SOME OBSERVATIONS ON THE LABRADOR CURRENT AT SAGLEK, LABRADOR

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25555

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SAGLEK, LABRADOR

BY

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A PROJECT

SUBMITTED TO THE COMMITTEE ON

GRADUATE STUDIES IN PARTIAL

FULFILLMENT OF THE REQUIREMENT

FOR THE DEGREE OF

MASTER OF ENGINEERING

MEMORIAL UNIVERSITY OF NEWFOUNDLAND

ST. JOHN'S, NEWFOUNDLAND

ACKNOWLEDGEMENTS

I wish to express my gratitude to the following:

Dr. J.H. Allen, my Supervisor, for his guidance, Mr. R. Soulis for his assistance with the spectral analysis, Mrs. H. Tiller and Miss B. Leitch for typing, Mrs. E. Reminsky for editing.

ABSTRACT

This project describes the processing of S.T.D. and current meter data which was obtained at Saglek, Labrador in August 1972. The current meter records reveal tidal period oscillations in the Labrador Current and two very good records of inertial currents. Ocean densities were calculated from the S.T.D. readings and an attempt was made to calculate current velocity from density differences.

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Introduction

The aim of this project is to investigate water movement at Saglek, Labrador in connection with a faculty study of iceberg movement. The data used in this project is salinity, temperature, and depth, (S.T.D) readings and current meter records which were obtained in August 1972, on the C.S.S. Dawson cruise by Memorial University Engineering Department.

Chapter I gives a general description of the data, (S.T.D. and current meter), and how it was processed. The current meter data is described and the various methods of plotting this data are described and interpreted. The most remarkable items found were tidal period oscillations in the current, and two very good records of inertial currents.

Chapter II gives some basic theory of inertial currents and discusses the oscillation period and radius of inertia of these inertial currents. The observed values were found to agree very well with theoretical values.

Chapter III gives some theory concerning the balance between advection and diffusion of concentrations in the ocean and describes an attempt to calculate current velocity from density differences. A brief comparison is given of salinities at Saglek with those of other studies in the Labrador area.

All the figures in this report are placed at the end of the text and revelant Appendices follow the Bibliography.

CHAPTER I

General Description

The data used in this project was collected on the Memorial University Engineering Department Oceanographic Cruise to Saglek, Labrador in August 1972, aboard the C.S.S. Dawson of the Bedford Institute of Oceanography (B.I.O.). The primary aim of this cruise was to study iceberg movement and possible prediction of iceberg movement from data collected in the area. The cruise schedule is given in Appendix A and the area of the study is shown in Figures 1 and 2. The aim of this project is to process and display some of the data, relating to the Labrador Current, which was collected on this cruise [1].

During this cruise, salinity, temperature and depth (S.T.D.) readings were taken at all stations shown on Figure 2 with a Bissett-Berman self-recording S.T.D. meter. The specifications of this instrument and a sample of its record are given in Appendix B. Two sets of these S.T.D. readings were taken along the three main East-West traverses; one set on August 11 to August 13, and another set on August 24 to August 26. S.T.D. spot readings were used to calculate the corresponding water densities and σ_t-values, for a regular grid of stations along the three main traverses from stations 1, 10, 23 on the West to stations 9, 18, 31 on the East (See Figure 2).

These densities were calculated by computer employing equation 1.1 below and Knudsen's tables [2].

$$\sigma_t = \Sigma_t + (\sigma_o + .1324)(1 - A_t + B_t(\sigma_o - .1324)) \qquad 1.1$$

The terms Σ_t, A_t and B_t are functions of temperature given by

Knudsen [2] and $\sigma_0(S_0 - 1) \times 10^{-3}$, where S_0 is the specific gravity of sea water at 0^0 Centigrade referred to distilled water at 4^0 Centigrade. The calculated term is $\sigma_t = (S_t - 1) \times 10^{-3}$ where S_t is the specific gravity of sea water at t^0 Centigrade (See Appendix D).

A contour mapping program [3] (See Appendic C) was developed by this writer, and used to draw ocean density (σ_t) contour maps of the area of the three main traverses for both the August 11-13 and the August 24-26 sets of S.T.D. readings. Density contour maps of horizontal cross-sections at the surface and at depths of 10, 20, 30, 50, and 75 meters were drawn by this program (See Figures 3 to 14). Vertical cross-sections were also contoured in this manner and are shown in Figures 15 to 20. These σ_t contour maps are discussed further in Chapter III.

The densities were also used in an attempt to calculate the velocities of the Labrador Current from density changes with respect to distance. This idea is developed and explained further in Chapter III.

Three Braincon Mooring Current Meters were placed at each of the stations A, B, and C and two N.B.A. Current Meters were placed at station D. The Braincon current meters have a savonius rotor with a photographic recording device and the N.B.A. meters have a screw impeller with a magnetic tape recording device. The specifications of these instruments are given in Appendix B. These meters were positioned to record surface, midwater, and bottom currents with the subscripts 1, 2, 3 referring to surface, midwater, and bottom positions respectively. The exact locations and depths of these meters are given in Table 1, and Figure 2.

The Braincon current meter records were read manually from the photographic film by Bedford Institute of Oceanography (B.I.O.) personnel and sent to Memorial University as rolled paper tape records. All Braincon meter records except C2 were returned from B.I.O. These paper tape

Station	N. Lat.	W. Long	Water Depth (m)	Inst. Depth (m)	Inst. Serial #	Time Set G.M.T.	Time Recovered G.M.T.	Total Time (Hrs. Min.)
					Braincon			
C1	58.39.4	62.01.9	176	13	124	Aug. 11 1219	Aug. 25 2047	344:28
C2	58.39.4	62.01.9	176	75	190	Aug. 11 1227	Aug. 25 2051	344:24
C3	58.39.4	62.01.9	176	166	90	Aug. 11 1234	Aug. 25 2055	344:21
B1	58.36.8	62.09.5	146	13	123	Aug. 11 1448	Aug. 25 1954	341:06
B2	58.36.8	62.09.5	146	75	088	Aug. 11 1453	Aug. 25 1957	341:04
B3	58.36.8	62.09.5	146	136	058	Aug. 11 1457	Aug. 25 2000	341:03
A1	58.28.2	61.57.0	165	13	121	Aug. 11 1700	Aug. 25 2352	342:52
A2	58.28.2	61.57.0	165	75	120	Aug. 11 1708	Aug. 25 2347	342:39
A3	58.28.2	61.57.0	165	155	122	Aug. 11 1713	Aug. 25 2344	342:31
					N.B.A.			
D1	58.42.7	61.53.1	183	13	105	Aug. 12 1130	Aug. 25 2205	322:35
D2	58.42.7	61.53.1	183	75	104	Aug. 12 1130	Aug. 25 2204	322:34
				DRIFTING SHIP CURRENT METER STUDY				
E_1(for'd)	58.18.20	62.01.80	172	30	Bendix	Aug. 20 2140	Aug. 20 2308	1:28
E_1(m'ship)	58.18.[illegible]	62.01.80	172	5 - 125	& HP	Aug. 20 2140	Aug. 20 2308	1:28
E_1(for'd)	58.18.35	62.01.55	179	30		Aug. 21 0816	Aug. 21 0912	0:56
E_1(m'ship)	58.18.35	62.01.55	179	5 - 100	Bendix	Aug. 21 0816	Aug. 21 0912	0:56

TABLE 1: EXACT LOCATIONS AND OPERATION TIMES OF THE CURRENT METERS

records were then transferred, by the Engineering Department's PDP/12 computer, through several steps to ASCII paper tape and to an IBM readable magnetic tape. Since these meter records were read manually and since the photographic film is difficult to interpret precisely, there is a great possibility of errors in this data.

After processing, these Braincon records consisted of five three digit numbers as shown below. These five numbers represent respectively;

089 048 273 000 000

the beginning reading (revolutions), the end reading (revolutions), magnetic direction, tilt of the meter, and degrees of tilt. The last two numbers designating tilt were usually 000 or 001, meaning that the tilt of the meters was insignificant; that is, the meters were near vertical in their moored positions. The fact that the tilt readings were 000 was taken as confirmation that the meters were moored properly in a vertical orientation. The present method of using tilt measures to correct the current meter readings has been disputed and is unreliable [5]. For the above reasons these current meter readings were not corrected for tilt.

The current speed V in cm/sec for each time interval DT in minutes was calculated by IBM 370 computer using equation 1.2 [5];

$$V = .4169R + 5.3312 - 3.356e^{-.3563R} \tag{1.2}$$

where $R = \dfrac{7200(IB - IE)}{360 \quad DT}$

and IB = beginning reading (revolutions)

IE = end reading (revolutions)

DT = interval between readings (approx. 20 min.)

and a special program developed by the writer for this purpose.

The speed and its corresponding direction was converted to North and East components by this same program.

This program was then modified to call a plotter subroutine package [7]; and velocity and direction in degrees true North were plotted against time for all meters at stations A, B and C (See Figures 21 to 28). The prescribed interval DT of 20 minutes between readings was used in these plots.

From these plots the following points can readily be seen:

1. A significant increase in speed occurred about August 22-23 for surface meters A1 and C1. The data for surface meter B1 did not show such an increase in speed.

2. A circular direction change accompanied these increases in speed. Note also that these events occurred at the same time as a severe low pressure in the study area. This low pressure is explained further in Chapter 2.

3. The speed recording device in both midwater meters A2 and B2 seems to have malfunctioned, since the readings are approximately the same for the whole record.

4. Although all the Braincon meters were set to read at 20 minute intervals, the bottom meter, C3, seems to have stopped 2 days before it was retrieved. It is not known whether the timing device in this meter operated correctly every 20 minutes and the meter stopped 2 days early, or if the timing device operated at 22.81 minute intervals and did operate until its recovery. It is now believed that this meter may have stopped and restarted itself one or more times before its recovery.

5. The meter at B3 behaved similarly to that at C3 as described above but the effect was not so great. Similarly, meter A3 appears to have operated beyond its recovery time or it took readings in 19.57 minute intervals.

The program was again modified to plot current velocities as North and East components. (See Figures 29 to 36). This method of displaying a current velocity vector by components is a standard method in oceanographic work [8]; whereas the previously described plots of speed and direction (Figures 21 to 28) are a simpler method which was found easier to understand and interpret visually. From these component-wise velocity plots the following can be seen:

6. For meters A1 and C1 from August 22 to August 24, the North and East components are about 1/4 period out of phase. This is an indication of an inertial current and is explained further in Chapter 2.

The North and East components were also plotted as a progressive vector diagram (Figures 27 to 44) to show the direction and magnitude of the current at each station with time. Time on these charts is marked at 0000 and 1200 GMT with a + sign and the date is written at 1200 GMT each day from August 12 to August 24. These charts employ a variable recording interval DT as described in 4 and 5 above. These progressive vector diagrams show more vividly the nature of the current at each station.

7. The net current movement for all meter stations is seen to be South and Southwest. The net current velocity components are given on these progressive vector diagrams.

8. The inertial currents of August 22 to August 24 at stations A1 and C1 are readily seen from these progressive vector diagrams.

9. The net southward movement of the current has superimposed upon it, small circular loops with a period of oscillation approximately equal to that of the semi-diurnal tide (12.42 hrs.).

These circular loops in the current path were compared with the tide tables and with the partial record of a tide guage which was installed at Saglek (Figure 45). The times of these loops were found to agree very well with the time of high water slack on both the tide tables and the tide guage record. This agreement, however, is restricted to the period before the influence of the low pressure system.

A power spectral analysis program (BMD02T) [13] was applied to the current meter data of stations A1, B1, and C1. The spectral analysis was first performed on the whole record and the predominant period of oscillation was found to be greater than 13 hours. Because of the profound effect of the storm of August 22, 1972, it was decided to do a separate spectral analysis for the periods before and after the storm. This revealed a tidal oscillation period of about 12.5 hours before the influence of the low pressure system for meters A1, B1, and C1. After the storm an oscillation period of about 14 hours was found for meter A1, 14.3 hours for C1, and B1 had an oscillation period of about 13.3 hours. These results are summarized in Table 2 and the 14 hour inertia period of meters A1 and C1 is further explained in Chapter 2.

TABLE 2

Summary of Spectral Analysis Results
for Oscillation Period T in Hours[1]

Current Meter	Whole Record	Before Storm	After Storm
A1	13.3	12.5	14
B1	13	12.5	13.3
C1	13.7	12.5	14.3

The NBA current meter record at station D was not processed with the Braincon records because the NBA data format is not compatable with the computer programs used for the Braincon records.

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[1] Since the power spectrum is a Fourier transform of the autocovariance function, and in this case is dominated by a single narrow-frequency brand; the peak to peak period of the autocovariance function, which was also generated by BMD02T, can be used to estimate the most significant frequency. The resolution of the autovariance function is the sample interval of the current records (.33 hrs.) and this determines the accuracy of estimating the peak to peak period. Then the probable error in the periods given in the above table is one half a sample interval or ±.17 hrs.

CHAPTER II

Inertial Currents

The following equations (2.1) and (2.2) represent a balance of coriolis and pressure gradient accelerations in a two dimensional, horizontal, frictionless ocean, [8], [4]:

$$\frac{du}{dt} - 2\omega \text{ Sin } \phi v = -\frac{1}{\rho}\frac{\partial p}{\partial x} \tag{2.1}$$

$$\frac{dv}{dt} + 2\omega \text{ Sin } \phi u = -\frac{1}{\rho}\frac{\partial p}{\partial y} \tag{2.2}$$

where u = horizontal velocity in the x direction

v = horizontal velocity in the y direction

p = pressure

ω = angular velocity of the earth

ϕ = latitude in degrees

ρ = density of sea water

The pressure gradient term in these equations could be caused by a sudden wind stress [8], causing a slope of the ocean surface, and when the wind stress ceases the pressure gradient becomes zero and equations 2.1 and 2.2 then become:

$$\frac{du}{dt} = 2\omega \text{ Sin } \phi v \tag{2.3}$$

$$\frac{dv}{dt} = -2\omega \text{ Sin } \phi u \tag{2.4}$$

These circumstances are suspected to have occurred in the Saglek area about August 22, 1972 after a severe low pressure system in that area. The passage of this low resulted in a drop in barometric pressure from 1007.7 mb to 980.2 mb., and a wind velocity of 50 knots at 270° [9]. This 27 mb. drop in barometric pressure would theoretically result in an elevation of the ocean surface of approximately 27 cm. [8]. The pressure gradient in this case could have resulted from wind stress, surface elevation under the low pressure, a density difference or the combined effect of all three of these [10].

Equations 2.3 and 2.4 represent a balance between particle acceleration and coriolis acceleration and the resulting current is an inertia of velocity $c = \sqrt{u^2 + v^2}$. Solving equations 2.3 and 2.4 simultaneously by addition we get,

$$u \frac{du}{dt} + v \frac{dv}{dt} = 0 \qquad 2.5$$

and since

$$\frac{d}{dt} c^2 = \frac{d}{dt} (u^2 + v^2) = 2u \frac{du}{dt} + 2v \frac{dv}{dt}$$

equation 2.5 becomes, $\frac{1}{2} \frac{d}{dt} c^2 = 0$.

This means that the speed c of a water particle is constant. The acceleration results from a direction change and not a speed change.

Solving equations 2.3 and 2.4 simultaneously by subtraction we get:

$$v \frac{du}{dt} - u \frac{dv}{dt} = 2\omega \sin \phi (u^2 + v^2) \qquad 2.6$$

and since

$$\frac{d}{dt} \left(\frac{u}{v}\right) = \frac{\left(\frac{v\, du}{dt}\right) - \left(\frac{u\, dv}{dt}\right)}{v^2}$$

equation 2.6 becomes

$$\frac{v^2 d}{dt}\left(\frac{u}{v}\right) = 2\omega \text{ Sin } \phi \text{ } c^2 \qquad 2.7$$

Now if α is the angle between the x-axis and the current direction then,

$$\text{Cot } \alpha = \frac{u}{v} \quad , \quad v = c \text{ Sin } \alpha$$

and substituting these into equation 2.7 and differentiating we get:

$$\frac{d\alpha}{dt} = 2\omega \text{ Sin } \phi$$

This equation shows that the inertia current changes direction at a constant rate for any given latitude.

The above explanation shows that a water particle in an inertia current moves in a circle at a constant speed. This circle is clockwise in the Northern Hemisphere and a counter-clockwise in the Southern Hemisphere.

The period T of an inertial circle of radius r is given by

$$T = \frac{2\pi r}{c} \qquad 2.8$$

Since the coriolis acceleration is balanced by the centrifugal acceleration, $\frac{c^2}{r}$, that is since $\frac{c^2}{r} = 2\omega \text{ Sin } \phi \text{ } c$, then

$$r = \frac{c}{2\omega \text{ Sin } \phi} \qquad 2.9$$

and equation 2.8 can be written as;

$$T = \frac{\pi}{\omega \text{ Sin } \phi} \qquad 2.8a$$

At Saglek, Labrador, latitude 58° 30' N, the inertia period T is iven by equation 2.8a as follows:

$$T = \frac{\pi}{\omega \text{ Sin } 58^{\circ}30'}$$

$$= \frac{3.1416}{\frac{3.1416}{12}(.8526)}$$

$$= 14.07 \text{ hours.}$$

The oscillation period for surface current meters was calculated on computer by a spectral analysis program and found to be approximately 14 hours for meter stations A1 and C1 for the period August 21 to August 24, 1972 (See Table 2). It can also be seen from the progressive vector diagrams for A1 (Figure 37) and C1 (Figure 43) that the period is approximately 14 hours. From these diagrams it seems that the clockwise inertialcurrent is superimposed on the Southward motion of the Labrador current.

From the North and East component velocity plots for meter stations A1 (Figure 29) and C1 (Figure 35) it can be seen that there is about a quarter period phase difference for the last 4 days of each record. The ratio of North and East components for meters A1 and C1 is approximately equal to one for the inertialportion of the record.

The above observations were also made by Gustavson and Kullenberg (1933) in the Baltic Sea [8], but these Saglek currents are not so well behaved in their circling paths as the Baltic Sea currents.

The current meter at station B1 (Figure 40) is also a surface meter, ut it apparently does not have the inertia circles of meters A1 and C1. (See Table 2). The oscillation period at station B1 is about 13.3 hours for the period August 21 to August 24 and this does not agree with the heoretical inertia period of 14.07 hours. Neither does B1 have the itude of velocity which was observed at stations A1 and C1 on ugust 22. However B1 does show inertial period influence.

If we take the current velocity c to be approximately 1.2 knots t station C1 on August 22, we get the radius of inertia by equation 2.9 s follows:

$$r = \frac{c}{2\omega \text{ Sin } \phi}$$

$$= \frac{6(1.2)}{\pi \text{ Sin } 58^{o}30'}$$

$$= 2.69 \text{ nautical miles.}$$

This calculated radius of inertia compares very well with the observed radius of inertia on the progressive vector diagram figure 43. From the progressive vector diagram for station A1 (figure 37) the radius of inertia seems to be about 2.2 nautical miles and this agrees well with the calculated value of 2.24 nautical miles, using a current velocity of 1 knot.

