UNIVERSITY OF WASHINGTON
DEPARTMENT OF
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Special Report No. 38

COMPUTATION OF PHYTOPLANKTON CELL NUMBERS, CELL VOLUME, CELL SURFACE AND PLASMA VOLUME PER LITER, FROM MICROSCOPICAL COUNTS

by

Paavo E. Kovala and Jerry D. Larrance

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July 1966

UWMS-1008
UWMS-1009

UNIVERSITY OF WASHINGTON
DEPARTMENT OF OCEANOGRAPHY
Applied Mathematics Section

Identification

a. PHPL, Phytoplankton numbers, volumes and surface areas by species.

* b. In correspondence refer to program number: UWMS-1008 or UWMS-1009.

c. FORTRAN IV program for IBM 7094.

d. Originated by Jerry Larrance (U.W. Fish and Wildlife Service, Bureau of Commercial Fisheries, Biological Laboratory, Seattle), July 1965.

e. Programmed by Paavo Kovala, March 1966.

f. Department of Oceanography, University of Washington, Seattle, Washington 98105.

R E P O R T

	Original:		Revision:	
Prepared by	P. Kovala	22 Jun 66 ;		
Checked by	H. MacIntosh	23 Jun 66 :		
Approved by	J. C. Dworski	13 Jul 66 ; (date)		(date)

* UWMS-1008 and UWMS-1009 differ in input format only. See section 4 (Usage) for explanatory details.

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REFERENCES

Jerry David Larrance

1964. A Method for Determining Volume of Phytoplankton in a Study of Detrital Chlorophyll a. A thesis submitted in partial fulfillment of the requirements for the degree of master of science, University of Wasnington. 107 pp.

1. Purpose

The program computes concentrations of cell numbers, cell surface areas and cell and plasma volumes in marine phytoplankton populations. Also mean cell areas, mean cell volumes and mean plasma volumes as well as the ratios cell area to cell volume and cell area to plasma volume can be computed optionally.

The input quantities cell numbers, cell shapes and dimensions are obtained from microscopical examination of preserved seawater samples sedimented in counting chambers. For further details see Larrance (1964).

2. Restrictions

a. The program includes a subroutine ARVZL, written in FORTRAN IV. Other subroutines needed are ELLAR (UWMS-1005, in FORTRAN IV) for computing the area of an ellipsoid, and BIDE (UWMS-0949, in MAP), BLDP (UWMS-0953, in MAP) and DEBI (UWMS-0947, in MAP) for modifying data words.

b. Input tape 5 and output tape 6 are used.

c. The main program requires 21361 storage locations, subroutine ARVZL 1775 locations, and subroutines ELLAS, BIDE, BLDP, and DEBI a total of 700 locations, for an overall total of 23836 locations. For storage space required by the system's subroutines see "memory map" in Appendix c.

d. For each "station" (a set of input data handled separately) there can be 1 to 6 depths, 1 to 250 species and 1 to 99 species groups.

e. Overflow and divide check are not tested, but FORTRAN IV writes an error comment in case of an overflow. Sense lights and sense switches are not used.

3. Method

a. Nomenclature

The subscripts i,j,k and g refer to the i^{th} species in the species list of a station, to the j^{th} sampling depth, to the k^{th} group of measured cells for a fixed pair i,j, and to the g^{th} species group, respectively.

The area unit u_1 for a_0 and a_{ij} can be arbitrary since only the ratio a_0/a_{ij} is needed. $R = u/\mu$ is a conversion factor from the (arbitrary) eyepiece micrometer unit u to microns u.

Symbol	Unit	Quantity
I		total number of species
J		number of sampling depths
$D_1, \ldots, D_J$	m	sampling depths
N_g		species number of the last species in the g^{th} species group ($N_0 = 0$)
K_{ij}		number of groups of measured cells
V_o	ml	counting chamber volume
a_o	u_1	total area of the counting chamber bottom
a_{ij}	u_1	area of the chamber bottom inspected
c_{ij}		number of cells counted
m_{ijk}		number of cells measured
$U_{(2)ijk}$	u^2	area of one cell
$U_{(3)ijk}$	u^3	volume of one cell
$U_{(4)ijk}$	u^3	plasma volume of one cell
$B_{(1)ij}$	ℓ^{-1}	number of cells per liter of sea water
$B_{(2)ij}$	$u^2\ell^{-1}$	cell area per liter of sea water

Symbol	Unit	Quantity
$B_{(3)ij}$	$u^3\ell^{-1}$	cell volume per liter of sea water
$B_{(4)ij}$	$u^3\ell^{-1}$	plasma volume per liter of sea water
$B_{(5)ij}$	u^{-1}	ratio cell area / cell volume
$B_{(6)ij}$	u^{-1}	ratio cell area / plasma volume
$B_{(7)ij}$	u^2	mean cell area
$B_{(8)ij}$	u^3	mean cell volume
$B_{(9)ij}$	u^3	mean plasma volume
$S_{(1)gj}$	ℓ^{-1}	number of cells per liter for a species group
$S_{(2)gj}$	$u^2\ell^{-1}$	cell area per liter for a species group
$S_{(3)gj}$	$u^3\ell^{-1}$	cell volume per liter for a species group
$S_{(4)gj}$	$u^3\ell^{-1}$	plasma volume per liter for a species group
$T_{(1)j}$	ℓ^{-1}	total number of cells per liter
$T_{(2)j}$	$u^2\ell^{-1}$	total cell area per liter
$T_{(3)j}$	$u^3\ell^{-1}$	total cell volume per liter
$T_{(4)j}$	$u^3\ell^{-1}$	total plasma volume per liter
$H_{(1)i}$	m^{-2}	number of cells of a species per 1 m^2 of sea surface
$H_{(2)i}$	u^2m^{-2}	cell area of a species per 1 m^2 of sea surface
$H_{(3)i}$	u^3m^{-2}	cell volume of a species per 1 m^2 of sea surface
$H_{(4)i}$	u^3m^{-2}	plasma volume of a species per 1 m^2 of sea surface
$G_{(1)g}$	m^{-2}	number of cells of a species group per 1 m^2 of sea surface
$G_{(2)g}$	u^2m^{-2}	cell area of a species group per 1 m^2 of sea surface
$G_{(3)g}$	u^3m^{-2}	cell volume of a species group per 1 m^2 of sea surface
$G_{(4)g}$	u^3m^{-2}	plasma volume of a species group per 1 m^2 of sea surface
$L_{(1)}$	m^{-2}	total number of cells per 1 m^2 of sea surface
$L_{(2)}$	u^2m^{-2}	total cell area per 1 m^2 of sea surface

Symbol	Unit	Quantity
$L_{(3)}$	$\mu^3 m^{-2}$	total cell volume per 1 m^2 of sea surface
$L_{(4)}$	$\mu^3 m^{-2}$	total plasma volume per 1 m^2 of sea surface
A_j	mg m^{-3}	amount of chlorophyll per 1 m^3 of sea water
A'_j	mg $m^{-3} t_1^{-1}$	carbon assimilation per 1 m^3 of sea water per time unit t_1
A''_j	mg $m^{-3} t_2^{-1}$	carbon assimilation per 1 m^3 of sea water per time unit t_2
A_ξ	mg m^{-2}	amount of chlorophyll per 1 m^2 of sea surface
A'_ξ	mg $m^{-2} t_1^{-1}$	carbon assimilation per 1 m^2 of sea surface per time unit t_1
A''_ξ	mg $m^{-2} t_2^{-1}$	carbon assimilation per 1 m^2 of sea surface per time unit t_2

The time units t_1 and t_2 depend upon the technique used.

For $5 \leq n \leq 9$, the ratios $S_{(n)\varepsilon j}$, $T'_{(n)j}$, $B_{(n)i}$, $G_{(n)\varepsilon}$ and $L_{(n)}$ defined below in formulas (6) have the same units as $B_{(n)ij}$.

b. Computations:

$$(1) \qquad B_{(1)ij} = \frac{1000\, a_o}{v_o\, a_{ij}}\, c_{ij}$$

$$(2) \qquad B_{(n)ij} = C_n B_{(1)ij} \sum_{k=1}^{K_{ij}} (n_{ijk}\, U_{(n)ijk}) \Big/ \sum_{k=1}^{K_{ij}} n_{ijk}$$

for $n = 2,3,4$; $\quad C_2 = R^2, \quad C_3 = C_4 = R^3$

$$(3) \qquad S_{(n)\varepsilon j} = \sum_{i=N_{\varepsilon-1}+1}^{N_\varepsilon} B_{(n)ij} \qquad \text{for } n = 1,2,3,4$$

$$(4) \qquad T_{(n)j} = \sum_{i=1}^{I} B_{(n)ij} \qquad \text{for } n = 1,2,3,4$$

$$(5) \qquad B_{(n)i} = \frac{1}{2} \sum_{j=2}^{J} (D_j - D_{j-1})(B_{(n)ij} + B_{(n)ij-1})$$

for $n = 1,2,3,4$

$$(6)\qquad G_{(n)g} = \sum_{i=N_{g-1}+1}^{N_g} H_{(n)i} \qquad \text{for } n = 1,2,3,4$$

$$(7)\qquad L_{(n)} = \sum_{i=1}^{I} H_{(n)i} \qquad \text{for } n = 1,2,3,4$$

$B_{(n)ij}$, $S_{(n)gj}$, $T_{(n)j}$, $H_{(n)i}$ and $L_{(n)}$ are obtained for $5 \le n \le 9$ from the formulas

$$(8)\qquad \begin{cases} Q_5 = Q_2 / Q_3 \\ Q_6 = Q_2 / Q_4 \\ Q_7 = Q_2 / Q_1 \\ Q_8 = Q_3 / Q_1 \\ Q_9 = Q_4 / Q_1 \end{cases}$$

by letting Q_n denote $B_{(n)ij}$, $S_{(n)gj}$, $T_{(n)j}$, $H_{(n)i}$ and $L_{(n)}$, respectively.

$$(9)\qquad A_t = \frac{1}{2} \sum_{j=2}^{J} (D_j - D_{j-1})(A_j + A_{j-1})$$

and A'_t and A''_t are obtained from the same formula by substituting A' and A'' for A, respectively. If any value of A_j, A'_j or A''_j is missing, the corresponding A_t, A'_t or A''_t is not computed.

If there is only one sampling depth (J=1), $H_{(n)i}$, $T_{(n)j}$, $L_{(n)}$, A_t, A'_t and A''_t are not computed.

For any $B_{(1)ij} = 0$, the corresponding ratios are $B_{(n)ij} = 0$ for $5 \le n \le 9$.

c. The results, except chlorophyll and assimilation values, are written with three figures. Since in most cases some of the cell dimensions have only two significant figures (in some cases only one), the

results generally have at most two significant figures.

d. The input of a job consists of one or more "stations" which are handled separately by the program. When the data cards of a station are read in, the identification and some other input quantities are checked. If an error is found, an error message is written and the program skips to the next station. When a set of cell dimensions has been read, the subroutine ARVØL computes the area, the volume and the plasma volume of the cell, using the formulas of Appendix a. Subsequently, the concentrations are computed from formulas (1) and (2). The species list is arranged into ascending order by species number, and if there is more than one sampling depth, the integrated values are computed for a 1 m^2 water column between the lowest and greatest sampling depths, using formulas (5) and (9). The species list is partitioned into species groups, the totals for each group are computed from formulas (3) and (6), and the grand totals for the whole list from formulas (4) and (7). If the ratios of concentrations are requested, they are computed from formulas (8).

4. Usage

a. Deck makeup.

A complete deck for a job consists of the system cards, the program deck and the data deck. The program deck consists of the main program and the subroutines. In the following description the cards required by the IBM 7090/7094 IBSYS Operating System are those applicable in the University of Washington installation.

The order of cards in a complete deck:

$JØB

$ID

$FØRMS

$EXECUTE IBJØB

$IBJØB

Main program.

Subroutines ARVØL, ELLAR, BIDE, BLDP, DEBI

$DATA

Data deck

$EØF

The order of the main program and the subroutines in the program deck is immaterial. Both source and object decks can be used. $FØRM card is used only in case of special printing (e.g., more than one copy of output is wanted).

SYSTEM CARDS

$JØB Card

Col. 1-4	$JØB
Col. 16	Priority code
Col. 17	Comma

Col. 18-30 Estimated maximum time on IBM 7094, followed by a comma, followed by estimated maximum number of lines printed, followed by blanks.

Col. 31-37 Job number

Col. 39-72 Anything (usually name of the person submitting the job)

$ID Card

Col. 1-3 $ID

$FØRMS Card

Col. 1-5 $FØRMS

Col. 8 6

Col. 16-27 PRØGRAM

Col. 28-31 Paper number

Col. 32 n for n-part paper

Col. 33 Number of lines per inch in printed output

$EXECUTE Card

Col. 1-8 $ENTRY

Col. 16-20 IBJØB

$IBJØB Card

Col. 1-5 $IBJØB

$DATA Card

Col. 1-5 $DATA

$EØF Card

Col. 1-4 $EØF

DATA DECK

The data deck consists of one or more station decks, each of which contains all information necessary for processing independently from other station decks. At the beginning of each station deck

there are group cards, each containing the number and the name of a species group. There may be more group cards than are needed for the station. These cards are followed by one or more subdecks, one for each sample. A subdeck begins with a sample card which is followed by one or more species cards, each with a species number and species name on it. Each species card is followed by at least one dimension card.

The group cards can be in any order at the beginning of the station deck. The subdecks must be in the order of increasing sampling depth. The species cards of a subdeck can be in any order, although when sorting the deck together they are automatically put into ascending order of species numbers. The order of dimension cards after a species card is immaterial.

The structure of a station deck summarized:

Group cards

1st sample card

Species card No. 1_1

Dimension card(s)

Species card No. 2_1

Dimension card(s)

(etc.)

Species card No. m_1

Dimension card(s)

2nd sample card

Species card No. 1_2

Dimension card(s)

(etc.)

3rd sample card

Species card No. 1_3

Dimension card(s)

(etc.)

Etc.

SPECIES GROUP NUMBERS AND SPECIES NUMBERS

Each species group in a station deck is given a number m such that $0 < m < 100$; the numbers need not be consecutive. Each species in a species group is given a species number $n = 1000\,m + i$ where $0 < i < 1000$; the numbers i need not be consecutive in a species group. Hence always $10^3 < n < 10^6$. In the output the species are listed in ascending order of n, i.e., the species groups are listed in ascending order of m and the species in each group in ascending order of i.

b. Data card formats

The programs UWMS-1008 and UWMS-1009 have different input formats. Each data card for one of these programs has the data fields identical with those on a corresponding data card for the other program, but the arrangement of the fields is different. (There is one exception: Country is recorded in species group cards for UWMS-1008 but not for UWMS-1009.)

Decimal points are omitted in input formats. If a number does not fill a whole numerical field, the remaining leftmost part of the field can be filled with zeros or left blank.

In the following description, the numerical fields are denoted by n x's where n is the number of columns in the appropriate field.

For the fields having one or more decimals, the position of the (omitted) decimal point is denoted by a period. The non-numerical fields accept any alphameric characters.

INPUT FORMATS FOR UWMS-1008

I Species group card

Col. 1-2		Code for the country; 31 for the USA. (Ignored by the program)
Col. 3-4	xx	Degrees of latitude.
Col. 5-7	xx.x	Minutes of latitude; if the decimal is not known, leave column 7 blank.
Col. 8		N for northern, S for southern latitude.
Col. 9-11	xxx	Degrees of longitude.
Col. 12-14	xx.x	Minutes of longitude; if the decimal is not known, leave column 14 blank.
Col. 15		E for eastern, W for western longitude.
Col. 16-21		Date, month and year of observation; e.g., March 22, 1965 is recorded 220365.
Col. 22-27		Blank.
Col. 28-29	xx	Species group number.
Col. 30-61		Species group name; start from column 30.
Col. 62	x	1 if ratios from formulas (8) are requested; otherwise 0.
Col. 67-68	xx	Number of species group cards for the station deck.
Col. 69	x	Number of samples for the station.
Col. 70-71		Extra identification.
Col. 72-76		Ship designation and cruise number.
Col. 77-79		Station number.
Col. 80	x	1.

II Sample card

Co. 1-4		Sampling hour, local time; 24-hour system is used; e.g., 2:40 p.m. is recorded 1440.
Col. 5-8	xx.xx	Chlorophyll *a* in mg/m^3.
Col. 9-13	xxx.xx	Carbon assimilation in $mg/m^3/t_1$, where t_1 is the time used with the technique in question.
Col. 14-15		Designation of the time unit t_1, e.g., HR = hour, HD = half a day, etc.
Col. 16		Technique used.
Col. 17-21	xxx.xx	Carbon assimilation in $mg/m^3/t_2$, where t_2 is the time unit used with the technique in question.
Col. 22-23		Designation of the time unit t_2.
Col. 24		Technique used.
Col. 25-59		Blank.
Col. 60-62	xxx	Number of species in the sample.
Col. 63-66	xxx.x	Sampling depth in meters.
Col. 67-69		Sample number.
Col. 70-79		The same as in the group card.
Col. 80	x	2.

III Species card

Col. 1-5	xxxxx	Species number.
Col. 6-45		Species name; start from column 6.
Col. 46-49	(xxxx)	Total bottom area of the counting chamber in arbitrary units. (Decimal point anywhere)

Col. 50-53	(xxxx)	Chamber bottom area inspected, in the same unit as total bottom area. (Decimal point anywhere)
Col. 54-57	xxxx	Number of cells counted.
Col. 58-59		Blank.
Col. 60-62	xx	Number of dimension cards for the species in question.
Col. 63-79		The same as in the sample card.
Col. 80	x	3.

IV Dimension card

Col. 1-5		The same as in the species card.
Col. 6-8	xxx	Number of cells measured (with identical dimensions).
Col. 9-10	xx	Cell shape number.
Col. 11-43	xxx,...	(11 fields of 3 digits) Dimensions A,B,C,D,E,F, G,H,J,K,L in eyepiece micrometer units u.
Col. 44-46	xx.x	Plasma thickness in units u.
Col. 47-50	xx.xx	Chamber volume in milliliters.
Col. 51-53	x.xx	Conversion factor from u to μ (length of u in microns).
Col. 54-62		Blank.
Col. 63-79		The same as in the species card.
Col. 80	x	4.

INPUT FORMATS FOR UWMS-1009

I Species group card

Col. 1-5		Ship designation and cruise number.
Col. 6-8		Station number.
Col. 9-10		Extra identification.
Col. 11-12	xx	Degrees of latitude.

Col. 13-15	xx.x	Minutes of latitude; if the decimal is not known, leave column 15 blank.
Col. 16		N for northern, S for southern latitude.
Col. 17-19	xxx	Degrees of longitude.
Col. 20-22	xx.x	Minutes of longitude; if the decimal is not known, leave column 22 blank.
Col. 23		E for eastern, W for western longitude.
Col. 24-29		Date, month and year of observation; e.g., March 22, 1965 is recorded 220365.
Col. 30	x	Number of samples for the station.
Col. 31-32	xx	Number of species group cards for the station deck.
Col. 33-40		Blank.
Col. 41-42	xx	Species group number.
Col. 43-74		Species group name; start from column 43.
Col. 75	x	1 if ratios from formulas (8) are requested; otherwise 0.
Col. 76-79		Blank.
Col. 80	x	1.

II Sample card

Col. 1-10		The same as in the group card.
Col. 11-13		Sample number.
Col. 14-17	xxx.x	Sampling depth in meters.
Col. 18-21		Sampling hour, local time, 24-hour system is used; e.g., 2:40 p.m. is recorded as 1440.
Col. 22-24	xxx	Number of species in the sample.
Col. 25-59		Blank.

Col. 60-63	xx.xx	Chlorophyll *a* in mg/m^3.
Col. 64-68	xxx.xx	Carbon assimilation in $mg/m^3/t_1$ where t_1 is the time unit used with the technique in question.
Col. 69-70		Designation of the time unit t_1, e.g., HR = hour, HD = half a day, etc.
Col. 71		Technique used.
Col. 72-76	xxx.xx	Carbon assimilation in $mg/m^3/t_2$ where t_2 is the time unit used with the technique in question.
Col. 77-78		Designation of the time unit t_2.
Col. 79		Technique used.
Col. 80	x	2.

III Species Card

Col. 1-17		The same as in the sample card.
Col. 18-20	xxx	Number of dimension cards for the species in questio
Col. 21-25	xxxxx	Species number.
Col. 26-65		Species name; start from column 26.
Col. 66-69	(xxxx)	Total bottom area of the counting chamber in arbitrary units. (Decimal point anywhere)
Col. 70-73		Chamber bottom area inspected, in the same units as total bottom area.
Col. 74-77	xxxx	Number of cells counted.
Col. 78-79		Blank.
Col. 80	x	3.

IV Dimension card

Col. 1-17		The same as in the species card.
Col. 18-20	xxx	Number of cells measured (with identical dimensions).

Col. 21-25		The same as in the species card.
Col. 26-27		Cell shape number.
Col. 28-60	xxx,...	(11 fields of 3 digits) Dimensions A,B,C,D,E,F, G,H,J,K,L in eyepiece micrometer units u.
Col. 61-63	xx.x	Plasma thickness in units u.
Col. 64-67	xx.xx	Chamber volume in milliliters.
Col. 68-70	x.xx	Conversion factor from u to μ (length of u in microns).
Col. 71-79		Blank.
Col. 80	x	4.

c. Job handling

There are four kinds of input forms, shown in Appendix d, used for recording input data for keypunching. The data deck is put together by sorting. First sort by column 80 so that card types 1,2,3 and 4 (group, sample, species and dimension cards, respectively) are separated into groups, called now decks 1,2,3 and 4. Put decks 1 and 2 aside, put deck 4 behind deck 3; the combined deck is called deck 34. Then proceed as follows.

UWMS-1008:

Sort deck 34 by columns 5,4,3,2, and 1 into ascending order of species number. Put deck 2 in front of sorted deck 34 and sort the combined deck by columns 66,65,64 and 63 into order of increasing sampling depth. Put deck 1 in front of the sorted deck and sort by columns 71,70,79,78, ..., 72 into station decks.

UWMS-1009:

Sort deck 34 by columns 25,24, ..., 21 into ascending order of species number. Put deck 2 in front of sorted deck 34 and sort the combined deck by columns 17, 16, 15 and 14 into order of increasing

sampling depth. Put deck 1 in front of the sorted deck and sort by columns 10,9, ..., 1 into station decks.

An example of a data deck used for testing program UWMS-1008 appears on page e1, and one for program UWMS-1009 on page e4.

The following is an example of using system cards:

$JØB (11 spaces) 3,2,2000 (7 spaces) 0100611 (Name)

$ID

$FØRMS 6 (7 spaces) PRØGRAM,141326

$IBJØB

(Program deck)

$DATA

(Data deck)

$EØF

The first card gives priority 3, maximum time of 2 minutes for compilation and execution, maximum of 2000 lines of printed output, and a job number 0100611. The third card tells that the output (from output tape 6) is printed on paper type No. 1413, two-part paper (one carbon copy), 6 lines per inch and using the first character of each line for carriage control.

d. Error Codes

The program does not use error codes but writes error messages which are self-explanatory. They can be read from FØRMAT statements No. 109, 117, 123, 132, 143, 163, 174, 202 and 206 in the program listing.

e. Timing

The sample data given in Appendix e require about 35 seconds computer time on an IBM 7094 with no compilation, if a complete output with computed ratios is requested.

f. Amount of output as a function of input:

$$L = \sum_{d=1}^{D} C_d(2G_d + S_d + 11)$$

$$P = \sum_{d=1}^{D} C_d \left\{\text{entier}\left[(6G_d + S_d + 19)/N\right] + 1\right\}$$

where

L = total number of printed lines in the output

P = total number of pages in the output

D = number of station decks in the data deck

G_d = (actual) number of species groups in the d^{th} station deck

S_d = total number of species in the d^{th} station deck

C_d = 9 if ratios are computed for station d, 4 otherwise

N = number of lines per page

entier(a) = largest integer not greater than a

5. Checkout

The test data cards and the test output are listed in Appendix e. The results agree with those obtained with the original program UWMS-0960. Cell areas, volumes and plasma volumes for shapes 1-18 (SPECIES 1 - SPECIES 18 in the data) agree with hand computed values. The integrated values for chlorophyll, assimilation and several species have been checked, as well as totals and grand totals for some depths. The same applies to the ratios.

6. Other information

If it is anticipated that in a substantial number of cases, some particular ratios are needed but not all of them, computer time and output could be minimized by handling only the ratios requested. This requires some changes in the program, but the input formats of both UWMS-1008 and UWMS-1009 have space reserved for four additional ratio codes, so that every one of the five ratios could be requested separately.

Appendix a

Formulas for Computing the Area, the Volume and the Plasma Volume of a Phytoplankton Cell

APPENDIX a.

Formulas for Computing the Area, the Volume and the Plasma Volume of a Phytoplankton Cell

The dimensions and shape numbers are indicated in Fig. 1. Shape numbers identify the equations. Restrictions on dimensions are also indicated (except that $0 \leq P \leq 99.9u$ for plasma thickness and $0 \leq d \leq 999u$ where d is A ... L as given below). If a restriction given in parentheses for a shape is violated, the plasma volume is made equal to the cell volume. If a restriction not in parentheses is violated, either the plasma volume alone or the cell area, cell volume and plasma volume are given the value -10^{30} to indicate an error.

Symbols Used

A_c = cell area

V_c = cell volume

V_v = vacuole volume

V_p = plasma volume

P = plasma thickness

A ... L = other cell dimensions

For all shapes

$$V_p = V_c - 0.9\ V_v \quad .$$

$P = 0$ means that the whole cell is filled with plasma and $V_p = V_c$. The special function E_a (computed by subroutine ELLAR) gives the area $E_a(x,y,z)$ of an ellipsoid with principal axes of length x, y, and z.

1. Sphere

Dimensions: A, P.

Restriction: $(A \geq 2P)$

$A_c = \pi A^2$

$V_c = \frac{\pi}{6} A^3$

$V_v = \frac{\pi}{6} (A - 2P)^3$

2. Ellipsoid

Dimensions: A, B, C, P.

Restriction: $(\min (A, B, C,) \geq 2P)$

$A_c = E_a(A, B, C)$

$V_c = \frac{\pi}{6} ABC$

$V_v = \frac{\pi}{6} (A - 2P)(B - 2P)(C - 2P)$

3. Right circular cylinder

(a girdle view, b valve view)

Dimensions: A, B, P.

Restriction: $(\min (A,B) \geq 2P)$

$A_c = \pi A(\frac{A}{2} + B)$

$V_c = \frac{\pi}{4} A^2 B$

$V_v = \frac{\pi}{4} (A - 2P)^2 (B - 2P)$

4. Shape similar to Grammatophora spp.

(a girdle view, b valve view)

Dimensions: A, B, C, P.

Restrictions: $A > B$, $(\min (B,C) \geq 2P)$

$$A_c = 2(A - B)(B + C) + \pi B\left(\frac{B}{2} + C\right)$$

$$V_c = BC\left(A - B + \frac{\pi}{4}B\right)$$

$$V_v = (B - 2P)(C - 2P)\left[A - B + \frac{\pi}{4}(B - 2P)\right]$$

5. Circular cylinder with hemispherical ends

(a girdle view, b valve view)

Dimensions: A, B, P.

Restrictions: $A > B\ (\geq 2P)$

$$A_c = \pi AB$$

$$V_c = \frac{\pi}{12}B^2(3A - B)$$

$$V_v = \frac{\pi}{12}(B - 2P)^2(3A - B - 4P)$$

6. Elliptical cylinder with conical ends

(a girdle view, b valve view)

Dimensions: A, B, C, D, E, P.

Restrictions: $(\min(B,C) \geq 2P)$

$$A_c = \frac{\pi}{8}(B^2 + C^2)^{\frac{1}{2}}\left[(B^2 + C^2 + 8D^2)^{\frac{1}{2}} + (B^2 + C^2 + 8E^2)^{\frac{1}{2}} + 4\sqrt{2}\,A\right]$$

$$V_c = \frac{\pi}{12}BC(3A + E + D)$$

$$V_v = \frac{\pi}{12}(B - 2P)(C - 2P)\left\{3A + (E + D)\left[(B - 2P)(C - 2P)/(BC)\right]^{\frac{1}{2}}\right\}$$

7. Rectangular box shape

Dimensions: A, B, C, P.

Restriction: $(\min(A,B,C) \geq 2P)$

$$A_c = 2(AB + BC + CA)$$

$$V_c = ABC$$

$$V_v = (A - 2P)(B - 2P)(C - 2P)$$

8. Prism or wedge

Dimensions: A, B, P.

