WATER MOVEMENT AND PLANKTON IN STRANGFORD LOUGH

Volume 1

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DECLARATION

This thesis entitled "Water movements and Plankton in Strangford Lough" has not previously been submitted for a degree at any other University. All results, observations and conclusions are my own.

Ian R Jenkinson.

Ian R. Jenkinson

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1. ABSTRACT

Data are presented from the deployment of a current meter in Strangford Lough. A tidal atlas is presented together with data on residual currents, short-term oscillations in velocity and temperature/salinity (T/S) relationships. On the basis of T/S relationship the water of lough has been found to divide into several surface-water masses.

A survey of the nutrients, nano- and micro- plankton and net plankton was undertaken in the water ebbing and flooding through the mouth of the lough. On the basis of measurements made on the nano- and micro- plankton, its contribution to biovolume and biomass are assessed. The annual variation of mean radiant flux was calculated for the water of Strangford Lough, and this was related to the succession of its nano- and micro- plankton.

Two small experiments demonstrated that Strangford Lough sediments buffer the concentration of inorganic phosphate.

2. INTRODUCTION

Strangford Lough, about 150 km^2 in are, supports wildfowl and wader populations of international importance. It also contains two marine nature reserves.

Conflicts over its use are percieved to exist between the following overlapping interests: 1) the need to maintain an unpolluted and undisturbed environment so as to conserve its diverse fauna and flora; 2) the desire to use Strangford Lough and its surroundings for education in environmental matters; 3) the growing demands for seafood and the corresponding demands of the mariculture industry; 4) the desires of, mostly part-time, local fishermen; 5) the requirements of various kinds of pleasure-boat users; 7) the desires of wildfowlers; 8) the needs of those who live from tourism; 9) the desirability of maintaining a rural and maritime "lung" within about 15 to 35 km of Belfast; and 10) the "need" to build a barrage across the mouth of the lough in order to generate tidal power.

The primary aim of this study has been to investigate the water movement and plankton of Strangford Lough, particularly as it may affect the culture of shellfish.

While the succession of nutrients and plankton caught with a 68-um net has already been investigated from spring to autumn throughout the body of the lough (Boyd, 1973a,b), it was decided to concentrate on the plankton and nutrients of the water flooding and ebbing through the mouth of the lough. It was also decided to document the movement of water in the lough by mooring a current meter at points throughout the lough. It would have been better to carry out the current survey first, and to design the plankton survey according to its results. As a oboat capable of deploying the current meter was not available until the first year of the project, however, the two main parts of the project had to be carried out the other way round.

There were two further parts to the project. Examination of the nano- and micro- plankton required fixing it and allowing it to settle, and no data on settling rates could be found. So a cursory investigation of settling rates of fixed nano- and micro- plankton was undertaken. After working out the data on concentrations of inorganic phosphate in the lough, it appeared that buffering of the phosphate might be occurring. Consequently two experiments were carried out to investigate the dynamics of phosphate partition between aerobic sedimant and water.

It is hoped that the data presented in this thesis may bring the body of knowledge on the dynamic ecology of Strangford Lough to a level where a start can be made in constructing an ecological model of it. Such a model, when working well, should be enormously helpful in predicting the effects of ecological constraints upon the lough. It would thus improve the quality of planning for the lough's use, or studied neglect.

3. THE STUDY AREA : STRANGFORD LOUGH

a) TOPOGRAPHY

While the topography of Strangford Lough (shown in figure 3.1) has been described by Williams (1954) and by Boyd (1973a), a brief resume is necessary here.

This sea lough is situated on the coast of County Down, Northern Ireland. The body of the lough is 22 1/2 km long, roughly from north to south, and from 4 to 7 km wide, from east to west. It is bounded by latitudes $54^o22'$ and $54^o35'$ north, and by longitudes $9^o43'$ and $9^o32'$west.

In what is now Strangford Lough, the last glaciation left many drumlins, which are manifest as peninsulas, islands, pladdies (drying banks), submerged reefs and a most uneven bottom.

Strangford Lough is connected from its south-eastern corner to the Irish Sea by a strait known as the Narrows, which runs roughly from north-west to south-east. It is 9 km long and from 0.7 to 2.5 km wide.

For convenience, we have divided the lough into five areas, shown in figure 3.2. This figure also shows the maximum depth of each area (below Chart Datum), and the mean depth (average of that at HW and that at LW). The maximum depth in cross-section of the Narrows varies from 58m near the inner end to 11 m over a rocky sill at the seaward extremity.

There are two main inputs of freshwater, the Quoile River, which enters the lough at the south-western corner, and the Comber River, which enters the eastern side of the

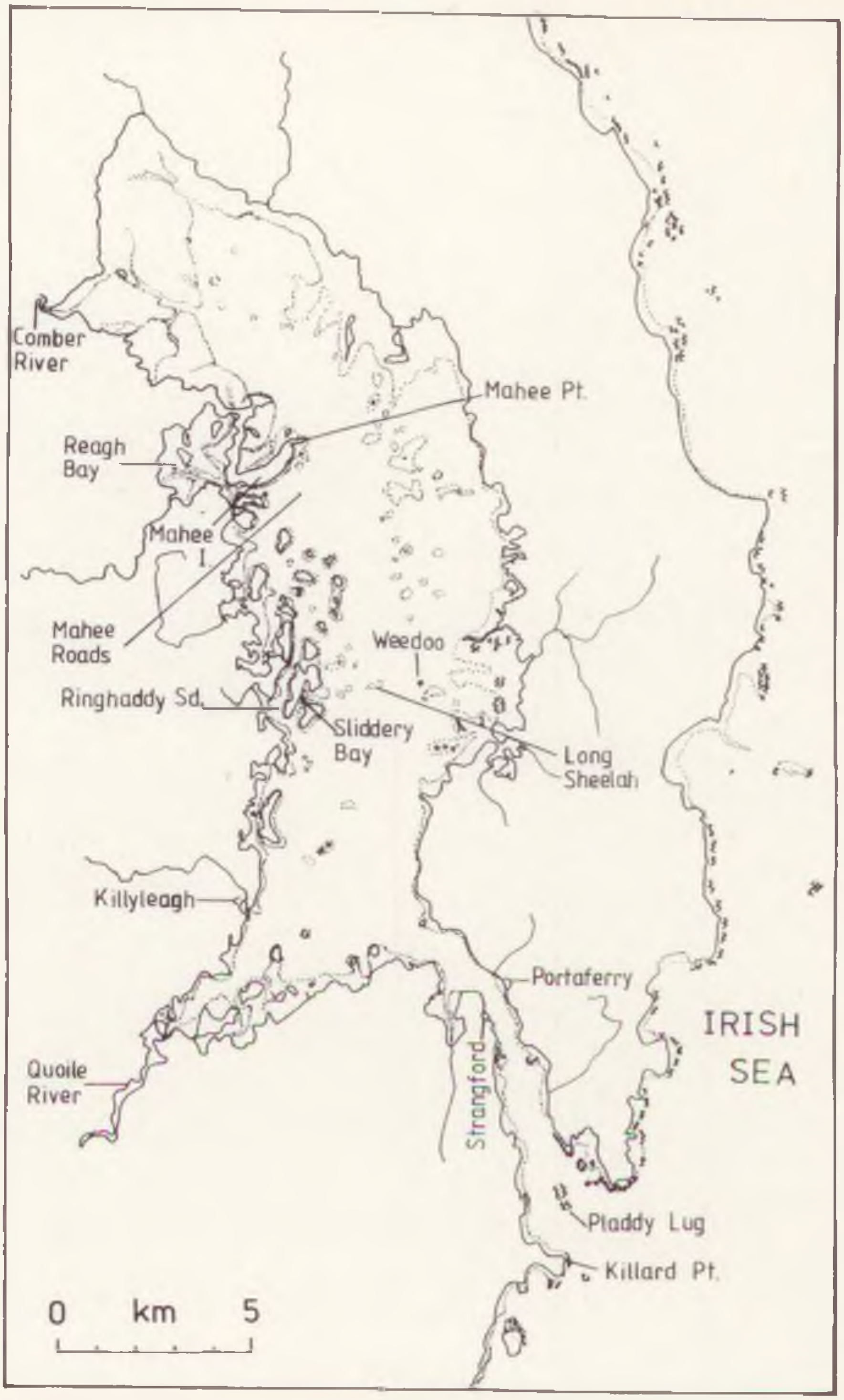


Figure 3.1. Strangford Lough. Places mentioned in the text. The left margin of the figure bears 002° True. More place names are shown in figure 5.1

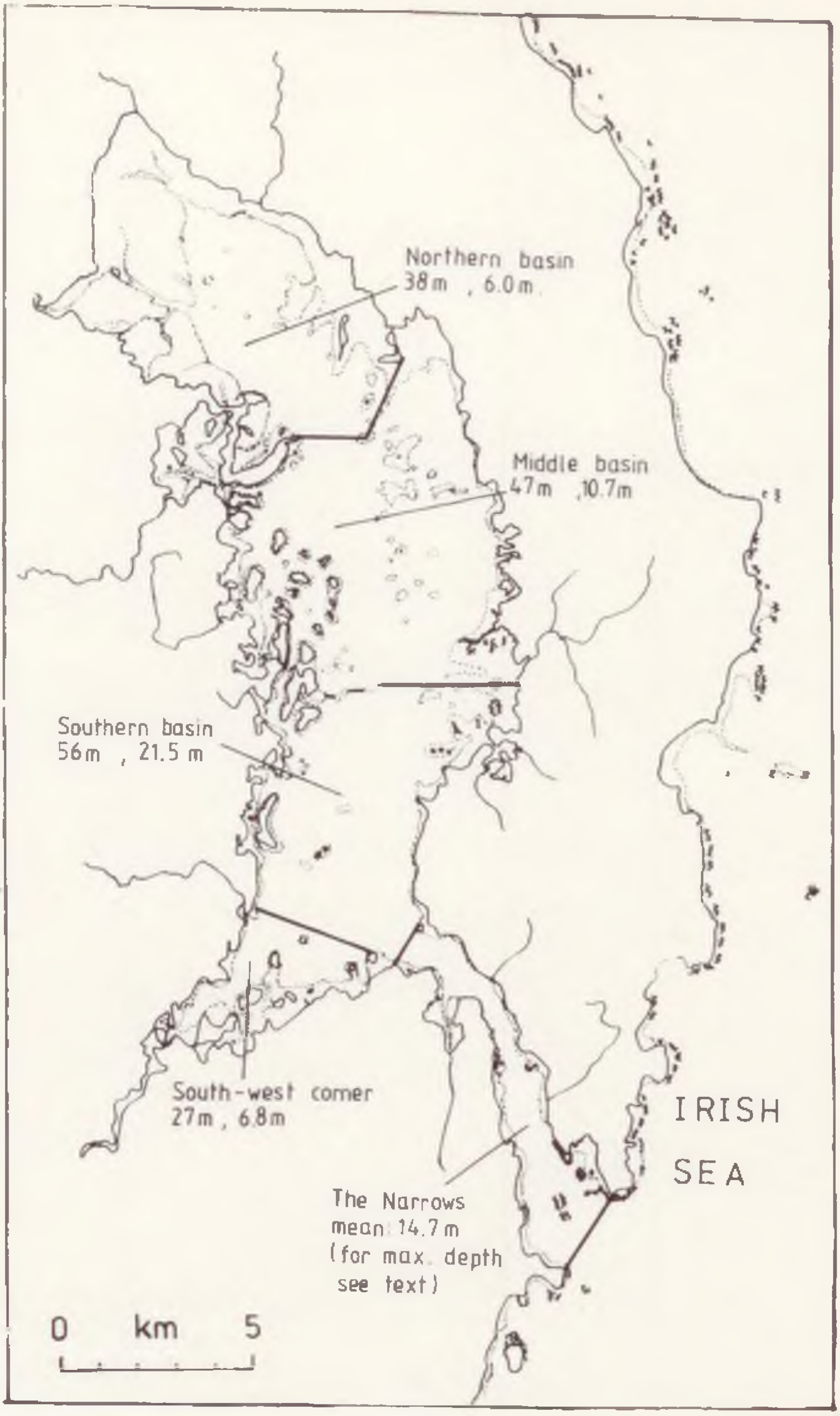


Figure 3.2. Strangford Lough. The maximum depths (below datum), and the mean depths (average of HW and LW depths) for each area

northern basin. Despite these influences, the character of the lough is marine throughout.

b) AREA, CAPACITY AND TIDAL EXCHANGE

The area of Strangford Lough was estimated by counting the number of intersects in the lough between each minute of longitude and each half-minute of latitude.

From measurements on Admiralty Chart 2156, 1' of longitude equals 0.588' of latitude, or 0.588 sea miles. Thus each such intersect represents 0.294 sea miles^2, or 1.007 km^2. The areas obtained thus for Strangford Lough were 99 km^2 for that part below Chart Datum, and 48 km^2 for the intertidal part. This compares with corresponding values of 102 and 49 km^2 (P.J.S. Boaden, pers. comm.), and with 92 and 52 km^2 (Northern Ireland Economic Council, 1981).

By estimating the depths at the above mentioned intersects on Admiralty Chart 2156 (98 subtidal intersects and 48 intertidal ones), the ELW volume of the lough was estimated to be 1109 X 10^6 m^3.

Boaden's estimates (pers. comm.), made using 2717 points on a chart showing many more soundings, gave a LW volume of 1305 x 10^6 m^3. in Admiralty Chart 2156, a tendancy to print low soundings in the interests of navigational safety, as well as the practice of truncating depths over 11 fathoms (c. 20 m) down to the nearest whole fathom is assumed to give mean depths that are too low; so the estimated subtidal depths have been increased to give a total volume equal to that arrived at by Boaden.

The tidal heights for the whole lough, and their relationship to Chart Datum, have been assumed to be the same as those for Killyleagh. The heights for MHWS and MHWN at Killyleagh are respectively 3.8 and 3.3m (Hydrographer of the

Navy, 1981). Values for MLWS and MLWN are not known.

Herein, the range in the whole of Strangford Lough has beenassumed to be the same as at Strangford, although because of resistance to tidal flow in the Narrows above Strangford, it may be a small unknown amount less.

The water heights at various stages of the tide, estimated thus, are shown in Table 3.1.

Assuming that the distribution of the heights of the intertidal ground are distributed uniformly from ELW to EHW, the volume of water in any area of the lough at any water height is given by

$$V_h = V_o + h.A_o + \frac{h}{R} (A_{HW} - A_o) . \frac{h}{2}$$

where h is the height of the water level above Chart Datum, V_o is the volume of water in the area when the water level is at Chart Datum, A_{HW} is the area at EHW, A_o is the area at ELW, and R is the range between EHW and ELW, in this case assumed to be 3.85 m.

The volumes of water estimated for different heights of tide in each of the areas of Strangford Lough are given in Table 3.2.

Apart from the boundary dividing the southern basin from the Narrows, the vertical areas of the boundaries dividing the other basins were estimated by constructing transects from Admiralty Chart 2156. A transect of the first boundary was determined by echo sounder from r.v. Nerilla. The areas of these boundaries are given in Table 3.3.

The net volume of water lost from each area during an ebb tide is given in Table 3.4 and the net volume crossing each boundary is shown in figure 3.3, as is the mean net excursion of water across each boundary, and the mean equivalent water velocity normal to the boundary, over the whole tide.

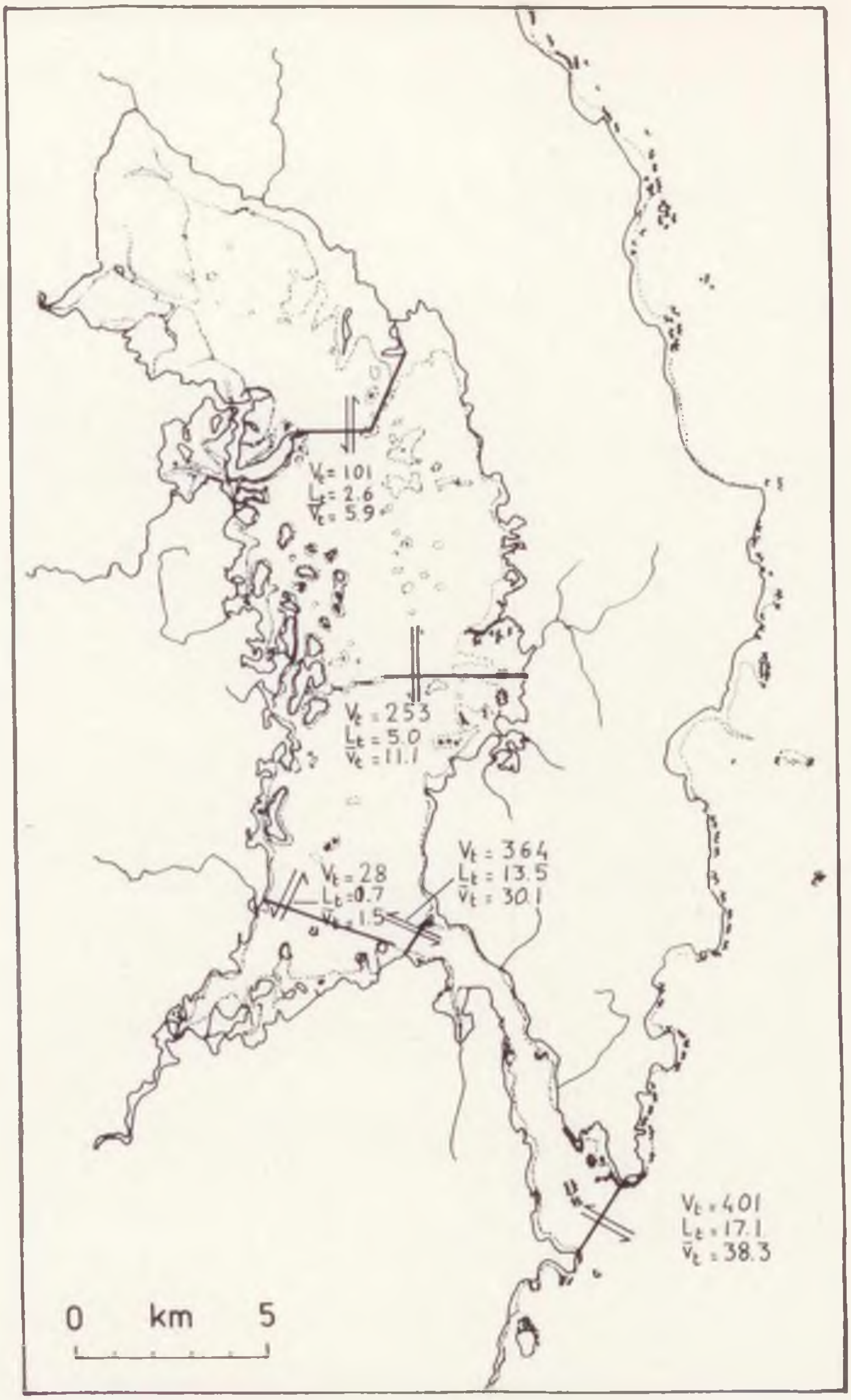


Figure 3.3. Net water trasfer across boundaries between the areas of Strangford Lough over the flood and ebb of a mean spring tide. V_t is tidal volume in $m^3 \times 10^6$. L_t is mean tidal excursion over the whole boundary in km. $\bar{v}_t$ is the corresponding mean tidal velocity normal to the boundary in cm s^{-1}. For mean neaps, values should be multiplied by about 0.69.

TABLE 3.1

Estimated water heights in Strangford Lough at various stages of the tide

Stage of tide	Height
Extreme Low Water (ELW)	0.0
Mean Low Water Springs(MLWS)	0.6
Mean Low Water Neaps (MLWN)	1.1
Mean Level (ML)	2.2
Mean High Water Neaps (MHWN)	3.3
Mean High Water Springs (MHWS)	3.8
Extreme High Water (EHW)	3.85

Units: m

TABLE 3.2

Capacities of the various areas of Strangford Lough

Area	Capacity MLWS	 MLWN	 MHWN	 MHWS
A	135.5	147.1	216.8	236.8
B	460.7	481.9	586.4	612.9
C	554.7	567.0	623.6	637.0
D	49.7	53.5	72.7	77.6
E	165.4	170.7	196.5	202.9
TOTAL:	1366.0	1420.2	1696.0	1767.2

Areas:

A - northern basin
B - middle basin
C - southern basin
D - south-west corner
E - the Narrows

Units: $m^3 \times 10^6$

TABLE 3.3

Vertical areas of boundaries between areas of Strangford Lough

Boundary	MLWS	MLWN	ML	MHWN	MHWS
A-B	33.0	34.7	38.7	42.4	44.2
B-C	44.5	46.5	50.9	55.4	57.4
C-D	37.0	38.5	41.8	45.1	46.7
C-E	25.4	25.9	27.0	28.1	28.6
E-Ir. Sea*	15.2	18.1	23.4	28.7	31.6

Areas:

A - northern basin
B - middle basin
C - southern basin
D - south-west corner
E - the Narrows

Units: m^2 X 10^3

* Assumed tidal heights at the Narrows/Irish Sea boundary are MLWS - 0.5 m; MLWM - 1.2 m; ML - 2.5 m; MHWN - 3.8 m; MHWS - 4.5 m - estimated from tidal data for Killard Point (Hydrographer of the Navy, 1981).

TABLE 3.4

Volume of net water loss and gain during each tide for each area of Strangford Lough.

Area	Mean Springs	Mean Neaps
A	101.3	69.7
B	152.2	104.5
C	82.3	56.6
D	27.9	19.2
E	37.5	25.8
Total	401.2	275.8

Areas:

A - northern basin
B - middle basin
C - southern basin
D - south-west corner
E - the Narrows

Units: $m^3 \times 10^6$

c) EXISTING DATA ON THE OCEANOGRAPHY OF STRANGFORD LOUGH

Published data on tidal levels in Strangford Lough appear to be confined to Admiralty charts and Admiralty tide tables (Hydrographer of the Navy, various years, e.g. 1981). The heights of HW and LW, relative to those predicted for Belfast, are given for Killard Point and for Strangford. The only port listed in the body of the lough is Killyleagh, and while times are given for HW and LW relative to Belfast, and for heights of HW, no heights are given for LW.

On the Admiralty charts, e.g. No. 2156, some arrows are shown representing the flood and the ebb streams in the Narrows, and those streams perceived at four locations in the body of the lough.

The strength of the tidal current in the Narrows is given as being up to 7.8 knots (400 cm s^{-1}) at Springs.

Boyd (1973b) made some observations on currents at three stations in Strangford Lough, using a boat-based current meter; he noted turbulent currents about 1 km south of Dunnyneill Island, particularly during the flood, a clockwise progression of tidal direction east-by-south of Long Sheelagh (c.f. station 7 in this thesis) and a net eastward flow during the flood at a station apparently close east-south-east of Mahee Point.

In a feasability study of a proposed tidal power scheme (Northern Ireland Economic Coundil, 1981), data on tidal levels at Kilclief Point are given over a period of one year.

Although much has been published on the benthic and littoral flora and fauna of Strangford Lough, publication concerning the chemical and biological properties of the water are few (Gotto, 1951). Additionally, Boyd (1973a,b) provided much information from a survey over two summers and one winter at stations from the Narrows to Mahee Point of temperature, salinity, water clarity, nutrient content and plankton sampled by pump and net. In addition, since 1974 or so, a considerable body of data has been built up on temperature and salinity, as well as nutrient and pigment concentrations in Strangford Lough (G. Savidge, pers. comm.).

d) SAMPLING POSITIONS IN THE PRESENT SURVEY

Good data were obtained with the current meter at 17 stations,2 to 18. Stations 2 to 12 are shown in figure 3.4.

Stations 13 to 18 were situated on a vertical plane comprising the boundary between the Narrows and the southern basin. It had been intended to obtain current meter data over the whole of this plane, but owing to the termination of the project only a portion of it was worked. The positions of stations 13 to 18 on this plane are shown in figure 3.5.

During most cruises, plankton and nutrient samples were obtained at three stations: the Bar buoy (B); in Marlfield Bay (M); and off Chapel Island (C). However, on cruise 1, a station was worked off Bankmore (BM), and another off Ballyhenry Island (BI), and on cruise 4, since the weather precluded work at the Bar buoy, two stations were worked close west of Pladdy Lug (P) (figure 3.4). The seaward stations (B and P) were worked on the flood, and the lough stations (C and M) were sampled on the ebb, in order to avoid undue suspended sediment and detritus. The position of the stations, tidally corrected to a distance seaward or landward of Bankmore at mid-tide, are shown in figure 3.6.

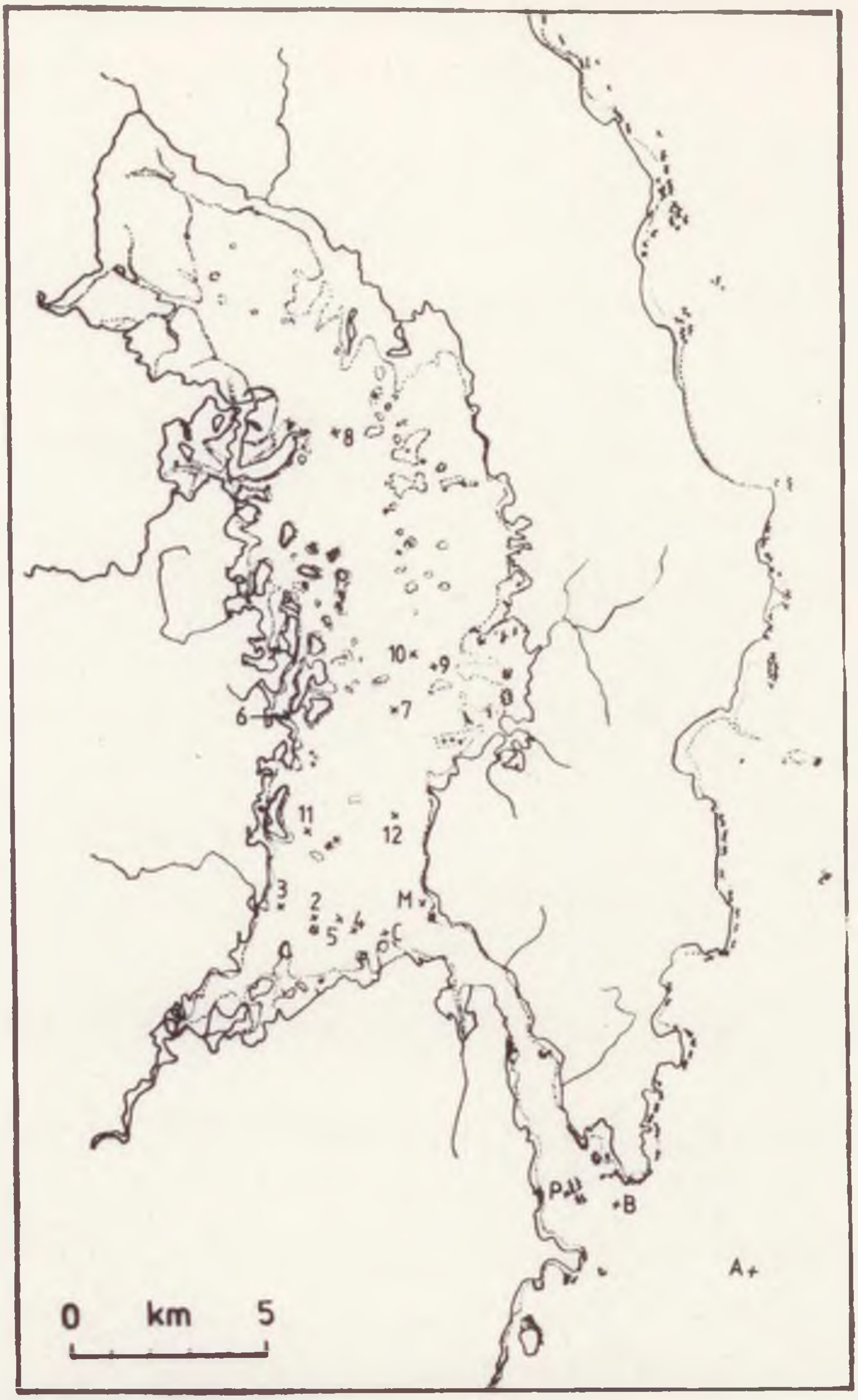


Figure 3.4. Stations used in the current meter survey, and in the plankton and nutrient survey.

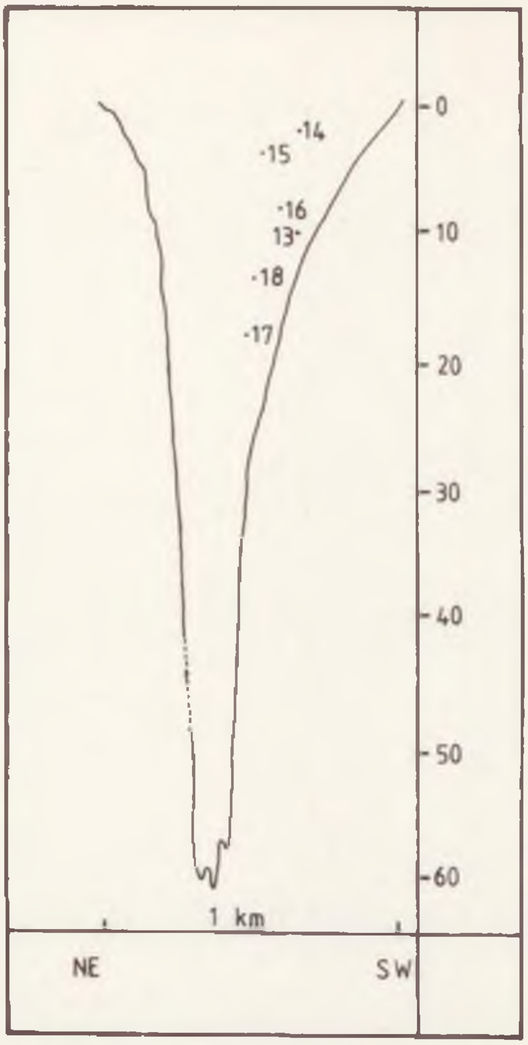


Figure 3.5. Vertical transect across the inner boundary of the Narrows, to show positions of current meter stations 13 to 18.

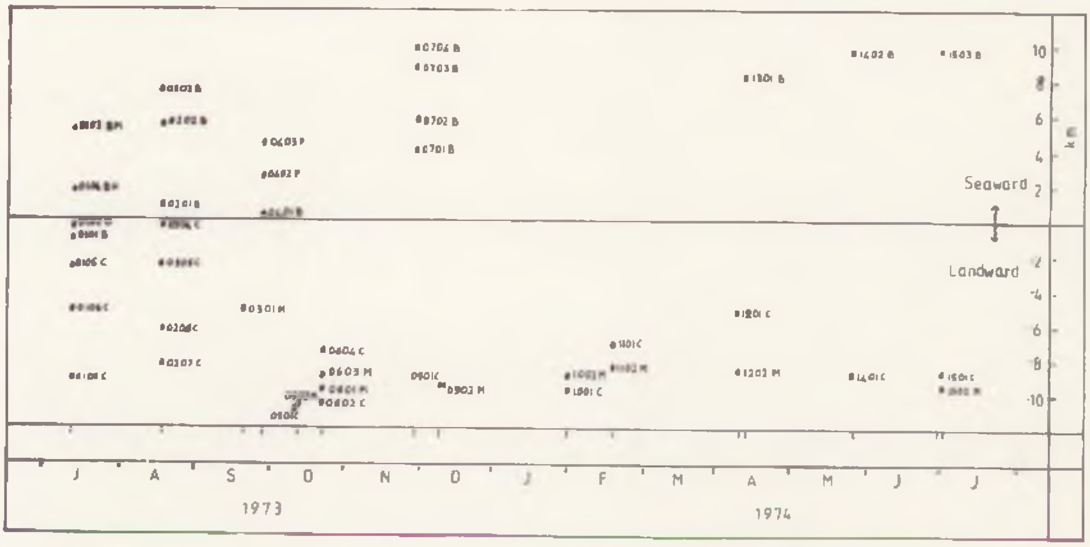


Figure 3.6. Positions of stations in the plankton and nutrient survey, tidally corrected to Bankmore at mid-tide.

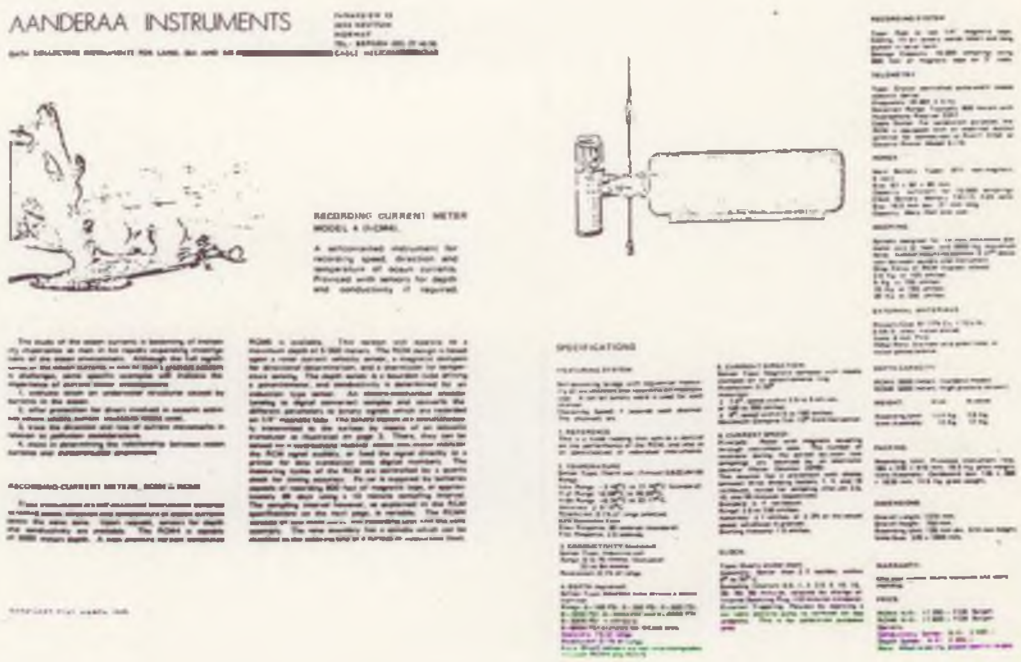
4. METHODS

a) CURRENT MEASUREMENTS, AND ASSOCIATED TEMPERATURE AND SALINITY DETERMINATION

i) The current meter and its operation

Eulerian measurement of water movement, together with depth, temperature and conductivity were measured every 10 minutes using an Aanderaa (Bergen) Model 4 recording current meter. Fig. 4.1. shows the manufacturer's data sheet on the instrument. The meter complied with these specifications except for the following modifications. Firstly, small horizontal vanes were fitted to the vertical vane to ensure that the meter remained horizontal in strong currents. Secondly, at station 8 and subsequently, a temperature probe with a 30-s reaction time was used. Thirdly, as the speed potentiometer broke down during operation at station 12, rotor revolutions were counted at subsequent stations by an electronic counter.

Except for the following faults, almost continuous data were obtained from all deployments: a) at station 1, no data was obtained because the clock battery had been incorrectly inserted; b) due to a fault in the speed potentiometer, as mentioned, only three days of good speed data were obtained from station 12; c) due to a tangled mooring and misaligned meter at station 16, no good direction data were obtained, and the speeds are probably too low; d) due to a sticky magnetic tape or recording head, the data from station 19



AANDERAA INSTRUMENTS

RECORDING CURRENT METER
MODEL 4 (RCM4)

A self-contained instrument for recording speed, direction and temperature of ocean currents. Provided with sensors for depth and conductivity if required.

SPECIFICATIONS

Figure 4.1. Manufacturer's data sheet on the current meter used in the present survey.

were unusable. Stations 1 and 19 will not be referred to again.

Occasional periods occurred of zero or low speeds (e.g. Fig. Al.11.11 These periods generally ended spontaneously, and may have been caused by fouling of the rotor.

Low conductivity readings, giving low salinities, occurred singly and in groups. In many cases, these have been edited out (see Section 4.a.iii), but figure Al.11.8 shows a group which has been left. These low readings may have been caused by debris fouling the conductivity probe, or perhaps by an animal inside the lumen of the probe.

ii) Mooring the current meter

Simple (i.e. non-vector-averaging) current meters suspended from surface buoys give current speeds which are too high (SCOR Working Group 21, 1974, 1975;) (Gould and Sambuco, 1975; Gould, 1977). Hence subsurface buoyancy was used, with U-type moorings. At stations 2 to 8, buoyancy was provided by two vinyl spheres, each lifting 20 kg. attached about 2 m above the meter. There was evidence of depth increase ("lying over") with this buoyancy at speeds above about 0.5 m s^{-1}, shown in figures A1.11.1 to A1.11.8, and it was felt that the high current speeds expected at subsequent stations might provide a problem in this respect.

As a result, a torpedo-shaped float was used at station 9, and at stations 13 to 18. This measured 1.5 m long by 0.4 m in diameter. It was fitted with horizontal and vertical fins at the back and a strong mooring point in the middle of the underside. It provided about 160 kg of buoyancy. At station 9, it leaked, and there was some lying over at this station. However, it was subsequently strengthened, and at stations 13 to 18, lying over was detected only at speeds above about 1.0 m s^{-1}.

At stations 2 to 8, rope 2 cm in diameter was used for the mooring, but at stations 9 to 18, wire 0.64 cm in diameter was used. The principal weights used were 125 kg with the spherical floats, and 225 kg with the torpedo-shaped float. There was no evidence that any of the moorings might have moved.

iii) Data processing

Aanderaa Instruments process the current meter-produced magnetic tape to produce non-standard paper tape, 9-track magnetic tape at a density of 800 bits per inch (B.P.I.), and/or a printout. Since at the time, magnetic tape reading at Q.U.B. was possible only at a density of 1600 B.P.I., non-standard paper tape and printout were obtained from Aanderaa. The non-standard tape was read to output another paper tape by a minicomputer at Q.U.B., using specially developed hardware. The second (standard) paper tape was then read into the International Computers Limited 1906S computer. (This complicated procedure would no longer be necessary, as magnetic tape of density 800 B.P.I. can now be read at Q.U.B.)

These data were converted to scientific units, and were then edited to eliminate obvious mistranscriptions using the printout supplied by Aanderaa, except where this was also evidently in error; in this case, linear interpolation was used.

These data were used to output graphs showing the variation with time of direction, speed, the easterly and northerly components of velocity, depth, computed salinity and temperature. A Calcomp-936 and a Calcomp-1012 graph plotter were used. At this stage, further errors became evident, and more editing was required before the final graphs were produced.

Salinity was computed from conductivity, temperature and depth (assuming a constant density of 1025 kg m^{-3}), using the relationship derived by Perkin and Walker (1972).

The processed data are stored on two identical 9-track magnetic tapes, one of which is held by the author, and the other is deposited at the Marine Biology Station, Portaferry.

iv) Calibration

The current meter was calibrated for speed, direction, temperature and hydrostatic pressure at the Institute of Oceanographic Sciences, Wormley.

The deviation of the compass varied in a highly non-sinusoidal way, quite different from the manufacturer's specification. Accurate calibration of the compass is strongly recommended (SCOR Working Group 21, 1969), and Gould (1973) has shown that the application of erroneous compass calibration always results in systematically extracting energy form the oscillations and adding it to the mean flow.

It was noted that the stiffness of the rotor varied during use. For this reason, the manufacturer's calibration was used throughout.

The calibration of the temperature probe initially fitted was completely different from that given by the manufacturer. A new temperature probe was fitted from station 8. G. Savidge checked it against reversing thermometers during immersion in the sea. The calibration was found to agree with that of the manufacturers to within 0.1°C.

Conductivity was computed using the manufacturer's formula; it was not calibrated directly. However, the computed salinity derived from conductivity, temperature and depth (Section 4. a.iii) was calibrated against practical salinity in two ways. Firstly, water samples were obtained by N.I.O. bottle from alongside the current meter at some stations. They were not analysed for salinity (Section 4.b.ii) until the end of the project, and contrary to expectations, the calibration varied from station to station. This may have resulted from drying of the conductivity probe (Electronic Switchgear Manual).

Most of the stations were subject to surface water masses 1 and/or 2 (section 6.iv), and readings of temperature and practical salinity were taken near Portaferry about twice per week.

Relationships between temperature and computed salinity were derived by inspection of those one-tide temperature/computed salinity diagrams (Figure A1.2.1 to A1.18.7) representing tides during which temperature/practical salinity measurements were made near Portaferry. The value of the computed salinity expected from the Portaferry temperature was compared with the Portaferry practical salinity to estimate the error inherent in values of computed salinity,

$$E_s = S_{com,port} - S_{port}$$

where $S_{com,port}$ is the value of computed salinity expected at the temperature of water near Portaferry, and S_{port} is the practical salinity of the same water near Portaferry.

v) Drogue release

On one occasion, four cruciform drogues were released in the Narrows during the flood tide. Positions were fixed using horizontal sextant angles.

b) THE PLANKTON AND NUTRIENT SURVEY

i) Sampling

Sampling was carried out from a 5.5-metre punt, the Dewdrop, fitted with a 10-horsepower outboard motor.

On some cruises, temperature profiles were determined with the use of a thermistor probe. As such measurements invariably indicated unstratified water columns, bottle samples were restricted to a single depth at each station. This was 7 m for the outer stations and 11 m for the inner ones, where it was deeper.

Water samples were taken using an N.I.O. (now Institute of Oceanographic Science, Wormley, England) bottle. The temperature of the water in this bottle was measured with a mercury stem thermometer, and samples were taken from the bottle for the analysis of: 1) salinity; 2) nano- and micro-plankton; 3) nitrate and nitrite; 4) phosphate; 5) silicate; and in a few cases 6) pigment concentrations. The clarity of the water was measured using a Secchi disc, and observations were made on the speed and direction of the wind.

Additionally, at most stations, a tow was made with a Gulf IV high-speed plankton sampler. This sampler is described in section 3.b.ii. The sampler was towed at about 2 m s^{-1} (4 to 5 knots) for 10 minutes. The towing rope was secured by taking three turns around a thwart, and every 2 minutes some rope was paid out such that it was judged that the sampler would be fishing near the bottom at the end of the towing period. The boat was then stopped and the sampler quickly hauled in. At the outer stations, the sampler was towed against the incoming tide; at the inner ones, it was towed from Marlfield Bay to Chapel Island or *vice versa*.

The sampling jars for plankton were taken to sea already containing fixative. The bottles for nutrient samples had been acid-soaked; those for the silicate samples were of polyethylene and the others were of glass.

On returning to the laboratory, no more than 6 hours after sampling, the nutrient samples were immediately filtered and put to store at -20°C or less. Pigment samples were analysed at once.

ii) The gulf IV high-speed plankton sampler

The gulf IV high-speed sampler used in this survey is shown diagrammatically in figure 4.2. A Scripps-type bronze depressor was used, as employed by Southward (1962) for the Gulf III sampler. The Gulf IV was calibrated by towing it over a measured distance with its net removed; it was assumed that the volume of water sampled was a cylinder of the same diameter as that of the aperture in the nose cone.

Southward (1962) found that the Gulf III sampler caught far more of certain species than did conventional plankton nets, and he found that a more streamlined version (Bary's sampler: Bary and Frazer, 1970) was even more efficient. The Gulf IV is more streamlined than the Gulf III, but less streamlined than Bary's sampler.

In the Gulf IV, the position of the flowmeter (rotor) centrally behind the front aperture may result in poor comparability of flow under different conditions of clogging, or without the net at all
(B. McK. Bary, pers. comm.).

In Bary's sampler, mentioned above, which had telemetric monitoring of the rotor speed, Bary and Frazer (1970) found that a net of aperture 0.43 mm gave a reduction in flow of about 20% relative to the flow in the absence of the net. Although in this survey the distance towed was not measured during routine sampling, the flow meter counts suggest that the water-flow indicated with the net fitted was not in general less than 50 to 80% of that when there was no net.

This suggests that the calculated volumes of water

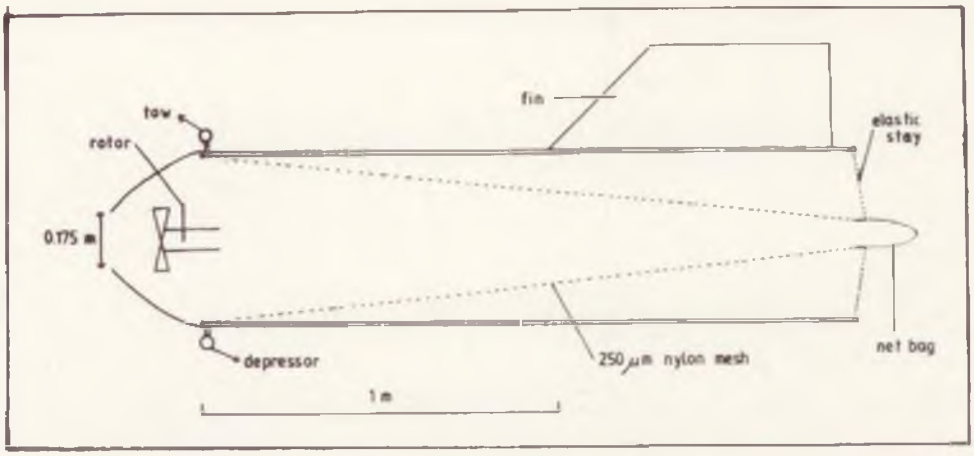


Figure 4.2. The Gulf IV high-speed plankton sampler.

fished are likely to bear a consistant relationship to the real volumes.

The Gulf IV sampler was easy to use from the punt, but required two people to haul it in quickly.

iii) Determination of chemical and pigment concentrations

Samples for the determination of nitrate/nitrite and phosphate were filtered using Watman's GF/C filters. Those for silicate determination were filtered through Fison's Metricel GA 3 filters of nominal pore size 1.2 um. The concentrations of these nutrients were then determined according to Strickland and Parsons (1972).

Samples for chorophyll a and phaeopigment determination were first filtered through Fison's Metricel GA 3 filters (nominal pore size 1.2 µm) and the filtrate was refiltered through Metricel GA 6 filters (0.45 µm). The filters were extractred into acetone and the chlorophyll a and phaeopigment determined according to Wetzel and Westlake (1969).

Salinity was measured using an "Autolab" salininometer at the Department of Oceanography, University College Galway.

iv) Experiment to determine the time necessary for settlement

A sample of seawater was obtained from the Marine Biology Station holding tanks. The water had just been pumped from the Narrows and was dominated by the diatom. *Rhizosolenia delicatula.* After the sample had been fixed with Lugol's iodine, it was used to fill ten settling chambers, described in Section 4.b.v.

The subsamples were allowed to settle for varying times before being prepared for counting. The following three categories of plankton were counted: diatom chains; flagellates; and spores (mostly of dinoflagellates).

v) Settlement and examination of nano- and micro-plankton

Settling chambers were constructed as illustrated in figure 4.3. except that, while in the figure the height of the tube was 5 cm, that of the tubes used in the present work was 20 cm.

Each settling chamber comprised an upper and a lower part. Each part comprised a rectangular piece of "Perspex" measuring 75 mm x 25 mm x 1.5 mm, in which a circular hole of diameter 15 mm was centered about 30 mm from one end (figure 4.3.a). To the upper part was cemented around the hole a 20 cm long "Perspex" tube of internal diameter the same as that of the hole (figure 4.3.b). To the lower part was attached by the mounting medium, "Eukitt" (manufactured by O. Kindler, Freiburg, Silberstrasse 25, Germany), a coverslip so as to make a seal around the hole. The upper and lower parts were sealed together using "Vaseline" white petroleum jelly (manufactured by Chesebrough Pond's Ltd., London NW10 6NA) (figure 4.3.b). Removal of the lower coverslip after use was facilitated using petrol.

A subsample of seawater preserved with Lugol's iodine (Saraceni and Ruggiu, 1969) was added to a height of 20 cm above the lower coverslip. During settlement the tube was covered to keep out dust and prevent evaporation of the iodine. At the end of the settlement time (three to five days) the upper column of water was slid away with the upper part of the chamber (figure 4.3.c), and a second coverslip was placed over the hole in the lower part (figure 4.3.d).

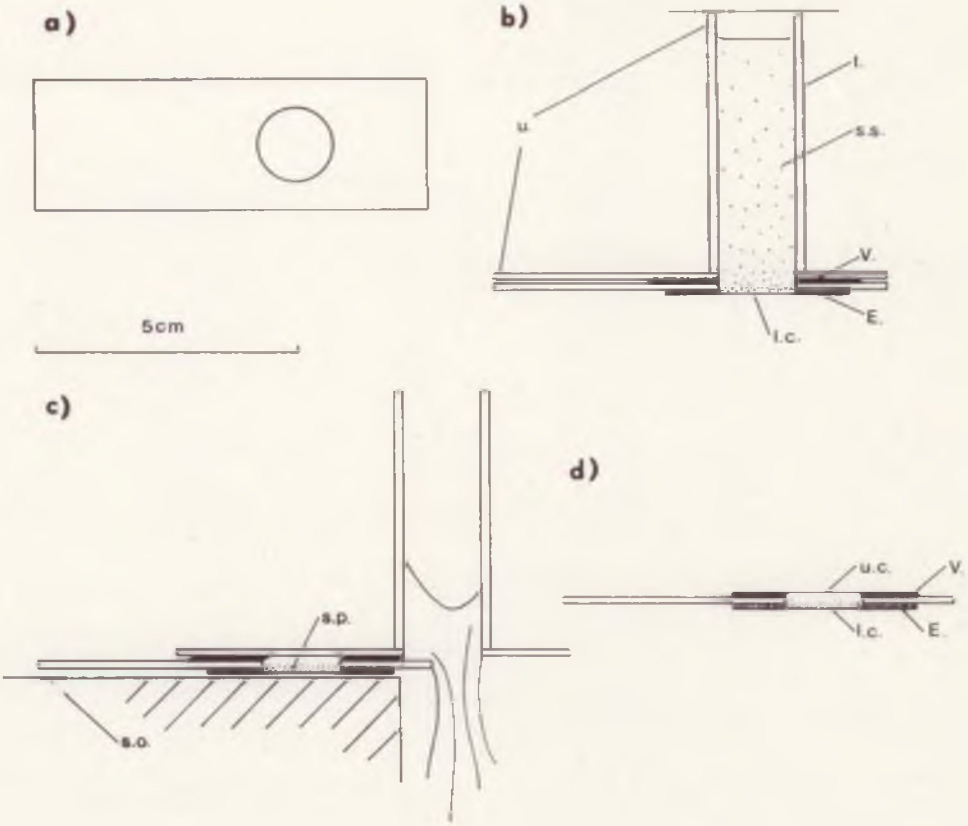


Figure 4.3. Settling and counting cell. (a) Plan view of base, applicable to both upper and lower parts.

(b) Longitudinal section through cell during settling of phytoplankton. (c) Upper part of cell and upper part of sub-sample are slid away. (d) Cell ready for examination. E: "Eukitt" mountingmedium; l.: lower part; l.c.: lower coverslip; s.o.: support object; s.p.: settled plankton; s.s.: sub-sample; t.: tube; u.: upper part; u.c.: upper coverslip; V.: "Vaseline".

The nano- and micro-plankton resting on the lower coverslip was now identified, measured and counted under oil immersion (100 x objective) by the Utermohl method (Lund et al., 1958; Hasle, 1978b) using a Wild M40 inverted microscope. Both bright-field and phase contrast illumination were used.

vi) The phosphate/sediment dynamics experiment

These two experiments were carried out to test the theory arising from examination of the data on phosphate concentration, that sediment might be buffering the concentration of phosphate in Strangford Lough.

In the first experiment, a sediment core was obtained from a depth of 20 m off Reagh Island on 20 June 1975. The top 0.5 cm of the core was light coloured, incicating aerobic conditions, and the rest was black.

Water obtained from the Narrows was filtered through Watman's GF/C filters. 450 cm^3 of this water was placed in each of two 5-dm^3 glass beakers. The water was stirred continuosly at full speed by "Handilab" stirrers fitted with stainless steel propellors. To one beaker was quickly added the top 0.5 cm of the sediment core, weighing 6 g. Samples of 220 cm^3 were taken immediately, and at intervals thereafter, from each beaker. The samples were filtered through Watman's GF/C filters, frozen, and later analysed for inorganic phosphate. The experiment continued for 262 h, until only about 1000 cm^3 of liquid remained in the beakers. During the experiment, the temperature of the water varied from 14.5 to 17^{o}C and most of the sediment was kept in suspension.

In the second experiment, aerobic sediment was obtained on 31 October 1975 from the top 0.5 cm at a depth of 2 m below Datum near Chapel Island. Water was obtained from the Narrows on 14 November. It was filtered and allowed to stand overnight. The water was added to each of four 5 - cm^3 glass beakers, and stirring was carried out using belt-driven stainless steel stirrers.

After stirring was started and initial samples had been taken, 4 cm^3 of 40% formaldehyde (neutralised with sodium glycerophosphate) was added to two of the beakers. To one beaker with formalin and one without was then added 4 g sediment. Samples were taken as in the first experiment, but they were analysed also for total phosphate after autoclaving with persulphate as well as for inorganic phosphate.

After 7 h the experiment had to be stopped because of problems with the stirrer bearings. During the experiment the beakers were cooled in a water-bath at $4^{o}C$.

Both experiments were carried out in alternating dark and subdued light. The subsequent filtering eluted water through some sediment and thus increased the effective exposure of water to sediment by an amount difficult to quantify.

METHODS

vii) Processing of the nano- and micro- plankton data

I General considerations.

The processing of the nano- and micro- plankton and associated data was carried out mostly on the Queen's University ICL 1906S computer, and multivariate analysis was carried out using the statistical package for the Social Sciences (Nie *et al*., 1970).

The computations of volume and organic carbon, however, were computed on University College Galway's Digital DEC-20, using raw data transferred from the 1906S in industrial-type format EBCDIC at 1600 Buts for 1 inch on 9-track magnetic tape. Appendices 4, 5 and 6 were printed out by an Anderson Jacobson AJ832 printer terminal on-line to the DEC-20.

II) Estimation of biovolume and organic carbon content of the nano- and micro-plankton.

Of eight methods tried by Buttewick *et al.* (1982) for estimating planktonic algae, namely: a) microscope counts; b) electronic (Coulter) counting; c) nephelometry (light scattering); d) *in vivo* attenuance; e) *in vivo* fluorescence of chlorophyll *a*; f) reducing capacity (carbon-equivalent by dichromate oxidation); g) extracted chlorophyll by spectrophotometry; and h) extracted cholrophyll by fluorometry; method a was considered to be the best for several reasons.

While mean cell volume has been calculated for taxa found in some surveys, (Cambell, 1973), the method for its estimation is rarely given. Kovala and Larrance (1966), however, published a computer program to calculate phytoplankton volume, and they related it to field data. They recognised 18 basic shapes, and for some organisms, eleven linear measurements are required. In the present survey, the following, much simpler method was used.

The volume of each organism measured (section 3.b.v) was determined according to the particular organism's observed shape. For many flagellates and diatoms, the shape was roughly ellipsoidal, in which case the following value was evaluated for the volume,

$$V = \frac{a.\ b.\ c.\ \pi}{6}$$

Where a, b, and c, are the length, width and depth. for indented organisms such as many dinoflagellates and ciliates, allowance for girdles and other indentations was made by the formula,

$$V = \frac{a.\ b.\ c.\ \pi}{6} \times \frac{2}{3}$$

Certain species of diatom, e.g. centric diatoms and *Rhizosolenia delicatula*, were treated as cylindrical, in which case the following formula was used,

$$V = \pi r^2 h$$

where r is the radius, and h is the height.

Asterionella glacialis was treated as conical, in which case,

$$V = \frac{\pi r^2 h}{3}$$

Because phytoplankton organisms vary greatly in volume between as well as within samples, it is important not to base the biovolume of organisms in one sample on measurements of the same species or taxon in another (Smayda, 1978). In the program used to produce the results herein, the volume contributed by each taxon was calculated from measurements made from the particular sample. However, where a taxon was counted in a particular sample but no measuremets were made, the biovolume used was the mean for the taxon over the whole survey. For five taxa, volumes were estimated from the literature. While estimations based on cytoplasm volume offer the best estimate of organic carbon (Smayda, 1978), the relationship between carbon and cell volume found by Strathmann (1967), as modified by Eppley (1970, 1974, both quoted by Smayda, 1978) offer the best available estimate using cell volume (Smayda, 1978). However, Antia et al, (1963, quoted by Strathmann, 1967) found that organic carbon: cell volume ratios may be reduced by more than 50% under conditions of low nitrate concentrations in the water.

Eppley's formulae used here are:

$$\log_{10} C = 0.76(\log_{10} V) - 0.352 \quad \text{(for diatoms)}$$

and

$$\log_{10} C = 0.94(\log_{10} V) - 0.60 \quad \text{(for other organisms)}$$

where C is the organic carbon content in pg, and V is the cell volume in μm^3.

The second equation has been used also for heterotrophs, particularly ciliates, although no organic carbon:cell volume relationships appear to have been investigated in these organisms.

III Multivariate analysis.

In order to make sense out of any set of data it is frequently necessary to simplify it. This is because the human brain has difficulty considering many interrelated variables at the same time. Simplification, however, involves loss of information, and if the information lost is relevant to the problem under consideration, misunderstanding is likely to occur.

Multivariate analysis aims to present an apparently complicated data set in such a way as to incorporate the maximum information in the fewest possible factors. Although multivariate analysis is a mathematical tool, albeit with many versions, its success must be judged subjectively, according to whether the user thinks it helps him to understand his data.

In the case of a plankton survey, the analysis usually starts with computing a multiple correlation table for all the taxa according to their abundance. This is R-type analysis: the case where the samples are cross-correlated is a Q-type analysis.

Since the technique of correlation assumes normality of the data, abundances of the plankton are usually transformed according to the formula:

$$b = \log_{10} (a + 1)$$

where a is the abundance.

However, Ibanez (1976, fig. 10) subjected the same set of data to seven different, harsh transformations and carried out principal component analysis (P.C.A.) on them. He showed that the relationship of the data points to each other remained essentially constant.

Nevertheless, as Allen and Skagen (1973) point out, the technique ignores curvilinear relationships between variables.

We will demonstrate the robustness of our data by showing that the same R-analysis gave similar results whether it was performed on the whole set of 42 samples or an only 35 of them.

Ibanez (1976) also draws attention to need to eliminate "du tableau des donées des hétérogénéités trop flagrantes, comme un nombre très élevé de zéros (dans ce cas, la première composante principale risque de se calquer sur la répartition de ces absences), ou des espèces de dispersion extrêmement différentes, de strates statistiques différentes, par example du macroplancton associé à du phytoplancton."

We have avoided the incorporation of net plankton results or physical variables in the data set for multivariate analysis, and have restricted it to nano- and micro- plankton. In the interests of limiting the numbers of zeros, only 30 of the most widespread taxa have been subjected to multivariate analysis.

Fasham and Angel (1975) report criticism by others of Q-type analysis because of difficulty in identifying the factor axes with physical or environmental causes. Fasham and Angel, however, maintain that Q-type analysis is useful providing that suitable factor rotation is undertaken and that the axes are used in classification rather than in trying to identify causes.

We will compare a Q-type analysis of our data with an R-type analysis loaded on to stations. The loading was carried out by normalising the data to a mean of zero and a variance of 1. The transferred values were loaded on to each factor for each sample.

As well as straighforward P.C.A., we carried out Varimax rotation and Rao's canonical factoring (Kim, 1975).

While various tests of significance have been proposed for multivariate analysis, they mostly make an assumption of normality about the data. Since there is no guarantee of normality, we have followed Ibanez (1976) incorporating a random variable into those of our R-type analyses which used all 42 stations.

Cassie (1963) suggests that an analysis should have the following properties: 1) the expression of the spatial relationships between species; 2) the grouping of species in an objective manner; 3) the examination of the relationships between groups of species, rather than between individual species; and 4) the ability to distinguish between regions of the environment on the basis of species assembly alone. If the word "spatiotemporal" is substituted for "spatial" in Cassie's above four points, we propose that we have achieved these objectives.

TABLE 4.1

Taxa used for multivariate analysis

M.A.A.	Taxon	Normal*
1	Flagellata indet.	101
2	Cryptophyceae	2
3	Prasinophyceae	91
4	Euglenaceae	88
5	Choanoflagellata	93
6	*Distephanus speculum*	22
7	*Dunaliella*	7
12	*Chaetoceros gracilis*	56
13	*C. curvisetum*	49
14	*Rhizosolenia stolterfothii*	74
16	*R. delicatula*	69
17	*Cylindrotheca closterium*	87
19	*Leptrocylindrus danicus*	30
20	*Guinardia flaccida*	75
23	*Skeletonema costatum*	32
30	Pennates indet.	88 (part)
31	*Chaetoceros* indet.	44
33	Ciliata	94 - 98
35	Spores	15
40	*Nitzschia seriata*	85
42	*Rhizosolenia alata*	67
47	Diatoms (mostly centrics)	88
48	*Nitzschia "delicatissima"*	134
60	*Chaetoceros holsaticum*	58
62	*Bacillaria paxillifer*	86
109	Gymnodiniaceae	8
115	*Protoperidinium*	16
118	*Prorocentrum* spp.	4
119	*Dinophysis* spp.	5+6+7
120	*Protodimium neapolitanum*	12
R (11)	Random number	-

* - i.e. in the taxon checkilist, Table 5.4.

viii) Preservation and estimation of the net plankton

The plankton in the Gulf sample was washed down into the net bag while the sample was held over the side of the boat. The net bag was then emptied and washed into a sampling jar into which a mixture of neutralised Formalin, propylene, phenoxitol and polypropylene glycol (Steedman, 1975).

The sedimentation volume was determined by allowing the plankton sample to settle for 12 hours in a measuring cone whose sides sloped about 35° from the vertical. It was found that this sedimentation volume did not decrease from 12 hours to 14 days after settling commenced.

Additionally counts of both plankton and zoo-plankton were made of 17 of the 38 net plankton samples taken.

5) RESULTS

a) CURRENT MEASUREMENTS, AND ASSOCIATED TEMPERATURE AND SALINITY DETERMINATIONS

i) Drogue release

Figure 5.1 shows the positions, and possible tracks of four drogues, depths 1, 2, 5 and 10 m, released 100 m off Church Point at 1 h 6 min. before HW Belfast. The tidal range at Belfast was 2.7 m.

In the first 16 min. after their deployment, the drogues moved 2.92 km into the lough, giving a water speed over this distance of 3.04 m s^{-1}. Corrected to mean springs this would give a mean speed of 4.2 m s^{-1} (7.3 knots), which is faster than that given on Admiralty chart 2156 (1968) for the parts of the lough traversed, namely 6 1/4 knots off Church Point, 4 1/4 knots off Ballyhenry Bay and 2 knots, 700 m off Ballyhenry Island.

For the following 39 min., the 10-m drogue continued towards Long Rock at a mean speed of 0.66 m s^{-1} (when corrected to mean springs equivalent to 0.94 m s^{-1} or 1.6 knots).

The other three drogues appeared to be affected by one or more gyres at the northern boundary of the incoming jetstream.

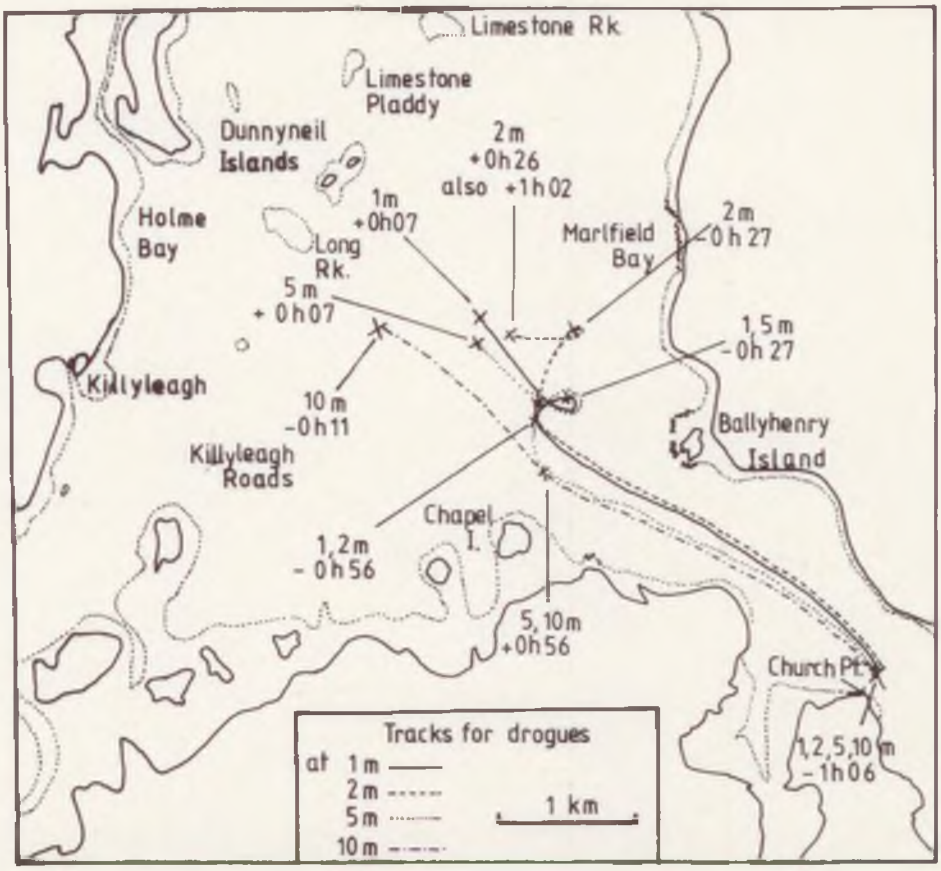


Figure 5.1 The south of Strangford Lough to show the tracks of four drogues released on 18 June 1973. The drogues are referred to by their depths, 1, 2, 5, and 10 m. Time are given relative to HW Belfast. Range of tide at Belfast 2.2 m. Also shown are place-names mentioned in the text.

ii) Time-series current meter data

I Time-series presentation

The data recorded by the current meter are presented in Appendix 1 as graphs over M_2 tides (24 hour 50 minute) of the following variables: direction; speed; the easterly and northerly components of velocity; depth; computed salinity; and temperature. Also shown are one-tide diagrams of temperature plotted against computed salinity. The relationship between computed salinity and practical salinity is shown in Appendix 2.

II Tidally averaged time-series presentation

Appendix 3 shows the current meter data at 10-minute intervals averaged over a number of successive M_2 (alternate 12 hour 20 minute and 12 hour 30 minute) cycles. The data are: 1) time after the start of the period; 2) temperature; 3) computed salinity; 4) depth; 5) speed; 6) northing; and 7) easting. Also shown are one-tide diagrams of temperature plotted against computed salinity. The relationship between computed salinity and practical salinity is shown in Appendix 2.

III The tidal streams of Strangford Lough

Data averaged over a number of M_2 tidal cycles, taken from Appendix 3, are shown as a tidal atlas of Strangford

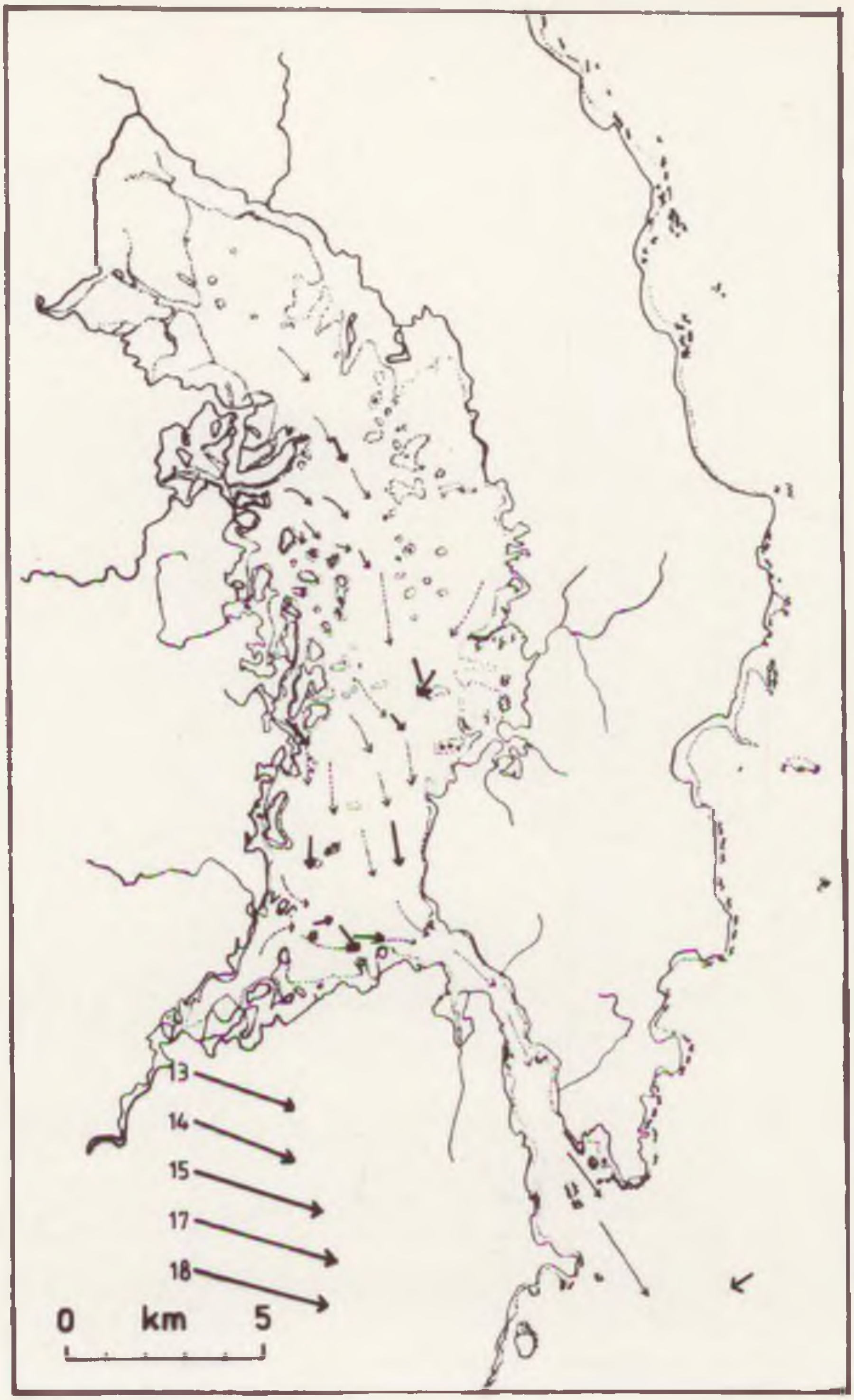


Figure 5.2. Currents in Strangford Lough at 6 h before HW Belfast. Thick arrows show representation of water passing each station every hour. Thin continuous arrows represent data from a float survey by members of Whiterock Sailing Club. Dotted arrows represent likely direction of current. Positions of stations 13 to 18 are shown in figure 3.5. <u>MEAN SPRINGS</u>

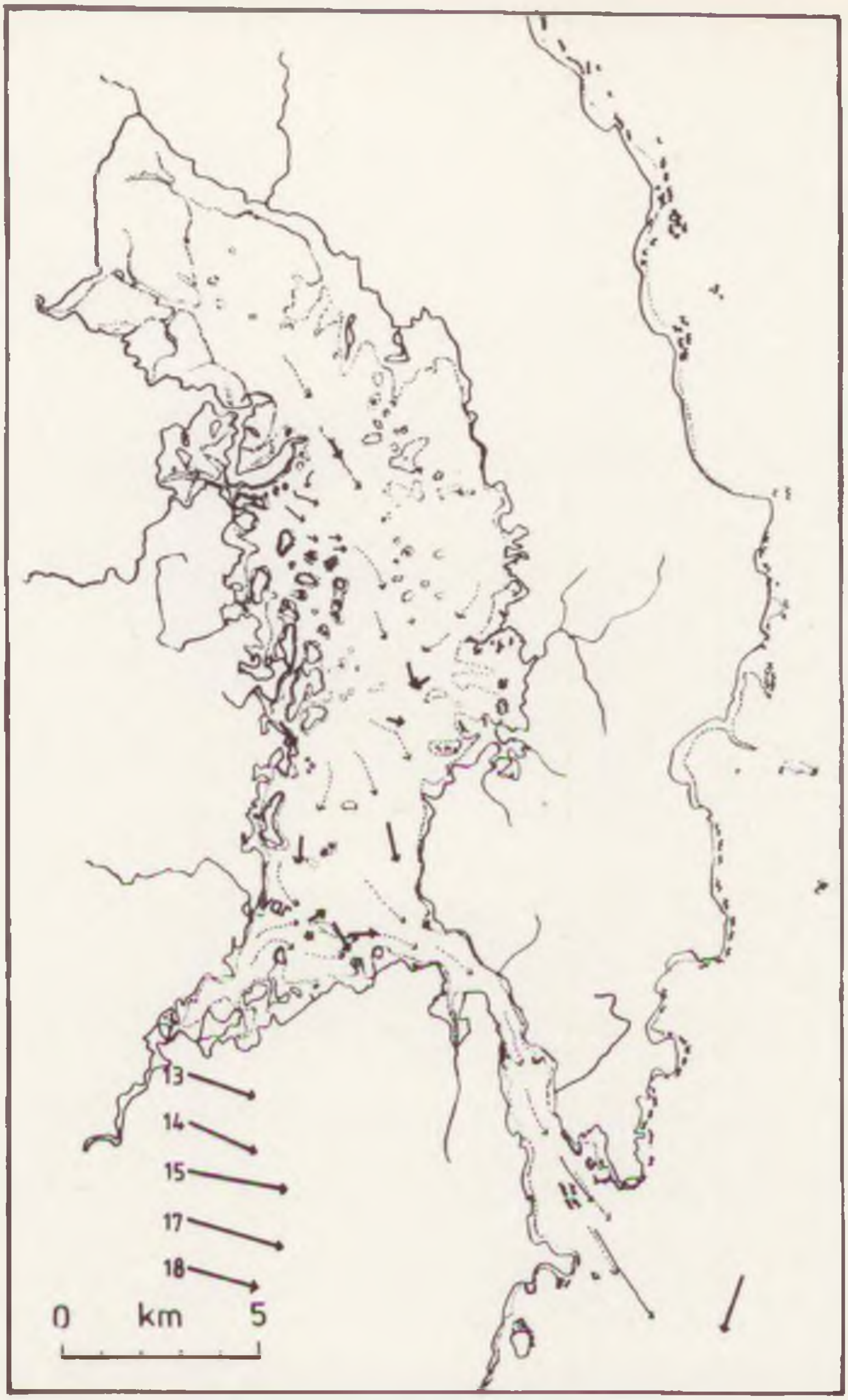


Figure 5.3. Currents in Strangford Lough at 5 h before HW Belfast.

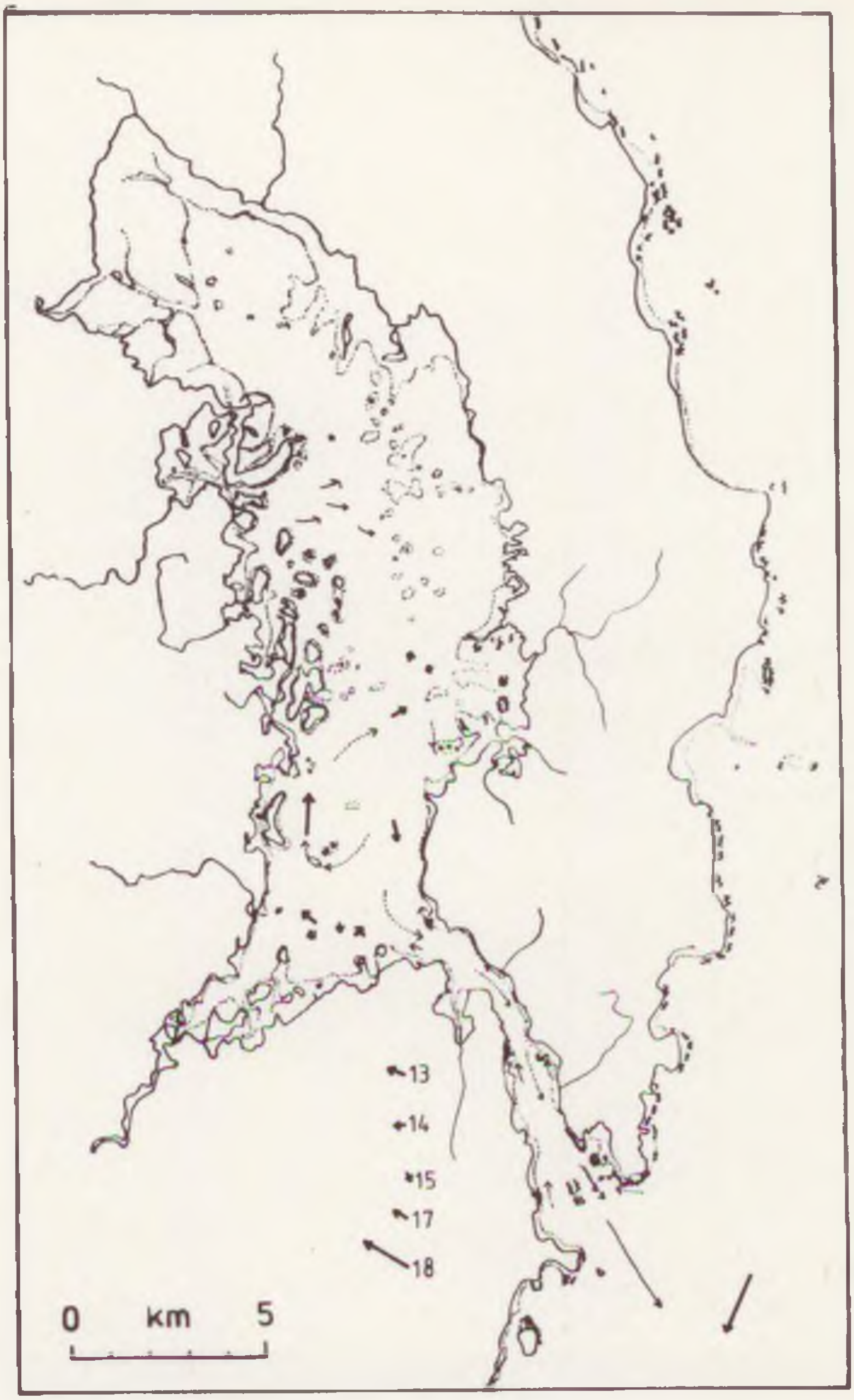


Figure 5.4. Currents in Strangford Lough at 4 h before HW Belfast.

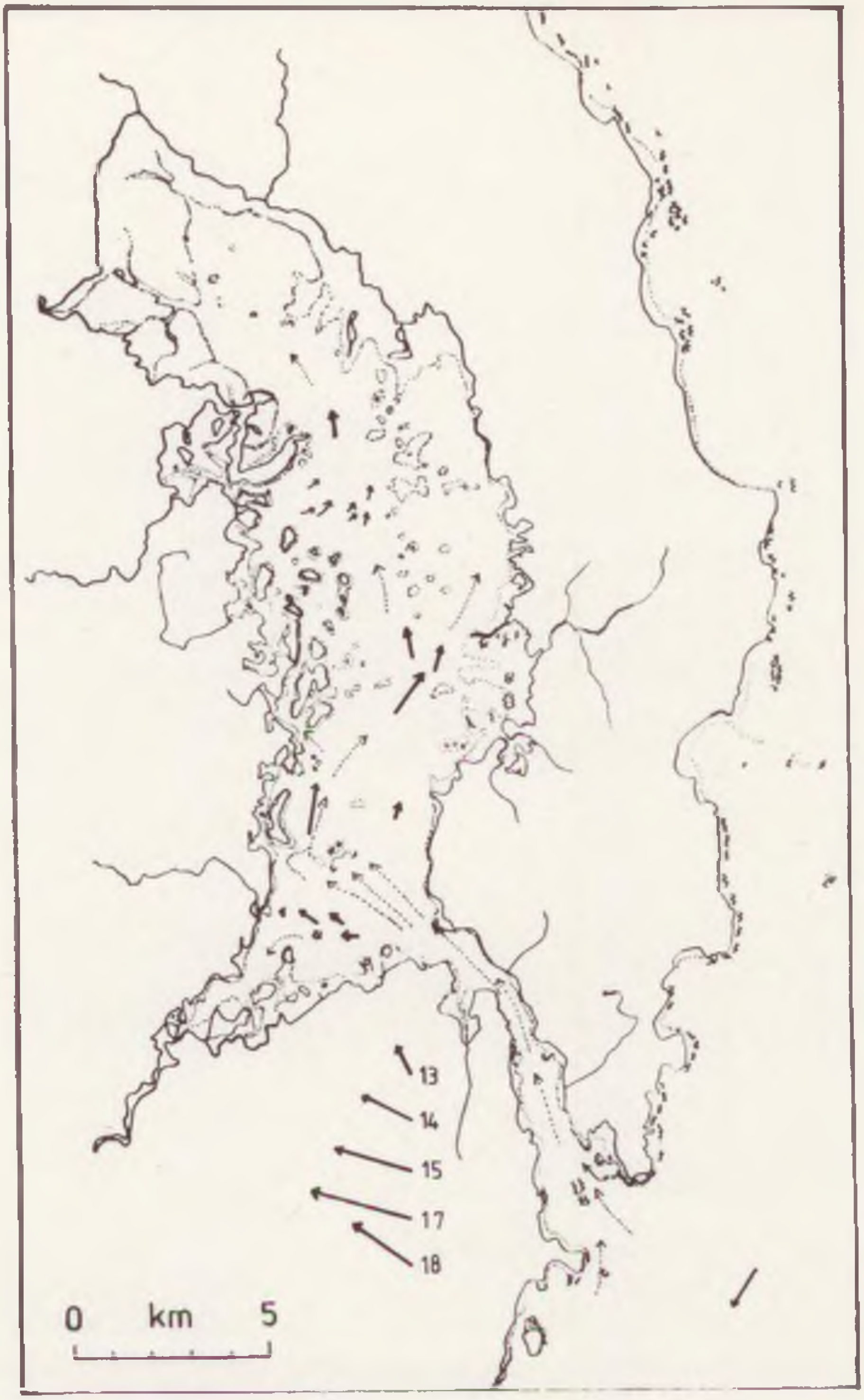


Figure 5.5. Currents in Strangford Lough at 3 h before HW Belfast.

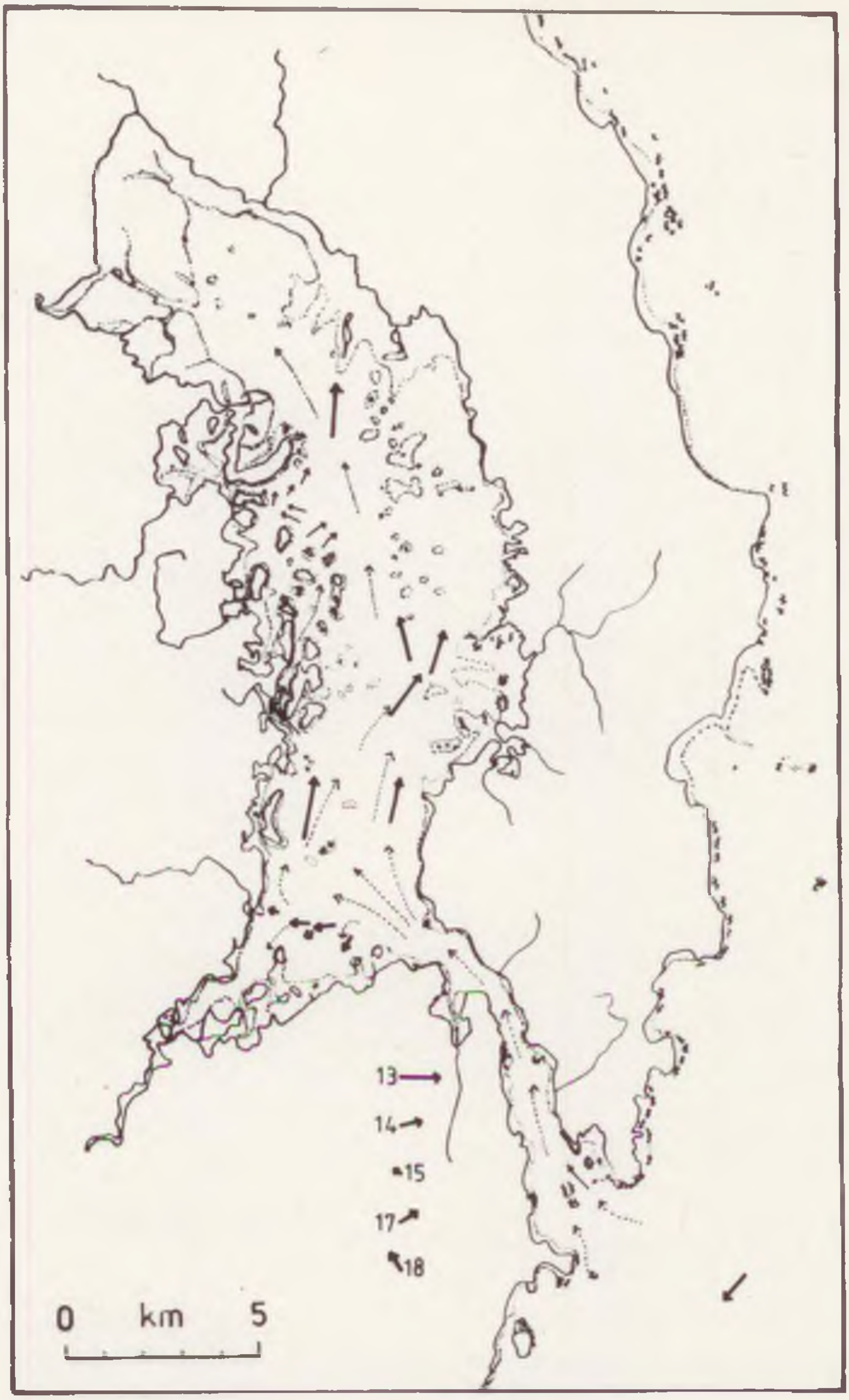


Figure 5.6. Currents in Strangford Lough at 2 h before HW Belfast.

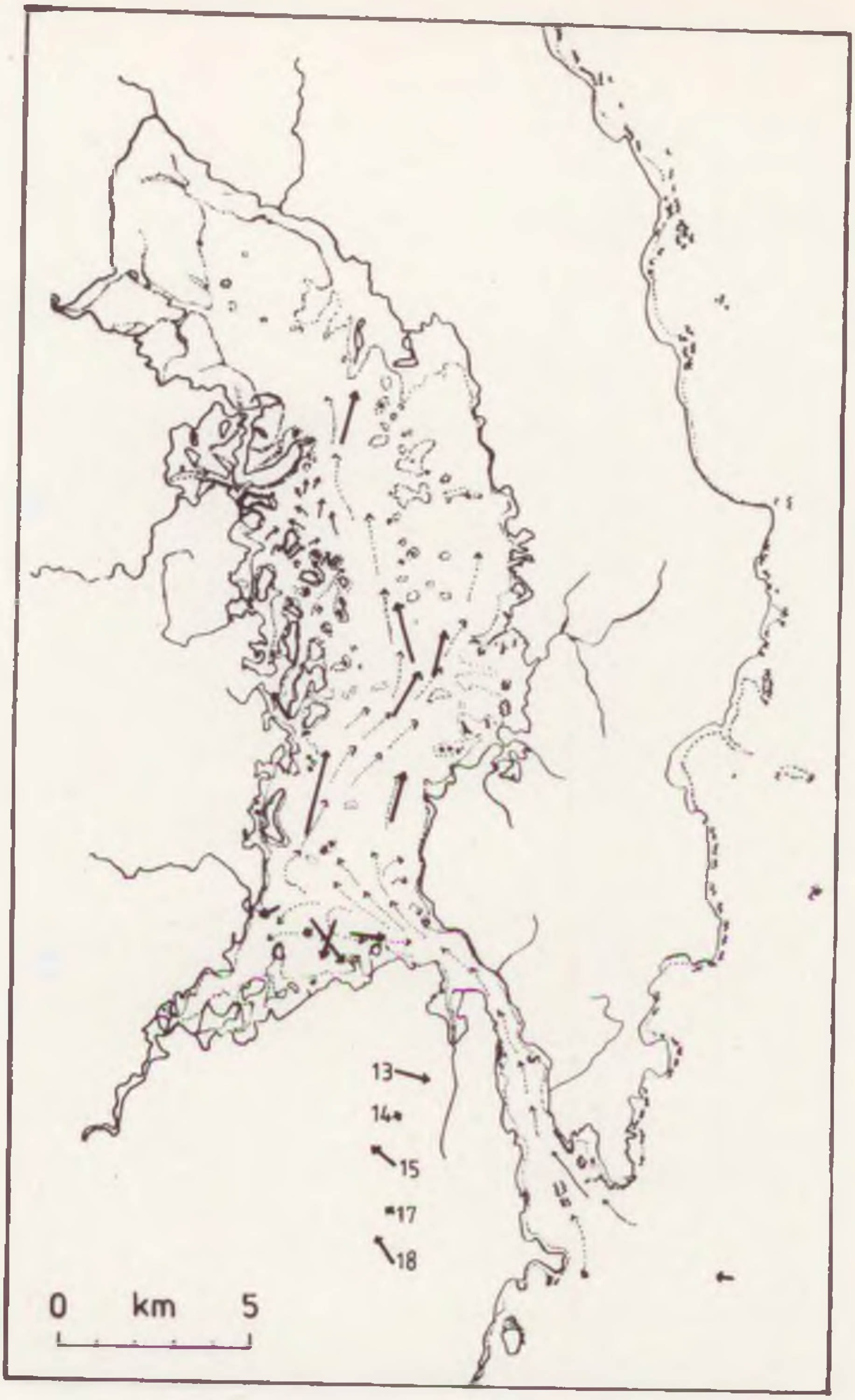


Figure 5.7. Currents in Strangford Lough at 1 h before HW Belfast.

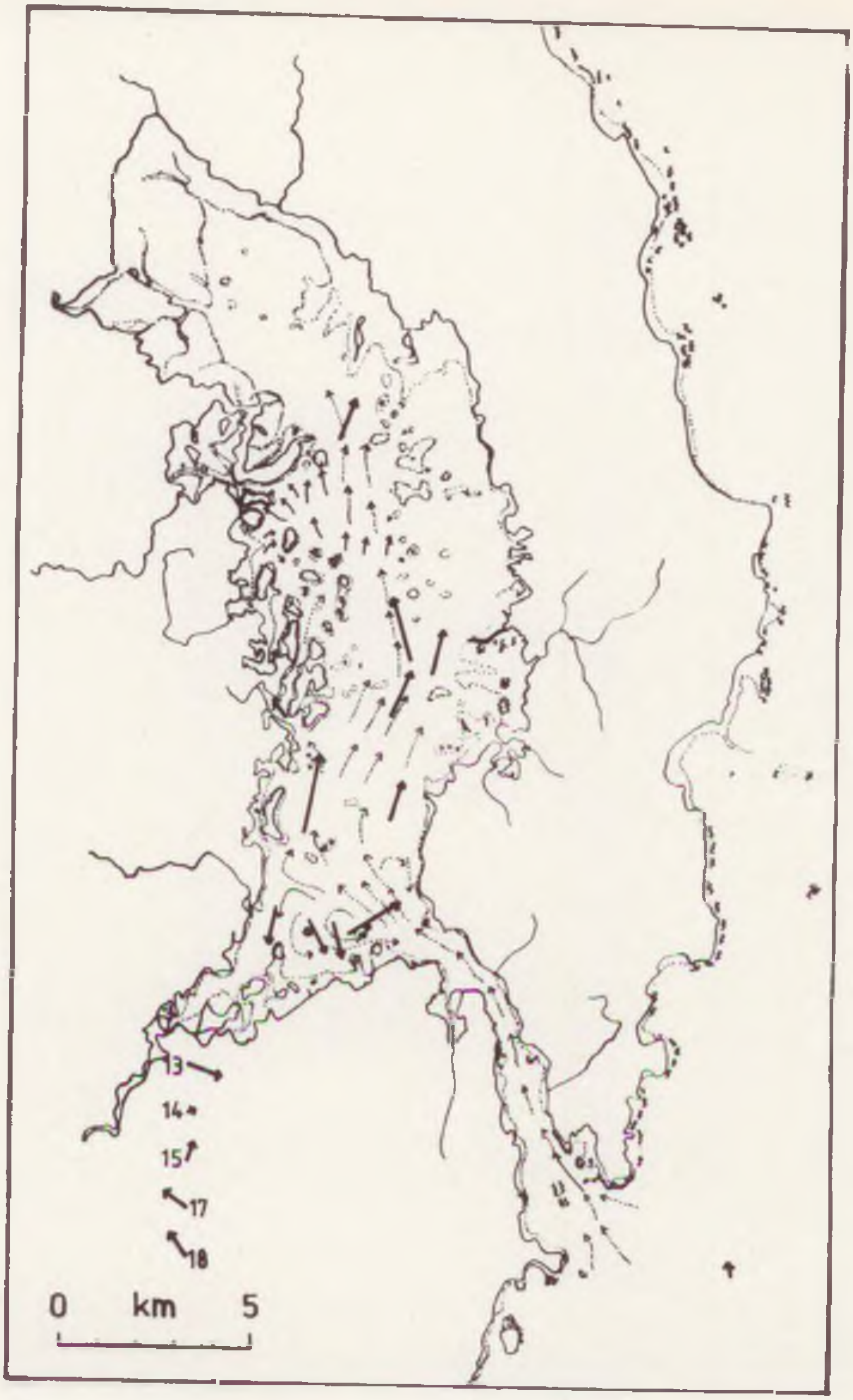


Figure 5.8. Currents in Strangford Lough at HW Belfast.

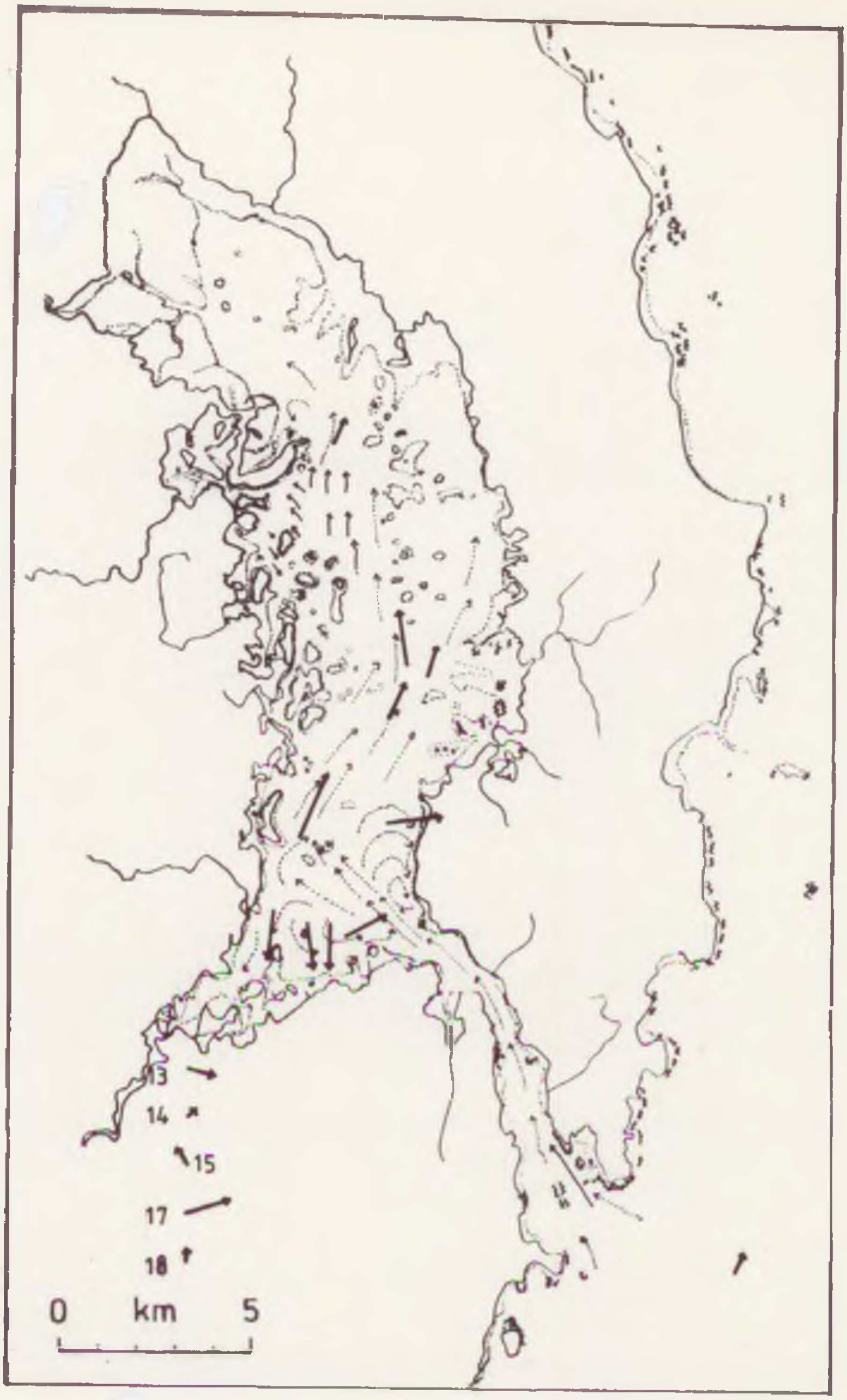


Figure 5.9. Currents in Strangford Lough at 1 h after HW Belfast.

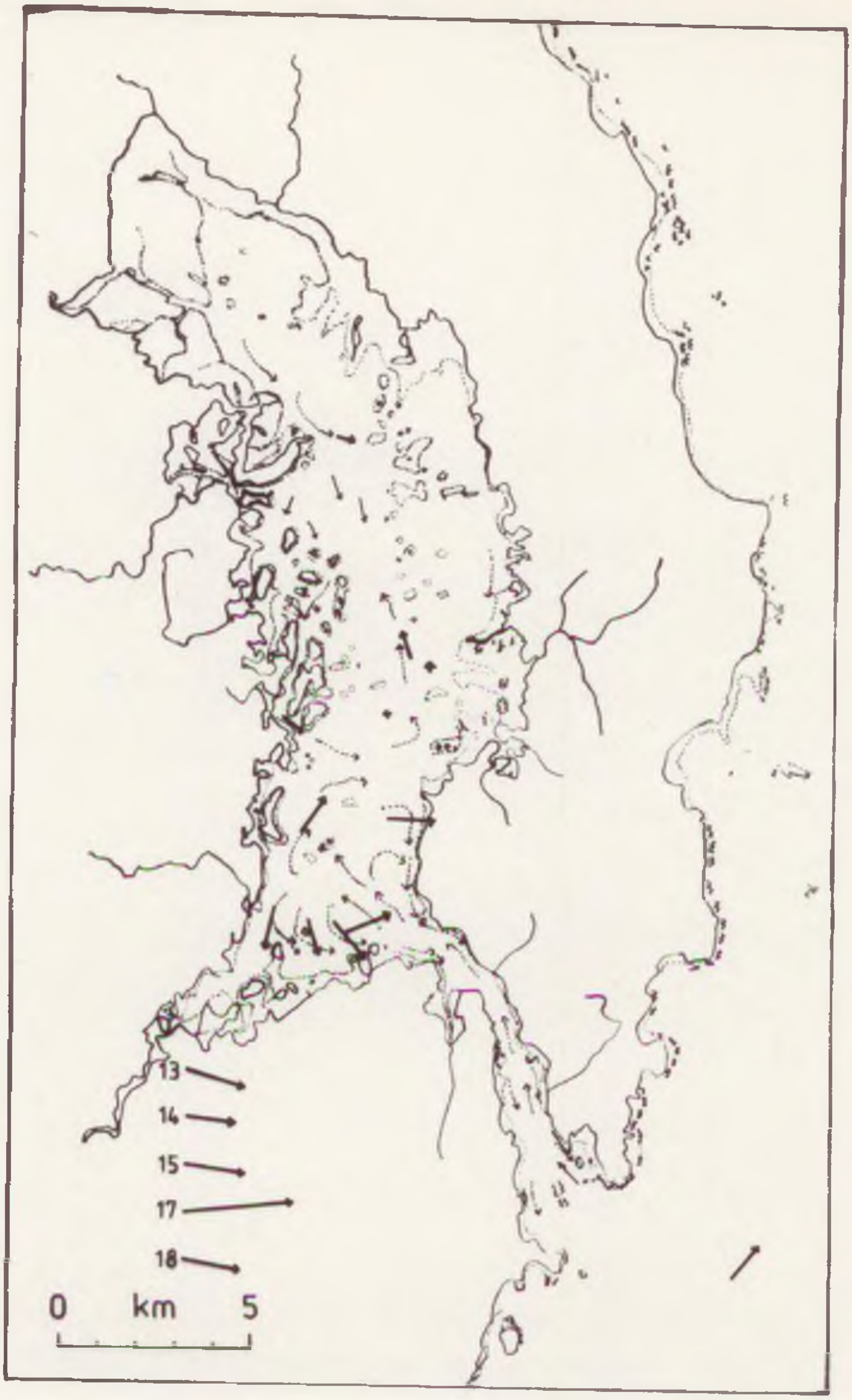


Figure 5.10. Currents in Strangford Lough at 2 h after HW Belfast.

Figure 5.11. Currents in Strangford Lough at 3 h after HW Belfast.

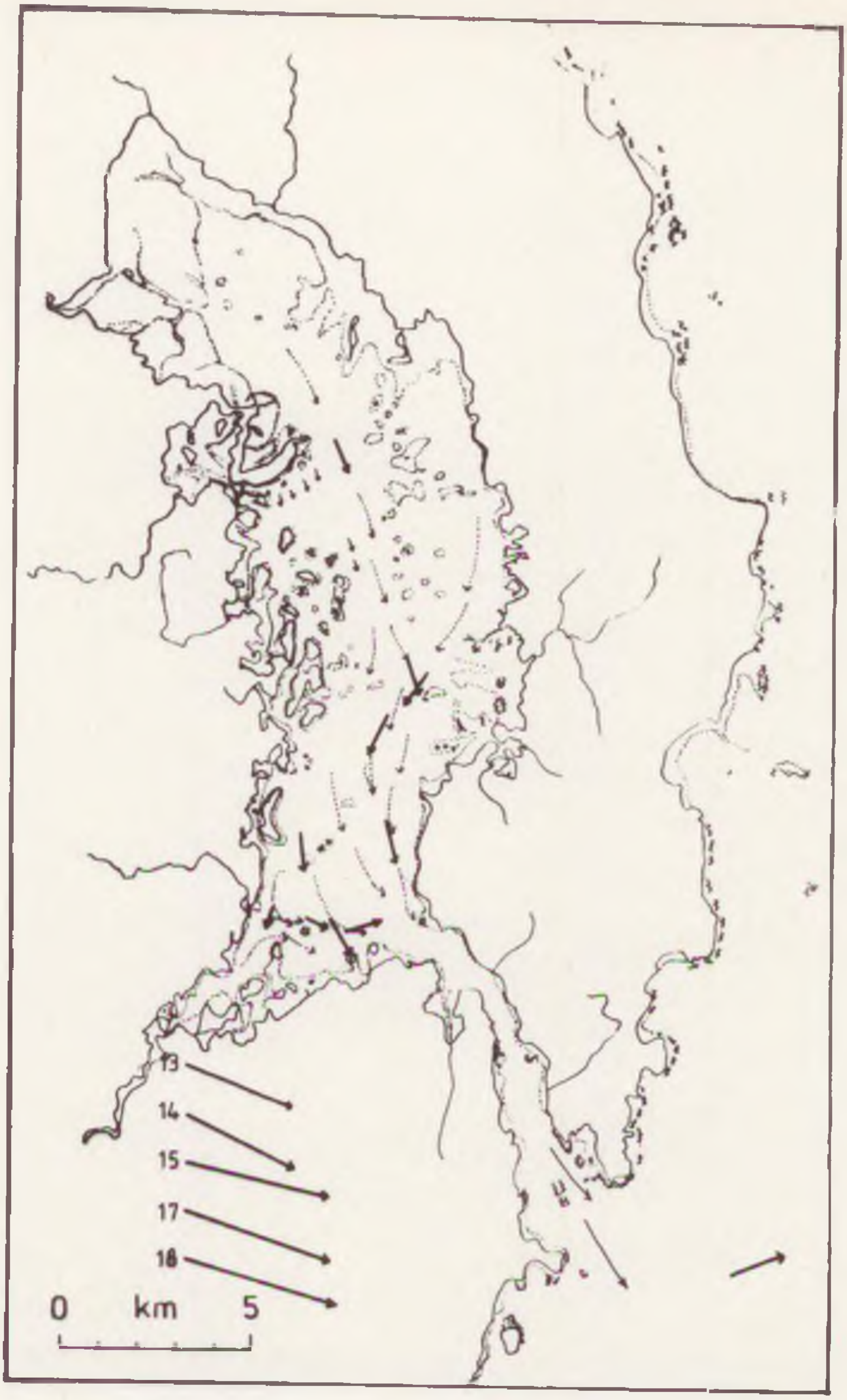


Figure 5.12. Currents in Strangford Lough at 4 h after HW Belfast.

Figure 5.13. Currents in Strangofrd Lough at 5 h after HW Belfast.

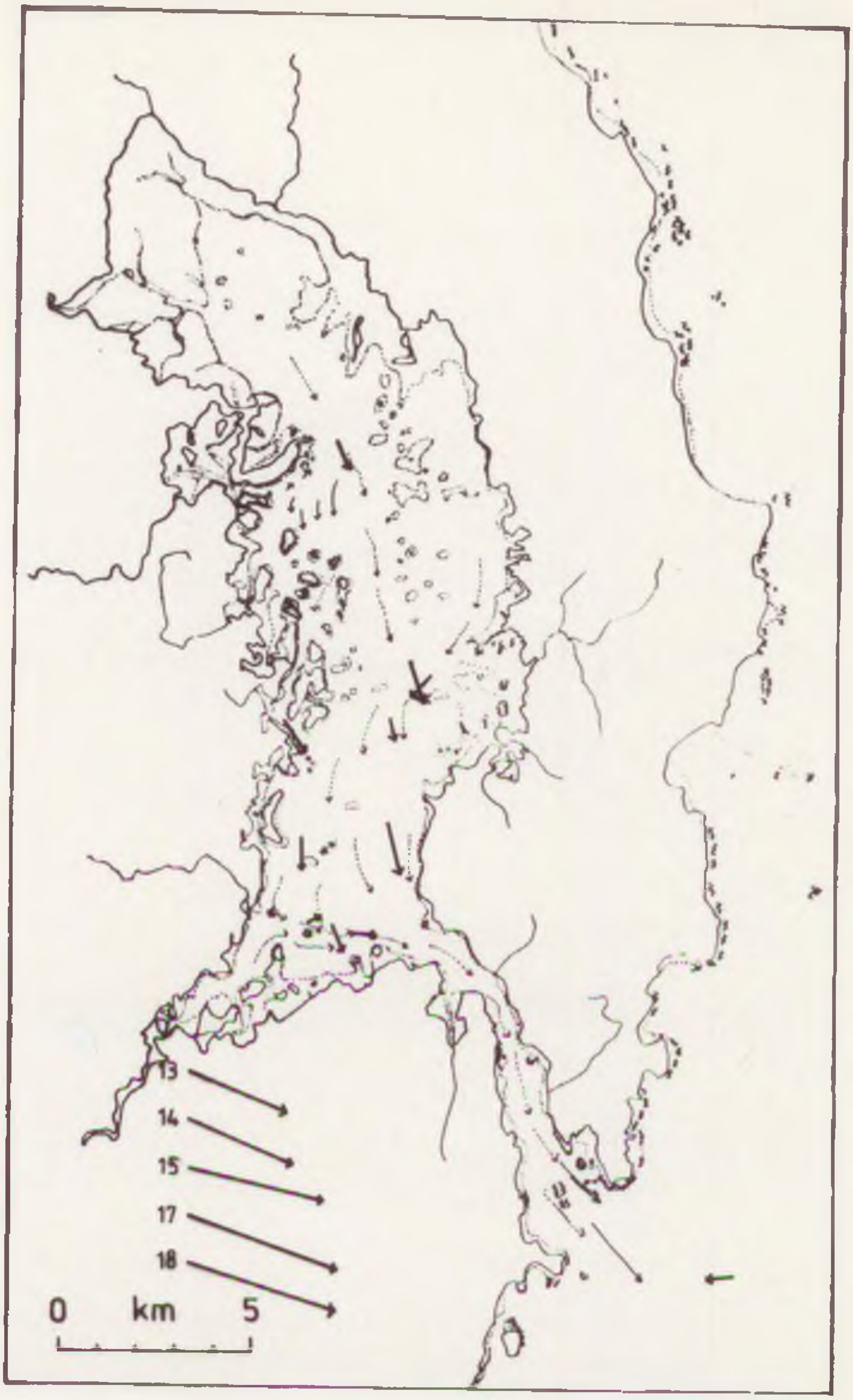


Figure 5.14. Currents in Strangford Lough at 6 h after HW Belfast.

Lough in figures 5.2 to 5.14. Data for station A has been taken from Chart 2156 (Hydrographer of the Navy,1968), and for the area south and south-east of Mahee Island from a float survey carried out by members of Whiterock Yacht Club in 1954. Discussions with others and personal experience have also been used in drawing in suggested streams. Where no tidal stream is shown this implies absence of data, not lack of a tidal stream.

Four hours after HW Belfast, the current in the centre of the Narrows whilst accelerating northwards, is still south-going, but near the shores of the Narrows, water has already started to move northwards.

In the southern basin, while water is still moving south on the eastern side, a vigorous counterflow has already begun to flow northwards on the western side of the basin, while on the boundary between the southern basin and the south-western corner, the stream is starting to turn west-north-west.

Between the southern and middle basins, the stream is just starting to flood, particularly in Ringhaddy Sound, while off Mahee Point, and south and east of Mahee Island, flow is very weakly eastwards.

By three hours before HW Belfast, the flood in the Narrows is well established. Along the boundary between the southern basin in the south-western corner, flow is roughly west-north-westwards. Otherwise flow throughout the body of the lough is roughly northwards, although this northward flow is still slow to develop in the east of the southern basin.

Because of the momentum of water flooding in from the Narrows at about 3 m s^{-1}, much of this water continues as a jetstream towards Dunnyneil Island and the shore around

Killyleagh, where it is likely that water piles up. In addition, clockwise vortices form on the northern edge of the jetstream, and anti-clockwise vortices probably form on its southern edge.

By two hours before HW Belfast, a countercurrent to the jetstream is starting to develop on the southern shore of the lough at witnessed by a south-south-east-going stream at station 4, and variable currents at stations 13 to 15 and 17 to 18. This countercurrent becomes stronger until local HW, about two and a quarter hours after HW Belfast.

During the flood, from 4 hours before HW Belfast until about 2 hours after HW Belfast, the relative strengths of the current between Long Sheelah and Weedoo (stations 7, 9 and 10) increase relative to that in Ringhaddy Sound, probably because water leaving the proposed area of increased water level near Killyleagh partly piles up against the southern sides of the reefs separating the middle and southern basins, and partly moves inertially northwards between these reefs into the middle basin. That the flow in Ringhaddy Sound reverses at about one and a half hours after HW Belfast, about three quarters of an hour before the general ebb begins in the lough, may result from this inertial injection of water into the middle basin.

The current direction at station 12 changes suddenly from north-north-east to east at, on average, half an hour after HW Belfast, after which a strong hourly periodicity is sometimes evident. This change of direction probably reflects the extension to this point, of a countercurrent on the northern side of the jetstream emanating from the Narrows.

At 2 hours after HW Belfast, the currents in the lough are beginning to turn. The current in mid-Narrows is still flooding, but at the sides, as witnesses by stations 13 to 15 and 17 to 18, it is beginning to ebb. The current off Mahee Point (station 8) is turning clockwise, and there are still inertial northward flows north of the gap between Long Sheelah and Weedoo (stations 9 and 10), as well as west (station 11) and probably also east of Dunnyneil Island. A south-going counterflow is well developed along the shore of Marlfield Bay.

Over the next hour (2 to 3 hours after HW Belfast), the countercurrents combine with the first of the ebb to produce, a peak of speed just after local HW (about 2 1/2 to 3 hours after HW Belfast) at stations 2, 4, 5 and 6. That the current at station 12 is still running fairly strongly east-south-east until 3 hours 20 minutes after HW Belfast (Appendix 3) is evidence of northward inertial flow persisting in the centre of the southern basin until this time or slightly before.

On the whole, with exceptions at stations 3 and 7, the tidal currents continue with little further general change in direction until 5 hours before HW Belfast. At station 3, however, the southward flow progressively slackens as it is opposed by the ebb from the Quoile estuary. This may be because as the water level falls, emerging banks prevent the escape eastwards of the ebb from the Quoile estuary: thus this ebbing water is increasingly directed north to oppose the southward flow at station 3. At station 7, the averaged south-westward flow progressively turns south-eastward. Individual tidal records show that the direction often varies greatly between four and a half hours after and 6 hours after HW Belfast, indicating that it is under the contrary influences of one current running south-westwards round the east of Long Sheelah and of another running south-eastwards round the west of this bank; at the start of the ebb the former current predomimates at the station, but during the ebb it gradually looses its dominance to the latter current.

Between 5 and 4 hours before HW Belfast, tidal currents in the lough gradually slacken and reverse, except in the centre of the Narrows and in the eastern part of the southern basin, where southward intertidal flows persist until three and a half hours before HW Belfast.

IV Residual currents

The averaged residuals, summed over an M_2 cycle, are shown in figure 5.15.

At stations 2 to 5 and 9 to 11, the residual directions are very similiar to the directions of the currents running during the latter half of the flood. This indicates that the residuals at these stations are dominated by countercurrents driven by the inertia of the flood stream injected into the southern basin.

The generally northerly residual between Long Sheelah and Weedoo, shown at stations 7, 9 and 10 probably results from the inertial contribution to the flood stream mentioned in section 5.1. It is partly compensated for by a southerly residual in Ringhaddy Sound. It is also likely that close east of Islandmore, the residual flow will be southward.

The southerly residual at station 6 in Ringhaddy Sound is

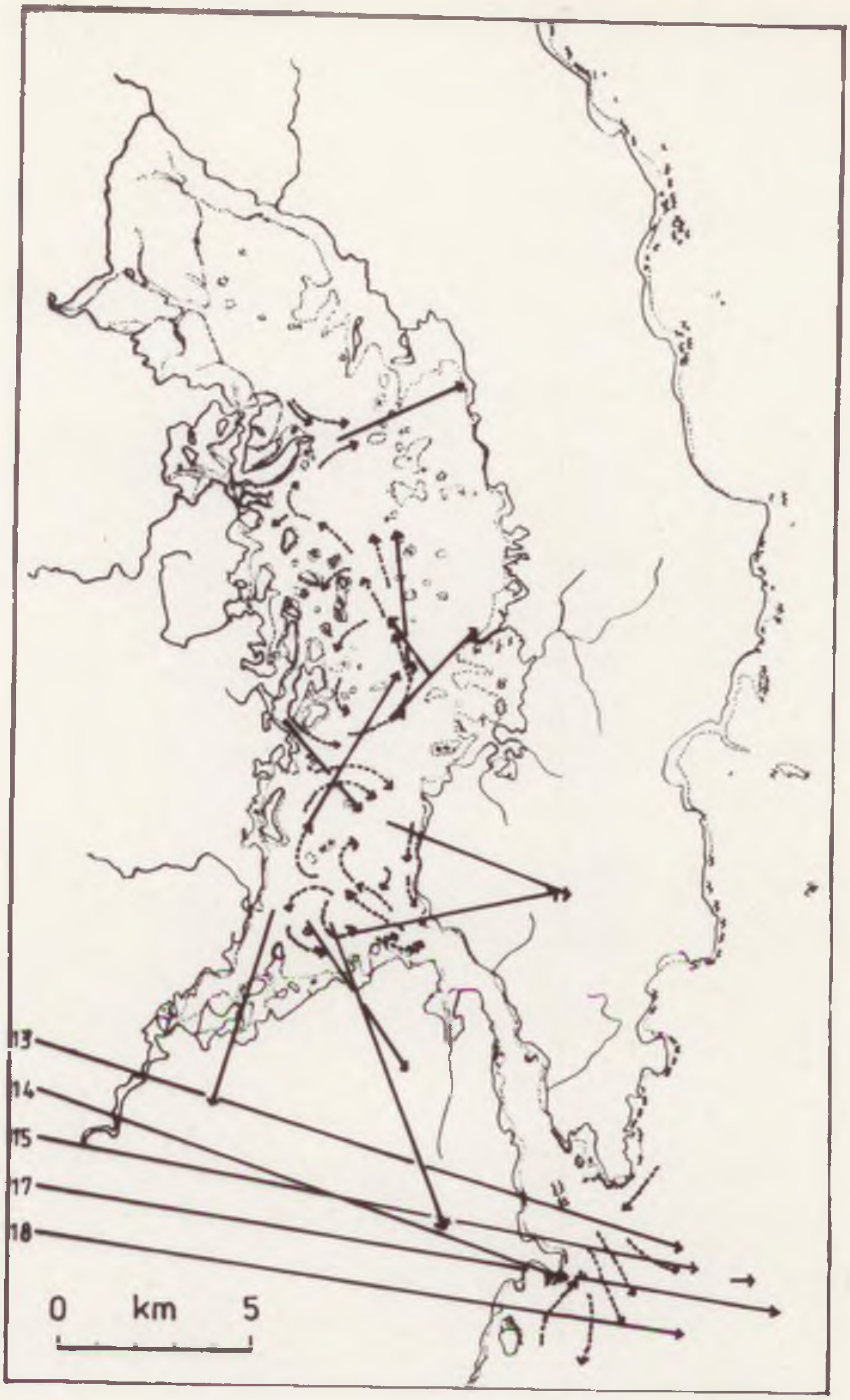


Figure 5.15. Tidal residuals in Strangford Lough. Thick, straight lines represent residual movement at each station. Dashed lines show likely direction of residuals in the rest of the lough. The positions of stations 13 to 18 are shown in figure 3.5.

MEAN SPRINGS

in the same direction as the ebb stream. This indicates that the flood stream in the centre of the lough drives a counter current tending to oppose the flood at station 6.

At stations 13 to 15 and 17 to 18, the residual directions are 0° to 5° north of the typical directions during the ebb.

The westerly component of the residual at station 9 may result from a nearby submarine spur projecting from the south-eastwards towards the meter, such that only 100 m south-east of the meter, the depth of the bottom was less than that of the meter; this is likely to deflect to to the north-west either the north-eastward flood stream or the south-westward ebb stream, or both. Where headlands project into a perpendicular tidal stream system, the residuals are invariably offshore (Pingree et al., 1978).

Similarly, at station 8, off Mahee Point, the east-north-easterly residual appears to be largely contributed by a current flowing north-east along the south-east coast of Mahee Island, and periodically affecting station 8 (see section 6.a.i.).

The east-south-easterly residual flow at station 12 is in the direction in which the water flows during the latter part of the flood and over local HW. As at stations 2, 3, 4, 5, 13, 14, 15, 17, and 18, the residual flow is also dominated by a counter current generated by the flood stream issuing from the Narrows.

V High-frequency oscillation of velocity

Superimposed on the dominent M_2 oscillation of velocity

TABLE 5.1

The most striking examples at each station of short oscillations in water velocity

Station	Period	Manifestation	Figures in which seen. Most striking examples underlined. Figures in brackets indicate first or second tide in figure.
2	60-80 min	easting - 2 to 3 peaks, late flood to HW	A1.2.1, A1.2.2
3	50-60 min	2-3 small peaks or troughs about HW - Easting	A1.3.2(2),A1.3.3(2)
4	50-60 min	easting - 3-4 sm. peaks, late flood to HW	A1.4.1(2),A1.4.2(2)
5	60-70 min	speed - 2-4 peaks or troughs about HW	A1.5.1 *1*
6		NONE	
7	40-70 min	easting - 4-5 peaks or troughs during ebb	A1.7.1,A1.7.2,A1.7.3 A1.7.4,A1.7.5(1) *2*
8	70-80 min	speed - 2-3 peaks during flood	A1.8.1(2),A1.8.2(2),A1.8.3(2)
		northing - 2-4 troughs during flood	A1.8.1(1),A1.8.2(2),A1.8.4, A1.8.5,A1.8.6,A1.8.7, A1.8.7,A1.8.8,A1.8.9
		easting - 2-6 peaks during flood and about HW	A1.8.1(1),A1.8.2(2),A1.8.3 A1.8.4,A1.8.5(1),A1.8.6, A1.8.7,A1.8.8,A1.8.9, A1.8.10,A1.8.11,A1.8.12
	c. 50 min	northing - up to 4 peaks during flood	A1.8.4,A1.8.7(2),A1.8.8, A1.8.9,A1.8.11 *3*
		easting - as above	A1.8.4,A1.8.9(2) *3*
		speed - as above	A1.8.4,A1.8.6,A1.8.7, A1.8.9(2) *3*
9	50-70 min	northing - late flood and late ebb up to 3 peaks ea.	A1.9.1,A1.9.2,A1.9.3(1), A1.9.4(2)
		easting - late flood and late ebb, up to 4 peaks ea.	A1.9.1,A1.9.2,A1.9.3(2), A1.9.4(1),A1.9.6(2) (80 min)
		direction - late flood and late ebb up to 3 peaks	A1.9.1
		speed - late flood, 3 peaks	A1.9.2(1)

TABLE 5.1 (cont.)

Station	Period	Manifestation	Figures in which seen
10	70-80 min	easting - flood	A1.10.1(1),A1.10.2,A1.10.3(1) A1.10.5,A1.10.6,A1.10.7 *5* A1.10.8
		direction - flood	A1.10.1(1),A1.10.5,A1.10.6, A1.10.7 *4*,A1.10.8,A1.10.9
		northing - flood	A1.10.3,A1.10.4,A1.10.5, A1.10.6,A1.10.7,A1.10.8
		speed - flood	A1.10.3
	60 min	northing - flood	A1.10.1,A1.10.3
		speed - flood	A1.10.2,A1.10.3
		temperature -	A1.10.2 *5*
11	70-80 min	northing - flood and ebb	A1.11.1,A1.11.2(1),A1.11.3, A1.11.4,A1.11.5,A1.11.6, A1.11.8,A1.11.9(1)
		easting - flood and ebb	A1.11.1(ebb 2),A1.11.2 A1.11.3(2),A1.11.5(flood), A1.11.6 *6*,A1.11.8(2), A1.11.10(1)
		direction- flood and ebb	A1.11.1(ebb 2),A1.11.5 (fl. 2), A1.11.6(1) *6*
12	70-80 min	northing - late flood	A1.12.1,A1.12.2
		easting - flood and over HW	A1.12.1,A1.12.2
		speed	A1.12.1,A1.12.2
13	60-75 min (also rather variable)	easting and speed - during flood	A1.13.2(2),A1.13.3,A1.13.4, A1.13.5(1),A1.13.7(1), A1.13.8(1),A1.13.9,A1.13.11, A1.13.12,A1.13.13,A1.13.14(2), A1.13.15,A1.13.16,A1.13.17, A1.13.18(1),A1.13.19(2)
14	c. 60-75 min	northing - during flood	A1.14.1(1)
15	c. 60 min	northing - during flood	A1.15.1(1),A1.15.2(2),A1.15.3
17	c. 50-60 min	northing - during flood	A1.17.1

TABLE 5.1 (cont.)

Station	Period	Manifestation	Figures in which seen
18	c. 50-60 min	northing - flood	A1.18.1,A1.18.3(1),A1.18.5(2)
		easting - flood	A1.18.3,A1.18.4(1),A1.18.5(2)
		speed - flood	A1.18.3,A1.18.5(2)
		direction - flood	A1.18.3,A1.18.4(1)
	c. 30-40 min	northing - flood and over HW	A1.18.1,A1.18.2,A1.18.3, A1.18.4,A1.15.5(2),A1.18.6, A1.18.7
		easting - flood	A1.18.1,A1.18.2(1),A1.18.3(2), A1.18.4,A1.18.6,A1.18.7
		speed - flood	A1.18.2(1),A1.18.3,A1.18.5(2), A1.18.6,A1.18.7
		direction - flood	A1.18.4,A1.18.6,A1.18.7

Notes: *1* - Peaks do not show up clearly in vectors because of a general, high variability in direction.

2 - Shorter period oscillation or turbulence imposed, especially in figure A1.7.4 (both tides).

3 - In figures A1.8.4 and A1.8.7, superimposed on a 70 to 80 min periodicity.

4 - Also during the ebb.

5 - Temperature peaks asscoiated in peaks of northing and speed

6 - Period 50-60 min

are oscillations of periods of about 50 to 80 min. To different degrees, such oscillations are present at all stations. They are manifest in the time-series graphs (Appendix 1) of easting, northing, direction and speed, but vary from tide to tide. For each station the most striking examples of these short oscillations at each station are mentioned in Table 5.1.

For most stations, such short oscillations are manifest primarily during flood and over local HW, except at station 7 where they occur during the ebb, and at station 11 where they occur during both the flood and the ebb.

VI Averaged progressive vector diagrams

Progressive vector diagrams for an M_2 tidal cycle, averaged over a number of cycles, and corrected to mean springs, are shown in figures 5.16 to 5.31.

VII Mean and maximum current speeds

Table 5.2 shows the mean and maximum current speeds over a ten-minute sampling interval for each station; they are corrected to mean springs.

VIII Temperature and salinity

Data on temperature and computed salinity are shown in Appendix 1, both in time-series and plotted against each other over M_2 cycles.

The temperature generally bears a positive relationship

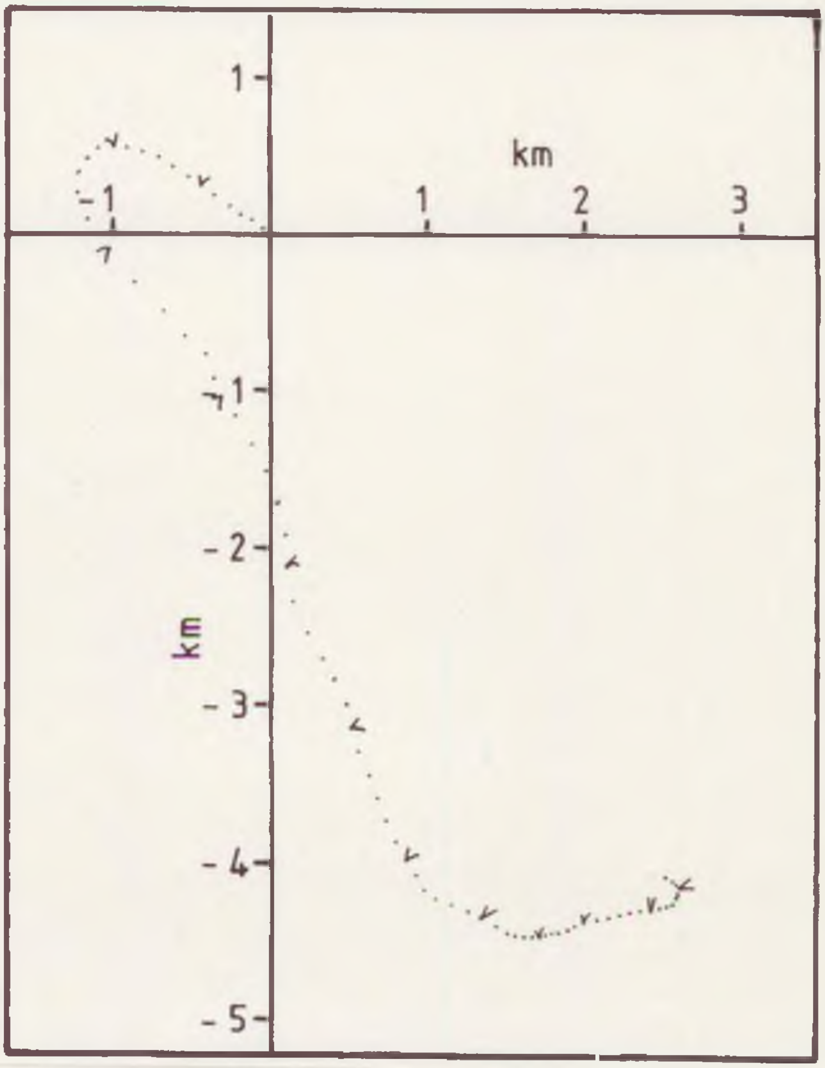


Figure 5.16. Station 2. Mean progressive vector diagram.. (Corrected to mean spring tides.)

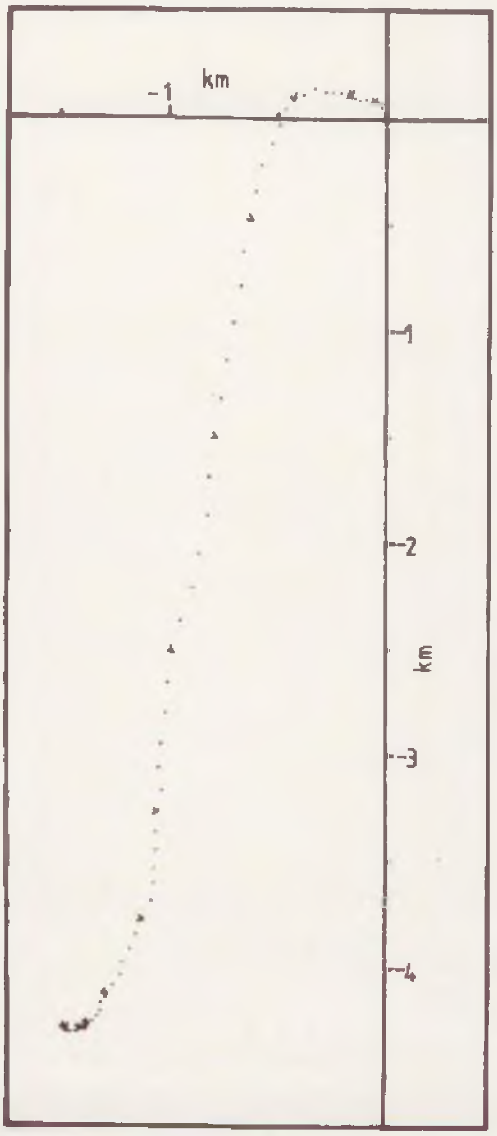


Figure 5.17 Station 3. Mean progressive vector diagram.

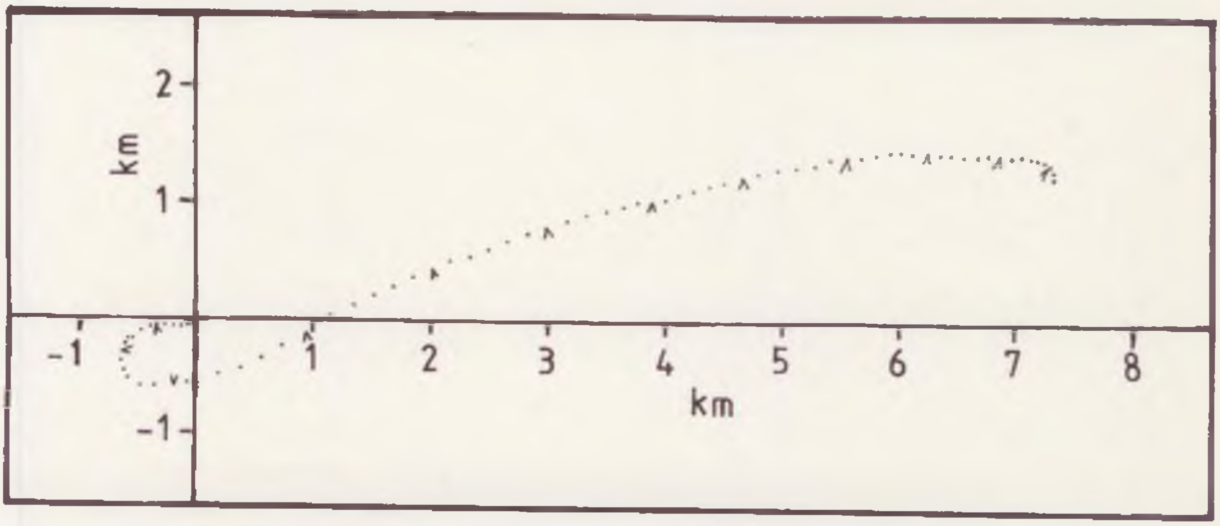


Figure 5.18. Station 4. Mean progressive vector diagram.

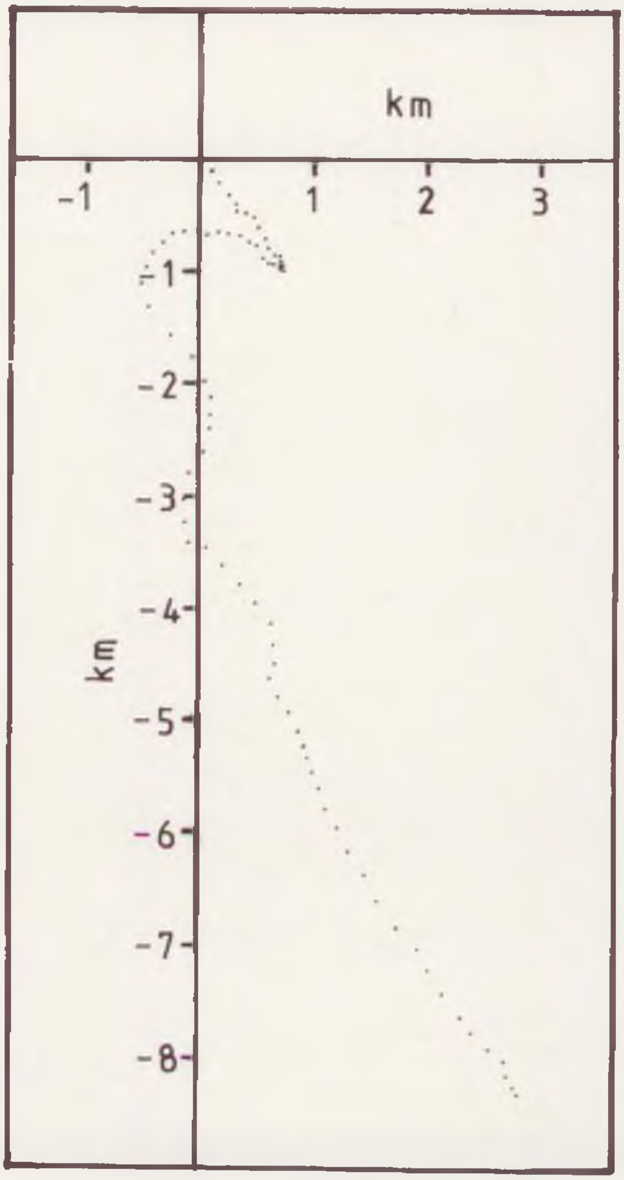


Figure 5.19. Station 5. Mean progressive vector diagram.

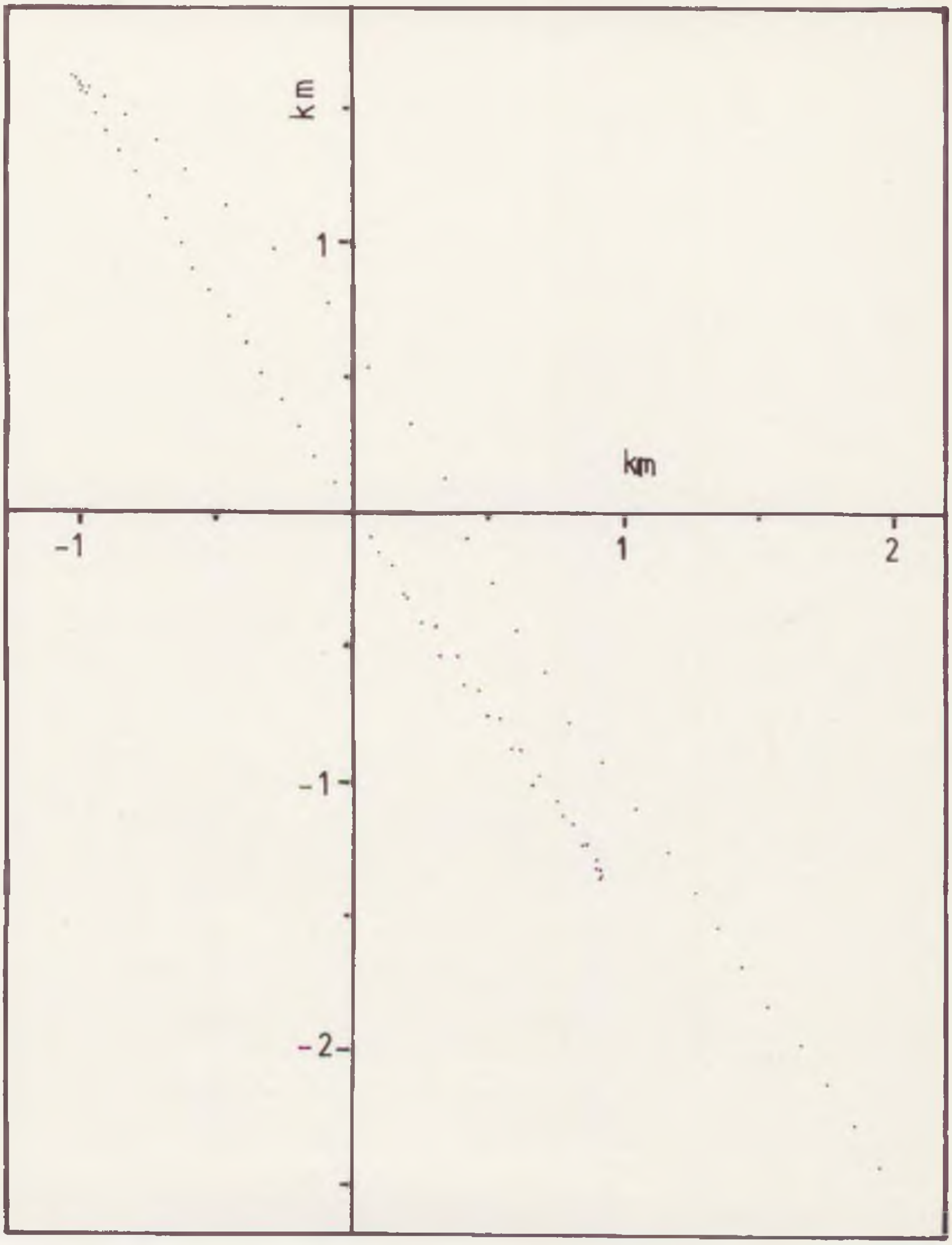


Figure 5.20. Station 6. Mean progressive vector diagram.

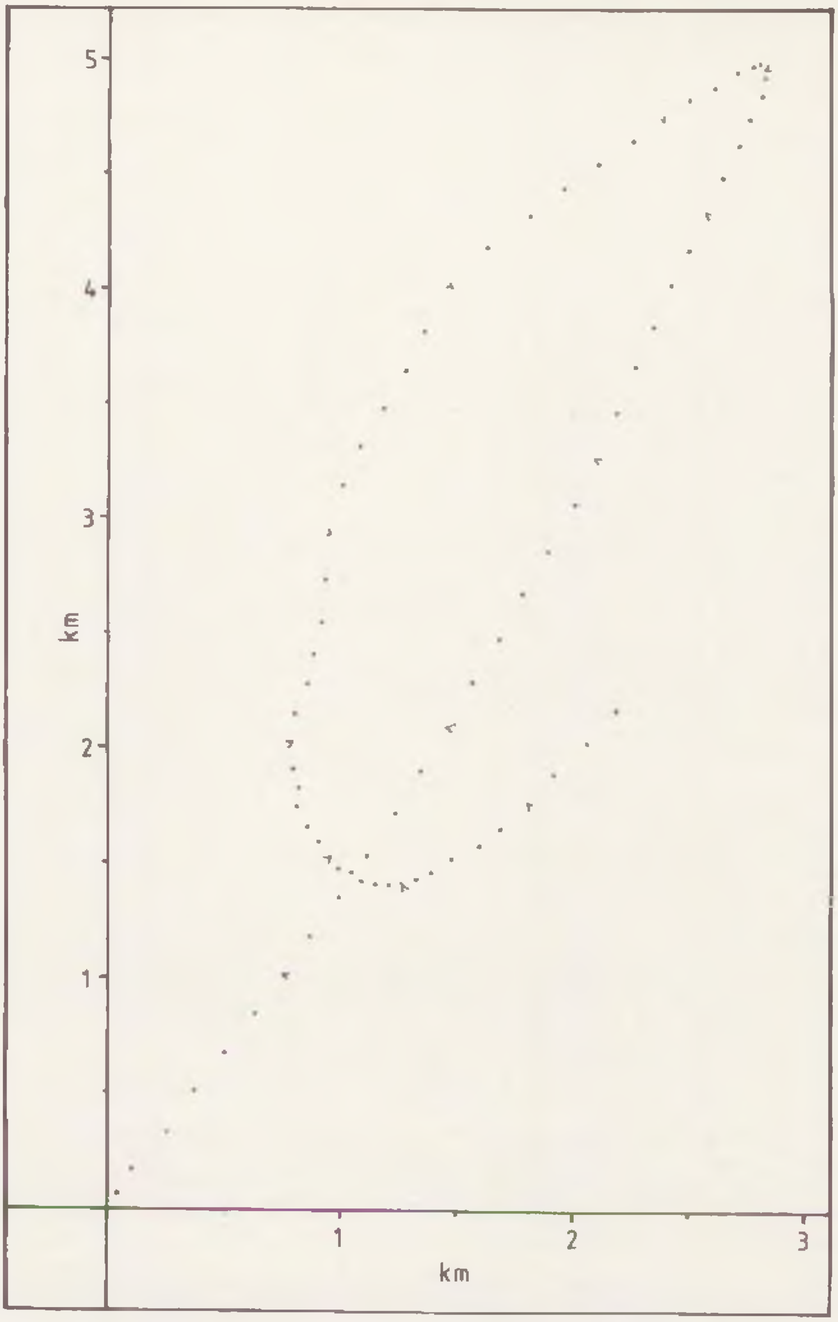


Figure 5.21. Station 7. Mean progressive vector diagram.

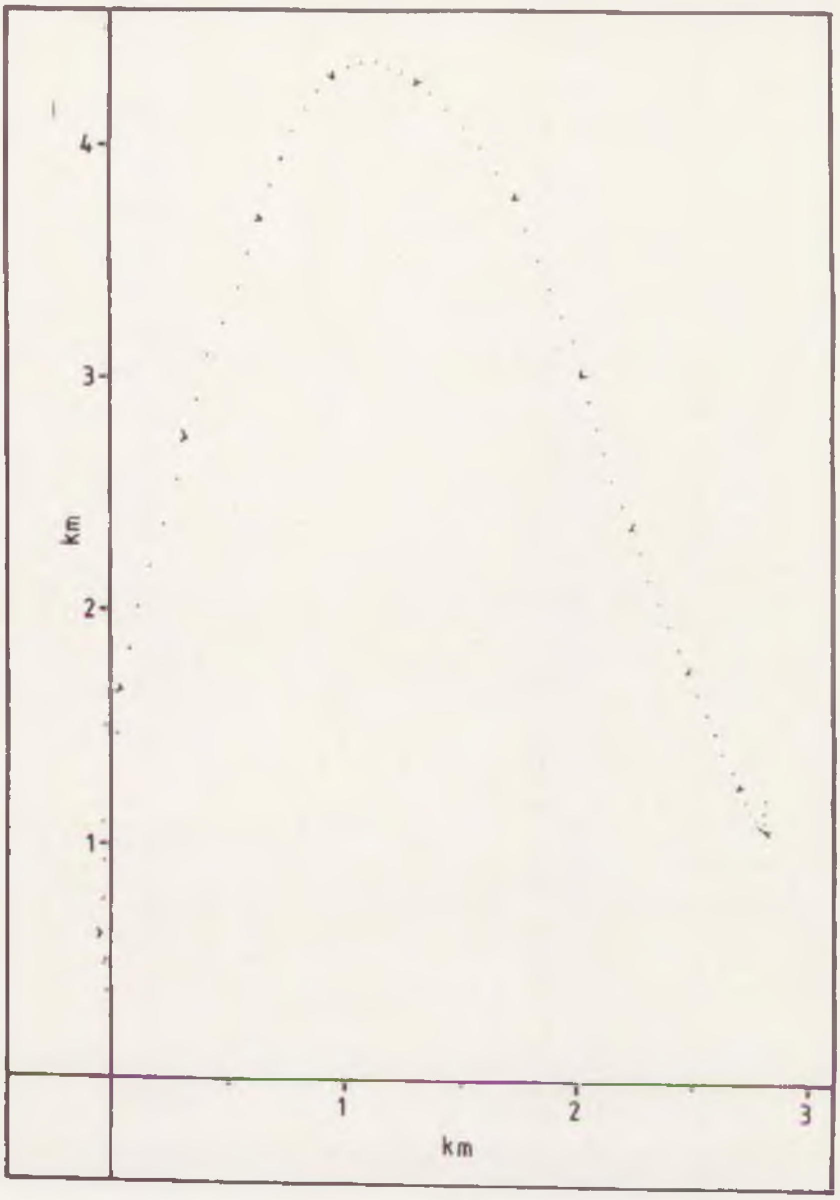


Figure 5.22. Station 8. Mean progressive vector diagram.

22

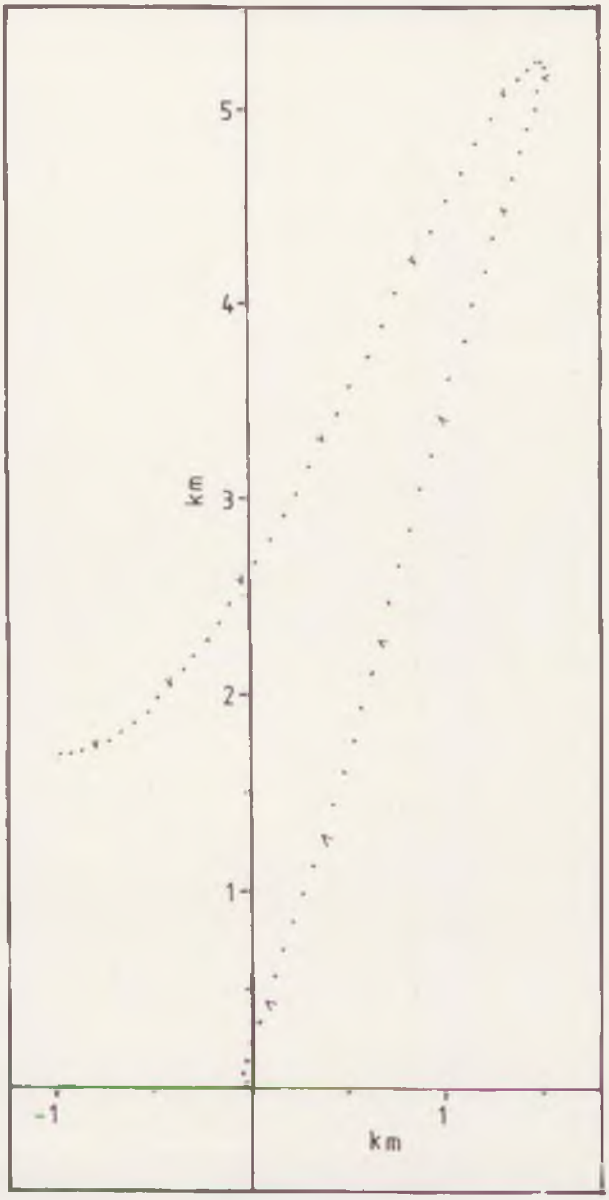


Figure 5.23. Station 9. Mean progressive vector diagram.

23

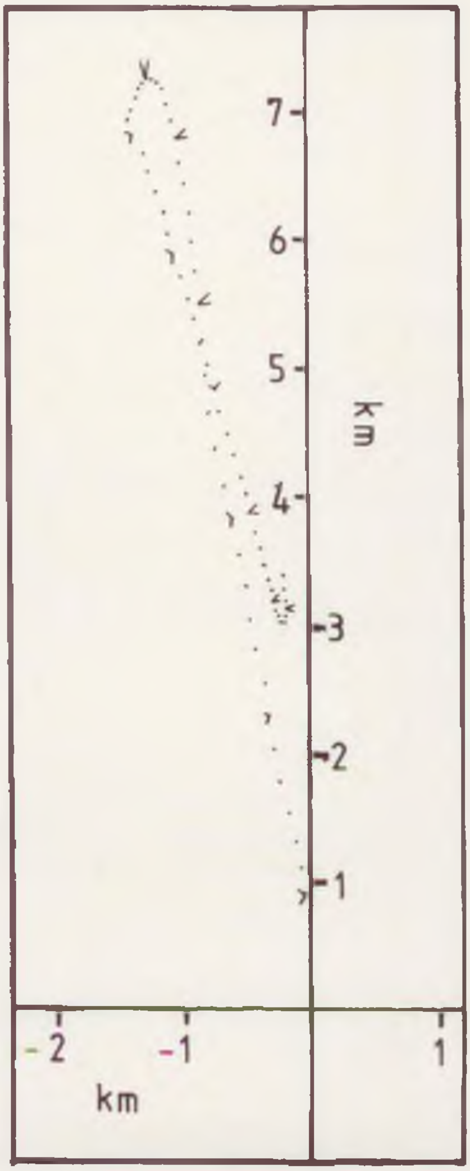


Figure 5.24. Station 10. Mean progressive vector diagram.

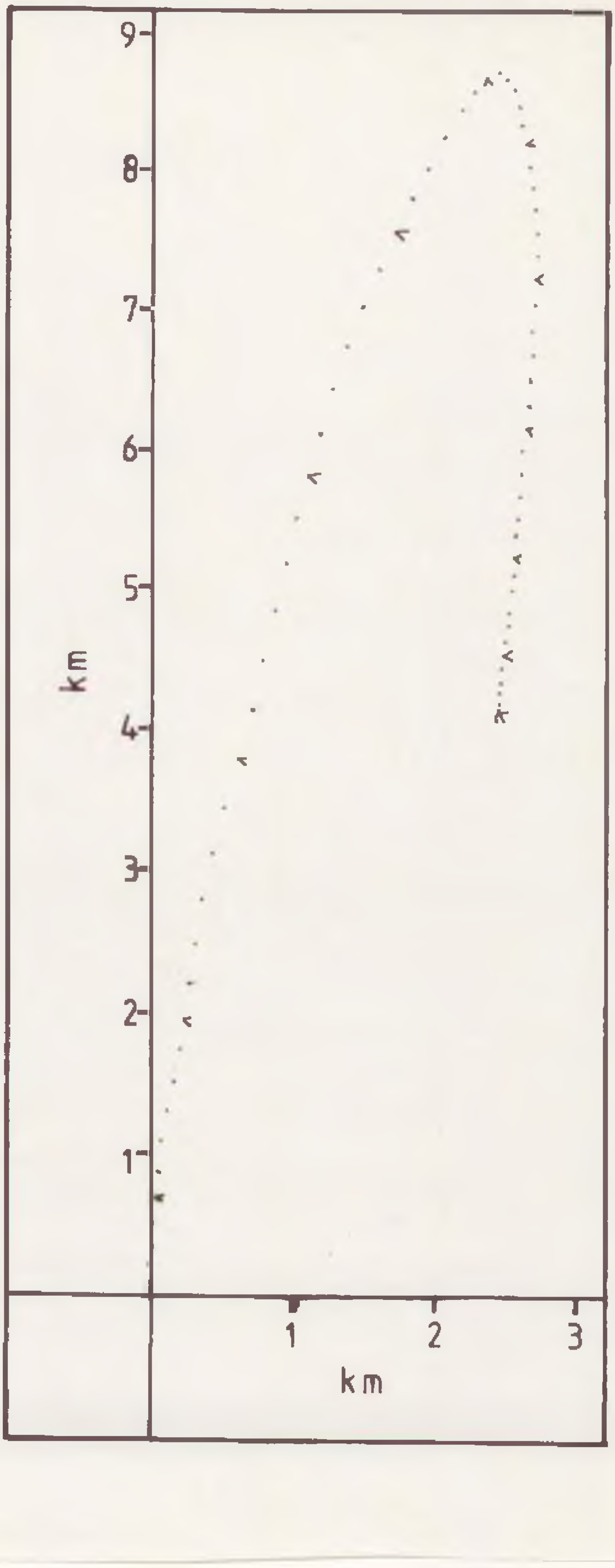


Figure 5.25. Station 11. Mean progressive vector diagram.