It is concluded then that the current oscillations after the storm at Saglek were certainly inertial, with a period of oscillation very close to the theoretical inertia period of 14.07 hours for that latitude. The radius of inertia of these currents is in agreement with their velocities and the general characteristics of these inertia currents are similar to those outlined by Webster [10]. However, it is not known why meter C1 had an inertial period slightly above the theoretical inertia period. The period of B1 was influenced by inertial currents but not to such an extent as to completely dominate the tidal period of 12.42 hours. This phenomena at B1 is discussed with respect to densities in Chapter III.

Russell [14] also observed inertial currents, in June 1971, farther south in the Labrador current about 200 miles North of St. John's at Latitude $50^{o}30'$ North and Longitude $52^{o}30'$ West. At this latitude the theoretical inertial period is 15.5 hours and Russell observed rotary currents with periods of 15.2, 15.8 and 15.3 hours respectively. These inertial currents however did not have a significant translatory component as did those reported above at Saglek in August 1972.

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CHAPTER III

Densities

Any scalar s is a function of time t and space location (x,y,z) and hence can be expressed as $s = f(x,y,z,t)$. Then the rate of change of s is given by:

$$\frac{ds}{dt} = \frac{\partial s}{\partial t} + \frac{\partial s}{\partial x} V_x + \frac{\partial s}{\partial y} V_y + \frac{\partial s}{\partial z} V_z . \qquad 3.1$$

Equation 3.1 is further expanded to yield

$$\frac{\partial s}{\partial t} = \frac{\partial}{\partial x}\left(\frac{Ax}{\rho}\frac{\partial s}{\partial x}\right) + \frac{\partial}{\partial y}\left(\frac{Ay}{\rho}\frac{\partial s}{\partial y}\right) + \frac{\partial}{\partial z}\left(\frac{Az}{\rho}\frac{\partial s}{\partial z}\right) - \left(V_x\frac{\partial s}{\partial x} + V_y\frac{\partial s}{\partial y} + V_z\frac{\partial s}{\partial z}\right) \qquad 3.2$$

where V_x, V_y, V_z are the velocity components; Ax, Ay, Az are the coefficients of eddy diffusivity; and ρ is the density. [6].

This equation represents the local time change of concentration as the effect of diffusion minus the effect of advection.

Now let the scalar s be the density of sea water ρ and let the positive x direction be southward and normal to the middle traverse at Saglek (See Figure 2). Then if the ocean density is to remain constant with time, that is $\frac{\partial s}{\partial t} = \frac{\partial \rho}{\partial t} = 0$, the result of advection must balance that of diffusion. Considering this balance in the x direction only we have;

$$\frac{\partial}{\partial x}\left(\frac{Ax}{\rho}\frac{\partial \rho}{\partial x}\right) = V_x \frac{\partial \rho}{\partial x} \qquad 3.3$$

which gives

$$\frac{Vx}{Ax} = \frac{\partial^2 \rho}{\partial x^2} \Big/ \left(\frac{\partial \rho}{\partial x}\right)\rho \qquad 3.4$$

The expressions $\frac{\partial^2\rho}{\partial x^2}$ and $\frac{\partial\rho}{\partial x}$ are approximated by

$$\frac{\partial\rho}{\partial x} = \frac{1}{2h}\,(\rho(x + h) - \rho(x - h)) \qquad 3.5$$

and

$$\frac{\partial^2\rho}{\partial x^2} = \frac{1}{h^2}\,(\rho(x + h) - 2\rho(x) + \rho(x - h)) \qquad 3.6$$

where h is the distance (15 nautical miles) between the traverse lines.

Equation 3.4 was used to calculate values of $\frac{V_x}{Ax}$ for both the sets of densities of August 11-13 and August 24-26. These velocity factors $\frac{V_x}{Ax}$ are given in Tables 3 and 4 respectively and represent a vertical cross section of the Labrador Current along the middle traverse. In these tables a positive value denotes a south flowing current and a negative value denotes a north flowing current.

As was already seen in Chapters 1 and 2, the Current as recorded by current meters was rotating as well as moving south. The above described velocity factors (Tables 3 and 4) can at most represent a net velocity vector. Since the S.T.D. readings were not taken simultaneously but over a period of about 2 days it is not expected that they be representative of the density structure of the ocean in this area. The water volume which was recorded, say, at the middle traverse at one time may have been recorded again at the south traverse sometime later and this is not representative of a density difference between the two locations.

It may also be that the southward advection current may be better approximated by balancing it against the vertical upward diffusion or the cross stream diffusion rather than against the longitudinal diffusion.

STATIONS

10	11	12	13	14	15	16	17	Depth Meters
0.083	0.016	-0.156	-0.057	-0.030	0.069	-0.163	-0.033	0 M
0.014	0.024	-0.918	0.025	-0.027	-0.039	-0.003	-0.130	10 M
-0.012	-6.128	-1.465	-0.594	0.006	1.184	-0.105	-0.033	20 M
-0.125	5.936	0.380	-0.406	-0.127	-0.226	0.796	0.540	30 M
-0.130	0.286	-0.130	0.014	-0.032	0.151	0.030	-0.000	50 M
-0.073	-3.322	0.0	0.130	-0.014	0.026	-0.136	-0.130	75 M

Velocity Factors, (V_x/A_x), at the Middle Traverse.

From S.T.D. readings of August 11-13, 1972 at Saglek.

A positive factor denotes a southward velocity and a negative factor denotes a northward velocity.

The coefficient of eddy diffusivity is not known but the magnitude of these velocity factors should vary directly as the magnitude of the current speed.

TABLE 3

STATIONS

10	11	12	13	14	15	16	17	18	Depth Meters
0.158	-0.210	0.285	0.226	-0.413	-0.377	-0.505	-0.144	-0.133	0 M
-0.361	-0.079	-0.037	0.514	-0.577	-0.389	-0.618	-0.183	-0.182	10 M
-0.119	-0.575	0.960	-0.472	0.345	-0.569	2.616	0.418	-0.254	20 M
-0.014	2.570	0.233	-0.136	0.407	0.707	0.454	1.269	-0.165	30 M
-0.038	0.145	-1.075	0.028	-0.186	1.504	31.638	5.068	-0.059	50 M
0.240	0.160	-0.251	-0.022	-0.048	-0.255	-0.279	3.322	5.847	75 M

Velocity Factors, (V_x/A_x), at the Middle Traverse.

From S.T.D. readings of August 24-26, 1972 at Saglek.

A positive factor denotes a southward velocity and a negative factor denotes a northward velocity.

The coefficient of eddy diffusivity is not known but the magnitude of these velocity factors should vary directly as the magnitude of the current speed.

TABLE 4

There must also be found a more accurate method of obtaining S.T.D. readings; preferably a method which eliminates the need to read the S.T.D. meter record manually.

The densities and σ_t-values which were described previously in this report are given in Appendix D; with station number, depth, and dates on which the data was collected. The six decimal places given in Appendix D for σ_t does not imply precision, but is a result of the computer print-out statement.

From the sigma-t contour maps (Figures 3-20) the following observations were made:

10. The horizontal σ_t contours before the storm (August 11-13) are fairly widely spaced while those after the storm (August 24-26) are more closely spaced at the surface and at depths of 10 and 20 meters. This shows mixing of the surface layers which was a result of the storm.

11. The vertical cross section σ_t contour maps show a marked increase in σ_t values of the surface layer after the storm. This is more apparent for the North and Middle traverses than for the South traverse. This shows that dense water from deeper layers was mixed with the surface layers as a result of the storm passage.

12. A closer look at the horizontal surface contour maps of August 24-26 (Figures 9-10) suggests to some extent why current meter B1 did not have the strong inertial current which was observed at meters A1 and C1. The meters A1 and C1 are close to the circular contour levels with steep σ_t gradients, whereas meter B1 is under the influence of a different contour level with a much weaker σ_t gradient. This indicates that B1 may have

been in a different current stream than A1 or C1.

The salinities and densities recorded at Saglek are much lower than those recorded by Lazier [11] in the Labrador Sea. This is understandable since the Saglek study area is near shore and hence is expected to be more affected by fresh water runoff than the offshore areas. In comparing these Saglek salinities with those of Templeman [12], farther south in the Hamilton Bank area, there is found a slight difference. The salinities recorded by Templeman, are slightly less at the surface than those recorded at Saglek. This implies that the Labrador current is influenced more by fresh water runoff as it moves southward and hence has reduced salinity.

Conclusions

It is concluded that the current at Saglek oscillated with the tidal eriod of 12.5 hours before the storm of August 22. After the storm e oscillation period was inertial for meter stations A1 and C1. ıe radius of inertia of these currents compares with their respective locities as the theory predicts they should. Meter station B1 was nfluenced by the inertial currents but not enough to dominate the tidal scillation period.

The attempt to calculate current velocity from density differences s not very meaningful. It is suggested that the balance of southward vection with vertical or cross-stream diffusion might be more meaningul. The σ_t contour maps show that the storm resulted in a mixing of he surface layer with deeper layers. These densities recorded at glek are lower than those recorded farther offshore and higher than hose recorded farther along the Labrador Coast.

The iceberg movement near Saglek is now being studied by Dr. .T. Dempster and R. Soulis of the Engineering Department at Memorial ıiversity.

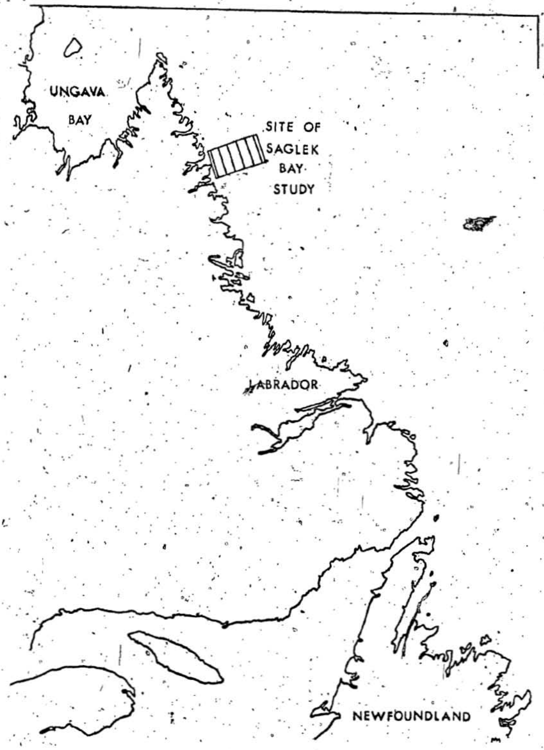


FIGURE I: LOCATION OF STUDY AREA

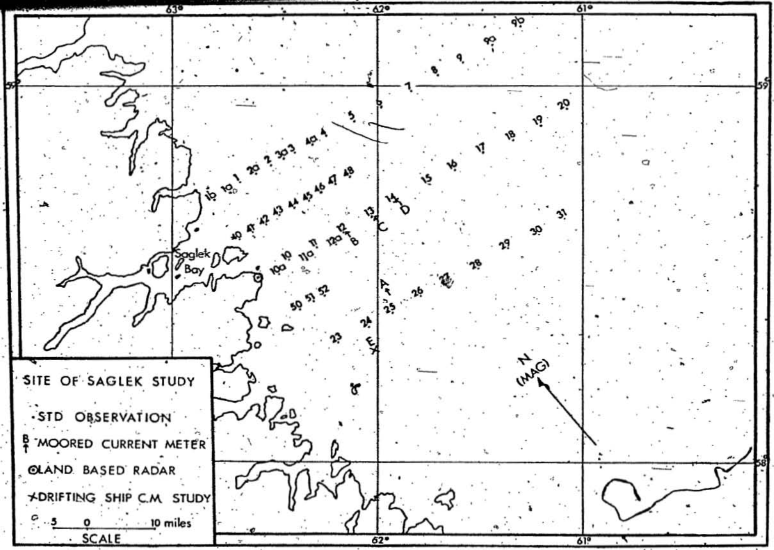
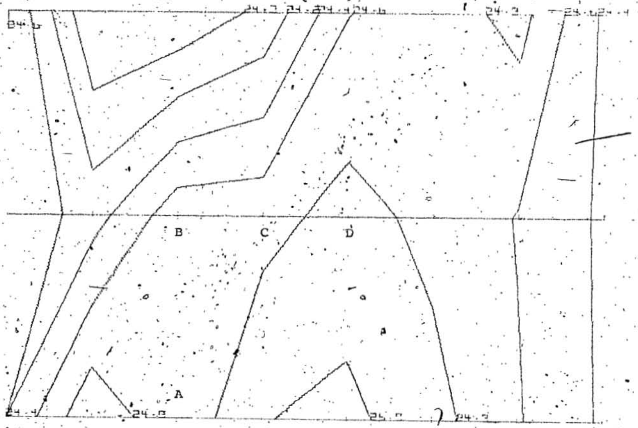


FIGURE 2: LOCATION OF OBSERVATION STATIONS

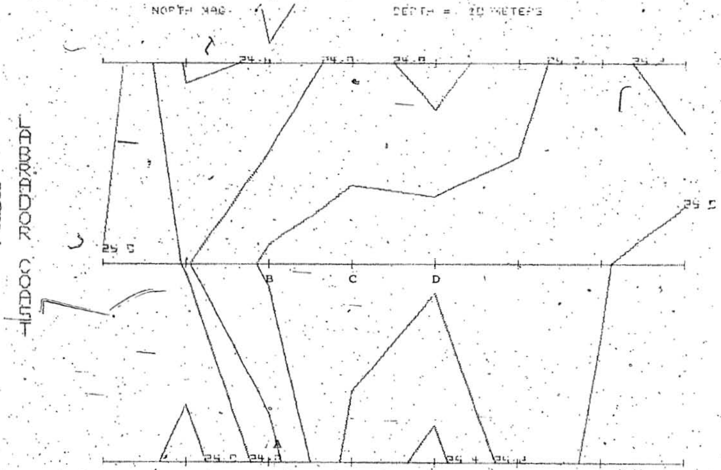
Sigma-t Contour Map Saglek, August 11-13, 1972



Scale 1 inch equals 6 Nautical Miles

FIGURE 3

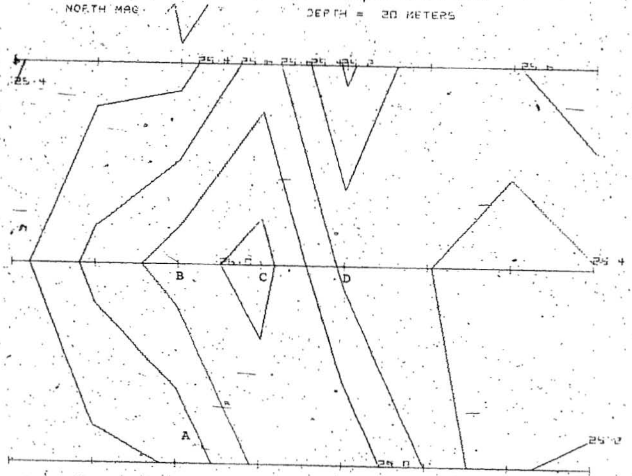
Sigma-t Contour Map Saglek, August 11-13, 1972



Scale 1 inch equals 6 Nautical Miles

FIGURE 4

Sigma-t Contour Map Saglek, August 11-13, 1972

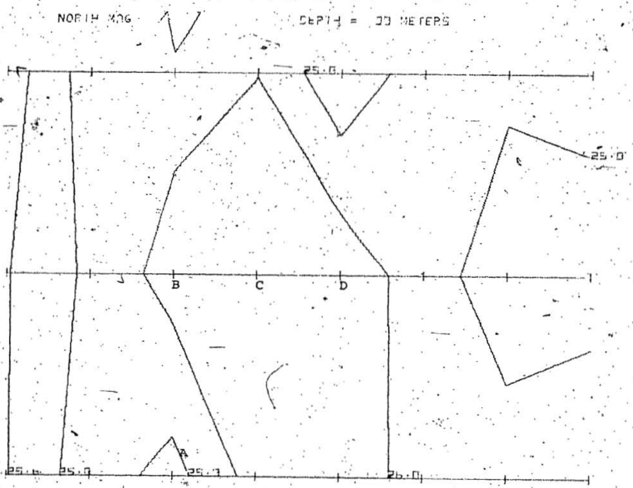


Scale 1 inch equals 6 Nautical Miles

LABRADOR COAST

FIGURE 5

Sigma-t Contour Map Saglek, August 11-13, 1972



Scale 1 inch equals 6 Nautical Miles

FIGURE 6

Sigma-t Contour Map Saglek, August 11-13, 1972

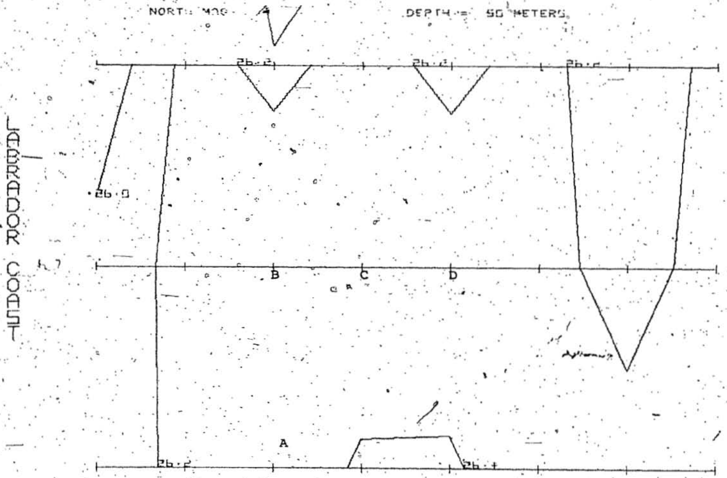
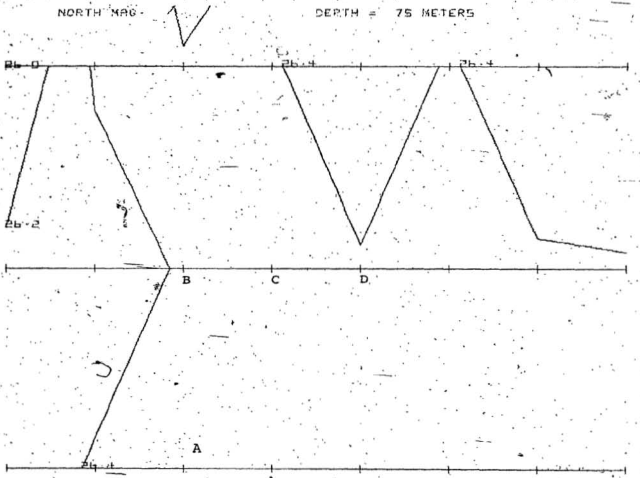