Restriction: $(\min (B, A/\sqrt{3}) \geq 2P)$

$$A_c = \left(\frac{\sqrt{3}}{2} A + 3B \right) A$$

$$V_c = \frac{\sqrt{3}}{4} A^2 B$$

$$V_v = \sqrt{3} \left(\frac{A}{2} - P\sqrt{3} \right)^2 (B - 2P)$$

9. Elliptical cylinder with 4 setae (Similar to Chaetaceros spp.)

(a girdle view, b valve view)

Dimensions: A, B, C, D, E, P.

(D = diameter of setae, E = sum of lengths of all 4 setae)

Restrictions: $(\min (A, B, C) \geq 2P)$

$$A_c = \pi \left[C \left(\frac{A^2 + B^2}{2} \right)^{\frac{1}{2}} + DE + \frac{AB}{2} \right]$$

$$V_c = \frac{\pi}{4} (ABC + D^2 E)$$

$$V_v = \frac{\pi}{4} (A - 2P)(B - 2P)(C - 2P)$$

10. Shape similar to Biddulphia longicruris. Elliptical cylinder with conical ends (valves); the setae are circular in cross section.

(a broad girdle view, b narrow girdle view, c valve view)

Dimensions: A, B, C, D, E, F, P.

(E = average diameter of setae, F = total length of all setae, E and F are not given in Fig. 1, shape No. 10)

Restrictions: $(\min (A,B) \geq 2P)$

$$A_c = \pi \left\{ \left(\frac{A^2 + B^2}{2} \right)^{\frac{1}{2}} \left[\left(\frac{A^2 + B^2}{8} + D^2 \right)^{\frac{1}{2}} + C \right] + EF \right\}$$

$$V_c = \frac{\pi}{12} \left[AB(3C + 2D) + 3E^2 F \right]$$

$$V_v = \frac{\pi}{12}(A - 2P)(B - 2P)\left\{3C + 2D\left[\frac{(A - 2P)(B - 2P)}{AB}\right]^{\frac{1}{2}}\right\}$$

11. Shape similar to Biddulphia aurita. Similar to shape 10 except the valves are paraboloids instead of cones and the setae are cones instead of cylinders.

Dimensions: A, B, C, D, E, F, P.

(E = diameter of base of setae, F = length of one seta; E and F are not given in Fig. 1, shape No. 11)

Restrictions: $(\min(A,B) \geq 2P)$

$$A_c = \pi\left\{2EF + C\left(\frac{A^2 + B^2}{2}\right)^{\frac{1}{2}} + \frac{(A^2 + B^2)}{192\,D^2}\left[\left(1 + \frac{32\,D^2}{A^2 + B^2}\right)^{3/2} - 1\right]\right\}$$

$$V_c = \pi\left[\frac{AB}{4}(C + D) + \frac{E^2F}{3}\right]$$

$$V_v = \pi\left[\frac{1}{4}(A - 2P)(B - 2P)(C + D - P) + \frac{1}{3}(E - 2P)^3\,F/E\right]$$

12. Truncate shape, similar to Licmophora spp.

(a narrow girdle view, b broad girdle view, c valve view)

Dimensions: A, B, C, D, E, P.

Restrictions: $B > C$, $D > E$, $(\min(A, B, D) \geq 2P)$

$$A_c = (D + E)\left[A^2 + \left(\frac{B - C}{2}\right)^2\right]^{\frac{1}{2}} + B(A + D) + C(A + E)$$

$$V_c = \frac{A}{6}\left[B(B + 2D) + C(D + 2E)\right]$$

$$V_v = \frac{C}{2}Q + \frac{A}{2}\frac{(B - C + 2P)^2}{B - C}\left(E + \frac{D - E}{3}\cdot\frac{B - C + 2P}{B - C}\right)$$

where, if $(A - 2P)(D - E) \leq A(D - 2P)$,

$Q = (D + E - 4P)(A - 2P)$,

and otherwise

$$Q = \frac{A(D - 2P)^2}{D - E}$$

13. Shape similar to Asterionella spp.

(a girdle view b valve view)

Dimensions: A, B, C, D, E, F, P.

Restrictions: $A > C$, $(\min (C,E) \geq 2P)$

$$A_c = \frac{\pi}{4}\left\{E\left[4C^2 + (B - D)^2\right]^{\frac{1}{2}} + (B + D)\left[2(C^2 + E^2)\right]^{\frac{1}{2}}\right\} + 2(D + F)(A - C)$$

$$V_c = \frac{\pi}{8} CE\,(B + D) + DF\,(A - C)$$

$$V_v = \frac{\pi}{8}(B + D - 2P)(C - 2P)(E - 2P) + (A - C - P)(D - 2P)(F - 2P)$$

14. Shape similar to Eucampia spp.

(a board girdle view of one complete cell and parts of two adjacent cells in the chain, b narrow girdle view, c valve view)

Dimensions: A, B, C, D, P.

Restrictions: $C > D$, $(B \geq 2P)$

$$A_c = \frac{\pi}{2}\left[(2C - E)\left(\frac{A^2 + B^2}{2}\right)^{\frac{1}{2}} + AB\right]$$

$$V_c = \frac{\pi}{8} AB\,(2C - E)$$

$$V_v = \frac{\pi}{8}(A - 2P)(B - 2P)(2C - E - 4P)$$

15. Rhomboform solid

Dimensions: A, B, C, D, P.

Restrictions: $(\min (A,B,C) \geq 2P)$

$$A_c = B\left[A^2 + (C - D)^2\right]^{\frac{1}{2}} + (C + D)\left[A^2 + B^2\right]^{\frac{1}{2}}$$

$$V_c = \frac{1}{6} AB(2C + D)$$

$$V_v = \frac{B(C - D)}{6A^2} h_{min}^2\,(3\,h_{max} - h_{min})$$

where $h_{min} = \min (h_1, h_2)$, $h_{max} = \max (h_1, h_2)$, and

$$h_1 = A - 2P\left[\left(\frac{A}{B}\right)^2 - 1\right]^{\frac{1}{2}}$$

$$h_2 = \frac{A}{C - D}\left\{C - 2P\left[1 + \left(\frac{C - D}{A}\right)^2\right]^{\frac{1}{2}}\right\}.$$

16. Dinoflagellate shape consisting of an elliptical cone resting on a half-spheriod with three conical processes.

(a broad girdle view, b narrow girdle view, c apical view)

Dimensions: A, B, C, D, E, F, G, H, J, K.

Restrictions: None

$$A_c = \frac{1}{2}E_a(A,F,2B) + \frac{\pi}{4}\left\{\frac{1}{2}\left[(A + F)(A + F + 8C)\right]^{\frac{1}{2}} + D(D^2 + 4E^2)^{\frac{1}{2}} + G(G^2 + 4H^2)^{\frac{1}{2}} + J(J^2 + 4K^2)^{\frac{1}{2}} - D^2 - G^2 - J^2\right\}$$

$$V_c = \frac{\pi}{12}\left[AF(2B + C) + D^2E + G^2H + J^2K\right]$$

$$V_v = 0$$

17. Dinoflagellate shape consisting of four conical processes on an ellipsoid.

(a broad girdle view, b narrow girdle view, c apical view)

Dimensions: A, B, C, D, E, F, G, H, J, K, L.

Restrictions: None

$$A_c = E_a(A,B,E) + \frac{\pi}{4}\left[D(D^2 + 4C^2)^{\frac{1}{2}} + G(G^2 + 4F^2)^{\frac{1}{2}} + J(J^2 + 4H^2)^{\frac{1}{2}} + L(L^2 + 4D^2)^{\frac{1}{2}} - D^2 - G^2 - J^2 - L^2\right]$$

$$V_c = \frac{\pi}{12}(2ABE + D^2C + G^2F + J^2H + L^2K)$$

$$V_v = 0$$

18. Dinoflagellate shape similar to Peridinium pentagonum.

(a broad girdle view, b narrow girdle view, c apical view)

Dimensions: A, B, C, D, E.

Restrictions: $A \geq D$.

$$A_c = \frac{\pi}{8}\left\{\left[(A^2 + E^2)(A^2 + E^2 + 8C^2)\right]^{\frac{1}{2}} + \left[(E^2 + (A - D)^2)\cdot(E^2 + (A^2 - D) + 8B^2)\right]^{\frac{1}{2}}\right\} + D(E^2 + 4B^2)$$

$$V_c = \frac{E}{12}\left\{\pi\left[AC + B(A-D)\right] + BD\right\}$$

$$V_v = 0.$$

a9

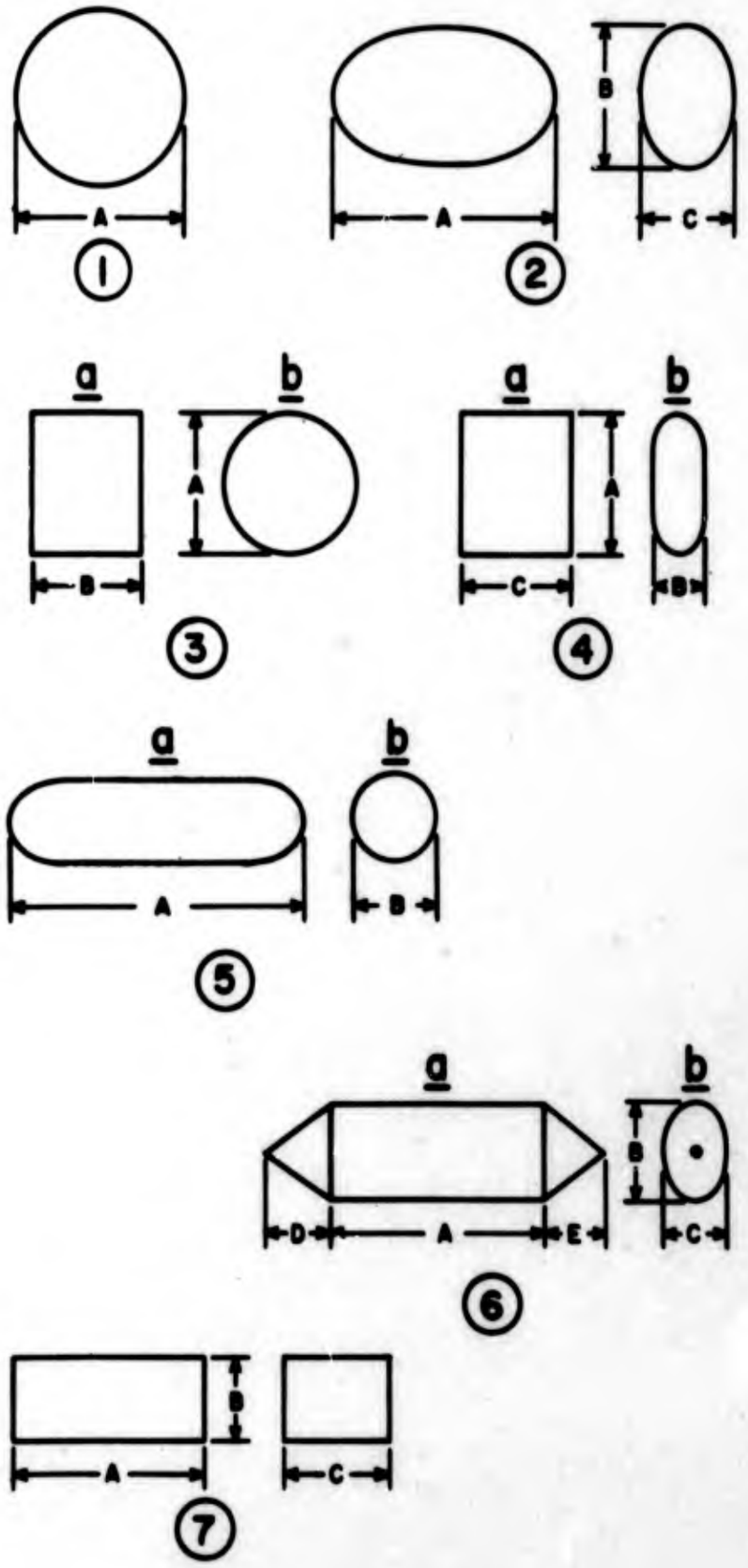
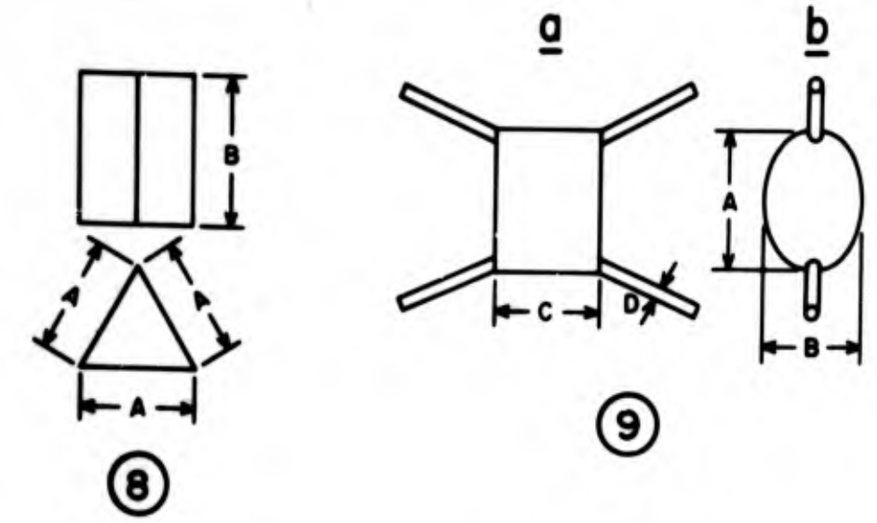
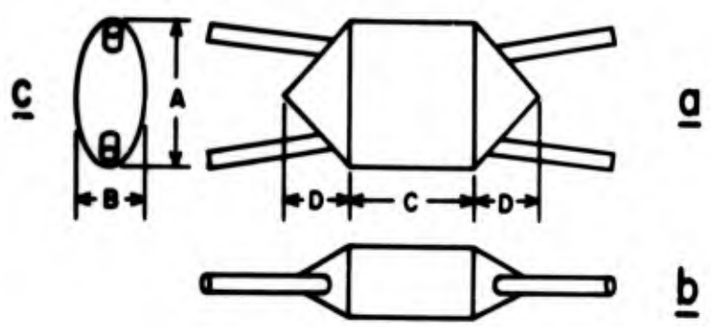


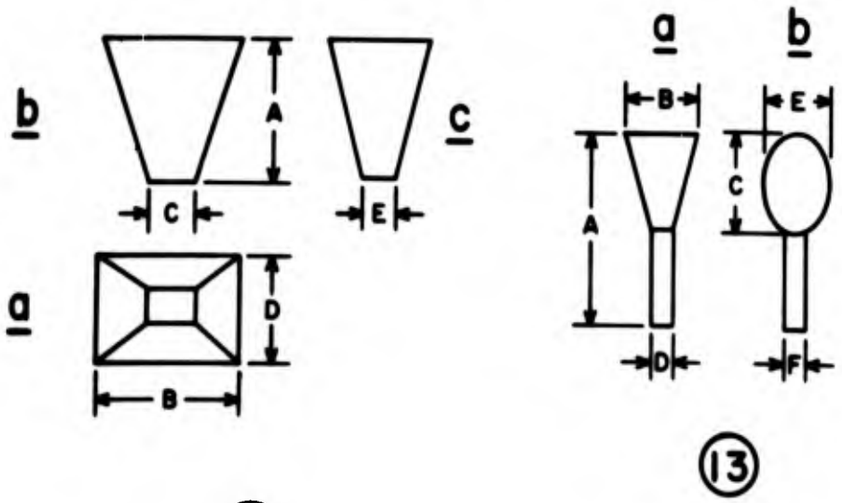
FIGURE 1



⑧ ⑨



⑩ ⑪



⑫ ⑬

FIGURE 1 (continued)

a 11

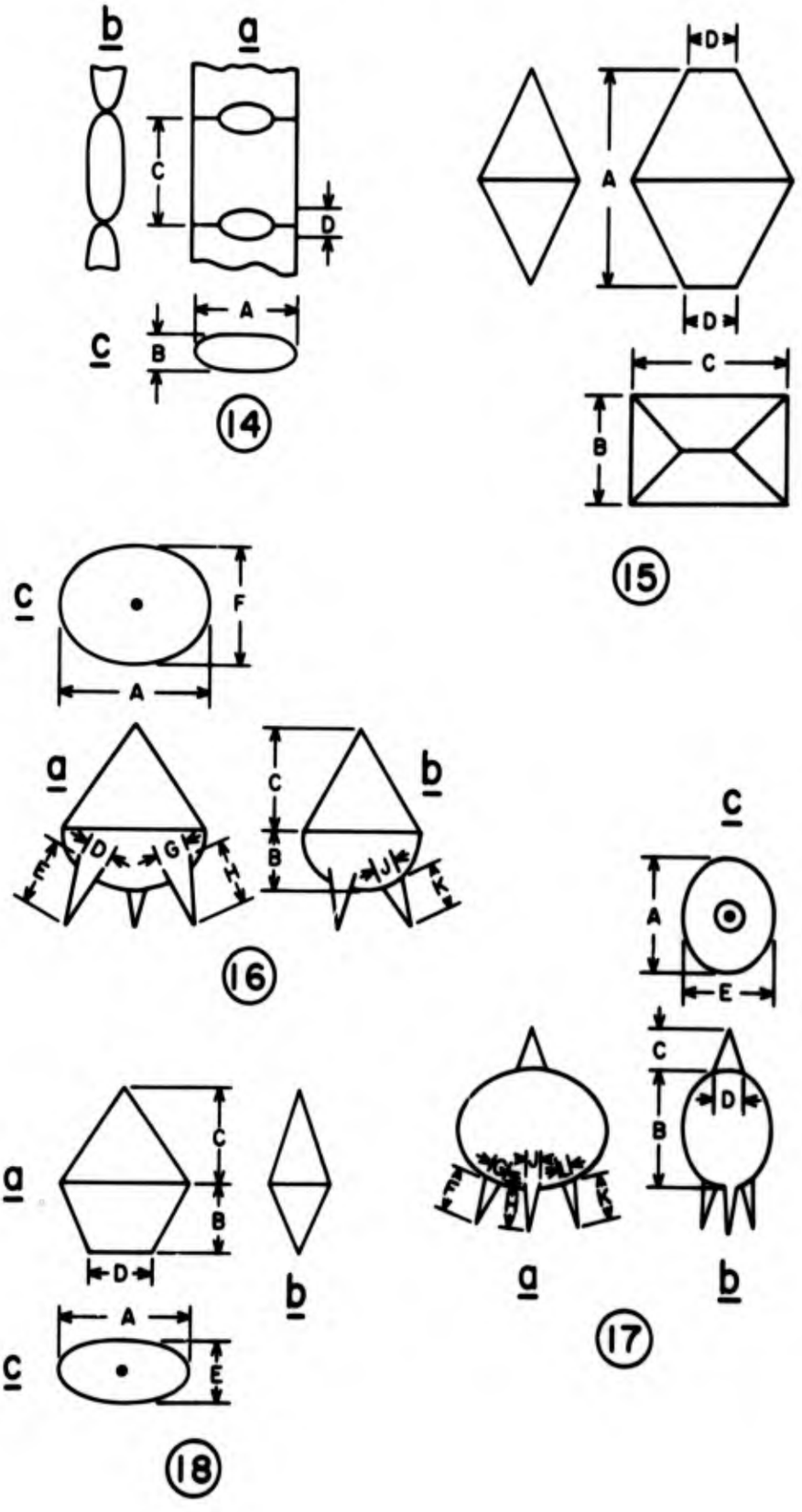
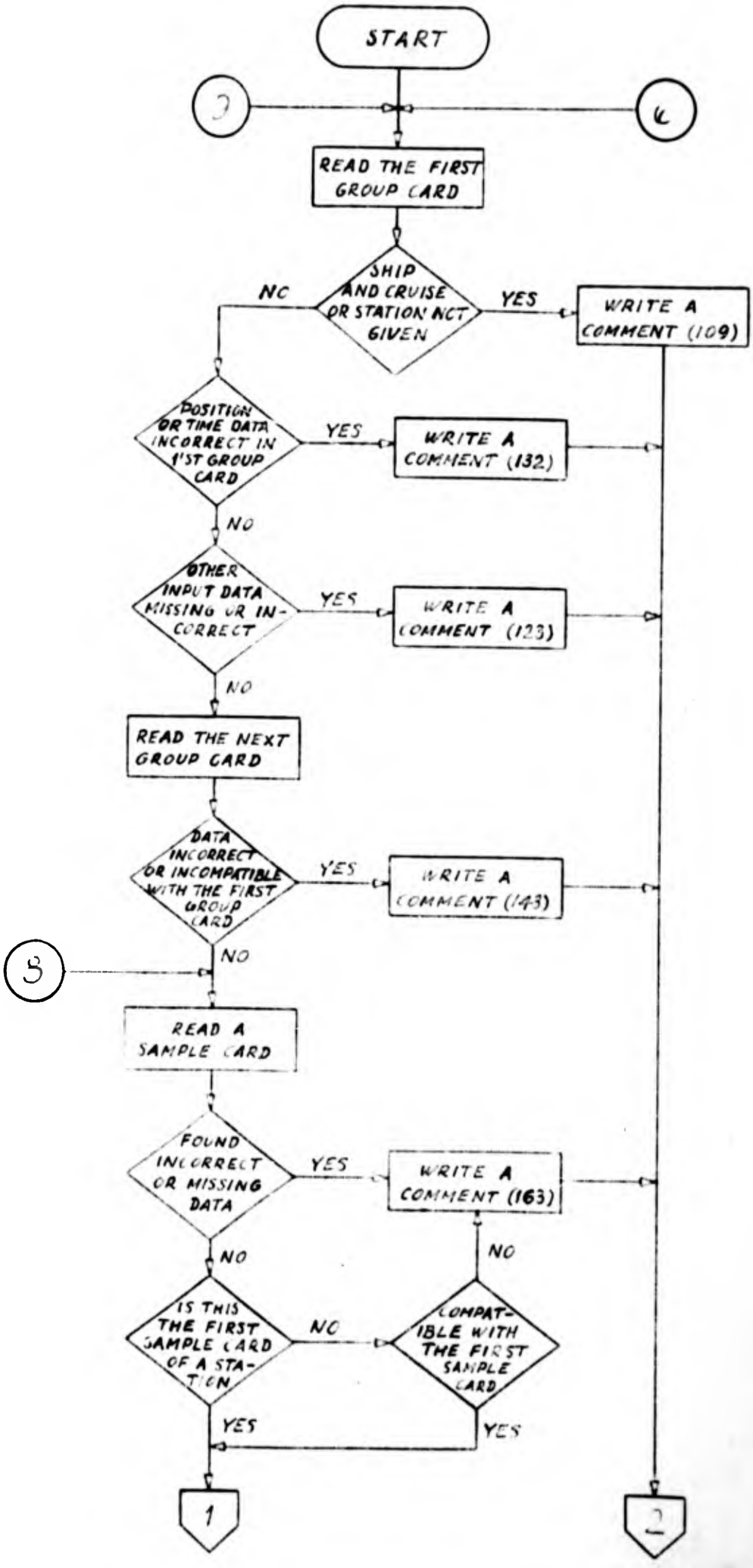
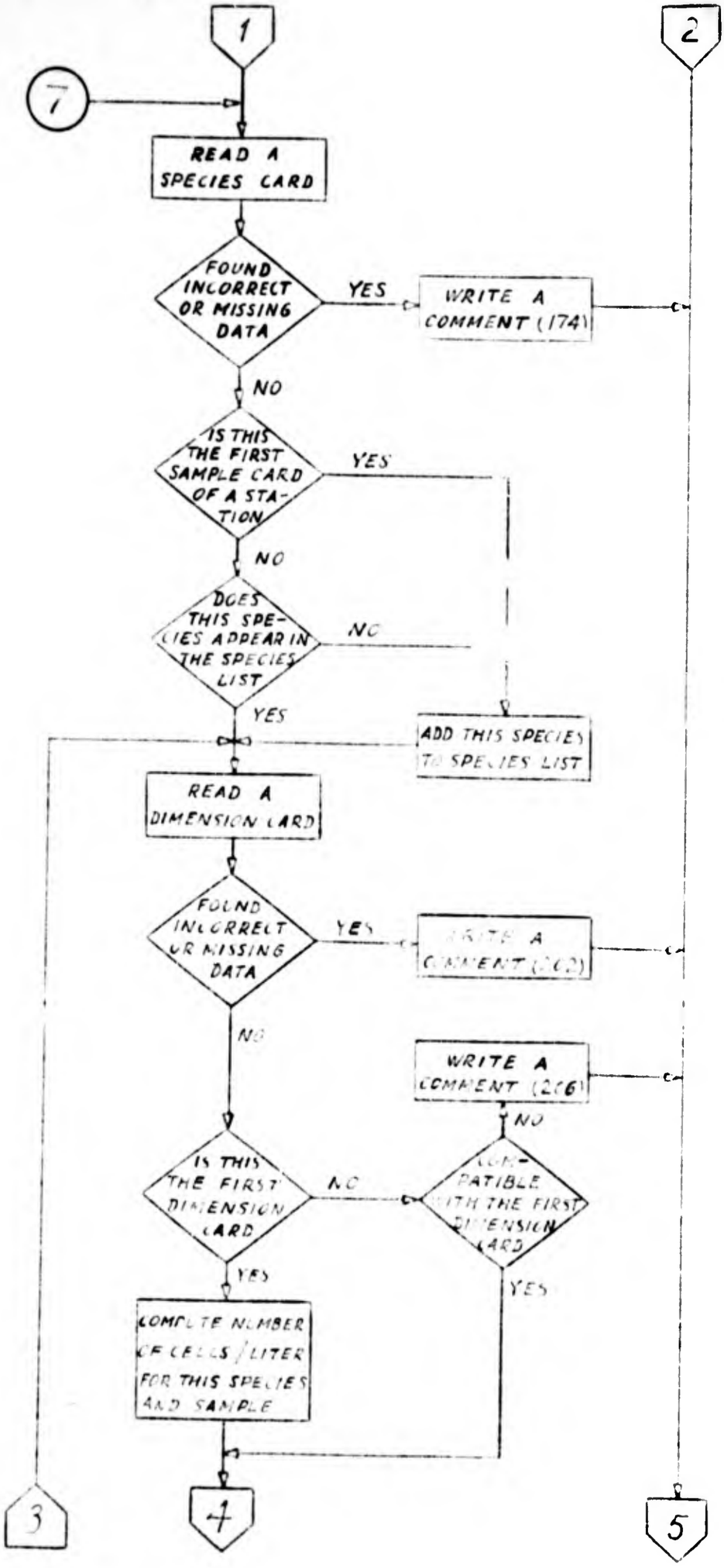


