(40), SAL(40), C(1, 40), OX2(40), OX1W(40),

DIMENSION OX2W(40), OX1P(40), C(2P, 40), NSI(40), IAV(6, 40),

1* SIG(6, 40), SIGTW(6, 40), SIGT(3, 40), AOU(6, 40), AOU(6, 40),

Synchronize
INITIALIZE ALL COUNTING

NOSALA = 0
NOSIG = 0
NOTMP = 0
NOXY = 0
NAPU = 0
NOXY = 0
NOMAST = 0
NODC = 0
NODC = 0

OCTAL EQUIVALENTS OF BCD CHARACTERS

BL = 606060606060
ONE = 016060606060
AJ = 416060606060
AK = 426060606060
AL = 436060606060
AM = 446060606060

AUMUS = 406060606060
ANORTH = 456060606060
SOUTH = 626060606060
EAST = 2656060606060
WEST = 6656060606060

TTHOMP = 636360606060
STAR = 546060606060
UNPRO = 646060606060
WL = 676060606060

YES = 702562606060

IT1 = 5
IT2 = 6
IT3 = 8

COMENT (20,11), KSTCOM (20)
CONSTANTS FOR SALINITY BRIDGE 1 AS OF 5/24/63

DELR(1,1) = 0.39
DELR(2,1) = 0.35
DELR(3,1) = 0.31
DELR(4,1) = 0.27
DELR(5,1) = 0.21
DELR(6,1) = 0.17
DELR(7,1) = 0.08
DELR(8,1) = 0.00
A(1) = -0.6098
B(1) = 45.8079E-03
C(1) = 72.332E-07

CONSTANTS FOR SALINITY BRIDGE 2 AS OF 5/24/63

DELR(1,2) = 0.77
DELR(2,2) = 0.66
DELR(3,2) = 0.55
DELR(4,2) = 0.44
DELR(5,2) = 0.33
DELR(6,2) = 0.22
DELR(7,2) = 0.10
DELR(8,2) = 0.00
A(2) = 4.6375
B(2) = 3.97605E-02
C(2) = 0.51637E-05

FIRST STATEMENT IN PROGRAM MUST BE CALL THERMO TO CONSTRUCT THE TABLE OF THERMOMETERS.

SENSE LIGHT 0
KPP = 0
CALL THERMO
KPP = 1
READ INPUT TAPE IT1,9000,TEST
9000 FORMAT(79X,A1)
B IF(EXORF(TEST,AM)) 100,500,100
C NO CRUISE PARAMETER CARD
100 READ 9010,SHIP
9010 FORMAT(2X,A2)

72
IF(EXOPF(SHIP,TITHOPD)) 110,120,110
110 WRITE OUTPUT TAPE IT1, 9020, SHIP
9020 FORMAT(3SH1CRUISE PARAMETER CARD MISSING FOR A2/6X55ASSUME THAT UP=0.2
DISTANCE IS 4 AND METER WHEEL IS OF TYPE 1.6X25HNO CARDS WILL BE
PUNCHING )
120 DIST = 4.0
NTYPE = 1
TAPE = BL
KSAL = 0
BACKSPACE IT1
GO TO 520
C READ CRUISE PARAMETER CARD
500 READ 9030,SHIP,DIST,NTYPE,PUNCH,TAPE,PSPCH
9030 FORMAT(2X,A2,6X,F2.0,11,3A3)
KSAL = 0C TEST TO SEE IF PUNCHING IS DESIRED
B IF(EXOPF(PUNCH,YES)) 520,510,520
C PUNCHING DESIRED
510 ASSIGN 5630 TO NPNCH2
ASSIGN 5680 TO NPNCH3
ASSIGN 5750 TO NPNCH6
ASSIGN 5820 TO NPNCH7
ASSIGN 5890 TO NPNCH8
ASSIGN 4640 TO NPNCH9
ASSIGN 5400 TO NPN10
GO TO 530
C PUNCHING NOT DESIRED
520 ASSIGN 5640 TO NPNCH2
ASSIGN 5690 TO NPNCH3
ASSIGN 5760 TO NPNCH6
ASSIGN 5830 TO NPNCH7
ASSIGN 5900 TO NPNCH8
ASSIGN 4650 TO NPNCH9
ASSIGN 5410 TO NPN10
GO TO 530
B 530 IF(EXOPF(TAPE,YES)) 540,550,540
C NO AUXILIARY TAPE DESIRED
540 NTAPE = 1
GO TO 560
C WRITE AUXILIARY TAPE
550 NTAPE = 2
NOTAPE = 1
C
560 READ INPUT TAPE IT1,9000,TEST
B 800 IF(EXOPF(TEST,AJ)) 810,1000,810
810 READ 9040,CRUZ,STAT
9040 FORMAT(73X,2A3)
IDT = 0
JOB = 0
NOCOM = 0
NOM = 0
NOMAST = NOMAST + 1
NOST = NOST + 1
C
IF NOM = 0 THERE IS NO MASTER CARD FOR THIS STATION

FILL THESE VARIABLES WITH BLANKS FOR PUNCHING DETAIL CARDS
WHEN THERE IS NO MASTER CARD.

DO 820 L = 1, 13
820 P3T024(L) = BL
SONICZ = BL
WRITE OUTPUT TAPE IT2, 9060
BACKSPACE IT1
GO TO 1320

READ STATION MASTER CARD
JOB IS THE NUMBER OF CASTS PER STATION
IDT IS THE NUMBER OF DETAIL CARDS PER STATION
NOCOM IS THE NUMBER OF COMMENT CARDS PER STATION

1000 JOB = 0
IDT = 0
NOCOM = 0

IF NOM = 0 THERE IS NO MASTER CARD FOR THIS STATION

NOM = 1
READ 9050, CO, SHIP, ALA1, ALA2, ALA3, ALA4, AL01, AL02, AL03, AL04, SQUA,
1 YR, AMO, DAY, HRGM1, TH1, TH2, TSTAGE, ZON, SSONICZ, COLOR, TRA, DIR, HA, PW,
2 WIND1, WIND2, BARA, TD, TW, WEA1, WEA2, CLT, CLA, VIS, CRUZ, STAT
9050 FORMAT(3A2,3A1,3A,3A1,3A,3A2,F3.1,A2,2A1,A2,A4,4X3A2,2A1,2A2,F3.1
12A3,5A1,6X2A3)
WRITE OUTPUT TAPE IT2, 9060
9060 FORMAT(1H1)
B IF(EXORF(CRUZ, BL)) 1010, 0550, 1010
1010 NORMC = NORMC + 1
NOST = NOST + 1
IF(BLANKF(HRGM1)) 1030, 1020, 1020
1020 HRGW = BIDEF(HRGM1, 4, 1)
GO TO 1040
1030 HRGW = BL
B1040 IF(EXORF(TH1, BL) + EXORF(TH2, BL) + EXORF(TSTAGE, BL) +
1 EXORF(ZON, BL)) 1050, 1060, 1050
C INSHORE INPUT
1050 INSH = 1
GO TO 1070
1060 INSH = 0
1070 IF(BLANKF(BARA)) 1090, 1080, 1080
1080 BAMA = BIDEF(BARA, 4, 1)
GO TO 1100
1090 BAMA = BL
1100 ALA3 = ALA3
B IF(EXORF(ALA3, 526060606060)) 1120, 1110, 1120
B1110 ALA3 = 0
GO TO 1140
B1120 IF(400000000000 * ALA3) 1130, 1150, 1130
B1130 ALA3 = ALA3 * 377777777777
1140 ALA5 = SOUTH
GO TO 1160

1150 ALAS = ANORTH
1160 ALO3 = ALO3
B
IF(EXOPF(ALO3, 5260606060606)) 1180, 1170, 1180
B1170 ALO3 = 0
GO TO 1200
B1180 IF((40000000000000 * ALO3) 1190, 1210, 1190
B1190 ALO3 = ALO3 * 37777777777
1200 ALO5 = EAST
GO TO 1220
1210 ALO5 = WEST
B1220 IF(EXOPF(TD, BL)) 1230, 1240, 1230
1230 TD = DEBIF(TD) * 0.1
WTD = BIDEF(TD, 4.1)
GO TO 1250
1240 SENSE LIGHT 2
WTD = BL
B1250 IF(EXOPF(TW, BL)) 1270, 1260, 1270
1260 WT = BL
GO TO 1310
1270 TW = DEBIF(TW) * 0.1
WTW = BIDEF(TW, 4.1)
IF(SENSE LIGHT 2) 1310, 1280
C
C COMPUTE RELATIVE HUMIDITY
C
1280 TTD = 1.0 + TD / 273.2
TTW = 1.0 + TW / 273.2
T1 = EXPF(25.22 * (1.0 / TTD - 1.0 / TTW))
T2 = EXPF(25.22 * (1.0 / TTD - 1.0))
RH = (TTD / TTW) ** 5.31 * (T1 - 10.16) * (2.02 + 0.927 * TTD) ** 5.31 * T2
RH = RH * 100.0
IF(RH - 100.0) 1300, 1290, 1290
1290 RH = 99.0
1300 RH = BIDEF(RH, 2.0)
GO TO 1320
1310 RH = BL
1320 READ INPUT TAPE IT1, 9000, TEST
B
IF(EXOPF(TEST, AK)) 2220, 2000, 2220
C
C READ PARAMETER CARD
C
2000 SENSE LIGHT 0
READ 9070, STATP
9070 FORMAT(76X/A3)
B
IF(EXOPF(STATP)) 3000, 2010, 3000
2010 JOB = JOB + 1
C
TEST FOR ZERO OR BLANK CAST NUMBER
READ 9074, J
9074 FORMAT(4X/A1)
IF(XDEBIF(J)) 2015, 2015, 2018
2015 WRITE OUTPUT TAPE IT2, 9076, J, CRUZ, STAT
1*IH-A3*, 21H* SKIP THIS STATION*) SYN116C
GO TO 2380 SYN117C
SYN118C
2018 READ 9080, J, (MEST(J), ZLAST(J), AN(J), WHEEL(J), LSAL(J), TITER(J)),
SYN119C
12, (FACTOR(J), SPCH(J), ZONE(J), N01(J), N02(J), CRU(J), STAP(J)) SYN120C
9080 FORMAT(4X11, I4, F4.0, A2, A4, I2, F4.2, I1, 38XF4.3, A1, A2, 211, 2A3)
NOPC = NOPC + 1 SYN121C
2020 JCA(JOB) = J SYN122C
JAEST(JOB) = J SYN123C
WHEEL(J) = DEBIF(WHEEL(J)) SYN124C
IF(WHEEL(J)) 2030, 2040, 2040 SYN125C
2030 WSIGN(J) = AMINUS SYN126C
GO TO 2050 SYN127C
2040 WSIGN(J) = BL SYN128C
2050 OFAC(J) = (0.5040 / TITER(J)) * 11.1965 SYN129C
XX(J) = (+1H+) SYN130C
LGMT(J) = MEST(J) + (XDEBIF(ZONE(J)) * 100) SYN131C
AMEST(J) = BIDEF(MEST(J), -4, -1) SYN132C
IF(EXOPF(0077000000 * ZONE(J), 005200000000)) 2070, 2060, 2070 SYN133C
B2060 ZONE(J) = 7709777777777 * ZONE(J) SYN134C
GO TO 2090 SYN135C
B2090 IF(ZONE(J) * 004000000000) 2080, 2100, 2080 SYN136C
B2080 ZONE(J) = ZONE(J) * 773777777777 SYN137C
2090 XX(J) = AMINUS SYN138C
2100 IF(LGMT(J)) 2110, 2120, 2120 SYN139C
2110 LGMT(J) = LGMT(J) + 2400 SYN140C
FLAG(J) = (+1H$) SYN141C
GO TO 2130 SYN142C
2120 FLAG(J) = BL SYN143C
IF(LGMT(J) - 2400) 2130, 2125, 2125 SYN144C
2125 FLAG(J) = STAR SYN145C
LGMT(J) = LGMT(J) - 2400 SYN146C
C LGMT(J) IS THE GMT-TIME OF THIS CAST.
2130 TI = LGMT(J) / 100 SYN147C
C TI IS THE HOURS-PART OF LGMT(J).
T2 = LGMT(J) - (LGMT(J) / 100) * 100 SYN148C
C T2 IS THE MINUTES-PART OF LGMT(J).
FGMT(J) = T1 + T2 / 60. SYN149C
C FGMT(J) IS NOW THE GMT TIME IN HOURS.
IF(SENSE LIGHT 1) 2120, 21140 SYN150C
2140 IF(J2) 2150, 2210, 2150 SYN151C
2150 READ 9090, J, (MEST(J), ZLAST(J), AN(J), WHEEL(J), LSAL(J), TITER(J)),
SYN152C
12, (FACTOR(J), SPCH(J), ZONE(J), N01(J), N02(J), CRU(J), STAP(J)) SYN153C
9090 FORMAT(25X11, I4, F4.0, A2, A4, I2, F4.2, I1, 38XF4.3, A1, A2, 211, 2A3)
SENSE LIGHT 1 SYN154C
JOB = JOB + 1 SYN155C
IF(JOB - 9) 2020, 2020, 2160 SYN156C
2160 WRITE OUTPUT TAPE IT2, 9100, STAT SYN157C
9100 FORMAT(39H00 OVERFLOW OF CAST DIMENSION ON STATION A3)
SYN158C
2170 READ INPUT TAPE IT1, 9000, TEST SYN159C
B IF(EXOPF(TEST, AK)) 2190, 2180, 2190 SYN160C
2180 NOPCK = NOPC + 1 SYN161C
GO TO 2170 SYN162C
B2190 IF(EXOPF(\text{TEST.AM})) 2200, 500, 2200
B2200 IF(EXOPF(\text{TEST.AJ})) 2170, 1000, 2170
B2210 READ INPUT TAPE IT1, 9000, TEST
B2220 IF(EXOPF(\text{TEST.ANORTH})) 2280, 2230, 2280
C READ DETAIL CARDS
C
B2230 NOCOM = NOCOM + 1
C IF(NOCOM - 20) 2240, 2240, 2250
B2240 READ 9110, KSTCOM(NOCOM), (COMENT(NOCOM\cdot LL), LL=1, 11)
9110 FORMAT(4X, 11, 11A6)
NOCC = NOCC + 1
GO TO 2210
B2250 IF(NOCMSK) 2260, 2260, 2270
B2260 WRITE OUTPUT TAPE IT2, 9120, STAT
9120 FORMAT(38H	vwO MANY COMMENT CARDS ON STATION A3)
C SKIP REST OF COMMENT CARDS
B2270 READ INPUT TAPE IT1, 9000, TEST
NOCMSK = NOCMSK + 1
B IF(EXOPF(\text{TEST.ANORTH})) 2280, 2270, 2280
C
B2280 IF(EXOPF(\text{TEST.AK})) 2290, 2000, 2290
B2290 IF(EXOPF(\text{TEST.AL})) 2350, 2300, 2350
C READ DETAIL CARDS
C
B2300 IDT = IDT + 1
C IF(IDT - 40) 2340, 2340, 2310
B2310 WRITE OUTPUT TAPE IT2, 9130, STAT
9130 FORMAT(46HOOFLOW OF DETAIL CARD DIMENSION ON STATION A3)
B2320 READ INPUT TAPE IT1, 9000, TEST
NODTSK = NODTSK + 1
B IF(EXOPF(\text{TEST.AM})) 2330, 500, 2330
B2330 IF(EXOPF(\text{TEST.AJ})) 2320, 1000, 2320
B2340 READ 9140, ICAST(IDT), WHL(IDT), EST(IDT), SLIP(IDT), REV(IDT), (BOTNO(L1, IDT), CAPT(L, IDT), TT(L, IDT), L=1, 3), OHM(IDT), OXY(IDT), CHEM(IDT), CRUD(IDT), STAD(IDT)
9140 FORMAT(4X, 2F4E0, F2, U, A2, 3(A6, A4, A3), F5, 2, F4, 2, A4, 4X, 2A3)
NODC = NODC + 1
B IF(EXOPF(\text{STAT.STAD(IDT)})) 2370, 2210, 2370
B2350 IF(EXOPF(\text{TEST.AJ})) 2360, 3000, 2360
B2360 IF(EXOPF(\text{TEST.AM})) 2370, 3000, 2370
C THE FOLLOWING BLOCK READS UNTIL A MASTER CARD OR CRUISE PARAMETER CARD IS REACHED. THIS IS DONE WHEN A CARD IS OUT OF ORDER OR WHEN A BAD CONTROL PUNCH IS READ.
C
B2370 WRITE OUTPUT TAPE IT2, 9150, STAT
9150 FORMAT(10X, 69HA CARD WAS EITHER OUT OF ORDER OR HAD A BAD CONTROL PUNCH IN STATION A3. 31H. PROCEED TO NEXT MASTER CARD.)
B2380 NOBP = NOBP + 1
B2390 READ INPUT TAPE IT1, 9000, TEST
B IF(EXOPF(\text{TEST.AM})) 2390, 500, 2390