FIGURE 7

Scale 1 inch equals 6 Nautical Miles

Sigma-t Contour Map Saglek, August 11-13, 1972

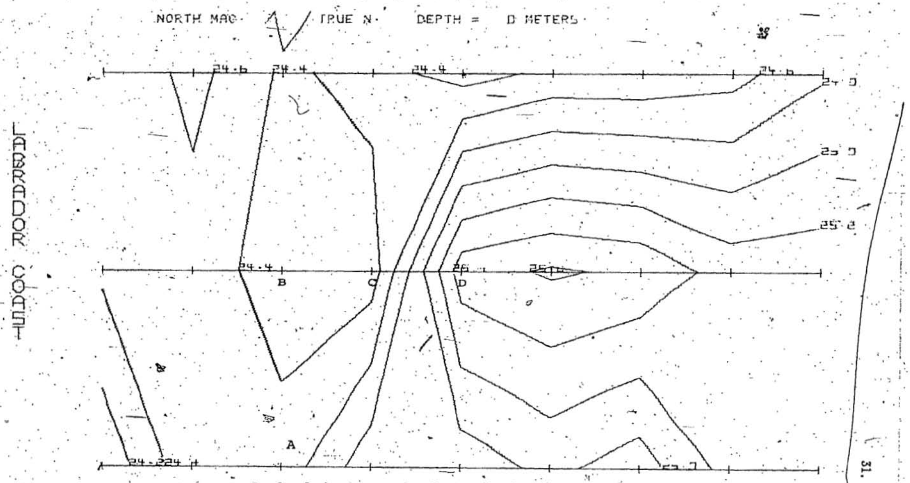


Scale 1 inch equals 6 Nautical Miles

LABRADOR COAST

FIGURE 8

Sigma-t Contour Map Saglek, August 24-26, 1972



Scale 1 inch equals 6 Nautical Miles

FIGURE 9

Sigma-t Contour Map Saglek, August 24-26, 1972

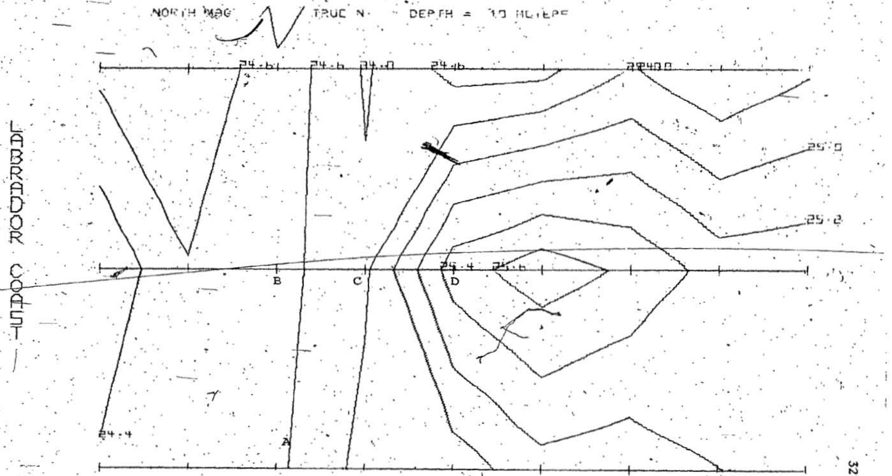


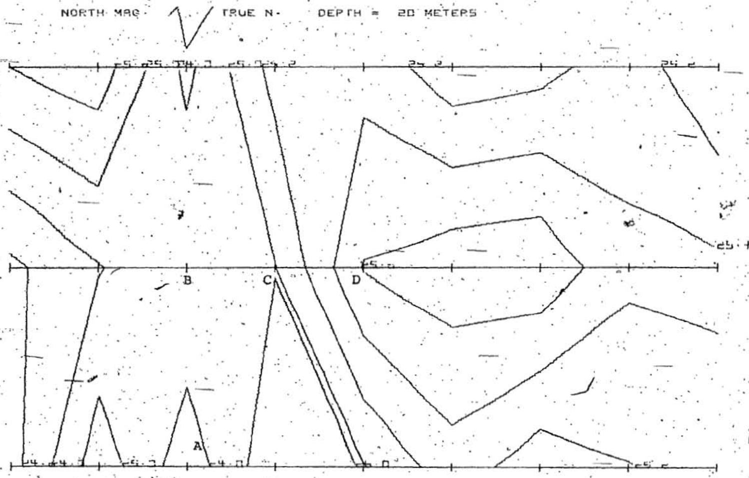
FIGURE 10

Scale 1 inch equals 6 Nautical Miles

FIGURE 11

LABRADOR COAST

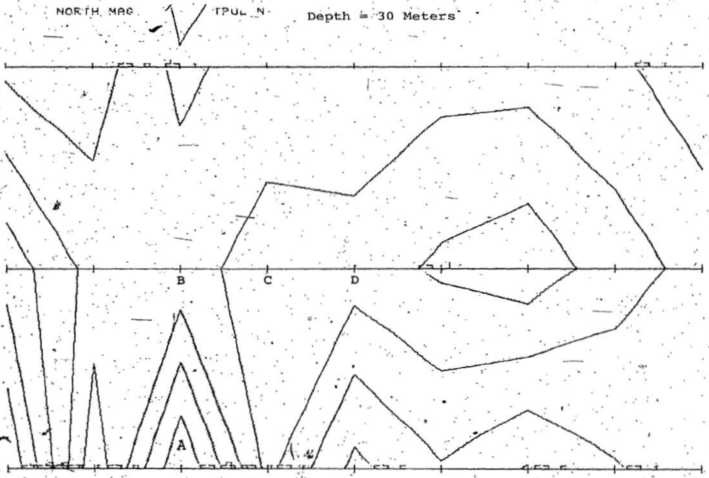
Sigma-t Contour Map Saglek, August 24-26, 1972



Scale 1 inch equals 6 Nautical Miles

Sigma-t Contour Map Saglek, August 24-26, 1972

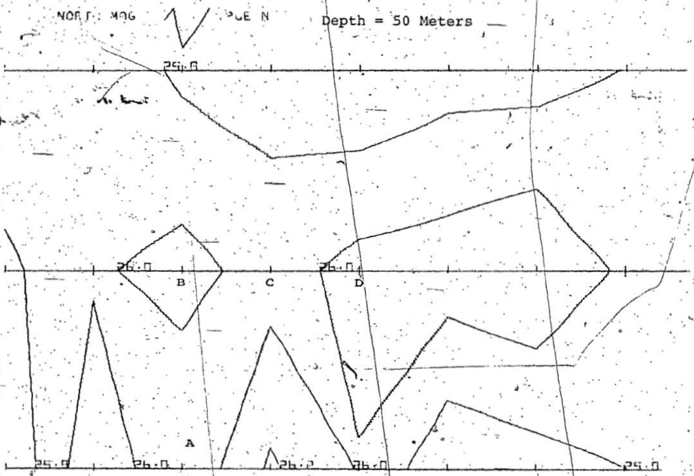
Depth = 30 Meters



Scale 1 inch equals 6 Nautical Miles

FIGURE 12

Sigma-t Contour Map Saglek, August 24-26, 1972



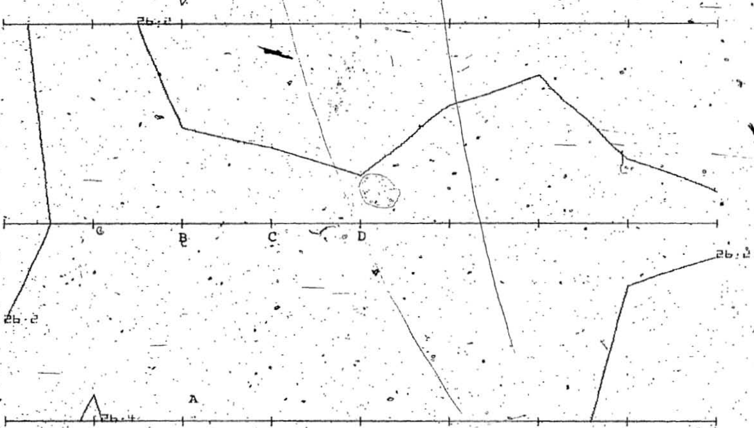
Scale 1 inch equals 6 Nautical Miles

FIGURE 13

LABRADOR COAST

Sigma-t Contour Map Saglek, August 24-26, 1972

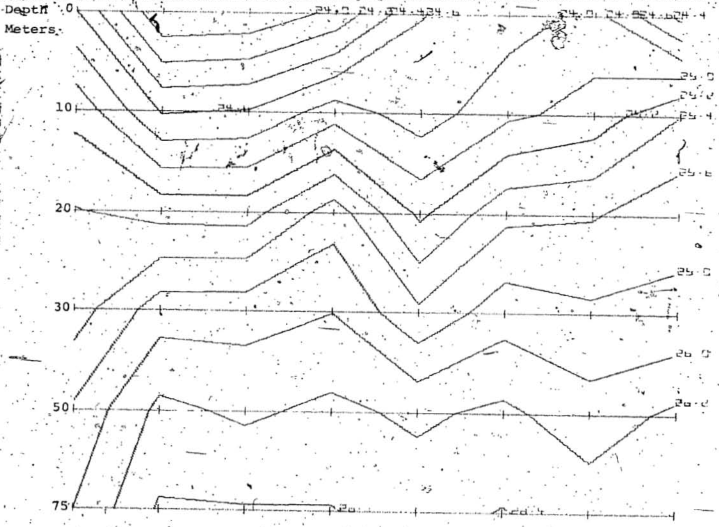
NORTH MAG TRUE N DEPTH = 75 METERS



LABRADOR COAST

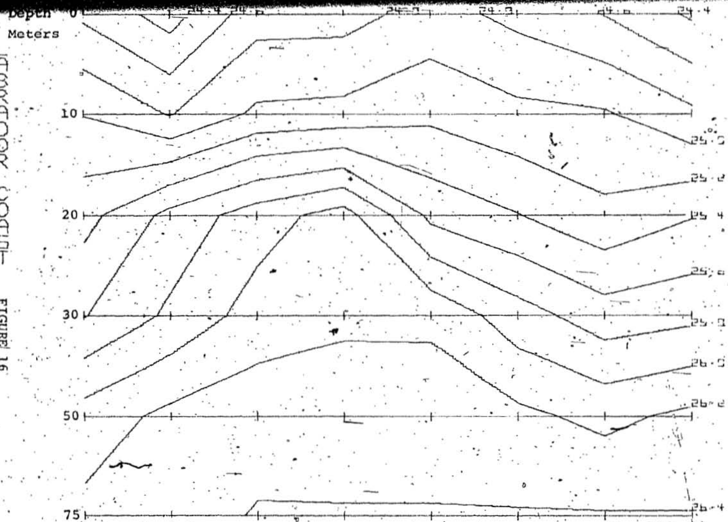
FIGURE 14

Scale 1 inch equals 6 Nautical Miles



VERTICAL CROSS SECTION — NORTH TRAVERSE — 1"=6NM.

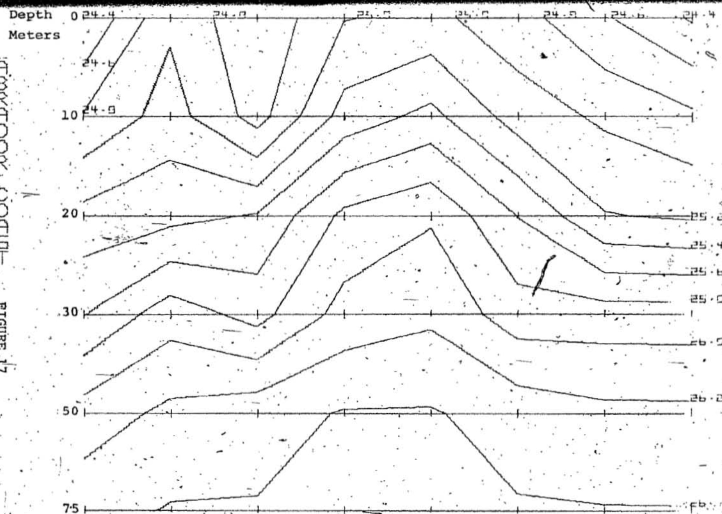
LABRADOR COAST : FIGURE 15



VERTICAL CROSS SECTION MIDDLE TRAVERSE 1"=6NM.

LABRADOR COAST

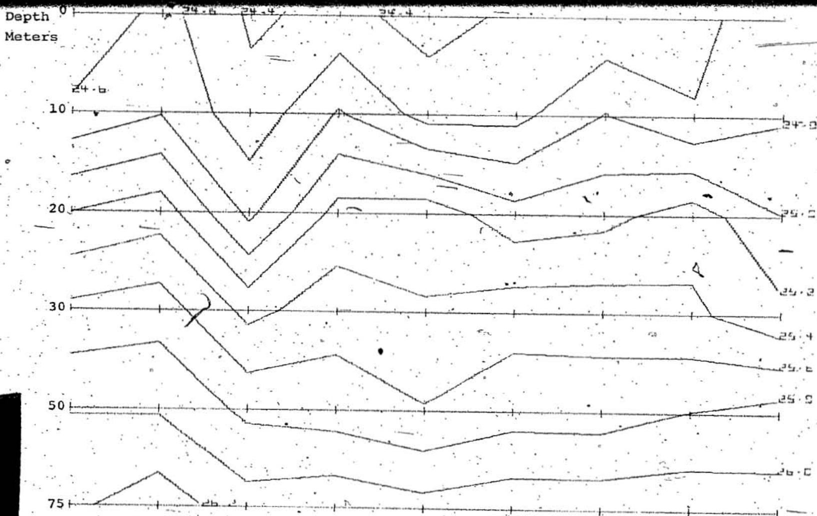
FIGURE 16



VERTICAL CROSS SECTION SOUTH TRAVERSE 1"=6NM.

LABRADOR COAST FIGURE 17

LABRADOR COAST



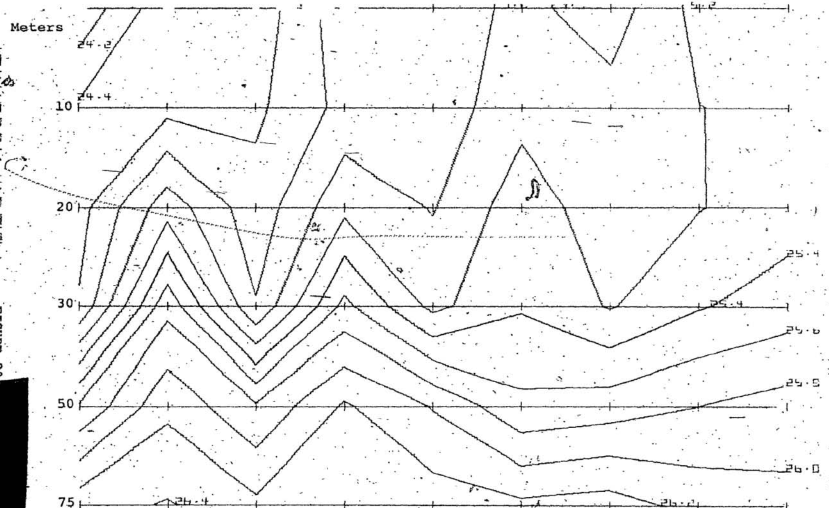
VERTICAL CROSS SECTION NORTH TRAVERSE 1"=6NM.

FIGURE 18

VERTICAL CROSS SECTION MIDDLE TRAVERSE 1"=6NM.

LABRADOR COAST

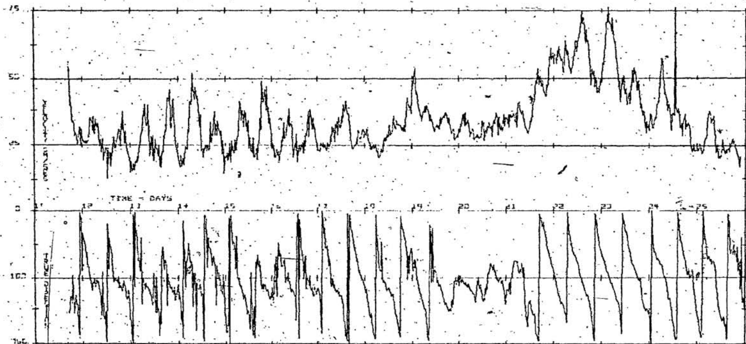
FIGURE 19



VERTICAL CROSS SECTION SOUTH TRAVERSE 1"=6NM.

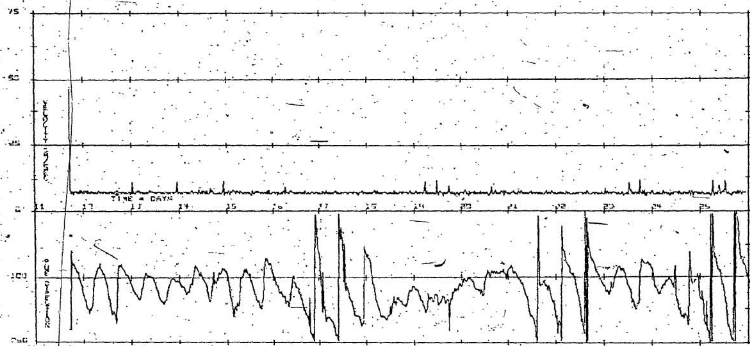
LABRADOR CURR-

FIGURE 20 [redacted]



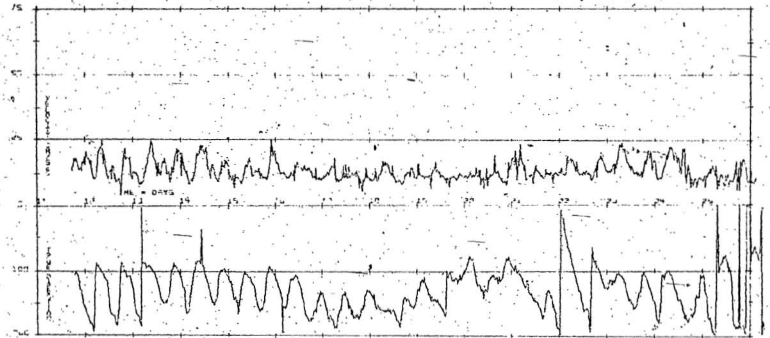
SAGLEK STATION A1 DEPTH = 13M G.M.T. AUG. 1972 CM/SEC. DIRECTION

FIGURE 21



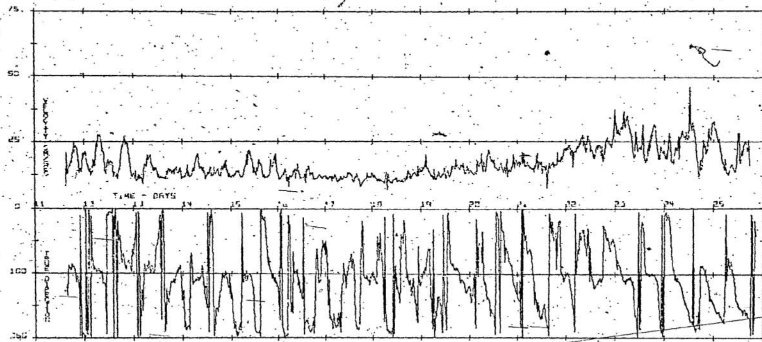
SAGLEK STATION A2 DEPTH = 75M G.M.T. AUG. 1972, CM/SEC. DIRECTION