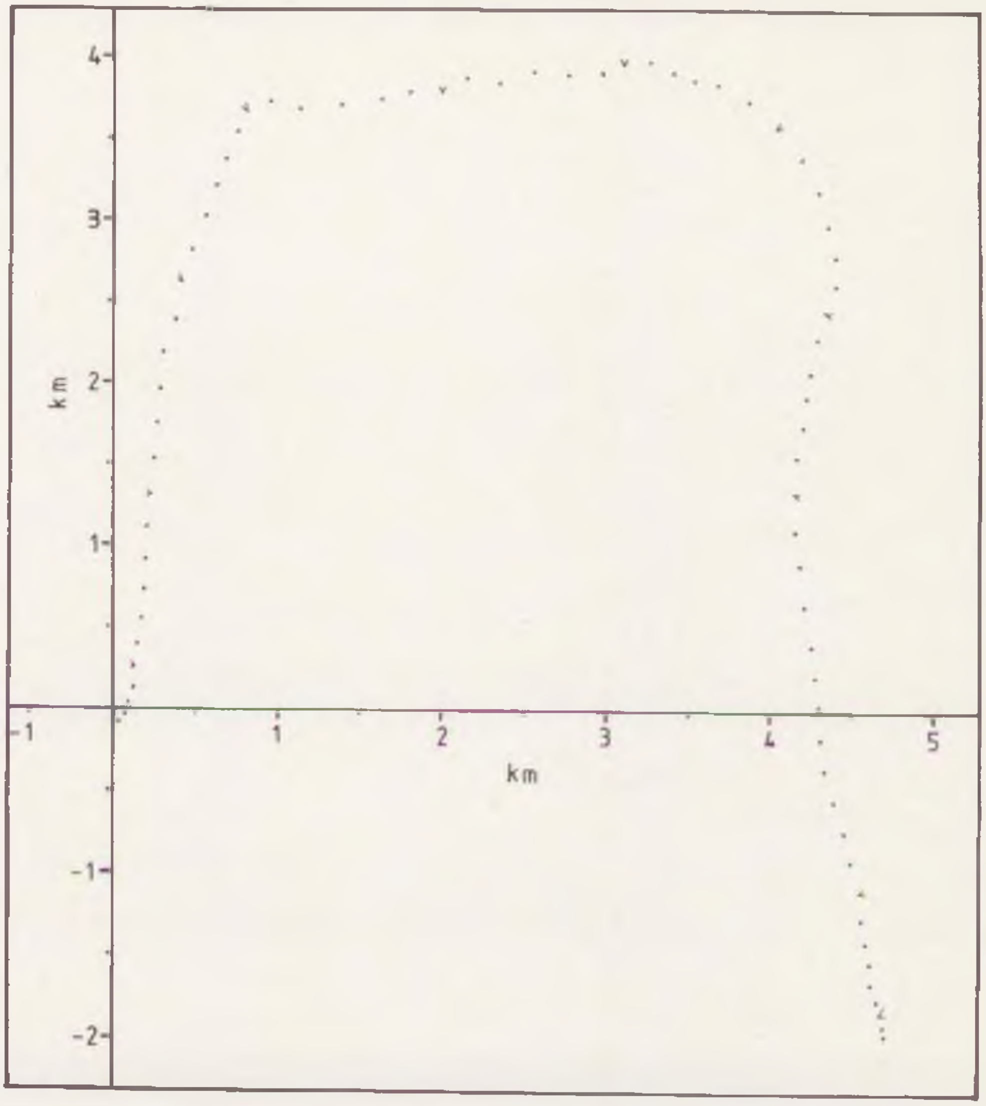


Figure 5.26. Station 12. Mean progressive vector diagram.

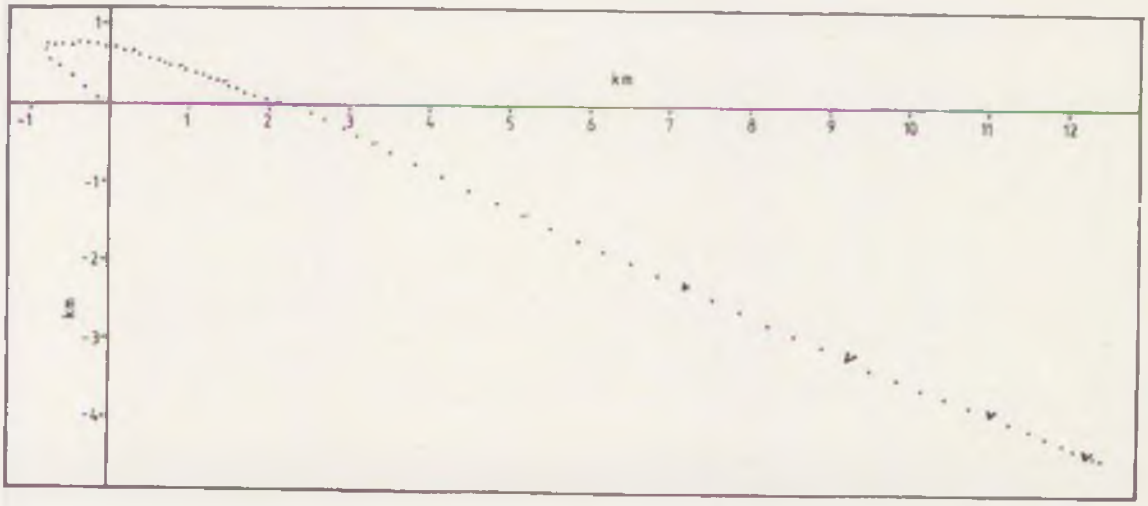


Figure 5.27. Station 13. Mean progressive vector diagram.

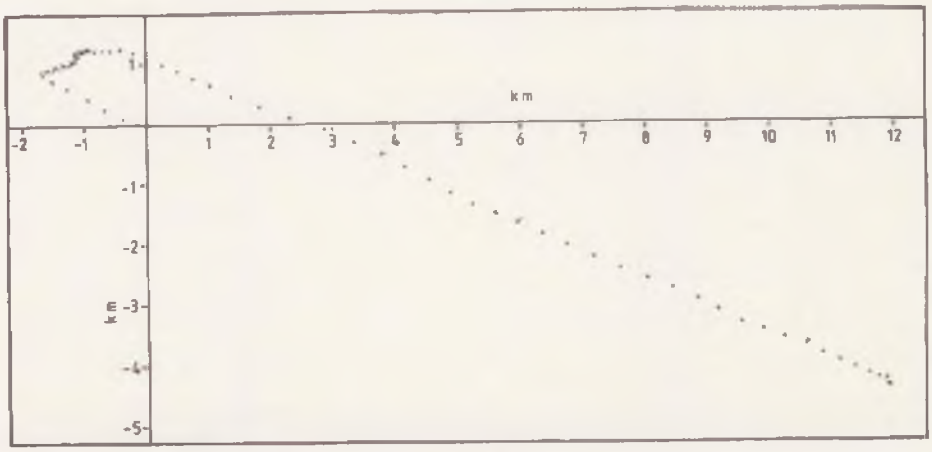


Figure 5.28. Station 14. Mean progressive vector diagram.

5.28

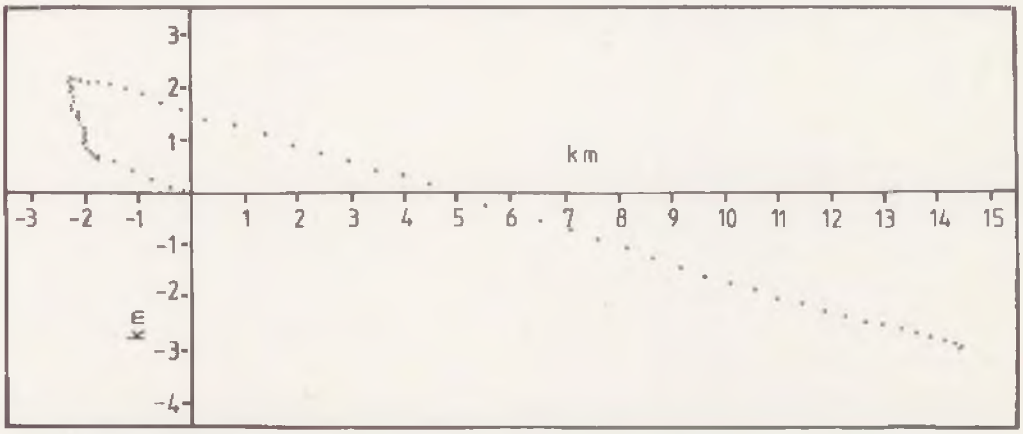


Figure 5.29. Station 15. Mean progressive vector diagram.

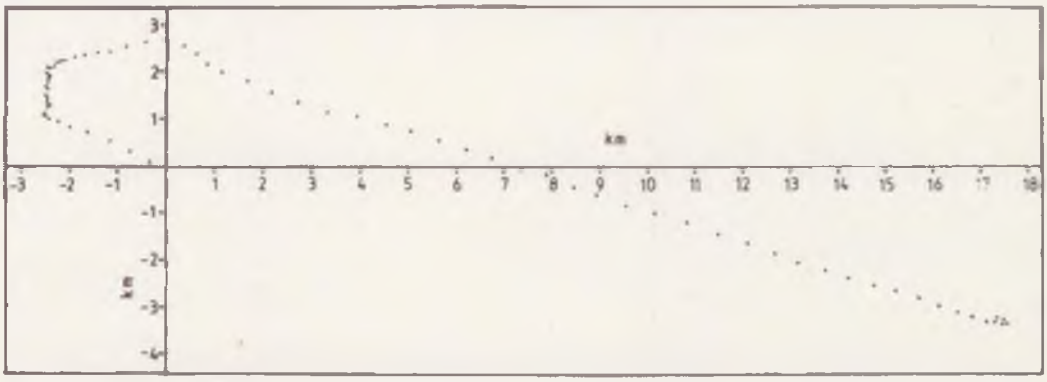


Figure 5.30. Station 17. Mean progressive vector diagram.

5.30

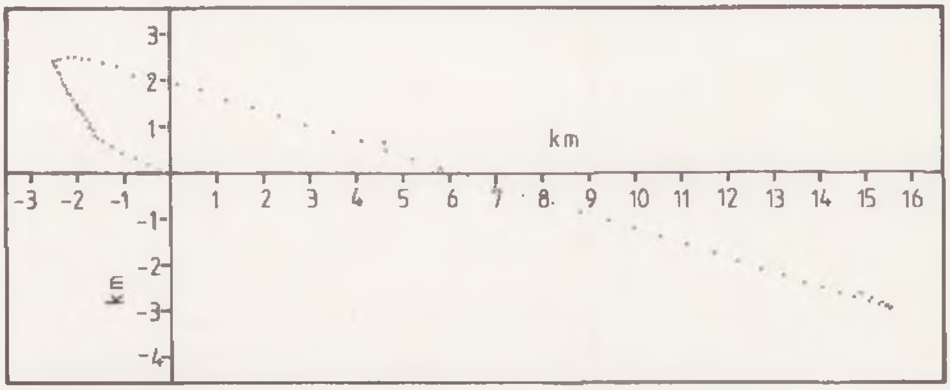


Figure 5.31. Station 18. Mean progressive vector diagram.

TABLE 5.2

Residual excursion, mean speed and maximum speed expected at Mean Spring Tides (Strangford range 3.2 m; Belfast range 3.1 m)

Station	RE		$\bar{S}$	S_{max}	$\frac{S_{max}}{\bar{S}}$	No. tides
	N	E				
2	-4.0	2.5	0.20	0.49	2.5	5
3	-4.8	-1.7	0.15	0.47	3.2	6
4	1.4	-7.9	0.24	0.48	2.1	5
5	-7.7	2.6	0.24	0.44	1.9	1
6	-2.3	1.9	0.22	0.45	2.1	1
7	2.2	2.2	0.29	0.61	2.1	10
8	1.4	3.1	0.23	0.55	2.4	24
9	1.6	0.9	0.21	0.40	1.9	12
10	3.3	-0.2	0.27	0.54	2.0	12
11	4.3	2.5	0.33	0.77	2.3	11
12	-1.8	4.3	0.27	0.47	1.8	3
13	-5.7	16.2	0.46	0.98	2.1	13
14	-4.8	13.1	0.43	0.97	2.2	2
15	-3.5	16.9	0.58	1.27	2.2	3
16	-	-	0.26*	0.60*	2.3	3
17	-3.2	17.3	0.59	1.20	2.0	2
18	-3.5	19.8	0.61	1.48	2.4	14

* - Possibly underestimates, as current meter mooring tangled.

Taking the ranges of tide given (Hydrographer of the Navy, 1980) for mean springs and mean neaps for Strangford and Belfast, and assuming a linear relationship between the ranges at the two ports, then

$$R_S = 0.617 + 0.8333 \cdot R_B$$

where R_B is the range at Strangford, and R_B is the range at Belfast (in metres). Thus, for neap tides, multiply RE, $\bar{S}$ and S_{max} by 0.6875.

Abbreviations: RE - residual excursion
$\bar{S}$ - mean speed
S_{max} - maximum speed

Units: RE - km
$\bar{S}$, S_{max} - m s^{-1}

to salinity in late spring and summer, and a negative one in late autumn and winter. Unseasonable air temperature, however, may temporarily suppress or reverse these relationships. One such reversal may be seen between the two T/S diagrams in figure A1.8.4, where an unseasonably cold night (-1.5°C.) occured on 8/9 April.

Over a tidal cycle, temperature seldom varied by more than 0.8°C. However, greater differences occurred at station 11, from 22 to 25 May, where the temperature varied constantly by more than 1.0°C over a tidal cycle. This coincided with a period of weather about 2°C warmer than during the previous two weeks.

At many stations, peaks or troughs occur on the temperature trace more or less consistantly at the same state of the tide, superimposed on a quasi-sinusoidal curve. Corresponding peaks or troughs in salinity are also apparent in some cases.

If allowance is made for "noise" in the salinity data, tidal variation of salinity rarely exceeded 0.3. No clear short-term effect of rainfall could be detected. However, at station 6, a tidal salinity range of 0.3 is replicated over the two successive tides during which the meter was deployed at this station. A greater tidal range of 0.6, indicated at station 8 on 4 April, just after the meter had been deployed, may have been caused by instrument drift, as there were no records of particularly high rainfall in the days and weeks before this date. Because the current meter obtained data at different stations at different times of the year, the annual variation in temperature and salinity cannot be determined from these data. However, The annual range of temperature and salinity in the Narrows is reported for 1973/1974 in section 5.b.i.

b) THE PLANKTON AND NUTRIENT SURVEY

i) Physical and chemical variables

I Temperature

The distribution of temperature as taken at the plankton and nutrient stations is shown in figure 5.32. Temperatures ranged from 14.0°C in August (station 2.2) to 7.0°C in January and February (stations 10.2, 11.1 and 11.2). The generally rightward slant of the isotherms indicates that temperature behaves more conservatively in the Irish sea than it does in Strangford Lough. This confirms the similiar relationships evident from the current meter data.

II Salinity

Figure 5.17 represents the spatial and temporal salinity as measured or during the plankton survey. In view of the considerable patchiness indicated by the current meter data, both spatially (vertically in the figure) and temporally (horizontally), the isohalines should be regarded as only schematic.

Considerable freshwater influence, resulting in salinity reductions of up to 0.7 or 0.8, is indicated in the lough during January (cruise 10), February (cruise 11) and to a small extent in March (cruises 12 and 13) of 1974. At other times of the year the influence of freshwater on salinity in Strangford Lough was small.

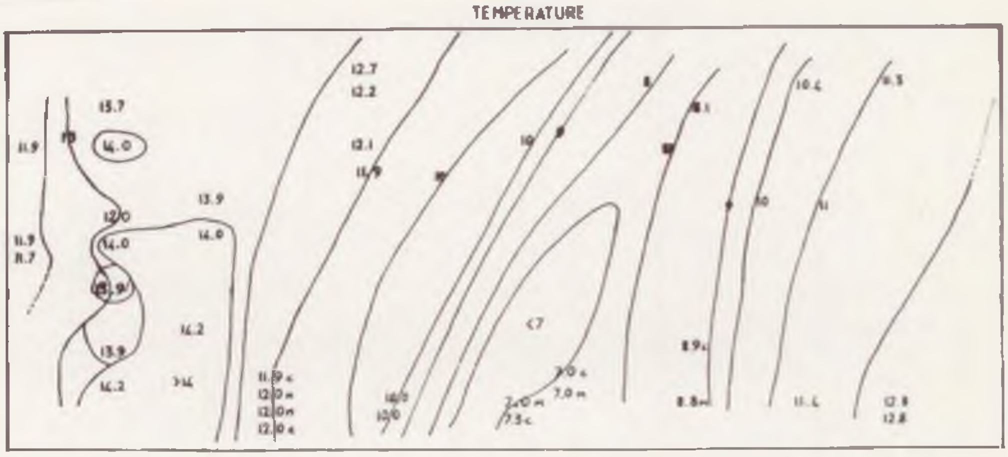


Figure 5.32. Temperature in the Narrows during 1973-1974. Spatio-temporal distribution of points as in figure 3.6.

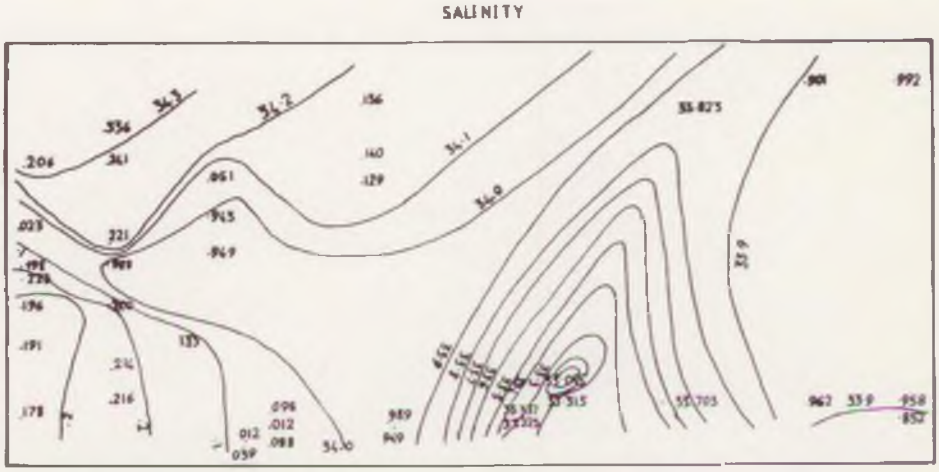


Figure 5.33. Salinity in the Narrows during 1973-1974.

5.33

Superimposed on the annual variation of salinity appears to be a long-term reduction in salinity in the Irish sea from around 34.2 or 34.3 in summer 1973 to 34.0 in summer 1974. Such long-term variations in the salinity of parts of the Irish Sea are well documented (Slinn, 1974).

III Water clarity

The spatial and temporal variation of water clarity, expressed as Secchi disc readings, are shown in figure 5.34. The Secchi disc depth varied from 1.4 m in January (station 10.1) to 12 m in July (Station 15.3). Water clarity was greatest in the summer and least in the winter, and in general it was higher in the Irish Sea than it was in Strangford Lough waters. The highest Secchi disc reading also coincided with the sample containing the largest biomass of nano- and micro-plankton. Thus it is indicated that water clarity was determined not by biological factors but by sediment content.

IV Dissolved inorganic phosphate.

The distribution of dissolved inorganic phosphate is shown in figure 5.19. Concentration ranged from 0.21 mmol m^{-3} in August (station 2.1) to 1.01 mmol m^{-3} in April (station 13.1).

Despite a gap in stations to seaward of the Narrows in winter, it still appears that the annual variation in phosphate concentrations is far greater to seaward of the Narrows than it is in the lough. In winter, values increase seawards, but in summer, if anything, they tend to decrease seawards.

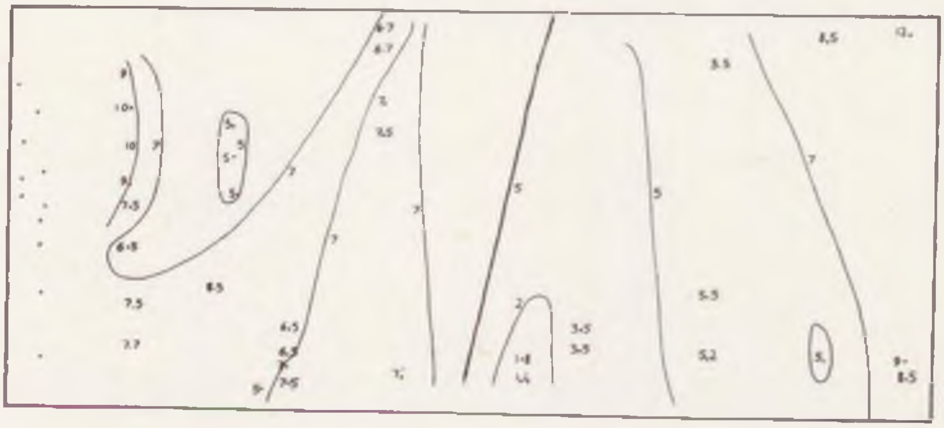


Figure 5.34. Water clarity, as Secchi disc reading (m) in the Narrows during 1973-1974.

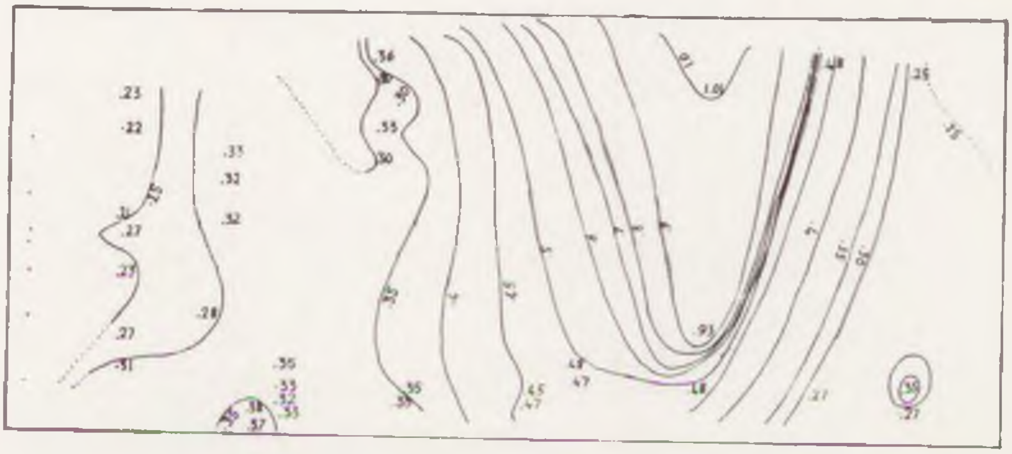


Figure 5.35. Dissolved inorganic phosphate (mmol m⁻³) during 1973-1974

V Dissolved inorganic nitrate and nitrite.

The distribution of dissolved inorganic nitrate is shown in figure 5.36. Concentrations varied from 0.26 mmol m^{-3} in July (station 15.1) to 12.44 mmol m^{-3} at the end of January (station 10.1).

The nitrate maximum occurred earlier in the year than that for phosphate. However, the lack of seaward stations during the winter does not allow us to say whether the high winter concentrations in the inshore waters of the Narrows were reflected by similar concentrations at their seaward waters.

The distribution of dissolved nitrite is shown in figure 5.37. It varied from 0.003 mmol m^{-3} in July (station 15.2) to 0.381 mmol m^{-3} in August (station 2.4)

Figure 5.38 shows the distribution of nitrite, expressed as a percentage of the combined concentrations of nitrate and nitrite.

There is a well-marked tendancy towards percentages of 3 or less from early December to mid-April, rising to more variable and generally higher percentages of 1 to 20 in summer (July to September).

VI Dissolved Silicate.

The distribution of dissolved silicate is shown in figure 5.39. Concentrations vary from 52 mmol m^{-3} in late January (station 10.1) to 1.0 mmol m^{-3}in July (station 15.1). Isopleths have not been included in this figure as the data are not suitable: they suggest considerable small-scale

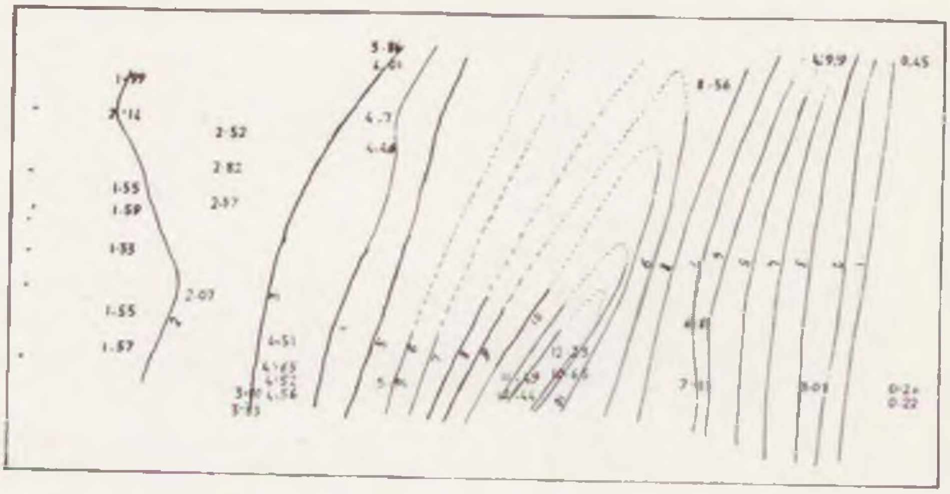


Figure 5.36. Dissolved nitrate (mmol m^{-3}) in the Narrows during 1973-1974.

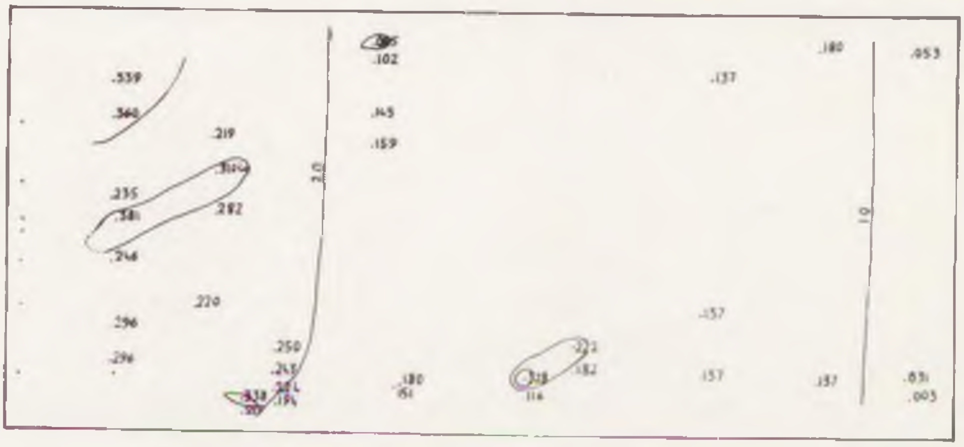


Figure 5.37. Dissolved nitrite (mmol m^{-3}) in the Narrows during 1973-1974.

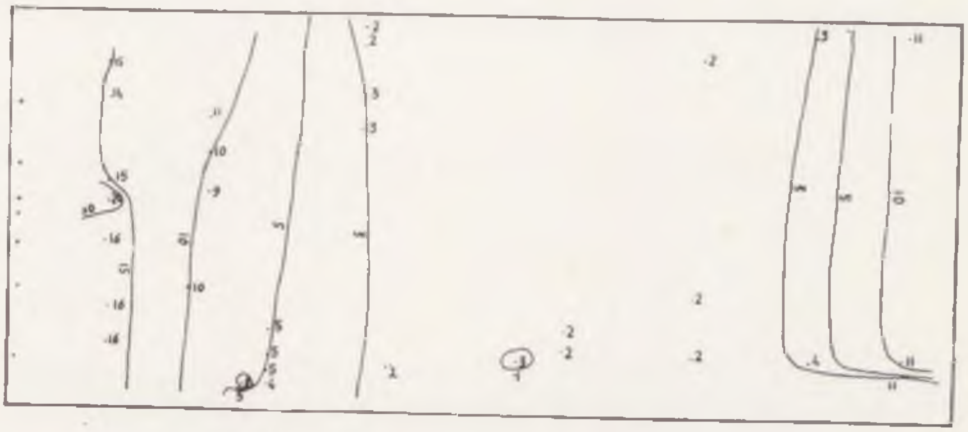


Figure 5.38. Dissolved nitrite expressed as a percentage of combined nitrite and nitrate in the Narrows during 1973-1974.

38

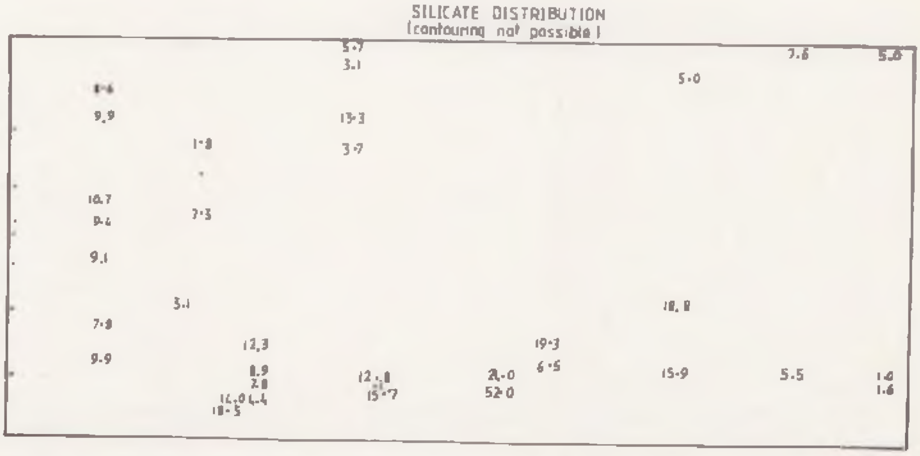


Figure 5.39. Dissolved silicate in the Narrows during 1973-1974.

variation over time. Nevertheless, values do tend to be highest in the winter and the two lowest values occurred in July (cruise 15) when nitrate and nitrite levels were also extremely low.

ii) Phosphate/sediment dynamics experiment

The results of the first experiment are shown in figure 5.40. It appears from this figure that there is a short term phosphate release by the sediment activity over a time span of 1 to 2 min. and a longer term release of phosphate acting over 100 or more hours. The equilibrium concentration for the long-term effect appeared to be about 1.0 mmol m^{-3}.

In the control beaker, after remaining constant at 0.7 mmol m^{-3} for the first 8 h or so, the phosphate concentration fell over the next 50 h to 0.2 or 0.3 mmol m^{-3}, and values remained at this level for the following 200 h.

The results of the second experiment are shown in figure 5.41. In all four beakers, inorganic phosphate levels, although curiously different at first by 1.0 mmol m^{-3}, settled within 4 min. to about 1.2 to 1.7 mmol m^{-3}. At 0.5 h after the start, phosphate concentration in the poisoned sample without sediment began to decline. The other three beakers showed unexplained peaks of concentration between 4 and 5 h after the start.

In both unpoisoned and poisoned beakers, concentration fell faster between 5 and 7 h than it did in the beakers with added sediment.

Although the second experiment did not continue long enough to demonstrate a long-term equilibrium concentration of inorganic phosphate, the results are compatible with the indication shown by the first experiment of long-term

40

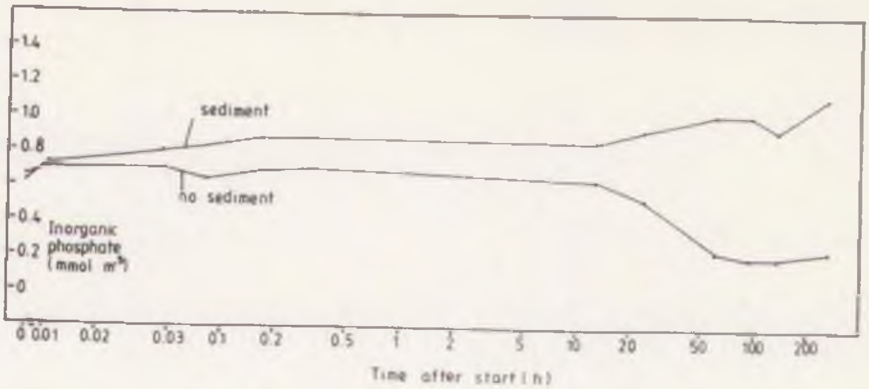


Figure 5.40. Concentration of dissolved inorganic phosphatein the water during the course of the first water/-sediment phosphate dynamics experiment.

41

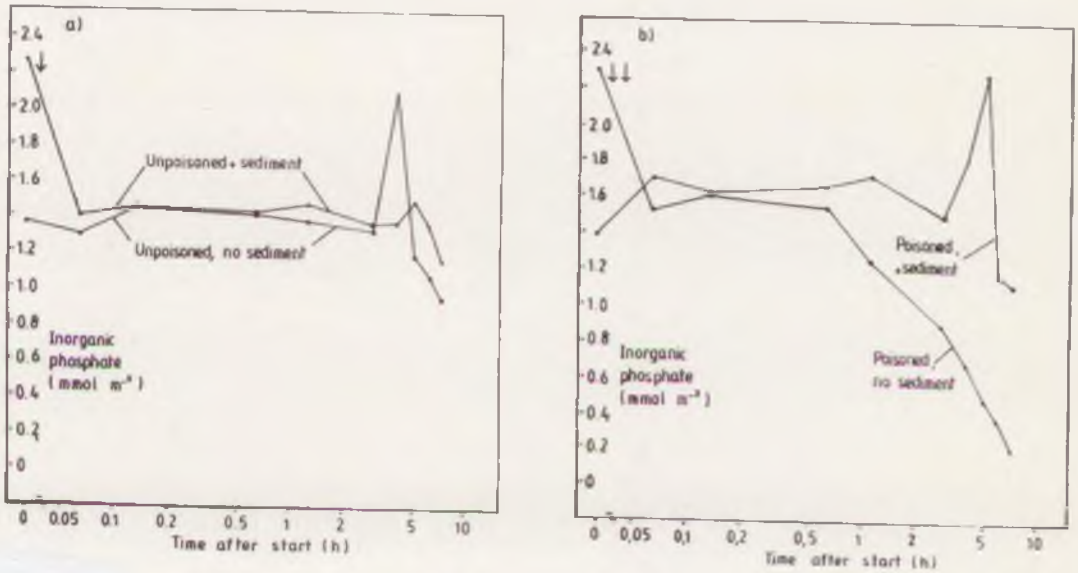


Figure 5.41. Concentration of phosphate during the second phosphate dynamics experiment. a) unpoisoned, b) poisoned.

seawater/sediment equilibrium values of about 1.0 mmol m^{-3}.

The broadly similar reactions of poisoned and unpoisoned sediment/seawater systems indicate that their phosphate dynamics were mediated by non-biological mechanisms.

Had the peaks of concentration occurred in the first experiment between 4 and 5 hours after the start, as they did in three out of four beakers in the second, the sampling regime would have left them undetected.

Discussion of these results is included in section 6.b.ii.

iii) The net plankton

The settled volume of net plankton is shown in figure 5.42. The settled volume of net plankton varied by a factor of 79, from50 x 10^{-9} in February (station 10.1) to 3960 x 10^{-9} in July 1973 (station 1.2). There appeared to be a general tendancy to higher values in the more offshore waters.

The volumes of net plankton were much higher in July 1973 than in July 1974. This may have been associated with the occurrence of *Pleurobrachia pileus* Muller in samples from the latter date.

The dominant organisms in the net plankton samples are given in Table 5.3.

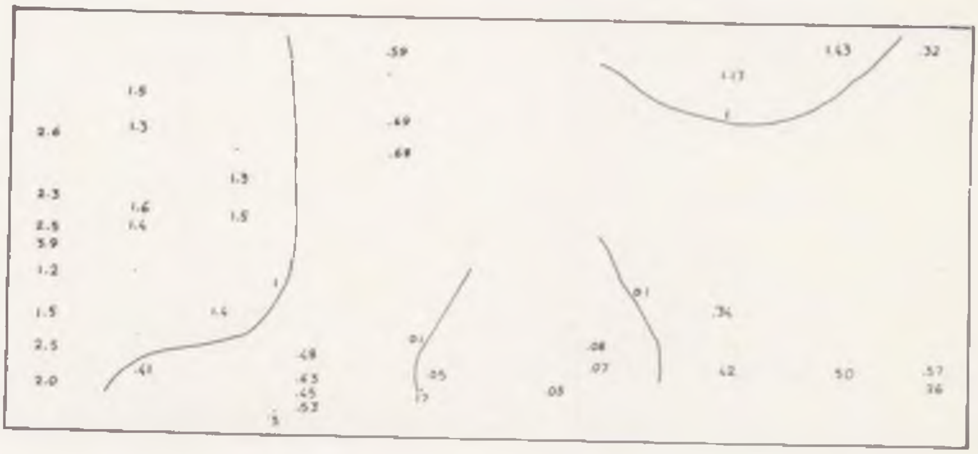


Figure 5.42 a..The settled volume of net plankton (unit volume x10^{-6}) in the Narrows during 1973-1974.

TABLE 5.3

The dominant organisms in the net samples, in terms of subjectively determined volume

Station	Taxa
1.1	A.c., Ps.el.
1.2	A.c., Ps.el.
1.3	Ps.el., A.c., O.s.
1.4	-
1.5	Cal.hel., Cal.fin., Ps.el.
1.6	-
1.7	A.c., Ps.el., O.s.
1.8	-
2.1	Cal.(j), A.c., Ps.el., O.s.
2.2	Cal.(mostly j), O.s., A.c.
2.3	Euphausiid larvae ?
2.4	Cal.(mostly j), A.c.
2.5	-
2.6	Cal.fin., O.s.
2.7	-
3.1	Cal. (mostly j), Decapod metanauplii
4.1	Cal. (mostly j), A.c., O.s., Decapod metanauplii
4.2	Cal., sm.cop., Sag., fish larv.
4.3	Cal., sm. cop., Sag.
5.2	Ps.el., Cal.(j), O.s., Sag.
6.1	sm.cop., Cal., Sag.
6.3	Sag., Cal., sm.cop.
6.4	Sag., sm.cop., Cal.
7.1	Sag., sm.cop., Cal.
7.2	Cal., Sag., O.s., fish larv.
7.4	-
9.1	Sag., Cal., sm.cop.
10.1	hardly anything - 1 fish larv., Cal., diatoms, Sag.
11.1	Cal.(j), Sag., fish larv., Tom., diatoms
11.2	Sag., medusae, Cal., Tom.

TABLE 5.3 (CONT.)

Station	Taxa
12.1	-
12.2	Barnacle nauplii, Cal., Sag., diatoms, *Limacina*
13.1	Barnacle nauplii, Cal., O.s., Ps.el., Sag
14.1	sm. cop., dec. larv., fish larv.
15.1	small *Pleurobrachia pileus*, dec. larv.
15.2	small *Pleurobrachia pileus*, dec ,larv., sm.cop.
15.3	Pleuro., sm. cop., dec larv., Cal., Sag.

Abbreviations:

A.c.	*Acartia clausi*
Cal.	*Calanus*
Cal.fin.	*Calanus finmarchicus*
Cal.hel.	*Calanus helgolandicus*
dec.larv.	decapod larvae
O.s.	*Oithona similis*
Ps.el.	*Pseudocalanus elongatus*
Sag.	*Sagitta*
sm.cop.	small copepods
Tom.	*Tomopteris*

iv) The nano- and micro- plankton

A total of 115 taxa were identified. Of these 103 were found in the bottle samples, and 12 species of phytoplankton were found only in the Gulf IV samples.

Of these taxa 74 have been identified to species level with reasonable confidence, and a further 15 have been identified either to species level with reservations expressed, or to invalid, commonly used "species" of convenience. The remaining 26 taxa are identified to the generic or supergeneric level.

Table 5.4 is an annotated checklist of the taxa. Perhaps one of the most striking aspects of the checklist is the contribution by species of the diatom genus *Chaetoceros*. Twenty-three species of this genus were identified, 26% of the total identified species. Eight species of *Rhizosolenia* were recorded, and six species of the dinoflagellate genus, *Ceratium*.

A total of 24 taxa of dinoflagellates, 16 monospecific, were identified, compared with 75 taxa of diatoms of which 64 were monospecific or essentially so.

A summary of the mean measured volumes of the nano- and micro- plankton is given in Table 5.5, together with derived estimates of their organic carbon content, standard deviations for both volume and carbon content, and the number of each taxon measured.

Abundances of the taxa are given in full in Appendix 4 as numbers of cells cm^{-3}, in Appendix 5 as contributions to the biovolume in $mm^3\ m^{-3}$ or x 10^{-9}, each and in Appendix 6 as then contribution to the concentration of particulate organic

Tab 5.4

TABLE 5.4

Checklist of nano- and micro- plankton taxa

Numbers before the taxon names indicate the number in the nano- and micro- plankton data files, in which distribution and abundance are given. Numbers after a taxon's name refer to notes at the end of this checklist. The letters, "B" or "M" indicate that the taxa were recorded by Boyd (1973a) or Maxwell (1978a) respectively.

PLANTAE:

CYANOPHYCEAE:

1 *Oscillatoria* sp(p). (1)

CRYPTOPHYCEAE:

2 Cryptomonadaceae indet.

DINOPHYCEAE:

3 *Prorocentrum micans* Ehrenberg

136 *Prorocentrum triestinum* Schiller (2)

4 *Prorocentrum* spp. (3)

5 *Dinophysis* ?*acuta* Ehrenberg

6 *Dinophysis norwegica* Claparède et Lachmann

7 *Dinophysis* spp. indet.

8 Gymnodiniaceae indet. (4)

9 *Amphidinium sphenoides* Wulff

10 *Gymnodinium spirale* (Bergh) Kofoid et Swezy

11 *Torodinium robustum* Kofoid et Swezy

12 *Protodinium neapolitanum* Schiller (5)

13 *Polykrikos* indet.

14 *Pronoctiluca* indet. (6)

Dissodinium pseudolunula Swift (7) (n) B M

15 Spores - Peridiniaceae indet (8)

16 *Protoperidinium* indet. (9) B M

TABLE 5.4 (cont.)

DINOPHYCEAE (cont.)

Protoperidinium depressum (Bailey) Balech (n) B M

Ceratium arcticum (Ehrenberg) Cleve (n)

17 *Ceratium furca* (Ehrenberg) Claparède et Lachmann B M

Ceratium fusus (Ehrenberg) Dujardin (n) B M

18 *Ceratium lineatum* (Ehrenberg) Cleve B M

Ceratium macroceros (Ehrenberg) Vanhöffen (n) B M

19 *Ceratium tripos* (O.F. Müller) Nitzsch B M

HAPTOPHYCEAE:

20 Coccolithophorids (10)

CHRYSOPHYCEAE:

21 *Dictyocha fibula* Ehrenberg (11)

22 *Distephanus speculum* (Ehrenberg) Haeckel

BACILLARIOPHYCEAE:

23 *Melosira jurgensii* Agardh B

24 *Melosira nummeloides* (Dillwyn) Agardh

25 *Paralia sulcata* (Ehrenberg) Cleve B M

26 *Stephanopyxis turris* (Greville) Halfs ex Pritchard B M

27 *Hyalodiscus subtilis* Bailey

28 *Podosira stelliger* (Bailey) Mann (12) M

29 *Schroederella delicatula* (Peragallo) Pavillard

30 *Leptocylindrus danicus* Cleve B

31 *Leptocylindrus minimus* Gran

32 *Skeletonema costatum* (Greville) Cleve B M

33 *Thalassiosira* c.f. *decipiens* (Grunow) Jörgensen

34 *Thalassiosira gravida* Cleve (14) B M

35 *Thalassiosira polychorda* (Gran) Jörgensen M

36 *Thalassiosira* indet.

37 *Lauderia borealis* Gran B M

38 *Detonula confervacea* (Cleve) Gran

39 *Coscinodiscus* "*lineatus* Ehrenberg" (13)

TABLE 5.4 (cont.)

BACILLARIOPHYCEAE (cont.):

Coscinodiscus commutatus Grunow (n)

Coscinodiscus concinnus W. Smith (n) B M

40 *Asteriomphalus hookerii* Ehrenberg

41 *Roperia tesselata* (Roper) Grunow

42 *Biddulphia* indet. (15)

Biddulphia regia (Schultze) Ostenfeld (n) B M

Biddulphia sinensis Greville (n) B M

43 *Triceratium* indet. (16)

Isthmia inervis Ehrenberg (n) M

Isthmia nervosa Kützing (n)

44 *Chaetoceros* indet.

45 *Chaetoceros affine* Lauder

46 *Chaetoceros atlanticum* Cleve

47 *Chaetoceros breve* Schütt

48 *Chaetoceros cinctus* Gran

49 *Chaetoceros curvisetum* Cleve (17) B

50 *Chaetoceros coronatum* Gran

51 *Chaetoceros danicum* Cleve

52 *Chaetoceros debile* Cleve

53 *Chaetoceros decipiens* Cleve B M

54 *Chaetoceros externum* Gran

55 *Chaetoceros filiforme* Meunier

135 *Chaetoceros fragile* Meunier (18)

56 *Chaetoceros gracile* Schütt

57 *Chaetoceros ingolfianum* Ostenfeld in Gran

58 *Chaetoceros holsaticum* Schütt (19)

Chaetoceros messanense Castracane (n)

59 *Chaetoceros neapolitanum* Schröder

60 *Chaetoceros perpusillum* Cleve

TABLE 5.4 (cont.)

61 *Chaetoceros scolopendra* Cleve
62 *Chaetoceros seriacanthus* Gran (20)
63 *Chaetoceros simile* Cleve
64 *Chaetoceros simplex* Ostenfeld
65 *Chaetoceros tortissimum* Gran
66 *Bacteriastrum* sp.
67 *Rhizosolenia alata* Brightwell B M
68 *Rhizosolenia cylindrus* Cleve
69 *Rhizosolenia delicatula* Cleve B
70 *Rhizosolenia fragilissima* Bergon B
71 *Rhizosolenia hebetata* Bailey M
72 *Rhizosolenia setigera* Brightwell B M
73 *Rhizosolenia shrubsolei* Cleve B M
74 *Rhizosolenia stolterfothii* Peragallo B M
75 *Guinardia flaccida* (Castracane) Peragallo B M
76 *Lithodesmium undulatum* Ehrenberg
77 ?*Fragilaria* sp. B
78 *Asterionella glacialis* Castracane (21)
79 *Thalassionema nitzschioides* Hustedt (22)
80 *Licmophora* sp. B M
81 *Cocconeis* indet.
82 *Pleurosigma* sp. B M
83 *Gyrosigma* sp. M
84 *Nitzschia apiculata* (Gregory) Grunow *in* Cleve et Grunow
134 *Nitzschia* "*delicatissima* Cleve" (23) B M
85 *Nitzschia seriata* Cleve B M (30)
86 *Bacillaria paxillifer* (Müller) Hendey (24) B M
87 *Cylindrotheca closterium* (Ehrenberg) Reinmann et Lewin (25)
88 Bacillariophyceae indet.

TABLE 5.4 (cont.)

EUGLENOPHYCEAE:

89 Euglenaceae indet.

90 *Eutreptia viridis* Perty

PRASINOPHYCEAE:

91 Prasinophyceae indet. (26)

CHLOROPHYCEAE:

92 *Dunaliella* sp(p).

ANIMALIA:

ZOOMASTIGOPHORA:

93 Choanoflagellata indet. (27)

CILIATA:

94 Ciliata indet. (28)

95 Tintinnidia indet.

96 *Tintinnopsis* ?*nucula* Fol

97 *Tintinnopsis parvula* Jörgensen

98 *Tintinnopsis* ?*strigosa* Meunier

99 *Helicostomella kiliensis* (Laackmann)

100 *Strobilidium* c.f. *striata* Wulff

INCERTAE SEDIS:

101 Flagellata indet.

102 Other unidentified specimens

103 Faecal pellets (29)

NOTES

n - In thissurvey observed only in net samples.

1 - Most cyanophytes encountered corresponded with *Oscillatoria thiebautii* (Gomont ex Gomont) Geitler *sensu* Sournia (1968) (= *Trichodesmium thiebautii* Gomont ex Gomont).

2 - Probably of this species.

3 - This taxon is probably restricted to *Prorocentrum balticum*

(Lohmann) Loeblich, *P. aporum* (Schiller) Dodge, *P. cassubicum* (Woloszynska) Dodge, *P. minimum* (Pavillard) Schiller and *P. nanum* Schiller.

4 - Included species of *Gymnodinium* Stein, *Gyrodinium* Kofoid et Swezy and *Amphidinium* Claparède et Lachmann.

5 - Perhaps the same as that recorded by many authors as *Gymnodinium simplex* (Lohmann) Kofoid et Swezy.

6 - Probably *Pronoctiluca*.

7 - = *Gymnodinium lunula*: see Drebes (1981).

8 - This taxon consists mainly of *Protoperidinium* spores, but includes also some non-dinoflagellate material, including some diatom spores.

9 - Mostly of this genus.

10 - Coccolithophorids are seldom recognised in samples preserved in Lugol's iodine as the acetic acid dissolves their coccoliths; occasionally, however, the organic "ghosts" of coccoliths remain to reveal their identity.

11 - Only distorted specimens, probably of *D. fibula*, were encountered.

12 - Dead frustules only.

13 - This species is no longer recognised, as it was originally described from material comprising several species from more than one genus (Hasle, 1976).

14 - May be conspecific with *T. rotula* (Hasle, 1976).

15 - Frustules only.

16 - Probably *Triceratium*.

17 - Possibly included some *Chaetoceros pseudocurvisetum* Mangin.

18 - Requires confirmation; not in Hendey's (1974) checklist.

19 - Possibly included some *Chaetoceros difficile* Cleve.

20 - Perhaps some confusion with *Chaetoceros subsecundum* (Grunow) Hustedt.

TABLE 5.4 (cont.)

21 - = *Asterionella japonica* Cleve et Möller.

22 - = *Thalassiothrix nitzschioides* Grunow.

23 - Hasle (1965) has shown "*Nizschia delicatissima* Cleve" to be a complex of planktonic species, of which the most characteristic of inshore waters are *N. delicatula* Hasle and *N. actydrophila* Hasle.

24 - = *Bacillaria paradoxa* Gmelin.

25 - = *Nitzschia closterium* Ehrenberg; may include some *Nitzschia longissima* (de Brébisson) Ralfs *ex* Pritchard, from which it cannot be reliably distinguished by light microscopy (Hasle, 1964).

26 - Includes *Pyramimonas* spp. and *Tetraselmis* spp.

27 - Some choanoflagellates must have been included in the taxon, "flagellata indet.".

27 - The vast majority of this taxon were of the genera, *Strombidium* Schewiakoff and *Strobilidium*.

29 - Counted only in some samples; not included in the totals for estimates of biovolume and organic carbon.

30 - In the light of work by Hasle (1972) on the distribution of species similar to *Nitzschia seriata*, it seems likely that the diatoms referred to in this thesis and earlier works (Boyd, 1973a; Maxell, 1978a) as *N. seriata* must have been really either *N. fraudulenta* Cleve or *N. pungens* Grunow *in* Cleve et Møller. Our identification has not been checked.

TABLE 5.5a

For each nano- and micro- plankton taxon,

1) the number of samples out of 42 in which it was found,

2) its mean abundance in terms of cells cm^{-3},

3) its mean concentration of volume, as x 10^{-9} or mm^{3} m^{-3}, and

4) its estimated biomass as mg m^{-3} of organic carbon.

TAXON	PRES	CONC	BIOVOL	BIOMASS
OSCILLATORIA SP(P).	7	0.580	0.052	0.010
CRYPTOMONADS	42	116.638	33.779	5.918
PROROCENTRUM MICANS	4	0.149	4.294	0.565
PROROCENTRUM SPP.	22	3.128	2.394	0.379
DINOPHYSIS ?ACUTA	2	0.055	0.915	0.128
DINOPHYSIS NORWEGICA	1	0.027	1.437	0.188
DINOPHYSIS SPP.	7	0.309	2.384	0.346
GYMNODINIACEAE INDET.	41	28.121	20.520	3.254
AMPHIDINIUM SPHENOIDES	1	0.103	0.343	0.053
GYRODINIUM SPIRALE	2	0.264	14.440	1.842
TORODINIUM ROBUSTUM	1	0.059	0.316	0.047
PROTODINIUM NEAPOLITANUM	40	25.907	3.269	0.606
POLYKRIKOS INDET.	3	0.127	0.093	0.016
PRONOCTILUCA INDET.	3	0.145	0.331	0.052
SPORES - PERIDINIACEAE	35	18.578	9.307	1.502
PROTOPERIDINIUM	30	7.840	19.458	2.864
CERATIUM FURCA	3	0.125	5.334	0.707
CERATIUM LINEATUM	1	0.022	0.917	0.122
CERATIUM TRIPOS	1	0.038	12.176	1.425
COCCOLITHOPHORIDS	1	0.027	0.008	0.001
DICTYOCHA FIBULA	2	0.086	0.239	0.036
DISTEPHANUS SPECULUM	18	2.149	11.728	1.743
MELOSIRA JURGENSII	2	0.263	0.326	0.026
MELOSIRA NUMMELOIDES	1	0.077	1.117	0.050
PARALIA SULCATA	1	0.106	0.214	0.015
STEPHANOPYXIS TURRIS	1	0.077	0.157	0.011
HYALODISCUS SUBTILIS	1	0.026	0.163	0.009
PODOSIRA STELLIGER (FRUSTULES)	1	0.024	0.000	0.000
SCHROEDERELLA DELICATULA	1	0.032	3.073	0.087
LEPTOCYLINDRUS DANICUS	12	2.682	4.024	0.284
LEPTOCYLINDRUS MINIMUS	4	0.386	0.207	0.019
SKELETONEMA COSTATUM	21	13.202	4.389	0.458
THALASSIOSIRA C.F. DECIPIENS	5	0.597	2.895	0.150
THALASSIOSIRA GRAVIDA	5	2.918	66.706	2.209
THALASSIOSIRA POLYCHORDA	1	0.024	0.436	0.018
THALASSIOSIRA INDET.	6	0.512	6.883	0.267
LAUDERIA BOREALIS	1	0.243	25.189	0.686
DETONULA CONFERVACEA	1	0.032	0.067	0.005
COSCINODISCUS "LINEATUS"	7	0.307	1.482	0.083
ASTERIOMPHALUS HOOKERI	1	0.057	0.961	0.041
ROPERIA TESSELATA	1	0.045	0.415	0.021
BIDDULPHIA INDET.	1	0.106	0.000	0.000
TRICERATIUM INDET.	1	0.025	0.712	0.027
CHAETOCEROS INDET.	19	3.922	2.047	0.185
CHAETOCEROS AFFINE	2	0.778	1.031	0.078

TABLE 5.5a (cont.

CHAETOCEROS ATLANTICUM	2	0.412	0.429	0.034
CHAETOCEROS BREVE	3	0.154	0.471	0.030
CHAETOCEROS CINCTUS	1	0.044	0.022	0.002
CHAETOCEROS CURVISETUM	13	2.276	1.832	0.148
CHAETOCEROS CORONATUM	1	0.047	0.075	0.006
CHAETOCEROS DANICUM	2	0.647	0.730	0.060
CHAETOCEROS DEBILE	3	1.129	3.821	0.240
CHAETOCEROS DECIPIENS	2	0.064	0.884	0.040
CHAETOCEROS EXTERNUM	7	3.146	2.899	0.242
CHAETOCEROS FILIFORME	1	0.022	0.001	0.000
CHAETOCEROS GRACILE	7	1.074	0.190	0.023
CHAETOCEROS INGOLFIANUM	1	0.032	0.004	0.001
CHAETOCEROS HOLSATICUM	4	0.590	0.211	0.023
CHAETOCEROS NEAPOLITANUM	1	0.064	0.029	0.003
CHAETOCEROS PERPUSILLUM	4	0.318	0.019	0.003
CHAETOCEROS SCOLOPENDRA	2	0.104	0.062	0.006
CHAETOCEROS SERIACANTHUS	1	0.437	0.451	0.038
CHAETOCEROS SIMILE	3	0.629	2.963	0.143
CHAETOCEROS SIMPLEX	2	0.084	0.014	0.002
CHAETOCEROS TORTISSIMUM	1	0.183	0.051	0.006
BACTERIASTRUM SP.	1	0.039	0.021	0.002
RHIZOSOLENIA ALATA	5	0.561	1.806	0.092
RHIZOSOLENIA CYLINDRUS	1	0.168	4.807	0.182
RHIZOSOLENIA DELICATULA	19	9.270	64.541	3.340
RHIZOSOLENIA FRAGILISSIMA	9	0.752	7.892	0.349
RHIZOSOLENIA HEBETATA	1	0.057	0.424	0.022
RHIZOSOLENIA SETIGERA	1	0.099	0.070	0.006
RHIZOSOLENIA SHRUBSOLEI	2	0.208	10.399	0.331
RHIZOSOLENIA STOLTERFOTHII	11	1.293	39.402	1.432
GUINARDIA FLACCIDA	7	0.448	148.405	3.011
LITHODESMIUM UNDULATUM	2	0.056	0.923	0.034
?FRAGILIARIA SP.	2	0.138	0.277	0.020
ASTERIONELLA GLACIALIS	2	0.417	1.381	0.084
THALASSIONEMA NITZSCHIOIDES	1	0.155	0.244	0.019
LICMOPHORA SP.	1	0.077	0.300	0.018
COCCONEIS INDET.	1	0.025	0.005	0.001
PLEUROSIGMA SP.	1	0.032	0.195	0.011
GYROSIGMA SP.	2	0.051	2.305	0.071
NITZSCHIA APICULATA	1	0.026	0.014	0.001
NITZSCHIA SERIATA	9	0.850	0.794	0.058
BACILLARIA PAXILLIFER	9	0.612	0.358	0.032
CYLINDROTHECA CLOSTERIUM	38	8.613	1.003	0.125
BACILLARIOPHYCEAE INDET.	41	14.494	31.275	1.494
EUGLENACEAE INDET.	19	2.122	1.495	0.237
EUTREPTIA VIRIDIS	1	0.183	0.024	0.004
PRASINOPHYCEAE INDET.	42	53.903	13.249	2.323
DUNALIELLA SPP.	34	10.272	1.955	0.351
CHOANOFLAGELLATA INDET.	28	5.228	0.350	0.067

TABLE 5.5a(cont.)

CILIATA INDET.	39	7.587	93.547	12.555
TINTINNIDIA INDET.	4	0.178	0.619	0.095
TINTINNOPSIS ?NUCULA	1	0.032	2.826	0.358
TINTINNOPSIS PARVULA	2	0.076	1.291	0.181
TINTINNOPSIS ?STRIGOSA	1	0.032	0.516	0.073
HELICOSTOMELLA KILIENSIS	1	0.060	2.029	0.273
STROBILIDIUM C.F. STRIATA	2	0.078	1.654	0.229
FLAGELLATA INDET.	4223	83.197	127.313	23.649
OTHER UNIDENTIFIED SPECIMENS	16	1.784	14.282	1.772
FAECAL PELLETS (ONLY SOME)	6	0.456	23.288	2.845
NITZSCHIA "DELICATISSIMA"	20	1.160	0.194	0.024
CHAETOCEROS FRAGILE	2	0.647	0.356	0.033
PROROCENTRUM ?TRIESTINUM	1	0.437	0.121	0.022

TABLE 5.5b

To show the measured volumes of the various taxa, with their computed contents of organic carbon

TAXON	VOL M	VOL SD	CARB M	CARB SD	NO MEASD
OSCILLATORIA SP(P).	92.	125.	17.	22.	22
CRYPTOMONADS	266.	260.	47.	43.	205
PROROCENTRUM MICANS	26951.	32420.	3530.	4185.	4
PROROCENTRUM SPP.	933.	1990.	146.	290.	48
DINOPHYSIS ?ACUTA	16692.	0.	2340.	0.	1
DINOPHYSIS NORWEGICA	15140.	18524.	2079.	2382.	6
DINOPHYSIS SPP.	7682.	5411.	1115.	750.	4
GYMNODINIACEAE INDET.	750.	2065.	119.	291.	176
AMPHIDINIUM SPHENOIDES	3342.	0.	516.	0.	1
GYRODINIUM SPIRALE	57792.	51783.	7357.	6387.	5
TORODINIUM ROBUSTUM	5396.	3134.	805.	443.	2
PROTODINIUM NEAPOLITANUM	131.	116.	24.	20.	113
POLYKRIKOS INDET.	666.	266.	113.	43.	5
PRONOCTILUCA INDET.	2280.	0.	360.	0.	1
SPORES - PERIDINIACEAE	576.	2187.	90.	304.	257
PROTOPERIDINIUM	3633.	10413.	516.	1347.	78
CERATIUM FURCA	42792.	0.	5669.	0.	0
CERATIUM LINEATUM	41182.	0.	5468.	0.	0
CERATIUM TRIPOS	317050.	156892.	37113.	17348.	2
COCCOLITHOPHORIDS	307.	0.	55.	0.	1
DICTYOCHA FIBULA	2788.	3449.	424.	512.	2
DISTEPHANUS SPECULUM	5417.	3054.	805.	430.	15
MELOSIRA JURGENSII	1615.	674.	121.	39.	2
MELOSIRA NUMMELOIDES	14451.	0.	645.	0.	1
PARALIA SULCATA	731.	1152.	56.	73.	7
STEPHANOPYXIS TURRIS	2048.	0.	146.	0.	1
HYALODISCUS SUBTILIS	6360.	0.	346.	0.	1
PODOSIRA STELLIGER (FRUSTULES)	1.	0.	1.	0.	1
SCHROEDERELLA DELICATULA	96042.	0.	2721.	0.	1
LEPTOCYLINDRUS DANICUS	1546.	1833.	109.	99.	4
LEPTOCYLINDRUS MINIMUS	628.	415.	57.	30.	10
SKELETONEMA COSTATUM	296.	305.	31.	24.	74
THALASSIOSIRA C.F. DECIPIENS	5987.	6294.	302.	252.	11
THALASSIOSIRA GRAVIDA	25041.	34455.	843.	936.	22
THALASSIOSIRA POLYCHORDA	18145.	0.	767.	0.	0
THALASSIOSIRA INDET.	15887.	20778.	601.	659.	9
LAUDERIA BOREALIS	103546.	56045.	2818.	1207.	4
DETONULA CONFERVACEA	2091.	0.	148.	0.	1
COSCINODISCUS "LINEATUS"	5008.	4051.	275.	169.	9
ASTERIOMPHALUS HOOKERI	16837.	0.	724.	0.	0
ROPERIA TESSELATA	9227.	1499.	458.	57.	2
BIDDULPHIA INDET. (FRUSTULES)	1.	0.	1.	0.	2
TRICERATIUM INDET.	27951.	0.	1065.	0.	1
CHAETOCEROS INDET.	573.	729.	50.	47.	42
CHAETOCEROS AFFINE	1047.	1050.	81.	64.	10
CHAETOCEROS ATLANTICUM	1135.	1377.	84.	83.	4
CHAETOCEROS BREVE	3066.	2247.	193.	107.	3
CHAETOCEROS CINCTUS	354.	184.	38.	15.	4
CHAETOCEROS CURVISETUM	810.	730.	67.	49.	17
CHAETOCEROS CORONATUM	1581.	0.	120.	0.	1
CHAETOCEROS DANICUM	1129.	0.	93.	0.	1
CHAETOCEROS DEBILE	2951.	1710.	187.	92.	4

TABLE 5.5b (cont.)

CHAETOCEROS DECIPIENS	13830.	2608.	623.	89.	2
CHAETOCEROS EXTERNUM	820.	544.	70.	36.	21
CHAETOCEROS FILIFORME	58.	0.	10.	0.	0
CHAETOCEROS GRACILE	185.	209.	22.	18.	9
CHAETOCEROS INGOLFIANUM	112.	0.	16.	0.	1
CHAETOCEROS HOLSATICUM	340.	91.	37.	8.	5
CHAETOCEROS NEAPOLITANUM	446.	0.	46.	0.	1
CHAETOCEROS PERPUSILLUM	61.	26.	10.	3.	3
CHAETOCEROS SCOLOPENDRA	514.	265.	50.	20.	2
CHAETOCEROS SERIACANTHUS	1033.	162.	87.	10.	4
CHAETOCEROS SIMILE	4363.	8421.	214.	318.	7
CHAETOCEROS SIMPLEX	172.	77.	22.	8.	2
CHAETOCEROS TORTISSIMUM	276.	0.	32.	0.	0
BACTERIASTRUM SP.	535.	0.	53.	0.	2
RHIZOSOLENIA ALATA	5444.	7917.	258.	317.	10
RHIZOSOLENIA CYLINDRUS	28671.	0.	1086.	0.	1
RHIZOSOLENIA DELICATULA	5933.	3796.	319.	142.	45
RHIZOSOLENIA FRAGILISSIMA	11080.	12416.	464.	452.	11
RHIZOSOLENIA HEBETATA	2081.	3333.	122.	166.	8
RHIZOSOLENIA SETIGERA	322.	433.	32.	32.	31
RHIZOSOLENIA SHRUBSOLEI	49076.	33827.	1567.	887.	5
RHIZOSOLENIA STOLTERFOTHII	29103.	16233.	1066.	469.	21
GUINARDIA FLACCIDA	334964.	156805.	6780.	3043.	7
LITHODESMIUM UNDULATUM	12954.	20413.	497.	700.	3
?FRAGILIARIA SP.	2007.	0.	144.	0.	1
ASTERIONELLA GLACIALIS	1327.	1750.	95.	95.	5
THALASSIONEMA NITZSCHIOIDES	1581.	0.	120.	0.	1
LICMOPHORA SP.	3905.	3127.	231.	148.	2
COCCONEIS INDET.	209.	244.	24.	21.	4
PLEUROSIGMA SP.	6147.	0.	337.	0.	1
GYROSIGMA SP.	47668.	57478.	1463.	1541.	2
NITZSCHIA APICULATA	528.	435.	50.	32.	3
NITZSCHIA SERIATA	1628.	2408.	107.	120.	12
BACILLARIA PAXILLIFER	601.	830.	53.	48.	20
CYLINDROTHECA CLOSTERIUM	121.	180.	15.	16.	137
BACILLARIOPHYCEAE INDET.	2113.	9661.	97.	297.	206
EUGLENACEAE INDET.	665.	1378.	106.	207.	30
EUTREPTIA VIRIDIS	130.	66.	24.	12.	6
PRASINOPHYCEAE INDET.	227.	281.	40.	46.	208
DUNALIELLA SPP.	190.	229.	34.	37.	130
CHOANOFLAGELLATA INDET.	120.	579.	21.	87.	90
CILIATA INDET.	13929.	30051.	1851.	3707.	112
TINTINNIDIA INDET.	3115.	1896.	479.	278.	4
TINTINNOPSIS ?NUCULA	88312.	0.	11201.	0.	1
TINTINNOPSIS PARVULA	15332.	3943.	2158.	522.	2
TINTINNOPSIS ?STRIGOSA	16130.	0.	2266.	0.	0
HELICOSTOMELLA KILIENSIS	33917.	0.	4556.	0.	1
STROBILIDIUM C.F. STRIATA	21075.	0.	2913.	0.	1
FLAGELLATA INDET.	54.	177.	10.	28.	571
OTHER UNIDENTIFIED SPECIMENS	17508.	49921.	2188.	6038.	45
FAECAL PELLETS (ONLY SOME)	51849.	95783.	6425.	11151.	14
NITZSCHIA "DELICATISSIMA"	161.	107.	20.	10.	31
CHAETOCEROS FRAGILE	466.	368.	45.	28.	5
PROROCENTRUM ?TRIESTINUM	278.	0.	50.	0.	2

Abbreviations:

VOL M - mean volume
VOL SD - standard deviation of the volume
CARB M - mean carbon content
CARB SD - standard deviation of the carbon content
NO MEASD - number measured

Units:

Volume in μm^3
Carbon content in pg

Note:

Where the number measured is given as 0., value estimated from the litterature.
For *Podosira* and *Biddulphia* frustules, nominal values given.

TABLE 5.6

Showing the presence or absence of each of the quantitatively estimated nano- and micro- plankton taxa by cruise

	CRUISE - 1	2	3	4	5	6	7	9	10	11	12	14	15
TAXON	MONTH - JY	A	S	S	O	O	N	D	J/F	F	A	M/J	JY
OSCILLATORIA SP(P).	1	0	0	0	1	1	1	0	1	1	0	0	0
CRYPTOMONADS	1	1	1	1	1	1	1	1	1	1	1	1	1
PROROCENTRUM MICANS	0	1	0	0	1	0	1	0	0	0	1	0	0
PROROCENTRUM SPP.	1	1	0	1	1	1	1	1	1	1	1	0	1
DINOPHYSIS ?ACUTA	1	0	0	0	0	0	0	0	0	0	0	0	0
DINOPHYSIS NORWEGICA	0	0	0	0	0	0	1	0	0	0	0	0	0
DINOPHYSIS SPP.	1	0	0	0	1	0	1	0	0	0	1	0	1
GYMNODINIACEAE INDET.	1	1	1	1	1	1	1	1	1	1	1	1	1
AMPHIDINIUM SPHENOIDES	0	0	0	0	0	0	0	0	0	0	1	0	0
GYRODINIUM SPIRALE	0	0	0	0	0	0	0	0	0	0	0	0	1
TORODINIUM ROBUSTUM	0	1	0	0	0	0	0	0	0	0	0	0	0
PROTODINIUM NEAPOLITANUM	1	1	1	1	1	1	1	1	1	1	1	1	1
POLYKRIKOS INDET.	0	1	0	0	0	0	0	0	0	0	0	0	0
PRONOCTILUCA INDET.	1	1	0	0	0	0	0	0	0	0	0	0	0
SPORES - PERIDINIACEAE	1	1	0	1	1	1	1	1	1	1	1	1	1
PROTOPERIDINIUM	1	1	1	1	1	1	1	0	1	1	1	1	1
CERATIUM FURCA	1	1	0	0	0	0	0	0	0	0	0	0	0
CERATIUM LINEATUM	1	0	0	0	0	0	0	0	0	0	0	0	0
CERATIUM TRIPOS	0	1	0	0	0	0	0	0	0	0	0	0	0
COCCOLITHOPHORIDS	0	0	0	0	0	0	1	0	0	0	0	0	0
DICTYOCHA FIBULA	1	0	0	0	0	0	0	0	1	0	0	0	0
DISTEPHANUS SPECULUM	1	1	0	1	1	1	0	1	0	0	0	1	0
MELOSIRA JURGENSII	0	1	0	1	0	0	0	0	0	0	0	0	0
MELOSIRA NUMMELOIDES	0	0	1	0	0	0	0	0	0	0	0	0	0
PARALIA SULCATA	0	0	0	0	0	0	0	0	1	0	0	0	0
STEPHANOPYXIS TURRIS	0	0	0	0	0	0	0	0	0	0	1	0	0
HYALODISCUS SUBTILIS	0	0	0	0	0	0	0	0	0	0	1	0	0
PODOSIRA STELLIGER (FRUSTULES)	0	0	0	0	0	0	0	0	0	0	1	0	0
SCHROEDERELLA DELICATULA	0	0	0	0	0	0	0	0	0	0	0	0	1
LEPTOCYLINDRUS DANICUS	1	1	0	0	0	0	0	0	0	0	0	1	1
LEPTOCYLINDRUS MINIMUS	0	1	0	0	0	0	0	0	0	0	0	0	1
SKELETONEMA COSTATUM	0	1	1	1	1	1	1	0	0	1	1	1	1
THALASSIOSIRA C.F. DECIPIENS	0	1	0	0	0	1	1	0	0	0	1	0	0
THALASSIOSIRA GRAVIDA	0	0	1	0	0	1	0	0	0	0	1	1	0
THALASSIOSIRA POLYCHORDA	1	0	0	0	0	0	0	0	0	0	0	0	0
THALASSIOSIRA INDET.	1	1	0	0	0	0	0	0	0	1	0	0	0
LAUDERIA BOREALIS	0	0	0	0	0	0	0	0	0	0	0	1	0
DETONULA CONFERVACEA	0	0	0	0	0	0	0	0	0	0	0	0	1
COSCINODISCUS "LINEATUS"	1	1	0	0	1	1	0	0	0	1	1	0	0
ASTERIOMPHALUS HOOKERI	1	0	0	0	0	0	0	0	0	0	0	0	0
ROPERIA TESSELATA	0	0	0	0	0	1	0	0	0	0	0	0	0
BIDDULPHIA INDET.	0	0	0	0	0	0	0	0	1	0	0	0	0
TRICERATIUM INDET.	0	0	0	0	1	0	0	0	0	0	0	0	0
CHAETOCEROS INDET.	1	1	1	1	0	1	0	0	0	0	1	1	1

TABLE 5.6 (cont.)

CRUISE —	1	2	3	4	5	6	7	9	10	11	12	14	15
MONTH _	JY	A	S	S	O	O	N	D	J/F	F	A	M/J	JY
CHAETOCEROS AFFINE	0	1	0	0	0	0	0	0	0	0	0	0	1
CHAETOCEROS ATLANTICUM	0	0	1	0	0	0	0	0	0	0	0	0	1
CHAETOCEROS BREVE	0	0	1	0	1	0	0	0	0	0	0	0	1
CHAETOCEROS CINCTUS	0	0	0	0	0	1	0	0	0	0	0	0	0
CHAETOCEROS CURVISETUM	1	1	0	1	1	0	0	0	0	0	0	1	1
CHAETOCEROS CORONATUM	0	0	0	0	0	0	0	0	0	0	1	0	0
CHAETOCEROS DANICUM	0	0	1	1	0	0	0	0	0	0	0	0	0
CHAETOCEROS DEBILE	0	1	0	1	0	0	0	0	0	0	0	0	1
CHAETOCEROS DECIPIENS	0	0	0	1	0	0	0	0	0	0	0	1	0
CHAETOCEROS EXTERNUM	0	1	0	1	1	0	0	0	0	0	0	0	1
CHAETOCEROS FILIFORME	1	0	0	0	0	0	0	0	0	0	0	0	0
CHAETOCEROS GRACILE	1	1	0	1	0	0	0	0	0	0	0	1	0
CHAETOCEROS INGOLFIANUM	0	0	0	0	0	0	0	0	0	0	0	0	1
CHAETOCEROS HOLSATICUM	1	1	0	0	1	0	0	0	0	0	0	1	0
CHAETOCEROS NEAPOLITANUM	0	0	0	0	0	0	0	0	0	0	0	0	1
CHAETOCEROS PERPUSILLUM	1	1	0	1	0	0	0	0	0	0	0	0	0
CHAETOCEROS SCOLOPENDRA	1	0	0	1	0	0	0	0	0	0	0	0	0
CHAETOCEROS SERIACANTHUS	0	0	0	0	0	0	0	0	0	0	0	0	1
CHAETOCEROS SIMILE	0	1	0	0	0	0	0	0	0	0	0	0	1
CHAETOCEROS SIMPLEX	0	1	0	1	0	0	0	0	0	0	0	0	0
CHAETOCEROS TORTISSIMUM	0	1	0	0	0	0	0	0	0	0	0	0	0
BACTERIASTRUM SP.	0	1	0	0	0	0	0	0	0	0	0	0	0
RHIZOSOLENIA ALATA	0	1	1	1	0	0	0	0	0	0	0	0	1
RHIZOSOLENIA CYLINDRUS	0	0	0	0	0	0	0	0	0	0	0	0	1
RHIZOSOLENIA DELICATULA	1	1	1	1	1	0	0	0	0	0	0	1	1
RHIZOSOLENIA FRAGILISSIMA	0	0	1	1	1	1	1	0	0	0	1	1	1
RHIZOSOLENIA HEBETATA	0	0	0	1	0	0	0	0	0	0	0	0	0
RHIZOSOLENIA SETIGERA	0	1	0	0	0	0	0	0	0	0	0	0	0
RHIZOSOLENIA SHRUBSOLEI	0	0	0	0	0	0	0	0	0	0	0	0	1
RHIZOSOLENIA STOLTERFOTHII	1	1	0	0	0	0	0	0	0	0	0	1	1
GUINARDIA FLACCIDA	1	1	0	0	0	0	0	0	0	0	0	1	1
LITHODESMIUM UNDULATUM	0	0	0	0	0	0	1	0	1	0	0	0	0
?FRAGILIARIA SP.	0	1	1	0	0	0	0	0	0	0	0	0	0
ASTERIONELLA GLACIALIS	0	0	0	0	0	0	0	0	0	0	0	1	0
THALASSIONEMA NITZSCHIOIDES	0	0	1	0	0	0	0	0	0	0	0	0	0
LICMOPHORA SP.	0	1	0	0	0	0	0	0	0	0	0	0	0
COCCONEIS INDET.	1	0	0	0	0	0	0	0	0	0	0	0	0
PLEUROSIGMA SP.	0	0	0	0	0	0	0	0	1	0	0	0	0
GYROSIGMA SP.	0	0	0	0	0	0	0	0	0	1	1	0	0
NITZSCHIA APICULATA	0	0	0	0	1	0	0	0	0	0	0	0	0
NITZSCHIA SERIATA	1	0	1	1	1	0	1	0	0	1	0	1	1
BACILLARIA PAXILLIFER	0	1	0	0	1	1	1	0	0	0	0	0	0
CYLINDROTHECA CLOSTERIUM	1	1	1	1	1	1	1	1	1	1	1	1	1
BACILLARIOPHYCEAE INDET.	1	1	1	1	1	1	1	1	1	1	1	1	1
EUGLENACEAE INDET.	1	1	1	1	0	1	0	0	0	1	1	1	0
EUTREPTIA VIRIDIS	0	1	0	0	0	0	0	0	0	0	0	0	0
PRASINOPHYCEAE INDET.	1	1	1	1	1	1	1	1	1	1	1	1	1
DUNALIELLA SPP.	1	1	1	1	1	1	1	1	1	1	1	1	1

TABLE 5.6 (cont.)

CRUISE -	1	2	3	4	5	6	7	9	10	11	12	14	15
MONTH -	JY	A	S	S	O	O	N	D	J/F	F	A	M/J	JY
CHOANOFLAGELLATA INDET.	1	1	1	1	1	1	1	1	1	1	1	1	1
CILIATA INDET.	1	1	1	1	1	1	1	1	1	1	1	1	1
TINTINNIDIA INDET.	0	0	0	0	0	1	1	0	0	0	0	1	0
TINTINNOPSIS ?NUCULA	0	0	0	0	0	0	0	0	0	0	0	0	1
TINTINNOPSIS PARVULA	0	1	0	0	0	0	0	0	1	0	0	0	0
TINTINNOPSIS ?STRIGOSA	0	0	0	0	0	0	0	0	0	0	0	0	1
HELICOSTOMELLA KILIENSIS	0	1	0	0	0	0	0	0	0	0	0	0	0
STROBILIDIUM C.F. STRIATA	0	1	0	0	0	0	0	0	0	0	0	0	1
FLAGELLATA INDET.	1	1	1	1	1	1	1	1	1	1	1	1	1
OTHER UNIDENTIFIED SPECIMENS	1	1	1	1	1	1	1	0	1	0	1	0	1
FAECAL PELLETS (ONLY SOME)	1	1	1	0	0	0	0	0	0	0	0	0	0
NITZSCHIA "DELICATISSIMA"	0	1	0	1	1	1	1	1	0	0	1	1	0
CHAETOCEROS FRAGILE	0	0	1	1	0	0	0	0	0	0	0	0	0
PROROCENTRUM ?TRIESTINUM	0	0	0	0	0	0	0	0	0	0	0	0	1

Convention: 0 - not found
1 - present

Note: Cruise 13 is included under cruise 12

TABLE 5.7

Contribution to the coefficient of biologically enclosed volume by various fractions of the nano- and micro- plankton

FORMAT OF THE STATIONS								1/1	1/2
1/3	1/4	1/5	1/6	1/8	2/1	2/2	2/3	2/4	2/5
2/6	2/7	3/1	4/1	4/2	4/3	5/1	5/2	6/1	6/2
6/3	6/4	7/1	7/2	7/3	7/4	9/1	9/2	10/1	10/2
11/1	11/2	12/1	12/2	13/1	14/1	14/2	15/1	15/2	15/3
CYANOPHYTA								0.000	0.000
0.000	0.000	0.000	0.945	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.318	0.000	0.000	0.000
0.781	0.080	0.018	0.000	0.000	0.000	0.000	0.000	0.037	0.000
0.000	0.009	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MEAN =	0.052								
CRYPTOMONADACEAE								47.879	26.729
54.132	43.830	57.360	49.261	56.264	85.753	49.592	166.536	80.485	46.478
166.873	38.049	32.942	23.694	29.663	27.116	11.630	19.228	8.704	8.276
10.674	15.604	3.787	7.180	1.564	14.992	3.355	7.108	9.056	16.906
10.073	4.613	16.970	13.527	22.915	53.236	2.077	34.705	11.474	28.420
MEAN =	33.779								
DINOPHYCEAE								88.503	55.482
68.006	38.145	119.381	264.673	53.620	112.008	568.783	148.330	38.575	419.813
282.528	24.537	32.496	43.936	27.561	21.666	19.896	41.507	14.683	13.664
82.479	33.842	12.934	22.349	61.624	101.635	4.323	13.664	15.728	37.844
10.385	24.115	14.324	93.878	117.961	124.858	4.206	127.996	478.677	237.397
MEAN =	98.048								
BACILLARIOPHYCEAE								268.338	812.045
565.723	129.401	103.096	233.193	235.888	251.398	51.559	29.658	137.961	249.118
631.205	146.794	256.297	53.136	17.130	71.683	17.114	298.067	11.050	23.221
28.952	33.659	57.443	4.440	44.553	4.692	5.234	137.503	15.337	41.463
29.449	216.517	177.961	239.691	64.343	2285.191	2358.924	1256.912	2011.091	5505.344
MEAN =	455.042								
OTHER FLAGELLATA								195.166	245.512
275.795	219.124	635.130	191.077	761.769	462.755	376.546	138.311	231.756	178.726
336.708	91.897	79.824	25.329	34.357	32.315	49.058	261.118	84.849	25.748
90.426	54.306	27.543	71.237	23.431	55.612	25.128	34.243	83.584	74.085
79.171	74.047	46.941	69.872	78.024	151.775	46.198	359.444	83.352	105.878
MEAN =	156.361								
CILIATA								0.000	310.782
125.485	225.119	314.833	247.336	366.163	34.415	175.225	58.304	54.769	129.353
108.301	85.232	28.779	36.346	0.000	0.267	4.999	32.302	29.848	33.278
6.880	19.922	18.754	20.078	42.471	7.018	145.309	27.813	26.301	8.180
294.320	137.011	154.155	14.496	160.953	60.605	207.694	38.770	206.136	306.246
MEAN =	102.482								
OTHERS								0.000	35.507
0.000	17.683	396.809	0.000	0.000	0.000	11.056	3.494	0.000	0.000
1.402	4.540	1.087	0.000	24.109	0.000	0.074	0.000	0.000	0.000
0.000	17.283	1.679	0.000	0.000	1.098	0.000	0.000	2.335	0.000
0.000	0.000	0.000	0.000	18.839	0.000	0.000	62.833	0.000	0.000
MEAN =	14.282								
TOTAL								599.886	1486.057
1089.141	673.302	1626.609	986.485	1473.704	946.329	1232.761	544.633	543.546	1023.488
1527.017	391.049	431.425	182.441	132.820	153.047	103.089	652.222	149.134	104.187
220.192	174.696	122.158	125.284	173.643	185.047	183.349	220.331	152.378	178.478
423.398	456.312	410.351	431.464	463.035	2675.665	2619.099	1880.660	2790.730	6183.285
MEAN =	860.046								

@
Units: $mm^3 m^{-3}$, or x 10^{-9}

TABLE 5.8

Estimated contribution to the concentration of organic carbon by various fractions of the nano- and micro- plankton

FORMAT OF THE STATIONS								1/1	1/2
1/3	1/4	1/5	1/6	1/8	2/1	2/2	2/3	2/4	2/5
2/6	2/7	3/1	4/1	4/2	4/3	5/1	5/2	6/1	6/2
6/3	6/4	7/1	7/2	7/3	7/4	9/1	9/2	10/1	10/2
11/1	11/2	12/1	12/2	13/1	14/1	14/2	15/1	15/2	15/3
CYANOPHYTA								0.000	0.000
0.000	0.000	0.000	0.174	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.062	0.000	0.000	0.000
0.138	0.015	0.004	0.000	0.000	0.000	0.000	0.000	0.008	0.000
0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MEAN =	0.010								
CRYPTOMONADACEAE								8.417	4.699
9.516	7.705	10.084	8.660	9.891	15.075	8.718	29.366	13.664	8.302
28.315	6.572	5.672	4.262	5.130	4.763	2.068	3.354	1.587	1.543
1.946	2.804	0.680	1.337	0.287	2.637	0.609	1.264	1.539	2.868
1.776	0.853	2.983	2.483	3.990	9.647	0.390	6.011	2.085	4.993
MEAN =	5.918								
DINOPHYCEAE								12.630	8.459
9.982	5.860	18.407	38.017	8.381	17.254	69.163	21.590	6.754	63.005
41.839	4.232	5.485	7.378	4.644	3.769	3.400	5.931	2.579	2.347
12.821	5.391	2.116	3.934	8.889	14.988	0.801	2.433	2.767	6.019
1.885	3.725	2.465	13.807	16.993	19.657	0.782	18.238	60.994	33.069
MEAN =	14.116								
BACILLARIOPHYCEAE								11.671	21.194
16.196	6.911	6.959	10.722	12.261	9.354	3.002	2.297	10.289	18.320
33.166	12.277	17.250	3.126	1.300	4.180	1.482	11.974	0.916	1.539
1.764	1.671	2.585	0.450	2.390	0.475	0.513	4.365	1.063	3.138
1.976	7.816	6.980	10.627	4.147	78.993	68.524	52.308	57.667	172.015
MEAN =	16.568								
OTHER FLAGELLATA								32.931	41.740
48.503	38.064	110.187	34.505	133.310	85.085	69.290	26.052	42.649	34.115
61.432	18.499	15.351	4.850	6.615	6.496	9.223	48.619	15.236	5.086
17.105	10.154	5.343	14.898	4.540	11.099	4.704	6.865	16.639	14.726
14.347	13.790	9.302	13.347	16.398	28.125	9.241	58.056	16.765	20.053
MEAN =	28.413								
CILIATA								0.000	41.297
16.675	29.914	42.800	32.866	48.656	5.181	24.488	8.738	7.985	18.676
15.719	11.449	4.066	4.995	0.000	0.051	0.758	4.741	4.409	4.799
1.082	3.000	2.689	2.711	5.768	1.112	17.871	3.950	3.827	1.296
36.060	17.281	18.963	2.255	21.554	9.324	27.224	5.871	26.990	40.913
MEAN =	13.762								
OTHERS								0.000	4.438
0.000	2.210	47.661	0.000	0.000	0.000	1.568	0.602	0.000	0.000
0.252	0.809	0.185	0.000	3.013	0.000	0.014	0.000	0.000	0.000
0.000	2.527	0.278	0.000	0.000	0.200	0.000	0.000	0.439	0.000
0.000	0.000	0.000	0.000	2.354	0.000	0.000	7.875	0.000	0.000
MEAN =	1.772								
TOTAL								65.649	121.827
100.872	90.664	236.098	124.944	212.499	131.949	176.229	88.645	81.341	142.418
180.723	53.838	48.009	24.611	20.702	19.259	17.007	74.619	24.727	15.314
34.856	25.562	13.695	23.330	21.874	30.511	24.498	18.877	26.282	28.047
56.044	43.467	40.693	42.519	65.436	145.746	106.161	148.359	164.501	271.043
MEAN =	80.558								

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Units: mg m^{-3}

carbon in the water in mg m^{-3}.

These data are averaged over the whole survey in Table 5.6. In addition, the contribution of various broad groups of nano- and micro- plankton to the biomass at each station are given as biovolume in Table 5.7. and as organic carbon concentration in Table 5.8.

The mean estimated biomass contributed by the nano- and micro- plankton was equivalent to an organic carbon concentration of 80.6 mg m^{-3} or a biovolume concentration of 860 x 10^{-9}. This measure of biovolume is equal to a few percent less than the wet weight expressed as mg m^{-3}.

The spatiotemporal variation in nano- and micro- plankton organic carbon is shown in figure 5.42. The three highest values - over 200 mg m^{-3} - were in July 1973 and July 1974. Low values - mostly below 60 - occured from September to April, although the value of 65 mg m^{-3} at station 13.1 indicated that values at the seaward end of the Narrows might be starting to increase in April. Because of high variance introduced by sampling error particularly of the largest microplankton, too much weight should not be placed on the values of individual samples.

The most important contributions to the mean organic carbon of the nano- and micro- plankton may be seen from Table 5.8 to be unidentified flagellates, with 29%, unidentified ciliates (16%), cryptomonads (7%), unidentified Gymnodiniaceae (4%), *Guinardia flaccida* (4%), faecal pellets (only some - 4%), *Protoperidinium* (4%), *Thalassiosira gravida* (3%) and Prasinophyceae (3%). Despite the number of species of *Chaetoceros* found the genus contributed on average only 2.6% of the nano- and micro- plankton organic carbon.

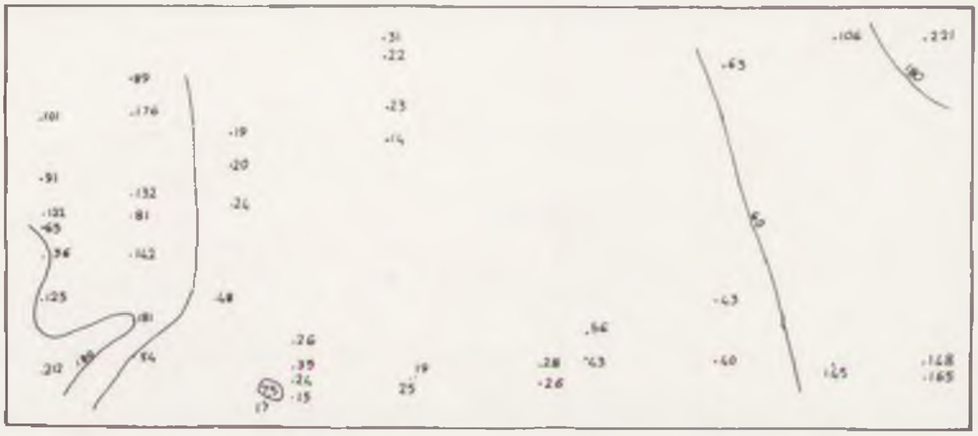


Figure 5.42 b. The estimated organic carbon (mg m^{-3}) contributed by nano- and micro-plankton, in the Narrows during 1973-1974.

.42b

v) Multivariate analysis of the nano- and microplankton data

The taxa used in the multivariate analyses are shown in Table 5.9, together with the numbers by which they have been denoted in the tables and figures concerning multivariate analysis.

Tables of multiple correlation are given in Appendix 7 between taxa (R-type analysis) and between stations (Q-type analysis). Correlations are generally much higher between stations (0.6 to 0.93) than they are between taxa (-0.5 to 0.7).

We will first consider six R-type analyses.

Figure 5.43 shows the factor loadings for taxa derived from an orthogonal (i.e. unrotated) R-type principal component analysis (P.C.A.).

Figure 5.44 shows a P.C.A. peformed on only 35 out of the 42 stations, with the random variable, R, omitted. The similarity between the two analyses shows that the data are robust.

The same 42-station R-type P.C.A. has been loaded on to stations in figure 5.45. Because stations with a negative loading on factor 1 show as either clearly positive or clearly negative on factor 2, the stations have been divided into three groups on the basis of the loadings on the first two factors. With exceptions, those stations loading the highest on to factor 2 are from July 1973, and those loading lowest on factor 2 are from August. Three stations, those from July 1974, load high only on factor 3. Thus in a trigonometrical picture of factors 1,2 and 3, the stations would lie within four

TABLE 5.9

Taxa used for multivariate analysis

M.A.A.	Taxon	Normal
1	Flagellata indet.	101
2	Cryptophyceae	2
3	Prasinophyceae	91
4	Euglenaceae	88
5	Choanoflagellata	93
6	*Distephanus speculum*	22
7	*Dunaliella*	7
12	*Chaetoceros gracilis*	56
13	*C. curvisetum*	49
14	*Rhizosolenia stolterfothii*	74
16	*R. delicatula*	69
17	*Cylindrotheca closterium*	87
19	*Leptrocylindrus danicus*	30
20	*Guinardia flaccida*	75
23	*Skeletonema costatum*	32
30	Pennates indet.	88 (part)
31	*Chaetoceros* indet.	44
33	Ciliata	94 - 98
35	Spores	15
40	*Nitzschia seriata*	85
42	*Rhizosolenia alata*	67
47	Diatoms (mostly centrics)	88
48	*Nitzschia* *"delicatissima"*	134
60	*Chaetoceros holsaticum*	58
62	*Bacillaria paxillifer*	86
109	Gymnodiniaceae	8
115	*Protoperidinium*	16
118	*Prorocentrum* spp.	4
119	*Dinophysis* spp.	5+6+7
120	*Protodinium neapolitanum*	12
R (11)	Random number	-

Abbreviations: M.A.A. - Taxon umber used in presentations of multivariate analysis

Normal - Taxon number used in checklist and tables of abundance.

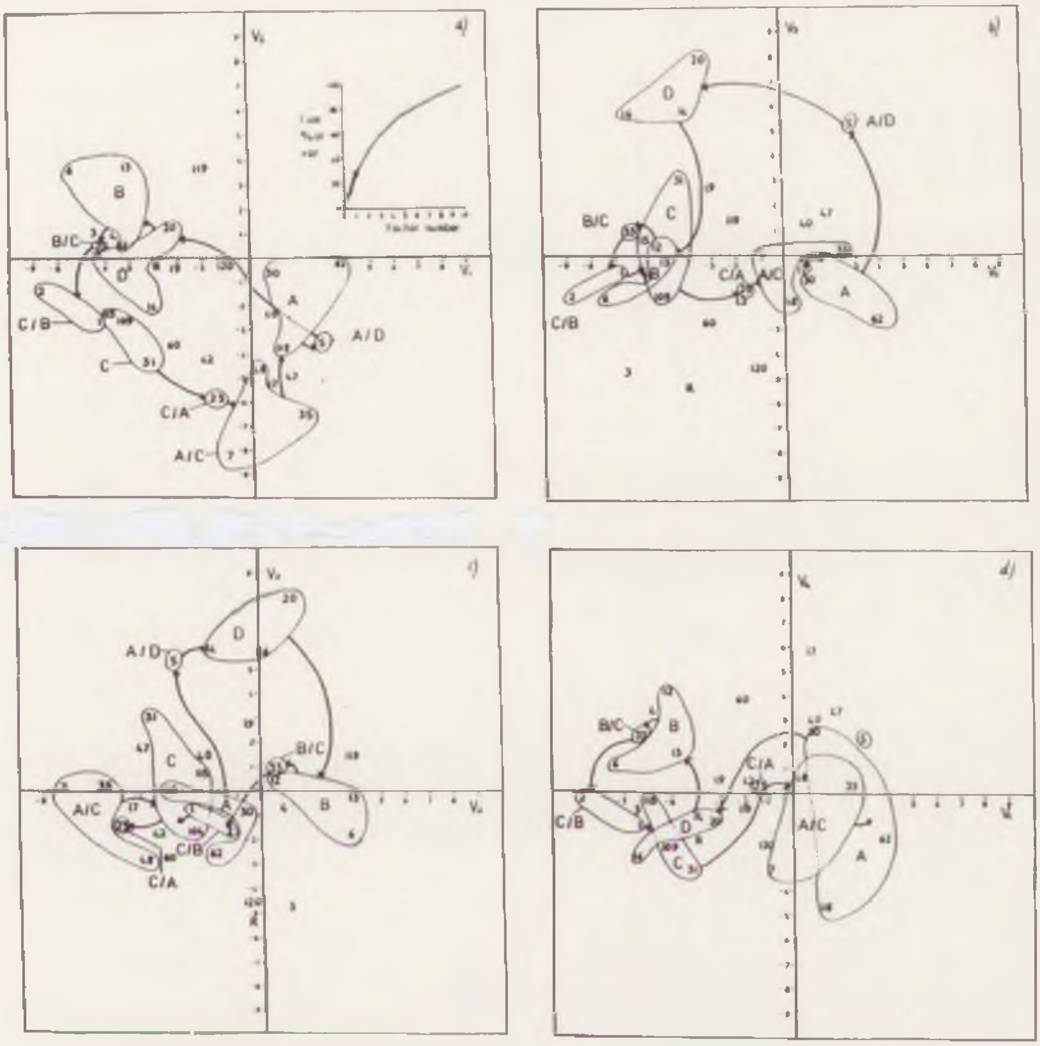


Figure 5.43. Results of an orthogonal R-type principal-component analysis for all 42 stations. a), b), c), d) loadings on factors 1 and 2; 1 and 3; 2 and 3; 2 and 4.

5.43

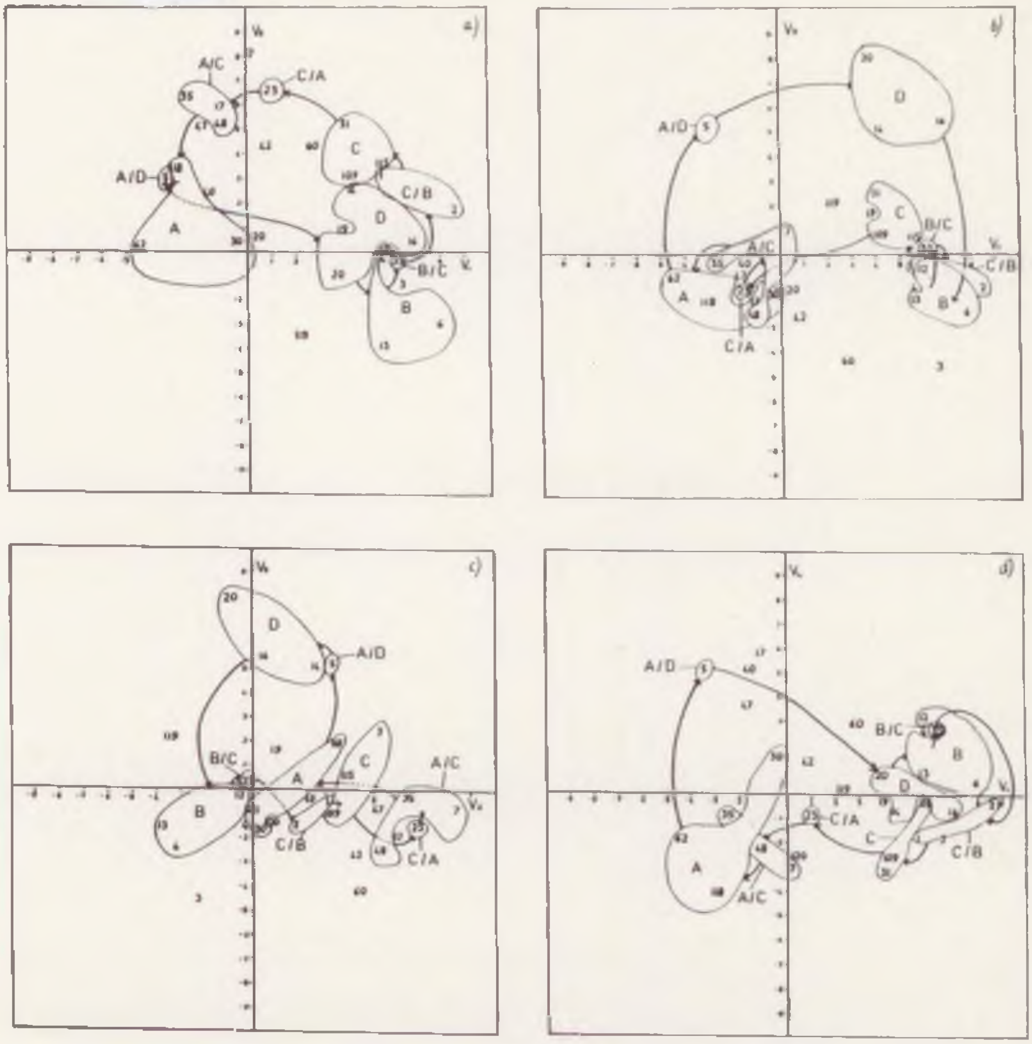


Figure 5.44. Results of an orthogonal R-type principal-component analysis for only 35 stations. a), b), c), d), loadings on factors 1 and 2; 1 and 3; 2 and 3; 2 and 4.

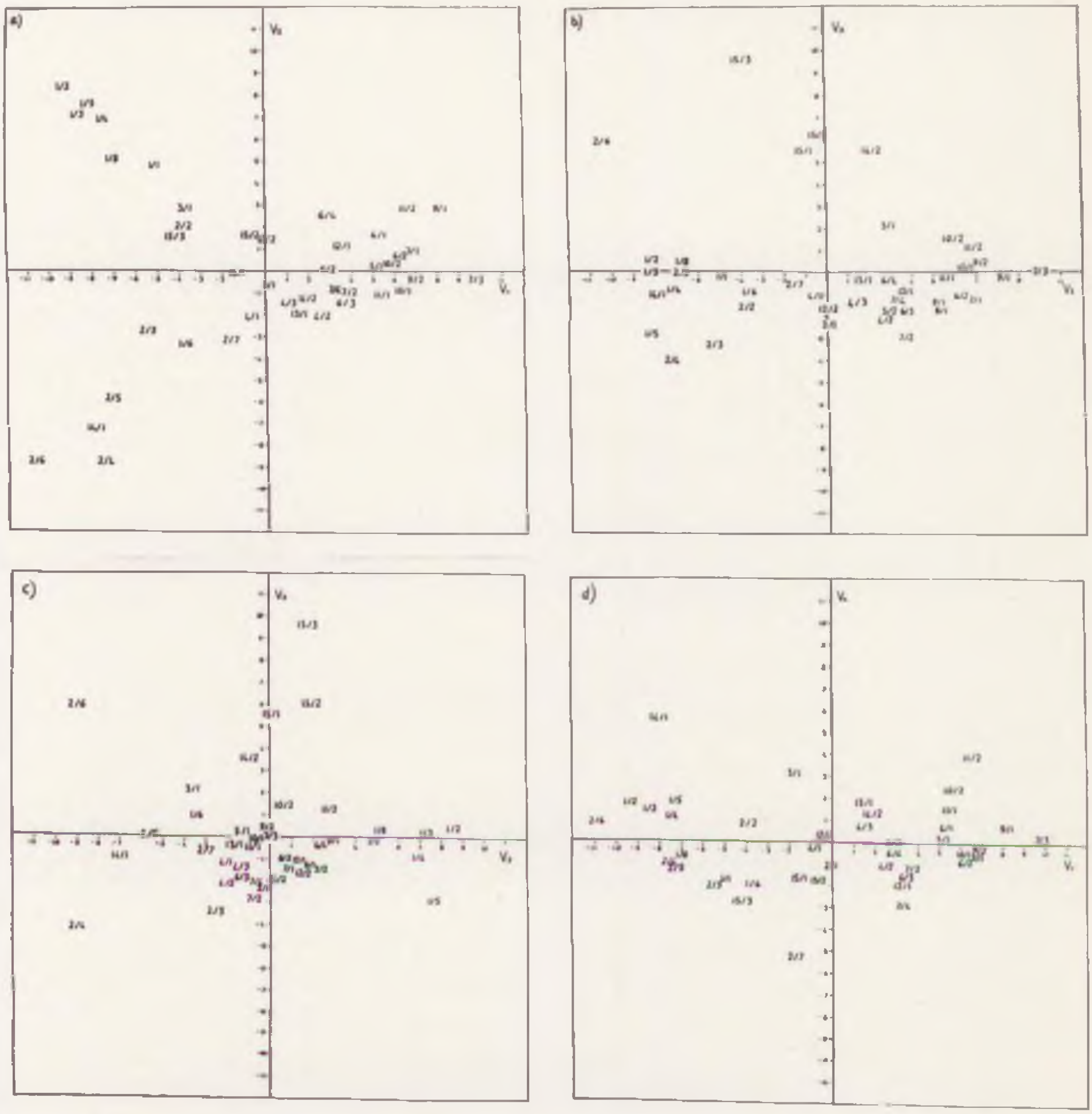


Figure 5.45. Results of an orthogonal R-type principal-component analysis loaded on to stations. a), b), c), d) factors 1 and 2; 1 and 3: 2 and 3; 1 and 4; e), f) distribution in the Narrows during 1973-1974 of factors 1; 2.

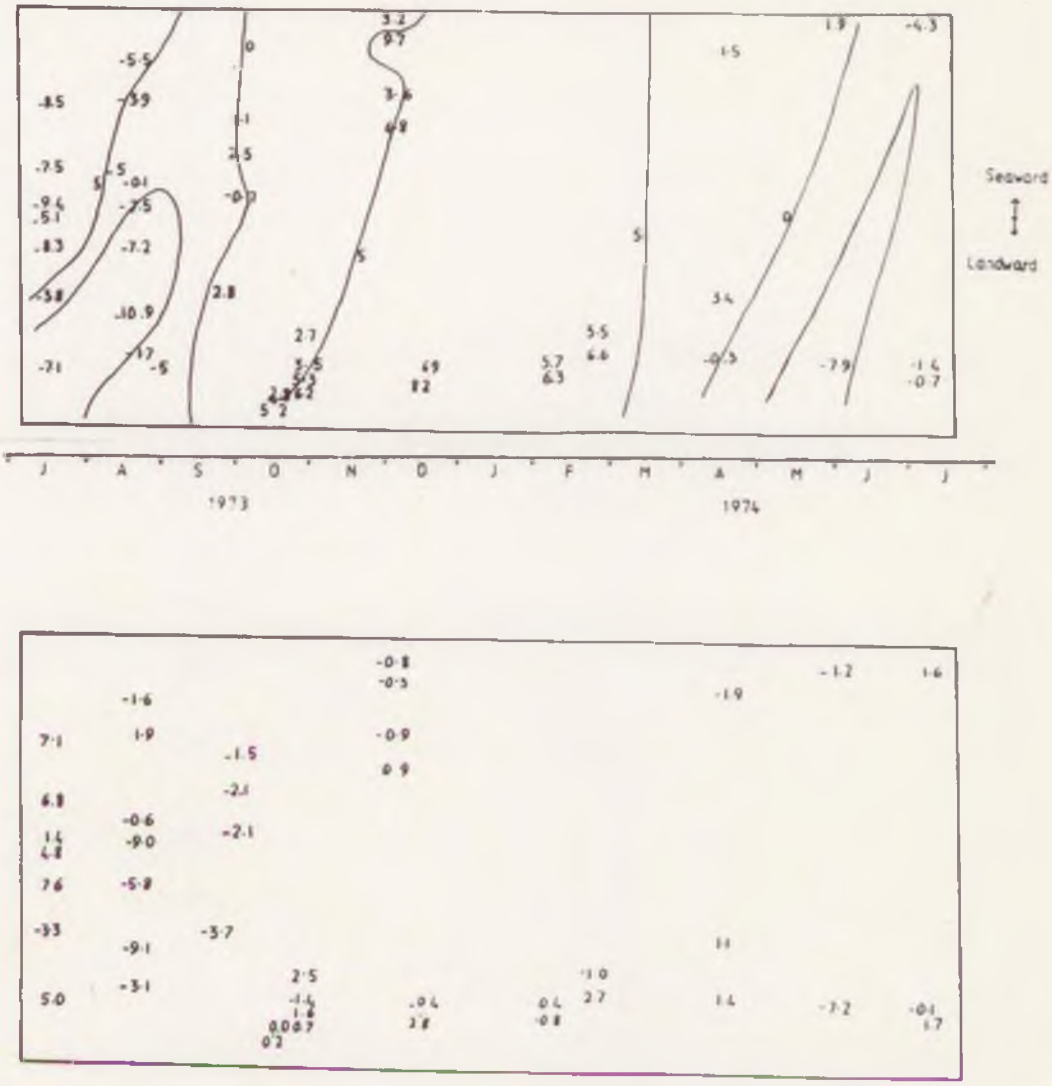


Figure 5.45. Legend page 141.

clusters radiating from the origin. The stations in these clusters shall be called groups A to D. Three more groups, E, F and G, to which none of the stations wholly belong, have been separated on the basis of their loadings on to factors 4 and 5.

The factor loadings of the groups are as follows:

Group A - positive on factor 1;

Group B - negative on factor 1, positive on factor 2;

Group C - negative on factor 1, negative on factor 2;

Group D - highly positive on factor 3;

Group E - highly negative on factor 5;

Group F - highly positive on factor 4;

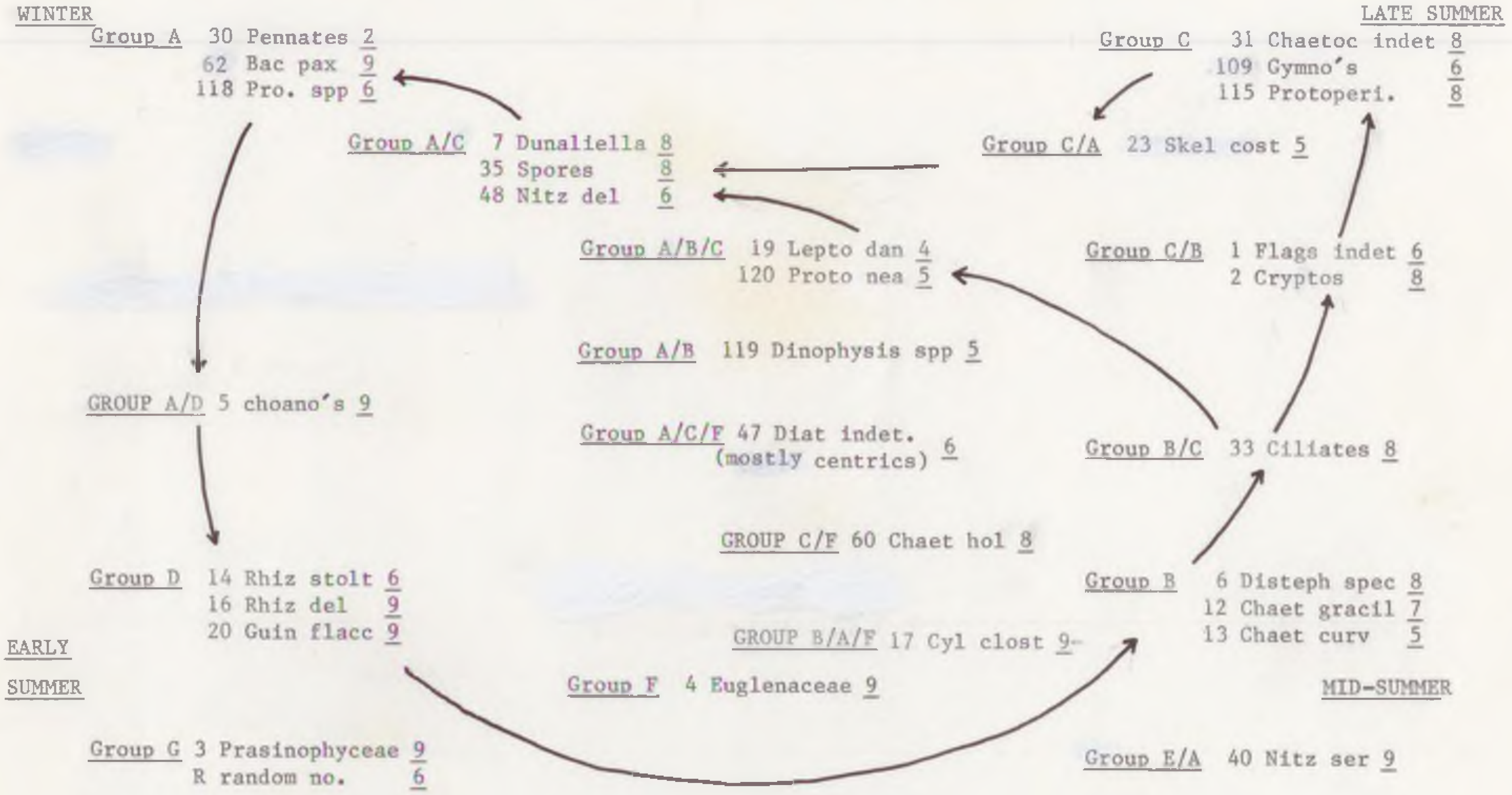
Group G - highly negative on factor 3.

Figure 5.46 shows the spatiotemporal distribution of these groups of stations. From October to March the microplankton in the Narrows was characterised by Group A, and during early summer by group D. During July, August and September considerable patterning was evident, although all stations from July 1973 except one were of group B, and all from August except two were of group C. During October three out of the four stations were intermediate between groups A and C.

The taxa on which the above analysis was based do not all fall readily into the same groups as the stations. Table 5.10 shows the taxa divided into groups using the criteria employed above for the stations. The times of year associated with groups A to D have been inserted in Table 5.6.

Groups of taxa intermediate between the main groups have been given intermediate positions. Groups E, F and G do not appear to be associated with any particular season.

TABLE 5.10 . Taxa grouped according to their factor loadings with R-type P.C.A.



WINTER

Group A 30 Pennates 2
62 Bac pax 9
118 Pro. spp 6

LATE SUMMER

Group C 31 Chaetoc indet 8
109 Gymno's 6
115 Protoperi. 8

Group A/C 7 Dunaliella 8
35 Spores 8
48 Nitz del 6

Group C/A 23 Skel cost 5

Group A/B/C 19 Lepto dan 4
120 Proto nea 5

Group C/B 1 Flags indet 6
2 Cryptos 8

Group A/B 119 Dinophysis spp 5

GROUP A/D 5 choano's 9

Group A/C/F 47 Diat indet. (mostly centrics) 6

Group B/C 33 Ciliates 8

GROUP C/F 60 Chaet hol 8

Group D 14 Rhiz stolt 6
16 Rhiz del 9
20 Guin flacc 9

Group B 6 Disteph spec 8
12 Chaet gracil 7
13 Chaet curv 5

EARLY SUMMER

GROUP B/A/F 17 Cyl clost 9

Group F 4 Euglenaceae 9

MID-SUMMER

Group G 3 Prasinophyceae 9
R random no. 6

Group E/A 40 Nitz ser 9

Conventions: The number before each taxon is that used to denote it in factor diagrams.
The underlined number after each shows its communality
Arrows show the suggested general annual succession.

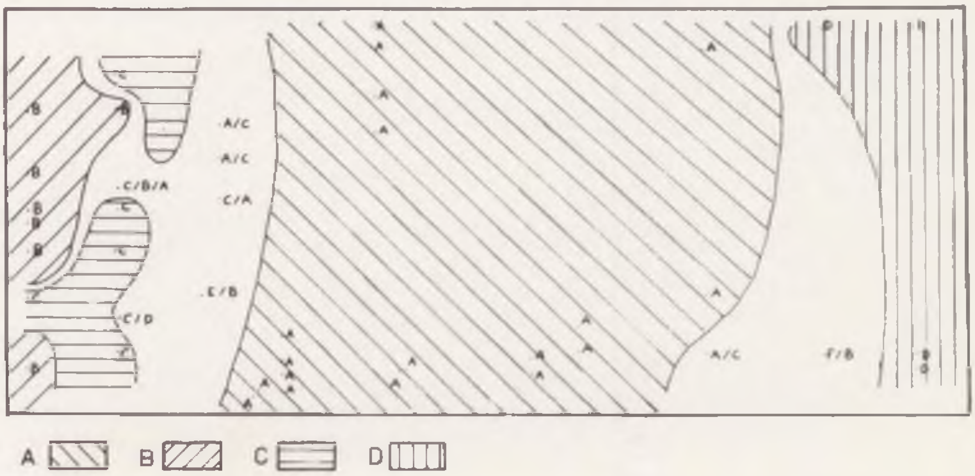


Figure 5.46. Distribution in the Narrows of groups of stations determined by inspection of the R-type orthogonal principal-component analysis loaded on to stations.

Group E appears to be largely determined by *Rhizosolenia alata* and *Nitzschia seriata* and the stations which are effected by this group are 3/1 and 15/1.

Group F, loading highly positive on factor 4, is largely determined by *Chaetoceros holsaticum*, Euglenoids, *Cylindrotheca closterium* and unidentified (mostly centric) diatoms. Many of the unidentified diatoms were probably benthic species; *C. closterium* is a bottom-living as well as a planktonic form (Hasle, 1964), and Euglenoids in inshore plankton are frequently associated with a high sediment or detrital content. It thus seems likely that this group, and factor 4, may have represented the effect of stirring up of benthic material.

In group G, although the random variable loads negative on factor 3, it is only slightly negatively correlated with the diatoms in group D, *Rhizosolenia stolterforthii* (-0.21), *R. delicatula* (-0.11) and *Guinardia flaccida* (-0.27), and the respective correlations for the other taxon in group G, the Prasinophyceae, were 0.00, +0.14 and -0.20. As shown by the 35-station P.C.A. (figure 5.44), factor 3 is stable as it is not substantially changed in the absence of the random variable. Negative loading on factor 3 may thus denote a lack of association with blooms rather than an association with a lack of blooms. This implies that most of the taxa used in the analyses are, to different degrees, positively associated with bloom conditions. Only *Bacillaria paxillifer* (included in group A) appears to be positively associated with non-bloom conditions.

Figure 5.47 shows the results of a Varimax-rotated (delta = 0.0) R-type P.C.A. The clustering around the origin,

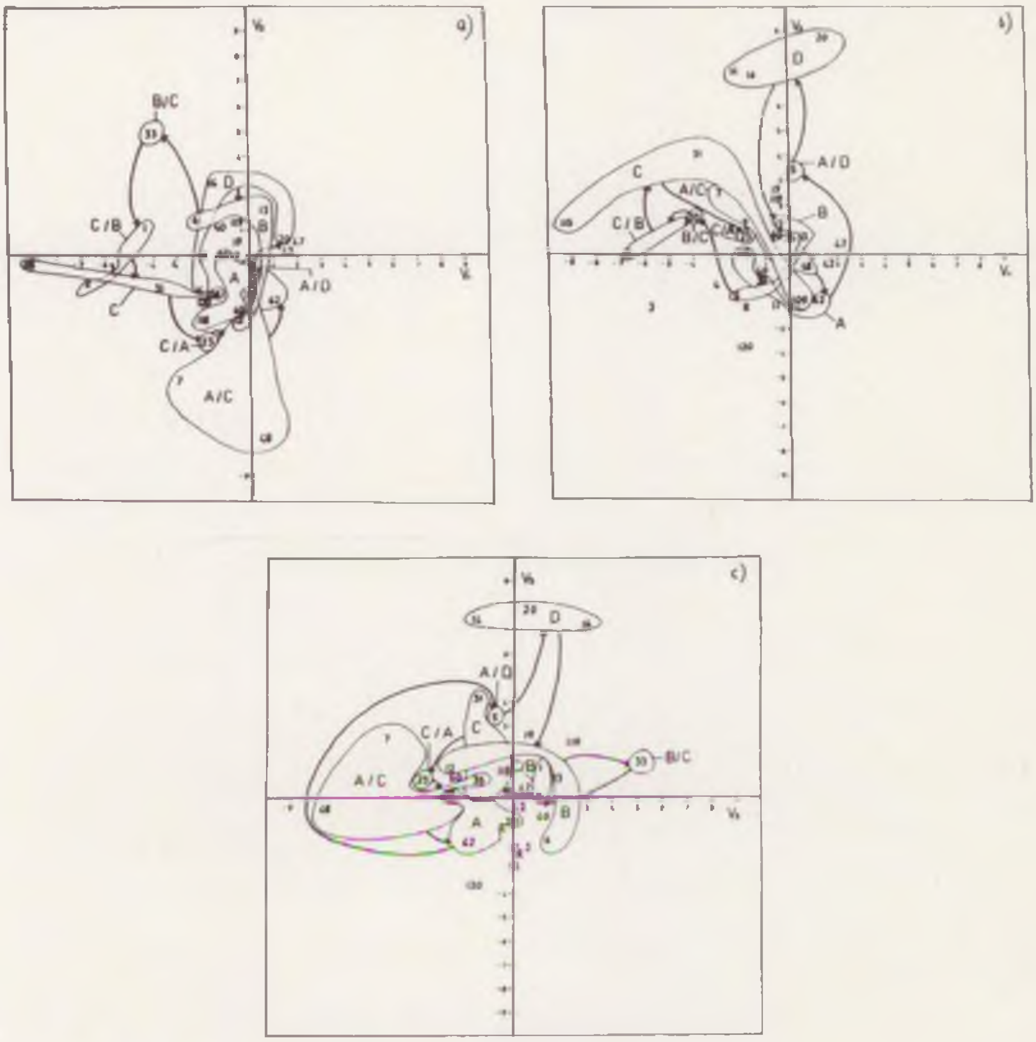


Figure 5.47. A R-type rotated principal-component analysis a) factors 1 and 2; b) factors 1 and 3; c) factors 2 and3.

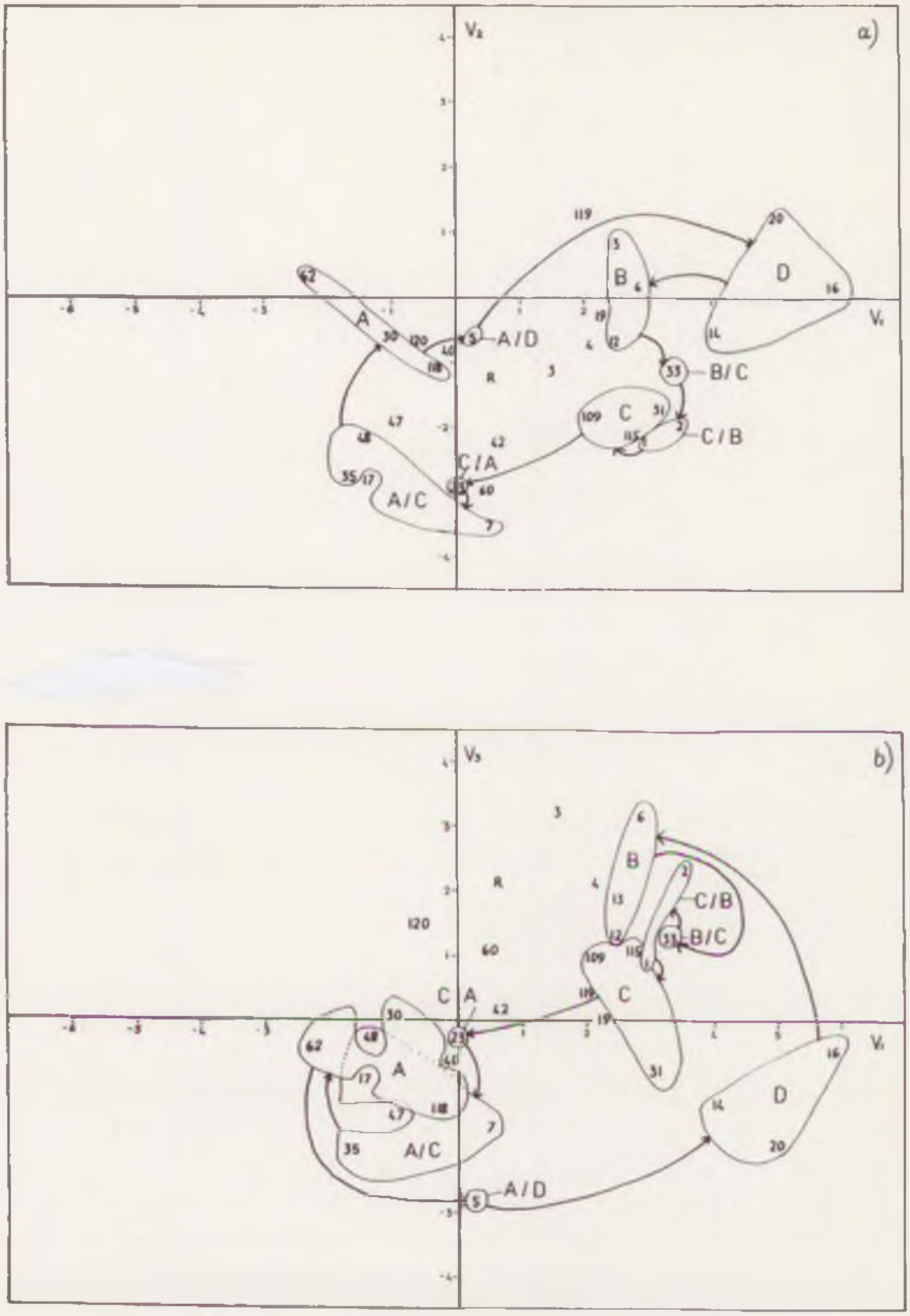


Figure 5.48. An orthogonal R-type canonical-factoring analysis.

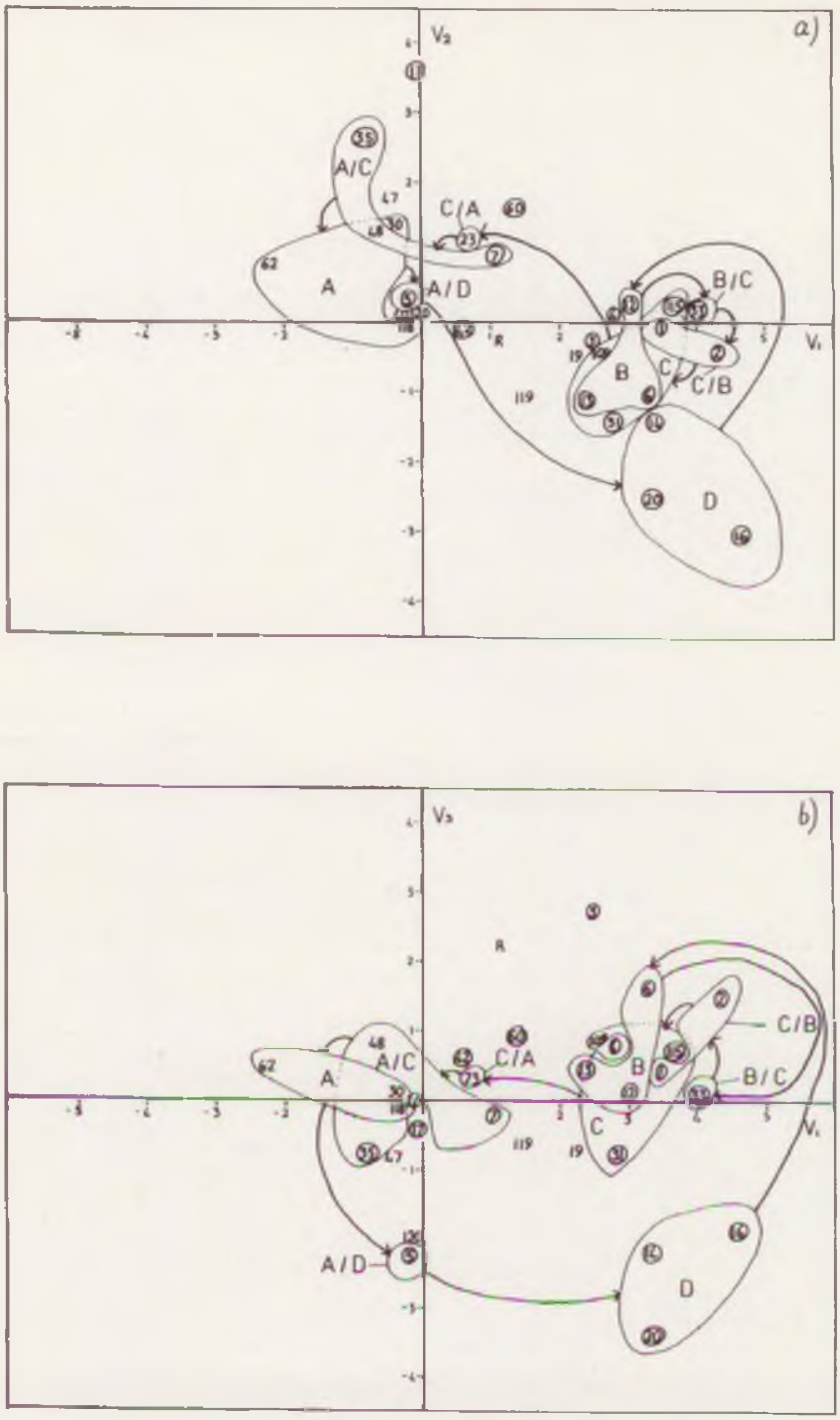


Figure 5.49. A rotated R-type canonical-factoring analysis.

of a large proportion of the factor loadings of the taxa, and the overlapping of groups leads to difficulty interpretation.

In the classical-factor solution (eg the principal-component method) one is seeking a minimum number of factors to account for the observed correlation matrix. The guiding principal of canonical factoring, however, is to find a factor in which the correlation between the set of hypothesized factors and the set of variables is maximised (Kim, 1975).

Figure 5.48 shows the loading of the first three factors derived by R-type canonical factoring. It differs considerably from the R-type P.C.A. While factor 1 still separates groups B and C (mid-summer and late summer) from groups A and A/C (winter and autumn) the main difference is that it loads highest on group D (early summer). Factor 2 is here similar to the same factor with P.C.A., separating groups B and C as well as groups A and A/C. Factor 3, however, loads highest on group B, less high on group C, and less high again on groups D, A and A/C.

The seasonal succession for the groups, as derived, is reflected in the plane of the first two factors of the canonical factoring by a figure-of-eight, as compared with a loop in the P.C.A. In canonical factoring the succession of groups represented in the plane between factors 1 and 3 was also more convoluted than in P.C.A. Therefore, unrotated R-type canonical was found to have less interpretive value, in this instance, than unrotated R-type P.C.A.

Considering a Varimax-rotated solution of canonical factoring (figure 5.49), the cluttering of the groups among factors 1, 2 and 3 rendered interpretation even more difficult than with any of the solutions considered hereto.

We will now consider four Q-type solutions. The first is a straightforward P.C.A. on to stations (figure 5.50). All the stations load highly negative on factor 1. The distribution between factors 2 and 3 is rather similar to a rotated version of the loadings on to factors 1 and 2 produced by the R-type analysis loaded on to stations (figure 5.45). Factor 4 of the Q-type analysis resembled factor 3 of the R-type analysis concerning the positively loading stations, but not concerning the negative loading ones.

While this Q-type analysis was not pursued further, and despite a first factor of virtually no apparent interpretive value which took 78% of the cumulative variance, it is considered that the interpretive value of this analysis would have have rivalled that of the R-type P.C.A.

The Q-type P.C.A. with factors Varimax rotated (delta = 0.0) is shown in figure 5.51. Factor 1 appears to have largely locked on to the summer-winter axis. Factors 2 and 3 separate groups B and C in a similar manner, but reversed the respective loadings of many stations within group A. Nevertheless, the correlation between the two factors is high, +0.6. Factor 4 loads highly positive on to group D, like factor 3 in the R-type unrotated P.C.A. (figure 5.45), but the least positively loading stations of these two factors are different. It is considered that this analysis is one of the most difficult to interpret.

The last two treatments to be considered are Q-type canonical-factor analyses, firstly orthogonal, and secondly rotated. The unrotated analysis is presented in figure 5.52. While factor 1, accounting for 78% of the

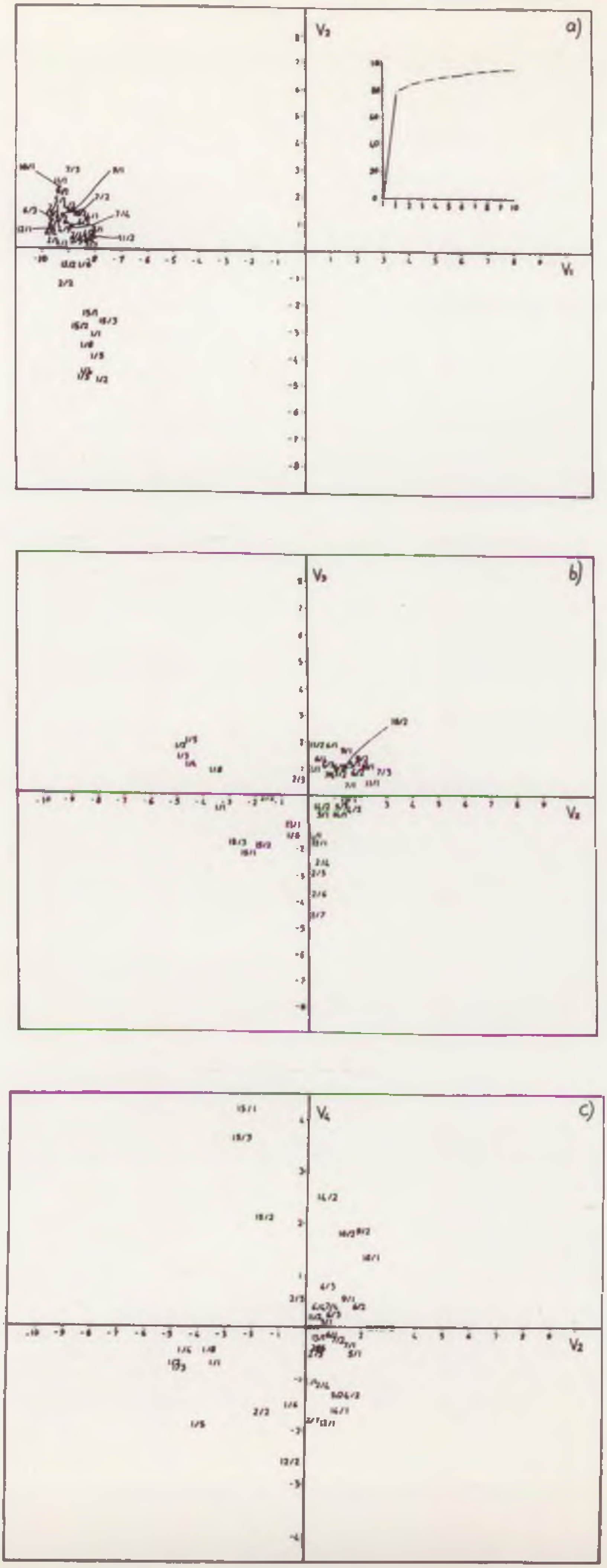
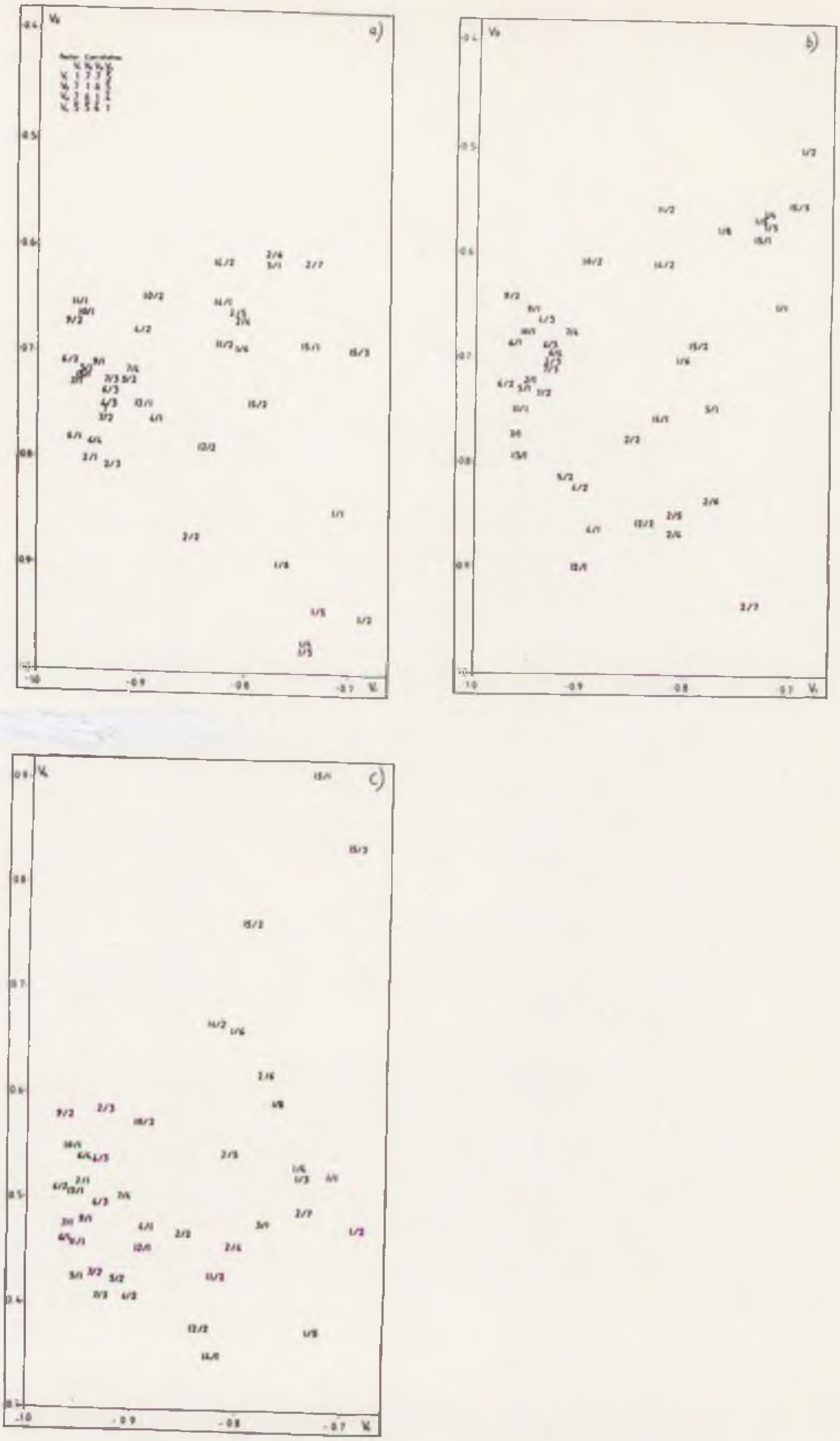


Figure 5.50. An orthogonal Q-type principal-component analysis.



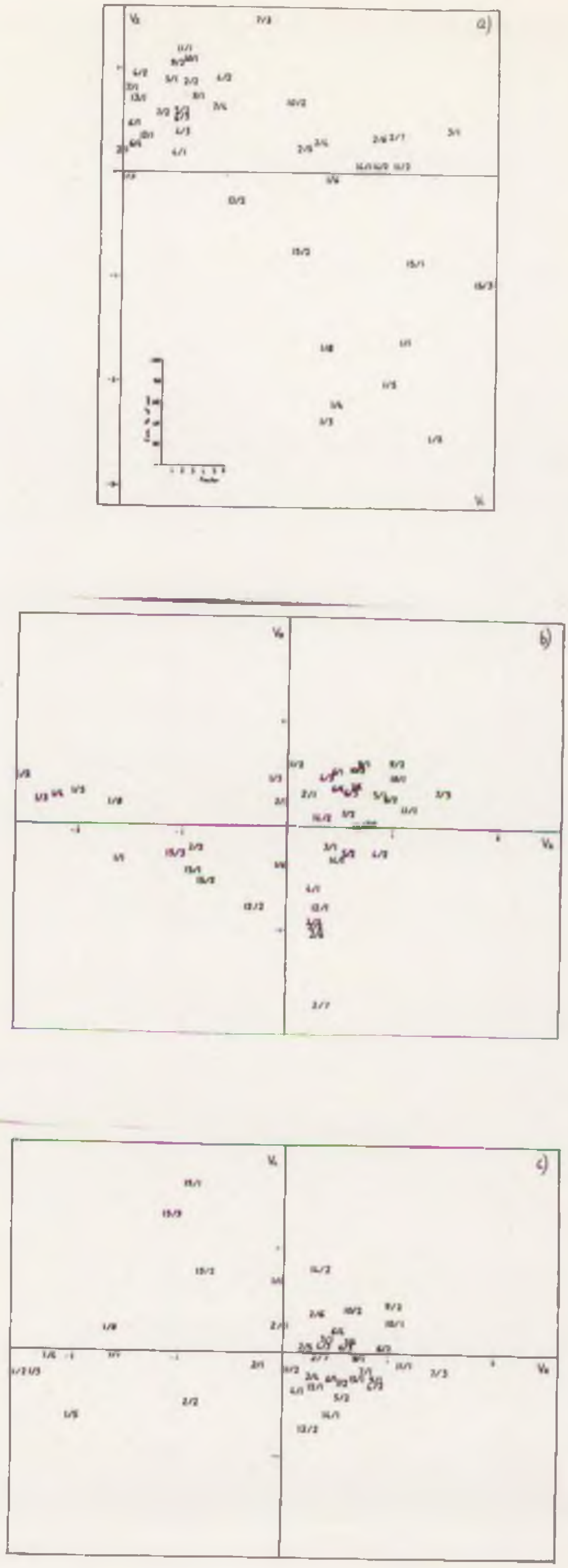


Figure 5.52. An orthogonal Q-type canonical-factoring analysis.

variance, has little interpretive value, factors 2,3 and 4 correspond reasonably closely with factors 1, 2 and 3 of the R-type P.C.A. loaded on to stations (figure 5.45). It is considered that this method of analysis would give good interpretive value were it developed further.

The Q-type canonical-factoring analysis, Varimax rotated (figure 5.53), gave a solution with low interpretive value as did the other rotated solutions considered here.

It was found that in all types of analysis considered, orthogonal solutions, both R-type and Q-type, were easier to interpret than rotated solutions. Furthermore, the results of principal-component analyses appeared to have more interpretive value than those of Rao's canonical-factoring analyses.

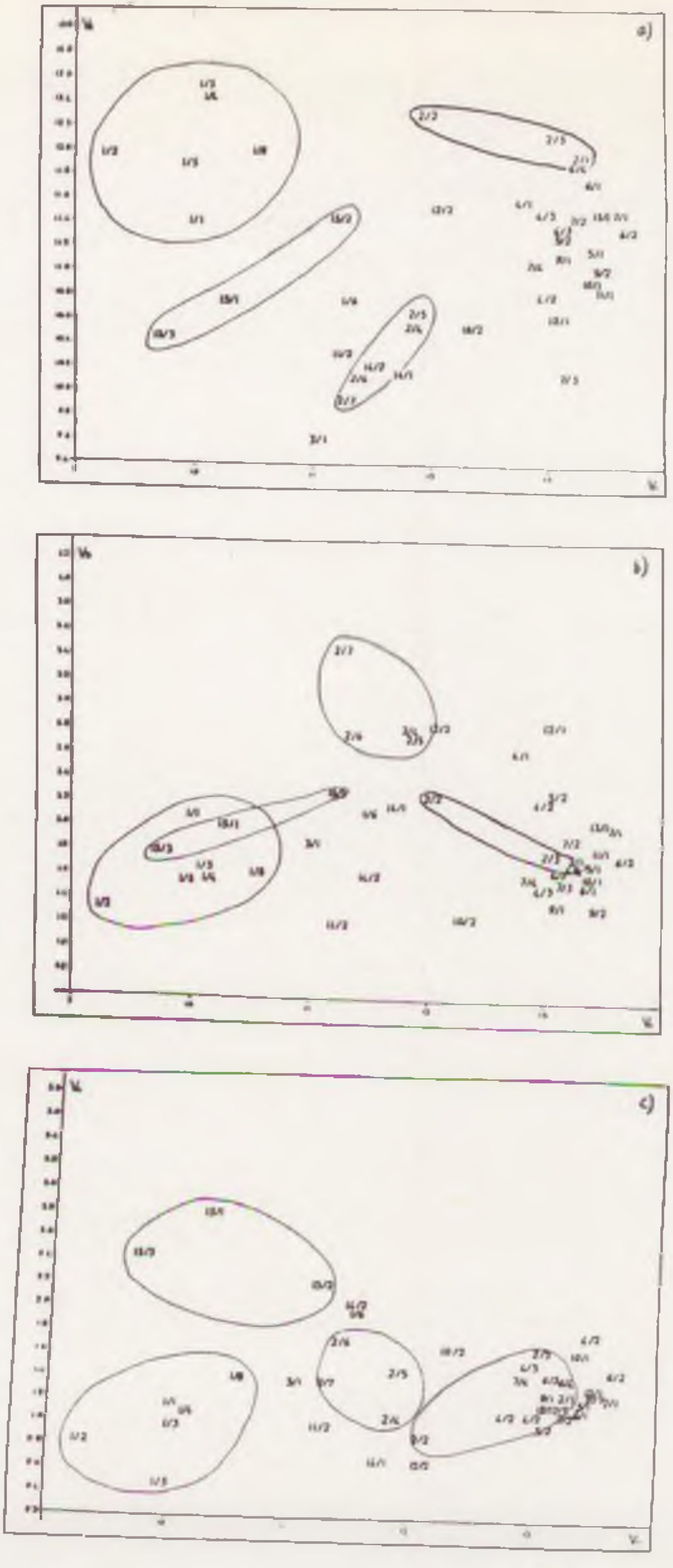


Figure 5.53. A rotated Q-type canonical-factoringanalysis. a), b), c), d) loading on to factors; e), f), g) distribution of factors in the Narrows.

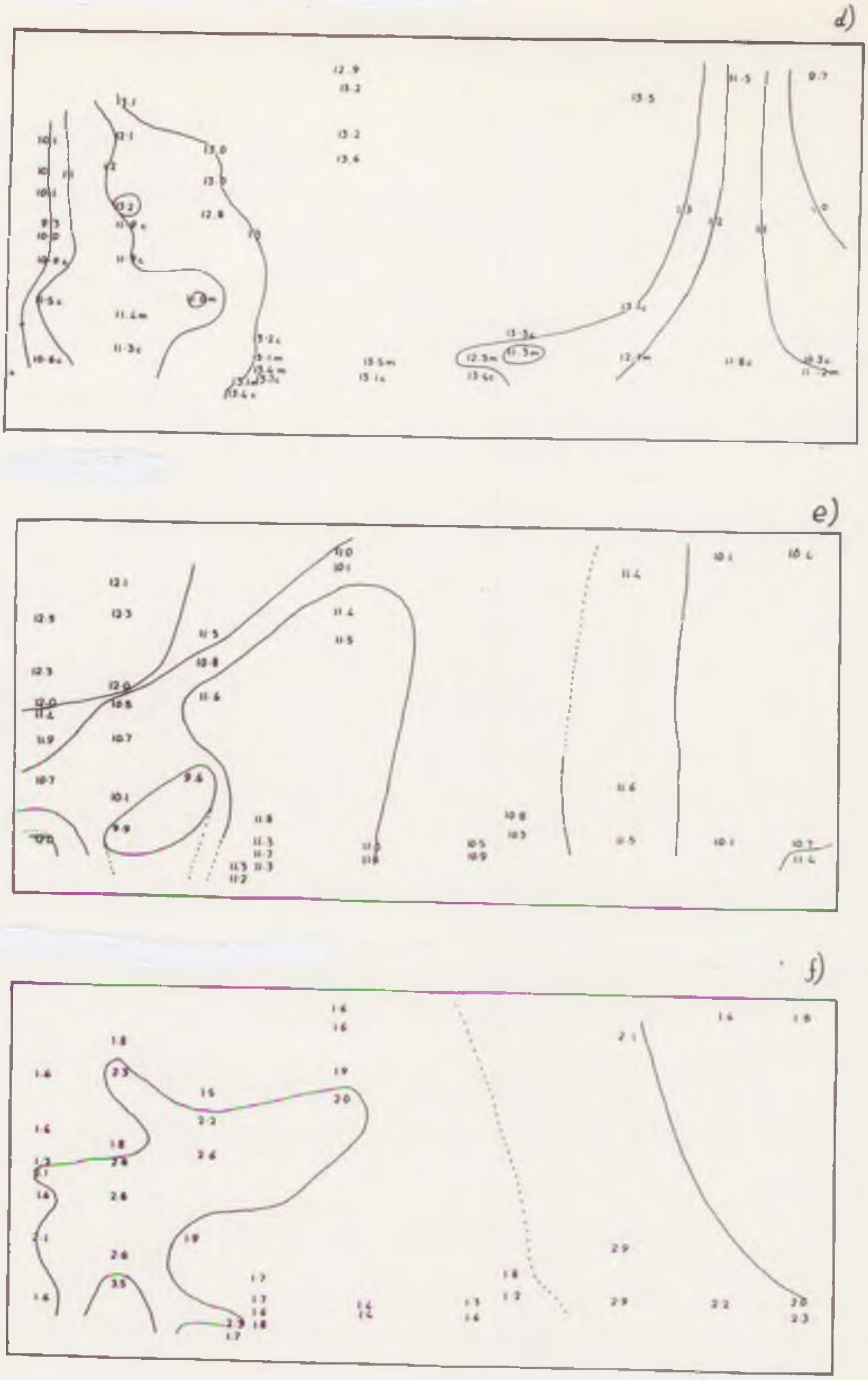


Figure 5.53. Legend page157.

vi) Pigment analyses

The results of the pigment analyses are shown in Table 5.11, the water sample having been filtered serially through the 1.2 um and the 0.45 um filters. Values for both filters have been summed to arrive at the "total" chlorphyll a and phaeophytin a.

In a few cases, small negative values were calculated from the spectrophotometer readings, and these have been counted as zero.

In the samples from cruises 12 and 13, where diatoms contributed 25% or less of the total nano- and micro-plankton organic carbon, the percentage of the total chorophyll a retained by the 1.2 um filter varied from 17 to 40. However, in the samples from cruise 15, where diatoms accounted for 35 to 65% of the nano- and micro- plankton organic carbon, the percentage retained by the 1.2 μm filter varied from 96 to 100%.

Figure 5.54 shows the relationship between total chorophyll a and the volume of nano- and micro- plankton for six samples from cruises 12, 13 and 15. Figure 5.55 shows the relationship with the concentration of nano- and micro-plankton-contributed organic carbon.

For the six samples the relationship between chlorophyll and volume had a significance level of only 0.09, while that between chlorophyll and estimated carbon had a significance level of 0.011. While results based on so few samples must be treated with the utmost caution, the indication is that organic carbon correlates better with chlorophyll a than does biovolume.