BEGIN PROCESSING ENTIRE STATION

THE FOLLOWING BLOCK IS TO SORT PARAMETER CARD INFORMATION BY ORDER OF INCREASING CAST NUMBER WHERE KCA IS THE NEW ARRAY OF CAST NOS.

3000 BACKSPACE IT1
N = 1
DO 3030 LL = 1, JOB
MIN = 10
DO 3020 LM = 1, JOB
IF (JCA(LM) = MIN) 3010, 3020, 3040
MIN = JCA(LM)
KK = LM
CONTINUE
KCA(LL) = MIN
JCA(KK) = 10

COMPARE EACH GMT CAST TIME WITH THAT ON FIRST CAST AND ADJUST BY ADDING 24.0 FOR NEXT DAY IF NECESSARY. CONVERT TO BCD.

LL = KCA(1)
IF (JOB = 1) 3070, 3075, 3080
DO 3065 J = 2, JOB
LM = KCA(J)
FM(TLM) = FGMT(LM) - FGMT(LL)
LM = KCA(J)
3050 FGMT(LM) = FGMT(LM) + 24.0
LGMT(LM) = LGMT(LM) + 2400
FLAG(LM) = STAR
CONTINUE
FGMT(LL) = BIDEF(FGMT(LL)*10., -3, 0)
GMT(LL) = BIDEF(LGMT(LL), -4, -1)
CONTINUE
FGMT(LL) = BIDEF(FGMT(LL)*10., -3, 0)
GMT(LL) = BIDEF(LGMT(LL), -4, -1)

GENERATE A NNW ARRAY OF WIRE ANGLES BY ORDER OF INCREASING CAST NO.

DO 3100 J = 1, JOB
LL = KCA(J)
B IF (EXORF(AN(LL) + BL)) 3090, 3090, 3090
3080 ANN(J) = (+2H--)
GO TO 3100
3090 ANN(J) = AN(LL)
3100 CONTINUE
IF (JOB = 1) 3130, 3130, 3110
3110 LL = JOB - 1
DO 3120 J = 1, LL
-OR- IN A COMMA (73)
3120 ANN(J) = ANN(J) + 000073000000
IF (JOB = 9) 3130, 3150, 3150
3130 LL = JOB + 1
DO 3140 J = LL, 9
```fortran
3140 ANN(J) = BL
3150 WRITE OUTPUT TAPE IT2, 9160
9160 FORMAT(6HO, =, 12I6H, =)
C WRITE MASTER CARD IN OFFSHORE OR INSHORE FORMAT
C IF (NOM) 3190, 3190, 3160
3160 IF (INSH) 3170, 3170, 3180
3170 WRITE OUTPUT TAPE IT2, 9170, SHIP, CRUZ, STAT, YR, AMO, DAY, HRGW, ALA1, ALA2, ALA3, ALA4, ALA5, AL01, AL02, AL03, AL04, AL05, SONICZ, WEA1, WEA2, WIND1, WIND2, VIS, BARA, CLT, CLA, WTD, WTW, RH, DIR, HA, PW, COLOR, TRA, LCT = 10, GO TO 3190
C INSHORE FORMAT
3180 WRITE OUTPUT TAPE IT2, 9180, SHIP, CRUZ, STAT, SQUAR, ZON, YR, AMO, DAY, ZON
1 HRGW, ALA1, ALA2, ALA3, ALA4, ALA5, AL01, AL02, AL03, AL04, AL05, SONICZ, WEA1, WEA2, WIND1, WIND2, VIS, BARA, CLT, CLA, WTD, WTW, RH, DIR, HA, PW, COLOR, TRA, LCT = 11, GO TO 3190
C START COMPUTING
3190 SENSE LIGHT 0
NZTST = 0
IF(NTYPE - 1) 3200, 3200, 3240
C CHECK DEPTHS
C NTVPE = 1 METER WHEEL + ESTIMATED DEPTH + DIST = FINAL DOWN READ
3200 DO 3230 I = 1, N
J = ICAST(I)
IF(WHL(I) + EST(I) + DIST - WHEEL(J)) 3220, 3210, 3220
FLG(I) = BL
GO TO 3230
3210 FLG(I) = BL
NZTST = 1
FLG(I) = STAR
NDN = NDN + 1
3230 CONTINUE
```
GO TO 3280
C NTYPE = 2 METER WHEEL - ESTIMATED DEPTH - DIST = FINAL DOWN READ
C
3240 DO 3270 I = 1,N
J = ICAST(I)
IF(WHL(I) - EST(I) - DIST - WHEEL(J)) 3260,3250,3260
3250 FLG(I) = BL
GO TO 3270
3260 NZST = 1
FLG(I) = STAR
NDN = NDN + 1
3270 CONTINUE
C
3280 DO 3290 I = 1,N
J = ICAST(I)
C COMPUTE TRUE WIRE LENGTH
ZTRUE(I) = XRND((EST(I) + SLIP(I)) * FACTOR(J))
C COMPUTE WIRE ANGLE DEPTH
ZANG(I) = ZTRUE(I) * COSF(DEBIF(AN(J)) * 0.01745329)
C AVERAGE THE TWO FOR THERMOMETRIC DEPTH CALCULATIONS
3290 ZAVE(I) = (ZTRUE(I) + ZANG(I)) / 2.0
C CALL THERMO ONCE FOR EVERY STATION
C
4000 KOL = 0
CALL THERMO
C COMPUTE SALINITY AND OXYGEN
C NOTEST = 0
ILLSAL = 0
ILLETTR = 0
DO 4390 I = 1, N
C BRIDGE NUMBER 88 - SALINITY ON CARDS IN XX.XXX FORMAT
C BRIDGE NUMBER 99 - SALINITY DONE BY TITRATION. NO EQUATIONS YET
C VALID SALINITY BRIDGE NUMBERS ARE 2, 4, 11, AND 22.
C JJ = ICAST(I)
IF(BLANKF(OHM(I))) 4010, 4020, 4020
4010 SALW(I) = BL
SALP(I) = BL
LSTE(I) = 0
GO TO 4210
4020 L = -1
IF (BLANKF(LSAL(JJ))) 4030, 4040, 4040
4030 ILLSAL = 1
LSAL(JJ) = KSAL
L = L + 1
4040 IF (L) 4050, 4050, 4010
4050 IF (LSAL(JJ) = 22) 4070, 4060, 4130
CONSTANTS FOR SALINITY BRIDGE 22 AS OF SEPTEMBER 1965

4060 SALL(I) = -0.06900 + 0.046528 * OHM(I) + (6.73 * OHM(I) * OHM(I))
  1 * 1*E-6
  GO TO 4200

4070 IF (LSAL(JJ) = -11) 4090, 4080, 4030

4080 JBD = 1
  GO TO 4170

4090 IF (LSAL(JJ) = -4) 4100, 4120, 4030

4100 IF (LSAL(JJ) = -2) 4030, 4110, 4030

4110 JBD = 2
  GO TO 4170

4120 SALL(I) = 3.32435 + 0.0414724 * OHM(I) + (5.398 * OHM(I) * OHM(I))
  1 * 1*E-6
  GO TO 4200

4130 IF (LSAL(JJ) = -88) 4030, 4150, 4140

4140 IF (LSAL(JJ) = -99) 4030, 4160, 4030

4150 SALL(I) = OHM(I) * 1.E-1
  GO TO 4200

4160 SALW(I) = (+6H TITR.)*
  SALP(I) = BL
  LSTE(I) = 0
  GO TO 4210

4170 IF (OHM(I) = 800.0) 4190, 4180, 4180

4180 SALW(I) = (+6H TITR.)*
  SALP(I) = BL
  LSTE(I) = 0
  GO TO 4210

4190 J = OHM(I) / 100.0
  J = J + 1
  RR = OHM(I) + DELR(J, JBD)

4200 SALL(I) = A(JBD) + (B(JBD) * RR) + (C(JBD) * RR * RR)

4210 KSAL = LSAL(JJ)

4220 OX1W(I) = BL
  OX1P(I) = BL
  OX2W(I) = BL
  OX2P(I) = BL
  GO TO 4320

4230 IF (BLANKF(TITER(JJ))) 4240, 4250, 4250

4240 ILLTTR = 1
  GO TO 4220

4250 IF (TITER(JJ) = 0.01) 4260, 4270, 4280

C

4260 OX1(I) = OXY(I) * 0.1
  GO TO 4290

C

4270 OX1(I) = OXY(I) / 11.1965
END SALINITY AND OXYGEN COMPUTATIONS

GO TO 4290

OXY(I) IS IN ML
OXY(I) = OXY(I) * 0.5040 / TITER(JJ)
OX1(I) = BIDEF(OXY(I) * 1000 * -3, 0)
OX1P(I) = BIDEF(OXY(I) * 1000 * -3, 0)