FIGURE 22



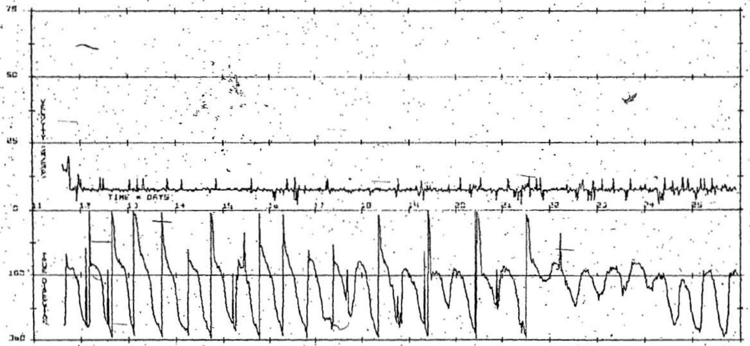
SAGLEK STATION A3 DEPTH = 155M G.M.T. AUG. 1972, CM/SEC. DIRECTION

FIGURE 23



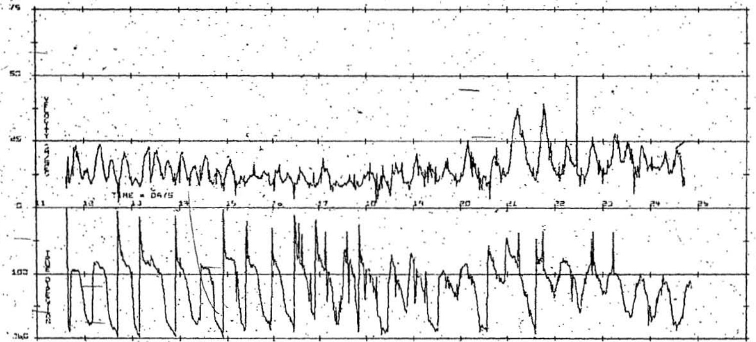
SAGLEK STATION B1 DEPTH = 19M G.M.T. AUG. 1972, CM/SEC. DIRECTION

FIGURE 24



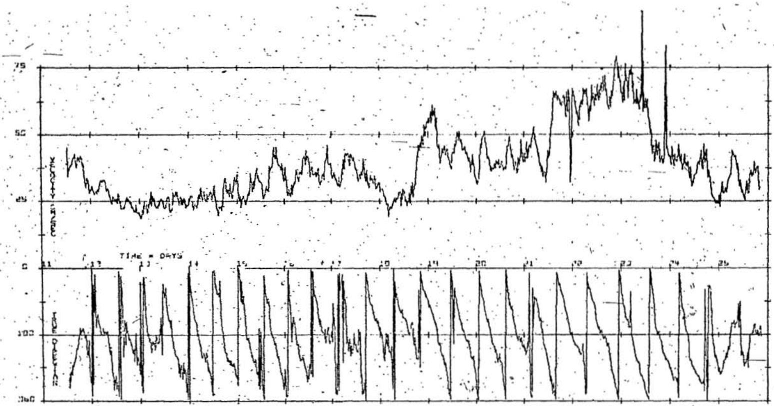
SAGLEK STATION B2 DEPTH = 15M G. M. T. AUG. 1972, CM/SEC. DIRECTION

FIGURE 25



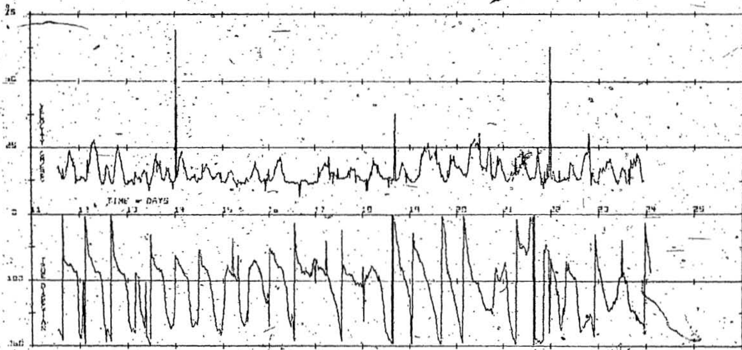
SAGLEK STATION B3 DEPTH = 136M G.M.T. AUG. 1972, CM/SEC. DIRECTION

FIGURE 26



SAGLEK STATION C1 DEPTH = 13M G.M.T. AUG. 1972, CM/SEC. DIRECTION.

FIGURE 27



SAGLEK STATION C3 DEPTH = 166M G.M.T. AUG. 1972, CM/SEC. DIRECTION

FIGURE 28

SAGLEK-STATION A1 DEPTH = 13M G.M.T. AUG. 1972, CM/SEC. DIRECTION

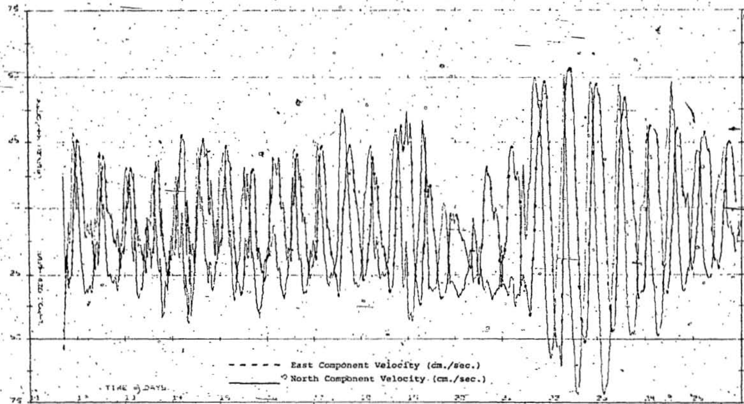


FIGURE 29

SAGLEK STATION A2 DEPTH = 75M G.M.T. AUG. 1972, CM/SEC. DIRECTION

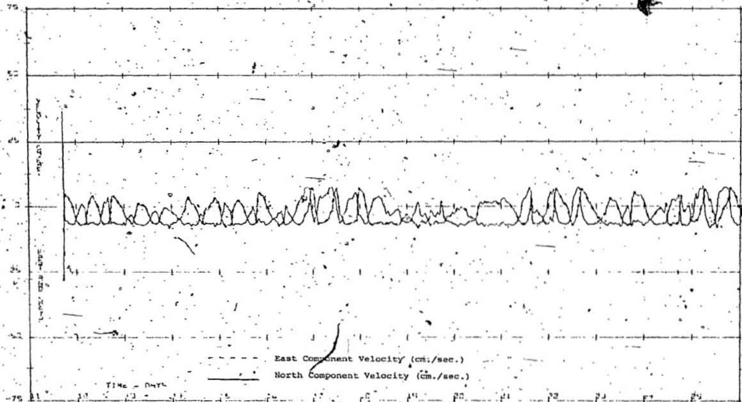


FIGURE 30

SAGLEK STATION A3 DEPTH = 155M G.M.T. AUG. 1972, CM/SEC. DIRECTION

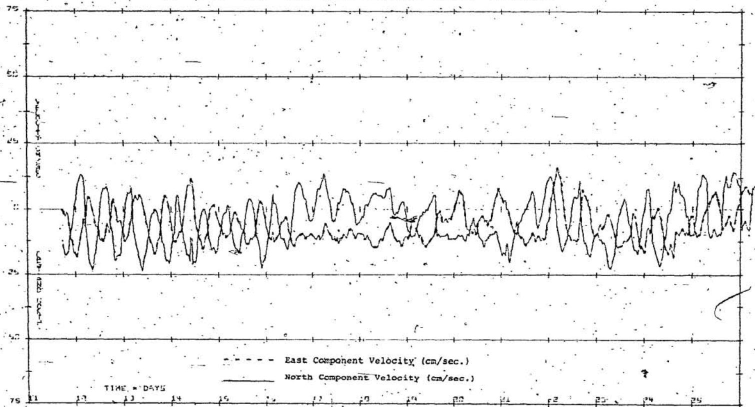


FIGURE 31

SAGLEK STATION B1 DEPTH = 13M G.M.T. AUG. 1972, CM/SEC. / DIRECTION

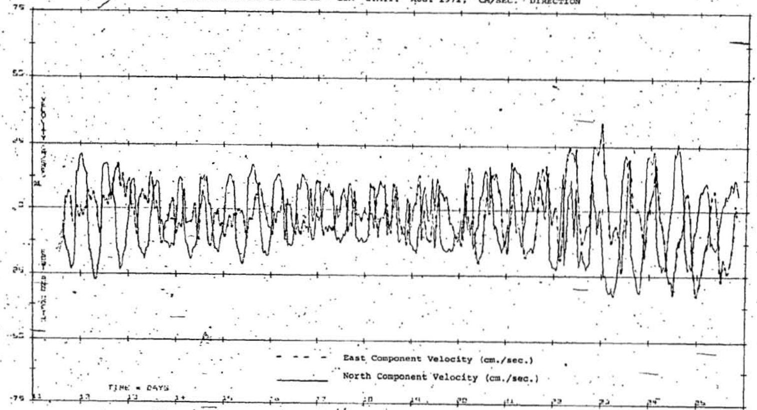


FIGURE 32

SAGLEX STATION B2 DEPTH = 75M G.M.T. AUG. 1972 CM/SEC. DIRECTION

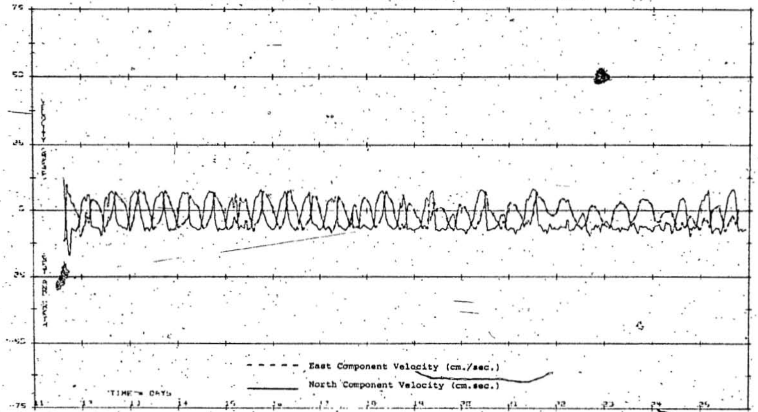


FIGURE 33

SAGLEK STATION B3 DEPTH = 136 G.M.T. AUG. 1972. CM/SEC. DIRECTION

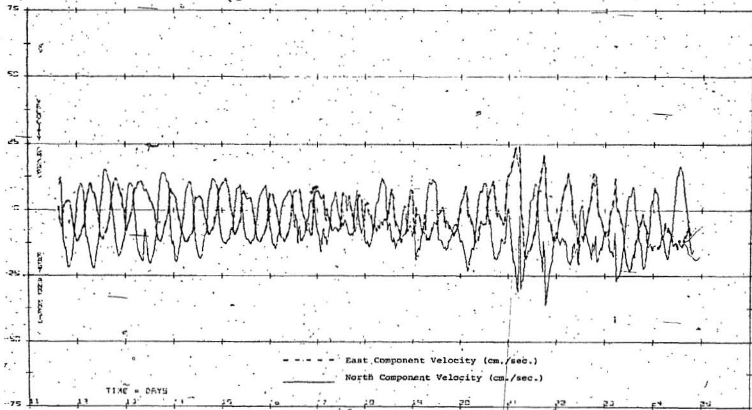


FIGURE 34

SAGLEK STATION C1 DEPTH = 13 G.M.T. AUG. 1972 CM/SEC. DIRECTION

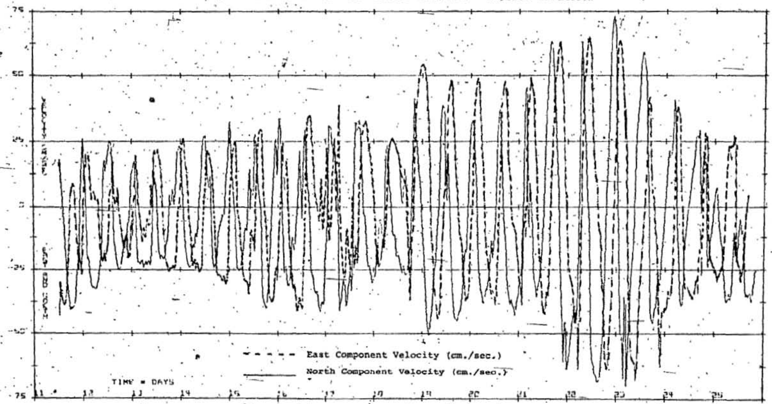


FIGURE 35

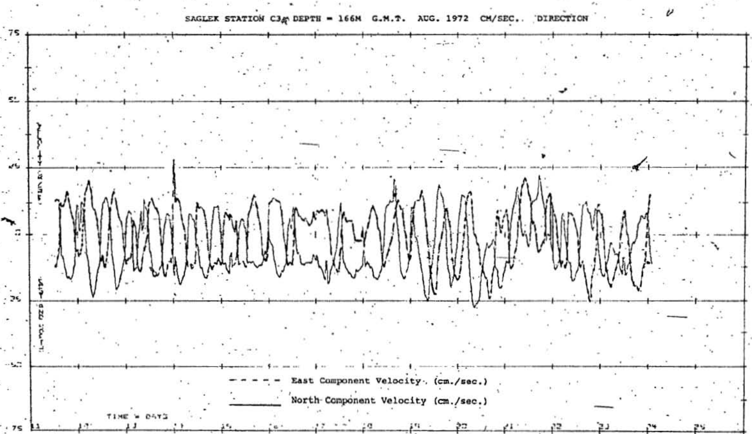
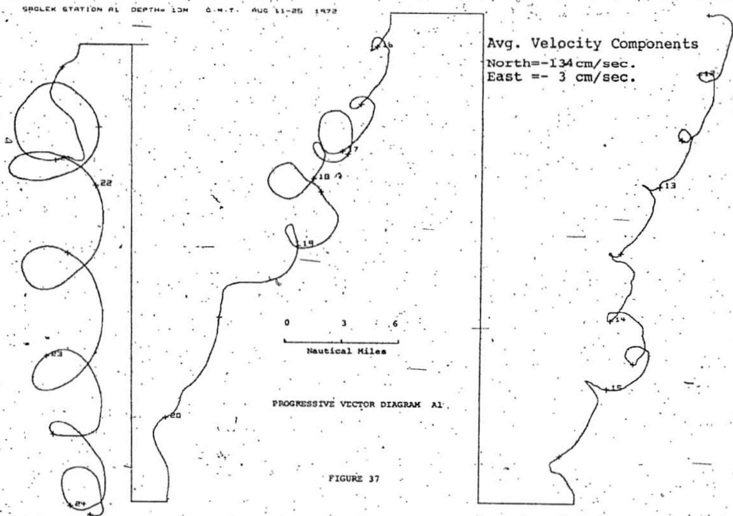

SAGLEK STATION C3 DEPTH = 166M G.M.T. AUG. 1972 CM/SEC. DIRECTION
East Component Velocity (cm./sec.)
North Component Velocity (cm./sec.)
TIME = DAYS
75
50
25
-25
-50
-75

FIGURE 36

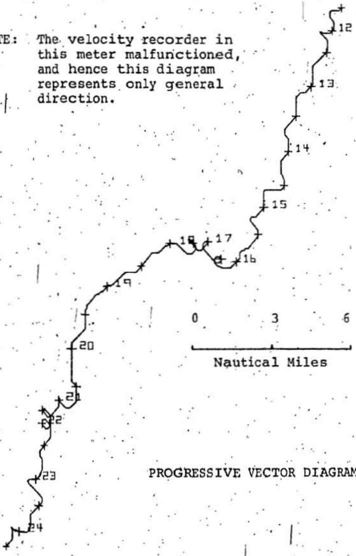


PROGRESSIVE VECTOR DIAGRAM A1

FIGURE 37

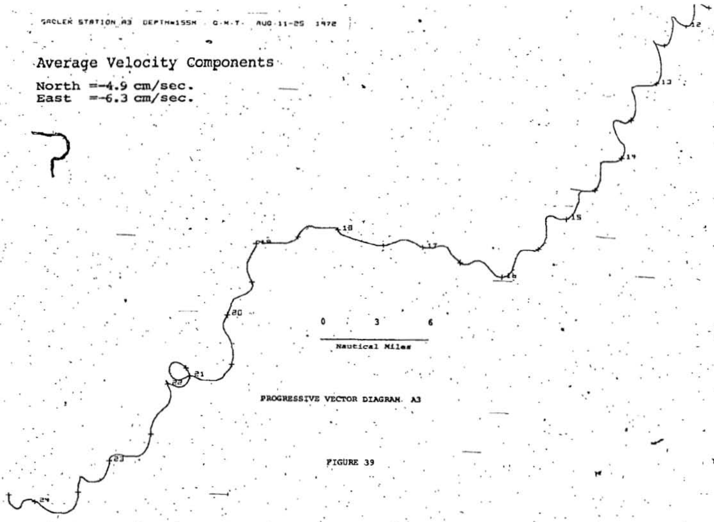
SAGLEK STATION A2 DEPTH= 75M G.M.T. AUG.11-25 1972

NOTE: The velocity recorder in this meter malfunctioned, and hence this diagram represents only general direction.



PROGRESSIVE VECTOR DIAGRAM A2

FIGURE 38



PROGRESSIVE VECTOR DIAGRAM. A3

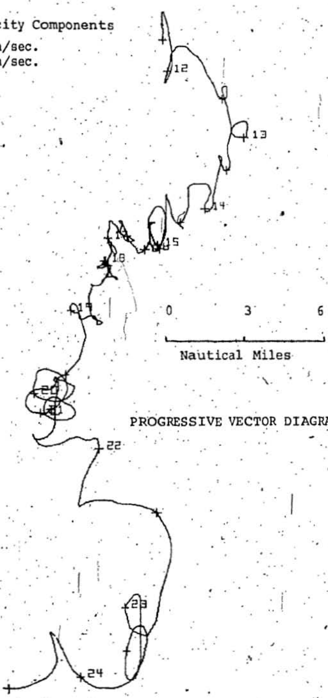
FIGURE 39

SAGLEK STATION B1 DEPTH= 13M G.M.T. AUG 11-25 1972

Average Velocity Components

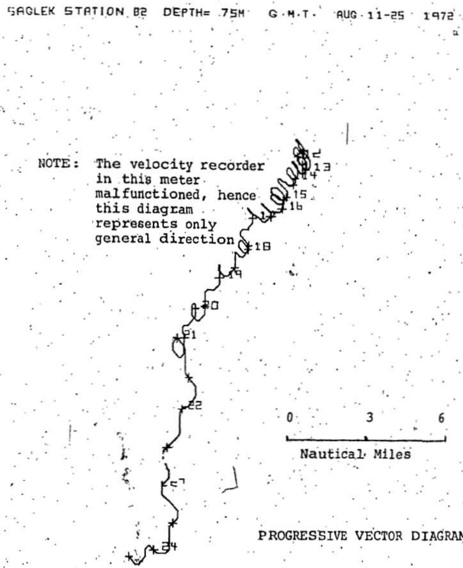
North = -3.7 cm/sec.

East = -1.7 cm/sec.