TABLE 5.11

Results of pigment analyses

Station	Pore size of filter	Chlor a	Phaeo a	Chlor a + Phaeo a	R
12.1	0.45	0.948	2.23	3.18	0.40
	1.2	0.632	1.59	2.22	
		1.580	3.82	5.40	
12.2	0.45	1.438	1.29	2.73	0.17
	1.2	0.286	2.36	2.64	
		1.724	3.65	5.37	
13.1	0.45	0.674	0.04	0.68	0.50
	1.2	0.674	0	0.68	
		1.348	0.04	1.35	
15.1	0.45	0	1.01	1.01	1.00
	1.2	2.214	0	2.21	
		2.214	1.01	3.21	
15.2	0.45	0	2.08	2.08	1.00
	1.2	2.63	0.60	3.23	
		2.63	2.68	5.31	
15.3	0.45	0.278	0.44	0.718	0.96
	1.2	6.246	0	6.246	
		6.524	0.44	6.964	

Abbreviations: Chlor a - chlorophyll a

Phaeo a - phaeophytin a

R - ratio of chlorophyll a retained by the 1.2-um filter to the sum of that retained by both the 1.2 and 0.45-um filters

Units: Pore size of filter - um

Pigment concentration - mg m^{-3}

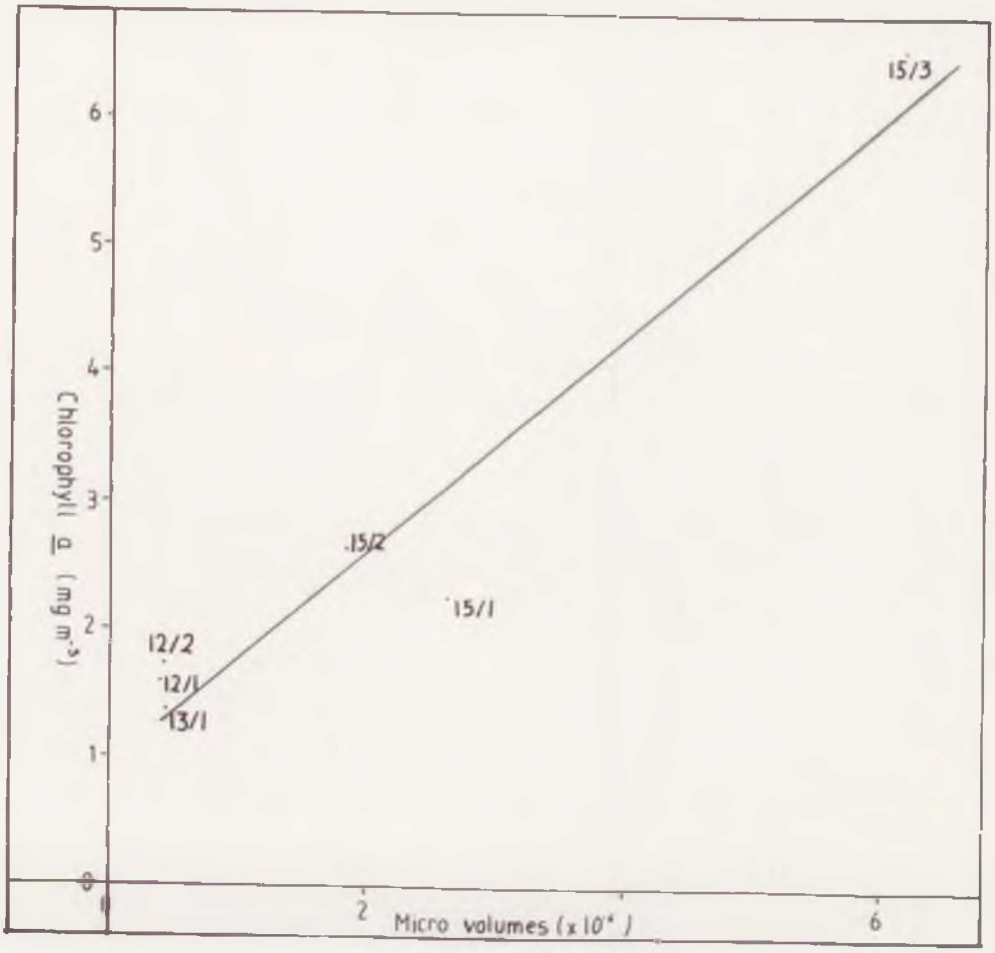


Figure 5.54. Relationship between chlorophyll a concentration and nano- and micro-plankton volume (figures show station numbers)

54

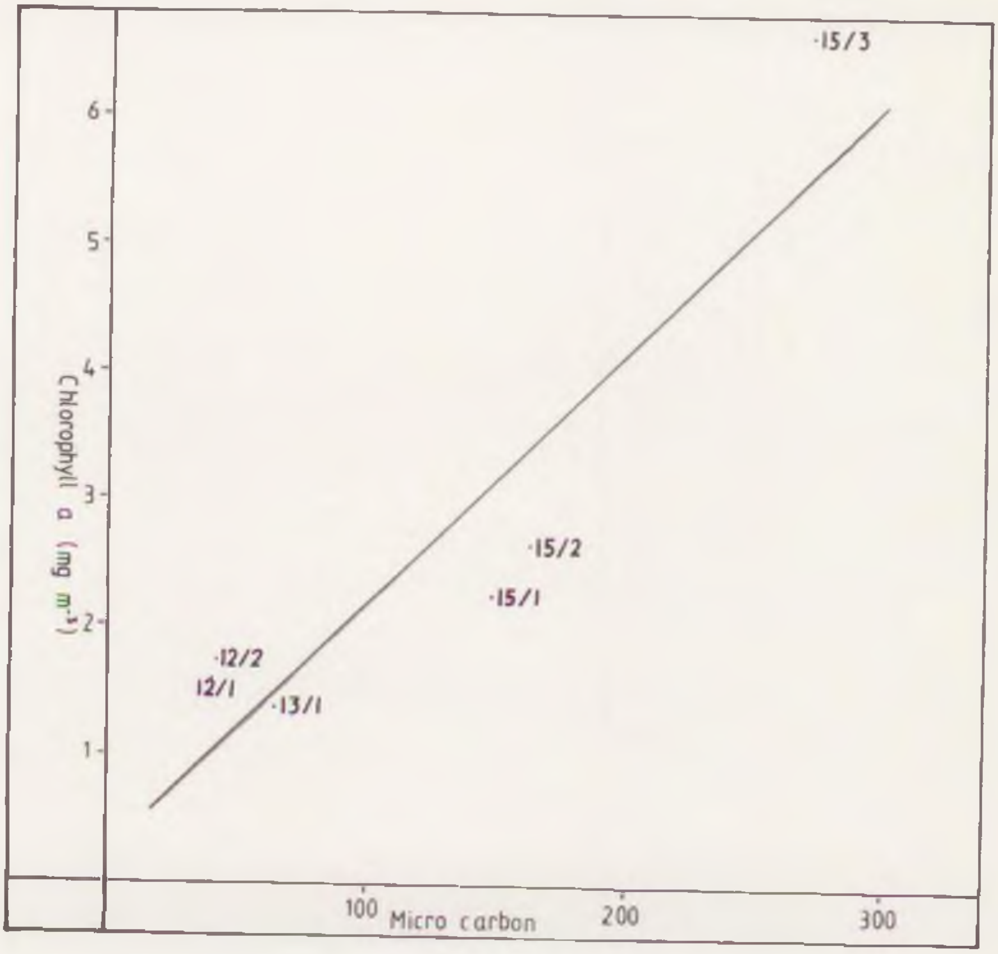


Figure 5.55. Relationship between chlorophyll a concentration and nano- and micro-plankton organic carbon.

The relationship between chlorophyll _a_ and organic carbon of about 2% is near the average for phytoplankton found by Antia _et al._ (1963, quoted by Takahashi _et al._, 1975).

Although the samples were filtered under weak vacuum, up to 83% of the chorophyll passed through a 1.2 um membrane filter with the sample was dominated by flagellate and ciliates. However, in samples dominated by large diatoms no more than 4% of the chlorophyll passed through. This indicates the the soft-walled organisms were rupturing under gentle vacuum, thus releasing their contents. This has implications not only for pigment analyses but also for nutrient determinations, especially where the nano- and micro- plankton is dominated by soft-walled flagellates and ciliates.

vii) Experiment to determine the time necessary for settlement

Figure 5.56 shows the counts of: diatom chains; flagellates; and spores for one pair of settlement chambers, prepared for counting after each of five settlement times.

The figure shows that settlement was still going on after about 8 hours for all three classes of plankton. Because of sampling error, however, no more precise relationship between settlement and time could be established.

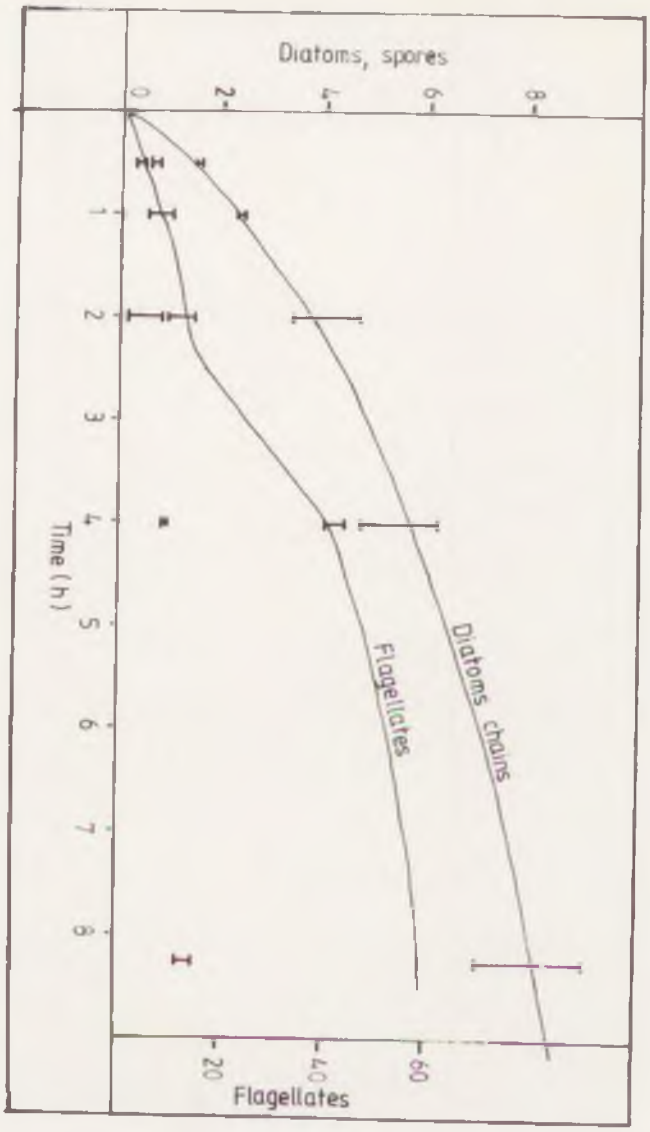


Figure 5.56. Quantity of diatoms, spores and flagellates settled in settling chambers after five different periods. (Bars show ranges).

6. DISCUSSION

(a) CURRENT MEASUREMENTS, AND ASSOCIATED TEMPERATURE AND SALINITY DETERMINATIONS

i) The short periodicities in velocity

I Types of short periodicities.

The terms, "short periodicity" and "short oscillation" are here used to mean those periodicities or oscillations of frequency greater than the M_2 tide (12 h 25 min).

From the data given in Table 5.1, the periodicities in water velocity found in Strangford Lough have been divided into three classes: 1) a 50- to 80- minute oscillation present at most stations during the flood and over local HW; 2) a 40- to 70- minute oscillation present during the ebb, and noticeable only at stations 7 and 11; and 3) a 30-to 40-minute periodicity noticed to be weekly present at station 18 during the flood.

II Theoretical considerations of possible resonance in Strangford Lough due to low-frequency gravity waves.

The principal oscillation in Strangford Lough, the M_2 tide, is due to forcing from outside through the Narrows.

The velocity of a gravity wave, whose length, ℓ, is long relative to the water depth, d, is independant of ℓ, and is given by

$v = \sqrt{g\ d}$ (Firth et al., 1973)

Where g is the acceleration due to gravity, and d is the depth.

Neglecting the Coriolis effect, the resonant frequency along the length of a wide, uniform body of water of length, , and depth, d, is thus

$$T = 2\frac{\ell}{\sqrt{g\ d}}$$

Since the topography of the lough is very complex, the full investigation of resonant frequencies would require a computer model beyond the scope of this thesis. However, by considering the lough and, separately, its basins, as uniform bodies of water, the following resonances have been calculated.

Along the lough,

where d = 30 m and ℓ = 20 km, then T = 38 min;

where d = 35 m and ℓ = 20 km, then T = 36 min;

where d = 25 m and ℓ = 25 km, then T = 53 min;

where d = 20 m and ℓ = 20 km, then T = 59 min.

Across the lough,

- southern basin,

where d = 30 m and ℓ = 4.5 km, then T = 9 min;

- middle basin,

where d = 12 m and ℓ = 6 km, then T = 18 min;

- northern basin,

where d = 5 m and ℓ = 6 km, then T = 28 min.

III The flood tide considered as an impinging jet, and its possible interation with low-frequency gravity waves.

When a gas jet is directed to impinge upon a plate, oscillations may build up resulting in an audible note. Research on this "screach effect" has been reviewed by Ho and Nosseir (1981), who also carried out measurements and photographic observations on impinging jets of gas leaving a nozzle at speeds of 0.3 to 0.9 Mach.

Ho and Nosseir demonstated two branches of a feedback loop leading to resonance in impinging air jets. The two branches were, firstly, downstream convected coherent vortices and, secondly, upstream-propagated pressure waves. Finally a phenomenon named "collective interaction" was observed, and shown to be essential for self-sustained oscillations in a non-resonant apparatus.

Ho and Nosseir also found that at the boundary of the jet, small vortices formed in the shear plane, but that as the distance from the nozzle increased, the vortices coalesced more and more into larger structures, tending to a limit corresponding to a resonant frequency. They showed that this coalescence was forced by "flapping" of the jet at the nozzle, leading to meandering of the consequent flow (figure 6.1) and that this was in turn forced by pressure waves propagated back upstream as a result of the large vortices impinging on the plate.

The jetstream issuing from the Narrows into the body of Strangford Lough during the flood may be considered

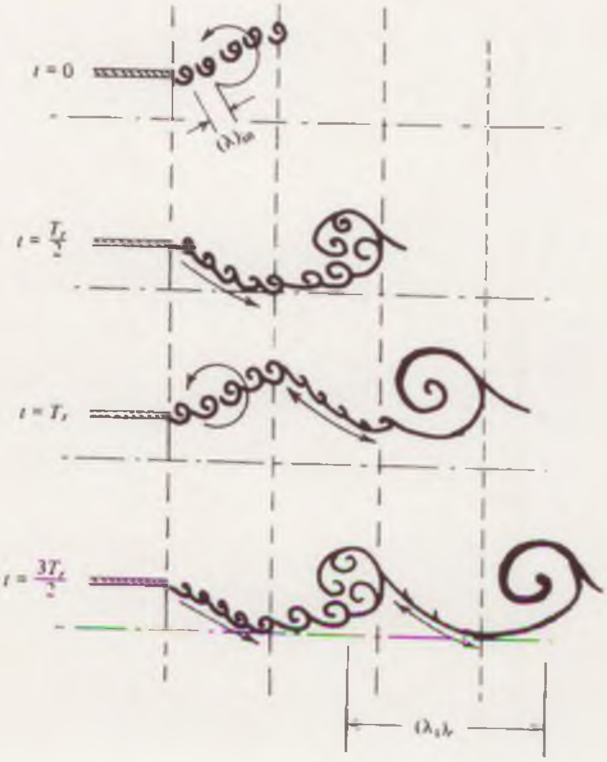


Figure 6.1. Diagrammatic representation of the coalition of small eddies, formed at the edge of an impinging air jet, into larger ones. This process was forced by "flapping" of the jet at the nozzle, itself forced by pressure waves propagated back upstream as a result of large vortices impiging on the plate (from Ho and Nosseir, 1981).

6.1

analagously. It emerges at at least 3 m s $^{-1}$ at mean springs; that is at about 0.15 of the speed of long gravity waves in that part of the lough. It may be considered as impinging on two plate-analogues, a porous one comprising the Limestone Rock-Limestone Pladdy- Dunnyneil Island-Long Rock-Killyleagh Reefs complex of shallow water, and behind it a solid one comprising the shore around Killyleagh and Holme Bay (figure 5.1).

Three possible mechanisms for the initiation and sustenance of a roughly hourly resonance are now considered.

The first possible mechanism is a feedback loop comprising coalescent vortices, formed in the shear plane at the edges of the jetstream, being entrained in the countercurrents north and south of the jetstream. As these are returned in the counter-current to the area where the jetstream emanates from the Narrows, and are re-entrained in the jetstream and/or destroyed, they may cause the jetstream to "flap".

Secondly, the drogue results (figure 5.1) tentatively suggest that water from the Narrows would take very roughly an hour to reach Dunnyneil Island. Since a gravity wave from a resultant change in sea level on the coast of Dunnyneil Island would take about 3 min (at 18 m s $^{-1}$) to reach the area of emanation from the Narrows, any modification of the flow by such gravity waves might lead to resonance at a frequency of about 1 h $^{-1}$.

A third possible mechanism for the hourly oscillation may be set up by the creation of a pressure wave when the flood initially emanates from the Narrows. This would resonate in the length of Strangford Lough at a frequency of

1/38 to 1/59 min^{-1}. As such a resonant wave would travel at a large angle to the jetstream, this would reinforce any tendancy it might have to cause "flapping" of the jet.

The earliest that oscillation can be seen on the traces of velocity is at about 1 h 40 min after the start of the flood, even at the Narrows. This, and the fact that these hourly oscillations vary in time relative to the start of the flood, indicate that turbulent effects are probably responsible for their initiation.

It is likely that either the first or the second above mentioned possible mechanisms of collective interaction, or both, are responsible for initiating oscillations, perhaps of a wide range of frequencies, and that along-lough tuning increases the "gain" in the feedback loop at a frequency of roughly 1 h^{-1}

IV The 40- to 70- minute ebb-tide oscillations

Except at stations 7 and 11, no oscillations could be detected in the lough during the ebb, later than one and a half hours after local HW.

Considering the averaged progressive vector diagram for station 7 (figure 5.21), it is clear that the ebb at this station begins running strongly south-west. From 2 to four and a half hours hours after local HW, however, it turns south, ant its mean velocity decreases.

Reference to the two-tide traces, however, shows that as the mean direction changes from south-west to south, and even to south-by-east during the period from 2 to four and a half hours hours after local HW, more or less periodic, sudden changes in direction occur between a strong south-westerly stream and a less strong south-easterly stream.

It is likely that the south-westerly and the south-easterly phases of this alternation represent currents passing southwards round, respectively, the eastern and the western points of Long Sheelah, a bank to the north of this station, and that as the ebb progresses, this station becomes more and more influenced by the stream from the west at the expense of that from the east, as suggested in section 4.a.ii.III. However, during this period, collective interaction between these two streams may cause the oscillation of both.

At station 11, the direction of the current changes only slightly during the ebb, from south-by-east to south-by-west. The mean speed decreases linearly between about 2 h after local HW and LW. During the ebb, small oscillations sometimes appear on the traces of easting, northing and direction.

It seems likely that the south-westerly stream, manifest at station 7 during the ebb, may continue by inertial flow to reinforce the ebb stream in the channel west of Dunnyneil Island, and that, consequently, oscillations in the strength and/or direction of this current may be felt even as far south as station 11.

V The 30- to 40-minute oscillation at station 18

Amongst the stations for which data are available, station 18 is that placed nearest to the centre of the jetstream. However, as shown in the mean progressive vector diagram (figure 5.31), after about an hour of the west-north-westerly flood stream, the countercurrent interacts with the jetstream to produce a low mean flow to the north-west, indicating a zone of entrainment into the jetstream.

Station 18's greatest proximity to the centre of the jetstream may be the cause of this being the only station at which such short oscillations are represented. They may be caused by small vortices in the course of coalescing into larger ones, as suggested in section 6.a.i.III. Alternatively, such oscillations may be caused by an unkown phenomenon operating further south in the Narrows. In either case, that oscillations of such frequency are present on the edge of the jetstream but are not important in the body of the lough is evidence that the lough has no tendancy to resonate at the frequency of 1/30 to 1/40 min $^{-1}$.

VI Further considerations

While more detailed consideration of the tidal spectra in Strangford Lough are beyond the scope of this thesis, the edited time-series current meter data are available for further analysis, and consideration of these data should be undertaken before planning any further current meter survey in Strangford Lough.

Useful further analyses of the present data could include: 1) polar listing of the velocity co-ordinates; 2) time-series progressive vector diagrams; 3) spectral analysis, using Fast Fourier Transform of the easterly and northerly components of velocity to give a rotationally-invariant estimate which can be related to horizontal kinetic energy; and 3) further investigation of the variation over time of different spectral components by means of complex demodulation (SCOR Working Group, 21, 1969).

Since at the Nyquist frequency (twice the sampling interval), environmental variations cannot be distinguished from encoding errors, current meter records cannot be used to investigate periodicities shorter than three times the sampling interval. In view of possible shorter periodicities in Strangford Lough, a survey with a current meter set to a short sampling interval, say 30 to 60 s, would be necessary to investigate them.

A survey using one or more automatic tide guages, preferably with sumultaneous current meter deployment, would be useful to indicate whether hourly sea-level oscillations, particularly south-east of Dunnyneil Island and in Holme Bay, may precede or follow the initiation of hourly oscillations in velocity in the flood-tide jetstream issuing from the Narrows. Such information could shed light on whether the first, second or third (Section 6.a i.III) or some other mechanism is responsible for the 50- to 80- minute periodicities generally prevalent in Strangford Lough.

Observations on the vorticity of the inflow could very easily be carried out by airborne infra-red photography of the southern basin at times of high temperature differences between Strangford Lough and the Irish Sea. Currently available satellite imagery may not have sufficient resolution.

ii) The tendancy of Strangford Lough to stratify

Because it reduces the mixing depth, stratification of the water column is a determinant of phytoplankton development(see section 6.iv).

Stratification in inshore and shelf waters may lead to dense blooms of dinoflagellates, particularly where fronts occur between stratified and unstratified water (De Souza & Silva, 1964; Evans, 1976; Simpson and Pingree, 1978; Simpson et al., 1979; Incze and Yentsch, 1981; Holligan, 1981). Such dinoflagellate blooms may prove toxic or otherwise fatal to marine organisms, especially farmed fish and shellfish. Examples of this problem around north-western Europe are related by Rae et al. (1965), Helm et al. (1974), Tangen (1977), Ottway et al. (1979), Leahy (1980), Jenkinson and Connors (1980), Cross and Southgate (1980), Parker (1981) and Jones et al. (1982).

Because large salinity differences appear not to occur in Strangford Lough (Boyd, 1973b; the present survey), salinity is unlikely to be important in determining stratification.

In any body of water in which there is net heat input to the surface layer, stratification tends to occur due to thermal expansion. A stratified water colum possesses stability because it has less potential energy than it would were it to be mixed. Thus in order to mix a stratified water column, energy must be supplied in practice, either by current shear at the bottom, or wind shear at the surface.

TABLE 6.1

The stratification parameter, S, for a selection of current meter stations and mid-Narrows, for mean springs. Stratification is expected to develop in summer at values above 2.0, and is not expected at values below 1.5 (Simpson and Hunter, 1974).

Location	S
station 2	0.8
station 3	1.1
station 4	0.7
station 5	0.5
station 6	0.2
station 7	0.7
station 8	1.2
station 9	0.8
station 10	0.7
station 11	0.2
station 12	0.7
station 18	-0.4
Mid-Narrows	roughly -1.4

For mean neaps, increase values by 0.25.
A reduction of water flow by a half, e.g. due to a barrage, would increase values by a further 0.3.

Pingree and Griffiths (1978) found that, whether the water column stratifies or remains mixed on the north-western European continental shelf in summer is determined in practice by a stratification parameter.

$$S = \log_{10}\left[\frac{d}{\langle |u|^3 \rangle}\right]$$

where d is the depth of water and $\langle |u|^3 \rangle$ is the mean of the cube of the current speed.

Simpson and Hunter (1974) have shown that the location of fronts separating mixed and stratified water may be predicted in practice, for the shelf in summer by calculating S. Where S exceeds 1.5 to 2, stratification occurs. Otherwise the water column remains mixed. In shallow water, however, wind-induced mixing may be more important than tidal stirring.

Table 6.1 gives values of S for a selection of current meter stations in Strangford Lough.

It is thus predicted on theoretical grounds that stratification will not normally develop in the body of Strangford Lough. Temporary stratification may occur, however, in particularly sheltered bays, especially during and after exceptional periods when calm weather, high heat input and neap tides coincide. Current measurements were not carried out in the inner northern basin and in the Quoile estuary, but these two areas might at present be occasionally susceptible to such stratification.

Temperature profiles carried out by the author in the southern basin showed the water column to be mixed, and the author is not aware of a thermocline having been observed in any part of Strangford Lough. Providing the tidal flow in Strangford Lough remains unaltered, it is unlikely that dinoflagellate blooms would pose a threat to marine organisms.

In a proposal for tidal barrage across the mouth of Strangford Lough (Northern Ireland Economic Council, 1981), a reduction in tidal range by a half is envisaged. This would increase the stratification parameter in the lough by 0.3. The water stations 8 and 3 (figure3.4) might then stratify during during warm spells and neap tides during the summer. The inner northern basin and the Quoile estuary would be likely to stratify for periods of several weeks in some summers, which could allow dinoflagellate blooms to develope in these areas, with the consequent potential for damage to fish and shellfish.

iv) Temperature-salinity data as indicitive of surface-water masses

Where water is isolated from the surface, as in the deep-water masses of the oceans, conservative properties such as temperature and salinity remain virtually unchanged except by mixing with other water masses. Consequently, deep-water masses may be characterized by the relationship between temperature and salinity, as shown in different parts of the water mass. By this means, deep-water masses may be traced over thousands of kilometers, and over tens to hundreds of years (King, 1962).

Where water is in contact with the surface, its properties, particularly temperature and salinity, are subject to much more rapid change. In practice, however, its temperature and salinity may still change sufficiently slowly that its T/S relationship may be used to characterize and follow it. The time-scale for which this is possible depends largely on the depth of the surface-water mass, but in inshore waters it is frequently a few hours to a few days.

Following this approach, Hensey (1980), who investigated the Shannon estuary at three times of year, found that its waters could consistantly be divided into three "water bodies", or surface-water masses, on the basis of their T/S relationships. Furthermore, she found that the zooplankton comprised different associations, characteristic of each water mass.

Previously, Bary (1964) had shown that three surface-water masses could be identified in the vicinity of the shelf-break in the north-east Atlantic. They were identified by their T/S characteristics, despite the seasonal variation of their temperatures and salinities. Although salinity and temperature varied more, over the year within each water mass, than it did between water masses, the partition of zooplankton species among the surface-water masses remained relatively constant. Bary interpreted this contancy of partition as evidence that the distribution of the zooplankton species was determined not by temperature and salinity, but by other unknown properties of each water mass.

From the time-series current meter data with associated T/S diagrams, presented in Appendix 1, the water in Strangford Lough has been divided into the following surface-water masses.

Surface-water mass 1: Irish Sea Water

Properties: This water is always more saline than the other water masses in the lough, and it is influenced by air temperature more slowly than are the other surface-water masses (SWM's). Thus in spring and summer surface-water mass 1 is generally colder, and in winter warmer than the other waters of the lough.

Manifestation: In the absence of simultaneous T/S data from the Irish Sea water outside the Narrows, it is impossible to know whether Irish Sea water reaches the inner end of the Narrows unmixed with Transition Water (surface-water mass 4). SWM 1 is shown well in most of graphs of data from stations 13, 14, 15, 16, 17 and 18 at the inner end of the Narrows. In some graphs, for example figures A1.13.9, A1.13.12, A1.13.13, A1.18.3 and A1.18.4, there is evidence that two SWM's, denoted SWM 1a and SWM 1b, may enter the lough with the flood tide.

Formation: The formation of the Irish Sea water is beyond the scope of this thesis. However, it may be noted that in summer the water outside the narrows is generally stratified. A front separating stratified water from mixed water to the north may be seen on satellite photographs (Simpson et al., 1979, fig. 1; Holligan, 1981) to intersect with the Ards Peninsula between Donaghadee and Strangford Lough entrance. Thus in summer, the flood tide may be expected to bring into the lough waters from both above and below the thermocline, mixed together to some extent during their passage through the Narrows.

Surface-water mass 2: Strangford Lough Central Water

Properties: This water is always less saline than SWM 1, and varies in salinity relative to SWM 3. During periods of warming it is generally colder than SWM 3, but warmer than SWM 1. However, its T/S properties do not in general lie on a straight line between those of SWM 1 and those of SWM 3. Nevertheless they often appear to do so within the resolution of the current meter's temperature and salinity probes.

Manifestation: Because SWM 2 is formed initially from the mixing of 1 and 3, during periods of stable temperature, it is indistinguishable from a mixture of SWM's 1 and 3 formed shortly before observation. During periods of rapid warming, however, its temperature falls below the straight line which represents the temperature-salinity mixture of SWM's 1 and 3, because SEM 3 is formed in shallow water.

During periods of cooling the contrary would be expected.

Formation: Strangford Lough Central Water is formed in the deeper areas of the middle and perhaps the northern basin of the lough, as well, perhaps, as in the northern part of the southern basin over LW. While there is exchange with SWM 3 and with SWM 1, SWM 2 has remained in the deep parts of the lough for, on average, a few tides. Thus it must have biological properties distinct from of SWM 4 (Transition Water).

Surface-water mass 3: Strangford Lough Peripheral Water

Properties: This water is always warmer than the other SWM's during periods of warming, and colder during periods of cooling. Its salinity varies from that of SWM 1 to considerably less than the other SWM's.

Manifestation: Characteristic T/S relationships frequently characterize this SWM. It is also often identified by short-lived spikes on the temperature and/or salinity traces, which incicate that the total volume of this SWM is not large.

Formation: Strangford Lough Peripheral Water is formed in bays, shallows and tidal parts of the lough. It is thus comprised of many more or less discrete sub-masses. Some of these have been identified from the current meter time-series data and T/S diagrams. They are as follows.

Sub-mass 3a: Quoile Estuary Water

Properties and manifestation: In some T/S diagrams for stations at the south of the lough and near the Narrows e.g.many figures A1.13.1 to A1.18.6, low salinity deviations may be observed relative to the usual SWM 1 - SWM 4 T/S relationships. That such deviations are not evident in all such traces may be due either to low freshwater discharge by the Quoile River or to intense mixing in the southern part of the lough, which may mask the manifestation of sub-mass 3a.

Formation: Quoile Estuary Water is formed in the Quoile estuary and over adjacent shallows and flats, and it receives variable freshwater input from the Quoile River.

Sub-mass 3b: Sliddery Bay Water

Properties and manifestation: This sub-mass is revealed by traces during two successive tides at station 6 (figure A1.6.1). On both tides, it was revealed by a peak of salinity just after local LW. On the first tide, this salinity peak coincided, at about 1900 GMT on 11 March, with a peak of temperature (6.96°C), and on the second tide the corresponding salinity peak coincided with a trough of temperature (6.50°C) at about 0700 on 12 March. Maximum and minimum air temperatures for the period between 0900 on the 11 March to 0900 on the 12 March were, respectively, 10.0°C and 1.5°C. The salinity of sub-mass 3b was compatable with that of SWM 4.

Formation: The switch in temperature from evening to morning suggests that sub-mass 3b is formed in a very shallow, perhaps tidal, area. The timing of its manifestation at station 6 points to Sliddery Bay as its area of formation. It appears that, during the flood, Sliddery

Bay fills with water of SWM 4. That manifest in the evening of 11 March had been warmed during the day; that manifest the next morning had been cooled overnight.

It is likely that there is little flow through Sliddery Bay, but that as the tide falls, Sliddery Bay water ebbs south into a channel which communicates both with Sliddery bay and with Ringhaddy Sound. Then as the tide begins to flood, it seems that at least some Sliddery Bay water is carried into Ringhaddy Sound past station 6.

Sub-mass 3c: Ringhaddy Sound Low-Salinity Water

Properties and manifestation: Sub-mass 3c is suggested at station 6 (figure A1.6.1) by small troughs low of salinity either side of local LW. These troughs correspond to T/S relationships different from those of the water masses present.

While the salinity of sub-mass 3c was at most 0.08 lower than that of SWM 2, the relative lack of "noise" on the salinity trace at this station enabled it to be resolved without much doubt.

Formation: It seems that sub-mass 3c is formed by mixing of freshwater from a stream, which enters Ringhaddy Sound about 200 m north-north-west of station 6, into the water passing through Ringhaddy sound.

At station 6, salinity in general appears to be low compared with station 5 and 7 worked before and after this station. That the salinity is really low is indicated both by the low computed salinity values at station 6, and from a bottle sample taken at this station for the calibration of salinity. However, since the evidence rests ultimately on this single calibration sample and since no evidence of such low-salinity water is found at any other stations, the existence of this possibly very localised effect requires confirmation.

Sub-mass 3d: Mahee Roads-Reagh Bay Water

Properties and manifestation: During periods of warming, sub-mass 3d was manifest at station 8 as peaks of temperature occurring during the flood. These peaks were strongly associated with peaks in the easterly component of current velocity. Similarly, when periods of cooling occurred, this sub-mass was shown by troughs of temperature associated with the easterly component of velocity during the flood (figures A1.8.4, A1.8.5, A1.8.6).

At station 8, because of small salinity differences and large variations in temperature, there is considerable relative "noise" in the salinity trace. Over many tides, any differences in T/S characteristics which Sub-mass 3d may have relative to sub-mass 3e, SWM 2 and SWM 4 are thus obscured.

Thus the existance of Sub-mass 3d is inferred mainly from the time-series trace of temperature in conjunction with that of the current vectors, rather than from the T/S diagrams.

Formation: During the flood, the tide runs north-north-easterly along the south coast of Mahee Island. The strong associations of this sub-mass with peaks in the easterly component of velocity thus suggest an origin for this water to the south of Mahee Island.

Over the course of the ebb, most of the water in Reagh Bay empties into Mahee Roads. Since an east-north-easterly current develops along the south-east coast of Mahee Island during the flood, it is likely that some of this water would affect station 8.

Mahee Roads and the area to the south of them are shallow (3 to 7 m) relative to the central part of the lough near Mahee Island (10 to 40 m). Thus it is likely that a mixture of water originating in Mahee Roads would show temperatures higher than those of SWM 2 during periods of warming.

The possibility has been considered that the peaks on the temperature trace at station 8 during the flood may be at least partly contributed by water carried south-east by a hypothetical countercurrent to the north-east of Mahee Island. However, that the temperature peaks repeatedly cease an hour or so after the current at station 8 has turned from north-east to south-east suggests that the water responsible for these peaks does not come from the north of Mahee Point.

Sub-mass 3e: Inner Northern Basin Water

Properties, Manifestation and formation: Inner Northern Basin Water is shown clearly at station 8 by peaks (troughs during periods of cooling) in the temperature trace around local LW. The T/S relationship in this sub-mass is often quite distinct from that in SWM 2, SWM 4 and sub-mass 3d. There occur occasional dramatic peaks (e.g. a single record of 8.50°C, 0.5°C higher than the surrounding records, at 2228 after a day with a maximum air temperature of 13.3°C., figure A1.18.11). In view of the great area of tidal flats available for intensive warming (or cooling), it seems likely that the proportion of sub-mass 3e reaching station 8 relative to that formed must be very small.

Surface-water mass 4: Transition Water

Properties and manifestation: Transition Water is formed by the mixing of SWM 1 and SWM 2. As a result, its T/S relationship comprises a straight line joining those of its two components. It is thus not a water mass in the true sense, but since it is the predominant or even the only kind of water present at some stations, it has been given the present designation.

Formation: SWM 4 results from the mixing of SWM 1 and SWM 2, mainly in the southern basin, but also in the middle basin, the Narrows, and perhaps in that part of the Irish Sea immediately outside the Narrows.

The biological significance of the surface-water masses will be discussed in Section 6b and the likely areas of formation of the various surface water masses are shown in figure 6.2.

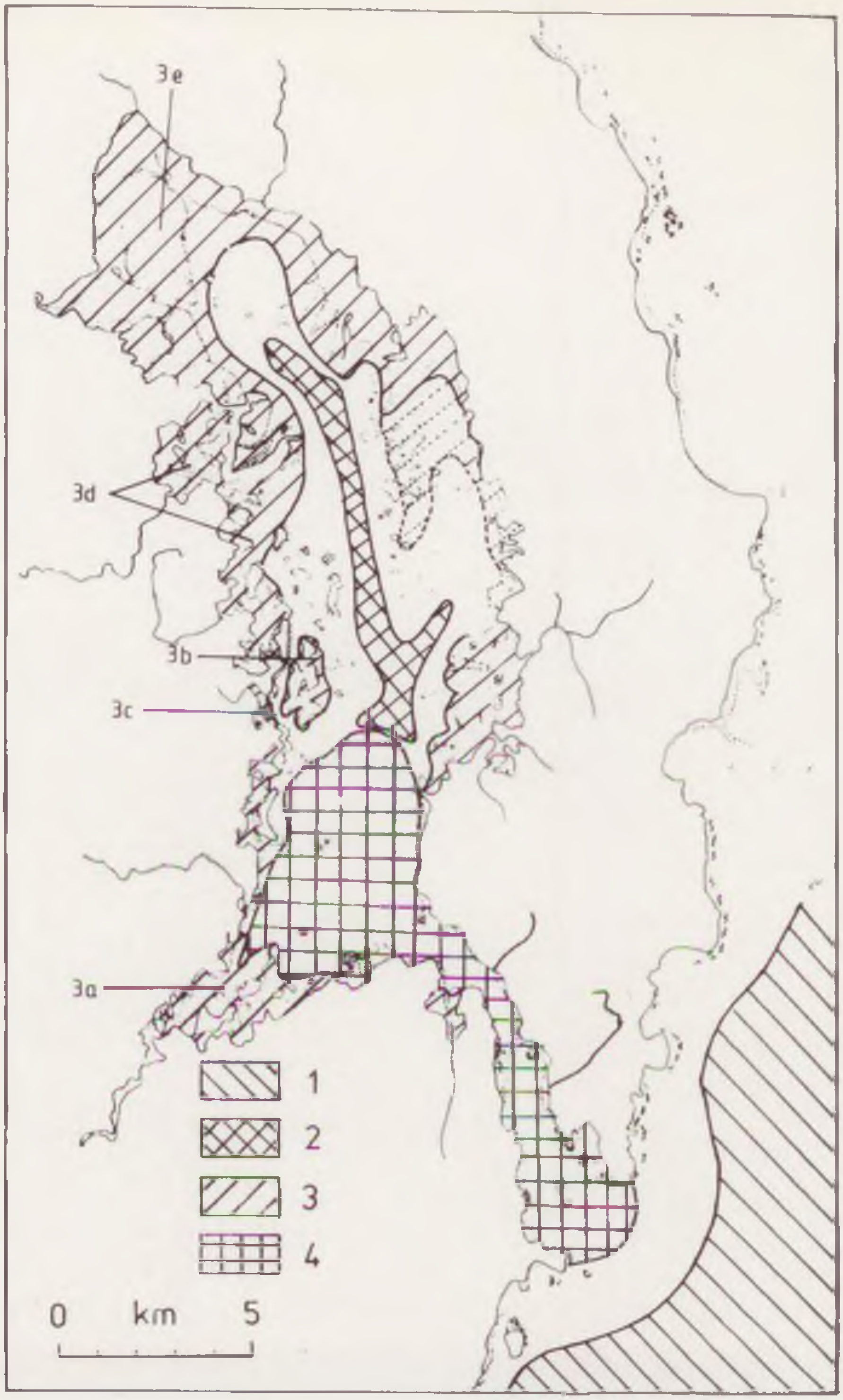


Figure 6.2. Likely areas of formation of the surface-water masses of Strangford Lough.

b) THE PLANKTON AND NUTRIENT SURVEY

i) Experiment to determine the time necessary for settlement

On the basis of the results (Section 5.b.vi), it appeared that plankton was still settling out steadily after 8 h in the settlement chambers. Hence it was decided that in the nano- and micro-plankton survey, settlement would be allowed to take several days.

In practice, a conflicting constraint was that with increasing settlement time the chambers became more likely to leak, and a minimum settlement time of three days was decided upon. In practice, however, the settlement time varied from three to five days.

Subsequently, Furet and Benson-Evans (1982) reported the settlement rates for 19 species of freshwater phytoplankton. These authors concluded that a settling time of 8 cm day^{-1} is acceptable for (freshwater) phytoplankton from temperate regions, when small diatoms can be disregarded. They also gave some tentative evidence from the literature that cells of *Chaetoceros* may be held up by the walls, especially in tall chambers.

If Furet and Benson-Evans' conclusions apply also to marine conditions, the settlement rate used in the present work (6.7 to 5 cm day^{-1}) was sufficiently low for most forms, but probably somewhat underestimated the small diatoms, especially *Chaetoceros*.

ii) Photosynthetically active radiation

Because autotrophic plankton need a certain level of illumination in order to grow, and because the waters of Strangford Lough are vertically mixed almost all the time (Section 5.a.iii), the mean flux of photosynthetically active radiation (P.A.R.) was estimated by the following method.

Records of monthly solar radiation for Aldergrove, about 40 km north-west-by-west of the centre of Strangford Lough, were supplied by the Meteorlogical Service (Appendix 8). They are shown in figure 6.4.

The mean/modal extinction coefficients for Strangford Lough were estimated for the entire lough from Secchi disc readings in Boyd (1973b) and in the present thesis (Table 6.2).

According to Bougis (1974), of the total radiation reaching the sea surface, about 50% (the P.A.R.) (45% assumed by Colijn, 1982) is available for photosynthesis. Only about 40% of this, the fraction between about 420 and 560 nm, peretrates more than a few cm into seawater. The remainder may comprise a significant fraction of the total radiation only in very shallow or very turbid waters (Bougis 1974). Depending on conditions, the fraction of light reflected at the water surface may vary from 3 to 40% (Bougis, 1974) but we have followed Poole and Atkins (1929) and Gieskes and Kraay (1975), in assuming a reflection of 15%. Thus the total "effective" P.A.R. passing the surface of the water is 0.17 of the total radiation.

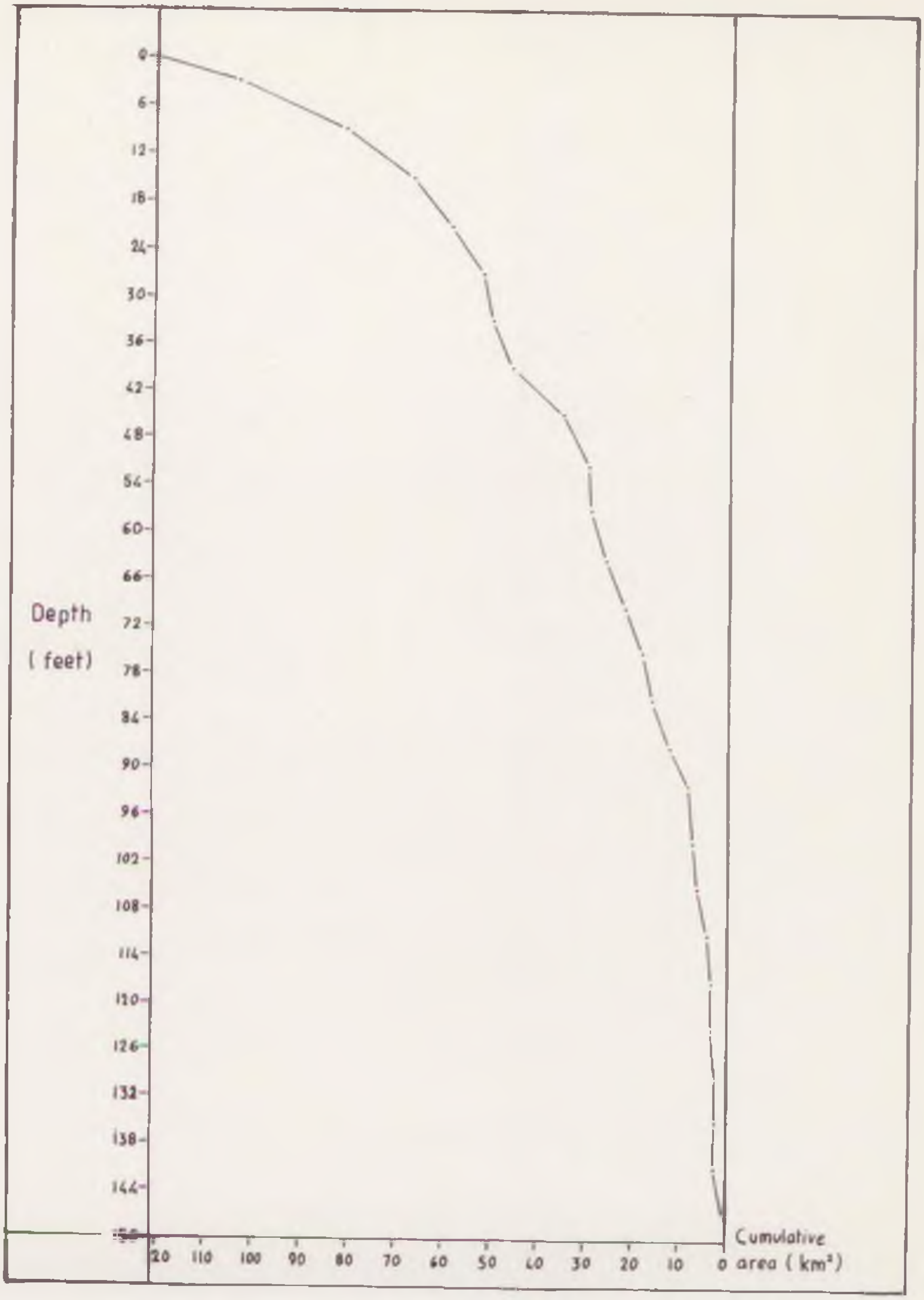


Figure 6.3. Distribution by area of the depths of Strangford Lough at MSL (1 foot = 0.305m).

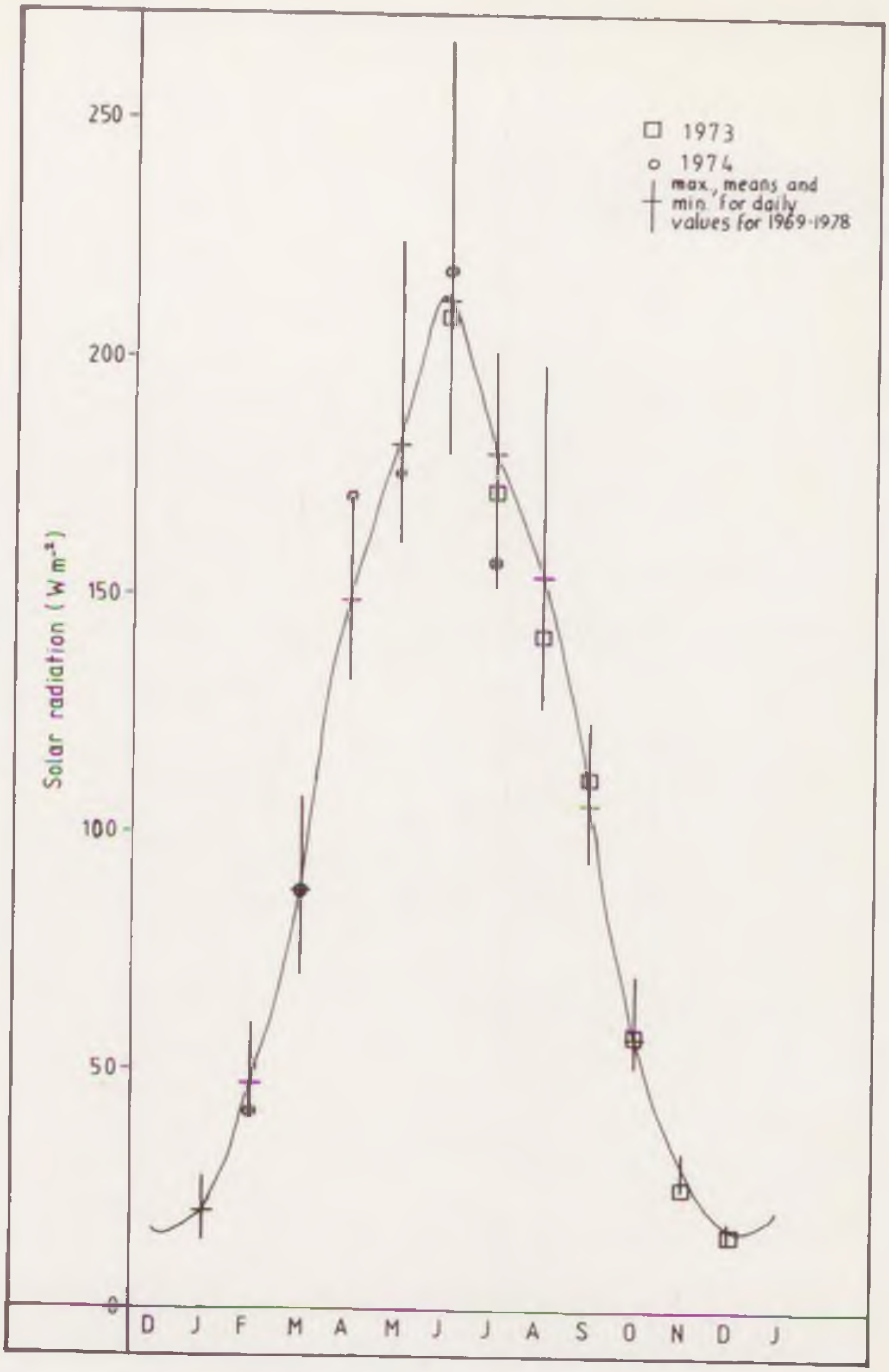


Figure 6.4. Annual variation of incident solar radiation at Aldergrove. Solid curve is 10-year mean for 1969-1978. Bars are ranges. Squares are values for 1973. Circles are values for 1974.

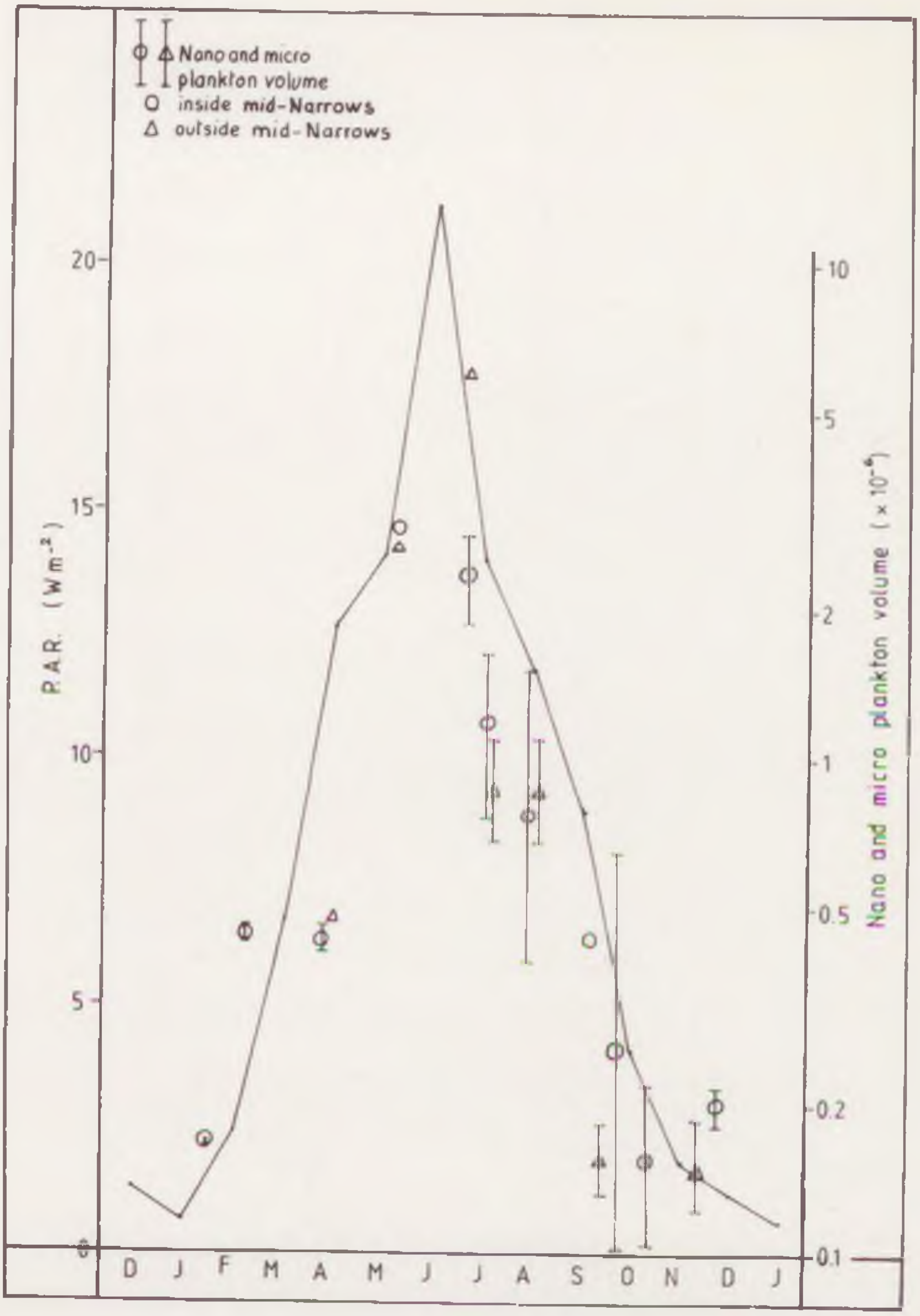


Figure 6.5. Mean radiant flux for the water in Strangford Lough. Based on water clarity values determined by Bayol (1973 b) and in the present survey, and on solar radiation values shown in figure 6.3. Symbols as in figure 6.3.

TABLE 6.2

Estimated mean/modal Secchi disc reading for Stangford Lough.

Month	Reading (Boyd, 1973b)	Reading (This survey)	$\bar{E}_s$
J	-	1.6	1.1
F	-	3.5	0.49
M	7.5	-	0.23
A	7.5	5.5	0.26
M	9	7	0.21
J	9	-	0.21
J	8	9	0.20
A	9	8.5	0.19
S	8	8.5	0.21
O	6	6	0.28
N	6	7	0.26
D	6	7.5	0.24

Abbreviations: $\bar{E}_s$ - mean/modal extinction coefficient

Reading - Secchi disc reading

Units: Reading - m

$\bar{E}_s$ - m^{-1}

We have used the formula obtained by Poole and Atkins (1929),

$$K_d = \frac{1.7}{D_s}$$

where K_d is the extinction coefficient for light, and D_s is the Secchi disc reading. This formula has been confirmed by Idso and Gilbert (1974, quoted by Parsons et al., 1975).

Another formula,

$$K_d = \frac{1.44}{D_s}$$

was found by Holmes (1970, quoted by Hitchcock et al., 1977) to be more suitable for turbid coastal waters, such as estuaries. It is thus conceivable that our estimates of P.A.R. for the turbid samples in January and February may be too low.

The depth of Strangford Lough at MSL was estimated for every km^2 (121 points in all) (figure 6.3). Then, for each point, the average monthly flux of P.A.R. was calculated using Riley's (1957, quoted in Gieskes and Kraay, 1975) formula,

$$I = \frac{I_o \ (1 - e^{-Kd.z})}{K_d \ z}$$

where I is the mean P.A.R. flux in the water column, K_d is the extinction coefficient, z is the depth of the water column, and I_o is the flux of P.A.R. just under the water surface.

One systematic error is extra illumination of the top few cm due to light outside the 420 to 560 nm band. On the other hand, the Secchi disc readings were all taken well away from the shore, and since turbidity generally increases near the shore and in shallows (Postma, 1961) this factor would tend to make our estimates of P.A.R. too high. Non-systematic errors involve variation in space and time of both Secchi disc reading and incident radiation.

The estimated mean monthly flux of P.A.R. is shown in figure 6.5.

b) THE PLANKTON AND NUTRIENT SURVEY

iii) Physical and chemical variables

Where stations are sufficiently numerous and close together, as in July and August 1973, the temperature and salinity isopleths reflect patchiness; this has been demonstrated by the current meter data.

This patchiness is likely to affect all the variables measured, and should be taken into account in interpreting all the spatiotemperal diagrams in this thesis. The isopleths are drawn partly to indicate the actual distribution of variables and partly to help in comparing partition of variables among stations.

Reference to figure 5.35 shows that while at the landward end of the Narrows, phosphate varies in concentration over the year only from 0.27 to 0.48 mmol m^{-3}, at the seaward end it varies from 0.23 to 1.01 mmol m^{-3}. Nitrate concentrations, however, vary from 12.44 to 0.22 mmol m^{-3} at the landward end of the Narrows, and from 0.45 to 8.56 mmol m^{-3} at the seaward end. So relative phosphate concentrations vary less over the year in Strangford Lough than in the Irish Sea; with relative nitrate concentrations the opposite is true. This strongly suggests that buffering of phosphate concentrations was occurring in the lough, with an equilibrium concentration of 0.3 to 0.4 mmol m^{-3}.

The results of the exploratory phosphate/sediment dynamic experiments (section 5.b.ii) are tentative. It is surprising that inorganic phosphate started to "disappear" after about 1 to 10 hours in experiments without sediment, whether poisoned or not. There is conflicting evidence concerning the loss of phosphate to polyethylene when samples are stored at room temperature (Hassenteufel et al., 1963, quoted by Strickland and Parsons, 1972). Adsorption onto glass or stainless steel may also be possible. In any case, the apparent loss of phosphate in the absence of sediment deserves further investigation.

Stirling and Wormald (1977) found that various marine and terrestial soils, in contact with seawater of various salinities, gave steady-state equilibrium phosphate concentrations of from 0.08 to 0.25 mmol m^{-3} with capacities of up to 2 g dm^{-3} of sediment. Adsorbtion was almost complete after 30 h (Stirling and Wormald, 1977). Other workers have found higher steady-state equilibrium values. Examples include the values: 0.7 to 0.9 mmol m^{-3} for the Dobey sound, Georgia, U.S.A. (Pomeroy, 1965) and 0.7 to 1.0 mmol m^{-3} for suspended sediments from the Amazon estuary (Chase and Sayles, 1980), both obtained experimentally. The following values were observed in the field: 1.04 mmol m^{-3} for the Columbia River, Oregon (Stephensson and Richards, 1963); 0.51 to 0.82 mmol m^{-3} for the Tama estuary, Cornwall (Butler and Tibbits, 1972); and 0.5 to 1.6 mmol m^{-3} for the Shannon estuary (Jenkinson, 1982).

The present work tentatively confirms the finding of Pomeroy et al. (1965), who observed phosphate/sediment dynamics in poisoned and unpoisoned systems using ^{32}P, that the poisoned samples gave long-term equilibrium values similar to the unpoisoned ones. Pomeroy et al. also concluded that in suspended sediments exchange rates due to bacteria were about as important as those due to exchange onto clay minerals.

In the present study, however, the experimentally suggested value of about 1.0 mmol m^{-3} for inorganic phosphate concentration is at variance with that of 0.3 to 0.4 apparent in the field observations. According to Nalewajko and Lean (1980), phosphate is, in general, released by anaerobic sediments and retained by aerobic ones, but they also point out that phosphorus fluxes between water and sediments are clearly a complex function of redox-dependent chemical equilibria.

As most sediments in Strangford Lough are stratified regarding redox potential, phosphate fluxes up and down through the sediment may be extremely complex. It is thus not surprising to find a descrepancy between experimented results and field observations concerning equilibrium concentration of inorganic phosphate in the water. Biological phosphate demand by the large quantities of Ascophyllum in Strangford Lough may also be important.

Although the distribution of inorganic phosphate in the waters of the Narrows indicate that there must be net transport of phosphate from the lough to the Irish Sea in summer, the reverse transport in winter appears to be much more important.

Some authors consider a concentration of 1.0 mmol m^{-3} of phosphate to be limiting for phytoplankton growth in the sea (e.g. Gieskes and Kraay, 1975), but many organisms can use organic phosphate when inorganic phosphate is in short supply (Provasoli et al., 1957, quoted by Bougis, 1974; Kuenzler and Perras, 1965). However, where inorganic phosphate concentration is buffered by the sediment, it is likely that the primary producers will be adapted to a low-phosphate regime (R.T.C. Raine, pers. comm.) and that inorganic phosphate will not be limiting.

Nitrate + nitrite concentrations show a maximum in January and February and, as Boyd (1973b) also found, a minimum in July when, together with silicate, they probably limit phytoplankton growth. Like Boyd, we found that nitrate levels are slow to increase from July to September, but thence they begin to climb more rapidly towards the winter/spring maximum.

Because of the buffering of phosphate concentrations, nitrate + nitrite:phosphate (N/P) ratios tend to follow nitrate + nitrite concentrations. The highest and lowest values, 27.0 and 0.81 occurred respectively in late January and early July. Ewins and Spencer (1967) found that N/P values in the Menai Straits increased throughout the winter from about 5 to about 25 immediately predeeding the spring bloom, with phosphate concentrations varying over the year only from 0.2 to 0.8 mmol m^{-3}. The disappearance of nitrate relative to that of phosphate during the bloom they found to be in the ratio of between 45 and 50, and assumed that this reflected a very high ratio of biological utilisation. However, buffering of phosphate by suspended sediment in the turbulent Menai Straits may have been the explanation, there as in Strangford Narrows.

High levels of nitrite have previously been shown as characteristic both of autumn conditions (Cooper, 1933; Spencer 1975; Slinn, 1974) and below density discontinuities or depths of maximum chlorophyll concentration (Rakestraw, 1936; Slinn, 1974).

Phytoplankton takes up nitrite, particularly when the concentration of nitrate is low (Cooper, 1933; Rakestraw, 1936). Thus low levels of nitrate are invariably accompanied by low nitrite concentrations. The concentration of nitrite in the sea is thus likely to result from two factors: (a) those processes leading to the production of nitrite; and (b) phytoplankton demand for both nitrate and nitrite. The expression of nitrite content as a ratio of nitrite:nitrate + nitrite is thus likely to eliminate, at least to some extent, factor b and thus reflect factor a more clearly. The occurrence of nitrite below chlorophyll maximum and in autumn, together with its chemical position intermediate in oxidation state between ammonia and nitrate, suggested to Cooper (1933), Rakestraw (1936) and Spencer (1975) that its concentration is related to the rate of remineralisation of nitrogen to nitrate. This may be at least partly factor a referred to above.

The occurence of the nitrite:nitrate + nitrite ratio in the Narrows (figure 5.38) shows highest values, 14 - 20% occurring in August after the summer bloom, lowest values, 1 to 3%, during the winter months, and generally rising but more variable values up to 11% during the following summer bloom.

From Slinn's (1974) data (figure 10) for nearby areas of the Irish Sea the highest, but also quite variable, nitrite:nitrate + nitrite ratios appear to occur in September with values of around 14% in surface waters (but only 2% below 80 m). Uniform values of about 2% occur in January and February.

Except for the high concentrations of silicate associated with low salinities in January and February, and low concentrations during the summer bloom, the distribution of silicate in the Narrows showed no clear trend.

Jenkinson (1982) found that in a part of the Shannon estuary showing high biological silicate demand in April, silicate concentrations were reduced to a fairly uniform concentration of 1.6 to 1.8 mmol m^{-3}. In an area of the Bristol Channel also showing high biological silicate demand, Abdullah et al (1973) found silicate concentrations of about 1.5 mmol m^{-3} (re-calculated from then figure 11).

It thus seems from the similarity of these concentrations that a silicate concentration of about 1.5 mmol m^{-3} may be limiting for some diatoms. Silicate concentrations below 1.0 mmol m^{-3} occur in the north-western Irish Sea in summer (Slinn, 1974) however; and Werner (1977), despite expressing doubts about the validity of the method, found that Si_o, the minimum concentration at which silicate uptake occurs, varied for various planktonic diatoms from 0.32 to 1.3 mmol m^{-3}. Si_o and rates of silicate uptake are clearly important determinants of the succession of diatoms, and the low concentrations found in the present survey during July and September are likely to have limited diatom growth somewhat.

iv) The plankton in context

Boyd(1973b), who sampled five stations between Dunnyneil Island and Mahee point, found systematic variation in diatom distribution between the lower and upper stations. In particular, Chaetoceros

curvisetum, C. decipiens and Rhizosolenia setigera were, when present, nearly always more numerous athe upper stations that at the lower ones, while with Lauderia borealis, Guinardia flaccida and Coscinodiscus concinnus the contray was usually the case. He also found that Chaetoceros debile, Rhizosolenia semispina and Rhizosolenia stolterfothii made their first appearances in the lough near the mouth, but later became commonest near the top end.

Weaver and Hirshfield (1976), who worked on the plankton in water flooding into and ebbing from a lagoon (Fire Island Inlet, Long Island, New York), found very distinct differences in the assemblies of plankton present between the flooding and ebbing water.

In the present survey, differences in the nano- and micro- plankton between the tidally corrected inner and outer stations of the Narrows were apparent on cruises 2, 12, 14 and 15. However, the differences were not sufficiently consistant from cruise to cruise for a factor loading on to Strangford Lough vs. Irish Sea Water to appear in any of the multivariate analyses which were performed.

In the light of the current meter survey, it is likely that all the ebbing water sampled was predominantly Transition Water (Surface-Water Mass 4) consisting of a mixture of Surface-Water Masses 1 and 2. That both the masses originate in similar depths may ensure similar autochthonous flora. Moreover, the almost continuous, vigorous mixing between the two components of Transition Water is likely to blur any differences that may occur. The egress of water at Killard Point was not investigated, but on the basis of the cross-sectional area of the Narrows, mean tidal currents are calculated to be higher there than at the inner end of the Narrows. This is likely to produce turbulent mixing outside the Bar similar to, if not greater than, that occurring in the southern basin of the lough.

The properties and origins of the incoming Irish Sea Water have been little investigated. From the coast south of Strangford Lough entrance, stretching east to the Isle of Man, is an area of weak tidal streams, in which the water is thermally stratified generally between May and September (Slinn, 1974). The extent of this stratified water appears sometimes to extend north of the lough entrance, and a front separating it from from colder, prsumably mixed, water to the north may be seen from satellite photographs to have occurred about 5 km off the entrance in June 1979 (Simpson _et al._, 1979, plate I) and to have intersected the coast just north of the entrance in May 1980 (Simpson, 1981, figure 1a-d).

High concentrations of chlorophyll are associated with stratified conditions in this area (Slinn, 1974). Williamson (1956) showed "high" levels of phytoplankton during March (_Chaetoceros_ and _Thalassiosira_ in 1951; _Ceratium_, diatoms and _Phaeocystis_ in 1952) west of the Isle of Man, but decreasing values towards the Irish coast. In September 1952 he found very little phytoplankton near the

Irish coast, but in October 1951 he found high levels up to the Irish coast (near Ardglass, about 15 km south of Strangford Lough entrance). These levels, however, were not as high as those near the coast of the Isle of Man.

From the sporadic data available, it thus appears that large year-to-year variations occur, not only in the salinity (see section 5.b.i.II) of the north-west Irish Sea, but also in its concentrations of chlorophyll levels, and in the degree and extent of its stratification.

Also, while the main drift in the Irish Sea is northwards (Bowden, 1955), there is evidence of occasional intrusions of water south through the North Channel. These intrusions pass south, close to the County Down coast (Williamson, 1956; Slinn, 1974). A front between thermally stratified water off the County Down coast and mixed water inshore would tend to produce a southward geostrophic flow (Mooers, 1978). It is likely that such year-to-year variations in the nearby parts of the Irish Sea will would cause variations of a similar scale in Strangford Lough.

One of the problems in any discontinuous sampling regime is the possibility of aliasing small-scale variation into apparently large-scale variation. Periodic variation in plankton may be caused either: a) by forcing caused by periodically varying physical parameters; b) by other periodically varying biological paramters; or c) by innate periodicity. In practice, amplification or damping between any or all of these mechanisms may occur.

A negative association has often been observed between phytoplankton or diatom concentration and that of herbvivorous copepods (e.g. Riley, 1976; Platt and Denmann, 1980). Boyd (1973b, figure 10) found an inverse relationship between numbers of diatoms and those of copepods present at the same time in Strangford Lough.

High levels of diatom-contributed organic carbon (52 to 172 mg m^{-3}) were encountered during July 1974. This compares with 7 to 21 mg m^{-3} for July 1973. In July 1974, the settling volume of net plankton was 260 to 320 x 10^{-6}, dominated in terms of volume by *Pleurobrachia*, compared with 1170 to 3960 x 10^{-6} in July 1973, when it was dominated by copepods. It seems likely that the diatom bloom in July may have taken place because of low grazing pressure. It is also tempting to suggest that that the low numbers of copepods had resulted from predation by *Pleurobrachia*, particularly since an increase in concentration of *Pleurobrachia* during the summer of 1980 in the Shannon estuary preceeded a crash in copepod numbers (Jenkinson, 1982). However, while Boyd (1973a) found *Pleurobrachia* in Strangford Lough in May and July 1968, copepod numbers were relatively high that spring, and continued to increase during the summer. Additionally, Boyd found *Pleurobrachia* in June, July and August 1969, yet copepod numbers increased from levels in spring 1969, similar to those in the spring of 1968, to levels in summer 1969 which were higher than in the summer of 1968.

Richerson *et al.* (1977), studying the spatial heterogeneity of closed basins, say that they expect temperature differences to be closely associated with biomass differences [at any one time]. In Strangford Lough, temperature and salinity vary as water of different surface-water masses flows past a current meter. Nevertheless, periodic variations (except for M_2) in temperature and salinity are evident only occasionally, despite the strong, approximately hourly, oscillations in water velocity. In Strangford Lough, it is likely that biomass, and concentrations of chlorophyll and nutrients, as well as the composition of the plankton assemblies, would be strongly associated at any one time with the water masses, and hence with temperature and salinity. This should be detectable by the continuous measurement of temperature and salinity together with at least one other variable such as chlorophyll concentration.

While turbulent mixing reduces spatial variability (Richerson et al., 1977), the associated water movement allows continuous recording at a fixed point of some of the variability which remains.

The settling volume of net plankton was highest in July 1973, with values of 1.47 to 3.96 x 10^{-6}, falling to 0.05 to 0.07 x 10^{-6} in January and February, and increasing only to 0.26 to 0.32 x 10^{-6} in July 1974.

If 1 cm^3 of settled zooplankton is equivalent to 30 mg of zooplankton-contributed carbon (Laevastu, 1958), this gives values for zooplankton-contributed carbon of 44 to 119 mg m^{-3} in July 1973, 1.5 to 2.1 mg m^{-3} for January and February, and 8 to 10 mg m^{-3} for July 1974.

From October to February, Sagitta was often dominant (Table 5.3), indicating intense predation on the few remaining copepods. Boyd's (1973a,b) sampling method could not estimate Sagitta. In April (no samples were taken in March) the estimated net plankton-contributed carbon was 10 to 35 mg m^{-3}, and it was dominated by barnacle nauplii. This corresponds with the large numbers of the nauplii of *Balanus balanoides* (L.) found by Boyd (1973a) in April and May 1969, particularly at the upper stations. Biomasses of diatoms remained low (4 to 11 mg m^{-3} of organic carbon), but those of ciliates were generally higher (2 to 22 mg m^{-3} of organic carbon).

It is difficult to speculate upon what the barnacle nauplii might have been eating unless flagellates and small diatoms had begun to bloom in restricted areas of the upper lough. It is also possible that the barnacle spawning seriously depletes the nano- and micro- plankton at the beginning af its growing season, and that, in turn, the nauplii provide the first food of the season for *Pleurobrachia*. In May, small copepods and decapod larvae dominated the net plankton, and in July 1974, *Pleurobrachia* was dominant.

In July 1973, the net plankton was dominated by *Acartia* and *Pseudocalanus*, and while these continued to be fairly abundant in August and September, *Calanus* was mostly dominant. In autumn, the samples were dominated mostly by *Sagitta*,*Acartia*, *Pseudocalanus*, *Oithona similis*, with decapod and fish larvae. While Boyd (1973a) found few *Calanus*, this was due to his sampling method. He found *Acartia clausi* to be most numerous from July to September, while he recorded *Pseudocalanus elongatus* as common throughout both years, and especially so at the lower stations.

One of the main reasons for expressing nano- and micro- planktonn as biovolume is that it is a measured value (counts x volumes), and it is directly comparable with other similarly obtained data. The values for nano- and micro-plankton-contributed organic carbon are derived separately from the measured volume of each organism. It is likely, however, that carbon content will vary according to the physiological state of the organisms. It is also likely that future work will improve upon the conversion formulae employed, in which case the data reported here on estimated carbon would no longer be useful for comparisons without the recalculation of the values.

The volumes of all nine species of plankton which are both reported by Paasche (1960, quoted by Raymont, 1980) and occurred in this study agree to within our standard deviations. Campbell (1973) lists the volumes of 37 brackish-water phytoflagellates. However, none of them correspond to the taxa used in this thesis.

Despite the feasability, for about the last 20 years of the Utermöhl method for quantitative estimation of nano- and micro- plankton, there still exist few estimates of biovolume or organic carbon based upon the method used here. One such study is by Smayda (1965). However I have been unable to obtain this work. Another is Jenkinson (1982) in which estimates were made of the contributions to the organic carbon by the microplankton and nanoplankton larger than 10 um. Organic carbon was estimated by Jenkinson according to the formula of Mullin et al. (1966),

$$\log_{10} = 0.76 \log_{10} V - 0.29$$

where C is the organic carbon content in pg, and V is cell volume in um^3. This method overestimated the contribution by diatoms by almost a factor of 2, compared with the method used in this thesis. Extreme values obtained for the mid Shannon estuary over a year were from 15 mg m^{-3} of carbon in October to 230 in May; the mean value was 96. In a small, stratified estuarine tributary, the Deel, values ranged from 30 in December to 1213 mg m^{-3} in July during a bloom of the dinoflagellate, Glenodinium foliaceum Stein; the mean here was 311. This compares with values of from 14 to 271 mg m^{-3} in the present survey (mean 81), albeit with less weight given to diatoms, and with nanoplankton less than 10 um included. Thus the standing crop of nano- and micro-plankton in Strangford Lough is similar to that in the mid Shannon estuary.

Our limited comparison of chlorophyll a concentration with nano- and micro- plankton organic carbon gave a chlorophyll:carbon ratio of about 0.02. However, measurements of chlorophyll, despite their imprecision as an estimate of biomass (Raymont, 1980; Butterwick et al., 1982), are much more widely availiable for comparison. If the Strangford Lough nano- and micro- plankton organic carbon data are multiplied by 0.02 to give estimated concentrations of chlorophyll a, values of from 0.27 to 5.7 mg m^{-3} of chlorophyll are obtained.

Boynton et al. (1982) reveiwed factors relating production in 25 river-dominated inshore areas, nine embayments, four lagoons and one fjord. By their definition, "only slightly influenced by freshwater inputs, having a good exchange with the ocean", Strangford lough is an embayment. Of the embayments reviewed, Strangford Lough comes second in terms of chlorophyll a concentration between Bedford Basin, Nova Scotia (third) and Loch Ewe, Scotland (first). However, many of the river-dominated areas have higher chlorophyll levels.

Boynton et al. (1982) ranked the inshore areas also in terms of phytoplankton production. Areas with generally high concentrations of chlorophyll tended to have high levels of production. It seems reasonable to speculate that primary productivity in Strangford Lough would be higher than average for temperate embayments and about the average or a little below that for river-dominated areas.

Chlorophyll a levels in a nearby stratified area of the Irish Sea were generally found by Slinn (1974) not to exceed 2 mg m^{-3}, except at the depth of density dicontinuities. However, on one occasion in May 1968, values of 2 to 4 were found in unstratified water near the coasts of both Ireland and the Isle of Man. While the following comparison should be treated with caution, it thus appears that phytoplankton biomass in the Strangford Narrows is generally only a ltle higher, perhaps by a factor of 1.5 than that found by Slinn (1974) in nearby areas of the Irish Sea.

It is difficult to compare the succession of phytoplankton species recorded in the present survey in bottle and high-speed net samples with those found by Boyd(1973a,b) in his pump-and-net samples. The phytoplankton of Boyd's samples was numerically dominated by Chaetoceros spp., particularly in April and in late summer and autumn. This genus also tended to be more often dominant at the upper stations. In our samples, however, Chaetoceros contributed on average only 2.6% of the estimated organic carbon. In any net survey, beacause of their long setae and generally small volume, *Chaetoceros* spp. are likely to be much more important than in a corresponding bottle survey.

Boyd found *Rhizosolenia* spp. to be particularly important in May and July 1968, and in July and August 1969. These species may, together with *Guinardia* represent the group D of this thesis (Table 5.10), suggesting that dominance by group D organisms may occur at any time in the summer. Boyd also found significant numbers of *Guinardia* only when *Rhizosolenia* was plentiful. The organism most associated with group A, or winter organisms, is *Bacillaria paxillifer.* Boyd found that this species (as *B. paradoxa*) occurred least often during mid summer.

Because a logarithmic transformation of taxon abundances was used to carry out the multivariate analyses, it is possible for the effects of taxa to be picked up by the factor loadings well before the taxa have made an important contribution to the biomass. In March and May, group A was less well represented at the inner stations of the Narrows than at the outer ones, while nano- and micro- plankton biomass levels were about the same. This may indicate that despite the stations of the Narrows all being in Transition Water, the inner stations were slightly influenced by plankton flushed out from blooming conditons at the top of the lough.

The finding that blooming in the lough commences when the mean radiant flux in the water reaches about 10 W s^{-1} (approximately 40 ly/day), and that the levels of nano- and micro- plankton-contributed organic carbon decline rapidly during September, after the mean radiant flux has fallen once more below 10 W s-1, is consistant with previous findings (Gieskes and Kraay, 1975; Hitchcock and Smayda, 1977; Raymont, 1980; Colijn, 1982).

Mean radiant flux in the shallow parts of the lough, where Surface-Water Mass 3 originates, will be higher than in the deeps. For this reason it would be expected that at times of sufficient light, and when nutrients are not limiting, SWM 3 would be richer in chlorophyll and phytoplankton than the other surface waters.

Strangford Lough is at latitude 54°N., and the length of its growing season is from April to early September. This is a little short compared with many estuaries at a similar latitude, but it is the same as that of the Wadden Sea (Netherlands) also at 54°N. (Sinclair et al., 1981).

Boyd (1973b) found nitrate concentrations to vary in 1969 from 1.3 mmol m^{-3} between June and September to 11 in December. In 1968, values ranged from 0.3 mmol m^{-3} in June to 5.7 in November. (There were no samples in December 1968.) That in both 1968 and 1969, values were lowest at Boyd's inner stations and highest at the outer ones indicated that, as suggested for different reasons above, phytoplankton growth continues in September at the top of the lough. That this trend in nitrate concentrations was not apparent in the present survey may be explained by the hypothesis that only Transition Water was samples. Further evidence that phytoplankton growth starts earlier at the top of the lough than it does near the mouth is Boyd's finding that in April and June 1969 nitrate levels were lower at the inner stations than at the outer ones. Overall, the nitrate levels in the present survey did not differ much from those found by Boyd, except that the values in this survey were rather lower than Boyd's.

The phosphate values found in the present survey differed considerably from those found by Boyd (1973b). While concentrations at the inner stations of our survey varied only from 0.23 to 0.48 mmol m-3 during the year, Boyd found values as low as 0.01 near Mahee Point in May 1968, and as high as 1.0 at the same station in October. These extreme values may indicate that phosphate buffering is less important near the top of the lough than it is in the strong currents near its mouth. Boyd found less extreme phosphate levels in 1969, from 0.1 mmol m^{-3} in June and July to 0.5 in September near Mahee Point.

In July 1968, Boyd found concentrations of silicate of 7 mmol m^{-3}, an extremely high value for the time of year. However, reduced salinities occurred in the same month. Silicate levels remained above 1.4 for the whole of the summer of 1968. In 1969, summer silicate values declined to low levels, about 0.15 to 1.3 mmol m^{-3} for April to September. They then increased to about 8 in December. In the present survey, silicate levels were generally higher than in 1968-69. Two extreme values,of 24 and 52 mmol m^{-3} in late January were associated with reduced salinities. The lowest values, 1.0 to 5.0, were found during the bloom of July 1974.

No ecological study can give as much information about the suitability of an area for shellfish culture as can field trials. However, concerning the food available for nano- and micro- planktivorous bivalves such as Ostrea, Crassostrea or Pecten, Strangford Lough ranks rather rich for an embayment, but rather poor compared with many estuaries. But conditions in the lough are much more stable, saline and sediment-free than most estuaries. The calculated stratification parameter indicates that harmful dinoflagellate blooms are unlikely to be a problem for mariculture.

Apart from pollution by toxins, the likely changes that could affect the plankton dynamics of the lough are: a) variation in nutrient input; b) variation in the turbidity of the waters; and c) variation in water flow and exchange with the Irish Sea.

Although we will not attempt it here, it is likely that with the data now available for Strangford Lough waters and those of nearby parts of the Irish Sea, e.g. Bowden (1955), Williamson (1956), Boyd (1973a,b), Slinn (1974), the present thesis, as well as much unpublished data gathered by members of the Portaferry Marine Biology Station, a start could now be made in creating an ecological model of the waters of the lough. While it would be for such a model to show up its own gaps, one or two appear obvious. They are the lack of data on: a) the overall productivity and growth of phytoplankton, phytobenthos and attached algae; b) the nitrogen nutrient species other than nitrate and nitrite; c) dissolved organic nutrients; d) the need for studies on eddy diffusion near the mouth of the lough to determine how much of the incoming water originated in the lough. The last study could use droques, current meter(s), and satellite or aerial resolution of the mixing of waters of different temperatures.

The consequences of changing the water flow by building a barrage across the mouth of the lough are likely to be extremely complex. Moreover it would initiate changes in the lough which could be still continuing after hundreds of years at least.

7. SUMMARY

This study is divided into two main parts, a survey of tidal currents and associated temperatures and salinities in the lough, and a 12-monthly programme for sampling plankton and nutrients in the water flooding and ebbing through the Narrows. Two smaller parts of the study were a cursory investigation of the settling rate of fixed nano- and micro-plankton and an investigation of the dynamics of inorganic phophate in seawater in the presence and the absence of sediment.

The currents, temperature and salinity of Strnagford Lough was investigated by deploying a current meter at 19 stations. Useful data were obtained at 17 of them. Drogues were also deployed on one occasion. From the current study, a tidal atlas of the lough is presented.

Three types of short oscillations of water velocity were found. The first is of 50 to 80 min, occurring over most of the lough during the flood. The possibility is discussed that it may be produced by interaction between the jetstream issuing from the Narrows into the southern basin and an intrinsic along-lough periodicity. A second periodicity of 50 to 80 min occurred on the ebb at stations south of the Long Sheelah bank, perhaps caused by the collective interaction between a stream passing to the east of the Long Sheelah and one passing to the west of it. A third periodicity, detected at one station in the Narrows on the flood, is not explained.

The maximum, mean and mimimum tidal currents expected at each station are prresented, together with the residuals for a mean spring M_2 tidal cycle.

On the basis of temperature/salinity (T/S) diagrams and T and S time-series traces, the waters of the lough appear to fall into three surface-water masses (SWM's), SWM 1 or Irish Sea Water, SWM 2 or Strangford Lough Central Water, and SWM 3 or Strangford Lough Peripheral Water. SWM 3 is divided into five sub-masses. A further water body, designated SWM 4 or Transitional Water, comprises a mixture of SWM 1 and SWM 2 in varying proportions. SWM 4 occupies most of the southern part of the lough.

The drogue study revealed a flood tide in the Narrows of 4.2 m s^{-1} (7.3 knots), corrected to mean springs. Gyres occurred at the northern edge of the flood stream in the southern basin.

In the nutrient and plankton study, the temperature was found to vary from 7.0°C to 14.0°C. Salinities fell over the year from about 34.2 to 34.3 in summer 1973 to 34.0 in summer 1974. In winter, salinity reductions of 0.7 or 0.8 were caused by freshwater runoff in the lough.

Secchi disc readings of from 1.4 m to 12 m were encountered.

Concentrations of dissolved inorganic phosphate were found to vary from 0.21 to 1.01 mmol m^{-3}. Those of dissolved nitrate ranged from 0.3 to 12.4 mmol m^{-3}. Nitrite concentrations varied from 0.003 to 0.4 mmol m^{-3}, and the ratio of the molar concentration of nitrite to that of nitrite + nitrate varied from 1% to 20%. The molar ratio of nitrate:phosphate varied from 0.7 to 26.8. Concentrations of silicate ranged from 1.0 to 52 mmol m^{-3}.

Net plankton was sampled quantitatively using a Gulf IV high-speed plankton sampler fitted with a net of mesh-size 250 um. Subjectivey appraised in terms of volume, the domiant organisms included Calanus spp., Acartia clausi, Pseudocalanus elongatus, Sagitta, Pleurobrachia and barnacle nauplii. The settling volume of net plankton varied from 50 x 10^{-9} to 4000 x 10^{-9}. There appeared to be a general tendancy to higher values in offshore waters.

The nano- and micro- plankton were sampled quantitatively by water bottle. This plankotn was fixed in Lugol's iodine and allowed to settle in a 20-cm high settling chamber for three to five days before being counted and measured by inverted microscopy. Previously it had been shown that plankton was still settling significantly in the settling chamber after 8 h.

A total of 103 taxa were separated from the bottle samples, and a further 12 species of phytoplankton wer found only in the net samples.

The volume of each organism was used to estimate its contribution to the particulate organic carbon of the sea.

Data on the mean and the standard deviation of both the volumes and the estimated content of organic carbon, are presented for each taxon found in the bottle samples. The total volume of the nano- and micro- plankton was found to vary by a factor 60, from 103 to 6200 x 10^{-9}, and the particulate organic carbon contributed by the nano- and micro- plankton varied by a factor of 19, from 14 to 270 mg m^{-3}. The difference in the variation of these two parameters reflects the finding that richest samples were generally dominated by large diatoms with low C:volume ratios, while in poor conditions the nanoplankton was usually relatively more important.

Several types of multivariate analyses were carried out on the logarithmically transformed abundances of the 30 most widespread taxa. The treatments included principal-component and coanonical-factoring analyses, both R-type (from taxa) and Q-type (from samples), and both orthogonal (unrotated) and Varimax-rotated. In addition the robustness of the data was tested by inclusion in the R-type analyses of a random variable. It was also tested by carrying out a duplicate R-type principal-component analysis on only 35 out of the 42 stations. The analysis proved to be very similar to that carried out using data from all the stations.

While all the analyses should contain the same information in different forms, the orthogonal analyses appeared to have greater interpretive usefulness than the rotated ones. Similarly, the principal-component analyses could be interpreted more easily than the canonical-factoring ones.

On the basis of the loadings of the factors produced from an R-type principal component analysis, both taxa and samples were classed on the basis of seven groups. Four of these groups were found to correspond to different stages of the succession of nano- and micro- plankton over the year. No factor or group loaded on to a Strangford Lough vs. Irish Sea cline.

The concentration of chlorophyll _a_ was determined for six stations by filtering a samples of water serially in each case through a 1.2-um and a 0.45-um membrane filter. Values for both filters were summed to arrive at the "total" concentration of chlorophyll _a._ The mean value of for the ratio of chlorophyll _a_ to nano- and micro- plankton carbon was 0.02.

Using this ratio as a basis for estimating the general chlorophyll _a_ content of the waters, Strangford Lough comes between first and second on a scale of nine embayments (Boynton _et al._, 1982). Since productivity ranking was related to ranking by chlorophyll content in these nine embayments, it is likely that Strangford Lough ranks reasonably high among embayments in terms of productivity.

Inorganic phosphate is buffered by Strangford Lough sediments.

The nutrient and plankton results are discussed in relation to the circulation of the lough, and to turbulence.

From data on incident radiation and turbidity, the average radiant flux has been calcualted for the water of Strangford Lough. It is shown that in general, phytoplankton growth occurs from April to September, when the mean raiant flux in the water is above about 10 W m^{-2}. This agrees with reported values. Notwithstanding, there is evidence of some growth at the top of the lough outside these months, and this may reflect a higher mean flux in the shallow parts of the lough.

Gaps are pointed out in the data relating to its ecological oceanography, but it is suggested that the amount of data available is now enough to allow a start to be made on the construction of an ecological model for Strangford Lough.

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WATER MOVEMENT AND PLANKTON IN STRANGFORD LOUGH

Volume 2

Ian R. Jenkinson

Ph.D. Thesis

Submitted to the Queen's University of Belfast

June 1983

INDEX

APPENDIX 1

A 1.2.1

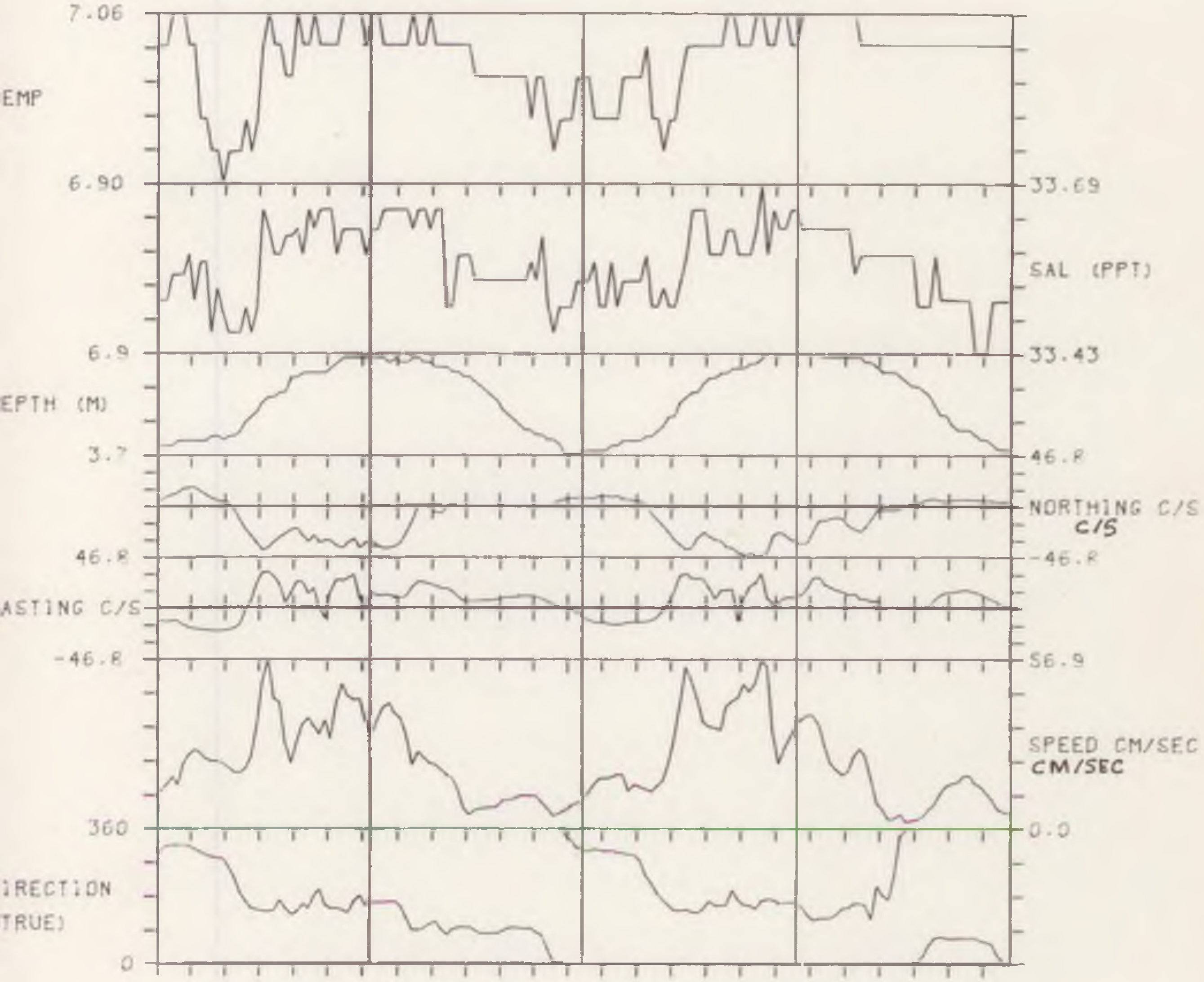
1.2.1

CURRENT METER DATA OVER TWO TIDES

STATION NO. 2

STARTING TIME: 2059 ON 28/2/75

WIRE LENGTH = 2.5 METRES



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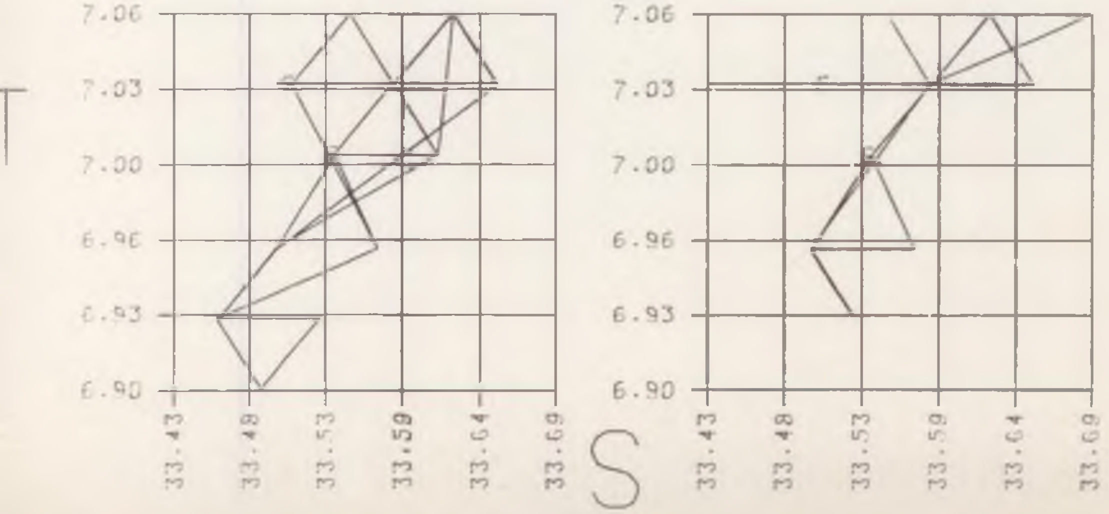

2

A1.2.2

CURRENT METER DATA OVER TWO TIDES

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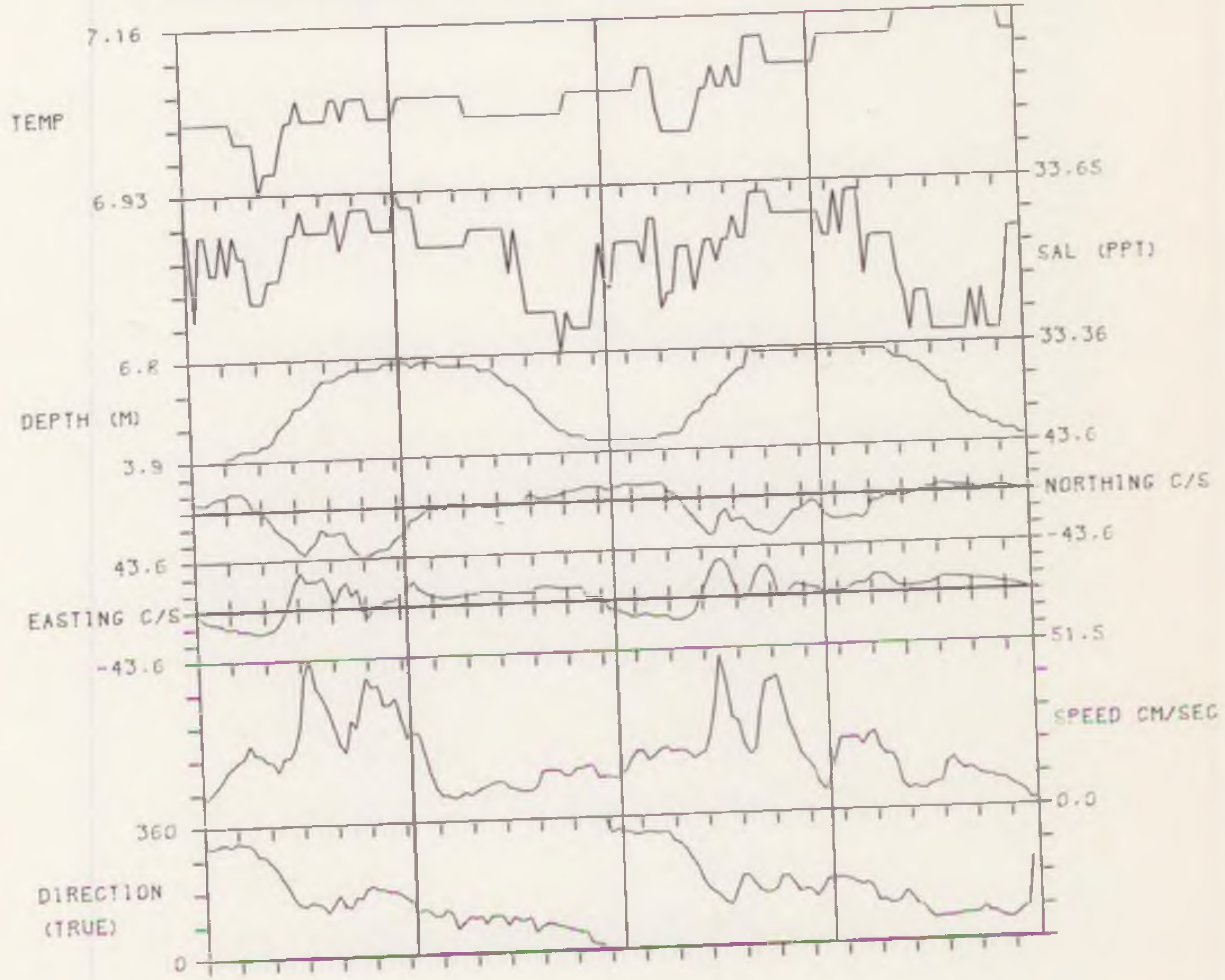
WIRE LENGTH = 2.5 METRES



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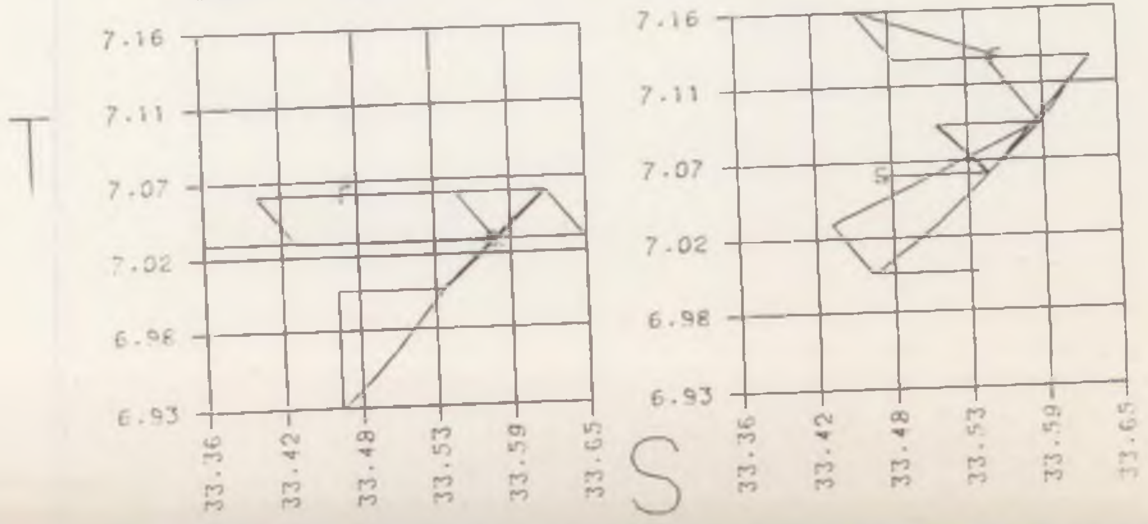

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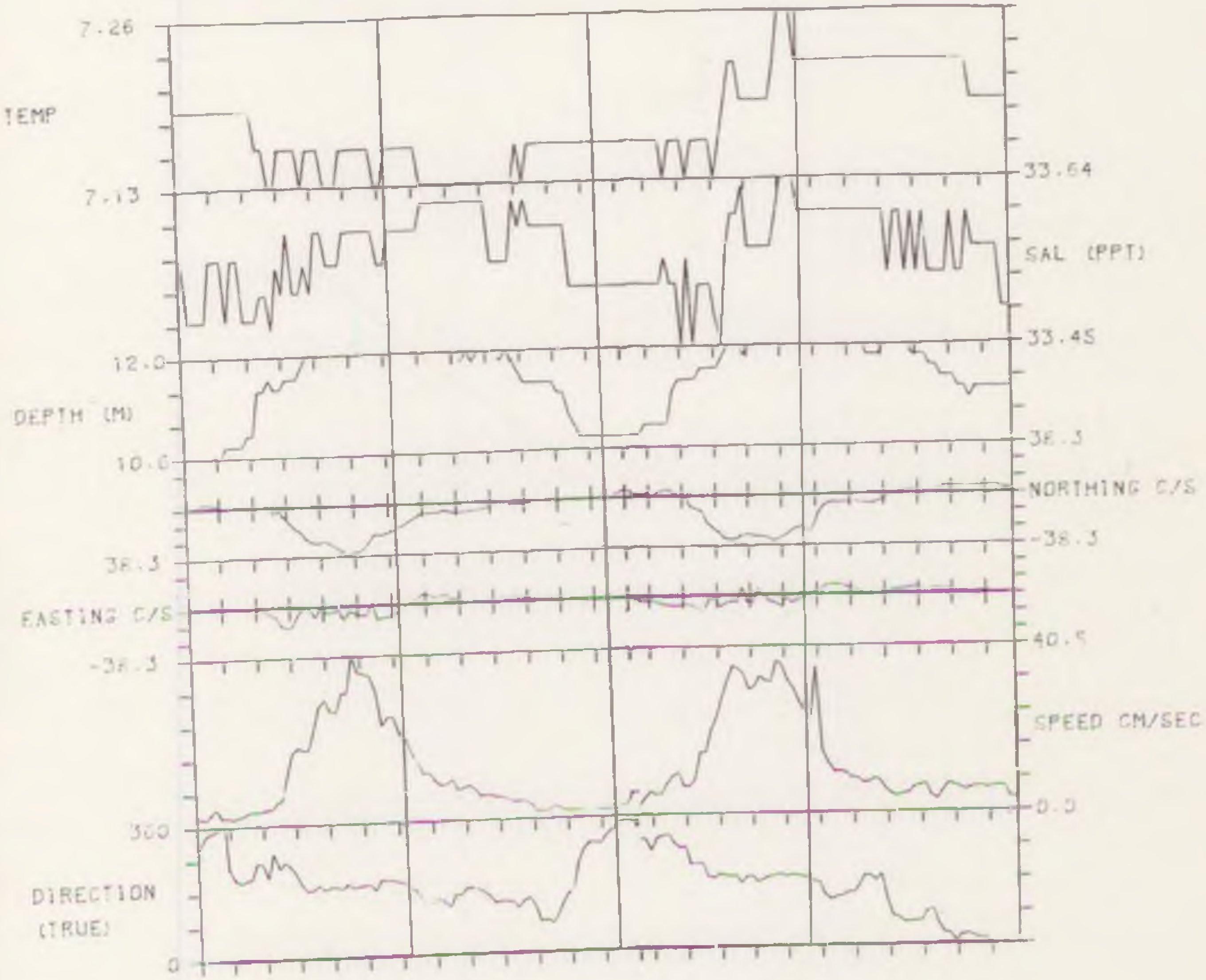

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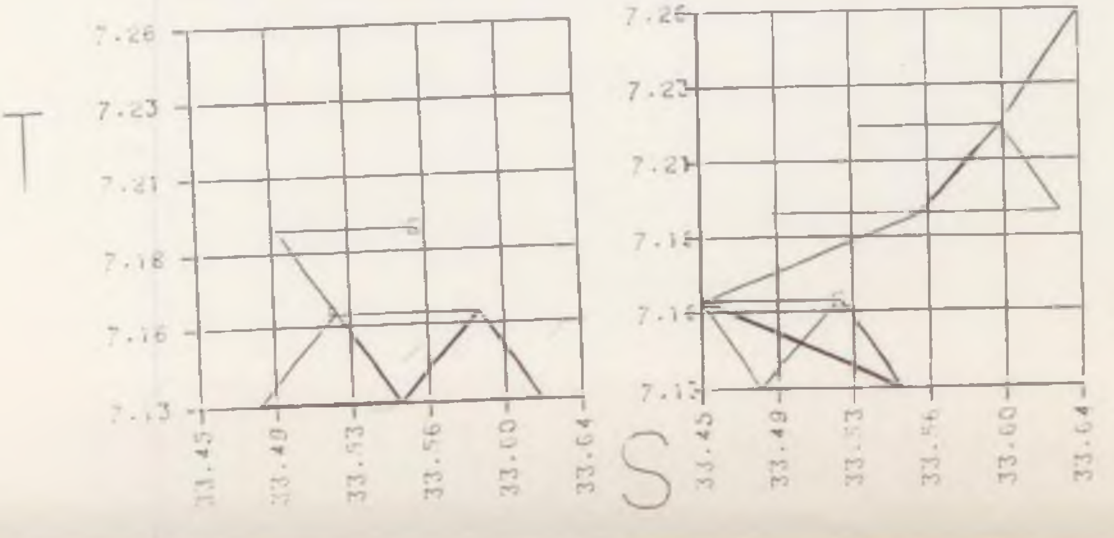

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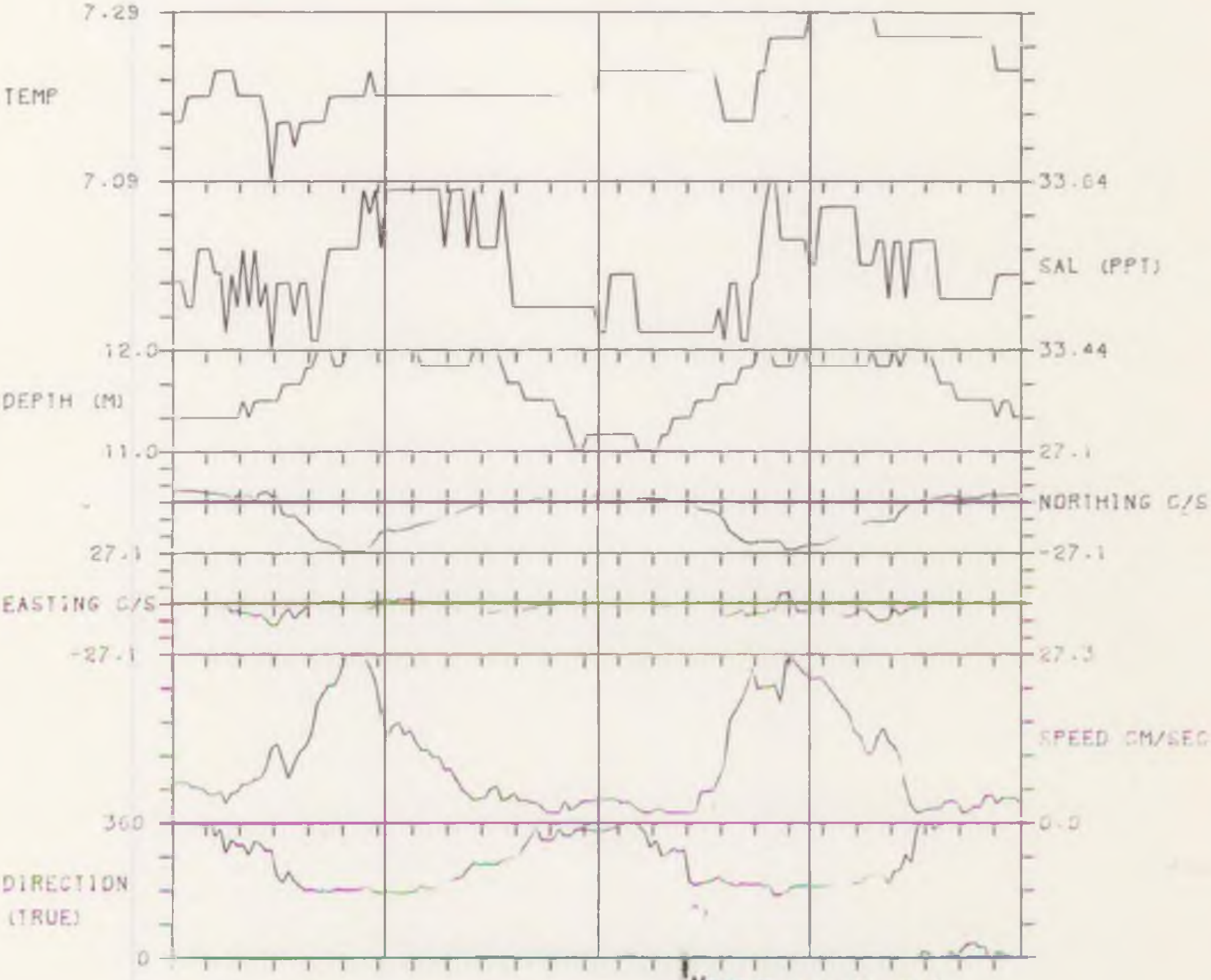
STARTING TIME: 0020 ON 5/3/75

WIRE LENGTH = 11.0 METRES



Narrows 34.01, 7.4

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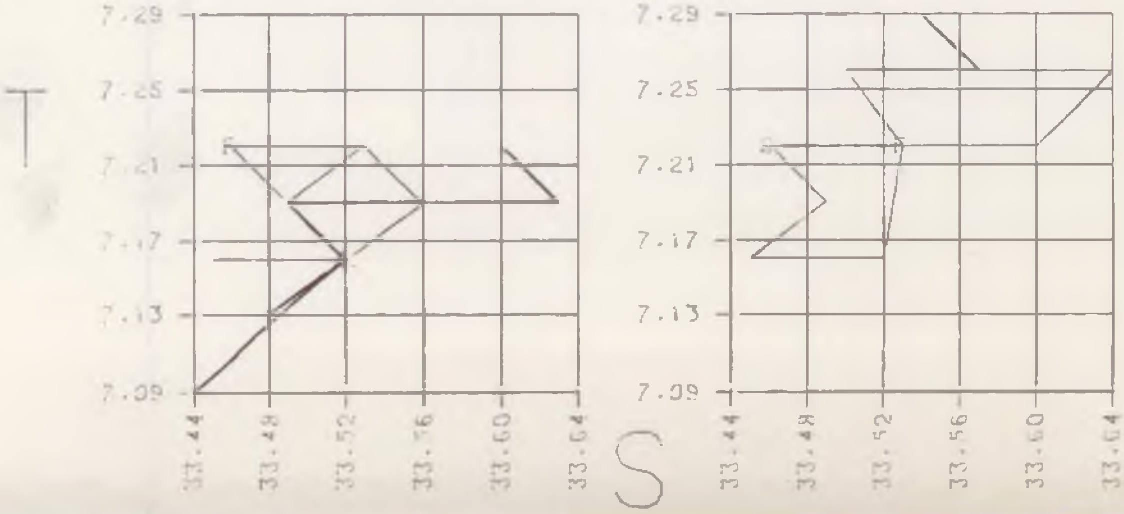

Sal. add .19

A1,3.3

CURRENT METER DATA OVER TWO TIDES

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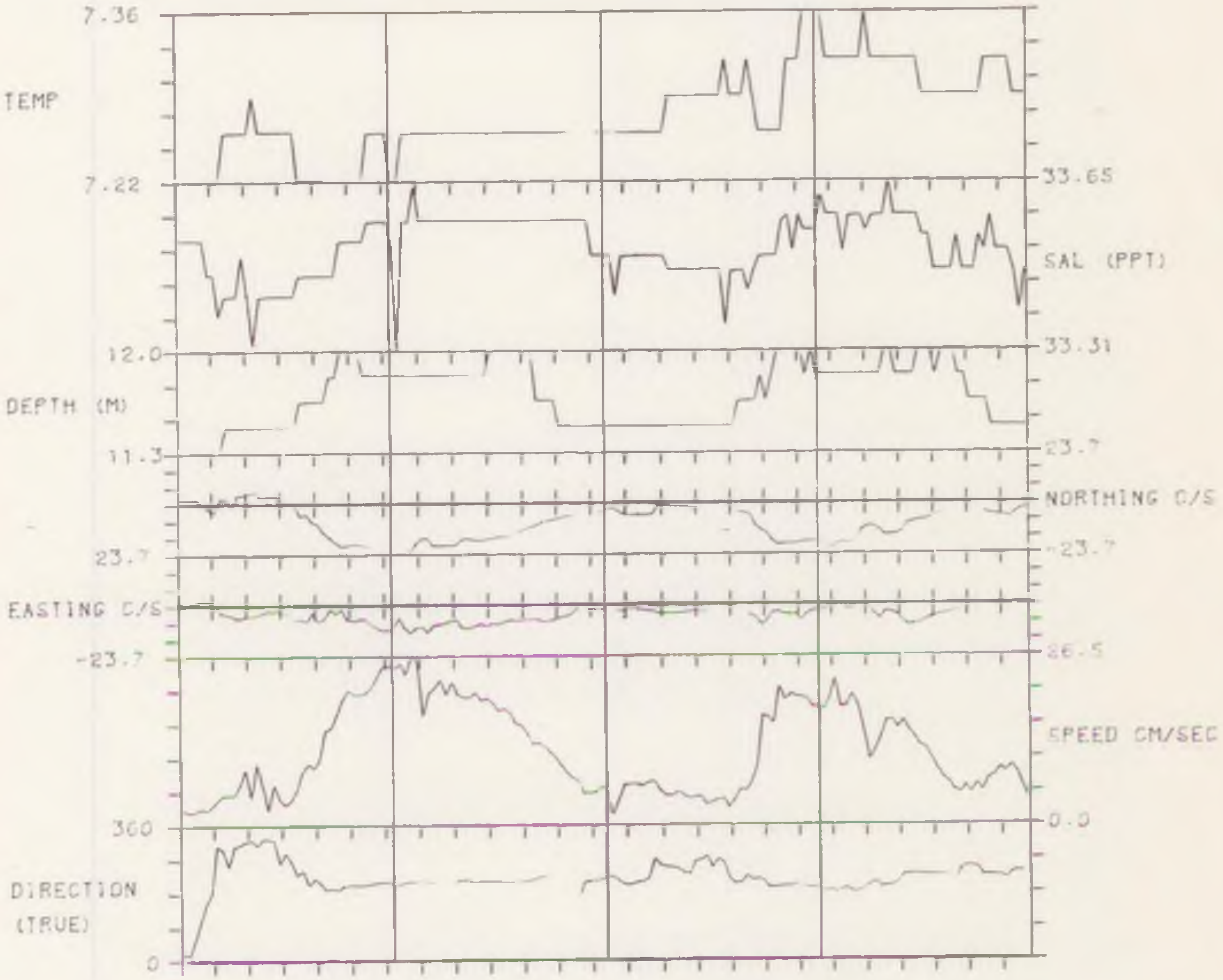

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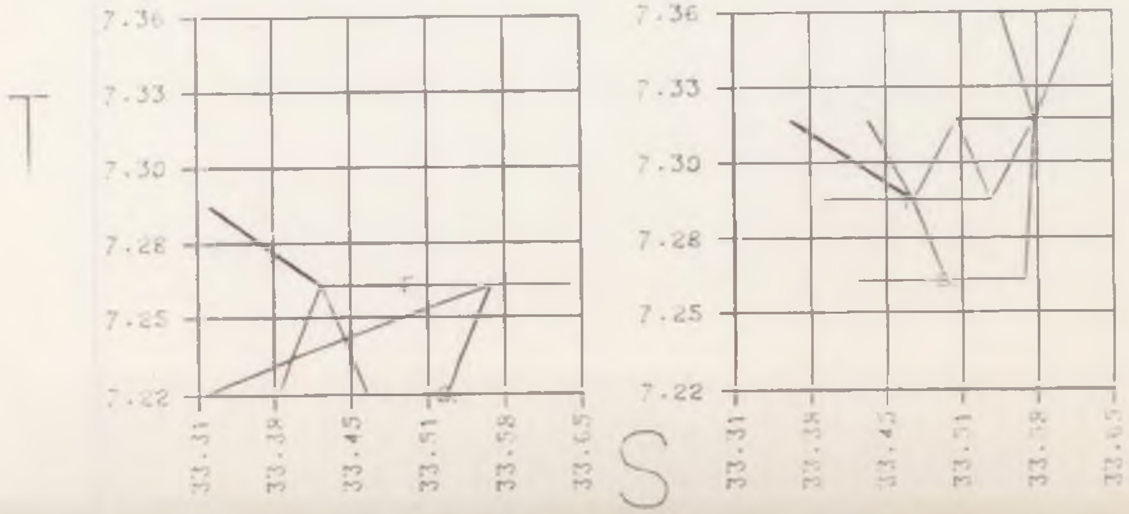

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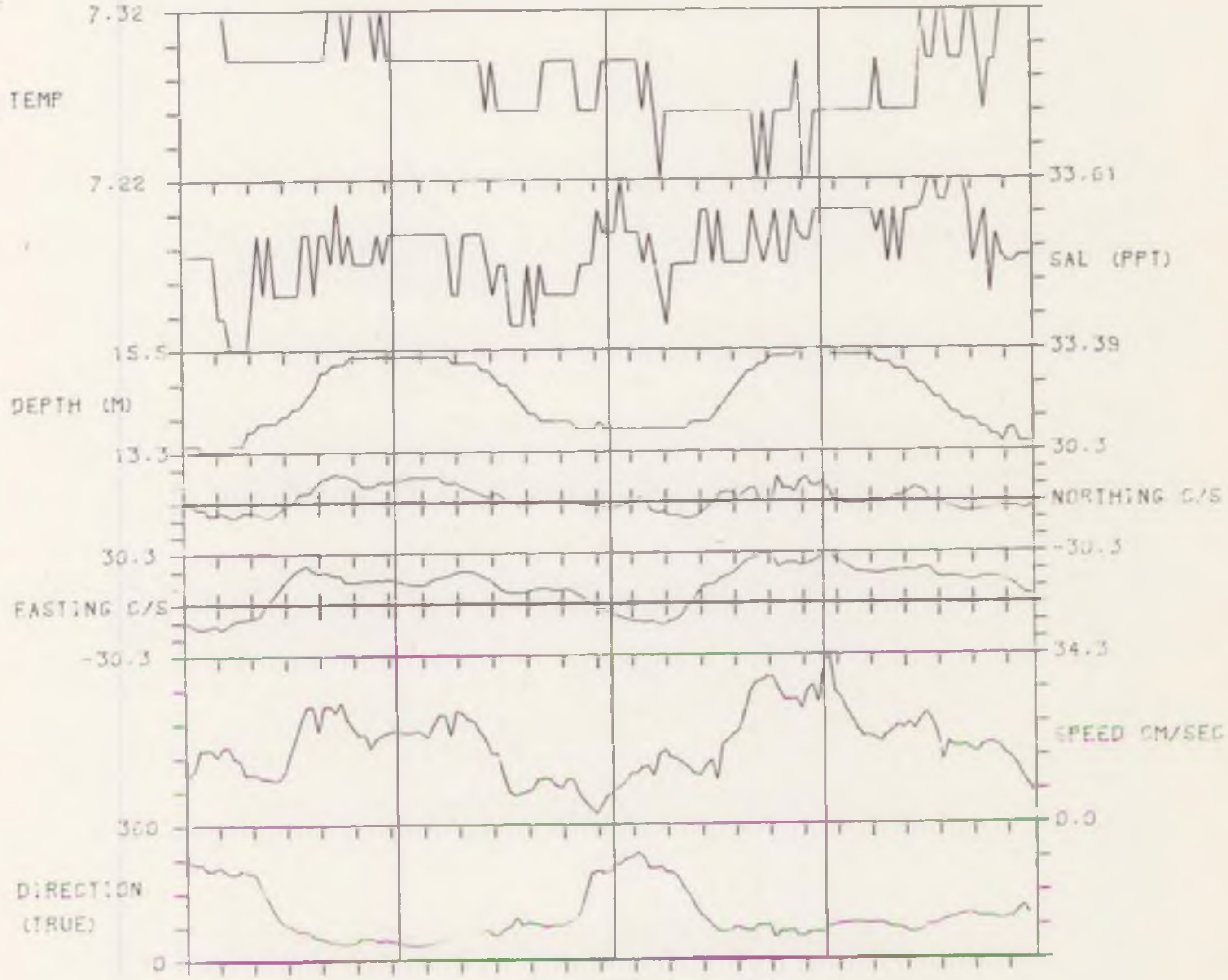

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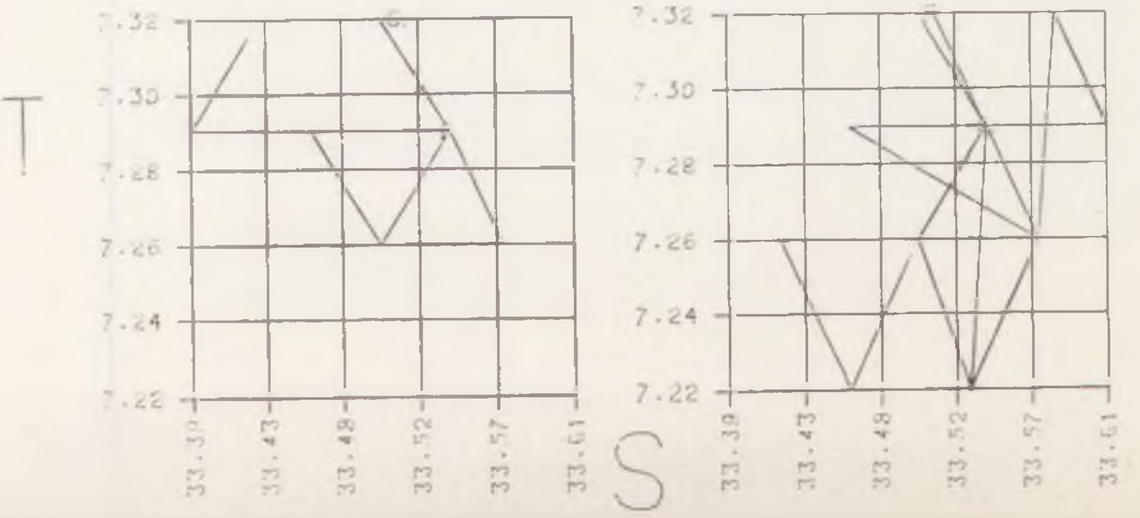

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CURRENT METER DATA OVER TWO TIDES

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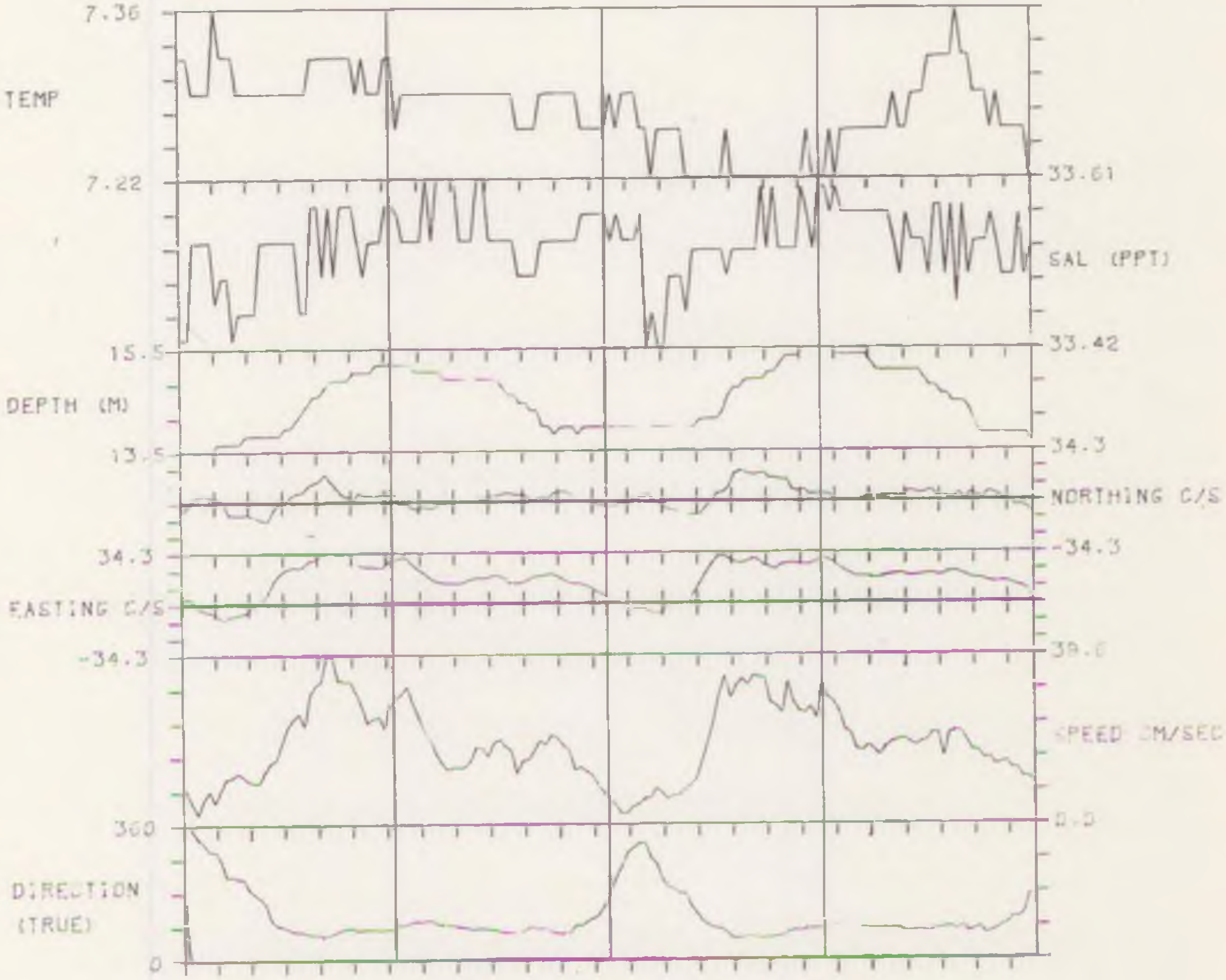

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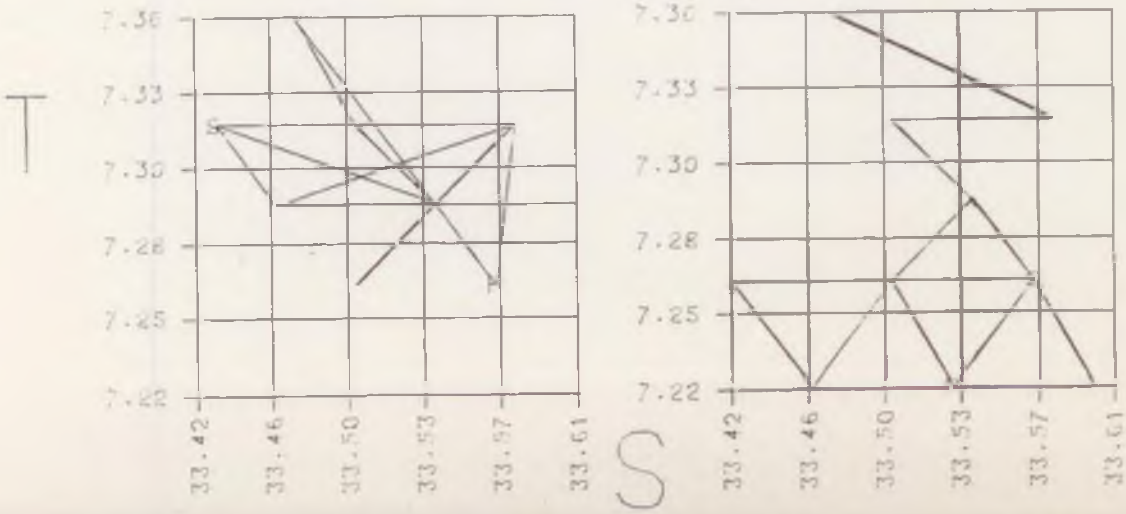

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CURRENT METER DATA OVER TWO TIDES

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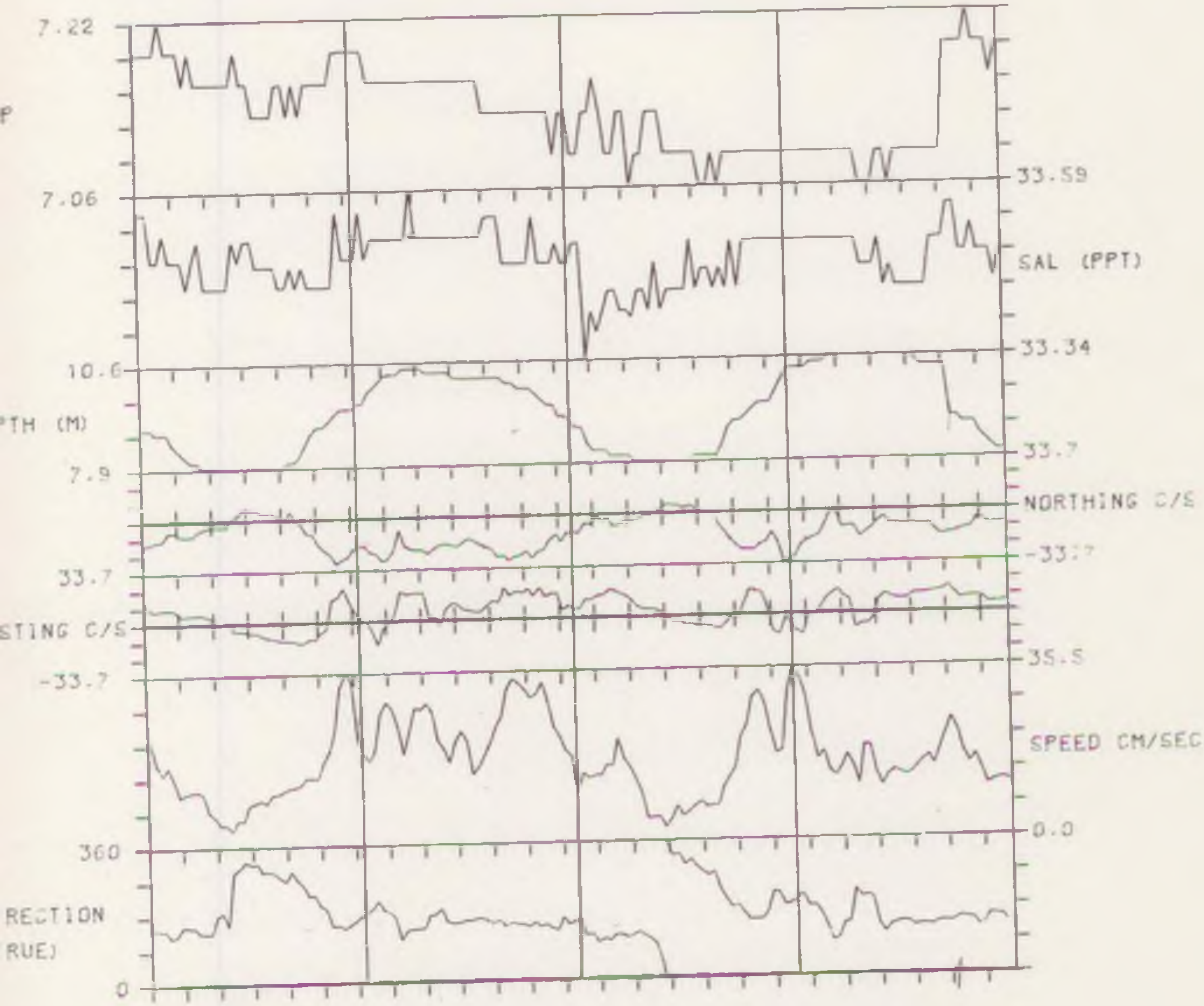

larrows 33.99, 7.2

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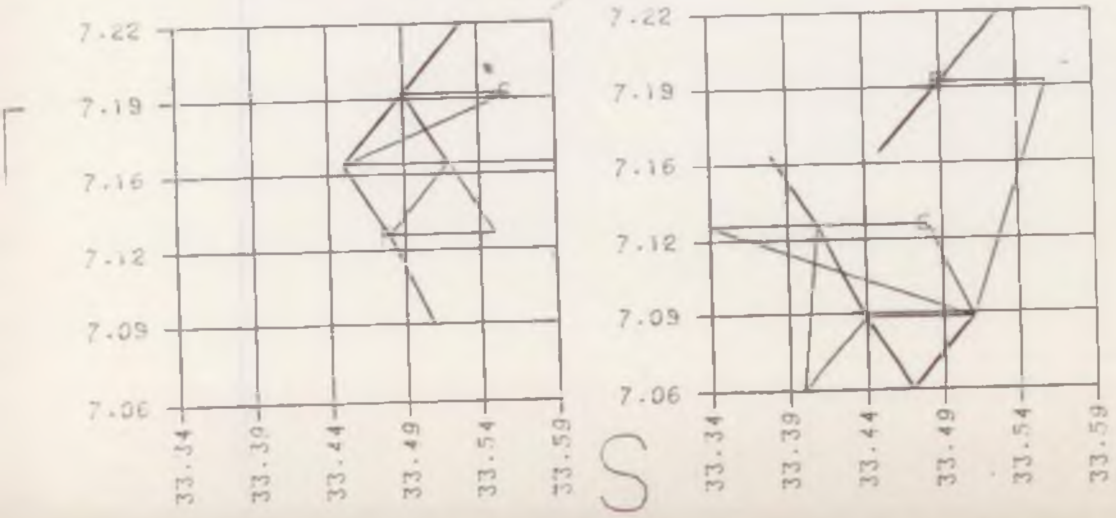

Sal ~~add~~ .19

Sal. add .44

CURRENT METER DATA OVER TWO TIDES

STATION NO. 6

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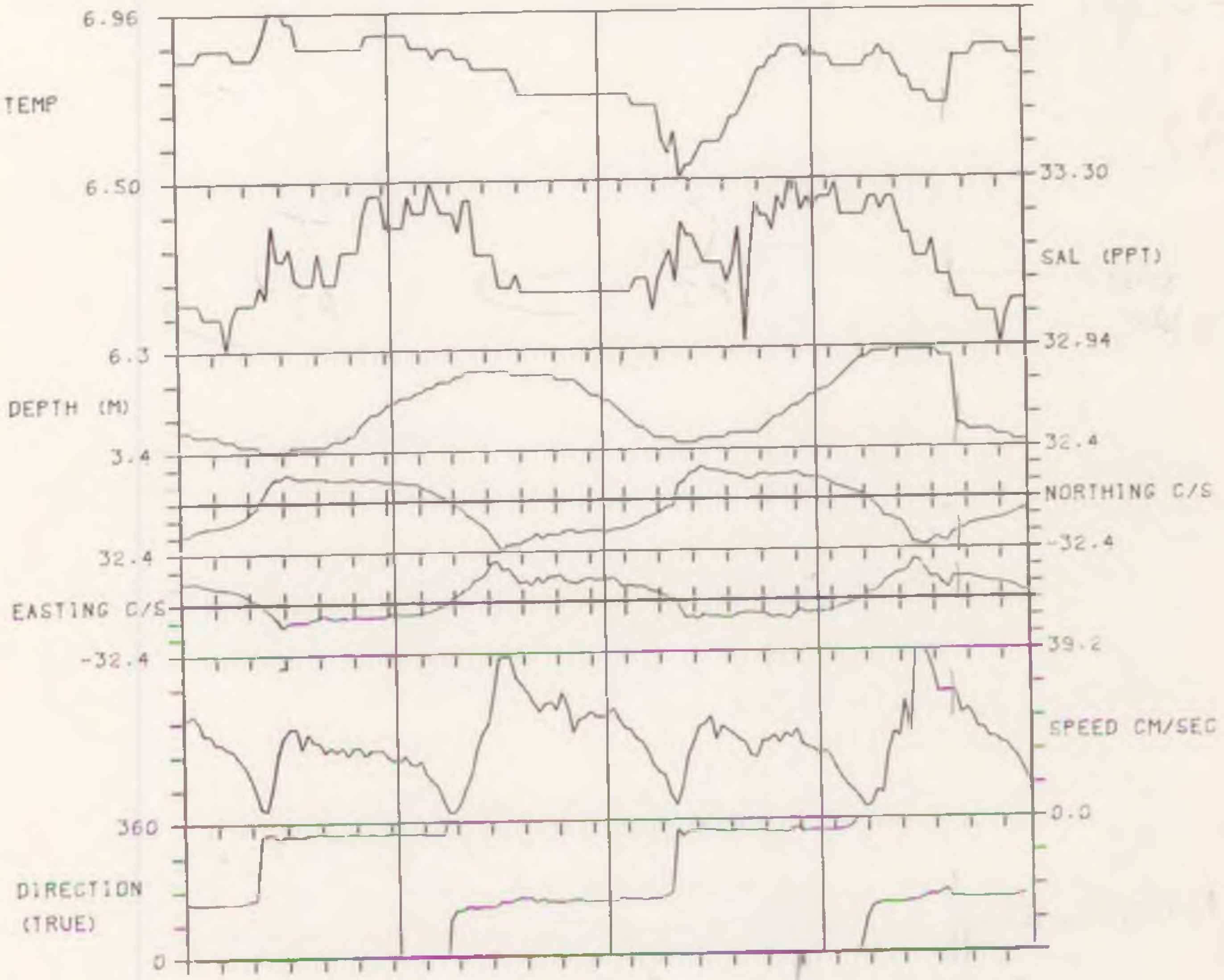

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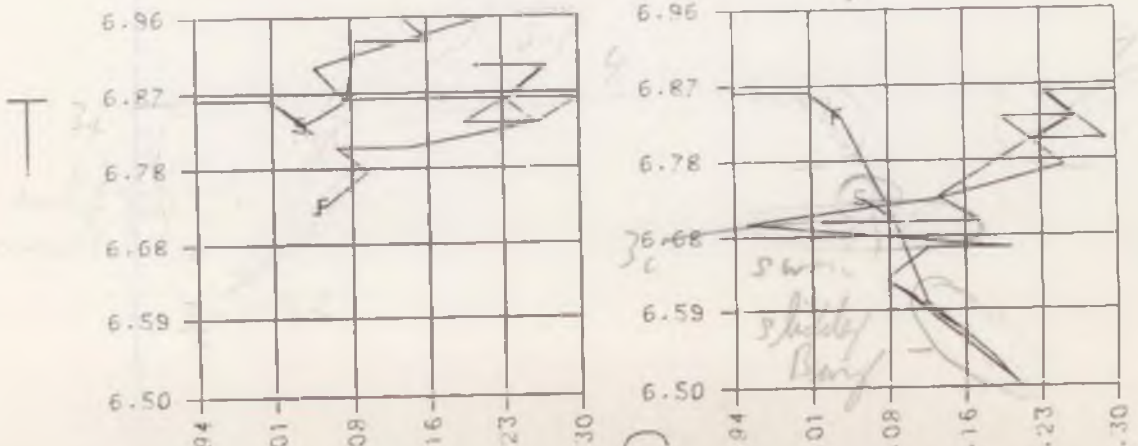

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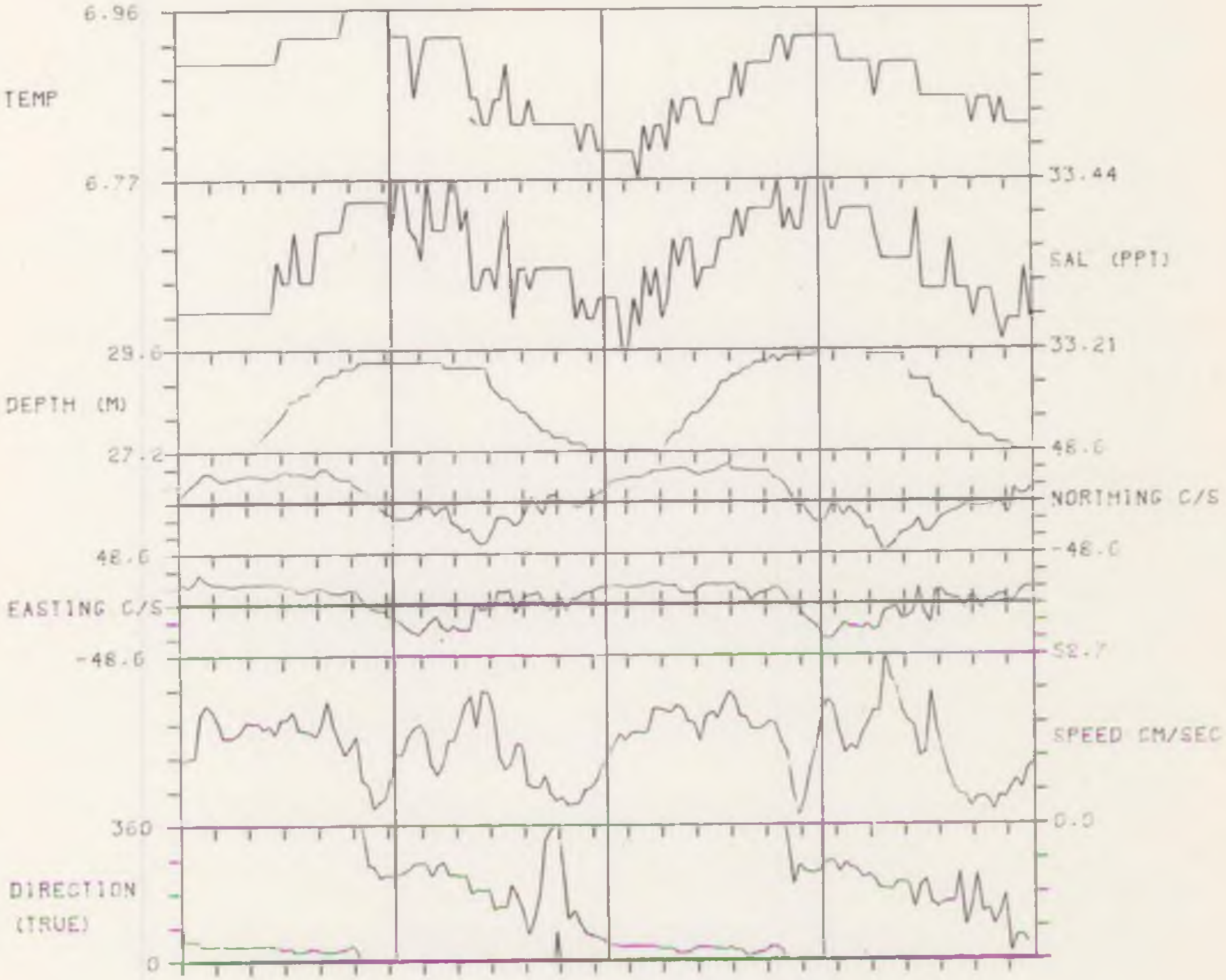

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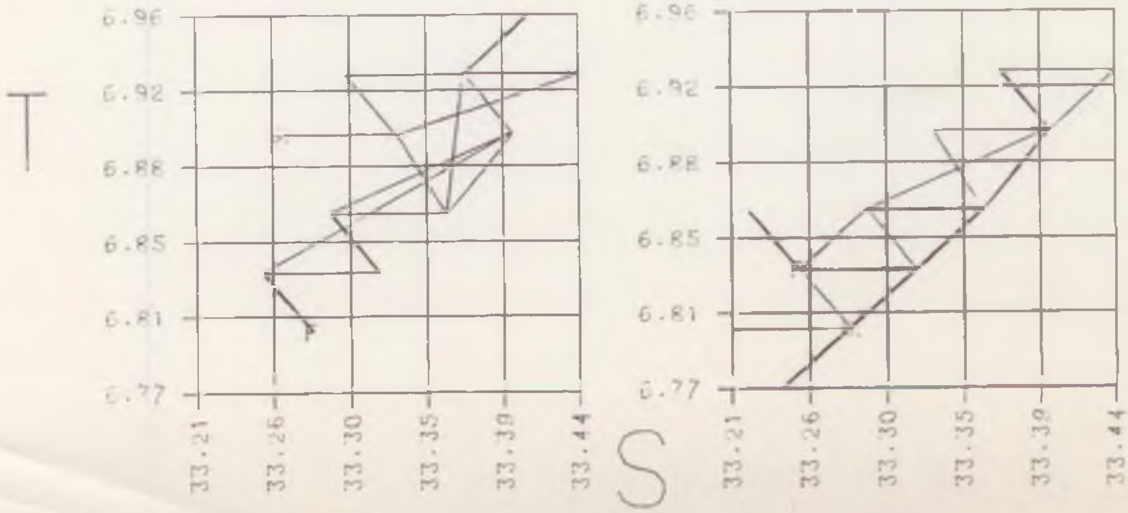

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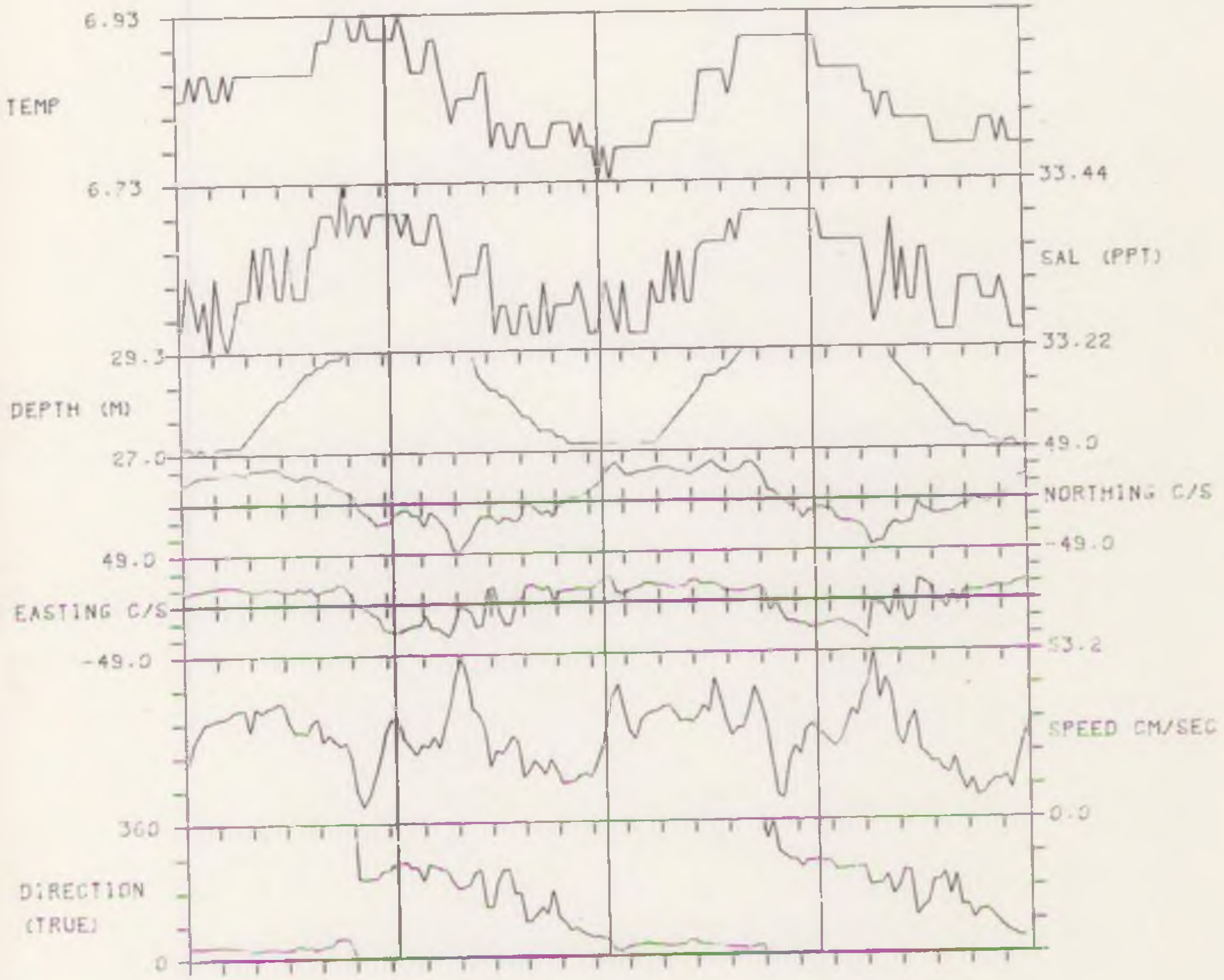

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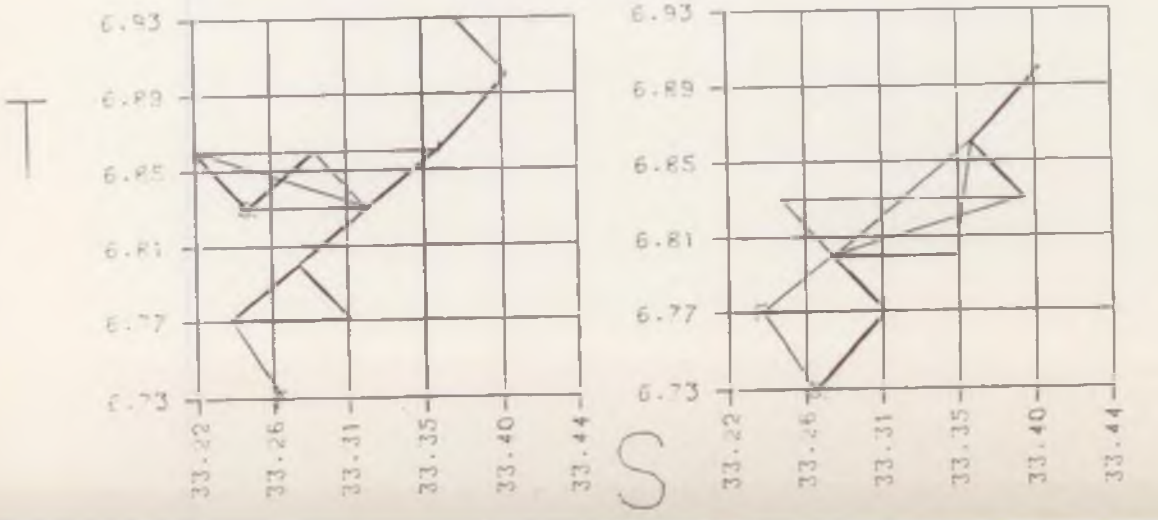

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CURRENT METER DATA OVER TWO TIDES