CONVERT FROM MG-A/L TO ML/L
OX2(I) = OXY(I) * 11.1965
IF(OX2(I) - 10.0) 4310, 4300, 4300

4300 NOTENG = 1
4310 OX2W(I) = BIDEF(OX2(I) * 5.2)
OX2P(I) = BIDEF(OX2(I) * 100 * -3, 0)
NOXY = NOXY + 1
LSTE(I) = LSTE(I) + 1

END SALINITY AND OXYGEN COMPUTATIONS

COMPUTE SIGMA-T, A.O.U. AND PERCENT SATURATION

IF(NSIGT(I)) 4390, 4390, 4330
4330 L = NSIGT(I)
DO 4380 K = 1, L
J = LSTE(I) - 2
IF (J) 4360, 4340, 4340
4340 SUMT = -(TAV(K*I) * (TAV(K*I) * (TAV(K,I) + 275.04) - 2236.8396))
1 + 4482.8332 / (503.57 * (TAV(K,I) + 67.26))
AT = 1.0 - 0.001 * TAV(K,I) * (TAV(K,I) * (TAV(K,I) * 1.0843E-03)
1 - 9.8185E-02) + 4.7867
BT = TAV(K,I) * (TAV(K,I) * (TAV(K,I) * 0.01667 - 0.8164) + 18.03)
1 * 1.0E-06
SG = SALL(I) * (SALL(I) * (SALL(I) * 0.6768E-05 - 48.2496E-05)
1 + 8148.7658E-04) - 934.4586E-04
SIGT(K,I) = SUMT + (AT + BT) * 5G) * SG + (AT - BT * 0.1324) * 0.1324
SIGTW(K,I) = BIDEF(SIGT(K,I) * 100 * 0.0, -4, 0)
NOSIG = NOSIG + 1
IF (J) 4370, 4330, 4350
4350 OST = 1.0E-5 * (TAV(K,I) * (TAV(K,I) * (48.21 - 0.4038 * TAV(K,I)) -
1 2464.5 + 88506 - SALL(I) * TAV(K,I) * (TAV(K,I) * (1.2338 - 16)) + 525.6))

APPARENT OXYGEN UTILIZATION IN MG-A/L
AOU(K,I) = OXY - OX1(I)
AOUW(K,I) = BIDEF(AOU(K,I) * 1000 * 0.0, -3, 0)
AOUW(K,I) = BIDEF(AOU(K,I), 6, 3)

PERCENT SATURATION
SATN(K,I) = 100 * 0 * OX1(I) / OST
SATNW(K,I) = BIDEF(SATN(K,I), 3, 0)
SATNP(K,I) = BIDEF(SATN(K,I), -3, 0)
NAOU = NAOU + 1
GO TO 4380

SIGTW(K,I) = BL
AOUW(K,I) = BL
AOUW(K,I) = BL
SATNP(K,I) = BL
SATNW(K,I) = BL
4380 CONTINUE
4390 CONTINUE

END SIGMA-T AND OXYGEN COMPUTATIONS

THE FOLLOWING BLOCK SORTS PARAMETER AND DETAIL CARDS BY ORDER OF
INCREASING DEPTH. THAT IS, WITHIN EACH CAST THE DEPTHS WILL BE
PRINTED AS THEY WERE SUBMITTED BUT THE SHALLOWEST CAST WILL BE
PRINTED FIRST.

MSD = 0.0
DO 4420 JJ = 1, JOB
    JB = JRES(JJ)
    ZMAX(JB) = -10.0
    DO 4410 I = 1, N
        IF (ICAST(I) - JB) 4410, 4400, 4410
    4400
        ZMAX(JB) = MAX1F(ZMAX(JB), EST(I))
    CONTINUE
    XMSD = MAX1F(XMSD, T(Z(I), ZANG(I))
    4410 CONTINUE
4420 CONTINUE
    ZMXX = 0.0
    DO 4430 JJ = 1, JOB
    4430 ZMXX = MAX1F(ZMXX, ZMAX(JJ))
    DO 4460 LL = 1, JOB
        ZMX = 300000.0
        DO 4450 JJ = 1, JOB
            JB = JRES(JJ)
            IF (ZMAX(JB) - ZMX) 4440, 4450, 4450
        4440
            ZMX = ZMAX(JB)
            MM = JB
        4450 CONTINUE
        MAXZ(LL) = MM
        ZMAX(MM) = 300000.0
    4460 CONTINUE

THE FOLLOWING BLOCK FINDS THE NUMBER OF DEPTH AND COMMENT
CARDS ON EACH CAST AND DETERMINES CARRIAGE CONTROL CHARACTERS.

DO 4470 I = 1, 9
    PAGE(I) = 0
    DO 4530 JJ = 1, JOB
        MM = MAXZ(JJ)
        DO 4490 I = 1, N
            IF (ICAST(I) - MM) 4490, 4480, 4490
        4480
            PAGE(MM) = PAGE(MM) + 1.
        4490 CONTINUE
        IF (NOCOM) 4530, 4530, 4530, 4530
    4500
        DO 4520 I = 1, NOCOM
            IF (KSTCOM(I) - MM) 4520, 4510, 4520
        4510
            PAGE(MM) = PAGE(MM) + 0.5
        4520 CONTINUE
CONTINUE
MM = MAXZ(JJ)
ZMX = 10. + 11. + 2.2*PAGE(MM)
PAGE(MM) = BL
IF (JOB - 1) 4610, 4610, 4540
DO 4600 JJ = 2, JOB
MM = MAXZ(JJ)
ZMJX = 11. + 2.2*PAGE(MM)
IF (ZMJX - 59.) 4580, 4580, 4550
ZMJD = ZMX - 59.
IF (XMSD + ZMJX - 59.) 4560, 4560, 4570
PAGE(MM) = BL
ZMX = ZMJD + ZMJX - 59.
GO TO 4600
4570 PAGE(MM) = ONE
ZMX = ZMJX
GO TO 4600
4580 IF (ZMX + ZMJX - 59.) 4590, 4590, 4570
4590 PAGE(MM) = BL
ZMX = ZMX + ZMJX
CONTINUE

PUNCH AUXILIARY CARD

CODE MAXIMUM SAMPLING DEPTH
4610 MSD = (XMSD + 49.5) * .01
IF (MSD - 99) 4630, 4630, 4620
4620 MSD = 99
4630 XMSD = BIDEF(MSD, -2., -1).
GO TO NPNCH9, (4640, 4650)
4640 PUNCH 9190, RH(ANN(LL), LL = 1.9), XMSD, CRUZ, STAT
9190 FORMAT(3X, A2, 4X, A2, 42X, A2, 2X, 2A3, 1HK)
4650 GO TO (4665, 4660), NTAPE
4660 WRITE OUTPUT TAPE IT3, 9190, RH(ANN(LL), LL = 1.9), XMSD, CRUZ, STAT

SET SPECIAL CHEMISTRY BOTTLE NUMBERS FOR PUNCHING BY OPTION
4665 IF (EXORF(PSPCH, YES)) 4690, 4670, 4690
4670 DO 4680 I = 1, N
4680 PSPC(I) = CHEM(I)
GO TO 5000
4690 DO 4700 I = 1, N
4700 PSPC(I) = BL

INITIALIZE
5000 LKLK = 0
LKL = 0
DO 5940 JOB = 1, JOB
MM = MAXZ(JOB)

WRITE PARAMETER CARD

CONTINUE
WRITE OUTPUT TAPE IT2,9200 PAGE(MM),SHIP,CRU(MM),STAP(MM),MAXZ(JO)
1),GMLT(MM),XX(MM),ZONE(MM),AMEST(MM),FLAG(MM),AN(MM),ZLAST(MM),WSI
2GN(MM),WHEEL(MM),LSAL(MM),TITER(MM),OFAC(MM),SPCH(MM),FACTOR(MM),
NO1(MM),NO2(MM)
9200 FORMAT(A1,6X2,A3,10H STATION A3,7H CAST I1,16H MESS,TIME GMT ASYN
14,7H LOCAL(A1,A2,2H) A4,A1,13H WIRE ANGLE A2,19H LAST APPL, DEPS
2H -4PF4,4,11H FINAL MW A1,-4PF4,4/11X15H SALINOMETER NO,12 SYN
3 12H OXY TITER OFPS,2, 14H OXY CONSTANT F6,4, 11H SP,CHMoNA1
4 12H MW FACTOR F5,3, 10H CARD NO,11,14H OF I1 //
B IF (EXORF(PAGE(MM),ONE)) 5020,5010,5020
5010 LCT = 0
5020 LCT = LCT + 1
WRITE COMMENTS
C IF (NCOM) 5060,5060,5030
5030 DO 5050 JJ = 1, NOCOM
IF (MM - KSTCOM(JJ)) 5050,5040,5050
5040 WRITE OUTPUT TAPE IT2,9210 (COMET(JJ,LL),LL=1,11)
9210 FORMAT(40X,11A6)
LCT = LCT + 1
5050 CONTINUE
WRITE OUTPUT TAPE IT2,9220
9220 FORMAT(IHO)
LCT = LCT + 2
WRITE COLUMN HEADINGS
5060 WRITE OUTPUT TAPE IT2,9230
9230 FORMAT(2X,3HREV 23X,1OHWIRE THERM 7X,1OHWIRE L-Z 5IX,11HSP,CHMo)
1 / 1X,68HBOTTLE LEFT MIDDLE RIGHT ANGLE DEPTH CALC LENGTH FROM
2 ACCEPTED AVE 16X,28H O X Y G E N --- BOTTLE / 1X,68H NO
3 T T T DEPTH (Z) (L-Z) (L) CURVE DEPTH T
459H SAL SIGMA-T ML/L MGA/L AOU SATN NO P04 NO3 SI03//)
WRITE DETAIL CARDS BELONGING TO THAT CAST
DO 5930 I = 1,N
IF ICAST(I) = MM) 5930,5070,5930
5070 JJ = N50(I) + 1
GO TO(S540,5100,5421,5099,5160,5220,5422,5250,5425,5080,5170,5210,
1 5180,5560,5300,5220,5310,5510,5423,5240,5426,5230,5320,5500,5427 SYN
2 5490,5429), JJ
5930 COMBINATION IS NOW P - -
5080 L1 = 1
L2 = 2
L3 = 3
GO TO 5110
COMBINATION IS NOW - P -
5090 L2 = 1
L1 = 2
L3 = 3
GO TO 5110

COMBINATION IS NOW -- P

5100 L3 = 1
L2 = 2
L1 = 3
GO TO 5110

COMBINATION IS NOW -- P

5110 TF(L1, I) = BIDEF(TF(L1, I), 5, 2)
ZANGT(I) = BIDEF(ZANG(I), -4, 0)
IF(ZANG(I) < 200.0) 5130, 5130, 5140
5130 ZANGP(I) = ZANGT(I)
GO TO 5150

ZANGP(I) = BL
5140 ZANGP(I) = BIDEF(ZANG(I), 4, 0)
TAVP(I, I) = BIDEF(TAV(I, I) * 100..-4, 0)
ZTRUP(I) = BIDEF(ZTRUE(I), 4, 0)
ZTRUT(I) = BIDEF(ZTRUE(I), -4, 0)
TAWV(I, I) = BIDEF(TAV(I, I), 5, 2)
GO TO 5600

COMBINATION IS NOW -- P

5160 L1 = 1
L2 = 2
L3 = 3
GO TO 5190

COMBINATION IS NOW -- P

5170 L2 = 1
L1 = 2
L3 = 3
GO TO 5190

COMBINATION IS NOW -- P

5180 L1 = 3
L2 = 2
L3 = 1
TF(L2, I) = BIDEF(TF(L2, I), 5, 2)
TF(L3, I) = BIDEF(TF(L3, I), 5, 2)
GO TO 5120

COMBINATION IS NOW -- P

5200 L1 = 1
L2 = 2
L3 = 3
GO TO 5260

C
COMBINATION IS NOW P - U

L2 = 1
L1 = 2
L3 = 3
GO TO 5260

COMBINATION IS NOW P U -

L2 = 1
L3 = 2
L1 = 3
GO TO 5260

COMBINATION IS NOW U P -

L3 = 1
L2 = 2
L1 = 3
GO TO 5260

COMBINATION IS NOW U - P

L3 = 1
L1 = 2
L2 = 3
GO TO 5260

COMBINATION IS NOW - U P

L1 = 1
L3 = 2
L2 = 3

TF(L1;1) = BL
TF(L2;1) = BL
TF(L3;1) = UNPRO

TF(L2;1) = BIDEF(TF(L2;1);5;2)
TF(L3;1) = BIDEF(TF(L3;1);5;2)
TAVP(1;1) = BIDEF(TAVP(1;1) * 100, -4, 0)

ZANG(1) = BIDEF(ZANG(1);4;0)

IF(ZANG(1) = 200;0) 5270; 5270; 5280

ZANG(1) = ZANG(1)
GO TO 5290

ZANGP(1) = BL

ZANGP(1) = BIDEF(ZANG(1);4;0)