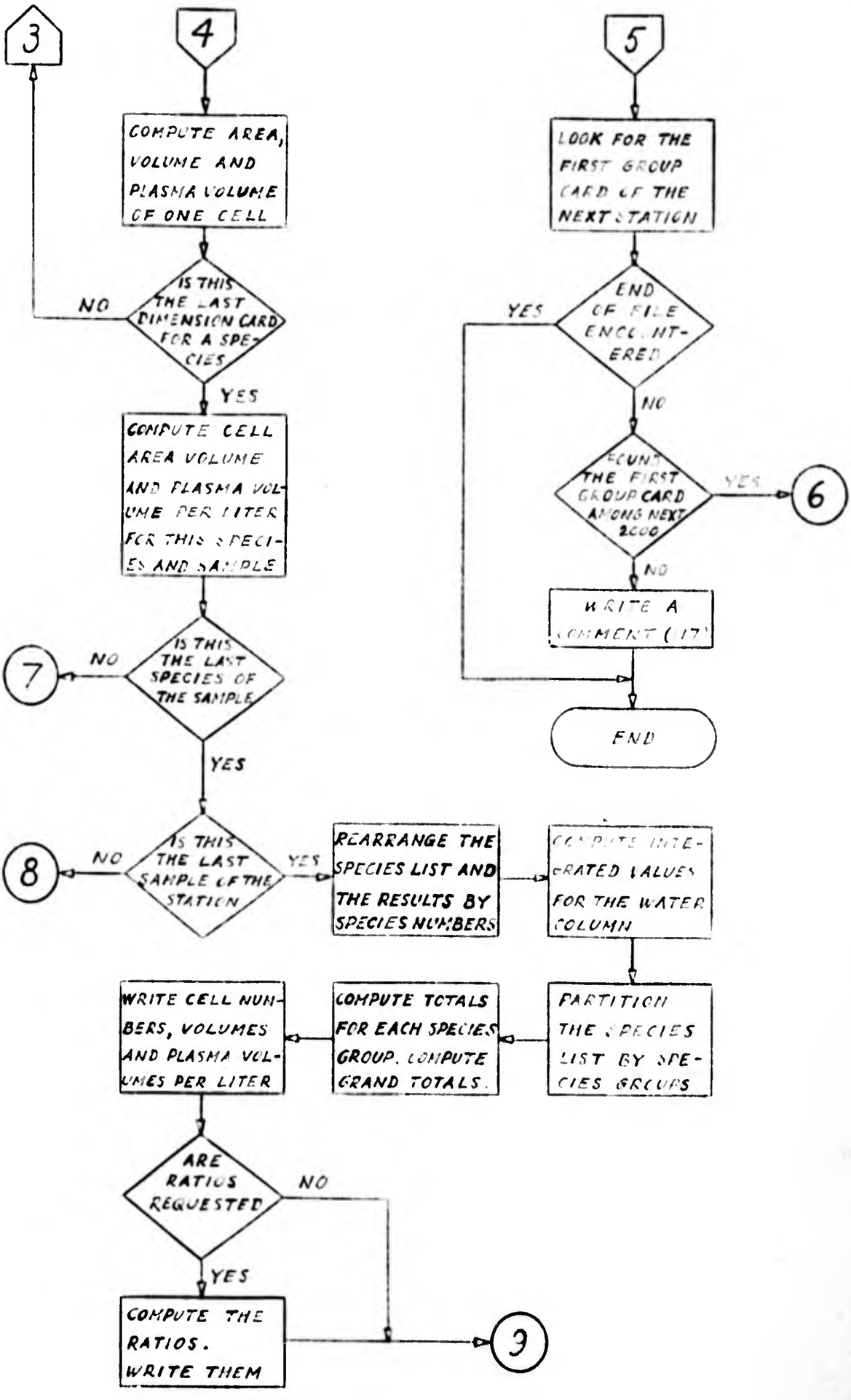
FIGURE 1 (continued)

Appendix b

Flow Chart


START
3
4
READ THE FIRST GROUP CARD
SHIP AND CRUISE OR STATION NCT GIVEN
NC
YES
WRITE A COMMENT (109)
POSITION OR TIME DATA INCORRECT IN 1'ST GROUP CARD
YES
WRITE A COMMENT (132)
NO
OTHER INPUT DATA MISSING OR IN-CORRECT
YES
WRITE A COMMENT (123)
NO
READ THE NEXT GROUP CARD
DATA INCORRECT OR INCOMPATIBLE WITH THE FIRST GROUP CARD
YES
WRITE A COMMENT (143)
3
NO
READ A SAMPLE CARD
FOUND INCORRECT OR MISSING DATA
YES
WRITE A COMMENT (163)
NO
NO
IS THIS THE FIRST SAMPLE CARD OF A STA-TION
NO
COMPAT-IBLE WITH THE FIRST SAMPLE CARD
YES
YES
1
2


1
2
7
READ A SPECIES CARD
FOUND INCORRECT OR MISSING DATA
YES
WRITE A COMMENT (174)
NO
IS THIS THE FIRST SAMPLE CARD OF A STATION
YES
NO
DOES THIS SPECIES APPEAR IN THE SPECIES LIST
NO
YES
ADD THIS SPECIES TO SPECIES LIST
READ A DIMENSION CARD
FOUND INCORRECT OR MISSING DATA
YES
WRITE A COMMENT (202)
NO
WRITE A COMMENT (206)
NO
IS THIS THE FIRST DIMENSION CARD
NO
COMPATIBLE WITH THE FIRST DIMENSION CARD
YES
YES
COMPUTE NUMBER OF CELLS/LITER FOR THIS SPECIES AND SAMPLE
3
4
5


3
4
5
COMPUTE AREA, VOLUME AND PLASMA VOLUME OF ONE CELL
IS THIS THE LAST DIMENSION CARD FOR A SPECIES
NO
YES
COMPUTE CELL AREA VOLUME AND PLASMA VOLUME PER LITER FOR THIS SPECIES AND SAMPLE
IS THIS THE LAST SPECIES OF THE SAMPLE
NO
7
YES
IS THIS THE LAST SAMPLE OF THE STATION
NO
8
YES
REARRANGE THE SPECIES LIST AND THE RESULTS BY SPECIES NUMBERS
COMPUTE INTEGRATED VALUES FOR THE WATER COLUMN
PARTITION THE SPECIES LIST BY SPECIES GROUPS
COMPUTE TOTALS FOR EACH SPECIES GROUP. COMPUTE GRAND TOTALS.
WRITE CELL NUMBERS, VOLUMES AND PLASMA VOLUMES PER LITER
ARE RATIOS REQUESTED
NO
YES
COMPUTE THE RATIOS. WRITE THEM
3
LOOK FOR THE FIRST GROUP CARD OF THE NEXT STATION
END OF FILE ENCOUNTERED
YES
NO
SCAN THE FIRST GROUP CARD AMONG NEXT 2000
YES
6
NO
WRITE A COMMENT (17)
END

Appendix c

Program Listing

```
C     PHPL - PHYTOPLANKTON NUMBERS, VOLUMES AND SURFACE AREAS BY SPE
C
C     UWMS-1008
C
C     UNIVERSITY OF WASHINGTON
C     DEPARTMENT OF OCEANOGRAPHY
C     SEATTLE, WASHINGTON  98105
C
C     ORIGINATED BY..   JERRY LARRANCE          JUNE 1965
C     PROGRAMMED BY..   PAAVO KOVALA            MARCH 1966
C
C     THIS PROGRAM IS BASED ON A PREVIOUS PROGRAM NO.  UWMS-0960.
C
C     PROGRAMMING LANGUAGE - FORTRAN IV, IBM VERSION 13
C     SUBROUTINES NEEDED - ARVOL,BIDE,BLOP,DEBI,ELLAR
C
      LOGICAL CHF,SWE,SWI,SWK,SWS
      INTEGER SPN(250),KCA(3),MCN(99),LNC(99)
      REAL TITL(16,9),FMT(12),FMC(9),FMA(12),FMR(10),CNAM(6,99),PT(9),
     1QE(14),RES(250,9,5),HR(8),CHA(9,3),DPT(8),SMP(8),SNAM(7,250),
     2DD(8),GTOT(9,5),TOT(99,9,5),FMV(12),FMU(15),FMV(14)
C
      COMMON /DIMS/ISH,A,B,C,D,E,F,G,H,FJ,FK,FL,P,AREA,VOL,PLVOL
C
      DATA TITL/864H                    N U M B E R   O F   C E L L S
     1  ( NUMBER / LITER )
     2   C E L L   A R E A S   ( SQ.MICRONS / LITER )
     3                        C E L L   V O L U M E S   ( CU.MICR
     4ONS / LITER )                                    P L A S
     5 M A   V O L U M E S   ( CU.MICRONS / LITER )
     6                R A T I O   -   A R E A   /   C E L L   V O L U M E
     7   ( 1 / MICRON )                        R A T I O   -   A R E A
     8   /   P L A S M A   V O L U M E   ( 1 / MICRON )
     9     R A T I O   -   A R E A   /   N U M B E R   O F   C E L L S
     X ( SQ.MICRONS )              R A T I O   -   C E L L   V O L U M E
     1   /   N U M B E R   O F   C E L L S   ( CU.MICRONS )     R A T I O
     2   -   P L A S M A   V O L U M E   /   N U M B E R   O F   C E L L
     3S   ( CU.MICRONS )   /
      DATA FMT/69H(11HOSAMPLE NO.,31X,(5HA5),10H(INTEGRATED/42X,
     10X,9HVALUES/M2)/,FMC/50H(23HOCHLOROPHYLL A  (MG/M3)17X,(5X,A5
     2),F10.2)/,FMA/60H(21HOASSIMILATION, TECH.  A2,9H(MG C/M3/A2,1H)5X,
     3     (4X,A6),F10.2)/,FMR/59H(/41X,     1X,9HRATIOS OF/1X,6A6,4X
     4    1X,9HINT. VAL.//1/,FMU/6H(1X)P6,6HA6,A6,,9*1H ,3H1X)/,2F,EF/
     56H13.7X,,6HE10.2,/,FMU/6H(16HOR,6HATIO O.6HF TOTA,6HLS 24X,
     66H,1PA1,,9*1H ,3H1X)/,FMV/6H(9HDTO.6HTAL - ,6H5A6,1P,3HA2,,9*1H ,
     73H1X)/,BL,UL/1H ,2H9H/
C
      CHF(K) = KT.EQ.K.AND.D3.EQ.EI.AND.D4.EQ.CR.AND.D5.EQ.ST
C
    1 FORMAT(1H1)
  100 SWE = .FALSE.
      DO 101  I=1,6
      DO 101  J=1,99
  101 CNAM(I,J) = BL
C
```



```
C     READING THE FIRST GROUP CARD
      READ (5,105)(PT(I),I=1,9),N,(CNAM(I,N),I=1,6),KDR,KMC,NSD,EI,CR,
     1ST,KT
  105 FORMAT(2X,3A2,A3,5A2,6X,I2,5A6,A2,I1,4X,I2,I1,A2,A9,A3,I1)
      IF(CR.NE.BL.AND.ST.NE.BL) GOTO 120
      IF(SWE) GOTO 107
      WRITE (6,1)
      SWE = .TRUE.
  107 BACKSPACE 5
      READ (5,108) QE
  108 FORMAT(13A6,A2)
      WRITE (6,109) QE
  109 FORMAT(59HOIDENTIFICATION IS INCOMPLETE IN FOLLOWING FIRST GROUP C
     1ARD/1HO,13A6,A2/25HOSKIPPED TO NEXT STATION.)
C
  112 L = 4
  113 DO 115  I=1,2000
      READ (5,114) N
  114 FORMAT(79X,I1)
  115 IF(N.EQ.L) GOTO 116
      IF(SWE) GOTO 116
      WRITE (6,1)
      SWE = .TRUE.
  116 WRITE (6,117)
  117 FORMAT(62HOCARD TYPE NUMBERS ARE INCORRECT OR CARDS ARE OUT OF SEQ
     1UENCE./19H JOB IS TERMINATED.)
      RETURN
C
  118 L = 1
      IF(N.NE.1) GOTO 113
      BACKSPACE 5
      GOTO 100
  120 DO 121  I=1,9
  121 IF(PT(I).LT.0.0.OR.PT(I).GT.UL) GOTO 130
      IF(KMC.GT.0.AND.NSD.GT.0.AND.N.GT.0.AND.KT.EQ.1) GOTO 140
      IF (SWE) GOTO 122
      WRITE (6,1)
      SWE = .TRUE.
  122 WRITE (6,123) CR,ST,EI
  123 FORMAT(99HONUMBER OF SPECIES GROUP NAMES, NUMBER OF SAMPLE CARDS,
     1OR SPECIES GROUP NUMBER IS MISSING, OR CARD/52H TYPE NUMBER IS NOT
     2 1 IN FIRST GROUP CARD OF CRUISE A5,9H STATION A3,A2,2H. SKIPPED
     1TO NEXT STATION.)
      GOTO 112
  130 IF(SWE) GOTO 131
      WRITE (6,1)
      SWE = .TRUE.
  131 WRITE(6,132) CR,ST,EI
  132 FORMAT(67HOPOSITION OR TIME DATA ARE INCOMPLETE IN FIRST GROUP CAR
     1D OF CRUISE A5,9H STATION A3,A2,1H./25H SKIPPED TO NEXT STATION.)
      GOTO 112
C
C     READING THE OTHER GROUP CARDS
  140 IF(KMC.EQ.1) GOTO 150
      DO 148  J=2,KMC
      READ (5,105)(QE(I),I=1,9),N,(CNAM(I,N),I=1,6),N1,N2,N3,D3,D4,D5,KT
```

```
     IF(CHF(1).AND.N.GT.0.AND.N1.EQ.KOR.AND.N2.EQ.KRC.AND.N3.EQ.NSD) GOPHPL116
    1TO 140                                                                PHPL117
 141 IF(SWE) GOTO 142                                                      PHPL118
     WRITE (6,1)                                                           PHPL119   113
     SWE = .TRUE.                                                          PHPL120
 142 WRITE (6,143) J,CR,ST,EI                                              PHPL121   114
 143 FORMAT(16H0GROUP CARD NO. I2,11H OF CRUISE A5,9H STATION A3,A2,42HPHPL122
    1 DOES NOT MATCH WITH THE FIRST GROUP CARD,/95H OR CARD TYPE NUMBERPHPL123
    2 IS INCORRECT, OR SPECIES GROUP NUMBER IS MISSING. SKIPPED TO NEXTPHPL124
    3 STATION.)                                                            PHPL125
     GOTO 112                                                              PHPL126
 145 DO 146  K=1,9                                                         PHPL127
 146 IF(QE(K).NE.PTEK(K)) GOTO 141                                         PHPL128
 148 CONTINUE                                                              PHPL129
 150 SWI = NSO.EQ.1                                                        PHPL130
     DO 230  I=1,NSD                                                       PHPL131
C                                                                          PHPL132
C    READING A SAMPLE CARD                                                 PHPL133
     READ (5,160) MRE(I),CHA(I,1),CHA(I,2),A,B,CHA(I,3),C,D,NS,DP,SPL,    PHPL134
    1D3,D4,D5,KT                                                           PHPL135   133
 160 FORMAT(2A4,2(A5,A2,A1),35X,I3,A4,A3,A2,A5,A3,I1)                      PHPL136
     IF(CHF(2).AND.DP.NE.BL.AND.NS.NE.0.AND.(A.NE.BL.OR.B.EQ.BL).AND.      PHPL137
    1(A.EQ.BL.OR.B.NE.BL).AND.(C.NE.BL.OR.D.EQ.BL).AND.(C.EQ.BL.OR.D       PHPL138
    2.NE.BL)) GOTO 164                                                     PHPL139
 161 IF(SWE) GOTO 162                                                      PHPL140
     WRITE (6,1)                                                           PHPL141   148
     SWE = .TRUE.                                                          PHPL142
 162 WRITE(6,163) I,CR,ST,EI                                               PHPL143   149
 163 FORMAT(103H0IDENTIFICATION, CARD TYPE NUMBER, ASSIMILATION TECHNIQPHPL144
    1UE OR TIME UNIT IS INCORRECT, OR DEPTH OR NUMBER/47H OF SPECIES CAPHPL145
    2RDS IS MISSING IN SAMPLE CARD NO.I2,11H OF CRUISE A5,9H STATION   PHPL146
    3A3,A2,26H. SKIPPED TO NEXT STATION.)                                  PHPL147
     GOTO 112                                                              PHPL148
 164 SWS = I.EQ.1                                                          PHPL149
     IF(SWS) GOTO 165                                                      PHPL150
     IF(A.EQ.BL.OR.A.EQ.U1.AND.B.EQ.T1) GOTO 166                           PHPL151
     IF(U1.NE.BL) GOTO 161                                                 PHPL152
 165 U1 = A                                                                PHPL153
     T1 = B                                                                PHPL154
     IF(SWS) GOTO 167                                                      PHPL155
 166 IF(C.EQ.BL.OR.C.EQ.U2.AND.D.EQ.T2) GOTO 170                           PHPL156
     IF(U2.NE.BL) GOTO 161                                                 PHPL157
 167 U2 = C                                                                PHPL158
     T2 = D                                                                PHPL159
C                                                                          PHPL160
 170 DO 171  K=1,4                                                         PHPL161
     DO 171  J=1,250                                                       PHPL162
 171 RES(J,I,K) = 0.0                                                      PHPL163
     DPT(I) = 0.1*DEBI(DP)                                                 PHPL164   183
     SMPL(I) = SPL                                                         PHPL165
     IF(SWS) NSP=NS                                                        PHPL166
     DO 220  J=1,NS                                                        PHPL167
C                                                                          PHPL168
C    READING A SPECIES CARD                                                PHPL169
     READ (5,172) ISP,(QE(L),L=1,7),ARTOT,ARINS,COUNT,KDC,D1,D2,D3,D4,     PHPL170
    1D5,KT                                                                 PHPL171   189
```



```
 172 FORMAT(I5,6A6,A4,3F4.0,2X,I3,A4,A3,A2,A5,A3,I1)                       PHPL172
     IF(CHF(3).AND.D1.EQ.DP.AND.D2.EQ.SPL.AND.ISP.GT.1000.AND.ARTOT.GT.    PHPL173
    10.0.AND.ARINS.GT.0.0.AND.COUNT.GT.0.0.AND.KDC.GT.0) GOTO 180          PHPL174
     IF(SWE) GOTO 173                                                      PHPL175
     WRITE (6,1)                                                           PHPL176   202
     SWE = .TRUE.                                                          PHPL177
 173 WRITE (6,174) J,DPT(I),CR,ST,EI                                       PHPL178   203
 174 FORMAT(17H0SPECIES CARD NO. I3,8H, DEPTH F5.1,11H OF CRUISE A5,9H PHPL179
    1STATION A3,A2,36H HAS INCORRECT IDENTIFICATION, DEPTH/100M OR CARDPHPL180
    2 TYPE, SAMPLE OR SPECIES NUMBER, OR SOME INPUT QUANTITY IS MISSINGPHPL181
    3. SKIPPED TO NEXT STATION.)                                           PHPL182
     GOTO 112                                                              PHPL183
C                                                                          PHPL184
 180 IF(.NOT.SWS) GOTO 181                                                 PHPL185
     LS = J                                                                PHPL186
     GOTO 183                                                              PHPL187
 181 DO 182  LS=1,NSP                                                      PHPL188
 182 IF(ISP.EQ.SPN(LS)) GOTO 186                                           PHPL189
     NSP = NSP + 1                                                         PHPL190
     LS = NSP                                                              PHPL191
 183 SPN(LS) = ISP                                                         PHPL192
     DO 184  K=1,7                                                         PHPL193
 184 SNAM(K,LS) = QE(K)                                                    PHPL194
 186 TMES = 0.0                                                            PHPL195
     Q1 = 0.0                                                              PHPL196
     Q2 = 0.0                                                              PHPL197
     Q3 = 0.0                                                              PHPL198
C                                                                          PHPL199
C    READING DIMENSION CARDS                                               PHPL200
     DO 211  K=1,KDC                                                       PHPL201
     READ (5,206) ISP,CMES,ISH,A,B,C,D,E,F,G,H,FJ,FK,FL,P,Q4,Q5,D1,D2,     PHPL202
    1D3,D4,D5,KT                                                           PHPL203   229
 200 FORMAT(I5,F3.0,I2,11F3.0,F3.1,F4.2,F3.2,9X,A4,A3,A2,A5,A3,I1)         PHPL204
     IF(CHF(4).AND.D1.EQ.DP.AND.D2.EQ.SPL.AND.ISP.EQ.SPN(LS).AND.CMES      PHPL205
    1.GT.0.0.AND.(ISH.GT.0.AND.ISH.LE.18.AND.Q4.GT.0.0.AND.Q5.GT.0.0) GOPHPL206
    2TO 203                                                                PHPL207
     IF(SWE) GOTO 201                                                      PHPL208
     WRITE (6,1)                                                           PHPL209   239
     SWE = .TRUE.                                                          PHPL210
 201 WRITE (6,202) K,SPN(LS),DPT(I),CR,ST,EI                               PHPL211   240
 202 FORMAT(19H0DIMENSION CARD NO. I3,16H OF SPECIES NO. I5,10H AT DEPTPHPL212
    1H F5.1,11H OF CRUISE A5,9H STATION A3,A2,14H HAS INCORRECT/105H IDPHPL213
    2ENTIFICATION, DEPTH, OR CARD TYPE, SAMPLE, SPECIES OR SHAPE NUMBERPHPL214
    3, OR SOME INPUT QUANTITY IS MISSING./25H SKIPPED TO NEXT STATION.)PHPL215
     L = 1                                                                 PHPL216
     GOTO 113                                                              PHPL217
C                                                                          PHPL218
 203 IF(K.GT.1) GOTO 204                                                   PHPL219
     VOLU = Q4                                                             PHPL220
     CONV = Q5                                                             PHPL221
     RES(LS,I,1) = 100C.0 * COUNT / Q4 * ARTOT / ARINS                     PHPL222
     GOTO 210                                                              PHPL223
 204 IF(Q4.EQ.VOLU.AND.Q5.EQ.CONV) GOTO 210                                PHPL224
     IF(SWE) GOTO 205                                                      PHPL225
     WRITE(6,1)                                                            PHPL226   254
     SWE = .TRUE.                                                          PHPL227
```

```
      WRITE (6,206) SPN(LS),DPT(I),CR,ST,EI                                 PHPL228   295
  206 FORMAT(93HMORE THAN ONE VALUE IS GIVEN TO CHAMBER VOLUME OR TO CO      PHPL229
     1NVERSION FACTOR IN DIMENSION CARDS OF/12H SPECIES NO.16,9H AT DEPT     PHPL230
     2H F6.1,9H, CRUISE A5,9H STATION A3,A2,26H. SKIPPED TO NEXT STATION    PHPL231
     3.)                                                                    PHPL232
      L = 1                                                                 PHPL233
      GOTO 113                                                              PHPL234
C                                                                           PHPL235
C     COMPUTING AREA, VOLUME AND PLASMA VOLUME OF MEASURED CELLS            PHPL236
  210 CALL ARVOL                                                            PHPL237
C     COMPUTING AREAS, VOLUMES AND PLASMA VOLUMES PER LITER                 PHPL238   260
      Q1 = Q1 + CNES * AREA                                                 PHPL239
      Q2 = Q2 + CNES * VOL                                                  PHPL240
      Q3 = Q3 + CNES * PLVOL                                                PHPL241
  211 TNES = TNES + CNES                                                    PHPL242
      R = CONV * CONV / TNES * RES(LS,I,1)                                  PHPL243
      RES(LS,I,2) = R * Q1                                                  PHPL244
      RES(LS,I,3) = CONV * R * Q2                                           PHPL245
  220 RES(LS,I,4) = CONV * R * Q3                                           PHPL246
  230 CONTINUE                                                              PHPL247
C                                                                           PHPL248
C     REARRANGING THE SPECIES BY SPECIES NUMBERS                            PHPL249
      IF(NSP.EQ.1) GOTO 4C0                                                 PHPL250
      DO 303  I=2,NSP                                                       PHPL251
      M = I - 1                                                             PHPL252
      DO 300  J=I,NSP                                                       PHPL253
  300 IF(SPN(J).LT.SPN(M)) M=J                                              PHPL254
      IF(M.LT.I) GOTO 303                                                   PHPL255
      L = SPN(M)                                                            PHPL256
      SPN(M) = SPN(I-1)                                                     PHPL257
      SPN(I-1) = L                                                          PHPL258
      DO 301  J=1,7                                                         PHPL259
      T = SNAM(J,M)                                                         PHPL260
      SNAM(J,M) = SNAM(J,I-1)                                               PHPL261
  301 SNAM(J,I-1) = T                                                       PHPL262
      DO 302  K=1,4                                                         PHPL263
      DO 302  J=1,NSD                                                       PHPL264
      T = RES(M,J,K)                                                        PHPL265
      RES(M,J,K) = RES(I-1,J,K)                                             PHPL266
  302 RES(I-1,J,K) = T                                                      PHPL267
  303 CONTINUE                                                              PHPL268
C                                                                           PHPL269
C     COMPUTING INTEGRATED VALUES FOR THE WATER COLUMN                      PHPL270
  400 ND1 = NSD + MIND(1,NSD-1)                                             PHPL271
      IF(SW1) GOTO 410                                                      PHPL272
      DO 401  I=2,NSD                                                       PHPL273
  401 DD(I) = DPT(I) - DPT(I-1)                                             PHPL274
      DO 403  K=1,4                                                         PHPL275
      DO 403  I=1,NSP                                                       PHPL276
      RES(I,ND1,K) = 0.0                                                    PHPL277
      DO 402  J=2,NSD                                                       PHPL278
  402 RES(I,ND1,K) = RES(I,ND1,K) + DD(J) * (RES(I,J-1,K) + RES(I,J,K))     PHPL279
  403 RES(I,ND1,K) = 500.0 * RES(I,ND1,K)                                   PHPL280
  410 DO 420  J=1,3                                                         PHPL281
      DO 411  I=1,NSD                                                       PHPL282
  411 IF(CHA(I,J).NE.BL) GOTO 412                                           PHPL283
```



```
      KCA(J) = -1                                                           PHPL284
      GOTO 420                                                              PHPL285
  412 KCA(J) = 0                                                            PHPL286
      IF(SW1) GOTO 415                                                      PHPL287
      DO 413  I=1,NSD                                                       PHPL288
  413 IF(CHA(I,J).EQ.BL) GOTO 415                                           PHPL289
      KCA(J) = I                                                            PHPL290
      CHA(ND1,J) = 0.0                                                      PHPL291
      Q1 = DEB(CHA(I,J))                                                    PHPL292   301
      DO 414  I=2,NSD                                                       PHPL293
      Q2 = DEB(CHA(I,J))                                                    PHPL294   305
      CHA(ND1,J) = CHA(ND1,J) + DD(I) * (Q1 + Q2)                           PHPL295
  414 Q1 = Q2                                                               PHPL296
      CHA(ND1,J) = 0.005 * CHA(ND1,J)                                       PHPL297
  415 M = MIND(J+1,3)                                                       PHPL298
      DO 416  I=1,NSD                                                       PHPL299
  416 CHA(I,J) = BLOP(CHA(I,J),M)                                           PHPL300   309
  420 CONTINUE                                                              PHPL301
C                                                                           PHPL302
C     PARTITIONING THE SPECIES LIST BY SPECIES GROUPS                       PHPL303
      J = 1                                                                 PHPL304
      DO 501  NAC=1,NSP                                                     PHPL305
      MCN(NAC) = SPN(J) / 1000                                              PHPL306
      IF(J.EQ.NSP) GOTO 502                                                 PHPL307
      J1 = J + 1                                                            PHPL308
      DO 500  J=J1,NSP                                                      PHPL309
  500 IF(SPN(J)/1000.NE.MCN(NAC)) GOTO 501                                  PHPL310
      GOTO 502                                                              PHPL311
  501 LNC(NAC) = J - 1                                                      PHPL312
  502 LNC(NAC) = NSP                                                        PHPL313
C                                                                           PHPL314
C     COMPUTING TOTALS FOR EACH SPECIES GROUP. COMPUTING GRAND TOTALS.      PHPL315
      DO 511  K=1,4                                                         PHPL316
      DO 511  J=1,ND1                                                       PHPL317
      GTOT(J,K) = 0.0                                                       PHPL318
      N = 0                                                                 PHPL319
      DO 511  I=1,NAC                                                       PHPL320
      M = N + 1                                                             PHPL321
      N = LNC(I)                                                            PHPL322
      TOT(I,J,K) = 0.0                                                      PHPL323
      DO 510  L=M,N                                                         PHPL324
  510 TOT(I,J,K) = TOT(I,J,K) + RES(L,J,K)                                  PHPL325
  511 GTOT(J,K) = GTOT(J,K) + TOT(I,J,K)                                    PHPL326
C                                                                           PHPL327
C     WRITING THE RESULTS                                                   PHPL328
      T = BIDE(MAXO(NSD,2),6,-1)                                            PHPL329   450
      PAT(6) = T                                                            PHPL330
      PAT(9) = T                                                            PHPL331
      PAC(6) = T                                                            PHPL332
      PAA(9) = T                                                            PHPL333
      PT(1) = BLOP(PT(1),6)                                                 PHPL334   450
      PT(4) = BLOP(PT(4),6)                                                 PHPL335   460
      SWR = .TRUE.                                                          PHPL336
      LR = 4                                                                PHPL337
      JM = 0                                                                PHPL338
  600 DO 650  K=1,LR                                                        PHPL339
```

```
      JM = JM + 1                                                       PHPL340
      WRITE (6,001) (TITL(I,JM),I=1,16),CR,ST,EI,(PT(I),I=1,6),PT(8),   PHPL341
     1PT(7),PT(9)                                                       PHPL342   446
  001 FORMAT(1H1,16X,16A6//8HBCRUISE A5,8X,8HSTATION A3,A2,8X,9HLATITUDEPHPL343
     1 A2,1H-A2,1H.A2,8X,10HLONGITUDE A3,1H-A2,1H.A2,11X,5HDATE A2,1H/A2PHPL344
     2,1H/A2)                                                           PHPL345
      WRITE (6,FMT) (SNP(I),I=1,NSD)                                    PHPL346   475
      IF(SWI) WRITE (6,002)                                             PHPL347   480
  002 FORMAT(1X)                                                        PHPL348
      WRITE (6,003) (DPT(I),I=1,NSD)                                    PHPL349   481
  P03 FORMAT(15HDEPTH (METERS) 25X,8F10.1)                              PHPL350
      WRITE (6,004) (HA(I),I=1,NSD)                                     PHPL351   486
  004 FORMAT(9HDTIME 35X,8(6X,A4))                                      PHPL352
      IF(RCA(1).LT.0) GOTO 005                                          PHPL353
      N = NSD + RCA(1)                                                  PHPL354
      WRITE (6,FMC) (CHA(I,1),I=1,N)                                    PHPL355   494
  005 IF(RCA(2).LT.0) GOTO 010                                          PHPL356
      N = NSD + RCA(2)                                                  PHPL357
      WRITE (6,FMA) T1,U1,(CHA(I,2),I=1,N)                              PHPL358   502
      IF(RCA(3).LT.0) GOTO 010                                          PHPL359
      N = NSD + RCA(3)                                                  PHPL360
      WRITE (6,FMA) T2,U2,(CHA(I,3),I=1,N)                              PHPL361   510
  010 N = 0                                                             PHPL362
      DO 030  L=1,NNC                                                   PHPL363
      J = NCN(L)                                                        PHPL364
      IF(SWK.OR.SWI.OR.L.NE.1) GOTO 011                                 PHPL365
      WRITE (6,FMA) (CNAM(I,J),I=1,6)                                   PHPL366   523
      GOTO 013                                                          PHPL367
  011 WRITE (6,012) (CNAM(I,J),I=1,6)                                   PHPL368   529
  012 FORMAT(1H0/1X,6A6//)                                              PHPL369
  013 N = N + 1                                                         PHPL370
      N = LNC(L)                                                        PHPL371
      DO 018  I=N,N                                                     PHPL372
      IF(SWI) GOTO 017                                                  PHPL373
      DO 016 ID=1,NSD                                                   PHPL374
      IF(RES(I,ID,K)) 015,014,015                                       PHPL375
  014 FMV(ID+2) = ZF                                                    PHPL376
      GOTO 016                                                          PHPL377
  015 FMV(ID+2) = EF                                                    PHPL378
  016 CONTINUE                                                          PHPL379
  017 FMV(ND1+2) = EF                                                   PHPL380
  018 WRITE (6,FMV) (SNAM(ID,I),ID=1,7),(RES(I,ID,K),ID=1,ND1)          PHPL381   556
      IF(SWK) GOTO 025                                                  PHPL382
      IF(SWI) GOTO 024                                                  PHPL383
      DO 023  I=1,NSD                                                   PHPL384
      IF(TOT(L,I,K)) 022,021,022                                        PHPL385
  021 FMU(I+5) = ZF                                                     PHPL386
      GOTO 023                                                          PHPL387
  022 FMU(I+5) = EF                                                     PHPL388
  023 CONTINUE                                                          PHPL389
  024 FMU(ND1+5) = EF                                                   PHPL390
      WRITE (6,FMU) BL,(TOT(L,I,K),I=1,ND1)                             PHPL391   585
      GOTO 030                                                          PHPL392
  025 IF(SWI) GOTO 029                                                  PHPL393
      DO 028  I=1,NSD                                                   PHPL394
      IF(TOT(L,I,K)) 027,026,027                                        PHPL395
```



```
  026 FMV(I+4) = ZF                                                     PHPL396
      GOTO 028                                                          PHPL397
  027 FMV(I+4) = EF                                                     PHPL398
  028 CONTINUE                                                          PHPL399
  029 FMV(ND1+4) = EF                                                   PHPL400
      WRITE (6,FMV) (CNAM(I,J),I=1,6),(TOT(L,I,K),I=1,ND1)              PHPL401   607
  030 CONTINUE                                                          PHPL402
      IF(SWK) GOTO 032                                                  PHPL403
      WRITE (6,031) (GTOT(I,K),I=1,ND1)                                 PHPL404   620
  031 FORMAT(1H0/22H RATIO OF GRAND TOTALS 19X,1P9E10.2)                PHPL405
      GOTO 050                                                          PHPL406
  032 WRITE (6,033) (GTOT(I,K),I=1,ND1)                                 PHPL407   626
  033 FORMAT(1H0/12H GRAND TOTAL 29X,1P9E10.2)                          PHPL408
  050 CONTINUE                                                          PHPL409
      IF(K.EQ.0.OR.LK.EQ.5) GOTO 100                                    PHPL410
      FMR(2) = T                                                        PHPL411
      FMR(7) = T                                                        PHPL412
      LK = 5                                                            PHPL413
      SWK = .FALSE.                                                     PHPL414
C                                                                       PHPL415
C     COMPUTING THE RATIOS IF REQUESTED                                 PHPL416
      DO 910  J=1,ND1                                                   PHPL417
      DO 902  I=1,NSP                                                   PHPL418
      Q1 = RES(I,J,1)                                                   PHPL419
      IF(Q1) 900,900,901                                                PHPL420
  900 RES(I,J,5) = 0.0                                                  PHPL421
      GOTO 902                                                          PHPL422
  901 Q2 = RES(I,J,2)                                                   PHPL423
      RES(I,J,1) = Q2 / RES(I,J,3)                                      PHPL424
      RES(I,J,2) = Q2 / RES(I,J,4)                                      PHPL425
      RES(I,J,5) = RES(I,J,4) / Q1                                      PHPL426
      RES(I,J,4) = RES(I,J,3) / Q1                                      PHPL427
      RES(I,J,3) = Q2 / Q1                                              PHPL428
  902 CONTINUE                                                          PHPL429
      DO 909  I=1,NNC                                                   PHPL430
      Q1 = TOT(I,J,1)                                                   PHPL431
      IF(Q1) 903,903,904                                                PHPL432
  903 TOT(I,J,5) = 0.0                                                  PHPL433
      GOTO 909                                                          PHPL434
  904 Q2 = TOT(I,J,2)                                                   PHPL435
      TOT(I,J,1) = Q2 / TOT(I,J,3)                                      PHPL436
      TOT(I,J,2) = Q2 / TOT(I,J,4)                                      PHPL437
      TOT(I,J,5) = TOT(I,J,4) / Q1                                      PHPL438
      TOT(I,J,4) = TOT(I,J,3) / Q1                                      PHPL439
      TOT(I,J,3) = Q2 / Q1                                              PHPL440
  909 CONTINUE                                                          PHPL441
      Q1 = GTOT(J,1)                                                    PHPL442
      IF(Q1) 906,906,907                                                PHPL443
  906 GTOT(J,5) = 0.0                                                   PHPL444
      GOTO 910                                                          PHPL445
  907 Q2 = GTOT(J,2)                                                    PHPL446
      GTOT(J,1) = Q2 / GTOT(J,3)                                        PHPL447
      GTOT(J,2) = Q2 / GTOT(J,4)                                        PHPL448
      GTOT(J,5) = GTOT(J,4) / Q1                                        PHPL449
      GTOT(J,4) = GTOT(J,3) / Q1                                        PHPL450
      GTOT(J,3) = Q2 / Q1                                               PHPL451
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910  CONTINUE                                          PHPL492
     GOTO 800                                          PHPL493
     END                                               PHPL494
```