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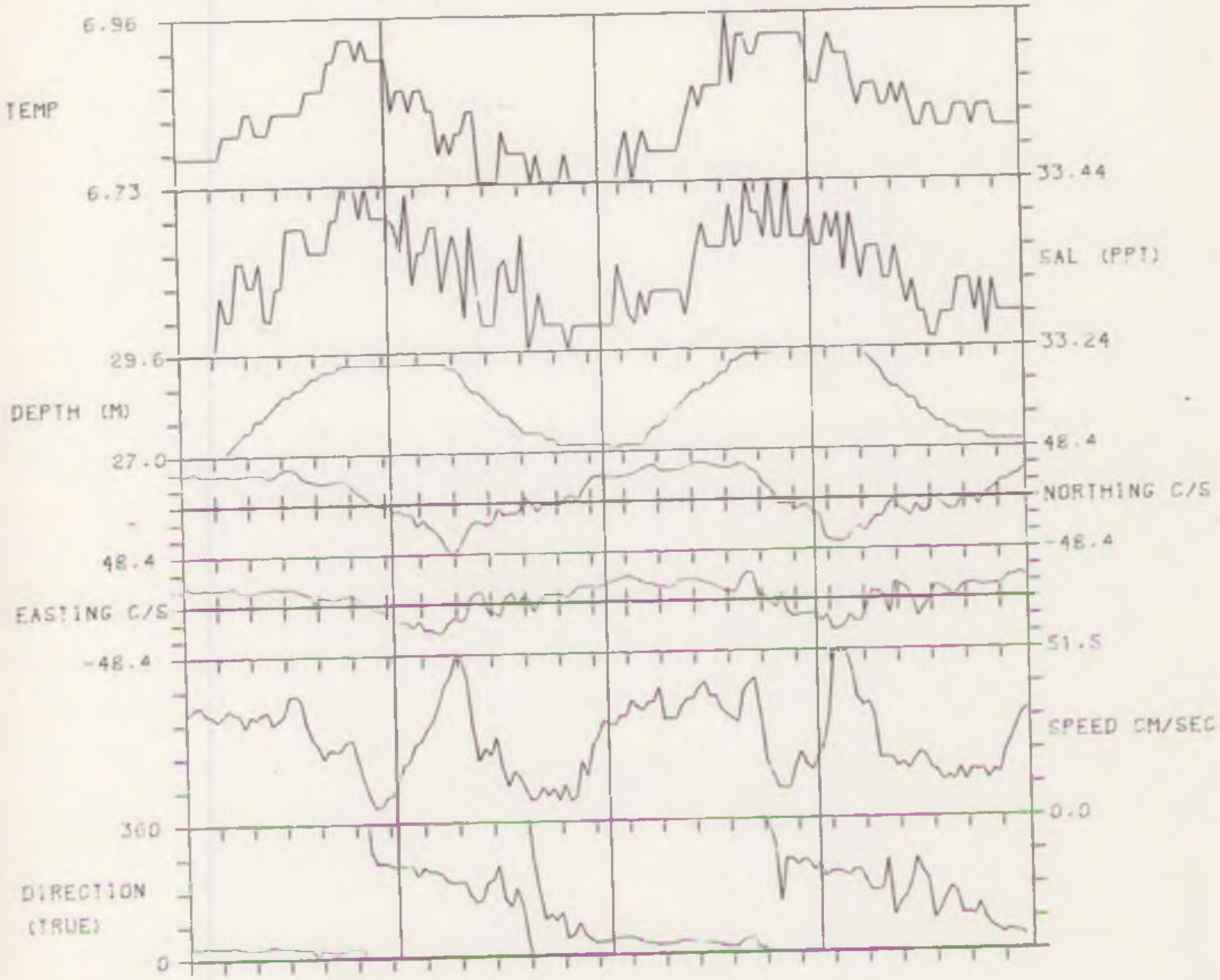

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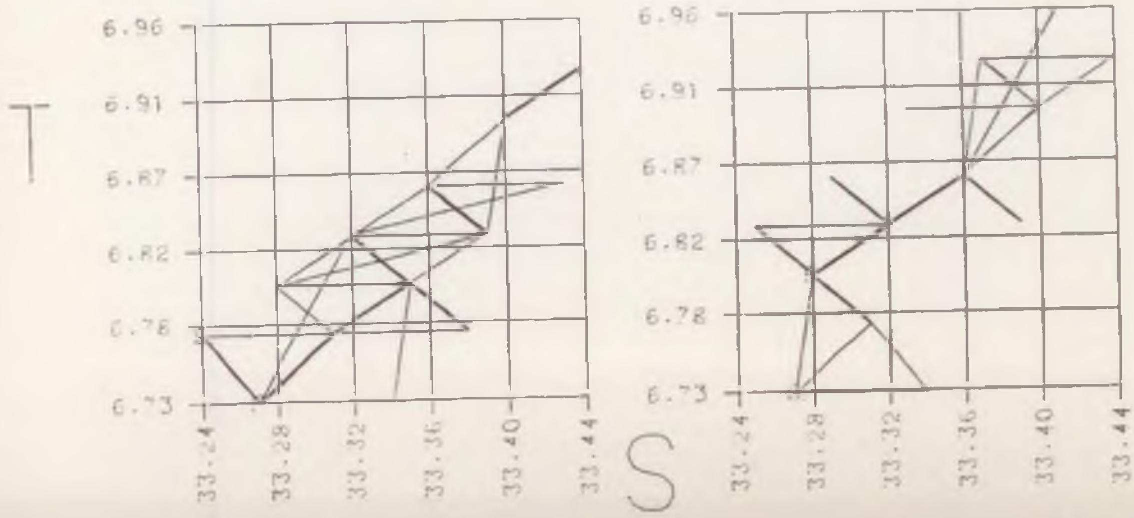

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CURRENT METER DATA OVER TWO TIDES

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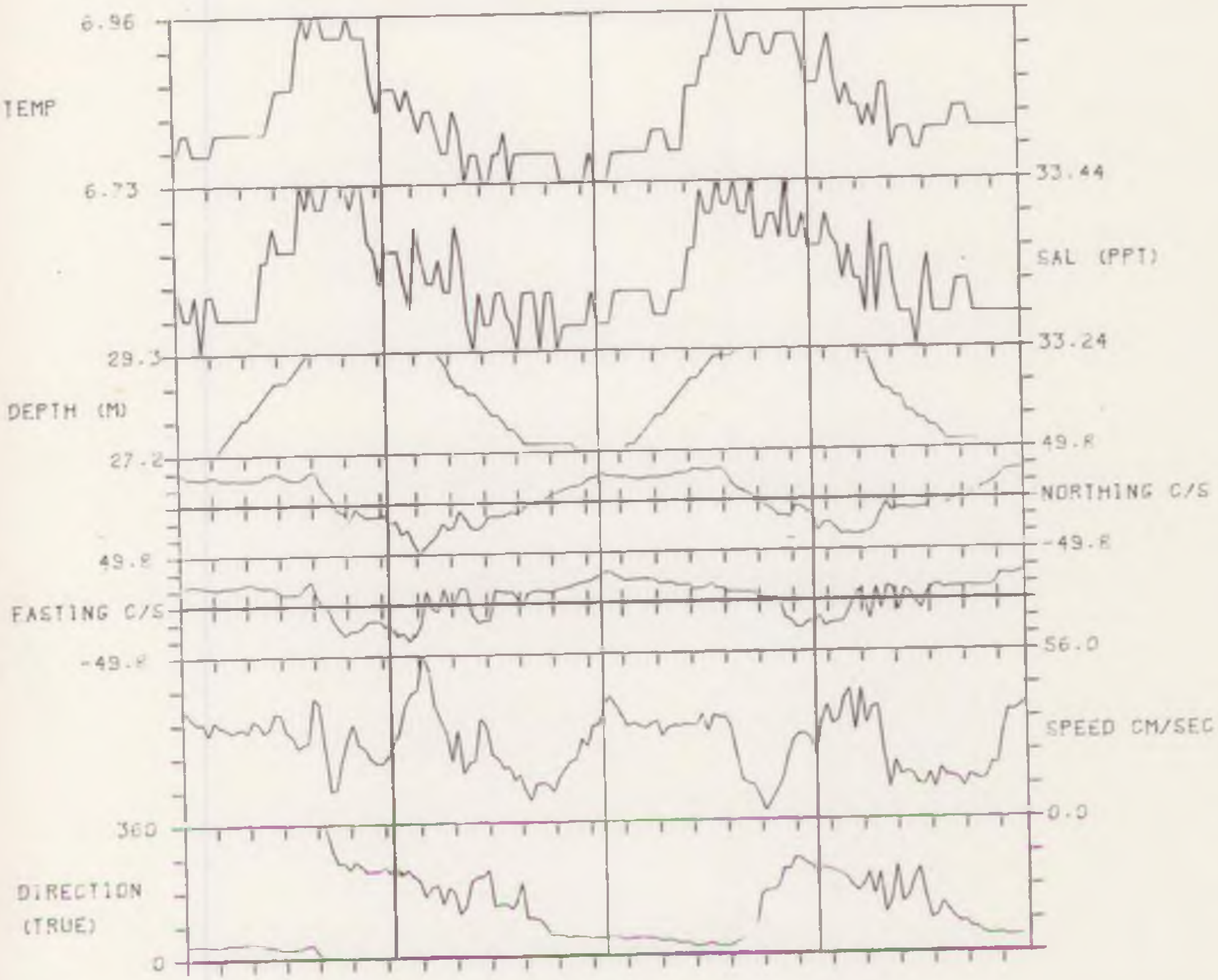
WIRE LENGTH = 8.5 METRES



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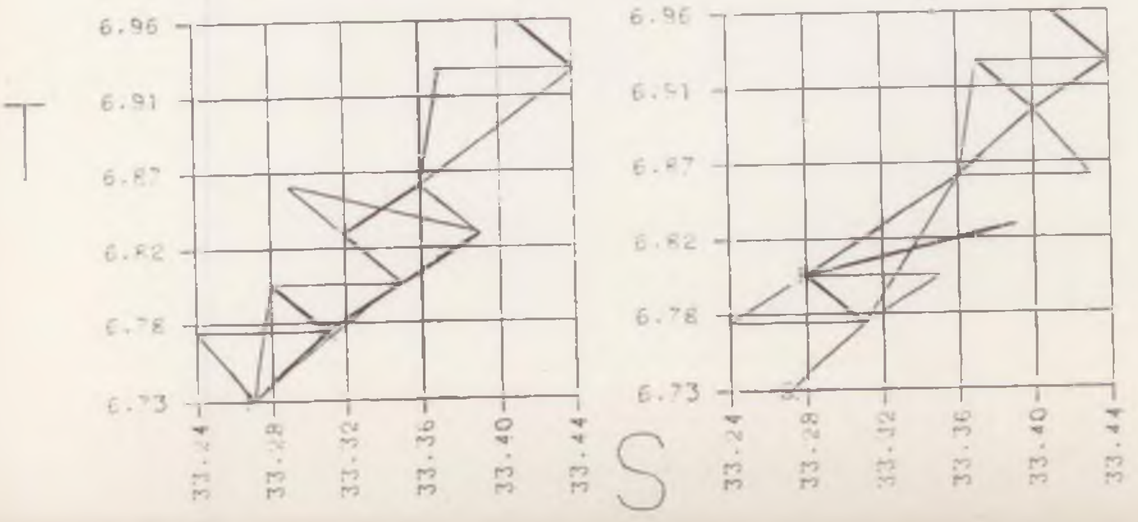

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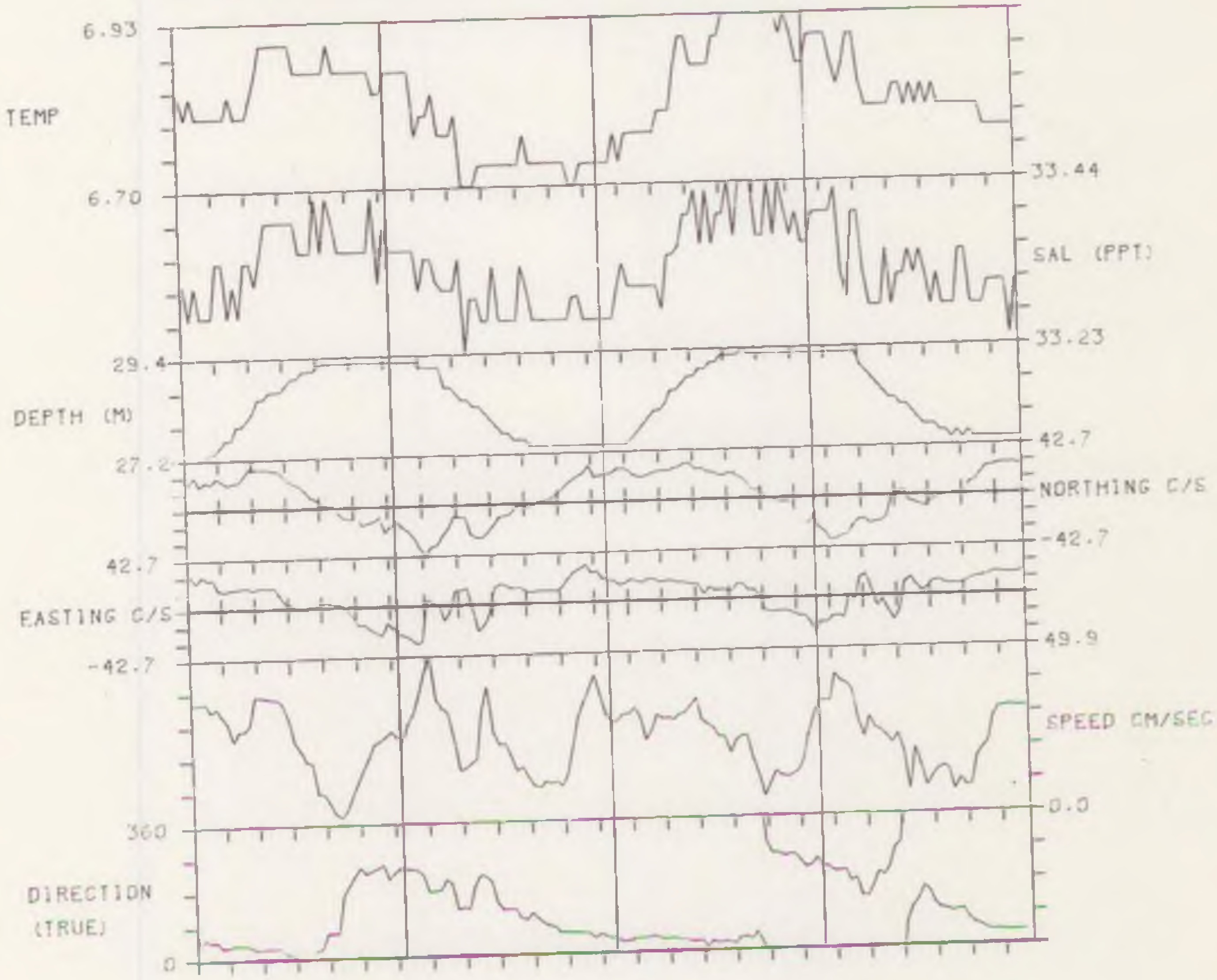

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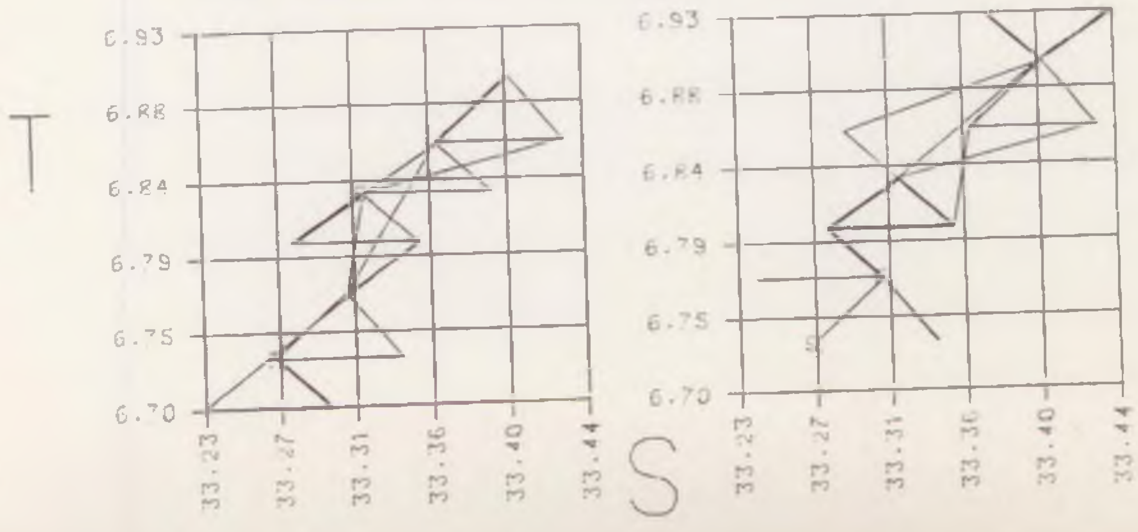

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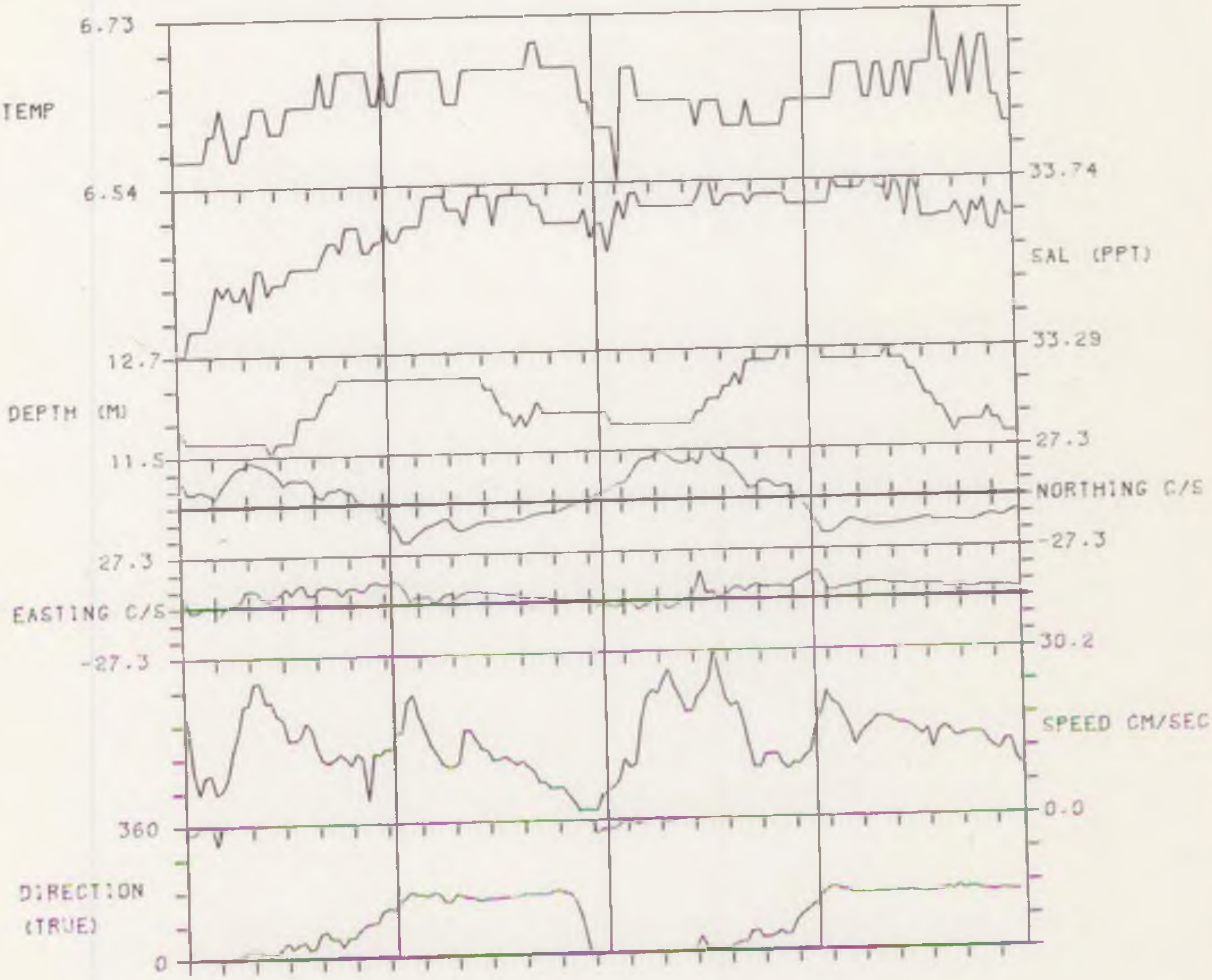

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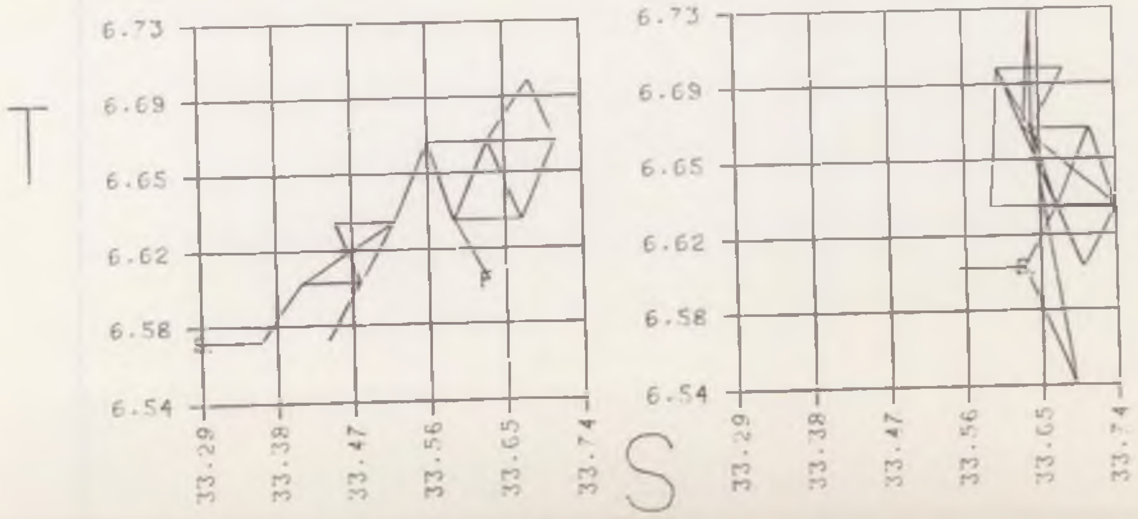

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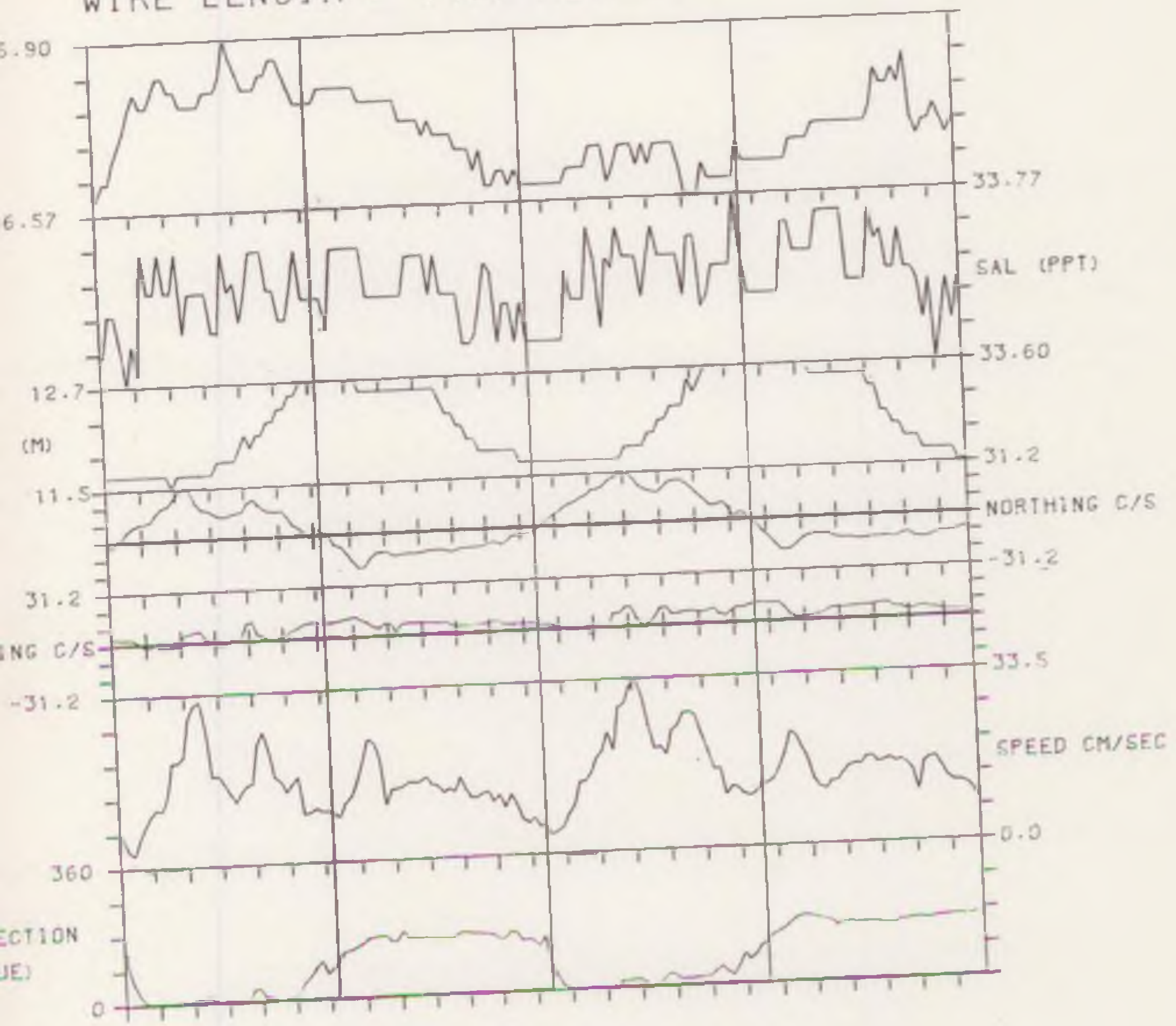

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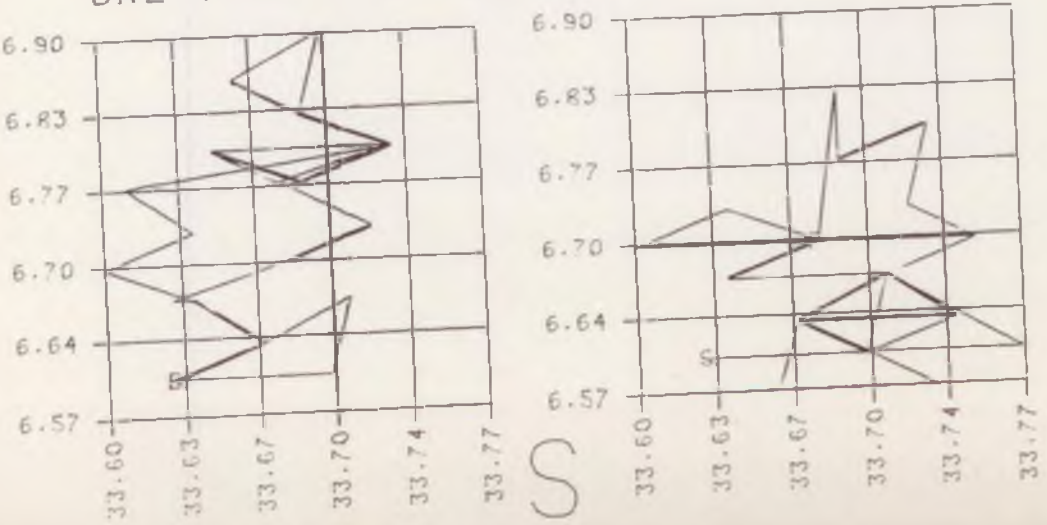

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STARTING TIME: 1538 ON 6/4/75

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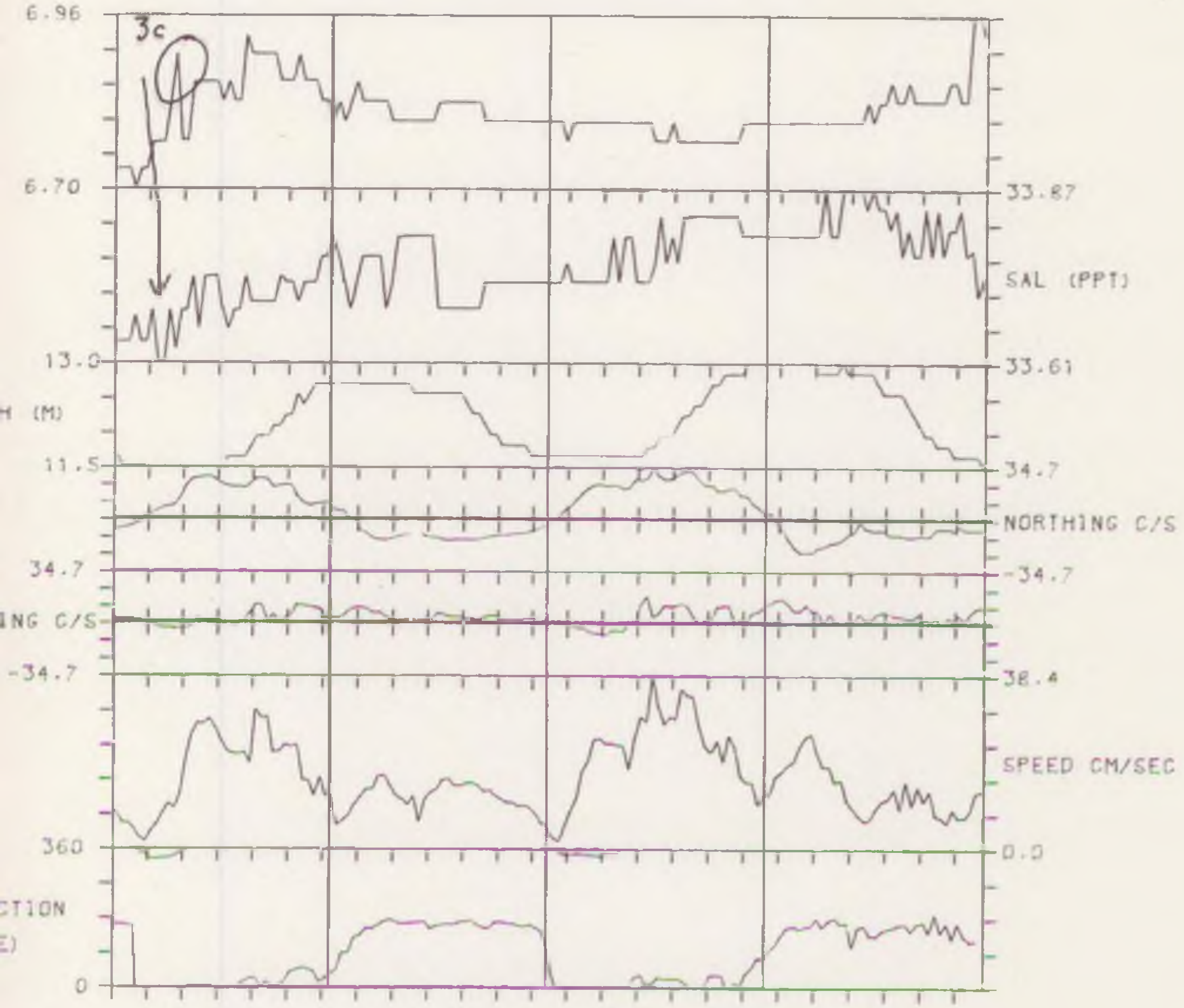

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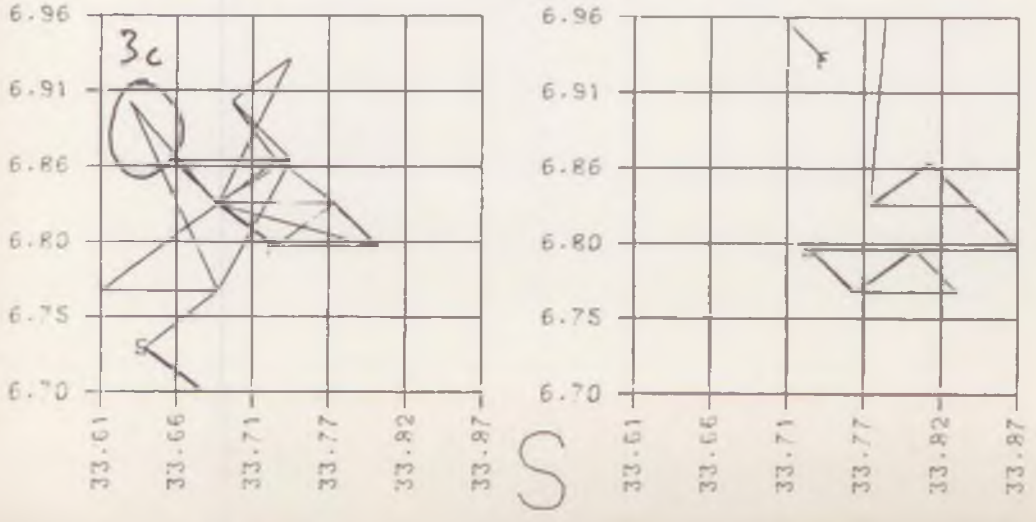

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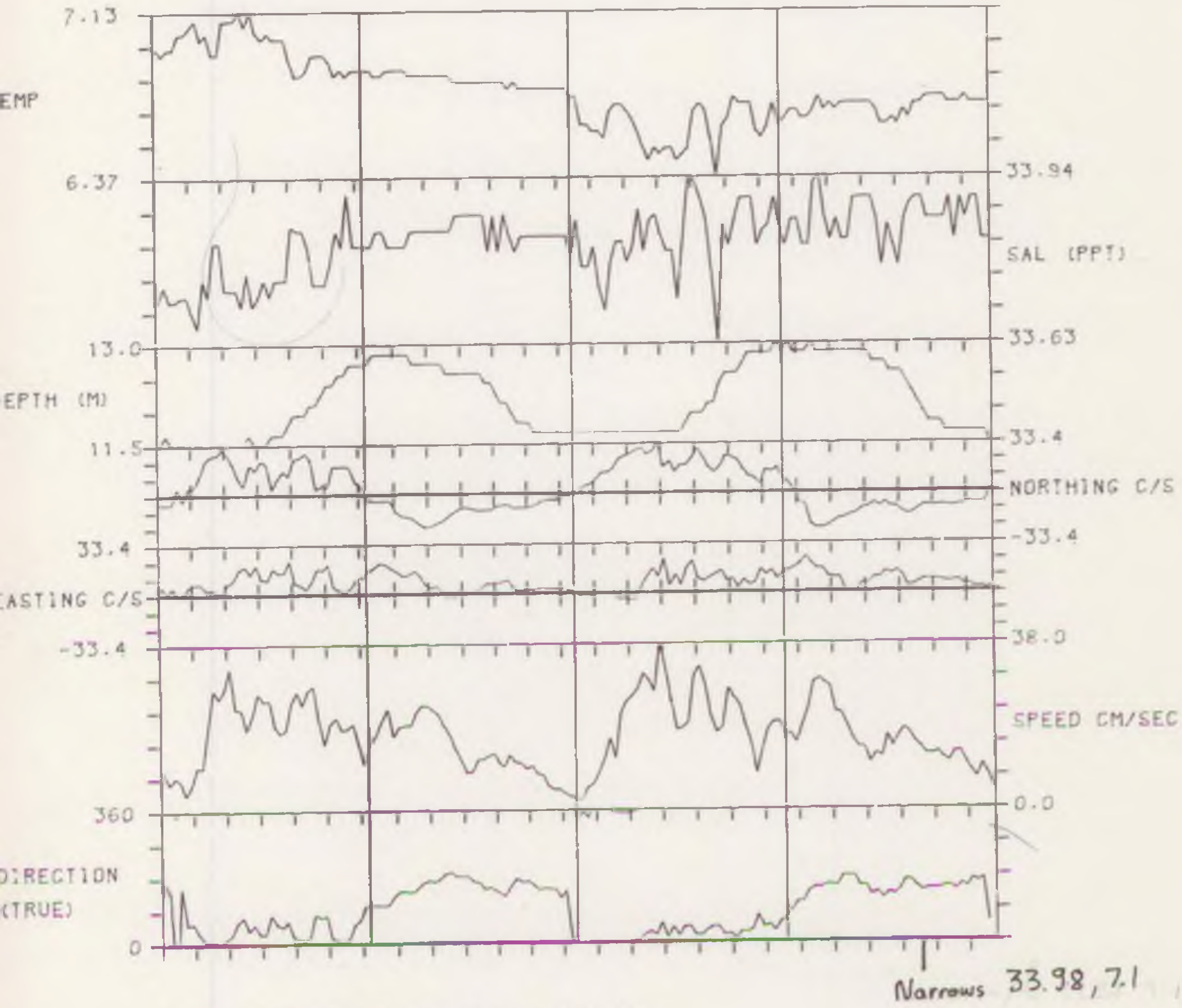
WIRE LENGTH = 14.0 METRES



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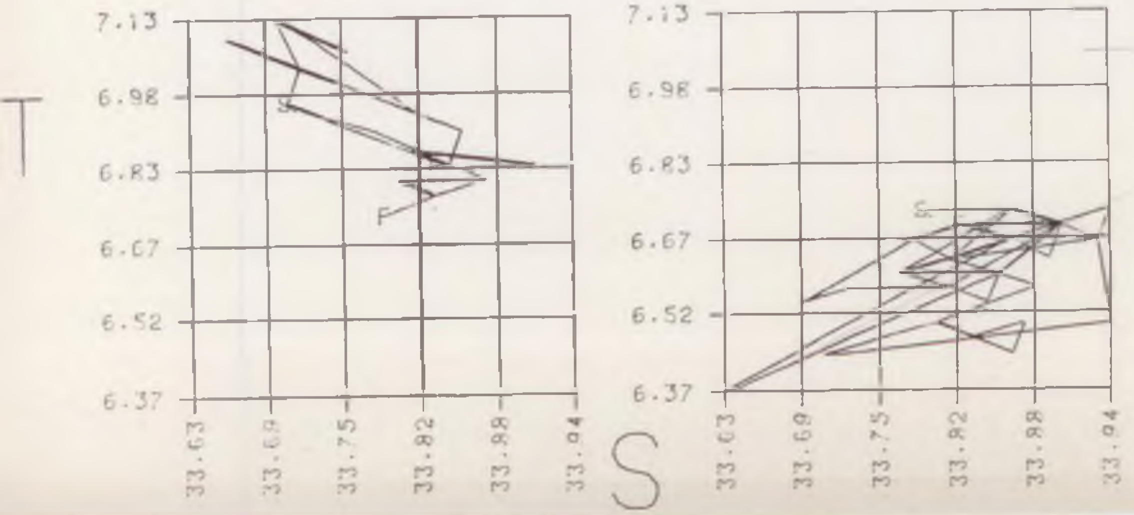

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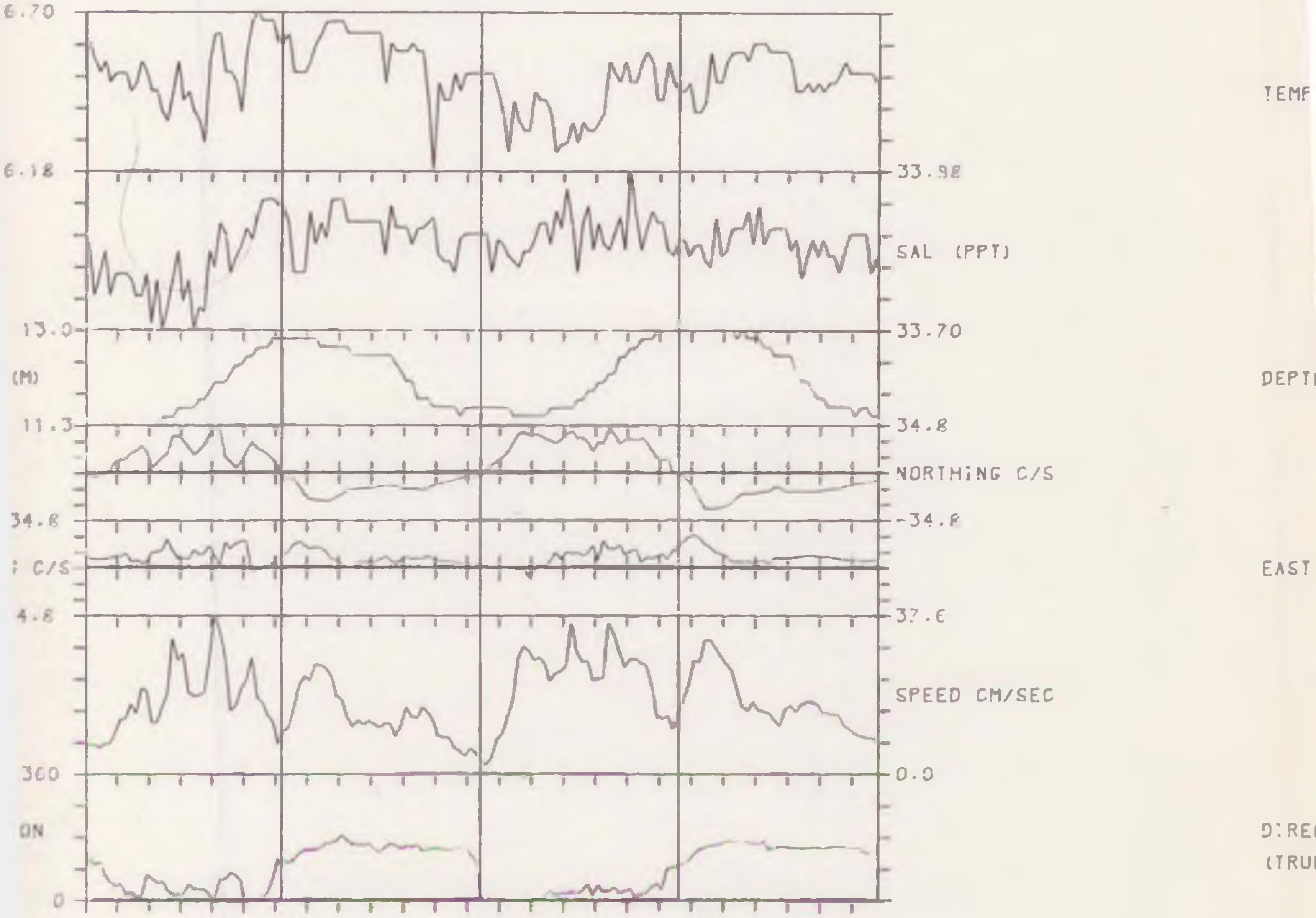

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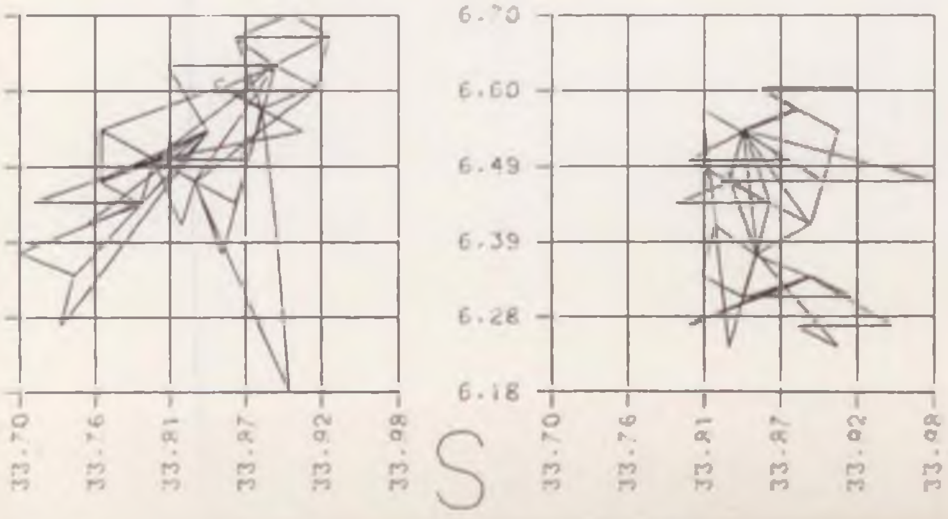

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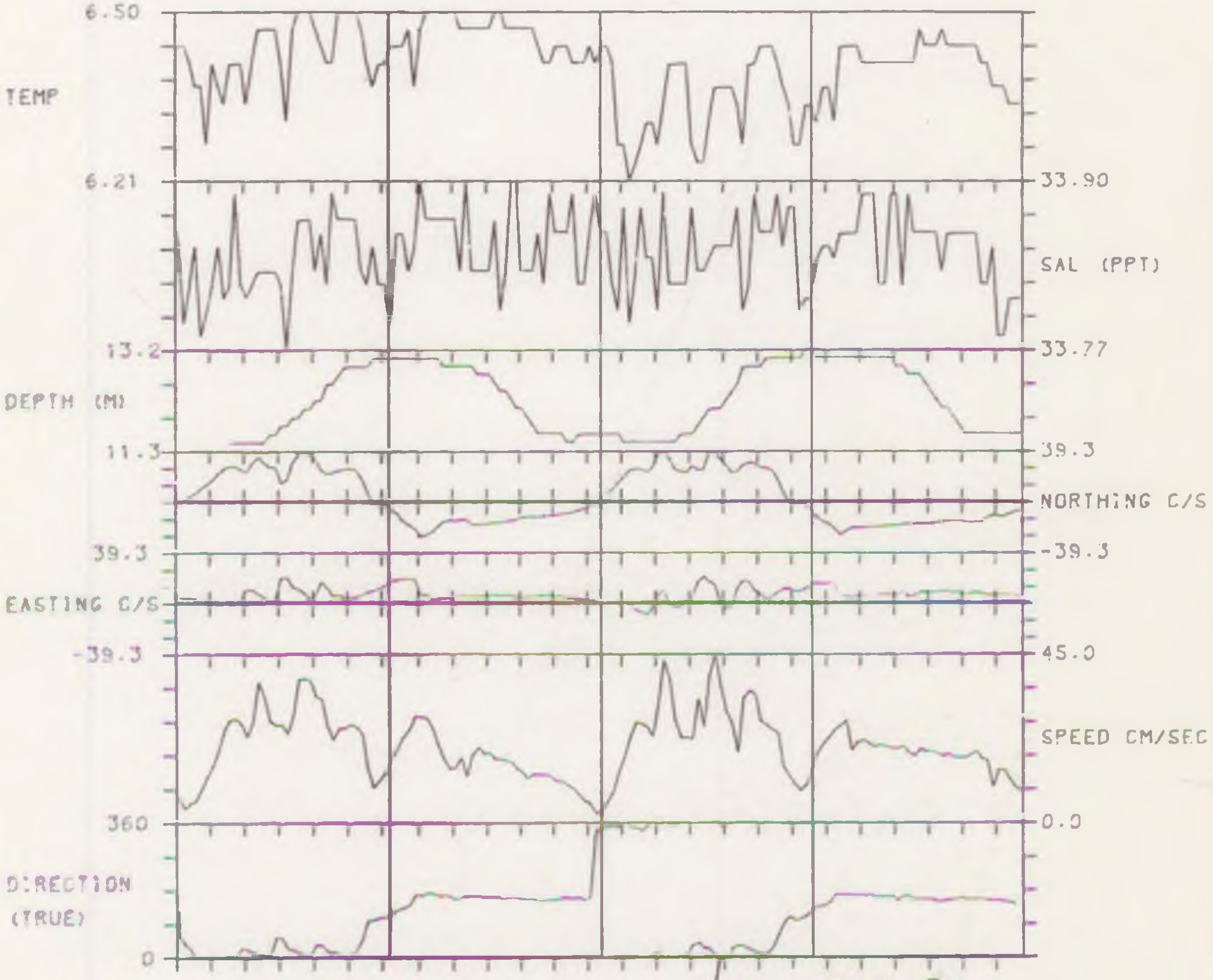

Narrows 34.01, 7.5

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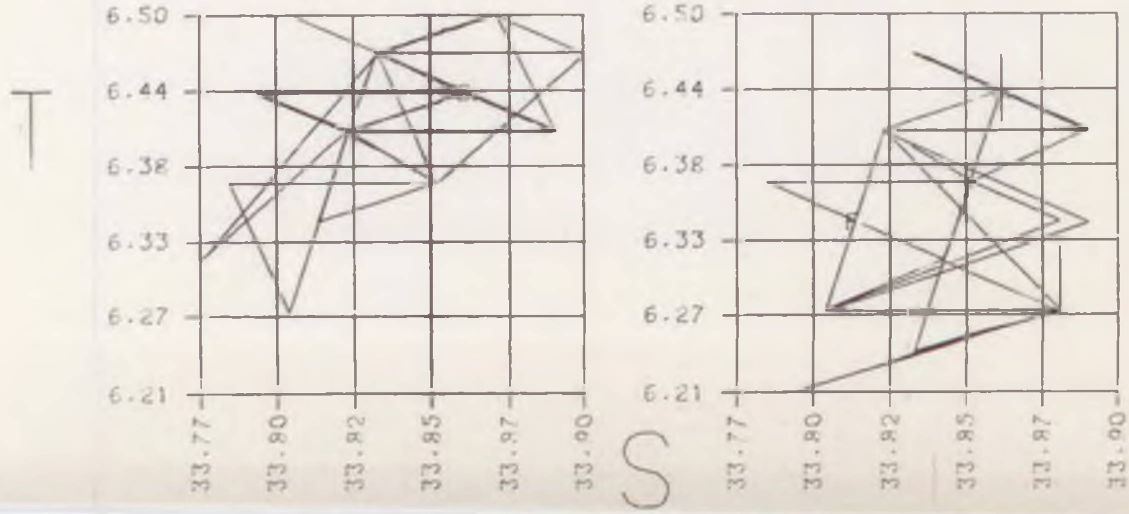

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CURRENT METER DATA OVER TWO TIDES

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STARTING TIME: 1858 ON 10/4/75

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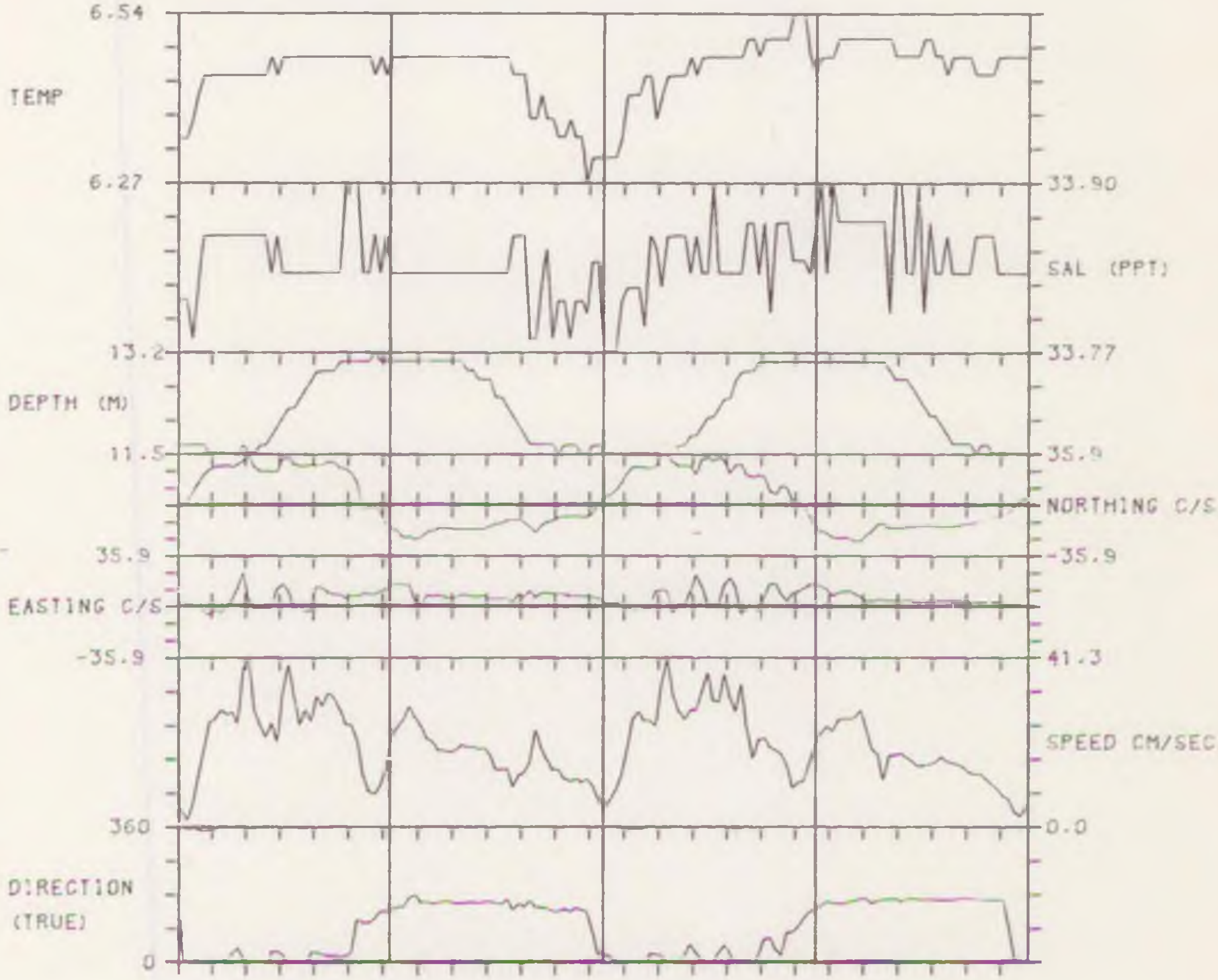

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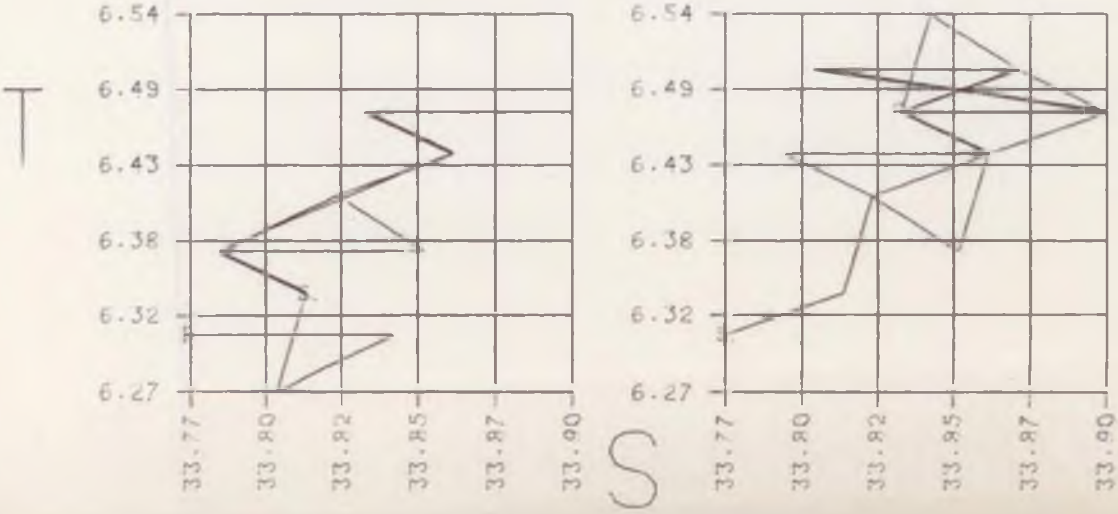

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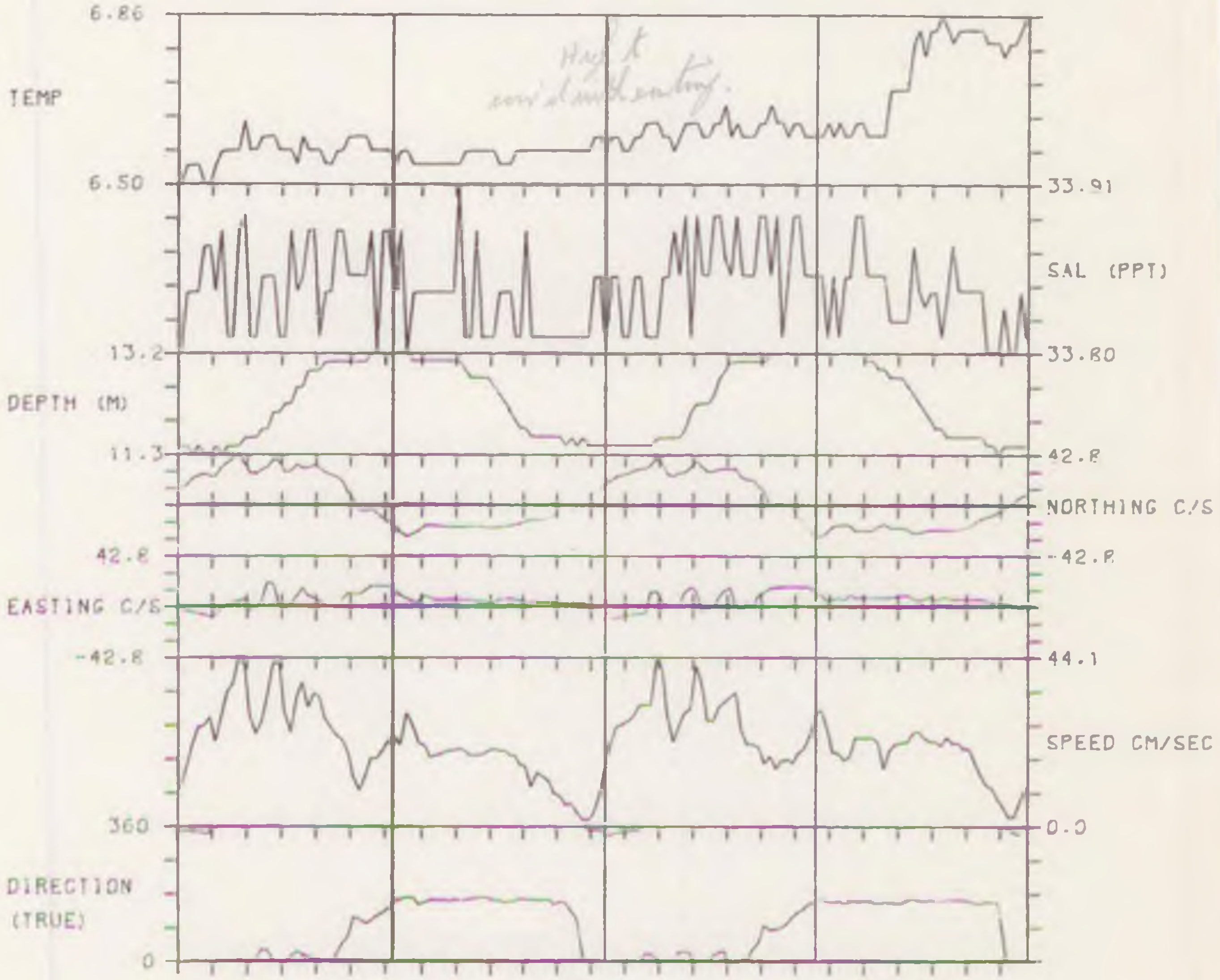

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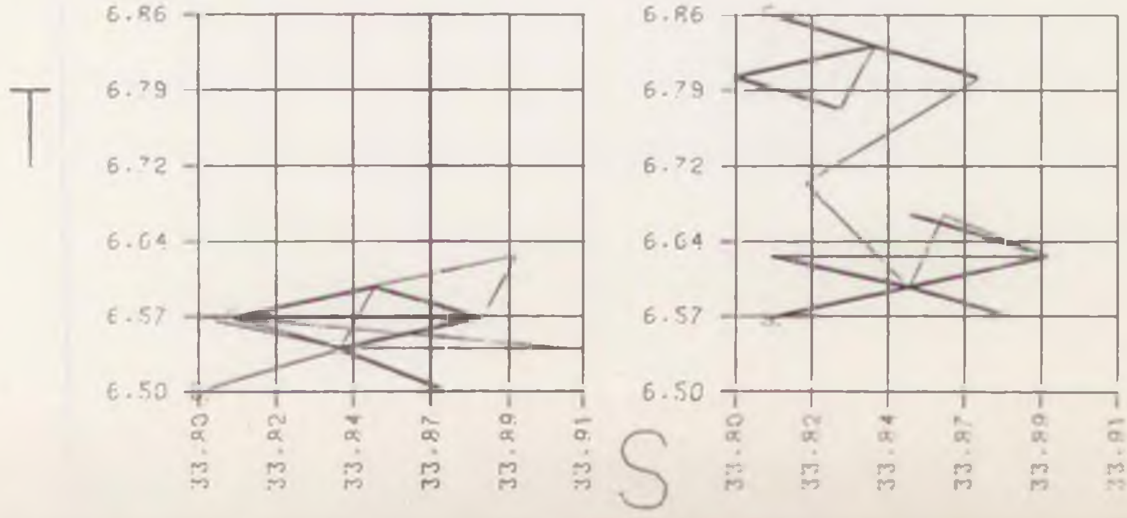

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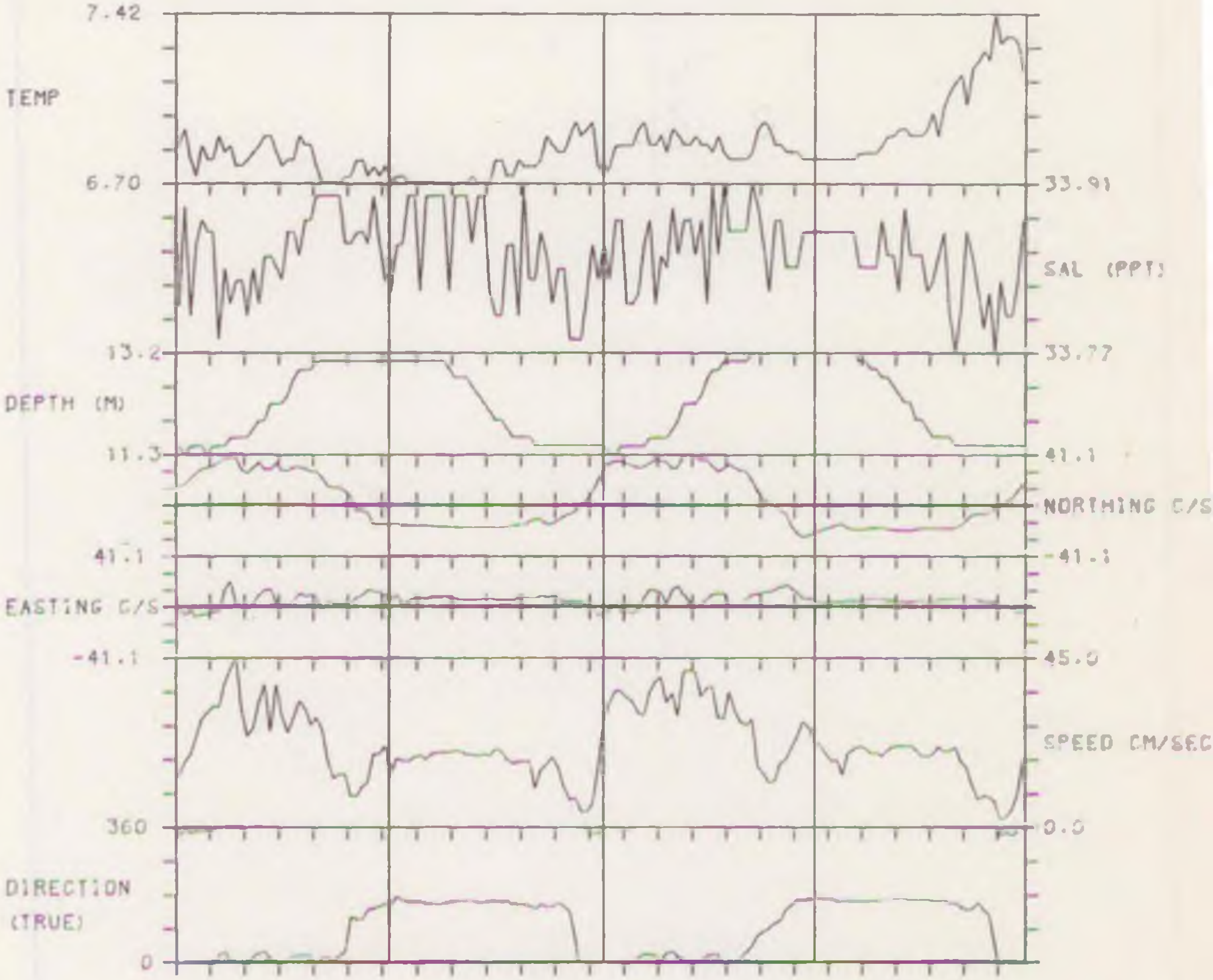

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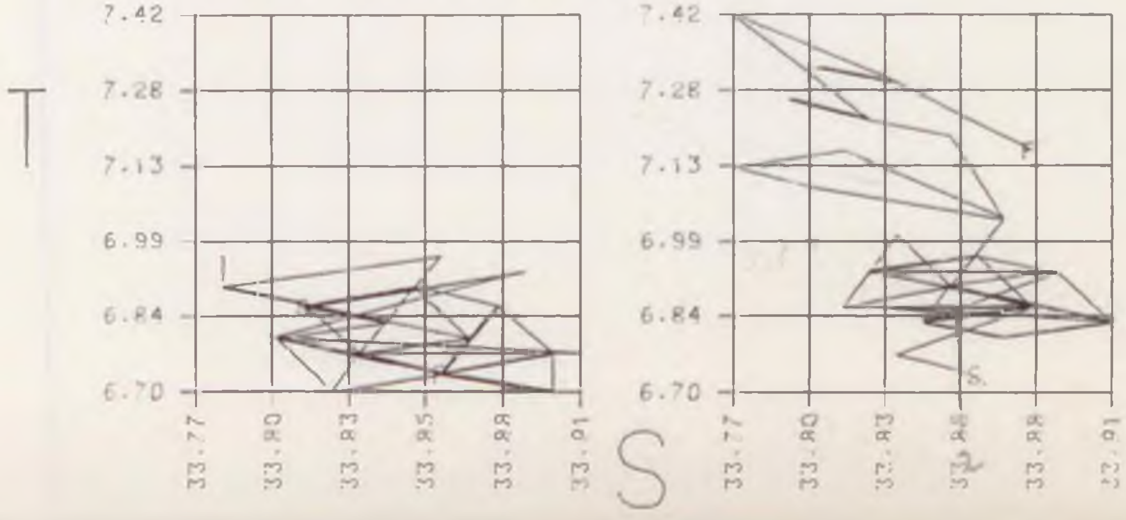

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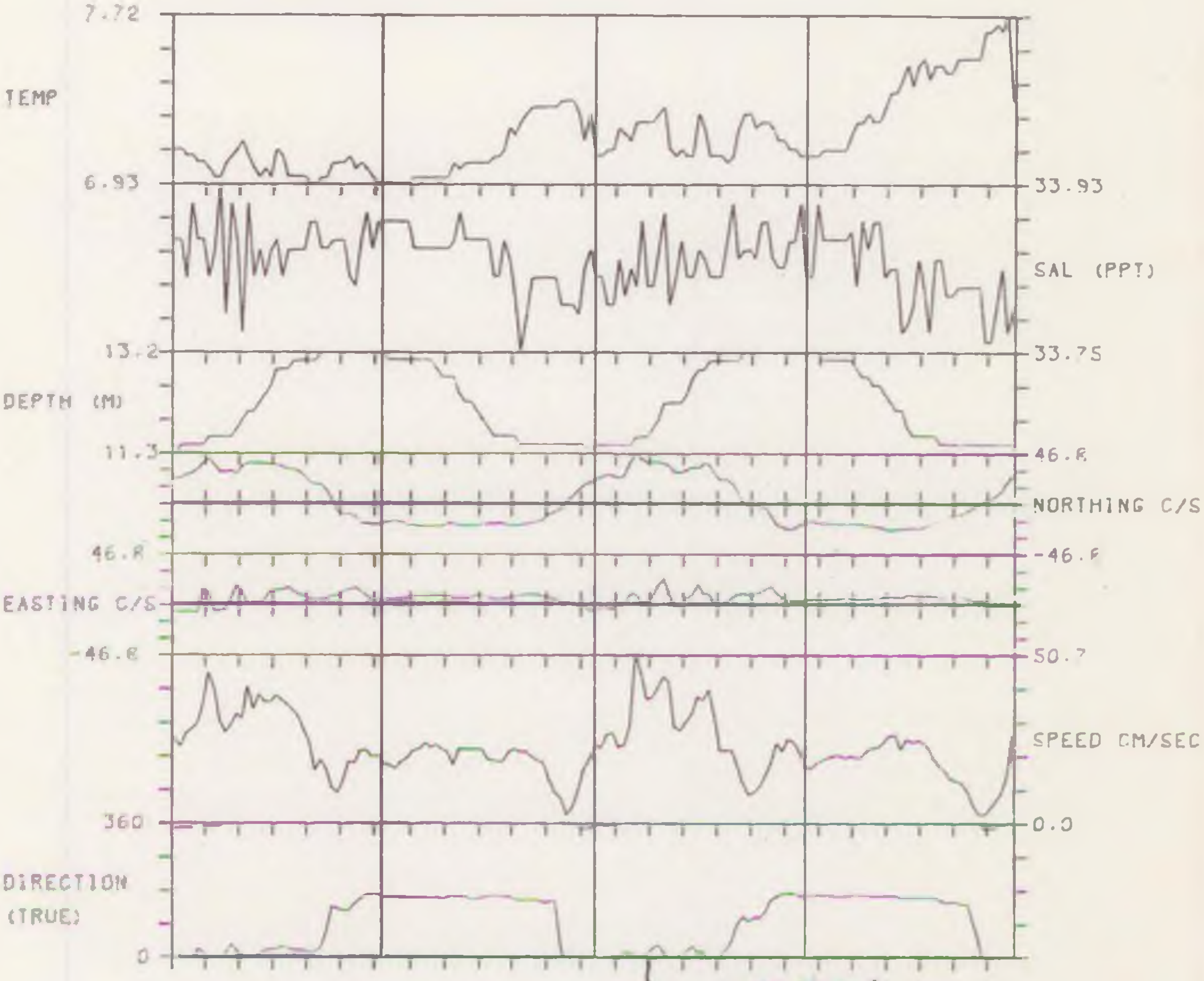
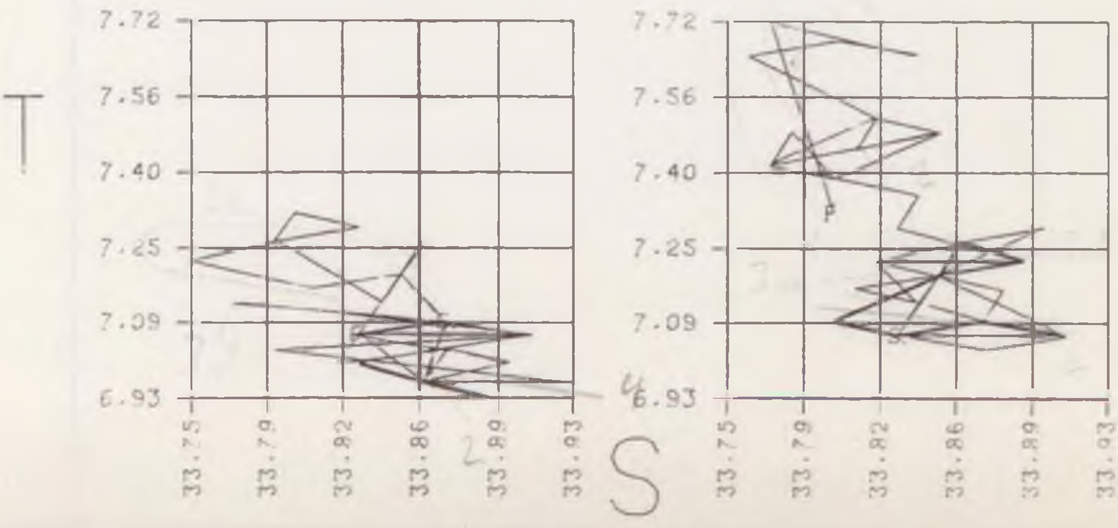


Narrows 33.95, 7.6

ONE-TIDE T/S DIAGRAMS



add .15

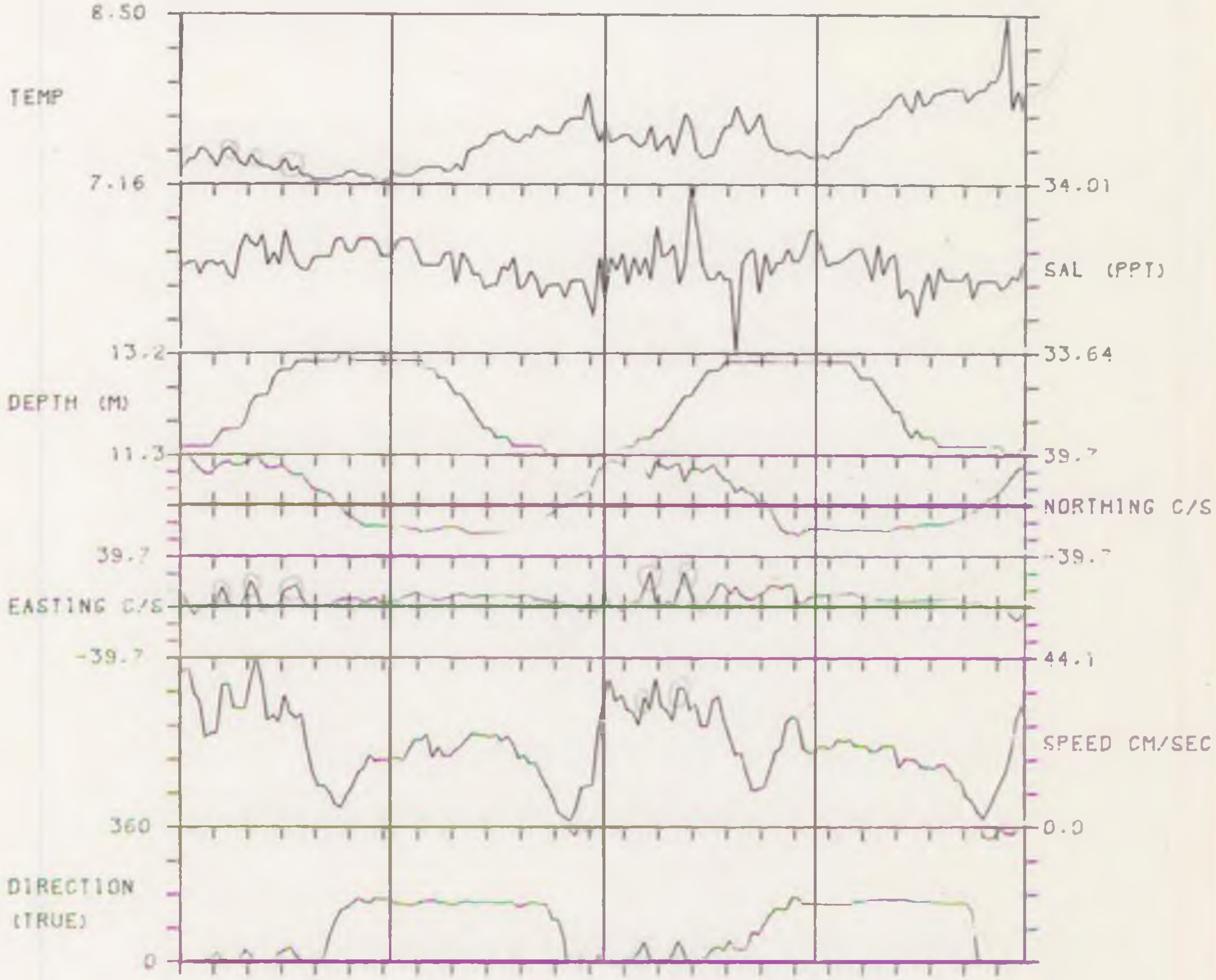
A 1.8.11

CURRENT METER DATA OVER TWO TIDES

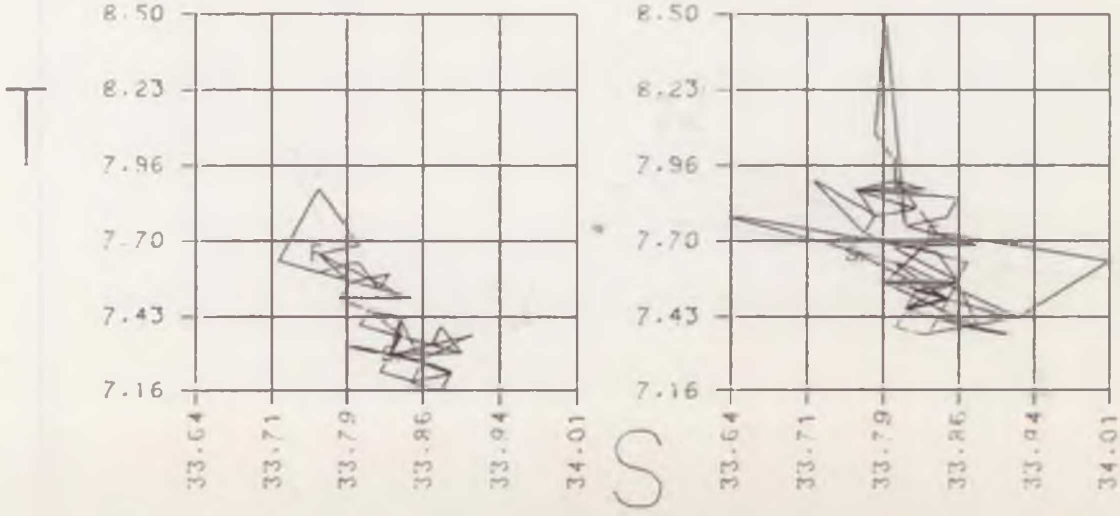
STATION NO. 8

STARTING TIME: 2218 ON 14/4/75

WIRE LENGTH = 14.0 METRES



ONE-TIDE T/S DIAGRAMS

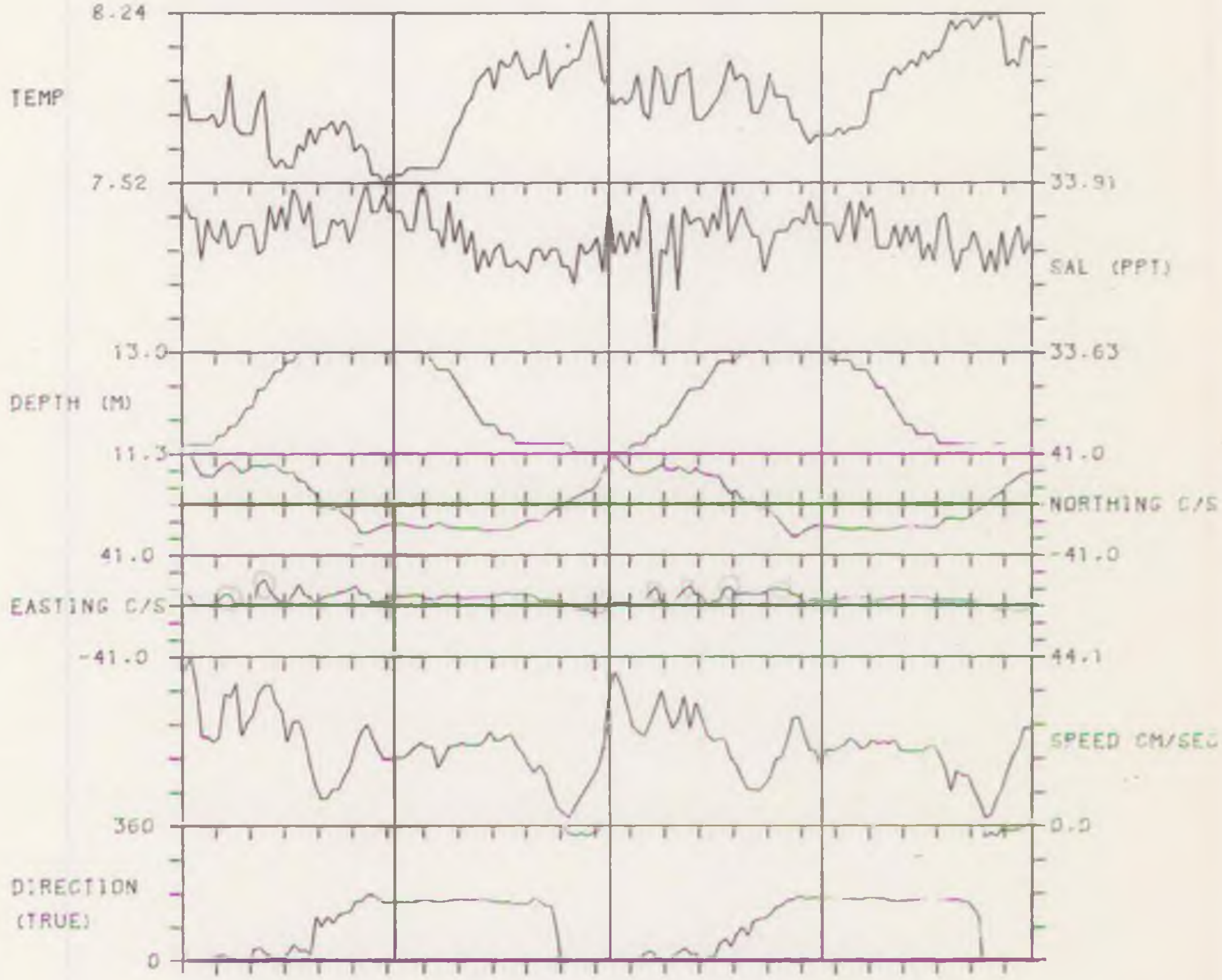


CURRENT METER DATA OVER TWO TIDES

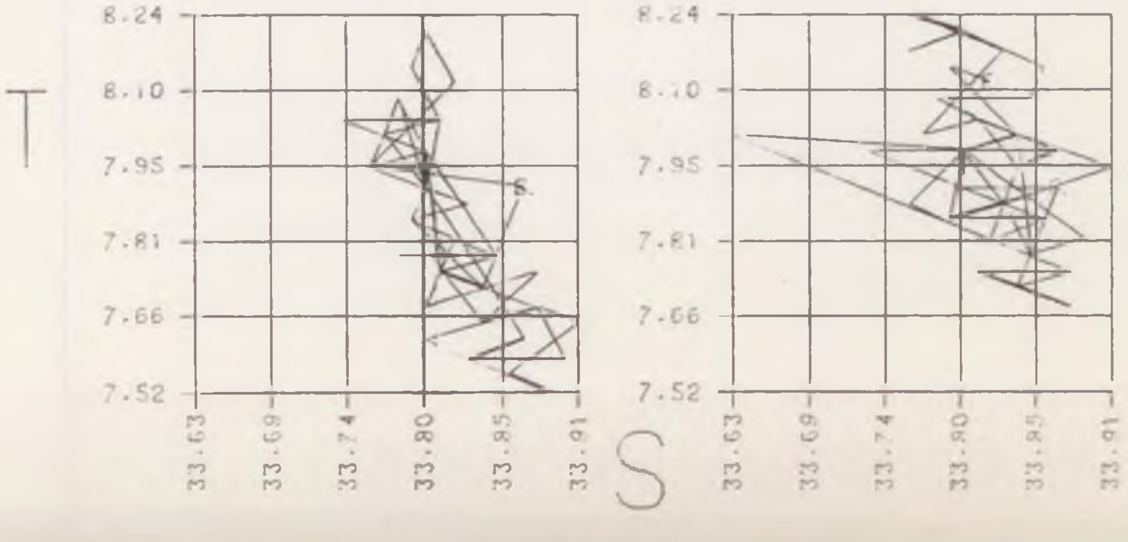
STATION NO. 8

STARTING TIME: 2308 ON 15/4/75

WIRE LENGTH = 14.0 METRES



ONE-TIDE T/S DIAGRAMS



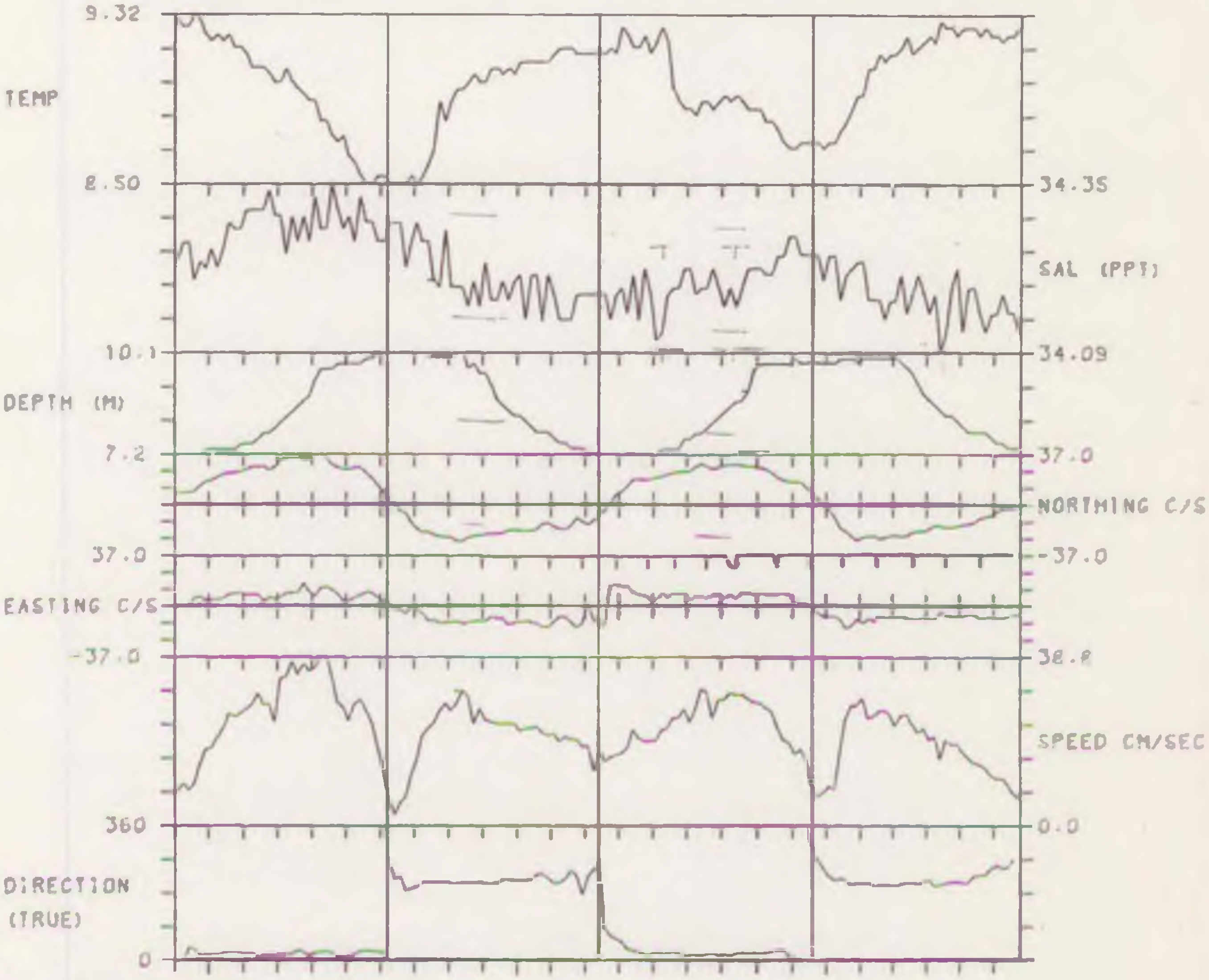
A.1.9.1

CURRENT METER DATA OVER TWO TIDES

STATION NO. 9

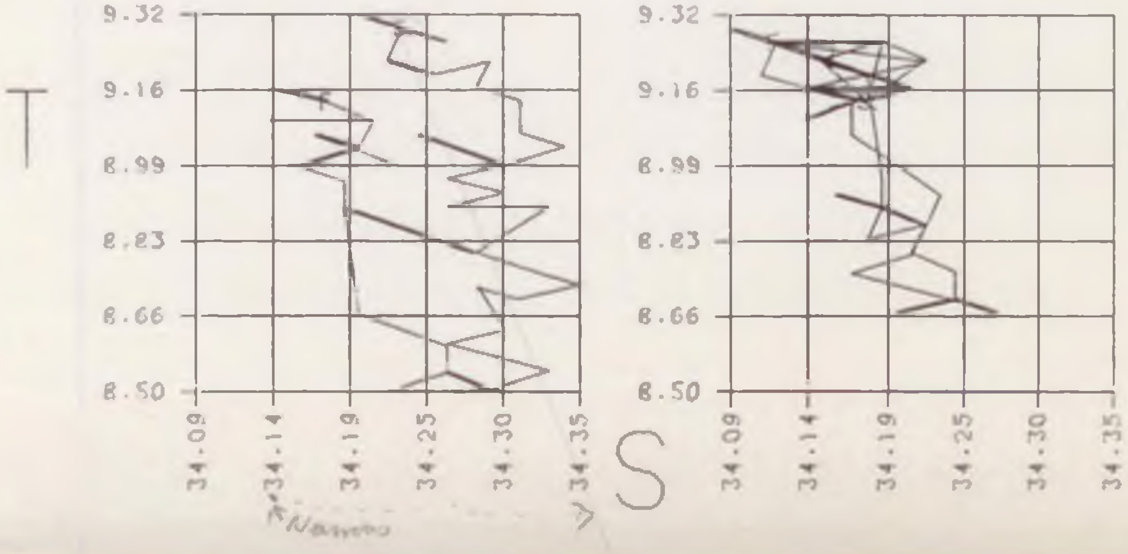
STARTING TIME: 2058 ON 28/4/75

WIRE LENGTH = 290.0 METRES



↑ Narrows 34.00, .82

ONE-TIDE T/S DIAGRAMS



Sal.
subtract .21

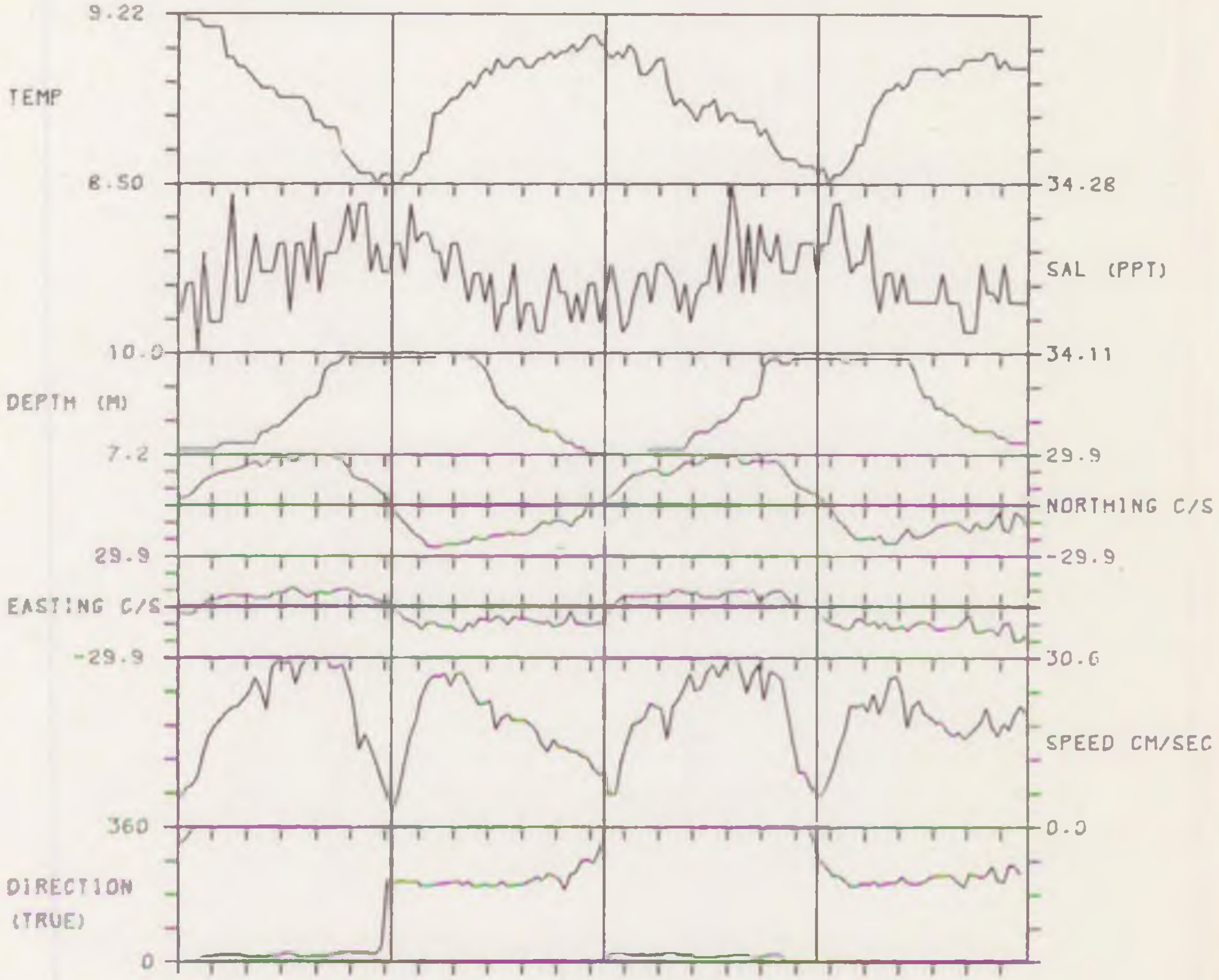
A 1.9.2.

CURRENT METER DATA OVER TWO TIDES

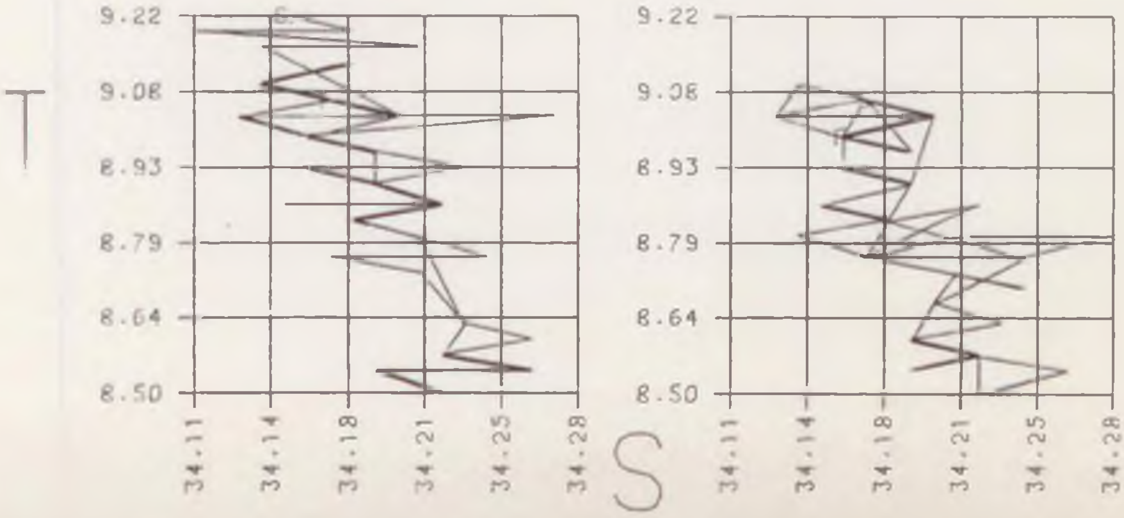
STATION NO. 9

STARTING TIME: 2148 ON 29/4/75

WIRE LENGTH = 290.0 METRES



ONE-TIDE T/S DIAGRAMS



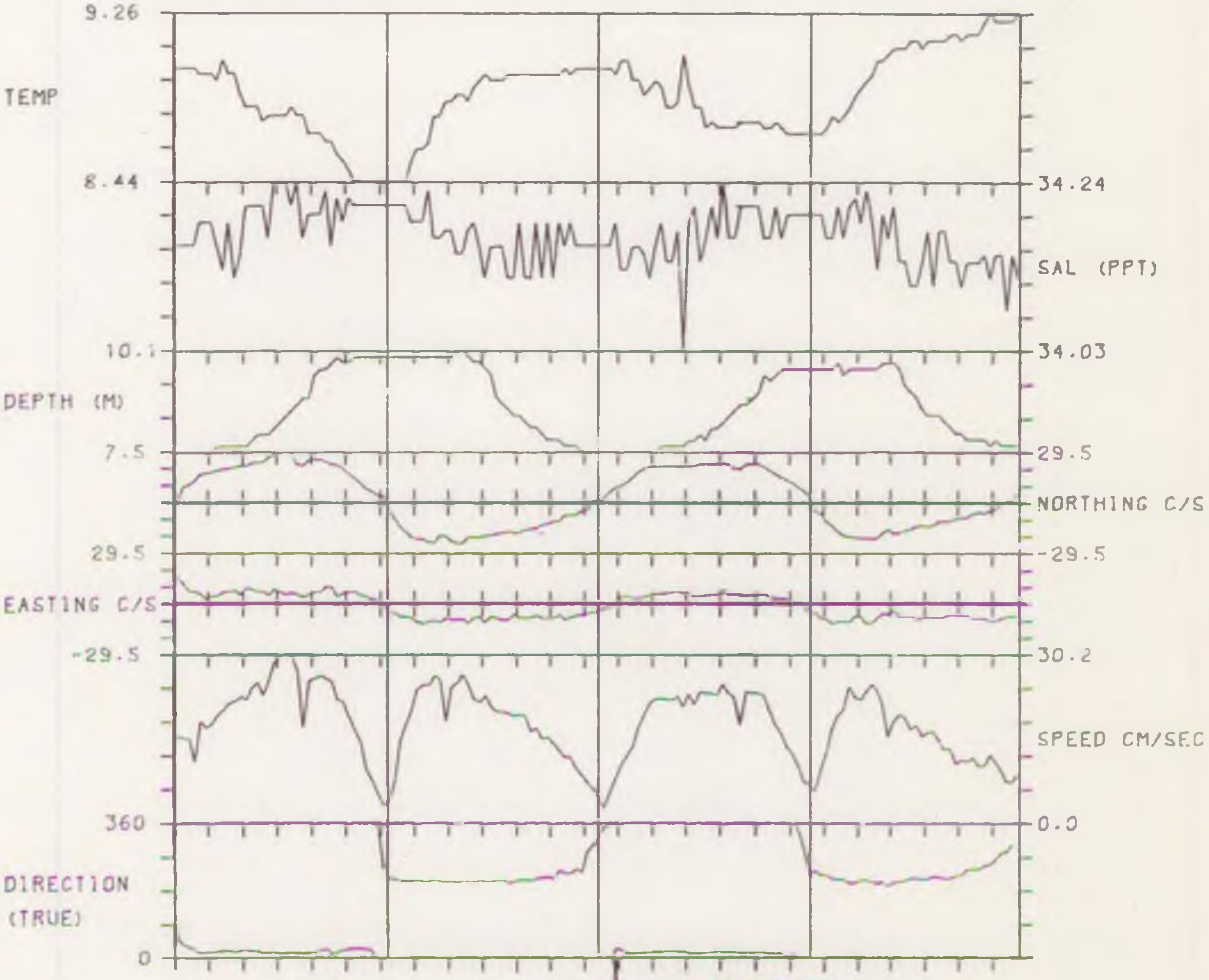
A 1.9.3

CURRENT METER DATA OVER TWO TIDES

STATION NO. 9

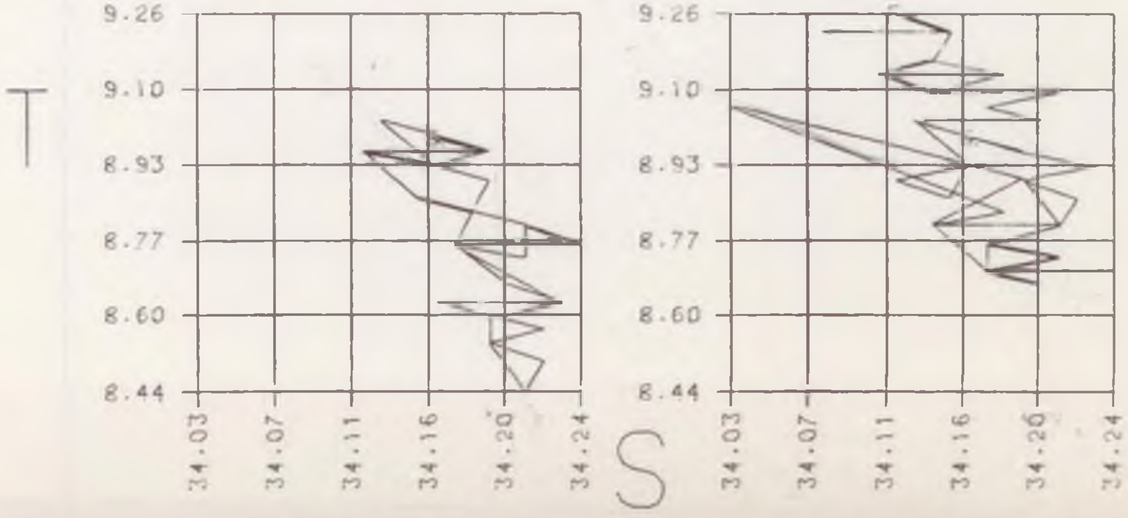
STARTING TIME: 2238 ON 30/4/75

WIRE LENGTH = 290.0 METRES



Narrows 34.05, 8.4

ONE-TIDE T/S DIAGRAMS



Substr
.15

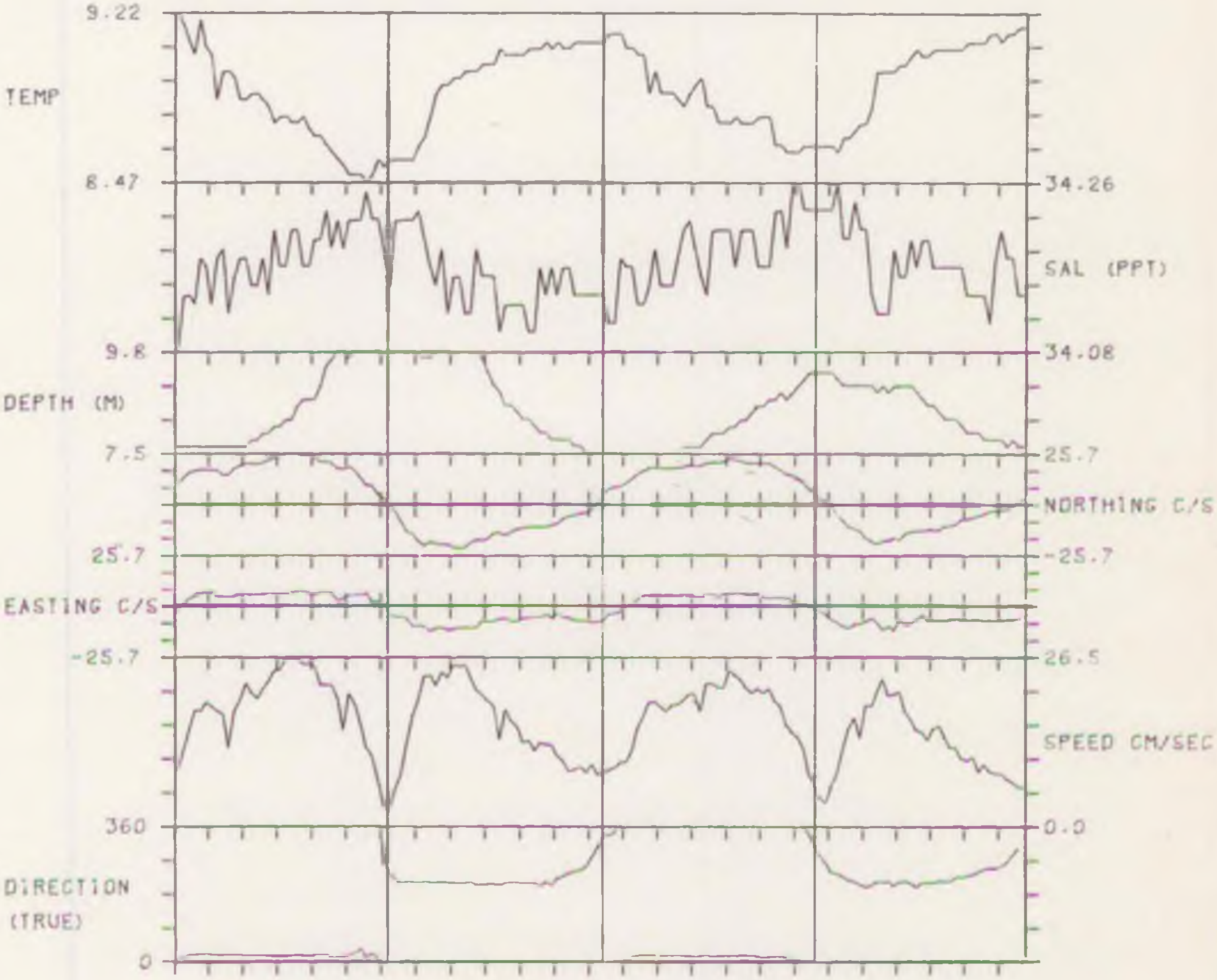
A 1.9.4

CURRENT METER DATA OVER TWO TIDES

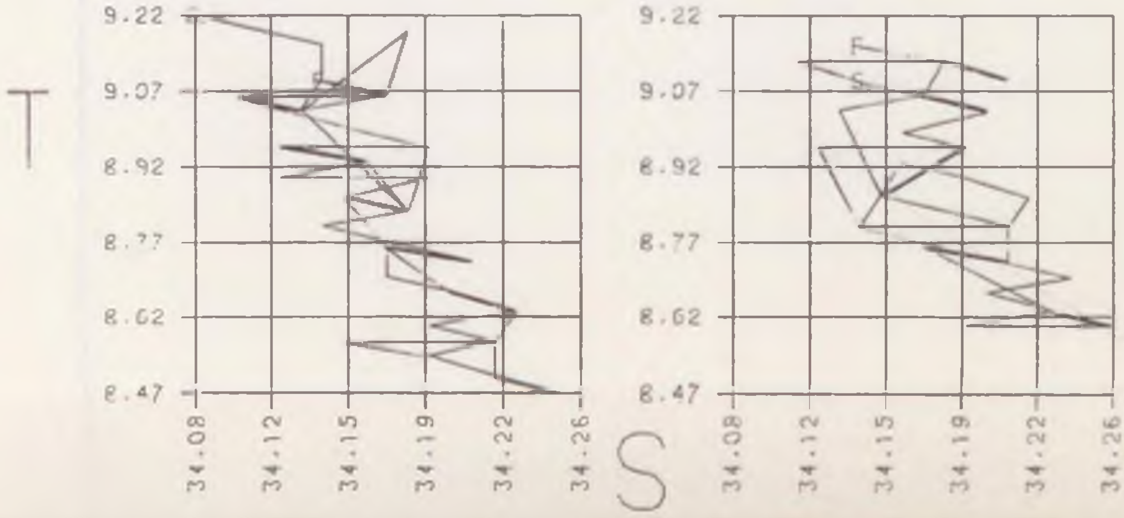
STATION NO. 9

STARTING TIME: 2328 ON 1/5/75

WIRE LENGTH = 290.0 METRES



ONE-TIDE T/S DIAGRAMS

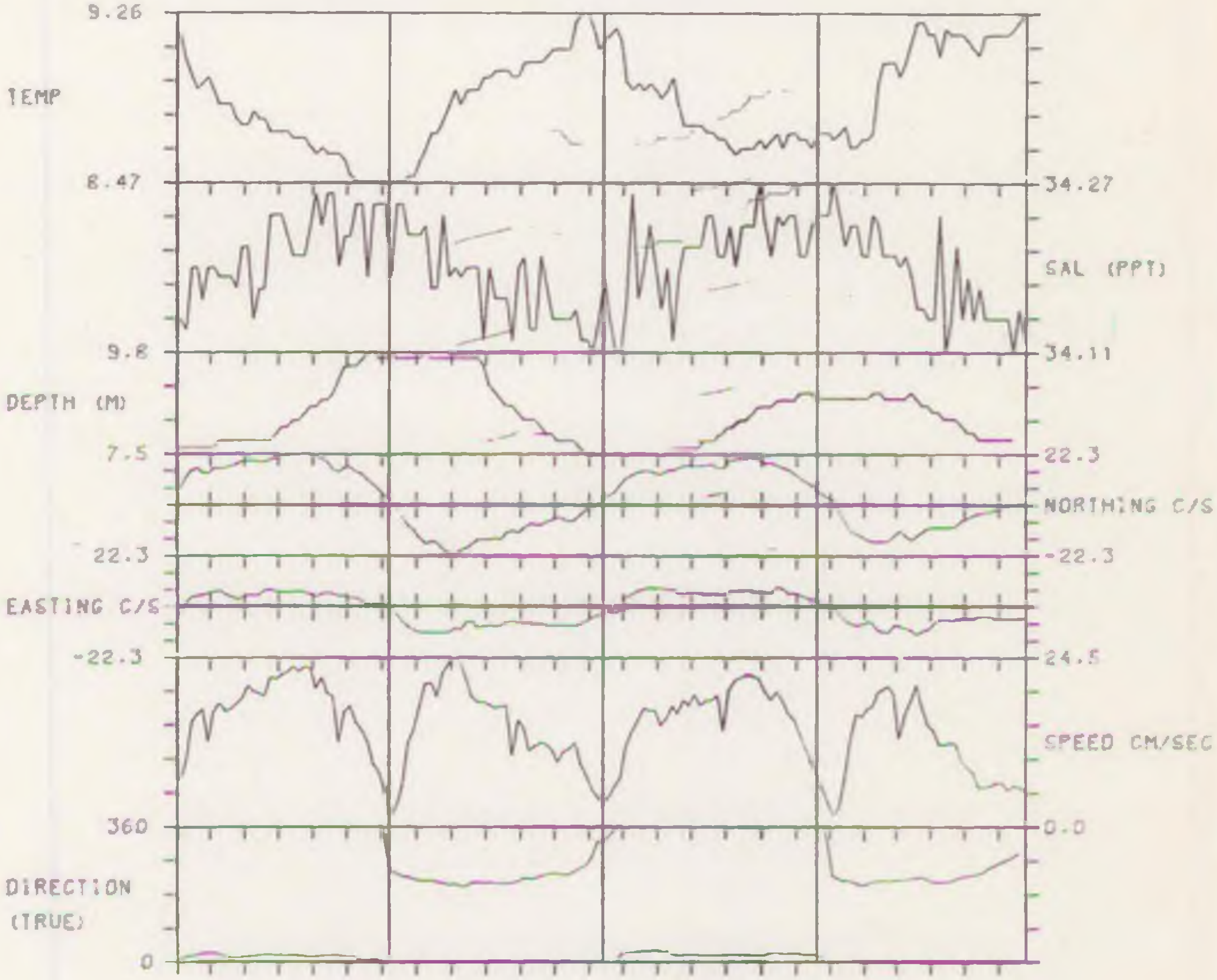


CURRENT METER DATA OVER TWO TIDES

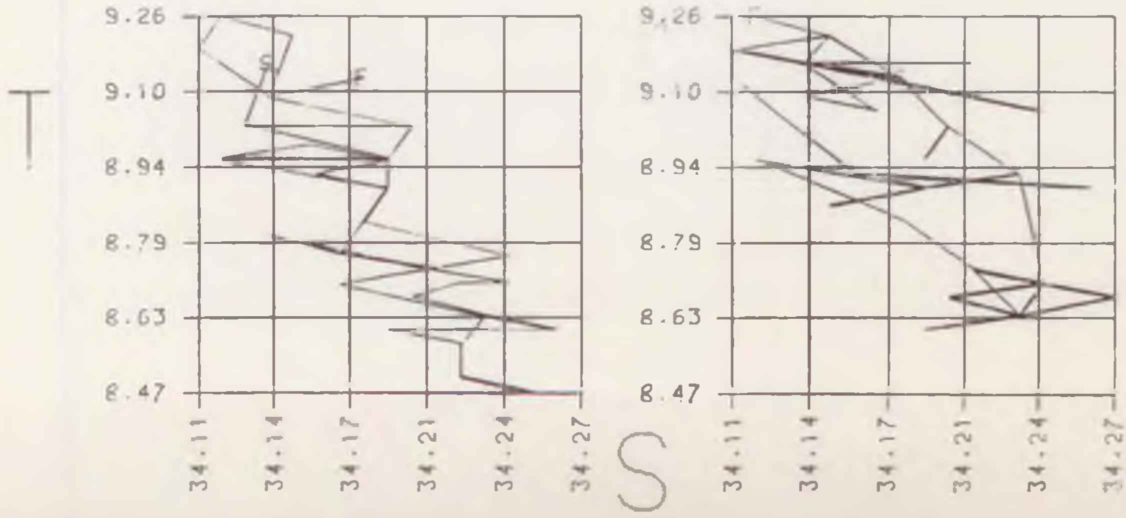
STATION NO. 9

STARTING TIME: 0018 ON 3/5/75

WIRE LENGTH = 290.0 METRES



ONE-TIDE T/S DIAGRAMS

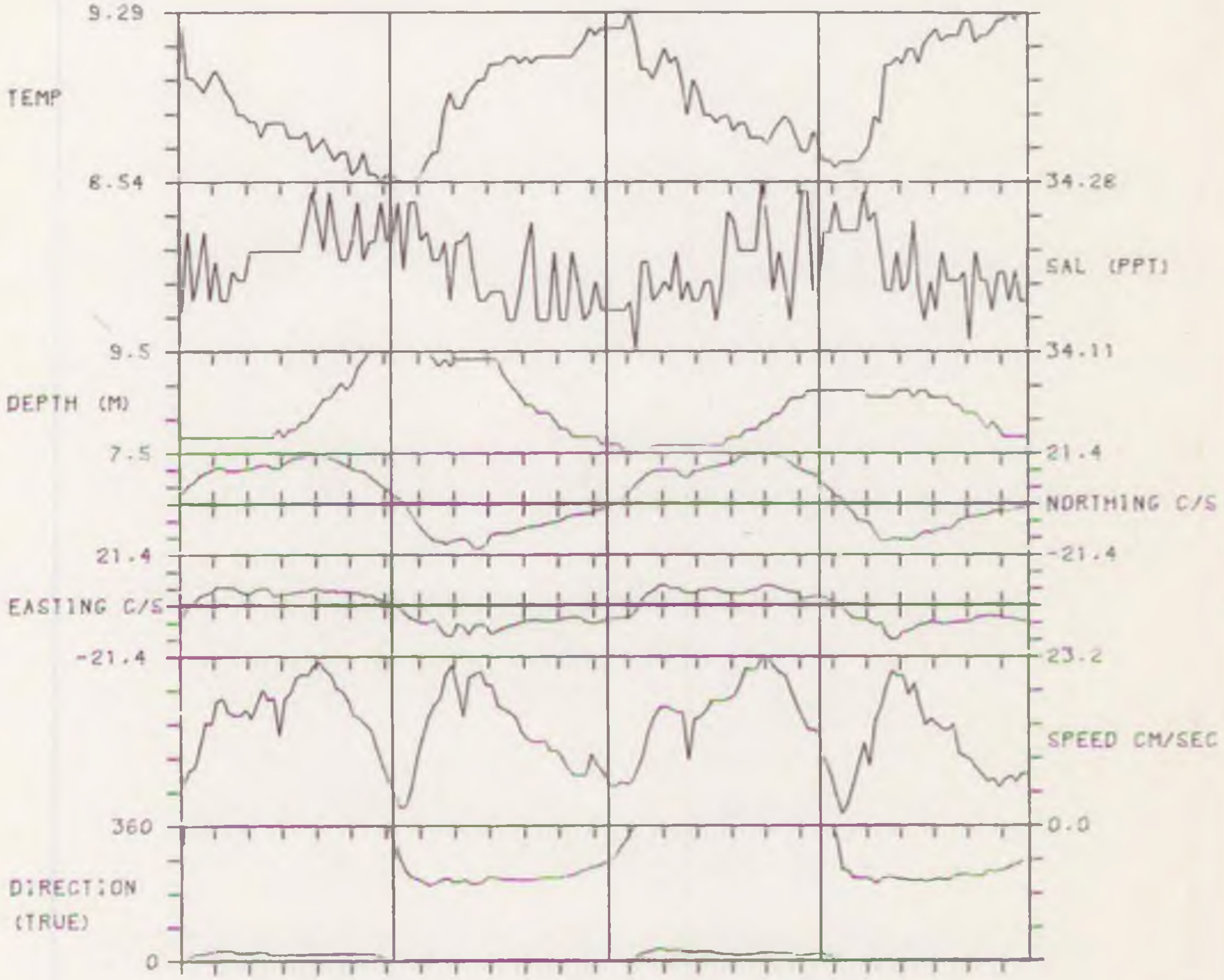


CURRENT METER DATA OVER TWO TIDES

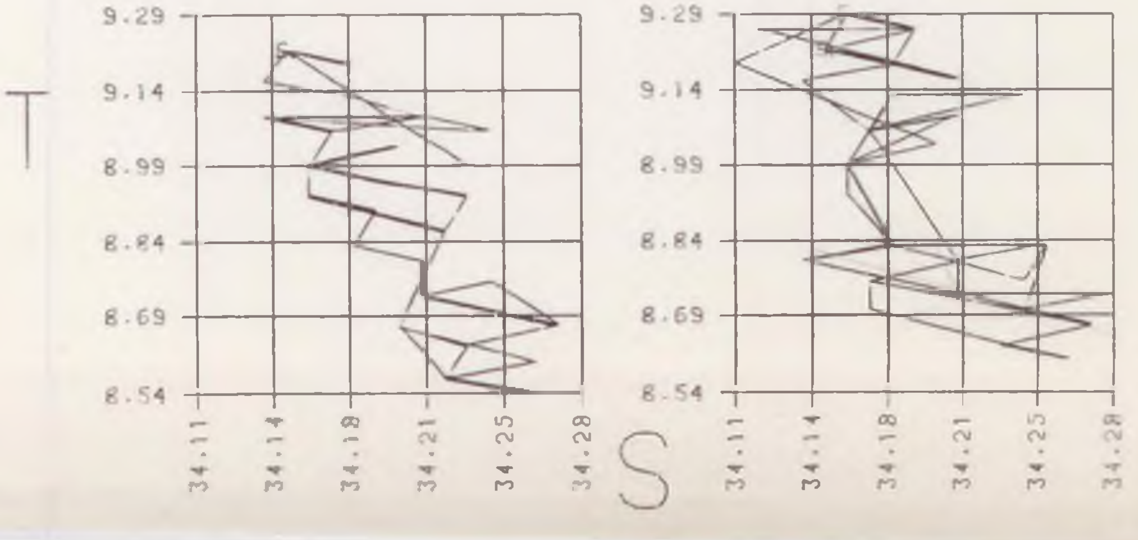
STATION NO. 9

STARTING TIME: 0108 ON 4/5/75

WIRE LENGTH = 290.0 METRES



ONE-TIDE T/S DIAGRAMS

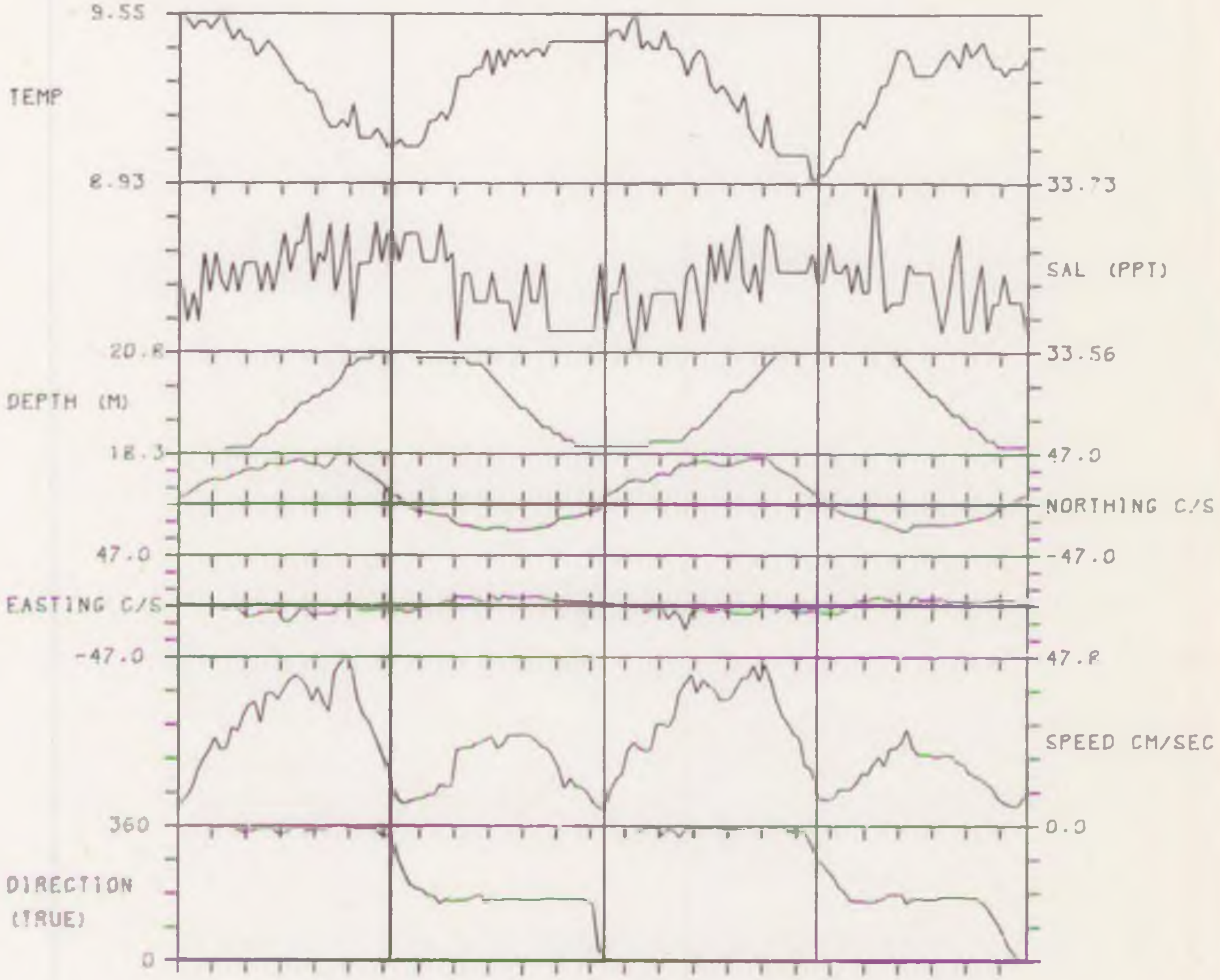


CURRENT METER DATA OVER TWO TIDES

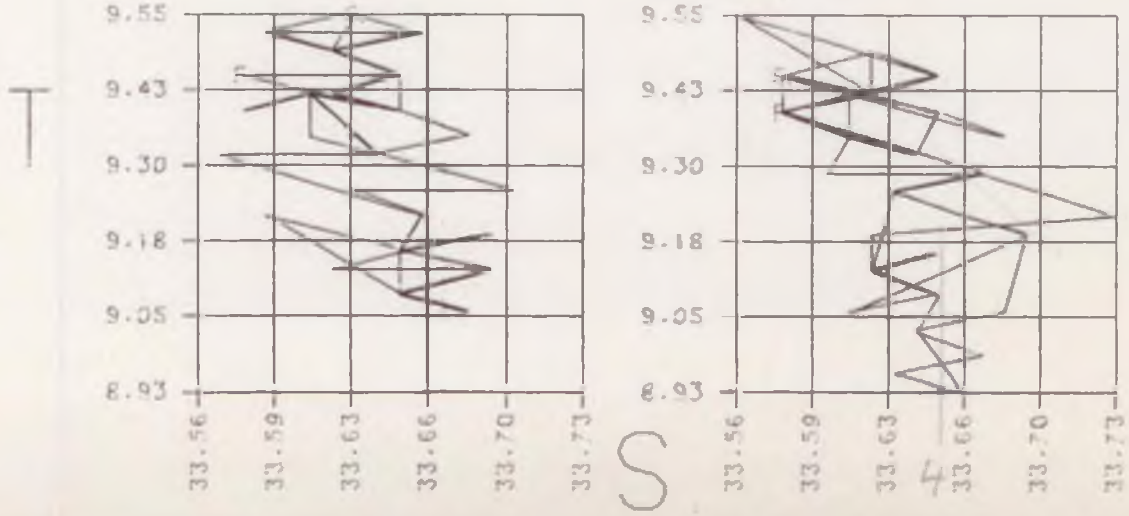
STATION NO. 10

STARTING TIME: 1818 ON 9/5/75

WIRE LENGTH = ~~81.0~~ 13.5 METRES



ONE-TIDE T/S DIAGRAMS.