TZ(1;1) = BIDEF(TZ(1;1);4;0)
ZTRUP(1) = BIDEF(ZTRUP(1);4;0)
ZTRUT(1) = BIDEF(ZTRUT(1);-4;0)
TAVW(1;1) = BIDEF(TAVW(1;1);5;2)
ELP(1;1) = BIDEF(ELP(1;1);4;0)
ELM(1;1) = BIDEF(ELM(1;1);-4;0)
GO TO 5790
COMBINATION IS NOW P P U

5300 L1 = 1
L2 = 2
L3 = 3
GO TO 5330

COMBINATION IS NOW P P U

5310 L1 = 1
L2 = 2
L3 = 3
GO TO 5330

COMBINATION IS NOW U P P

5320 L3 = 1
L2 = 2
L1 = 3
5330 TF(L1, I) = BIDEF(TF(L1, I), 5, 2)
GO TO 5260

COMBINATION IS NOW ----

5340 IF(ZANG(I) - 200.0) 5350, 5350, 5360
5350 ZANGP(I) = BIDEF(ZANG(I), -4, 0)
GO TO 5370

5360 ZANGP(I) = BL
5370 ZANGP(I) = BIDEF(ZANGP(I), 4, 0)
ZTRUP(I) = BIDEF(ZTRUE(I), 4, 0)
WRITE OUTPUT TAPE IT2, 9240, REV(I), (TF(JJ, I) * JJ = 1, 3) * ZANG(I),
1 ZTRUP(I), FLG(I), SALW(I), OX2W(I), OX1W(I), CHEM(I)
9240 FORMAT(1H0, 2XAZ, 2X, 3(A5, 2X), A4, '3X, A4, A1, 14X, 4H33333333X6, 7X, A5, 1X)
1 A5, 13X, A4)
LCT = LCT + 2
IF(LCT = 59) 5390, 5390, 5380
5380 WRITE OUTPUT TAPE IT2, 9250
9250 FORMAT(1H1)
LCT = 0
5390 LKLK = 1
GO TO NPN10, (5410, 5400)
5400 PUNCH 9280, ICAST(I), P3T024, FGTM(MM), ZANGP(I), BL, SALP(I), BL, BL,
1 OX2P(I), OX1P(I), BL, PSPC(I), CRUD(I), STAD(I)
5410 GO TO (5930, 5420), NTAPE
5420 WRITE OUTPUT TAPE IT3, 9280, ICAST(I), P3T024, FGTM(MM), ZANGT(I) * BL,
1 SALP(I), BL, OX2P(I), OX1P(I), BL, ZTRUE(I), ELM(I), CRUD(I), STAD(I)
GO TO 5930

COMBINATION IS NOW ONE OF THE UNPROTECTED THERMOMETERS

5421 L1 = 1
L2 = 2
L3 = 3
GO TO 5424

COMBINATION IS NOW U - U
5422
L1 = 1
L2 = 2
L3 = 3
GO TO 5424

COMBINATION IS NOW U - U
5423
L1 = 1
L2 = 2
L3 = 3
GO TO 5424

COMBINATION IS NOW U - U
5424
L1 = 1
L2 = 2
L3 = 3
GO TO 5424

COMBINATION IS NOW U - U
5425
L1 = 1
L2 = 2
L3 = 3
GO TO 5424

COMBINATION IS NOW U - U
5426
L1 = 1
L2 = 2
L3 = 3
GO TO 5424

COMBINATION IS NOW U - U
5427
L1 = 1
L2 = 2
L3 = 3
GO TO 5424

COMBINATION IS NOW U - U
5428
L1 = 1
L2 = 2
L3 = 3
GO TO 5424

COMBINATION IS NOW U - U
5429
L1 = 1
L2 = 2
L3 = 3
GO TO 5424

IF(ZANG(I) = 200.0) 5440, 5440, 5450
5440 ZANGP(I) = BDEF(ZANG(I),-4.0)
GO TO 5460
5450 ZANGP(I) = BL
5460 ZANG(I) = BIDEF(ZANG(I),4,0)
ZTRUP(I) = BIDEF(ZTRUE(I),4,0)
WRITE OUTPUT TAPE IT2,9260,REV(I),(TF(JJ,I),TFLAG(JJ,I),JJ=1,3),
1,ZANG(I),ZTRUP(I),SALW(I),OX2W(I),OX1W(I),CHEM(I)
9260 FORMAT(1X,H0,2X,A2,2X,A5,A1,1X),A4,13H $*$ $*$ $*$ A4,22XA6,7XA5,
1 1XAS,13XA4)
LCT = LCT + 2
IF (LCT - 59) 5480,5480,5470
5470 WRITE OUTPUT TAPE IT2,9250
LCT = 0
5480 L3LL = 1
GO TO NPN10, (5410,5400)
C COMBINATION IS NOW U U P
C 5490 L1 = 1
L2 = 2
L3 = 3
GO TO 5520
C COMBINATION IS NOW U P U
C 5500 L1 = 1
L2 = 2
L3 = 3
GO TO 5520
C COMBINATION IS NOW P U U
C 5510 L3 = 1
L2 = 2
L1 = 3
5520 TFLAG(L3,I) = BL
TFLAG(L2,I) = UNPRO
TFLAG(L1,I) = UNPRO
TF(L1,I) = BIDEF(TF(L1,I),5,2)
TF(L2,I) = BIDEF(TF(L2,I),5,2)
TF(L3,I) = BIDEF(TF(L3,I),5,2)
ZANG(T,I) = BIDEF(ZANG(I),-4,0)
IF (ZANG(I) - 200.0) 5530,5530,5540
5530 ZANGP(I) = ZANGT(I)
GO TO 5550
5540 ZANGP(I) = BL
5550 ZANG(I) = BIDEF(ZANG(I),4,0)
TZ(1,I) = BIDEF(TZ(1,I),4,0)
ZTRUP(I) = BIDEF(ZTRUE(I),4,0)
ZTRUT(I) = BIDEF(ZTRUE(I),-4,0)
TAVP(I) = BIDEF(TAV(I),1,0,3,2)
TAVW(I) = BIDEF(TAV(I),1,0,3,2)
ELP(I,I) = BIDEF(ELM(I,I),-4,0)
ELM(I,I) = BIDEF(ELM(I,I),4,0)
GO TO 5720
C COMBINATION IS NOW P P P
C
C

TF(1, I) = BIDEF(TF(1, I), 5, 2)
TF(2, I) = BIDEF(TF(2, I), 5, 2)
TF(3, I) = BIDEF(TF(3, I), 5, 2)
IF(ZANG(I) = 200.0) 5570, 5570, 5580
5570 ZANGP(I) = BIDEF(ZANG(I), -4, 0)
GO TO 5590
5580 ZANGP(I) = ZANGP(I)
5590 ZANG(I) = BIDEF(ZANG(I), 4, 0)
TAVP(I, I) = BIDEF(TAVP(I, I) * 100.0, -4, 0)
ZTRUP(I) = BIDEF(ZTRUP(I), 4, 0)
TAWW(I, I) = BIDEF(TAWW(I, I), 5, 2)

C WRITING FOR A COMBINATION OF P P P, P P - AND P - P -

5600 WRITE OUTPUT TAPE IT2, 9270, REV(I), (TF(J, I), J = 1, 3),
1 ZANG(I), ZTRUP(I), FLG(I), TAWW(I, I), APF(I, I), SALW(I), SIGTW(I, I),
2 OX2W(I), OX1W(I), AOUW(I, I), SATNW(I, I), CHEM(I)
9270 FORMAT(1H0, 2X, A2, 2X, 3(A5, 3X), A4, 13X, A4, A1, 13X, A5, A2, 1X, A6, 1X, A5,
1 1X, A5, 1X, A5, 1X, A6, 1X, A3, 2X, A4)
LCT = LCT + 2
IF(LCT = 59) 5620, 5620, 5610
5610 WRITE OUTPUT TAPE IT2, 9250
LCT = 0
5620 GO TO NPNCH2, (5630, 5640)
5630 PUNCH 9280, ICAST(I), P3T024, FGMT(MM), ZANGP(I), TAVP(I, I), SALP(I),
1 SIGTP(I, I), SATNP(I, I), OX2P(I), OX1P(I), AOU(M, I), PSPC(I), CRUD(I)
2 STAD(I)
9280 FORMAT(1H0, 11, 2A2, 3A1, A3, 3A1, A3, 3A2, A3, A4, 1XA4, 1XA5, A4, A3, 1XA3, 3X
1 2A3, 7XA4, 2A3, 12A4, 3A3)
5640 GO TO (5660, 5650), NTape
5650 WRITE OUTPUT TAPE IT3, 9290, ICAST(I), P3T024, FGMT(MM), ZANGT(I), TAVP(SYN5300C,
11, I), SALP(I), SIGTP(I, I), SATNP(I, I), OX2P(I), OX1P(I), AOU(M, I), PSPC(I), CRUD(I)
2(I), ELM(I, I), CRUD(I), STAD(I)
9290 FORMAT(1H0, 11, 2A2, 3A1, A3, 3A1, A3, 3A2, A3, A4, 1XA4, 1XA5, A4, A3, 4X2A3)
5660 IF(NSIGT(I) = 1) 5930, 5930, 5670
5670 L = NSIGT(I)
DO 5710 M = 2, L
TAVW(M, I) = BIDEF(TAVW(M, I), 5, 2)
TAVP(M, I) = BIDEF(TAVP(M, I) * 100.0, -4, 0)
WRITE OUTPUT TAPE IT2, 9300, TAWW(M, I), APF(M, I), SIGTW(M, I), AOUW(M, I)
9300 FORMAT(1H0, 62X, A5, A2, 8X, A5, 13X, A6, 1X, A3)
GO TO NPNCH3, (5680, 5690)
5680 PUNCH 9280, ICAST(I), P3T024, FGMT(MM), ZANGP(I), TAVP(M, I), SALP(I),
1 SIGTP(M, I), SATNP(M, I), OX2P(I), OX1P(I), AOU(M, I), PSPC(I), CRUD(I)
2STAD(I)
5690 GO TO (5710, 5700), NTape
5700 WRITE OUTPUT TAPE IT3, 9290, ICAST(I), P3T024, FGMT(MM), ZANGT(I), TAVP(SYN5390C,
1M, I), SALP(I), SIGTP(M, I), SATNP(M, I), OX2P(I), OX1P(I), AOU(M, I), PSPC(I), CRUD(I)
2(I), BL, CRUD(I), STAD(I)
5710 CONTINUE
GO TO 5930

WRITING WITH A COMBINATION SUCH AS U U P

5720 WRITE OUTPUT TAPE IT2, 9310, REV(1) *(TF(J, 1) > TFLAG(J, 1). J = 1, 3),
1 ZANG(J), TZ(1, 1), AUFP(1, 1), ELP(1, 1), ZTRUP(1, 1), FLG(1), TAVP(1, 1),
2 APF(1, 1), SALP(1, 1), SIGT(1, 1), SATP(1, 1), SATW(1, 1), SATN(1, 1),
3 CHEM(1)

9310 FORMAT(1H0, 2X, A2, 2X, A5, A1, 1X, A4, A1, 1X, A4, A1, 13X,
1 A5, A1, 2X, A6, 1X, A5, A1, 5X, A5, A1, 6X, A6, 1X, A3, 2X, A4)
LCT = LCT + 2
IF(LCT = 59) 5740, 5740, 5710

5730 WRITE OUTPUT TAPE IT2, 9250
LCT = 0

5740 GO TO NPNCH6, (5750, 5760)

5750 PUNCH 9280, ICAS(1), P3T24, FGTM(MM), ZANGP(1), TAVP(1), SALP(1),
1 SIGT(1, 1), SATP(1, 1), OX2P(1), OX1P(1), A0UP(1, 1), PROT(1),
2 STAD(1)

5760 TZ(2, 1) = BIDEF(TZ(2, 1), 4, 0)
ELP(2, 1) = BIDEF(ELM(2, 1), 4, 0)
ELM(2, 1) = BIDEF(ELM(2, 1), 4, 0)
WE OUT OUTPUT TAPE IT2, 9320, TZ(2, 1), AUF(2, 1), ELP(2, 1)

9320 FOR(I = 1, I = 1, 1, A4) GO TO 5930, 5770, NTABE

5770 DO 5780, L = 1, 2

5780 WRITE OUTPUT TAPE IT3, 9290, ICAS(1), P3T24, FGTM(MM), ZANGT(1),
1 TAVP(1, 1), SATNP(1, 1), SATP(1, 1), OX2P(1), OX1P(1), A0UP(1, 1),
2 ZTRUT(1), ELM(L, 1), CRUD(1), STAD(1)
GO TO 5930