PROGRESSIVE VECTOR DIAGRAM B1

FIGURE 40



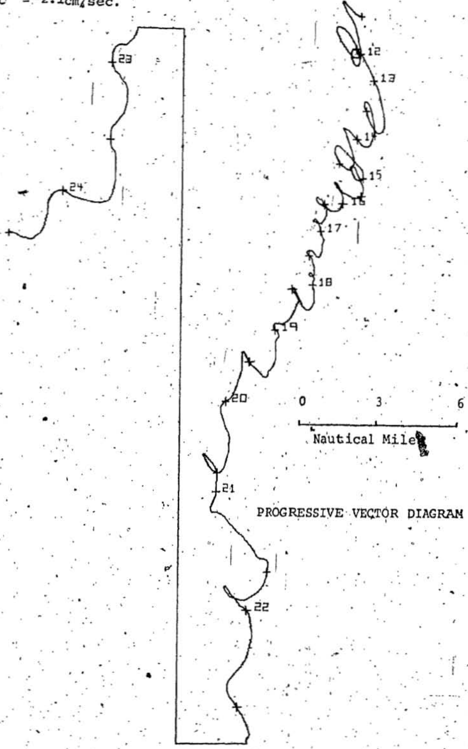
PROGRESSIVE VECTOR DIAGRAM B2

FIGURE 41

SAGLEK STATION B3 DEPTH=136M G.M.T. AUG 11-25 1972

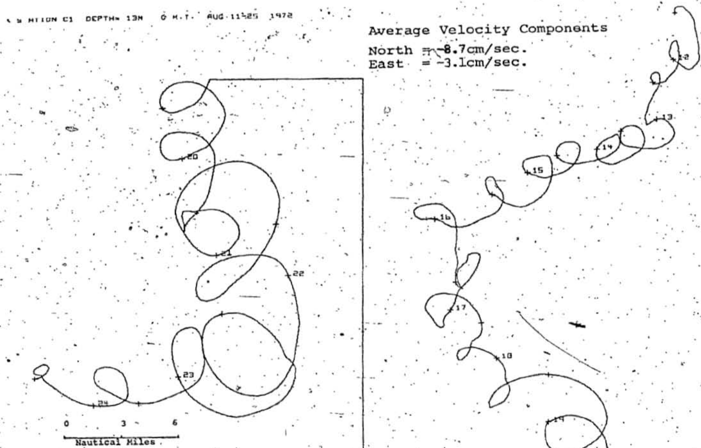
Average Velocity Components

North = -5.9cm/sec.
East = -2.1cm/sec.



PROGRESSIVE VECTOR DIAGRAM B3

FIGURE 42



PROGRESSIVE VECTOR DIAGRAM C1

FIGURE 43

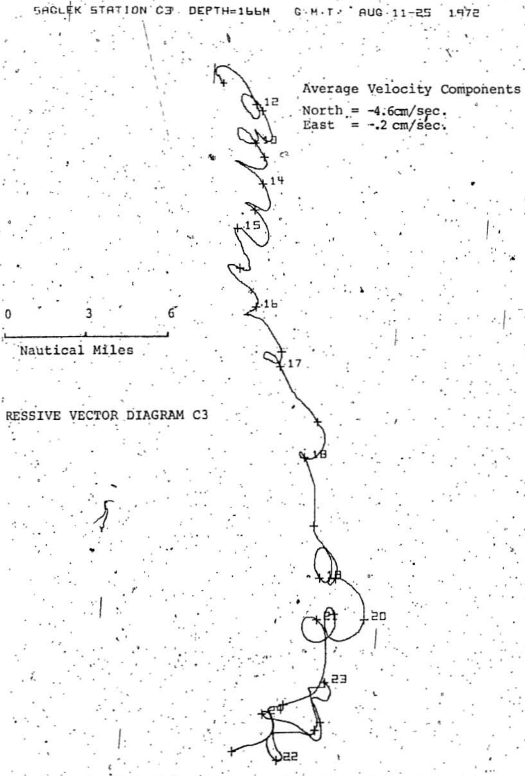

SAGLEK STATION C3 DEPTH=166M G.M.T. AUG 11-25 1972
Average Velocity Components
North = -4.6cm/sec.
East = -.2 cm/sec.
12
13
14
15
16
17
18
19
20
21
22
23
24
0
3
6
Nautical Miles
RESSIVE VECTOR DIAGRAM C3

FIGURE 44

PARTIAL RECORD OF TIDE GAUGE

SAGLEK, LABRADOR

1972

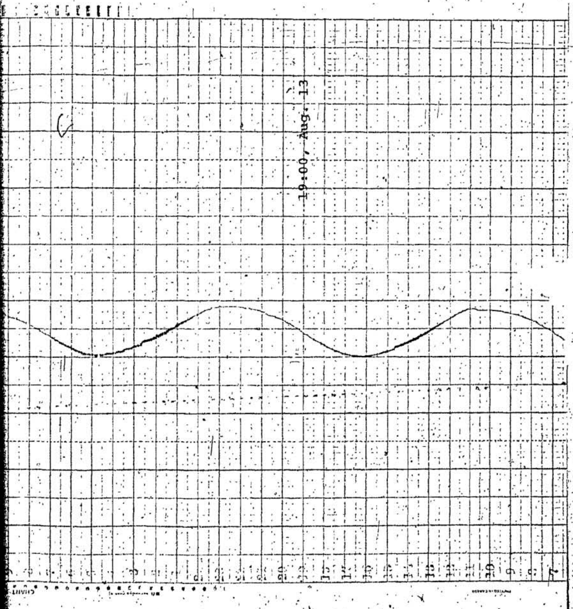


FIGURE 45

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APPENDIX A

Chronological Listing of C.S.S. Dawson Activities

C. S. S. DAWSON

DATE	G.M.T. TIME	LOCATION AND ACTIVITY
Aug. 7-10		proceeded to Saglek, slow during night due to icebergs and fog.
Aug. 11	1137	STD reading taken to locate thermocline.
	1221	current meter C moored.
	1448	current meter B moored.
	1700	current meter A moored.
	1935	began Middle Traverse at station 10, taking STD and grab samples.
Aug. 12	0537	completed Middle Traverse at station 18.
	1210	current meter D moored.
	1340	attempted to tow bergy-bit; unsuccessful due to complications in securing sling.
	1713	three drogues released near current meter C.
	1915	stereo-photographed berg near current meter C.
	1930	began recovery of the three drogues.
	2215	began South Traverse at station 23, taking STD and grab samples.
Aug. 13	0412	completed South Traverse at station 29.
	0720	began North Traverse at station 8, taking STD and grab samples; BT measurements taken at stations 2 and 1.
	1442	completed North Traverse at station 1.
	1605	released drogues SW of station 2.
	1630	towed bergy-bit for two hours near station 2.

CHRONOLOGICAL LISTING OF C.S.S. DAWSON ACTIVITIES

APPENDIX "A"

DATE	G.M.T. TIME	LOCATION AND ACTIVITY
	1935	began recovery of drogues.
	2055	studied bergs north of station 2.
	2211	released drogues NW of station 2 and tracked their movement.
ug. 14	1138	began close proximity studies of bergs in the eastern half of the study area, doing profiles and stereo-photography.
	1145	began recovery of drogues and continued close proximity study of bergs in the eastern half of the area.
ug. 15	2045	scuba divers left for dive in Saglek Bay; returned in an hour.
ug. 16	1105	divers returned from second 30 minute dive in Saglek Bay.
	1400	began berg towing study SW of station 45; launched two drogues.
	1600	terminated towing bergy-bit (sling slipped off).
	1706	took grab sample and sediment cores near station 47.
	1910	began recovery of two drogues.
	2300	began releasing drogues NW of station 2A and NW of station 3A.
g. 17	0030	began North Traverse at station 1A, taking STD readings.
	1700	completed North Traverse at station 4.
	1925	began taking grab samples and sediment core NW of station 42.

CHRONOLOGICAL LISTING OF C.S.S. DAWSON ACTIVITIES

APPENDIX "A"

DATE	G.M.T. TIME	LOCATION AND ACTIVITY
	2230	began North Intermediate Traverse at station 40, taking STD readings; BT measurement taken at station 41.
Aug. 18	0311	completed North Intermediate Traverse at station 48.
	0433	began Middle Traverse at station 12, taking STD readings.
	0743	completed Middle Traverse at station 10A.
	0819	began South Intermediate Traverse at station 50, taking STD measurements; BT reading taken at station 52.
	1005	completed South Intermediate Traverse at station 52.
	1040	began drogue tracking study near station 52.
	1206	began recovery of drogues.
	1700	began stereo-photography and profiling of grounded berg SW of station 23.
	1840	began stereo-photography and testing of Furuno echo sounder at berg SE of station 23.
	1904	released and tracked drogues south of station 23 and 24.
[illegible]g. 19	1125	stereo-photographed and profiled berg south of station 28.
	1227	began recovery of drogues.
	1446	began releasing drogues.
	1636	began stereo-photography and profiling of two bergs south of station 24.
	2030	began mooring E (SW of station 24) STD and current meter study.

CHRONOLOGICAL LISTING OF C.S.S. DAWSON ACTIVITIES

APPENDIX "A"

DATE	G.M.T. TIME	LOCATION AND ACTIVITY
Aug. 20	1038	began recovery of drogues.
Aug. 21	0820	scuba divers departed for Saglek Bay for biological study.
	0937	scuba divers returned.
	1105	began release of two drogues; profiled and stereo-photographed ice bergs near station 13 and 16.
Aug. 22	1445	searched for drogues
	1615	began sounding profile towards Watchman Island.
	1730	completed sounding profile.
	1959	began close proximity study of berg from W of station 23 to station 53, taking grab samples, profiles, stereo photographs, and STD measurements.
Aug. 23	1158	studied bergs near stations 45 and 46 taking STD and BT readings, profiling, stereo-photographing, releasing drogues, and recovering grab and core sediment samples.
	2014	began releasing and tracking of drogues near station 1
Aug. 24	1720	began recovery of drogues.
	1808	took grab samples and sediment cores near station 12.
	2323	began North Traverse at station 1, taking STD measurements; BT reading taken at station 1.
Aug. 25	0843	completed North Traverse at station 9B.
	0954	began Middle Traverse at station 20, taking STD measurements; BT readings taken at stations 16 and 13.
	1732	completed Middle Traverse at station 10.

CHRONOLOGICAL LISTING OF C.S.S. DAWSON ACTIVITIES

APPENDIX "A"

DATE	G.M.T. TIME	LOCATION AND ACTIVITY
	2316	recovered current meter moorings B, C, D and A.
Aug. 26	0050	began South Traverse at station 23, taking STD measurements.
	0808	completed South Traverse at station 31.
	1312	headed for St. John's.

CHRONOLOGICAL LISTING OF C.S.S. DAWSON ACTIVITIES

APPENDIX "A"

APPENDIX B

Specifications

of

Instruments

BRAINCON CORP.
MARION, MASS. 02738 Tel. 748-1085

A SUBSIDIARY OF THE SPACE AND SYSTEMS DIVISION OF GENERAL TIME

Data Sheet 37, May 1, 1968

TYPE 381 HISTOGRAM* CURRENT METER

The Type 381 HCM Current Meter is a photo-recording instrument which measures and records current speed, direction, and instrument tilt. It is a completely new, miniaturized version of the well-known Braincon Type 316 HCM Current Meter, and uses the same patented method of data acquisition.

OPERATION

The Type 381 HCM Current Meter is programmed by a Bulova Accutron† Timer. It records on 16mm film by making a time exposure of radio luminous material applied to the sensors. When the programmer contact closes it activates a transistor switch, energizing the film drive motor for 30 seconds, which advances the film to the next data frame. The camera continuously records the sensor output until the next programmer switch closure.

FEATURES

Small Size — The Type 381 measures only 30¼" between mooring eyes. With a total weight in air of less than 35 lbs. it requires little storage space and can easily be handled by one man.

Convenience — In addition to reducing size and weight, Braincon has eliminated tie rods. Removing the end cap is now a matter of unscrewing three captive nuts, with no special tools required.

Piston "O" Rings — These provide positive protection at all depths within the instrument's pressure range. The "O" ring cannot accidentally slip from place during pressure case assembly.

Accutron Timer — Maximum timing accuracy and reliability is assured through use of a Bulova Accutron Timer. This device is powered by a self-contained mercury cell and accuracy of timekeeping is plus or minus 2 seconds per day under most operating conditions.

Magazine Film Loading — The Type 381 uses a standard, readily available Kodak daylight loading 16mm film magazine. No dark room or film threading is required. The camera can be loaded or unloaded in seconds, even on deck.

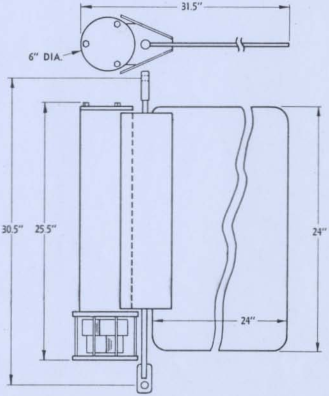
High Corrosion Resistance — All exposed aluminum parts are Sanford Hard-Coated to thickness of .002" and covered with two coats of synthetic "H" coating. Passivated stainless steel, inert plastics and two sacrificial magnesium anodes complete the anti-corrosion protection.

Design Simplicity — This instrument consists of two basic assemblies, each attached to a pressure case end cap. One contains the camera, drive motor, timer and power supply. The other is comprised of the Savonius Rotor (external), compass and inclinometer assemblies, including the sensor display. The pressure case itself provides proper spacing between assemblies.

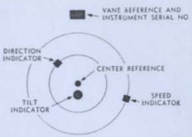
Histogram Recording Technique — The Type 381 HCM Current Meter employs a histogram recording technique which consists of making sequential time exposures of the self-luminous sensor indicators. Each data frame thus obtained is a histogram of current direction, tilt direction and instrument tilt, and an average of current speed. The luminous instrument serial number appears on each data frame. The camera will record all data occurring for a period of 15 seconds or longer.

The Self-Luminous Sensor Indicators — These light sources require no external power, thereby minimizing battery requirements. Four readily available alkaline A cells will advance the entire film load and provide an excellent safety factor, even at −2°C.

The inherent reliability of self-luminous sensor indicators, mechanical simplicity and very low power requirements combine to make the Type 381 HCM unusually dependable in its operating environment.



†TM Bulova Watch Co.
*Reg. T.M.



TYPICAL DATA FRAME

Typical data record from Braincon Type 381 Histogram Current Meter. Data frame drawing at right illustrates ease of visual interpretation. Braincon maintains complete processing and data translation facilities.

For more detailed information on the Type 381 Histogram Current Meter contact the Sales Department, Braincon Corporation.

SPECIFICATIONS

CURRENT SPEED SENSOR

Type: Savonius Rotor (Balanced in Air)
Speed Range: 0 to 5 Knots
Calibration Threshold: 0.05 Knots (Minimum)
Sensitivity: 142 R.P.M./Knot (nominal)
Mounting: Tungsten carbide pivot bearings to instrument pressure case.

CURRENT SPEED OUTPUT

Format: Circular Analog
Sensitivity: Typically 140°/knot over 20 minute sample period with 7200:1 gear train.
Indicator: Radioluminous light source
Transfer Mechanism: Magnetically coupled gear train
Accuracy: ±3% of full scale (5.0 Knots) when used with calibration curve and corrected for tilt error.

CURRENT DIRECTION SENSOR

Type: Large area vane (3.65 square feet, balanced in water to be insensitive to tilt.)
Magnetic Direction: 0 to 360° (Continuous)
Sensitivity: ±5° at 0.05 Knots
Mounting: Faired brackets welded to pressure case.
Bearing Materials: Teflon and 300 series stainless steel.

CURRENT DIRECTION OUTPUT

Format: Circular analog; viscous damped permanent magnet compass.
Indicator: Radioluminous light source.
Transfer Mechanism: Direct through instrument pressure case.
Accuracy: ±1%

INSTRUMENT TILT AND TILT DIRECTION SENSOR

Tilt Range: 0 to 30°
Direction: 0 to 360° (continuous)

INSTRUMENT TILT AND TILT DIRECTION OUTPUT

Format: Circular analog, viscous damped.
Sensitivity: ±0.5% Direction
Indicator: Radioluminous light source.
Transfer Mechanism: Direct
Accuracy: 10% Tilt Angle; ±3% full scale Tilt Direction.

RECORDER

Method: Direct photographic time exposure of sensor outputs.
Camera: Integral unit attached to removable end cap. Unit contains film magazine, timer, drive motor and batteries.
Film Type: Kodak Tri-X Reversal film in standard 50 ft. 16mm magazine; Kodak Spec. TXR447.
Power: 4 alkaline penlite cells (RCA Type VS1334 or equivalent)

MODE

Number of Recordings: 3600
Rate: 1 Frame/20 minutes standard; 1 frame/10 minutes to 1 frame/hour per special order.
Maximum Unattended Recording Period: 50 days at 1 frame/20 minutes.
Test: Continuous, 1 frame/30 seconds.

TIME MECHANISM

Type: Bulova Accutron Timer.
Timekeeping Accuracy: ±2 seconds/day under most operating conditions.
Power: Self contained mercury cell.

OPERATING ENVIRONMENT

Operating Medium: Sea Water
Operating Temp. Range: −2 to 38°C (28 to 100°F)
Storage Temp. Range: −34 to 65°C (−30 to 149°F)
Maximum Pressure: 8,000 psi standard
Max. Tensile Load: 8,000 lbs. across suspension bar.

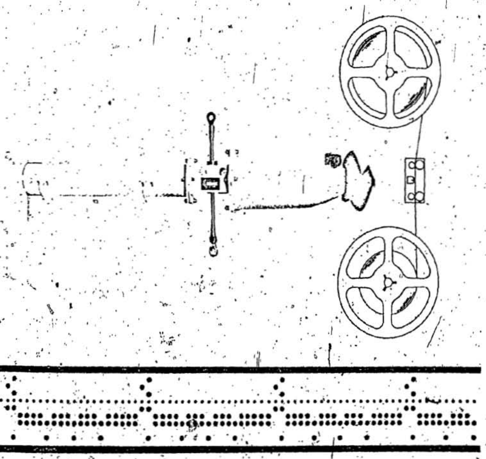
INSTRUMENT HOUSING

Material: Aluminum; 7075-T6, Fed. Spec. QQ-A-200 or equivalent.
Finish: Sanford Hard Coated
Coating: Double coated with Synthetic "H" coating.
Color: Black.
Hardware: 300 series Stainless Steel, welded where necessary.
Anti-Corrosion Protection: Sacrificial magnesium anode.
Anti-Fouling Protection: Applied commercial coating to sensors if required.
Condensation Control: Replaceable desiccant.
Size: Pressure Case — 6" O.D. x 25.5" long: 30.5" between mooring eyes.
Direction Vane — 24" x 24" x ⅛".
Weight: In Air — 34 lbs. approx.
In Sea Water — 14 lbs. approx.

Self Recording CURRENT METER

MODEL DNC-2

FOR CURRENT VELOCITY
AND DIRECTION MEASUREMENT



N.B.A. (CONTROLS) LTD.

SELF RECORDING CURRENT METER
MODEL DNC-2

The Current Meter DNC-2 is designed for measuring and recording the velocities and directions of currents and tidal streams in the seas, oceans, straits, harbours and bays, as well as for investigating the nature of such water movements in channels, rivers and estuaries. With this model the readings can be recorded over a cycle of up to 380 days in situ at depths down to 2,000 feet (600 metres).