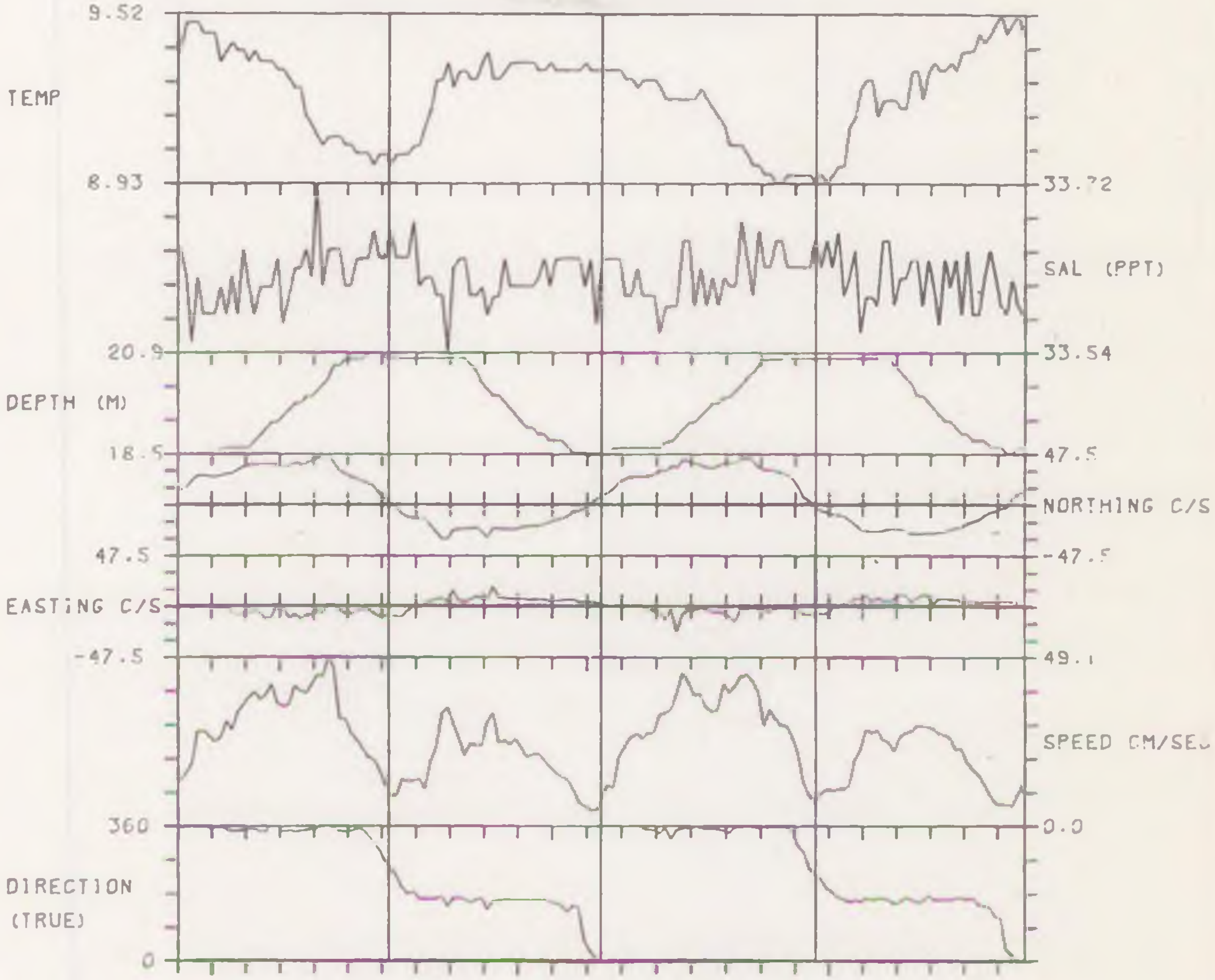


CURRENT METER DATA OVER TWO TIDES

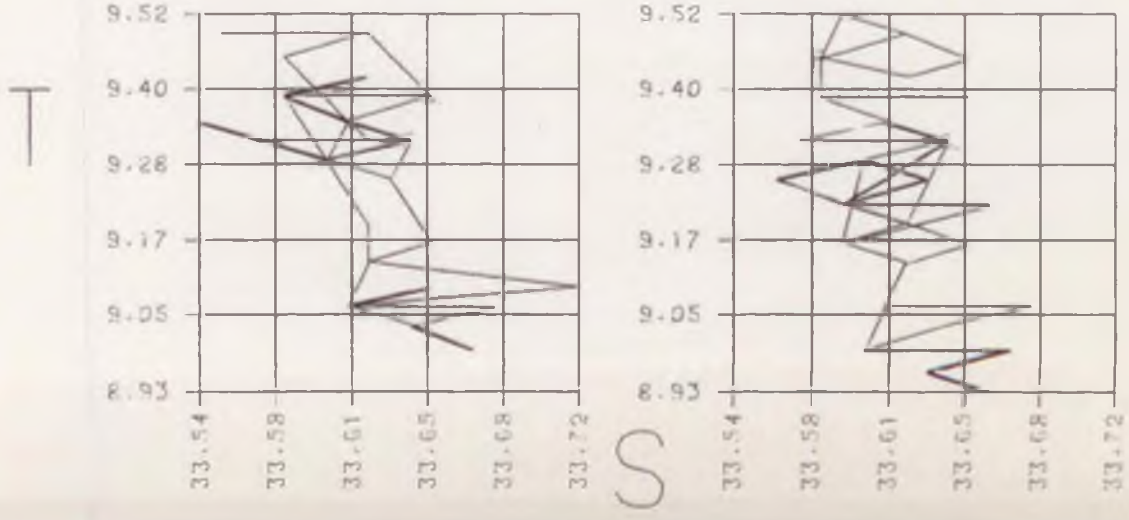
STATION NO. 10

STARTING TIME: 1908 ON 10/5/75

WIRE LENGTH = 13.5 METRES



ONE-TIDE T/S DIAGRAMS



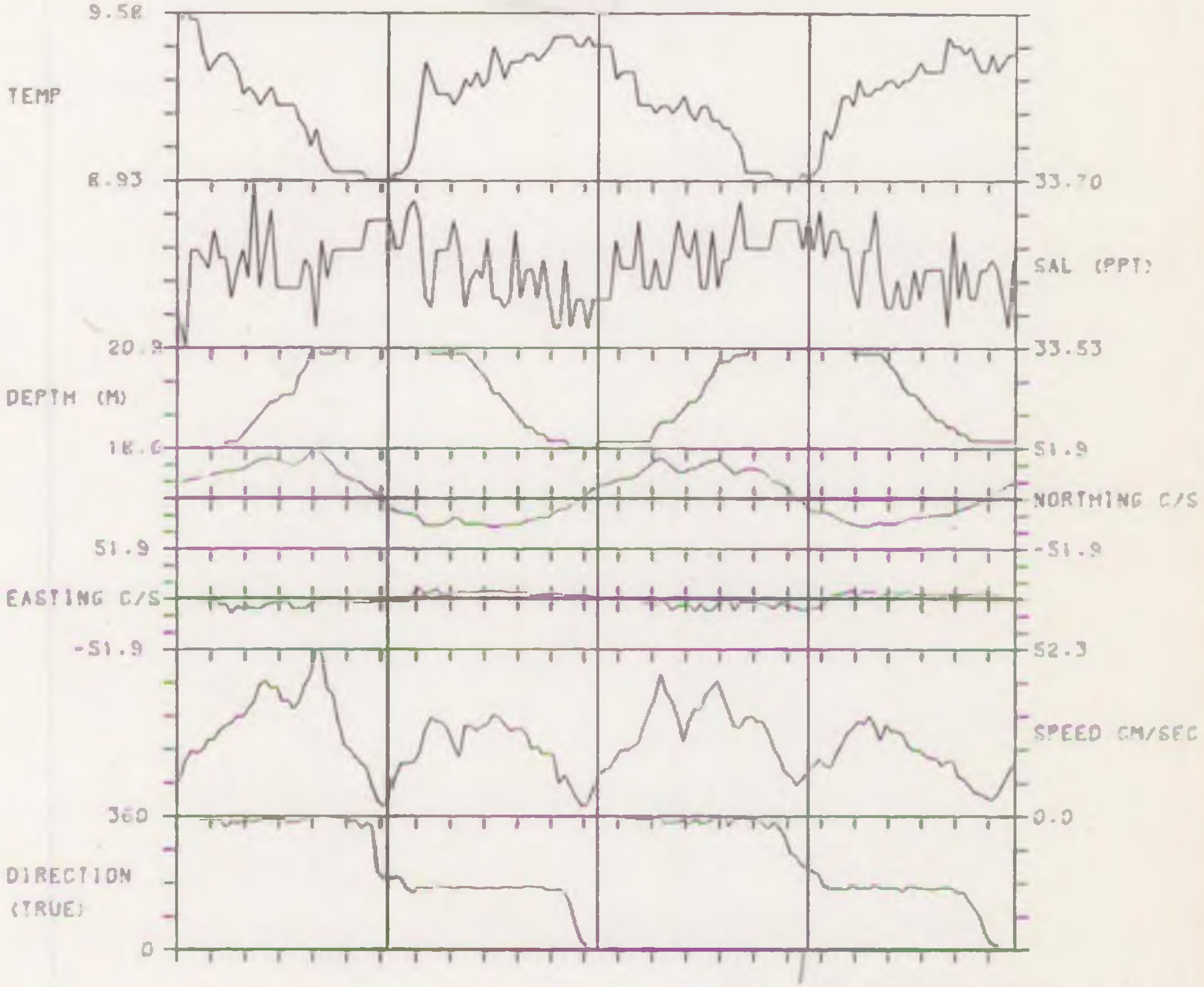
A 1.10.3

CURRENT METER DATA OVER TWO TIDES

STATION NO. 10

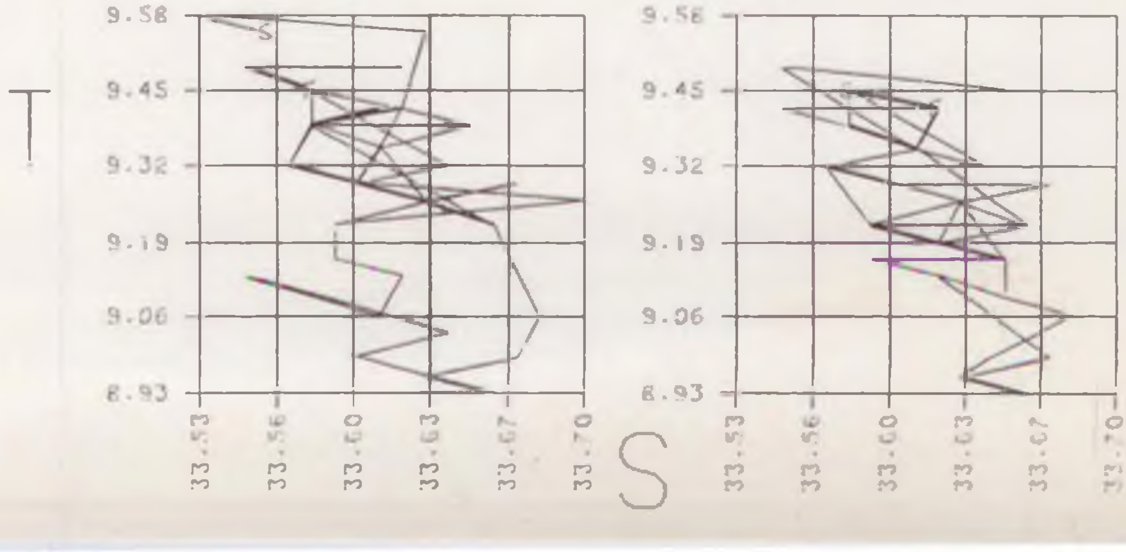
STARTING TIME: 1958 ON 11/5/75

WIRE LENGTH = 13.5 METRES



Newnews 34 07, 86

ONE-TIDE T/S DIAGRAMS

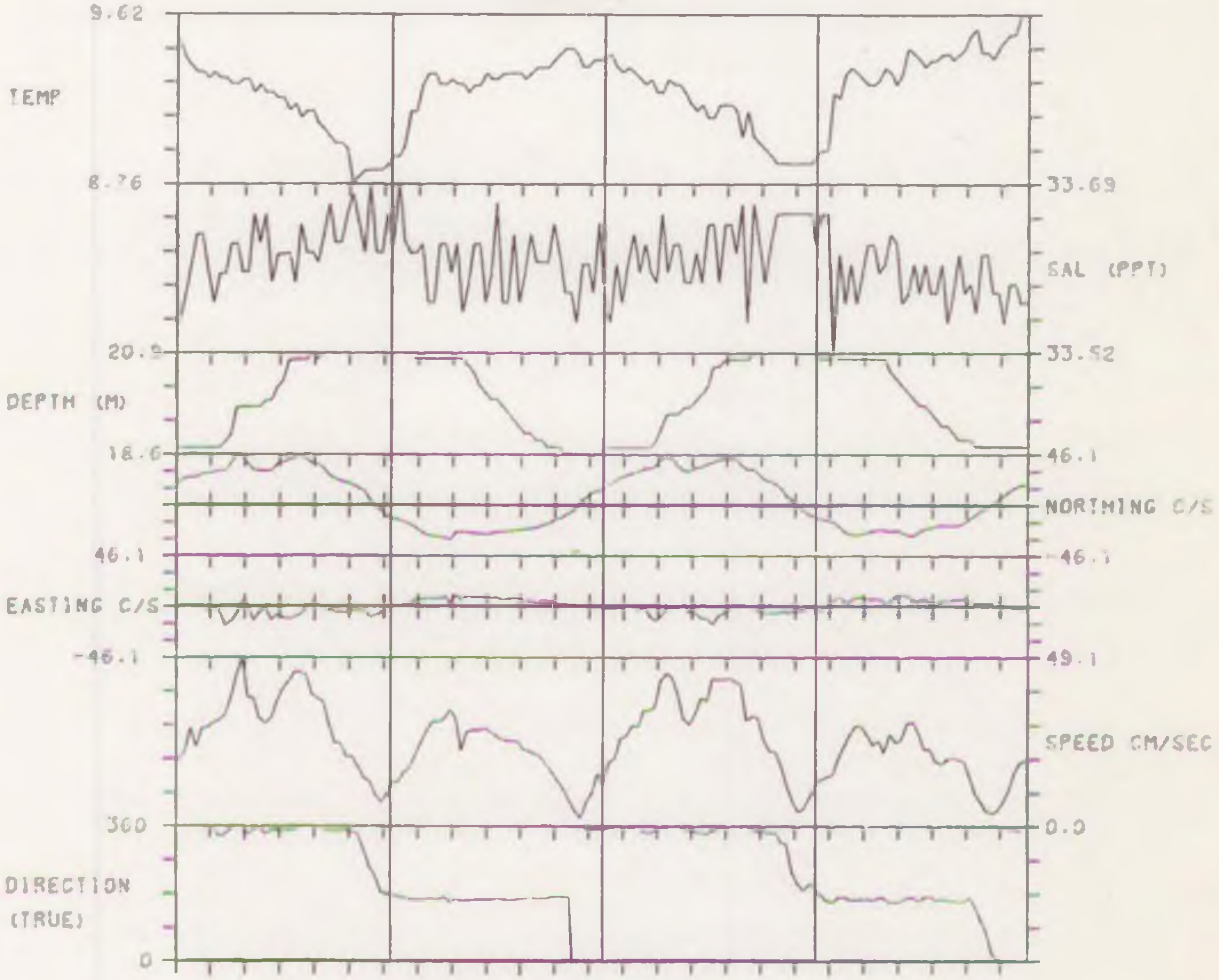


CURRENT METER DATA OVER TWO TIDES

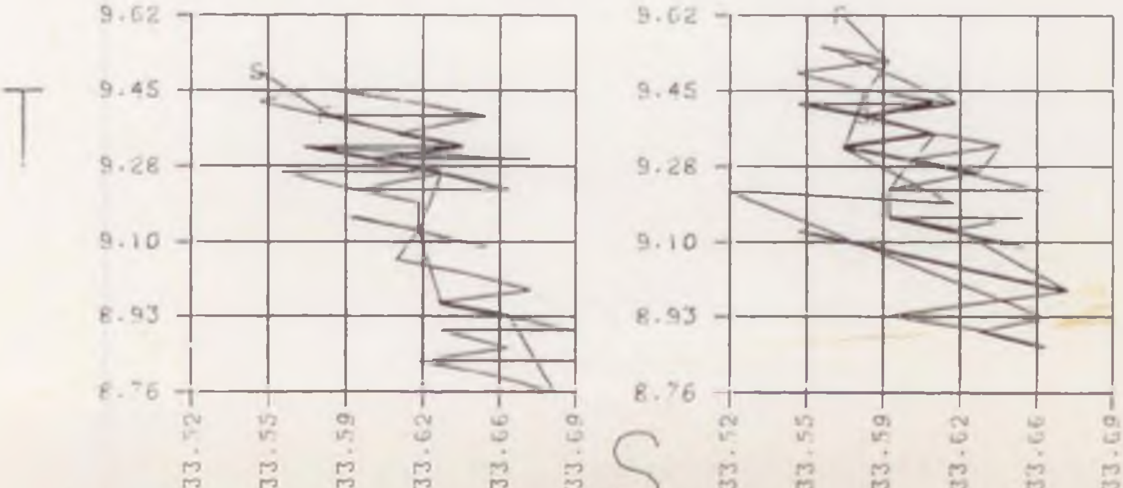
STATION NO. 10

STARTING TIME: 2048 ON 12/5/75

WIRE LENGTH = 13.5 METRES



ONE-TIDE T/S DIAGRAMS



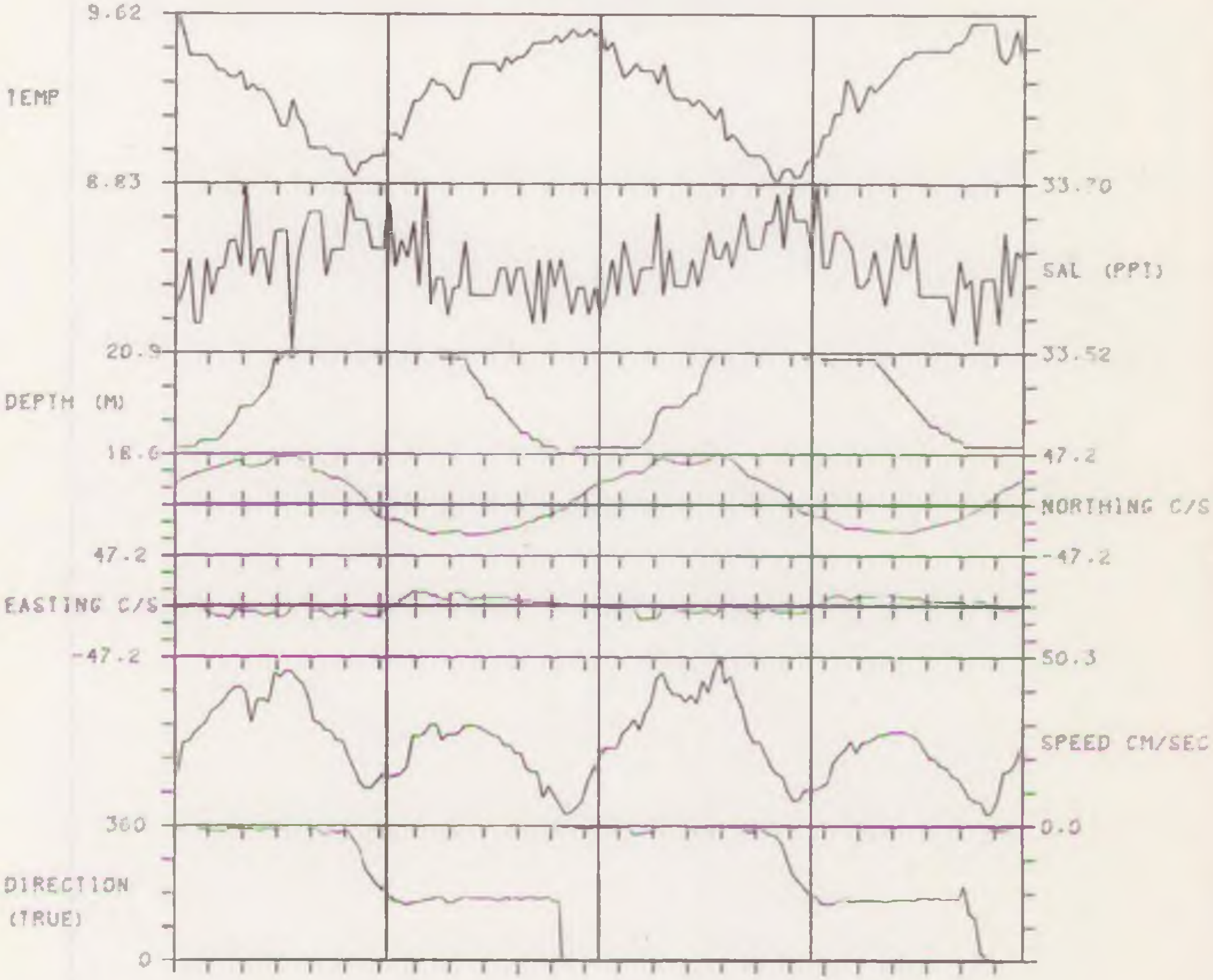
A 1.10.5

CURRENT METER DATA OVER TWO TIDES

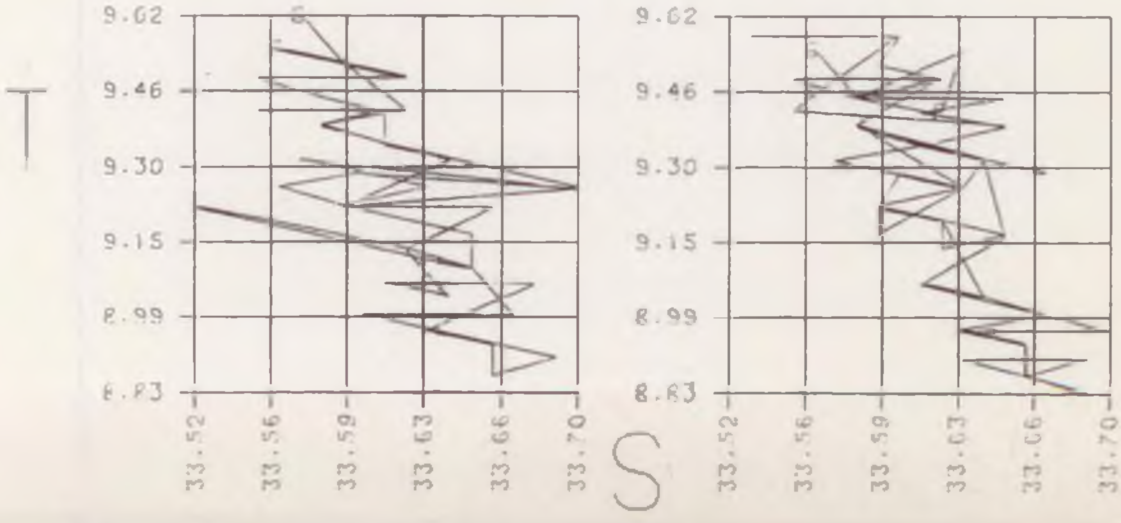
STATION NO. 10

STARTING TIME: 2138 ON 13/5/75

WIRE LENGTH = 13.5 METRES



ONE-TIDE T/S DIAGRAMS



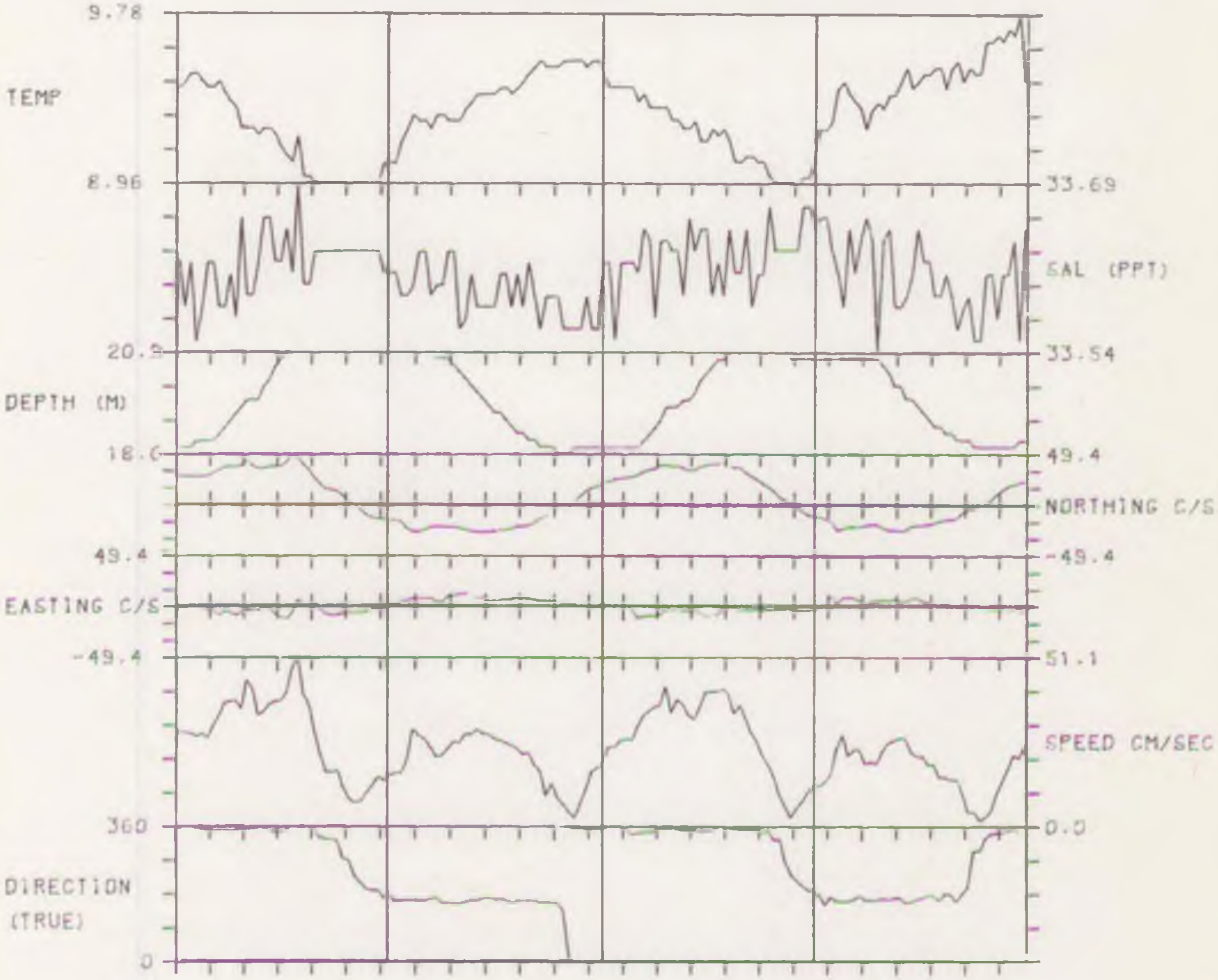
A 1.10.6

CURRENT METER DATA OVER TWO TIDES

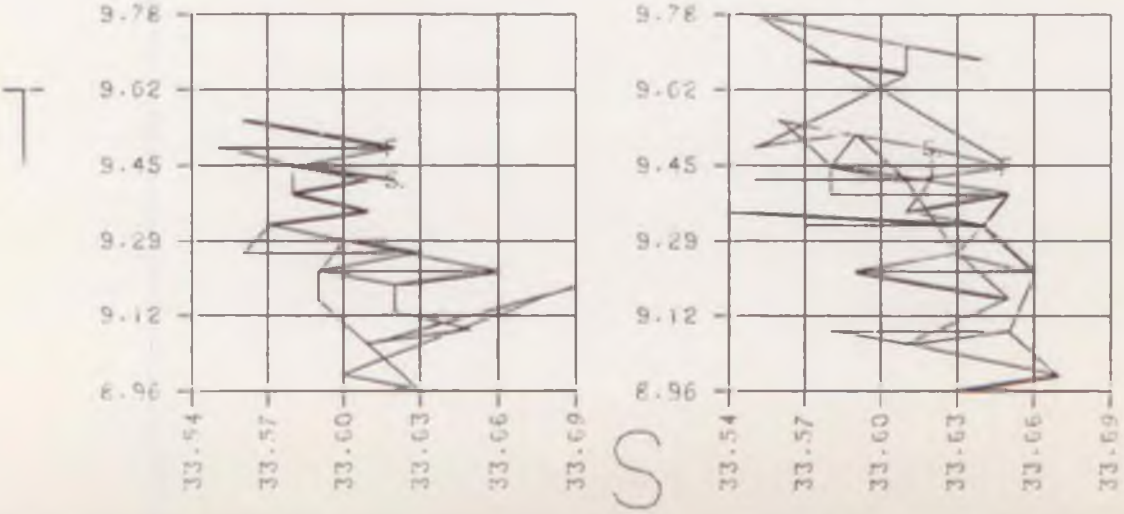
STATION NO. 10

STARTING TIME: 2228 ON 14/5/75

WIRE LENGTH = 135 METRES



ONE-TIDE T/S DIAGRAMS



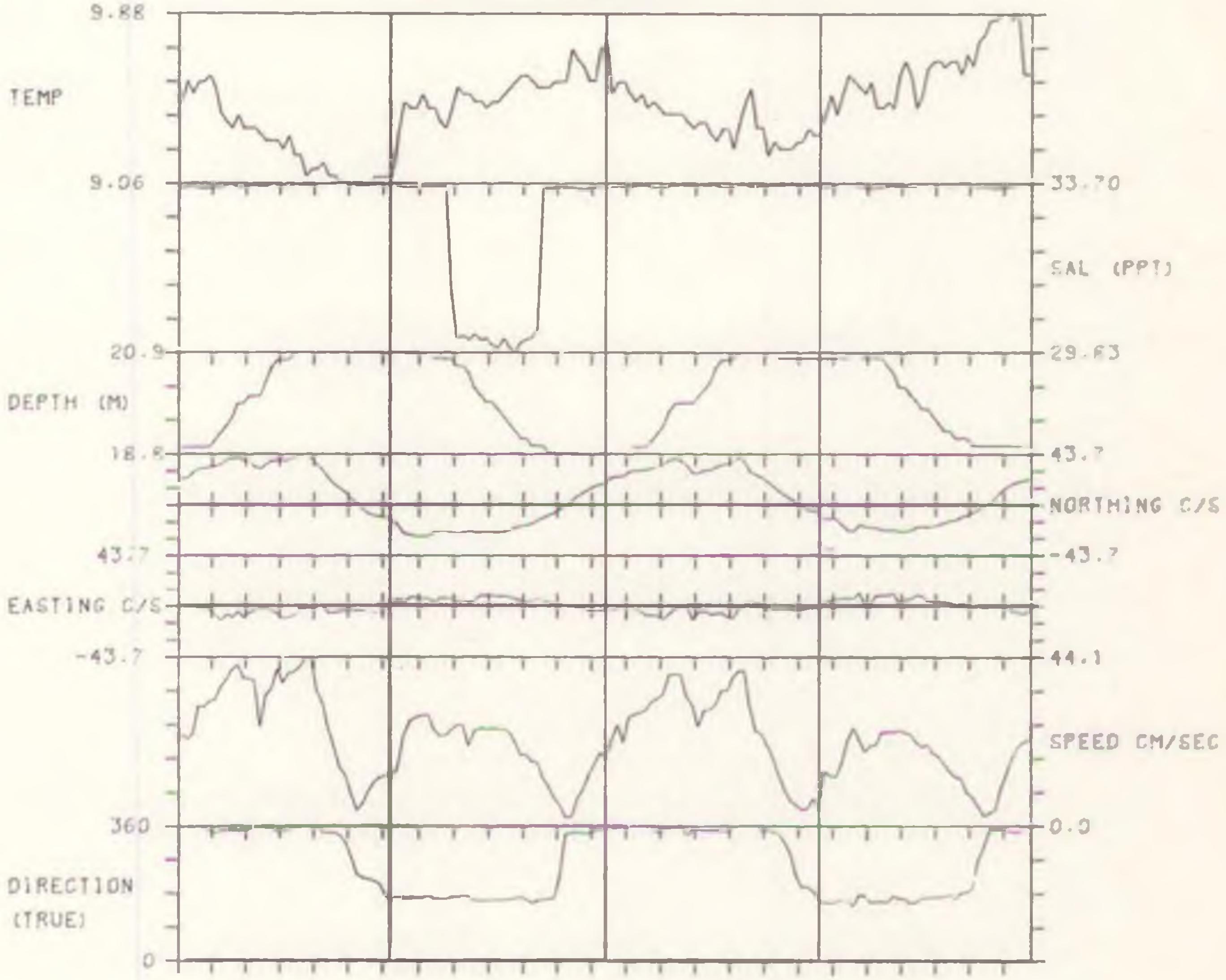
A 1. 10.7

CURRENT METER DATA OVER TWO TIDES

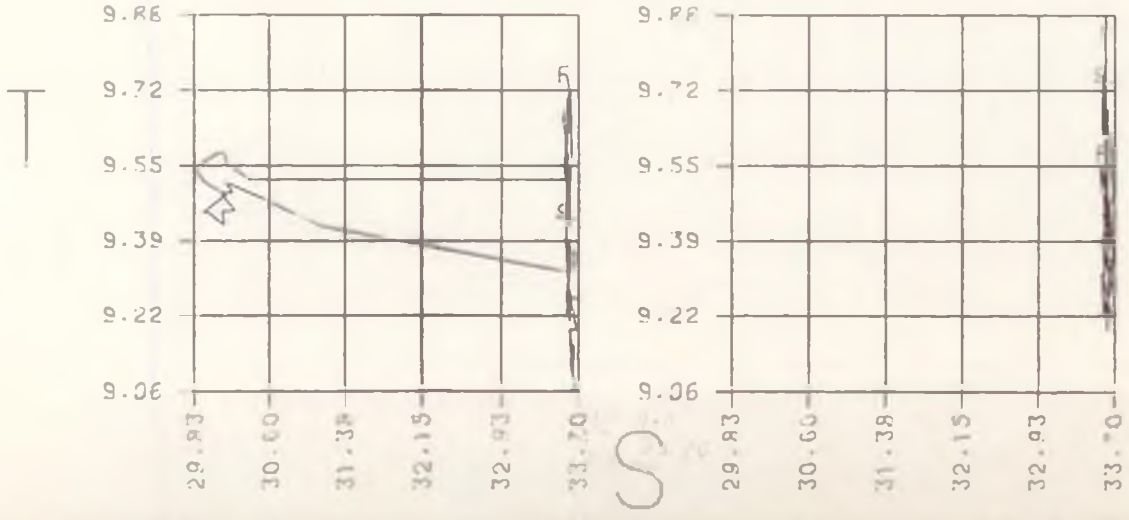
STATION NO. 10

STARTING TIME: 2318 ON 15/5/75

WIRE LENGTH = 13.5 METRES



ONE-TIDE T/S DIAGRAMS

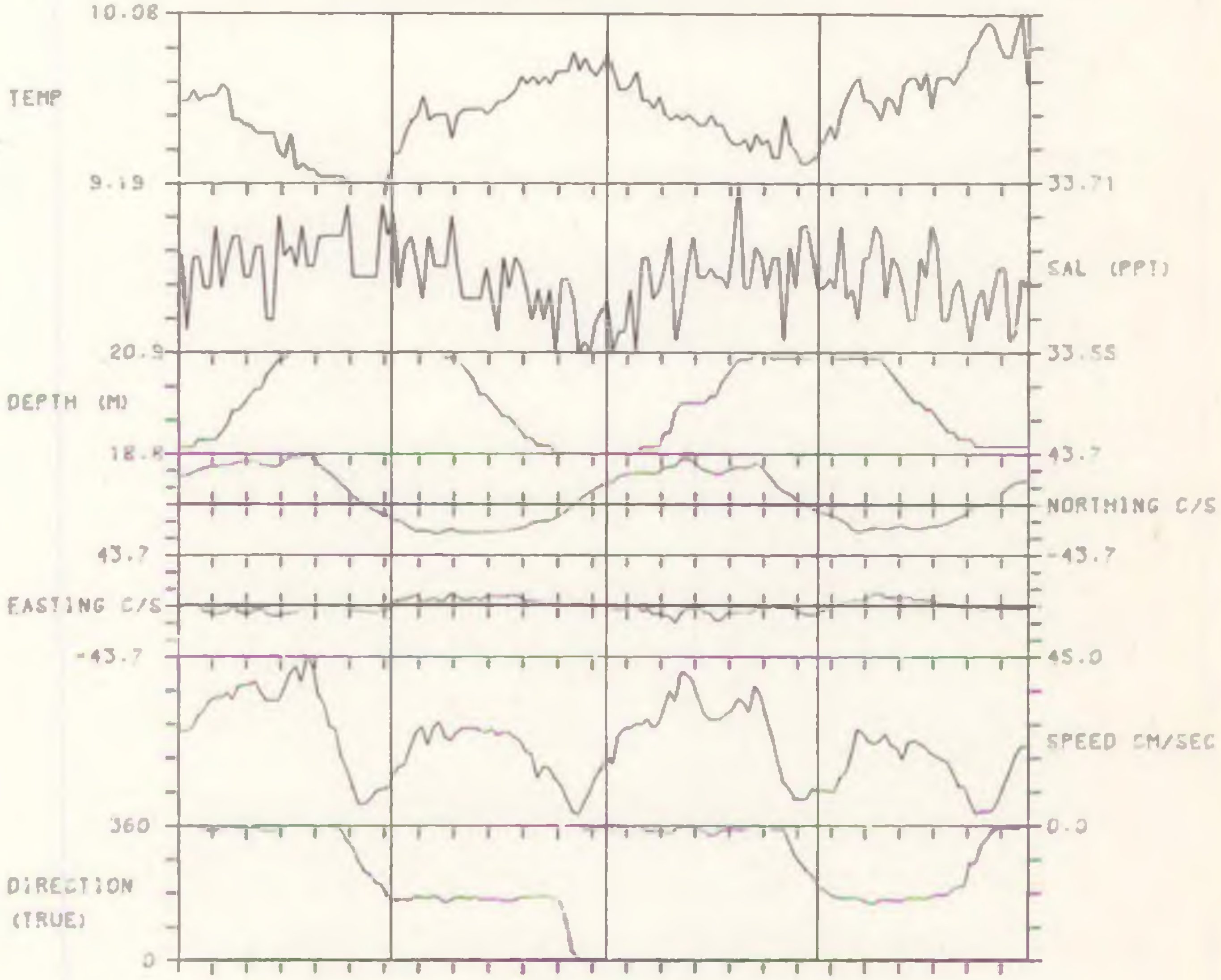


CURRENT METER DATA OVER TWO TIDES

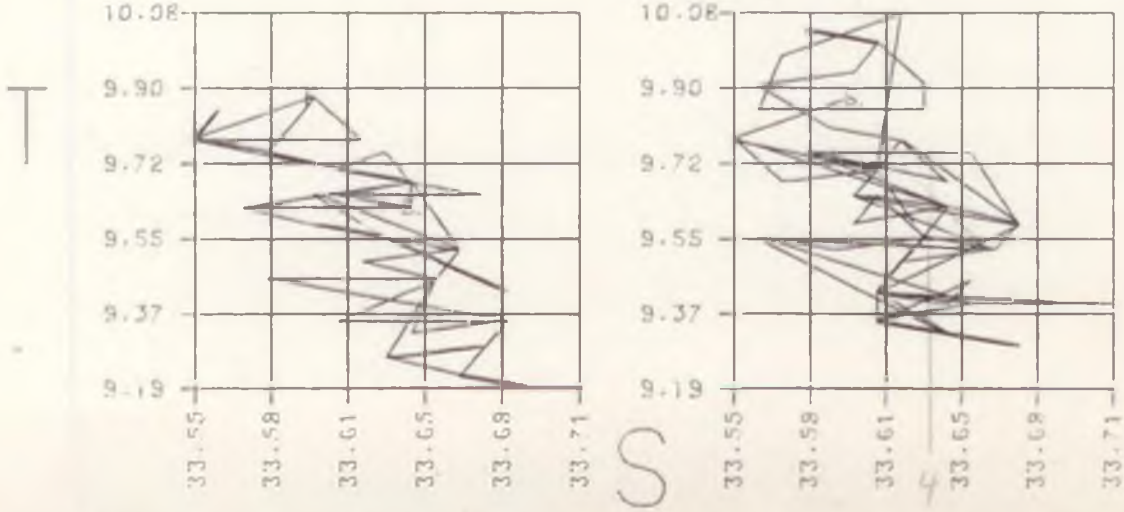
STATION NO. 10

STARTING TIME: 0008 ON 17/5/75

WIRE LENGTH = 13.5 METRES



ONE-TIDE T/S DIAGRAMS



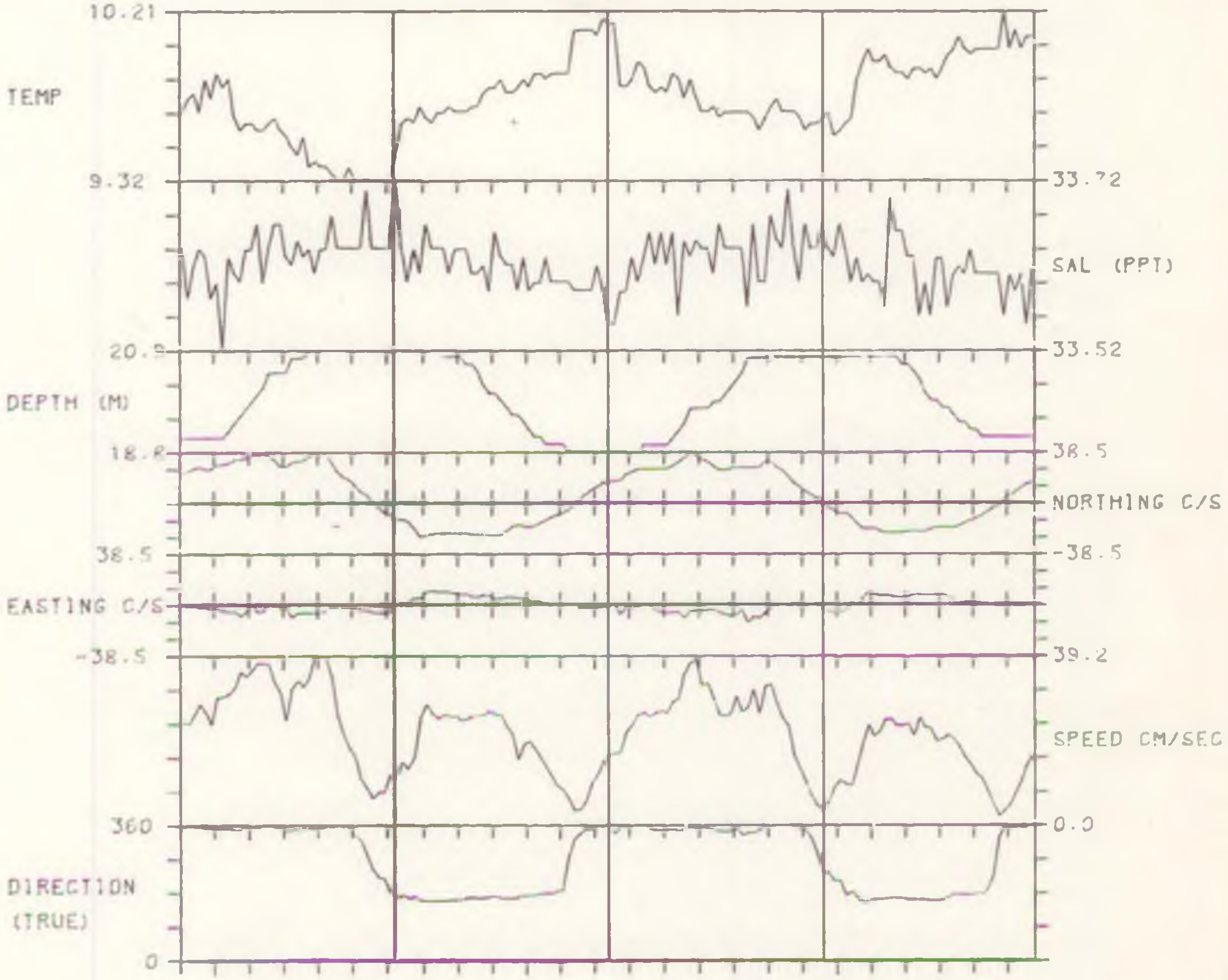
A1.10.9

CURRENT METER DATA OVER TWO TIDES

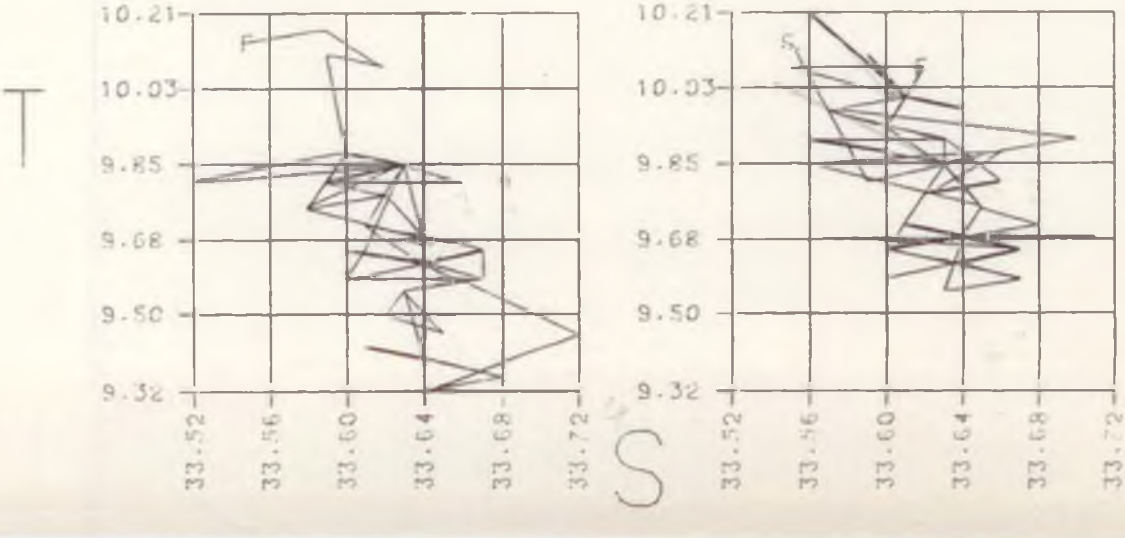
STATION NO. 10

STARTING TIME: 0058 ON 18/5/75

WIRE LENGTH = 13.5 METRES



ONE-TIDE T/S DIAGRAMS



Narrows
34.06, 8.8

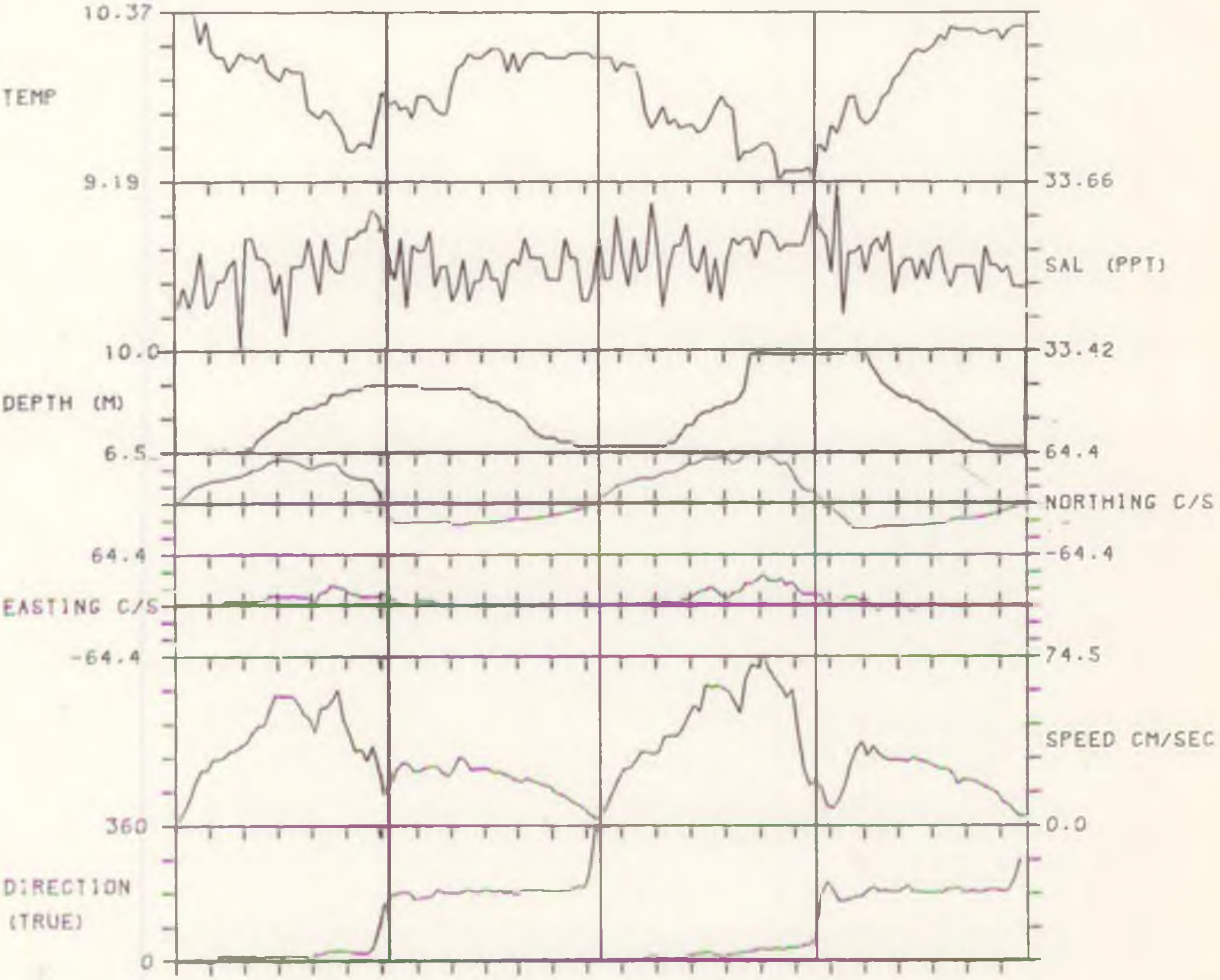
A 1.11.1

CURRENT METER DATA OVER TWO TIDES

STATION NO. 11

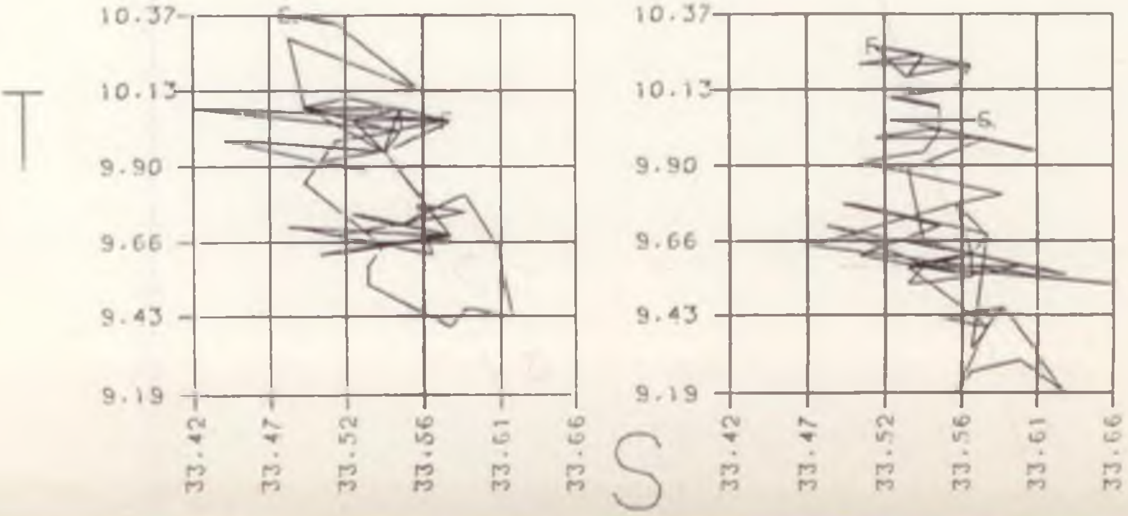
STARTING TIME: 1658 ON 22/5/75

WIRE LENGTH = 7.4 METRES



ONE-TIDE T/S DIAGRAMS

Add 58



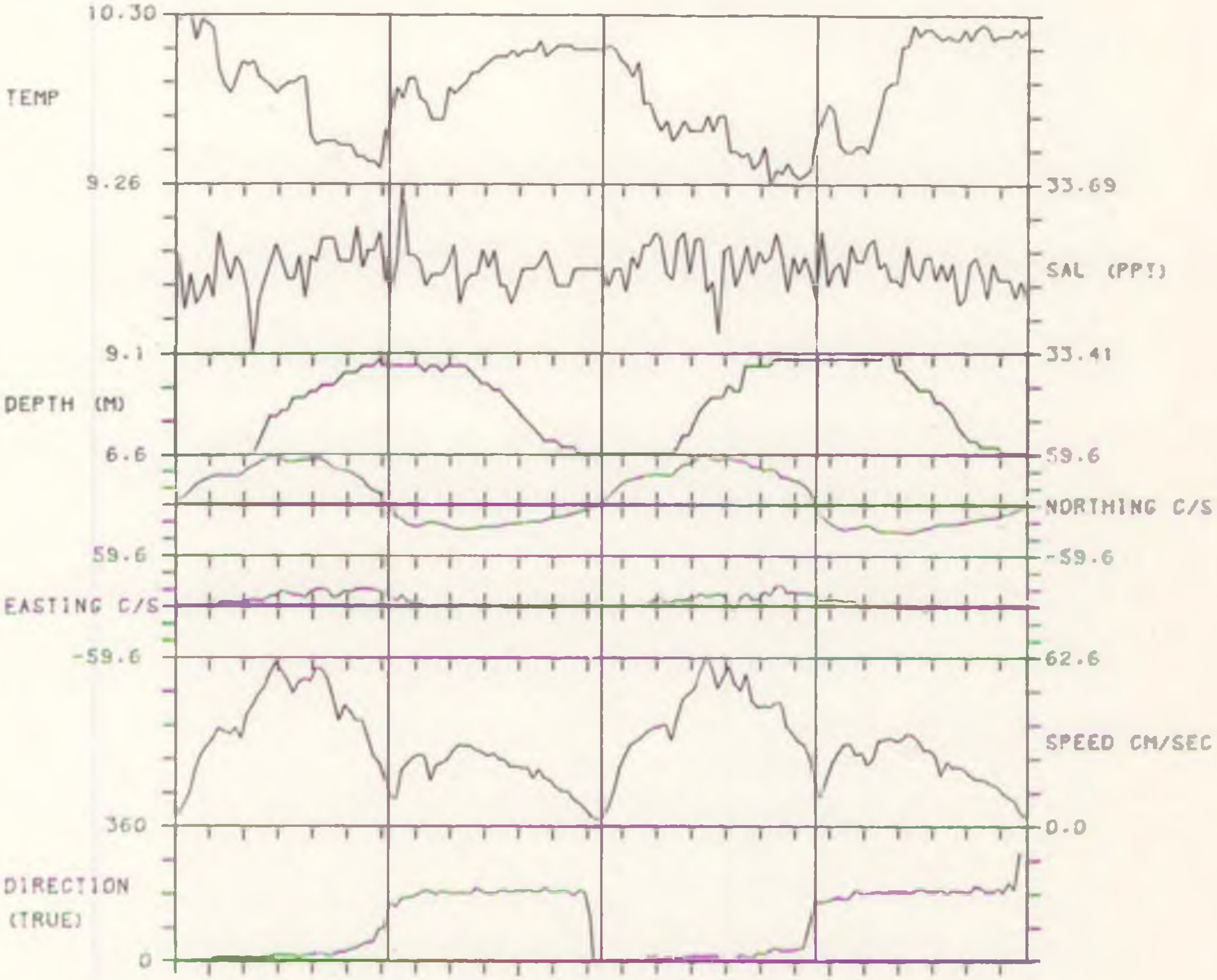
A 1.11.2

CURRENT METER DATA OVER TWO TIDES

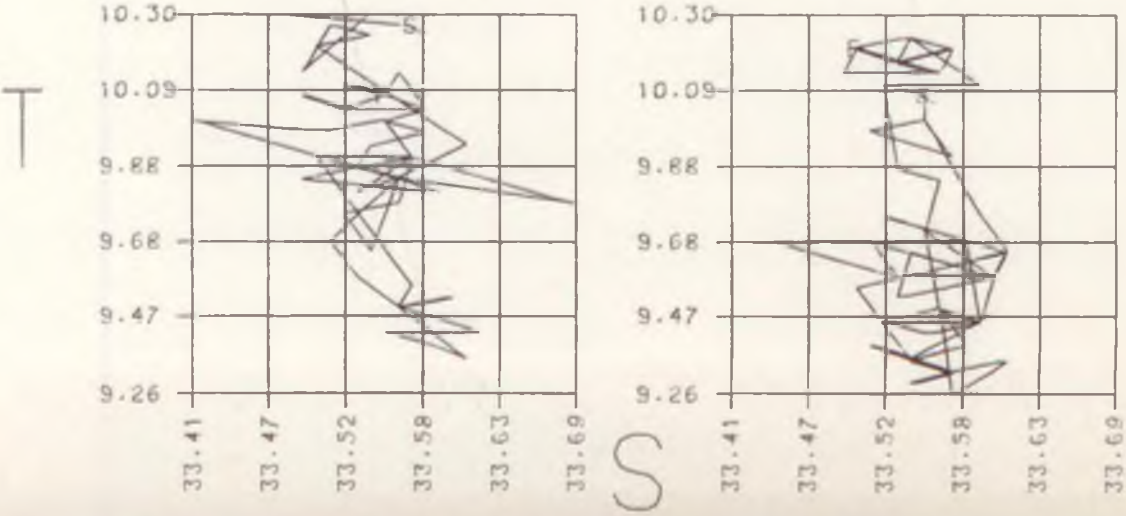
STATION NO. 11

STARTING TIME: 1748 ON 23/5/75

WIRE LENGTH = 7.4 METRES



ONE-TIDE T/S DIAGRAMS



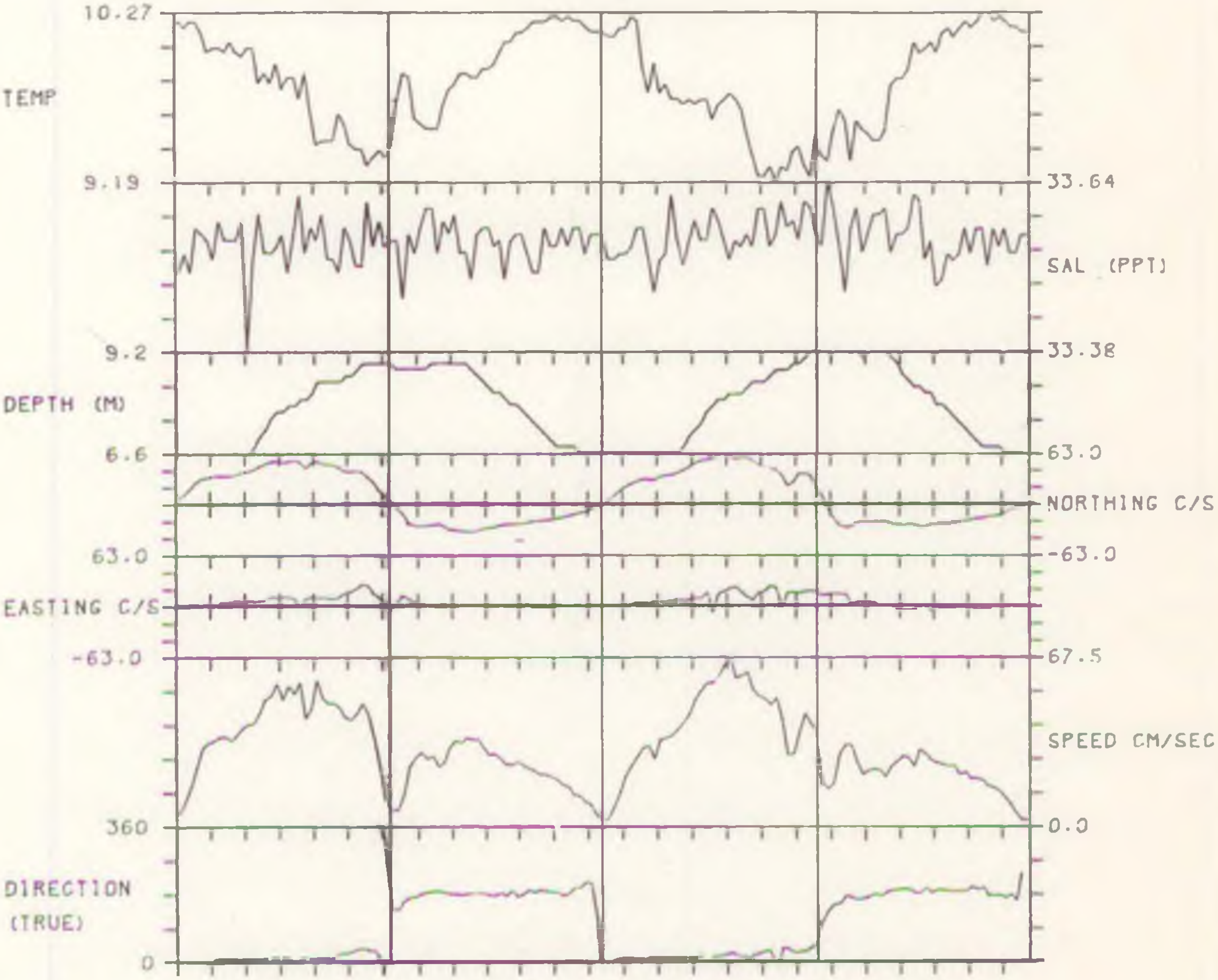
A 1.11.3

CURRENT METER DATA OVER TWO TIDES

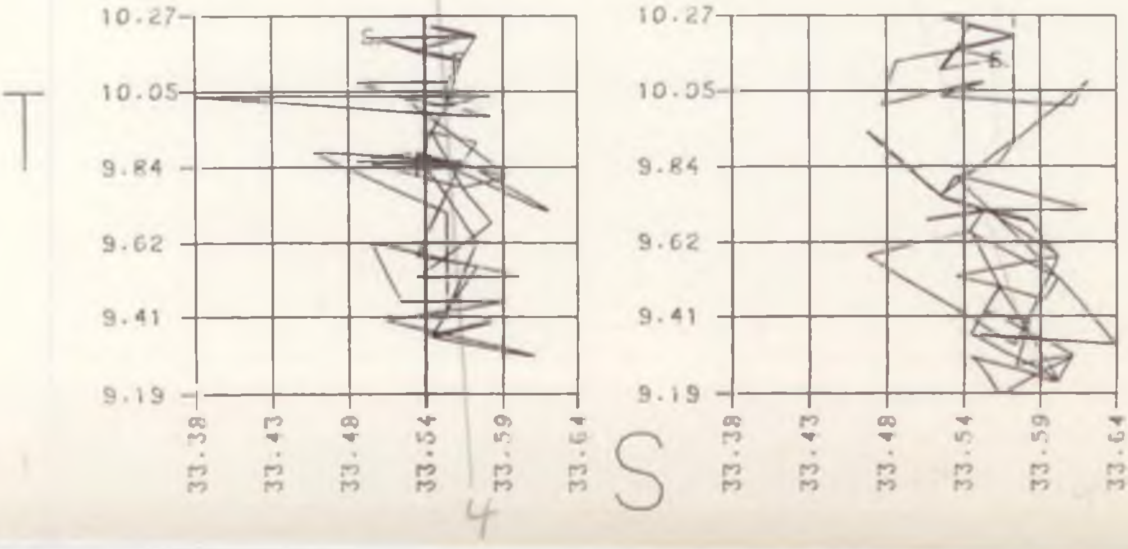
STATION NO. 11

STARTING TIME: 1838 ON 24/5/75

WIRE LENGTH = 7.4 METRES



ONE-TIDE T/S DIAGRAMS



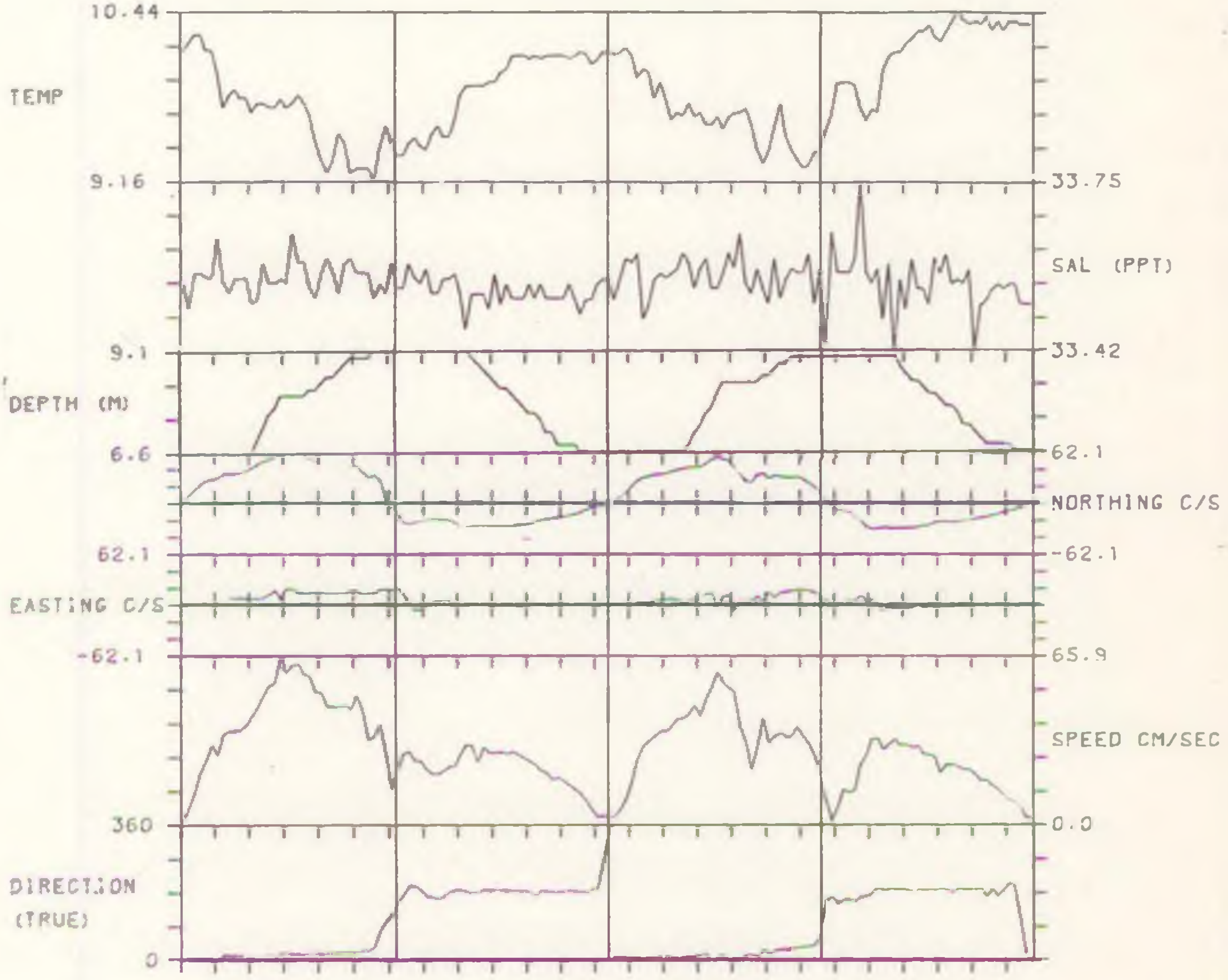
A 1.11.4

CURRENT METER DATA OVER TWO TIDES

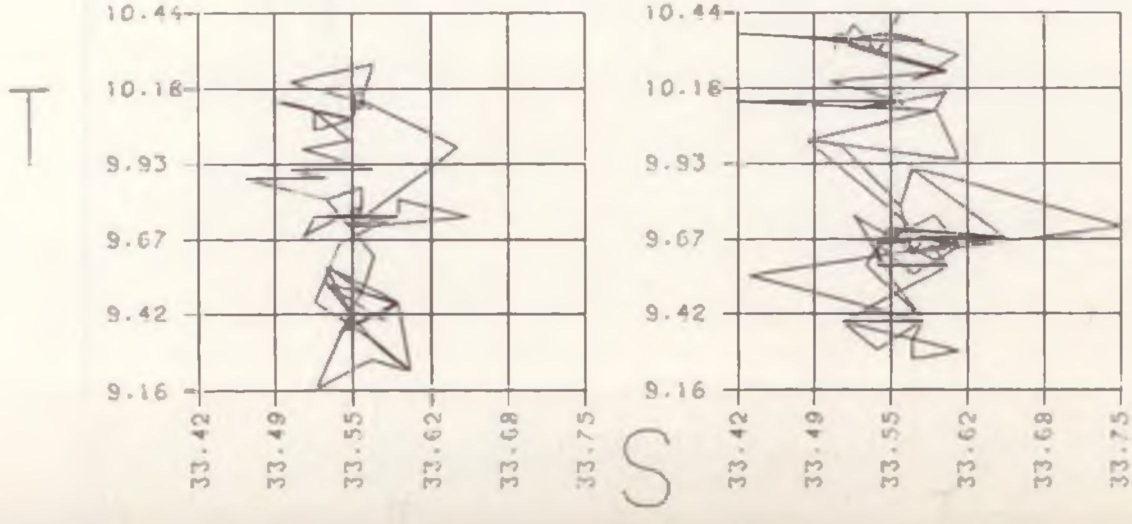
STATION NO. 11

STARTING TIME: 1928 ON 25/5/75

WIRE LENGTH = 7.4 METRES



ONE-TIDE T/S DIAGRAMS



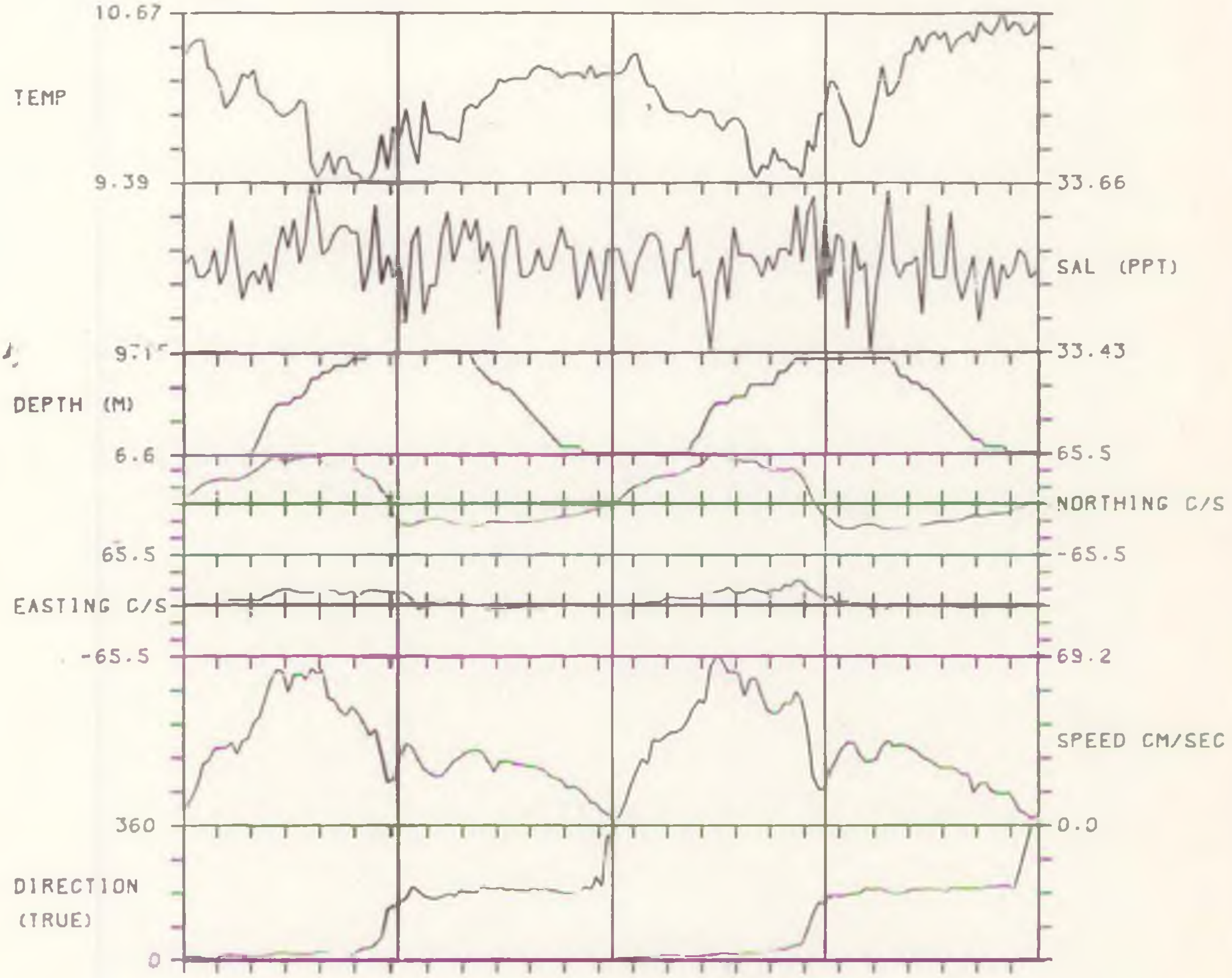
A 1.11.5

CURRENT METER DATA OVER TWO TIDES

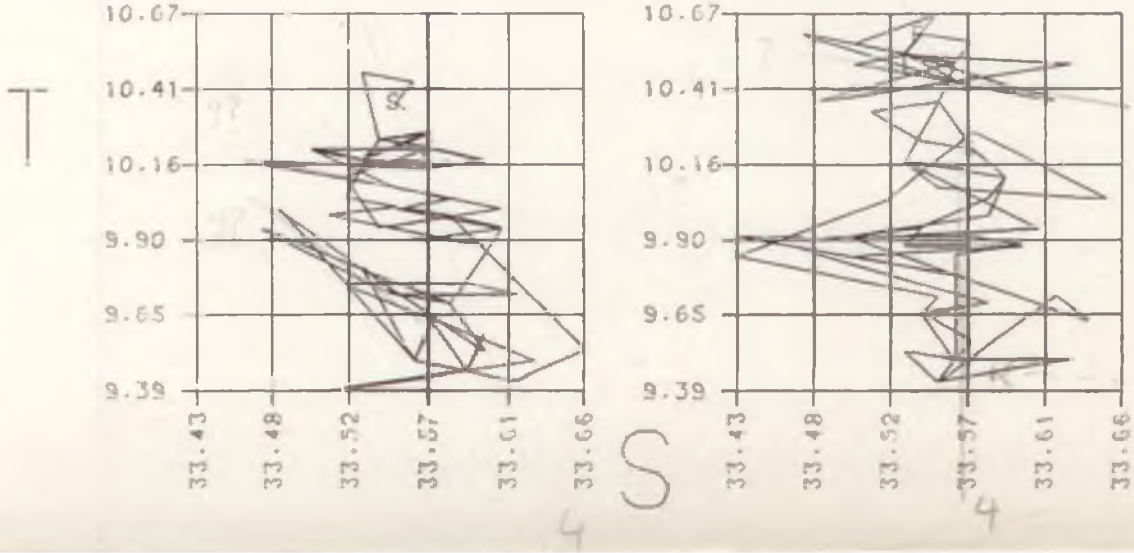
STATION NO. 11

STARTING TIME: 2018 ON 26/5/75

WIRE LENGTH = 7.4 METRES



ONE-TIDE T/S DIAGRAMS



Add .53

47

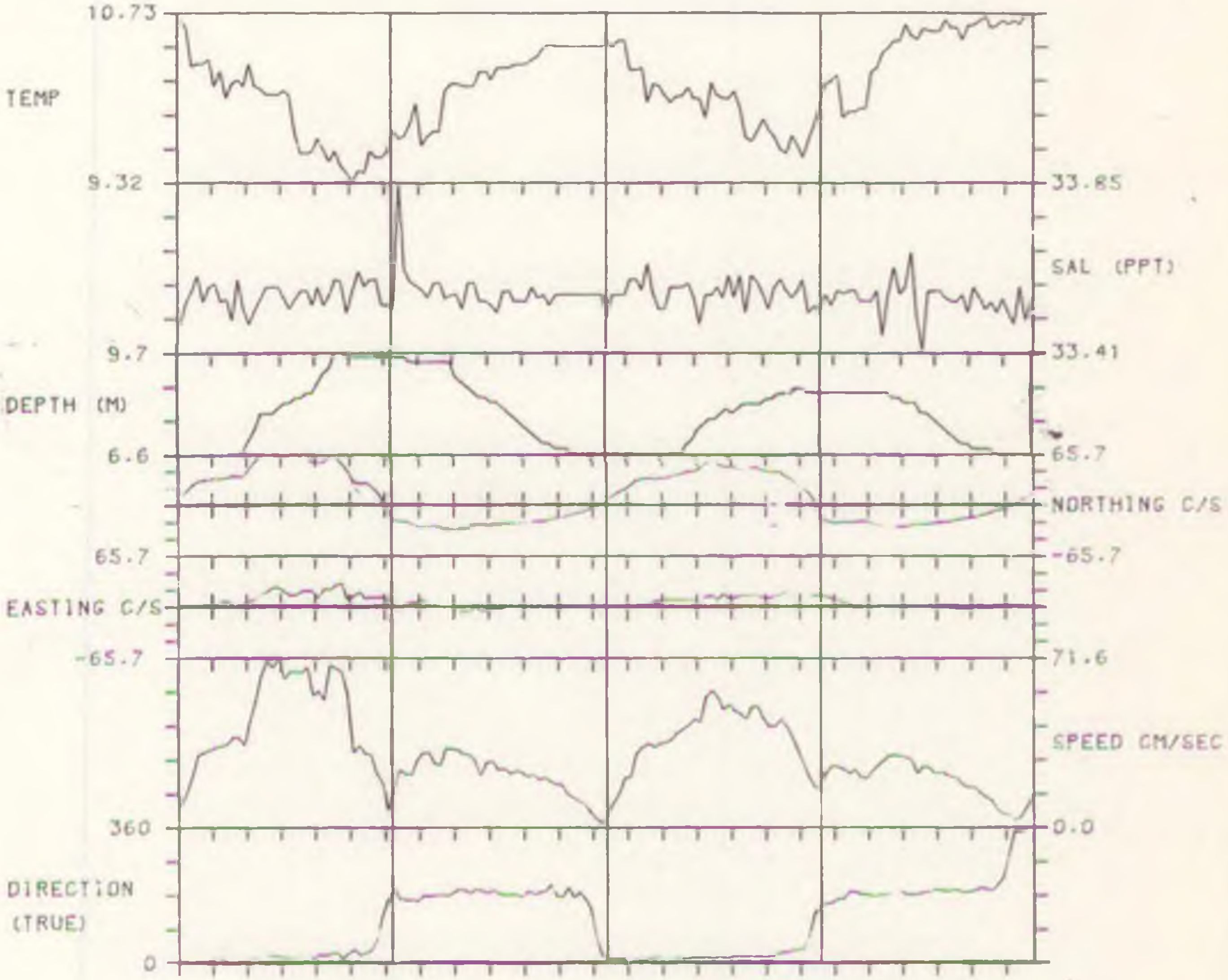
A 1.11.6

CURRENT METER DATA OVER TWO TIDES

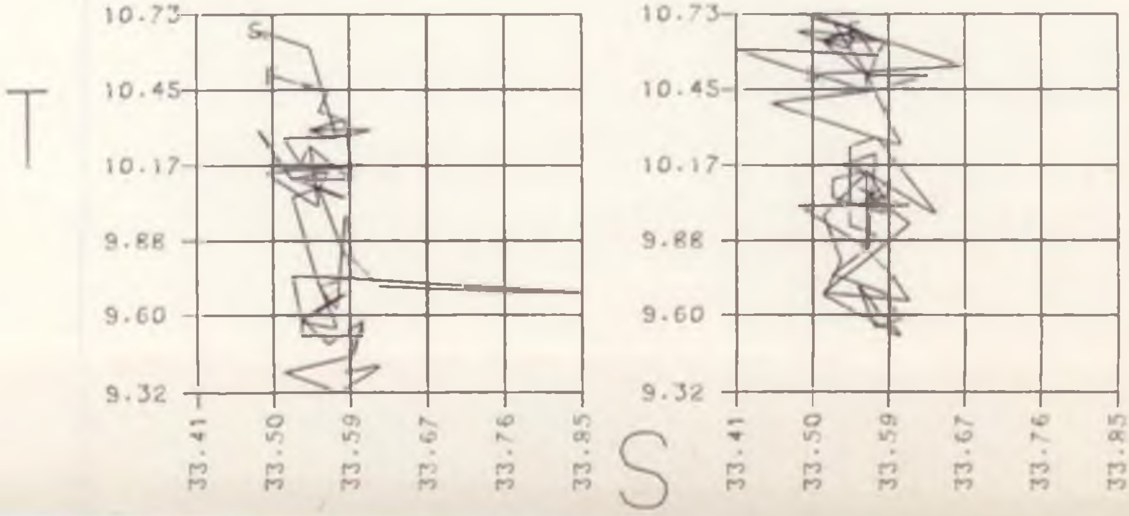
STATION NO. 11

STARTING TIME: 2108 ON 27/5/75

WIRE LENGTH = 7.4 METRES



ONE-TIDE T/S DIAGRAMS



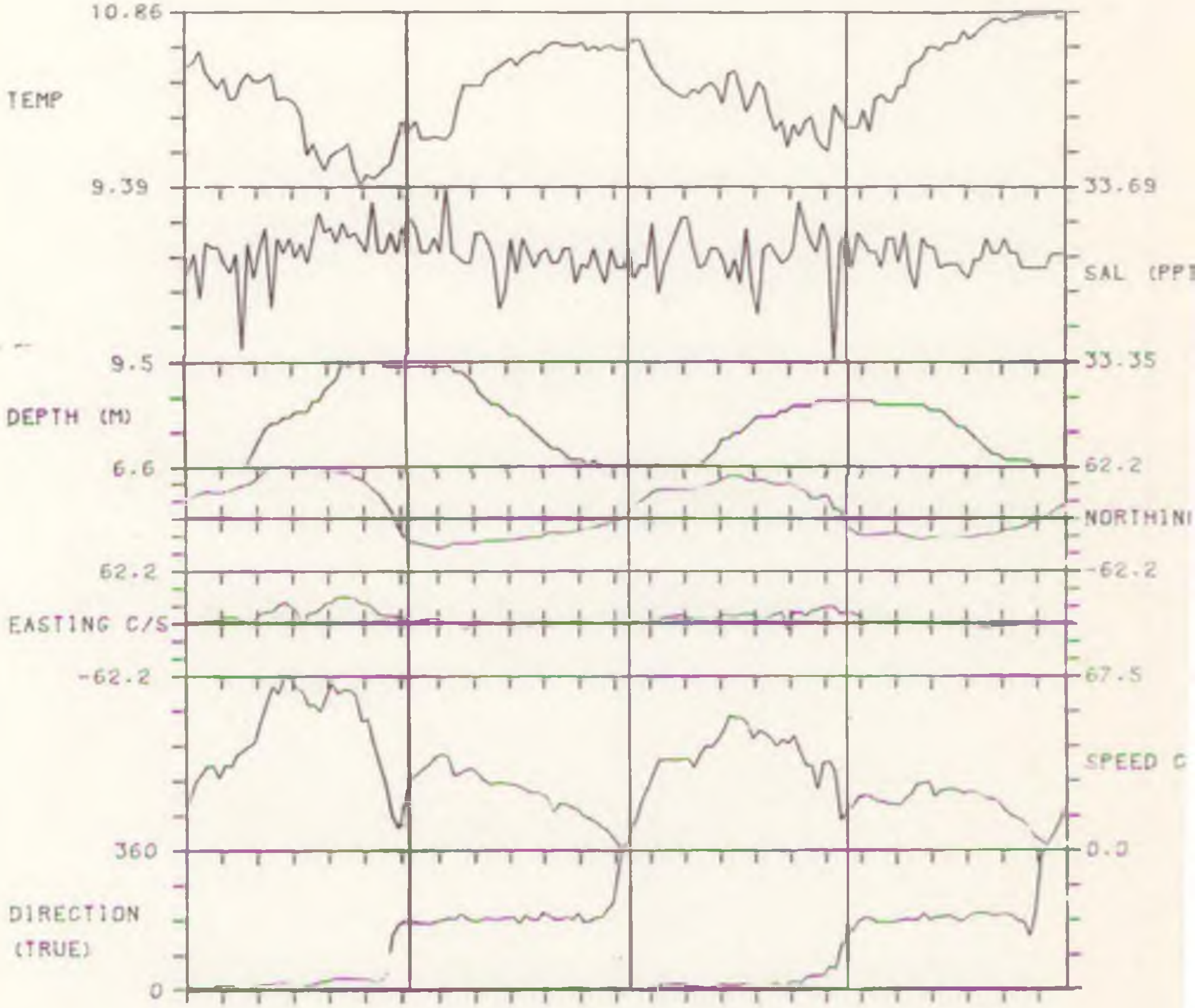
A 1.11.7

CURRENT METER DATA OVER TWO TIDES

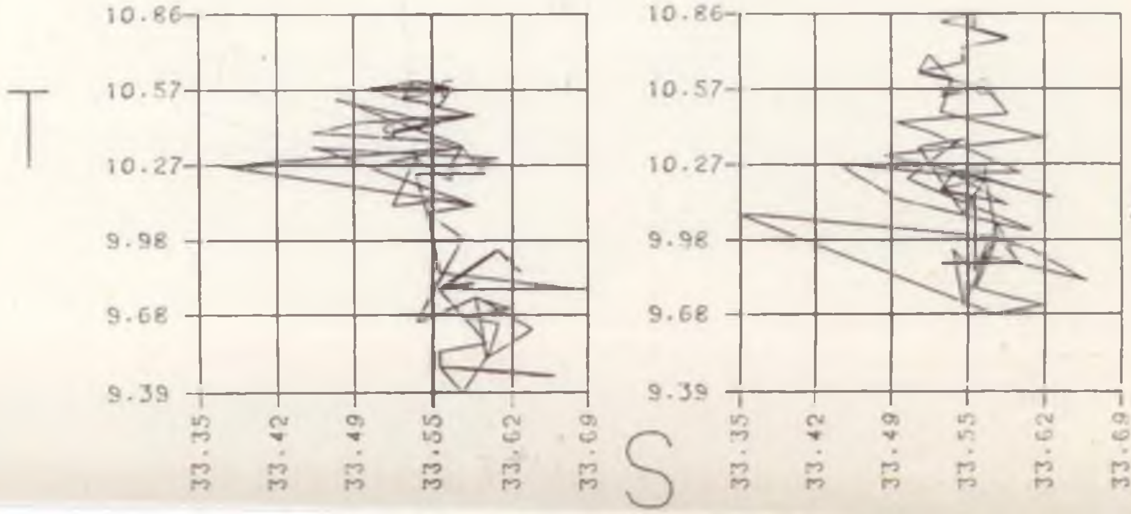
STATION NO. 11

STARTING TIME: 2158 ON 28/5/75

WIRE LENGTH = 7.4 METRES



ONE-TIDE T/S DIAGRAMS



Add
·54

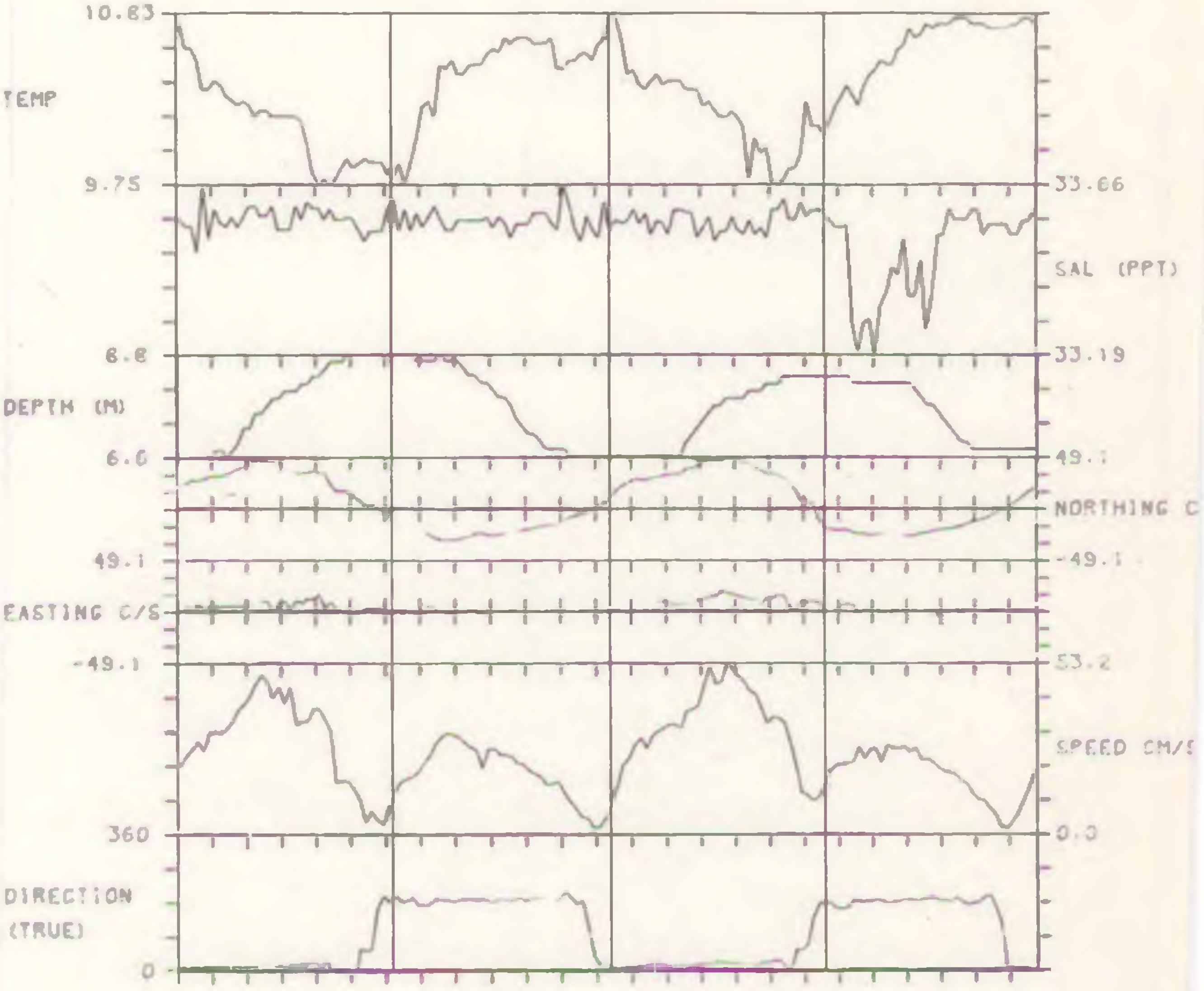
A 1.11.8

CURRENT METER DATA OVER TWO TIDES

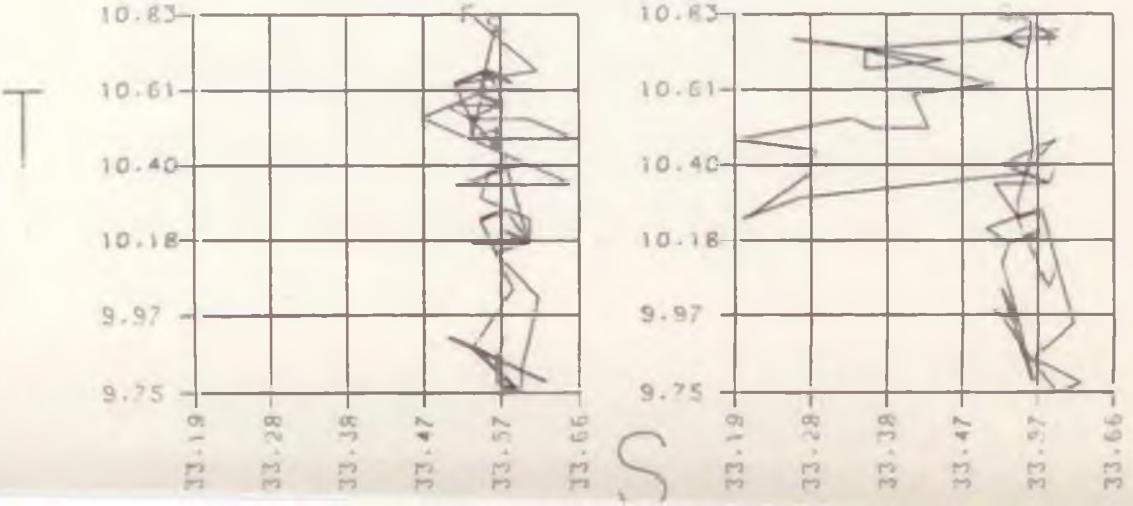
STATION NO. 11

STARTING TIME: 2248 ON 29/5/75

WIRE LENGTH = 7.4 METRES



ONE-TIDE T/S DIAGRAMS

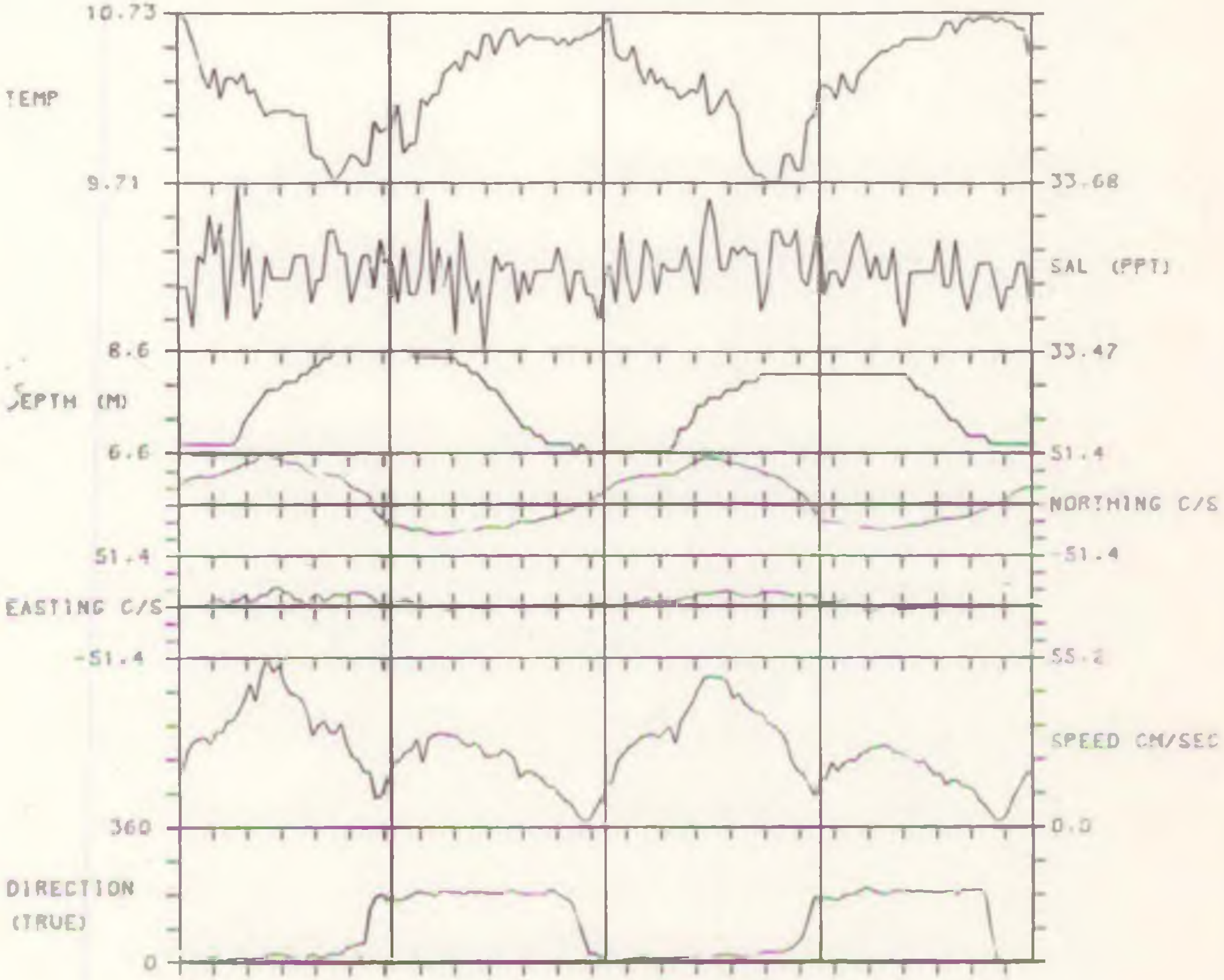


CURRENT METER DATA OVER TWO TIDES

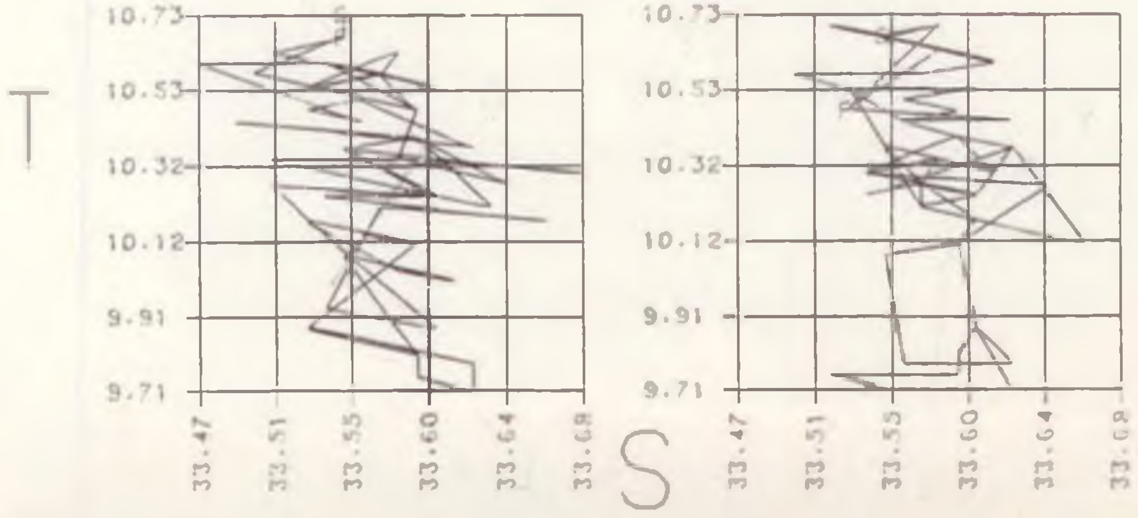
STATION NO. 11

STARTING TIME: 2338 ON 30/5/75

WIRE LENGTH = 7.4 METRES



ONE-TIDE T/S DIAGRAMS



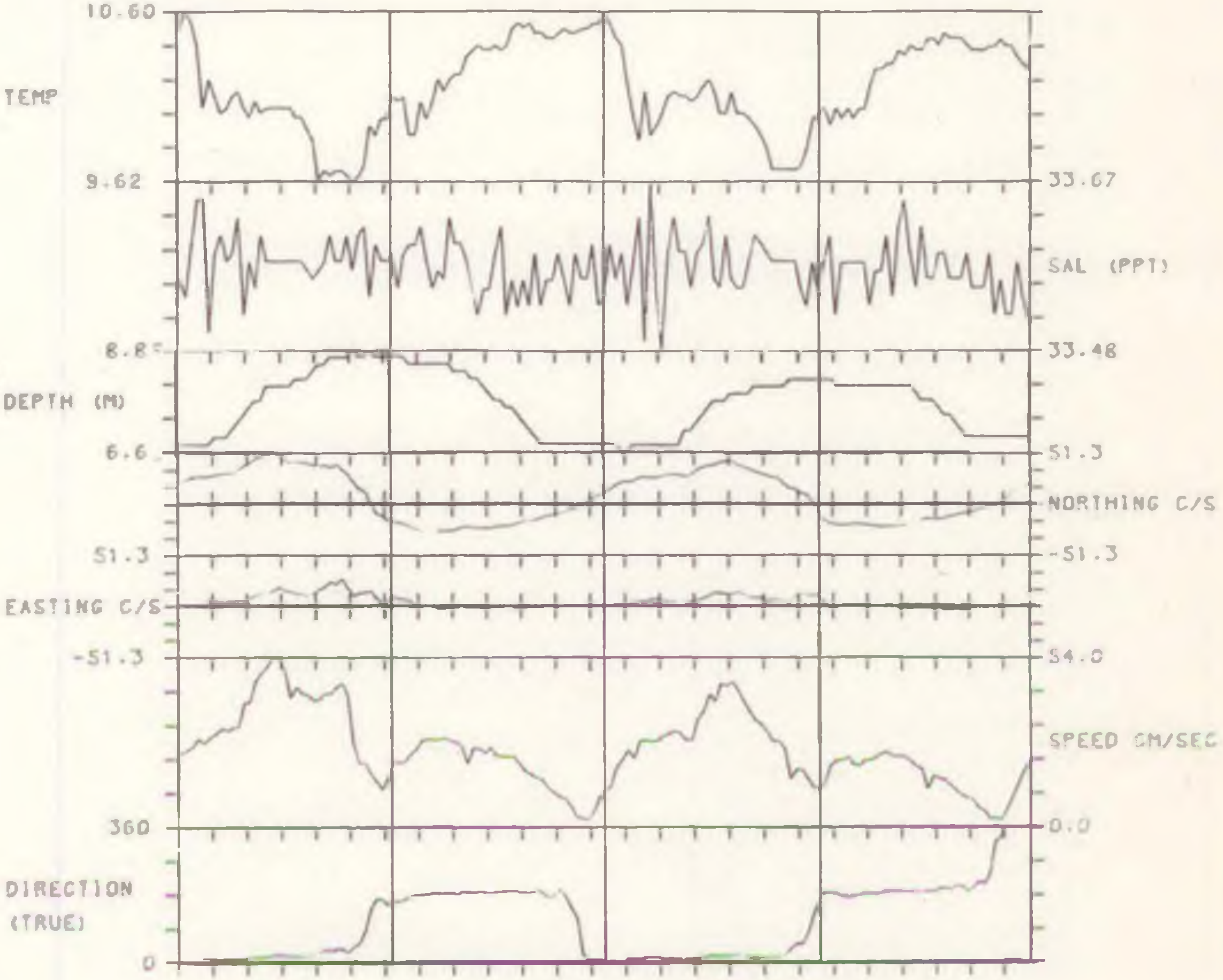
A 1.11.10

CURRENT METER DATA OVER TWO TIDES

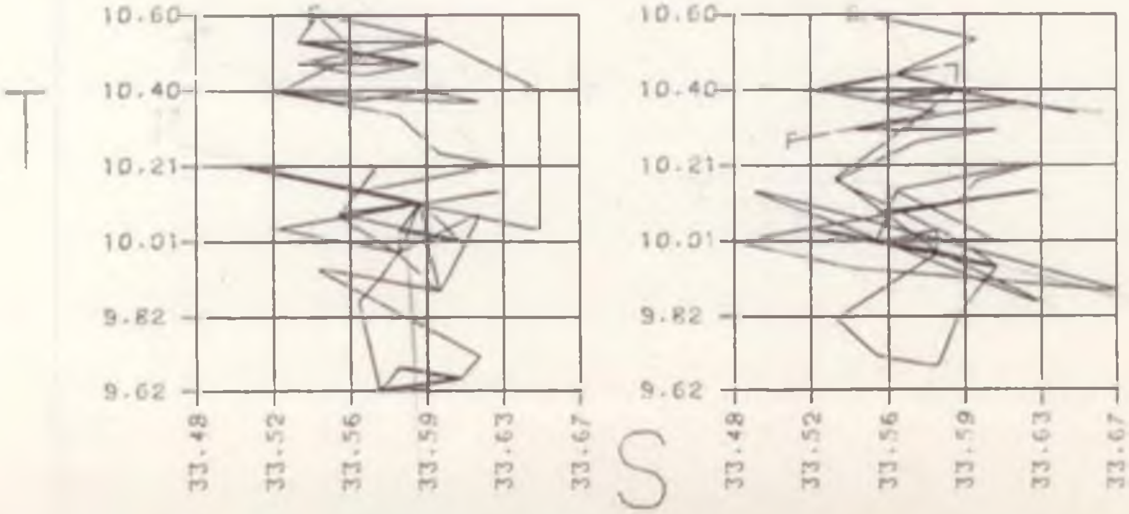
STATION NO. 11

STARTING TIME: 0028 ON 1/6/75

WIRE LENGTH = 7.4 METRES



ONE-TIDE T/S DIAGRAMS



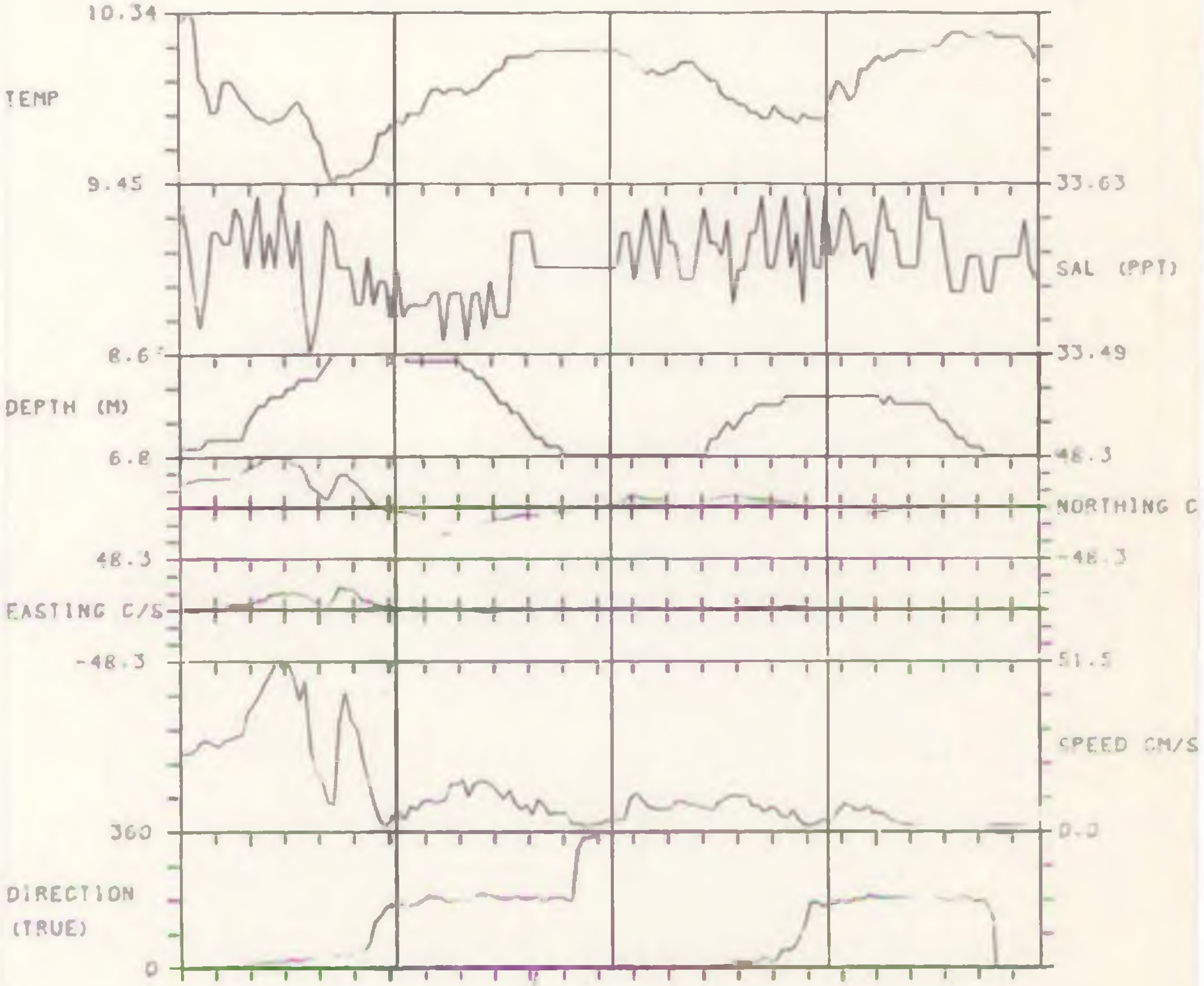
A1.11.11

CURRENT METER DATA OVER TWO TIDES

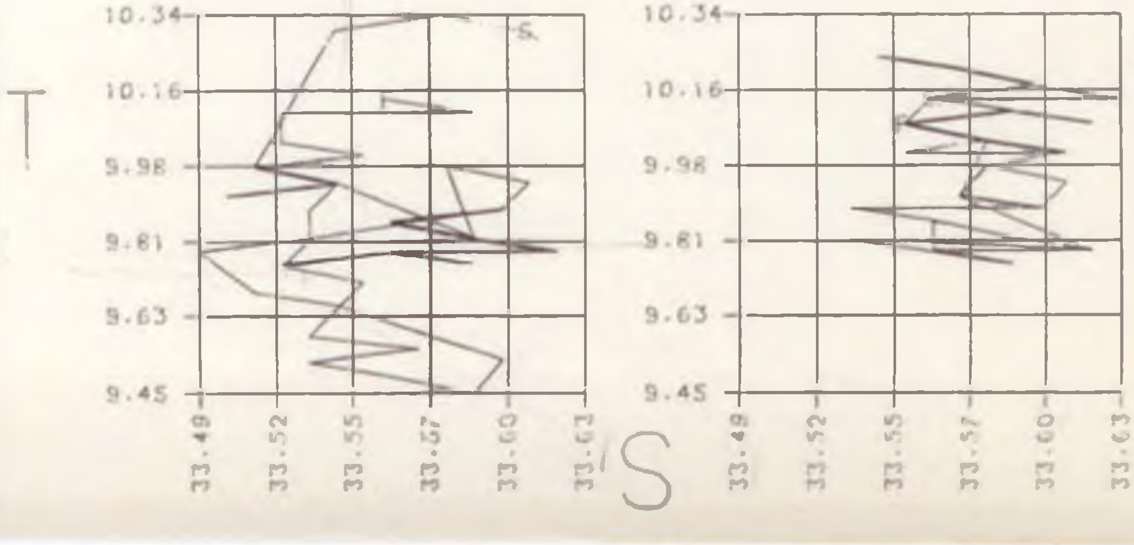
STATION NO. 11

STARTING TIME: 0118 ON 2/6/75

WIRE LENGTH = 7.4 METRES



ONE-TIDE T/S DIAGRAMS



Subtract
.52

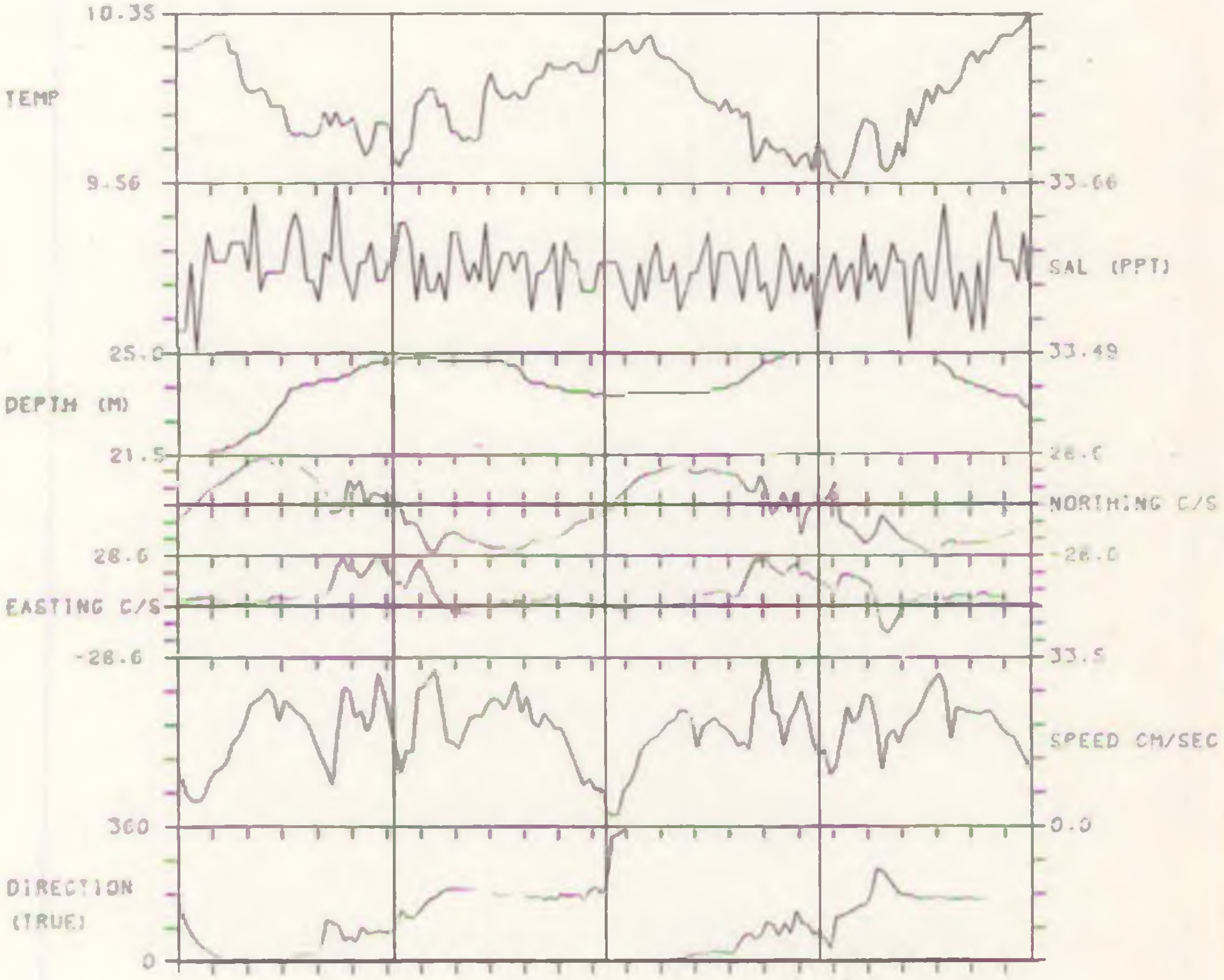
A 1.12.1

CURRENT METER DATA OVER TWO TIDES

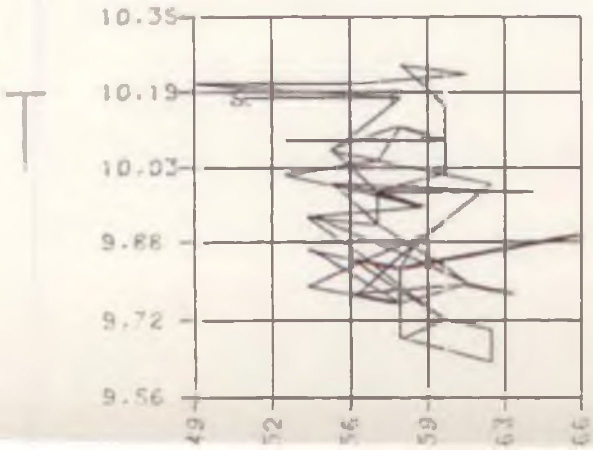
STATION NO. 12

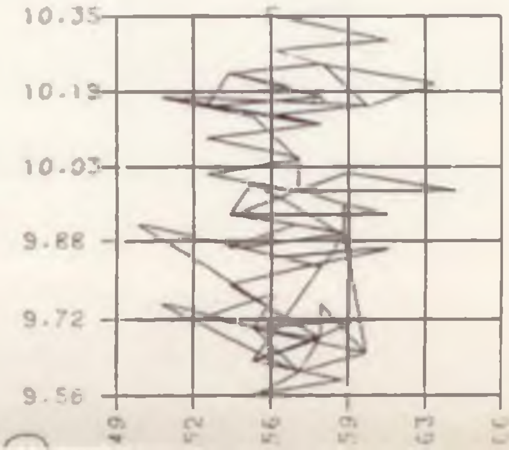
STARTING TIME: 1540 ON 4/6/75

WIRE LENGTH = 13.5 METRES



ONE-TIDE T/S DIAGRAMS





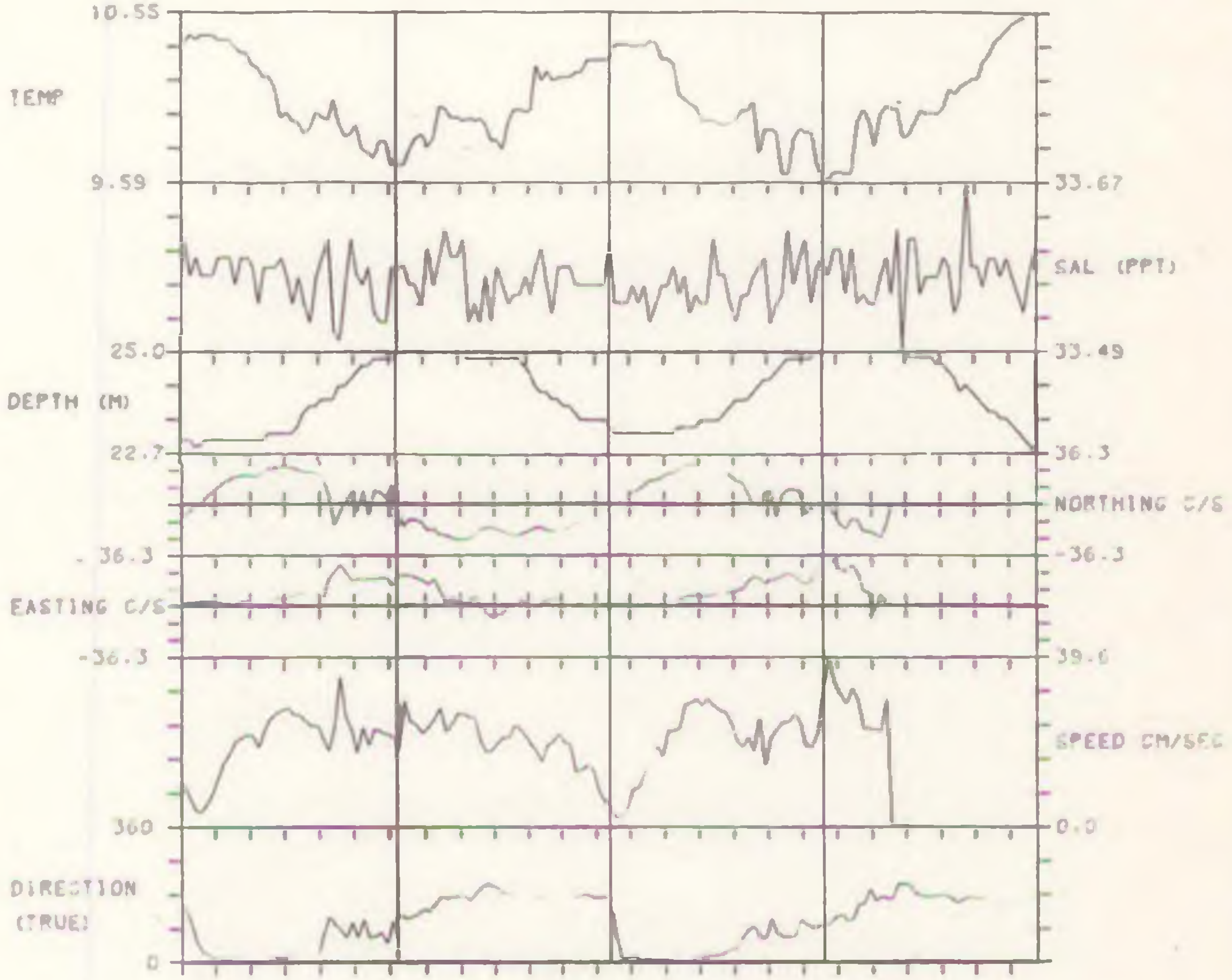
CURRENT METER DATA OVER TWO TIDES

A.1.12.2

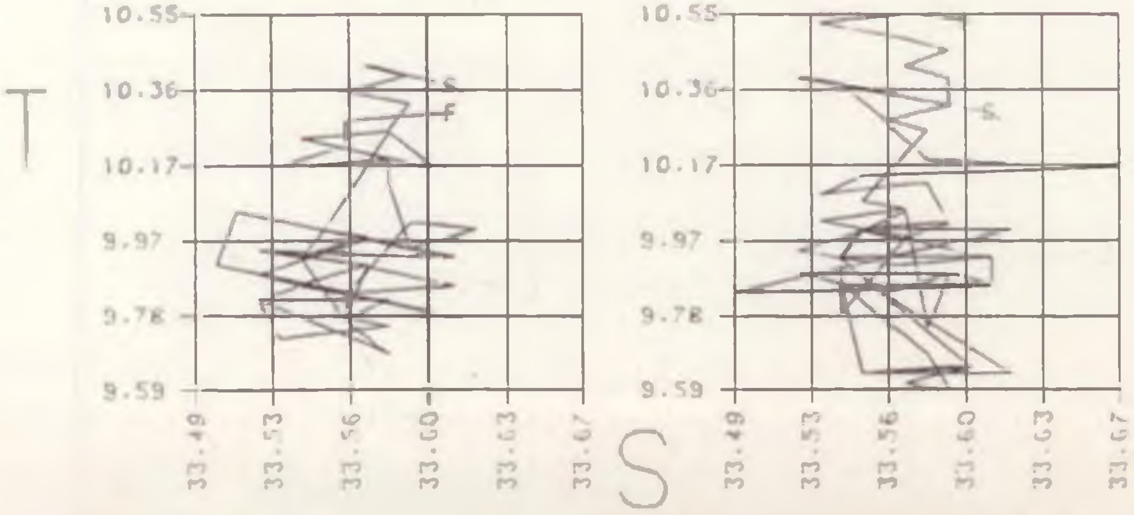
STATION NO. 12

STARTING TIME: 1630 ON 5/6/75

WIRE LENGTH = 13.5 METRES



ONE-TIDE T/S DIAGRAMS



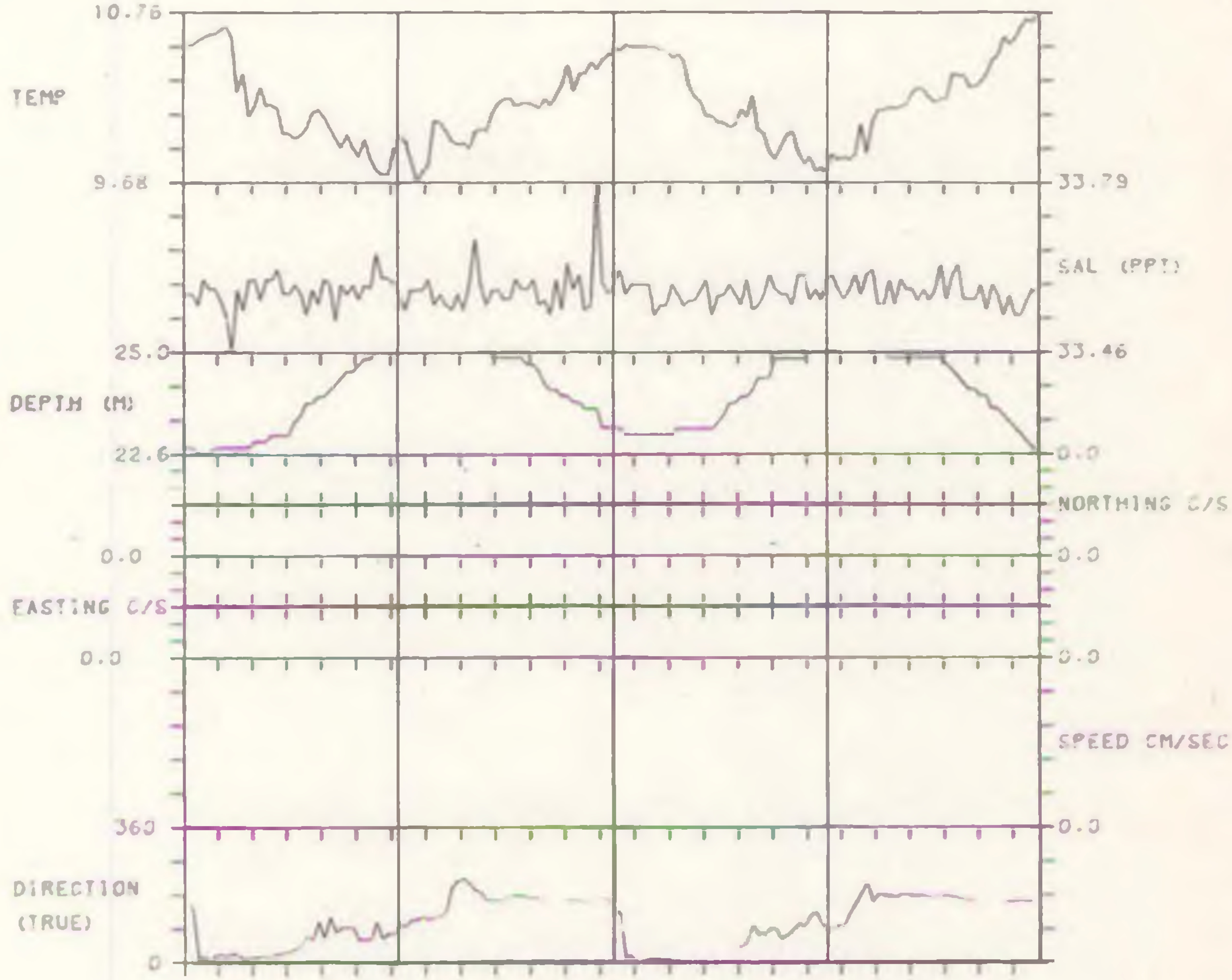
A 1.12.3

CURRENT METER DATA OVER TWO TIDES

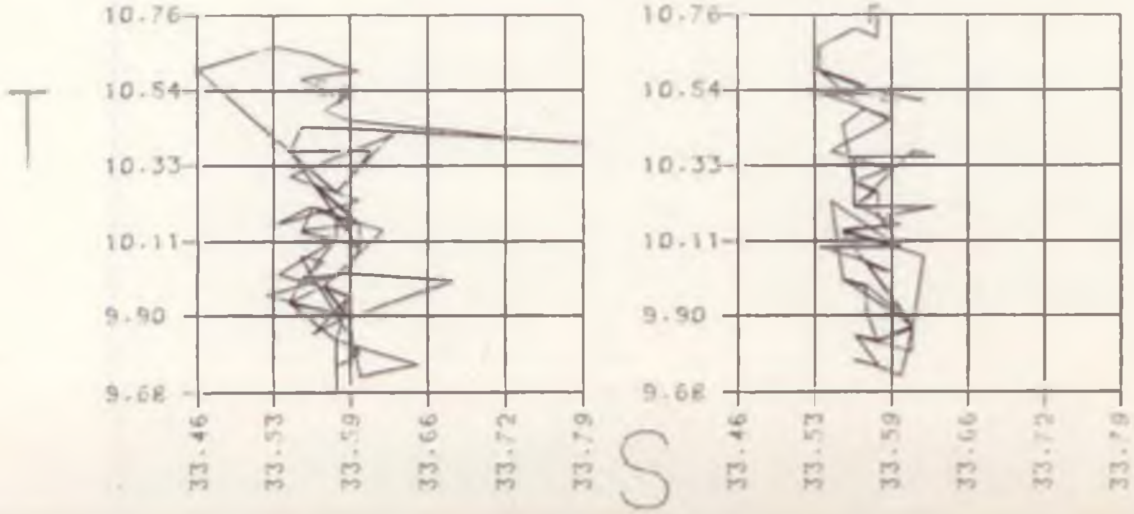
STATION NO. 12

STARTING TIME: 1720 ON 6/6/75

WIRE LENGTH = 13.5 METRES



ONE-TIDE T/S DIAGRAMS



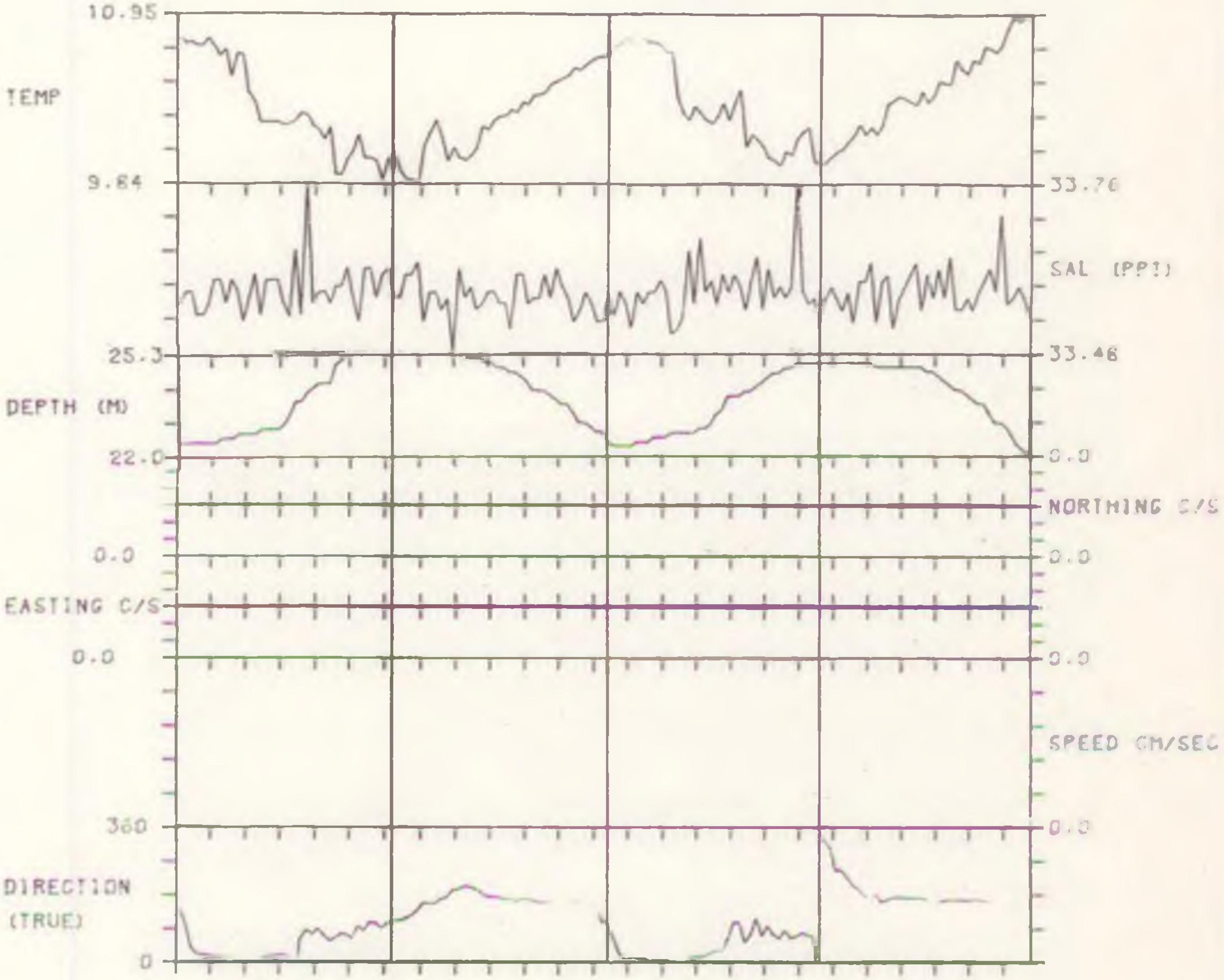
A 1.12.4

CURRENT METER DATA OVER TWO TIDES

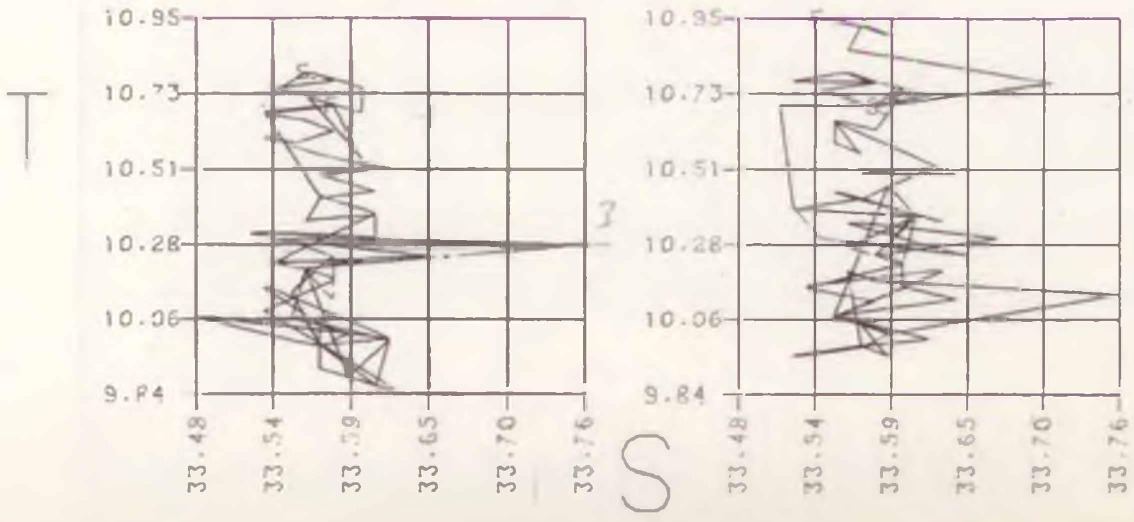
STATION NO. 12

STARTING TIME: 1810 ON 7/6/75

WIRE LENGTH = 13.5 METRES



ONE-TIDE T/S DIAGRAMS



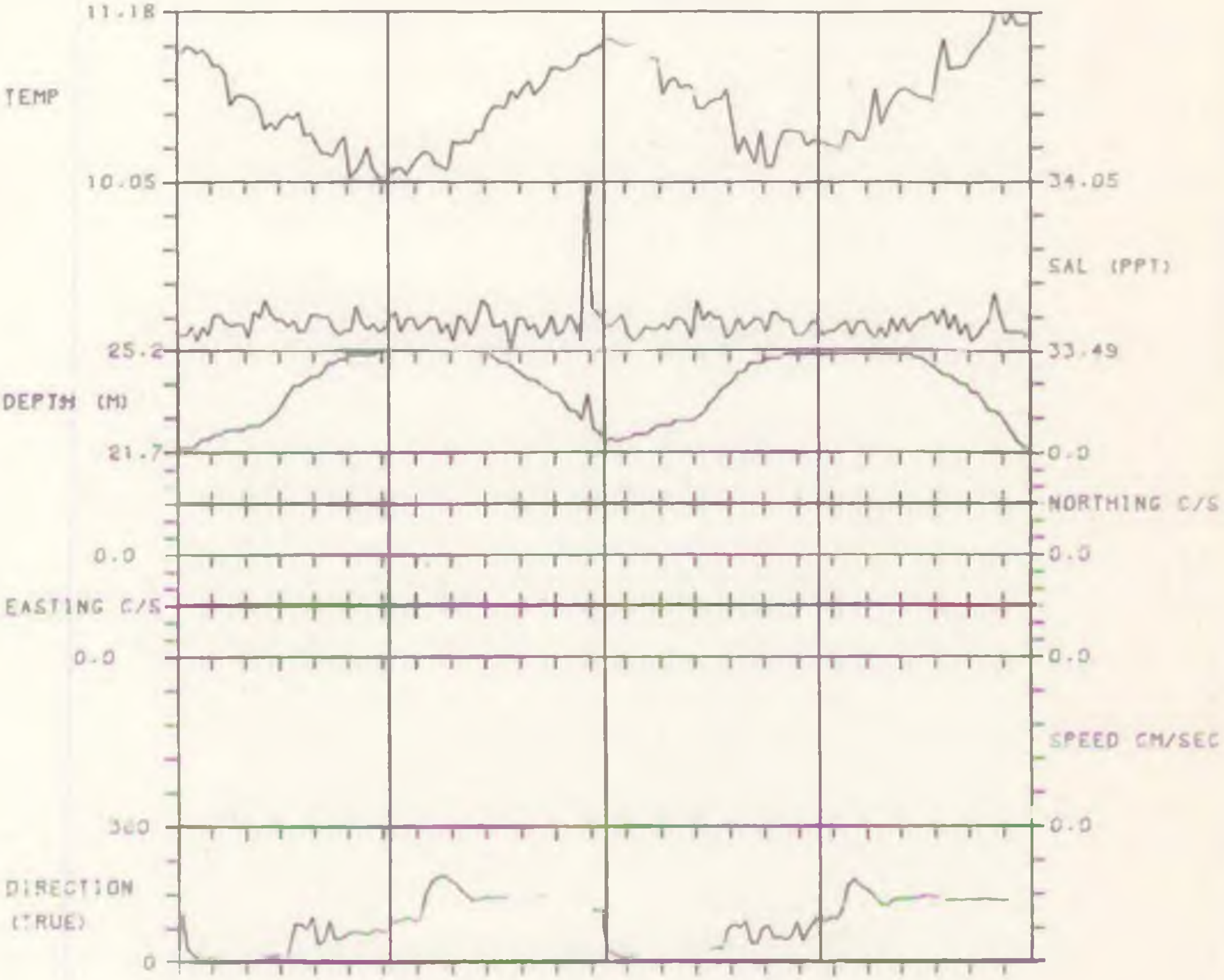
A1.12.5

CURRENT METER DATA OVER TWO TIDES

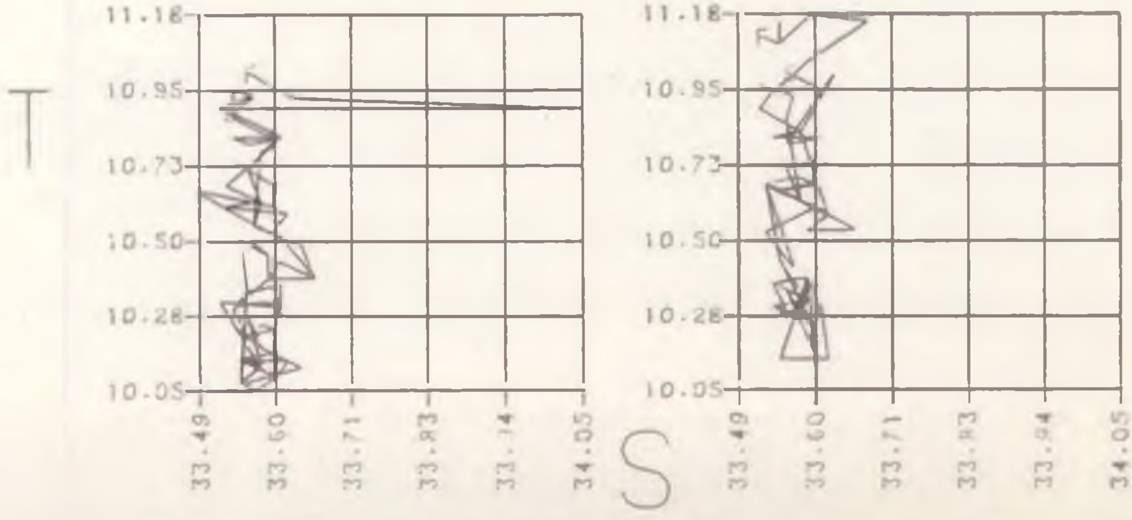
STATION NO. 12

STARTING TIME: 1900 ON 8/6/75

WIRE LENGTH = 13.5 METRES



ONE-TIDE T/S DIAGRAMS



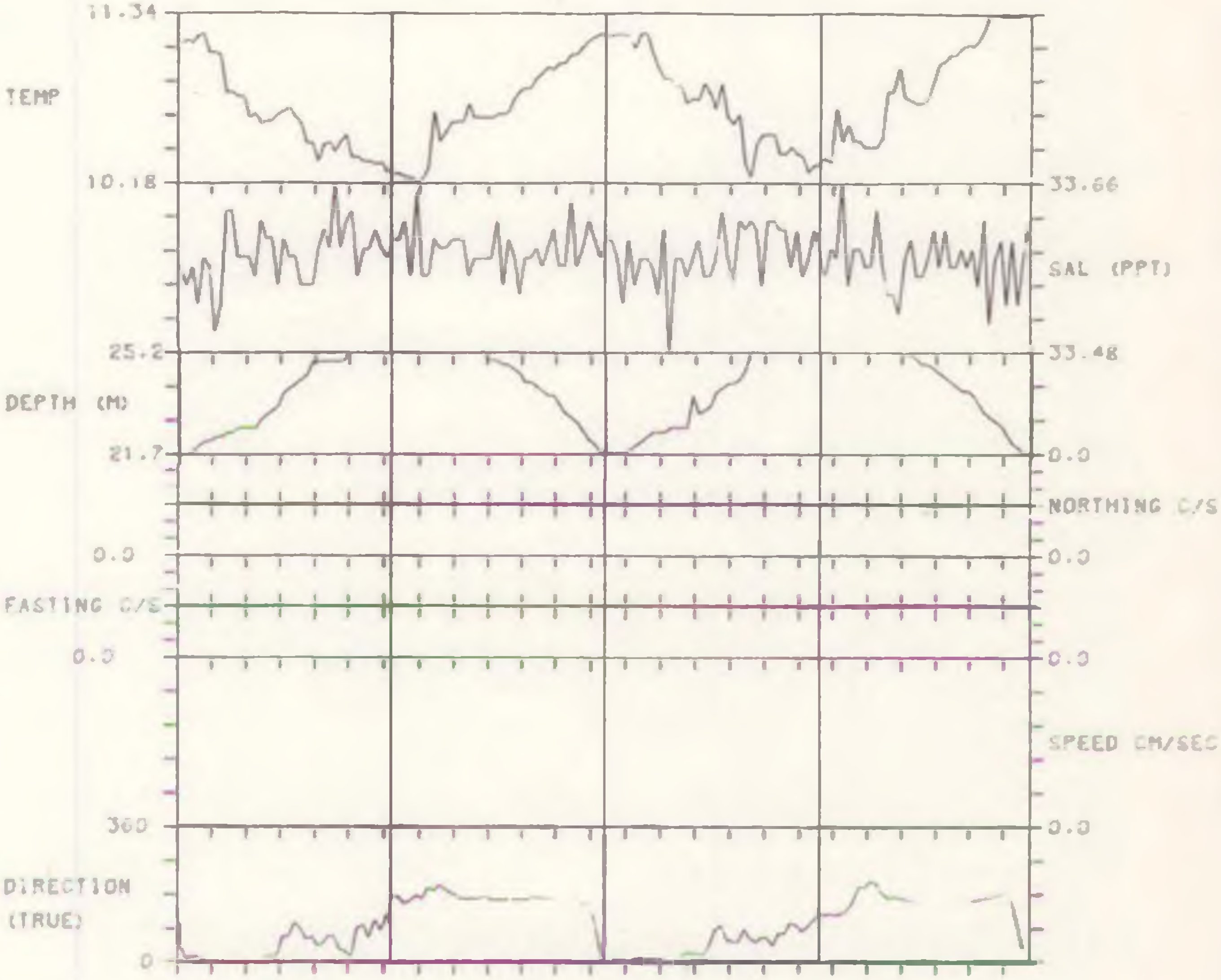
A 1.12.6

CURRENT METER DATA OVER TWO TIDES

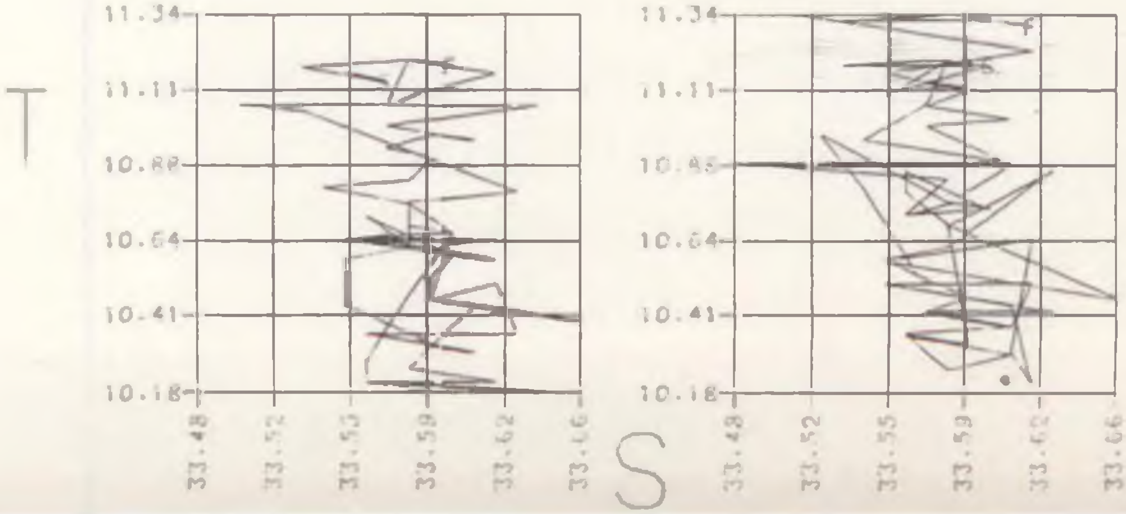
STATION NO. 12

STARTING TIME: 1950 ON 9/6/75

WIRE LENGTH = 13.5 METRES



ONE-TIDE T/S DIAGRAMS



Subtract
·46

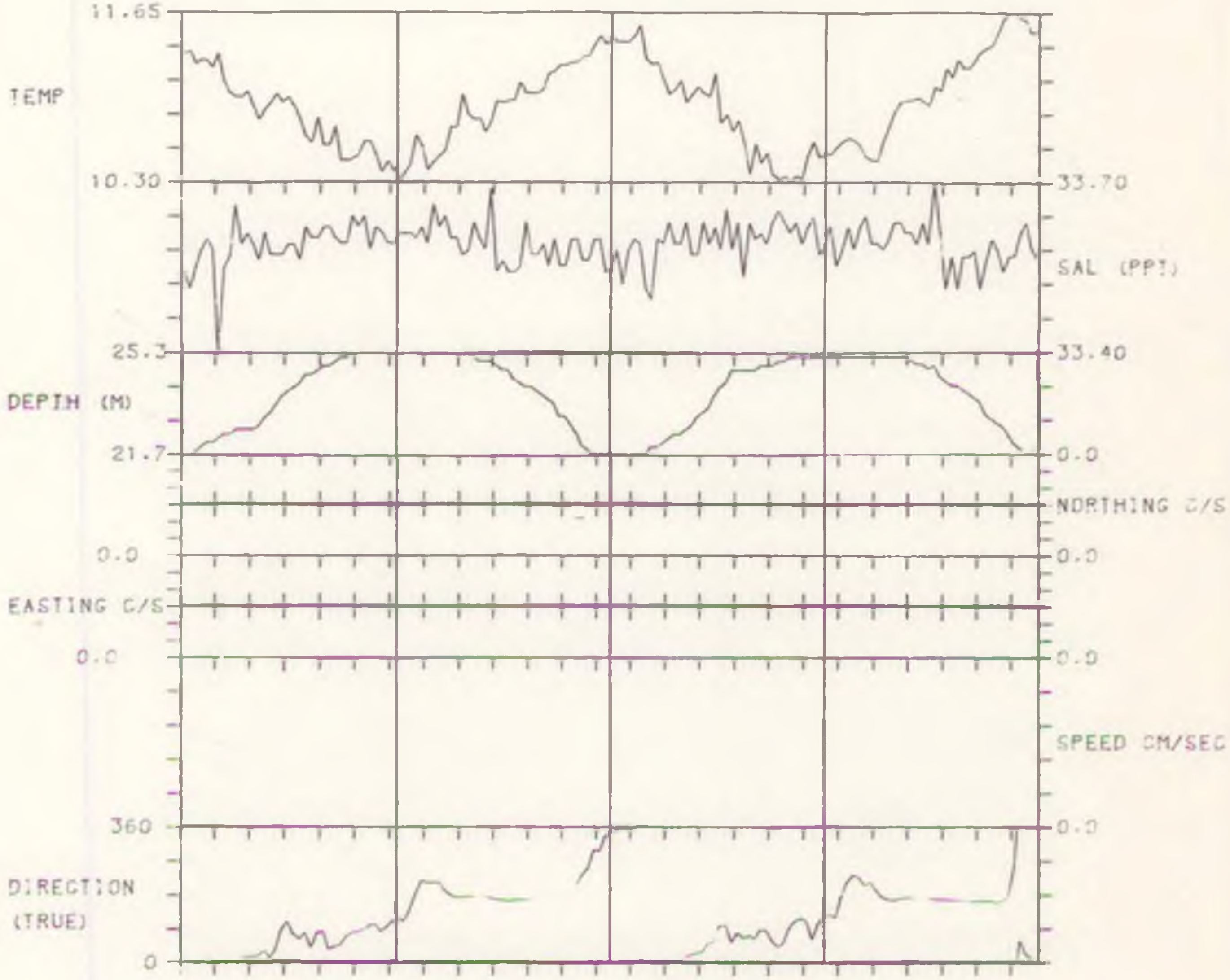
A 1.12.7

CURRENT METER DATA OVER TWO TIDES

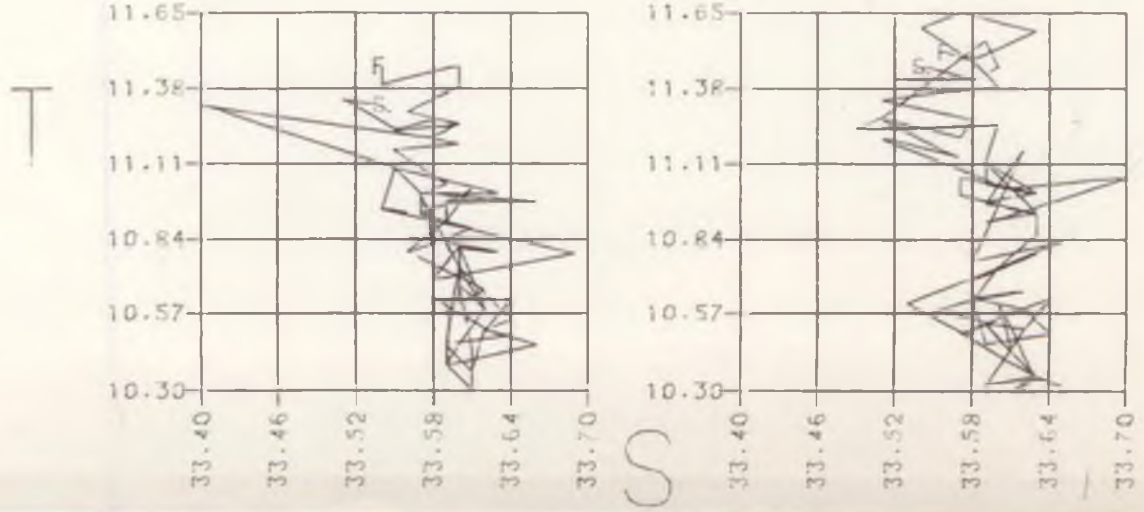
STATION NO. 12

STARTING TIME: 2040 ON 10/6/75

WIRE LENGTH = 13.5 METRES



ONE-TIDE T/S DIAGRAMS



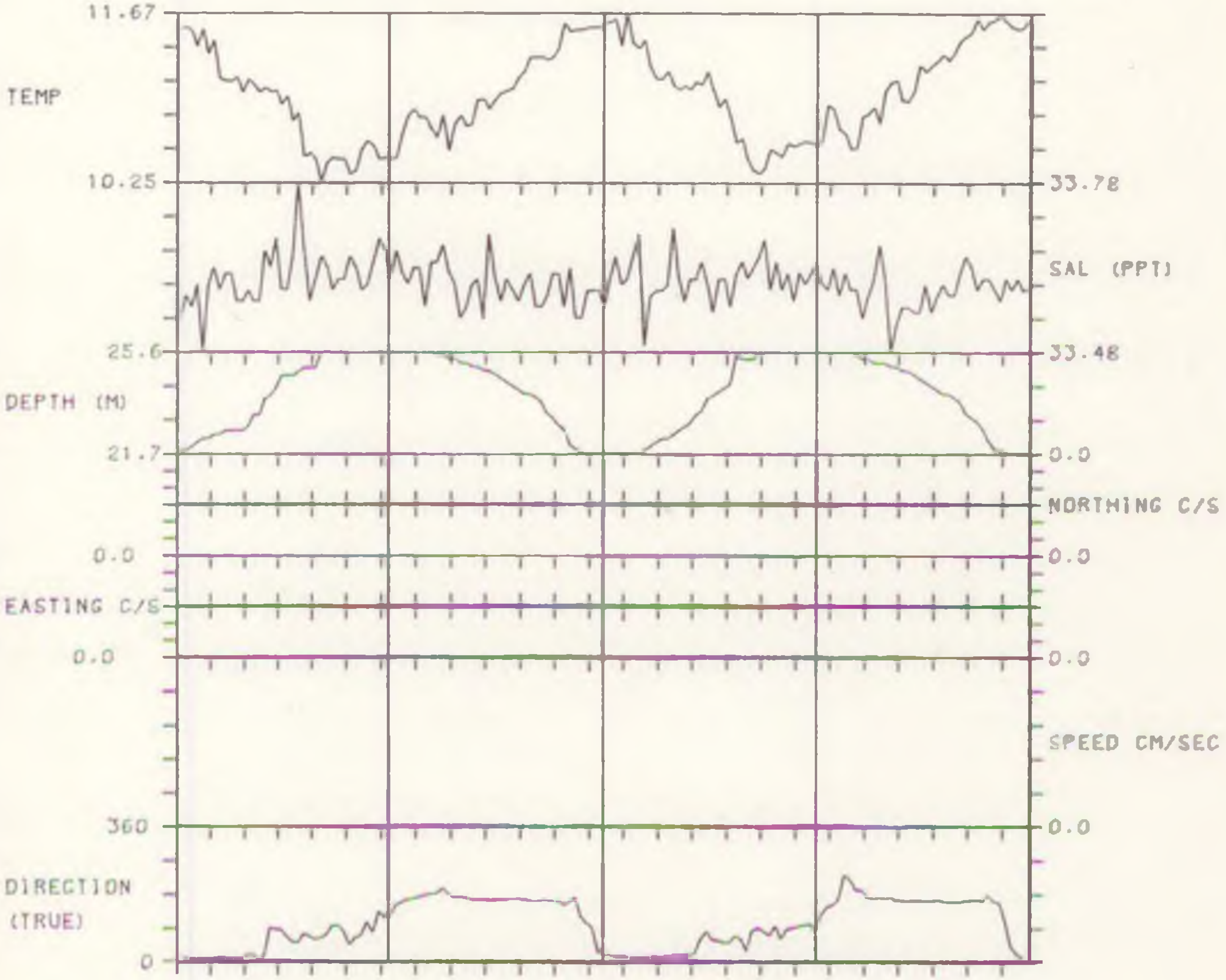
CURRENT METER DATA OVER TWO TIDES

A.1.12.8.