WRITING BLOCK FOR COMBINATIONS OF EITHER P P U OR P - U

5790 WRITE OUTPUT TAPE IT2, 9330, REV(1), *(TF(J, 1) > TFLAG(J, 1). J = 1, 3),
1 ZANG(J), TZ(1, 1), AUFP(1, 1), ELP(1, 1), ZTRUP(1, 1), FLG(1), TAVP(1, 1),
2 APF(1, 1), SALP(1, 1), SIGT(1, 1), SATP(1, 1), SATW(1, 1), SATN(1, 1),
3 CHEM(1)

9330 FORMAT(1H0, 2X, A2, 2X, A5, A1, 1X, A4, A1, 1X, A4, A1, 13X,
1 A5, A1, 2X, A6, 1X, A5, A1, 5X, A5, A1, 6X, A6, 1X, A3, 2X, A4)
LCT = LCT + 2
IF(LCT = 59) 5810, 5810, 5800

5800 WRITE OUTPUT TAPE IT2, 9250
LCT = 0

5810 GO TO NPNCH8, (5820, 5830)

5820 PUNCH 9280, ICAS(1), P3T24, FGTM(MM), ZANGP(1), TAVP(1, 1), SALP(1),
1 SIGT(1, 1), SATNP(1, 1), OX2P(1), OX1P(1), A0UP(1, 1), PROT(1),
2 STAD(1)

5830 GO TO 5830, 5840, NTABE

5840 WRITE OUTPUT TAPE IT3, *(ICAS(1), P3T24, FGTM(MM), ZANGT(1),
1 TAVP(1), SATNP(1), SATP(1, 1), OX2P(1), OX1P(1), A0UP(1, 1),
2 ZTRUT(1), ELM(L, 1), CRUD(1), STAD(1)

5850 IF(NSIGT(I) = 1) 5830, 5840, 5860

5860 L = NSIGT(I)
DO 5920 M = 2, L
TAVP(M, 1) = BIDEF(TAVP(M, 1), 10, 0), 10
**TAVW(M,I) = BIDEF(TAV(M,I) * 5 + 2)**  
**TF(L1,I) = BL**  
**TF(L2,I) = BL**  
**TF(L3,I) = BIDEF(TF(4,I) * 5 + 2)**  
**TZ(M,I) = BIDEF(TZ(M,I) * 4 + 0)**  
**ELP(M,I) = BIDEF(ELM(M,I) * 4 + 0)**  
**ELM(M,I) = BIDEF(ELM(M,I) * 4 + 0)**  
**WRITE OUTPUT TAPE IT2,9340,(TF(J,I),TFLAG(J,I),J=1,3),TZ(M,I)**  
**1,ELP(M,I),TAVW(M,I),APF(M,I),SIGTW(M,I),AOUW(M,I),SATNW(M,I)**  
**9340 FORMAT(1H06X3(A5,1X),5XA4,2XA4,2XA4,2AXA5,13XA6,1XA3)**  
**LCT = LCT + 2**  
**IF(LCT - 59) 5880,5880,5870**  
**5870 WRITE OUTPUT TAPE IT2,9250**  
**5880 GO TO NPNC8,(5890,5900)**  
**5890 PUNCH 9280 ,ICAST(I),P3T024,FGMT(MM),ZANGP(I),TAVP(M,I),SALP(I),**  
**1, SIGTW(M,I),SATNW(M,I),OX2P(I),OX1P(I),AOUP(M,I),PSPC(I),CRUD(I)**  
**2, STAD(I)**  
**5900 GO TO (5920,5910), NTAPE**  
**5910 WRITE OUTPUT TAPE IT3,9290,(ICAST(I),P3T024,FGMT(MM),ZANGT(I),**  
**1, TAVP(M,I),SALP(I),SIGTW(M,I),SATNW(M,I),OX2P(I),OX1P(I),AOUP(M,I)**  
**2, ZTRUT(I),ELM(M,I),CRUD(I),STAD(I)**  
**5920 CONTINUE**  
**5930 CONTINUE**  
**5935 FORMAT(///)**  
**5940 CONTINUE**  
**5945 WRITE OUTPUT TAPE IT2,9160**  
**9999 CONTINUE**  
**WRITE OUTPUT TAPE IT2,9350**  
**WRITE OUTPUT TAPE IT2,9160**  
**KOL IS THE NUMBER OF THERMOMETERS THAT COULDN'T BE FOUND FOR**  
**THIS STATION**  
**IF(LKLK) 7010,7010,7000**  
**7000 WRITE OUTPUT TAPE IT2,9360**  
**9360 FORMAT(10X81H$$$$ - NO TEMPERATURES COULD BE COMPUTED AT THESE DEPS**  
**1THS.  ALL THREE THERMOMETERS/1X66H WERE EITHER MALFUNCTIONS, BLANKSYN5845**  
**2S, OR NOT IN THE THERMOMETER TABLE/*/)**  
**SYN5845A**  
**SYN5850**  
**SYN5855**  
**SYN5860**  
**7010 IF(LKLL) 7030,7030,7020**  
**7020 WRITE OUTPUT TAPE IT2,9370**  
**9370 FORMAT(10X63H$$$$ - AT THESE DEPTHS, ONLY UNPROTECTED THERMOMETERSSYN5870**  
**1 OCCURRED.  /1X42HSEE BELOW FOR POSSIBLE THERMOMETRIC DEPHTS/**)**  
**SYN5875A**  
**SYN5880**  
**SYN5885**  
**SYN5890**  
**SYN5895**  
**7030 SONICZ = DEBIF(SONICZ)**  
**7040 ILLTTR = ZMXX**  
**7050 WRITE OUTPUT TAPE IT2,9380**  
**7060 IF(LSAL) 7080,7080,7070**  
**7070 WRITE OUTPUT TAPE IT2,9390,KSA**  
**7080 IF(ISSLTR) 7100,7100,7090**  
**7090 WRITE OUTPUT TAPE IT2,9400**  
**9400 FORMAT(10X46HOXYGEN TITER IS MISSING--OXYGENS NOT COMPUTED.)**  
**SYN5935C**
```
7100 IF(NOTEST) 7120,7120,7110
7110 WRITE OUTPUT TAPE IT2,9410
9410 FORMAT(10X8HJSOME OXYGENS IN ABOVE STATION ARE ABOVE 10.00 ML/L--SYN595UC)
1ADJUST OBSERVED CARDS ACCORDINGLY."
7120 IF(KOL - 1) 7180,7130,7130
7130 WRITE OUTPUT TAPE IT2,9420 ,STAT
9420 FORMAT(53HUN 1 T - THERMOMETER NOT FOUND IN TABLE FOR STATION A3)SYN597UB
IF(KOL - 30) 7150,7150,7140
7140 WRITE OUTPUT TAPE IT2,9430
9430 FORMAT(10X9X53HMORE THAN 3* FOR THIS STATION--REFER TO DETAIL CARD IS*)
GO TO 7170
7150 DO 7160 J = 1, KOL
WRITE OUTPUT TAPE IT2,9440 ,BN0T(J),DZD(J)
9440 FORMAT(20X*A6+10H AT DEPTH -4PF4.4)
7160 CONTINUE
7170 NOBO = NOBO + KOL
7180 IF(NZTST) 7500,7500,7190
7190 WRITE OUTPUT TAPE IT2,9450
9450 FORMAT(10X101HSOME DEPTHS IN THE ABOVE STATION DO NOT CHECK, NOTESYN6035)
1 THE ASTERISKS (*) NEXT TO THE WIRE LENGTH FIELD."
C THIS BLOCK IS TO COMPUTE AND WRITE ANY ADDITIONAL THERMOMETRIC
C DEPTHS WHICH OCCURRED IN ARRANGEMENTS SUCH AS -- U, - U U, OR
C U U U. THIS CAN BE DONE ONLY IF THERE IS A PROTECTED THERMOMETER
C WITHIN 10 METERS ON THE SAME CAST
C
7500 NUT = 0
DO 7920 I = 1, KOL
7920 IF(NSIGT(I)) 7920,7510,7920
7510 IF(I-1) 7610,7610,7520
7520 IF(ABS(ZTRUE(I) - ZTRUE(I-1)) -10.0) 7530,7530,7510
7530 IF(ICAST(I) - ICASS(I)) 7610,7610,7610
7540 IF(NSIGT(I-1)) 7560,7560,7590
7550 NPP = I - 1
GO TO 7710
7560 IF(I-2) 7610,7610,7570
7570 IF(ABS(ZTRUE(I) - ZTRUE(I-2)) -10.0) 7580,7580,7610
7580 IF(ICAST(I) - ICASS(I-2)) 7610,7590,7610
7590 IF(NSIGT(I-2)) 7610,7610,7600
7600 NPP = I - 2
GO TO 7710
7610 IF(I + I - N) 7620,7620,7920
7620 IF(ABS(ZTRUE(I) - ZTRUE(I+1)) -10.0) 7630,7630,7920
7630 IF(ICAST(I) - ICASS(I+1)) 7920,7640,7920
7640 IF(NSIGT(I+1)) 7660,7660,7650
7650 NPP = I + 1
GO TO 7710
7660 IF( I + 2 - N) 7670,7670,7920
7670 IF(ABS(ZTRUE(I) - ZTRUE(I+2)) -10.0) 7680,7680,7920
7680 IF(ICAST(I) - ICASS(I+2)) 7920,7690,7920
7690 IF(NSIGT(I+2)) 7920,7920,7700
7700 NPP = I + 2
```
7710 M = NSO(I) + 1
GO TO (7920, 7920, 7720, 7920, 7920, 7920, 7920, 7730, 7920, 7760, 7920, 7520,
1 7920, 7920, 7920, 7920, 7920, 7920, 7920, 7740, 7920, 7920, 7770, 7920, 7920,
2 7920, 7780, 7920, 7820) M
C COMBINATION IS NOW - - U
7720 LM = 3
GO TO 7750
C COMBINATION IS NOW - U -
7730 LM = 2
GO TO 7750
C COMBINATION IS NOW U - -
7740 LM = 1
7750 ASSIGN 7920 TO JJ
GO TO 7830
C COMBINATION IS NOW - U U
7760 LM = 2
LL = 3
GO TO 7790
C COMBINATION IS NOW - U U
7770 LM = 1
LL = 3
GO TO 7790
C COMBINATION IS NOW - U -
7780 LM = 1
LL = 2
7790 SENSE LIGHT 1
ASSIGN 7800 TO JJ
GO TO 7830
7800 IF(SENSE LIGHT 1) 7810, 7920
7810 LM = LL
GO TO 7830
C COMBINATION IS NOW U U U
7820 LM = 1
ASSIGN 7900 TO JJ
7830 M = NSIGT(NPP)
7840 DO 7890 KKK = I, M
NUT = NUT + 1
C CORRECT UNPROTECTED
C
TTF(NUT) = (((CAPT(LM+I) + VV(LM+I)) *(TAV(KKK,NPP) - TT(LM+I)))
1 / (PP(LM+I) - (TAV(KKK,NPP) - TT(LM+I)))) + TCOR(LM+I)
2 + CAPT(LM+I)
NOTMP = NOTMP + 1
C COMPUTE THERMOMETRIC DEPTH
THZT(NUT) = XRNDP((TTF(NUT) - TAV(KKK,NPP)) / (RHOM(I) * QQ(LM+I)))
C COMPUTE L - Z
ELZO(NUT) = ZTRUE(I) - THZT(NUT)
BBT(NUT) = BOTNO(LM+I)
TFT(NUT) = TAV(KKK,NPP)
ZZO(NUT) = ZTRUE(I)
REVV(NUT) = REV(I)
SALO(NUT) = SALW(I)
7850 J = LSTE(I) - 2
7860 IF (J) 7880,7890,7870
7870 SIGW(NUT) = BL
7880 APO(NUT) = BIDEF(OST - OX10(NUT),6,3)
7890 CONTINUE
GO TO 7840
7900 IF (LM - 3) 7910,7920,7900
7910 LM = LM + 1
GO TO 7840
7920 CONTINUE