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$IBFTC ARVD   DECK                                     ARVD000
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```
C     ARVOL - SUBPROGRAM FOR COMPUTING AREAS, VOLUMES AND PLASMA VOLUMES OF PHYTOPLANKTON CELLS
C
C     ORIGINATED BY..   JERRY LARRANCE          JANUARY 1963
C     PROGRAMMED BY..   PAAVO KOVALA            MARCH 1966
C
C
C     PROGRAMMING LANGUAGE - FORTRAN IV, IBM VERSION 13
C     SUBROUTINES NEEDED - ELLAR
C
C     AREA = AREA OF ONE CELL
C     VOL = VOLUME OF ONE CELL
C     PLVOL = PLASMA VOLUME OF ONE CELL
C             (10 PERCENT OF COMPUTED VACUOLE VOLUME ADDED)
      SUBROUTINE AARVOL
      COMMON /DIMS/ISH,A,B,C,D,E,F,G,H,FJ,FK,FL,P,AREA,VOL,PLVOL
      DATA PI,PI4,PI6,PI8,PI12/3.1415927,0.78539816,0.52359878,
     10.39269908,0.261799939/
      P = 2. * P
      GO TO (10,20,30,40,50,60,70,80,90,100,110,120,130,140,150,160,170,
     1 180), ISH
C     SHAPE 1
   10 AREA = PI * A * A
      VOL = AREA * 4 / 6.
      IF (P) 195, 185, 11
   11 IF (P .GE. A) GOTO 185
      PLVOL = VOL - 0.9 * PI6 * (A - P) ** 3
      RETURN
C     SHAPE 2
   20 AREA = ELLAR(A,B,C)
      VOL = PI6 * A * B * C
      IF (P) 195, 185, 21
   21 IF (A .LE. P .OR. B .LE. P .OR. C .LE. P) GOTO 185
      PLVOL = VOL - 0.9 * PI6 * (A - P) * (B - P) * (C - P)
      RETURN
C     SHAPE 3
   30 AREA = PI * A * (0.5 * A + B)
      VOL = PI4 * A * A * B
      IF (P) 195, 185, 31
   31 IF(A .LE. P .OR. B .LE. P) GOTO 185
      PLVOL = VOL - 0.9 * PI4 * (B - P) * (A - P) ** 2
      RETURN
C     SHAPE 4
   40 IF (A .LE. B) GOTO 190
      Q = A - B + PI4 * B
      AREA = 2. * (A - B) * (B + C) + PI * B * (0.5 * B + C)
      VOL = B * C + Q
      IF (P) 195, 185, 41
   41 IF (B .LE. P .OR. C .LE. P) GOTO 185
      PLVOL = VOL - 0.9 * (B - P) * (C - P) * (Q - PI4 * P)
      RETURN
C     SHAPE 5
   50 IF (A .LE. B) GOTO 190
      AREA = PI * A * B
      VOL = PI12 * B * B * (3. * A - B)
```



```
      IF (P) 195, 185, 51
   51 IF (B .LE. P) GOTO 185
      PLVOL = VOL - 0.9 * PI12 * (B - P) ** 2 * (3. * A - B - 2. * P)
      RETURN
C     SHAPE 6
C     SQRT(32.) = 5.6568542
   60 Q = B * B + C * C
      AREA = PI8 * SQRT(Q) * (SQRT(Q + 8. * D * D) + SQRT(Q + 8. * E
     1 * E) + 5.6568542 * A)
      VOL = PI12 * B * C * (3. * A + E + D)
      IF (P) 195, 185, 61
   61 IF(B .LE. P .OR. C .LE. P) GOTO 185
      R = (B - P) * (C - P)
      PLVOL = VOL - 0.9 * PI12 * R * (3.* A + (E + D) * SQRT(R / B / C))
      RETURN
C     SHAPE 7
   70 AREA = 2. * (A * B + C * (A + B))
      VOL = A * B * C
      IF (P) 195, 185, 71
   71 IF (A .LE. P .OR. B .LE. P .OR. C .LE. P) GOTO 185
      PLVOL = VOL - 0.9 * (A - P) * (B - P) * (C - P)
      RETURN
C     SHAPE 8
   80 AREA = A * (0.866025404 * A + 3. * B)
      VOL = 0.433012702 * A * A * B
      IF (P) 195, 185, 81
   81 Q = SQRT(1.732050808)
      Q = 0.5 * (A / Q - P * Q)
      IF (Q .LE. 0. .OR. B .LE. P) GOTO 185
      PLVOL = VOL - 2.7 * Q * Q * (B - P)
      RETURN
C     SHAPE 9
   90 AREA = PI * (C * SQRT(0.5 * (A * A + B * B)) + D * E + 0.5* A * B)
      VOL = PI4 * (A * B * C + D * D * E)
      IF (P) 195, 185, 91
   91 IF (A .LE. P .OR. B .LE. P .OR. C .LE. P) GOTO 185
      PLVOL = VOL - 0.9 * PI4 * (A - P) * (B - P) * (C - P)
      RETURN
C     SHAPE 10
  100 Q = 0.5 * (A * A + B * B)
      AREA = PI * (SQRT(Q) * (0.5 * SQRT(Q + 4. * D * D) + C) + E * F)
      VOL = PI12 * (A * B * (3.* C + 2.* D) + 3.* E * E * F)
      IF (P) 195, 185, 101
  101 IF (A .LE. P .OR. B .LE. P) GOTO 185
      R = (A - P) * (B - P)
      PLVOL = VOL - 0.9 * PI12 * R * (3. * C + 2. * D * SQRT(R / A / B))
      IF (PLVOL) 190, 185, 200
C     SHAPE 11
  110 Q = 0.125 * (A * A + B * B)
      T = D * D / Q
      U = 1. + 4. * T
      AREA = PI * (2. * (E * F + C * SQRT(Q)) + Q / (3. * T) * (U *
     1 SQRT(U) - 1.))
      VOL = PI * (0.25 * A * B * (C + D) + E * E * F / 3.)
      IF (P) 195, 185, 111
  111 IF (A .LE. P .OR. B .LE. P .OR. D .LE. P) GOTO 185
```

```
      PLVOL = VOL - 0.9 * PI * (0.25 * (A - P) * (B - P) * (C + D - 0.5 ARV0117
     1 * P) + AMAX1(0.0, E-P) ** 3 / E * F / 3.)                        ARV0118
      RETURN                                                            ARV0119
C     SHAPE 12                                                          ARV0120
  120 IF (B .LE. C .OR. D .LE. E) GOTO 190                              ARV0121
      AREA =  (D + E) * SQRT(A * A + (0.5 * (B - C)) ** 2) + B *        ARV0122
     1 (A + D) + C * (A + E)                                            ARV0123   79
      VOL = A * (C * (D + 2. * E) + B * (E + 2. * D)) / 6.              ARV0124
      IF (P) 195, 185, 121                                              ARV0125
  121 IF (A .LE. P .OR. B .LE. P .OR. D .LE. P) GOTO 185                ARV0126
      Q = B - C                                                         ARV0127
      S = D - E                                                         ARV0128
      X = (B - P + SQRT(1. + 0.25 * (Q / A) ** 2)) * A / Q              ARV0129   84
      T = X - 0.5 * P                                                   ARV0130
      IF (T) 185, 185, 122                                              ARV0131
  122 IF (S) 125, 125, 123                                              ARV0132
  123 IF (T + P .GT. A) GOTO 124                                        ARV0133
      PLVOL = 0.5 * Q * T / A * X * (D - P)                             ARV0134
      GOTO 127                                                          ARV0135
  124 PLVOL = (X / A - 0.5) * Q * (A - P) * (D - P)                     ARV0136
      GOTO 127                                                          ARV0137
  125 X = (Q + P) ** 2                                                  ARV0138
      Y = (Q - P) ** 3                                                  ARV0139
      PLVOL = 0.5 * A / Q * (E * X + S / 3. * Y / Q)                    ARV0140
      R = A - P                                                         ARV0141
      U = D - P                                                         ARV0142
      IF (A * U / S .GE. R) GOTO 126                                    ARV0143
      PLVOL = PLVOL + 0.5 * A * C * U / S                               ARV0144
      GOTO 127                                                          ARV0145
  126 PLVOL = PLVOL + 0.5 * C * R * (U + E - P)                         ARV0146
  127 PLVOL = VOL - 0.9 * PLVOL                                         ARV0147
      RETURN                                                            ARV0148
C     SHAPE 13                                                          ARV0149
  130 IF (A .LT. C) GOTO 190                                            ARV0150
      AREA =  0.5 * PI * (E * SQRT(C * C + (0.5 * (B - D)) ** 2) +      ARV0151
     1 (B + D) * SQRT(0.5 * (C * C + E * E))) + 2. * (D + F) * (A - C)  ARV0152   104  105
      VOL =  PI8 * C * E * (B + D) + D * F * (A - C)                    ARV0153
      S = A - C - P                                                     ARV0154
      IF (P) 195, 185, 131                                              ARV0155
  131 U = D - P                                                         ARV0156
      IF (F .LT. P .OR. S .LT. 0. .OR. U .LT. 0.) U = 0.                ARV0157
      IF (C .LE. P .OR. E .LE. P) GOTO 185                              ARV0158
      PLVOL = VOL - 0.9 * (PI8 * (B + U) * (C - P) * (E - P) * (F - P) *ARV0159
     1 S * U)                                                           ARV0160
      RETURN                                                            ARV0161
C     SHAPE 14                                                          ARV0162
  140 IF (C .LT. D) GOTO 190                                            ARV0163
      Q = C - 0.5 * D                                                   ARV0164
      AREA = PI * (Q * SQRT(0.5 * (A * A + B * B)) + 0.5 * A * B)       ARV0165   116
      VOL = PI4 * A * B * Q                                             ARV0166
      IF (P) 195, 185, 141                                              ARV0167
  141 IF (A .LE. P .OR. B .LE. P) GOTO 185                              ARV0168
      PLVOL = VOL - 0.9 * PI4 * (A - P) * (B - P) * (C - 0.5 * D - P)   ARV0169
      RETURN                                                            ARV0170
C     SHAPE 15                                                          ARV0171
  150 Q = C - D                                                         ARV0172
```



```
      H = A * A                                                         ARV0173
      AREA = B * SQRT(R + U * U) + (C + D) * SQRT(R + R * R)            ARV0174   122  123
      VOL = A * B * (2. * C + D) / 6.                                   ARV0175
      IF (P) 195, 185, 151                                              ARV0176
  151 S = R - P * SQRT(1. + (B / A) ** 2)                               ARV0177   126
      IF (S) 185, 185, 152                                              ARV0178
  152 T = C - P * SQRT(1. + (Q / A) ** 2)                               ARV0179   129
      IF (T) 185, 185, 153                                              ARV0180
  153 U = S * A / B                                                     ARV0181
      IF (Q) 154, 154, 155                                              ARV0182
  154 PLVOL = 0.5 * U * S * T                                           ARV0183
      GOTO 156                                                          ARV0184
  155 V = A * T / Q                                                     ARV0185
      X = AMIN1(U,V)                                                    ARV0186
      PLVOL = B * Q / (6. * R) * X * X * (3. * AMAX1(U,V) - X)          ARV0187
  156 PLVOL = VOL - 0.9 * PLVOL                                         ARV0188
      RETURN                                                            ARV0189
C     SHAPE 16                                                          ARV0190
  160 R = 2. * B                                                        ARV0191
      S = A * A * F * F                                                 ARV0192
      T = D * D                                                         ARV0193
      U = G * G                                                         ARV0194
      V = FJ * FJ                                                       ARV0195
      AREA =  0.5 * ELLARI(A,F,R) + PI4 * (0.5 * SQRT(S + T + S *       ARV0196
     1 C * C)) + D * SQRT(T + 4. * E * E) + G * SQRT(U + 4. * H * H)    ARV0197
     2 + FJ * SQRT(V + 4. * FK * FK) - T - U - V)                       ARV0198   138  139  140  141  142
      VOL = PI12 * (A * F * (R + C) + T * E + U * H + V * FK)           ARV0199
      PLVOL = VOL                                                       ARV0200
      RETURN                                                            ARV0201
C     SHAPE 17                                                          ARV0202
  170 R = D * D                                                         ARV0203
      S = G * G                                                         ARV0204
      T = FJ * FJ                                                       ARV0205
      U = FL * FL                                                       ARV0206
      AREA =  ELLARI(A,B,E) + PI4 * (D * SQRT(R + 4. * C * C) +         ARV0207
     1 G * SQRT(S + 4. * F * F) + FJ * SQRT(T + 4. * H * H) + FL *      ARV0208
     2 SQRT(U + 4. * FK * FK) - R - S - T - U)                          ARV0209   144  145  146  147  148
      VOL = PI12 * (2. * A * B * E + R * C + S * F + T * H + U * FK)    ARV0210
      PLVOL = VOL                                                       ARV0211
      RETURN                                                            ARV0212
C     SHAPE 18                                                          ARV0213
  180 IF (A .LT. D) GOTO 190                                            ARV0214
      R = A * A + E * E                                                 ARV0215
      S = E * E + (A - D) ** 2                                          ARV0216
      AREA =  PI8 * (SQRT(R + 8. * C * C)) + SQRT(S * (S +              ARV0217
     1 8. * B * B))) + D * SQRT(E * E + 4. * B * B)                     ARV0218   192  193  194
      VOL = 0.5 * E * (PI6 * (A * C + B * (A - D)) + B * D)             ARV0219
  185 PLVOL = VOL                                                       ARV0220
      RETURN                                                            ARV0221
  190 AREA = -1.E38                                                     ARV0222
      VOL = -1.E38                                                      ARV0223
  195 PLVOL = -1.E38                                                    ARV0224
  200 RETURN                                                            ARV0225
      END                                                               ARV0226
```

$IBFTC ELLA DECK ELLA000

ELLA - EFN SOURCE STATEMENT - IFN(S) -

```
C     ELLAR - SUBPROGRAM FOR COMPUTING AREA OF AN ELLIPSOID                ELLA001
C                                                                          ELLA002
C     UWNS-1005                                                            ELLA003
C                                                                          ELLA004
C     UNIVERSITY OF WASHINGTON                                             ELLA005
C     DEPARTMENT OF OCEANOGRAPHY                                           ELLA006
C     SEATTLE, WASHINGTON  98105                                           ELLA007
C                                                                          ELLA008
C     PROGRAMMED BY..   PAAVO KOVALA            JANUARY 1966             ELLA009
C                                                                          ELLA010
C     X, Y, Z = PRINCIPAL AXES OF THE ELLIPSOID                            ELLA011
C     ELLC = COMPLETE ELLIPTIC INTEGRAL OF SECOND KIND                     ELLA012
C     N = NUMBER OF PAIRS OF INTERVALS IN THE SIMPSON'S RULE               ELLA013
C                                                                          ELLA014
C     THIS PROGRAM IS A FORTRAN IV VERSION OF AN EARLIER PROGRAM WRITTEN   ELLA015
C     IN FORTRAN II.                                                       ELLA016
C                                                                          ELLA017
      FUNCTION ELLAR(X,Y,Z)                                                ELLA020
      DATA PI,PI2,N/3.1415927,1.5707963,32/                                ELLA021
      ELLC(T) = 1. + (((0.013693065 * T + 0.0475738035) * T +              ELLA022
     1 0.0626060012) * T + 0.4432514411) * T - (((0.0092644964 * T +       ELLA023
     2 0.0406969751) * T + 0.0920001800) * T + 0.2499983681) * T * ALOG(1/T) ELLA024
C                                                                          ELLA025    2
      A = X                                                                ELLA026
      B = Y                                                                ELLA027
      S = Z                                                                ELLA028
      IF (A .GT. 0.0 .AND. B .GT. 0.0 .AND. S .GT. 0.0) GOTO 1             ELLA029
      ELLAR = 0.0                                                          ELLA030
      RETURN                                                               ELLA031
    1 A = AMAX1(A,B,S)                                                     ELLA032
      C = AMIN1(A,B,S)                                                     ELLA033
      IF (A .NE. C) GOTO 2                                                 ELLA034
C                                                                          ELLA035
C     SPHERE                                                               ELLA036
      ELLAR = PI * A * A                                                   ELLA037
      RETURN                                                               ELLA038
    2 B = A - C + B - A + S                                                ELLA039
      IF (A .GT. 1.0001 * B) GOTO 5                                        ELLA040
C                                                                          ELLA041
C     OBLATE SPHEROID                                                      ELLA042
      R = SQRT(A * A - C * C)                                              ELLA043   16
      ELLAR = PI2 * A * (A + 0.5 * C * C / R * ALOG((A + R) / (A - C)))    ELLA044   17
      RETURN                                                               ELLA045
    3 IF (B .GT. 1.0001 * C) GOTO 4                                        ELLA046
C                                                                          ELLA047
C     PROLATE SPHEROID                                                     ELLA048
      R = SQRT(A * A - C * C)                                              ELLA049   21
      ELLAR = PI2 * C * (C + A * A / R * ATAN(R / C))                      ELLA050   22
      RETURN                                                               ELLA051
C                                                                          ELLA052
C     ELLIPSOID WITH PRINCIPAL AXES OF 3 DIFFERENT LENGTH                  ELLA053
C     SIMPSONS RULE IS USED FOR COMPUTING THE DEFINITE INTEGRAL            ELLA054
    4 R = (C / B) ** 2                                                     ELLA055
      S = R - (C / A) ** 2                                                 ELLA056
      R = 1. - R                                                           ELLA057
```