PRINCIPLE OF OPERATIONS

The instrument operates by sampling the direction and average velocity readings at pre-set intervals and recording them on magnetic tape.

A translation unit is used to replay the tapes into a usable form (usually punched paper tape) for subsequent computer processing.

CONSTRUCTION

Model DNC-2 comprises two watertight compartments separated by a gimbal assembly, constructed of heavy duty stove enamelled marine alloy, containing velocity measuring and storage electronics, tape recorder, batteries, digital compass, crystal clock and associated electronics. The instrument has a neutrally buoyant impeller and detachable polypropylene stabilising tail plane.

CURRENT VELOCITY MECHANISM

The impeller, rotated by the water-current, is magnetically coupled through the front bulkhead, to a reed switch mechanism that converts the rotation to electrical pulses. These are fed into an integrated circuit memory, which stores the number of rotations as a binary number. There are two modes of operation, (selected by means of a soldered link), which are as follows :

1. The memory is reset to zero after every interrogation. This means that the velocity reading recorded is directly proportional to the average velocity measured between two interrogation periods.

2. The memory is not reset to zero after an interrogation. This means that the velocity reading recorded is an accumulative one, and is thus directly proportional to the total water flow past the instrument.

In both modes the reading is recorded as a 10 bit binary number, and can be scaled by pre-selecting (by means of soldered links) the division ratios in the electronic accumulator/memory. This scaling facility is extremely useful, since it can be selected to provide optimum resolution and dynamic range for all the available interrogation times and velocity conditions.

The impeller has a starting velocity of less than 3 cm/sec., and a calibrated linearity up to 250 cm/sec of better than 2%.

CURRENT DIRECTION MECHANISM

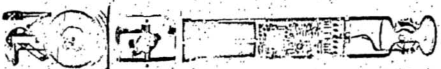
1 The direction of the current is determined by a precision double mounted compass with a 7 bit optical encoding disc which is sampled every interrogation period, and recorded as a 7 bit binary number. The optical encoding disc is scaled such that 360° is represented as binary 120.

Accuracy : Resolution 3°.

TIMING

All timing sequences within the instrument are derived from a crystal controlled clock, within an overall accuracy over the temperature range 0-20°C of better than ± 2 sec/day. Since all the time references are reset to zero when the instrument is activated (by removing an external magnet and thus closing a switch in the instrument) it is a very simple matter to synchronise the instrument, or a complete string of instruments both to an external time reference and to each other.

The interrogation rate may be selected by means of soldered links to any period required from 0.5 min. to 31.5 min, in 0.5 min steps, as standard.



MODEL DNC-2 WITH PRESSURE CASES REMOVED

RECORDING

The instrument contains a two track 1/4" specially designed tape transport mechanism for storing the obtained information. The recording time for each interrogation period is approximately 1 second, at a bit-density of approximately 75 BPI, and the following information recorded on Track 1 (Track 2 is used for reference clock pulses).

1. Instrument Serial No. - 8 bits, which is split up into two sections of 4 bits each. This information is used in the replay system both to identify the source of the tape, and to act as a check on information reliability. (See replay).
2. Reading No. - 12 bits. This reading commences at 1, and increases by one at each interrogation period up to 8, 191 after which it repeats. The information is used to obtain time references on playback, enables correct time information to be obtained even if other sections of the recordings are destroyed and allows analysis of the recording to commence at any part of the tape.
3. Velocity Reading - 10 bits.
4. Direction Reading - 7 bits.
5. A parity bit is recorded at the end of each interrogation period to give even parity to the information recording (see replay).

The whole recording system is designed so as to be extremely flexible. Repeat sampling can be used if other parameters are to be measured (e.g. temperature, pressure etc.)

CAPACITY

With 5" reels of triple play tape, the capacity of the recorder at standard bit density is over 20,000 sets of 38 bit readings. Higher bit densities can be supplied for special purposes.

POWER SUPPLY

The instrument is powered from a 12 v 5 AHr self contained leak proof primary pack.
The battery life depends upon the interrogation interval, e.g. for an interrogation interval of 5 mins, life = 63 days, for an interrogation interval of 30 mins, life = 380 days.

SUSPENSION

In-line mounting via solid stainless steel tie bar with PTFE gimbal bearings and standard stainless steel shackles. Alternatively, a hollow tie bar assembly for position adjustment of a string of units can be provided.

OPTIONAL EXTRAS

1. Hydrophone.

Model DNC-2 is designed with a facility for a hydrophone attachment. This consists of a low power acoustic transducer which transmits in digital form (15 KHz power output 100 milliwatts), the electrical inputs from both current velocity and direction. Two surface units are available (a) for listening only (i.e. system "check" out comprising headset and probe (b) for recording; as (a) but with interface electronics and recorder. The use of the hydrophone will reduce batter life.

2. Telemetry

Model DNC-2 can be supplied with acoustic, UHF or VHF telemetry links.

BUOYED SYSTEM

Model DNC-2, being completely self-contained and in-line mounted, makes recording from many units in a vertical "string" relatively simple as it is not necessary to use suspension frames or electrical slip rings. The design also allows the instrument(s) to be handled/launched with a minimum of difficulty. Such systems can be quoted for complete with straing cable, surface/sub-surface support buoys; single or double time releases containing separate back-up timing mechanism or acoustic release plus back-up timer.

WEIGHTS AND DIMENSIONS

Overall length	:	42.50	108.00 cms
Frontal Section Diameter	:	7.25	18.00 cms
Rear Section Diameter	:	3.75	9.60 cms
Weight in Air	:	59 lbs	27.00 kilos

REPLAY SYSTEM

There are two basic methods available to enable the recordings to be processed.

1. The self contained translation unit.
2. The translation service.

The self contained translation unit can be supplied in several forms, to customers' requirements. However, the standard unit consists of the following sub-units:–

1. TAPE REPLAY DECK

   The tape replay transport, based on a standard deck, will accept directly the spools from the DNC-2 Recorder. Facilities include playback at 15/16"/sec, equivalent to approximately 1 set of readings per sec. This enables the individual readings to be monitored on the display unit for individual analysis. The normal playback speed into the Facit punch is 3 ¾"/sec.

2. SIGNAL PROCESSING AND DISPLAY UNIT

   The signals from the tape deck are processed and stored both for display and for feeding the punch unit. The display shows the following information in normal decimal:–

   1. Instrument Number
   2. Reading Number
   3. Velocity reading
   4. Direction reading (directly in degrees)
   5. Total number of Parity errors.
   6. Total number of serial no. errors.

3. PUNCH/PRINTER

   The normal punch used in the unit is a Facit. Type 4070.
   The system produces standard 8 hole punch paper tape (ASCII code) with the requisite format for further processing.

   Alternative punches and printers are available to order, as is a multi-channel real time analogue output.

TRANSLATION SERVICE

The data handling division of N.B.A. (Controls) Ltd. can provide tape translation facilities by return of post to any customers who prefer not to invest in a translation unit.

N.B.A. (CONTROLS) LTD.
Manufacturers Of Oceanographic Instruments
Progress House, Albert Road
Aldershot, Hants
Telephone: Aldershot 28028/9

BISSETT BERMAN

Specifications

SALINITY
Range:
30-40 ppt (other ranges available on special order)

Accuracy:
±0.05 ppt

Resolution:
0.02 ppt

Temperature Compensation Time Constant:
350 milliseconds or less

Recorder Slew Rate:
3 ppt/Sec

TEMPERATURE
Range:
-2° to +35° in two overlapping and automatically switched ranges

Accuracy:
±0.1°C

Resolution:
0.05°C

Temperature Sensor Time Constant:
350 milliseconds or less

Recorder Slew Rate:
6°C/Sec

DEPTH
Range:
The following standard ranges are available:
0-100 meters
0-300 meters
0-500 meters
0-1000 meters
0-2000 meters
0-4000 meters
0-6000 meters

Accuracy:
±0.25% of full scale

Resolution:
±0.1% of full scale

RECORDER
Type:
Cylindrical drum plotter with two overlapping styli

Recording Format:
Analog X1X2Y Plot

Chart Size:
6-1/2 inches x 9-1/2 inches (one frame) x 100 feet long; (100 charts/roll)

Chart Capacity:
100 frames

Sampling Rate:
Continuous

Recording Rate:
Continuous. Recorder responds to a step change input in less than 3 seconds for full-scale travel of styli; 5 seconds for full rotation of drum

GENERAL FEATURES
Pressure Case Material:
Aluminium alloy for operation to 2000 meters
High-strength alloy over 2000 meters

Size:
32 inches long overall; 6-inch diameter barrel with 20-inch guard frame

Weight:
Aluminum alloy case: 63 lbs in air; 21 lbs in water
High pressure case: 155 lbs in air; 120 lbs in water

Access to Chart:
Through double O-ring sealed end cap

Power:
Self-contained batteries provide (8 hours continuous operation; size AA rechargeable nickle-cadmium; 10 batteries supplied with unit unless other type specified

Accessories:
Each instrument supplied with batteries, two rolls of chart paper and instruction manual.

RECORD NO.

LOCATION STN 11

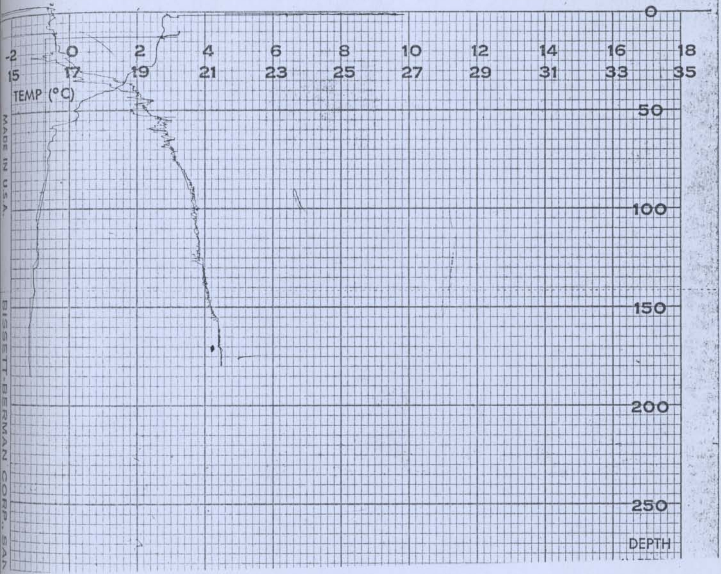
TIME 16:40

OPERATOR JMJ/DB

DATE 25-8-72

SERIAL NO.

REMARKS:



APPENDIX C

Contour Mapping Program

```
L 21                    MAIN                    DATE = 74065          00/56/14

BRENDAN HOLDEN , OCEAN ENGINEERING , MEMORIAL UNIVERSITY OF NFLD. , CANADA.
BRENDAN HOLDEN , 450 TOPSAIL RD. , ST. JOHN"S , NFLD. , CANADA PH 3689750

B HOLDEN  OCEAN DENSITY CONTOURS ( I.E, SIGT CONTOURS )   FEBRUARY 73
THESE DENSITIES  WERE CALCULATED FROM READINGS TAKEN AT SAGLEK AUG  72

   DIMENSION    XA(1700)  , YA(1700)   , XB(1700)  , YB(1700)
   DIMENSION  YBP(1700) , SIG (30,400) , X(600) , Y(600)
   FORMAT ('1')
   FORMAT  ( I6, I5, F7.1, F6.1,       F7.2, 2F14.6, I6  )
   FORMAT ( ' ' , 9F10.2 , ///////////////)
   FORMAT    ( ' ', 3F10.2,  2I8 , // )
   FORMAT (3X,4HCALL,2X,4HPLOT,10X,4HLIFT,2X,3HPEN)
   FORMAT (    3X, 5HBEGIN,2X,4HSCAN)
   FORMAT (1X,15HLABRADOR COAST )
   FORMAT(1X,37HNORTH MAG.        TRUE N.    DEPTH = ,I3,7H METERS)
   FORMAT (F4.1)
   FORMAT ( 39HOCEAN DENSITY CONTOURS , AUG. 25 , 1972 )
   FORMAT (40X ,30H DIMENSION OVER RUN ERROR                )
   D = 0

THE GIVEN AREA TO BE CONTOURED , WITH SIGT VALUES , WILL BE CALLED "MATRIX'
M = THE NO. OF ROWS IN THE MATRIX
N = THE NO. OF COLS IN THE MATRIX
(I,J) = (X,Y) COORDINATES  OF THE SIGT READINGS IN THE MATRIX AREA.
K = INDEX OF THE INITIAL SCAN POINTS (XA(K),YA(K)) .
IDD = CARDINALITY OF THE SET OF REMAINING SCAN POINTS.
L = INDEX OF THE POINTS ON THE CONTOUR LINE (XB(L),YB(L)) .
XA(K) =    X COORDINATE OF A  SCAN   POINT.
YA(K) =    Y COORDINATE OF A  SCAN   POINT.
XB(L) =    X COORDINATE OF A CONTOUR POINT.
YB(L) =    Y COORDINATE OF A CONTOUR POINT.
CMIN = THE LOWEST CONTOUR LEVEL------CMAX = THE HIGHEST CONTOUR LEVEL
CDEL = THE INTERVAL BETWEEN CONTOUR LEVELS
CX = SCALE IN INCHES PER USER UNIT ON THE 'X' AXIS
CY = SCALE IN INCHES PER USER UNIT ON THE 'Y' AXIS

READ THE DATA  POINTS INTO THEIR CORRECT POSITIONS

   DO 560 ITT = 1,15
   FORMAT( 2X ,          30F4.0         )
   FORMAT(     12X , 30F4.0  )
   CMIN = 140.01
   CDEL = 20.0
   CMAX = 202.0
   M = 398
   N = 30
   SCY = .04
```

[redacted]

APPENDIX "C"

```
SCX = SCY
READ(01,84) (                     (SIG (I,J),I=1,N),J=1,M)
CONTINUE
MDO = M-1

RINT  OUT  THE  MATRIX  AS  IT  SHOULD  LOOK
IS CHECKS THAT ALL THE SIGT VALUES HAVE BEEN ASSIGNED THE CORRECT COORDS.
 PRINT 80
 PRINT 94 ,D
 PRINT 87 , D
 DO  16  J = 1 , M   , MDO
 PRINT  83 , ( SIG(I,J) , I=1,N )
 IF (ITT.LE.10)                   GO TO 560
 CONTINUE
 MDO = M-1
 NDO = N-1
 CALL PLOTR(10)
 CALL SCALE (1.0,1.0,-10.0,-18.0)
 CALL PLOT (1,1.0,8.0)
 CALL SCALE (SCX,SCY,0.0,0.0)
 CALL PLOT (1,1.0,-1.0)
 CALL WAIT
 DO 19 MGRID =1,M,MDO
 GRIM = -MGRID
 CALL GRID (0,1.0,GRIM,1.0,NDO)
 CONTINUE
ESE PLOT STATEMENTS  DRAW A NORTH MAGNETIC ARROW  FOR REFERENCE
 IF (M.NE.3)              GO TO 20
 CALL PLOT    (1,2.8,-.75)
 CALL PLOT    (2,2.9,-.7)
 CALL PLOT      (2,3.0,-.9)
 CALL PLOT     (2,3.3,-.7)
 CALL CHAR (1.5,-.75,.1,.1,0.0)
 WRITE (10,94) D
 CALL CHAR (0.0,-1.25,.2,.2,1.0)
 WRITE (10,93)
 CALL CHAR (1.0,-0.60,.2,.2,0.0)
 WRITE (10,96)
 CONTINUE
FINE C  AND  SCAN THE PERIMETER & INTERIOR  ROWS
 C = CHIN
IS SCAN FINDS ALL POINTS WHERE THE 'C' CONTOUR INTERSECTS THESE ROWS .
 K = 0
 L = 0
 PRINT 92
 J = 1

IS DO LOOP SCANS L TO R ACCROSS THE TOP BOUNDARY OF THE MATRIX
```


[redacted]

```
 DO  23     I = 2 ; NDO , 1
 IF ((C.GE.SIG(I,J)).AND.(C.LE.SIG (I+1,J)))  GO TO 21
 IF ((C.LE.SIG(I,J)).AND.(C.GE.SIG (I+1,J)))  GO TO 21
 GO TO 23
 K = K+ 1
 YA (K)   = J
 XA(K) = I + (C-SIG(I,J)) / (SIG(I+1,J)-SIG(I,J))
 CONTINUE
 I = N

HIS DO LOOP SCANS DOWN THERIGHT HAND BOUNDRY OF THE MATRIX.
 DO 27  J = 1 , MDO , 1
 IF   (( C.GE.SIG(I,J)).AND.(C.LE.SIG(I,J+1))) GO TO 25
 IF   (( C.LE.SIG(I,J)).AND.(C.GE.SIG(I,J+1))) GO TO 25
 GO TO 27
 K = K+ 1
 YA (K)  = J +  (C-SIG(I,J)) / (SIG(I,J+1)-SIG(I,J))
 XA(K) = I
 CONTINUE
 J = M
HIS DO LOOP SCANS R TO L ACCROSS THE BOTTOM BOUNDRY OF THE MATRIX.
 DO 31  KDO = 1 , NDO
 I = N+1 - KDO
 IF ((C.GE.SIG(I,J)).AND.(C.LE.SIG(I-1,J))) GO TO 29
 IF ((C.LE.SIG(I,J)).AND.(C.GE.SIG(I-1,J))) GO TO 29
 GO TO 31
 K = K+ 1
 YA(K)   = J
 XA(K) = I -  (C-SIG(I,J)) / (SIG(I-1,J)-SIG(I,J))
 CONTINUE
 I = 1
HIS DO LOOP SCANS UP THE LEFT HAND BOUNDRY OF THE MATRIX.
 DO 35    KDO = 1 , MDO
 J = M+1-KDO
 IF ((C.GE.SIG(I,J)).AND.(C.LE.SIG(I,J-1)))  GO TO 33
 IF ((C.LE.SIG(I,J)).AND.(C.GE.SIG(I,J-1)))  GO TO 33
 GO TO 35
 K = K+ 1
 YA(K)  = J - (C-SIG(I,J)) / (SIG(I,J-1)-SIG(I,J))
 XA(K) = I
 CONTINUE
HIS DO LOOP SCANS L TO R THRU ALL CENTRE ROWS OF THE MATRIX.
 DO 39  J = 2, MDO    , 1
 DO 39      I = 2, NDO, 1
 IF ((C.GE.SIG(I,J)).AND.(C.LE.SIG (I+1,J)))  GO TO 37
 IF ((C.LE.SIG(I,J)).AND.(C.GE.SIG (I+1,J)))  GO TO 37
 GO TO 39
 K = K+1
```

APPENDIX "C"