C NUT IS THE NUMBER OF THERMOMETRIC DEPTHS COMPUTED FROM COMBINATION
C SUCH AS - - U, - U U, AND U U U
C IF (NUT) 7950,7950,7930
7930 WRITE OUTPUT TAPE IT2.9460.STAT9460 FORMAT(1HO,39X,43HADDITIONAL THERMOMETRIC DEPTHS FOR STATION A3 //SYN6700
1 4X,21HREV UNPROTECTED 17X,6HTHERMOS5X4HWISE 13X,3ML-Z / SYN6705
13X,72HBOTTLE THERMO TEMP PROTECTED DEPTH LENGTH C SYN6710
2ALC FROM 19X,25H -- 0 X Y G E N -- -- / 5X,2HNO 8X, SYN6715
3 2HNO 13X,90HTEMP USEU (Z) (L) (L-Z) CURVE SAL SYN6720
4 SIGMA-T ML/L MGA/L AOU SATN)
DO 7940 J = 1, NUT
THZT(J) = BIDEF(THZT(J),4,0)
ZZO(J) = BIDEF(ZZO(J),4,0)
1 ZZO(J), ELZ0(J), SAJO(J), SIGW(J), 0X20(J), 0X10(J), AP0(J), SATJ(J)
SYN6795
9470 FORMAT(5X,A2,6X,A6,2X,F5.2,6X,F5.2,6X,A4,6X,A4,13X,A6,2X,A5,5X,A4,2X,A5)
SYN6760
7940 WRITE OUTPUT TAPE IT2*9470, REVV(J), ABT(J), TTF(J), TFT(J), THZT(J),
SYN6775
GO TO (7970, 7960), NTAPE
7950 WRITE OUTPUT TAPE IT3*9480 SYN6780
7960 WRITE OUTPUT TAPE IT3*9480
SYN6785
7970 READ INPUT TAPE IT1, 9000, TEST SYN6790
1 IF(EXOPF(TEST, AM)) * 800, 500, 800 SYN6795
B C
8500 WRITE OUTPUT TAPE IT2*9060
SYN6800
IF(NOBP) 8510, 8510, 8520 SYN6805
8510 WRITE OUTPUT TAPE IT2*9490
SYN6810
9490 FORMAT(10X,6H, THERE WERE NO BAD CONTROL PUNCHES OR CARDS OUT OF ORDER) SYN6820
1 ER *)
GO TO 8530 SYN6825
8520 WRITE OUTPUT TAPE IT2*9500, NOBP SYN6830
9500 FORMAT(50H, BAD CONTROL PUNCHES OR CARDS OUT OF ORDER) SYN6835
8530 WRITE OUTPUT TAPE IT2*9510, NOST SYN6840
9510 FORMAT(16H, OF STATIONS) SYN6845
8540 WRITE OUTPUT TAPE IT2*9520, NOMC SYN6850
9520 FORMAT(20H, OF MASTER CARDS) SYN6855
8550 WRITE OUTPUT TAPE IT2*9530, NOMIC SYN6860
9530 FORMAT(37H, OF STATIONS WITHOUT MASTER CARDS) SYN6865
8560 WRITE OUTPUT TAPE IT2*9540, NOPC SYN6870
9540 FORMAT(23H, OF PARAMETER CARDS) SYN6875
8570 WRITE OUTPUT TAPE IT2*9550, NOPCSK SYN6880
9550 FORMAT(31H, OF PARAMETER CARDS SKIPPED) SYN6885
8580 WRITE OUTPUT TAPE IT2*9560, NODC SYN6890
9560 FORMAT(20H, OF DETAIL CARDS) SYN6895
8590 WRITE OUTPUT TAPE IT2*9570, NODTSK SYN6900
9570 FORMAT(10H, OF DETAIL CARDS SKIPPED AFTER MAX* OF 40 SYN6905
8600 WRITE OUTPUT TAPE IT2*9580, NOCC SYN6910
9580 FORMAT(21H, OF COMMENT CARDS) SYN6915
8610 WRITE OUTPUT TAPE IT2*9590, NOMIC SYN6920
9590 FORMAT(29H, OF COMMENT CARDS SKIPPED) SYN6925
8620 WRITE OUTPUT TAPE IT2*9600, NOML SYN6930
9600 FORMAT(35H, OF MALFUNCTIONING THERMOMETERS) SYN6935
8630 WRITE OUTPUT TAPE IT2*9610, NOBO SYN6940
9610 FORMAT(40H, OF THERMOMETERS NOT FOUND) SYN6945
8640 WRITE OUTPUT TAPE IT2*9620, NOSALA SYN6950
9620 FORMAT(27H, OF SALINITIES COMPUTED) SYN6955
8650 WRITE OUTPUT TAPE IT2*9630, NOSIG SYN6960
9630 FORMAT(26H, OF SIGMA-T-S COMPUTED) SYN6965
8660 WRITE OUTPUT TAPE IT2*9640, NOTMP SYN6970
9640 FORMAT(29H, OF TEMPERATURES COMPUTED) SYN6975
8670 WRITE OUTPUT TAPE IT2*9650, NOXY SYN6980
9650 FORMAT(24H, OF OXYGENS COMPUTED) SYN6985
8680 WRITE OUTPUT TAPE IT2*9660, NAOU SYN6990
9660 WRITE OUTPUT TAPE IT2*9670, NAOY SYN6995
9660 FORMAT(1HO,49HNO, OF AOU-S AND PERCENT SATURATIONS COMPUTED
WRITE OUTPUT TAPE IT2,9670,NDN
9670 FORMAT(34HNO, OF DEPTHS WHICH DID NOT CHECK16X15)
IF (NOTAPE) 8550,8550,8540
8540 WRITE OUTPUT TAPE IT3,9680
9680 FORMAT(79X,1HZ)
END FILE IT3
REWIND IT3
8550 CALL EXIT
END
APPENDIX 4 Subroutine THERMØ

Subroutine to correct reversing thermometers and calculate thermometric depths
C THERM  SUBROUTINE THERMO-REVISION C
C DEPARTMENT OF OCEANOGRAPHY
C UNIVERSITY OF WASHINGTON
C SEATTLE, WASHINGTON 98105
C
C PROGRAMMED BY:  MARSHA M. WALLIN       JUNE 1964
C REVISION A BY:  LINDA S. GREEN          NOVEMBER 1965
C REVISION C BY:  LINDA S. GREEN          APRIL 1966
C
C SUBROUTINE TO COMPUTE TEMPERATURE AND THERMOMETRIC DEPTHS
C FOR SYNOPTIC PROGRAM (UWMS-0980).
C
C SUBROUTINE THERMO
D DIMENSION RHO(14), Z(14), THM(300), VO(300), P(300), Q(300), T(300,15),
1 D(300,15), BT(3,40), NBASE(3),
2 TFIN(4,40), CT(3,40), TV(3,40), PP(3,40), QQ(3,40), ST(3,40),
3 T(3,40), DZZ(30), DDEPTH(40), BT(30), N(40), NS(40),
4 TAVE(6,40), AFP(6,40), AFU(3,40), RHOM(40), THERZ(3,40), ALMZ(3,40),
5 ALZ(40), ID(3),
C DIMENSION TITLE(12)
C
C COMMON BT, CT, ST, TDEP, THERZ, TAVE, II, NS, KP, NSOL, ALZ, ALMZ, TFIN,
1 KR, DZZ, BT, AFP, AFU, TV, PP, QQ, T, THERM, RHOM, NOML, NOTMP, BL, IT1, IT2
C
C IF(KP) 300, 100, 300
C
C CODE = 101010106060
A AMALF = 604421432660
A ALEFT = 436060606060
A AMID = 446060606060
A RIGHT = 516060606060
A ALFMD = 444606066060
A AMDRT = 444516060606
A ALFRT = 435160606060
A IDOT = 0.06 * 100.
A IDOT = 6
C
C LIST OF MEAN DENSITIES
RHO(1) = 1.0242
RHO(2) = 1.0253
RHO(3) = 1.0261
RHO(4) = 1.0267
RHO(5) = 1.0275
RHO(6) = 1.0282
RHO(7) = 1.0291
RHO(8) = 1.0305
RHO(9) = 1.0318
RHO(10) = 1.0330
RHO(11) = 1.0344
RHO(12) = 1.0355
RHO(13) = 1.0366
C
RHO(14) = 1.0510

LIST OF CORRESPONDING DEPTHS

Z(1) = 0.0
Z(2) = 100.0
Z(3) = 200.0
Z(4) = 300.0
Z(5) = 500.0
Z(6) = 700.0
Z(7) = 1000.0
Z(8) = 1500.0
Z(9) = 2000.0
Z(10) = 2500.0
Z(11) = 3000.0
Z(12) = 3500.0
Z(13) = 4000.0
Z(14) = 10000.0

READ INPUT TAPE IT1,900,TITLE THM0530

900 FORMAT(12A6)

LCNT = 60

I = 0

105 I = I + 1

IF (I-1) 110,110,115

110 READ INPUT TAPE IT1,924,THM(I),UP,VO(I),P(I),Q(I),(T(I,J),D(I,J)),J=1,10)

ASSIGN 180 TO NNN

GO TO 150

115 IF(I-300) 125,125,120

120 WRITE OUTPUT TAPE IT2,910

910 FORMAT(10X39HOVERFLOW OF THERMOMETER TABLE DIMENSION)

CALL EXIT

125 READ INPUT TAPE IT1,924,THM(I),UP,VO(I),P(I),Q(I),(T(I,J),D(I,J)),J=1,10)

1 D(I,J),J=1,10),AMON,YER

ASSIGN 185 TO NNN

I = I - 1

GO TO 160
DO 155 J = 11, 15
B 155 T(I,J) = 400000000000
ASSIGN 180 TO NNN
B 160 IF (EXORF (THM(I), BT(I,J))) 165, 190, 165
165 IF (LCNT < 58) 170, 170
170 WRITE OUTPUT TAPE IT2, 940, TITLE
940 FORMAT (1H19X1<6A6>/)
LCNT = 0
175 LCNT = LCNT + 1
GO TO NNN, (180, 185)
180 WRITE OUTPUT TAPE IT2, 950, THM(I), UP, VO(I), P(I), Q(I), (T(I,J),
1 D(I,J), J = 1, 10), AMON, YER, I
950 FORMAT (1X, A6, A1, F5.4, F6.4, F8.5, 10(F4.0, F5.2), 1X, A2, 1X, A2, 1X)
GO TO 105
185 WRITE OUTPUT TAPE IT2, 960, THM(I), D(I,J), J = 11, 15
960 FORMAT (1X, A6, 2X, S(F4.0, F5.2))
GO TO 105
190 LLB = I - 1
DO 200 L = 1, LLB
DO 200 J = 2, 15
IF (BLANKF (D(L,J))) 195, 200, 200
195 LO = J - 1
D(L,J) = D(L,LO)
T(L,J) = T(L,LO)
200 CONTINUE
RETURN
C
FIND THERMOMETERS
C
300 DO 888 NO = 1, 11
DO 380 I = 1, 3
ALMZ (I, NO) = BL
B IF (EXORF (BT(I, NO), BL)) 310, 305, 310
C THERMOMETER IS BLANK OR MALFUNCTION
305 NBASE(I) = 0
B IF (EXORF (CT(I, NO), CODE)) 320, 315, 320
315 NBASE(I) = 0
B IF (EXORF (CT(I, NO), CODE)) 320, 315, 320
C THERMOMETER WAS NEITHER A BLANK NOR A MALFUNCTION
325 DO 375 J = 1, LLB
IF (EXORF (BT(I, NO), THM(J))) 375, 330, 375
C FOUND THERMOMETER, NOW IS IT PROTECTED OR UNPROTECTED--
C
330 IF (BLANKF (Q(J))) 335, 340, 340
C IT IS PROTECTED
335 NBASE(I) = 1
GO TO 345
IT IS UNPROTECTED

340 NBASE(I) = 2
QQ(I,NO) = Q(J)
345 VV(I,NO) = V0(J)
PP(I,NO) = P(J)
CT(I,NO) = DEBIF(CT(I,NO)) * 0.01
ST(I,NO) = DEBIF(ST(I,NO)) * 0.1
350 DO 370 K = 1,15
IF(CT(I,NO) - T(J,K)) 350,365,370
350 IF(K - 1) 355,355,360
355 TCOR(I,NO) = D(J,K)
GO TO 380
360 TCOR(I,NO) = (CT(I,NO) - T(J*K-1)) * (D(J,K) - D(J*K-1)) / (T(J,K)
1 - T(J*K-1)) + D(J*K-1)
GO TO 380
365 TCOR(I,NO) = D(J,15)
GO TO 380
370 CONTINUE
TCOR(I,NO) = D(J,15)
GO TO 380
375 CONTINUE

KEEP TRACK OF MISSING THERMOMETERS

380 CONTINUE

THE FOLLOWING EQUATION GIVES A VALUE WHICH DETERMINES THE
EXACT POSITIONS AND ARRANGEMENTS OF THE THERMOMETERS

390 DO 405 L = 1,3
TFIN(L,NO) = CT(L,NO) + ((CT(L,NO) + VV(L,NO)) * (CT(L,NO) - ST(L,NO)
1) / (PP(L,NO) - (CT(L,NO) + VV(L,NO)) - (CT(L,NO) -
1 ST(L,NO)))) + TCOR(L,NO)
405 CONTINUE
NOTMP = NOTMP + 3
TMAX = MAX1(F(TFIN(1,NO),TFIN(2,NO),TFIN(3,NO)))

COMBINATION IS NOW PROTECTED
TMN = MIN(TFIN(1,NO), TFIN(2,NO), TFIN(3,NO))

ARE ALL THREE WITHIN 0.06 OF EACH OTHER. IF SO, EXIT WITH THE AVERAGE.

MMMM = XRNDF(TMAX*100.) - XRNDF(TMIN*100.)