```
      H = PI2 / FLOAT(N)                                                ELLA058
      HA = H                                                            ELLA059
      HB = 0.5 * H                                                      ELLA060
      SUMA = 0.                                                         ELLA061
      SUMB = 0.                                                         ELLA062
      M = N - 1                                                         ELLA063
      DO 5  I = 1, M                                                    ELLA064
      PA = SIN(HA)                                                      ELLA065   28
      PB = SIN(HB)                                                      ELLA066   29
      QA = PA * PA                                                      ELLA067
      QB = PB * PB                                                      ELLA068
      RA = 1. - R * QA                                                  ELLA069
      RB = 1. - R * QB                                                  ELLA070
      SUMA = SUMA + PA * SQRT(RA) * ELLC(1. - S * QA / RA)              ELLA071   30
      SUMB = SUMB + PB * SQRT(RB) * ELLC(1. - S * QB / RB)              ELLA072   31
      HA = HA + H                                                       ELLA073
5     HB = HB + H                                                       ELLA074
      PB = SIN(HB)                                                      ELLA075   35
      QB = PB * PB                                                      ELLA076
      RB = 1. - R * QB                                                  ELLA077
      SUMB = SUMB + PB * SQRT(RB) * ELLC(1. - S * QB / RB)              ELLA078   36
      ELLAR = A * H / 3. * (C * ELLC((B / A) ** 2) + 2. * B * (SUMA +   ELLA079
     1 2. * SUMB))                                                      ELLA080
      RETURN                                                            ELLA081
       END                                                              ELLA082
```


MAIN PROGRAM

COMMON VARIABLES

COMMON BLOCK DIMS ORIGIN 00001 LENGTH 00020

SYMBOL	LOCATION	TYPE	SYMBOL	LOCATION	TYPE	SYMBOL	LOCATION	TYPE
ISH	00000	I	A	00001	R	B	00002	R
C	00003	R	D	00004	R	E	00005	R
F	00006	R	G	00007	R	H	00010	R
FJ	00011	R	PR	00012	R	PL	00013	R
P	00014	R	AREA	00015	R	VOL	00016	R
PLVOL	00017	R						

DIMENSIONED PROGRAM VARIABLES

SYMBOL	LOCATION	TYPE	SYMBOL	LOCATION	TYPE	SYMBOL	LOCATION	TYPE
SPN	00021	I	KCA	00413	I	NCN	00416	I
LMC	00561	I	TITL	00724	R	PMT	01144	R
PMC	01160	R	PRA	01171	R	PMR	01205	R
CMAN	01217	R	PT	02341	R	QQ	02352	R
RES	02370	R	MR	30352	R	CMA	30362	R
DPT	30415	R	SMP	30425	R	SMAN	30435	R
DD	33763	R	GTOT	33773	R	TOT	34050	R
PMN	44617	R	PMU	44633	R	PMV	44652	R

UNDIMENSIONED PROGRAM VARIABLES

SYMBOL	LOCATION	TYPE	SYMBOL	LOCATION	TYPE	SYMBOL	LOCATION	TYPE
SWE	44670	L	SWI	44671	L	SWK	44672	L
SWS	44673	L	K	44674	I	KT	44675	I
D3	44676	R	EI	44677	R	D4	44700	R
CR	44701	R	D5	44702	R	ST	44703	R
I	44704	I	J	44705	I	BL	44706	R
N	44707	I	KOR	44710	I	KMC	44711	I
NSD	44712	I	L	44713	I	M	44714	I
UL	44715	R	N1	44716	I	N2	44717	I
N3	44720	I	N5	44721	I	DP	44722	R
SPL	44723	R	U1	44724	R	T1	44725	R
U2	44726	R	T2	44727	R	MSP	44730	I
ISP	44731	I	ARTOT	44732	R	AAINS	44733	R
COUNT	44734	R	KDC	44735	I	D1	44736	R
D2	44737	R	LS	44740	I	TMES	44741	R
Q1	44742	R	Q2	44743	R	Q3	44744	R
CMES	44745	R	Q4	44746	R	Q5	44747	R
VOLU	44750	R	CONV	44751	R	R	44752	R
T	44753	R	ND1	44754	I	NMC	44755	I
J1	44756	I	LR	44757	I	JM	44760	I
ZF	44761	R	FF	44762	R			

ENTRY POINTS

STORAGE MAP

.....	SECTION	5						

SUBROUTINES CALLED

.FADD.	SECTION	6	.FMRD.	SECTION	7	.FBST.	SECTION	8
.FSLI.	SECTION	9	.FSLD.	SECTION	10	DEBI	SECTION	11
ARVOL	SECTION	12	BLOP	SECTION	13	BIDE	SECTION	14
.UNOS.	SECTION	15	.FRTN.	SECTION	16	.FCNV.	SECTION	17
.UNO6.	SECTION	18	.FFIL.	SECTION	19	SYSLOC	SECTION	20

EFN IFN CORRESPONDENCE

EFN	IFN	LOCATION	EFN	IFN	LOCATION	EFN	IFN	LOCATION
1	FORMAT	45023	100	9A	45620	101	11A	45631
105	FORMAT	45024	120	65A	46041	107	39A	45727
108	FORMAT	45035	109	FORMAT	45037	112	44A	45761
113	45A	45763	115	50A	45776	114	FORMAT	45061
118	59A	46026	116	58A	46017	117	FORMAT	45063
121	69A	46044	130	84A	46127	140	89A	46157
122	82A	46112	123	FORMAT	45102	131	87A	46142
132	FORMAT	45145	150	128A	46325	148	125A	46323
145	116A	46312	141	111A	46260	142	114A	46273
143	FORMAT	45172	146	119A	46315	230	270A	47426
160	FORMAT	45234	164	151A	46502	161	146A	46450
162	149A	46463	163	FORMAT	45263	165	163A	46531
166	167A	46540	167	173A	46556	170	174A	46562
171	179A	46577	220	267A	47411	172	FORMAT	45311
180	206A	46770	173	203A	46747	176	FORMAT	45320
181	210A	46776	183	219A	47017	182	213A	47004
186	227A	47036	184	223A	47032	211	262A	47355
200	FORMAT	45365	203	244A	47251	201	240A	47224
202	FORMAT	45377	204	249A	47271	210	259A	47346
205	255A	47313	206	FORMAT	45452	400	318A	47575
303	315A	47573	300	282A	47456	301	301A	47531
302	311A	47564	410	353A	47720	401	326A	47616
403	347A	47711	402	340A	47700	420	402A	50120
411	359A	47755	412	366A	47766	415	393A	50065
413	373A	50002	414	389A	50056	416	397A	50105
501	424A	50176	502	428A	50203	500	417A	50163
511	450A	50320	510	445A	50313	600	462A	50400
650	631A	51304	601	FORMAT	45513	602	FORMAT	45542
603	FORMAT	45543	604	FORMAT	45551	605	495A	50626
610	515A	50712	650	616A	51236	611	529A	50751
613	534A	50771	61.	FORMAT	45555	618	556A	51033
617	554A	51031	616	552A	51026	615	550A	51024
614	547A	51021	625	591A	51152	624	583A	51122
623	581A	51117	622	579A	51115	621	576A	51112
629	605A	51177	620	603A	51174	627	601A	51172
626	598A	51167	632	626A	51264	631	FORMAT	45560
633	FORMAT	45570	910	697A	51526	902	659A	51415
906	645A	51372	901	648A	51374	905	679A	51476
903	665A	51451	904	668A	51453	906	683A	51503
907	686A	51505						

THE FIRST LOCATION NOT USED BY THIS PROGRAM IS 51560.

STORAGE MAP

SUBROUTINE ARVOL

COMMON VARIABLES

COMMON BLOCK DIMS ORIGIN 00001 LENGTH 00020

SYMBOL	LOCATION	TYPE	SYMBOL	LOCATION	TYPE	SYMBOL	LOCATION	TYPE
ESM	00000	I	A	00001	R	B	00002	R
C	00003	R	D	00004	R	E	00005	R
F	00006	R	G	00007	R	H	00010	R
FJ	00011	R	FK	00012	R	FL	00013	R
P	00014	R	AREA	00015	R	VOL	00016	R
PLVOL	00017	R						

UNDIMENSIONED PROGRAM VARIABLES

SYMBOL	LOCATION	TYPE	SYMBOL	LOCATION	TYPE	SYMBOL	LOCATION	TYPE
PI	00021	R	PI6	00022	R	PI4	00023	R
Q	C0024	R	PI12	00025	R	PI8	00026	R
R	00027	R	T	00030	R	U	00031	R
S	C0032	R	X	00033	R	Y	00034	R
V	00035	R						

ENTRY POINTS

ARVOL	SECTION	5						

SUBROUTINES CALLED

ELLAR	SECTION	6	SQRT	SECTION	7	.FREN.	SECTION	8
SYSLOC	SECTION	9						

EFN IFN CORRESPONDENCE

EFN	IFN	LOCATION	EFN	IFN	LOCATION	EFN	IFN	LOCATION
10	3A	00126	20	8A	00167	30	14A	00252
40	19A	00331	50	26A	00436	60	33A	00523
70	42A	00674	80	47A	00757	90	54A	01047
100	60A	01166	110	69A	01345	120	76A	01544
130	101A	02104	140	113A	02320	150	121A	02436
160	137A	02642	170	145A	03032	180	149A	03212
195	157A	03353	185	155A	03344	11	5A	00142
21	11A	00210	31	16A	00279	190	196A	03347
41	23A	00400	51	30A	00466	61	38A	00616
71	44A	00717	81	49A	01002	91	57A	01124
101	64A	01264	200	158A	03355	111	73A	01455
121	81A	01645	122	86A	01724	125	94A	01775
123	88A	01717	124	92A	01752	127	100A	02076
126	99A	02062	131	107A	02232	141	118A	02375
191	129A	02513	192	128A	02535	193	131A	02557
194	133A	02566	195	135A	02576	196	136A	02634

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ARVO STORAGE MAP

THE FIRST LOCATION NOT USED BY THIS PROGRAM IS 03377.

DATE 06/23/66 TIME 17:11:16 PAGE 22

ELLA STORAGE MAP

FUNCTION ELLAR TYPE R

UNDIMENSIONED PROGRAM VARIABLES

SYMBOL	LOCATION	TYPE
P.0000	00001	R
S	00004	R
PI	00007	R
N	CC012	I
SUMA	00015	R
I	C0020	I
QA	C0023	R
RB	C0026	R
R	00002	R
A	00005	R
PI2	00010	R
HA	00013	R
SUMB	00016	R
PA	00021	R
QB	00024	R
B	00003	R
C	00006	R
H	00011	R
HB	00014	R
R	00017	I
PB	00022	R
RA	00025	R

ENTRY POINTS

ELLAR SECTION 3

SUBROUTINES CALLED

ALOG	SECTION	4	SQRT	SECTION	5	ATAN	SECTION	6
SIN	SECTION	7	E.1	SECTION	8	E.2	SECTION	9
E.3	SECTION	10	E.4	SECTION	11	CC.1	SECTION	12
CC.2	SECTION	13	CC.3	SECTION	14	CC.4	SECTION	15
SYSLOC	SECTION	16						

EFN IPN CORRESPONDENCE

EFN	IPN	LOCATION	EFN	IPN	LOCATION	EFN	IPN	LOCATION
1	8A	00194	2	12A	00210	3	16A	00274
4	23A	00343	5	32A	00526			

THE FIRST LOCATION NOT USED BY THIS PROGRAM IS 00657.

COMPILATION PHPL

DIAGNOSTIC MESSAGES

PHASE 0 DIAGNOSTIC MESSAGES

1 SOURCE ERROR 173 LEVEL 1 - WARNING ONLY
DATA STATEMENT. VARIABLE LIST LONGER THAN LITERAL LIST.

2 SOURCE ERROR 173 LEVEL 1 - WARNING ONLY
DATA STATEMENT. VARIABLE LIST LONGER THAN LITERAL LIST.

3 SOURCE ERROR 173 LEVEL 1 - WARNING ONLY
DATA STATEMENT. VARIABLE LIST LONGER THAN LITERAL LIST.

4 SOURCE ERROR 173 LEVEL 1 - WARNING ONLY
DATA STATEMENT. VARIABLE LIST LONGER THAN LITERAL LIST.

5 SOURCE ERROR 173 LEVEL 1 - WARNING ONLY
DATA STATEMENT. VARIABLE LIST LONGER THAN LITERAL LIST.

SIBMAP BIDEF 100,DECK BIDE000

BEGIN ASSEMBLY BIDEF TIME 17:11:49 ELAPSED TIME 00:00:29

```
        $IBLDR BIDEF                                                    BIDE0000
```



```
        $TEXT  BIDEF                                                    BIDE0001
                                *BIDEF MAP PROGRAM FOR CONVERTING FLOATING OR (FORTRAN) FIXED POINT      BIDE001
                                *      BINARY NUMBERS IN BCD FORM.                                       BIDE002
                                *      UWMS-0949                                                         BIDE003
                                *                                                                        BIDE004
                                *      UNIVERSITY OF WASHINGTON                                          BIDE005
                                *      DEPARTMENT OF OCEANOGRAPHY                                        BIDE006
                                *      SEATTLE, WASHINGTON  98105                                        BIDE007
                                *                                                                        BIDE008
                                *     PROGRAMMED BY..   PAAVO KOVALA                                     BIDE009
                                *     REVISED BY..      FREDERICK EASTON         DECEMBER 1964           BIDE00A
                                *                                                                        BIDE010
                                *      Q = BIDEF (P, M, N)                                               BIDE011
                                *      Q = BCD NUMBER                                                    BIDE012
                                *      P = BINARY NUMBER                                                 BIDE013
                                *      M = TOTAL NUMBER OF CHARACTERS IN Q, MAXIMUM 6                    BIDE014
                                *      N = NUMBER OF DECIMALS, MAXIMUM 6                                 BIDE015
                                *      IF  M = 0,  Q = BLANK.                                            BIDE016
                                *      IF M IS NEGATIVE, LEADING ZEROES ARE RETAINED AND MINUS SIGN,     BIDE017
                                *      IF NEEDED, IS COMBINED WITH THE RIGHTMOST CHARACTER OF Q.          BIDE018
                                *      IF  N = 0,  THERE IS NO DECIMAL POINT.                            BIDE019
                                *      IF N IS NEGATIVE, P IS A FORTRAN INTEGER.                         BIDE020
                                *                                                                        BIDE021
                                       ENTRY  BIDE                                                      BIDE022
                                       ENTRY  BIDEF                                                     BIDE023
                          00000  BIDE  NULL                                                            BIDE024
BINARY CARD ID. BIDE0002
      00000  0634 00 1 00125  10001  BIDEF  SXA   XR,1          SAVE XR1                                BIDE025
      00001  0634 00 2 00126  10001         SXA   XR+1,2        SAVE XR2                                BIDE026
      00002  0634 00 3 00127  10001         SXA   XR+2,3        SAVE XR3                                BIDE027
      00003  0774 00 1 00000  10000         ARX   0,1                                                   BIDE028
      00004  0774 00 2 00000  10000         ARX   0,2                                                   BIDE029
      00005  0774 00 3 00000  10000         ARX   0,3                                                   BIDE030
      00006  0560 60 4 00003  10000         CLA*  3,4                                                   BIDE031
      00007  0100 00 0 00012  10001         TZE   PLA-1                                                 BIDE032
      00010  0120 00 0 00013  10001         TPL   PLA                                                   BIDE033
      00011  0774 00 1 00001  10000         ARX   1,1           1 INTO XR1 IF P IS NEGATIVE             BIDE034
      00012  0760 00 0 00000  10000         SSP                 SET SIGN OF P PLUS                      BIDE035
      00013  0601 00 0 00131  10001  PLA    STO   A             P INTO A                                BIDE036
      00014  0560 60 4 00004  10000         LDQ*  4,4                                                   BIDE037
      00015  0200 00 0 00143  10001         MPY   =06           60N INTO AC                             BIDE038
      00016  0131 00 0 00000  10000         XCA                                                         BIDE039
      00017  4100 00 0 00022  10001         TNZ   NNZ                                                   BIDE040
      00020  0500 00 0 00142  10001         CLA   B+2                                                   BIDE041
      00021  C020 00 0 00125  10001         TRA   XR            N=0, Q=BLANK                            BIDE042
      00022  0120 00 0 00025  10001  NNZ    TPL   NST-1                                                 BIDE043
BINARY CARD ID. BIDE0003
      00023  1 00002 1 01001  10011         TXI   *+1,1,2       N IS NEGATIVE, ADD 2 TO C(XR1)          BIDE044
      00024  0760 00 0 00003  10000         SSP                                                         BIDE045
      00025  0621 00 0 00123  10001         STA   FIN+1         ABS. VALUE OF N INTO ADDRESS OF FIN-1   BIDE046
      00026  0560 60 4 00005  10000  NST    LDQ*  5,4           N INTO MQ                               BIDE047
      00027  0162 00 0 00040  10001         TQP   PLN                                                   BIDE048
      00030  0500 00 0 00131  10001         CLA   A             N IS NEGATIVE, P IS FIXED PT. NUMBER    BIDE049
```

ASSEMBLED TEXT.

```
00031  4100 00 0 00035  10001        TNZ   NZA                                          BIDE050
00032  3 00001 1 00034  10001  NVA   TSM   NZA-1,1,1      IF NEGATIVE N, LEADING ZEROES RETAINED  BIDE051
00033  0500 00 0 00140  10001        CLA   0              N IS POSITIVE, BLANKS ADDED     BIDE052
00034  0020 00 0 00122  10001        TRA   FIN                                          BIDE053
00035  4130 00 0 00000  10000  NZA   RCL   1              REVERSE P INTO MQ               BIDE054
00036  0760 00 0 00000  10000        CLR                                                BIDE055
00037  0020 00 0 00042  10001        TRA   CVT            READY FOR CONVERTING INTO DCD   BIDE056
00040  0300 00 0 00143  10001  PLN   RDV   =0A           N IS POSITIVE, 0+N INTO AC      BIDE057
00041  0131 00 0 00000  10000        XCA                                                BIDE058
00042  0100 00 0 00044  10001        TZE   IND                                          BIDE059
00043  0737 00 2 00000  10000        PAC   0,2            N IS POSITIVE, -0+N INTO XR2    BIDE060
00044  0500 00 0 00131  10001  IND   CLA   A                                            BIDE061
00045  0100 00 0 00101  10001        TZE   ADJ            P=0, BYPASS CONVERSION          BIDE062

BINARY CARD ID. BIDE0004
00046  7 00000 2 00053  10001        TXL   FIX,2,0                                     BIDE063
00047  0131 00 0 00000  10000        XCA                                                BIDE064
00050  0500 00 4 00005  10000        CLA*  5,4            N IS POSITIVE               BIDE065
00051  0737 00 3 00000  10000        PAC   ,3             PUT N INTO XR3              BIDE066
00052  0260 00 3 00131  10001        FMP   A,3            MULTIPLY P BY 10**N         BIDE067
00053  4300 00 0 00144  10001  FIX   UFA   =0233000000000 CONVERT FL. PT. P INTO FIXED PT. NUMBER BIDE068
00054  0760 00 0 00011  10000        FAN                  ROUND P                     BIDE069
00055  4320 00 0 00145  10001        ANA   =01777777       REMOVE CHARACTERISTIC       BIDE070
00056  4100 00 0 00061  10001        TNZ   CVT-1                                      BIDE071
00057  0600 00 0 00131  10001        STZ   A              P=0 AFTER ROUNDING. 0 INTO A    BIDE072
00060  0020 00 0 00101  10001        TRA   ADJ            BYPASS CONVERSION           BIDE073
00061  4765 00 0 00044  10000        LGR   36             SHIFT P INTO MQ             BIDE074
00062  0221 00 0 00144  10001  CVT   DVP   =012           LAST CHARACTER OF 0 IN AC       BIDE075
00063  7 00002 1 00067  10001        TXL   LOOP-2,1,2                                 BIDE076
00064  4100 00 0 00066  10001        TNZ   LOOP-5         P AND N ARE NEGATIVE,       BIDE077
00065  4501 00 0 00144  10001        ORA   =012           LAST CHAR. OF 0 IS 0, MAKE IT MINUS ZERO  BIDE078
00066  4501 00 0 00147  10001        ORA   =040           COMBINE MINUS SIGN WITH LAST CHAR. OF 0 BIDE079
00067  0601 00 0 00131  10001        STO   A              LAST CHARACTER OF 0 INTO A  BIDE080
00070  0774 00 3 00038  10000        AXT   24,3                                       BIDE081

BINARY CARD ID. BIDE0005
00071  0760 00 0 00000  10000  LOOP  CLR                  CLEAR AC                    BIDE082
00072  0221 00 0 00144  10001        DVP   =012                                       BIDE083
00073  0767 00 3 00036  10000        ALS   30,3           SHIFT NEXT CHAR. OF 0 IN FRONT OF OTHERS  BIDE084
00074  0400 00 0 00131  10001        ADD   A              AND COMBINE IT WITH THEM    BIDE085
00075  0601 00 0 00131  10001        STO   A                                          BIDE086
00076  2 00006 3 00071  10001        TIX   LOOP,3,6                                   BIDE087
00077  4763 00 0 00102  10000        LGL   66                                         BIDE088
00100  0400 00 0 00131  10001        ADD   A              CONVERTED NUMBER NOW IN AC  BIDE089
00101  7 00000 2 00106  10001  ADJ   TXL   NDP,2,0       IF N IS NONPOSITIVE, NO DECIMAL POINT  BIDE090
00102  4765 00 2 00000  10000        LGR   0,2            SHIFT DECIMALS INTO MQ      BIDE091
00103  0767 00 0 00006  10000        ALS   6              SHIFT INTEGER, MAKE ROOM FOR DECIMAL PT.  BIDE092
00104  4501 00 0 00150  10001        ORA   =033           INSERT DECIMAL POINT        BIDE093
00105  4763 00 2 00000  10000        LGL   0,2            SHIFT 0 INTO AC             BIDE094
00106  0100 00 0 00032  10001  NDP   TZE   NVA            IF 0 CONSISTS OF ZEROES,BYPASS FOLLOWING  BIDE095
00107  3 00001 1 00122  10001        TSM   FIN,1,1        IF N IS NEGATIVE, RETAIN LEADING ZEROES  BIDE096
00110  7 00000 2 00116  10001        TXL   BLA-2,2,0      IF N IS NONPOSITIVE, TRANSFER  BIDE097
00111  7 77750 2 00122  10001        TXL   FIN,2,-24      IF N IS GREATER THAN 3, SKIP FOLLOWING  BIDE098
00112  1 77764 2 01001  10011        TXI   *+1,2,-12      N IS POSITIVE, LESS THAN 4  BIDE099
00113  4765 00 2 00000  10000        LGR   0,2            SHIFT N+2 CHARACTERS INTO MQ  BIDE100
```


ASSEMBLED TEXT.

```
BINARY CARD ID. BIDE0006
00114  0100 00 0 00120  10001  REP   TZE   BLA              IF 0 IN AC, PUT BLANKS IN AC  BIDE101
00115  7 77734 2 00121  10001        TXL   BLA+1,2,-36      IF 6 CHARACTERS IN MQ, SHIFT INTO AC  BIDE102
00116  4765 00 0 00006  10000        LGR   6                SHIFT ONE MORE CHARACTER INTO MQ  BIDE103
00117  1 77772 2 00114  10001        TXI   REP,2,-6                                   BIDE104
00120  4500 00 1 00142  10001  BLA   CAL   0+2,1                                      BIDE105
00121  4763 00 2 00000  10000        LGL   0,2              SHIFT 0 INTO AC, RIGHT ADJUSTED  BIDE106
00122  0560 00 0 00142  10001  FIN   LDQ   B+2              FILL MQ WITH BLANKS         BIDE107
00123  4765 00 0 00000  10000        LGR   **               SHIFT 0 INTO MQ, LEFT ADJUSTED  BIDE108
00124  0131 00 0 00000  10000        XCA                    0 INTO AC                   BIDE109
00125  0774 00 1 0C000  10000  XR    AXT   **,1             RESTORE XR1                 BIDE110
00126  0774 00 2 00000  10000        AXT   **,2             RESTORE XR2                 BIDE111
00127  0774 00 3 0C000  10000        AXT   **,3             RESTORE XR3                 BIDE112
00130  0020 00 4 00001  10000        TRA   1,4                                        BIDE113
00131  00C000000000     10000  A     DEC   0.10..100..1000..10000..100000..1000000.   BIDE114
00132  204500000000     10000
00133  207620000000     10000
00134  212764000000     10000
00135  216470400000     10000
00136  221606500000     10000

BINARY CARD ID. BIDE0007
00137  224758220000     10000
00140  606060606000     10000  B     OCT   606060606000,606060606040,606060606060   BIDE115
00141  606060606040     10000
00142  606060606060     10000
00143  600000000006     10000        *LORG
00144  233000000000     10000
00145  000001777777     10000
00146  000000000012     10000
00147  000000000040     10000
00150  000000000033     10000
                00000 01111         END                                              BIDE116
```

CONTROL DICTIONARY

```
          $COICT BIDEF                                                    BIDE0008

BINARY CARD ID. BIDE0009
          000151000000          PREFACE   START=0,LENGTH=105,TYPE=7094,CMPLR=5
          00C004C00005
          223124252660  BIDEF   DECK      LOC=0,LENGTH=105
          C0015100000C
          223124256060  BIDE    REAL      LOC=0,LENGTH=0
          0C0000000000
          223124252660  BIDEF   REAL      LOC=0,LENGTH=0
          L00000000000

          $DKEND BIDEF                                                    BIDE0010

NO MESSAGES FOR THIS ASSEMBLY
```


SYMBOL REFERENCE DATA

REFERENCES TO DEFINED SYMBOLS.

CLASS	SYMBOL	VALUE	REFERENCES
	ADJ	00101	45,60
	A	00131	13,30,44,52,57,67,74,75,100
	BIDEF	00000	
	BIDE	00000	
	BLA	00120	110,114,115
	B	00140	20,33,120,122
	CVT	00062	37,56
	FIN	00122	25,34,107,111
	FIX	00053	46
	IND	00044	42
	LOOP	00071	63,64,76
	MNZ	00022	17
	NOP	00106	101
	NST	00026	22
	NUL	00032	106
	NZA	00035	31,32
	PLA	00013	7,10
	PLN	00040	27
	REP	00114	117
LCTR	BLCTR		
QUAL	UNDS		
LCTR	//		
	XR	00125	0,1,2,21

```
$IBMAP BLDP    50,DECK                                    BLDP000
BEGIN ASSEMBLY   BLDP   TIME 17011055       ELAPSED TIME 00000406
```



```
7094 RELMOD ASSEMBLY.
        $IBLDR BLDP                                       BLDP0000
```

ASSEMBLED TEXT.

STEXT BLDP BLDP0031

```
                    *   BLDP .. INSERTING DECIMAL POINT TO AND REMOVING LEADING ZEROES   BLDP003
                    *   FROM A BCD NUMBER                                                BLDP002
                        UWNS-0953                                                        BLDP003
                                                                                         BLDP004
                        UNIVERSITY OF WASHINGTON                                         BLDP005
                        DEPARTMENT OF OCEANOGRAPHY                                       BLDP006
                        SEATTLE, WASHINGTON  98105                                       BLDP007
                                                                                         BLDP008
                        PROGRAMMED BY..  PAAVO KOVALA          1965                      BLDP009
                                                                                         BLDP010
                    *   B = BLDP(A,N)                                                    BLDP011
                    *   B = RESULTING BCD WORD                                           BLDP012
                    *   A = ORIGINAL BCD NUMBER                                          BLDP013
                    *   N = NUMBER OF CHARACTERS TO THE LEFT FROM DECIMAL POINT          BLDP014
                    *   IF A IS A BLANK WORD OR N IS ZERO OR NEGATIVE, B = A.            BLDP015
                                                                                         BLDP016
                        ENTRY   BLDP                                                     BLDP017

BINARY CARD ID. BLDP0002
00000  4500 60 4 00003  10000  BLDP  CAL*   3,4                                        BLDP018
00001  4340 00 0 00062  10001        LAS    =0606060606060                             BLDP019
00002  0020 00 0 01002  10011        TRA    **2                                        BLDP020
00003  0020 00 0 00013  10001        TRA    BL                                         BLDP021
00004  4130 00 0 00000  10000        XCL                                               BLDP022
00005  0500 60 4 00004  10000        CLA*   4,4                                        BLDP023
00006  0340 00 0 00063  10001        CAS    =1                                         BLDP024
00007  0020 00 0 00022  10001        TRA    TWO                                        BLDP025
00010  0020 00 0 00015  10001        TRA    ONE                                        BLDP026
00011  0131 00 0 00000  10000        XCA                                               BLDP027
00012  0020 00 4 00001  10000        TRA    1,4                                        BLDP028
00013  4760 00 0 00003  10000  BL    SSM                                               BLDP029
00014  0020 00 4 00001  10000        TRA    1,4                                        BLDP030
00015  4763 00 0 00006  10000  ONE   LGL    6                                          BLDP031
00016  0767 00 0 00006  10000        ALS    6                                          BLDP032
00017  4501 00 0 00064  10001        ORA    =03                                        BLDP033
00020  4763 00 0 00030  10000        LGL    24                                         BLDP034
00021  0020 00 4 00001  10000        TRA    1,4                                        BLDP035
00022  0340 00 0 00065  10001  TWO   CAS    =6                                         BLDP036

BINARY CARD ID. BLDP0003
00023  0020 00 0 00037  10001        TRA    RT+1                                       BLDP037
00024  0020 00 0 00037  10001        TRA    RT+1                                       BLDP038
00025  0767 00 0 00001  10000        ALS    1                                          BLDP039
00026  0400 60 4 00004  10000        ADD*   4,4                                        BLDP040
00027  0767 00 0 00001  10000        ALS    1                                          BLDP041
00030  0621 00 0 00033  10001        STA    LT                                         BLDP042
00031  0400 00 0 00065  10001        ADD    =6                                         BLDP043
00032  0621 00 0 00036  10001        STA    RT                                         BLDP044
00033  4763 00 0 00000  10000  LT    LGL    **                                         BLDP045
00034  0767 00 0 00006  10000        ALS    6                                          BLDP046
00035  4501 00 0 00064  10001        ORA    =033                                       BLDP047
00036  4765 00 0 00000  10000  RT    LGR    **                                         BLDP048
00037  4130 00 0 00000  10000        XCL                                               BLDP049
00040  4340 00 0 00066  10001        LAS    =0810000000000                             BLDP050
```


ASSEMBLED TEXT.

```
00041  0020 00 4 00001  10000        TRA    1,4                                        BLDP051
00042  0020 00 4 00001  10000        TRA    1,4                                        BLDP052
00043  0634 00 1 00060  10001  ZE    SXA    IR,1                                       BLDP053
00044  0774 00 1 00030  10000        AXT    24,1                                       BLDP054
00045  4765 00 0 00030  10000        LGR    24                                         BLDP055

BINARY CARD ID. BLDP0004
00046  4100 00 0 00052  10001  LOOP  TNZ    NZ                                         BLDP056
00047  4763 00 0 00006  10000        LGL    6                                          BLDP057
00050  2 00006 1 00046  10001        TIX    LOOP,1,6                                   BLDP058
00051  1 77772 1 00052  10001        TXI    NZ,1,-6                                    BLDP059
00052  0340 00 0 00067  10001  NZ    CAS    =032                                       BLDP060
00053  4501 00 0 00070  10001        ORA    =0606060606060                             BLDP061
00054  0020 00 0 01002  10011        TRA    **2                                        BLDP062
00055  4501 00 0 00071  10001        ORA    =0606060606060                             BLDP063
00056  4765 00 1 00044  10000        LGR    36,1                                       BLDP064
00057  0131 00 0 00000  10000        XCA                                               BLDP065
00060  0774 00 1 00000  10000  IR    AXT    **,1                                       BLDP066
00061  0020 00 4 00001  10000        TRA    1,4                                        BLDP067
00062  6060606060606    10000        *LORG
00063  0000000000001    10000
00064  0000000000033    10000
00065  0000000000006    10000
00066  0100000000000    10000
00067  0000000000032    10000
00070  6060606000000    10000

BINARY CARD ID. BLDP0005
00071  6060606060000    10000
                00000  01111        END                                        BLDP068
```

```
                SCDICT BLDP                                                    BLDP0004

BINARY CARD ID. BLDP0007
          C00072000000          PREFACE   START=0,LENGTH=58,TYPE=7094,CMPLX=5
          0L0U'04C00005
          224324476060  BLDP    DECK      LOC=0,LENGTH=58
          C00072DC0000
          224324476060  BLDP    REAL      LOC=0,LENGTH=0
          CCCN00000000

                SDKEND BLDP                                                    BLDP0006

NO MESSAGES FOR THIS ASSEMBLY
```


REFERENCES TO DEFINED SYMBOLS.

CLASS	SYMBOL	VALUE	REFERENCES
	BLDP	00000	
	BL	00013	3
	IA	00060	43
	LOOP	00046	50
	LT	00033	38
	NZ	00052	46,51
	ONE	00015	10
	RT	00036	23,24,32
LCTR	BLCTR		
QUAL	UNQS		
LCTR	//		
	TWO	00022	7
	ZE	00043	

```
SIBMAP DEBI    ICO,DECK                                          DEBI000
BEGIN ASSEMBLY  DEBI   TIME 17.12.00        ELAPSED TIME 00.00.05
```



```
      SIBLDR DEBI
      $FILE  DEBI    *COMMENTS*,OU,NOLIST,OUTPUT,BCD,BLK=14          DEBI0080
                                                                     DEBI0081
```

```
                                                    DEBI     DATE 06/23/66     TIME 17011055          PAGE 39

          FILE DICTIONARY.