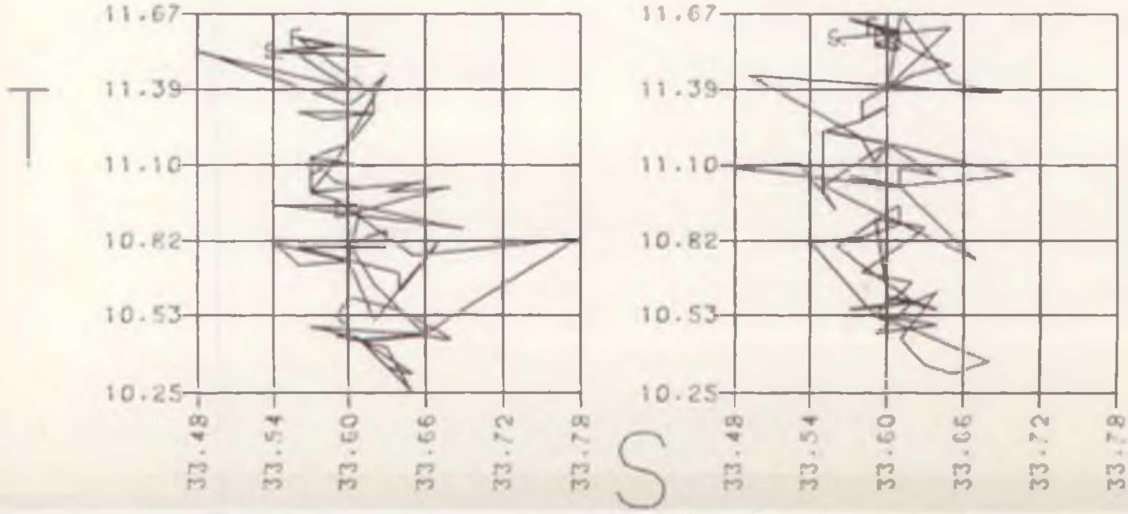
STATION NO. 12

STARTING TIME: 2130 ON 11/6/75

WIRE LENGTH = 13.5 METRES



ONE-TIDE T/S DIAGRAMS



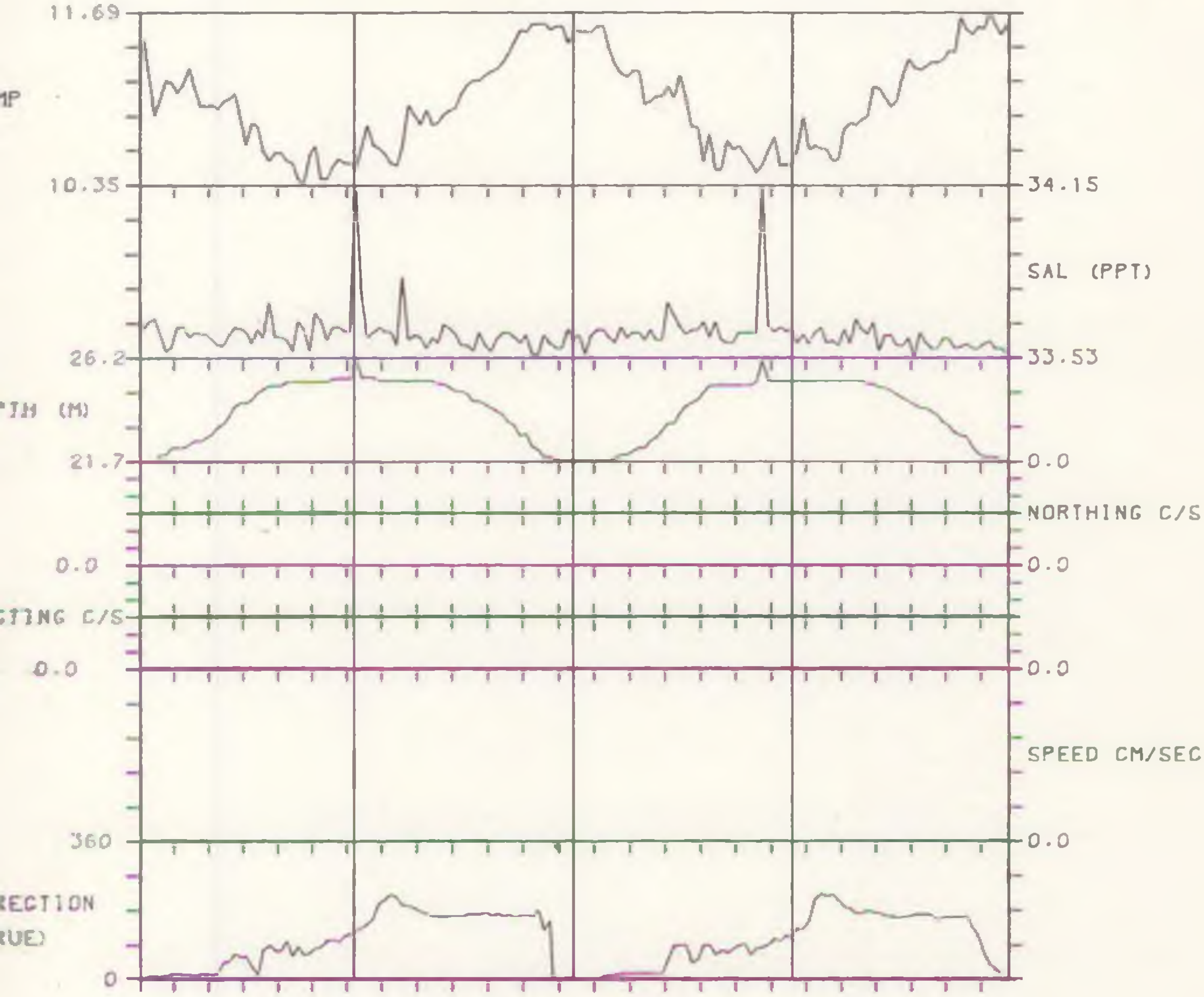
A 1.12.9

CURRENT METER DATA OVER TWO TIDES

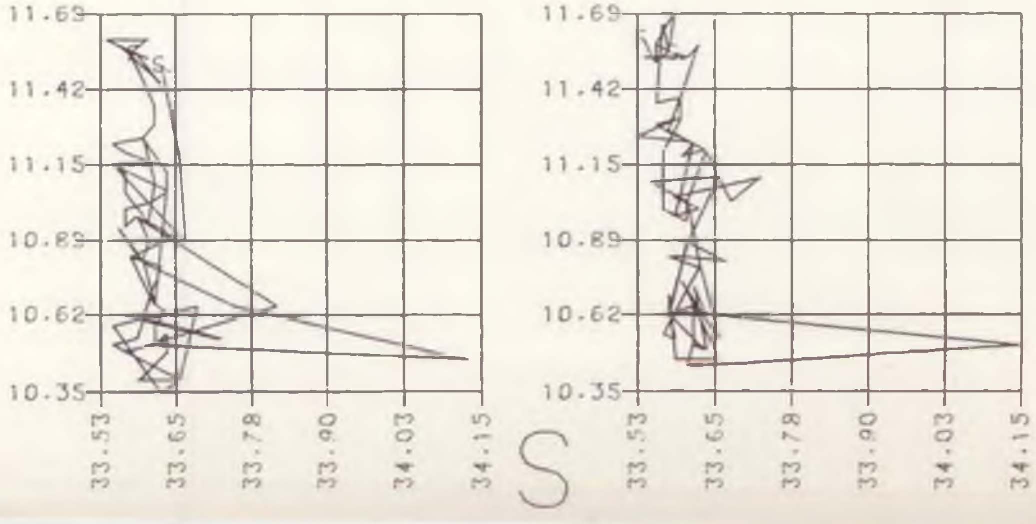
STATION NO. 12

STARTING TIME: 2220 ON 12/6/75

WIRE LENGTH = 13.5 METRES



ONE-TIDE T/S DIAGRAMS



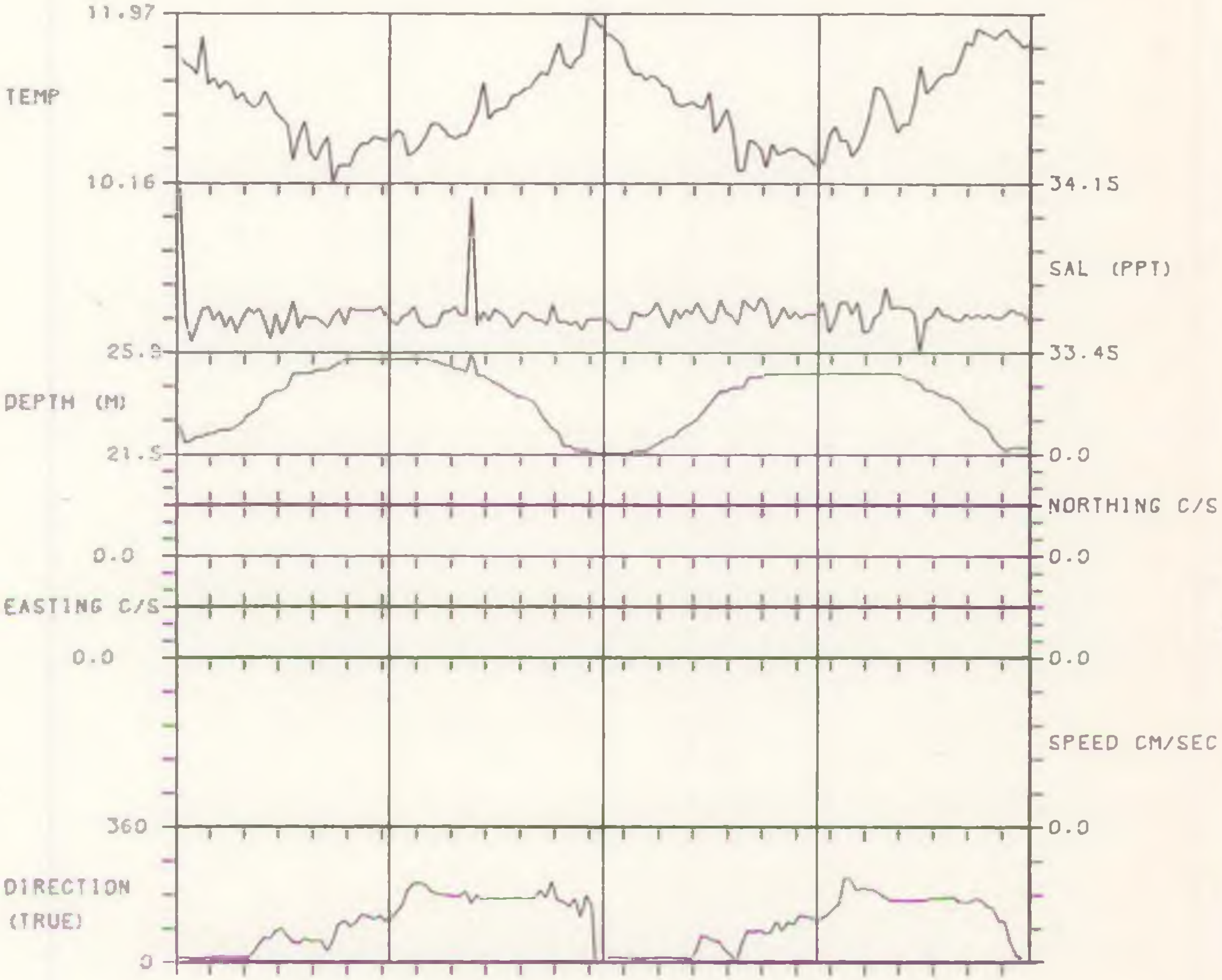
A 1.12.10

CURRENT METER DATA OVER TWO TIDES

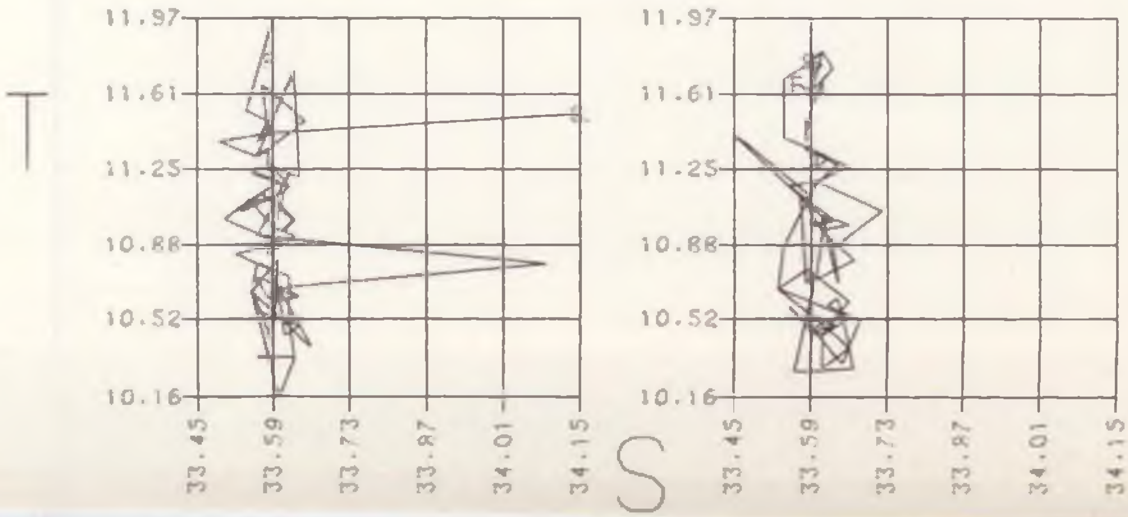
STATION NO. 12

STARTING TIME: 2310 ON 13/6/75

WIRE LENGTH = 13.5 METRES



ONE-TIDE T/S DIAGRAMS



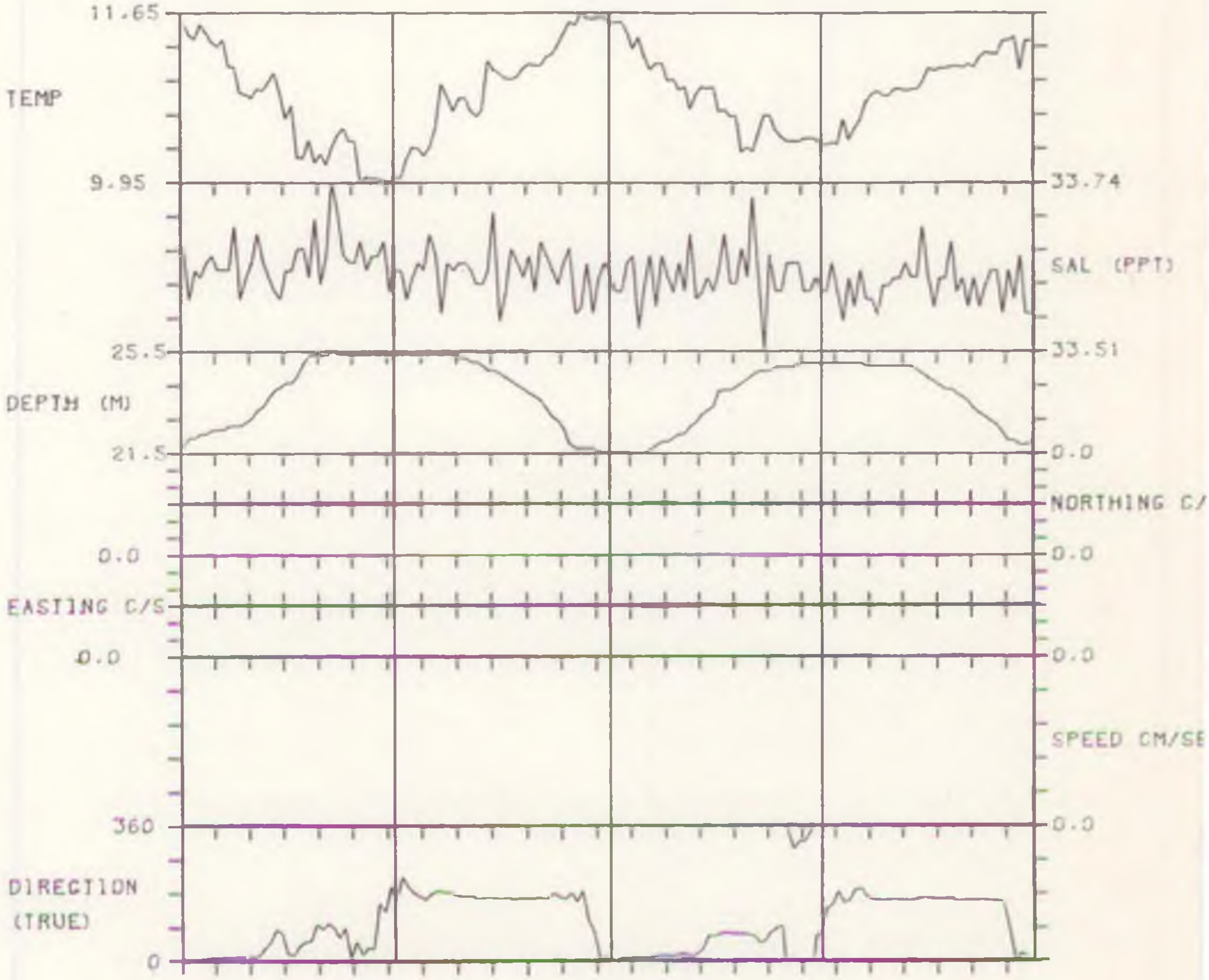
A 1.12.11

CURRENT METER DATA OVER TWO TIDES

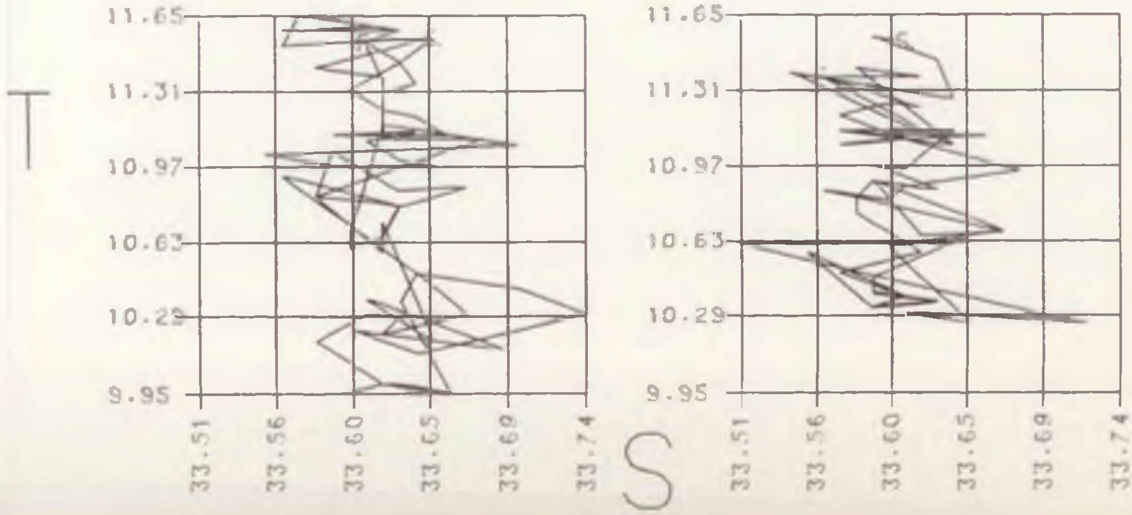
STATION NO. 12

STARTING TIME: 0000 ON 15/6/75

WIRE LENGTH = 13.5 METRES



ONE-TIDE T/S DIAGRAMS



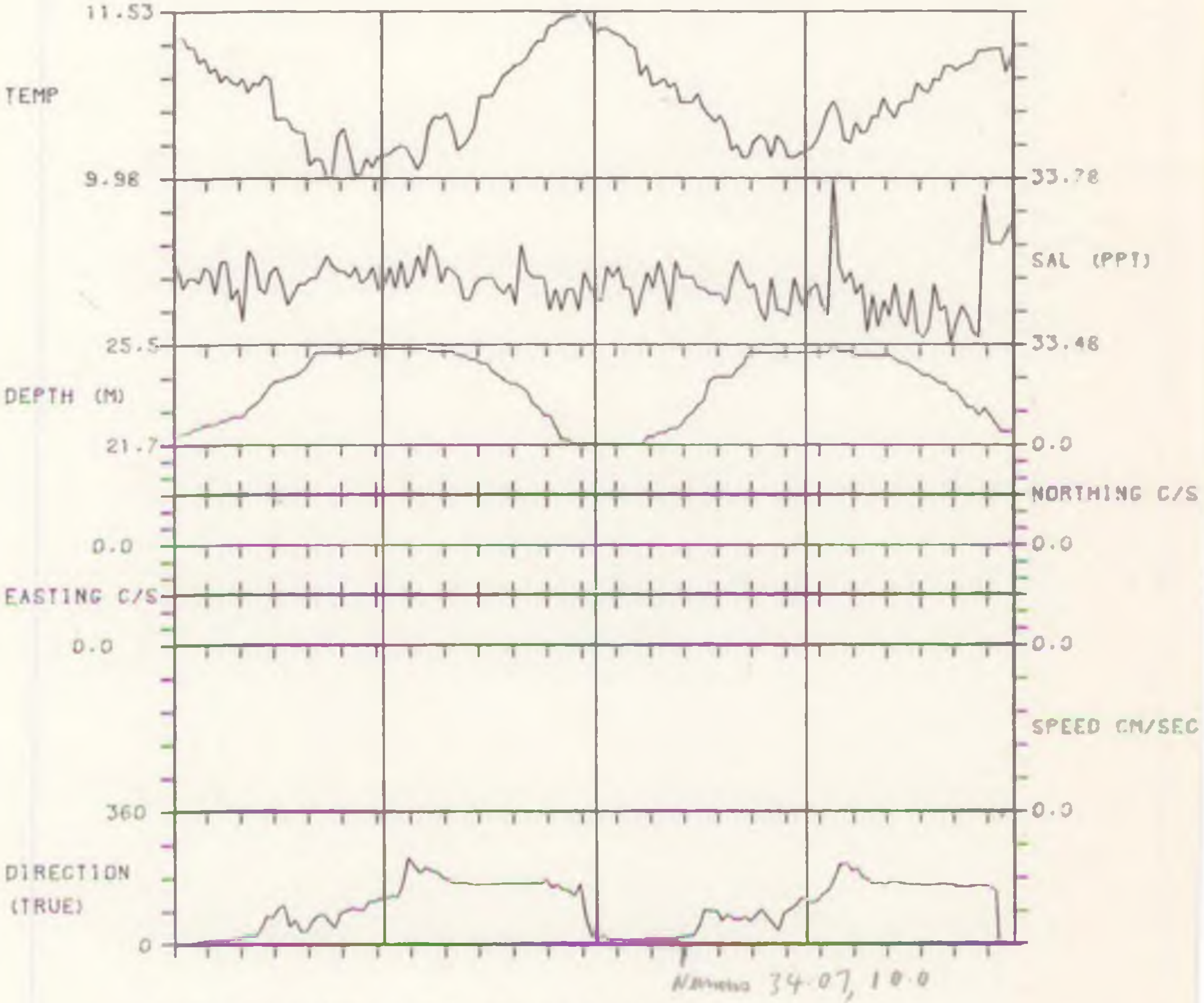
A 1.12.12

CURRENT METER DATA OVER TWO TIDES

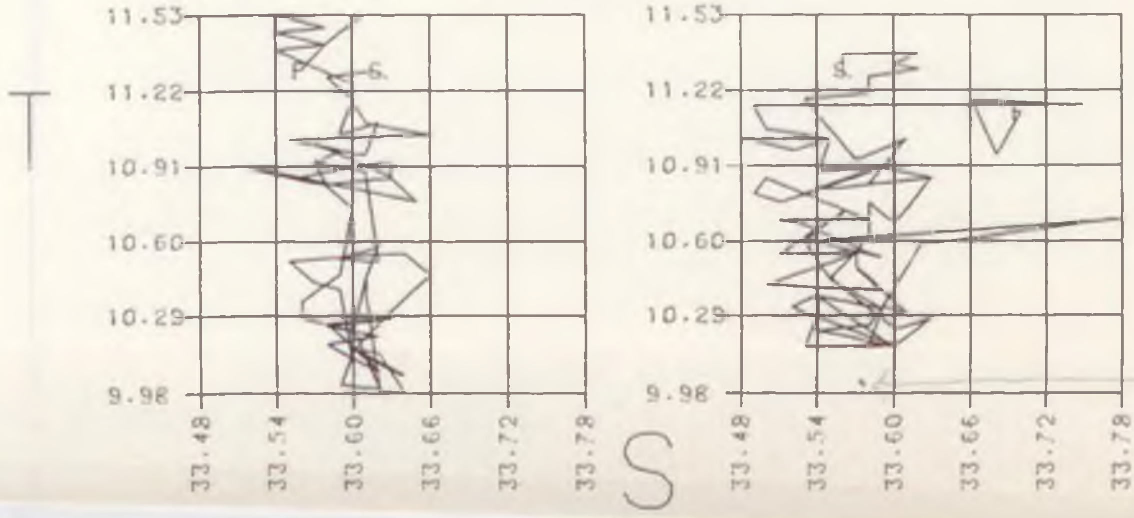
STATION NO. 12

STARTING TIME: 0050 ON 16/6/75

WIRE LENGTH = 13.5 METRES



ONE-TIDE T/S DIAGRAMS



Add
~5.49

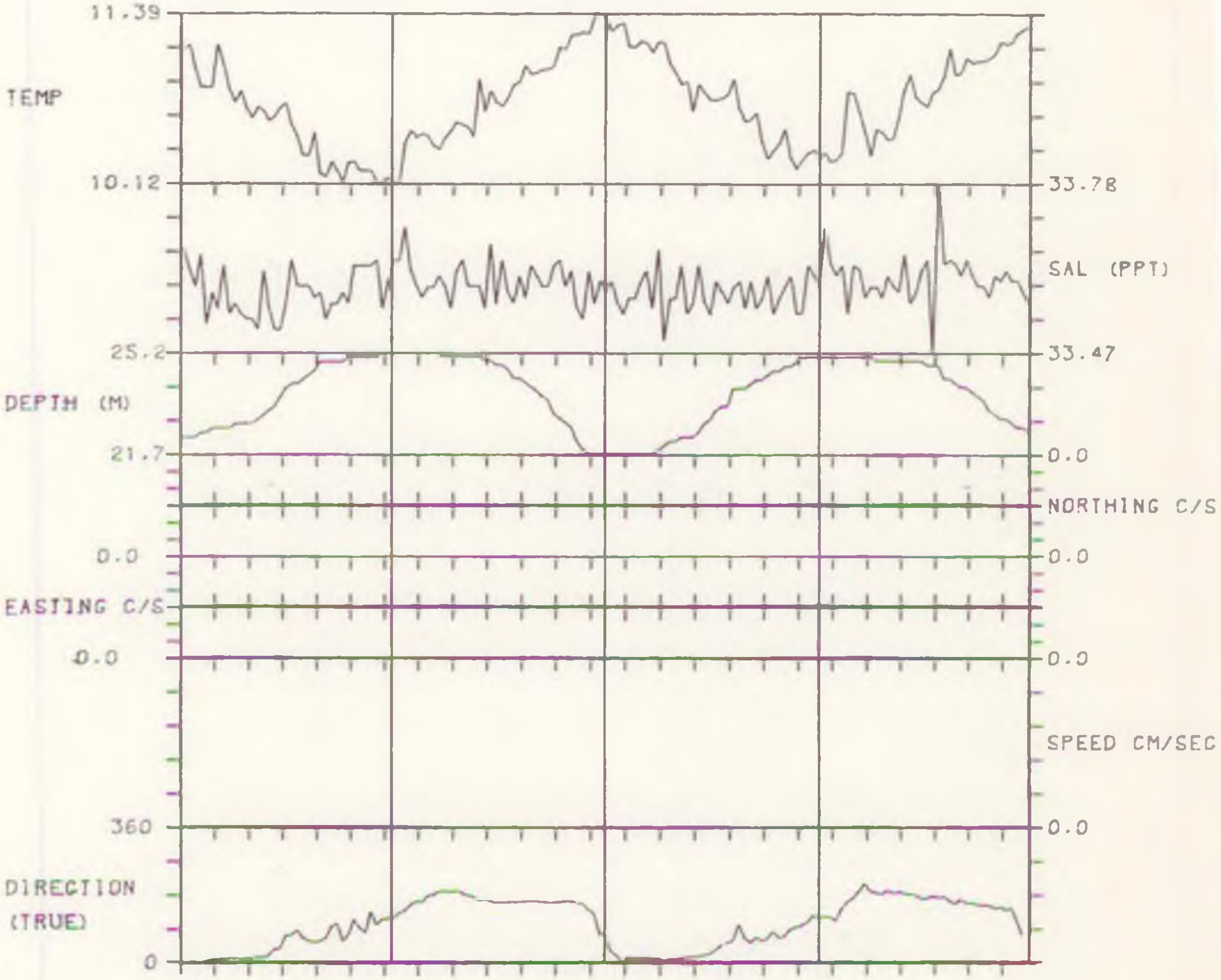
A 1.12.13

CURRENT METER DATA OVER TWO TIDES

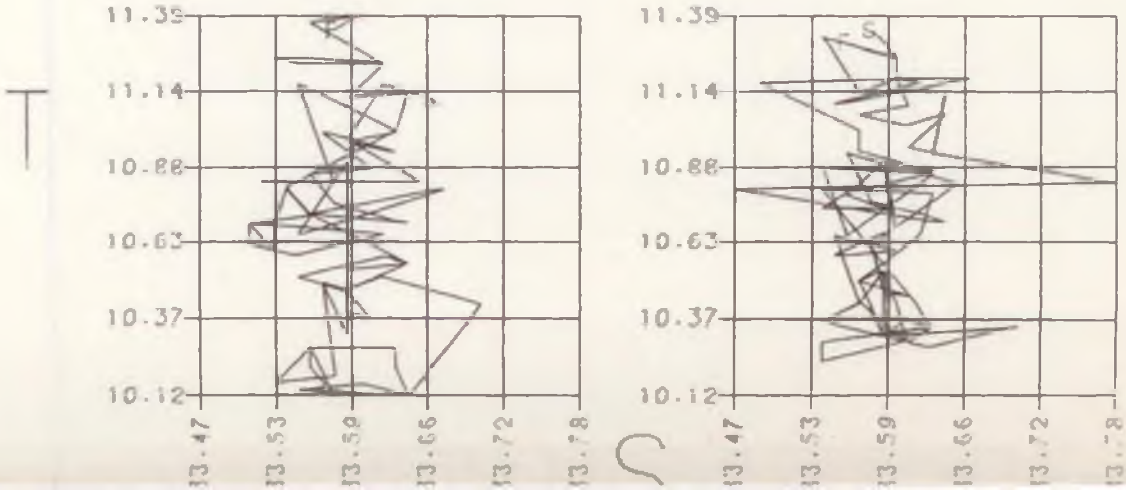
STATION NO. 12

STARTING TIME: 0140 ON 17/6/75

WIRE LENGTH = 13.5 METRES



ONE-TIDE T/S DIAGRAMS



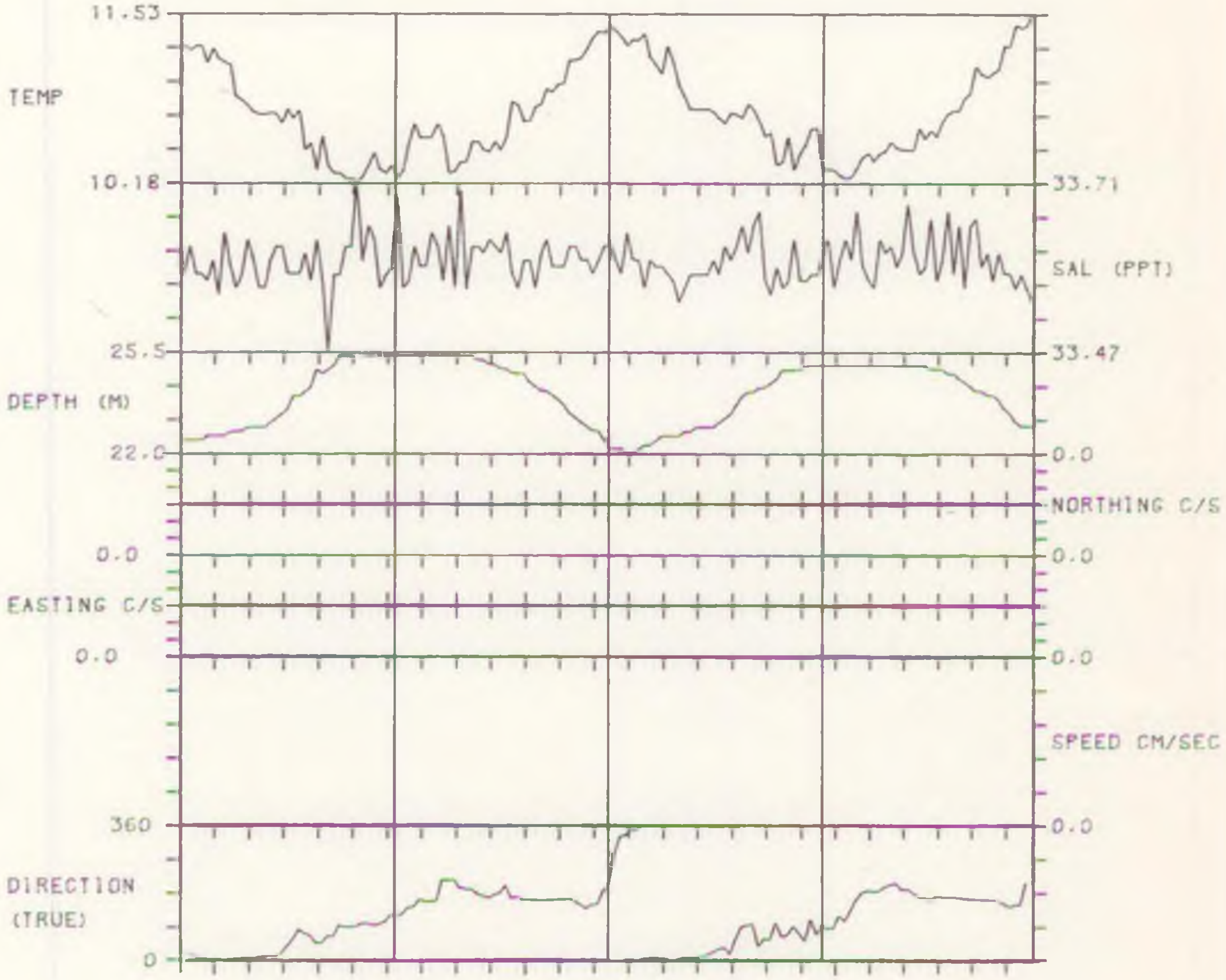
A1.12.14

CURRENT METER DATA OVER TWO TIDES

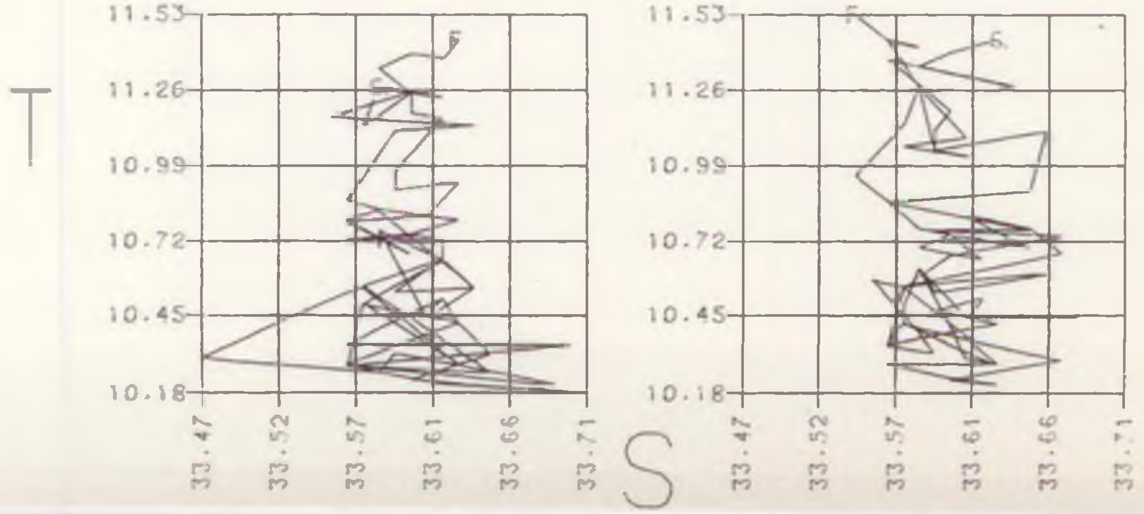
STATION NO. 12

STARTING TIME: 0230 ON 18/6/75

WIRE LENGTH = 13.5 METRES



ONE-TIDE T/S DIAGRAMS



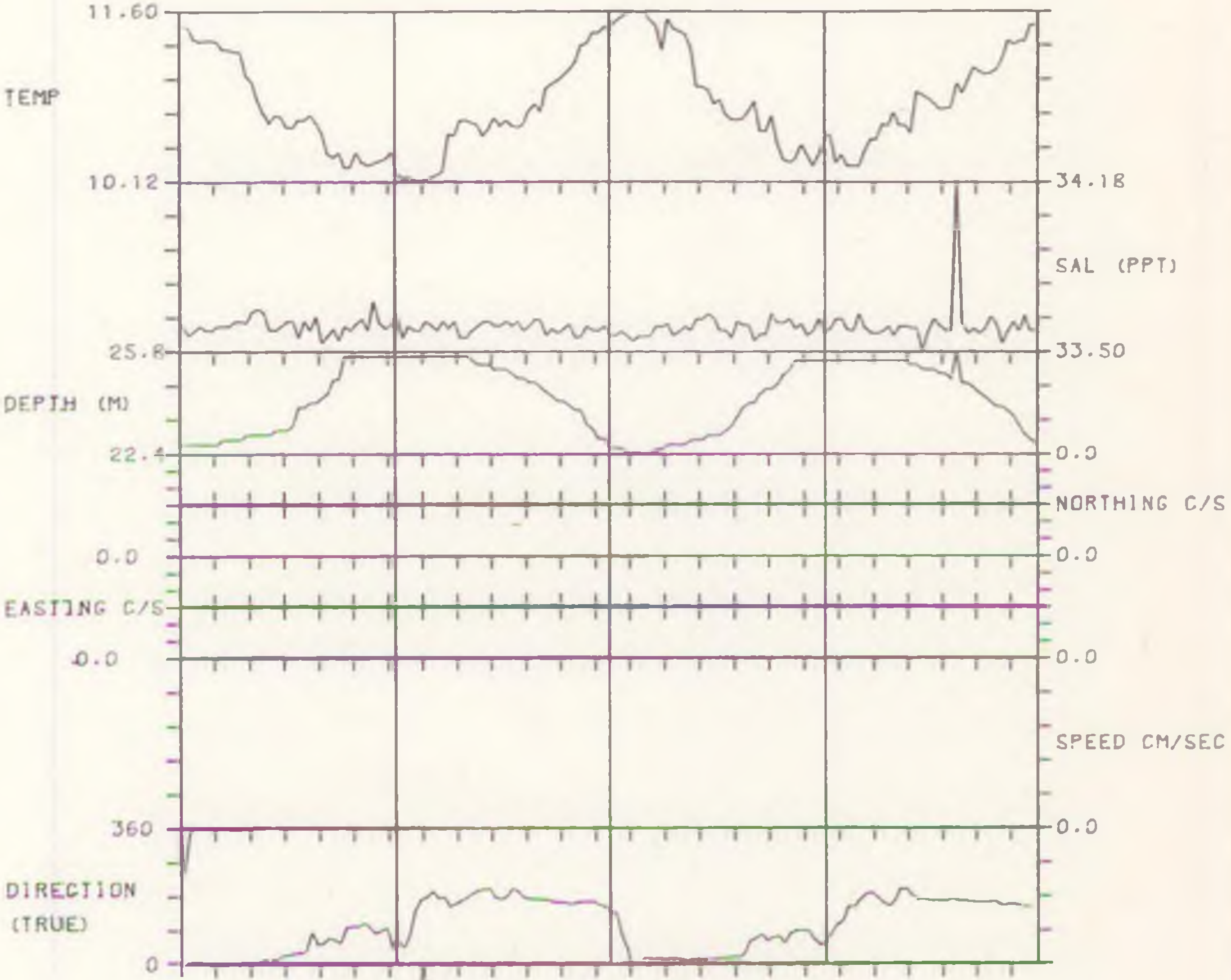
A 1.12.15

CURRENT METER DATA OVER TWO TIDES

STATION NO. 12

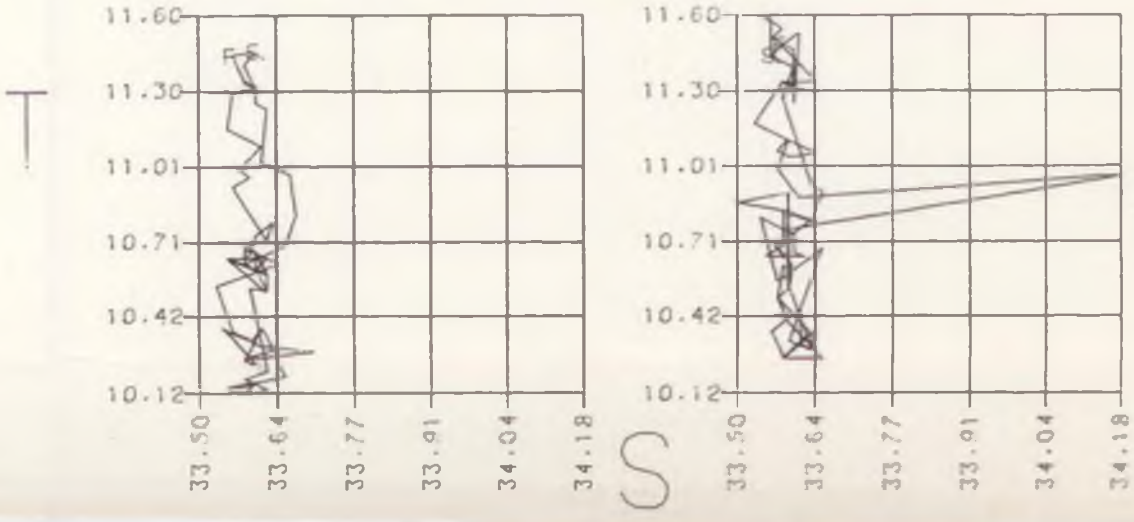
STARTING TIME: 0320 ON 19/6/75

WIRE LENGTH = 13.5 METRES



Nansen 34.12, 10.2

ONE-TIDE T/S DIAGRAMS



Add
~ S.51

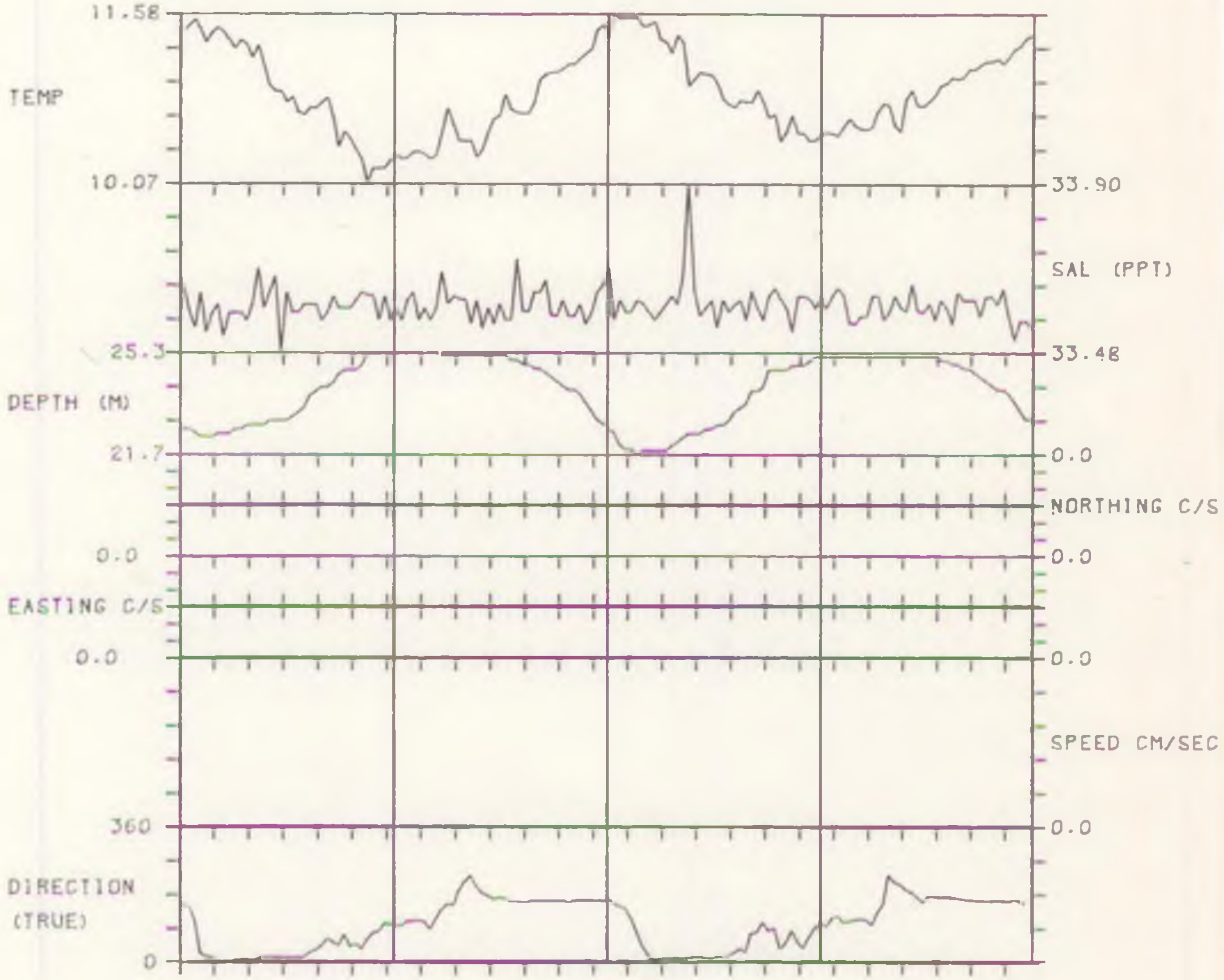
A 1.12.16

CURRENT METER DATA OVER TWO TIDES

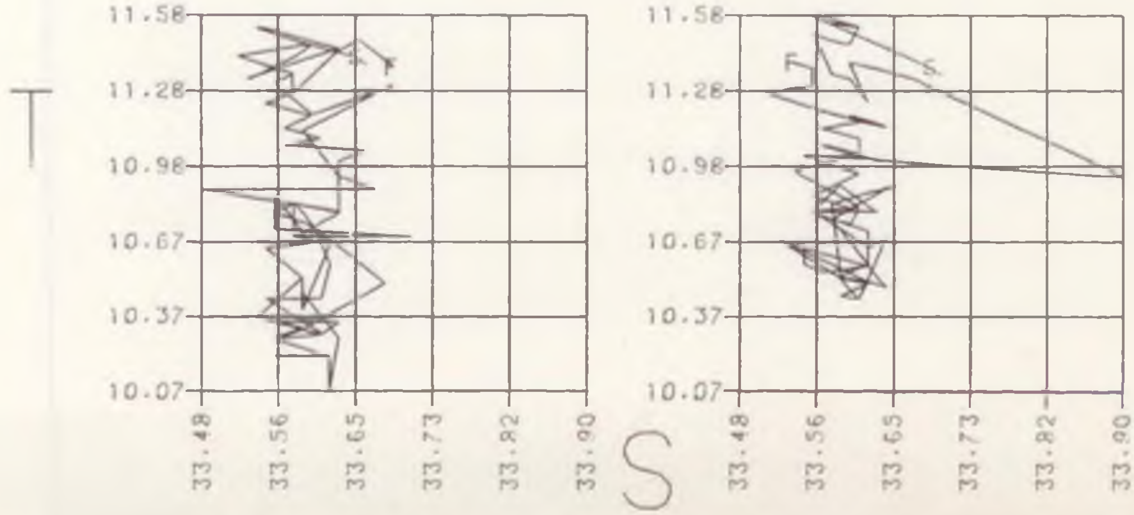
STATION NO. 12

STARTING TIME: 0410 ON 20/6/75

WIRE LENGTH = 13.5 METRES



ONE-TIDE T/S DIAGRAMS



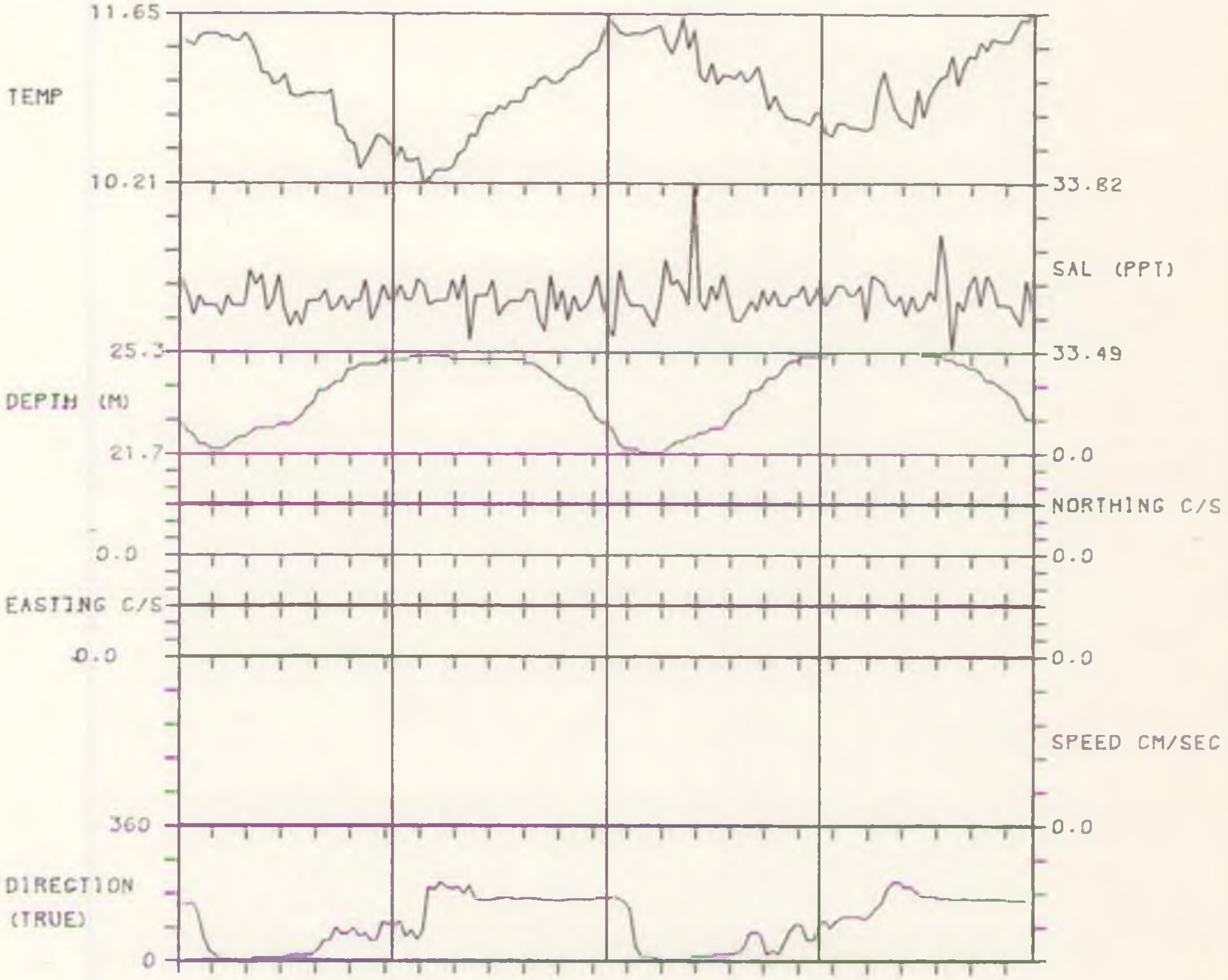
A1.12.17

CURRENT METER DATA OVER TWO TIDES

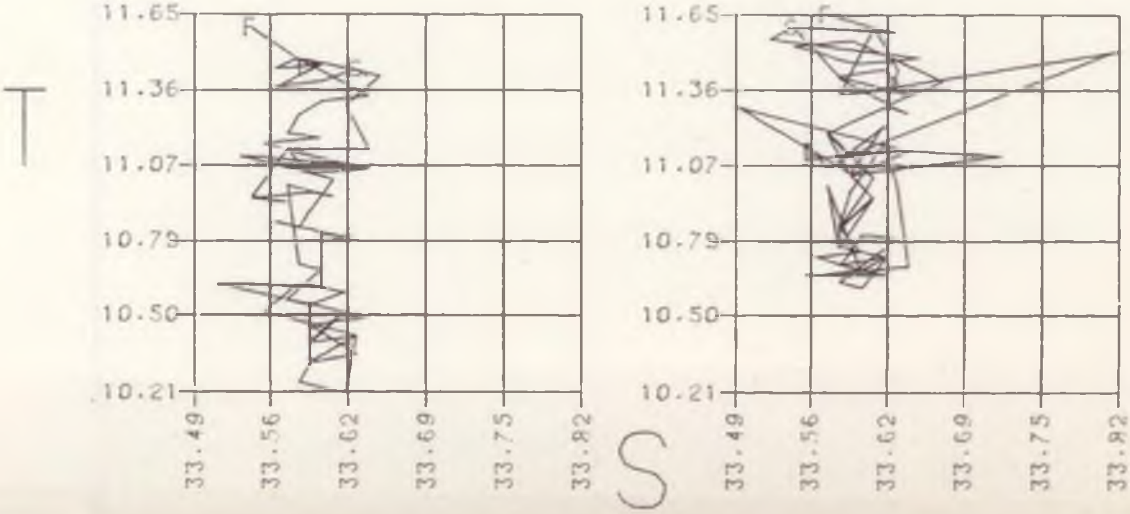
STATION NO. 12

STARTING TIME: 0500 ON 21/6/75

WIRE LENGTH = 13.5 METRES



ONE-TIDE T/S DIAGRAMS



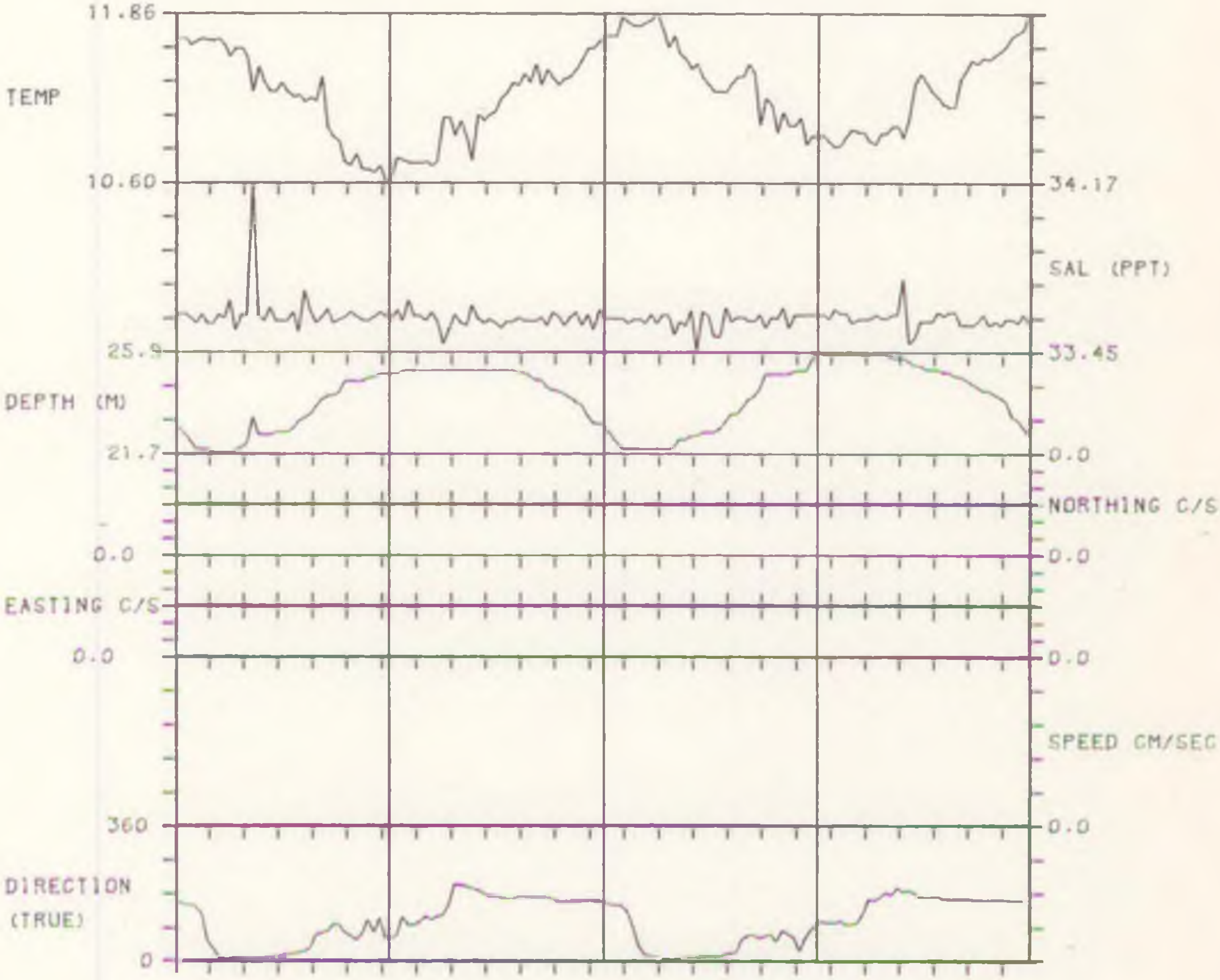
A 1.12.18

CURRENT METER DATA OVER TWO TIDES

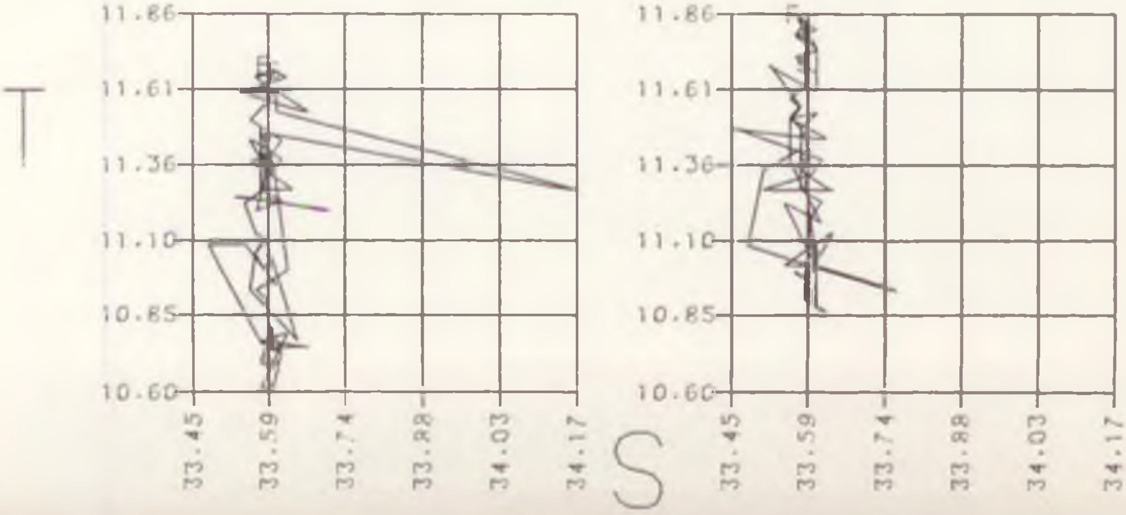
STATION NO. 12

STARTING TIME: 0550 ON 22/6/75

WIRE LENGTH = 13.5 METRES



ONE-TIDE T/S DIAGRAMS



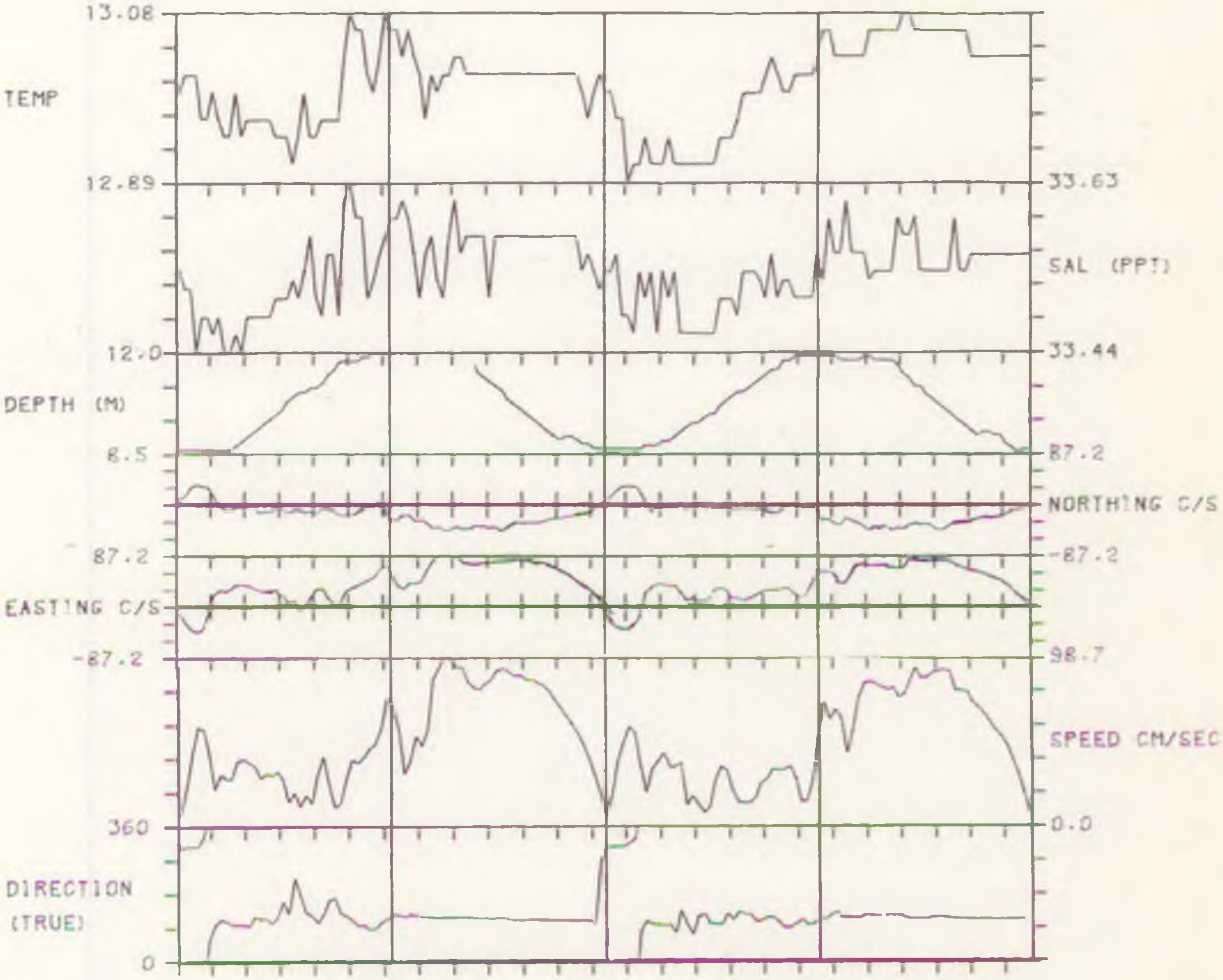
A1.13.1

CURRENT METER DATA OVER TWO TIDES

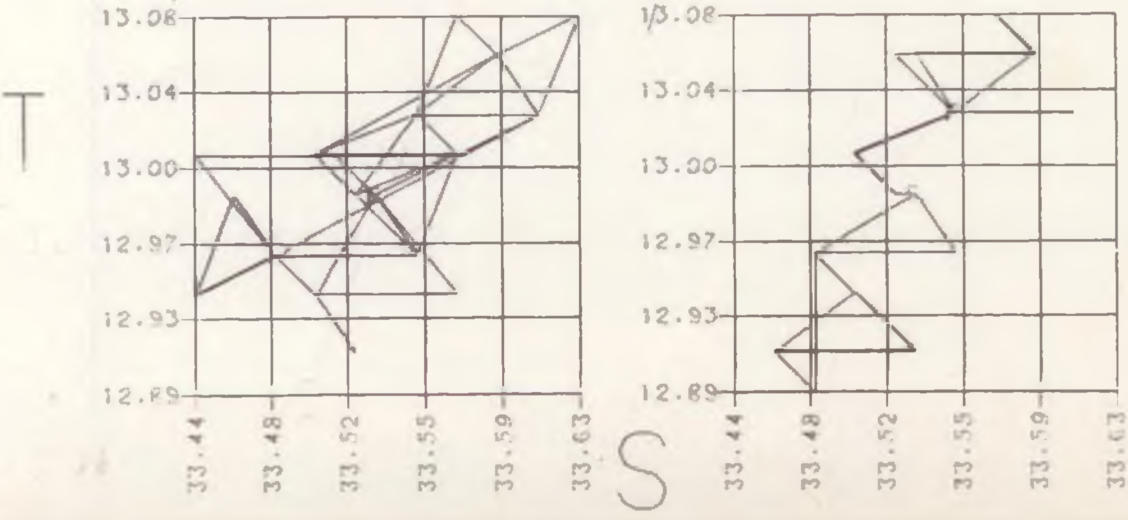
STATION NO. 13

STARTING TIME: 2039 ON 7/10/75

WIRE LENGTH = 2.0 METRES



ONE-TIDE T/S DIAGRAMS



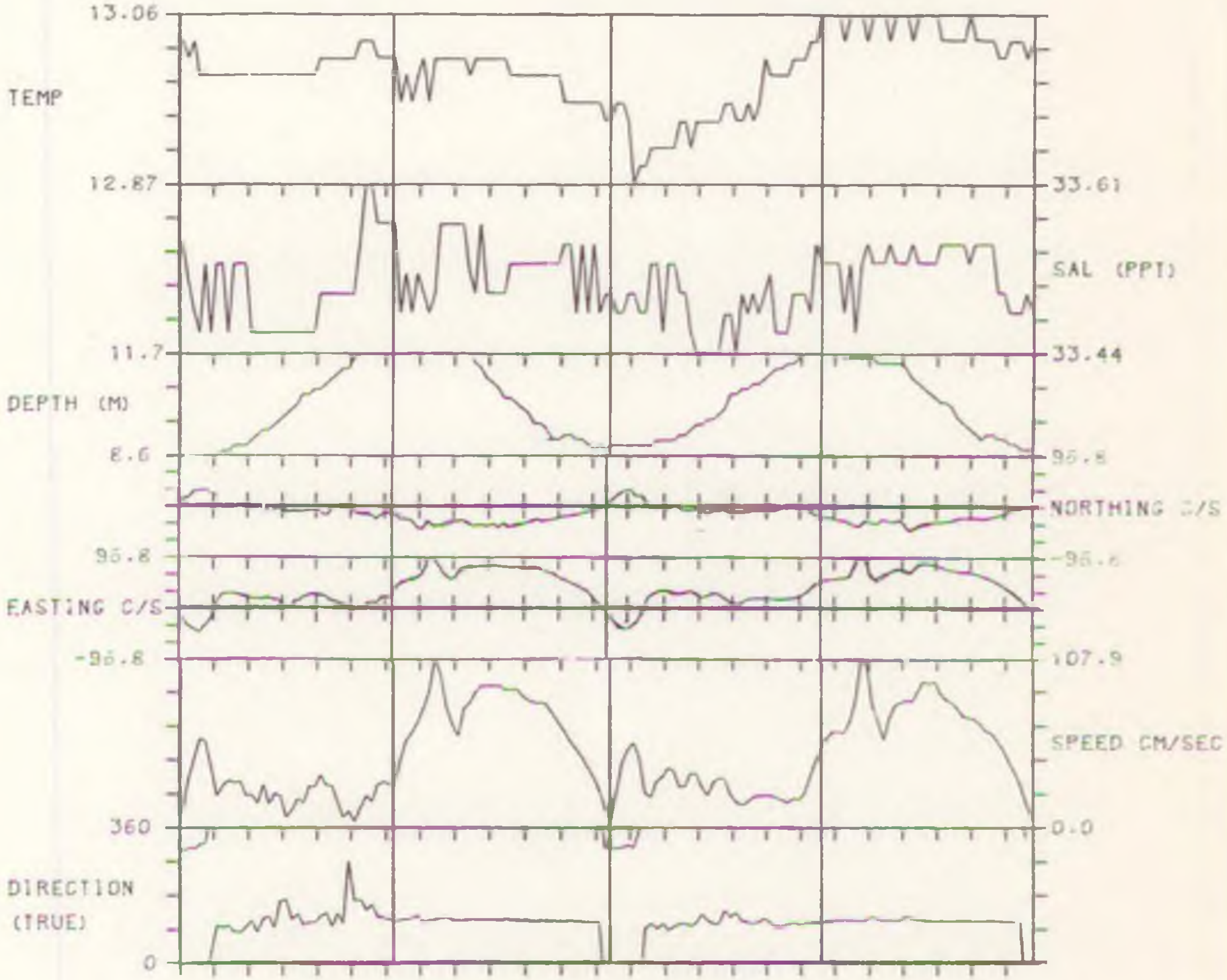
A 1.13.2

CURRENT METER DATA OVER TWO TIDES

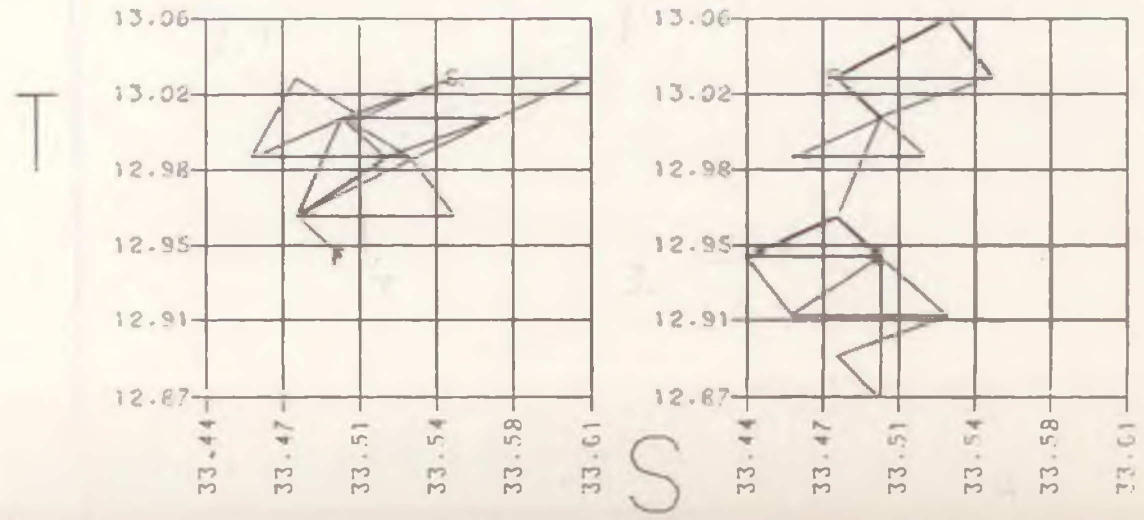
STATION NO. 13

STARTING TIME: 2129 ON 8/10/75

WIRE LENGTH = 2.0 METRES



ONE-TIDE T/S DIAGRAMS



A 1.13.3

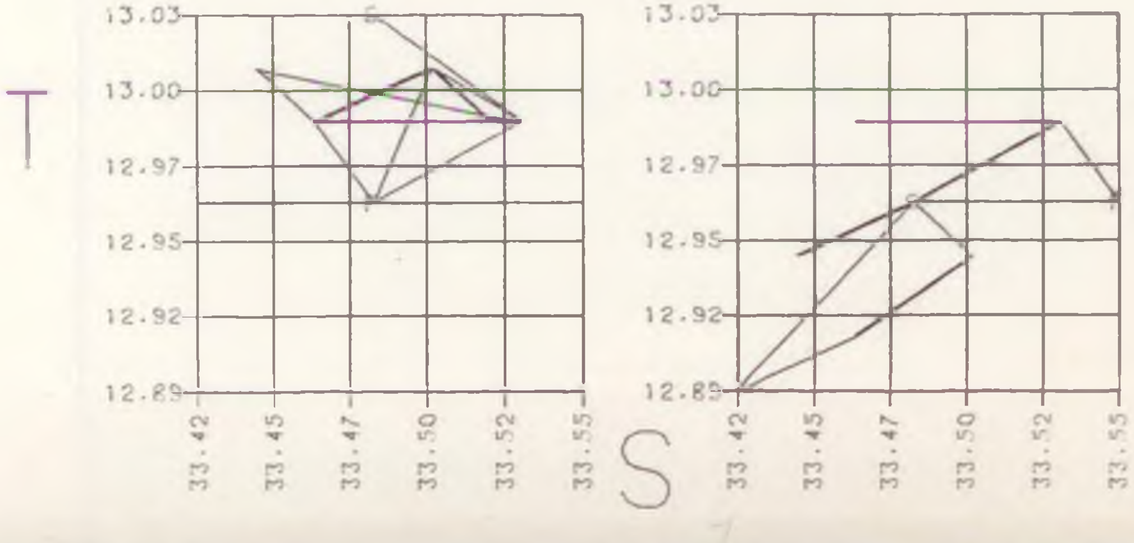
CURRENT METER DATA OVER TWO TIDES

STATION NO. 13

STARTING TIME: 2219 ON 9/10/75

WIRE LENGTH = 2.0 METRES

ONE-TIDE T/S DIAGRAMS



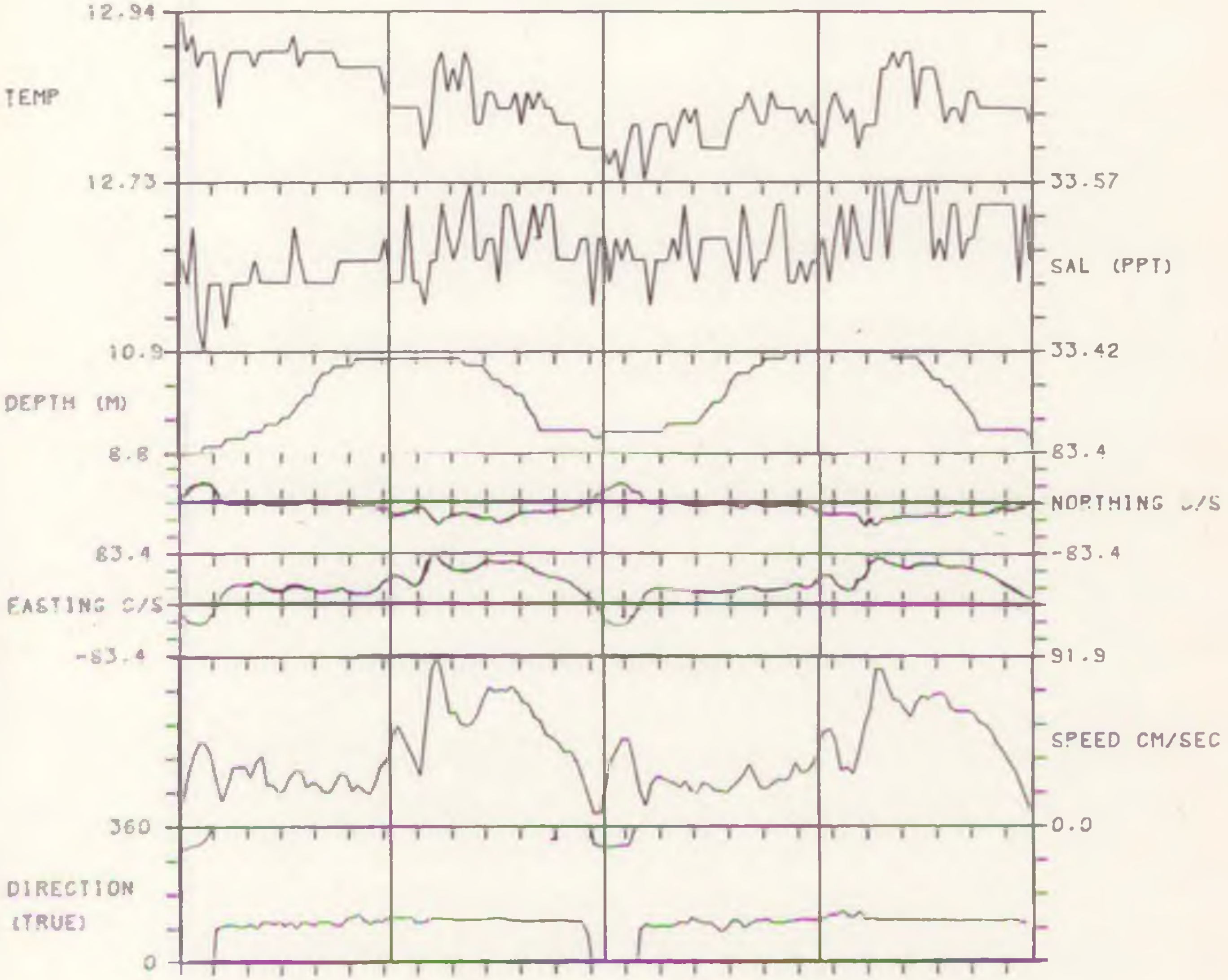
A.1.13.4

CURRENT METER DATA OVER TWO TIDES

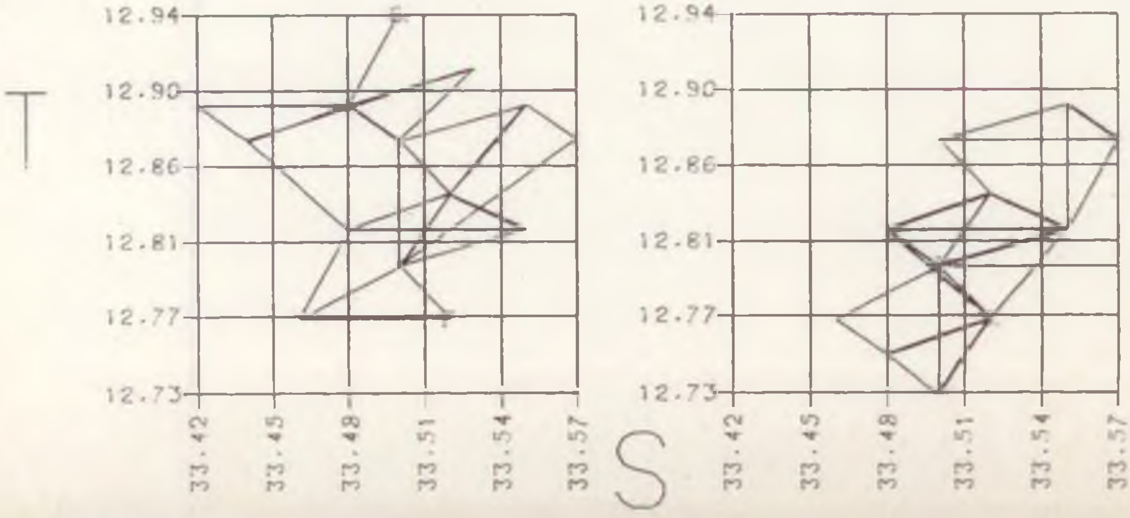
STATION NO. 13

STARTING TIME: 2309 ON 10/10/75

WIRE LENGTH = 2.0 METRES



ONE-TIDE T/S DIAGRAMS



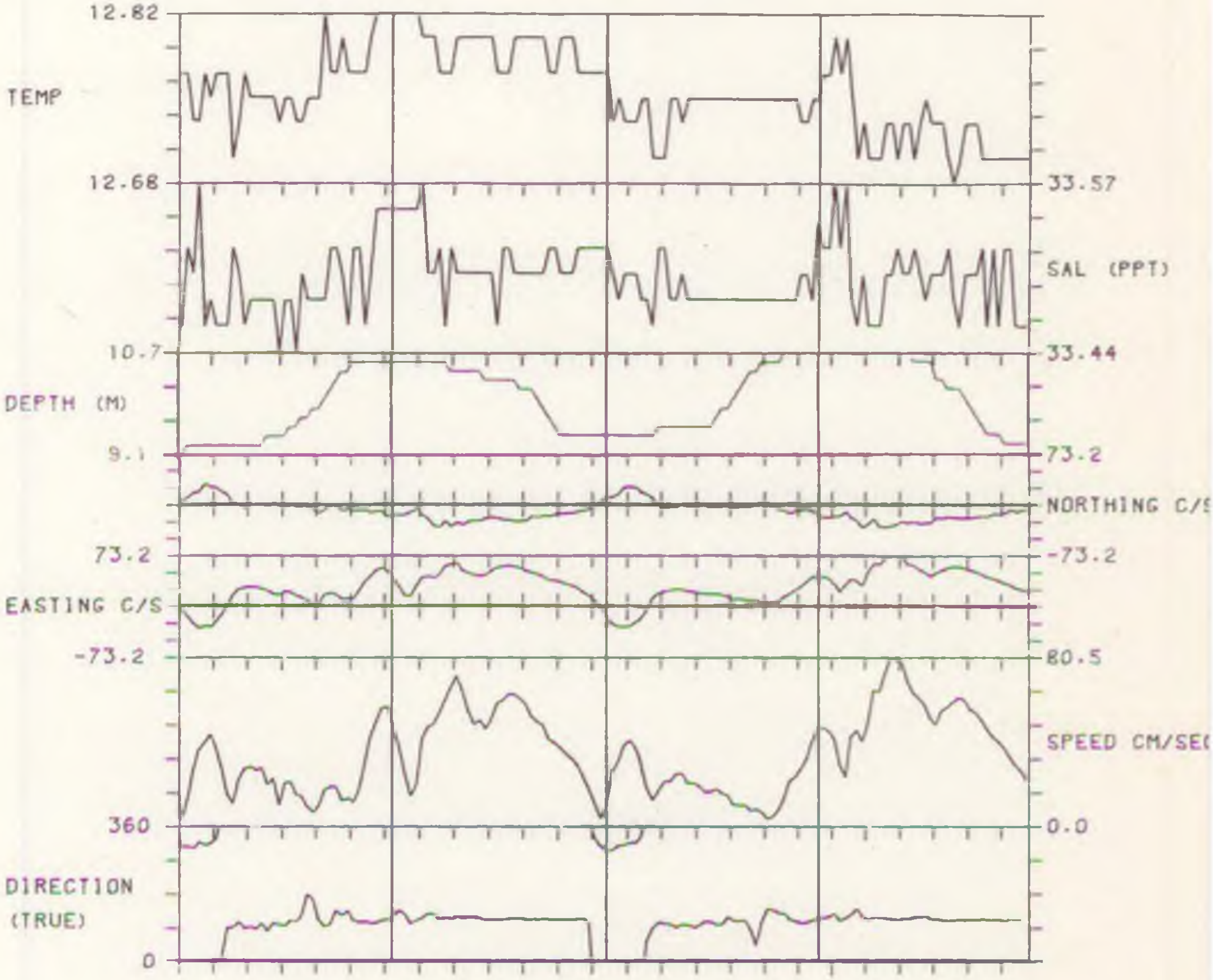
A.1.13.5

CURRENT METER DATA OVER TWO TIDES

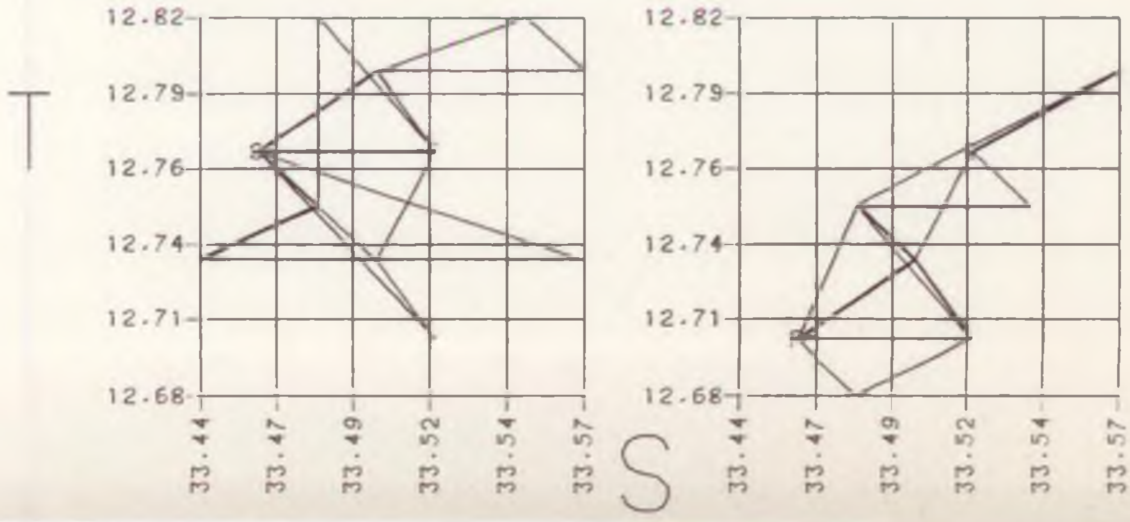
STATION NO. 13

STARTING TIME: 2359 ON 11/10/75

WIRE LENGTH = 2.0 METRES



ONE-TIDE T/S DIAGRAMS



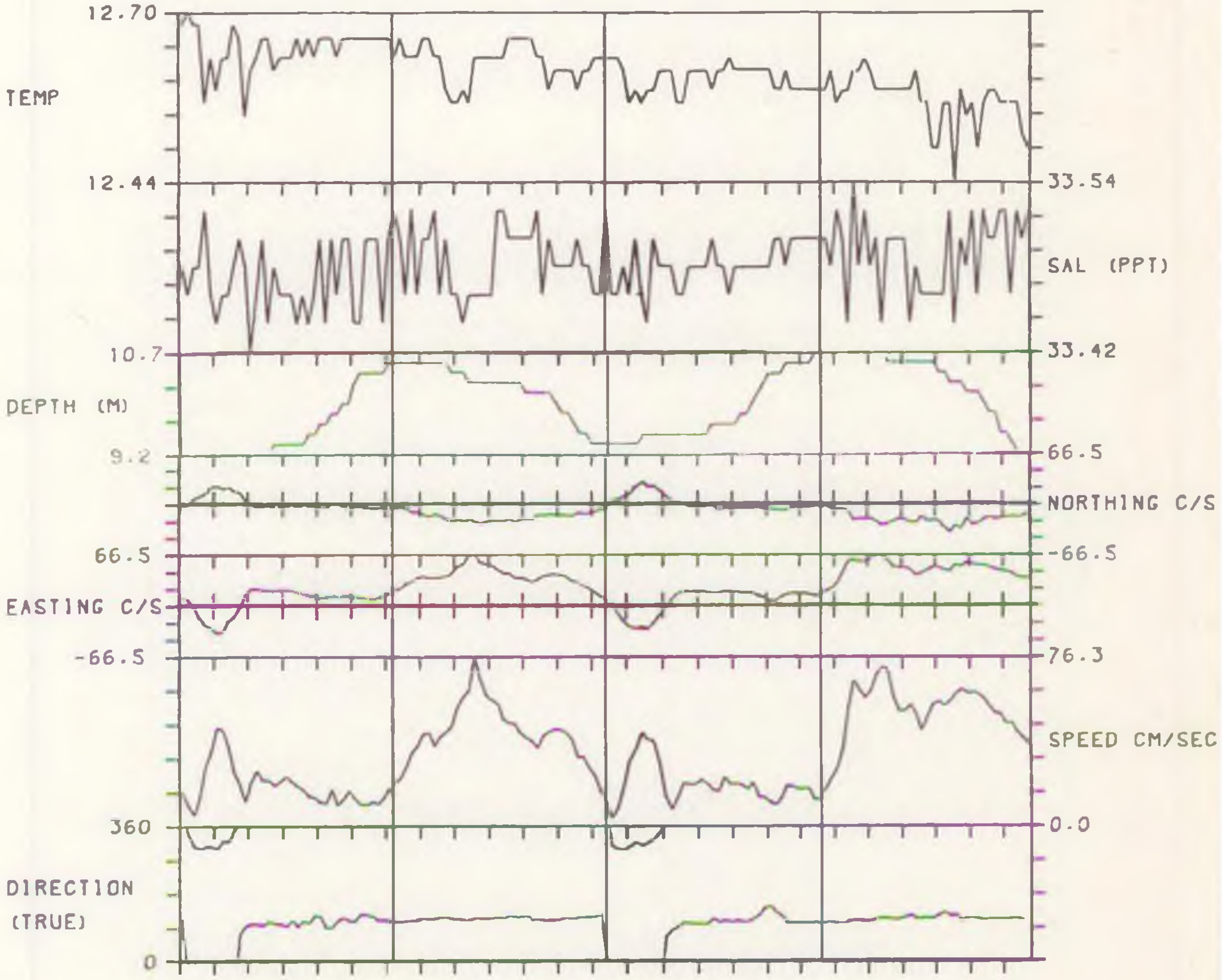
A.1.13.6

CURRENT METER DATA OVER TWO TIDES

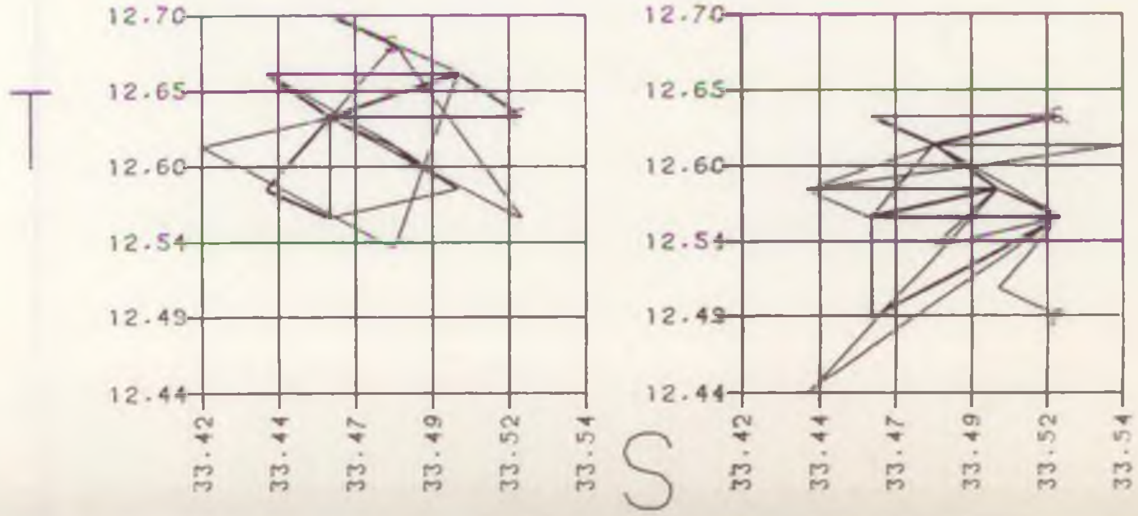
STATION NO. 13

STARTING TIME: 0049 ON 13/10/75

WIRE LENGTH = 2.0 METRES



ONE-TIDE T/S DIAGRAMS



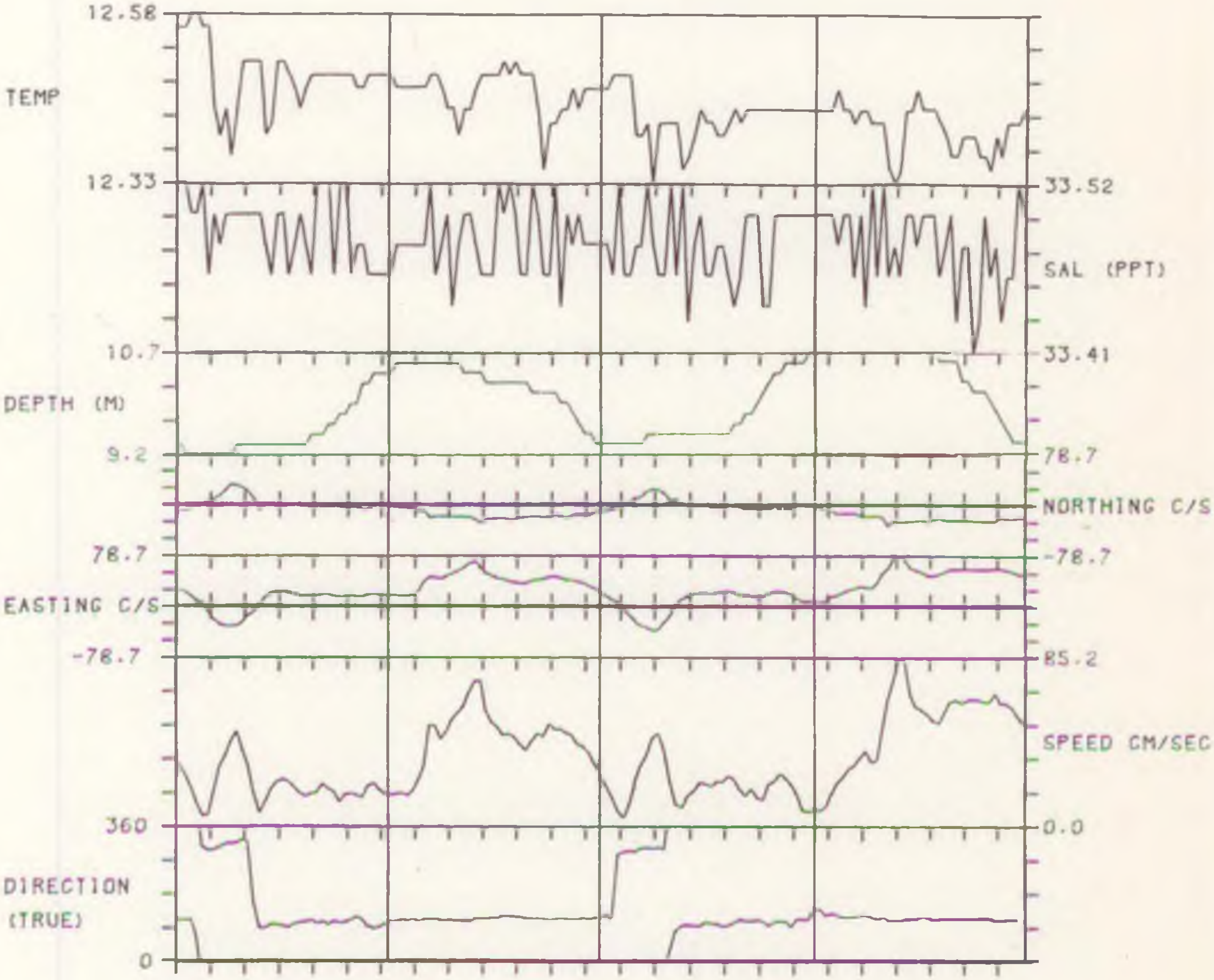
A.1.13.7

CURRENT METER DATA OVER TWO TIDES

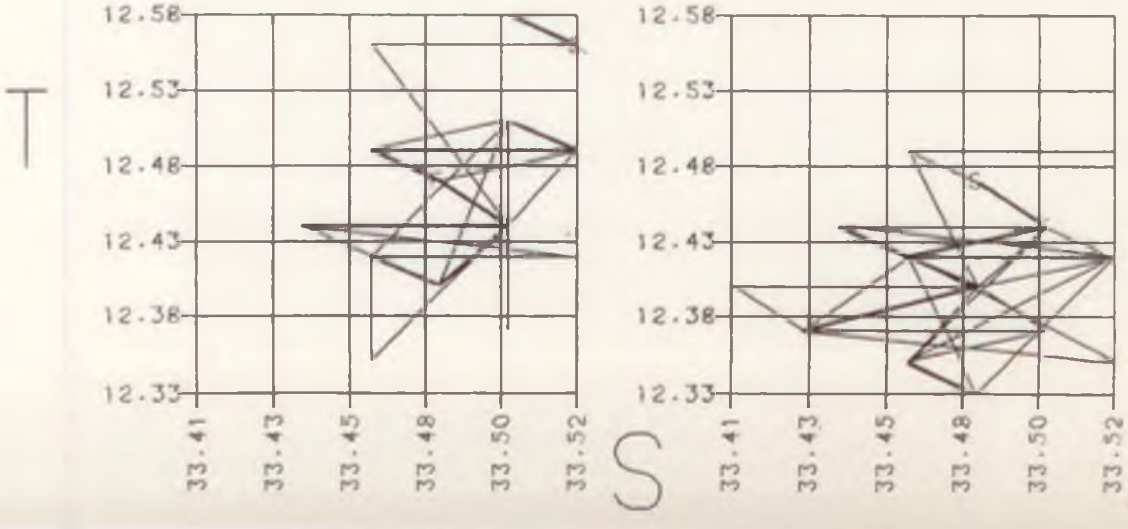
STATION NO. 13

STARTING TIME: 0139 ON 14/10/75

WIRE LENGTH = 2.0 METRES



ONE-TIDE T/S DIAGRAMS



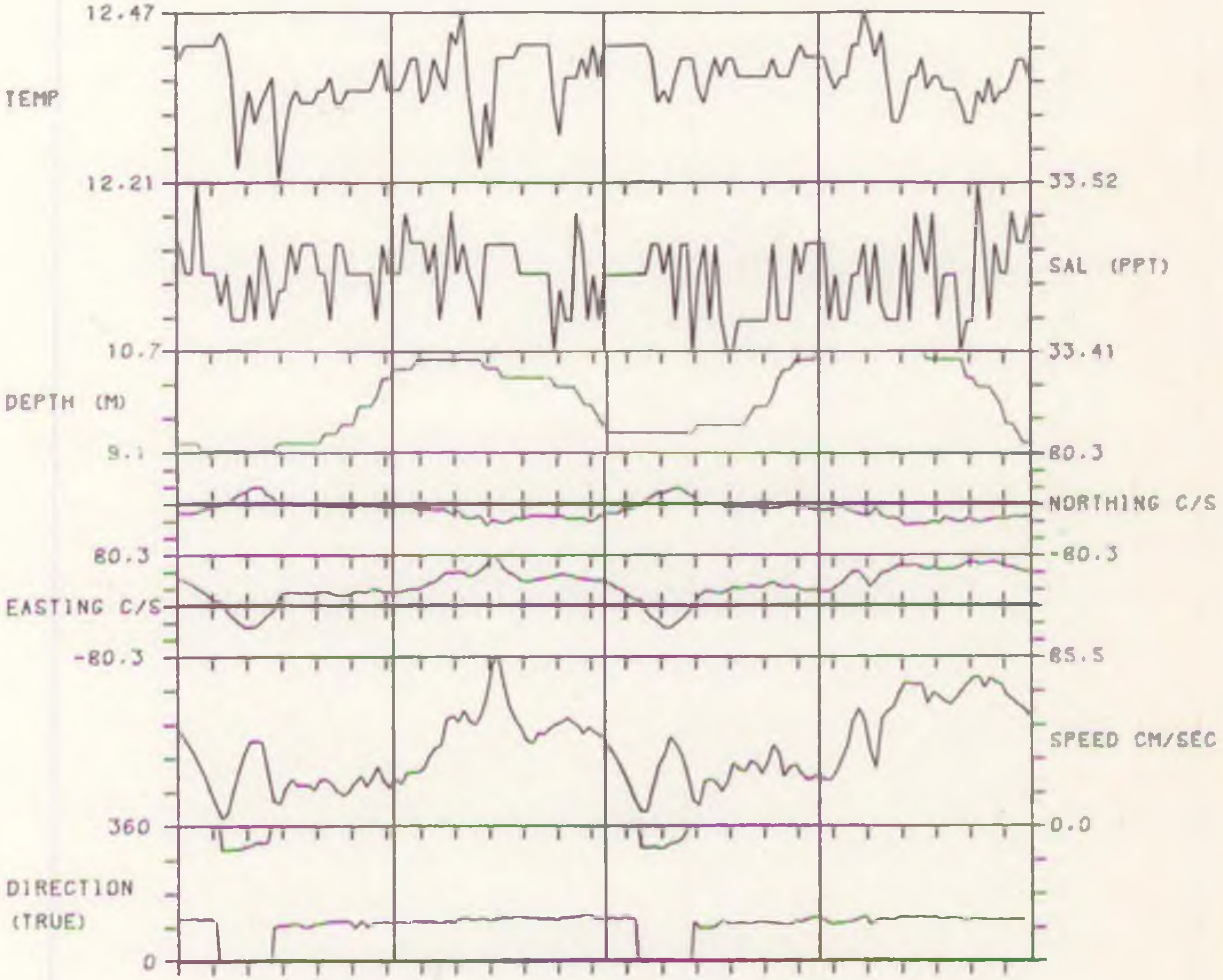
A.1.13.8

CURRENT METER DATA OVER TWO TIDES

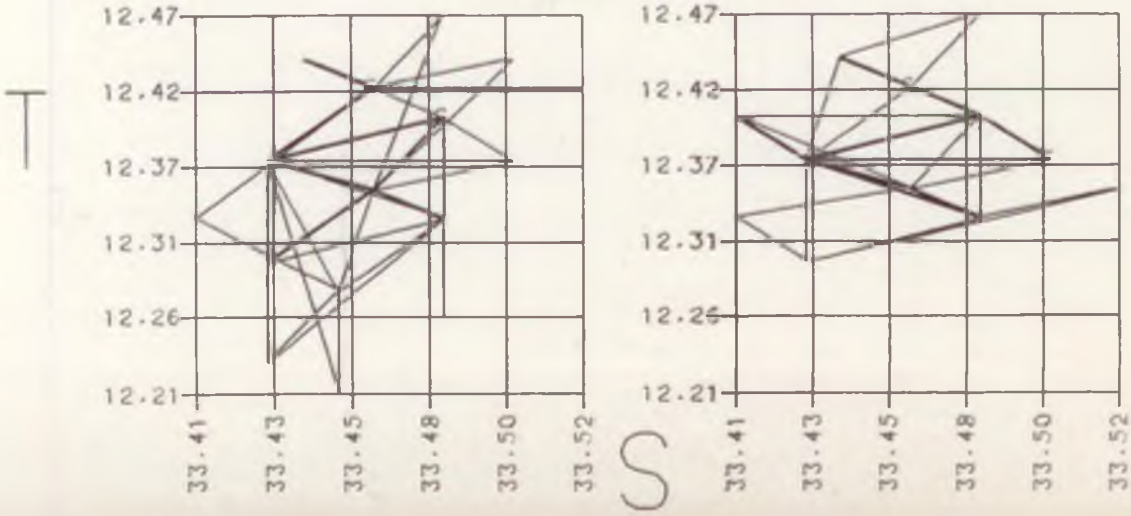
STATION NO. 13

STARTING TIME: 0229 ON 15/10/75

WIRE LENGTH = 2.0 METRES



ONE-TIDE T/S DIAGRAMS



Add
S~.33

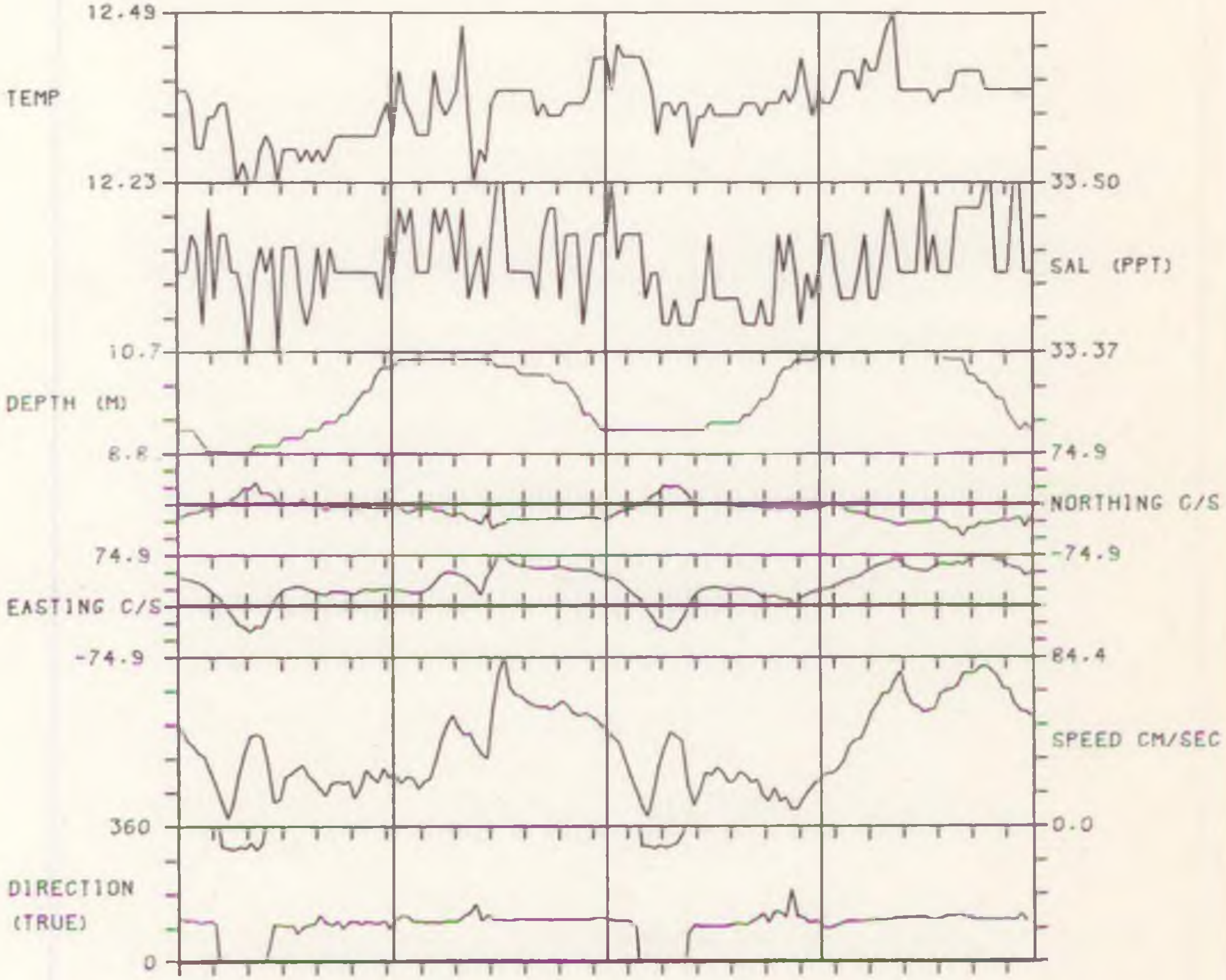
A 1.13.9

CURRENT METER DATA OVER TWO TIDES

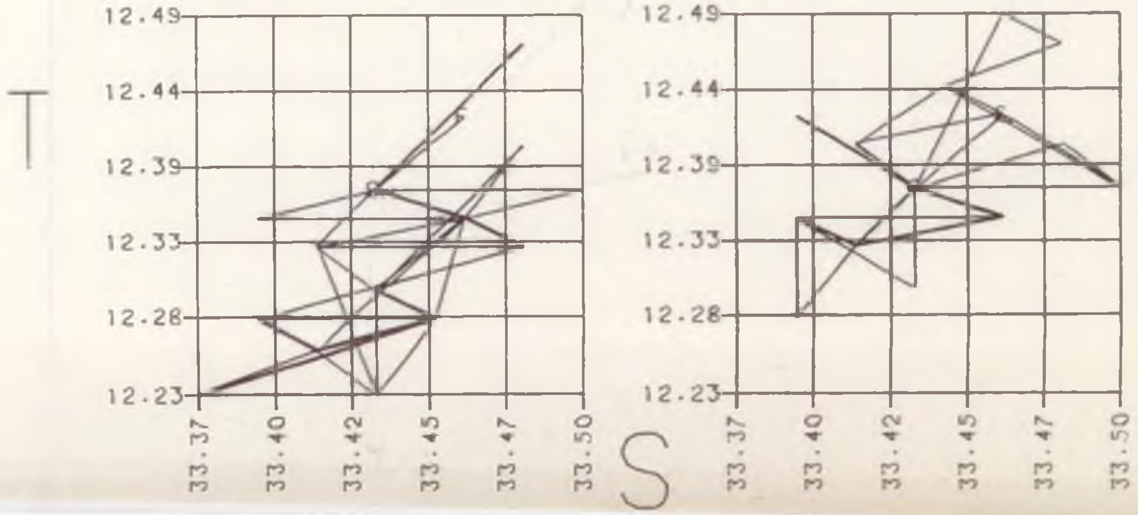
STATION NO. 13

STARTING TIME: 0319 ON 16/10/75

WIRE LENGTH = 2.0 METRES



ONE-TIDE T/S DIAGRAMS



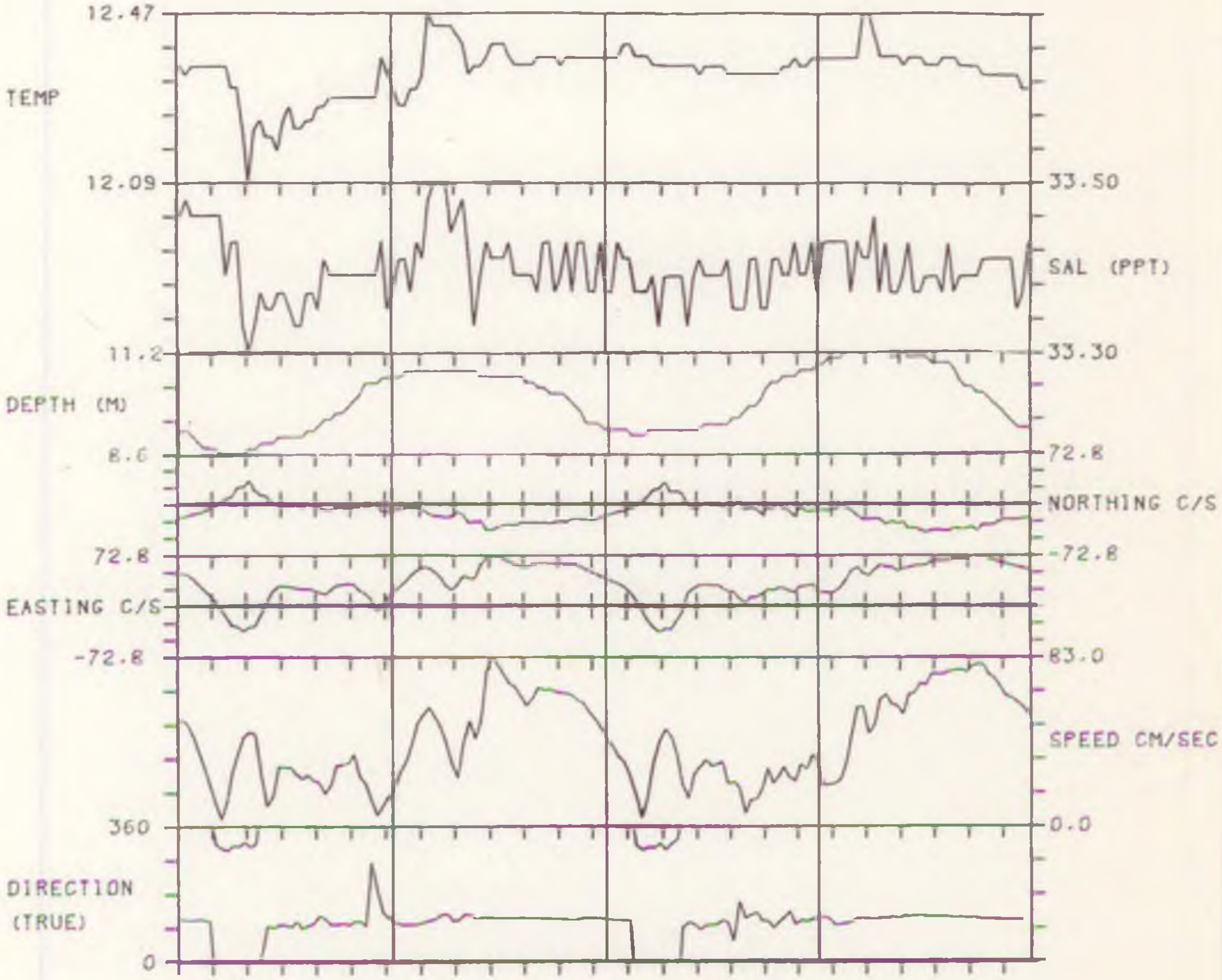
A 1.13.10

CURRENT METER DATA OVER TWO TIDES

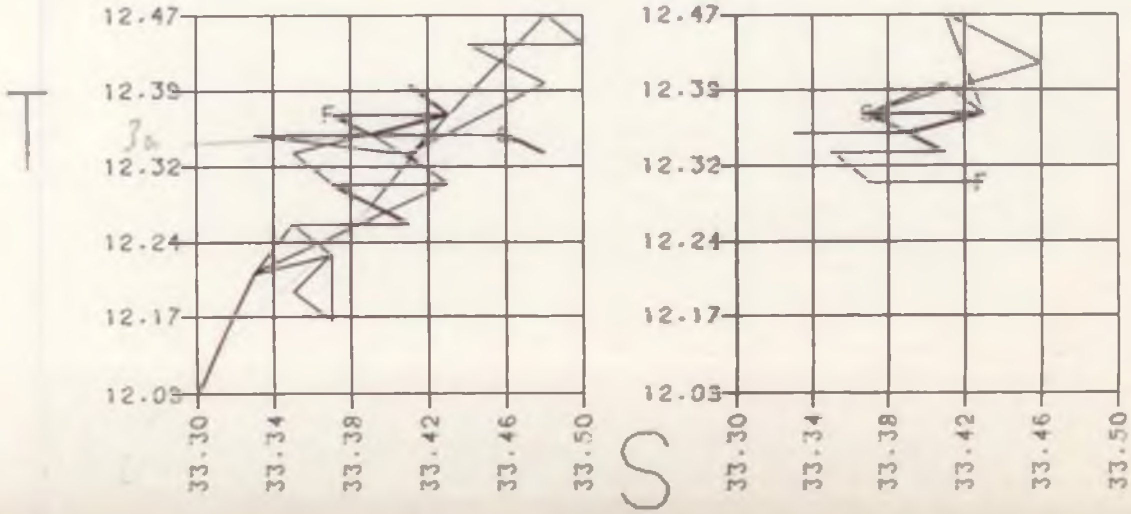
STATION NO. 13

STARTING TIME: 0409 ON 17/10/75

WIRE LENGTH = 2.0 METRES



ONE-TIDE T/S DIAGRAMS



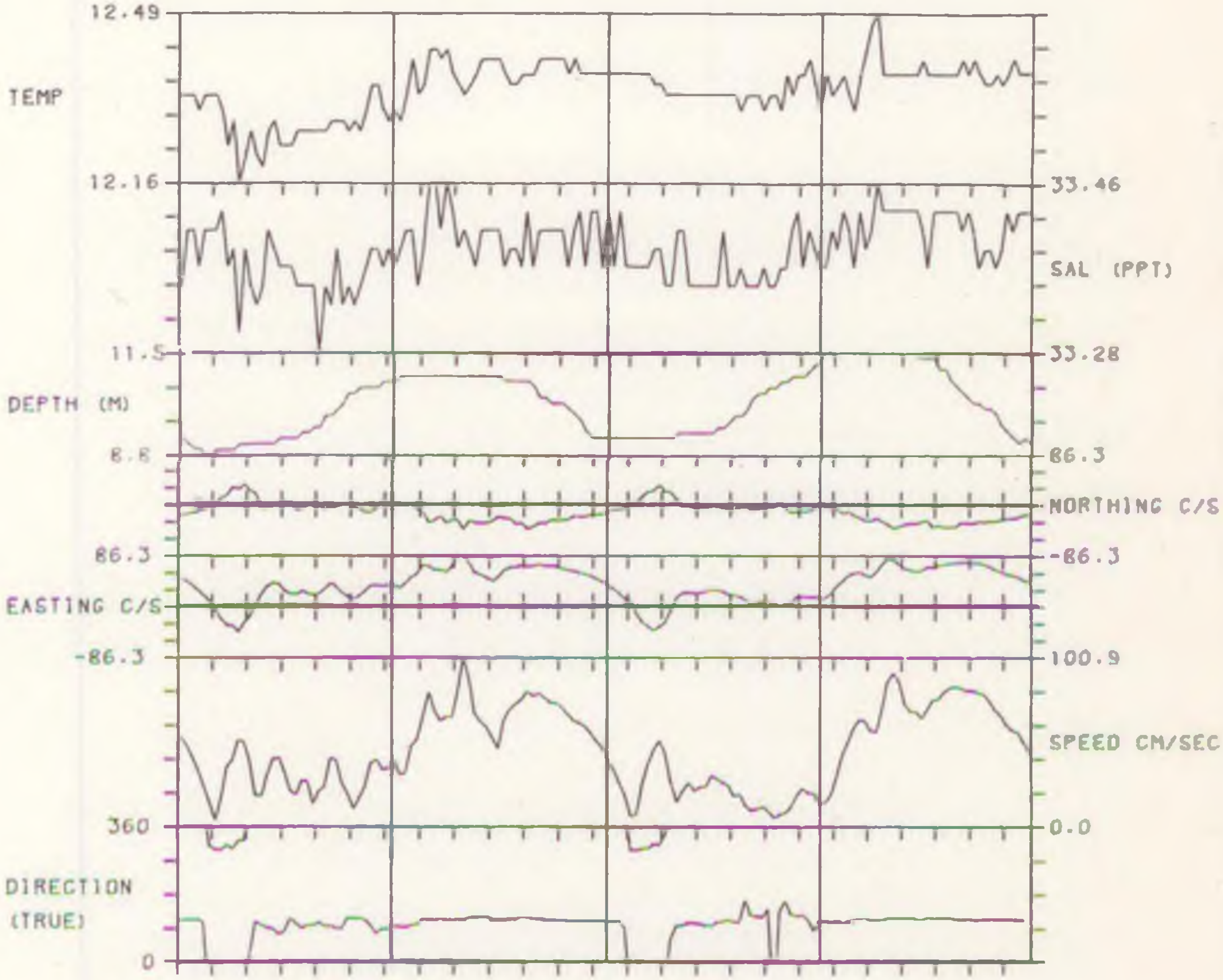
A 1.13.11

CURRENT METER DATA OVER TWO TIDES

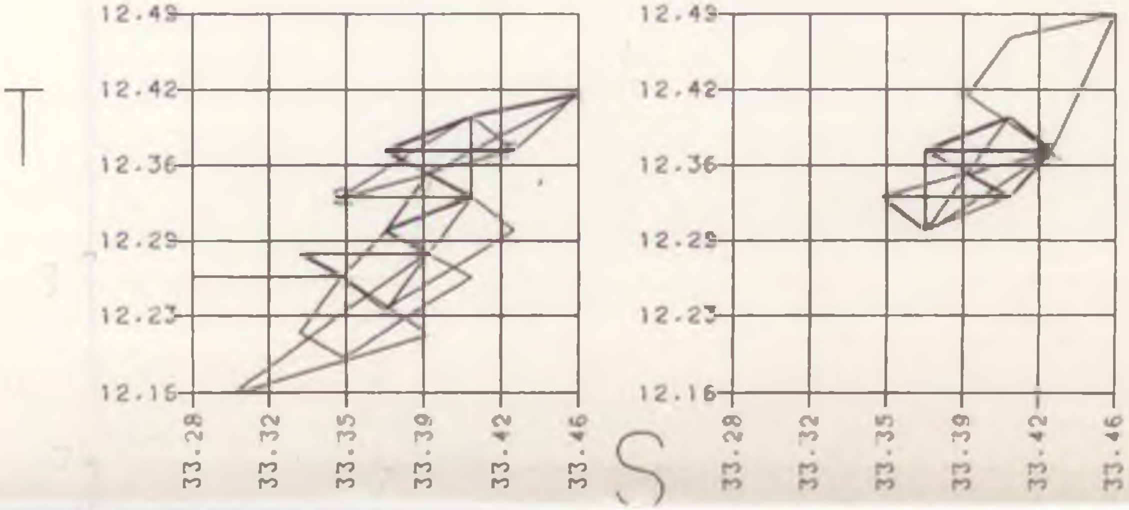
STATION NO. 13

STARTING TIME: 0459 ON 18/10/75

WIRE LENGTH = 2.0 METRES



ONE-TIDE T/S DIAGRAMS



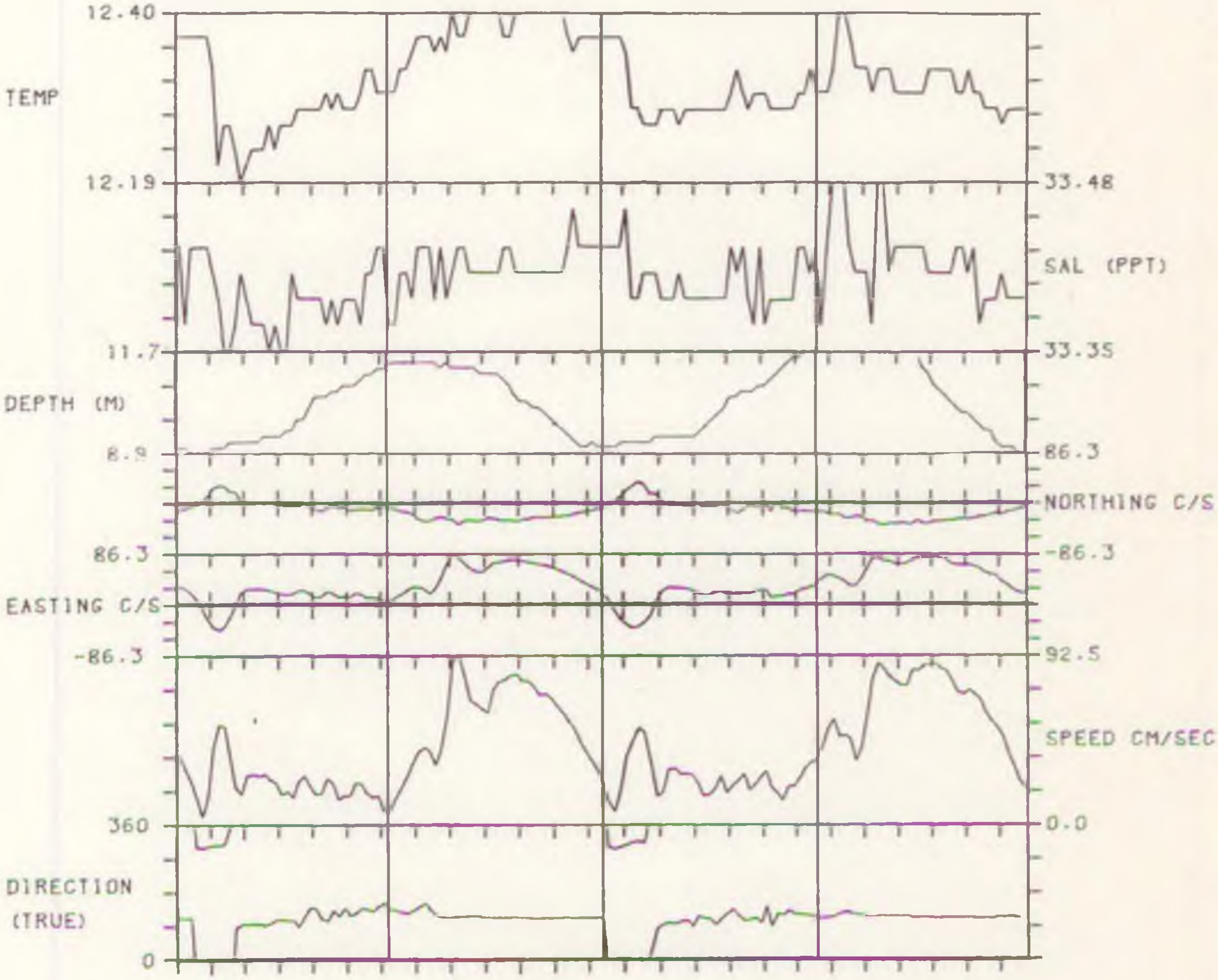
A 1.13.12

CURRENT METER DATA OVER TWO TIDES

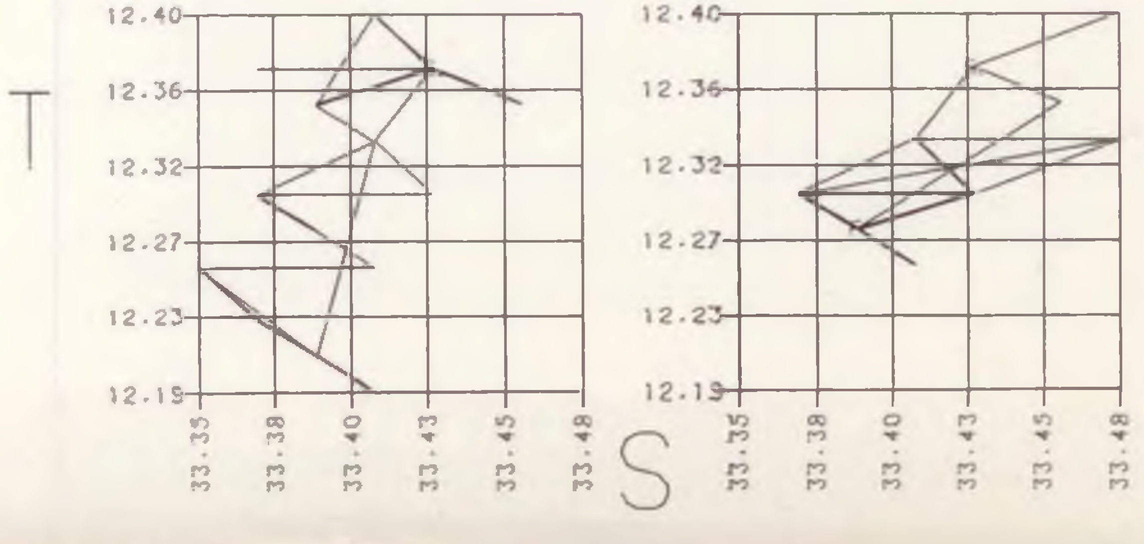
STATION NO. 13

STARTING TIME: 0549 ON 19/10/75

WIRE LENGTH = 2.0 METRES



ONE-TIDE T/S DIAGRAMS



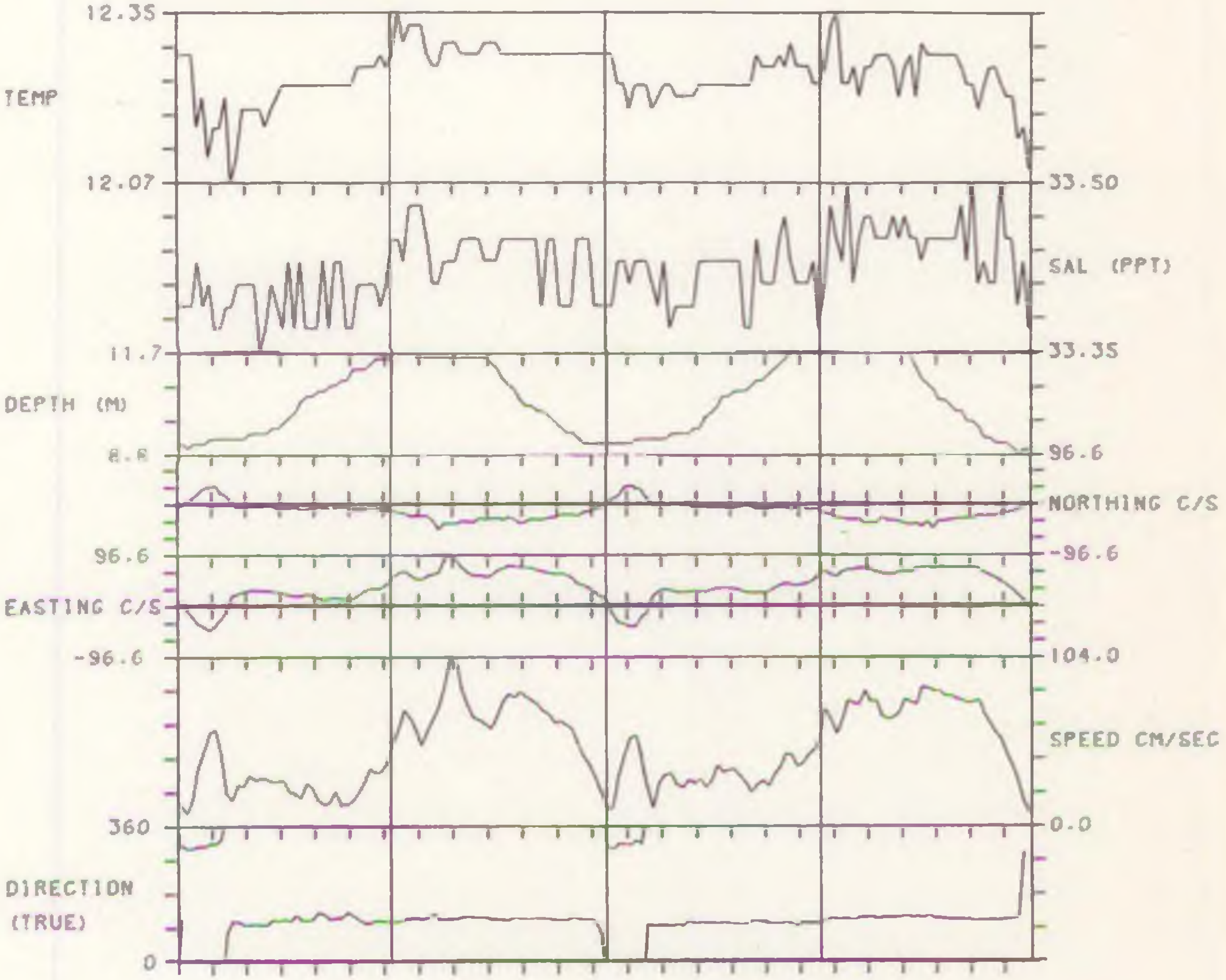
A.1.13.13

CURRENT METER DATA OVER TWO TIDES

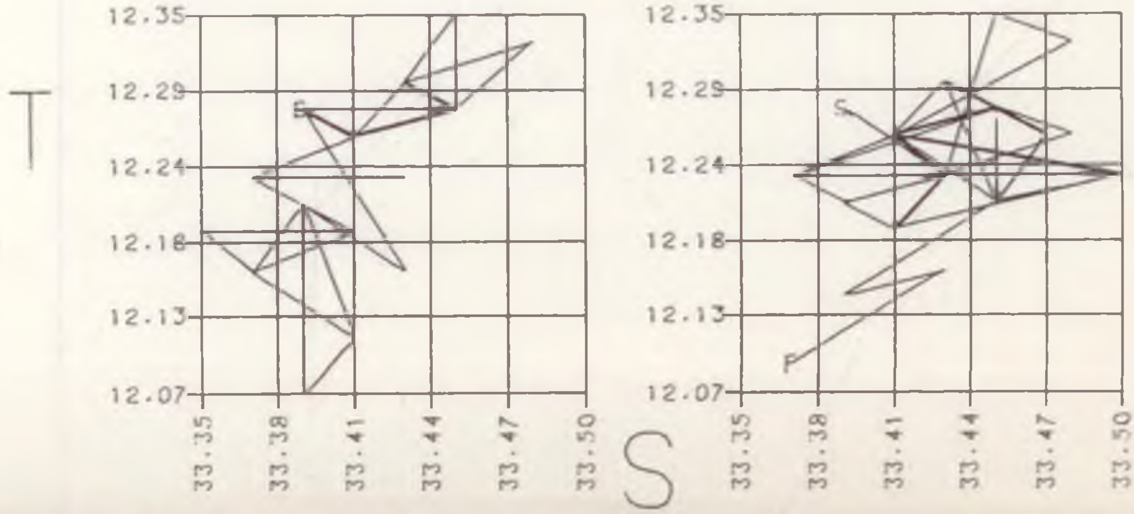
STATION NO. 13

STARTING TIME: 0639 ON 20/10/75

WIRE LENGTH = 2.0 METRES



ONE-TIDE T/S DIAGRAMS



84

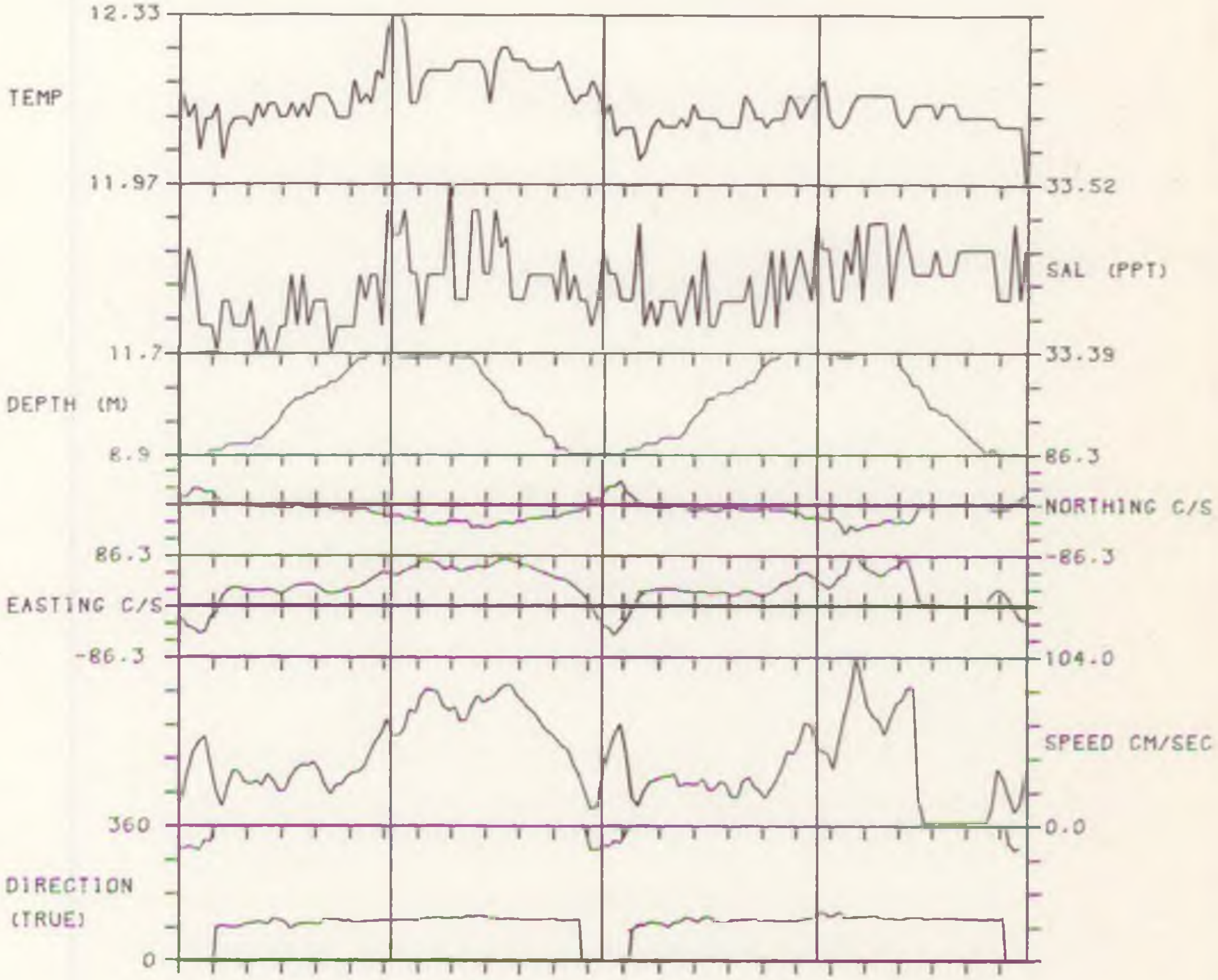
A1.13.14

CURRENT METER DATA OVER TWO TIDES

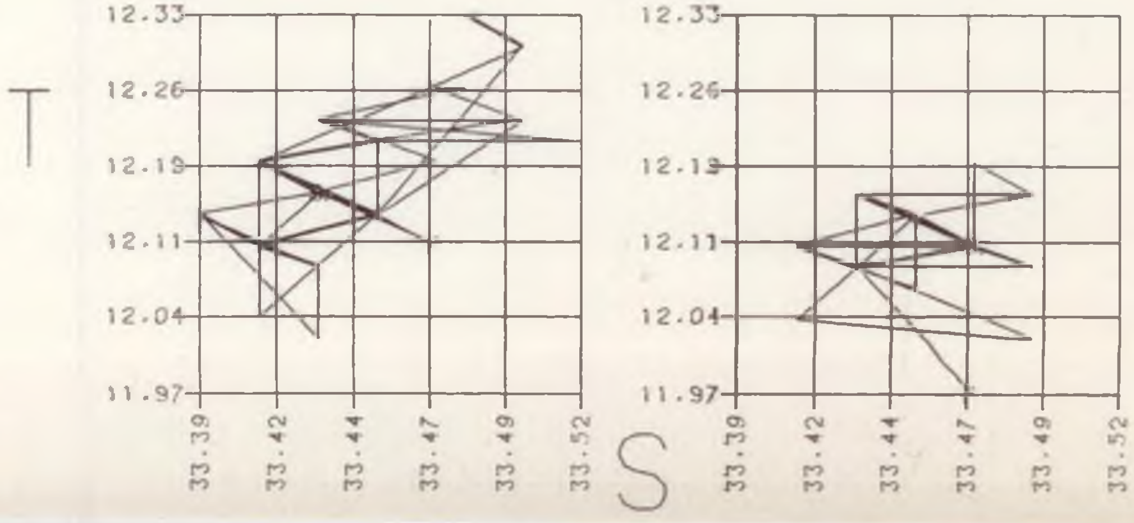
STATION NO. 13

STARTING TIME: 0729 ON 21/10/75

WIRE LENGTH = 2.0 METRES



ONE-TIDE T/S DIAGRAMS



A 1.13.15

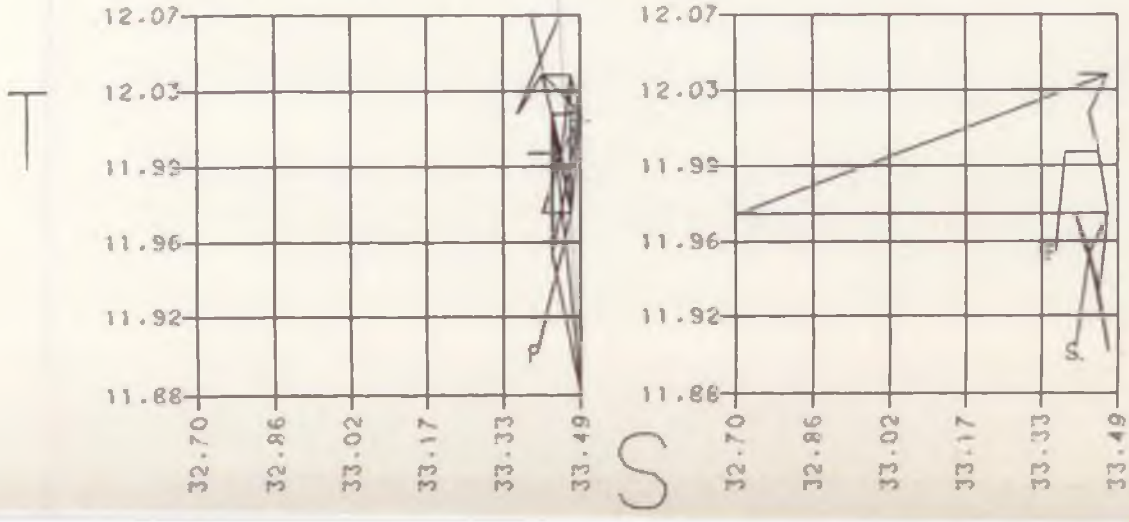
CURRENT METER DATA OVER TWO TIDES

STATION NO. 13

STARTING TIME: 0819 ON 22/10/75

WIRE LENGTH = 2.0 METRES

ONE-TIDE T/S DIAGRAMS



Add
S ~ 52

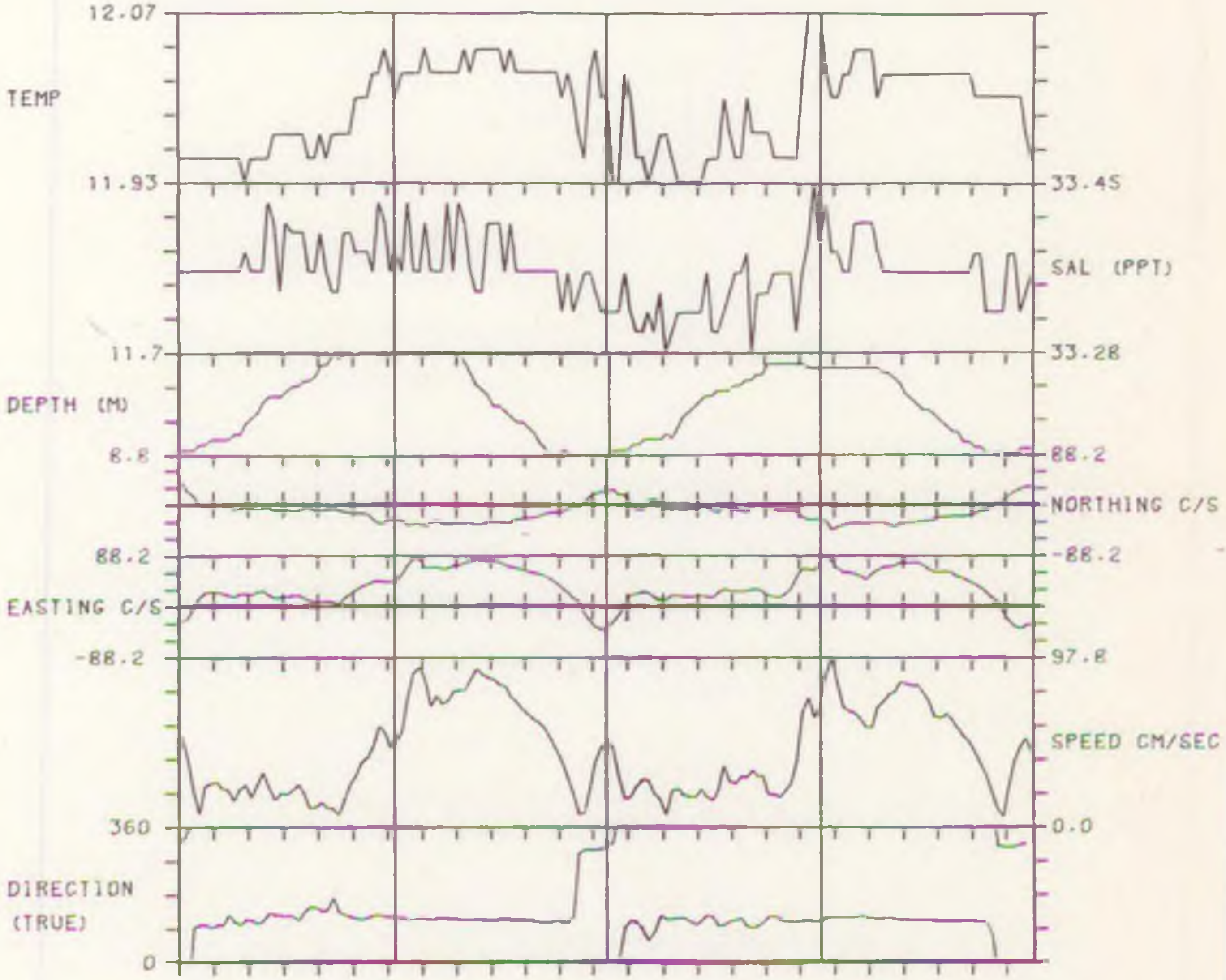
A 1.13.16

CURRENT METER DATA OVER TWO TIDES

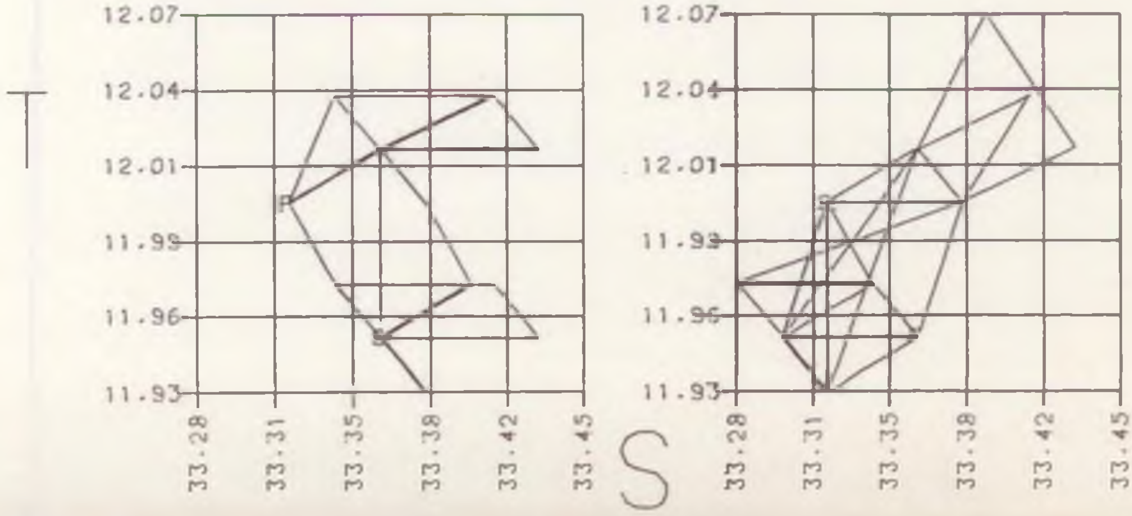
STATION NO. 13

STARTING TIME: 0909 ON 23/10/75

WIRE LENGTH = 2.0 METRES



ONE-TIDE T/S DIAGRAMS



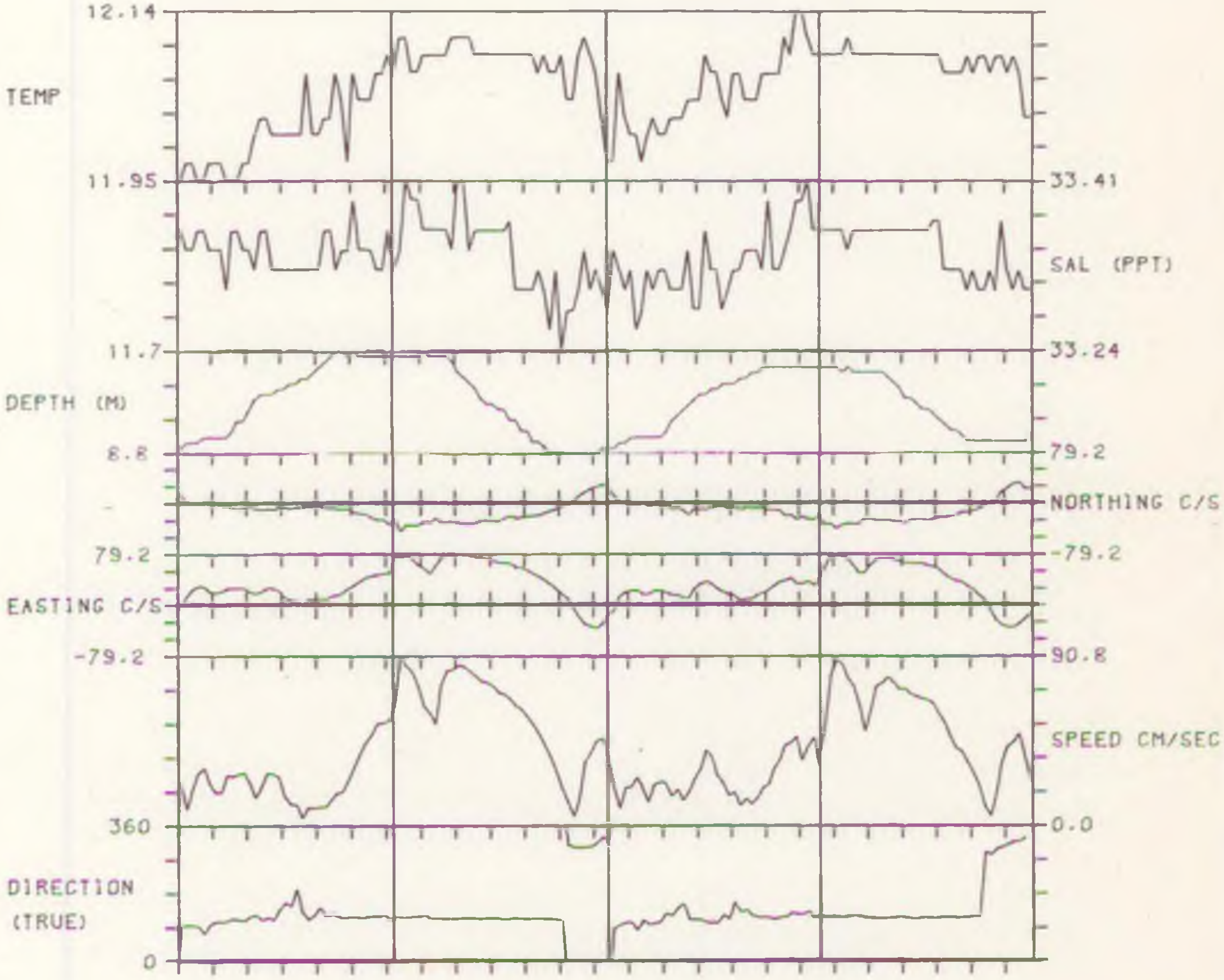
A 1.13.17

CURRENT METER DATA OVER TWO TIDES

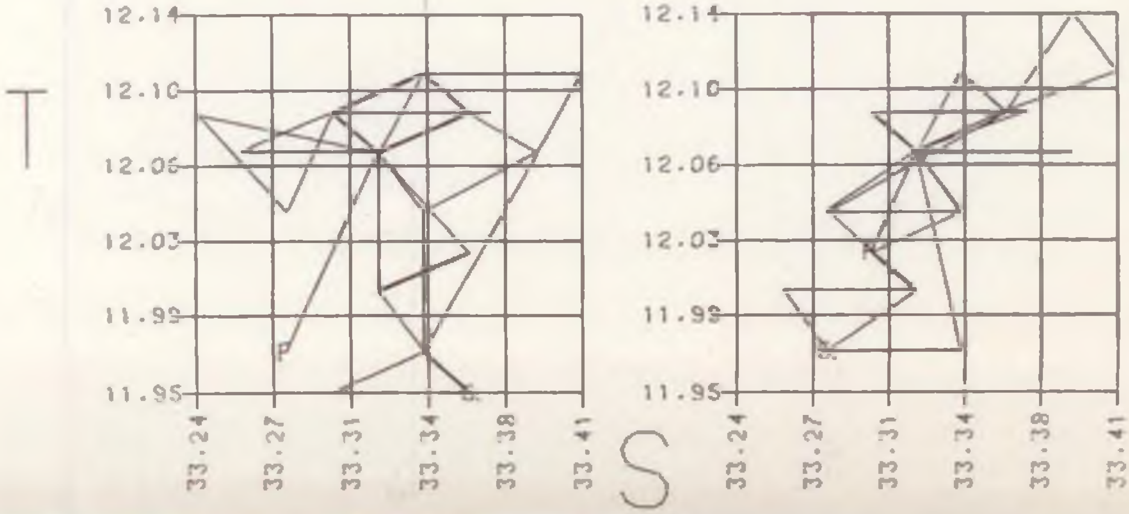
STATION NO. 13

STARTING TIME: 0959 ON 24/10/75

WIRE LENGTH = 2.0 METRES



ONE-TIDE T/S DIAGRAMS



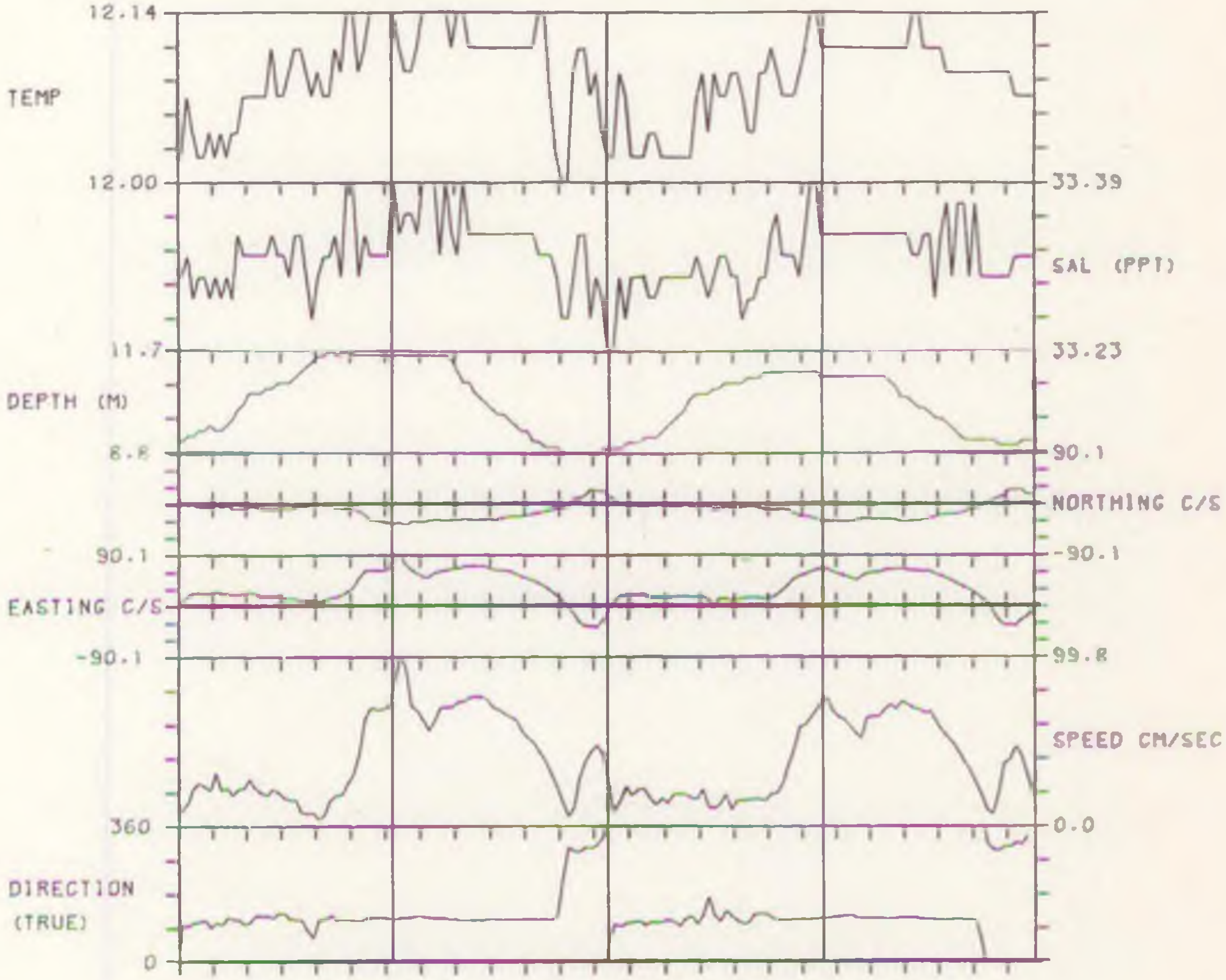
A 1.13.18

CURRENT METER DATA OVER TWO TIDES

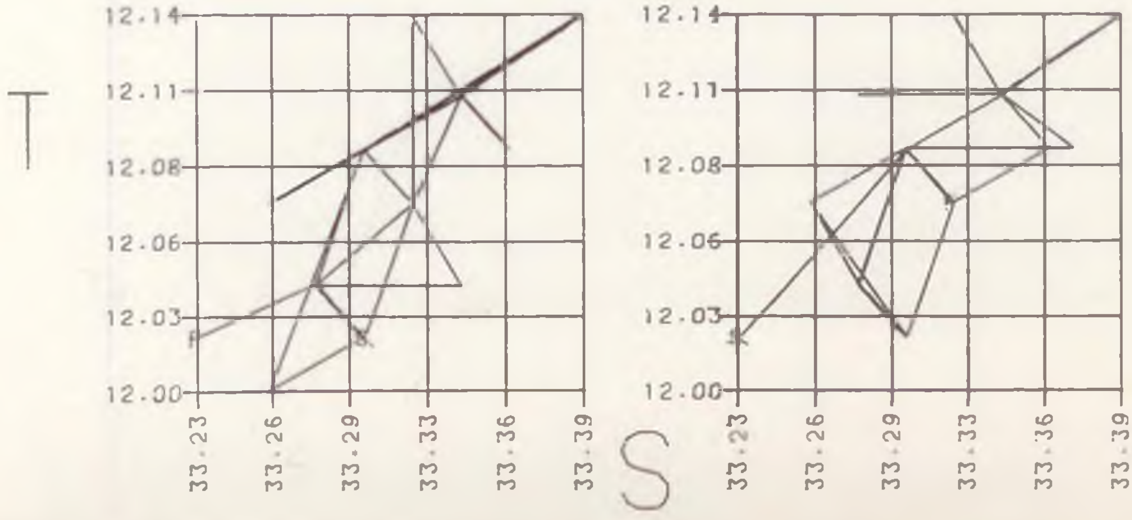
STATION NO. 13

STARTING TIME: 1059 ON 25/10/75

WIRE LENGTH = 2.0 METRES



ONE-TIDE T/S DIAGRAMS



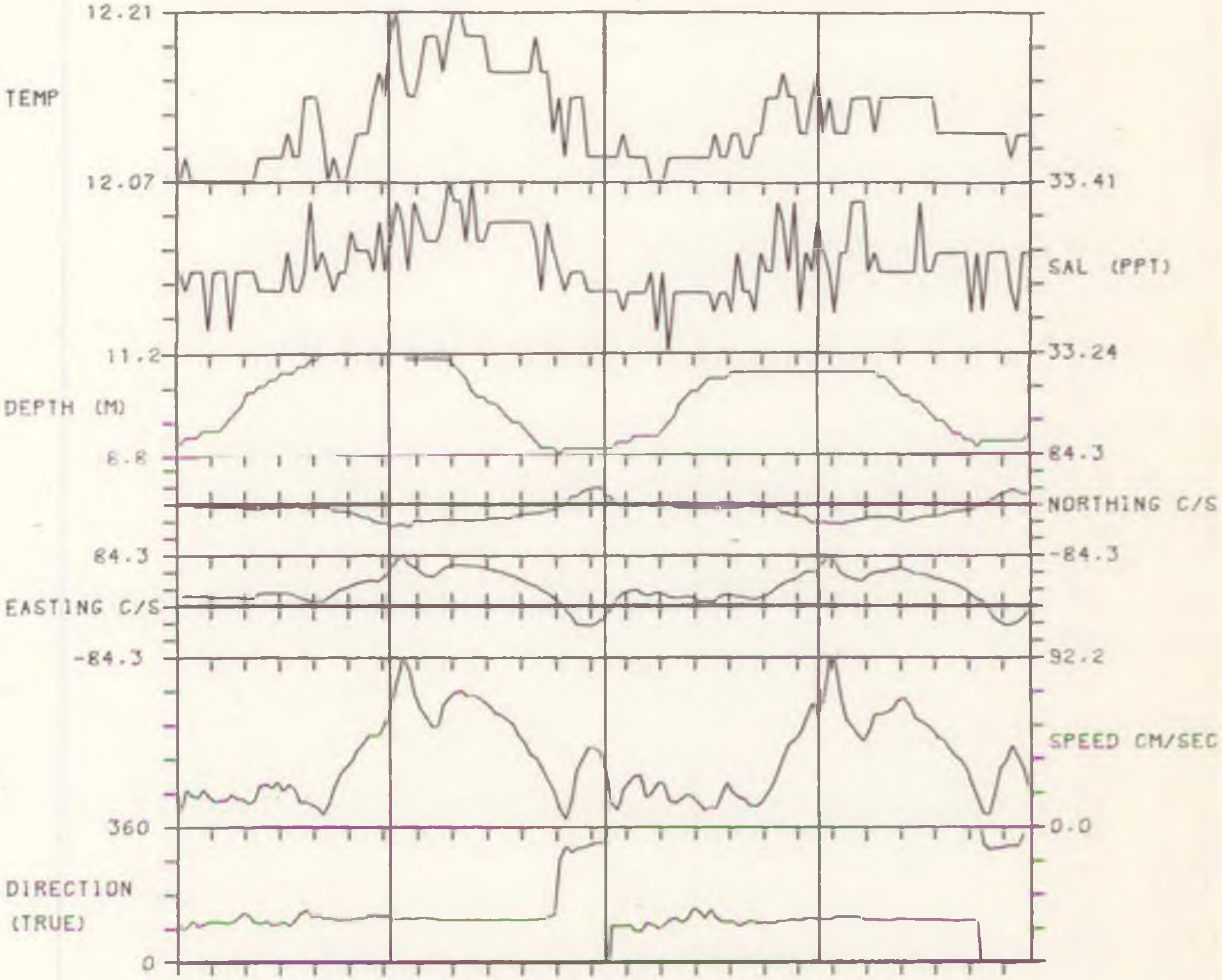
A 1.13.19

CURRENT METER DATA OVER TWO TIDES

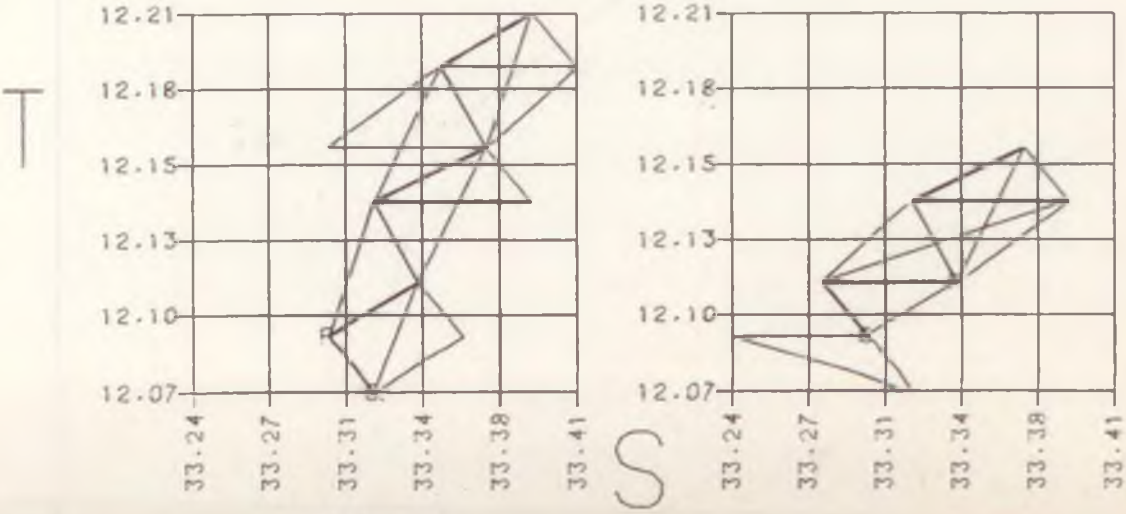
STATION NO. 13

STARTING TIME: 1149 ON 26/10/75

WIRE LENGTH = 2.0 METRES



ONE-TIDE T/S DIAGRAMS



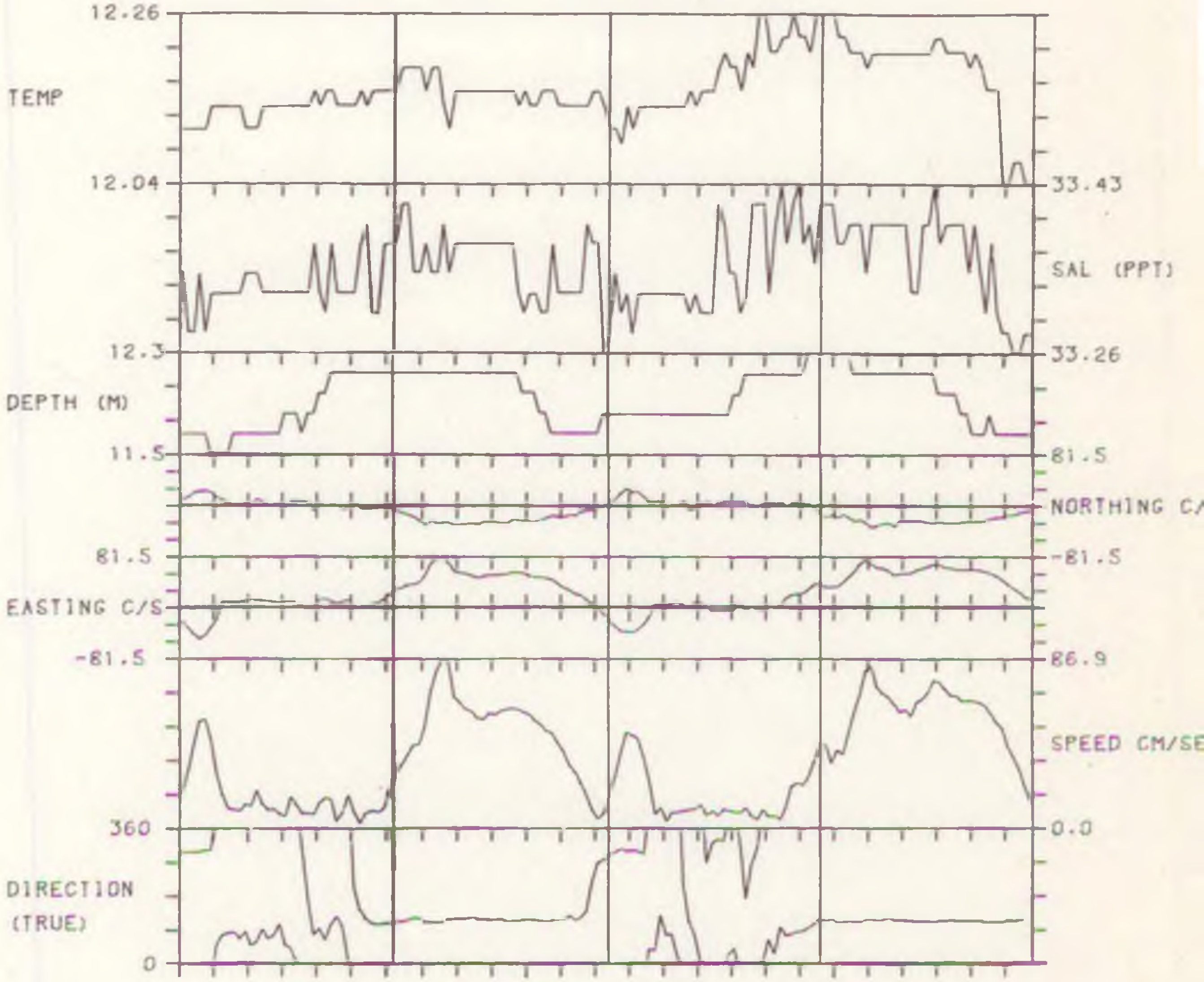
A 1.14.1

CURRENT METER DATA OVER TWO TIDES

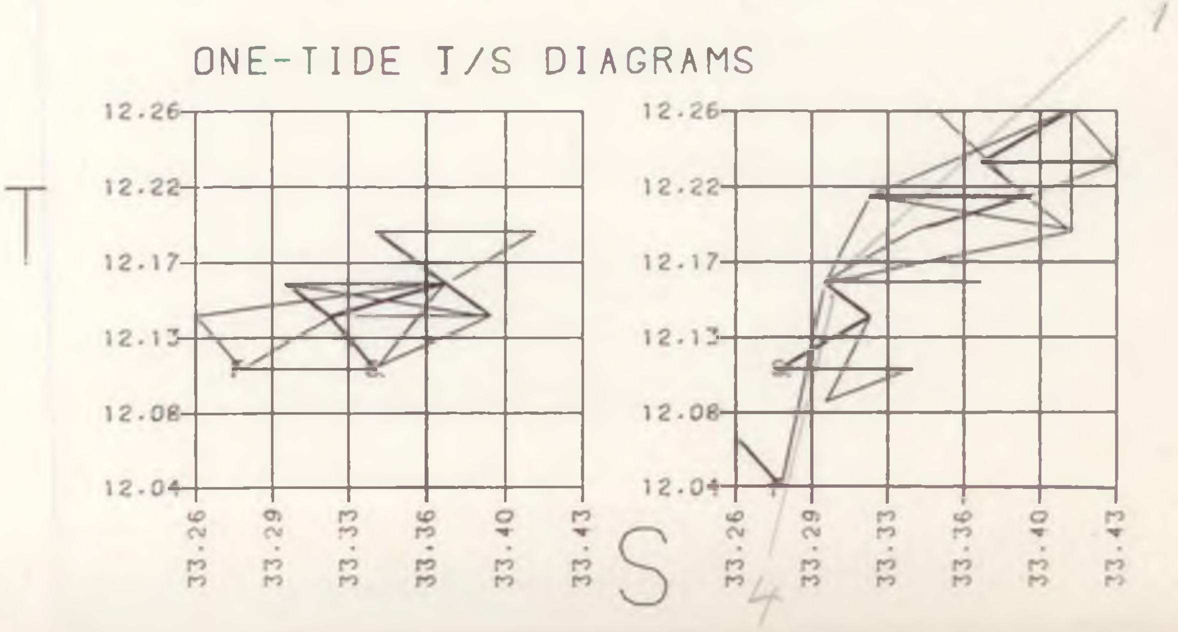
STATION NO. 14

STARTING TIME: 0019 ON 28/10/75

WIRE LENGTH = 9.0 METRES



ONE-TIDE T/S DIAGRAMS



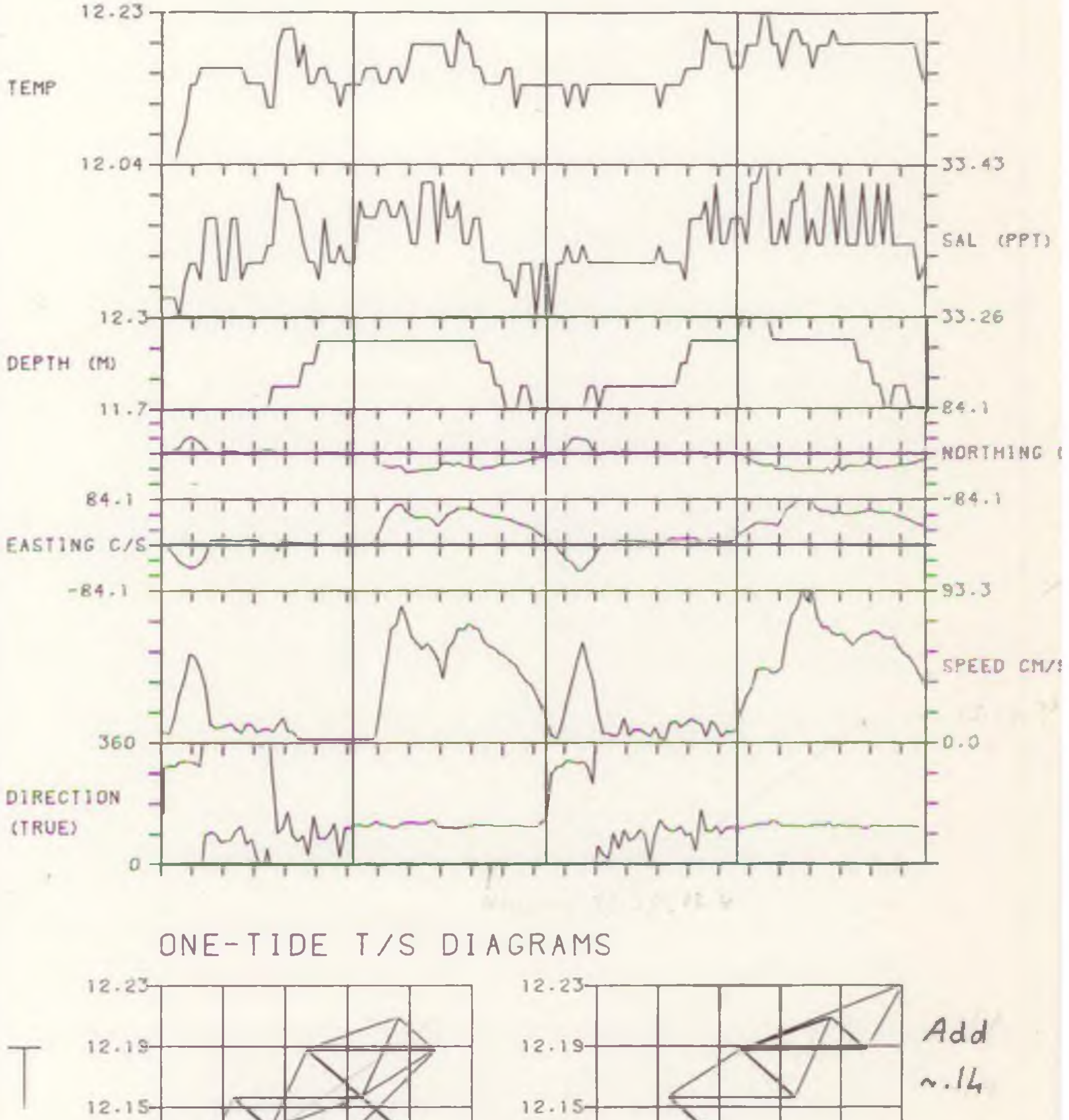
A 1.14.2

CURRENT METER DATA OVER TWO TIDES

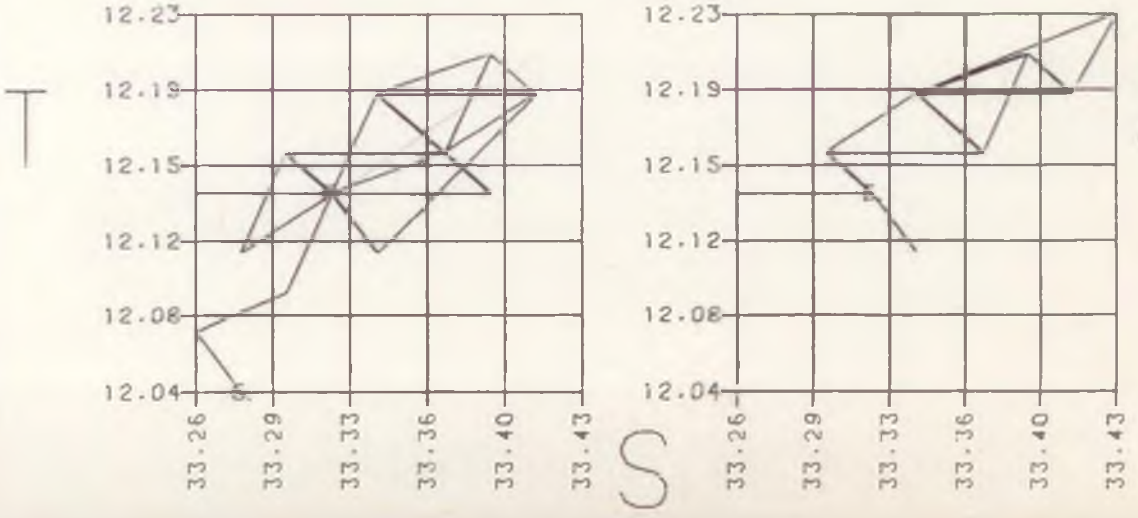
STATION NO. 14

STARTING TIME: 0109 ON 29/10/75

WIRE LENGTH = 9.0 METRES



ONE-TIDE T/S DIAGRAMS



Add ~.14

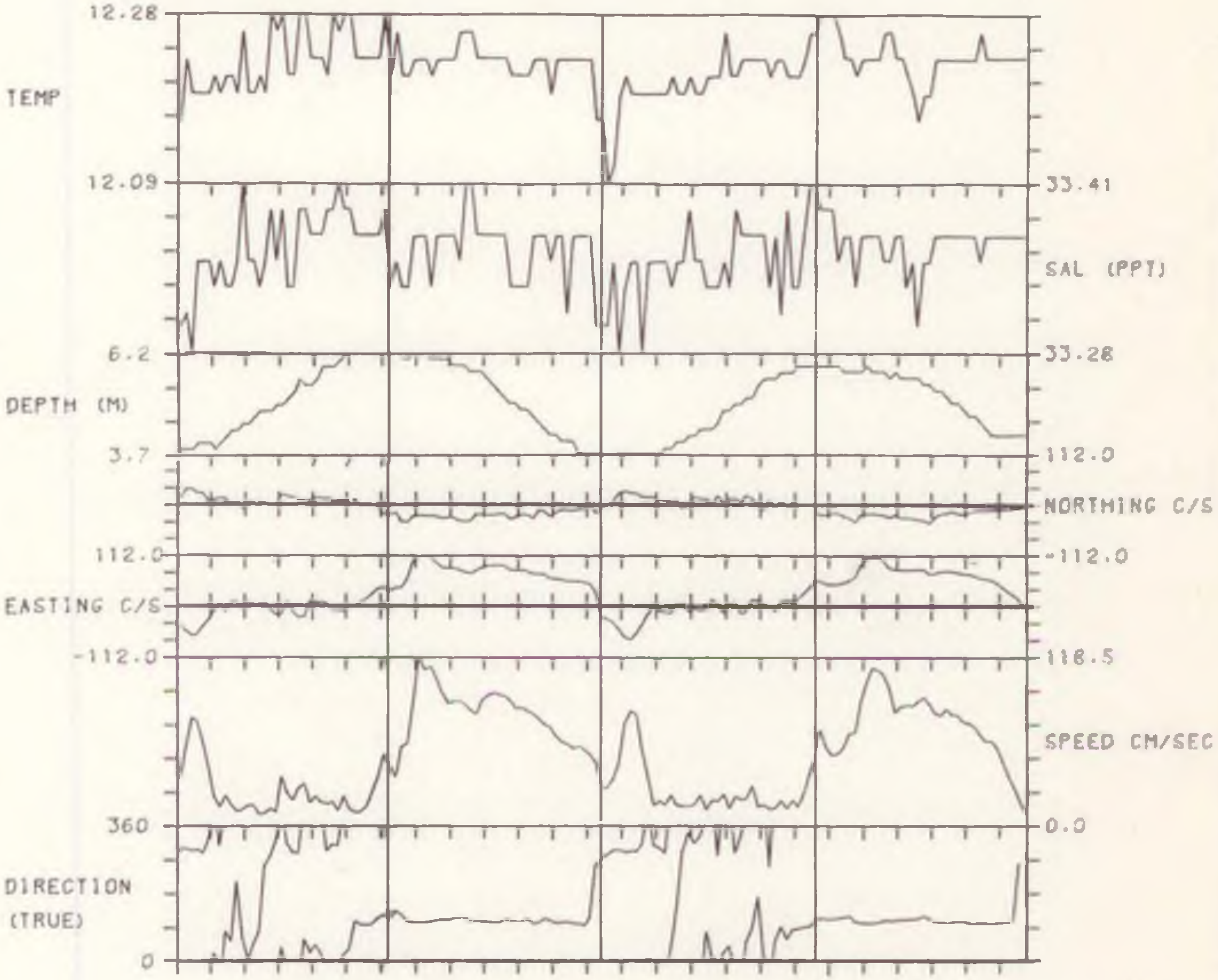
A1.15.1

CURRENT METER DATA OVER TWO TIDES

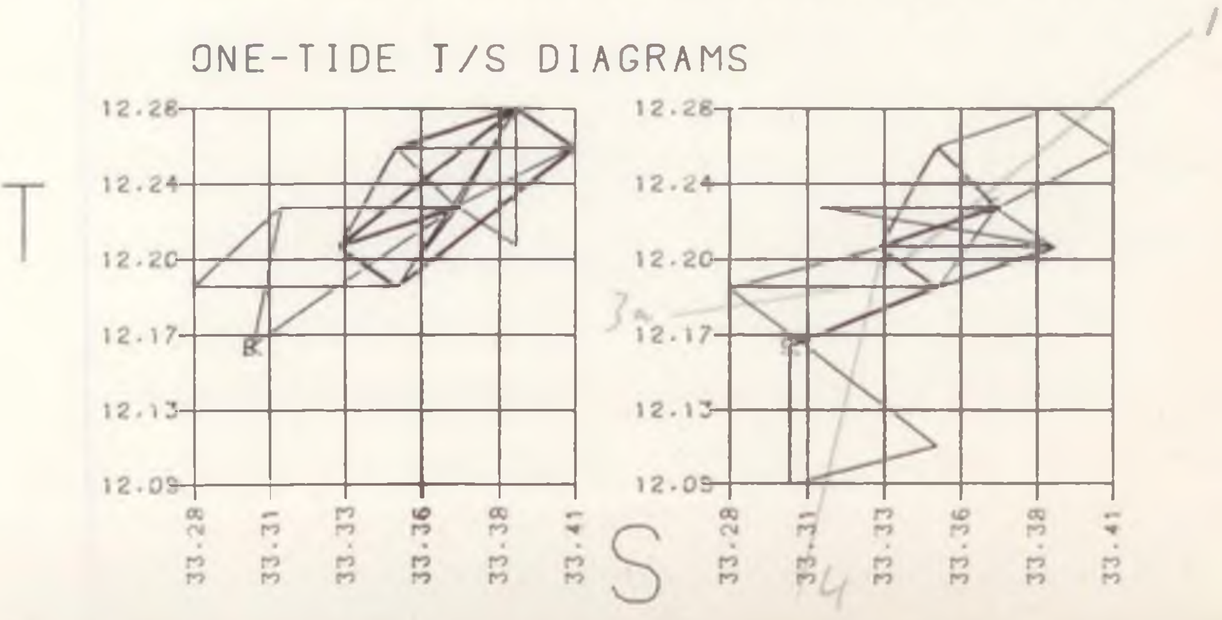
STATION NO. 15

STARTING TIME: 1529 ON 30/10/75

WIRE LENGTH = 18.0 METRES



ONE-TIDE T/S DIAGRAMS



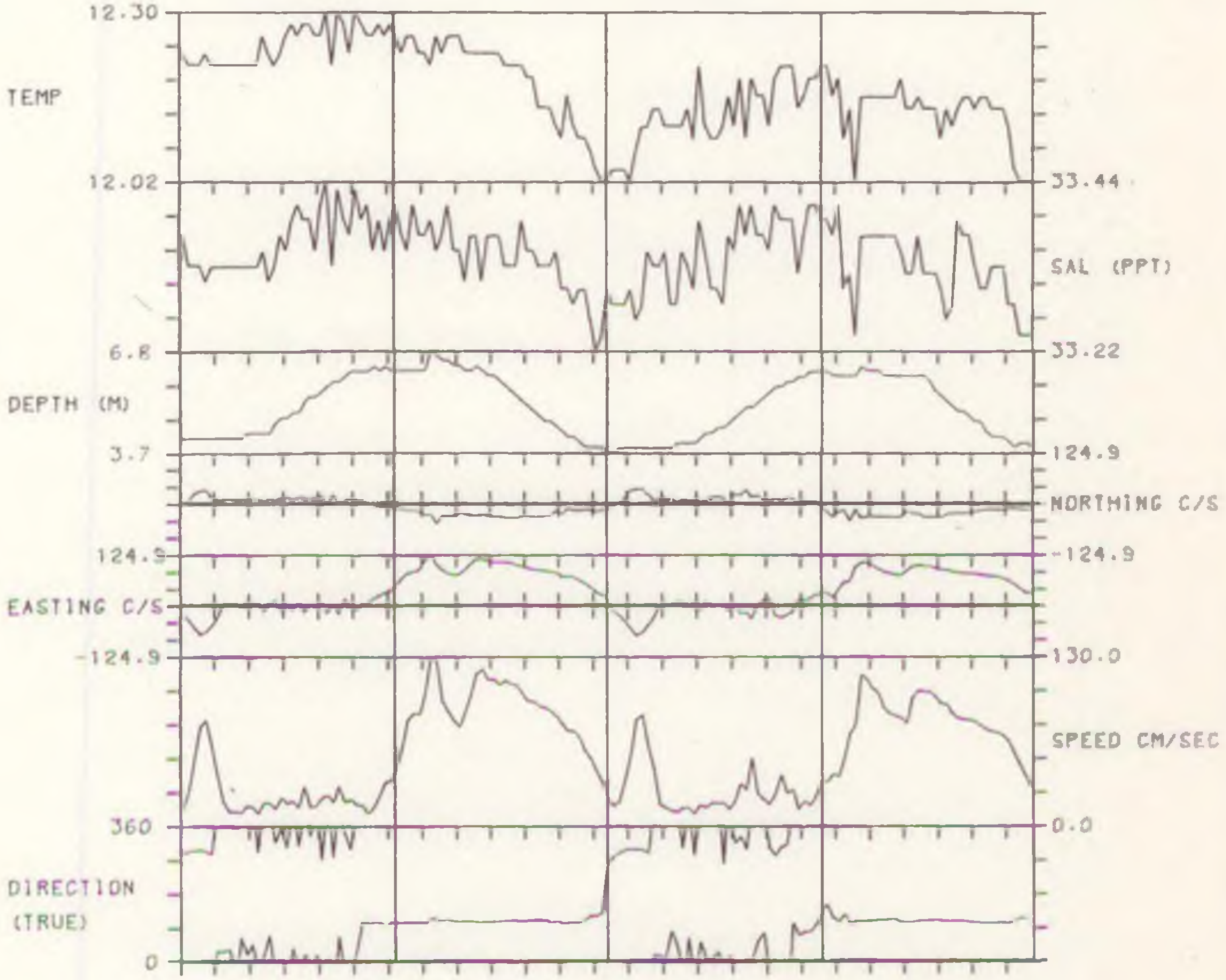
A 1.15.2

CURRENT METER DATA OVER TWO TIDES

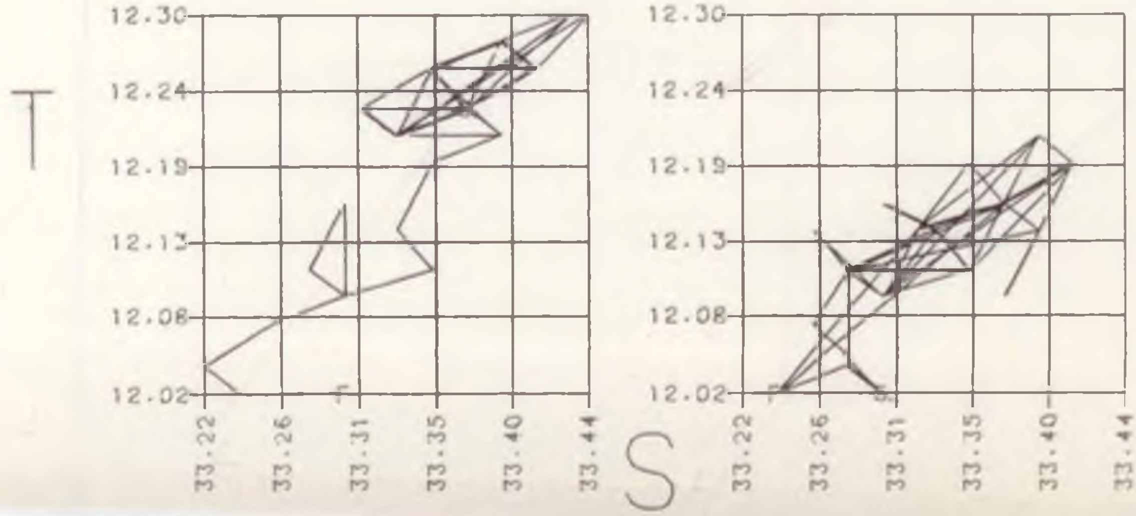
STATION NO. 15

STARTING TIME: 1619 ON 31/10/75

WIRE LENGTH = 18.0 METRES



ONE-TIDE T/S DIAGRAMS



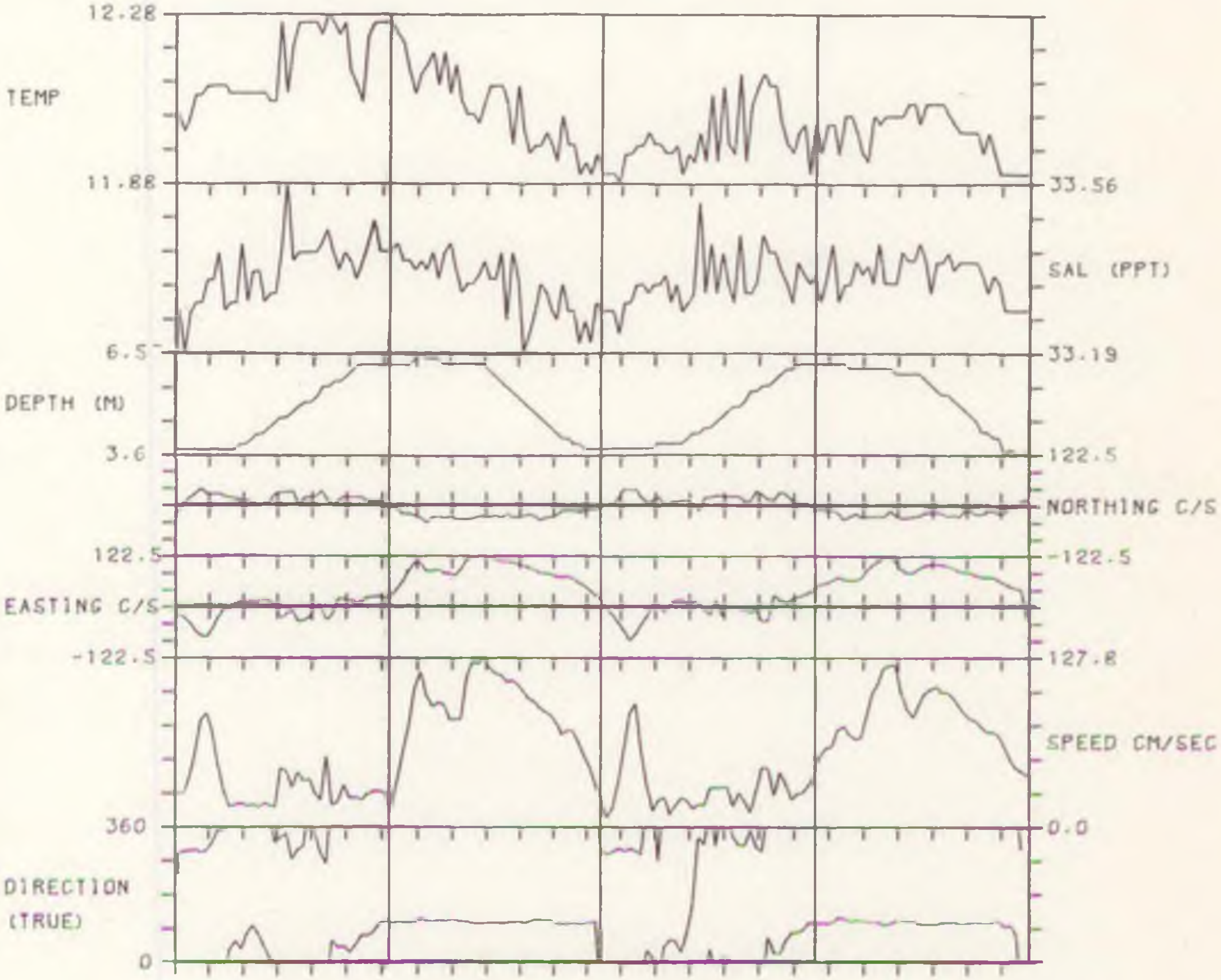
A 1.15.3

CURRENT METER DATA OVER TWO TIDES

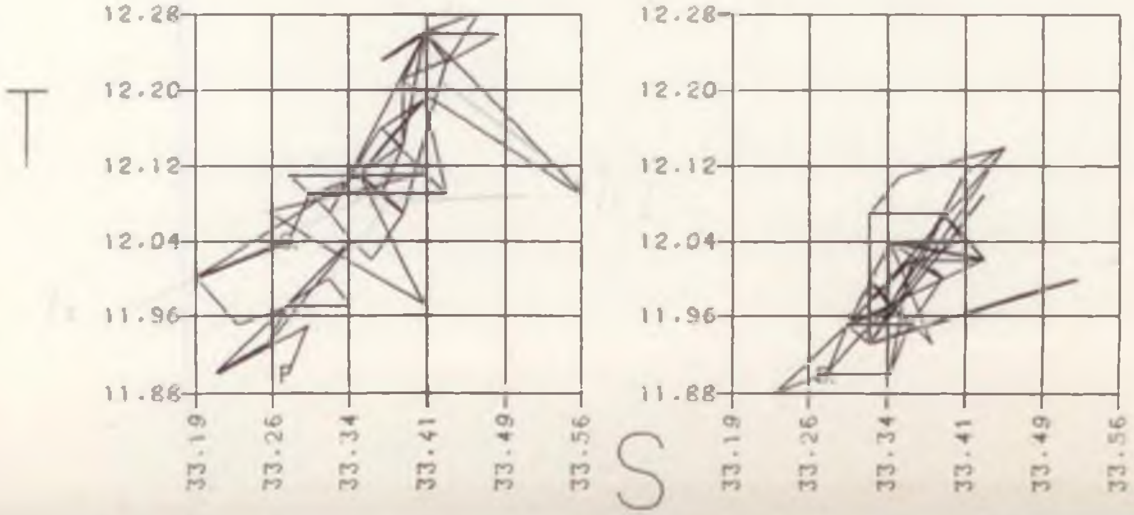
STATION NO. 15

STARTING TIME: 1709 ON 1/11/75

WIRE LENGTH = 18.0 METRES



ONE-TIDE T/S DIAGRAMS



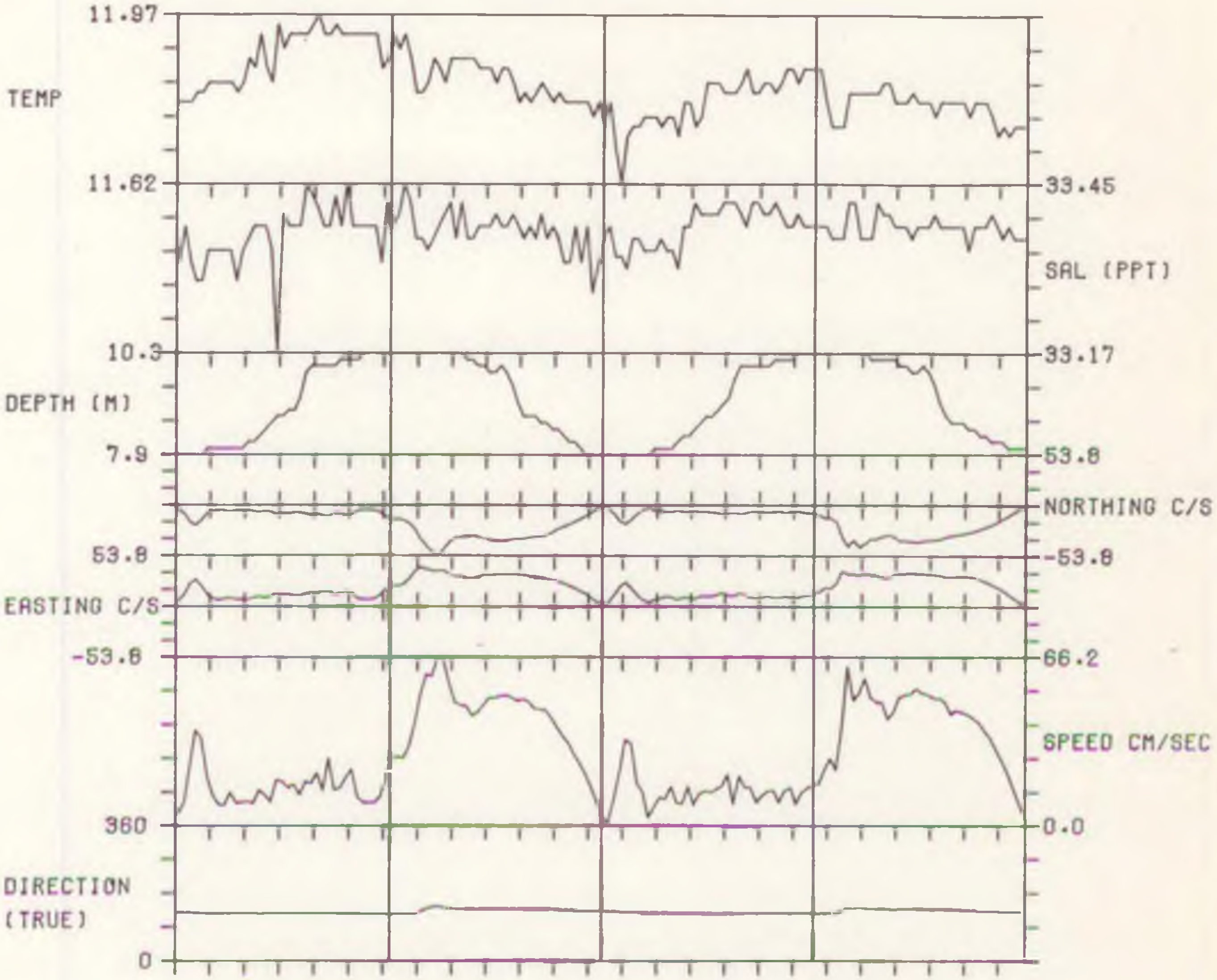
A 1.16.1

CURRENT METER DATA OVER TWO TIDES

STATION NO. 16

STARTING TIME: 1849 ON 3/11/75

WIRE LENGTH = 9.5 METRES



ONE-TIDE T/S DIAGRAMS

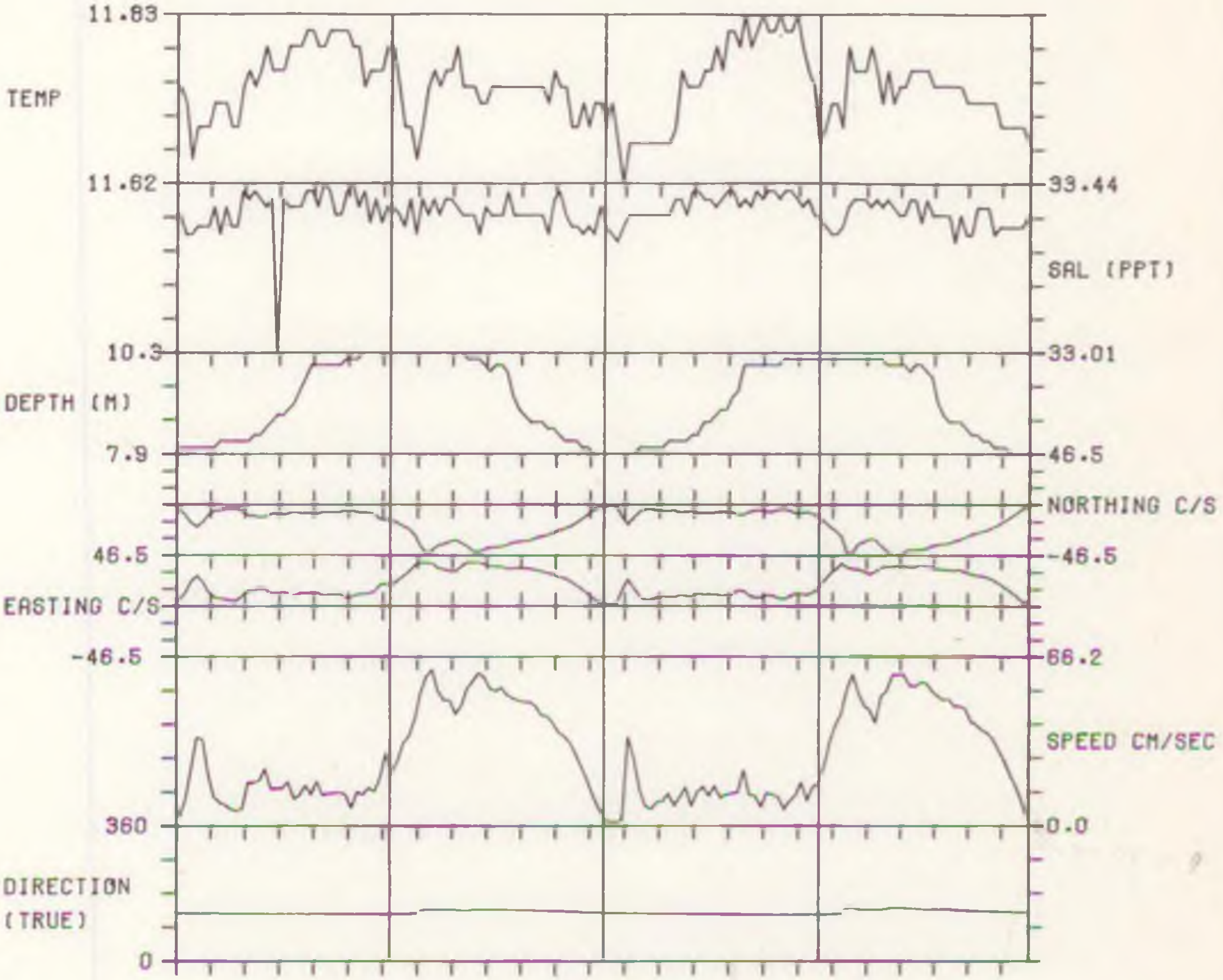
A 1.16.2

CURRENT METER DATA OVER TWO TIDES

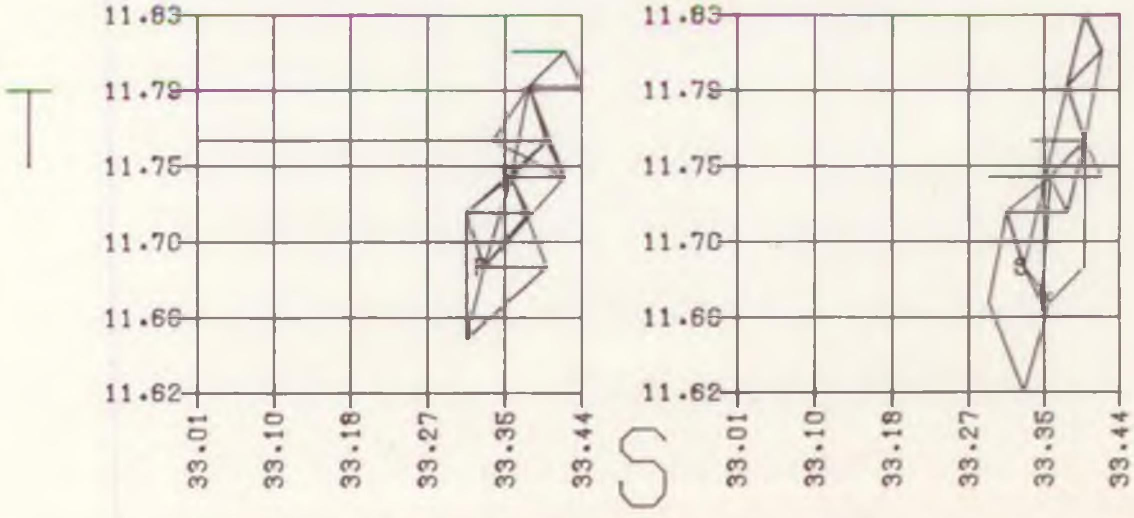
STATION NO. 16

STARTING TIME: 1939 ON 4/11/75

WIRE LENGTH = 9.5 METRES



ONE-TIDE T/S DIAGRAMS



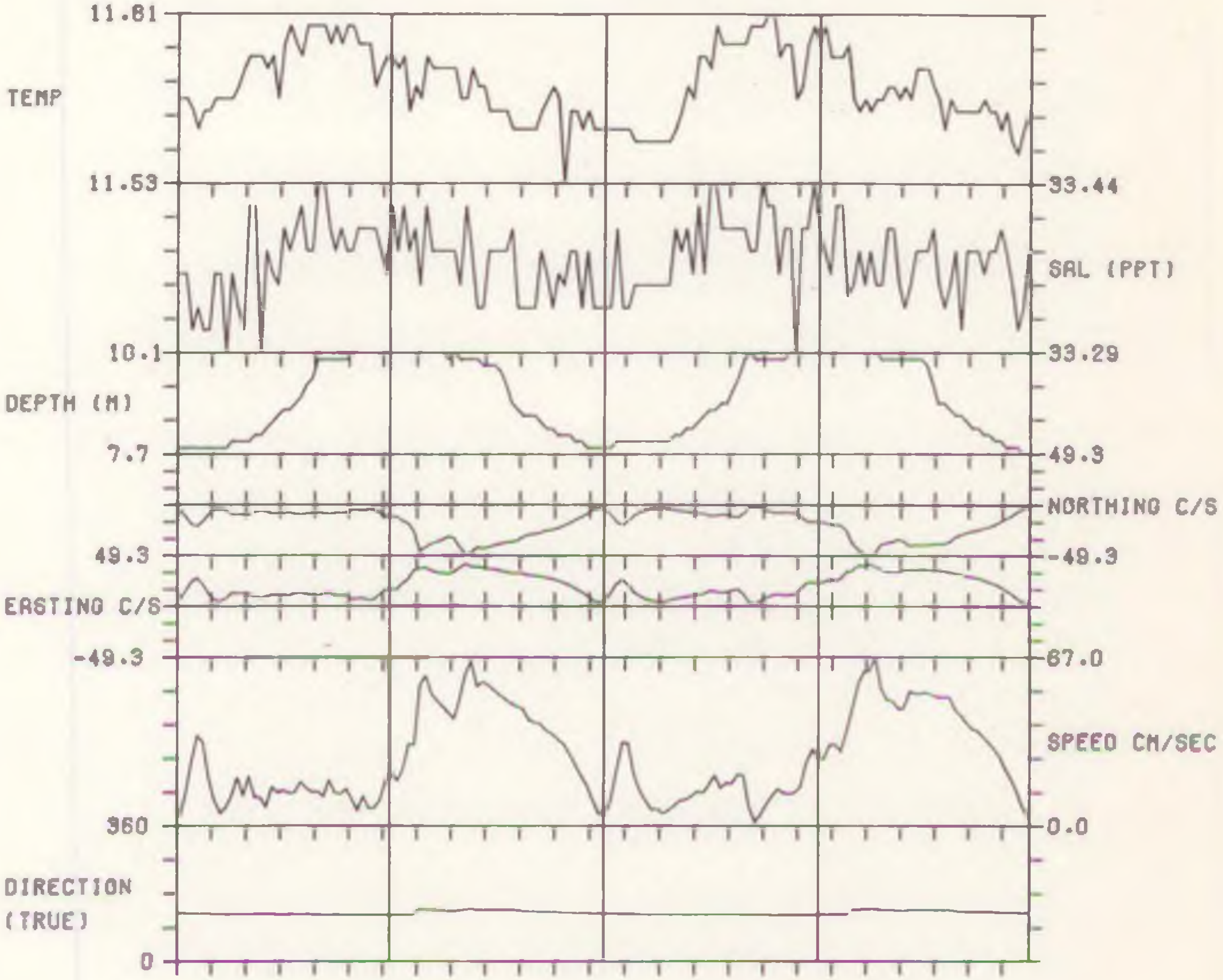
Add
~ .42

CURRENT METER DATA OVER TWO TIDES

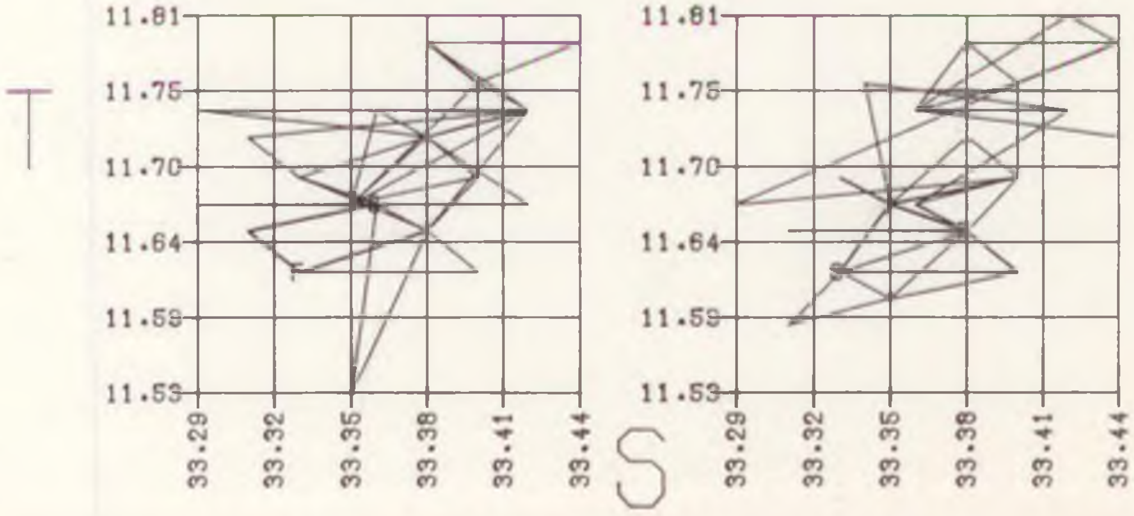
STATION NO. 16

STARTING TIME: 2029 ON 5/11/75

WIRE LENGTH = 9.5 METRES



ONE-TIDE T/S DIAGRAMS



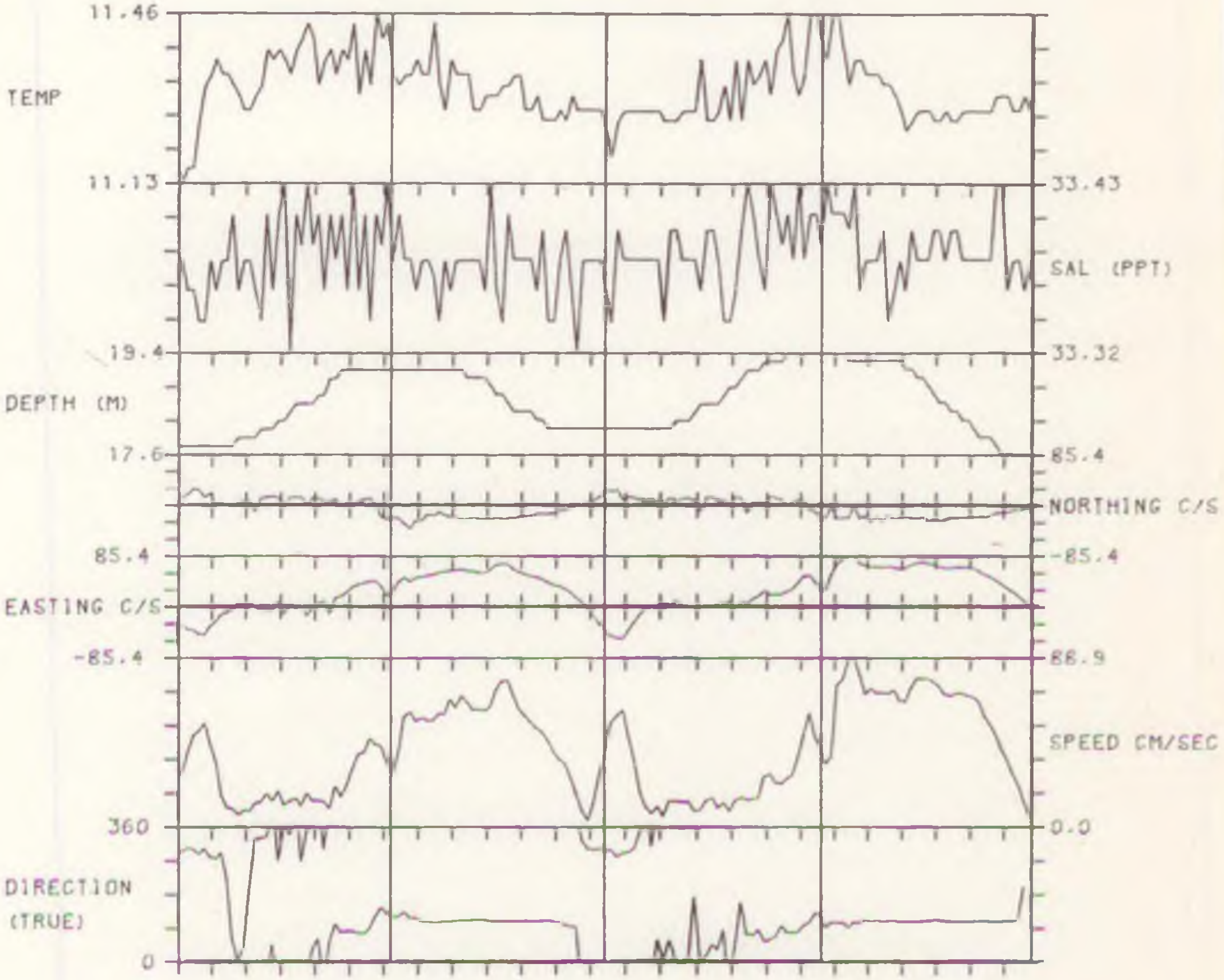
A 1.17.1

CURRENT METER DATA OVER TWO TIDES

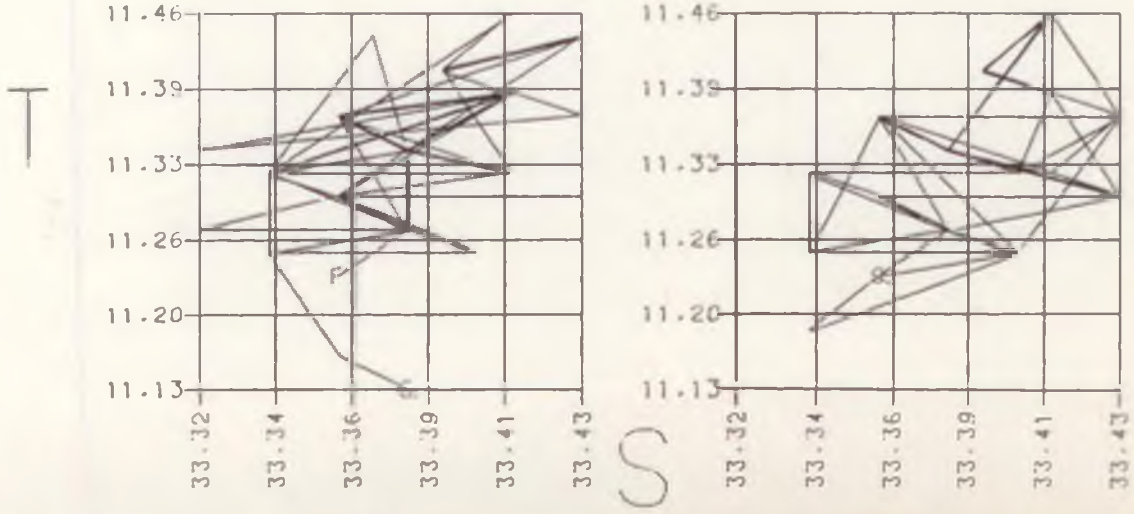
STATION NO. 17

STARTING TIME: 0208 ON 12/11/75

WIRE LENGTH = 9.0 METRES



ONE-TIDE T/S DIAGRAMS



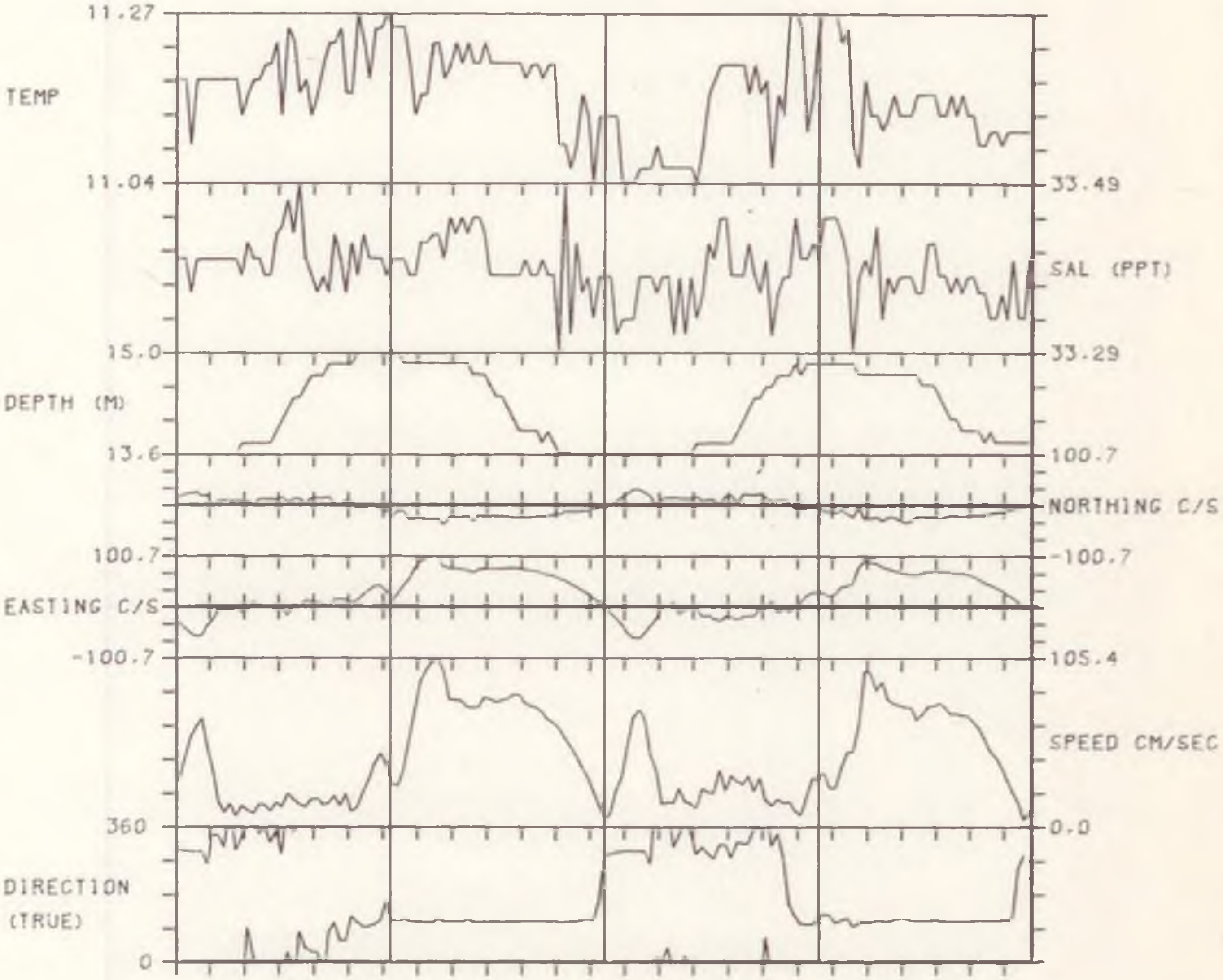
A 1.18.1

CURRENT METER DATA OVER TWO TIDES

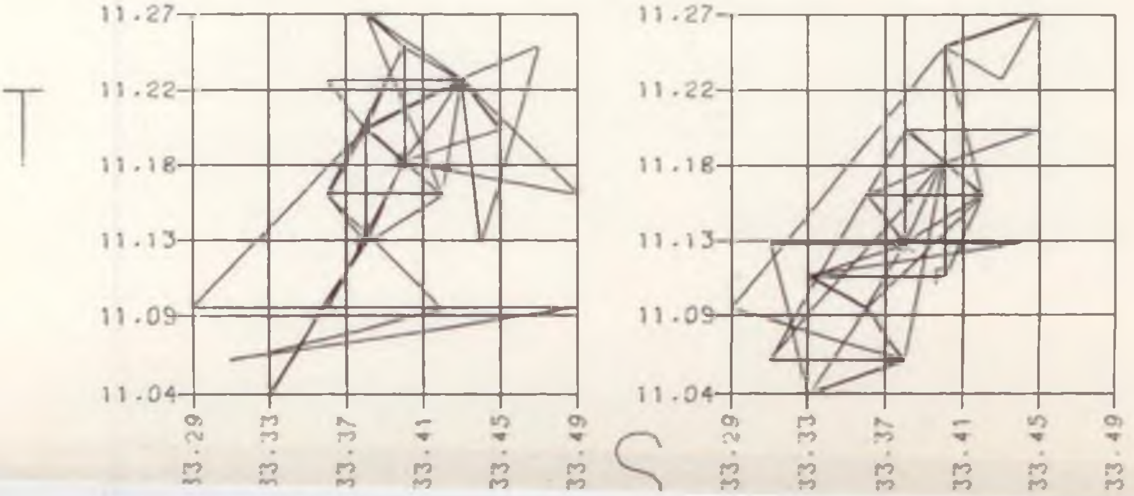
STATION NO. 18

STARTING TIME: 1528 ON 13/11/75

WIRE LENGTH = 9.0 METRES



ONE-TIDE T/S DIAGRAMS



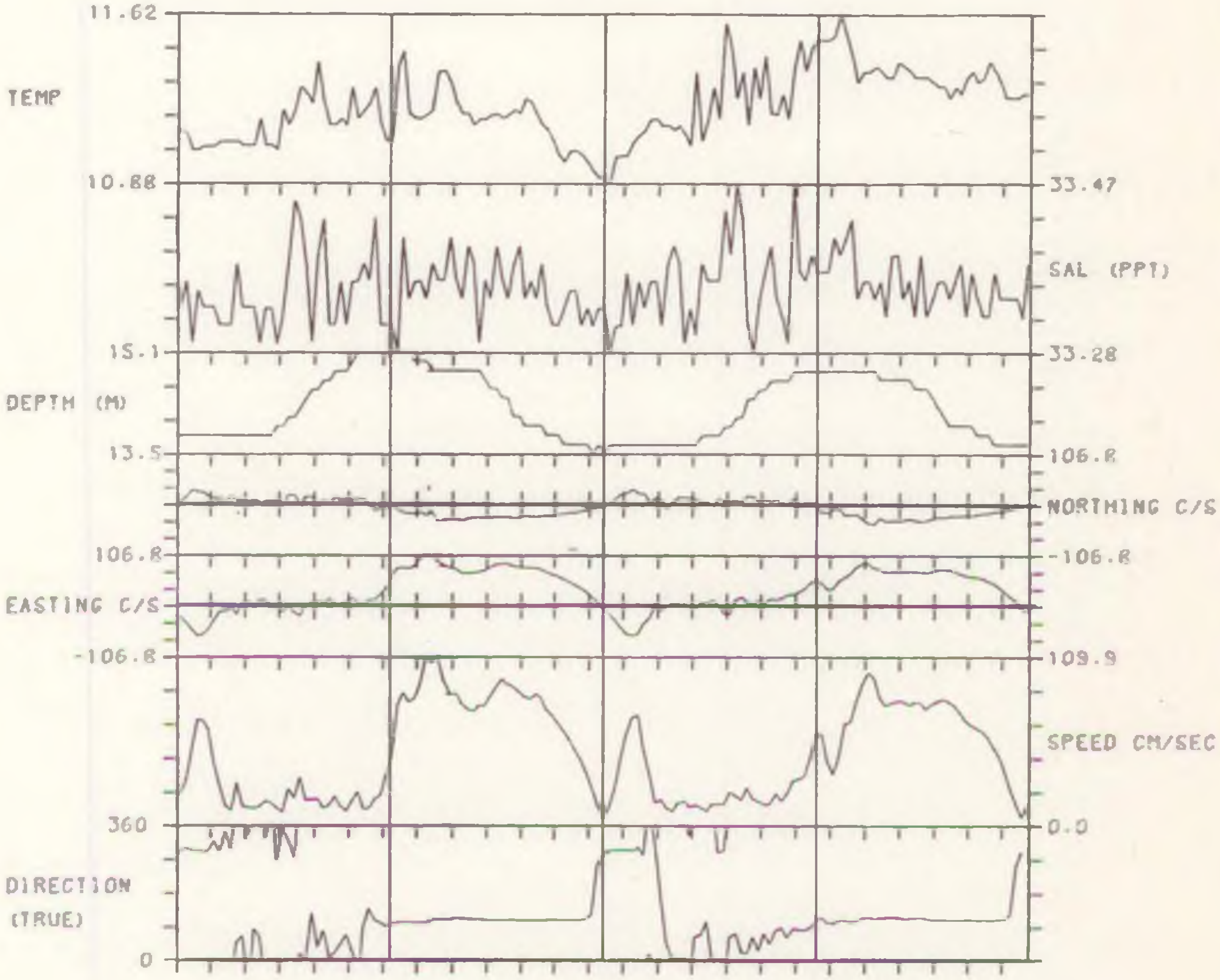
A 1.18.2

CURRENT METER DATA OVER TWO TIDES

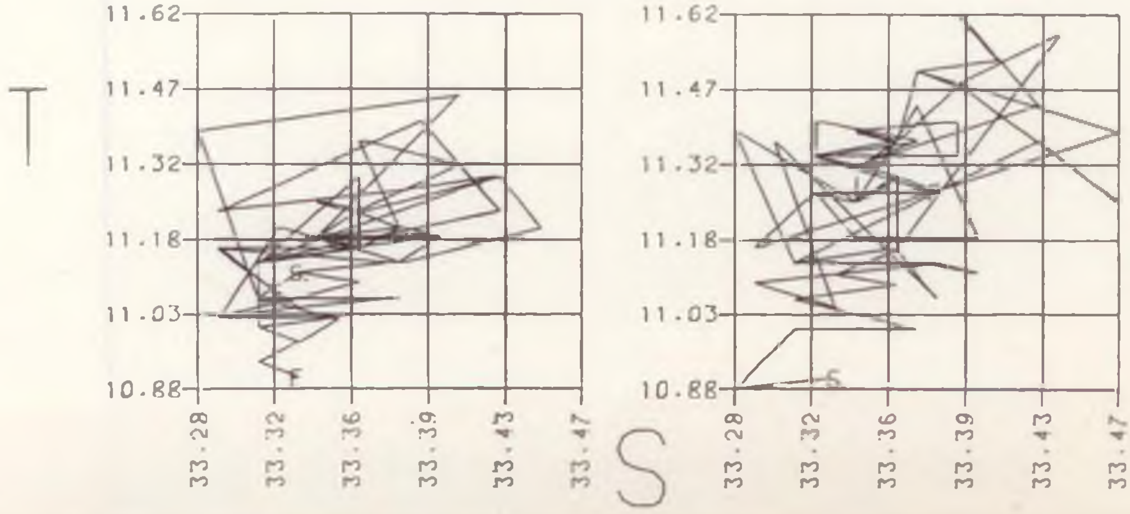
STATION NO. 18

STARTING TIME: 1618 ON 14/11/75

WIRE LENGTH = 9.0 METRES



ONE-TIDE T/S DIAGRAMS



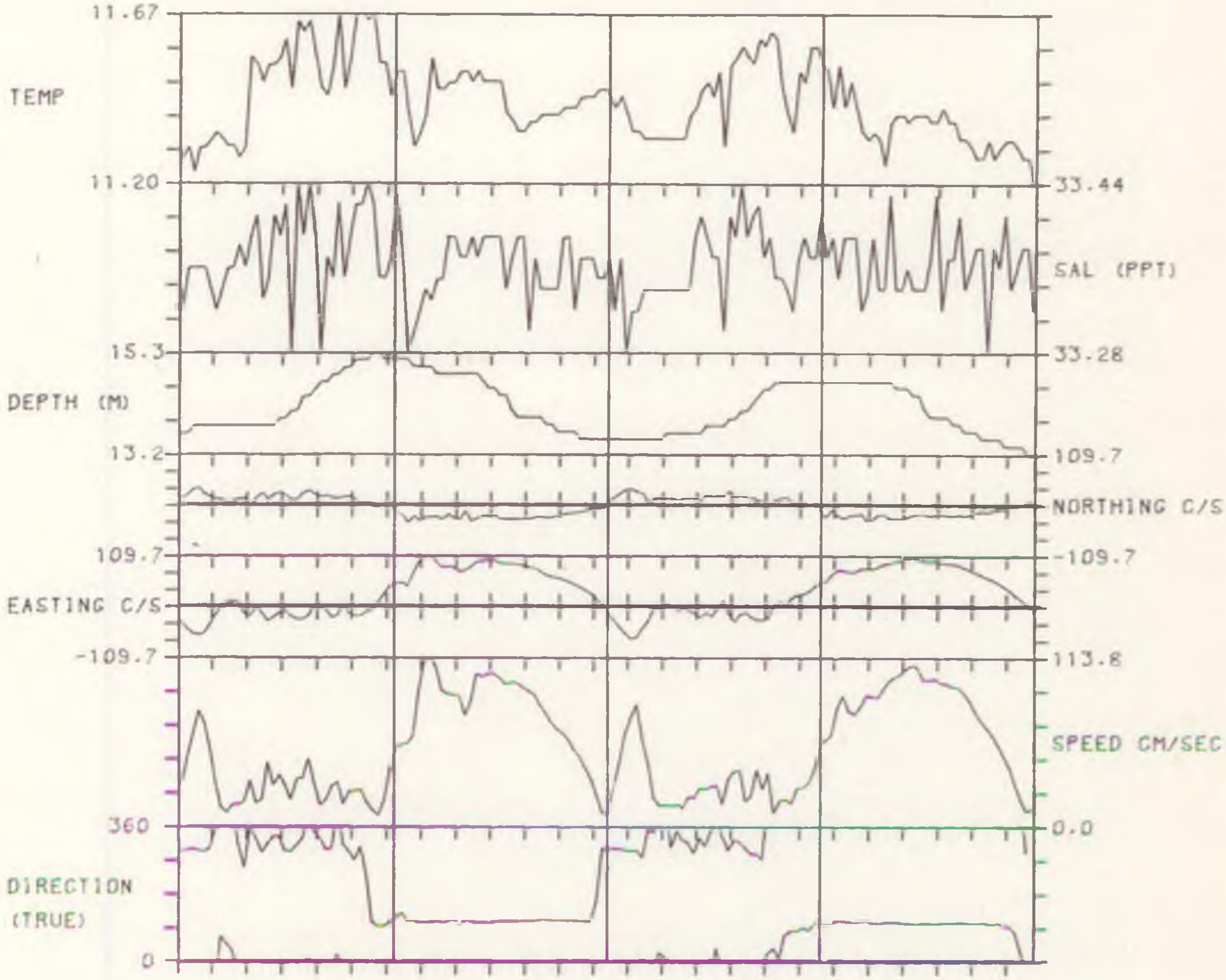
A 1.18.3

CURRENT METER DATA OVER TWO TIDES

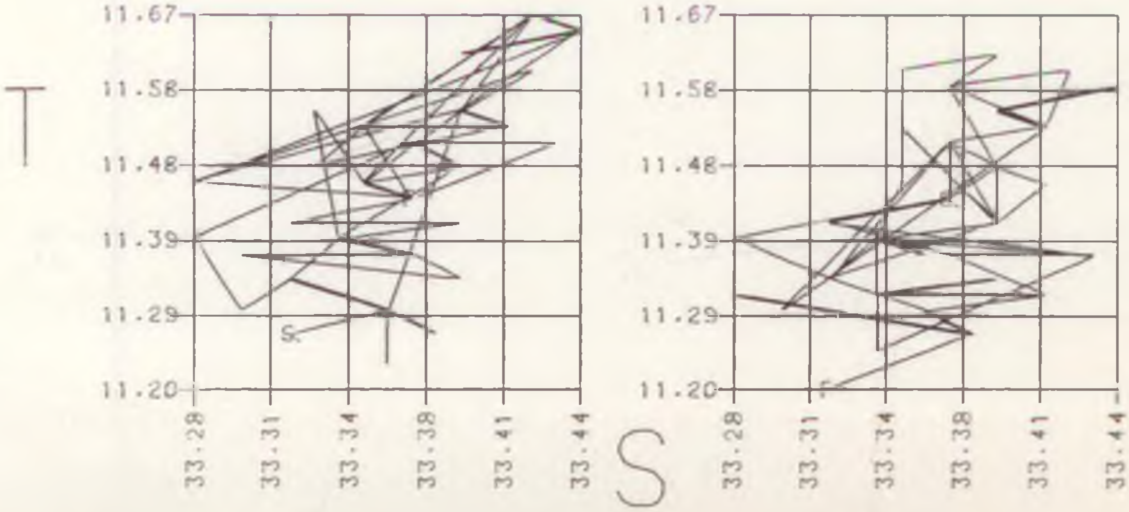
STATION NO. 18

STARTING TIME: 1708 ON 15/11/75

WIRE LENGTH = 9.0 METRES



ONE-TIDE T/S DIAGRAMS



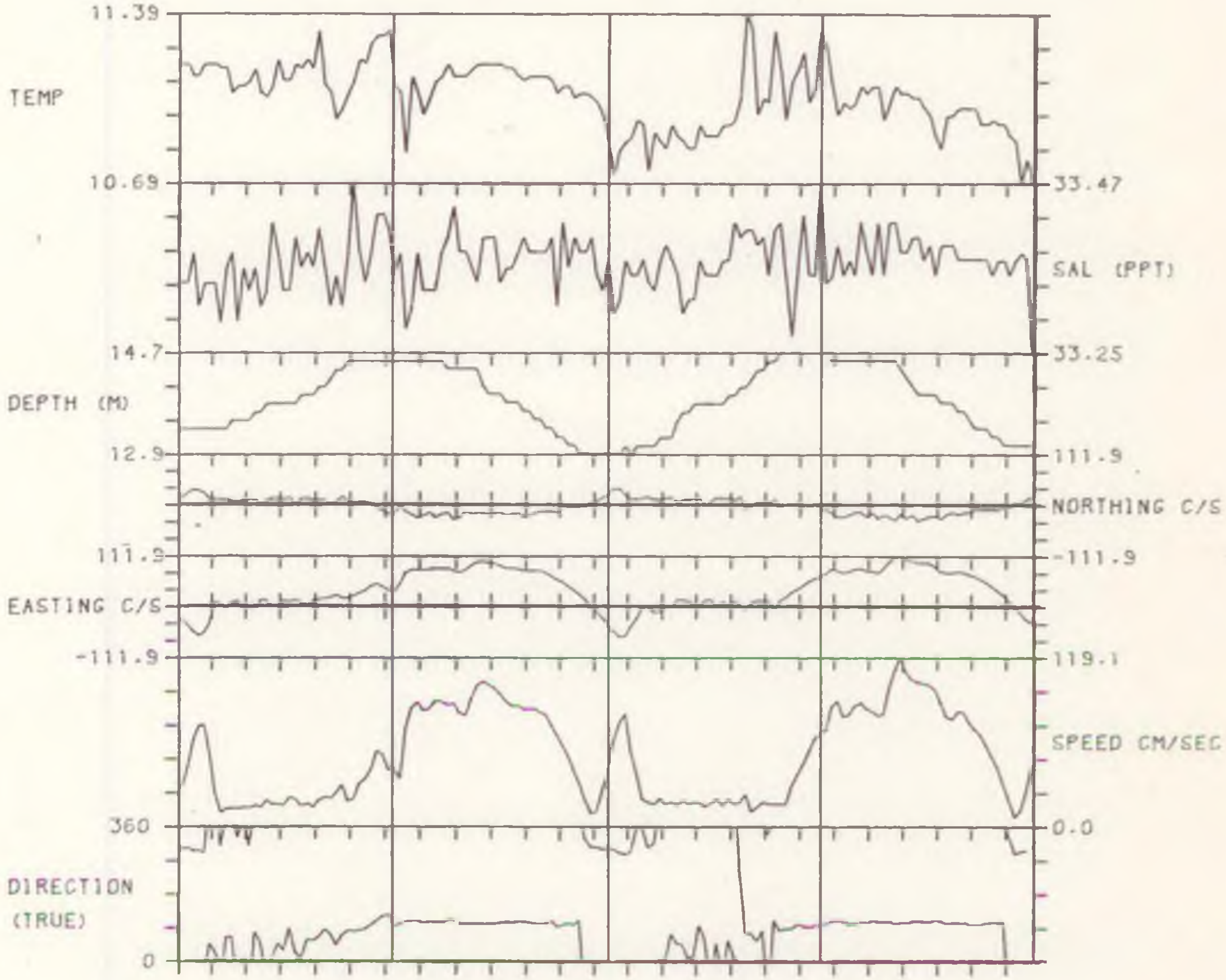
A 1.184

CURRENT METER DATA OVER TWO TIDES

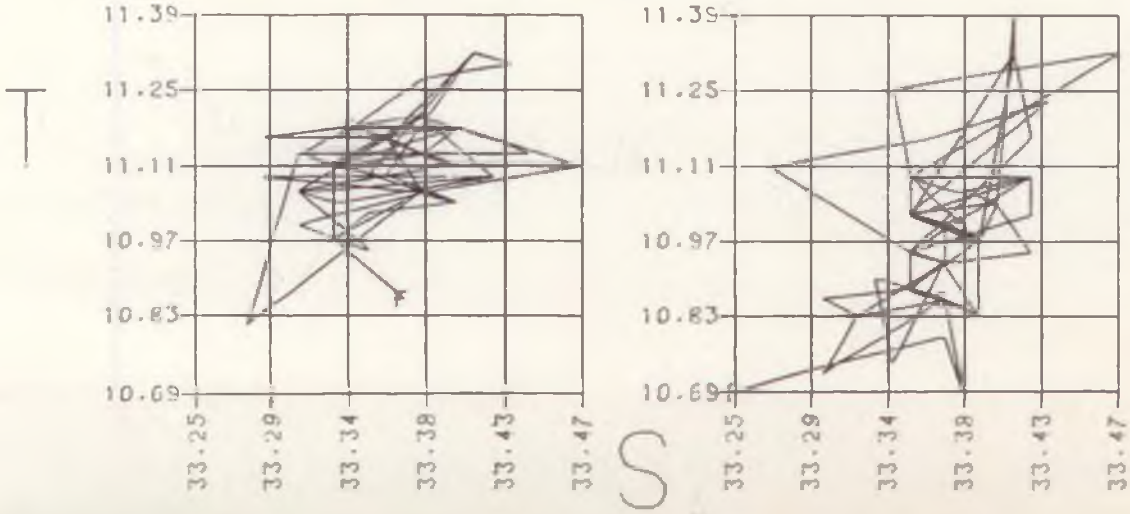
STATION NO. 18

STARTING TIME: 1758 ON 16/11/75

WIRE LENGTH = 9.0 METRES



ONE-TIDE T/S DIAGRAMS



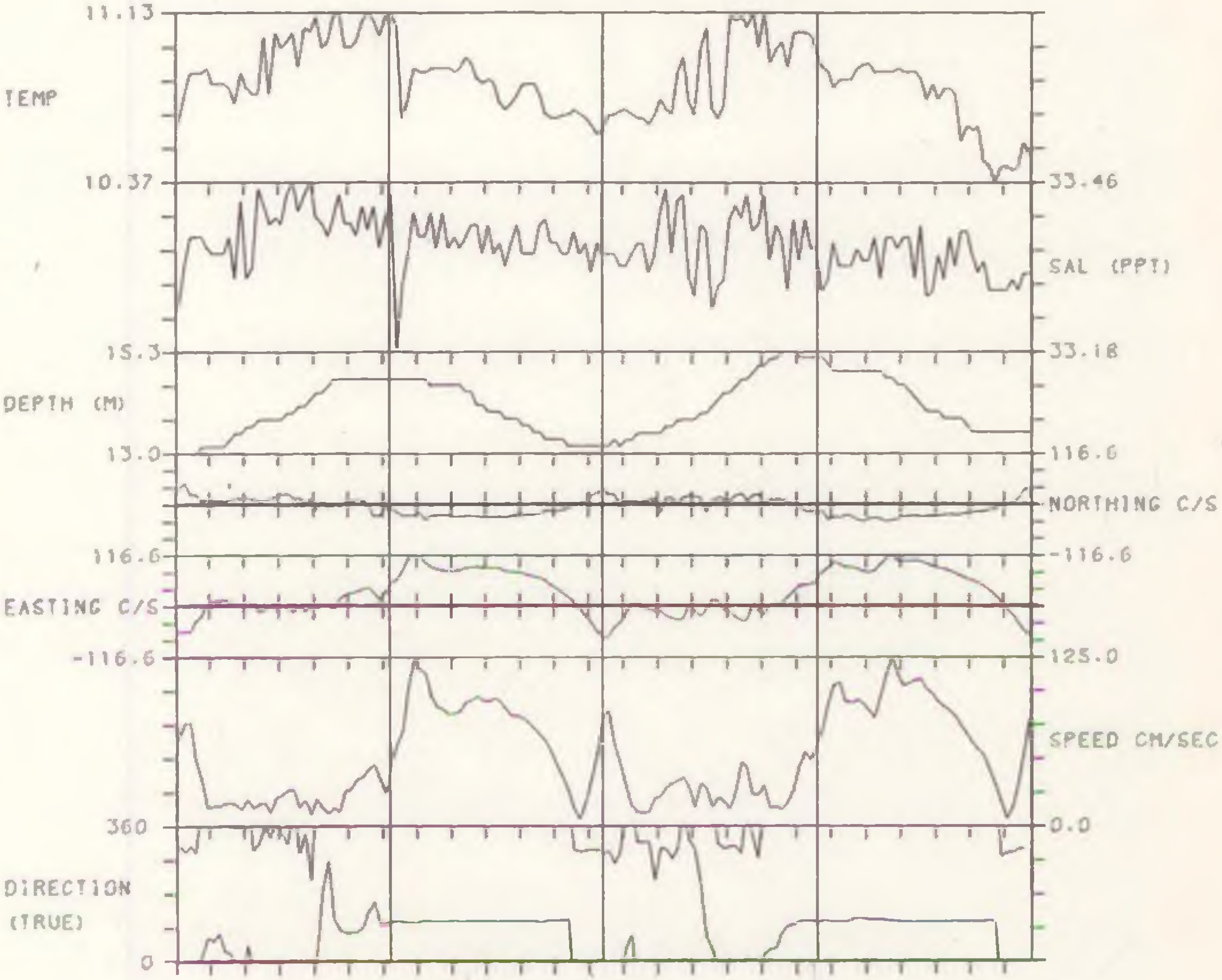
A 1.18.5

CURRENT METER DATA OVER TWO TIDES

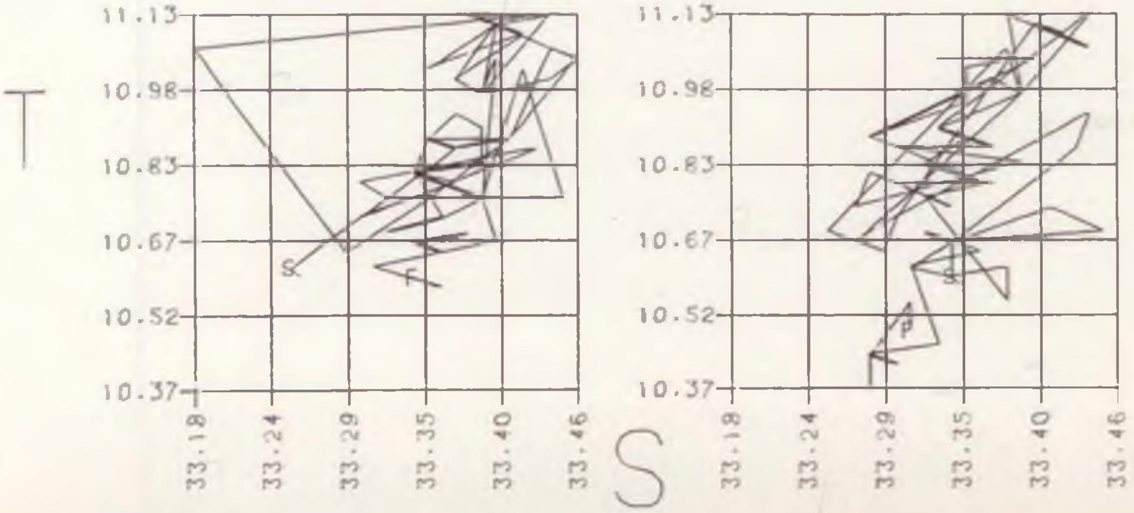
STATION NO. 18

STARTING TIME: 1848 ON 17/11/75

WIRE LENGTH = 9.0 METRES



ONE-TIDE T/S DIAGRAMS

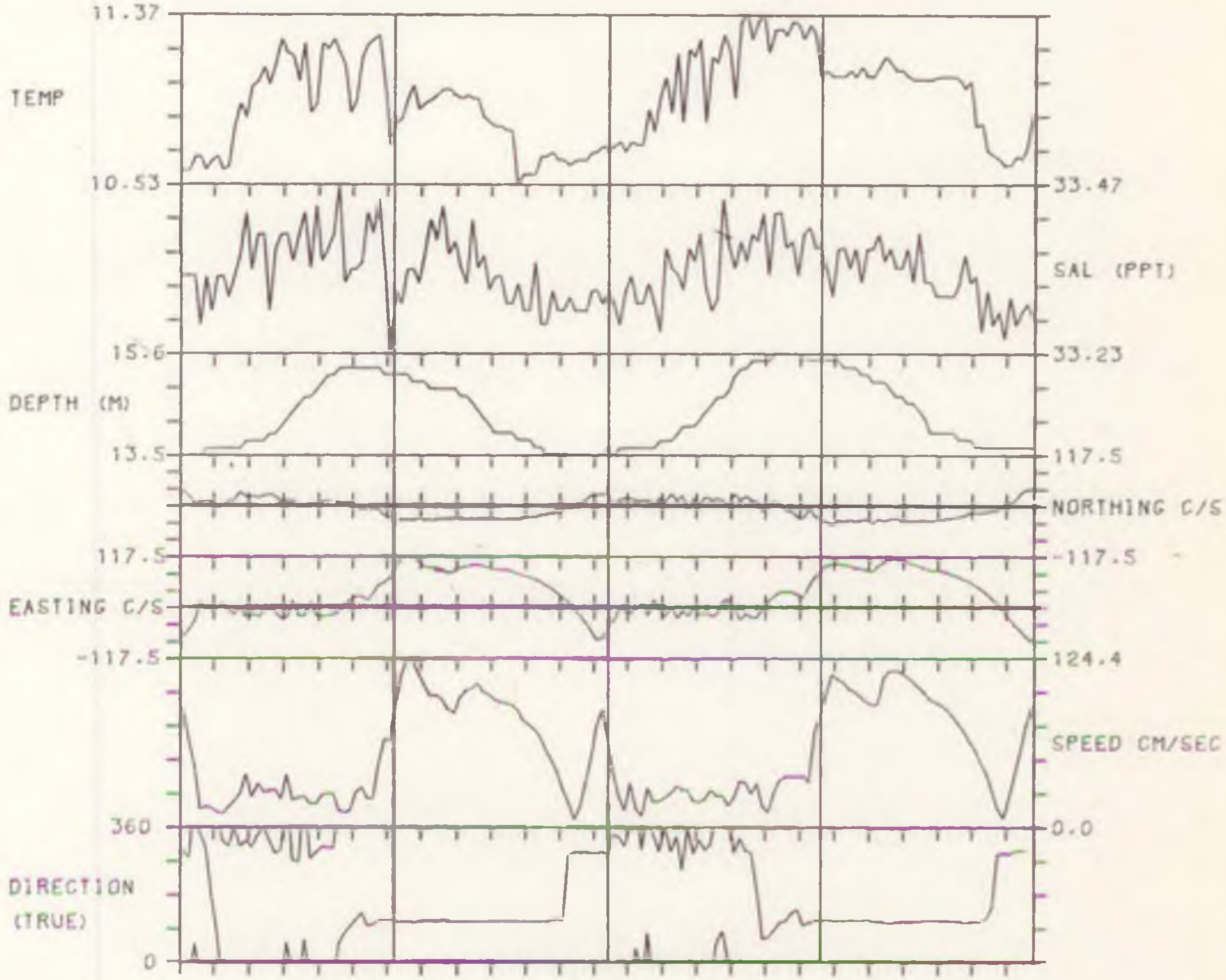


CURRENT METER DATA OVER TWO TIDES

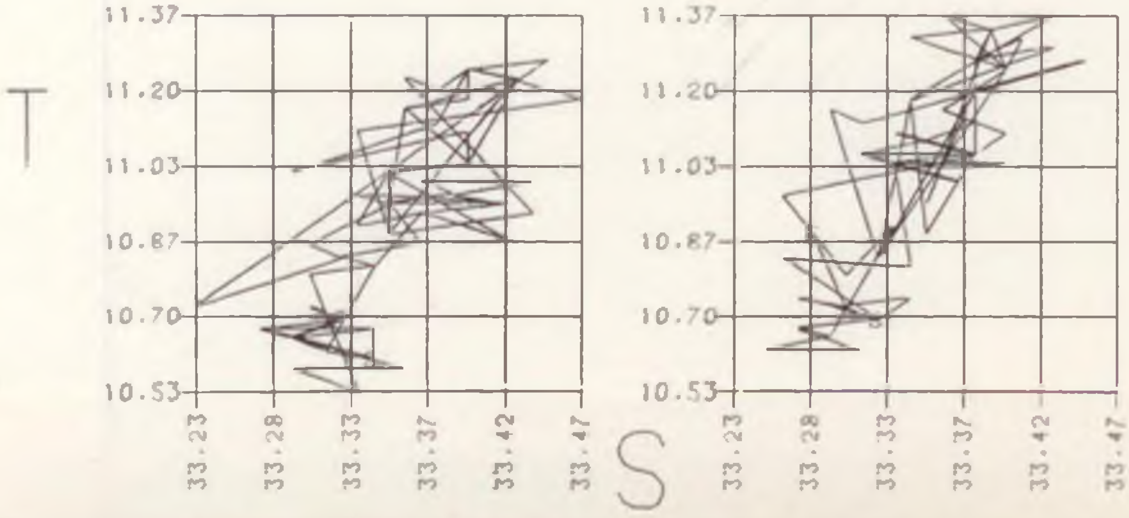
STATION NO. 18

STARTING TIME: 1938 ON 18/11/75

WIRE LENGTH = 9.0 METRES



ONE-TIDE T/S DIAGRAMS



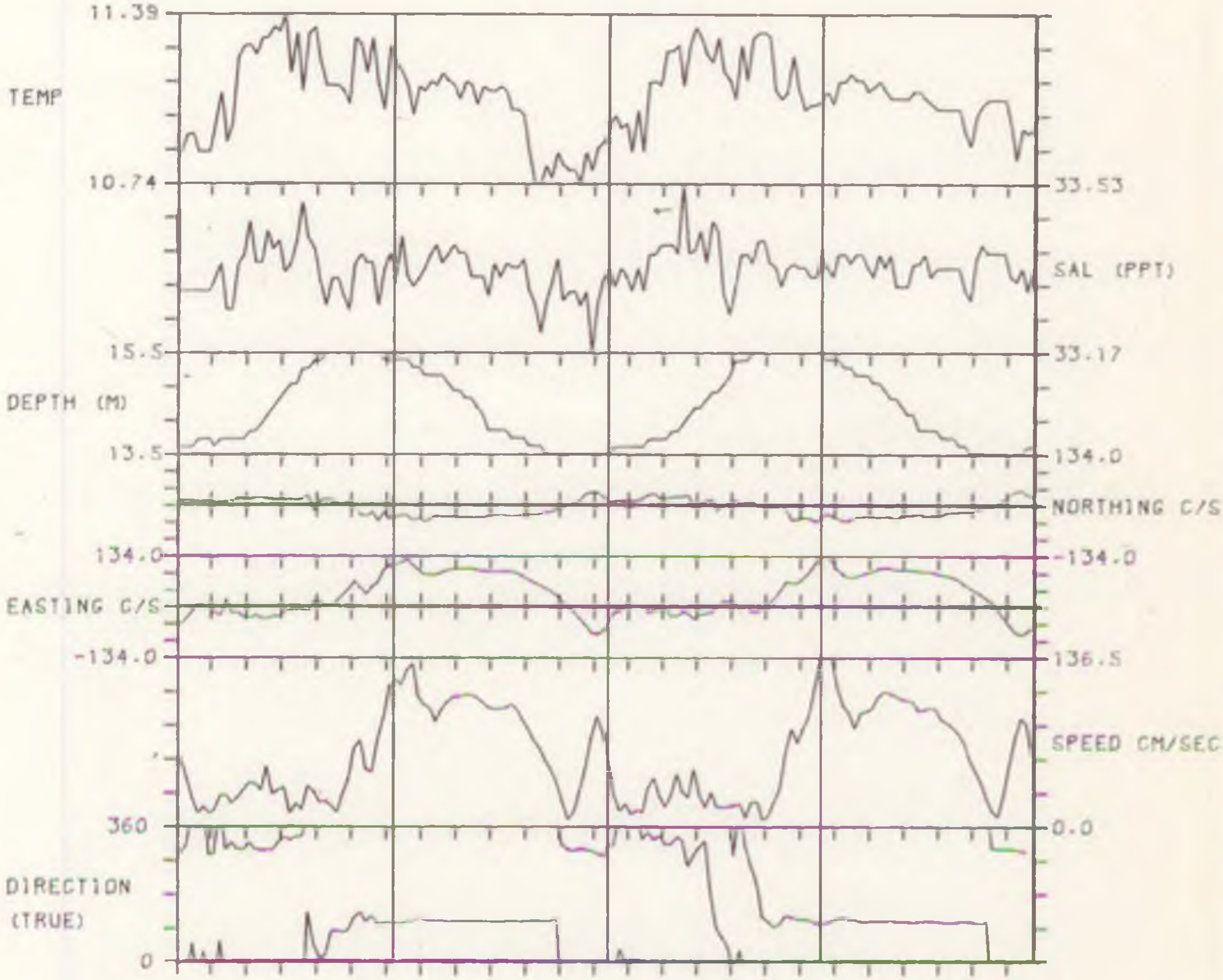
A1.18.7

CURRENT METER DATA OVER TWO TIDES

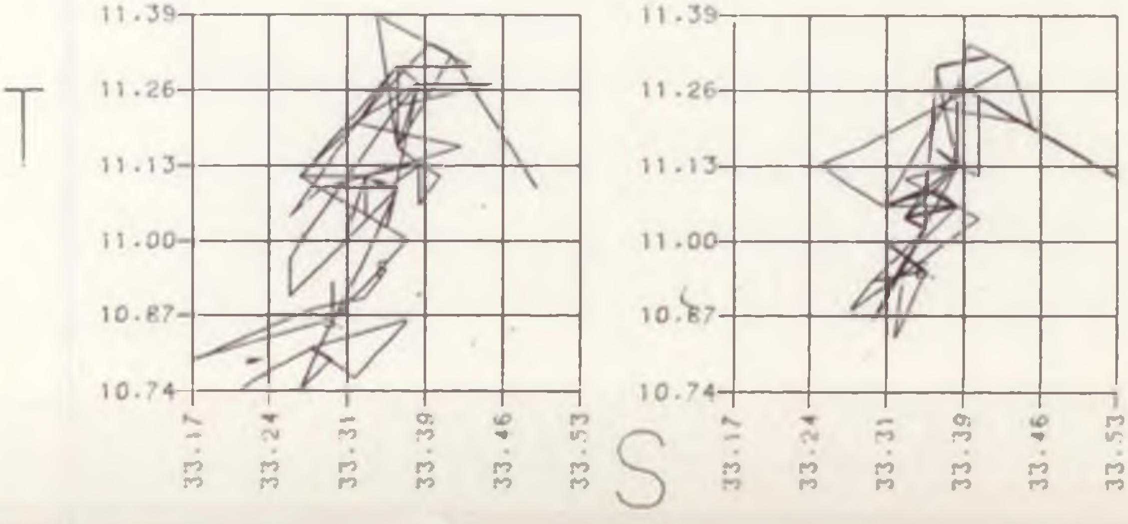
STATION NO. 18

STARTING TIME: 2028 ON 19/11/75

WIRE LENGTH = 9.0 METRES



ONE-TIDE T/S DIAGRAMS



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APPENDIX 2

```
PROGRAM    AVERAGE
DATA AVERAGED OVER   5 TIDAL CYCLES AT STN.   2
THE FIRST RECORD FOR EACH  CYCLE  OCCURRED:
                                 HW Belfast   Time before HW Belfast
 ON 28/ 2/75 AT 2059               0052          3.53
 ON  1/ 3/75 AT  919               1316          3.57
 ON  1/ 3/75 AT 2149               0139          3.50
 ON  2/ 3/75 AT 1009               1405          3.96
 ON  2/ 3/75 AT 2239               0247          3.48   mean 3hours 53min
                                                             sd      9min

THE MEAN TIDAL RANGE PREDICTED AT BELFAST
OVER THE WHOLE PERIOD WAS 3.35 METRES.
Max range was 3.7m.

 SPEED ENCOUNTERED (CM/SEC):
 MEAN = 20.9  MIN =   1.5 MAX =  56.4

 MEAN RESIDUAL EXCURSION =
    -6.30 KM NORTH.  2.65 KM EAST.
```

```
 TIME AFTER START        TEMP   SAL     DEP   SPEED   NORTHING EASTING
 0 HRS.  0 MINS.         7.05  33.55    5.0    9.6       5.1    -9.0
 0 HRS. 10 MINS.         7.06  33.48    5.1   11.9       7.6   -11.0
 0 HRS. 20 MINS.         7.05  33.53    5.1   13.0       9.1   -12.1
 0 HRS. 30 MINS.         7.05  33.53    5.1   13.9      10.2   -13.3
 0 HRS. 40 MINS.         7.05  33.52    5.1   14.0      10.7   -14.4
 0 HRS. 50 MINS.         7.06  33.52    5.1   14.6      10.7   -15.5
 1 HRS.  0 MINS.         7.04  33.52    5.5   19.9      11.9   -15.2
 1 HRS. 10 MINS.         7.04  33.52    5.7   20.9      10.1   -16.4
 1 HRS. 20 MINS.         7.04  33.55    5.1   19.1       9.0   -17.8
 1 HRS. 30 MINS.         7.03  33.55    5.3   19.5       7.2   -18.4
 1 HRS. 40 MINS.         7.03  33.56    5.3   19.1       3.5   -17.6
 1 HRS. 50 MINS.         7.00  33.60    5.2   17.5       3.3   -17.0
 2 HRS.  0 MINS.         7.00  33.68    5.4   17.3      -3.6   -15.4
 2 HRS. 10 MINS.         6.98  33.60    4.4   13.9      -9.2   -13.3
 2 HRS. 20 MINS.         6.99  33.50    5.0   17.5     -16.0    -9.1
 2 HRS. 30 MINS.         6.99  33.50    5.0   20.6     -22.8    -0.5
 2 HRS. 40 MINS.         6.99  33.57    5.0   22.6     -28.2    10.6
 2 HRS. 50 MINS.         7.01  33.54    5.0   28.9     -33.0    23.9
 3 HRS.  0 MINS.         7.05  33.54    5.0   36.9     -36.8    30.4
 3 HRS. 10 MINS.         7.05  33.60    5.0   40.0     -33.6    28.3
 3 HRS. 20 MINS.         7.07  33.58    5.7   40.3     -26.8    26.3
 3 HRS. 30 MINS.         7.05  33.50    5.7   30.1     -25.2    20.2
 3 HRS. 40 MINS.         7.05  33.59    5.4   24.2     -22.8    10.6
 3 HRS. 50 MINS.         7.05  33.50    6.2   23.4     -22.5    10.4
 4 HRS.  0 MINS.         7.05  33.58    6.6   29.0     -23.6    13.2
 4 HRS. 10 MINS.         7.08  33.60    6.6   31.0     -28.9    13.5
 4 HRS. 20 MINS.         7.08  33.63    6.4   37.0     -31.2    13.7
 4 HRS. 30 MINS.         7.08  33.60    6.4   36.0     -36.6     9.7
 4 HRS. 40 MINS.         7.07  33.60    6.3   39.3     -37.3     6.5
 4 HRS. 50 MINS.         7.07  33.61    6.3   39.0     -35.6     1.3
 5 HRS.  0 MINS.         7.07  33.61    6.3   33.4     -34.6     8.6
 5 HRS. 10 MINS.         7.07  33.61    6.0   39.2     -33.9    16.8
 5 HRS. 20 MINS.         7.07  33.61    6.5   39.3     -31.3    14.3
 5 HRS. 30 MINS.         7.07  33.61    6.6   33.5     -25.3    12.3
 5 HRS. 40 MINS.         7.07  33.61    6.7   29.3     -28.2    15.5
 5 HRS. 50 MINS.         7.07  33.61    6.7   29.3     -28.7    15.2
 6 HRS.  0 MINS.         7.06  33.50    6.0   27.5     -26.0     6.1
 6 HRS. 10 MINS.         7.07  33.61    6.0   27.1     -25.6     9.4
 6 HRS. 20 MINS.         7.08  33.61    6.0   26.4     -25.5     9.7
 6 HRS. 30 MINS.         7.08  33.61    6.0   24.6     -25.8    10.2
 6 HRS. 40 MINS.         7.08  33.61    6.0   24.3     -22.3    12.1
 6 HRS. 50 MINS.         7.08  33.60    6.0   23.8     -19.0    13.6
 7 HRS.  0 MINS.         7.08  33.58    6.0   23.2     -17.1    11.1
 7 HRS. 10 MINS.         7.08  33.60    6.0   19.3     -14.6    11.3
 7 HRS. 20 MINS.         7.09  33.59    6.0   18.5     -11.9    13.6
 7 HRS. 30 MINS.         7.08  33.60    6.0   19.2      -6.1    16.0
 7 HRS. 40 MINS.         7.08  33.59    6.0   19.2      -8.1    16.7
 7 HRS. 50 MINS.         7.09  33.58    6.0   19.2      -8.8    16.4
 8 HRS.  0 MINS.         7.08  33.58    6.3   24.0      -8.1    14.9
 8 HRS. 10 MINS.         7.08  33.56    6.3   17.0      -7.3    12.8
 8 HRS. 20 MINS.         7.07  33.54    6.3   14.1      -3.3    11.2
 8 HRS. 30 MINS.         7.07  33.56    6.3   11.9      -1.3    10.4
 8 HRS. 40 MINS.         7.07  33.55    6.3   10.0      -1.7     8.1
 8 HRS. 50 MINS.         7.08  33.55    6.2    8.6      -0.7     7.3
 9 HRS.  0 MINS.         7.08  33.55    6.2    8.6       0.7     7.0
 9 HRS. 10 MINS.         7.07  33.59    6.0    8.3       0.8     7.0
 9 HRS. 20 MINS.         7.07  33.57    6.0    8.1       2.8     7.6
 9 HRS. 30 MINS.         7.07  33.57    6.0    8.1       3.2     7.3
 9 HRS. 40 MINS.         7.07  33.50    6.0    4.0       3.2     9.4
 9 HRS. 50 MINS.         7.06  33.60    5.3   11.3       2.9    13.3
10 HRS.  0 MINS.         7.06  33.59    5.3   13.3       2.1    13.0
10 HRS. 10 MINS.         7.06  33.60    5.1   13.5       2.5    13.2
10 HRS. 20 MINS.         7.06  33.57    5.9   12.3       2.6    14.8
10 HRS. 30 MINS.         7.06  33.47    5.0   12.4       2.9    13.3
10 HRS. 40 MINS.         7.07  33.55    5.3   12.6       3.2    11.7
10 HRS. 50 MINS.         7.06  33.50    5.3   12.8       3.6    10.9
11 HRS.  0 MINS.         7.07  33.50    5.2   12.6       3.9     9.6
11 HRS. 10 MINS.         7.06  33.50    5.2   11.0       3.4     7.6
11 HRS. 20 MINS.         7.06  33.42    5.3    9.0       4.1     9.2
11 HRS. 30 MINS.         7.05  33.42    5.3    9.0       4.8     3.0
11 HRS. 40 MINS.         7.06  33.43    5.4    8.3       5.7     1.8
11 HRS. 50 MINS.         7.06  33.49    5.1    8.3       5.5     1.3
12 HRS.  0 MINS.         7.05  33.39    4.0    8.3       4.2    -5.0
12 HRS. 10 MINS.         7.06  33.30    4.0    8.1       4.2    -5.0
12 HRS. 20 MINS.         7.07  33.30    4.0    9.0       5.2    -6.0
```

```
PROGRAM   AVERAGE

DATA AVERAGED OVER   6 TIDAL CYCLES AT STN.   3
THE FIRST RECORD FOR EACH  CYCLE  OCCURRED:
                                  HW Belfast      Time diff
 ON  3/ 3/75 AT 2330                 0318            3.48
 ON  4/ 3/75 AT 1150                 1951            8.01
 ON  5/ 3/75 AT   20                 0419            3.59
 ON  5/ 3/75 AT 1240                 1658            4.18
 ON  6/ 3/75 AT  110                 0544            4.34
 ON  6/ 3/75 AT 1330                 1914            5.44 - mean time diff 1hr 0min.
                                                                      s.d.     22min
THE MEAN TIDAL RANGE PREDICTED AT BELFAST
OVER THE WHOLE PERIOD WAS 2.15 METRES.
Max range was 2.6m

 SPEED ENCOUNTERED (CM/SEC):
 MEAN = 11.1  MIN =   1.5 MAX =  40.5

 MEAN RESIDUAL EXCURSION =
    -3.59 KM NORTH, -1.25 KM EAST.
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```
TIME AFTER START         TEMP  SAL     DEP    SPEED  NORTHING EASTING
 0 HRS.  0 MINS.         7.20 33.55   11.1    3.6      1.6    -1.1
 0 HRS. 10 MINS.         7.20 33.50   11.1    2.8      2.9    -0.8
 0 HRS. 20 MINS.         7.21 33.58   11.1    3.3      2.6    -1.0
 0 HRS. 30 MINS.         7.21 33.51   11.1    4.7      2.1    -0.7
 0 HRS. 40 MINS.         7.21 33.52   11.1    4.2      1.6    -0.4
 0 HRS. 50 MINS.         7.21 33.52   11.1    3.6      0.8    -0.4
 1 HRS.  0 MINS.         7.21 33.55   11.1    3.6     -0.3    -1.1
 1 HRS. 10 MINS.         7.21 33.46   11.1    3.0      0.3    -1.8
 1 HRS. 20 MINS.         7.22 33.46   11.1    3.2      0.2    -2.7
 1 HRS. 30 MINS.         7.22 33.46   11.2    3.6      0.4    -3.1
 1 HRS. 40 MINS.         7.22 33.53   11.5    4.0      0.1    -4.0
 1 HRS. 50 MINS.         7.22 33.46   11.5    4.0      1.7    -4.0
 2 HRS.  0 MINS.         7.22 33.40   11.3    4.5      1.7    -4.5
 2 HRS. 10 MINS.         7.22 33.46   11.3    5.0      1.6    -4.4
 2 HRS. 20 MINS.         7.21 33.46   11.5    5.2      0.6    -4.8
 2 HRS. 30 MINS.         7.21 33.48   11.5    5.7      0.5    -4.6
 2 HRS. 40 MINS.         7.20 33.47   11.5    6.2      1.5    -6.6
 2 HRS. 50 MINS.         7.19 33.48   11.5    7.0     -2.5    -7.2
 3 HRS.  0 MINS.         7.21 33.49   11.5    9.3     -2.9    -7.1
 3 HRS. 10 MINS.         7.21 33.50   11.6    9.1     -6.0    -5.5
 3 HRS. 20 MINS.         7.21 33.49   11.6   10.1     -9.6    -2.9
 3 HRS. 30 MINS.         7.20 33.47   11.7   12.3    -12.1    -4.2
 3 HRS. 40 MINS.         7.18 33.46   11.7   15.2    -14.6    -6.9
 3 HRS. 50 MINS.         7.19 33.40   11.8   17.3    -17.7    -3.2
 4 HRS.  0 MINS.         7.20 33.51   11.8   19.9    -18.8    -3.9
 4 HRS. 10 MINS.         7.21 33.50   11.8   20.5    -20.6    -4.4
 4 HRS. 20 MINS.         7.20 33.51   11.9   22.4    -22.4    -1.5
 4 HRS. 30 MINS.         7.19 33.54   11.9   23.0    -23.6    -5.7
 4 HRS. 40 MINS.         7.20 33.54   11.9   23.3    -24.8    -3.3
 4 HRS. 50 MINS.         7.21 33.50   11.9   25.3    -25.5    -3.3
 5 HRS.  0 MINS.         7.21 33.56   12.0   26.5    -25.7    -3.9
 5 HRS. 10 MINS.         7.21 33.53   12.0   26.3    -25.5    -4.8
 5 HRS. 20 MINS.         7.22 33.56   11.9   26.3    -25.3    -1.6
 5 HRS. 30 MINS.         7.24 33.58   11.9   25.7    -24.6    -4.8
 5 HRS. 40 MINS.         7.25 33.59   11.9   25.4    -24.0    -5.3
 5 HRS. 50 MINS.         7.24 33.58   11.9   24.6    -22.3    -6.3
 6 HRS.  0 MINS.         7.24 33.57   12.0   22.2    -20.6    -4.4
 6 HRS. 10 MINS.         7.24 33.57   11.9   20.9    -19.7    -3.7
 6 HRS. 20 MINS.         7.24 33.55   11.9   20.2    -21.0    -4.1
 6 HRS. 30 MINS.         7.24 33.60   11.9   22.2    -19.8    -6.0
 6 HRS. 40 MINS.         7.24 33.60   11.9   19.6    -17.0    -1.3
 6 HRS. 50 MINS.         7.24 33.61   11.9   17.3    -14.3     0.6
 7 HRS.  0 MINS.         7.24 33.58   11.9   14.7    -13.1    -0.5
 7 HRS. 10 MINS.         7.24 33.61   11.9   13.3    -13.4    -2.0
 7 HRS. 20 MINS.         7.22 33.60   11.9   13.9    -12.6    -0.9
 7 HRS. 30 MINS.         7.22 33.60   11.9   13.2    -11.3    -0.6
 7 HRS. 40 MINS.         7.22 33.50   11.9   11.7    -10.0    -1.0
 7 HRS. 50 MINS.         7.22 33.58   11.9   11.5    -10.0    -2.4
 8 HRS.  0 MINS.         7.24 33.50   11.9   11.5    -10.8    -4.0
 8 HRS. 10 MINS.         7.23 33.60   11.8   12.1    -10.2    -4.5
 8 HRS. 20 MINS.         7.23 33.64   11.9   11.9     -9.8    -4.3
 8 HRS. 30 MINS.         7.23 33.59   11.8   10.9     -9.3    -4.7
 8 HRS. 40 MINS.         7.23 33.60   11.9   10.2     -8.5    -2.8
 8 HRS. 50 MINS.         7.23 33.57   11.9    9.6     -5.8    -3.0
 9 HRS.  0 MINS.         7.23 33.57   12.0    8.6     -5.5    -3.1
 9 HRS. 10 MINS.         7.23 33.55   12.0    7.0     -4.3    -2.1
 9 HRS. 20 MINS.         7.23 33.53   12.0    7.0     -3.5    -2.2
 9 HRS. 30 MINS.         7.23 33.53   11.9    7.3     -3.5    -1.0
 9 HRS. 40 MINS.         7.23 33.55   11.9    6.5     -3.1    -1.8
 9 HRS. 50 MINS.         7.23 33.55   11.8    6.1     -3.0    -1.6
10 HRS.  0 MINS.         7.23 33.53   11.9    5.2     -2.4    -1.2
10 HRS. 10 MINS.         7.23 33.53   11.8    5.2     -1.7    -1.2
10 HRS. 20 MINS.         7.23 33.54   11.6    5.4     -0.7    -1.4
10 HRS. 30 MINS.         7.23 33.57   11.6    5.6     -0.2    -1.4
10 HRS. 40 MINS.         7.23 33.54   11.5    4.9     -0.3    -1.2
10 HRS. 50 MINS.         7.23 33.54   11.5    4.4     -0.3    -1.2
11 HRS.  0 MINS.         7.23 33.54   11.5    4.3     -0.5    -1.2
11 HRS. 10 MINS.         7.24 33.55   11.4    4.6     -0.5    -1.2
11 HRS. 20 MINS.         7.23 33.55   11.4    5.1     -0.1    -1.4
11 HRS. 30 MINS.         7.23 33.57   11.4    4.8     -0.2    -1.3
11 HRS. 40 MINS.         7.22 33.57   11.4    4.9      0.3    -1.2
11 HRS. 50 MINS.         7.22 33.57   11.3    4.9      0.3    -1.7
12 HRS.  0 MINS.         7.22 33.56   11.3    4.7      0.4    -1.7
12 HRS. 10 MINS.         7.22 33.56   11.3    4.1      0.6    -1.6
12 HRS. 20 MINS.         7.22 33.53   11.3    3.5      0.9    -1.8
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A 3.2

```
PROGRAM   AVERAGE
DATA AVERAGED OVER   5 TIDAL CYCLES AT STN.   4
THE FIRST RECORD FOR EACH  CYCLE  OCCURRED:
                                 Hw Belfast      Time before Hw Belfast
 ON  7/ 3/75 AT 1550               1932               3.42
 ON  8/ 3/75 AT  410               0802               3.52
 ON  8/ 3/75 AT 1640               2033               3.53
 ON  9/ 3/75 AT  5 0               0857               3.57
 ON  9/ 3/75 AT 1730               2121               3.51   mean 3h. 51min.
                                                               s.d.   5min.
THE MEAN TIDAL RANGE PREDICTED AT BELFAST
OVER THE WHOLE PERIOD WAS 2.01 METRES.
Max range was 2.4m.

 SPEED ENCOUNTERED (CM/SEC):
 MEAN = 16.9  MIN =   1.9 MAX =  39.0

 MEAN RESIDUAL EXCURSION =
     0.98 KM NORTH,  5.66 KM EAST.
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```
TIME AFTER START      TEMP   SAL     DEP    SPEED   NORTHING EASTING
 0 HRS.  0 MINS.      7.28 33.50    13.7     7.6     -3.9    -1.1
 0 HRS. 10 MINS.      7.30 33.50    13.7     6.9     -2.8    -4.0
 0 HRS. 20 MINS.      7.28 33.55    13.7     8.9     -1.9    -6.5
 0 HRS. 30 MINS.      7.27 33.55    13.7     8.7     -1.3    -7.5
 0 HRS. 40 MINS.      7.30 33.55    13.7     9.0     -0.2    -7.9
 0 HRS. 50 MINS.      7.30 33.53    13.6     8.4      0.2    -8.3
 1 HRS.  0 MINS.      7.28 33.46    13.8     9.8     -0.8    -9.2
 1 HRS. 10 MINS.      7.29 33.46    13.8     9.8     -1.8    -9.3
 1 HRS. 20 MINS.      7.28 33.40    13.7    10.9     -4.2    -8.3
 1 HRS. 30 MINS.      7.28 33.42    13.7    10.5     -4.8    -7.8
 1 HRS. 40 MINS.      7.28 33.43    13.7     8.5     -6.1    -5.9
 1 HRS. 50 MINS.      7.27 33.47    13.8     8.3     -8.8    -4.3
 2 HRS.  0 MINS.      7.27 33.48    13.8     9.0     -8.0    -2.8
 2 HRS. 10 MINS.      7.27 33.50    13.8     9.5     -8.5    -0.6
 2 HRS. 20 MINS.      7.26 33.40    13.9    10.3    -10.5     2.1
 2 HRS. 30 MINS.      7.26 33.52    13.9    11.2    -10.0     6.9
 2 HRS. 40 MINS.      7.26 33.52    13.9    13.5     -6.1    12.9
 2 HRS. 50 MINS.      7.26 33.55    13.9    15.6     -2.5    16.8
 3 HRS.  0 MINS.      7.26 33.51    14.0    18.6      1.6    20.6
 3 HRS. 10 MINS.      7.26 33.53    14.1    22.9      5.2    23.3
 3 HRS. 20 MINS.      7.26 33.50    14.2    24.1      8.3    22.0
 3 HRS. 30 MINS.      7.26 33.40    14.6    24.6      8.2    22.8
 3 HRS. 40 MINS.      7.25 33.50    14.5    27.3     11.8    24.4
 3 HRS. 50 MINS.      7.26 33.51    14.6    27.7     14.6    23.7
 4 HRS.  0 MINS.      7.27 33.54    14.7    30.1     16.2    23.6
 4 HRS. 10 MINS.      7.26 33.55    14.8    30.2     15.2    23.2
 4 HRS. 20 MINS.      7.26 33.53    14.9    30.1     13.4    24.6
 4 HRS. 30 MINS.      7.27 33.53    14.9    28.7     12.0    23.4
 4 HRS. 40 MINS.      7.26 33.55    15.0    26.9      9.6    22.4
 4 HRS. 50 MINS.      7.29 33.57    15.0    25.2     11.0    20.6
 5 HRS.  0 MINS.      7.28 33.54    15.1    23.1      8.0    21.0
 5 HRS. 10 MINS.      7.26 33.52    15.1    24.1      9.0    21.1
 5 HRS. 20 MINS.      7.27 33.53    15.1    22.1      5.9    21.1
 5 HRS. 30 MINS.      7.27 33.53    15.3    23.1      7.6    21.0
 5 HRS. 40 MINS.      7.26 33.52    15.3    23.3      9.8    20.8
 5 HRS. 50 MINS.      7.26 33.53    15.3    23.0      7.0    20.9
 6 HRS.  0 MINS.      7.26 33.54    15.3    22.3      7.8    21.9
 6 HRS. 10 MINS.      7.26 33.56    15.3    25.3      9.0    22.9
 6 HRS. 20 MINS.      7.26 33.55    15.3    23.2      6.2    22.6
 6 HRS. 30 MINS.      7.26 33.53    15.2    23.6      4.8    20.8
 6 HRS. 40 MINS.      7.26 33.54    15.2    22.2      3.2    18.7
 6 HRS. 50 MINS.      7.26 33.53    15.2    19.5      2.7    16.6
 7 HRS.  0 MINS.      7.26 33.53    15.1    19.2      4.1    13.3
 7 HRS. 10 MINS.      7.26 33.54    15.1    17.3      3.5    13.9
 7 HRS. 20 MINS.      7.26 33.55    15.1    17.3      2.4    15.1
 7 HRS. 30 MINS.      7.25 33.55    15.1    17.3      5.1    15.6
 7 HRS. 40 MINS.      7.26 33.54    15.1    17.3      4.8    16.5
 7 HRS. 50 MINS.      7.26 33.53    15.0    18.4      5.1    17.5
 8 HRS.  0 MINS.      7.26 33.53    15.0    19.2      5.3    18.5
 8 HRS. 10 MINS.      7.26 33.52    15.0    19.5      5.9    19.5
 8 HRS. 20 MINS.      7.26 33.55    14.9    20.5      4.3    20.4
 8 HRS. 30 MINS.      7.26 33.53    14.9    21.5      4.6    20.5
 8 HRS. 40 MINS.      7.26 33.52    14.9    20.5      3.0    19.2
 8 HRS. 50 MINS.      7.26 33.54    14.9    18.9      2.2    18.6
 9 HRS.  0 MINS.      7.26 33.53    14.8    19.6      3.3    18.5
 9 HRS. 10 MINS.      7.27 33.54    14.7    18.0      3.2    17.6
 9 HRS. 20 MINS.      7.27 33.53    14.6    16.3      2.6    16.1
 9 HRS. 30 MINS.      7.28 33.53    14.5    15.3      0.6    13.2
 9 HRS. 40 MINS.      7.28 33.54    14.4    12.3     -0.4    12.9
 9 HRS. 50 MINS.      7.27 33.51    14.3    14.5     -0.7    13.9
10 HRS.  0 MINS.      7.26 33.55    14.2    14.2     -1.0    14.1
10 HRS. 10 MINS.      7.27 33.50    14.4    16.9     -0.7    14.6
10 HRS. 20 MINS.      7.26 33.52    14.1    15.1     -1.6    12.1
10 HRS. 30 MINS.      7.28 33.53    14.0    14.3     -0.7    13.6
10 HRS. 40 MINS.      7.27 33.51    13.9    14.0     -0.9    13.8
10 HRS. 50 MINS.      7.26 33.52    13.8    14.1      0.1    13.7
11 HRS.  0 MINS.      7.25 33.55    13.8    14.2      0.9    12.8
11 HRS. 10 MINS.      7.25 33.55    13.8    13.0     -0.3    11.5
11 HRS. 20 MINS.      7.26 33.51    13.8    11.6     -0.4    11.0
11 HRS. 30 MINS.      7.25 33.52    13.7    11.3     -1.9     9.8
11 HRS. 40 MINS.      7.25 33.52    13.8     9.1     -2.5     8.3
11 HRS. 50 MINS.      7.25 33.55    13.8     9.3     -3.3     6.3
12 HRS.  0 MINS.      7.25 33.55    13.8     8.0     -3.6     3.8
12 HRS. 10 MINS.      7.25 33.57    13.8     7.0     -4.2     3.1
12 HRS. 20 MINS.      7.25 33.55    13.7     6.2     -4.7     0.6
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A 3.3

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PROGRAM   AVERAGE
DATA AVERAGED OVER   1 TIDAL CYCLES AT STN.    5
THE FIRST RECORD FOR EACH  CYCLE  OCCURRED:
 ON 10/ 3/75 AT 16 0
THE MEAN TIDAL RANGE PREDICTED AT BELFAST
OVER THE WHOLE PERIOD WAS 2.35 METRES.

 SPEED ENCOUNTERED (CM/SEC):
 MEAN = 18.9  MIN =   3.1 MAX =  33.9

 MEAN RESIDUAL EXCURSION =
    -6.23 KM NORTH,  2.12 KM EAST.
```

HW Belfast 21.39

Time before HW Belfast 5.59

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TIME AFTER START        TEMP   SAL     DEP   SPEED   NORTHING EASTING
 0 HRS.  0 MINS.        7.19  33.36    8.9   28.0    -13.6    12.3
 0 HRS. 10 MINS.        7.19  33.36    8.9   17.1    -13.8     8.3
 0 HRS. 20 MINS.        7.19  33.40    8.8   12.0    -12.3    10.0
 0 HRS. 30 MINS.        7.19  33.40    8.8   16.7    -12.0     9.4
 0 HRS. 40 MINS.        7.22  33.32    8.8   15.8     -6.6    10.2
 0 HRS. 50 MINS.        7.16  33.32    8.5   10.5     -7.2     6.0
 1 HRS.  0 MINS.        7.19  33.40    8.3   11.3    -10.2     4.9
 1 HRS. 10 MINS.        7.19  33.40    8.2   11.7    -10.0     6.0
 1 HRS. 20 MINS.        7.16  33.45    8.0   11.7     -9.7     5.8
 1 HRS. 30 MINS.        7.16  33.36    8.0   10.0     -6.3     6.5
 1 HRS. 40 MINS.        7.16  33.32    7.9    7.2     -4.6     4.7
 1 HRS. 50 MINS.        7.16  33.45    7.9    6.0     -3.5     3.8
 2 HRS.  0 MINS.        7.16  33.45    7.9    4.4     -4.4    -0.2
 2 HRS. 10 MINS.        7.16  33.45    7.9    4.6     -3.7    -0.6
 2 HRS. 20 MINS.        7.16  33.45    7.9    3.1     -3.8    -2.0
 2 HRS. 30 MINS.        7.16  33.45    7.9    3.6     -2.3    -4.9
 2 HRS. 40 MINS.        7.16  33.32    7.9    5.2      4.1    -5.7
 2 HRS. 50 MINS.        7.19  33.45    7.9    6.8      7.2    -5.6
 3 HRS.  0 MINS.        7.16  33.32    7.9    6.3      6.2    -7.1
 3 HRS. 10 MINS.        7.16  33.32    7.9    7.7      6.0    -6.2
 3 HRS. 20 MINS.        7.13  33.48    7.9    8.0      3.9    -9.1
 3 HRS. 30 MINS.        7.13  33.48    7.9   10.0      4.6    -9.0
 3 HRS. 40 MINS.        7.13  33.48    7.9   10.9      3.5   -10.7
 3 HRS. 50 MINS.        7.13  33.48    7.9   11.7      1.0   -11.9
 4 HRS.  0 MINS.        7.16  33.45    7.9   12.2     -1.0   -12.2
 4 HRS. 10 MINS.        7.16  33.45    8.0   14.2      3.3   -11.4
 4 HRS. 20 MINS.        7.13  33.48    8.0   13.0     -0.2   -13.6
 4 HRS. 30 MINS.        7.16  33.48    8.5   13.2     -3.0   -11.5
 4 HRS. 40 MINS.        7.13  33.48    8.5   13.8     -6.3   -10.2
 4 HRS. 50 MINS.        7.16  33.45    8.0   14.2    -10.8   -11.6
 5 HRS.  0 MINS.        7.16  33.45    8.9   17.5    -17.5    -6.0
 5 HRS. 10 MINS.        7.16  33.45    8.9   19.5    -21.4    -4.2
 5 HRS. 20 MINS.        7.16  33.45    9.1   25.1    -20.1    12.0
 5 HRS. 30 MINS.        7.16  33.45    9.2   32.7    -28.8    16.5
 5 HRS. 40 MINS.        7.19  33.32    9.4   33.5    -26.6    22.3
 5 HRS. 50 MINS.        7.19  33.40    9.4   33.9    -24.7    12.6
 6 HRS.  0 MINS.        7.19  33.40    9.3   21.9    -19.6     5.6
 6 HRS. 10 MINS.        7.19  33.40    9.3   19.7    -17.8     1.8
 6 HRS. 20 MINS.        7.19  33.36    9.5   17.1    -18.5    -1.0
 6 HRS. 30 MINS.        7.19  33.40    9.8   19.9    -22.8    -8.1
 6 HRS. 40 MINS.        7.16  33.32   10.0   27.3    -25.8   -13.4
 6 HRS. 50 MINS.        7.16  33.32   10.1   26.7    -28.5    -8.0
 7 HRS.  0 MINS.        7.16  33.32   10.3   28.1    -26.3    -0.5
 7 HRS. 10 MINS.        7.16  33.32   10.3   24.5    -21.0     4.9
 7 HRS. 20 MINS.        7.16  33.32   10.3   19.7     -7.8    19.4
 7 HRS. 30 MINS.        7.16  33.32   10.4   24.2    -19.1    17.2
 7 HRS. 40 MINS.        7.16  33.32   10.4   28.1    -21.1    16.3
 7 HRS. 50 MINS.        7.16  33.30   10.4   27.7    -21.7    16.2
 8 HRS.  0 MINS.        7.16  33.32   10.3   29.0    -21.6    18.1
 8 HRS. 10 MINS.        7.16  33.32   10.3   27.2    -23.3     7.1
 8 HRS. 20 MINS.        7.16  33.32   10.3   21.3    -23.3     1.1
 8 HRS. 30 MINS.        7.16  33.32   10.3   19.5    -17.7    -3.8