[redacted]

```
 XA(K) = I + (C-SIG(I,J)) / (SIG(I+1,J)-SIG(I,J))
 YA (K) = J
 CONTINUE
 IF ( K.GE.1700)                    GO TO 570
 KT = K
F NO POINTS ARE FOUND ON THE ABOVE SCANS , GO TO 555.
 IF ( KT.EQ.0)     GO TO 555
 PRINT 91
 CONTINUE
AKE THE 1 ST POINT FROM THIS SET OF SCAN POINTS.
 KTDO = KT
 IF (KTDO.LE.0 )          GO TO 555
 K = 1
 PRINT 90 , C , XA(K) , YA(K) , K , D
RUNCATE THIS PT, TO OBTAIN THE (I,J) COORDS OF THE GRID BOX
 I = XA(K)
 J = YA(K)
 L = L + 1
TORE THIS 1ST POINT AS (XE,YE) FOR FUTURE REFERENCE,
 XE = XA(K)
 YE = YA(K)
HIS POINT IS THE 1 ST POINT ON THE CONTOUR , HENCE IT IS ALSO (XB,YB),
 XB(L) = XA(K)
 YB (L) = YA(K)
HANGE THE SIGN OF Y COORD  FOR THE SAKE OF THE PLOT SUBROUTINE,
 YBP(L) =  -YB(L)
 PRINT 90 , C , XB(L) , YBP(L) ,L ,D
 IF  (M.GE.200 )                    GO TO 42
 IF ( XB(L).EQ.N )                  GO TO 42
 CLABL = C
 IF ( CLABL.GE.100.0 )                        CLABL = CLABL - 100.0
 CALL CHAR (XB(L),YBP(L),.06,.06,0.0)
 WRITE (10,95)  CLABL
 CONTINUE
 CALL   PLOT(1,XB(L),YBP(L))
 KTDO = KTDO - 1
 IF (KTDO.LE.0 )       GO TO 3
HIS DO LOOP  DELETES THE ABOVE MENTIONED POINT FROM THE SET OF SCAN POINT
 DO   3   K = 1 ,     KTDO
 XA(K) =   XA(K+1)
 YA (K) =   YA(K+1)
 CONTINUE

ESE IF STATEMENTS DECIDE WHETHER THECONTOUR IS GOING UP,DOWN,LEFT,RIGHT.
OCEED UP 400 , DOWN 200 , RIGHT 100 , LEFT 300  AS  DIRECTED
 IF (( I.EQ.1)   .AND.  ( J.EQ.1))      GO TO 100
 IF (( I.EQ.N)   .AND.  ( J.EQ.1))      GO TO 300
 IF (( I.EQ.1)   .AND.  ( J.EQ.M))      GO TO 400
```


[redacted]

```
  IF  (  I .EQ.1  )     GO TO  100
  IF  (  I .EQ.N  )     GO TO  300
  IF  (  J .EQ.1  )     GO TO  200
  IF  (  J .EQ.M  )     GO TO  400
  GO TO 200

THIS SET OF STATEMENTS (100_115)  FIND THE NEXT POINT ON A CONTOUR
WHICH IS GOING TO THE RIGHT.
WHEN THE NEXT POINT IS FOUND , THE APPROPRIATE SUBROUTINE IS CALLED,
THE POINT IS CALCULATED , AND WE GO TO 500 TO CHECK THIS NEW POINT.
   CONTINUE
   IF ((C.GE.SIG(I,J)).AND.(C.LE.SIG (I+1,J)))    GO TO 101
   IF ((C.LE.SIG(I,J)).AND.(C.GE.SIG (I+1,J)))    GO TO 101
   GO TO 105
  CALL EAST   (I,J,L,C,SIG(I,J),SIG(I+1,J),XB(L+1),YB(L+1))
   YBP(L) =  -YB(L)
   CALL     PLOT(2,XB(L),YBP(L))
   GO TO 500
   I = I+1
   IF  (( C.LE.SIG(I,J)).AND.(C.GE.SIG(I,J+1)))   GO TO 106
   IF  (( C.GE.SIG(I,J)).AND.(C.LE.SIG(I,J+1)))   GO TO 106
   GO TO 110
  CALL  SOUTH (I,J,L,C,SIG(I,J),SIG(I,J+1),XB(L+1),YB(L+1))
   YBP(L) =  -YB(L)
   CALL     PLOT(2,XB(L),YBP(L))
   GO TO 500
   J = J+1
   IF ((C.LE.SIG(I,J)).AND.(C.GE.SIG(I-1,J)))     GO TO 111
   IF ((C.GE.SIG(I,J)).AND.(C.LE.SIG(I-1,J)))     GO TO 111
   GO TO 115
  CALL  WEST  (I,J,L,C,SIG(I,J),SIG(I-1,J),XB(L+1),YB(L+1))
   YBP(L) =  -YB(L)
   CALL     PLOT(2,XB(L),YBP(L))
   GO TO 500
IF THERE IS NO  "NEXT POINT" ,
WE TERMINATE THIS CONTOUR , GO BACK TO 2 , AND TAKE THE NEXT SCAN POINT.
   GO TO 2

THIS SET OF STATEMENTS (200_215)  FIND THE NEXT POINT ON A CONTOUR
WHICH IS GOING DOWN.
WHEN THE NEXT POINT IS FOUND , THE APPROPRIATE SUBROUTINE IS CALLED,
THE POINT IS CALCULATED , AND WE GO TO 500 TO CHECK THIS NEW POINT.
   I = I+1
   IF  (( C.LE.SIG(I,J)).AND.(C.GE.SIG(I,J+1)))   GO TO 201
   IF  (( C.GE.SIG(I,J)).AND.(C.LE.SIG(I,J+1)))   GO TO 201
   GO TO 205
  CALL  SOUTH (I,J,L,C,SIG(I,J),SIG(I,J+1),XB(L+1),YB(L+1))
   YBP(L) =  -YB(L)
```

APPENDIX "C"

[redacted]

```
  CALL    PLOT(2,XB(L),YBP(L))
  GO TO 500
  J = J+1
  IF ((C.LE.SIG(I,J)).AND.(C.GE.SIG(I-1,J)))         GO TO 206
  IF ((C.GE.SIG(I,J)).AND.(C.LE.SIG(I-1,J)))         GO TO 206
  GO TO 210
 CALL WEST  (I,J,L,C,SIG(I,J),SIG(I-1,J),XB(L+1),YB(L+1))
  YBP(L) =   -YB(L)
  CALL    PLOT(2,XB(L),YBP(L))
  GO TO 500
  I = I-1
  IF ((C.LE.SIG(I,J)).AND.(C.GE.SIG(I,J-1)))         GO TO 211
  IF ((C.GE.SIG(I,J)).AND.(C.LE.SIG(I,J-1)))         GO TO 211
  GO TO 215
 CALL NORTH  (I,J,L,C,SIG(I,J),SIG(I,J+1),XB(L+1),YB(L+1))
  YBP(L) =   -YB(L)
  CALL    PLOT(2,XB(L),YBP(L))
  GO TO 500
IF THERE IS NO  "NEXT POINT"
HF TERMINATE THIS CONTOUR , GO BACK TO 2 ,  AND TAKE THE NEXT SCAN POINT.
  GO TO 2

THIS SET OF STATEMENTS (300-315)  FIND THE NEXT POINT ON A CONTOUR
WHICH IS GOING TO THE LEFT.
WHEN THE NEXT POINT IS FOUND , THE APPROPRIATE SUBROUTINE IS CALLED,
THE POINT IS CALCULATED , AND WE GO TO 500 TO CHECK THIS NEW POINT.
  J = J+1
  IF ((C.LE.SIG(I,J)).AND.(C.GE.SIG(I-1,J)))         GO TO 301
  IF ((C.GE.SIG(I,J)).AND.(C.LE.SIG(I-1,J)))         GO TO 301
  GO TO 305
 CALL WEST  (I,J,L,C,SIG(I,J),SIG(I-1,J),XB(L+1),YB(L+1))
  YBP(L) =  -YB(L)
  CALL    PLOT(2,XB(L),YBP(L))
  GO TO 500
  I = I-1
  IF ((C.LE.SIG(I,J)).AND.(C.GE.SIG(I,J-1)))         GO TO 306
  IF ((C.GE.SIG(I,J)).AND.(C.LE.SIG(I,J-1)))         GO TO 306
  GO TO 310
 CALL NORTH  (I,J,L,C,SIG(I,J),SIG(I,J-1),XB(L+1),YB(L+1))
  YBP(L) =   -YB(L)
  CALL    PLOT(2,XB(L),YBP(L))
  GO TO 500
  J = J-1
  IF ((C.LE.SIG(I,J)).AND.(C.GE.SIG (I+1,J)))        GO TO 311
  IF ((C.GE.SIG(I,J)).AND.(C.LE.SIG (I+1,J)))        GO TO 311
  GO TO 315
 CALL EAST   (I,J,L,C,SIG(I,J),SIG(I+1,J),XB(L+1),YB(L+1))
  YBP(L) =  -YB(L)
```

APPENDIX "C" [redacted]

```
CALL    PLOT(2,XB(L),YBP(L))
GO TO 500
IF THERE IS NO  "NEXT POINT"
E TERMINATE THIS CONTOUR , GO BACK TO 2 , AND TAKE THE NEXT SCAN POINT.
GO TO 2

THIS SET OF STATEMENTS (400-415). FIND THE NEXT POINT ON A CONTOUR
WHICH IS GOING UP.
WHEN THE NEXT POINT IS FOUND , THE APPROPRIATE SUBROUTINE IS CALLED,
THE POINT IS CALCULATED , AND WE GO TO 500 TO CHECK THIS NEW POINT.
 CONTINUE
 IF ((C.LE.SIG(I,J)).AND.(C.GE.SIG(I,J-1)))      GO TO 401
 IF ((C.GE.SIG(I,J)).AND.(C.LE.SIG(I,J-1)))      GO TO 401
 GO TO 405
CALL NORTH  (I,J,L,C,SIG(I,J),SIG(I,J-1),XB(L+1),YB(L+1))
 YBP(L) =  -YB(L)
 CALL    PLOT(2,XB(L),YBP(L))
 GO TO 500
 J = J-1
 IF ((C.GE.SIG(I,J)).AND.(C.LE.SIG (I+1,J)))     GO TO 406
 IF ((C.LE.SIG(I,J)).AND.(C.GE.SIG (I+1,J)))     GO TO 406
 GO TO 410
CALL EAST   (I,J,L,C,SIG(I,J),SIG(I+1,J),XB(L+1),YB(L+1))
 YBP(L) =  -YB(L)
 CALL    PLOT(2,XB(L),YBP(L))
 GO TO 500
 I=I+1
 IF   (( C.LE.SIG(I,J)).AND.(C.GE.SIG(I,J+1)))   GO TO 411
 IF   (( C.GE.SIG(I,J)).AND.(C.LE.SIG(I,J+1)))   GO TO 411
 GO TO 415
CALL SOUTH  (I,J,L,C,SIG(I,J),SIG(I,J+1),XB(L+1),YB(L+1))
 YBP(L) =  -YB(L)
 CALL    PLOT(2,XB(L),YBP(L))
 GO TO 500
IF THERE IS NO  "NEXT POINT"
E TERMINATE THIS CONTOUR , GO BACK TO 2 , AND TAKE THE NEXT SCAN POINT.
 GO TO 2
 IF (KTDO.LE.0 )        GO TO 506
 DO 504  K = 1,KTDO
 KTD = K
IF THIS NEW POINT (XB,YB)=ANY POINT ALREADY IN THE SCAN SET,
THEN DELETE IT FROM THESCAN SET AND CONTINUE.
 DIFYA =      ABS (YA(K)-YB(L))
 DIFXA =      ABS (XA(K)-XB(L))
 IF (DIFXA.LT.(.0001) .AND. DIFYA.LT. (.0001))        GO TO 505
 CONTINUE
 GO TO 506
 KTDO = KTDO -1
```

[redacted]

APPENDIX "C"

```
  IF (KTDO.LE.0 )          GO TO 506
   DO 506  K = KTD , KTDO
  XA(K)  =  XA(K+1)
  YA(K)  =  YA(K+1)
  CONTINUE
  IF ( L.GE.1700)                    GO TO 570
HECK    IF  POINT  IS   INITIAL OR BOUNDRY  POINT AND CONTINUE
  DIFXE = ABS(XB(L)-XE)
  DIFYE = ABS(YB(L)-YE)
F THIS NEW POINT (XB,YB)=  THE 1 ST POINT (XE,YE),
E TERMINATE THIS CONTOUR , GO BACK TO 2 , AND TAKE THE NEXT SCAN POINT,
  IF (  DIFXE.LT.(.0001).AND.DIFYE.LT. (.0001))        GO TO 2
F THIS NEW POINT (XB,YB)  IS ON THE BORDER OF THE MATRIX,
E TERMINATE THIS CONTOUR , GO BACK TO 2 , AND TAKE THE NEXT SCAN POINT.
  IF (XB(L).EQ.1 .OR.XB(L).EQ.N)                   GO TO 2
  IF (YB(L).EQ.1.OR.YB(L).EQ.M)                    GO TO 2
  CONTINUE
HECK WHICH DIRECTION THE CONTOUR  IS GOING "NOW" ,UP,DOWN,LEFT,RIGHT ?
  I = XB(L)
  J = YB(L)
  IF (YB(L).EQ.INT(YB(L)))                          GO TO 527
  IF (XB(L).EQ.INT(XB(L)))                          GO TO 517
  IF(XB (L).LT.XB (L-1))                            GO TO 300
  IF(XB (L).GT.XB (L-1))                            GO TO 100
   IF (YB(L).LT.YB(L-1) )                           GO TO 400
   IF (YB(L).GT.YB(L-1) )                           GO TO 200
  GO TO 2
  CONTINUE
NCREASE "C" BY .2 (STANDARD OCEANOGRAPHIC STEP) AND GO TO NEXT CONTOUR.
  C = C + CDEL
  IF (C.EQ.160.01)                   C = 180.01
  IF (C.LE.CHAX)                     GO TO 17
  CONTINUE
  GO TO 571
   PRINT 97
  CONTINUE
  CALL  QUIT
   STOP
  END
```

APPENDIX "C"

[redacted]

```
SUBROUTINE EAST   (I,J,L,C,SIGA,SIGB,XBB,YBB)
FORMAT    ( '1', 3F10.2,  2I8 , // )
L = L + 1
XBB = I   +  (C-SIGA)/(SIGB-SIGA)
YBB = J
RETURN
END
```

APPENDIX "C" [redacted]

```
SUBROUTINE WEST   (I,J,L,C,SIGA,SIGB,XBB,YBB)
FORMAT    ( '1', 3F10.2,  2I8 , // )
L = L + 1
XBB = I  -  (C-SIGA)/(SIGB-SIGA)
YBB = J
RETURN
END
```

[redacted]

APPENDIX "C"

```
SUBROUTINE NORTH  (I,J,L,C,SIGA,SIGB,XBB,YBB)
FORMAT   ( [illegible], 3F10.2,  2I8 , // )
L = L + 1
XBB = I
YBB = J  -   (C-SIGA)/(SIGB-SIGA)
RETURN
END
```

APPENDIX "C"

```
      SUBROUTINE SOUTH  (I,J,L,C,SIGA,SIGB,XBB,YBB)
      FORMAT    ( '1', 3F10.2,  2I8 , // )
      L = L + 1
      XBB = I
      YBB = J  +  (C-SIGA)/(SIGB-SIGA)
      RETURN
      END
```

APPENDIX "C"

APPENDIX D

Tables

of

Salinity

Temperature

Depth

Density

σ_t-Values

SAGLEK S.T.D. DATA AUG. 11-13 , 1972

DEPTH	STN	TEMP	SAL	SGMO	SGMT	DENSITY	
0	1	3.4	30.9	24.82	24.603210	1.024603	1
0	10	1.8	30.7	24.66	24.565811	1.024566	2
0	23	3.0	30.6	24.58	24.399353	1.024399	3
0	2	4.5	30.0	24.11	23.802338	1.023802	4
0	11	2.2	30.4	24.43	24.310760	1.024311	5
0	24	3.0	31.3	25.15	24.962997	1.024963	6
0	3	4.2	30.0	24.11	23.831039	1.023831	7
0	12	3.1	31.0	24.91	24.717499	1.024718	8
0	25	4.0	31.0	24.91	24.637817	1.024638	9
0	4	3.5	30.2	24.27	24.051590	1.024052	10
0	13	3.0	31.0	24.91	24.725662	1.024726	11
0	26	3.6	31.4	25.23	24.990219	1.024990	12
0	5	3.5	30.9	24.82	24.594452	1.024594	13
0	14	3.1	31.2	25.07	24.875656	1.024876	14
0	27	3.8	31.5	25.31	25.050842	1.025051	15
0	6	3.3	31.0	24.91	24.700699	1.024701	16
0	15	2.8	31.0	24.91	24.741745	1.024742	17
0	28	3.1	31.2	25.07	24.875656	1.024876	18
0	7	3.2	31.2	25.07	24.867264	1.024867	19
0	16	2.6	30.8	24.74	24.588898	1.024589	20
0	29	3.2	30.9	24.82	24.620224	1.024620	21
0	8	2.6	30.5	24.50	24.351242	1.024351	22
0	17	3.4	30.6	24.58	24.366241	1.024366	23
0	30	3.3	30.6	24.58	24.374725	1.024375	24

APPENDIX D

SAGLEK S.T.D. DATA AUG. 11-13 , 1972

DEPTH	STN	TEMP	SAL	SGMO	SGMT	DENSITY	
10	1	0.3	31.3	25.15	25.136871	1.025137	25
10	10	0.2	31.1	25.00	24.991592	1.024992	26
10	23	0.2	30.9	24.82	24.811737	1.024812	27
10	2	1.6	30.7	24.66	24.578430	1.024578	28
10	11	2.2	31.0	24.91	24.786774	1.024787	29
10	24	2.4	31.4	25.23	25.089386	1.025089	30
10	3	3.3	30.9	24.82	24.611786	1.024612	31
10	12	2.0	31.3	25.15	25.038895	1.025039	32
10	25	3.1	31.0	24.91	24.717499	1.024718	33
10	4	2.7	31.2	25.07	24.907959	1.024908	34
10	13	2.8	31.4	25.23	25.058411	1.025058	35
10	26	3.0	31.7	25.47	25.279434	1.025279	36
10	5	3.4	31.0	24.91	24.692078	1.024692	37
10	14	2.6	31.5	25.31	25.153366	1.025153	38
10	27	1.7	31.8	25.55	25.456436	1.025456	39
10	6	3.1	31.3	25.15	24.954742	1.024955	40
10	15	1.8	31.3	25.15	25.052460	1.025052	41
10	28	3.2	31.5	25.31	25.104416	1.025104	42
10	7	1.3	31.3	25.15	25.084091	1.025084	43
10	16	1.0	31.2	25.07	25.021606	1.025022	44
10	29	3.0	31.3	25.15	24.962997	1.024963	45
10	8	-0.2	31.6	25.39	25.398300	1.025398	46
10	17	2.7	31.1	25.00	24.838669	1.024839	47
10	30	2.7	31.1	25.00	24.838669	1.024839	48