                    $FDICT DEBI                                                          DEB10002

BINARY CARD ID. DEB10003
          201002000016  OUTPUT FILE   'COMMENTS          '          BCD,OUTPUT,NONCVN,BLK=14
          000000000000
          234444442345
          636260666060
          606060606060
```

```
                                                    DEBI     DATE 06/23/66     TIME 17011055          PAGE 40

          ASSEMBLED TEXT.

                    $TEXT  DEBI                                                          DEB10004

                                        * DEBI MAP PROGRAM FOR CONVERTING BCD NUMBERS                          DEB11001
                                        *      WITH POSSIBLE MINUS SIGN COMBINED WITH UNIT CHARACTER,          DEB11002
                                        *      INTO FLOATING OR (FORTRAN) FIXED POINT BINARY NUMBERS.          DEB11003
                                        *      UWMS-0947                                                       DEB11004
                                        *                                                                      DEB11005
                                        *      UNIVERSITY OF WASHINGTON                                        DEB11006
                                        *      DEPARTMENT OF OCEANOGRAPHY                                      DEB11007
                                        *      SEATTLE, WASHINGTON  98105                                      DEB11008
                                        *                                                                      DEB11009
                                        *      PROGRAMMED BY.. PAAVO KOVALA                                    DEB1100A
                                        *    REVISED BY..      FREDERICK EASTON          DECEMBER 1964       DEB11010
                                        *                                                                      DEB11011
                                        *      BCD INPUT DATA WORD MUST HAVE 6 NUMERICAL CHARACTERS.           DEB11012
                                        *      IN CASE OF ILLEGAL CHARACTER, COMMENT IS                        DEB11013
                                        *      WRITTEN AND RESULT IS MADE ZERO. BLANKS ARE READ AS ZEROES.     DEB11014
                                        *                                                                      DEB11015
                                              ENTRY   IDEBIF                                                   DEB11016
                                              ENTRY   IDEBI                                                    DEB11017
                                              ENTRY   DEBIF                                                    DEB11018
                                              ENTRY   DEBI                                                     DEB11019
                                        OUTPUT FILE   COMMENTS,OU,NOLIST,OUTPUT,BCD                            DEB11020
                              00000     DEBI   NULL                                                            DEB11021

BINARY CARD ID. DEB1C005
          C0000  0600 00 0 00114  10001  DEBIF  STZ    TEST          ZERO FOR FLOATING POINT                  DEB11022
          C0001  6020 00 0 01002  10011         TRA    *+2                                                    DEB11023
                              00002     IDEBI  NULL                                                            DEB11024
          00002  4625 00 0 00114  1C001  IDEBIF STL    TEST          NONZERO FOR FIXED POINT                  DEB11025
          00003  0634 00 1 00076  10001         SXA    IR,1          SAVE INDEX REGISTERS                     DEB11026
          0C004  0634 00 2 C0077  10001         SXA    IR+1,2                                                 DEB11027
          0C005  0634 00 4 00100  10001         SXA    IR+2,4                                                 DEB11028
          C0006  0774 00 1 0C006  10000         AXT    6,1                                                    DEB11029
          00C07  0774 00 2 C0C00  10000         AXT    0,2                                                    DEB11030
          00010  0500 60 4 00C03  10000         CLA*   3,4                                                    DEB11031
          00011  0601 00 0 00130  10001         STO    AA                                                     DEB11032
          00012  0601 00 0 00141  10001         STO    D                                                      DEB11033
          00013  4760 00 0 00016  10000         ENTM                                                          DEB11034
          C0014  4320 00 0 00147  1C001  LOOP   ANA    =077          LAST CHARACTER IN AC                     DEB11035
          C0015  0402 00 0 C0150  1C001         SUB    =060          CHECK WHETHER IT IS BLANK                DEB11036
          C0016  4160 00 0 00024  1C001         TNZ    FOUND         NOT BLANK, TRANSFER                      DEB11037
          C0017  4500 00 0 00141  10001         CAL    D             IT WAS BLANK                             DEB11038
          00020  0771 00 0 00006  10000         ARS    6             TAKE NEXT CHARACTER                      DEB11039
          00021  0602 C0 0 00141  10001         SLW    D                                                      DEB11040
          C0022  2 00001 1 00014  10001         TIX    LOOP,1,1                                               DEB11041

BINARY CARD ID. DEB10006
          C0023  6020 00 0 C0076  10001         TRA    IR                                                     DEB11042
          C0024  4540 C0 0 00141  10001  FOUND  CAL    D                                                      DEB11043
          0C025  0100 00 0 00076  10001         TZE    IR            NUMBER IS 0, SKIP THE REST               DEB11044
          0C026  0774 00 1 CCCCC  10000         AXT    0,1                                                    DEB11045
          C0027  0560 0C 0 00151  10001         LDQ    =011          9 INTO MQ                                DEB11046
          00030  4320 00 C C0152  1C001         ANA    =040          CHECK FOR MINUS SIGN                     DEB11047
          00031  0100 00 0 00044  10001         TZE    POS           NO MINUS SIGN IF 0 IN AC                 DEB11048
          00032  4540 C0 0 00141  10001         CAL    D                                                      DEB11049
```

```
00033  4320 00 0 00153  10001          ANA    =0777777777737   REMOVE MINUS SIGN                        DEBI050
00034  0602 00 0 00141  10001          SLW    D                                                        DEBI051
00035  4320 00 0 00147  10001          ANA    =077             CHECK LAST CHARACTER                    DEBI052
00036  0100 00 0 00105  10001          TZE    NON+2            IT WAS MINUS SIGN ALONE. ILLEGAL.       DEBI053
00037  4625 00 0 00132  10001          STL    A-6              THERE IS MINUS SIGN                     DEBI054
00040  0402 00 0 00146  10001          SUB    D+5              CHECK WHETHER IT WAS MINUS ZERO (52)    DEBI055
00041  4100 00 0 00045  10001          TNZ    POS+1                                                    DEBI056
00042  0600 00 0 00140  10001          STZ    A                IT WAS MINUS ZERO, 0 INTO A             DEBI057
00043  0020 00 0 00051  10001          TRA    POS+5                                                    DEBI058
00044  06C0 00 0 00132  10001  POS     STZ    A-6                                                      DEBI059
00045  4500 00 0 00141  10001          CAL    D                                                        DEBI060

BINARY CARD ID. DEBI0007
00046  4320 00 0 00147  10001          ANA    =077                                                     DEBI061
00047  0040 00 0 00103  10001          TLQ    NON              CHECK FOR NON-NUMERIC CHARACTERS        DEBI062
00050  0602 00 1 00140  10001          SLW    A,1              STORE NUMERIC CHARACTER                 DEBI063
00051  45C0 00 0 00141  10001          CAL    D                                                        DEBI064
00052  0771 00 0 00006  10000          ARS    6                                                        DEBI065
00053  0602 00 0 00141  10001          SLW    D                                                        DEBI066
00054  0100 00 0 01002  10011          TZE    *+2              FINISH CHECKING IF 0 IN AC              DEBI067
00055  1 00001 3 00046  10001          TXI    POS+2,3,1        NUMBER OF CHARACTERS INTO XR1, XR2      DEBI068
00056  7 00000 1 00067  10001          TXL    SIGN,1,0                                                 DEBI069
00057  0560 00 1 00147  10001  MULT    LDQ    D+6,1                                                    DEBI070
00060  0200 00 1 00140  10001          MPY    A,1              MULTIPLY CHARACTERS BY APPROPRIATE      DEBI071
00061  4600 00 1 00140  10001          STQ    A,1              POWER OF 10                             DEBI072
00062  2 00001 1 00057  10001          TIX    MULT,1,1                                                 DEBI073
00063  0500 00 0 00140  10001          CLA    A                                                        DEBI074
00064  0440 00 2 00140  10001          ADD    A,2              SUM THE PRODUCTS                        DEBI075
00065  2 00001 2 41001  10011          TIX    *-1,2,1                                                  DEBI076
00066  0601 00 0 00140  10001          STQ    A                RESULTING BINARY NUMBER INTO A          DEBI077
00067  0500 00 0 00140  10001  SIGN    CLA    A                                                        DEBI078
00070  0520 00 0 00132  10001          ZET    A-6                                                      DEBI079

BINARY CARD ID. DEBI0008
00071  4760 00 0 00003  10000          SSM                     SET SIGN MINUS FOR NEGATIVE NUMBER      DEBI080
00072  0520 00 0 00114  10001          ZET    TEST                                                     DEBI081
00073  0020 00 0 00076  10001          TRA    IR                                                       DEBI082
00074  4501 00 0 00154  10001          ORA    =0233000000000   MAKE FLOATING POINT NUMBER              DEBI083
00075  0300 00 0 00154  10001          FAD    =0233000000000                                           DEBI084
00076  0774 00 1 CC0C0  10000  IR      AXT    **,1             RESTORE INDEX REGISTERS                 DEBI085
00077  0774 00 2 C00C0  10000          AXT    **,2                                                     DEBI086
00100  0774 00 4 00000  10000          AXT    **,4                                                     DEBI087
00101  0760 00 0 00016  10000          LNTH                                                            DEBI088
00102  0020 00 4 00001  10000          TRA    1,4                                                      DEBI089
00103  0402 00 0 00150  10001  NON     SUB    =060             CHECK WHETHER IT WAS BLANK              DEBI090
00104  0100 00 0 00050  10001          TZE    POS+4            CONSIDER BLANK AS ZERO                  DEBI091
00105  C074 00 4 04000  10011          TSX    .OPEN,4                                                  DEBI092
00106  4 00000 0 04001  10010          NZE    OUTPUT                                                   DEBI093
00107  0074 00 4 07CC0  10011          TSX    .WRITE,4         NON-NUMERIC CHARACTER IN DATA WORD      DEBI094
00110  0 00000 0 04001  10010          PZE    OUTPUT,,0                                                DEBI095
00111  3 00014 0 C0115  10001          IOCT   MES3,,12                                                 DEBI096
00112  4754 00 0 00000  10000  ZERO    PXD    0,0              RESULT MADE ZERO                        DEBI097
00113  0020 00 0 CC076  10001          TRA    IR                                                       DEBI098

BINARY CARD ID. DEBI0009
00114  00C000000000     10000  TEST    DEC    0                                                        DEBI099
```



```
00115  602425223160     10000  MES3    BCI    7, DEBI ON IODEBI WAS FED NON-NUMERICAL DATA             DEBI100
00116  465160312425     10000
00117  223160662162     10000
00120  602625246045     10000
00121  464540656444     10000
00122  255131232143     10000
00123  602421632160     10000
00124  606330256022     10000          BCI    4, THE BCD DATA WORD WAS                                 DEBI101
00125  232460262163     10000
00126  216066465124     10000
00127  606621626060     10000
00130  0 00000 0 00000  10000  AA
00140  2C0000000007     00001  A       BES    7                                                        DEBI102
00140  0 00000 0 00000  10000          PZE                                                             DEBI103
00141  C0C000000000     10000  D       DEC    0,100000,10000,1000,100,10                               DEBI104
00142  000[  ]303240    10000                                                                          DEBI105
00143  00C000023420     10000
00144  000000001750     10000

BINARY CARD ID. DEBI0010
00145  00C000000144     10000
00146  000000000012     10000
00147  000000000077     10000          *LORG
00150  00C000000060     10000
00151  000C00C00011     10000
00152  050000C000040    10000
00153  7777777777737    10000
00154  233000000000     10000
                00000   01111          END                                                              DEBI106
```

CONTROL DICTIONARY — DEBI DATE 06/23/66 TIME 17:11:55 PAGE 43

$CDICT DEBI — DEB10011

BINARY CARD ID. DEB10012

000159000000		PREFACE	START=0,LENGTH=109,TYPE=7094,CMPLX=5
000004C00005			
242522316060	DEBI	DECK	LOC=0,LENGTH=109
F00159000000			
242522312660	DEBIP	REAL	LOC=0,LENGTH=0
00CC00000000			
242522316060	DEBI	REAL	LOC=0,LENGTH=0
000C00000000			
312429223126	IDEBIP	REAL	LOC=2,LENGTH=0
C00C00C00002			
312429223160	IDEBI	REAL	LOC=2,LENGTH=0
C00000000002			
334647294560	.OPEN	VIRTUAL	SECT. 6
206000000000			
334671316325	.WRITE	VIRTUAL	SECT. 7
20C000000000			

$DKEND DEBI — DEB10013

NO MESSAGES FOR THIS ASSEMBLY

SYMBOL REFERENCE DATA — DEBI DATE 06/23/66 TIME 17:11:55 PAGE 44

REFERENCES TO DEFINED SYMBOLS.

CLASS	SYMBOL	VALUE	REFERENCES
	AA	00130	11
	A	00140	37,42,44,58,60,61,63,64,66,67,70
	DEBIP	00000	
	DEBI	00000	
	D	00141	12,17,21,24,32,34,48,49,51,53,57
	FOUND	00024	16
	IDEBIP	00002	
	IDEBI	C0002	
	IR	00076	3,4,5,23,25,73,113
	LOOP	00014	22
	MESS	00115	111
	MULT	00057	62
	NON	00103	36,47
FILE	OUTPUT	1	104,110
	POS	00044	31,41,43,55,104
LCTR	BLCTR		
QUAL	UNIOS		
LCTR	//		
	SIGN	00067	56
	TEST	00114	8,2,72
	ZERO	00112	

REFERENCES TO VIRTUAL SYMBOLS.

.OPEN	6	105
.WRITE	7	107

BEGIN LOADING — IOLOA VER 5 TIME 17:12:06 — ELAPSED TIME 00:00:06

* MEMORY MAP *

```
SYSTEM                                  00000 THRU  02717
FILE BLOCK ORIGIN                       02720
FILES       1.      COMMENTS
            2.      UNIT05
            3.      UNIT06
FILE LIST ORIGIN                        02764
PRE-EXECUTION INITIALIZATION            02772
CALL ON OBJECT PROGRAM                  03015
OBJECT PROGRAM                          03022 THRU  75447
```

	DECK	ORIGIN	CONTROL SECTIONS (/NAME/=NON 0 LENGTH, (LOC)=DELETED, *=NOT REFERENCED)											
1.	PMPL	03022	/DIMS /	03024	EVEN	03023	.....	54556 *						
2.	ARVO	54603	/DIMS /	(03024)	ARVOL	60150								
3.	ELLA	60162	EVEN	60163	ELLAR	61020								
4.	BIDEF	61042	BIDE	61042	BIDEF	(61042)								
5.	BLOP	61213	BLOP	(61213)										
6.	DEBI	61305	DEBIF	61305 *	DEB.	(61305)	IDEBIF	61307 *	IDEBI	61307 *				
7.	.LXCON	61462	.LXSTR	61462 *	.LXLTP	61465	.LXOUT	61533	.LXERR	61542	.LXCAL	61545 *		
			.LXRTN	61545	IDEXIT	61545 *	.DBCLS	61727 *	.LXARG	62076	.LO	62171 *		
			.CLSE	62127	.LFBL	62130 *	.LUNB	62131	.DFOUT	62132				
8.	.IODEF	62136	.DEFIN	62136	.ATTAC	62142 *	.CLOSE	62144	.OPEN	62146	.READ	62150		
			.WRITE	62152	.BSR	62162	.READR	62172	.RELES	62174 *	.LAREA	62205		
			.LFBLK	62223	.LTSX	62226 *	.AREAL	62240	.LUNBL	62246	.ENTRY	62252		
			.GOA	62305	.GO	62311	.DERR	62325	.NOPRI	62326	.COMRI	62330		
			.EX36	62352										
9.	.LXSL	62357	.LXSBL	62357	.LXSLI	62360	.LXTST	62363 *	.LXOVL	62423 *	.LXMOD	62465 *		
			.LXIND	62511 *	.LXDIS	62514 *	.LXFLG	62515 *	.LTCH	62516				
10.	.FPTRP	62524	.FPPT.	62524 *	.FPOUT	62661	.FPARG	62667	/.COUNT/	62671 *	OVFLOW	62735 *		
11.	.ERAS.	62744	E.1	62744	E.2	62745	E.3	62746	E.4	62747				
12.	.ACC.	62750	CC.1	62750	CC.2	62751	CC.3	62752	CC.4	62753				
13.	XIT	62754	EXIT	62754	.EXIT.	62754 *								
14.	FREN	62755	.FREN.	62755	.FROUT	63322	.FEARG	63330	/.OPEN./	63404 *	/.OPTN./	63410 *		
15.	FOUT	63421	.FOUT.	63421										
16.	FCNV	63762	.FCON.	63762	.FCNV.	64005	.ENDFS	64020	.CNVSW	64022	.FDX1	64026		
			.FDX2	64027	.DBC	64031	.DBC10	64167	.DBC20	64215	.DDSW	64275		
			.DDFIX	64234	.FIXSW	64242	.DDBC	64317	.DDRS1	64562	.DDRS2	64564 *		
			.D1	64567	.D2	64571	.FERR2	64656 *	.ANPT	64712	.ONPT	64727		
			.LNTP	65012	.AOUT	65061	.OFLT	65077	.PLT	65233	.DERPN	65323		
			.FXD	65324	.HOUT	65454	.INTG	65524	.LOUT	65642	.OOUT	65661		
			.XCP	65712	.TEST	66420	.XOUNT	66423	.LIST	66426	.DONE	66437		
			.OUTBF	66504	EVEN	66503	.BUF	66534	.OSTO	66535	.WIDTH	66536		
			.GAIN	66537	.GAIN1	66540	.FBUBF	66550	EVEN	66561	.DOOFL	66575		
			.DOPLG	66576	.NOD	66577	.PEX	66600	.FEXP	66601	.DIG	66602		
17.	FIOS	66620	.FIOS.	66620	.FSEL.	66700	.FILR.	66764 *	.FRT0.	66773 *	.FRTD.	67000		
			.FILL.	67003	.FCLS	67005 *	.FOPN	67011 *	REOF	67015 *	.TOUT.	67160		
			.REED	67166 *	.BIN	67167 *	.FCT	67170	.FCRSZ	67172 *				
18.	FIOH	67254	.FIOH.	67254	.FFIL.	70041	.FRTN.	70066						
19.	FWRD	70264	.FWRD.	70264										
20.	FRDD	70310	.FRDD.	70310										
21.	UNCS	70336	.UNOS.	70336										
22.	UN06	70337	.UN06.	70337	.BUFSZ	70340								
23.	FLOG	70343	ALOG10	70343 *	ALOG	70344								
24.	FSCN	70547	COS	70547 *	SIN	70590								

25.	FSQR	70743	SQRT	70743										
26.	FATN	71016	ATAN2	71016 *	ATAN	71017								
27.	FBST	71250	.FBST.	71250										
28.	FSLOI	71465	.FSLI.	71503	.FSOI.	71511 *								
29.	FSLI	71522	.SLI.	71522	.SLI1.	71527	.SOI.	71535	.SJII.	71543				
30.	FSLOO	71556	.FSLO.	71574	.FSOO.	71602 *								
31.	FSLO	71613	.SLO.	71613	.SLO2.	71621	.SOO.	71626	.SOO2.	71635				
32.	.IOCS	71647	.LIOI	71647	.MONSW	71667	.TEOR	71736	.OEPI.	72016	.JOINX	72062 *		
			.CLOS.	72101	.ATTC.	72114	.SWI	72526 *	.SW9	72570 *	.OPEN.	72411		
			.OP4	72437 *	.OP7	72470 *	.OP9.2	72504 *	.RLSE.	72556	.WER2.	72556		
			.READ.	72557	.REB1.	72602	.WRIT.	72604	.WRTIA	72772 *	.EOFER	73053 *		
			.PEEIT	73123	.GTIOX	73144	.RW7	73262 *	.RE7	73705 *	.ENDTR	74346		
			.SEL59	74350 *	.BSR.	74761	.EOTOP	75106	.ETOP3	75114 *	.SWITC	75143		
			.TCHEX	75444	.BASIO	75447 *								
33.	.IOCSM	75450												

```
I/O BUFFERS                             75450 THRU  77364

UNUSED CORE                             77365 THRU  77400

BEGIN EXECUTION   TIME 17:12:25         ELAPSED TIME 00:00:19
```

Appendix d

Data Sheets

UNIVERSITY OF WASHINGTON
DEPARTMENT OF OCEANOGRAPHY

PHYTOPLANKTON - UwMS-1008
GROUP CARDS

PAGE _____ OF _____

COUNTRY	LAT. XX°XX.X'N/S	LONG. XXX°XX.X'E/W	DATE DA MO YR	(BLANK)	SPECIES GROUP NO.	SPECIES GROUP NAME	RATIO CODE	(BLANK)	NO. SPECIES CRF. CARDS	NO. SAMPLES	EXTRA ID	SHIP	CRUISE	STATION	CONTROL
1-2	3 8	9 15	16 21	22 27	28-29	30 61	62	63-66	67-68	69	70-71	72-73	74-76	77-79	80
XX	XXXXXN	XXXXXXW	XXXXXX		XX		X		XX	X		LL	XXX	XXX	1

TP

UNIVERSITY OF WASHINGTON
DEPARTMENT OF OCEANOGRAPHY

PHYTOPLANKTON - UWMS-1008
SAMPLE CARDS

PAGE _____ OF _____

HOUR	CHLORO. a.	ASSIMILATION 1			ASSIMILATION 2			(BLANK)	NUMBER OF SPEC. CARDS	DEPTH (m)	SAMPLE	EXTRA ID	SHIP	CRUISE	STATION	CONTROL
		$mg/m^3/t_1$	Time Unit	Tech.	$mg/m^3/t_2$	Time Unit	Tech.									
1-4	5-8	9 13	14-15	16	17 21	22-23	24	25 59	60-62	63-66	67-69	70-71	72-73	74-76	77-79	80
XXXX	XXXX	XXXXX	LL	X	XXXXX	LL	X		XXX	XXXX	XXX		LL	XXX	XXX	2

UNIVERSITY OF WASHINGTON
DEPARTMENT OF OCEANOGRAPHY

PHYTOPLANKTON - UWMS-1008
SPECIES CARDS

PAGE _____ OF _____

SPECIES NUMBER	SPECIES NAME (Genus, species, variety)	CHAMBER AREA TOTAL	CHAMBER AREA INSP.	NUMBER OF CELLS CNTD.	(BLANK)	NUMBER OF DIMENS. CDS	DEPTH (m)	SAMPLE	EXTRA ID	SHIP	CRUISE	STATION	CONTROL
1 5	6 45	46-49	50-53	54-57	58-59	60-62	63-66	67-69	70-71	72-73	74-76	77-79	80
XXXXX		XXXX	XXXX	XXXX		XXX	XXXX	XXX		LL	XXX	XXX	3

(p3)

UNIVERSITY OF WASHINGTON
DEPARTMENT OF OCEANOGRAPHY

PHYTOPLANKTON - UWMS-1008
DIMENSION CARDS

PAGE_____OF_____

SPECIES NUMBER	NUMBER OF CELLS MEAS	SHAPE	DIMENSIONS												CHAMBER VOL(ml)	R(#/unit)	(BLANK)	DEPTH (m)	SAMPLE	EXTRA ID	SHIP	CRUISE	STATION	CONTROL
			A	B	C	D	E	F	G	H	J	K	L	P										
1 5	6-8	9-10	11-13	14-16	17-19	20-22	23-25	26-28	29-31	32-34	35-37	38-40	41-43	44-46	47-50	51-53	54-62	63-66	67-69	70-71	72-73	74-76	77-79	80
XXXXX	XXX	XX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXXX	XXX		XXXX	XXX		LL	XXX	XXX	4

UNIVERSITY OF WASHINGTON
DEPARTMENT OF OCEANOGRAPHY

PHYTOPLANKTON - UWMS-1009
GROUP CARD

PAGE_____OF_____

SHIP	CRUISE	STATION	EXTRA ID	LATITUDE	LONGITUDE	DATE	NO. SAMPLES	NO. SPECIES GRP CARDS	(BLANK)	SPECIES GRP NO.	SPECIES GROUP NAME	RATIO CODE	(BLANK)	CONTROL
				XX°XX.X'N/S	XXX°XX.X'E/W	DA MO YR								
1-2	3-5	6-8	9-10	11 16	17 23	24 29	30	31-32	33-40	41-42	43 74	75	76-79	80
LL	XXX	XXX		XXXXXN	XXXXXXW	XXXXXX	X	XX		XX		X		1

SP

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PHYTOPLANKTON - UWMS-1009
SAMPLE CARD

PAGE_____OF_____

SHIP	CRUISE	STATION	EXTRA ID	SAMPLE	DEPTH (m)	HOUR	NO. SPECIES CARDS	(BLANK)	CHLORO. al	ASSIMILATION 1			ASSIMILATION 2			CONTROL
										$mg/m^3/t_1$	Time Unit t_1	TECH	$mg/m^3/t_2$	Time Unit t_2	TECH	
1 - 2	3 - 5	6-8	9-10	11 13	14 17	18 21	22-24	25 59	60 63	64 68	69-70	71	72 76	77-78	79	80
LL	XXX	XXX		XXX	XXX.X	XXXX	XXX		XX.XX	XXX.XX	LL	X	XXX.XX	LL	X	2

9p

UNIVERSITY OF WASHINGTON
DEPARTMENT OF OCEANOGRAPHY

PHYTOPLANKTON - UWMS-1009
SPECIES CARD

PAGE _____ OF _____

SHIP	CRUISE	STATION	EXTRA ID	SAMPLE	DEPTH (m)	NO. OF DIMENSION CARDS	SPECIES NUMBER	SPECIES NAME (GENUS, Species, variety)	CHAMBER AREA	CHAMBER AREA INSP.	NO. OF CELLS COUNTED	(BLANK)	CONTROL
1-2	3-5	6 - 8	9 -10	11 13	14 17	18 20	21 25	26 65	66 -69	70-73	74 - 77	78-79	80
LL	XXX	XXX		XXX	XXX.X	XXX	XXXXX		XXXX	XXXX	XXXX		3

d7

UNIVERSITY OF WASHINGTON
DEPARTMENT OF OCEANOGRAPHY

PHYTOPLANKTON - UWMS-1009
DIMENSION CARD

PAGE _____ OF _____

SHIP	CRUISE	STATION	EXTRA ID	SAMPLE	DEPTH (m)	NO. OF CELLS MEASURED	SPECIES NUMBER	SHAPE	DIMENSIONS												CHAMBER VOLUME	R(μ/UNIT)	(BLANK)	CONTROL
									A	B	C	D	E	F	G	H	J	K	L	P				
1 2	3 5	6 8	9-10	11-13	14 17	18 20	21 25	26-27	28-30	31-33	34-36	37-39	40-42	43-45	46-48	49-51	52-54	55-57	58-60	61-63	64-67	68-70	71-79	80
LL	XXX	XXX		XXX	XXX.X	XXX	XXXXX	XX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XX.X	XX.XX	X.X		4

8p

Appendix e

Test Case

BLANK PAGE

SAMPLE DATA FOR UWMS-1008