IF(MMM = IDOT) 410, 410, 415

THE THREE TEMPERATURES ARE WITHIN 0.06 OF EACH OTHER SO RETURN

WITH THE MEAN

410 NSIG(NO) = 1

TAVE(1,NO) = (TFIN(1,NO) + TFIN(2,NO) + TFIN(3,NO)) / 3.0

B AFP(1,NO) = BL

GO TO 888

415 IDELT(1) = XABS(XRNDF(TFIN(1,NO)*100.) - XRNDF(TFIN(2,NO)*100.))

IDELT(2) = XABS(XRNDF(TFIN(1,NO)*100.) - XRNDF(TFIN(3,NO)*100.))

IDELT(3) = XABS(XRNDF(TFIN(2,NO)*100.) - XRNDF(TFIN(3,NO)*100.))

NOBJ = 0

DO 425 KJR = 1, 3

IF(IDELT(KJR) - IDOT) 425, 425, 420

420 NOBJ = NOBJ + 1

425 CONTINUE

IF(NOBJ - 2) 465, 435, 430

NONE OF THE DIFFERENCES WAS LESS THAN 0.06 SO EXIT WITH EACH ONE.

430 TAVE(1,NO) = TFIN(1,NO)

TAVE(2,NO) = TFIN(2,NO)

TAVE(3,NO) = TFIN(3,NO)

B AFP(1,NO) = ALEFT

B AFP(2,NO) = AMID

B AFP(3,NO) = RIGHT

NSIG(NO) = 3

GO TO 888

435 NSIG(NO) = 2

IF(IDELT(1) - IDELT(2)) 440, 440, 445

440 IF(IDELT(1) - IDELT(3)) 450, 450, 460

445 IF(IDELT(2) - IDELT(3)) 455, 455, 460

DELT(1) IS LESS THAN 0.06

450 TAVE(1,NO) = (TFIN(1,NO) + TFIN(2,NO)) / 2.0

TAVE(2,NO) = TFIN(3,NO)

B AFP(1,NO) = ALFMD

B AFP(2,NO) = RIGHT

GO TO 888

DELT(2) IS LESS THAN 0.06

455 TAVE(1,NO) = (TFIN(1,NO) + TFIN(3,NO)) / 2.0
TAVE(2,NO) = TFIN(2,NO)
B
AFP(1,NO) = ALFRT
B
AFP(2,NO) = AMID
GO TO 888
C
DEL(T3) IS LESS THAN 0.06
C
460 TAVE(1,NO) = (TFIN(2,NO) + TFIN(3,NO)) / 2.0
TAVE(2,NO) = TFIN(1,NO)
B
AFP(1,NO) = AMDRT
B
AFP(2,NO) = ALEFT
GO TO 888
C
ONLY ONE DIFFERENCE WAS GREATER THAN 0.06 SO EXIT WITH ALL THREE
SEPARATELY, THE AVERAGE OF ALL THREE TOGETHER, AND ALSO THE TWO
AVERAGES OF THOSE WITHIN 0.06 OF EACH OTHER.
C
465 SENSE LIGHT 0
NSIG(NO) = 6
TAVE(1,NO) = TFIN(1,NO)
TAVE(2,NO) = TFIN(2,NO)
TAVE(3,NO) = TFIN(3,NO)
TAVE(4,NO) = (TFIN(1,NO) + TFIN(2,NO) + TFIN(3,NO)) / 3.0
B
AFP(1,NO) = ALEFT
B
AFP(2,NO) = AMID
B
AFP(3,NO) = RIGHT
B
AFP(4,NO) = BL
NJO = 4
IF(IDE(LT(1)) - IDOT) 470, 470, 475
470 NJO = NJO + 1
TAVE(NJO,NO) = (TFIN(1,NO) + TFIN(2,NO)) / 2.0
B
AFP(NJO,NO) = ALFMD
IF(IDE(LT(2)) - IDOT) 480, 480, 485
475 SENSE LIGHT 1
480 NJO = NJO + 1
TAVE(NJO,NO) = (TFIN(1,NO) + TFIN(3,NO)) / 2.0
B
AFP(NJO,NO) = ALFRT
IF(SENSE LIGHT 1) 485, 888
485 NJO = NJO + 1
TAVE(NJO,NO) = (TFIN(2,NO) + TFIN(3,NO)) / 2.0
B
AFP(NJO,NO) = AMDRT
GO TO 888
C
COMBINATION IS NOW UPP OR SOME ARRANGEMENT THEREOF
C
490 LI = 1
L2 = 2
L3 = 3
B
AFP(L2,NO) = AMID
B
AFP(L3,NO) = RIGHT
GO TO 505
IT IS PUP

495 L2 = 1
L1 = 2
L3 = 3
B
AFP(L3, NO) = RIGHT
B
AFP(L2, NO) = ALEFT
GO TO 505

C
C
IT IS PPU

500 L2 = 1
L3 = 2
L1 = 3
B
AFP(L2, NO) = ALEFT
B
AFP(L3, NO) = AMID
GO TO 510

A
ASSIGN 510 TO ITRA
GO TO 575

C
C
DO 525 KJ = 2, 14
IF(DDEPTH(NO) - Z(KJ)) 515, 520, 525
515 RHOM(NO) = (DDEPTH(NO) - Z(KJ-1)) / (Z(KJ) - Z(KJ - 1)) * 1(RHO(KJ) - RHO(KJ-1)) + RHO(KJ - 1)
GO TO 530

520 RHOM(NO) = RHO(KJ)
GO TO 530
C
CONTINUE
RHOM(NO) = RHO(14)

530 LK = 1
LM = L1
C
C
CORRECT UNPROTECTED

535 TFIN(LM, NO) = (((C(T(L1, NO) + VV(L1, NO))) * (TAVE(LK, NO)
1 - ST(L1, NO))) / (PP(L1, NO) - (TAVE(LK, NO) - ST(L1, NO)))) +
2 TCOR(L1, NO) + CT(L1, NO)
C
C
COMPUTE THERMOMETRIC DEPTH

S40 THERZ(LK, NO) = (TFIN(LM, NO) - TAVE(LK, NO)) / (RHOM(NO) * QQ(L1, NO))
THERZ(LK, NO) = XRND(THERZ(LK, NO))
C
C
COMPUTE L - Z

ALMZ(LK, NO) = ALZ(NO) - THERZ(LK, NO)
IF(SENSE LIGHT 1) 545, 550
545 LK = 2
LM = 4
GO TO 535

550 NOTMP = NOTMP + 1
GO TO 888
C
C
COMBINATION IS NOW - P P OR SOME ARRANGEMENT THEROF
C
C
IT IS NOW - P P

555 L1 = 1
L2 = 2
L3 = 3
AFP(L2,NO) = AMID
AFP(L3,NO) = RIGHT
GO TO 570
C IT IS NOW P - P

560 L2 = 1
L1 = 2
L3 = 3
B A FP(L2,NO) = A LEFT
B A FP(L3,NO) = RIGHT
GO TO 570
C IT IS NOW P - P

565 L2 = 1
L3 = 2
L1 = 3
B A FP(L2,NO) = A LEFT
B A FP(L3,NO) = AMID

570 A SSIGN 888 TO ITRA
575 SENSE LIGHT 1
C C ORRECT PROTECTED

580 TFIN(LO,NO) = CT(LO,NO) + (((CT(LO,NO) + VV(LO,NO)) * (CT(LO,NO)
1 - ST(LO,NO)) / (PP(LO,NO) - (CT(LO,NO) + VV(LO,NO))) -
2 (CT(LO,NO) - ST(LO,NO)))) + TCOR(LO,NO)
IF(SENSE LIGHT 1) 585, 590

585 LO = L3
GO TO 580
590 NNN = XS ABSF(XRNDF(TFIN(L2,NO)*100.) - XRNDF(TFIN(L3,NO)*100.))
NOTMP = NOTMP + 2
C ARE THE TEMPERATURES WITHIN 0.06 OF EACH OTHER
IF(NNN - IDOT) 595, 595.600
C YES, THEY ARE SO AVERAGE THEM

595 NSIG(No) = 1
TAVE(1,NO) = (TFI N(L2,NO) + TFIN(L3,NO)) / 2.0
AFP(1,NO) = BL
GO TO ITRA, (510, 888)
C THEY ARE NOT WITHIN 0.06 OF EACH OTHER SO RETURN WITH BOTH

600 NSIG(No) = 2
TAVE(1,NO) = TFIN(L2,NO)
TAVE(2,NO) = TFIN(L3,NO)
AFP(1,NO) = A FP(L2,NO)
AFP(2,NO) = A FP(L3,NO)
SENSE LIGHT 1
GO TO ITRA, (510, 888)
C COMBINATION IS NOW P - U OR SOME ARRANGEMENT THEREOF
C IT IS NOW - U P

605 L1 = 1
L2 = 2
L3 = 3
GO TO 635
C IT IS NOW U - P
610 L2 = 1
L1 = 2
L3 = 3
GO TO 635
C IT IS NOW - P U
615 L1 = 1
L3 = 2
L2 = 3
GO TO 635
C IT IS NOW P - U
620 L3 = 1
L1 = 2
L2 = 3
GO TO 635
C IT IS NOW U P -
625 L2 = 1
L3 = 2
L1 = 3
GO TO 635
C IT IS NOW P U -
630 L3 = 1
L2 = 2
L1 = 3
GO TO 635
C IT IS NOW U P -
635 NSIG(NO) = 1
B AFP(1, NO) = BL
TFIN(L3, NO) = CT(L3, NO) + ((CT(L3, NO) + VV(L3, NO)) * (CT(L3, NO)
1 - ST(L3, NO)) / (PP(L3, NO) - (CT(L3, NO) + VV(L3, NO)) - (CT(L3, NO)
1 - ST(L3, NO))) + TCOR(L3, NO)
TAKE(1, NO) = TFIN(L3, NO)
C CORRECT UNPROTECTED
C COMPUTE THERMOMETRIC DEPTH
C DO 650 KL = 2, 14
IF (DEPTH(NO) - Z(KL)) 640, 645, 650
640 RHOM(NO) = ((DEPTH(NO) - Z(KL)) / (Z(KL) - Z(KL - 1)))*
1 (RHO(KL) - RHO(KL - 1)) + RHO(KL - 1)
GO TO 655
645 RHOM(NO) = RHO(KL)
GO TO 655
650 CONTINUE
655 THERZ(1, NO) = XRNDF((TFIN(L2, NO) - TAVE(1, NO)) / (RHOM(NO) * QQ(L2, NO))
C COMPUTE L - Z
C ALMZ(1, NO) = ALZ(NO) - THERZ(1, NO)
NOTMP = NOTMP + 2
GO TO 888

COMBINATION IS NOW P U U OR SOME ARRANGEMENT THEREOF

IT IS NOW P U U

L1 = 1
L2 = 2
L3 = 3

AFU(L2, NO) = AMID
AFU(L3, NO) = RIGHT
GO TO 675

COMBINATION IS NOW U P U

L2 = 1
L1 = 2
L3 = 3

AFU(L2, NO) = ALEFT
AFU(L3, NO) = RIGHT
GO TO 675

IT IS NOW U U P

L2 = 1
L3 = 2
L1 = 3

AFU(L2, NO) = ALEFT
AFU(L3, NO) = AMID

TFIN(L1, NO) = CT(L1, NO) + (((CT(L1, NO) + VV(L1, NO)) * (CT(L1, NO))
1 - ST(L1, NO))) / ((PP(L1, NO) - (CT(L1, NO) + VV(L1, NO)) - (CT(L1, NO))
2 - ST(L1, NO))) + TCOR(L1, NO)
SENSE LIGHT 1
TAVE(L1, NO) = TFIN(L1, NO)
LU = L2

TFIN(LU, NO) = (((CT(LU, NO) + VV(LU, NO)) * (TAVE(L1, NO) - ST(LU, NO)))
1 / (PP(LU, NO) - (TAVE(L1, NO) - ST(LU, NO))) + TCOR(LU, NO) + CT(LU, NO)

IF (SENSE LIGHT 1) 685, 690

LU = L3
GO TO 680

DO 705 KK = 2, 14

IF (DDEPHTH(NU) - Z(KK)) 695, 700, 705

RHO(NU) = (((DDEPHTH(NU) - Z(KK-1)) / (Z(KK) - Z(KK-1))) * (RHO(KK) -
1 RHO(KK-1))) + RHO(KK-1)
GO TO 710

700 RHO(NU) = RHO(KK)
GO TO 710

705 CONTINUE

RHO(NU) = RHO(14)

710 SENSE LIGHT 1
JJ = 1
LP = L2

THERZ(JJ, NO) = XRNDF((TFIN(LP, NO) - TAVE(1, NO)) / (RHO(NU) * QQ(LP, 1
NO)))

C

COMPUTE L - Z

ALMZ(JJ, NO) = ALZ(NO) - THERZ(JJ, NO)
IF (SENSE LIGHT 1) 720, 725

J1 = 2
LP = L3
GO TO 715

725 NSIG(NO) = 1
AFU(1, NO) = AFU(L2, NO)
AFU(2, NO) = AFU(L3, NO)

B
AFP(1, NO) = BL
NOTMP = NOTMP + 3
GO TO 888

C
COMBINATION IS NOW U U U, U U -, OR U -- OR SOME ARRANGEMENT THEREOF. THERMOMETRIC DEPTHS WILL BE COMPUTED IN THE MAIN PROGRAM IF THERE IS A PROTECTED THERMOMETER WITHIN 10 METERS ON THE SAME CAST.