APPENDIX D

SAGLEK S.T.D. DATA AUG. 11-13 , 1972

DEPTH	STN	TEMP	SAL	SGMO	SGMT	DENSITY	
20	1	-0.5	31.6	25.39	25.409485	1.025409	49
20	10	-0.5	31.5	25.31	25.329330	1.025329	50
20	23	-0.9	31.4	25.23	25.261963	1.025262	51
20	2	-0.4	31.5	25.31	25.325851	1.025326	52
20	11	-0.9	31.9	25.63	25.663376	1.025663	53
20	24	1.0	31.6	25.39	25.340393	1.025340	54
20	3	-0.2	31.5	25.31	25.318237	1.025318	55
20	12	-1.0	32.2	25.87	25.907196	1.025907	56
20	25	1.1	31.7	25.47	25.414459	1.025414	57
20	4	0.0	32.0	25.71	25.710007	1.025710	58
20	13	-1.4	32.4	26.04	26.088867	1.026089	59
20	26	0.5	32.2	25.87	25.846085	1.025846	60
20	5	2.5	31.5	25.31	25.161072	1.025161	61
20	14	0.0	31.8	25.55	25.550003	1.025550	62
20	27	-0.7	32.3	25.95	25.977798	1.025978	63
20	6	-0.2	31.8	25.55	25.558426	1.025558	64
20	15	1.2	31.7	25.47	25.408493	1.025408	65
20	28	2.0	32.0	25.71	25.594681	1.025595	66
20	7	-1.0	31.8	25.55	25.585953	1.025586	67
20	16	2.4	31.6	25.39	25.247955	1.025248	68
20	29	0.4	31.4	25.23	25.212158	1.025212	69
20	8	-1.1	32.0	25.71	25.749435	1.025749	70
20	17	0.1	31.6	25.39	25.385757	1.025386	71
20	30	1.2	31.4	25.23	25.169586	1.025170	72

APPENDIX D

SAGLEK S.T.D. DATA AUG. 11-13 , 1972

DEPTH	STN	TEMP	SAL	SGMO	SGMT	DENSITY	
30	1	-0.7	31.7	25.47	25.496490	1.025496	73
30	10	-1.1	31.8	25.55	25.588745	1.025589	74
30	23	-1.2	31.8	25.55	25.591415	1.025591	75
30	2	-1.0	32.2	25.87	25.907196	1.025907	76
30	11	-1.5	32.1	25.79	25.839828	1.025840	77
30	24	-1.1	32.2	25.87	25.910126	1.025910	78
30	3	-1.2	32.2	25.87	25.912918	1.025913	79
30	12	-1.4	32.4	26.04	26.088867	1.026089	80
30	25	-0.5	32.0	25.71	25.730103	1.025730	81
30	4	-1.3	32.3	25.95	25.995926	1.025996	82
30	13	-1.4	32.5	26.11	26.159256	1.026159	83
30	26	-0.9	32.4	26.04	26.074814	1.026075	84
30	5	-0.3	31.9	25.63	25.642410	1.025642	85
30	14	-1.3	32.5	26.11	26.156738	1.026157	86
30	27	-1.5	32.5	26.11	26.161728	1.026162	87
30	6	-1.2	32.2	25.87	25.912918	1.025913	88
30	15	-0.4	32.2	25.87	25.886719	1.025887	89
30	28	-0.6	32.2	25.87	25.894089	1.025894	90
30	7	-1.4	32.1	25.79	25.837494	1.025837	91
30	16	0.4	32.0	25.71	25.691422	1.025691	92
30	29	-0.6	32.2	25.87	25.894089	1.025894	93
30	8	-1.4	32.1	25.79	25.837494	1.025837	94
30	17	-1.0	32.0	25.71	25.746567	1.025747	95
30	30	-0.6	32.2	25.87	25.894089	1.025894	96

APPENDIX D

SAGLEK S.T.D. DATA AUG. 11-13 , 1972

DEPTH	STN	TEMP	SAL	SGMO	SGMT	DENSITY	
50	1	-1.1	32.1	25.79	25.829788	1.025830	97
50	10	-1.4	32.4	26.04	26.088867	1.026089	98
50	23	-1.4	32.4	26.04	26.088867	1.026089	99
50	2	-1.5	32.6	26.20	26.252258	1.026252	100
50	11	-1.6	32.6	26.20	26.254547	1.026255	101
50	24	-1.3	32.6	26.20	26.247192	1.026247	102
50	3	-1.6	32.5	26.11	26.163971	1.026164	103
50	12	-1.5	32.7	26.27	26.322662	1.026323	104
50	25	-1.5	32.7	26.27	26.322662	1.026323	105
50	4	-1.4	32.6	26.20	26.249756	1.026250	106
50	13	-1.5	32.7	26.27	26.322662	1.026323	107
50	26	-1.5	32.8	26.36	26.413193	1.026413	108
50	5	-1.5	32.5	26.11	26.161728	1.026162	109
50	14	-1.4	32.7	26.27	26.320129	1.026320	110
50	27	-1.6	32.8	26.36	26.415543	1.026416	111
50	6	-1.4	32.6	26.20	26.249756	1.026250	112
50	15	-1.2	32.6	26.20	26.244461	1.026244	113
50	28	-1.6	32.7	26.27	26.324982	1.026325	114
50	7	-1.2	32.4	26.04	26.083710	1.026084	115
50	16	-1.0	32.5	26.11	26.148132	1.026148	116
50	29	-1.4	32.6	26.20	26.249756	1.026250	117
50	8	-1.4	32.6	26.20	26.249756	1.026250	118
50	17	-1.3	32.6	26.20	26.247192	1.026247	119
50	30	-1.2	32.6	26.20	26.244461	1.026244	120

APPENDIX D

SAGLEK S.T.D, DATA AUG. 11-13 , 1972

DEPTH	STN	TEMP	SAL	SGMO	SGMT	DENSITY	
75	1	-1,4	32,3	25,95	25,998383	1,025998	121
75	10	-1,5	32,6	26,20	26,252258	1,026252	122
75	23	-1,5	32,7	26,27	26,322662	1,026323	123
75	2	-1,8	32,8	26,36	26,419815	1,026420	124
75	11	-1,7	32,7	26,27	26,327148	1,026327	125
75	24	-1,5	32,8	26,36	26,413193	1,026413	126
75	3	-1,5	32,8	26,36	26,413193	1,026413	127
75	12	-1,5	32,8	26,36	26,413193	1,026413	128
75	25	-1,5	32,8	26,36	26,413193	1,026413	129
75	4	-1,4	32,8	26,36	26,410629	1,026411	130
75	13	-1,4	32,8	26,36	26,410629	1,026411	131
75	26	-1,4	32,9	26,43	26,481003	1,026481	132
75	5	-1,4	32,7	26,27	26,320129	1,026320	133
75	14	-1,4	32,8	26,36	26,410629	1,026411	134
75	27	-1,5	32,9	26,43	26,483612	1,026484	135
75	6	-1,4	32,8	26,36	26,410629	1,026411	136
75	15	-1,5	32,8	26,36	26,413193	1,026413	137
75	28	-1,6	32,8	26,36	26,415943	1,026416	138
75	7	-1,4	32,7	26,27	26,320129	1,026320	139
75	16	-1,5	32,8	26,36	26,413193	1,026413	140
75	29	-1,4	32,8	26,36	26,410629	1,026411	141
75	8	-1,0	32,7	26,27	26,308762	1,026309	142
75	17	-1,3	32,8	26,36	26,408005	1,026408	143
75	30	-1,3	32,8	26,36	26,408005	1,026408	144

APPENDIX D

SAGLEK S,T,D, DATA AUG, 24-26 , 1972

DEPTH	STN	TEMP	SAL	SGMO	SGMT	DENSITY	
0	1	2,9	30,6	24,58	24,407379	1,024407	1
0	10	3,4	30,7	24,66	24,449221	1,024445	2
0	23	4,3	30,3	24,34	24,047989	1,024048	3
0	2	2,6	30,9	24,82	24,668121	1,024668	4
0	11	2,7	30,7	24,66	24,502090	1,024502	5
0	24	3,2	30,8	24,74	24,541168	1,024541	6
0	3	2,4	30,5	24,50	24,365967	1,024366	7
0	12	3,2	30,5	24,50	24,304031	1,024304	8
0	25	3,1	30,7	24,66	24,470383	1,024470	9
0	4	2,1	30,6	24,58	24,466431	1,024466	10
0	13	3,3	30,5	24,50	24,295715	1,024296	11
0	26	3,4	31,3	25,15	24,929062	1,024929	12
0	5	2,0	30,4	24,42	24,314407	1,024314	13
0	14	0,9	31,8	25,55	25,505478	1,025505	14
0	27	3,0	31,2	25,07	24,883881	1,024884	15
0	6	2,4	30,6	24,58	24,445236	1,024445	16
0	15	1,5	32,0	25,71	25,628616	1,025629	17
0	28	1,8	31,3	25,15	25,052460	1,025052	18
0	7	2,4	30,6	24,58	24,445236	1,024445	19
0	16	1,4	31,9	25,63	25,555496	1,025556	20
0	29	2,8	31,2	25,07	24,900085	1,024900	21
0	8	2,4	30,7	24,66	24,524521	1,024525	22
0	17	1,5	31,6	25,39	25,310425	1,025310	23
0	30	2,1	31,6	25,39	25,270020	1,025270	24
0	9	2,4	31,0	24,91	24,772263	1,024772	25
0	18	1,3	31,6	25,39	25,322906	1,025323	26
0	31	1,4	31,6	25,39	25,316772	1,025317	27

APPENDIX D

SAGLEK S.T.D. DATA AUG. 24-26 , 1972

DEPTH	STN	TEMP	SAL	SGMO	SGMT	DENSITY	
10	1	2,5	30.9	24,79	24,645935	1,024646	28
10	10	3,2	30.4	24,43	24,234863	1,024235	29
10	23	3,6	30.7	24,66	24,427780	1,024428	30
10	2	2,2	31.0	24,91	24,786774	1,024787	31
10	11	2,6	30.8	24,74	24,588898	1,024589	32
10	24	3,2	30.8	24,74	24,541168	1,024541	33
10	3	2,1	30.6	24,58	24,466431	1,024466	34
10	12	2,4	30.7	24,66	24,524521	1,024525	35
10	25	3,0	30.8	24,74	24,557556	1,024558	36
10	4	1,7	31.0	24,91	24,820557	1,024821	37
10	13	2,5	31.0	24,91	24,764816	1,024765	38
10	26	3,3	31.2	25,07	24,858734	1,024859	39
10	5	1,2	30.6	24,58	24,522568	1,024523	40
10	14	0,9	31.8	25,55	25,505478	1,025505	41
10	27	3,0	31.2	25,07	24,883881	1,024884	42
10	6	2,1	30.7	24,66	24,545792	1,024546	43
10	15	1,4	32.1	25,79	25,714661	1,025715	44
10	28	1,8	31.4	25,23	25,131927	1,025132	45
10	7	1,8	31.0	24,91	24,814102	1,024814	46
10	16	1,3	31.9	25,63	25,561722	1,025562	47
10	29	2,6	31.4	25,23	25,074142	1,025074	48
10	8	2,2	30.8	24,74	24,618179	1,024618	49
10	17	1,4	31.6	25,39	25,316772	1,025317	50
10	30	2,0	31.5	25,31	25,197678	1,025198	51
10	9	2,3	31.0	24,91	24,779526	1,024780	52
10	18	1,2	31.6	25,39	25,328857	1,025329	53
10	31	1,4	31.5	25,31	25,237198	1,025237	54

SAGLEK S.T.D. DATA AUG. 24-26 , 1972

DEPTH	STN	TEMP	SAL	SGMO	SGMT	DENSITY	
20	1	0.7	31.4	25.23	25.197189	1.025197	55
20	10	2.0	30.7	24.66	24.552582	1.024553	56
20	23	3.4	30.8	24.74	24.524216	1.024524	57
20	2	0.0	31.5	25.31	25.309998	1.025310	58
20	11	2.2	31.0	24.91	24.786774	1.024787	59
20	24	0.7	31.3	25.15	25.117416	1.025117	60
20	3	1.4	30.9	24.82	24.749817	1.024750	61
20	12	1.6	31.2	25.07	24.985947	1.024986	62
20	25	2.5	30.9	24.82	24.675659	1.024676	63
20	4	0.8	31.5	25.31	25.271759	1.025272	64
20	13	1.5	31.2	25.07	24.992249	1.024992	65
20	26	1.5	31.4	25.23	25.151337	1.025151	66
20	5	1.2	31.6	25.39	25.328857	1.025329	67
20	14	0.4	31.9	25.63	25.611542	1.025612	68
20	27	2.7	31.3	25.15	24.987152	1.024987	69
20	6	1.4	31.3	25.15	25.078049	1.025078	70
20	15	1.3	32.1	25.79	25.720932	1.025721	71
20	28	1.4	31.6	25.39	25.316772	1.025317	72
20	7	1.7	31.4	25.23	25.138489	1.025138	73
20	16	0.8	32.1	25.79	25.750290	1.025750	74
20	29	2.6	31.4	25.23	25.074142	1.025074	75
20	8	0.0	31.5	25.31	25.309998	1.025310	76
20	17	0.6	31.7	25.47	25.441772	1.025442	77
20	30	2.1	31.5	25.31	25.190659	1.025191	78
20	9	1.3	31.2	25.07	25.004486	1.025004	79
20	18	0.5	31.7	25.47	25.446854	1.025447	80
20	31	1.6	31.6	25.39	25.304001	1.025304	81

APPENDIX D

SAGLEK S.T.D. DATA AUG. 24-26 , 1972

DEPTH	STN	TEMP	SAL	SGMO	SGMT	DENSITY	
30	1	-0.4	31.9	25.63	25.646347	1.025646	82
30	10	1.4	31.3	25.15	25.078049	1.025078	83
30	23	3.2	30.9	24.82	24.620224	1.024620	84
30	2	-0.1	32.0	25.71	25.714310	1.025714	85
30	11	1.5	31.8	25.55	25.469528	1.025470	86
30	24	-0.8	32.0	25.71	25.740387	1.025740	87
30	3	-0.8	31.5	25.31	25.339142	1.025339	88
30	12	0.1	31.8	25.55	25.545700	1.025546	89
30	25	1.8	31.0	24.91	24.814102	1.024814	90
30	4	0.7	31.8	25.55	25.516342	1.025516	91
30	13	-0.8	31.9	25.63	25.660141	1.025660	92
30	26	-0.7	31.9	25.63	25.656921	1.025657	93
30	5	1.1	31.7	25.47	25.414459	1.025414	94
30	14	0.2	32.0	25.71	25.701050	1.025701	95
30	27	1.6	31.4	25.23	25.144974	1.025145	96
30	6	0.6	31.8	25.55	25.521591	1.025522	97
30	15	0.7	32.2	25.87	25.835480	1.025835	98
30	28	0.2	31.6	25.39	25.381302	1.025381	99
30	7	0.7	31.8	25.55	25.516342	1.025516	100
30	16	0.4	32.3	25.95	25.931046	1.025931	101
30	29	2.2	31.5	25.31	25.183472	1.025183	102
30	8	0.6	31.7	25.47	25.441772	1.025442	103
30	17	0.3	32.0	25.71	25.696228	1.025696	104
30	30	1.6	31.7	25.47	25.383514	1.025384	105
30	9	-0.8	31.4	25.23	25.258881	1.025259	106
30	18	0.4	31.8	25.55	25.531662	1.025532	107
30	31	1.0	31.8	25.55	25.499771	1.025500	108

APPENDIX D

SAGLEK S.T.D. DATA AUG. 24-26 , 1972

DEPTH	STN	TEMP	SAL	SGMO	SGMT	DENSITY	
50	1	-1.1	32.3	25.95	25.990479	1.025990	109
50	10	-1.2	32.0	25.71	25.752167	1.025752	110
50	23	0.2	31.9	25.63	25.621109	1.025621	111
50	2	-0.8	32.3	25.95	25.981140	1.025981	112
50	11	-0.5	32.3	25.95	25.970566	1.025971	113
50	24	-1.2	32.5	26.11	26.154053	1.026154	114
50	3	-1.3	32.0	25.71	25.754780	1.025755	115
50	12	-0.9	32.4	26.04	26.074814	1.026075	116
50	25	-0.9	32.1	25.79	25.823929	1.025824	117
50	4	0.0	32.0	25.71	25.710007	1.025710	118
50	13	-1.2	32.2	25.87	25.912918	1.025913	119
50	26	-0.7	32.6	26.20	26.228485	1.026228	120
50	5	0.3	31.9	25.63	25.616318	1.025616	121
50	14	-0.7	32.4	26.04	26.068039	1.026068	122
50	27	-1.0	32.3	25.95	25.987518	1.025988	123
50	6	-0.2	32.0	25.71	25.718552	1.025719	124
50	15	0.1	32.5	26.11	26.105484	1.026105	125
50	28	-0.4	31.9	25.63	25.646347	1.025646	126
50	7	0.0	32.0	25.71	25.710007	1.025710	127
50	16	0.1	32.6	26.20	26.195450	1.026195	128
50	29	0.1	32.0	25.71	25.705643	1.025706	129
50	8	-0.4	32.1	25.79	25.806595	1.025807	130
50	17	-0.2	32.3	25.95	25.958740	1.025959	131
50	30	-0.2	32.1	25.79	25.798615	1.025799	132
50	9	-0.7	32.2	25.87	25.897583	1.025898	133
50	18	-0.5	32.2	25.87	25.890411	1.025890	134
50	31	-0.4	32.2	25.87	25.886719	1.025887	135

SAGLEK S.T.D. DATA AUG. 24-26 , 1972

DEPTH	STN.	TEMP	SAL	SGMO	SGMT	DENSITY	
75	1	-1.2	32.5	26.11	26.154053	1.026154	136
75	10	-1.2	32.4	26.04	26.083710	1.026084	137
75	23	-1.4	32.7	26.27	26.320129	1.026320	138
75	2	-1.4	32.7	26.27	26.320129	1.026320	139
75	11	-1.0	32.7	26.27	26.308762	1.026309	140
75	24	-1.6	32.8	26.36	26.415543	1.026416	141
75	3	-1.3	32.4	26.04	26.086380	1.026086	142
75	12	-1.0	32.7	26.27	26.308762	1.026309	143
75	25	-1.0	32.6	26.20	26.238480	1.026238	144
75	4	-0.9	32.5	26.11	26.145050	1.026145	145
75	13	-0.9	32.6	26.20	26.235367	1.026235	146
75	26	-0.7	32.7	26.27	26.298676	1.026299	147
75	5	-1.0	32.4	26.04	26.077866	1.026078	148
75	14	-1.0	32.6	26.20	26.238480	1.026238	149
75	27	-1.1	32.7	26.27	26.311844	1.026312	150
75	6	-0.7	32.5	26.11	26.138229	1.026138	151
75	15	-0.6	32.7	26.27	26.295013	1.026295	152
75	28	-1.2	32.6	26.20	26.244461	1.026244	153
75	7	-0.7	32.5	26.11	26.138229	1.026138	154
75	16	-0.6	32.8	26.36	26.385223	1.026385	155
75	29	-0.6	32.7	26.27	26.295013	1.026295	156
75	8	-0.8	32.5	26.11	26.141632	1.026142	157
75	17	-0.7	32.6	26.20	26.228485	1.026228	158
75	30	-0.6	32.5	26.11	26.134644	1.026135	159
75	9	-0.8	32.4	26.04	26.071411	1.026071	160
75	18	-0.6	32.6	26.20	26.224854	1.026225	161
75	31	-0.6	32.4	26.04	26.064484	1.026064	162

APPENDIX D