```
$DATA
  47463N122512W040261
1255006500123XX502000HR6
02001OXYTOXUM SP.
0200100117          43011
  47463N122512W040261
  47463N122512W040261
  47463N122512W040261
  47463N122512W040261
  47463N122512W040261
1210011701234XX500300HR6
01001MELOSIRA SULCATA
01001   603 13 08
01003THALASSIOSIRA SP.
01003   103 48 13
01003   203 26 06
01004COSCINODISCUS SP.
01004   203 23 07
01004   103 13 04
01005CORETHRON HYSTRIX
01005   105 54 17
01008CENTRALES
01008   103 28 06
01010PLEUROSIGMA SP.
 1010   115167 23 04 04
01014RHOICOSPHENIA CURVATA
01014   109 35 05 08 00
01015COCCONEIS SP.
01015   109 25 18 03 00
01017PENNALES
01017   107130 05 15
12350234            10000HR6
01003THALASSIOSIRA SP.
01003   103 15 09
01003   103 25 06
01003   103 27 06
01005CORETHRON HYSTRIX
01005   105 45 17
01006CHAETOCEROS CONCAVICORNIS
01006   209 17 17 15 03765
01007CHAETOCEROS SP.
01007   109              03500
01007   109              04965
01007   209              04980
01008CENTRALES
01008   103 16 06
01008   103 14 04
01008   103 13 04
01009PLEUROSIGMA FASCIOLA
 1009   115 08 06 03 03
01011NITZSCHIA CLOSTERIUM
01011   106 00 04 04 12 13
01013NITZSCHIA SP.
01013   107112 03 07
01015COCCONEIS SP.
01015   109 23 12 06
```

```
02DINOFLAGELLATES                                  1     011   DAB170021
                                                 0010100   3   DAB170022
                                287503830001     0010100   3   DAB170023
021  8                           2640100           0100   3   DAB170024
  040THER AUTOTROPHIC FLAGELLATES                  1     058   DAB170021
  03COCCOLITHOPHORIDS              1     058   DAB170021
  01DIATOMS                        1     058   DAB170021
  050THERS                         1     058   DAB170021
  02DINOFLAGELLATES                1     058   DAB170021
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               287528750003      0030050   2   DAB170023
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              202640100            0050   2   DAB170024
              202640100            0050   2   DAB170024
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              202640100            0050   2   DAB170024
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              102640100            0050   2   DAB170024
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01004  203 43 08
01012NITZSCHIA DELICATISSIMA
01012  115 09 03 01 01
01016PENNALES A
01016  107 08 01 03
01017PENNALES
01017  107 50 03 05
01017  107 20 02 06
01017  115 20 05 02 02
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02001  117 00 00 43 11    21 08
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                 0011000  8  DAB170022
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SAMPLE DATA FOR UWMS-1009

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DAB17001    201000010200117       043011   021008                        2640100       4
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DAB17002  47463N122512W040261805          03COCCOLITHPHORIDS               1    1
DAB17002  47463N122512W040261805          01DIATOMS                        1    1
DAB17002  47463N122512W040261805          05OTHERS                         1    1
DAB17002  47463N122512W040261805          02DINOFLAGELLATES                1    1
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DAB17002    10000  10100505 54 17                                        052640100     4
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DAB17002    10000  10100803 28 06                                        202640100     4
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SECF
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NUMBER OF CELLS (NUMBER / LITER)

CRUISE DA817	STATION 002	LATITUDE 47-46.3N	LONGITUDE 122-51.2W	DATE 02/04/81
SAMPLE NO.		3		
DEPTH (METERS)		10.0		
TIME		1255		
CHLOROPHYLL A (MG/M3)		0.65		
ASSIMILATION, TECH. 5 (MG C/M3/HR)		1.23		
ASSIMILATION, TECH. 6 (MG C/M3/HR)		20.00		
DINOFLAGELLATES				
OXYTOXUM SP.		2.84E 02		
TOTAL - DINOFLAGELLATES		2.84E 02		
GRAND TOTAL		2.84E 02		

CELL AREAS (SQ.MICRONS / LITER)

CRUISE DA817	STATION 002	LATITUDE 47-46.3N	LONGITUDE 122-51.2W	DATE 02/04/81
SAMPLE NO.		3		
DEPTH (METERS)		10.0		
TIME		1255		
CHLOROPHYLL A (MG/M3)		0.65		
ASSIMILATION, TECH. 5 (MG C/M3/HR)		1.23		
ASSIMILATION, TECH. 6 (MG C/M3/HR)		20.00		
DINOFLAGELLATES				
OXYTOXUM SP.		2.48E 05		
TOTAL - DINOFLAGELLATES		2.48E 05		
GRAND TOTAL		2.48E 05		

CELL VOLUMES (CU.MICRONS / LITER)

CRUISE DAB17	STATION 002	LATITUDE 47-46.3N	LONGITUDE 122-51.2W	DATE 02/04/61
SAMPLE NO.		3		
DEPTH (METERS)		10.0		
TIME		1255		
CHLOROPHYLL A (MG/M3)		0.65		
ASSIMILATION, TECH. 5 (MG C/M3/HR)		1.23		
ASSIMILATION, TECH. 6 (MG C/M3/HR)		20.00		
DINOFLAGELLATES				
OXYTOXUM SP.		4.07E 05		
TOTAL - DINOFLAGELLATES		4.07E 05		
GRAND TOTAL		4.07E 05		

PLASMA VOLUMES (CU.MICRONS / LITER)

CRUISE DAB17	STATION 002	LATITUDE 47-46.3N	LONGITUDE 122-51.2W	DATE 02/04/61
SAMPLE NO.		3		
DEPTH (METERS)		10.0		
TIME		1255		
CHLOROPHYLL A (MG/M3)		0.65		
ASSIMILATION, TECH. 5 (MG C/M3/HR)		1.23		
ASSIMILATION, TECH. 6 (MG C/M3/HR)		20.00		
DINOFLAGELLATES				
OXYTOXUM SP.		4.07E 05		
TOTAL - DINOFLAGELLATES		4.07E 05		
GRAND TOTAL		4.07E 05		

RATIO - AREA / CELL VOLUME (1 / MICRON)

CRUISE DAB17	STATION 002	LATITUDE 47-46.3N	LONGITUDE 122-51.2W	DATE 02/04/61
SAMPLE NO.		3		
DEPTH (METERS)		10.0		
TIME		1255		
CHLOROPHYLL A (MG/M3)		0.65		
ASSIMILATION, TECH. 5 (MG C/M3/XX)		1.23		
ASSIMILATION, TECH. 6 (MG C/M3/HR)		20.00		
DINOFLAGELLATES				
OXYTOXUM SP.		5.09E-01		
RATIO OF TOTALS		5.09E-01		
RATIO OF GRAND TOTALS		5.09E-01		

RATIO - AREA / PLASMA VOLUME (1 / MICRON)

CRUISE DAB17	STATION 002	LATITUDE 47-46.3N	LONGITUDE 122-51.2W	DATE 02/04/61
SAMPLE NO.		3		
DEPTH (METERS)		10.0		
TIME		1255		
CHLOROPHYLL A (MG/M3)		0.65		
ASSIMILATION, TECH. 5 (MG C/M3/XX)		1.23		
ASSIMILATION, TECH. 6 (MG C/M3/HR)		20.00		
DINOFLAGELLATES				
OXYTOXUM SP.		5.09E-01		
RATIO OF TOTALS		5.09E-01		
RATIO OF GRAND TOTALS		5.09E-0		

RATIO - AREA / NUMBER OF CELLS (50.MICRONS)

CRUISE DAB17	STATION 002	LATITUDE 47-46.3N	LONGITUDE 122-51.2W	DATE 02/04/61
SAMPLE NO.		3		
DEPTH (METERS)		10.0		
TIME		1255		
CHLOROPHYLL A (MG/M3)		0.65		
ASSIMILATION, TECH. 5 (MG C/M3/XX)		1.23		
ASSIMILATION, TECH. 6 (MG C/M3/HR)		20.00		
DINOFLAGELLATES				
OXYTOXUM SP.		0.72E 02		
RATIO OF TOTALS		0.72E 02		
RATIO OF GRAND TOTALS		0.72E 02		

RATIO - CELL VOLUME / NUMBER OF CELLS (CU.MICRONS)

CRUISE CAB17	STATION 002	LATITUDE 47-46.3N	LONGITUDE 122-51.2W	DATE 02/04/61
SAMPLE NO.		3		
DEPTH (METERS)		10.0		
TIME		1255		
CHLOROPHYLL A (MG/M3)		0.65		
ASSIMILATION, TECH. 5 (MG C/M3/HR)		1.23		
ASSIMILATION, TECH. 6 (MG C/M3/HR)		20.00		
DINOFLAGELLATES				
GYMNODINIUM SP.		1.71E 03		
RATIO OF TOTALS		1.71E 03		
RATIO OF GRAND TOTALS		1.71E 03		

RATIO - PLASMA VOLUME / NUMBER OF CELLS (CU.MICRONS)

CRUISE CAB17	STATION 002	LATITUDE 47-46.3N	LONGITUDE 122-51.2W	DATE 02/04/61
SAMPLE NO.		3		
DEPTH (METERS)		10.0		
TIME		1255		
CHLOROPHYLL A (MG/M3)		0.65		
ASSIMILATION, TECH. 5 (MG C/M3/HR)		1.23		
ASSIMILATION, TECH. 6 (MG C/M3/HR)		20.00		
DINOFLAGELLATES				
GYMNODINIUM SP.		1.71E 03		
RATIO OF TOTALS		1.71E 03		
RATIO OF GRAND TOTALS		1.71E 03		

NUMBER OF CELLS (NUMBER / LITER)

CRUISE DAB17 STATION 002 LATITUDE 47-46.3N LONGITUDE 122-51.2W DATE 92/04/01

SAMPLE NO.	1	2	3	4	5	6	7	8	INTEGRATE VALUES/M2
DEPTH (METERS)	0.0	5.0	10.0	20.0	30.0	50.0	75.0	100.0	
TIME	1210	1255	1255	1320	1345	1415	1440	1530	
CHLOROPHYLL A (MG/M3)	1.17	2.34	0.65	1.50	1.00	0.60	0.30	0.00	79.50
ASSIMILATION, TECH. 5 (MG C/M3/HR)	12.34		1.23	1.05		0.50	0.15		
ASSIMILATION, TECH. 6 (MG C/M3/HR)	3.00	100.00	20.00	10.00	5.00	3.00	2.50	0.00	962.50
DIATOMS									
MELOSIRA SULCATA	3.79E 01	0	0	0	0	0	0	0	9.47E 04
MELOSIRA NUMULOIDES	0	0	1.71E 03	0	0	0	0	0	1.28E 07
THALASSIOSIRA SP.	1.14E 02	1.14E 02	0	0	0	0	0	0	8.52E 05
COSCINODISCUS SP.	1.14E 02	0	0.55E 02	0	0	0	0	0	6.70E 06
CORETHRON HYSTRIX	3.79E 01	3.79E 01	0	0	0	0	0	0	2.84E 05
CHAETOCEROS CONCAVICORNIS	0	7.58E 01	0	0	0	0	0	0	1.79E 05
CHAETOCEROS SP.	0	1.14E 02	0	0	0	0	0	0	9.68E 05
CENTRALES	3.79E 01	1.89E 02	0	0	0	0	0	0	1.04E 06
PLEUROSIGMA FASCIOLA	0	3.79E 01	0	0	0	0	0	0	1.89E 05
PLEUROSIGMA SP.	3.79E 01	0	0	0	0	0	0	0	9.47E 04
NITZSCHIA CLOSTERIUM	0	3.03E 02	0	0	0	0	0	0	1.97E 06
NITZSCHIA DELICATESSIMA	0	0	1.45E 03	0	0	0	0	0	1.07E 07
NITZSCHIA SP.	0	3.79E 01	0	0	0	0	0	0	1.89E 05
RHIZOSPHENIA CURVATA	3.79E 01	0	0	0	0	0	0	0	9.47E 04
COCCONEIS SP.	3.79E 01	1.14E 02	0	0	0	0	0	0	6.63E 05
PENNALES A	0	0.64E 03	1.80E 04	0	0	0	0	0	1.04E 06
PENNALES	3.79E 01	7.58E 01	0.59E 02	0	0	0	0	0	6.89E 06
TOTAL - DIATOMS	4.92E 02	9.73E 03	2.37E 04	0	0	0	0	0	2.27E 08
DINOFLAGELLATES									
OXYTOXUM SP.	0	0	2.05E 02	0	0	0	0	0	2.14E 06
TOTAL - DINOFLAGELLATES	0	0	2.05E 02	0	0	0	0	0	2.14E 06
COCCOLITHOPHORIDS									
SPECIES 1	0	0	0	1.00E 02	0	0	0	0	1.00E 06
SPECIES 4	0	0	0	1.00E 02	0	0	0	0	1.00E 06
SPECIES 8	0	0	0	0	1.00E 02	0	0	0	1.50E 06
SPECIES 9	0	0	0	0	1.00E 02	0	0	0	1.50E 06
SPECIES 10	0	0	0	0	1.00E 02	0	0	0	1.50E 06
SPECIES 11	0	0	0	0	1.00E 02	0	0	0	1.50E 06
SPECIES 12	0	0	0	0	1.00E 02	0	0	0	1.50E 06
SPECIES 13	0	0	0	0	1.00E 02	0	0	0	1.50E 06
SPECIES 16	0	0	0	0	0	1.00E 02	0	0	1.50E 06
TOTAL - COCCOLITHOPHORIDS	0	0	0	2.00E 02	5.00E 02	1.00E 02	1.00E 02	0	1.42E 07
OTHER AUTOTROPHIC FLAGELLATES									
SPECIES 2	0	0	0	1.00E 02	0	0	0	0	1.00E 06
SPECIES 5	0	0	0	1.00E 02	0	0	0	0	1.00E 06
SPECIES 7	0	0	0	1.00E 02	0	0	0	0	1.00E 06
SPECIES 14	0	0	0	0	0	1.00E 02	0	0	2.25E 06
SPECIES 15	0	0	0	0	0	1.00E 02	0	0	2.25E 06
SPECIES 17	0	0	0	0	0	0	1.00E 02	0	2.50E 06
TOTAL - OTHER AUTOTROPHIC FLAGELLATES	0	0	0	3.00E 02	0	2.00E 02	1.00E 02	0	1.00E 07
OTHERS									
SPECIES 10	0	0	0	0	0	0	0	1.00E 02	1.25E 06
SPECIES 6	0	0	0	1.00E 02	0	0	0	0	1.00E 06
SPECIES 3	0	0	0	1.00E 02	0	0	0	0	1.00E 06
TOTAL - OTHERS	0	0	0	2.00E 02	0	0	0	1.00E 02	3.25E 06
GRAND TOTAL	4.92E 02	9.73E 03	2.39E 04	7.00E 02	5.00E 02	3.00E 02	2.00E 02	1.00E 02	2.57E 08

CELL AREAS (SQ.MICRONS / LITER)

CRUISE DA017 STATION 002 LATITUDE 47-46.3N LONGITUDE 122-51.2W DATE 02/04/61

SAMPLE NO.	1	2	3	4	5	6	7	8	INTEGRATED VALUES/M2
DEPTH (METERS)	0.0	5.0	10.0	20.0	30.0	50.0	75.0	100.0	
TIME	1210	1235	1255	1320	1345	1415	1440	1530	
CHLOROPHYLL A (MG/M3)	1.17	2.34	0.65	1.50	1.00	0.60	0.30	0.00	70.50
ASSIMILATION, TECH. 5 (MG C/M3/HR)	12.34		1.23	1.05		0.50	0.15		
ASSIMILATION, TECH. 6 (MG C/M3/HR)	3.00	100.00	20.00	10.00	5.00	3.00	2.50	0.00	982.50
DIATOMS									
MELOSIRA SULCATA	2.24E 04	0	0	0	0	0	0	0	5.61E 07
MELOSIRA NUMULOIDES	0	0	1.06E 06	0	0	0	0	0	7.90E 09
THALASSIOSIRA SP.	3.29E 05	1.47E 05	0	0	0	0	0	0	1.96E 09
COSCINODISCUS SP.	1.18E 05	0	3.41E 06	0	0	0	0	0	2.59E 10
CORETHRON HYSTRIX	1.09E 05	9.10E 04	0	0	0	0	0	0	7.28E 08
CHAETOCEROS CONCAVICORNIS	0	6.41E 05	0	0	0	0	0	0	3.21E 09
CHAETOCEROS SP.	0	1.10E 06	0	0	0	0	0	0	5.89E 09
CENTRALES	6.66E 04	1.02E 05	0	0	0	0	0	0	6.77E 08
PLEUROSIGMA FASCIOLA	0	4.09E 03	0	0	0	0	0	0	2.05E 07
PLEUROSIGMA SP.	1.97E 05	0	0	0	0	0	0	0	4.91E 08
NITZSCHIA CLOSTERIUM	0	4.82E 04	0	0	0	0	0	0	2.41E 08
NITZSCHIA DELICATISSIMA	0	0	6.55E 04	0	0	0	0	0	4.91E 08
NITZSCHIA SP.	0	8.64E 04	0	0	0	0	0	0	4.32E 08
AMPHIPROSPHENIA CURVATA	3.42E 04	0	0	0	0	0	0	0	8.55E 07
COCCONEIS SP.	3.46E 04	8.06E 04	0	0	0	0	0	0	5.20E 08
PENNALES A	0	6.09E 05	1.32E 06	0	0	0	0	0	1.29E 10
PENNALES	2.03E 05	4.01E 04	3.07E 05	0	0	0	0	0	3.65E 09
TOTAL - DIATOMS	1.11E 06	3.04E 06	6.24E 06	0	0	0	0	0	6.40E 10
DINOFLAGELLATES									
GYMNODINIUM SP.	0	0	2.49E 05	0	0	0	0	0	1.87E 09
TOTAL - DINOFLAGELLATES	0	0	2.49E 05	0	0	0	0	0	1.87E 09
COCCOLITHOPHORIDS									
SPECIES 1	0	0	0	3.14E 04	0	0	0	0	3.14E 08
SPECIES 4	0	0	0	1.27E 05	0	0	0	0	1.27E 09
SPECIES 8	0	0	0	0	3.87E 04	0	0	0	5.80E 08
SPECIES 9	0	0	0	0	8.74E 04	0	0	0	1.31E 09
SPECIES 10	0	0	0	0	1.66E 05	0	0	0	2.49E 09
SPECIES 11	0	0	0	0	1.84E 05	0	0	0	2.76E 09
SPECIES 12	0	0	0	0	1.84E 05	0	0	0	2.75E 09
SPECIES 13	0	0	0	0	0	1.29E 05	0	0	2.90E 09
SPECIES 16	0	0	0	0	0	0	4.19E 04	0	1.05E 09
TOTAL - COCCOLITHOPHORIDS	0	0	0	1.59E 05	6.59E 05	1.29E 05	4.19E 04	0	1.54E 10
OTHER AUTOTROPHIC FLAGELLATES									
SPECIES 2	0	0	0	3.14E 04	0	0	0	0	3.14E 08
SPECIES 5	0	0	0	3.46E 05	0	0	0	0	3.46E 09
SPECIES 7	0	0	0	7.00E 04	0	0	0	0	7.00E 08
SPECIES 14	0	0	0	0	0	1.10E 05	0	0	2.66E 09
SPECIES 15	0	0	0	0	0	2.04E 05	0	0	4.59E 09
SPECIES 17	0	0	0	0	0	0	4.27E 04	0	1.07E 09
TOTAL - OTHER AUTOTROPHIC FLAGELLATES	0	0	0	4.47E 05	0	3.22E 05	4.27E 04	0	1.20E 10
OTHERS									
SPECIES 18	0	0	0	0	0	0	0	7.16E 04	8.95E 08
SPECIES 6	0	0	0	3.33E 05	0	0	0	0	3.33E 09
SPECIES 1	0	0	0	4.71E 04	0	0	0	0	4.71E 08
TOTAL - OTHERS	0	0	0	3.81E 05	0	0	0	7.16E 04	4.70E 09
GRAND TOTAL	1.11E 06	3.04E 06	6.49E 06	9.86E 05	6.59E 05	4.51E 05	8.46E 04	7.16E 04	9.96E 10

CELL VOLUMES (CU.MICRONS / LITER)

CRUISE OABIT STATION 002 LATITUDE 47-46.3N LONGITUDE 122-51.2W DATE 02/04/61

SAMPLE NO.	1	2	3	4	5	6	7	8	INTEGRATED VALUES/M2
DEPTH (METERS)	0.0	5.0	10.0	20.0	30.0	50.0	75.0	100.0	
TIME	1210	1235	1255	1320	1345	1415	1440	1530	
CHLOROPHYLL A (MG/M3)	1.17	2.34	0.65	1.50	1.00	0.60	0.30	0.00	70.50
ASSIMILATION, TECH. 5 (MG C/M3/HR)	12.34		1.23	1.05		0.50	0.15		
ASSIMILATION, TECH. 6 (MG C/M3/HR)	5.00	100.00	20.00	10.00	5.00	1.00	2.50	0.00	962.50
DIATOMS									
MELOSIRA SULCATA	4.02E 04	0	0	0	0	0	0	0	1.01E 00
MELOSIRA NUMULOIDES	0	0	2.33E 06	0	0	0	0	0	1.79E 10
THALASSIOSIRA SP.	1.13E 06	3.02E 05	0	0	0	0	0	0	4.34E 09
COSCINODISCUS SP.	2.40E 05	0	9.94E 06	0	0	0	0	0	7.91E 10
CORETHRON HYSTRIX	4.16E 05	3.36E 05	0	0	0	0	0	0	2.73E 09
CHAETOCEROS CONCAVICORNIS	0	6.68E 05	0	0	0	0	0	0	3.34E 09
CHAETOCEROS SP.	0	1.14E 06	0	0	0	0	0	0	9.72E 09
CENTRALES	1.40E 05	1.49E 05	0	0	0	0	0	0	1.09E 09
PLEUROSIGMA PARCIOLA	0	2.73E 03	0	0	0	0	0	0	1.36E 07
PLEUROSIGMA SP.	2.91E 05	0	0	0	0	0	0	0	7.27E 08
NITZSCHIA CLUSTERIUM	0	3.17E 06	0	0	0	0	0	0	1.59E 09
NITZSCHIA DELICATISSIMA	0	0	1.92E 04	0	0	0	0	0	1.44E 08
NITZSCHIA SP.	0	8.91E 04	0	0	0	0	0	0	6.69E 08
RHIZOSPHENIA CURVATA	4.16E 04	0	0	0	0	0	0	0	1.04E 08
COCCONEIS SP.	4.02E 04	1.68E 05	0	0	0	0	0	0	6.19E 08
PENNALES A	0	2.87E 05	4.52E 05	0	0	0	0	0	4.42E 09
PENNALES	3.69E 05	4.69E 04	3.11E 05	0	0	0	0	0	3.49E 09
TOTAL - DIATOMS	2.71E 06	3.13E 06	1.30E 07	0	0	0	0	0	1.20E 11
DINOFLAGELLATES									
BRYTONUM SP.	0	0	4.09E 05	0	0	0	0	0	3.66E 09
TOTAL - DINOFLAGELLATES	0	0	4.09E 05	0	0	0	0	0	3.66E 09
COCCOLITHOPHORIDS									
SPECIES 1	0	0	0	5.24E 04	0	0	0	0	5.24E 08
SPECIES 4	0	0	0	2.79E 05	0	0	0	0	2.79E 09
SPECIES 8	0	0	0	0	4.33E 04	0	0	0	4.58E 08
SPECIES 9	0	0	0	0	1.99E 05	0	0	0	2.58E 09
SPECIES 10	0	0	0	0	4.20E 05	0	0	0	6.29E 09
SPECIES 11	0	0	0	0	4.72E 05	0	0	0	7.08E 09
SPECIES 12	0	0	0	0	4.70E 05	0	0	0	6.60E 09
SPECIES 13	0	0	0	0	0	1.93E 05	0	0	4.34E 09
SPECIES 16	0	0	0	0	0	0	5.58E 04	0	1.37E 09
TOTAL - COCCOLITHOPHORIDS	0	0	0	3.31E 05	1.49E 06	1.93E 05	5.58E 04	0	3.14E 10
OTHER AUTOTROPHIC FLAGELLATES									
SPECIES 2	0	0	0	9.18E 04	0	0	0	0	9.18E 08
SPECIES 5	0	0	0	8.58E 05	0	0	0	0	8.58E 09
SPECIES 7	0	0	0	1.00E 05	0	0	0	0	1.00E 09
SPECIES 14	0	0	0	0	0	2.79E 05	0	0	6.19E 09
SPECIES 15	0	0	0	0	6.17E 05	0	0	0	9.37E 09
SPECIES 17	0	0	0	0	0	0	5.60E 04	0	1.40E 09
TOTAL - OTHER AUTOTROPHIC FLAGELLATES	0	0	0	9.90E 05	0	6.92E 05	5.60E 04	0	2.69E 10
OTHERS									
SPECIES 18	0	0	0	0	0	0	0	1.29E 05	1.01E 09
SPECIES 6	0	0	0	9.42E 05	0	0	0	0	9.42E 09
SPECIES 3	0	0	0	7.05E 04	0	0	0	0	7.05E 08
TOTAL - OTHERS	0	0	0	1.02E 06	0	0	0	1.29E 05	1.19E 10
GRAND TOTAL	2.71E 06	3.13E 06	1.35E 07	2.34E 06	1.49E 06	8.04E 05	1.11E 05	1.29E 05	1.94E 11

PLASMA VOLUMES (CU.MICRONS / LITER)

CRUISE 8AB17 STATION 002	LATITUDE 47-46.3N		LONGITUDE 122-51.2W			DATE 02/06/81			
SAMPLE NO.	1	2	3	4	5	6	7	8	INTEGRATED VALUES/M2
DEPTH (METERS)	0.0	5.0	10.0	20.0	30.0	50.0	75.0	100.0	
TIME	1210	1235	1255	1320	1345	1415	1440	1530	
CHLOROPHYLL A (MG/M3)	1.17	2.34	0.65	1.50	1.00	0.60	0.30	0.00	70.50
ASSIMILATION, TECH. 5 (MG C/M3/HR)	12.34		1.23	1.05		0.50	0.15		
ASSIMILATION, TECH. 6 (MG C/M3/HR)	3.00	100.00	20.00	10.00	5.00	3.00	2.50	0.00	962.50
DIATOMS									
MELOSIRA SULCATA	3.15E 04	0	0	0	0	0	0	0	7.00E 07
MELOSIRA NUMULOIDES	0	0	1.64E 06	0	0	0	0	0	1.23E 10
THALASSIOSIRA SP.	6.14E 05	2.34E 05	0	0	0	0	0	0	2.70E 09
COSCINODISCUS SP.	1.76E 05	0	6.26E 06	0	0	0	0	0	4.74E 10
CORETHRON HYSTRIX	8.80E 04	1.09E 05	0	0	0	0	0	0	7.68E 08
CHAETOCEROS CONCAVICORNIS	0	5.11E 05	0	0	0	0	0	0	2.55E 09
CHAETOCEROS SP.	0	1.14E 06	0	0	0	0	0	0	5.72E 09
CENTRALES	1.09E 05	1.14E 05	0	0	0	0	0	0	8.41E 08
PLEUROSIGMA FASCIOLA	0	2.45E 05	0	0	0	0	0	0	1.22E 07
PLEUROSIGMA SP.	1.02E 05	0	0	0	0	0	0	0	4.55E 08
NITZSCHIA CLOSTERIUM	0	3.17E 04	0	0	0	0	0	0	1.59E 08
NITZSCHIA DELICATISSIMA	0	0	1.92E 04	0	0	0	0	0	1.44E 08
NITZSCHIA SP.	0	7.03E 04	0	0	0	0	0	0	3.52E 08
RHIZOSOLENIA CURVATA	2.57E 04	0	0	0	0	0	0	0	6.44E 07
COCCONEIS SP.	1.03E 04	8.03E 04	0	0	0	0	0	0	4.47E 08
PENNALES A	0	2.07E 05	4.52E 05	0	0	0	0	0	4.62E 09
PENNALES	3.22E 05	3.76E 04	2.41E 05	0	0	0	0	0	2.00E 09
TOTAL - DIATOMS	1.57E 06	2.54E 06	9.61E 06	0	0	0	0	0	8.12E 10
DINOFLAGELLATES									
OXYTOXUM SP.	0	0	4.89E 05	0	0	0	0	0	3.66E 09
TOTAL - DINOFLAGELLATES	0	0	4.89E 05	0	0	0	0	0	3.66E 09
COCCOLITHOPHORIDS									
SPECIES 1	0	0	0	2.82E 04	0	0	0	0	2.82E 08
SPECIES 4	0	0	0	1.27E 05	0	0	0	0	1.27E 09
SPECIES 8	0	0	0	0	3.00E 04	0	0	0	4.50E 08
SPECIES 9	0	0	0	0	7.72E 04	0	0	0	1.16E 09
SPECIES 10	0	0	0	0	1.59E 05	0	0	0	7.38E 09
SPECIES 11	0	0	0	0	1.77E 05	0	0	0	1.66E 09
SPECIES 12	0	0	0	0	1.14E 05	0	0	0	1.71E 09
SPECIES 13	0	0	0	0	0	1.04E 05	0	0	2.34E 09
SPECIES 16	0	0	0	0	0	0	5.50E 04	0	1.57E 09
TOTAL - COCCOLITHOPHORIDS	0	0	0	1.55E 05	5.56E 05	1.04E 05	5.50E 04	0	1.36E 10
OTHER AUTOTROPHIC FLAGELLATES									
SPECIES 2	0	0	0	2.81E 04	0	0	0	0	2.81E 08
SPECIES 5	0	0	0	3.61E 05	0	0	0	0	3.61E 09
SPECIES 7	0	0	0	4.11E 04	0	0	0	0	4.11E 08
SPECIES 14	0	0	0	0	0	1.17E 05	0	0	2.64E 09
SPECIES 15	0	0	0	0	0	1.98E 05	0	0	4.46E 09
SPECIES 17	0	0	0	0	0	0	5.60E 04	0	1.40E 09
TOTAL - OTHER AUTOTROPHIC FLAGELLATES	0	0	0	4.50E 05	0	3.16E 05	5.60E 04	0	1.30E 10
OTHERS									
SPECIES 18	0	0	0	0	0	0	0	1.29E 05	1.61E 09
SPECIES 6	0	0	0	3.47E 05	0	0	0	0	3.47E 09
SPECIES 3	0	0	0	4.23E 04	0	0	0	0	4.23E 08
TOTAL - OTHERS	0	0	0	3.90E 05	0	0	0	1.29E 05	5.50E 09
GRAND TOTAL	1.57E 06	2.54E 06	9.10E 06	9.95E 05	5.56E 05	4.20E 05	1.11E 05	1.29E 05	1.17E 11