730 NSIG(NO) = 0
DO 745 JOK = 2, 14
735 RHOM(NO) = ((DDEPTH(NO) - Z(JOK))/((Z(JOK) - Z(JOK-1)))/(RHO(JOK) - RHO(JOK-1))**RHO(JOK-1)
GO TO 888
740 RHOM(NO) = RHO(JOK)
GO TO 888
745 CONTINUE
RHOM(NO) = RHO(14)
GO TO 888

C
COMBINATION IS NOW -- --

750 NSIG(NO) = -1
GO TO 888

C
COMBINATION IS NOW -- P OR SOME ARRANGEMENT THEREOF IT IS NOW -- -

755 L1 = 3
GO TO 770

C
IT IS NOW - - -

760 L1 = 2
GO TO 770

C
IT IS NOW P --

765 L1 = 1
770 TFIN(L1, NO) = CT(L1, NO) + CT(L1, NO) + VV(L1, NO)) * (CT(L1, NO) - ST(L1, NO)) - ((CT(L1, NO) + VV(L1, NO)) * (CT(L1, NO) - ST(L1, NO))) + T(COR(L1, NO)) - TAVE(1, NO) = TFIN(L1, NO)
NSIG(NO) = 1
NOTMP = NOTMP + 1
B
AFP(1, NO) = BL
888 CONTINUE
RETURN
END
APPENDIX 5  Subroutine BIDE
FAP
FAP COUNT 100

* BIDE FAP PROGRAM FOR CONVERTING FLOATING OR (FORTRAN) FIXED POINT
* BINARY NUMBERS IN BCD FORM.
* UWMS-0950
* UNIVERSITY OF WASHINGTON
* DEPARTMENT OF OCEANOGRAPHY
* SEATTLE, WASHINGTON 98105
* PROGRAMMED BY PAAVO KOVALA

Q = BIDEF (P, M, N)
P = BINARY NUMBER
M = TOTAL NUMBER OF CHARACTERS IN Q, MAXIMUM 6
N = NUMBER OF DECIMALS, MAXIMUM 6
IF M = 0, Q = BLANK
IF M IS NEGATIVE, LEADING ZEROES ARE RETAINED AND MINUS SIGN
IS COMBINED WITH THE RIGHTMOST CHARACTER OF Q.
IF N = 0, THERE IS NO DECIMAL POINT.
IF N IS NEGATIVE, P IS A FORTRAN II INTEGER.
ENTRY BIDE
ENTRY XBIDE

XBIDE
SXA XR+1, SAVE XR1
SXA XR+1,2, SAVE XR2
SXA XR+2,4, SAVE XR4
AXT 0,7, O INTO XR1, XR2, XR4
TZE PLA-1
TPL PLA
AXT 1,1, 1 INTO XR1 IF P IS NEGATIVE
SSP SET SIGN OF P PLUS
PLA STO A
MPY =0300000
TNZ MNZ
CLA B+2
TRA XR
MNZ TPL NST-1
TXI **+1,1,2
SSP M IS NEGATIVE, ADD 2 TO C(XR1)
STA FIN+1
ABS, VALUE OF M INTO ADDRESS OF FIN-1
NST LDQ -3
TQP PLN
CLA A
N IS NEGATIVE, P IS FIXED PT. NUMBER
TNZ NZA
NUL TXH NZA-1,1,1
CLA 8
TRA FIN
NZA LGR 54
TRA CVT
PLN MPY =0300000

READY FOR CONVERTING INTO BCD
N IS POSITIVE, \(-6\times N\) INTO XR2

P=0, BYPASS CONVERSION

N IS POSITIVE, PUT N INTO XR4

MULTIPLY P BY \(10^{\text{NCONV}}\)

ROUND P

REMOVE CHARACTERISTIC

PUT N INTO XR4

MULTIPLY P BY 10**N

CONVERT FL. PT. P INTO FIXED PT. NUMBER

ROUND PREMOVE CHARACTERISTIC

BLANKS AND POSSIBLE MINUS SIGN INTO XR4

SHIFT P INTO MQ

LAST CHARACTER OF Q IN AC

P AND M ARE NEGATIVE,

P AND M ARE NEGATIVE,

LAST CHAR. OF Q IS 0, MAKE IT MINUS ZERO

LAST CHARACTER OF Q INTO AC

CLEAR AC

SHIFT NEXT CHAR. OF Q IN FRONT OF OTHERS AND COMBINE IT WITH THEM

CONVERTED NUMBER NOW IN AC

IF N IS NONPOSITIVE, NO DECIMAL POINT

SHIFT DECIMALS INTO MQ

SHIFT INTEGER, MAKE ROOM FOR DECIMAL POINT

INSERT DECIMAL POINT

SHIFT Q INTO AC

IF Q CONSISTS OF ZEROES, BYPASS FOLLOWING

IF M IS NEGATIVE, RETAIN LEADING ZEROS

IF N IS NONPOSITIVE, TRANSFER

IF N IS GREATER THAN 3, SKIP FOLLOWING

N IS POSITIVE, LESS THAN 4

SHIFT N+2 CHARACTERS INTO MQ

SHIFT ONE MORE CHARACTER INTO MQ

BLANKS AND POSSIBLE MINUS SIGN INTO AC

SHIFT Q INTO AC, RIGHT ADJUSTED

FILL MQ WITH BLANKS

SHIFT Q INTO MQ, LEFT ADJUSTED

Q INTO AC

RESTORE XR1

RESTORE XR2

RESTORE XR4
<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>DEC</th>
<th>OCT</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRA</td>
<td>1,4</td>
<td>9,10,100,1000,10000,100000,1000000</td>
<td>606060606000,606060606040,606060606060</td>
</tr>
</tbody>
</table>
APPENDIX 6  Subroutine DEBI
* FAP
* COUNT 100
* XDEBI, DEBI AND XDEBI, FAP PROGRAMS FOR CONVERTING BCD NUMBERS,
* WITH POSSIBLE MINUS SIGN COMBINED WITH UNIT CHARACTER,
* INTO FLOATING OR (FORTRAN II) FIXED POINT BINARY NUMBERS.
* UWMS-0948
* UNIVERSITY OF WASHINGTON
* DEPARTMENT OF OCEANOGRAPHY
* SEATTLE, WASHINGTON 98105
* PROGRAMMED BY: PAAVO KOVALA
* BCD INPUT DATA WORD MUST HAVE 6 NUMERICAL CHARACTERS.
* IN CASE OF ILLEGAL CHARACTER OR TOO LARGE NUMBER, COMMENT IS
* WRITTEN ON TAPE NO. 6 (A3) AND RESULT IS MADE ZERO.
* BLANKS ARE READ AS ZEROES.
* ENTRY XDEBI
* ENTRY DEBI
* XDEBI
* STZ A-7
* TRA *+2
* DEBI
* STL A-7
* SXA IR+1
* SXA IR+1+2
* AXT 6+1
* AXT 0+2
* STO MES2+6
* STO MES1+2
* STO D
* LOOP
* ANA =777
* SUB =660
* TNZ FOUND
* CAL D
* SLW D
* TRA DTZE IR
* FOUND
* CAL D
* TZE IR
* AXT 0+1
* LDQ =011
* ANA =040
* TZE POS
* CAL D
* ANA =0777777777737
* SLW D
* ANA =077
* TZE NON+2
* STL A-6
* SUB D+5
* TNZ POS+1
* STZ A
* TRA POS+5
* ZERO FOR FIXED POINT
* NONZERO FOR FLOATING POINT
* SAVE INDEX REGISTERS 1
* AND 2
* SAVE ORIGINAL WORD
* LAST CHARACTER IN AC
* CHECK WHETHER IT IS BLANK
* NOT BLANK, TRANSFER
* IT WAS BLANK
* TAKE NEXT CHARACTER
* NUMBER IS 0, SKIP THE REST
* 9 INTO MQ
* CHECK FOR MINUS SIGN
* NO MINUS SIGN IF 0 IN AC
* REMOVE MINUS SIGN
* CHECK LAST CHARACTER
* IT WAS MINUS SIGN ALONE. ILLEGAL.
* THERE IS MINUS SIGN
* CHECK WHETHER IT WAS MINUS ZERO (52)
* IT WAS MINUS ZERO, 0 INTO A
MAKE FLOATING POINT NUMBER

CHECK FOR NON-NUMERIC CHARACTERS
STORE NUMERIC CHARACTER

FINISH CHECKING IF 0 IN AC
NUMBER OF CHARACTERS INTO XR1, XR2

MULTIPLY CHARACTERS BY APPROPRIATE POWER OF 10

SUM THE PRODUCTS
RESULTING BINARY NUMBER INTO A

SET SIGN MINUS FOR NEGATIVE NUMBER

OVERFLOW INDICATOR OFF
SHIFT FIXED PT. INTEGER INTO DECREMENT
CHECK WHETHER NUMBER WAS TOO LARGE
NUMBER WAS TOO LARGE FOR FORTRAN II
WRITE A COMMENT

MAKE FLOATING POINT NUMBER

RESTORE INDEX REGISTERS 1
AND 2

CHECK WHETHER IT WAS BLANK
CONSIDER BLANK AS ZERO
NON-NUMERIC CHARACTER IN DATA WORD

WAIT UNTIL WRITING IS COMPLETED
RESULT MADE ZERO

NON-A. 1
D
6
D
*+2POS+2.3.1
SIGNSIGN,1.0
MULTLDQD+6.1
MPY A,1
STQ A,1
TIXMULT,1.1
CLAA
ADD A,2
STO A

SIGN

SIGN

C
ZET A-6

NAME

ZET A-7
TRA IR-2
TOV ++1
ALS 18
TNO IR
WTDA 3
RCHA COM1
TRA ZERO-1
ORA =023300000000
FAD =023300000000
IR

AXT **,1
AXT **,2
TRA 1.4

NON

SUB =060
TZE POS+4
WTDA 3
RCHA COM2

TCOA *

ZERO PXD 0.0
TRA IR

COM1 IOCDSMES1,9
COM2 IOCDSMES2,7
MES1 BCIBCI9* THE NUMBER IS TOO LARGE FOR FORTRAN II I FORMAT
MES2 BCIBCI7DEBI OR XDEBI WAS FED BAD BCD WORD
D DEC

A BES
PZE

END
APPENDIX 7 Subroutine RDBUF

* FAP
COUNT 18
* BUFFER-TO-STOREAGE HOLLERITH
* UWMS-0933
* UNIVERSITY OF WASHINGTON
* DEPARTMENT OF OCEANOGRAPHY
* SEATTLE, WASHINGTON 98105
* PROGRAMMED BY CHARLES KIRKLEY
* A FORTRAN READ STATEMENT WILL CAUSE IOH TO TREAT THE CONTENTS
* OF ITS BUFFER AS NEW INPUT.
* LBL RDBUF,KIRK
ENTRY (BSH)
ENTRY (CSH)
(BSH) BSS 0
(CSH) CAL NTIN
LD0 +2
TRA* $(IOH)
NOP +1
TRA 1.4
NTIN PZE ,5
END

APPENDIX 8 Subroutine EXOR

* FAP
COUNT 8
* EXOR LOGICAL FORTRAN FUNCTION EXORF(A,B)
* UWMS-0945
* UNIVERSITY OF WASHINGTON
* DEPARTMENT OF OCEANOGRAPHY
* SEATTLE, WASHINGTON 98105
* ENTRY EXOR
EXOR STQ A
ERA A
TRA 1.4
A BSS 1
END
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A coordinated computer-compatible system has been developed to eliminate most of the hand calculations involved in processing oceanographic data taken at a hydrographic (water-sampling) station. A special field-log form is used at the time the oceanographic station is occupied so that machine processing of the data is expedited. These data are first punched either on paper tape using a Friden Flexowriter or on Hollerith (IBM) cards and then submitted to a computer to make selected computations.

The computer program uses only uncorrected readings from the meter wheel, estimated wire length, reversing thermometers, salinity, oxygen, and other chemical determinations. The final results are printed, and other output options may be selected such as punched cards, magnetic tape, or both. Output formats for punched cards are essentially those used by the National Oceanographic Data Center. Many error checks and quality control evaluations are incorporated into the program.

The program is written in FORTRAN-II and FAP especially for the IBM-7094-7040 Direct Couple System. An average of 2.5 sec of computer time is required for a station of 12 sampling depths.
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