 8 HRS. 40 MINS.        7.16  33.32   10.3   19.7    -17.2     8.0
 8 HRS. 50 MINS.        7.16  33.35   10.3   21.2    -19.0    11.2
 9 HRS.  0 MINS.        7.16  33.32   10.1   23.2    -20.0     9.7
 9 HRS. 10 MINS.        7.16  33.35   10.1   21.5    -16.5     6.3
 9 HRS. 20 MINS.        7.16  33.32   10.1   14.2    -13.0     5.6
 9 HRS. 30 MINS.        7.16  33.32   10.1   13.3    -16.5     4.4
 9 HRS. 40 MINS.        7.16  33.32   10.1   10.3    -18.7     2.7
 9 HRS. 50 MINS.        7.19  33.32   10.1   20.3    -20.3     2.5
10 HRS.  0 MINS.        7.13  33.35   10.1   24.1    -21.7    12.5
10 HRS. 10 MINS.        7.13  33.35   10.1   26.1    -27.0    13.4
10 HRS. 20 MINS.        7.13  33.35   10.1   31.8    -25.3    20.7
10 HRS. 30 MINS.        7.13  33.28   10.0   33.9    -29.4    12.6
10 HRS. 40 MINS.        7.13  33.28   10.0   32.7    -26.3    18.7
10 HRS. 50 MINS.        7.13  33.48    9.6   31.4    -25.7    16.7
11 HRS.  0 MINS.        7.13  33.48    9.8   29.8    -22.8    19.8
11 HRS. 10 MINS.        7.13  33.48    9.7   30.6    -28.1    13.0
11 HRS. 20 MINS.        7.13  33.35    9.5   33.1    -23.4    20.4
11 HRS. 30 MINS.        7.13  33.48    9.4   29.0    -22.1    14.3
11 HRS. 40 MINS.        7.13  33.48    9.4   23.6    -15.4    16.5
11 HRS. 50 MINS.        7.13  33.48    9.4   21.6    -12.4    13.0
12 HRS.  0 MINS.        7.09  33.21    8.9   19.7    -17.6     8.0
12 HRS. 10 MINS.        7.13  33.28    8.9   19.2    -15.8     8.2
12 HRS. 20 MINS.        7.13  33.48    8.9   10.1     -9.1     6.2
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A 3.4

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PROGRAM   AVERAGE
DATA AVERAGED OVER   1 TIDAL CYCLES AT STN.   6
THE FIRST RECORD FOR EACH  CYCLE  OCCURRED:
 ON 11/ 3/75 AT 1610

THE MEAN TIDAL RANGE PREDICTED AT BELFAST
OVER THE WHOLE PERIOD WAS 2.55 METRES.


 SPEED ENCOUNTERED (CM/SEC):
 MEAN = 18.7  MIN =   1.9 MAX =  30.4

 MEAN RESIDUAL EXCURSION =
    -1.99 KM NORTH,  1.60 KM EAST.
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HW Belfast 2234

Time before HW Belfast 6.24

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TIME AFTER START        TEMP   SAL     DEP   SPEED   NORTHING EASTING
 0 HRS,  0 MINS,        6.83  33.04    5.1   24.1    -20.7    15.5
 0 HRS, 10 MINS,        6.83  33.04    4.1   25.3    -19.8    14.4
 0 HRS, 20 MINS,        6.83  33.04    3.9   23.6    -17.1    13.8
 0 HRS, 30 MINS,        6.83  33.04    3.9   20.6    -16.5    12.0
 0 HRS, 40 MINS,        6.86  33.01    3.9   20.4    -15.7    11.4
 0 HRS, 50 MINS,        6.86  33.01    3.9   18.3    -15.2    10.2
 1 HRS,  0 MINS,        6.86  33.01    3.9   19.3    -14.9     9.0
 1 HRS, 10 MINS,        6.86  33.01    3.7   17.1    -14.0     9.5
 1 HRS, 20 MINS,        6.86  32.94    3.7   16.7    -13.1     8.0
 1 HRS, 30 MINS,        6.86  33.01    3.7   13.0    -11.8     7.9
 1 HRS, 40 MINS,        6.83  33.04    3.6   13.4    -10.2     6.6
 1 HRS, 50 MINS,        6.83  33.04    3.0   10.9     -8.2     4.4
 2 HRS,  0 MINS,        6.83  33.04    3.0    7.7     -4.9     2.2
 2 HRS, 10 MINS,        6.83  33.08    3.9    3.1     -2.9     1.1
 2 HRS, 20 MINS,        6.86  33.08    3.4    2.7      4.6    -3.2
 2 HRS, 30 MINS,        6.90  33.05    3.4    8.5     11.1    -2.9
 2 HRS, 40 MINS,        6.90  33.21    3.4   16.7     13.7    -9.8
 2 HRS, 50 MINS,        6.90  33.11    3.4   20.4     15.6   -13.0
 3 HRS,  0 MINS,        6.96  33.13    3.4   24.0     18.7   -11.7
 3 HRS, 10 MINS,        6.93  33.16    3.0   25.0     16.0   -11.2
 3 HRS, 20 MINS,        6.93  33.06    3.0   17.1     16.8   -11.0
 3 HRS, 30 MINS,        6.86  33.08    3.0   20.3     13.8   -11.0
 3 HRS, 40 MINS,        6.86  33.08    3.0   16.7     13.9    -9.5
 3 HRS, 50 MINS,        6.86  33.08    3.0   18.3     13.0    -8.6
 4 HRS,  0 MINS,        6.86  33.15    3.0   16.3     13.5    -7.1
 4 HRS, 10 MINS,        6.86  33.08    3.9   17.5     13.8    -9.2
 4 HRS, 20 MINS,        6.86  33.08    3.9   16.3     13.5   -10.2
 4 HRS, 30 MINS,        6.86  33.08    3.7   17.5     14.1    -8.5
 4 HRS, 40 MINS,        6.86  33.15    3.6   13.6     13.7    -9.7
 4 HRS, 50 MINS,        6.86  33.15    3.9   17.5     13.8    -8.5
 5 HRS,  0 MINS,        6.86  33.15    3.9   17.5     13.8    -9.0
 5 HRS, 10 MINS,        6.86  33.15    4.2   13.4     13.0    -9.2
 5 HRS, 20 MINS,        6.86  33.24    4.4   10.7     14.2    -8.6
 5 HRS, 30 MINS,        6.90  33.27    4.5   10.7     14.2    -8.8
 5 HRS, 40 MINS,        6.90  33.27    4.3   10.7     12.0    -9.1
 5 HRS, 50 MINS,        6.90  33.27    4.7   13.0     12.7    -8.2
 6 HRS,  0 MINS,        6.90  33.20    4.0   14.2     12.4    -6.6
 6 HRS, 10 MINS,        6.90  33.20    4.0   13.8     12.5    -7.5
 6 HRS, 20 MINS,        6.90  33.20    3.8   13.4     11.0    -8.1
 6 HRS, 30 MINS,        6.90  33.20    3.8   13.4     11.8    -7.6
 6 HRS, 40 MINS,        6.90  33.27    3.0   14.0     11.6    -7.2
 6 HRS, 50 MINS,        6.86  33.24    5.1   14.2     10.6    -6.3
 7 HRS,  0 MINS,        6.86  33.24    5.1   10.9      8.4    -5.6
 7 HRS, 10 MINS,        6.86  33.24    5.3    9.3      6.0    -3.2
 7 HRS, 20 MINS,        6.86  33.26    5.4    6.1      5.5    -3.6
 7 HRS, 30 MINS,        6.83  33.26    5.4    4.5      2.7    -1.9
 7 HRS, 40 MINS,        6.86  33.29    5.4    1.9      1.7    -1.2
 7 HRS, 50 MINS,        6.86  33.29    5.4    4.3     -0.6     3.3
 8 HRS,  0 MINS,        6.86  33.23    5.0    4.7     -3.6     3.1
 8 HRS, 10 MINS,        6.83  33.26    5.9    8.7     -5.0     7.0
 8 HRS, 20 MINS,        6.83  33.26    5.7   11.3    -10.0    10.0
 8 HRS, 30 MINS,        6.83  33.26    5.7   17.1    -11.9    14.7
 8 HRS, 40 MINS,        6.80  33.14    5.7   20.3    -14.9    15.9
 8 HRS, 50 MINS,        6.80  33.14    5.5   26.3    -17.8    19.1
 9 HRS,  0 MINS,        6.80  33.12    5.5   29.2    -22.1    25.4
 9 HRS, 10 MINS,        6.80  33.14    5.7   30.0    -27.5    28.5
 9 HRS, 20 MINS,        6.80  33.07    5.7   30.4    -32.4    23.2
 9 HRS, 30 MINS,        6.80  33.07    5.7   30.0    -28.0    21.9
 9 HRS, 40 MINS,        6.80  33.07    5.0   31.2    -26.6    18.6
 9 HRS, 50 MINS,        6.77  33.10    5.0   31.4    -26.5    12.0
10 HRS,  0 MINS,        6.73  33.06    5.0   29.8    -25.2    13.4
10 HRS, 10 MINS,        6.73  33.06    5.0   25.3    -24.2    10.3
10 HRS, 20 MINS,        6.73  33.06    5.0   25.3    -21.9    13.8
10 HRS, 30 MINS,        6.73  33.02    5.0   27.3    -24.3    12.1
10 HRS, 40 MINS,        6.73  33.02    5.0   25.7    -21.3    16.1
10 HRS, 50 MINS,        6.73  33.06    5.0   25.7    -22.5    16.3
11 HRS,  0 MINS,        6.73  33.06    5.4   24.8    -21.9    17.7
11 HRS, 10 MINS,        6.73  33.06    5.4   20.5    -19.4    13.1
11 HRS, 20 MINS,        6.73  33.06    5.4   23.4    -18.5    12.0
11 HRS, 30 MINS,        6.73  33.06    5.4   23.6    -21.3    11.8
11 HRS, 40 MINS,        6.73  33.06    5.3   23.1    -20.5    13.8
11 HRS, 50 MINS,        6.73  33.06    5.1   25.3    -19.2    15.5
12 HRS,  0 MINS,        6.73  33.06    5.0   24.1    -20.0    13.5
12 HRS, 10 MINS,        6.73  33.06    5.0   24.1    -19.7    14.3
12 HRS, 20 MINS,        6.73  33.06    4.0   24.5    -21.0    12.6
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PROGRAM   AVERAGE

DATA AVERAGED OVER  10 TIDAL CYCLES AT STN.    7

THE FIRST RECORD FOR EACH  CYCLE  OCCURRED:
                                HW Belfast      Time before HW Belfast
 ON 12/ 3/75 AT 1920            2307                3.47
 ON 13/ 3/75 AT  740            1122                3.42
 ON 13/ 3/75 AT 2010            2338                3.28
 ON 14/ 3/75 AT  830            1153                3.23
 ON 14/ 3/75 AT 21 0            0009                3.09
 ON 15/ 3/75 AT  920            1223                3.03
 ON 15/ 3/75 AT 2150            0042                2.52
 ON 16/ 3/75 AT 1010            1255                2.45
 ON 16/ 3/75 AT 2240            0116                2.36
 ON 17/ 3/75 AT 11 0            1329                2.29   mean 3h. 7min.
                                                            s.d.  27min.
THE MEAN TIDAL RANGE PREDICTED AT BELFAST
OVER THE WHOLE PERIOD WAS 2.67 METRES.
Max range 2.8m.

 SPEED ENCOUNTERED (CM/SEC):
 MEAN = 25.5  MIN =   1.9 MAX =  56.0

 MEAN RESIDUAL EXCURSION =
     1.96 KM NORTH,  1.97 KM EAST,
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TIME AFTER START        TEMP   SAL    DEN    SPEED    NORTHING EASTING
 0 HRS.  0 MINS.        6.78  33.24  27.5    29.6      22.5     19.5
 0 HRS. 10 MINS.        6.79  33.28  27.2    32.0      22.8     20.6
 0 HRS. 20 MINS.        6.79  33.27  27.1    33.0      25.7     19.2
 0 HRS. 30 MINS.        6.79  33.27  27.5    32.8      23.6     19.4
 0 HRS. 40 MINS.        6.79  33.28  27.5    32.7      25.7     19.3
 0 HRS. 50 MINS.        6.80  33.27  27.2    32.1      25.8     18.0
 1 HRS.  0 MINS.        6.79  33.20  27.3    31.1      25.5     17.4
 1 HRS. 10 MINS.        6.80  33.29  27.3    31.0      25.6     18.9
 1 HRS. 20 MINS.        6.81  33.27  27.3    32.9      27.0     18.7
 1 HRS. 30 MINS.        6.81  33.26  27.3    33.3      27.4     17.2
 1 HRS. 40 MINS.        6.81  33.29  27.6    31.8      27.4     16.7
 1 HRS. 50 MINS.        6.81  33.30  27.7    35.6      28.4     16.6
 2 HRS.  0 MINS.        6.82  33.32  27.6    33.8      29.1     16.8
 2 HRS. 10 MINS.        6.83  33.33  28.0    33.7      28.1     16.6
 2 HRS. 20 MINS.        6.85  33.33  28.1    33.6      29.3     16.1
 2 HRS. 30 MINS.        6.84  33.33  28.3    33.5      28.9     17.1
 2 HRS. 40 MINS.        6.85  33.33  28.4    33.2      29.6     16.2
 2 HRS. 50 MINS.        6.85  33.35  28.3    34.7      30.2     13.7
 3 HRS.  0 MINS.        6.86  33.35  28.9    32.2      28.5     13.5
 3 HRS. 10 MINS.        6.87  33.37  28.7    32.6      28.6     13.3
 3 HRS. 20 MINS.        6.87  33.36  28.6    30.7      27.1     11.5
 3 HRS. 30 MINS.        6.87  33.36  28.9    29.0      26.0     10.3
 3 HRS. 40 MINS.        6.88  33.37  28.9    27.5      22.6     11.7
 3 HRS. 50 MINS.        6.90  33.38  29.1    27.3      24.0     10.9
 4 HRS.  0 MINS.        6.89  33.30  29.5    26.3      22.8     11.4
 4 HRS. 10 MINS.        6.91  33.30  29.2    25.3      21.4      9.3
 4 HRS. 20 MINS.        6.91  33.41  29.5    23.0      18.4      9.2
 4 HRS. 30 MINS.        6.91  33.42  29.5    20.1      13.0      3.8
 4 HRS. 40 MINS.        6.91  33.40  29.3    19.0      10.7      2.2
 4 HRS. 50 MINS.        6.92  33.40  29.3    19.5       6.6     -1.2
 5 HRS.  0 MINS.        6.92  33.41  29.3    17.0       2.9     -2.2
 5 HRS. 10 MINS.        6.92  33.39  29.3    14.0      -1.8     -4.7
 5 HRS. 20 MINS.        6.91  33.40  29.3    14.9      -4.0    -11.6
 5 HRS. 30 MINS.        6.92  33.41  29.3    15.2      -8.5    -13.2
 5 HRS. 40 MINS.        6.92  33.30  29.3    17.4      -8.9    -16.1
 5 HRS. 50 MINS.        6.90  33.30  29.3    20.8     -13.2    -16.7
 6 HRS.  0 MINS.        6.88  33.38  29.3    26.2     -12.8    -19.5
 6 HRS. 10 MINS.        6.89  33.39  29.3    25.4     -14.9    -21.8
 6 HRS. 20 MINS.        6.88  33.36  29.3    28.0     -16.2    -23.2
 6 HRS. 30 MINS.        6.88  33.37  29.3    30.7     -19.1    -23.8
 6 HRS. 40 MINS.        6.89  33.38  29.3    33.4     -20.6    -25.2
 6 HRS. 50 MINS.        6.88  33.36  29.4    34.1     -26.0    -22.8
 7 HRS.  0 MINS.        6.86  33.37  29.3    37.1     -27.4    -18.3
 7 HRS. 10 MINS.        6.86  33.36  29.3    34.3     -25.2    -12.2
 7 HRS. 20 MINS.        6.87  33.36  29.3    30.2     -25.7    -16.6
 7 HRS. 30 MINS.        6.87  33.36  29.3    33.1     -25.1    -12.5
 7 HRS. 40 MINS.        6.85  33.35  29.2    33.9     -25.6    -11.6
 7 HRS. 50 MINS.        6.83  33.34  29.1    34.2     -31.2     -7.1
 8 HRS.  0 MINS.        6.83  33.33  28.8    33.1     -30.6     -3.1
 8 HRS. 10 MINS.        6.83  33.33  28.8    33.3     -28.8     -3.3
 8 HRS. 20 MINS.        6.83  33.32  28.8    27.4     -21.9     -3.1
 8 HRS. 30 MINS.        6.82  33.33  28.7    33.0     -19.6     -5.5
 8 HRS. 40 MINS.        6.81  33.30  28.6    37.2     -20.8     -7.9
 8 HRS. 50 MINS.        6.81  33.31  28.5    33.7     -18.6     -1.7
 9 HRS.  0 MINS.        6.81  33.34  28.3    23.6     -16.5      1.9
 9 HRS. 10 MINS.        6.79  33.20  28.6    19.1     -12.1      2.0
 9 HRS. 20 MINS.        6.80  33.30  28.1    18.7     -13.5      5.6
 9 HRS. 30 MINS.        6.80  33.30  28.0    18.2     -13.3      6.5
 9 HRS. 40 MINS.        6.80  33.28  27.9    17.0      -6.8      8.7
 9 HRS. 50 MINS.        6.79  33.28  27.8    14.0      -8.5      7.2
10 HRS.  0 MINS.        6.80  33.30  27.7    16.0      -5.8      5.8
10 HRS. 10 MINS.        6.80  33.28  27.6    11.3      -4.8      7.6
10 HRS. 20 MINS.        6.79  33.28  27.5    12.3      -4.8      6.8
10 HRS. 30 MINS.        6.80  33.30  27.5    10.4      -2.9      9.3
10 HRS. 40 MINS.        6.79  33.30  27.5    12.0      -0.7      9.3
10 HRS. 50 MINS.        6.79  33.30  27.3    10.8       1.7      8.8
11 HRS.  0 MINS.        6.79  33.28  27.3    12.2       1.8     10.5
11 HRS. 10 MINS.        6.80  33.28  27.3    12.5       5.2     10.3
11 HRS. 20 MINS.        6.79  33.27  27.2    10.1       8.2     13.4
11 HRS. 30 MINS.        6.79  33.28  27.2    17.8       8.4     15.4
11 HRS. 40 MINS.        6.77  33.29  27.2    21.2      11.3     16.0
11 HRS. 50 MINS.        6.78  33.27  27.2    23.1      17.0     16.2
12 HRS.  0 MINS.        6.78  33.27  27.2    25.1      18.3     18.4
12 HRS. 10 MINS.        6.78  33.27  27.2    27.7      20.2     20.2
12 HRS. 20 MINS.        6.77  33.27  27.2    30.2      22.5     20.0
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A 3.6

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PROGRAM    AVERAGE

DATA AVERAGED OVER  24 TIDAL CYCLES AT STN.    8

THE FIRST RECORD FOR EACH  CYCLE  OCCURRED
                                      HW Belfast    Time before HW Belfast
 ON   4/ 4/75 AT 1358                 1734          3.30
 ON   5/ 4/75 AT  218                 0409          3.46
 ON   5/ 4/75 AT 1448                 1856          4.08
 ON   6/ 4/75 AT  318                 0722          4.10
 ON   6/ 4/75 AT 1518                 2001          4.33
 ON   7/ 4/75 AT  358                 0822          4.20
 ON   7/ 4/75 AT 1628                 2050          4.22
 ON   8/ 4/75 AT  448                 0908          4.20
 ON   8/ 4/75 AT 1718                 2130          4.12
 ON   9/ 4/75 AT  538                 0946          4.08
 ON   9/ 4/75 AT 18 8                 2205          3.57
 ON  10/ 4/75 AT  628                 1020          3.52
 ON  10/ 4/75 AT 1858                 2237          3.39
 ON  11/ 4/75 AT  718                 1052          3.34
 ON  11/ 4/75 AT 1948                 2308          3.20
 ON  12/ 4/75 AT  8 8                 1122          3.14
 ON  12/ 4/75 AT 2038                 2339          3.01
 ON  13/ 4/75 AT  858                 1153          2.55
 ON  13/ 4/75 AT 2128                 0012          2.44
 ON  14/ 4/75 AT  928                 1227          2.34
 ON  14/ 4/75 AT 2218                 0048          2.30
 ON  15/ 4/75 AT 1038                 1305          2.27
 ON  15/ 4/75 AT 23 8                 0129          2.21
 ON  16/ 4/75 AT 1128                 1349          2.21   mean 3h 30min
                                                            s.d.  44min

THE MEAN TIDAL RANGE PREDICTED AT BELFAST
OVER THE WHOLE PERIOD WAS 2.39 METRES.
Max range was 2.8m

 SPEED ENCOUNTERED (CM/SEC):
 MEAN = 18.9  MIN =   4.5 MAX =  50.7

 MEAN RESIDUAL EXCURSION =
     1.10 KM NORTH,  2.54 KM EAST.
```

```
TIME AFTER START      TEMP   SAL     DEP   SPEED   NORTHING  EASTING
 0 HRS.  0 MINS.      6.82  33.77   11.6   14.6      11.1     -0.2
 0 HRS. 10 MINS.      6.82  33.77   11.5   15.0      13.1     -0.6
 0 HRS. 20 MINS.      6.81  33.76   11.5   15.6      14.5     -0.7
 0 HRS. 30 MINS.      6.80  33.77   11.8   19.8      16.0     -1.5
 0 HRS. 40 MINS.      6.81  33.77   11.3   19.1      16.8     -1.7
 0 HRS. 50 MINS.      6.81  33.77   11.3   19.1      19.5     -0.7
 1 HRS.  0 MINS.      6.81  33.77   11.6   21.4      22.2     -0.1
 1 HRS. 10 MINS.      6.84  33.70   11.8   26.5      26.5      1.3
 1 HRS. 20 MINS.      6.83  33.74   11.8   28.5      26.3      2.3
 1 HRS. 30 MINS.      6.83  33.73   11.6   28.3      27.7      2.2
 1 HRS. 40 MINS.      6.83  33.70   11.7   28.7      28.5      2.3
 1 HRS. 50 MINS.      6.83  33.81   11.7   29.3      27.7      4.2
 2 HRS.  0 MINS.      6.82  33.76   11.6   28.2      27.1      5.3
 2 HRS. 10 MINS.      6.82  33.70   11.6   28.6      27.1      6.0
 2 HRS. 20 MINS.      6.84  33.70   11.9   28.3      26.2      7.8
 2 HRS. 30 MINS.      6.82  33.80   11.9   29.1      27.0      7.6
 2 HRS. 40 MINS.      6.81  33.80   12.0   29.3      27.1      8.2
 2 HRS. 50 MINS.      6.81  33.78   12.1   28.3      26.3      8.5
 3 HRS.  0 MINS.      6.81  33.70   12.2   27.8      25.5      7.1
 3 HRS. 10 MINS.      6.80  33.80   12.2   27.3      25.8      7.0
 3 HRS. 20 MINS.      6.82  33.80   12.3   26.2      23.8     10.0
 3 HRS. 30 MINS.      6.83  33.80   12.5   26.8      23.1      9.8
 3 HRS. 40 MINS.      6.83  33.80   12.5   25.3      23.0      8.7
 3 HRS. 50 MINS.      6.85  33.80   12.3   24.2      21.8      7.6
 4 HRS.  0 MINS.      6.84  33.81   12.8   24.6      21.3      7.2
 4 HRS. 10 MINS.      6.82  33.81   12.6   22.0      19.5      7.8
 4 HRS. 20 MINS.      6.82  33.81   12.7   20.5      18.3      7.3
 4 HRS. 30 MINS.      6.84  33.81   12.6   18.3      13.8      6.0
 4 HRS. 40 MINS.      6.84  33.82   12.6   17.5      11.9      8.4
 4 HRS. 50 MINS.      6.84  33.81   12.8   17.4       8.3      9.0
 5 HRS.  0 MINS.      6.84  33.82   12.9   16.4       6.2     10.7
 5 HRS. 10 MINS.      6.82  33.82   12.9   16.6       3.8      9.1
 5 HRS. 20 MINS.      6.81  33.83   12.9   16.7       0.2      8.5
 5 HRS. 30 MINS.      6.81  33.85   12.9   16.3      -2.6      9.2
 5 HRS. 40 MINS.      6.80  33.83   12.8   15.1      -4.3      8.6
 5 HRS. 50 MINS.      6.80  33.83   12.8   15.0      -5.8      8.8
 6 HRS.  0 MINS.      6.80  33.82   13.0   15.7      -7.3      9.5
 6 HRS. 10 MINS.      6.79  33.82   13.0   16.7     -10.0     10.3
 6 HRS. 20 MINS.      6.80  33.82   13.0   16.9     -11.8     10.8
 6 HRS. 30 MINS.      6.80  33.81   12.9   18.9     -14.9     10.8
 6 HRS. 40 MINS.      6.80  33.81   12.9   20.5     -15.7     10.8
 6 HRS. 50 MINS.      6.79  33.81   12.9   20.6     -17.1     10.5
 7 HRS.  0 MINS.      6.81  33.82   12.9   21.5     -19.5      8.4
 7 HRS. 10 MINS.      6.81  33.82   12.9   21.0     -19.5      8.3
 7 HRS. 20 MINS.      6.82  33.83   12.9   20.8     -19.2      7.2
 7 HRS. 30 MINS.      6.82  33.84   12.8   20.9     -18.8      7.2
 7 HRS. 40 MINS.      6.85  33.82   12.8   19.6     -17.9      6.4
 7 HRS. 50 MINS.      6.85  33.82   12.9   18.6     -17.5      5.5
 8 HRS.  0 MINS.      6.86  33.82   12.7   18.3     -17.0      5.3
 8 HRS. 10 MINS.      6.86  33.82   12.7   17.3     -16.9      5.4
 8 HRS. 20 MINS.      6.88  33.83   12.6   17.7     -16.9      5.2
 8 HRS. 30 MINS.      6.89  33.83   12.6   17.0     -16.5      5.5
 8 HRS. 40 MINS.      6.88  33.83   12.2   17.3     -16.3      6.4
 8 HRS. 50 MINS.      6.88  33.82   12.2   17.5     -15.9      6.8
 9 HRS.  0 MINS.      6.90  33.82   12.3   18.7     -15.7      6.3
 9 HRS. 10 MINS.      6.92  33.80   12.3   18.7     -15.2      6.2
 9 HRS. 20 MINS.      6.90  33.80   12.2   18.2     -15.2      6.2
 9 HRS. 30 MINS.      6.91  33.80   12.2   18.6     -12.6      8.0
 9 HRS. 40 MINS.      6.92  33.81   12.1   10.1     -14.9      6.0
 9 HRS. 50 MINS.      6.92  33.80   12.0   10.3     -14.5      6.2
10 HRS.  0 MINS.      6.92  33.81   11.9   13.5     -14.0      6.0
10 HRS. 10 MINS.      6.93  33.70   11.8   12.2     -13.9      5.9
10 HRS. 20 MINS.      6.94  33.70   11.8   12.8     -13.1      5.8
10 HRS. 30 MINS.      6.94  33.70   11.7   14.2     -12.2      5.6
10 HRS. 40 MINS.      6.92  33.80   11.7   12.0     -11.0      5.2
10 HRS. 50 MINS.      6.92  33.70   11.7   11.8      -9.7      4.8
11 HRS.  0 MINS.      6.94  33.70   11.7   10.2      -8.1      4.5
11 HRS. 10 MINS.      6.93  33.70   11.6    6.0      -6.8      3.5
11 HRS. 20 MINS.      6.96  33.70   11.6    9.2      -5.2      3.0
11 HRS. 30 MINS.      6.95  33.78   11.6    7.0      -3.2      2.0
11 HRS. 40 MINS.      6.96  33.78   11.6    7.0      -1.2      1.0
11 HRS. 50 MINS.      6.98  33.78   11.6    8.0      -0.1      1.3
12 HRS.  0 MINS.      6.93  33.80   11.6    9.0       2.6      0.8
12 HRS. 10 MINS.      6.93  33.70   11.6    9.7       0.4     -0.7
12 HRS. 20 MINS.      6.90  33.70   11.6   13.7       0.1      1.1
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A 3.7

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PROGRAM    AVERAGE

DATA AVERAGED OVER  12 TIDAL CYCLES AT STN.    9

THE FIRST RECORD FOR EACH  CYCLE  OCCURRED:
                                   hw Belfast     Time before hw Belfast?
 ON 28/ 4/75 AT 2058                 0051           3.53
 ON 29/ 4/75 AT  918                 1321           4.03
 ON 29/ 4/75 AT 2148                 0138           3.50
 ON 30/ 4/75 AT 1018                 1411           4.03
 ON 30/ 4/75 AT 2238                 0226           3.48
 ON  1/ 5/75 AT 1058                 1503           4.05
 ON  1/ 5/75 AT 2328                 0317           3.49
 ON  2/ 5/75 AT 1148                 1558           4.10
 ON  3/ 5/75 AT  018                 0412           3.54
 ON  3/ 5/75 AT 1238                 1700           4.22
 ON  4/ 5/75 AT  1 8                 0518           4.10
 ON  4/ 5/75 AT 1328                 1809           4.41     mean 4hr 6min
                                                                s.d.    15 min

THE MEAN TIDAL RANGE PREDICTED AT BELFAST
OVER THE WHOLE PERIOD WAS 2.36 METRES.
Max range was 3.0 m.

 SPEED ENCOUNTERED (CM/SEC):
 MEAN = 17.2  MIN =   1.5 MAX =  38.8

 MEAN RESIDUAL EXCURSION =
     1.29 KM NORTH, =0.74 KM EAST.
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TIME AFTER START      TEMP  SAL     DIR   SPEED   NORTHING  EASTING
 0 HRS.  0 MINS.      9.11  34.18   7.5     8.2       2.3     -1.3
 0 HRS. 10 MINS.      9.11  34.17   7.5     8.6       6.3     -1.7
 0 HRS. 20 MINS.      9.10  34.16   7.5     9.9       8.6      1.7
 0 HRS. 30 MINS.      9.08  34.16   7.5    11.2      10.9      3.2
 0 HRS. 40 MINS.  [illegible]  34.18   7.5    13.8      12.9      4.8
 0 HRS. 50 MINS.  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
 1 HRS.  0 MINS.  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
 1 HRS. 10 MINS.      9.00  34.19  [illegible]  [illegible]  17.2      5.9
 1 HRS. 20 MINS.      8.98  34.18   7.0    18.8      17.8      6.2
 1 HRS. 30 MINS.      8.99  34.19   7.0    19.0      18.0      6.4
 1 HRS. 40 MINS.  [illegible]  34.17  [illegible]  [illegible]  [illegible]  6.3
 1 HRS. 50 MINS.  [illegible]  34.18  [illegible]  19.7  [illegible]  [illegible]
 2 HRS.  0 MINS.      8.92  34.19   7.6    20.8      19.9      6.8
 2 HRS. 10 MINS.  [illegible]  34.19   7.7    21.5  [illegible]  6.6
 2 HRS. 20 MINS.  [illegible]  34.20  [illegible]  [illegible]  [illegible]  [illegible]
 2 HRS. 30 MINS.  [illegible]  [illegible]  [illegible]  [illegible]  21.1  [illegible]
 2 HRS. 40 MINS.  [illegible]  34.20   7.9    22.5      21.4      6.2
 2 HRS. 50 MINS.  [illegible]  34.21   7.9    24.1      22.7      5.7
 3 HRS.  0 MINS.  [illegible]  34.20   8.0  [illegible]  [illegible]  6.1
 3 HRS. 10 MINS.  [illegible]  34.20   8.1    23.2      22.0      6.4
 3 HRS. 20 MINS.      8.78  34.21  [illegible]  22.6      23.6      6.7
 3 HRS. 30 MINS.      8.78  34.21  [illegible]  24.6      23.9      6.8
 3 HRS. 40 MINS.      8.77  34.22   8.4    25.0      24.3      7.2
 3 HRS. 50 MINS.  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
 4 HRS.  0 MINS.  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
 4 HRS. 10 MINS.      8.73  [illegible]  [illegible]  24.8  [illegible]  [illegible]
 4 HRS. 20 MINS.      8.71  34.23   9.0    24.9      23.4      7.9
 4 HRS. 30 MINS.      8.70  34.23   9.1    24.5      22.2      7.2
 4 HRS. 40 MINS.      8.69  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
 4 HRS. 50 MINS.      8.67  34.21   9.4    21.9      20.5      6.1
 5 HRS.  0 MINS.      8.63  34.22   9.3    21.0      19.1      6.2
 5 HRS. 10 MINS.      8.61  34.23   9.4    19.3      17.3  [illegible]
 5 HRS. 20 MINS.      8.60  [illegible]  9.3  [illegible]  [illegible]  [illegible]
 5 HRS. 30 MINS.      8.58  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
 5 HRS. 40 MINS.      8.57  34.24   9.0    12.7      11.3      2.4
 5 HRS. 50 MINS.      8.58  34.23   9.0    10.7       8.9      2.2
 6 HRS.  0 MINS.  [illegible]  34.22  [illegible]   7.9       6.5     -0.8
 6 HRS. 10 MINS.      8.58  34.21  [illegible]   5.9       3.2     -1.2
 6 HRS. 20 MINS.      8.58  [illegible]  [illegible]   3.4      =0.5     =3.5
 6 HRS. 30 MINS.      8.57  [illegible]   9.0  [illegible]  [illegible]  [illegible]
 6 HRS. 40 MINS.      8.58  [illegible]   9.0     9.6      =7.0     =6.8
 6 HRS. 50 MINS.      8.60  [illegible]  [illegible]  [illegible]  =10.7     =7.8
 7 HRS.  0 MINS.  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
 7 HRS. 10 MINS.      8.65  34.21   9.0    19.3     =17.1    =10.2
 7 HRS. 20 MINS.      8.70  34.21  [illegible]  [illegible]  [illegible]   =9.7
 7 HRS. 30 MINS.  [illegible]  [illegible]   9.0  [illegible]  [illegible]  [illegible]
 7 HRS. 40 MINS.      8.81  [illegible]   9.0    22.0     =19.2    =10.5
 7 HRS. 50 MINS.      8.86  34.20   9.0    22.0     =19.9    =10.1
 8 HRS.  0 MINS.      8.90  34.19   9.0    22.9     =20.5    =10.7
 8 HRS. 10 MINS.      8.95  34.17   9.0  [illegible]  [illegible]  =10.5
 8 HRS. 20 MINS.      8.97  [illegible]  [illegible]  [illegible]  [illegible]  =10.6
 8 HRS. 30 MINS.      8.98  34.18  [illegible]  [illegible]  =18.7    =10.3
 8 HRS. 40 MINS.      8.99  34.18  [illegible]  20.6     =18.3  [illegible]
 8 HRS. 50 MINS.      9.02  34.16  [illegible]  20.3     =17.9     =9.5
 9 HRS.  0 MINS.  [illegible]  34.18  [illegible]  20.6  [illegible]  [illegible]
 9 HRS. 10 MINS.  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
 9 HRS. 20 MINS.  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
 9 HRS. 30 MINS.      9.06  34.16   8.7    17.9     =15.0     =8.4
 9 HRS. 40 MINS.      9.08  34.15  [illegible]  16.7     =14.0     =9.0
 9 HRS. 50 MINS.  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
10 HRS.  0 MINS.  [illegible]  [illegible]   8.3    15.4     =13.0     =8.8
10 HRS. 10 MINS.      9.08  34.15   8.3    15.2     =12.3     =8.1
10 HRS. 20 MINS.      9.09  34.16   8.2    14.4     =11.6     =7.8
10 HRS. 30 MINS.      9.10  34.17  [illegible]  13.8     =10.7     =7.8
10 HRS. 40 MINS.  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
10 HRS. 50 MINS.      9.09  34.14   8.0    13.0      =8.8     =6.9
11 HRS.  0 MINS.      9.10  34.16   7.9    12.1      =8.6     =7.9
11 HRS. 10 MINS.      9.11  34.16   7.9    11.8      =8.3     =7.4
11 HRS. 20 MINS.  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
11 HRS. 30 MINS.  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
11 HRS. 40 MINS.  [illegible]  34.16  [illegible]  [illegible]  [illegible]  [illegible]
11 HRS. 50 MINS.      9.15  34.16  [illegible]  [illegible]  [illegible]  [illegible]
12 HRS.  0 MINS.  [illegible]  34.15  [illegible]  [illegible]  [illegible]  [illegible]
12 HRS. 10 MINS.      9.14  34.15  [illegible]  [illegible]  [illegible]  [illegible]
12 HRS. 20 MINS.      9.15  34.15   7.8  [illegible]       0.3     =7.4
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A 3.8

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PROGRAM   AVERAGE
DATA AVERAGED OVER  12 TIDAL CYCLES AT STN.  10
THE FIRST RECORD FOR EACH  CYCLE  OCCURRED:
                                   HW Belfast     Time before HW Belfast
 ON  9/ 5/75 AT 1818               2205           3.07
 ON 10/ 5/75 AT  638               1019           2.91
 ON 10/ 5/75 AT 19[illegible]      2237           3.29
 ON 11/ 5/75 AT  72[illegible]     1051           3.23
 ON 11/ 5/75 AT 19[illegible]      2310           3.12
 ON 12/ 5/75 AT  81[illegible]     1146           3.08
 ON 12/ 5/75 AT 2048               2347           2.59
 ON 13/ 5/75 AT  9[illegible]      1204           2.54
 ON 13/ 5/75 AT 213[illegible]     0047           2.49
 ON 14/ 5/75 AT  95[illegible]     1247           2.49
 ON 14/ 5/75 AT 222[illegible]     0111           2.43
 ON 15/ 5/75 AT 1048               1236           2.48      mean 3hr 8min
                                                              s.d.   22min
THE MEAN TIDAL RANGE PREDICTED AT BELFAST
OVER THE WHOLE PERIOD WAS 2.63 METRES.
Max range was 3.0 m.

 SPEED ENCOUNTERED (CM/SEC):
 MEAN = 23.8  MIN =   1.5 MAX =  52.3

 MEAN RESIDUAL EXCURSION =
     2.88 KM NORTH, -0.19 KM EAST.
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TIME AFTER START       TEMP   SAL    DEP   SPEED  NORTHING EASTING
 0 HRS.  0 MINS.       [illegible]
 0 HRS. 10 MINS.       [illegible]
 0 HRS. 20 MINS.       [illegible]
 0 HRS. 30 MINS.       [illegible]
 0 HRS. 40 MINS.       [illegible]
 0 HRS. 50 MINS.       [illegible]
 1 HRS.  0 MINS.       [illegible]
 1 HRS. 10 MINS.       [illegible]
 1 HRS. 20 MINS.       [illegible]
 1 HRS. 30 MINS.       [illegible]
 1 HRS. 40 MINS.       [illegible]
 1 HRS. 50 MINS.       [illegible]
 2 HRS.  0 MINS.       [illegible]
 2 HRS. 10 MINS.       [illegible]
 2 HRS. 20 MINS.       [illegible]
 2 HRS. 30 MINS.       [illegible]
 2 HRS. 40 MINS.       [illegible]
 2 HRS. 50 MINS.       [illegible]
 3 HRS.  0 MINS.       [illegible]
 3 HRS. 10 MINS.       [illegible]
 3 HRS. 20 MINS.       [illegible]
 3 HRS. 30 MINS.       [illegible]
 3 HRS. 40 MINS.       [illegible]
 3 HRS. 50 MINS.       [illegible]
 4 HRS.  0 MINS.       [illegible]
 4 HRS. 10 MINS.       [illegible]
 4 HRS. 20 MINS.       [illegible]
 4 HRS. 30 MINS.       [illegible]
 4 HRS. 40 MINS.       [illegible]
 4 HRS. 50 MINS.       [illegible]
 5 HRS.  0 MINS.       [illegible]
 5 HRS. 10 MINS.       [illegible]
 5 HRS. 20 MINS.       [illegible]
 5 HRS. 30 MINS.       [illegible]
 5 HRS. 40 MINS.       [illegible]
 5 HRS. 50 MINS.       [illegible]
 6 HRS.  0 MINS.       [illegible]
 6 HRS. 10 MINS.       [illegible]
 6 HRS. 20 MINS.       [illegible]
 6 HRS. 30 MINS.       [illegible]
 6 HRS. 40 MINS.       [illegible]
 6 HRS. 50 MINS.       [illegible]
 7 HRS.  0 MINS.       [illegible]
 7 HRS. 10 MINS.       [illegible]
 7 HRS. 20 MINS.       [illegible]
 7 HRS. 30 MINS.       [illegible]
 7 HRS. 40 MINS.       [illegible]
 7 HRS. 50 MINS.       [illegible]
 8 HRS.  0 MINS.       [illegible]
 8 HRS. 10 MINS.       [illegible]
 8 HRS. 20 MINS.       [illegible]
 8 HRS. 30 MINS.       [illegible]
 8 HRS. 40 MINS.       [illegible]
 8 HRS. 50 MINS.       [illegible]
 9 HRS.  0 MINS.       [illegible]
 9 HRS. 10 MINS.       [illegible]
 9 HRS. 20 MINS.       [illegible]
 9 HRS. 30 MINS.       [illegible]
 9 HRS. 40 MINS.       [illegible]
 9 HRS. 50 MINS.       [illegible]
10 HRS.  0 MINS.       [illegible]
10 HRS. 10 MINS.       [illegible]
10 HRS. 20 MINS.       [illegible]
10 HRS. 30 MINS.       [illegible]
10 HRS. 40 MINS.       [illegible]
10 HRS. 50 MINS.       [illegible]
11 HRS.  0 MINS.       [illegible]   11.0   [illegible]
11 HRS. 10 MINS.       [illegible]
11 HRS. 20 MINS.       [illegible]
11 HRS. 30 MINS.       [illegible]
11 HRS. 40 MINS.       9.46  33.50  [illegible]   7.0     3.4     1.5
11 HRS. 50 MINS.       [illegible]
12 HRS.  0 MINS.       [illegible]
12 HRS. 10 MINS.       [illegible]
12 HRS. 20 MINS.       9.65  33.60  18.7  13.2    15.0    -1.3
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A 3.9

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PROGRAM   AVERAGE
DATA AVERAGED OVER  11 TIDAL CYCLES AT STN.  11
THE FIRST RECORD FOR EACH  CYCLE  OCCURRED:
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	HW Belfast	Time before HW Belfast
ON 22/ 5/75 AT 1638	2035	3.57
ON 23/ 5/75 AT 518	0912	3.54
ON 23/ 5/75 AT 1748	2140	3.52
ON 24/ 5/75 AT 608	0959	3.51
ON 24/ 5/75 AT 1838	2225	3.47
ON 25/ 5/75 AT 658	1043	3.45
ON 25/ 5/75 AT 1928	2303	3.35
ON 26/ 5/75 AT 748	1127	3.39
ON 26/ 5/75 AT 2018	2345	3.27
ON 27/ 5/75 AT 838	1213	3.35
ON 27/ 5/75 AT 2108	0030	3.22

mean = 3hr 42min
sd. 11min

```
THE MEAN TIDAL RANGE PREDICTED AT BELFAST
OVER THE WHOLE PERIOD WAS 2.84 METRES.
```

Max range was 3.0m.