CRUISE DAB17 STATION 002 LATITUDE 47-46.3N LONGITUDE 122-51.2W DATE 02/20/81

SAMPLE NO.	1	2	3	4	5	6	7	8	INTEGRATED VALUES/M2
DEPTH (METERS)	0.0	5.0	10.0	20.0	30.0	50.0	75.0	100.0	
TIME	1210	1235	1255	1320	1345	1415	1440	1530	
CHLOROPHYLL A (MG/M3)	1.17	2.34	0.65	1.50	1.00	0.60	0.30	0.00	70.50
ASSIMILATION, TECH. 5 (MG C/M3/HR)	12.34		1.23	1.05		0.50	0.15		
ASSIMILATION, TECH. 6 (MG C/M3/HR)	5.00	100.00	25.00	10.00	5.00	3.00	2.50	0.00	962.50
DIATOMS									RATIOS OF INT. VAL.
MELOSIRA SULCATA	5.50E-01	0	0	0	0	0	0	0	5.50E-01
MELOSIRA NUMULOIDES	0	0	4.57E-01	0	0	0	0	0	4.57E-01
THALASSIOSIRA SP.	2.90E-01	4.07E-01	0	0	0	0	0	0	3.50E-01
COSCINODISCUS SP.	4.09E-01	0	5.43E-01	0	0	0	0	0	5.44E-01
CORETHRON HYSTRIX	2.63E-01	2.69E-01	0	0	0	0	0	0	2.67E-01
CHAETOCEROS CONCAVICORNIS	0	9.61E-01	0	0	0	0	0	0	9.61E-01
CHAETOCEROS SP.	0	1.03E 00	0	0	0	0	0	0	1.03E 00
CENTRALES	4.76E-01	6.87E-01	0	0	0	0	0	0	6.19E-01
PLEUROSIGMA FASCIOLA	0	1.50E 00	0	0	0	0	0	0	1.50E 00
PLEUROSIGMA SP.	6.76E-01	0	0	0	0	0	0	0	6.76E-01
NITZSCHIA CLOSTERIUM	0	1.52E 00	0	0	0	0	0	0	1.52E 00
NITZSCHIA DELICATISSIMA	0	0	3.41E 00	0	0	0	0	0	3.41E 00
NITZSCHIA SP.	0	9.70E-01	0	0	0	0	0	0	9.70E-01
RHOICOSPHENIA CURVATA	0.21E-01	0	0	0	0	0	0	0	0.21E-01
COCCONEIS SP.	0.60E-01	5.99E-01	0	0	0	0	0	0	6.30E-01
PENNALES A	0	2.92E 00	2.92E 00	0	0	0	0	0	2.92E 00
PENNALES	5.49E-01	1.03E 00	1.24E 00	0	0	0	0	0	1.05E 00
RATIO OF TOTALS	4.10E-01	9.72E-01	4.70E-01	0	0	0	0	0	9.90E-01
DINOFLAGELLATES									
GYMNODINIUM SP.	0	0	9.09E-01	0	0	0	0	0	9.09E-01
RATIO OF TOTALS	0	0	9.09E-01	0	0	0	0	0	9.09E-01
COCCOLITHOPHORIDS									
SPECIES 1	0	0	0	6.00E-01	0	0	0	0	6.00E-01
SPECIES 4	0	0	0	4.96E-01	0	0	0	0	4.96E-01
SPECIES 8	0	0	0	0	8.93E-01	0	0	0	8.93E-01
SP[illegible]S 9	0	0	0	0	9.91E-01	0	0	0	9.91E-01
SPE[illegible]S 10	0	0	0	0	3.99E-01	0	0	0	3.99E-01
SPE[illegible]S 11	0	0	0	0	3.04E-01	0	0	0	3.04E-01
SPECIES 12	0	0	0	0	4.59E-01	0	0	0	4.59E-01
SPECIES 13	0	0	0	0	0	6.69E-01	0	0	6.69E-01
SPECIES 16	0	0	0	0	0	0	7.62E-01	0	7.62E-01
RATIO OF TOTALS	0	0	0	4.79E-01	4.41E-01	6.69E-01	7.62E-01	0	4.91E-01
OTHER AUTOTHOPHIC FLAGELLATES									
SPECIES 2	0	0	0	6.05E-01	0	0	0	0	6.05E-01
SPECIES 5	0	0	0	4.13E-01	0	0	0	0	4.13E-01
SPECIES 7	0	0	0	7.00E-01	0	0	0	0	7.00E-01
SPECIES 14	0	0	0	0	0	4.31E-01	0	0	4.31E-01
SPECIES 15	0	0	0	0	0	4.90E-01	0	0	4.90E-01
SPECIES 17	0	0	0	0	0	0	7.63E-01	0	7.63E-01
RATIO OF TOTALS	0	0	0	4.92E-01	0	4.66E-01	7.63E-01	0	4.76E-01
OTHERS									
SPECIES 10	0	0	0	0	0	0	0	5.57E-01	5.57E-01
SPECIES 6	0	0	0	3.54E-01	0	0	0	0	3.54E-01
SPECIES 3	0	0	0	6.00E-01	0	0	0	0	6.00E-01
RATIO OF TOTALS	0	0	0	3.79E-01	0	0	0	5.57E-01	3.90E-01
RATIO OF GRAND TOTALS	4.10E-01	9.72E-01	4.70E-01	4.21E-01	4.41E-01	5.10E-01	7.62E-01	5.57E-01	5.13E-01

RATIO - AREA / PLASMA VOLUME (1/MICRON)

CRUISE (ABBR) STATION CO2 LATITUDE 47-46.3N LONGITUDE 122-51.2W DATE 02/04/81

SAMPLE NO.	1	2	3	4	5	6	7	8	INTEGRATED VALUES/M2
DEPTH (METERS)	0.0	5.0	10.0	20.0	30.0	50.0	75.0	100.0	
TIME	1210	1235	1255	1320	1345	1415	1440	1530	
CHLOROPHYLL A (MG/M3)	1.17	2.34	0.65	1.50	1.00	0.60	0.30	0.00	70.50
ASSIMILATION, TECH. 5 (MG C/M3/HR)	2.34		1.23	1.05		0.50	0.15		
ASSIMILATION, TECH. 6 (MG C/M3/HR)	3.00	100.00	20.00	10.00	5.00	3.00	2.50	0.00	962.50
DIATOMS									RATIOS OF INT. VAL.
MELOSIRA SULCATA	7.11E-01	0	0	0	0	0	0	0	7.11E-01
MELOSIRA NUMULOIDES	0	0	6.49E-01	0	0	0	0	0	6.49E-01
THALASSIOSIRA SP.	5.36E-01	6.29E-01	0	0	0	0	0	0	5.76E-01
COSCINODISCUS SP.	6.68E-01	0	9.45E-01	0	0	0	0	0	9.46E-01
CORETHRON HYSTRIX	1.23E 00	8.33E-01	0	0	0	0	0	0	9.48E-01
CHAETOCEROS CONCAVICORNIS	0	1.26E 00	0	0	0	0	0	0	1.26E 00
CHAETOCEROS SP.	0	1.03E 00	0	0	0	0	0	0	1.03E 00
CENTRALES	6.11E-01	8.09E-01	0	0	0	0	0	0	8.09E-01
PLEUROSIGMA FASCIOLA	0	1.67E 00	0	0	0	0	0	0	1.67E 00
PLEUROSIGMA SP.	1.00E 00	0	0	0	0	0	0	0	1.00E 00
NITZSCHIA CLOSTERIUM	0	1.52E 00	0	0	0	0	0	0	1.52E 00
NITZSCHIA DELICATISSIMA	0	0	3.41E 00	0	0	0	0	0	3.41E 00
NITZSCHIA SP.	0	1.23E 00	0	0	0	0	0	0	1.23E 00
RHOICOSPHENIA CURVATA	1.33E 00	0	0	0	0	0	0	0	1.33E 00
COCCONEIS SP.	1.09E 00	1.10E 00	0	0	0	0	0	0	1.10E 00
PENNALES A	0	2.92E 00	2.92E 00	0	0	0	0	0	2.92E 00
PENNALES	6.29E-01	1.20E 00	1.60E 00	0	0	0	0	0	1.50E 00
RATIO OF TOTALS	7.10E-01	1.20E 00	7.25E-01	0	0	0	0	0	7.98E-01
DINOFLAGELLATES									
OXYTOXUM SP.	0	0	5.09E-01	0	0	0	0	0	5.09E-01
RATIO OF TOTALS	0	0	5.09E-01	0	0	0	0	0	5.09E-01
COCCOLITHOPHORIDS									
SPECIES 1	0	0	0	1.11E 00	0	0	0	0	1.11E 00
SPECIES 4	0	0	0	1.00E 00	0	0	0	0	1.00E 00
SPECIES 8	0	0	0	0	1.29E 00	0	0	0	1.29E 00
SPECIES 9	0	0	0	0	1.13E 00	0	0	0	1.13E 00
SPECIES 10	0	0	0	0	1.05E 00	0	0	0	1.05E 00
SPECIES 11	0	0	0	0	1.04E 00	0	0	0	1.04E 00
SPECIES 12	0	0	0	0	1.61E 00	0	0	0	1.61E 00
SPECIES 13	0	0	0	0	0	1.24E 00	0	0	1.24E 00
SPECIES 16	0	0	0	0	0	0	7.62E-01	0	7.62E-01
RATIO OF TOTALS	0	0	0	1.02E 00	1.10E 00	1.24E 00	7.62E-01	0	1.13E 00
OTHER AUTOTROPHIC PLACOLATES									
SPECIES 2	0	0	0	1.12E 00	0	0	0	0	1.12E 00
SPECIES 5	0	0	0	9.57E-01	0	0	0	0	9.57E-01
SPECIES 7	0	0	0	1.15E 00	0	0	0	0	1.15E 00
SPECIES 14	0	0	0	0	0	1.01E 00	0	0	1.01E 00
SPECIES 15	0	0	0	0	0	1.03E 00	0	0	1.03E 00
SPECIES 17	0	0	0	0	0	0	7.63E-01	0	7.63E-01
RATIO OF TOTALS	0	0	0	9.92E-01	0	1.02E 00	7.63E-01	0	9.83E-01
OTHERS									
SPECIES 18	0	0	0	0	0	0	0	9.57E-01	9.57E-01
SPECIES 6	0	0	0	9.60E-01	0	0	0	0	9.60E-01
SPECIES 3	0	0	0	1.11E 00	0	0	0	0	1.11E 00
RATIO OF TOTALS	0	0	0	9.77E-01	0	0	0	9.57E-01	8.94E-01
RATIO OF GRAND TOTALS	7.10E-01	1.20E 00	7.13E-01	9.91E-01	1.10E 00	1.08E 00	7.62E-01	9.57E-01	8.91E-01

RATIO - AREA / NUMBER OF CELLS (50.MICRONS)

CRUISE DA817 STATION 002 LATITUDE 47-46.3N LONGITUDE 122-51.2W DATE 02/04/81

SAMPLE NO.	1	2	3	4	5	6	7	8	INTEGRATED VALUES/M2
DEPTH (METERS)	0.0	5.0	10.0	20.0	30.0	50.0	75.0	100.0	
TIME	1210	1235	1255	1320	1345	1415	1440	1530	
CHLOROPHYLL A (MG/M3)	1.17	2.34	0.65	1.50	1.00	0.60	0.30	0.00	70.50
ASSIMILATION, TECH. 5 (MG C/M3/HR)	12.34		1.23	1.09		0.50	0.15		
ASSIMILATION, TECH. 6 (MG C/M3/HR)	3.00	100.00	20.00	10.00	5.00	3.00	2.50	0.00	962.50
DIATOMS									RATIOS TO INT. VAL.
MELOSIRA SULCATA	5.92E 02	0	0	0	0	0	0	0	5.92E 02
MELOSIRA NUMULOIDES	0	0	6.22E 02	0	0	0	0	0	6.22E 02
THALASSIOSIRA SP.	2.89E 03	1.29E 03	0	0	0	0	0	0	1.03E 03
COSCINODISCUS SP.	1.03E 03	0	3.99E 03	0	0	0	0	0	3.86E 03
CORETHRON HYSTRIX	2.88E 03	2.40E 03	0	0	0	0	0	0	2.56E 03
CHAETOCERUS CONCAVICORNIS	0	8.47E 03	0	0	0	0	0	0	8.47E 03
CHAETOCEROS SP.	0	1.64E 06	0	0	0	0	0	0	1.64E 06
CENTRALES	1.76E 03	9.39E 02	0	0	0	0	0	0	4.50E 02
PLEUROSIGMA FASCIOLA	0	1.00F 02	0	0	0	0	0	0	1.00E 02
PLEUROSIGMA SP.	9.19E 03	0	0	0	0	0	0	0	9.19E 03
NITZSCHIA CLOSTERIUM	0	1.59E 02	0	0	0	0	0	0	1.59E 02
NITZSCHIA DELICATISSIMA	0	0	4.60E 01	0	0	0	0	0	4.60E 01
NITZSCHIA SP.	0	2.28E 03	0	0	0	0	0	0	2.28E 03
RHOICOSPHENIA CURVATA	9.03E 02	0	0	0	0	0	0	0	9.03E 02
COCCONEIS SP.	9.12E 02	7.79E 02	0	0	0	0	0	0	7.98E 02
PENNALES A	0	7.00E 01	7.00E 01	0	0	0	0	0	7.00E 01
PENNALES	5.35E 03	6.35E 02	4.92E 02	0	0	0	0	0	5.30E 02
RATIO OF TOTALS	2.26E 03	3.12E 02	2.64E 02	0	0	0	0	0	2.09E 02
DINOFLAGELLATES									
OXYTOXUM SP.	0	0	8.72E 02	0	0	0	0	0	8.72E 02
RATIO OF TOTALS	0	0	8.72E 02	0	0	0	0	0	8.72E 02
COCCOLITHOPHORIDS									
SPECIES 1	0	0	0	3.14E 02	0	0	0	0	3.14E 02
SPECIES 4	0	0	0	1.27E 03	0	0	0	0	1.27E 03
SPECIES 8	0	0	0	0	3.07E 02	0	0	0	3.07E 02
SPECIES 9	0	0	0	0	8.76E 02	0	0	0	8.76E 02
SPECIES 10	0	0	0	0	1.66E 03	0	0	0	1.66E 03
SPECIES 11	0	0	0	0	1.04E 03	0	0	0	1.04E 03
SPECIES 12	0	0	0	0	1.04E 03	0	0	0	1.04E 03
SPECIES 13	0	0	0	0	0	1.29E 03	0	0	1.29E 03
SPECIES 16	0	0	0	0	0	0	4.19E 02	0	4.19E 02
RATIO OF TOTALS	0	0	0	7.93E 02	1.32E 03	1.29E 03	4.19E 02	0	1.00E 03
OTHER AUTOTHOPHIC FLAGELLATES									
SPECIES 2	0	0	0	3.14E 02	0	0	0	0	3.14E 02
SPECIES 5	0	0	0	3.66E 03	0	0	0	0	3.66E 03
SPECIES 7	0	0	0	7.00E 02	0	0	0	0	7.00E 02
SPECIES 14	0	0	0	0	0	1.10E 03	0	0	1.10E 03
SPECIES 15	0	0	0	0	0	2.04E 03	0	0	2.04E 03
SPECIES 17	0	0	0	0	0	0	4.27E 02	0	4.27E 02
RATIO OF TOTALS	0	0	0	1.49E 03	0	1.61E 03	4.27E 02	0	1.28E 03
OTHERS									
SPECIES 18	0	0	0	0	0	0	0	7.16E 02	7.16E 02
SPECIES 6	0	0	0	3.33E 03	0	0	0	0	3.33E 03
SPECIES 3	0	0	0	4.71E 02	0	0	0	0	4.71E 02
RATIO OF TOTALS	0	0	0	1.90E 03	0	0	0	7.16E 02	1.49E 03
RATIO OF GRAND TOTALS	2.26E 03	3.12E 02	2.71E 02	1.41E 03	1.32E 03	1.90E 03	4.23E 02	7.16E 02	3.87E 02

RATIO - CELL VOLUME / NUMBER OF CELLS (CU.MICRONS)

CRUISE DA81? STATION 082 LATITUDE 47-46.3N LONGITUDE 122-51.2W DATE 02/04/81

SAMPLE NO.	1	2	3	4	5	6	7	8	INTEGRATED VALUES/M2
DEPTH (METERS)	0.0	5.0	10.0	20.0	30.0	50.0	75.0	100.0	
TIME	1210	1235	1255	1320	1345	1415	1440	1510	
CHLOROPHYLL A (MG/M3)	1.17	2.34	0.65	1.90	1.00	0.60	0.30	0.00	70.50
ASSIMILATION, TECH. 5 (MG C/M3/HR)	12.34		1.23	1.09		0.50	0.15		
ASSIMILATION, TECH. 6 (MG C/M3/HR)	3.00	100.00	20.00	10.00	5.00	1.00	2.50	0.00	962.50
DIATOMS									RATIOS OF INT. VAL.
MELOSIRA SULCATA	1.06E 03	0	0	0	0	0	0	0	1.06E 03
MELOSIRA NUMULOIDES	0	0	1.36E 03	0	0	0	0	0	1.36E 03
THALASSIOSIRA SP.	9.97E 03	2.66E 03	0	0	0	0	0	0	5.09E 03
COSCINODISCUS SP.	2.12E 03	0	1.06E 04	0	0	0	0	0	1.12E 04
CORETHRON HYSTRIX	1.10E 04	8.93E 03	0	0	0	0	0	0	9.61E 03
CHAETOCEROS CONCAVICORNIS	0	8.81E 03	0	0	0	0	0	0	8.81E 03
CHAETOCEROS SP.	0	1.01E 04	0	0	0	0	0	0	1.01E 04
CENTRALES	3.69E 03	7.04E 02	0	0	0	0	0	0	1.05E 03
PLEUROSIGMA FASCIOLA	0	7.20E 01	0	0	0	0	0	0	7.20E 01
PLEUROSIGMA SP.	7.68E 03	0	0	0	0	0	0	0	7.68E 03
NITZSCHIA CLOSTERIUM	0	1.05E 02	0	0	0	0	0	0	1.05E 02
NITZSCHIA DELICATISSIMA	0	0	1.35E 01	0	0	0	0	0	1.35E 01
NITZSCHIA SP.	0	2.35E 03	0	0	0	0	0	0	2.35E 03
RHOICOSPHENIA CURVATA	1.10E 03	0	0	0	0	0	0	0	1.10E 03
COCCONEIS SP.	1.06E 03	1.30E 03	0	0	0	0	0	0	1.27E 03
PENNALES A	0	2.40E 01	2.40E 01	0	0	0	0	0	2.40E 01
PENNALES	9.75E 03	6.19E 02	3.63E 02	0	0	0	0	0	5.06E 02
RATIO OF TOTALS	5.50E 03	3.21E 02	5.51E 02	0	0	0	0	0	9.29E 02
DINOFLAGELLATES									
OXYTOXUM SP.	0	0	1.71E 03	0	0	0	0	0	1.71E 03
RATIO OF TOTALS	0	0	1.71E 03	0	0	0	0	0	1.71E 03
COCCOLITHOPHORIDS									
SPECIES 1	0	0	0	5.24E 02	0	0	0	0	5.24E 02
SPECIES 4	0	0	0	2.79E 03	0	0	0	0	2.79E 03
SPECIES 8	0	0	0	0	4.33E 02	0	0	0	4.33E 02
SPECIES 9	0	0	0	0	1.54E 03	0	0	0	1.54E 03
SPECIES 10	0	0	0	0	4.20E 03	0	0	0	4.20E 03
SPECIES 11	0	0	0	0	4.72E 03	0	0	0	4.72E 03
SPECIES 12	0	0	0	0	4.00E 03	0	0	0	4.00E 03
SPECIES 13	0	0	0	0	0	1.93E 03	0	0	1.93E 03
SPECIES 16	0	0	0	0	0	0	5.50E 02	0	5.50E 02
RATIO OF TOTALS	0	0	0	1.65E 03	2.99E 03	1.93E 03	5.50E 02	0	2.21E 03
OTHER AUTOTHOPHIC FLAGELLATES									
SPECIES 2	0	0	0	5.18E 02	0	0	0	0	5.18E 02
SPECIES 5	0	0	0	8.38E 03	0	0	0	0	8.38E 03
SPECIES 7	0	0	0	1.00E 03	0	0	0	0	1.00E 03
SPECIES 14	0	0	0	0	0	2.75E 03	0	0	2.75E 03
SPECIES 15	0	0	0	0	0	4.17E 03	0	0	4.17E 03
SPECIES 17	0	0	0	0	0	0	5.60E 02	0	5.60E 02
RATIO OF TOTALS	0	0	0	3.30E 03	0	3.46E 03	5.60E 02	0	2.69E 03
OTHERS									
SPECIES 18	0	0	0	0	0	0	0	1.29E 03	1.29E 03
SPECIES 6	0	0	0	9.42E 03	0	0	0	0	9.42E 03
SPECIES 3	0	0	0	7.05E 02	0	0	0	0	7.05E 02
RATIO OF TOTALS	0	0	0	5.11E 03	0	0	0	1.29E 03	3.64E 03
RATIO OF GRAND TOTALS	5.50E 03	3.21E 02	5.45E 02	3.35E 03	2.99E 03	2.95E 03	5.55E 02	1.29E 03	7.59E 02

RATIO - PLASMA VOLUME / NUMBER OF CELLS (CU.MICRONS)

CRUISE DA017 STATION C02 LATITUDE 47-46.3N LONGITUDE 122-51.2W DATE 02/04/61

SAMPLE NO.	1	2	3	4	5	6	7	8	INTEGRATED VALUES/M2
DEPTH (METERS)	1.0	5.0	10.0	20.0	30.0	50.0	75.0	100.0	
TIME	1210	1235	1255	1320	1345	1415	1440	1530	
CHLOROPHYLL A (MG/M3)	1.17	2.34	0.65	1.50	1.00	0.00	0.30	0.00	70.50
ASSIMILATION, TECH. 5 (MG C/M3/HR)	12.34		1.23	1.05		0.50	0.15		
ASSIMILATION, TECH. 6 (MG C/M3/HR)	3.00	100.00	20.00	10.00	5.00	3.00	2.50	0.00	962.50
DIATOMS									RATIOS OF INT. VAL.
MELOSIRA SULCATA	8.33E 02	0	0	0	0	0	0	0	8.33E 02
MELOSIRA NUMULOIDES	0	0	9.50E 02	0	0	0	0	0	9.50E 02
THALASSIOSIRA SP.	5.40E 03	2.06E 03	0	0	0	0	0	0	3.17E 03
CUSCINODISCUS SP.	1.55E 03	0	7.32E 03	0	0	0	0	0	3.07E 03
COMETHRON HYSTRIX	2.55E 03	2.08E 03	0	0	0	0	0	0	2.70E 03
CHAETOCEROS CONCAVICORNIS	0	6.76E 03	0	0	0	0	0	0	6.76E 03
CHAETOCEROS SP.	0	1.01E 04	0	0	0	0	0	0	1.01E 04
CENTRALES	2.08E 03	6.00E 02	0	0	0	0	0	0	8.07E 02
PLEUROSIGMA FASCIOLA	0	6.46E 01	0	0	0	0	0	0	6.46E 01
PLEUROSIGMA SP.	4.01E 03	0	0	0	0	0	0	0	4.01E 03
NITZSCHIA CLOSTERIUM	0	1.05E 02	0	0	0	0	0	0	1.05E 02
NITZSCHIA DELICATISSIMA	0	0	1.35E 01	0	0	0	0	0	1.35E 01
NITZSCHIA SP.	0	1.06E 03	0	0	0	0	0	0	1.06E 03
RHIZOSOLENIA CURVATA	6.00E 02	0	0	0	0	0	0	0	6.00E 02
COCCONEIS SP.	4.03E 02	2.67E 02	0	0	0	0	0	0	6.75E 02
PENNALES A	0	2.40E 01	2.40E 01	0	0	0	0	0	2.40E 01
PENNALES	8.50E 03	4.97E 02	2.02E 02	0	0	0	0	0	4.07E 02
RATIO OF TOTALS	3.10E 03	2.61E 02	3.66E 02	0	0	0	0	0	3.57E 02
DINOFLAGELLATES									
OXYTHRIX SP.	0	0	1.71E 03	0	0	0	0	0	1.71E 03
RATIO OF TOTALS	0	0	1.71E 03	0	0	0	0	0	1.71E 03
COCCOLITHOPHORIDS									
SPECIES 1	0	0	0	2.02E 02	0	0	0	0	2.02E 02
SPECIES 6	0	0	0	1.27E 03	0	0	0	0	1.27E 03
SPECIES 8	0	0	0	0	3.00E 02	0	0	0	3.00E 02
SPECIES 9	0	0	0	0	7.72E 02	0	0	0	7.72E 02
SPECIES 10	0	0	0	0	1.59E 03	0	0	0	1.59E 03
SPECIES 11	0	0	0	0	1.77E 03	0	0	0	1.77E 03
SPECIES 12	0	0	0	0	1.14E 03	0	0	0	1.14E 03
SPECIES 13	0	0	0	0	0	1.04E 03	0	0	1.04E 03
SPECIES 16	0	0	0	0	0	0	5.90E 02	0	5.90E 02
RATIO OF TOTALS	0	0	0	7.77E 02	1.11E 03	1.04E 03	5.90E 02	0	9.59E 02
OTHER AUTOTROPHIC FLAGELLATES									
SPECIES 2	0	0	0	2.01E 02	0	0	0	0	2.01E 02
SPECIES 5	0	0	0	3.61E 03	0	0	0	0	3.61E 03
SPECIES 7	0	0	0	6.11E 02	0	0	0	0	6.11E 02
SPECIES 14	0	0	0	0	0	1.17E 03	0	0	1.17E 03
SPECIES 15	0	0	0	0	0	0	5.60E 02	0	5.60E 02
SPECIES 17	0	0	0	0	0	1.90E 03	0	0	1.90E 03
RATIO OF TOTALS	0	0	0	1.90E 03	0	1.50E 03	5.60E 02	0	1.90E 03
OTHERS									
SPECIES 18	0	0	0	0	0	0	0	1.29E 03	1.29E 03
SPECIES 4	0	0	0	3.67E 03	0	0	0	0	3.67E 03
SPECIES 3	0	0	0	4.23E 02	0	0	0	0	4.23E 02
RATIO OF TOTALS	0	0	0	1.95E 03	0	0	0	1.29E 03	1.69E 03
RATIO OF GRAND TOTALS	3.10E 03	2.61E 02	3.40E 02	1.62E 03	1.11E 03	1.49E 03	5.95E 02	1.29E 03	4.95E 02