```
 SPEED ENCOUNTERED (CM/SEC):
 MEAN = 30.5  MIN =   1.5 MAX =  74.5

 MEAN RESIDUAL EXCURSION =
     3.98 KM NORTH,  2.36 KM EAST.
```

```
TIME AFTER START       TEMP  SAL     DEP    SPEED  NORTHING  EASTING
 0 HRS.  0 MINS.  [illegible]        0.0    [illegible]
 0 HRS. 10 MINS.  10.24  31.12       0.0     7.6     10.2     -0.1
 0 HRS. 20 MINS.  10.23  31.13       0.0    13.1     16.6      0.7
 0 HRS. 30 MINS.  10.21  31.15       0.0    20.3     22.7      1.4
 0 HRS. 40 MINS.  [illegible]
 0 HRS. 50 MINS.  [illegible]
 1 HRS.  0 MINS.  [illegible]
 1 HRS. 10 MINS.  [illegible]
 1 HRS. 20 MINS.  [illegible]
 1 HRS. 30 MINS.  [illegible]
 1 HRS. 40 MINS.  [illegible]
 1 HRS. 50 MINS.  [illegible]
 2 HRS.  0 MINS.  [illegible]
 2 HRS. 10 MINS.  [illegible]
 2 HRS. 20 MINS.  [illegible]
 2 HRS. 30 MINS.  [illegible]
 2 HRS. 40 MINS.  [illegible]
 2 HRS. 50 MINS.  [illegible]
 3 HRS.  0 MINS.  [illegible]
 3 HRS. 10 MINS.  [illegible]
 3 HRS. 20 MINS.  [illegible]
 3 HRS. 30 MINS.  [illegible]
 3 HRS. 40 MINS.  [illegible]
 3 HRS. 50 MINS.  [illegible]
 4 HRS.  0 MINS.  [illegible]
 4 HRS. 10 MINS.  [illegible]
 4 HRS. 20 MINS.  [illegible]
 4 HRS. 30 MINS.  [illegible]
 4 HRS. 40 MINS.  [illegible]
 4 HRS. 50 MINS.  [illegible]
 5 HRS.  0 MINS.  [illegible]
 5 HRS. 10 MINS.  [illegible]
 5 HRS. 20 MINS.  [illegible]
 5 HRS. 30 MINS.  [illegible]
 5 HRS. 40 MINS.  [illegible]
 5 HRS. 50 MINS.  [illegible]
 6 HRS.  0 MINS.  [illegible]
 6 HRS. 10 MINS.  [illegible]
 6 HRS. 20 MINS.  [illegible]
 6 HRS. 30 MINS.  [illegible]
 6 HRS. 40 MINS.  [illegible]
 6 HRS. 50 MINS.  [illegible]
 7 HRS.  0 MINS.  [illegible]
 7 HRS. 10 MINS.  [illegible]
 7 HRS. 20 MINS.  [illegible]
 7 HRS. 30 MINS.  [illegible]
 7 HRS. 40 MINS.  [illegible]
 7 HRS. 50 MINS.  [illegible]
 8 HRS.  0 MINS.  [illegible]
 8 HRS. 10 MINS.  [illegible]
 8 HRS. 20 MINS.  [illegible]
 8 HRS. 30 MINS.  [illegible]
 8 HRS. 40 MINS.  [illegible]
 8 HRS. 50 MINS.  [illegible]
 9 HRS.  0 MINS.  [illegible]
 9 HRS. 10 MINS.  [illegible]
 9 HRS. 20 MINS.  [illegible]
 9 HRS. 30 MINS.  [illegible]
 9 HRS. 40 MINS.  [illegible]
 9 HRS. 50 MINS.  [illegible]
10 HRS.  0 MINS.  [illegible]
10 HRS. 10 MINS.  [illegible]
10 HRS. 20 MINS.  [illegible]
10 HRS. 30 MINS.  [illegible]
10 HRS. 40 MINS.  [illegible]
10 HRS. 50 MINS.  [illegible]
11 HRS.  0 MINS.  [illegible]
11 HRS. 10 MINS.  [illegible]
11 HRS. 20 MINS.  [illegible]
11 HRS. 30 MINS.  [illegible]
11 HRS. 40 MINS.  [illegible]
11 HRS. 50 MINS.  [illegible]
12 HRS.  0 MINS.  [illegible]
12 HRS. 10 MINS.  [illegible]
12 HRS. 20 MINS.  [illegible]
```

A 3.10

```
PROGRAM   AVERAGE

DATA AVERAGED OVER   3 TIDAL CYCLES AT STN.  12

THE FIRST RECORD FOR EACH  CYCLE  OCCURRED:
                                HW Belfast    Time before HW Belfast
 ON  4/ 6/75 AT 1540             1920          3.40
 ON  5/ 6/75 AT  4[illegible]    0702          3.02
 ON  5/ 6/75 AT 1630             2011          3.41      mean 3 hr. [illegible] min.
                                                              s.d.       1 min.

THE MEAN TIDAL RANGE PREDICTED AT BELFAST
OVER THE WHOLE PERIOD WAS 1.97 METRES.
Max range was 2.1 m

 SPEED ENCOUNTERED (CM/SEC):
 MEAN = 19.1  MIN =   1.9 MAX =  35.1

 MEAN RESIDUAL EXCURSION =
    -1.26 KM NORTH,  3.03 KM EAST.
```

```
TIME AFTER START       TEMP   SAL      DIR       SPEED   NORTHING  EASTING
 0 HRS.  0 MINS.       10.24  [illegible]  [illegible]   7.6     -5.7      2.4
 0 HRS. 10 MINS.       10.20  [illegible]  [illegible]   3.6     -3.3      2.0
 0 HRS. 20 MINS.       10.23  [illegible]  [illegible]   3.5     -1.0      [illegible]
 0 HRS. 30 MINS.       10.28  [illegible]  [illegible]   5.0      4.0      [illegible]
 0 HRS. 40 MINS.       10.29  [illegible]  [illegible]   6.6      7.0      2.2
 0 HRS. 50 MINS.       10.27  [illegible]  [illegible]   [illegible]  10.2  [illegible]
 1 HRS.  0 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
 1 HRS. 10 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  15.0  [illegible]
 1 HRS. 20 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
 1 HRS. 30 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  18.7  [illegible]
 1 HRS. 40 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  20.1  [illegible]
 1 HRS. 50 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  21.4  [illegible]
 2 HRS.  0 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  22.0  [illegible]
 2 HRS. 10 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  22.9  [illegible]
 2 HRS. 20 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  24.1  [illegible]
 2 HRS. 30 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  23.3  [illegible]
 2 HRS. 40 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
 2 HRS. 50 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  25.4  [illegible]
 3 HRS.  0 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  22.1  [illegible]
 3 HRS. 10 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
 3 HRS. 20 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
 3 HRS. 30 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
 3 HRS. 40 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
 3 HRS. 50 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
 4 HRS.  0 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
 4 HRS. 10 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
 4 HRS. 20 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
 4 HRS. 30 MINS.       [illegible]  [illegible]  [illegible]  27.2  [illegible]  [illegible]
 4 HRS. 40 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
 4 HRS. 50 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
 5 HRS.  0 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
 5 HRS. 10 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
 5 HRS. 20 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
 5 HRS. 30 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
 5 HRS. 40 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
 5 HRS. 50 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
 6 HRS.  0 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
 6 HRS. 10 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
 6 HRS. 20 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
 6 HRS. 30 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
 6 HRS. 40 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
 6 HRS. 50 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
 7 HRS.  0 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
 7 HRS. 10 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
 7 HRS. 20 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
 7 HRS. 30 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
 7 HRS. 40 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
 7 HRS. 50 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
 8 HRS.  0 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
 8 HRS. 10 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
 8 HRS. 20 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
 8 HRS. 30 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
 8 HRS. 40 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
 8 HRS. 50 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
 9 HRS.  0 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
 9 HRS. 10 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
 9 HRS. 20 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
 9 HRS. 30 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
 9 HRS. 40 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
 9 HRS. 50 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
10 HRS.  0 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
10 HRS. 10 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
10 HRS. 20 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
10 HRS. 30 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
10 HRS. 40 MINS.       [illegible]  [illegible]  [illegible]  21.0  -20.2  [illegible]
10 HRS. 50 MINS.       10.13  [illegible]  [illegible]  20.9  -20.0   5.2
11 HRS.  0 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  -19.2  [illegible]
11 HRS. 10 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  -17.2  [illegible]
11 HRS. 20 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  -16.8  [illegible]
11 HRS. 30 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  -13.7  [illegible]
11 HRS. 40 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  -13.1  [illegible]
11 HRS. 50 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
12 HRS.  0 MINS.       [illegible]  [illegible]  [illegible]  [illegible]  -9.1  [illegible]
12 HRS. 10 MINS.       10.23  [illegible]  [illegible]  [illegible]  -7.0   1.2
12 HRS. 20 MINS.       10.20  33.30  23.3      0.1     -5.9      1.5
```

A 3.11

```
PROGRAM    AVERAGE

DATA AVERAGED OVER  13 TIDAL CYCLES AT STN.  13

THE FIRST RECORD FOR EACH  CYCLE  OCCURRED:
                                  HW Belfast   Time before HW Belfast
 ON   7/10/75  AT  2039            0005          3.26
 ON   8/10/75  AT   859            1248          3.49
 ON   8/10/75  AT  2129            0115          3.46
 ON   9/10/75  AT   929            1338          3.49
 ON   9/10/75  AT  2219            0208          3.49
 ON  10/10/75  AT  1039            1429          3.50
 ON  10/10/75  AT  [illegible]     0304          3.58
 ON  11/10/75  AT  [illegible]     1524          3.55
 ON  11/10/75  AT  [illegible]     0405          4.06
 ON  12/10/75  AT  [illegible]     1626          4.07
 ON  13/10/75  AT   049            0511          4.27
 ON  13/10/75  AT  [illegible]     1744          4.31
 ON  14/10/75  AT  [illegible]     0624          4.45   mean  4 hr. 1 min.
                                                          s.d.     21 min.

THE MEAN TIDAL RANGE PREDICTED AT BELFAST
OVER THE WHOLE PERIOD WAS 2.58 METRES.
```

Max range was 3.5 m.

```
 SPEED ENCOUNTERED (CM/SEC):
 MEAN = 40.1  MIN =   2.9 MAX = 107.9

 MEAN RESIDUAL EXCURSION =
     -6.95 KM NORTH, 16.01 KM EAST.
```

```
TIME AFTER START       TEMP.  SAL      DIR    SPEED    NORTHING  EASTING
 0 HRS. 10 MINS.      11.86  33.40     9.0    23.0      11.7     -19.5
 0 HRS. 20 MINS.      11.85  33.30     9.0    32.4      20.3     -27.3
 0 HRS. 30 MINS.      [illegible]
 0 HRS. 40 MINS.      [illegible]
 0 HRS. 50 MINS.      [illegible]
 1 HRS.  0 MINS.      [illegible]
 1 HRS. 10 MINS.      [illegible]
 1 HRS. 20 MINS.      [illegible]
 1 HRS. 30 MINS.      [illegible]
 1 HRS. 40 MINS.      [illegible]
 1 HRS. 50 MINS.      [illegible]
 2 HRS.  0 MINS.      [illegible]
 2 HRS. 10 MINS.      [illegible]
 2 HRS. 20 MINS.      [illegible]
 2 HRS. 30 MINS.      [illegible]
 2 HRS. 40 MINS.      [illegible]
 2 HRS. 50 MINS.      [illegible]
 3 HRS.  0 MINS.      [illegible]
 3 HRS. 10 MINS.      [illegible]
 3 HRS. 20 MINS.      [illegible]
 3 HRS. 30 MINS.      [illegible]
 3 HRS. 40 MINS.      [illegible]
 3 HRS. 50 MINS.      [illegible]
 4 HRS.  0 MINS.      [illegible]
 4 HRS. 10 MINS.      [illegible]
 4 HRS. 20 MINS.      [illegible]
 4 HRS. 30 MINS.      [illegible]
 4 HRS. 40 MINS.      [illegible]
 4 HRS. 50 MINS.      [illegible]
 5 HRS.  0 MINS.      [illegible]
 5 HRS. 10 MINS.      [illegible]
 5 HRS. 20 MINS.      [illegible]
 5 HRS. 30 MINS.      [illegible]
 5 HRS. 40 MINS.      [illegible]
 5 HRS. 50 MINS.      [illegible]
 6 HRS.  0 MINS.      [illegible]
 6 HRS. 10 MINS.      [illegible]
 6 HRS. 20 MINS.      [illegible]
 6 HRS. 30 MINS.      [illegible]
 6 HRS. 40 MINS.      [illegible]
 6 HRS. 50 MINS.      [illegible]
 7 HRS.  0 MINS.      [illegible]
 7 HRS. 10 MINS.      [illegible]
 7 HRS. 20 MINS.      [illegible]
 7 HRS. 30 MINS.      [illegible]
 7 HRS. 40 MINS.      [illegible]
 7 HRS. 50 MINS.      [illegible]
 8 HRS.  0 MINS.      [illegible]
 8 HRS. 10 MINS.      [illegible]
 8 HRS. 20 MINS.      [illegible]
 8 HRS. 30 MINS.      [illegible]
 8 HRS. 40 MINS.      [illegible]
 8 HRS. 50 MINS.      [illegible]
 9 HRS.  0 MINS.      [illegible]
 9 HRS. 10 MINS.      [illegible]
 9 HRS. 20 MINS.      [illegible]
 9 HRS. 30 MINS.      [illegible]
 9 HRS. 40 MINS.      [illegible]
 9 HRS. 50 MINS.      [illegible]
10 HRS.  0 MINS.      [illegible]
10 HRS. 10 MINS.      [illegible]
10 HRS. 20 MINS.      [illegible]
10 HRS. 30 MINS.      [illegible]
10 HRS. 40 MINS.      [illegible]
10 HRS. 50 MINS.      [illegible]
11 HRS.  0 MINS.      [illegible]
11 HRS. 10 MINS.      [illegible]
11 HRS. 20 MINS.      [illegible]
11 HRS. 30 MINS.      [illegible]
11 HRS. 40 MINS.      [illegible]
11 HRS. 50 MINS.      [illegible]
12 HRS.  0 MINS.      [illegible]
12 HRS. 10 MINS.      [illegible]
12 HRS. 20 MINS.      11.81  33.31     9.0    13.2      -0.2      [illegible]
```

A 3.12

```
PROGRAM   AVERAGE
DATA AVERAGED OVER   2 TIDAL CYCLES AT STN.  16
THE FIRST RECORD FOR EACH  CYCLE  OCCURRED:
                          HW Belfast     Time before HW Belfast
 ON 29/10/75 AT  019        0410           3.51
 ON 29/10/75 AT 1239        1640           4.01     mean  3 hr 56 min
                                                     sd         7 min

THE MEAN TIDAL RANGE PREDICTED AT BELFAST
OVER THE WHOLE PERIOD WAS 2.33 METRES.
Max range was 2.7 m.

 SPEED ENCOUNTERED (CM/SEC):
 MEAN = 34.5  MIN =   2.3 MAX =  86.9

 MEAN RESIDUAL EXCURSION =
    -3.83 KM NORTH, 10.63 KM EAST.
```

```
TIME AFTER START      TEMP   SAL    DEP   SPEED  NORTHING EASTING
 0 HRS.  0 MINS.     12.11 33.31   11.7   17.5      2.8   -21.4
 0 HRS. 10 MINS.     12.11 33.31   11.7   28.1     12.8   -32.1
 0 HRS. 20 MINS.     12.10 33.20   11.7   41.1     21.6   -41.5
 0 HRS. 30 MINS.     12.12 33.33   11.7   52.4     25.5   -45.0
 0 HRS. 40 MINS.     12.12 33.28   11.7   51.6     22.8   -42.7
 0 HRS. 50 MINS.     12.14 33.32   11.7   43.9     20.3   -35.6
 1 HRS.  0 MINS.     12.14 33.32   11.7   31.6     12.3   -22.6
 1 HRS. 10 MINS.     12.14 33.32   11.7   20.0      6.5    -5.0
 1 HRS. 20 MINS.     12.14 33.32   11.7    8.2      4.3     7.2
 1 HRS. 30 MINS.     12.14 33.35   11.7    9.5      3.5     6.2
 1 HRS. 40 MINS.     12.14 33.33   11.7    3.6     -1.4     7.4
 1 HRS. 50 MINS.     12.12 33.33   11.7   10.3      3.3     9.3
 2 HRS.  0 MINS.     12.12 33.33   11.7    9.4      1.3    11.7
 2 HRS. 10 MINS.     12.12 33.33   11.7   14.3     -2.9     6.8
 2 HRS. 20 MINS.     12.15 33.32   11.7   13.3     -1.9     2.4
 2 HRS. 30 MINS.     12.16 33.32   11.7    9.5     -2.1     9.8
 2 HRS. 40 MINS.     12.15 33.31   11.7   10.7      3.1     8.1
 2 HRS. 50 MINS.     12.15 33.31   11.7    6.5      4.4     3.2
 3 HRS.  0 MINS.     12.15 33.31   11.8    7.3     -1.0     1.6
 3 HRS. 10 MINS.     12.17 33.37   11.8   11.2      7.5     2.9
 3 HRS. 20 MINS.     12.18 33.35   11.9   12.3      7.6    -0.6
 3 HRS. 30 MINS.     12.17 33.35   11.9    7.8      6.9    -2.2
 3 HRS. 40 MINS.     12.17 33.35   11.9    7.4      5.4    -1.1
 3 HRS. 50 MINS.     12.16 33.37   11.9    7.4     -1.4     4.1
 4 HRS.  0 MINS.     12.18 33.32   12.1   11.0     -4.5     4.3
 4 HRS. 10 MINS.     12.18 33.35   12.1   10.7     -3.0     7.6
 4 HRS. 20 MINS.     12.21 33.30   12.1    9.2      1.8     0.5
 4 HRS. 30 MINS.     12.20 33.37   12.1    6.3      1.5    -0.1
 4 HRS. 40 MINS.     12.18 33.32   12.1    6.0     -1.0     5.4
 4 HRS. 50 MINS.     12.18 33.35   12.1   11.4     -0.0     9.9
 5 HRS.  0 MINS.     12.19 33.37   12.1   10.0     -6.0     7.9
 5 HRS. 10 MINS.     12.20 33.37   12.1    6.7     -3.9     7.2
 5 HRS. 20 MINS.     12.20 33.40   12.1   13.0     -0.2    13.7
 5 HRS. 30 MINS.     12.20 33.37   12.1   16.3     -0.1    14.8
 5 HRS. 40 MINS.     12.20 33.33   12.1   14.5     -0.3    16.6
 5 HRS. 50 MINS.     12.19 33.38   12.2   18.3     -2.8    22.2
 6 HRS.  0 MINS.     12.21 33.36   12.2   28.6     -6.0    32.3
 6 HRS. 10 MINS.     12.21 33.36   12.2   33.5    -10.8    32.9
 6 HRS. 20 MINS.     12.22 33.41   12.2   37.5    -16.6    32.3
 6 HRS. 30 MINS.     12.22 33.42   12.2   33.3    -15.0    35.3
 6 HRS. 40 MINS.     12.21 33.35   12.2   41.3    -10.9    35.9
 6 HRS. 50 MINS.     12.21 33.35   12.2   40.3    -19.4    40.9
 7 HRS.  0 MINS.     12.19 33.38   12.2   51.1    -26.1    51.8
 7 HRS. 10 MINS.     12.20 33.37   12.1   62.8    -26.8    65.5
 7 HRS. 20 MINS.     12.20 33.37   12.1   74.8    -28.6    74.8
 7 HRS. 30 MINS.     12.17 33.37   12.1   34.0    -28.0    79.1
 7 HRS. 40 MINS.     12.16 33.37   12.1   83.9    -32.4    69.1
 7 HRS. 50 MINS.     12.18 33.38   12.1   69.2    -32.2    59.5
 8 HRS.  0 MINS.     12.18 33.38   12.1   66.2    -28.8    58.0
 8 HRS. 10 MINS.     12.19 33.38   12.1   63.6    -28.3    55.6
 8 HRS. 20 MINS.     12.19 33.38   12.1   61.3    -32.0    50.1
 8 HRS. 30 MINS.     12.19 33.38   12.1   55.9    -27.3    53.6
 8 HRS. 40 MINS.     12.19 33.38   12.1   57.0    -24.3    52.5
 8 HRS. 50 MINS.     12.19 33.35   12.1   58.1    -24.9    54.4
 9 HRS.  0 MINS.     12.19 33.35   12.1   61.5    -25.2    56.0
 9 HRS. 10 MINS.     12.19 33.38   12.1   63.5    -26.9    58.2
 9 HRS. 20 MINS.     12.19 33.38   12.1   63.3    -28.6    60.8
 9 HRS. 30 MINS.     12.20 33.40   12.1   68.5    -24.6    63.6
 9 HRS. 40 MINS.     12.19 33.35   12.1   67.6    -24.6    61.4
 9 HRS. 50 MINS.     12.19 33.35   12.1   64.9    -26.5    59.0
10 HRS.  0 MINS.     12.18 33.35   12.0   62.7    -26.4    55.9
10 HRS. 10 MINS.     12.18 33.35   12.0   61.0    -23.0    53.3
10 HRS. 20 MINS.     12.19 33.38   12.0   58.5    -22.5    53.3
10 HRS. 30 MINS.     12.18 33.32   11.8   57.2    -21.8    52.4
10 HRS. 40 MINS.     12.19 33.38   11.7   56.5    -19.8    51.0
10 HRS. 50 MINS.     12.17 33.33   11.7   53.3    -21.6    47.2
11 HRS.  0 MINS.     12.15 33.31   11.7   50.3    -20.1    43.5
11 HRS. 10 MINS.     12.15 33.35   11.7   43.0    -15.0    39.8
11 HRS. 20 MINS.     12.15 33.30   11.7   40.0    -16.0    34.3
11 HRS. 30 MINS.     12.10 33.33   11.7   36.8    -13.6    30.2
11 HRS. 40 MINS.     12.09 33.30   11.7   28.0    -13.5    23.5
11 HRS. 50 MINS.     12.11 33.31   11.7   21.0     -9.5    16.6
12 HRS.  0 MINS.     12.11 33.31   11.7   16.7     -7.0     9.6
12 HRS. 10 MINS.     12.10 33.27   11.7   14.1     -4.0     1.1
12 HRS. 20 MINS.     12.08 33.28   11.7   14.3     -1.0    -2.8
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A 3.13

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PROGRAM   AVERAGE

DATA AVERAGED OVER   3 TIDAL CYCLES AT STN.  15

THE FIRST RECORD FOR EACH  CYCLE  OCCURRED:
                              HW Belfast     Time before HW Belfast
 ON 30/10/75 AT 1529          1909           3.40
 ON 31/10/75 AT  349          0755           4.06
 ON 31/10/75 AT 1619          2011           3.52       mean  3hr. 52 min.
                                                        s.d.      13 min.

THE MEAN TIDAL RANGE-PREDICTED AT BELFAST
OVER THE WHOLE PERIOD WAS 2.65 METRES.
Max range was 3.2 m.

 SPEED ENCOUNTERED (CM/SEC):
 MEAN = 51.1  MIN =   7.7 MAX = 130.0

 MEAN RESIDUAL EXCURSION =
    -3.05 KM NORTH, 16.88 KM EAST.
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TIME AFTER START     TEMP   SAL     DEP    SPEED   NORTHING  EASTING
 0 HRS.  0 MINS.    12.18  33.32    3.9    24.5       2.0    -28.3
 0 HRS. 10 MINS.    12.18  33.31    3.9    37.4      16.6    -41.8
 0 HRS. 20 MINS.    12.17  33.32    3.9    54.4      23.8    -54.4
 0 HRS. 30 MINS.    12.20  33.32    4.0    64.7      30.8    -61.6
 0 HRS. 40 MINS.    12.21  33.33    4.0    70.8      30.8    -58.3
 0 HRS. 50 MINS.    12.20  33.34    4.0    60.7      15.0    -50.5
 1 HRS.  0 MINS.    12.20  33.34    3.9    45.3      15.5    -32.2
 1 HRS. 10 MINS.    12.20  33.32    4.0    27.8      14.6     -8.0
 1 HRS. 20 MINS.    12.20  33.34    4.0    21.0      13.6     -9.0
 1 HRS. 30 MINS.    12.20  33.34    4.1    12.6       8.6      6.7
 1 HRS. 40 MINS.    12.20  33.34    4.1    12.4       0.5     -2.3
 1 HRS. 50 MINS.    12.22  33.36    4.3    13.7       1.6     -3.4
 2 HRS.  0 MINS.    12.20  33.34    4.3    17.2       7.8     -0.6
 2 HRS. 10 MINS.    12.20  33.34    4.2    12.1      10.4      6.0
 2 HRS. 20 MINS.    12.22  33.34    4.4    13.0      10.2     -0.7
 2 HRS. 30 MINS.    12.21  33.35    4.5    13.4       7.2      0.8
 2 HRS. 40 MINS.    12.23  33.36    4.6    13.3       6.8      0.1
 2 HRS. 50 MINS.    12.23  33.36    4.7    17.6       6.0    -15.8
 3 HRS.  0 MINS.    12.25  33.36    4.7    21.0      18.0     -8.3
 3 HRS. 10 MINS.    12.23  33.35    4.8    19.0       9.0      5.2
 3 HRS. 20 MINS.    12.25  33.38    4.9    16.0      17.6     -3.8
 3 HRS. 30 MINS.    12.27  33.37    5.5    20.6       7.5    -20.8
 3 HRS. 40 MINS.    12.26  33.37    5.6    19.5      11.7      6.3
 3 HRS. 50 MINS.    12.23  33.37    5.5    17.5      13.4      6.5
 4 HRS.  0 MINS.    12.24  33.38    5.4    20.1      14.8     -1.3
 4 HRS. 10 MINS.    12.25  33.39    5.6    19.0      10.8     -6.8
 4 HRS. 20 MINS.    12.27  33.40    5.8    20.3      17.0     -8.6
 4 HRS. 30 MINS.    12.27  33.40    5.9    20.2       2.6     -7.9
 4 HRS. 40 MINS.    12.26  33.30    5.9    19.3       1.6      2.6
 4 HRS. 50 MINS.    12.26  33.36    6.0    17.9      12.6     -5.9
 5 HRS.  0 MINS.    12.27  33.40    6.0    13.6       3.6     -8.3
 5 HRS. 10 MINS.    12.25  33.38    6.0    13.8       8.8      8.0
 5 HRS. 20 MINS.    12.23  33.30    6.0    10.5      -2.6     12.5
 5 HRS. 30 MINS.    12.25  33.35    6.1    15.6      -3.5     17.0
 5 HRS. 40 MINS.    12.26  33.36    6.1    20.3      -1.7     25.5
 5 HRS. 50 MINS.    12.24  33.36    6.1    30.0      -3.0     35.5
 6 HRS.  0 MINS.    12.27  33.40    6.1    40.9      -9.3     41.3
 6 HRS. 10 MINS.    12.24  33.38    6.1    45.4     -13.4     46.6
 6 HRS. 20 MINS.    12.26  33.37    6.1    54.1     -18.3     55.9
 6 HRS. 30 MINS.    12.25  33.36    6.0    64.1     -20.5     59.1
 6 HRS. 40 MINS.    12.25  33.38    6.0    74.7     -22.5     66.3
 6 HRS. 50 MINS.    12.24  33.36    6.1    94.5     -22.8     70.8
 7 HRS.  0 MINS.    12.33  33.37    6.0    91.8     -25.4     92.8
 7 HRS. 10 MINS.    12.32  33.35    6.2   101.6     -28.1     95.5
 7 HRS. 20 MINS.    12.33  33.34    6.1   101.0     -37.0     89.6
 7 HRS. 30 MINS.    12.33  33.34    6.1   105.2     -35.4     90.8
 7 HRS. 40 MINS.    12.34  33.38    6.1    93.3     -27.6     88.1
 7 HRS. 50 MINS.    12.34  33.36    6.0    92.3     -24.1     87.9
 8 HRS.  0 MINS.    12.35  33.36    6.0    90.5     -25.1     88.5
 8 HRS. 10 MINS.    12.35  33.34    5.9    93.7     -30.6     88.6
 8 HRS. 20 MINS.    12.35  33.38    5.9    93.8     -32.6     86.6
 8 HRS. 30 MINS.    12.34  33.38    5.9    92.1     -28.1     88.3
 8 HRS. 40 MINS.    12.33  33.35    5.8    93.0     -25.3     90.8
 8 HRS. 50 MINS.    12.33  33.36    5.7    95.8     -27.6     91.2
 9 HRS.  0 MINS.    12.31  33.35    5.6    96.1     -29.7     91.3
 9 HRS. 10 MINS.    12.31  33.35    5.6    97.3     -30.0     92.0
 9 HRS. 20 MINS.    12.31  33.35    5.4    94.0     -33.1     91.0
 9 HRS. 30 MINS.    12.32  33.36    5.2    91.0     -25.0     86.9
 9 HRS. 40 MINS.    12.32  33.36    5.0    90.5     -23.0     85.4
 9 HRS. 50 MINS.    12.32  33.36    5.0    86.6     -22.9     82.3
10 HRS.  0 MINS.    12.31  33.35    4.9    84.0     -22.5     79.4
10 HRS. 10 MINS.    12.31  33.35    4.8    81.0     -27.3     75.5
10 HRS. 20 MINS.    12.20  33.36    4.6    79.0     -26.5     74.6
10 HRS. 30 MINS.    12.20  33.36    4.5    76.2     -21.8     71.8
10 HRS. 40 MINS.    12.20  33.36    4.3    76.0     -21.5     67.9
10 HRS. 50 MINS.    12.18  33.36    4.5    73.8     -17.8     62.6
11 HRS.  0 MINS.    12.19  33.35    4.3    67.5     -18.9     60.8
11 HRS. 10 MINS.    12.21  33.35    4.1    63.0     -14.2     58.7
11 HRS. 20 MINS.    12.19  33.35    4.0    58.2     -13.0     53.6
11 HRS. 30 MINS.    12.18  33.35    3.9    52.0     -11.5     48.1
11 HRS. 40 MINS.    12.18  33.35    3.9    45.0     -10.8     40.7
11 HRS. 50 MINS.    12.18  33.33    3.9    40.7     -11.0     33.1
12 HRS.  0 MINS.    12.17  33.33    3.9    33.0     -11.9     22.0
12 HRS. 10 MINS.    12.14  33.30    3.9    31.6     -11.0     -6.4
12 HRS. 20 MINS.    12.14  33.32    3.9    18.5      -6.9     -6.4
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A 3.14

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PROGRAM    AVERAGE

DATA AVERAGED OVER    3 TIDAL CYCLES AT STN.  16

THE FIRST RECORD FOR EACH  CYCLE  OCCURRED:
                              HW Belfast   Time before HW Belfast
 ON   3/11/75 AT 1849          2219         3.30
 ON   6/11/75 AT  909          1257         3.48
 ON   6/11/75 AT 1039          1418         3.39   mean   3 hr 40 min
                                                   s.d.        7 min

THE MEAN TIDAL RANGE PREDICTED AT BELFAST

OVER THE WHOLE PERIOD WAS 3.37 METRES.

Max range was 3.5 m.

 SPEED ENCOUNTERED (CM/SEC):

 MEAN = 27.0  MIN =   1.5 MAX =  66.2


 MEAN RESIDUAL EXCURSION =
    -4.75 KM NORTH, 11.62 KM EAST.
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TIME AFTER START         TEMP  SAL     DEP    SPEED   NORTHING EASTING
 0 HRS.  0 MINS.        11.76 33.35    7.9     3.6      -1.3     9.1
 0 HRS. 10 MINS.        11.77 33.36    7.9     7.0      -6.1    12.3
 0 HRS. 20 MINS.        11.71 33.32    7.9    16.0      -7.8    23.8
 0 HRS. 30 MINS.        11.71 33.32    7.9    31.2      -9.8    31.0
 0 HRS. 40 MINS.        11.74 33.31    7.9    33.8      -8.5    27.5
 0 HRS. 50 MINS.        11.75 33.34    8.0    23.5      -5.5    17.7
 1 HRS.  0 MINS.        11.76 33.36    8.0    13.2      -3.5    11.2
 1 HRS. 10 MINS.        11.77 33.33    8.0    10.2      -2.4     5.0
 1 HRS. 20 MINS.        11.77 33.35    8.0     6.4      -2.3     7.4
 1 HRS. 30 MINS.        11.76 33.34    8.1     9.0      -2.5     8.4
 1 HRS. 40 MINS.        11.75 33.33    8.1     8.6      -2.5     8.6
 1 HRS. 50 MINS.        11.78 33.37    8.1     8.8      -3.2    10.8
 2 HRS.  0 MINS.        11.80 33.37    8.1    15.9      -3.5    12.3
 2 HRS. 10 MINS.        11.77 33.37    8.5    11.6      -3.5    12.0
 2 HRS. 20 MINS.        11.83 33.36    8.5    13.4      -4.3    14.8
 2 HRS. 30 MINS.        11.81 33.38    8.4    10.6      -3.8    13.1
 2 HRS. 40 MINS.        11.78 33.30    8.6    10.6      -3.4    12.3
 2 HRS. 50 MINS.        11.82 33.10    8.7    14.0      -4.1    14.5
 3 HRS.  0 MINS.        11.85 33.40    8.8    15.2      -4.1    14.5
 3 HRS. 10 MINS.        11.85 33.30    8.9    15.5      -5.0    13.8
 3 HRS. 20 MINS.        11.85 33.30    9.0    13.7      -5.6    15.0
 3 HRS. 30 MINS.        11.84 33.30    9.2    13.3      -4.1    15.0
 3 HRS. 40 MINS.        11.85 33.43    9.6    17.3      -4.0    14.5
 3 HRS. 50 MINS.        11.86 33.42    9.9    16.4      -4.3    15.8
 4 HRS.  0 MINS.        11.86 33.40   10.0    19.1      -4.3    15.8
 4 HRS. 10 MINS.        11.86 33.40   10.0    13.6      -4.2    15.2
 4 HRS. 20 MINS.        11.85 33.41   10.0    17.0      -3.8    14.4
 4 HRS. 30 MINS.        11.86 33.40   10.0    15.0      -3.3    12.1
 4 HRS. 40 MINS.        11.86 33.38   10.1    15.2      -3.9    13.5
 4 HRS. 50 MINS.        11.86 33.42   10.1    14.8      -3.9    14.1
 5 HRS.  0 MINS.        11.84 33.41   10.1    14.4      -3.3    12.3
 5 HRS. 10 MINS.        11.85 33.40   10.3    11.1      -3.0    11.0
 5 HRS. 20 MINS.        11.84 33.40   10.3    11.7      -3.0    11.0
 5 HRS. 30 MINS.        11.85 33.37   10.3    12.0      -3.1    11.5
 5 HRS. 40 MINS.        11.84 33.30   10.3    10.4      -3.1    12.1
 5 HRS. 50 MINS.        11.83 33.15   10.3    14.6      -4.4    17.2
 6 HRS.  0 MINS.        11.84 33.30   10.3    20.6      -5.3    20.2
 6 HRS. 10 MINS.        11.85 33.38   10.3    20.5      -5.5    21.5
 6 HRS. 20 MINS.        11.85 33.38   10.3    23.1      -6.3    24.5
 6 HRS. 30 MINS.        11.80 33.10   10.3    27.0      -7.5    27.9
 6 HRS. 40 MINS.        11.77 33.10   10.3    30.0      -8.3    31.6
 6 HRS. 50 MINS.        11.73 33.14   10.3    37.6     -11.3    39.5
 7 HRS.  0 MINS.        11.73 33.17   10.3    47.6     -20.3    49.8
 7 HRS. 10 MINS.        11.70 33.17   10.3    60.0     -28.3    50.9
 7 HRS. 20 MINS.        11.82 33.16   10.5    56.3     -27.6    49.3
 7 HRS. 30 MINS.        11.81 33.17   10.5    58.6     -27.0    48.3
 7 HRS. 40 MINS.        11.81 33.16   10.5    57.3     -26.5    47.6
 7 HRS. 50 MINS.        11.81 33.10   10.6    51.6     -27.9    43.5
 8 HRS.  0 MINS.        11.81 33.00   10.6    46.6     -22.9    42.0
 8 HRS. 10 MINS.        11.81 33.00   10.2    47.4     -20.4    42.6
 8 HRS. 20 MINS.        11.81 33.17   10.1    47.4     -20.8    42.0
 8 HRS. 30 MINS.        11.81 33.17   10.0    48.1     -21.8    44.7
 8 HRS. 40 MINS.        11.80 33.16   10.0    51.4     -23.5    46.2
 8 HRS. 50 MINS.        11.79 33.18   10.0    52.3     -23.6    46.4
 9 HRS.  0 MINS.        11.80 33.17    9.8    51.8     -23.0    46.4
 9 HRS. 10 MINS.        11.79 33.18    9.9    52.3     -24.2    46.2
 9 HRS. 20 MINS.        11.80 33.17   10.0    52.2     -23.8    46.0
 9 HRS. 30 MINS.        11.81 33.10    9.8    51.2     -22.8    45.0
 9 HRS. 40 MINS.        11.78 33.10    9.4    50.2     -22.0    44.0
 9 HRS. 50 MINS.        11.77 33.17    9.0    49.8     -21.0    43.0
10 HRS.  0 MINS.        11.76 33.17    8.6    48.8     -21.0    43.0
10 HRS. 10 MINS.        11.77 33.17    8.7    46.8     -20.1    41.8
10 HRS. 20 MINS.        11.78 33.17    8.7    43.9     -18.8    41.0
10 HRS. 30 MINS.        11.79 33.18    8.6    44.5     -18.2    40.1
10 HRS. 40 MINS.        11.76 33.14    8.5    43.2     -15.8    38.7
10 HRS. 50 MINS.        11.78 33.30    8.5    41.5     -15.1    36.7
11 HRS.  0 MINS.        11.78 33.30    8.4    36.5     -14.1    34.3
11 HRS. 10 MINS.        11.77 33.15    8.3    33.7     -12.7    31.6
11 HRS. 20 MINS.        11.75 33.15    8.3    32.3     -11.4    28.6
11 HRS. 30 MINS.        11.75 33.30    8.1    28.3     -10.8    25.5
11 HRS. 40 MINS.        11.75 33.30    8.0    24.3      -9.8    21.8
11 HRS. 50 MINS.        11.73 33.16    7.8    19.6      -5.8    15.8
12 HRS.  0 MINS.        11.74 33.14    7.9    14.0      -4.0    10.8
12 HRS. 10 MINS.        11.75 33.15    7.9     8.3      -1.8     5.5
12 HRS. 20 MINS.        11.75 33.35    7.9     2.9      -0.9     2.9
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A 3.15

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PROGRAM   AVERAGE
DATA AVERAGED OVER   2 TIDAL CYCLES AT STN.  17
THE FIRST RECORD FOR EACH  CYCLE  OCCURRED:
                      HW Belfast     Time before HW Belfast
 ON 12/11/75 AT  [illegible]   0548            3.40
 ON 12/11/75 AT 1628        1909            3.41     mean 3hr 40min
                                                        s.d.      0.2min.

THE MEAN TIDAL RANGE PREDICTED AT BELFAST
OVER THE WHOLE PERIOD WAS 1.85 METRES.
Max range was 2.1 m.

 SPEED ENCOUNTERED (CM/SEC):
 MEAN = 39.8  MIN =   2.9 MAX =  88.9

 MEAN RESIDUAL EXCURSION =
    -2.18 KM NORTH, 11.66 KM EAST.
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TIME AFTER START      TEMP   SAL    DEG   SPEED   NORTHING  EASTING
 0 HRS.  0 MINS.   [illegible]
 0 HRS. 10 MINS.   11.17 33.35  17.9   47.5     21.9    -45.6
 0 HRS. 20 MINS.   11.21 33.35  17.9   33.6     27.6    -47.6
 0 HRS. 30 MINS.   11.26 33.32  17.9   36.5     15.8    -50.5
 0 HRS. 40 MINS.   11.30 33.36  17.9   30.8     13.9    -42.3
 0 HRS. 50 MINS.   11.31 33.35  17.9   30.5     15.4    -28.0
 1 HRS.  0 MINS.   11.32 33.37  17.9   23.5      5.4    -17.8
 1 HRS. 10 MINS.   [illegible] 33.38  17.9   16.9      4.5     -7.0
 1 HRS. 20 MINS.   [illegible] 33.38  17.9    9.1      6.5     -3.9
 1 HRS. 30 MINS.   [illegible] 33.40  17.9    9.8     -0.2     -5.3
 1 HRS. 40 MINS.   [illegible] 33.39  17.9    5.5      4.4      7.2
 1 HRS. 50 MINS.   [illegible] 33.30  17.9   11.3     10.8      8.8
 2 HRS.  0 MINS.   [illegible] 33.30  18.1   10.3      6.9      8.8
 2 HRS. 10 MINS.   [illegible] 33.37  18.1   14.5      0.1     -1.3
 2 HRS. 20 MINS.   [illegible] 33.36  18.1   13.5     11.8     -3.0
 2 HRS. 30 MINS.   [illegible] 33.40  18.2   14.8     10.8     -5.0
 2 HRS. 40 MINS.   11.17 33.36  18.2   11.0      1.6     -3.2
 2 HRS. 50 MINS.   [illegible] 33.41  18.2   19.5     12.7     -3.6
 3 HRS.  0 MINS.   [illegible] 33.43  18.2   13.1      5.8     -4.2
 3 HRS. 10 MINS.   [illegible] 33.35  18.4   11.7     11.0      3.9
 3 HRS. 20 MINS.   11.15 33.37  18.6   14.8     10.3      0.2
 3 HRS. 30 MINS.   11.13 33.37  18.7    9.2      7.3     -0.3
 3 HRS. 40 MINS.   [illegible] 33.40  18.7   13.6      6.5     -0.3
 3 HRS. 50 MINS.   11.13 33.40  18.7   14.4     12.3      3.4
 4 HRS.  0 MINS.   [illegible] 33.42  18.9   13.9     -1.6      0.2
 4 HRS. 10 MINS.   [illegible] 33.36  18.9   13.9      4.8     12.0
 4 HRS. 20 MINS.   [illegible] 33.40  19.0   12.2      7.8      3.1
 4 HRS. 30 MINS.   [illegible] 33.39  19.1   15.5      6.0      6.5
 4 HRS. 40 MINS.   [illegible] 33.45  19.2   21.8      3.8     10.3
 4 HRS. 50 MINS.   [illegible] 33.30  19.2   26.5      8.6     26.8
 5 HRS.  0 MINS.   [illegible] 33.41  19.2   28.7      6.1     28.5
 5 HRS. 10 MINS.   [illegible] 33.39  19.2   35.1      2.6     36.3
 5 HRS. 20 MINS.   [illegible] 33.45  19.2   35.7      6.2     36.7
 5 HRS. 30 MINS.   11.11 33.30  19.2   46.0     11.6     42.6
 5 HRS. 40 MINS.   11.10 33.40  19.2   43.9      3.8     48.0
 5 HRS. 50 MINS.   [illegible] 33.40  19.2   50.7    -14.5     42.1
 6 HRS.  0 MINS.   [illegible] 33.43  19.2   50.1    -18.6     49.3
 6 HRS. 10 MINS.   11.17 33.30  19.2   33.7    -22.9     26.3
 6 HRS. 20 MINS.   [illegible] 33.42  19.2   30.1    -20.7     36.3
 6 HRS. 30 MINS.   [illegible] 33.40  19.2   47.3    -17.1     32.8
 6 HRS. 40 MINS.   [illegible] 33.40  19.2   67.0    -31.3     57.3
 6 HRS. 50 MINS.   [illegible] 33.30  19.2   60.6    -22.8     65.4
 7 HRS.  0 MINS.   [illegible] 33.30  19.2   72.7    -25.3     67.0
 7 HRS. 10 MINS.   [illegible] 33.31  19.5   72.2    -23.3     69.9
 7 HRS. 20 MINS.   [illegible] 33.34  19.2   67.5    -20.3     69.8
 7 HRS. 30 MINS.   11.13 33.36  19.2   64.5    -15.3     63.6
 7 HRS. 40 MINS.   [illegible] 33.33  19.2   63.9    -23.1     62.9
 7 HRS. 50 MINS.   11.15 [illegible]  19.2   64.4    -19.6     64.3
 8 HRS.  0 MINS.   [illegible] 33.36  19.2   68.2    -23.2     63.5
 8 HRS. 10 MINS.   [illegible] 33.36  19.2   69.5    -21.5     62.5
 8 HRS. 20 MINS.   [illegible] [illegible]  19.1   66.5    -23.6     61.6
 8 HRS. 30 MINS.   [illegible] 33.38  19.1   64.5    -20.7     60.0
 8 HRS. 40 MINS.   [illegible] 33.39  19.0   63.3    -21.5     61.3
 8 HRS. 50 MINS.   [illegible] [illegible]  19.0   56.0    -21.3  [illegible]
 9 HRS.  0 MINS.   [illegible] 33.41  18.9   60.8    -23.0     60.2
 9 HRS. 10 MINS.   11.19 [illegible]  18.7   73.0    -20.3     73.6
 9 HRS. 20 MINS.   11.10 33.36  18.7   77.2    -26.2     72.1
 9 HRS. 30 MINS.   11.19 [illegible]  18.6   76.2    -22.2     70.3
 9 HRS. 40 MINS.   [illegible] [illegible]  18.2   71.1  [illegible]  [illegible]
 9 HRS. 50 MINS.   [illegible] 33.30  18.2  [illegible]  [illegible]     60.8
10 HRS.  0 MINS.   11.16 33.30 [illegible]  63.3  [illegible]     60.2
10 HRS. 10 MINS.   [illegible] 33.37 [illegible]  62.0  [illegible]  [illegible]
10 HRS. 20 MINS.   [illegible] [illegible] [illegible] [illegible]  -16.6  [illegible]
10 HRS. 30 MINS.   [illegible] 33.30 [illegible] [illegible]  [illegible]  [illegible]
10 HRS. 40 MINS.   11.16 33.36  18.0   50.2    -16.3     51.6
10 HRS. 50 MINS.   11.16 33.36  17.9   54.0    -16.9     46.2
11 HRS.  0 MINS.   11.17 33.38  17.9   40.3    -16.0     36.3
11 HRS. 10 MINS.   [illegible] 33.36  17.9   33.0    -13.0     38.3
11 HRS. 20 MINS.   11.20 33.40  17.9   36.5     -6.8     31.9
11 HRS. 30 MINS.   11.19 33.37  17.8   29.5     -6.0     26.1
11 HRS. 40 MINS.   [illegible] 33.37  17.8   21.5     -5.5     17.6
11 HRS. 50 MINS.   [illegible] 33.38  17.8   12.2     -0.8      9.1
12 HRS.  0 MINS.   [illegible] 33.39  17.8   18.2      3.0     -9.8
12 HRS. 10 MINS.   [illegible] 33.39  17.8   20.2      3.9    -11.9
12 HRS. 20 MINS.   11.25 33.37  17.8   24.2      8.4    -17.7
```

A 3.16

```
PROGRAM   AVERAGE
DATA AVERAGED OVER  16 TIDAL CYCLES AT STN.  18
THE FIRST RECORD FOR EACH  CYCLE  OCCURRED:
                                   HW Belfast    Time before HW Belfast
 ON 13/11/[illegible] AT 152[illegible]     1512?          3.56
 ON 14/11/[illegible] AT  32[illegible]     0756           4.08
 ON 14/11/[illegible] AT 161[illegible]     2014           3.56
 ON 15/11/[illegible] AT  43[illegible]     0842           4.04
 ON 15/11/[illegible] AT 17[illegible]      2058           3.50
 ON 16/11/[illegible] AT  52[illegible]     0922           3.54
 ON 16/11/[illegible] AT 175[illegible]     2135           3.37
 ON 17/11/[illegible] AT  61[illegible]     0956           3.13
 ON 17/11/[illegible] AT 184[illegible]     2209           3.21
 ON 18/11/[illegible] AT  7[illegible]      1029           3.21
 ON 18/11/[illegible] AT 193[illegible]     2240           3.02
 ON 19/11/[illegible] AT  75[illegible]     1101           3.03
 ON 19/11/[illegible] AT 202[illegible]     2312           2.44
 ON 20/11/[illegible] AT  84[illegible]     1134           2.46   mean 3hr. 31min
                                                                s.d.      28min.

THE MEAN TIDAL RANGE PREDICTED AT BELFAST
OVER THE WHOLE PERIOD WAS 2.42 METRES.
Max range was 2.8 m.

 SPEED ENCOUNTERED (CM/SEC):
 MEAN = 50.6  MIN =   3.7 MAX = 136.5

 MEAN RESIDUAL EXCURSION =
    -21.33 KM NORTH, 13.36 KM EAST.
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```
TIME AFTER START      TEMP  SAL      DEP     SPEED   NORTHING  EASTING
[illegible]
```

A 3.17

APPENDIX 4

A 4.1.1

TABLE A4

Concentration of nano- and micro- plankton expressed as cells cm^{-3}

Note: The volume counted is given at the end of this table.

```
 0 FORMAT OF THE STATIONS                                                     1/1      1/2
  1/3      1/4      1/5      1/6      1/8      2/1      2/2      2/3      2/4      2/5
  2/6      2/7      3/1      4/1      4/2      4/3      5/1      5/2      6/1      6/2
  6/3      6/4      7/1      7/2      7/3      7/4      9/1      9/2     10/1     10/2
 11/1     11/2     12/1     12/2     13/1     14/1     14/2     15/1     15/2     15/3

 1 OSCILLATORIA SP(P).                                                      0.000    0.000
  0.000    0.000    0.000   10.280    0.000    0.000    0.000    0.000    0.000    0.000
  0.000    0.000    0.000    0.000    0.000    0.000    4.430    0.000    0.000    0.000
  2.830    1.048    2.077    0.000    0.000    0.000    0.000    0.000    1.335    0.000
  0.000    2.358    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000

 2 CRYPTOMONADS                                                           179.856  100.406
203.346  164.646  215.470  185.047  211.356  322.131  186.290  473.047  184.358  185.547
339.583  103.015   68.182   98.571   78.512  117.085   38.760   56.684   45.794   66.346
 62.264   62.893   20.768   52.632   11.561   44.983   21.675   31.694   17.356   44.444
 37.037   43.632   51.360   83.168   71.044  335.404   26.820  100.324   61.828   93.897

 3 PROROCENTRUM MICANS                                                      0.000    0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
  2.083    0.000    0.000    0.000    0.000    0.000    0.000    1.070    0.000    0.000
  0.000    0.000    0.000    0.000    0.963    0.000    0.000    0.000    0.000    0.000
  0.000    0.000    0.000    0.000    2.153    0.000    0.000    0.000    0.000    0.000

 4 PROROCENTRUM SPP.                                                        0.000    0.000
  0.000    0.000    0.000   14.953    0.000    2.459    0.000   16.502    0.000    3.906
  0.000    5.025    0.000    0.000    4.132    1.195    4.430    1.070    0.000    2.885
 18.868    3.145    0.000    4.049    2.890   14.994    0.985   12.022    8.011    0.000
  1.122    0.000    1.007    0.000    0.000    0.000    0.000    5.394    0.000    2.347

 5 DINOPHYSIS ?ACUTA                                                        0.000    1.014
  1.287    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000

 6 DINOPHYSIS NORWEGICA                                                     0.000    0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
  0.000    0.000    0.000    0.000    0.000    1.153    0.000    0.000    0.000    0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000

 7 DINOPHYSIS SPP.                                                          0.000    1.014
  1.287    0.000    2.762    0.000    0.000    0.000    0.000    0.000    0.000    0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    1.070    0.000    0.000
  0.000    0.000    0.000    0.000    0.000    1.153    0.000    0.000    0.000    0.000
  0.000    0.000    0.000    0.990    0.000    0.000    0.000    0.000    0.000    4.695
```

A 4.1.2

TABLE A4 (cont.)

8 GYMNODINIACEAE INDET.								33.573	30.426
21.879	28.283	21.179	5.607	35.752	19.672	31.452	85.809	96.834	136.719
54.167	20.101	38.961	58.571	20.661	20.311	17.719	5.348	13.084	7.692
36.792	15.723	7.269	21.592	8.671	94.579	0.985	24.044	9.346	13.333
19.080	0.000	16.113	8.911	17.223	20.704	7.663	18.339	13.441	23.474
9 AMPHIDINIUM SPHENOIDES								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	4.306	0.000	0.000	0.000	0.000	0.000
10 GYRODINIUM SPIRALE								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	4.032	7.042
11 TORODINIUM ROBUSTUM								0.000	0.000
0.000	0.000	0.000	0.000	0.000	2.459	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12 PROTODINIUM NEAPOLITANUM								25.180	25.355
11.583	17.172	17.495	51.402	58.885	82.787	23.387	33.003	29.795	25.391
10.417	12.563	34.091	24.286	68.871	38.232	35.437	31.016	47.664	15.385
22.642	22.013	16.615	82.321	44.316	46.136	18.719	10.929	12.016	0.000
10.101	7.075	6.042	11.881	10.764	14.493	0.000	1.079	8.065	23.474
13 POLYKRIKOS INDET.								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.820	2.419	0.000	0.000	0.000
2.083	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14 PRONOCTILUCA INDET.								0.000	2.028
0.000	0.000	0.000	0.000	0.000	2.459	1.613	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15 SPORES - PERIDINIACEAE								0.000	0.000
0.000	0.000	0.000	25.234	0.000	10.656	12.903	16.502	13.035	91.797
31.250	7.538	0.000	15.715	9.642	15.532	15.504	18.182	18.691	15.385
9.434	24.109	7.269	6.748	17.341	14.994	14.778	15.301	41.388	48.889
22.447	25.943	20.141	7.921	41.981	76.605	34.483	5.394	13.441	14.084

A 4.1.3

TABLE A4 (cont.)

16 PROTOPERIDINIUM								2.398	0.000
5.148	4.040	20.258	51.402	5.258	6.557	14.516	2.200	1.862	11.719
81.250	17.588	1.623	15.714	0.000	0.000	0.000	1.070	0.000	0.000
4.717	1.048	1.038	1.350	0.000	6.920	0.000	0.000	1.335	0.000
0.000	7.075	1.007	11.881	4.306	33.126	0.000	2.157	1.344	9.390
17 CERATIUM FURCA								1.199	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.953
2.083	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
18 CERATIUM LINEATUM								0.000	0.000
0.000	0.000	0.000	0.935	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
19 CERATIUM TRIPOS								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	1.613	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
20 COCCOLITHOPHORIDS								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	1.153	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
21 DICTYOCHA FIBULA								0.000	0.000
0.000	0.000	0.000	0.935	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.670	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
22 DISTEPHANUS SPECULUM								14.388	17.241
11.583	12.121	7.366	2.804	3.155	0.000	2.419	3.300	1.862	3.906
2.083	0.000	0.000	1.429	1.377	0.000	1.107	0.000	0.000	0.000
0.000	1.048	0.000	0.000	0.000	0.000	0.985	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	2.070	0.000	0.000	0.000	0.000
23 MELOSIRA JURGENSII								0.000	0.000
0.000	0.000	0.000	0.000	0.000	9.836	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	1.195	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

A4.1.4

TABLE A4 (cont.)

24 MELOSIRA NUMMELOIDES								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	3.247	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
25 PARALIA SULCATA								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	4.444
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
26 STEPHANOPYXIS TURRIS								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	3.229	0.000	0.000	0.000	0.000	0.000
27 HYALODISCUS SUBTILIS								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	1.076	0.000	0.000	0.000	0.000	0.000
28 PODOSIRA STELLIGER (FRUSTULES)								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	1.007	0.000	0.000	0.000	0.000	0.000	0.000	0.000
29 SCHROEDERELLA DELICATULA								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.344	0.000
30 LEPTOCYLINDRUS DANICUS								16.787	8.114
7.722	3.030	0.921	0.000	6.309	0.000	2.419	0.000	0.000	31.250
6.250	22.613	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	2.554	0.000	0.000	4.695
31 LEPTOCYLINDRUS MINIMUS								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	5.587	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	3.236	2.688	4.695

A 4.1.5

TABLE A4 (cont.)

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 32 SKELETONEMA COSTATUM                                                 0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    4.839    0.000   91.248   78.125
  60.417  123.116   14.610   10.000   17.906    0.000    4.430   25.668    0.935    2.885
   0.000    0.000    2.077    2.699    6.744    0.000    0.000    0.000    0.000    0.000
   8.979    0.000   18.127   21.782    7.535   49.689    0.000    0.000    2.688    0.000

 33 THALASSIOSIRA C.F. DECIPIENS                                         0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000   13.035    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.935    0.000
   0.000    0.000    2.077    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    8.056    0.990    0.000    0.000    0.000    0.000    0.000    0.000

 34 THALASSIOSIRA GRAVIDA                                                0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000   43.831    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    1.048    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000   10.891    0.000   47.619   19.157    0.000    0.000    0.000

 35 THALASSIOSIRA POLYCHORDA                                             0.000    0.000
   0.000    1.010    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000

 36 THALASSIOSIRA INDET.                                                 0.000    0.000
   0.000    0.000    0.000    7.477    0.000    0.000    0.806    0.000    0.000    3.906
   2.083    2.513    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    4.717    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000

 37 LAUDERIA BOREALIS                                                    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000   10.217    0.000    0.000    0.000

 38 DETONULA CONFERVACEA                                                 0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    1.344    0.000

 39 COSCINODISCUS "LINEATUS"                                             0.000    0.000
   0.000    0.000    3.683    0.000    0.000    0.000    0.000    0.000    1.862    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    1.070    0.000    0.962
   0.943    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   3.367    0.000    0.000    0.990    0.000    0.000    0.000    0.000    0.000    0.000
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A 4.1.6

TABLE A4 (cont.)

40 ASTERIOMPHALUS HOOKERI								2.398	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
41 ROPERIA TESSELATA								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1.887	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
42 BIDDULPHIA INDET.								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	4.444
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
43 TRICERATIUM INDET.								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.070	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
44 CHAETOCEROS INDET.								14.388	1.014
0.000	0.000	0.000	16.822	0.000	0.000	0.806	0.000	13.035	41.016
18.750	17.588	6.494	4.286	1.377	1.195	0.000	0.000	0.000	0.000
0.943	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	2.014	4.950	0.000	0.000	5.109	7.551	2.688	4.695
45 CHAETOCEROS AFFINE								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	17.578
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	15.102	0.000	0.000
46 CHAETOCEROS ATLANTICUM								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	14.610	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.688	0.000
47 CHAETOCEROS BREVE								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	3.247	0.000	0.000	0.000	0.000	2.139	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.079	0.000	0.000

A 4.1.7

TABLE A4 (cont.)

48 CHAETOCEROS CINCTUS								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.869	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
49 CHAETOCEROS CURVISETUM								0.000	12.170
3.861	10.101	37.753	0.000	5.258	0.000	0.000	0.000	0.000	5.859
0.000	0.000	0.000	0.000	2.755	5.974	1.107	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	2.070	3.831	2.157	2.688	0.000
50 CHAETOCEROS CORONATUM								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	1.980	0.000	0.000	0.000	0.000	0.000	0.000
51 CHAETOCEROS DANICUM								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	25.974	0.000	0.000	1.195	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
52 CHAETOCEROS DEBILE								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
39.583	0.000	0.000	0.000	1.377	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	6.472	0.000	0.000
53 CHAETOCEROS DECIPIENS								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	1.429	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	1.277	0.000	0.000	0.000
54 CHAETOCEROS EXTERNUM								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.953
0.000	40.201	0.000	1.429	0.000	0.000	0.000	1.070	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	7.551	56.452	23.474
55 CHAETOCEROS FILIFORME								0.000	0.000
0.000	0.000	0.000	0.935	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

A4.1.8

TABLE A4 (cont.)

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56 CHAETOCEROS GRACILE                                                               0.000    11.156
     2.574    10.101     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
     6.250     0.000     0.000     1.429     0.000     1.195     0.000     0.000     0.000     0.000
     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
     0.000     0.000     0.000     0.000     0.000    12.422     0.000     0.000     0.000     0.000

57 CHAETOCEROS INGOLFIANUM                                                           0.000     0.000
     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     1.344     0.000

58 CHAETOCEROS HOLSATICUM                                                            0.000     0.000
     0.000     0.000     0.921     0.000     0.000     0.000     0.000     0.000     9.311     0.000
     0.000     0.000     0.000     0.000     0.000     0.000     0.000     2.139     0.000     0.000
     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
     0.000     0.000     0.000     0.000     0.000    12.422     0.000     0.000     0.000     0.000

59 CHAETOCEROS NEAPOLITANUM                                                          0.000     0.000
     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     2.688     0.000

60 CHAETOCEROS PERPUSILLUM                                                           0.000     0.000
     0.000     0.000     0.000     1.869     0.000     0.000     0.000     0.000     3.724     0.000
     4.167     0.000     0.000     0.000     0.000     3.584     0.000     0.000     0.000     0.000
     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000

61 CHAETOCEROS SCOLOPENDRA                                                           0.000     0.000
     0.000     0.000     0.000     0.000     3.155     0.000     0.000     0.000     0.000     0.000
     0.000     0.000     0.000     0.000     0.000     1.195     0.000     0.000     0.000     0.000
     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000

62 CHAETOCEROS SERIACANTHUS                                                          0.000     0.000
     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
     0.000     0.000     0.000     0.000     0.000     0.000     0.000    18.339     0.000     0.000

63 CHAETOCEROS SIMILE                                                                0.000     0.000
     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     3.906
     4.167     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
     0.000     0.000     0.000     0.000     0.000     0.000     0.000    18.339     0.000     0.000
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A4.1.9

TABLE A4 (cont.)

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64 CHAETOCEROS SIMPLEX                                                          0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   2.083    0.000    0.000    1.429    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000

65 CHAETOCEROS TORTISSIMUM                                                      0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    7.701    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000

66 BACTERIASTRUM SP.                                                            0.000    0.000
   0.000    0.000    0.000    0.000    0.000    1.639    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000

67 RHIZOSOLENIA ALATA                                                           0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    1.100   16.760    0.000
   0.000    0.000    3.247    0.000    1.377    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    1.079    0.000    0.000

68 RHIZOSOLENIA CYLINDRUS                                                       0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    7.042

69 RHIZOSOLENIA DELICATULA                                                      2.398   10.142
  16.731   10.101    0.000    9.346   18.927    0.000    1.613    2.200   13.035   15.625
  20.833    2.513    1.623    0.000    0.000    1.195    0.000    1.070    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    2.554   76.591   34.946  147.887

70 RHIZOSOLENIA FRAGILISSIMA                                                    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    1.623    1.429    0.000    0.000    1.107    0.000    0.000    0.000
   0.943    0.000    0.000    0.000    0.000    1.153    0.000    0.000    0.000    0.000
   0.000    0.000    1.007    0.000    0.000    0.000    2.554   19.417    0.000    2.347

71 RHIZOSOLENIA HEBETATA                                                        0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    2.389    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
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A4.1.10

TABLE A4 (cont.)

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 72 RHIZOSOLENIA SETIGERA                                                  0.000    0.000
    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
    4.167    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000

 73 RHIZOSOLENIA SHRUBSOLEI                                                0.000    0.000
    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    4.032    4.695

 74 RHIZOSOLENIA STOLTERFOTHII                                             5.995    0.000
    0.000    0.000    0.000    0.000    1.052    0.820    0.000    0.000    0.000    1.953
    6.250    2.513    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
    0.000    0.000    0.000    0.000    0.000    8.282    3.831    2.157    2.688   18.779

 75 GUINARDIA FLACCIDA                                                     0.000    2.028
    1.287    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
    2.083    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
    0.000    0.000    0.000    0.000    0.000    0.000    1.277    1.079    4.032    7.042

 76 LITHODESMIUM UNDULATUM                                                 0.000    0.000
    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
    0.000    0.000    1.038    0.000    0.000    0.000    0.000    0.000    1.335    0.000
    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000

 77 ?FRAGILIARIA SP.                                                       0.000    0.000
    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
    4.167    0.000    1.623    0.000    0.000    0.000    0.000    0.000    0.000    0.000
    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000

 78 ASTERIONELLA GLACIALIS                                                 0.000    0.000
    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
    0.000    0.000    0.000    0.000    0.000   12.422    5.109    0.000    0.000    0.000

 79 THALASSIONEMA NITZSCHIOIDES                                            0.000    0.000
    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
    0.000    0.000    6.494    0.000    0.000    0.000    0.000    0.000    0.000    0.000
    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
```

TABLE A4 (cont.)

80 LICMOPHORA SP.								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	3.226	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
81 COCCONEIS INDET.								0.000	0.000
0.000	0.000	0.000	0.000	1.052	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
82 PLEUROSIGMA SP.								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.335	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
83 GYROSIGMA SP.								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1.122	0.000	1.007	0.000	0.000	0.000	0.000	0.000	0.000	0.000
84 NITZSCHIA APICULATA								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	1.107	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
85 NITZSCHIA SERIATA								0.000	0.000
0.000	0.000	0.000	1.869	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	22.727	0.000	0.000	1.195	1.107	0.000	0.000	0.000
0.000	0.000	0.000	1.350	0.963	0.000	0.000	0.000	0.000	0.000
0.000	1.179	0.000	0.000	0.000	2.070	0.000	3.236	0.000	0.000
86 BACILLARIA PAXILLIFER								0.000	0.000
0.000	0.000	0.000	0.000	0.000	1.639	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	3.209	0.935	4.808
1.887	0.000	2.077	2.699	3.854	4.614	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
87 CYLINDROTHECA CLOSTERIUM								0.000	3.043
6.435	1.010	5.525	5.607	0.000	11.475	11.290	5.501	16.760	21.484
37.500	0.000	19.481	10.000	5.510	7.168	4.430	6.417	9.346	2.885
5.660	3.145	4.154	8.097	8.671	8.074	4.926	6.557	6.676	17.778
11.223	12.972	1.007	5.941	18.299	24.845	19.157	0.000	1.344	2.347

A 4.1.12

TABLE A4 (cont.)

88 BACILLARIOPHYCEAE INDET.								2.398	22.312
9.009	17.172	18.416	21.495	39.958	16.394	16.129	18.702	20.484	27.344
41.667	0.000	29.221	7.143	6.887	16.726	21.041	12.834	7.477	11.539
6.604	6.289	3.115	1.350	11.561	4.613	10.837	9.836	8.010	31.111
14.590	9.433	3.021	5.941	20.452	28.986	15.326	11.866	2.688	18.780
89 EUGLENACEAE INDET.								14.388	12.170
9.009	0.000	7.366	0.935	2.103	3.279	8.871	1.100	1.862	0.000
10.417	0.000	1.623	0.000	1.377	1.195	0.000	0.000	0.000	0.000
1.887	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	1.179	0.000	1.980	2.153	6.211	0.000	0.000	0.000	0.000
90 EUTREPTIA VIRIDIS								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	7.701	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
91 PRASINOPHYCEAE INDET.								71.942	72.008
91.377	80.808	153.775	84.112	114.616	55.738	36.290	209.021	87.523	68.359
29.167	87.940	14.610	27.143	19.284	53.763	35.437	27.807	41.121	39.423
36.792	39.832	41.537	56.680	9.634	53.057	17.734	16.393	20.027	31.111
35.915	33.019	40.282	91.089	34.446	107.660	19.157	36.677	22.849	18.779
92 DUNALIELLA SPP.								0.000	0.000
0.000	0.000	0.000	80.374	0.000	7.377	15.323	22.002	31.657	25.391
75.000	30.151	1.623	7.143	9.642	9.558	3.322	3.209	0.935	3.846
3.774	6.289	8.307	8.097	4.817	6.920	1.970	2.186	9.346	0.000
3.367	0.000	4.028	0.990	3.229	20.704	6.386	5.394	6.720	2.347
93 CHOANOFLAGELLATA INDET.								0.000	0.000
0.000	0.000	0.000	8.411	0.000	0.000	0.000	2.200	0.000	0.000
12.500	0.000	47.078	2.857	1.377	2.389	1.107	0.000	5.607	2.885
2.830	5.241	4.154	4.049	7.707	4.614	0.000	6.557	2.670	4.444
5.612	11.792	0.000	0.990	4.306	20.704	2.554	9.709	18.817	16.432
94 CILIATA INDET.								0.000	22.312
9.009	16.162	18.416	17.757	26.288	10.656	16.129	16.502	7.449	15.625
16.667	0.000	3.247	4.286	0.000	2.389	1.107	6.417	6.542	4.808
2.830	5.241	2.077	1.350	3.854	3.460	0.985	2.186	4.005	4.444
4.489	2.358	2.014	5.941	5.382	14.493	6.386	8.630	2.688	14.085
95 TINTINNIDIA INDET.								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.935	0.000
0.000	1.048	0.000	1.350	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	4.141	0.000	0.000	0.000	0.000

TABLE A4 (cont.)

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 96 TINTINNOPSIS ?NUCULA                                           0.000   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   1.344   0.000

 97 TINTINNOPSIS PARVULA                                           0.000   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   1.862   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   1.335   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000

 98 TINTINNOPSIS ?STRIGOSA                                         0.000   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   1.344   0.000

 99 HELICOSTOMELLA KILIENSIS                                       0.000   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
   0.000   2.513   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000

100 STROBILIDIUM C.F. STRIATA                                      0.000   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   1.953
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   1.344   0.000

101 FLAGELLATA INDET.                                           1693.0462367.140
3454.3112505.0512048.8032544.8602640.3793311.4753483.8717069.3076100.5594613.281
5333.3333143.2161201.2992014.2861652.8931348.865 673.3113458.824 836.449 901.923
1164.1511026.205 685.3584968.961 470.1351453.287 533.9901041.5303355.1401853.333
1161.616 594.3401149.0431266.3376242.1962184.2652238.8251533.9812892.4731882.629

102 OTHER UNIDENTIFIED SPECIMENS                                   0.000   2.028
   0.000   1.010   2.762   0.000   0.000   0.000   0.806   6.601   0.000   0.000
  10.417  15.075   1.623   0.000   1.377   0.000   1.107   0.000   0.000   0.000
   0.000   2.096   2.077   0.000   0.000   5.767   0.000   0.000  20.027   0.000
   0.000   0.000   0.000   0.000   1.076   0.000   0.000   1.079   0.000   0.000

103 FAECAL PELLETS (ONLY SOME)                                     4.796   0.000
   1.287   0.000   5.525   0.000   1.052   0.000   3.226   0.000   0.000   0.000
   0.000   0.000   3.247   0.000   0.000   0.000   0.000   0.000   0.000   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
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A4.1.14

TABLE A4 (Cont.)

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134 NITZSCHIA "DELICATISSIMA"                                                 0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    2.200    3.724    0.000
   2.083    2.513    0.000    4.286    2.755    7.168    1.107    0.000    0.935    0.000
   4.717    1.048    2.077    1.350    0.963    2.307    0.000    1.093    0.000    0.000
   0.000    0.000    1.007    1.980    0.000    4.141    1.277    0.000    0.000    0.000

135 CHAETOCEROS FRAGILE                                                       0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000   25.974    0.000    0.000    1.195    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000

136 PROROCENTRUM ?TRIESTINUM                                                  0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000   18.339    0.000    0.000

104 VOLUME COUNTED (CUBIC CM)                                                 0.834    0.986
   0.777    0.990    1.086    1.070    0.951    1.220    1.240    0.909    0.537    0.512
   0.480    0.398    0.616    0.700    0.726    0.837    0.903    0.935    1.070    1.040
   1.060    0.954    0.963    0.741    1.038    0.867    1.015    0.915    0.749    0.225
   0.891    0.848    0.993    1.010    0.929    0.483    0.783    0.927    0.744    0.426
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APPENDIX 5

A5.1

TABLE A5

Contribution to the biovolume by nano- and micro-plankton x 10^{-9} (or $mm^3 m^{-3}$)

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  0 FORMAT OF THE STATIONS                                                1/1     1/2
   1/3      1/4      1/5      1/6      1/8      2/1      2/2      2/3     2/4     2/5
   2/6      2/7      3/1      4/1      4/2      4/3      5/1      5/2     6/1     6/2
   6/3      6/4      7/1      7/2      7/3      7/4      9/1      9/2    10/1    10/2
  11/1     11/2     12/1     12/2     13/1     14/1     14/2     15/1    15/2    15/3

  1 OSCILLATORIA SP(P).                                                 0.000   0.000
   0.000    0.000    0.000    0.945    0.000    0.000    0.000    0.000   0.000   0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.318    0.000   0.000   0.000
   0.781    0.080    0.018    0.000    0.000    0.000    0.000    0.000   0.037   0.000
   0.000    0.009    0.000    0.000    0.000    0.000    0.000    0.000   0.000   0.000

  2 CRYPTOMONADS                                                       47.879  26.729
  54.132   43.830   57.360   49.261   56.264   85.753   49.592  166.536  80.485  46.478
 166.873   38.049   32.942   23.694   29.663   27.116   11.630   19.228   8.704   8.276
  10.674   15.604    3.787    7.180    1.564   14.992    3.355    7.108   9.056  16.906
  10.073    4.613   16.970   13.527   22.915   53.236    2.077   34.705  11.474  28.420

  3 PROROCENTRUM MICANS                                                 0.000   0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000   0.000   0.000
  56.138    0.000    0.000    0.000    0.000    0.000    0.000   28.837   0.000   0.000
   0.000    0.000    0.000    0.000   37.368    0.000    0.000    0.000   0.000   0.000
   0.000    0.000    0.000    0.000   58.025    0.000    0.000    0.000   0.000   0.000

  4 PROROCENTRUM SPP.                                                   0.000   0.000
   0.000    0.000    0.000   13.949    0.000    2.294    0.000   10.067   0.000   3.644
   0.000    1.879    0.000    0.000    1.130    0.210    2.695    0.894   0.000   1.720
  17.601    9.437    0.000    0.587    0.615    2.143    0.062    1.012   3.719   0.000
   0.097    0.000    0.702    0.000    0.000    0.000    0.000   25.514   0.000   0.562

  5 DINOPHYSIS ?ACUTA                                                   0.000  16.926
  21.483    0.000    0.000    0.000    0.000    0.000    0.000    0.000   0.000   0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000   0.000   0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000   0.000   0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000   0.000   0.000

  6 DINOPHYSIS NORWEGICA                                                0.000   0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000   0.000   0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000   0.000   0.000
   0.000    0.000    0.000    0.000    0.000   60.336    0.000    0.000   0.000   0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000   0.000   0.000

  7 DINOPHYSIS SPP.                                                     0.000   7.789
   9.887    0.000   21.217    0.000    0.000    0.000    0.000    0.000   0.000   0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    3.878   0.000   0.000
   0.000    0.000    0.000    0.000    0.000    8.857    0.000    0.000   0.000   0.000
   0.000    0.000    0.000   11.040    0.000    0.000    0.000    0.000   0.000  37.447
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A 5.2

TABLE A5 (cont.)

8 GYMNODINIACEAE INDET.								25.196	22.834
16.420	21.226	41.280	4.208	26.831	15.653	10.951	34.469	26.061	267.027
18.442	7.946	25.389	21.111	5.404	14.685	2.740	1.768	5.500	5.494
52.976	4.278	3.575	7.884	2.744	16.848	0.593	7.181	5.065	9.661
4.537	0.000	7.931	56.383	4.525	7.639	1.768	8.763	35.791	3.062
9 AMPHIDINIUM SPHENOIDES								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	14.391	0.000	0.000	0.000	0.000	0.000
10 GYRODINIUM SPIRALE								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	436.851	169.634
11 TORODINIUM ROBUSTUM								0.000	0.000
0.000	0.000	0.000	0.000	0.000	13.268	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12 PROTODINIUM NEAPOLITANUM								3.287	3.309
1.512	2.241	2.283	6.709	7.686	10.805	3.052	4.358	2.356	3.893
1.360	1.689	4.450	3.170	7.883	3.418	4.625	2.361	3.320	1.101
8.541	4.020	1.163	9.785	3.150	6.022	1.709	1.357	2.012	0.000
0.995	0.923	0.906	1.551	1.405	1.892	0.000	0.141	1.241	5.605
13 POLYKRIKOS INDET.								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.737	1.204	0.000	0.000	0.000
1.949	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14 PRONOCTILUCA INDET.								0.000	4.624
0.000	0.000	0.000	0.000	0.000	5.607	3.678	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15 SPORES - PERIDINIACEAE								0.000	0.000
0.000	0.000	0.000	14.547	0.000	37.279	6.420	9.098	3.997	51.561
24.482	5.384	0.000	5.713	13.144	3.353	9.836	1.562	5.863	5.349
1.592	4.257	4.406	3.890	17.747	1.730	1.959	4.114	4.568	28.183
4.756	0.708	3.650	1.636	17.117	60.440	2.438	23.763	2.758	3.605

TABLE A5 (cont.)

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16 PROTOPERIDINIUM                                                        8.712    0.000
   18.704   14.678   54.601  186.755   19.103   26.365   32.076   90.338    6.161   10.115
   91.021    7.639    2.657   13.942    0.000    0.000    0.000    2.207    0.000    0.000
    1.769   11.850    3.790    0.203    0.000    5.699    0.000    0.000    0.364    0.000
    0.000   22.484    1.135   23.268   22.498   54.887    0.000   64.713    2.036   17.482

17 CERATIUM FURCA                                                        51.308    0.000
    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000   83.573
   89.136    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000

18 CERATIUM LINEATUM                                                      0.000    0.000
    0.000    0.000    0.000   38.505    0.000    0.000    0.000    0.000    0.000    0.000
    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000

19 CERATIUM TRIPOS                                                        0.000    0.000
    0.000    0.000    0.000    0.000    0.000    0.000  511.402    0.000    0.000    0.000
    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000

20 COCCOLITHOPHORIDS                                                      0.000    0.000
    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
    0.000    0.000    0.000    0.000    0.000    0.355    0.000    0.000    0.000    0.000
    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000

21 DICTYOCHA FIBULA                                                       0.000    0.000
    0.000    0.000    0.000    2.607    0.000    0.000    0.000    0.000    0.000    0.000
    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    7.443    0.000
    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000

22 DISTEPHANUS SPECULUM                                                  77.937   93.391
   62.743   65.657   39.900   15.189   17.090    0.000    9.507   24.335   10.086   12.004
   11.283    0.000    0.000    7.903    6.488    0.000    5.216    0.000    0.000    0.000
    0.000    4.115    0.000    0.000    0.000    0.000    5.968    0.000    0.000    0.000
    0.000    0.000    0.000    0.000    0.000   23.752    0.000    0.000    0.000    0.000

23 MELOSIRA JURGENSII                                                     0.000    0.000
    0.000    0.000    0.000    0.000    0.000   11.193    0.000    0.000    0.000    0.000
    0.000    0.000    0.000    0.000    0.000    2.499    0.000    0.000    0.000    0.000
    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
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A 5.4

TABLE A5 (cont.)

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 24 MELOSIRA NUMMELOIDES                                                     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000    46.921     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000

 25 PARALIA SULCATA                                                          0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     8.994
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000

 26 STEPHANOPYXIS TURRIS                                                     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     6.614     0.000     0.000     0.000     0.000     0.000

 27 HYALODISCUS SUBTILIS                                                     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     6.843     0.000     0.000     0.000     0.000     0.000

 28 PODOSIRA STELLIGER (FRUSTULES)                                           0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.001     0.000     0.000     0.000     0.000     0.000     0.000     0.000

 29 SCHROEDERELLA DELICATULA                                                 0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000   129.081     0.000

 30 LEPTOCYLINDRUS DANICUS                                                  25.952    12.544
  11.938     4.684     1.424     0.000     2.586     0.000     3.740     0.000     0.000    48.311
   4.650    34.959     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000    10.946     0.000     0.000     7.258

 31 LEPTOCYLINDRUS MINIMUS                                                   0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     1.119     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     1.624     0.558     5.399
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A 5.5

TABLE A5 (cont.)

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 32 SKELETONEMA COSTATUM                                           0.000   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.318   0.000   8.113  32.339
  29.255  41.185   7.039   2.107   0.864   0.000   3.921   7.841   0.047   0.887
   0.000   0.000   0.318   0.647   0.995   0.000   0.000   0.000   0.000   0.000
   0.197   0.000   1.337  10.582   2.798  33.081   0.000   0.000   0.451   0.000

 33 THALASSIOSIRA C.F. DECIPIENS                                   0.000   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000  16.083   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   4.164   0.000
   0.000   0.000  12.434   0.000   0.000   0.000   0.000   0.000   0.000   0.000
   0.000   0.000  85.585   3.311   0.000   0.000   0.000   0.000   0.000   0.000

 34 THALASSIOSIRA GRAVIDA                                          0.000   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
   0.000   0.000  33.545   0.000   0.000   0.000   0.000   0.000   0.000   0.000
   0.000  23.002   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
   0.000   0.000   0.000 213.597   0.0001888.986 642.523   0.000   0.000   0.000

 35 THALASSIOSIRA POLYCHORDA                                       0.000   0.000
   0.000  18.326   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000

 36 THALASSIOSIRA INDET.                                           0.000   0.000
   0.000   0.000   0.000 118.789   0.000   0.000  22.750   0.000   0.000  14.396
  12.698   1.917   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
   0.000 118.551   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000

 37 LAUDERIA BOREALIS                                              0.000   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
   0.000   0.000   0.000   0.000   0.000   0.0001057.931   0.000   0.000   0.000

 38 DETONULA CONFERVACEA                                           0.000   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   2.810   0.000

 39 COSCINODISCUS "LINEATUS"                                       0.000   0.000
   0.000   0.000  18.446   0.000   0.000   0.000   0.000   0.000  10.362   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   8.034   0.000   3.475
   6.261   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
  13.104   0.000   0.000   2.542   0.000   0.000   0.000   0.000   0.000   0.000
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TABLE A5 (cont.)

40 ASTERIOMPHALUS HOOKERI								40.375	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
41 ROPERIA TESSELATA								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
17.412	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
42 BIDDULPHIA INDET.								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.006
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
43 TRICERATIUM INDET.								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	29.908	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
44 CHAETOCEROS INDET.								8.243	0.581
0.000	0.000	0.000	9.637	0.000	0.000	0.147	0.000	16.738	13.987
2.227	7.838	3.789	1.768	0.789	1.374	0.000	0.000	0.000	0.000
0.540	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.247	0.557	0.000	0.000	6.748	2.925	4.978	2.868
45 CHAETOCEROS AFFINE								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	32.673
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	10.643	0.000	0.000
46 CHAETOCEROS ATLANTICUM								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	9.519	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	8.483	0.000
47 CHAETOCEROS BREVE								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	5.748	0.000	0.000	0.000	0.000	12.108	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.906	0.000	0.000

A 5.7

TABLE A5 (cont.)

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48 CHAETOCEROS CINCTUS                                                    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.918    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000

49 CHAETOCEROS CURVISETUM                                                 0.000    9.855
   3.127    8.180   28.027    0.000    4.258    0.000    0.000    0.000    0.000    7.471
   0.000    0.000    0.000    0.000    0.829    3.815    0.231    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.647    6.055    0.655    3.778    0.000

50 CHAETOCEROS CORONATUM                                                  0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    3.131    0.000    0.000    0.000    0.000    0.000    0.000

51 CHAETOCEROS DANICUM                                                    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000   29.317    0.000    0.000    1.349    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000

52 CHAETOCEROS DEBILE                                                     0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
 129.526    0.000    0.000    0.000    0.828    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000   30.141    0.000    0.000

53 CHAETOCEROS DECIPIENS                                                  0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000   17.128    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000   20.016    0.000    0.000    0.000

54 CHAETOCEROS EXTERNUM                                                   0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.393
   0.000   33.046    0.000    0.860    0.000    0.000    0.000    0.151    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    6.456   61.327   19.540

55 CHAETOCEROS FILIFORME                                                  0.000    0.000
   0.000    0.000    0.000    0.054    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
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TABLE A5 (cont.)

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56 CHAETOCEROS GRACILE                                                     0.000   2.061
  0.475   1.866   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
  0.541   0.000   0.000   0.143   0.000   0.210   0.000   0.000   0.000   0.000
  0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
  0.000   0.000   0.000   0.000   0.000   2.692   0.000   0.000   0.000   0.000

57 CHAETOCEROS INGOLFIANUM                                                 0.000   0.000
  0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
  0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
  0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
  0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.150   0.000

58 CHAETOCEROS HOLSATICUM                                                  0.000   0.000
  0.000   0.000   0.313   0.000   0.000   0.000   0.000   0.000   2.904   0.000
  0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.803   0.000   0.000
  0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
  0.000   0.000   0.000   0.000   0.000   4.844   0.000   0.000   0.000   0.000

59 CHAETOCEROS NEAPOLITANUM                                                0.000   0.000
  0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
  0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
  0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
  0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   1.199   0.000

60 CHAETOCEROS PERPUSILLUM                                                 0.000   0.000
  0.000   0.000   0.000   0.114   0.000   0.000   0.000   0.000   0.119   0.000
  0.277   0.000   0.000   0.000   0.000   0.301   0.000   0.000   0.000   0.000
  0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
  0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000

61 CHAETOCEROS SCOLOPENDRA                                                 0.000   0.000
  0.000   0.000   0.000   0.000   2.213   0.000   0.000   0.000   0.000   0.000
  0.000   0.000   0.000   0.000   0.000   0.390   0.000   0.000   0.000   0.000
  0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
  0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000

62 CHAETOCEROS SERIACANTHUS                                                0.000   0.000
  0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
  0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
  0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
  0.000   0.000   0.000   0.000   0.000   0.000   0.000  18.935   0.000   0.000

63 CHAETOCEROS SIMILE                                                      0.000   0.000
  0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   4.286
 97.576   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
  0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
  0.000   0.000   0.000   0.000   0.000   0.000   0.000  22.591   0.000   0.000
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TABLE A5 (cont.)

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64 CHAETOCEROS SIMPLEX                                                      0.000     0.000
  0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
  0.244     0.000     0.000     0.323     0.000     0.000     0.000     0.000     0.000     0.000
  0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
  0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000

65 CHAETOCEROS TORTISSIMUM                                                  0.000     0.000
  0.000     0.000     0.000     0.000     0.000     0.000     0.000     2.125     0.000     0.000
  0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
  0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
  0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000

66 BACTERIASTRUM SP.                                                        0.000     0.000
  0.000     0.000     0.000     0.000     0.000     0.877     0.000     0.000     0.000     0.000
  0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
  0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
  0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000

67 RHIZOSOLENIA ALATA                                                       0.000     0.000
  0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.748     5.961     0.000
  0.000     0.000    32.247     0.000    10.364     0.000     0.000     0.000     0.000     0.000
  0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
  0.000     0.000     0.000     0.000     0.000     0.000     0.000    26.530     0.000     0.000

68 RHIZOSOLENIA CYLINDRUS                                                   0.000     0.000
  0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
  0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
  0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
  0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000   201.902

69 RHIZOSOLENIA DELICATULA                                                 14.228    60.176
 99.270    59.932     0.000    55.453   133.542     0.000     6.557     8.697    64.211    68.162
100.944    14.376     5.772     0.000     0.000     4.856     0.000     2.219     0.000     0.000
  0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
  0.000     0.000     0.000     0.000     0.000     0.000    15.508   449.220   168.9591378.651

70 RHIZOSOLENIA FRAGILISSIMA                                                0.000     0.000
  0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
  0.000     0.000    42.023    21.571     0.000     0.000     0.197     0.000     0.000     0.000
  0.173     0.000     0.000     0.000     0.000     1.542     0.000     0.000     0.000     0.000
  0.000     0.000     0.210     0.000     0.000     0.000    80.936   115.807     0.000    69.003

71 RHIZOSOLENIA HEBETATA                                                    0.000     0.000
  0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
  0.000     0.000     0.000     0.000     0.000    17.794     0.000     0.000     0.000     0.000
  0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
  0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
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A 5.10

TABLE A5 (cont.)

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72 RHIZOSOLENIA SETIGERA                                                       0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   2.928    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000

73 RHIZOSOLENIA SHRUBSOLEI                                                     0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000  186.511  250.256

74 RHIZOSOLENIA STOLTERFOTHII                                                174.472    0.000
   0.000    0.000    0.000    0.000    8.623   41.875    0.000    0.000    0.000   13.093
 220.018   13.135    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000  277.165   82.556   61.440   68.252  694.247

75 GUINARDIA FLACCIDA                                                          0.000  679.307
 431.099    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   4.702    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000  427.749  496.2071369.9812823.984

76 LITHODESMIUM UNDULATUM                                                      0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000   37.905    0.000    0.000    0.000    0.000    0.000    0.853    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000

77 ?FRAGILIARIA SP.                                                            0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   8.364    0.000    3.258    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000

78 ASTERIONELLA GLACIALIS                                                      0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000   55.189    2.800    0.000    0.000    0.000

79 THALASSIONEMA NITZSCHIOIDES                                                 0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000   10.268    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
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TABLE A5 (cont.)

80 LICMOPHORA SP.								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	12.598	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
81 COCCONEIS INDET.								0.000	0.000
0.000	0.000	0.000	0.000	0.220	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
82 PLEUROSIGMA SP.								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	8.206	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
83 GYROSIGMA SP.								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7.882	0.000	88.930	0.000	0.000	0.000	0.000	0.000	0.000	0.000
84 NITZSCHIA APICULATA								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.585	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
85 NITZSCHIA SERIATA								0.000	0.000
0.000	0.000	0.000	3.043	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	6.151	0.000	0.000	0.281	0.987	0.000	0.000	0.000
0.000	0.000	0.000	0.509	1.384	0.000	0.000	0.000	0.000	0.000
0.000	9.991	0.000	0.000	0.000	3.370	0.000	7.631	0.000	0.000
86 BACILLARIA PAXILLIFER								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.985	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	5.225	0.281	1.596
0.799	0.000	0.763	1.035	1.852	2.509	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
87 CYLINDROTHECA CLOSTERIUM								0.000	0.367
0.775	0.122	0.666	0.676	0.000	1.383	0.962	0.534	2.262	2.059
4.519	0.000	2.348	1.205	0.882	0.242	0.534	0.635	1.086	0.132
0.546	0.142	1.095	0.686	1.050	0.277	0.711	0.997	0.370	3.833
1.701	4.210	0.614	0.633	1.203	1.647	0.714	0.000	0.162	0.131

88 BACILLARIOPHYCEAE INDET.								5.068	47.154
19.039	36.291	54.220	45.427	84.446	195.085	4.487	17.381	9.415	11.948
12.328	0.000	3.959	7.577	1.767	37.328	10.480	231.143	4.437	17.131
2.342	10.334	4.571	1.488	39.078	0.129	4.523	136.468	5.908	28.630
6.565	83.765	0.840	5.019	46.885	15.996	4.192	4.201	4.411	52.105
89 EUGLENACEAE INDET.								9.568	8.093
5.991	0.000	4.898	0.622	1.399	1.017	1.693	2.425	8.223	0.000
16.730	0.000	0.406	0.000	0.169	0.180	0.000	0.000	0.000	0.000
0.201	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.171	0.000	0.123	0.067	0.810	0.000	0.000	0.000	0.000
90 EUTREPTIA VIRIDIS								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.999	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
91 PRASINOPHYCEAE INDET.								16.359	16.374
20.778	18.375	79.368	19.126	83.336	23.985	7.511	47.529	15.047	19.721
11.045	12.539	3.835	5.040	0.832	8.344	5.452	6.323	5.838	5.995
5.916	5.991	5.280	7.031	1.275	7.391	2.730	2.928	3.135	4.903
8.625	6.030	2.681	20.683	6.086	14.186	3.847	8.340	3.490	3.143
92 DUNALIELLA SPP.								0.000	0.000
0.000	0.000	0.000	15.286	0.000	1.403	12.045	3.197	7.584	5.468
8.505	4.053	0.868	1.287	1.376	1.242	0.453	0.441	0.224	0.371
0.524	0.978	0.812	1.843	0.499	1.406	0.296	0.348	0.863	0.000
0.433	0.000	0.749	0.032	0.723	4.630	0.507	1.051	2.070	0.562
93 CHOANOFLAGELLATA INDET.								0.000	0.000
0.000	0.000	0.000	1.009	0.000	0.000	0.000	0.050	0.000	0.000
1.531	0.000	3.083	0.375	0.035	0.287	0.074	0.000	0.243	0.175
0.113	0.402	0.151	0.194	0.726	0.230	0.000	0.192	0.245	0.112
0.306	1.080	0.000	0.025	0.527	1.555	0.126	0.305	0.987	0.564
94 CILIATA INDET.								0.000	310.782
125.485	225.119	314.833	247.336	366.163	34.415	175.225	58.304	21.029	88.193
108.301	0.000	28.779	36.346	0.000	0.267	4.999	32.302	27.878	33.278
6.880	16.658	18.754	18.804	42.471	7.018	145.309	27.813	5.832	8.180
294.320	137.011	154.155	14.496	160.953	41.127	207.694	38.770	37.441	306.246
95 TINTINNIDIA INDET.								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.970	0.000
0.000	3.264	0.000	1.274	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	19.478	0.000	0.000	0.000	0.000

A 5.13

TABLE A5 (cont.)

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 96 TINTINNOPSIS ?NUCULA                                           0.000   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000 118.691   0.000

 97 TINTINNOPSIS PARVULA                                           0.000   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000  33.740   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000  20.469   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000

 98 TINTINNOPSIS ?STRIGOSA                                         0.000   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000  21.679   0.000

 99 HELICOSTOMELLA KILIENSIS                                       0.000   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
   0.000  85.232   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000

100 STROBILIDIUM C.F. STRIATA                                      0.000   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000  41.160
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000  28.325   0.000

101 FLAGELLATA INDET.                                             91.302 127.654
 186.283 135.092 510.964 137.238 659.944 436.350 345.790  59.776 190.816 141.533
 287.614  75.305  71.632  10.724  25.457  22.262  37.863 254.354  78.544  19.207
  83.672  42.820  21.300  62.169  20.931  46.230  16.134  30.775  71.898  69.070
  69.807  66.766  43.511  49.009  70.621 106.842  41.718 349.748  76.805 101.609

102 OTHER UNIDENTIFIED SPECIMENS                                   0.000  35.507
   0.000  17.683 396.809   0.000   0.000   0.000  11.056   3.494   0.000   0.000
   1.402   4.540   1.087   0.000  24.109   0.000   0.074   0.000   0.000   0.000
   0.000  17.283   1.679   0.000   0.000   1.098   0.000   0.000   2.335   0.000
   0.000   0.000   0.000   0.000  18.839   0.000   0.000  62.833   0.000   0.000

103 FAECAL PELLETS (ONLY SOME)                                   248.667   0.000
  66.730   0.000 485.540   0.000   4.201   0.000   4.603   0.000   0.000   0.000
   0.000   0.000 168.353   0.000   0.000   0.000   0.000   0.000   0.000   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
```

TABLE A5 (cont.)

A5.14

134 NITZSCHIA "DELICATISSIMA"									0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.173	0.674	0.000
	0.408	0.338	0.000	0.454	0.807	0.687	0.179	0.000	0.117	0.000
	0.879	0.181	0.357	0.075	0.194	0.235	0.000	0.038	0.000	0.000
	0.000	0.000	0.197	0.319	0.000	1.574	0.250	0.000	0.000	0.000
135 CHAETOCEROS FRAGILE									0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	14.393	0.000	0.000	0.557	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
136 PROROCENTRUM ?TRIESTINUM									0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	5.102	0.000	0.000

APPENDIX 6

A 6. 1.

TABLE A6

Estimated contribution to the concentration of particulate organic carbon by the nano- and micro- plankton taxa (mg m^{-3})

```
 0 FORMAT OF THE STATIONS                                                   1.1       1.2
  1.3      1.4      1.5      1.6      1.8      2.1      2.2      2.3      2.4       2.5
  2.6      2.7      3.1      4.1      4.2      4.3      5.1      5.2      6.1       6.2
  6.3      6.4      7.1      7.2      7.3      7.4      9.1      9.2     10.1      10.2
 11.1     11.2     12.1     12.2     13.1     14.1     14.2     15.1     15.2      15.3

 1 OSCILLATORIA SP(P).                                                     0.000     0.000
  0.000    0.000    0.000    0.174    0.000    0.000    0.000    0.000    0.000     0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.062    0.000    0.000     0.000
  0.138    0.015    0.004    0.000    0.000    0.000    0.000    0.000    0.008     0.000
  0.000    0.002    0.000    0.000    0.000    0.000    0.000    0.000    0.000     0.000

 2 CRYPTOMONADS                                                            8.417     4.699
  9.516    7.705   10.084    8.660    9.891   15.075    8.718   29.366   13.664     8.302
 28.315    6.572    5.672    4.262    5.130    4.763    2.068    3.354    1.587     1.543
  1.946    2.804    0.680    1.337    0.287    2.637    0.609    1.264    1.539     2.868
  1.776    0.853    2.983    2.483    3.990    9.647    0.390    6.011    2.085     4.993

 3 PROROCENTRUM MICANS                                                     0.000     0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000     0.000
  7.354    0.000    0.000    0.000    0.000    0.000    0.000    3.777    0.000     0.000
  0.000    0.000    0.000    0.000    4.979    0.000    0.000    0.000    0.000     0.000
  0.000    0.000    0.000    0.000    7.601    0.000    0.000    0.000    0.000     0.000

 4 PROROCENTRUM SPP.                                                       0.000     0.000
  0.000    0.000    0.000    2.183    0.000    0.359    0.000    1.697    0.000     0.570
  0.000    0.330    0.000    0.000    0.203    0.039    0.455    0.150    0.000     0.293
  2.755    1.427    0.000    0.108    0.112    0.394    0.012    0.194    0.641     0.000
  0.019    0.000    0.119    0.000    0.000    0.000    0.000    3.762    0.000     0.102

 5 DINOPHYSIS ?ACUTA                                                       0.000     2.372
  3.011    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000     0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000     0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000     0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000     0.000

 6 DINOPHYSIS NORWEGICA                                                    0.000     0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000     0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000     0.000
  0.000    0.000    0.000    0.000    0.000    7.897    0.000    0.000    0.000     0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000     0.000

 7 DINOPHYSIS SPP.                                                         0.000     1.131
  1.435    0.000    3.081    0.000    0.000    0.000    0.000    0.000    0.000     0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.596    0.000     0.000
  0.000    0.000    0.000    0.000    0.000    1.286    0.000    0.000    0.000     0.000
  0.000    0.000    0.000    1.585    0.000    0.000    0.000    0.000    0.000     5.407

 8 GYMNODINIACEAE INDET.                                                   3.987     3.614
  2.598    3.359    6.429    0.666    4.246    2.549    1.886    5.957    4.653    40.118
  3.253    1.366    4.234    3.592    0.965    2.473    0.503    0.307    0.943     0.918
  7.994    0.766    0.607    1.351    0.481    3.042    0.101    1.250    0.852     1.604
  0.812    0.000    1.338    8.053    0.807    1.330    0.318    1.502    5.271     0.568
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A 6.2

TABLE A6 ____ (cont.)

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 9 AMPHIDINIUM SPHENOIDES                                                      0.000     0.000
  0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
  0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
  0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
  0.000     0.000     0.000     0.000     2.222     0.000     0.000     0.000     0.000     0.000

10 GYRODINIUM SPIRALE                                                          0.000     0.000
  0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
  0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
  0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
  0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000    54.695    22.659

11 TORODINIUM ROBUSTUM                                                         0.000     0.000
  0.000     0.000     0.000     0.000     0.000     1.980     0.000     0.000     0.000     0.000
  0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
  0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
  0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000

12 PROTODINIUM NEAPOLITANUM                                                    0.608     0.612
  0.280     0.415     0.422     1.241     1.421     1.998     0.565     0.812     0.454     0.721
  0.251     0.314     0.823     0.586     1.486     0.654     0.855     0.456     0.644     0.214
  1.472     0.737     0.226     1.828     0.611     1.114     0.326     0.254     0.368     0.000
  0.189     0.171     0.167     0.287     0.260     0.350     0.000     0.026     0.228     1.000

13 POLYKRIKOS INDET.                                                           0.000     0.000
  0.000     0.000     0.000     0.000     0.000     0.123     0.208     0.000     0.000     0.000
  0.325     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
  0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
  0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000

14 PRONOCTILUCA INDET.                                                         0.000     0.730
  0.000     0.000     0.000     0.000     0.000     0.886     0.581     0.000     0.000     0.000
  0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
  0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
  0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000

15 SPORES - PERIDINIACEAE                                                      0.000     0.000
  0.000     0.000     0.000     2.279     0.000     5.334     1.066     1.551     0.695     8.854
  3.898     0.895     0.000     0.954     1.990     0.603     1.587     0.294     0.992     0.922
  0.291     0.761     0.701     0.609     2.706     0.316     0.362     0.735     0.841     4.415
  0.865     0.145     0.654     0.291     2.911     9.685     0.464     3.298     0.470     0.635

16 PROTOPERIDINIUM                                                             1.238     0.000
  2.658     2.086     8.475    26.535     2.714     4.025     4.994    11.573     0.952     1.670
 14.949     1.327     0.428     2.246     0.000     0.000     0.000     0.351     0.000     0.000
  0.309     1.700     0.582     0.038     0.000     0.939     0.000     0.000     0.065     0.000
  0.000     3.409     0.187     3.591     3.192     8.292     0.000     8.736     0.330     2.698

17 CERATIUM PURCA                                                              6.797     0.000
  0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000    11.072
 11.809     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
  0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
  0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
```

A 6.3

TABLE .. (cont.)

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18 CERATIUM LINEATUM                                                                 0.000    0.000
   0.000    0.000    0.000    5.113    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000

19 CERATIUM TRIPOS                                                                   0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000   59.863    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000

20 COCCOLITHOPHORIDS                                                                 0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.063    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000

21 DICTYOCHA FIBULA                                                                  0.000    0.000
   0.000    0.000    0.000    0.396    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    1.131    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000

22 DISTEPHANUS SPECULUM                                                             11.588   13.885
   9.329    9.762    5.932    2.258    2.541    0.000    1.453    3.572    1.500    1.862
   1.678    0.000    0.000    1.184    0.981    0.000    0.789    0.000    0.000    0.000
   0.000    0.613    0.000    0.000    0.000    0.000    0.889    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    3.405    0.000    0.000    0.000    0.000

23 MELOSIRA JURGENSII                                                                0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.919    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.177    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000

24 MELOSIRA NUMMELOIDES                                                              0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    2.094    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000

25 PARALIA SULCATA                                                                   0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.621
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000

26 STEPHANOPYXIS TURRIS                                                              0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.472    0.000    0.000    0.000    0.000    0.000
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TABLE A6 (cont.)

A 6.4

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27 HYALODISCUS SUBTILIS                                                                   0.000      0.000
  0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
  0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
  0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
  0.000      0.000      0.000      0.000      0.372      0.000      0.000      0.000      0.000      0.000

28 PODOSIRA STELLIGER (FRUSTULES)                                                         0.000      0.000
  0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
  0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
  0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
  0.000      0.000      0.001      0.000      0.000      0.000      0.000      0.000      0.000      0.000

29 SCHROEDERELLA DELICATULA                                                               0.000      0.000
  0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
  0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
  0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
  0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      3.657      0.000

30 LEPTOCYLINDRUS DANICUS                                                                 1.823      0.881
  0.839      0.329      0.100      0.000      0.271      0.000      0.263      0.000      0.000      3.394
  0.423      2.456      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
  0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
  0.000      0.000      0.000      0.000      0.000      0.000      0.654      0.000      0.000      0.510

31 LEPTOCYLINDRUS MINIMUS                                                                 0.000      0.000
  0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.136      0.000
  0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
  0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
  0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.162      0.069      0.442

32 SKELETONEMA COSTATUM                                                                   0.000      0.000
  0.000      0.000      0.000      0.000      0.000      0.000      0.050      0.000      1.205      3.362
  2.923      4.492      0.710      0.248      0.147      0.000      0.313      0.870      0.008      0.099
  0.000      0.000      0.042      0.077      0.130      0.000      0.000      0.000      0.000      0.000
  0.042      0.000      0.197      1.044      0.286      2.914      0.000      0.000      0.059      0.000

33 THALASSIOSIRA C.F. DECIPIENS                                                           0.000      0.000
  0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      1.218      0.000
  0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.247      0.000
  0.000      0.000      0.627      0.000      0.000      0.000      0.000      0.000      0.000      0.000
  0.000      0.000      3.981      0.210      0.000      0.000      0.000      0.000      0.000      0.000

34 THALASSIOSIRA GRAVIDA                                                                  0.000      0.000
  0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
  0.000      0.000      2.954      0.000      0.000      0.000      0.000      0.000      0.000      0.000
  0.000      0.929      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
  0.000      0.000      0.000      8.341      0.000     60.010     20.534      0.000      0.000      0.000

35 THALASSIOSIRA POLYCHORDA                                                               0.000      0.000
  0.000      0.775      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
  0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
  0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
  0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
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TABLE A6 (cont.)

A 6.5

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36 THALASSIOSIRA INDET.                                                          0.000     0.000
   0.000     0.000     0.000     4.491     0.000     0.000     0.865     0.000     0.000     0.842
   0.697     0.173     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     4.126     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000

37 LAUDERIA BOREALIS                                                             0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000    28.794     0.000     0.000     0.000

38 DETONULA CONFERVACEA                                                          0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.199     0.000

39 COSCINODISCUS "LINEATUS"                                                      0.000     0.000
   0.000     0.000     1.011     0.000     0.000     0.000     0.000     0.000     0.581     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.381     0.000     0.216
   0.337     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.776     0.000     0.000     0.172     0.000     0.000     0.000     0.000     0.000     0.000

40 ASTERIOMPHALUS HOOKERI                                                        1.736     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000

41 ROPERIA TESSELATA                                                             0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.864     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000

42 BIDDULPHIA INDET.                                                             0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.002
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000

43 TRICERATIUM INDET.                                                            0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     1.139     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000

44 CHAETOCEROS INDET.                                                            0.720     0.051
   0.000     0.000     0.000     0.842     0.000     0.000     0.019     0.000     1.268     1.517
   0.298     0.758     0.349     0.183     0.069     0.113     0.000     0.000     0.000     0.000
   0.047     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.035     0.079     0.000     0.000     0.507     0.307     0.339     0.274
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A 6.6

TABLE A6 (cont.)

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 45 CHAETOCEROS AFFINE                                                          0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     2.296
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.974     0.000     0.000

 46 CHAETOCEROS ATLANTICUM                                                      0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.891     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.545     0.000

 47 CHAETOCEROS BREVE                                                           0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.425     0.000     0.000     0.000     0.000     0.677     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.141     0.000     0.000

 48 CHAETOCEROS CINCTUS                                                         0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.092     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000

 49 CHAETOCEROS CURVISETUM                                                      0.000     0.813
   0.258     0.675     2.187     0.000     0.351     0.000     0.000     0.000     0.000     0.597
   0.000     0.000     0.000     0.000     0.094     0.331     0.029     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.073     0.459     0.074     0.295     0.000

 50 CHAETOCEROS CORONATUM                                                       0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.238     0.000     0.000     0.000     0.000     0.000     0.000

 51 CHAETOCEROS DANICUM                                                         0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     2.413     0.000     0.000     0.111     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000

 52 CHAETOCEROS DEBILE                                                          0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   8.252     0.000     0.000     0.000     0.079     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     1.765     0.000     0.000

 53 CHAETOCEROS DECIPIENS                                                       0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.799     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.876     0.000     0.000     0.000
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A 6.7

TABLE A6 (cont.)

54 CHAETOCEROS EXTERNUM								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.049
0.000	2.803	0.000	0.082	0.000	0.000	0.000	0.020	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.564	4.962	1.685
55 CHAETOCEROS FILIFORME								0.000	0.000
0.000	0.000	0.000	0.009	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
56 CHAETOCEROS GRACILE								0.000	0.242
0.056	0.219	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.082	0.000	0.000	0.021	0.000	0.027	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.300	0.000	0.000	0.000	0.000
57 CHAETOCEROS INGOLFIANUM								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.022	0.000
58 CHAETOCEROS HOLSATICUM								0.000	0.000
0.000	0.000	0.034	0.000	0.000	0.000	0.000	0.000	0.323	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.086	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.515	0.000	0.000	0.000	0.000
59 CHAETOCEROS NEAPOLITANUM								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.123	0.000
60 CHAETOCEROS PERPUSILLUM								0.000	0.000
0.000	0.000	0.000	0.019	0.000	0.000	0.000	0.000	0.023	0.000
0.045	0.000	0.000	0.000	0.000	0.046	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
61 CHAETOCEROS SCOLOPENDRA								0.000	0.000
0.000	0.000	0.000	0.000	0.204	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.043	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
62 CHAETOCEROS SERIACANTHUS								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.589	0.000	0.000

TABLE A6 (cont.)

63 CHAETOCEROS SIMILE								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.353
3.878	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.768	0.000	0.000
64 CHAETOCEROS SIMPLEX								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.035	0.000	0.000	0.039	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
65 CHAETOCEROS TORTISSIMUM								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.246	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
66 BACTERIASTRUM SP.								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.086	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
67 RHIZOSOLENIA ALATA								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.070	0.626	0.000
0.000	0.000	1.574	0.000	0.541	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.042	0.000	0.000
68 RHIZOSOLENIA CYLINDRUS								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	7.645
69 RHIZOSOLENIA DELICATULA								0.766	3.239
5.344	3.226	0.000	2.985	7.079	0.000	0.397	0.511	3.672	3.853
5.796	0.801	0.361	0.000	0.000	0.294	0.000	0.158	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.852	24.703	9.743	66.492
70 RHIZOSOLENIA FRAGILISSIMA								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	1.631	0.953	0.000	0.000	0.025	0.000	0.000	0.000
0.022	0.000	0.000	0.000	0.000	0.122	0.000	0.000	0.000	0.000
0.000	0.000	0.026	0.000	0.000	0.000	2.992	6.302	0.000	2.597
71 RHIZOSOLENIA HEBETATA								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.930	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

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72 RHIZOSOLENIA SETIGERA                                                       0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.270    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000

73 RHIZOSOLENIA SHRUBSOLEI                                                     0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    6.014    7.884

74 RHIZOSOLENIA STOLTERFOTHII                                                  6.393    0.000
   0.000    0.000    0.000    0.000    0.441    1.380    0.000    0.000    0.000    0.703
   7.673    0.748    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    9.865    3.338    2.307    2.656   24.626

75 GUINARDIA FLACCIDA                                                          0.000   13.751
   8.726    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.328    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    8.658    9.652   28.648   56.686

76 LITHODESMIUM UNDULATUM                                                      0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    1.354    0.000    0.000    0.000    0.000    0.000    0.080    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000

77 ?FRAGILIARIA SP.                                                            0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.599    0.000    0.233    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000

78 ASTERIONELLA GLACIALIS                                                      0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    3.269    0.271    0.000    0.000    0.000

79 THALASSIONEMA NITZSCHIOIDES                                                 0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.779    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000

80 LICMOPHORA SP.                                                              0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.745    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
   0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
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TABLE A6 (cont.)

A 6.10

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81 COCCONEIS INDET.                                                            0.000    0.000
  0.000    0.000    0.000    0.000    0.025    0.000    0.000    0.000    0.000    0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000

82 PLEUROSIGMA SP.                                                             0.000    0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.450    0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000

83 GYROSIGMA SP.                                                               0.000    0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
  0.418    0.000    2.570    0.000    0.000    0.000    0.000    0.000    0.000    0.000

84 NITZSCHIA APICULATA                                                         0.000    0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.055    0.000    0.000    0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000

85 NITZSCHIA SERIATA                                                           0.000    0.000
  0.000    0.000    0.000    0.200    0.000    0.000    0.000    0.000    0.000    0.000
  0.000    0.000    0.708    0.000    0.000    0.034    0.086    0.000    0.000    0.000
  0.000    0.000    0.000    0.054    0.107    0.000    0.000    0.000    0.000    0.000
  0.000    0.507    0.000    0.000    0.000    0.222    0.000    0.515    0.000    0.000

86 BACILLARIA PAXILLIFER                                                       0.000    0.000
  0.000    0.000    0.000    0.000    0.000    0.087    0.000    0.000    0.000    0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.355    0.032    0.172
  0.083    0.000    0.082    0.110    0.182    0.241    0.000    0.000    0.000    0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000

87 CYLINDROTHECA CLOSTERIUM                                                    0.000    0.045
  0.096    0.015    0.082    0.083    0.000    0.170    0.146    0.072    0.282    0.259
  0.557    0.000    0.289    0.148    0.096    0.040    0.066    0.081    0.131    0.023
  0.079    0.025    0.113    0.092    0.132    0.052    0.091    0.116    0.062    0.440
  0.181    0.428    0.059    0.088    0.192    0.260    0.130    0.000    0.020    0.022

88 BACILLARIOPHYCEAE INDET.                                                    0.233    2.172
  0.877    1.672    3.545    2.093    3.890    6.712    0.517    1.371    0.870    1.095
  1.259    0.000    0.494    0.587    0.183    1.880    0.885    8.207    0.390    1.029
  0.221    0.694    0.321    0.104    1.815    0.026    0.422    4.242    0.471    2.075
  0.559    2.755    0.086    0.414    2.825    1.401    0.428    0.443    0.316    3.152

89 EUGLENACEAE INDET.                                                          1.520    1.286
  0.952    0.000    0.778    0.099    0.222    0.181    0.310    0.380    1.248    0.000
  2.584    0.000    0.073    0.000    0.032    0.033    0.000    0.000    0.000    0.000
  0.038    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
  0.000    0.032    0.000    0.024    0.013    0.149    0.000    0.000    0.000    0.000
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TABLE A6 (cont.)

90 EUTREPTIA VIRIDIS								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.186	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
91 PRASINOPHYCEAE INDET.								2.887	2.890
3.667	3.243	13.339	3.375	13.914	4.073	1.336	8.388	2.736	3.506
1.941	2.299	0.676	0.925	0.164	1.540	1.006	1.116	1.086	1.109
1.086	1.107	0.990	1.316	0.238	1.369	0.498	0.528	0.577	0.908
1.527	1.096	0.521	3.578	1.111	2.542	0.686	1.472	0.635	0.570
92 DUNALIELLA SPP.								0.000	0.000
0.000	0.000	0.000	2.747	0.000	0.252	1.976	0.590	1.351	0.987
1.590	0.743	0.150	0.234	0.256	0.232	0.085	0.082	0.041	0.071
0.097	0.180	0.155	0.331	0.095	0.255	0.055	0.063	0.165	0.000
0.081	0.000	0.137	0.006	0.129	0.834	0.098	0.191	0.367	0.102
93 CHOANOFLAGELLATA INDET.								0.000	0.000
0.000	0.000	0.000	0.173	0.000	0.000	0.000	0.010	0.000	0.000
0.288	0.000	0.599	0.070	0.007	0.049	0.014	0.000	0.048	0.034
0.023	0.077	0.030	0.039	0.133	0.046	0.000	0.039	0.047	0.023
0.060	0.205	0.000	0.005	0.099	0.296	0.025	0.062	0.192	0.114
94 CILIATA INDET.								0.000	41.297
16.675	29.914	42.800	32.866	48.656	5.181	24.488	8.738	3.279	12.987
15.719	0.000	4.066	4.995	0.000	0.051	0.758	4.741	4.096	4.799
1.082	2.498	2.689	2.499	5.768	1.112	17.871	3.950	0.946	1.296
36.060	17.281	18.963	2.255	21.554	6.378	27.224	5.871	4.975	40.913
95 TINTINNIDIA INDET.								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.313	0.000
0.000	0.502	0.000	0.212	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	2.946	0.000	0.000	0.000	0.000
96 TINTINNOPSIS ?NUCULA								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	15.054	0.000
97 TINTINNOPSIS PARVULA								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	4.706	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.881	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
98 TINTINNOPSIS ?STRIGOSA								0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	3.046	0.000

TABLE A6 (cont.)

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 99 HELICOSTOMELLA KILIENSIS                                               0.000     0.000
     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
     0.000    11.449     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000

100 STROBILIDIUM C.F. STRIATA                                              0.000     0.000
     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     5.689
     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     3.915     0.000

101 FLAGELLATA INDET.                                                     16.936    23.679
    34.555    25.059    90.138    25.457   116.633    80.579    64.215    12.926    35.814    27.760
    53.351    15.457    13.853     2.437     5.175     4.642     7.329    47.421    14.061     3.872
    15.861     8.177     4.168    13.212     4.074     9.366     3.262     6.235    14.719    13.795
    12.679    12.457     8.644     9.734    15.046    20.899     8.432    56.331    15.571    19.267

102 OTHER UNIDENTIFIED SPECIMENS                                           0.000     4.438
     0.000     2.210    47.661     0.000     0.000     0.000     1.568     0.602     0.000     0.000
     0.252     0.809     0.185     0.000     3.013     0.000     0.014     0.000     0.000     0.000
     0.000     2.527     0.278     0.000     0.000     0.200     0.000     0.000     0.439     0.000
     0.000     0.000     0.000     0.000     2.354     0.000     0.000     7.875     0.000     0.000

103 FAECAL PELLETS (ONLY SOME)                                            30.814     0.000
     8.269     0.000    58.165     0.000     0.642     0.000     0.745     0.000     0.000     0.000
     0.000     0.000    20.862     0.000     0.000     0.000     0.000     0.000     0.000     0.000
     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000

134 NITZSCHIA "DELICATISSIMA"                                              0.000     0.000
     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.027     0.085     0.000
     0.051     0.046     0.000     0.066     0.091     0.100     0.023     0.000     0.016     0.000
     0.111     0.023     0.046     0.013     0.024     0.034     0.000     0.007     0.000     0.000
     0.000     0.000     0.025     0.041     0.000     0.164     0.031     0.000     0.000     0.000

135 CHAETOCEROS FRAGILE                                                    0.000     0.000
     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
     0.000     0.000     1.345     0.000     0.000     0.054     0.000     0.000     0.000     0.000
     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000

136 PROROCENTRUM ?TRIESTINUM                                               0.000     0.000
     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.914     0.000     0.000
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APPENDIX 7a

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STATISTICAL PACKAGE FOR THE SOCIAL SCIENCES, VERSION OF 02/01/72                    10/09/75         PAGE    1
                   RUN NAME         CANONICAL ANALYSIS OF SPECIES USING LOGDENSITY
                   SUBFILE LIST     SF1,SF2,SF3,SF4,SF5,SF6,SF7,SF9,SF10,SF11,SF12,SF13,
                                    SF14,SF15
                   # OF CASES         7,    7, 1,  3,  9,  4,  4,  2,   2,   2,   2,   1,
                                        2, 3
                   VARIABLE LIST    VAR001 TO VAR130
                   VAR LABELS       VAR100,VOLUME SCANNED/
                                    VAR001, OTHER FLAGS/
                                    VAR002, POINTED FLAGS/
                                    VAR003, ROUNDED FLAGS/
                                    VAR004, EUGLENOIDS/
                                    VAR005, OBVIOUS CHOANOFLAGS/
                                    VAR006, DYCTIOCHA SPECULUM/
                                    VAR007, FLAGELLATES TYPE A/
                                    VAR010, COSCINOSIRA POLYCHORDA/
                                    VAR011, ASTERIONPHALUS HOOKERI/
                                    VAR012, CHAETOCEROS GRACILE/
                                    VAR013, CHAETOCEROS CURVISETUM/
                                    VAR014, RHIZOSOLENIA STOLTERFOTHII/
                                    VAR015, RHIZOSOLENIA HEBETATA/
                                    VAR016, RHIZOSOLENIA DELICATULA/
                                    VAR017, NITZCHIA CLOSTERIUM/
                                    VAR018, LEPTOCYLINDRICUS MINIMUS/
                                    VAR019, LEPTOCYLINDRICUS DANICUS/
                                    VAR020, GUINARDIA FLACCIDA/
                                    VAR021, CHAETOCEROS RADICANS/
                                    VAR022, STAURONEIS QUADRIPEDIS/
                                    VAR023, SKELETONEMA COSTATUM/
                                    VAR024, CHAETOCEROS CORONATUM/
                                    VAR025, LICMOPHORA SP/
                                    VAR026, CHAETOCEROS COMPRESSUM/
                                    VAR027, RHIZOSOLENIA SETIGERA/
                                    VAR028, BACTERIASTRUM SP/
                                    VAR029, MELOSIRA JUERGENSII/
                                    VAR030, NAVICULA SP/
                                    VAR031, CHAETOCEROS SP/
                                    VAR032, THALLASIOSIRA SP/
                                    VAR033, CILIATED LARVAE & TINTINNIDS/
                                    VAR035,AUXO & OTHER SPORES/
                                    VAR036, CHAETOCEROS FRAGILE/
                                    VAR037, CHAETOCEROS CINTUM/
                                    VAR038, CHAETOCEROS BREVE/
                                    VAR039, CHAETOCEROS ATLANTICUS/
                                    VAR040,NITZCHIA SERIATA/
                                    VAR041, THALLASSIOTHRIX NITZCHOIDES/
                                    VAR042, RHIZOSOLENIA ALATA/
                                    VAR043, RHIZOSOLENIA FRAGILLISSIMA/
                                    VAR044, THALLASSIOSIRA GRAVIDA/
                                    VAR045, MELOSIRA NUMMULOIDES/
                                    VAR046, FRAGILARIA SP/
                                    VAR047, DIATOMS INDET/
                                    VAR048,NITZCHIA DELICATISSIMA/
                                    VAR049,CHAETOCEROS DEBILE/
                                    VAR050,CHAETOCEROS DIDYMUS
                                    VAR051,CHAETOCEROS PERPUSILLUM/
                                    VAR052,CHAETOCEROS SIMPLEX/
                                    VAR053,CHAETOCEROS EXTERNUM/
                                    VAR054,CHAETOCEROS DECIPIENS/
                                    VAR055,THALLASSIOSIRA DECIPIENS/
                                    VAR101,DAYS AFTER 1-7-73/
                                    VAR102,PHOSPHATE MICROGRAMS PER LITRE OF PO4-P/
                                    VAR103,NITRATE    MICROGRAMS PER LITRE OF NO3-N/
                                    VAR104,NITRITE    MICROGRAMS PER LITRE OF NO2-N/
                                    VAR105,CHLOROPHYLL                               /
                                    VAR106,TEMPERATURE CELSIUS/
                                    VAR110, GYMNO-GYRO-AMPHIDINIUM/
                                    VAR111, CERATIUM TRIPOS/
                                    VAR112, CERATIUM FURCA/
                                    VAR112, CERATIUM FUSUS/
                                    VAR113, CERATIUM LINEATUM/
                                    VAR114, CERATIUM MACROCEROS/
                                    VAR115, PERIDINIUM INDET/
                                    VAR116, [illegible] ROBUSTUM/
                                    VAR117, POLYKRIKOS SP/
                                    VAR118, APPARENT NOCTILUCA/
                                    VAR121,CURLY FLAGELLATES/
                                    VAR129,SECCHI DISC READING IN METRES
                   PRINT FORMATS    VAR001 TO VAR100(0)/VAR091(0)/VAR002(1)/VAR093(1)/VAR094(2)/
                                    VAR095 TO VAR100(1)/VAR100(4)/VAR101 TO VAR130(0)
                   INPUT FORMAT     FIXED (12(10F8.3/),10F8.3)
```

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CANONICAL ANALYSIS OF SPECIES USING LOGDENSITY                                             10/09/75          PAGE    2

IGNORING INDEFINITE REPETITION. THE INPUT FORMAT PROVIDES FOR 130 VARIABLES.  130 WILL BE READ.
IT PROVIDES FOR 13 RECORDS ('CARDS') PER CASE.

                    INPUT MEDIUM     OTHER
                    FACTOR           VARIABLES= VAR001 TO VAR007,VAR011 TO VAR014,VAR016,VAR017,
                                     VAR019,VAR020,VAR023,VAR030,VAR031,VAR033,VAR035,VAR040,VAR042,
                                     VAR047,VAR048,VAR060,VAR062,VAR109,VAR115,VAR118,VAR119,VAR120
                                      TYPE=RAO/ITERATE = 99
                    STATISTICS        1,2,3,4,5,6,7,8
```

```
  1.VARIABLE LIST
VARIABLES ...
VAR001
VAR00[illegible]
VAR00[illegible]
VAR00[illegible]
VAR00[illegible]
VAR[illegible]
VAR[illegible]
VAR[illegible]
VAR[illegible]
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VAR[illegible]
VAR[illegible]
VAR[illegible]
VAR[illegible]
VAR[illegible]
VAR[illegible]
VAR119
VAR120
                   READ INPUT DATA
```

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CANONICAL ANALYSIS OF SPECIES USING LOGDENSITY                                      10/09/75         PAGE    6
FILE    NONAME    (CREATION DATE = 10/09/75)
SUBFILE     SF1          SF2          SF3          SF4          SF5          SF6          SF7          SF9          SF10         SF11
            SF12         SF13         SF14         SF15

VARIABLE             MEAN      STANDARD DEV      CASES

VAR001             3.2772            0.3043         62
VAR002             1.9202            0.3731         62
VAR003             1.6650            0.2675         62
VAR004             0.2660            0.3640         62
VAR005             0.3377            0.4083         62
VAR006             0.2803            0.3876         62
VAR007             0.7127            0.5217         62
VAR011             0.4736            0.3554         62
VAR012             0.3283            0.3185         62
VAR013             0.2303            0.4030         62
VAR014             0.1740            0.3321         62
VAR016             0.6430            0.6097         62
VAR017             0.8340            0.3672         62
VAR019             0.0616            0.5052         62
VAR020             0.0860            0.2112         62
VAR023             0.3670            0.6837         62
VAR030             0.6699            0.4024         62
VAR031             0.3620            0.6860         62
VAR033             0.7847            0.3030         62
VAR035             0.8814            0.3263         62
VAR040             0.1099            0.5005         62
VAR043             0.0689            0.2266         62
VAR047             0.6871            0.4537         62
VAR048             0.2397            0.2072         62
VAR060             0.0490            0.6437         62
VAR062             0.1202            0.6435         62
VAR100             1.2992            0.4086         62
VAR115             0.3862            0.5300         62
VAR118             0.3886            0.4445         62
VAR119             0.0847            0.1514         62
VAR120             1.2812            0.428[illegible]         62
```

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CANONICAL ANALYSIS OF SPECIES USING LOGDENSITY                                   10/09/75        PAGE    5

FILE     NONAME     (CREATION DATE = 10/09/75)
SUBFILE    SF1         SF2         SF3         SF4         SF5         SF6         SF7         SF8         SF10        SF11
           SF12        SF13        SF14        SF15

CORRELATION COEFFICIENTS..

             VAR001      VAR002      VAR003      VAR004      VAR005      VAR006      VAR007      VAR011      VAR012      VAR013

VAR001      1.00000     0.63285     0.43559     0.28056    -0.23267     0.31730     0.33069     0.36066     0.19088     0.16780
VAR002      0.63285     1.00000     0.71261     0.53206    -0.22810     0.38789     0.17076     0.65590     0.39273     0.30872
VAR003      0.43559     0.71261     1.00000     0.35400    -0.43782     0.55688     0.04236     0.68568     0.25291     0.36420
VAR004      0.28056     0.53206     0.35400     1.00000    -0.13807     0.63006    -0.17389     0.08094     0.46553     0.26267
VAR005     -0.23267    -0.22810    -0.43762    -0.13807     1.00000    -0.67339     0.24080    -0.66053    -0.00256    -0.30410
VAR006      0.31730     0.38789     0.55688     0.63006    -0.67339     1.00000    -0.21993     0.24555     0.34363     0.56294
VAR007      0.33069     0.17076     0.04236    -0.17360     0.24080    -0.21993     1.00000     0.12228    -0.00302    -0.25054
VAR011      0.36066     0.65590     0.68568     0.08094    -0.66053     0.24555     0.12228     1.00000     0.04792     0.34701
VAR012      0.19088     0.39273     0.25291     0.46553    -0.00256     0.34363    -0.00302     0.04792     1.00000     0.42320
VAR013      0.16780     0.30872     0.36420     0.26267    -0.30419     0.56296    -0.25056     0.34701     0.42329     1.00000
VAR014      0.22278     0.31037    -0.00880     0.15493     0.26646     0.06910     0.22628    -0.11566     0.20583     0.07317
VAR016      0.61050     0.42076     0.13150     0.12810     0.05163     0.33388     0.10860     0.07951     0.22555     0.31835
VAR017      0.15028    -0.01347    -0.20710     0.10751     0.20803    -0.17366     0.24720    -0.14707     0.12026    -0.16698
VAR019      0.23022     0.22546     0.04055     0.07056    -0.02815     0.17541     0.05809    -0.07740     0.27083     0.22512
VAR020      0.18368     0.09367    -0.20616     0.13821     0.28810     0.06803     0.00245    -0.23001     0.24563     0.20843
VAR023      0.24921     0.14150    -0.00323     0.07364    -0.02946    -0.11431     0.46347     0.20490     0.08033    -0.17625
VAR030     -0.01723    -0.09010     0.12527    -0.03708     0.02505    -0.09386     0.01123    -0.11542     0.07656     0.02265
VAR031      0.30087     0.32558     0.05709     0.17465     0.01881     0.16046     0.45524     0.09900    -0.01862    -0.01488
VAR033      0.40261     0.30715     0.41197     0.23052    -0.02758     0.39096    -0.02773     0.23531     0.39259     0.37922
VAR035      0.17215    -0.10603    -0.18860    -0.27264     0.14474    -0.30850     0.58060    -0.11066    -0.15095    -0.32658
VAR040     -0.19246    -0.07402    -0.14751     0.13296     0.55300    -0.16560     0.08153     0.02007     0.02338    -0.03768
VAR042      0.22786     0.10058     0.16065     0.08796     0.03042     0.02620     0.24233     0.28366    -0.12577    -0.06667
VAR047     -0.08678    -0.07050    -0.35105    -0.14300     0.20568    -0.23500     0.22182    -0.14290    -0.03342    -0.15890
VAR048     -0.13305     0.04452     0.10560     0.01542     0.08516    -0.19603     0.48527     0.11369     0.16611    -0.12581
VAR060      0.23908     0.20420     0.28249     0.26031    -0.01351     0.11787     0.24616     0.20368     0.28257     0.07678
VAR062     -0.21383    -0.32145    -0.15213    -0.29318     0.04113    -0.36568     0.06067     0.09908    -0.20402    -0.29956
VAR106      0.52906     0.56520     0.34527     0.21454    -0.13385     0.34408     0.23450     0.30502     0.19505     0.16990
VAR115      0.42966     0.63287     0.41783     0.38797     0.04867     0.27001     0.30078     0.06168     0.26768     0.02897
VAR118      0.08747    -0.00550    -0.06176    -0.21064     0.16350    -0.21363     0.55160    -0.07250    -0.18483    -0.27103
VAR119     -0.01753     0.06255     0.12241     0.14275    -0.03080     0.16553    -0.26029    -0.06825     0.02862     0.20457
VAR120      0.05415     0.22075     0.10065     0.05576    -0.16645     0.19030     0.14801     0.35582    -0.02019    -0.05767


             VAR014      VAR016      VAR017      VAR019      VAR020      VAR023      VAR030      VAR031      VAR033      VAR035

VAR001      0.22278     0.61050     0.15028     0.23022     0.18365     0.24921    -0.01723     0.30087     0.60261     0.17215
VAR002      0.31037     0.42076    -0.01347     0.22546     0.09387     0.16150    -0.09010     0.32558     0.36715    -0.10603
VAR003     -0.00880     0.13750    -0.20710     0.04455    -0.20416    -0.00323     0.12957     0.05709     0.41097    -0.18860
VAR004      0.15493     0.12810     0.10751     0.07056     0.13621     0.07364    -0.03708     0.17685     0.23952    -0.27264
VAR005      0.26640     0.05163     0.20113    -0.02815     0.28810    -0.02948     0.02595     0.01881    -0.02758     0.14474
VAR006      0.06910     0.33388    -0.17360     0.17549     0.06803    -0.11431    -0.09386     0.14046     0.39096    -0.39850
VAR007      0.22628     0.10860     0.24721     0.05801     0.00245     0.46347     0.01123     0.45856    -0.02773     0.58060
VAR011     -0.11566     0.07951    -0.14707    -0.07740    -0.23001     0.20460    -0.11542     0.00000     0.23531    -0.11064
VAR012      0.20583     0.22555     0.12021     0.27083     0.24563     0.08533     0.07656    -0.01862     0.39259    -0.15905
VAR013      0.07317     0.31835    -0.16698     0.22512     0.20843    -0.17625     0.02265    -0.01488     0.37022    -0.32658
VAR014      1.00000     0.56121    -0.22221     0.33588     0.01416    -0.15000    -0.08104     0.48750     0.16792     0.06652
VAR016      0.56121     1.00000    -0.30251     0.34186     0.73171    -0.01775    -0.16115     0.53528     0.66442    -0.21567
VAR017     -0.12728    -0.34256     1.00000     0.00713    -0.12539     0.27916     0.27386    -0.04403     0.20722     0.51697
VAR019      0.33586     0.34176     0.00713     1.00000     0.22281     0.01287    -0.05297     0.14098     0.35432    -0.02720
VAR020      0.61410     0.73171    -0.22535     0.22261     1.00000    -0.13136    -0.12575     0.26816     0.26516    -0.16714
VAR023      0.15000    -0.01775     0.27916     0.01287    -0.13136     1.00000     0.14171     0.46930    -0.09038     0.27117
VAR030     -0.08106    -0.16115     0.27386    -0.05297    -0.12573     0.14171     1.00000    -0.16858     0.03106     0.13980
VAR031      0.48750     0.53528    -0.04413     0.14098     0.26816     0.46930    -0.16858     1.00000     0.02950     0.07804
VAR033      0.16202     0.66442     0.20722     0.35432     0.26516    -0.09038     0.03106     0.02950     1.00000    -0.01826
VAR035      0.06452    -0.21567     0.51697    -0.02720    -0.16714     0.27117     0.13980     0.07806    -0.01826     1.00000
VAR040     -0.00520     0.06370   [illegible]   -0.17033    -0.08745     0.07673    -0.01421     0.15477    -0.06283    -0.20755
VAR042     -0.11181     0.26050   [illegible]   -0.06338    -0.07525     0.32163    -0.14053     0.30386    -0.00135    -0.01524
VAR047      0.13256    -0.06470   [illegible]    0.28606    -0.13709     0.16030     0.00010     0.07015    -0.00299     0.43927
VAR048     -0.12250    -0.27336   [illegible]    0.00312    -0.20106     0.31311    -0.01586     0.09957    -0.25218     0.23584
VAR060      0.17631     0.06417   [illegible]   -0.05777    -0.19023     0.43648     0.17006     0.02111     0.20572     0.13617
VAR062     -0.23167    -0.32415   [illegible]   -0.15938    -0.20581    -0.03904    -0.06718    -0.34096    -0.11092     0.01564
VAR106      0.16170     0.27550   [illegible]    0.13470     0.15103     0.25346    -0.19310     0.33177     0.28890     0.03740
VAR115      0.38251     0.29367   [illegible]    0.23264     0.06649     0.20870     0.01530     0.42432     0.43235    -0.06204
VAR118      0.00701     0.03631   [illegible]   -0.02475    -0.04632    -0.04625    -0.00172     0.12602    -0.11712     0.31522
VAR119      0.13788   [illegible] [illegible]   -0.13576     0.30352    -0.21602    -0.18370    -0.10303     0.28117    -0.29378
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NONICAL ANALYSIS OF SPECIES USING LOGDENSITY                                                10/09/75       PAGE    6
ILE   NONAME    (CREATION DATE = 10/09/75)
JBFILE  SF1          SF2          SF3          SF4          SF5          SF6          SF7          SF9          SF10         SF11
        SF12         SF13         SF14         SF15


          VAR014      VAR016      VAR017      VAR018      VAR020      VAR023      VAR030      VAR031      VAR033      VAR035

AR120    -0.21619    -0.11701    -0.02993    -0.13237    -0.26900     0.07713    -0.06560    -0.10761     0.01366    -0.24409


          VAR040      VAR042      VAR047      VAR048      VAR060      VAR062      VAR109      VAR115      VAR118      VAR119

VAR001   -0.19260     0.22784    -0.08678    -0.03505     0.23906    -0.21583     0.52904     0.62966     0.08767    -0.01258
VAR002   -0.01602     0.10085    -0.06650     0.04492     0.28020    -0.32145     0.52520     0.63287    -0.00950     0.08258
VAR003   -0.10781     0.00080    -0.35105     0.10480     0.28741    -0.15213     0.34520     0.41783    -0.06076     0.12240
VAR004    0.03294     0.08798    -0.14806     0.01542     0.26031    -0.29318     0.21486     0.38797    -0.01096     0.14278
VAR005    0.53390     0.05042     0.29548     0.08514    -0.01331     0.04113    -0.13385     0.04847     0.14539    -0.03980
VAR006   -0.16560     0.02920    -0.23500    -0.15693     0.11787    -0.36568     0.34408     0.27001    -0.21303     0.16558
VAR007    0.08153     0.24233     0.29182     0.48527     0.24610     0.00047     0.23439     0.30078    -0.33160    -0.24920
VAR011    0.02007     0.20364    -0.14258     0.11869     0.29366     0.09908     0.30292     0.06168    -0.02259    -0.06828
VAR012    0.02138    -0.12577    -0.03362     0.14611     0.28257    -0.20402     0.19503     0.26768    -0.18483     0.02842
VAR013   -0.03768    -0.00467    -0.15560    -0.12581     0.07476    -0.29956     0.16999     0.02897    -0.27103     0.20657
VAR014   -0.00520    -0.11181     0.15754    -0.02050     0.17481    -0.23187     0.16176     0.38751     0.00701     0.13784
VAR016    0.04579     0.20810    -0.06471    -0.27836     0.00402    -0.33409     0.29529     0.28767     0.01631     0.19448
VAR017    0.14108     0.14006     0.24575     0.14076     0.27409     0.02061     0.06481     0.13154    -0.01580    -0.12162
VAR018   -0.12933    -0.05332     0.28066     0.00802    -0.08777    -0.15118     0.13470     0.23248    -0.02475    -0.15574
VAR020   -0.08743    -0.07279    -0.13766    -0.20105    -0.11033    -0.20580     0.05193     0.09619    -0.04032     0.39552
VAR023    0.07473     0.32103     0.28139     0.39391     0.43288    -0.03062     0.25342     0.26879    -0.04475    -0.21692
VAR030   -0.01421    -0.14053     0.10016    -0.01466     0.12906    -0.04718    -0.19310     0.01539    -0.00172    -0.18370
VAR031    0.15477     0.30384     0.17115     0.00657     0.02111    -0.34664     0.33177     0.42432     0.12602    -0.10398
VAR033   -0.04283    -0.00935    -0.00299    -0.25216     0.20572    -0.11992     0.28890     0.45235    -0.11712     0.28117
VAR035   -0.20753    -0.01324     0.43927     0.23964     0.13617     0.01544     0.03740    -0.04206     0.31522    -0.29378
VAR040    1.00000     0.30811     0.30162    -0.03550     0.08793    -0.05488    -0.06432     0.02865     0.01066    -0.19121
VAR042    0.30811     1.00000     0.24226     0.20405     0.47154    -0.15384     0.33472    -0.10987    -0.04880    -0.13797
VAR047    0.30162     0.24226     1.00000     0.04266     0.20208    -0.09087    -0.00896    -0.13379     0.11028    -0.35644
VAR048   -0.03550     0.20405     0.04266     1.00000     0.28400     0.09822     0.29096     0.06276     0.22622    -0.15254
VAR060    0.08793     0.47154     0.20208     0.28400     1.00000    -0.01690     0.12511     0.19178    -0.22110     0.03813
VAR062   -0.05486    -0.15384    -0.09087     0.09822    -0.01690     1.00000    -0.08693    -0.19059     0.27395     0.00991
VAR109   -0.06432     0.33472    -0.00896     0.29096     0.12511    -0.08693     1.00000     0.24009     0.20650     0.03388
VAR115    0.02865    -0.10987    -0.13379     0.06276     0.19178    -0.19059     0.24009     1.00000     0.12223     0.15660
VAR118    0.01066    -0.04880     0.11028     0.22622    -0.22110     0.27355     0.20650     0.12223     1.00000    -0.13956
VAR119   -0.19121    -0.13797    -0.35644    -0.15254     0.03813     0.00991     0.03388     0.15460    -0.13056     1.00000
VAR120    0.17203     0.11325    -0.10302     0.16447     0.05015     0.33116     0.25750     0.10646     0.20839     0.07465


          VAR120

VAR001    0.15415
VAR002    0.22079
VAR003    0.19445
VAR004    0.15576
VAR005   -0.16445
VAR006    0.19830
VAR007    0.14501
VAR011    0.35586
VAR012   -0.02019
VAR013   -0.05767
VAR014   -0.21619
VAR016   -0.11701
VAR017   -0.02993
VAR018   -0.13237
VAR020   -0.26900
VAR023    0.07713
VAR030   -0.06560
VAR031   -0.10761
VAR033    0.01366
VAR035   -0.24409
VAR040    0.17203
VAR042    0.11325
VAR047   -0.10302
VAR048    0.16447
VAR060    0.05015
VAR062    0.33116
```

```
CANONICAL ANALYSIS OF SPECIES USING LOGDENSITY                                         10/09/75        PAGE    7
FILE    NONAME    (CREATION DATE = 10/04/75)
SUBFILE   SF1          SF2          SF3          SF4          SF5          SF6          SF7          SF9          SF10         SF11
          SF12         SF13         SF14         SF15


            VAR120

VAR109       0.25750
VAR115       0.10669
VAR118       0.20839
VAR119       0.07463
VAR120       1.00000

SQUARED MULTIPLE CORRELATIONS CANNOT BE FOUND.
INITIAL ESTIMATE OF COMMUNALITIES IS MAXIMUM OFF-DIAGONAL ELEMENT OF CORRELATION MATRIX.
```

APPENDIX 7b

```
STATISTICAL PACKAGE FOR THE SOCIAL SCIENCES, VERSION OF 02/01/72                    01/09/75          PAGE    1

                    RUN NAME         FACTOIAL ANALYSES OF STATIONS
                    # OF CASES       30
                    VARIABLE LIST    VAR001 TO VAR042
                    INPUT FORMAT     FIXED (4(10F8.3/),2F8.3)

IGNORING INDEFINITE REPETITION, THE INPUT FORMAT PROVIDES FOR  42 VARIABLES.   42 WILL BE READ.
IT PROVIDES FOR  5 RECORDS ('CARDS') PER CASE.

                    INPUT MEDIUM     OTHER
                    FACTOR           VARIABLES= VAR001 TO VAR042
                                     TYPE= PA2/
                                     ROTATE= VARIMAX/
                                     ROTATE = QUARTIMAX/
                                     ROTATE = EQUIMAX/
                                     ROTATE = OBLIQUE/ DELTA = -1.0,0.2,1.0/
                    STATISTICS       1,2,4,5,6,7,8
```

```
FACTUIAL ANALYSES OF STATIONS                                                          01/09/75          PAGE    2

  1,VARIABLE LIST

VARIABLES ,..

VAR001
VAR002
VAR003
VAR004
VAR005
VAR006
VAR007
VAR008
VAR009
VAR010
VAR011
VAR012
VAR013
VAR014
VAR015
VAR016
VAR017
VAR018
VAR019
VAR020
VAR021
VAR022
VAR023
VAR024
VAR025
VAR026
VAR027
VAR028
VAR029
VAR030
VAR031
VAR032
VAR033
VAR034
VAR035
VAR036
VAR037
VAR038
VAR039
VAR040
VAR041
VAR042              READ INPUT DATA
```

```
FACTORIAL ANALYSES OF STATIONS                                                      01/09/75        PAGE   3
FILE   NONAME   (CREATION DATE = 01/09/75)

VARIABLE              MEAN       STANDARD DEV       CASES

VAR001              0.3633             0.8366          30
VAR002              0.8307             0.8309          30
VAR003              0.8509             0.8400          30
VAR004              0.3943             0.8371          30
VAR005              0.8133             0.8720          30
VAR006              0.7799             0.8792          30
VAR007              0.8231             0.8899          30
VAR008              0.8174             0.8760          30
VAR009              0.8030             0.8508          30
VAR010              0.7510             0.9440          30
VAR011              0.8820             0.9192          30
VAR012              0.9632             0.9279          30
VAR013              1.0703             0.8407          30
VAR014              0.8403             0.8868          30
VAR015              0.8600             0.7279          30
VAR016              0.8520             0.7219          30
VAR017              0.8127             0.7283          30
VAR018              0.8400             0.7253          30
VAR019              0.3493             0.8851          30
VAR020              0.3700             0.7727          30
VAR021              0.8970             0.7229          30
VAR022              0.3109             0.7140          30
VAR023              0.8130             0.7235          30
VAR024              0.3109             0.7211          30
VAR025              0.8719             0.8490          30
VAR026              0.8043             0.8300          30
VAR027              0.3133             0.8826          30
VAR028              0.8134             0.7193          30
VAR029              0.393[illegible]             0.8792          30
VAR030              0.893[illegible]             0.7147          30
VAR031              0.3193             0.7030          30
VAR032              0.849[illegible]             0.8119          30
VAR033              0.38[illegible]             0.7459          30
VAR034              0.86[illegible]             0.7109          30
VAR035              0.47[illegible]             0.7137          30
VAR036              0.37[illegible]             0.7325          30
VAR037              0.807[illegible]             0.8267          30
VAR038              0.984[illegible]             0.8179          30
VAR039              0.383[illegible]             0.7223          30
VAR040              0.84[illegible]             0.7277          30
VAR041              0.3902             0.7566          30
VAR042              0.7107             0.8163          30
```

```
FACTUIAL ANALYSES OF STATIONS                                                              09/09/75          PAGE    4
FILE    NONAME   (CREATION DATE = 09/09/75)

CORRELATION COEFFICIENTS..


                VAR001      VAR002      VAR003      VAR004      VAR005      VAR006      VAR007      VAR008      VAR009      VAR010

VAR001         1.00000     0.82055     0.84336     0.80326     0.79249     0.71085     0.81572     0.75787     0.81816     0.77039
VAR002         0.82055     1.00000     0.93550     0.93724     0.87780     0.82410     0.84123     0.72488     0.81938     0.76516
VAR003         0.84336     0.93550     1.00000     0.94362     0.91531     0.70065     0.87196     0.79222     0.80677     0.81762
VAR004         0.80326     0.93724     0.94362     1.00000     0.88654     0.69526     0.93002     0.79685     0.82792     0.81202
VAR005         0.79249     0.87780     0.91531     0.88654     1.00000     0.66420     0.84064     0.79941     0.86567     0.78403
VAR006         0.71085     0.82410     0.70065     0.69526     0.66420     1.00000     0.72465     0.85420     0.78185     0.86739
VAR007         0.81572     0.84123     0.87196     0.93002     0.84064     0.72465     1.00000     0.83200     0.81004     0.81449
VAR008         0.75787     0.72488     0.79222     0.79685     0.79941     0.85420     0.83200     1.00000     0.89068     0.93681
VAR009         0.81816     0.81938     0.80677     0.82792     0.86567     0.78185     0.81004     0.89068     1.00000     0.86605
VAR010         0.77039     0.70516     0.81762     0.81202     0.78403     0.86739     0.81449     0.93681     0.86605     1.00000
VAR011         0.71673     0.65050     0.68769     0.67305     0.63053     0.70963     0.70180     0.76614     0.81080     0.80146
VAR012         0.67073     0.62753     0.68033     0.69936     0.65073     0.76946     0.71111     0.80935     0.82802     0.79827
VAR013         0.66767     0.50252     0.65375     0.62945     0.57496     0.82583     0.65364     0.77738     0.80400     0.77508
VAR014         0.72105     0.54476     0.61796     0.62215     0.60305     0.77359     0.63511     0.74505     0.75864     0.78108
VAR015         0.67067     0.57497     0.61210     0.60947     0.58664     0.68125     0.60118     0.71402     0.71173     0.68186
VAR016         0.76046     0.69701     0.75459     0.77011     0.76052     0.81636     0.75840     0.88620     0.89136     0.86385
VAR017         0.75961     0.60591     0.67534     0.68162     0.68016     0.73556     0.70226     0.85149     0.79786     0.85499
VAR018         0.75100     0.73352     0.76311     0.70688     0.73517     0.77964     0.70205     0.89701     0.78819     0.89865
VAR019         0.71937     0.67515     0.71065     0.72746     0.69881     0.73376     0.77950     0.89756     0.78550     0.86736
VAR020         0.68571     0.60141     0.73557     0.73502     0.71596     0.73518     0.70045     0.90080     0.85950     0.83636
VAR021         0.70089     0.73721     0.77265     0.76835     0.75555     0.75082     0.77705     0.92267     0.87150     0.89894
VAR022         0.69526     0.60917     0.70779     0.72532     0.69522     0.78973     0.70103     0.93329     0.82462     0.90962
VAR023         0.73027     0.60543     0.74109     0.71940     0.73385     0.81368     0.74030     0.92075     0.82760     0.93607
VAR024         0.73050     0.73572     0.78063     0.77456     0.77930     0.82117     0.77908     0.92405     [illegible] 0.93322
VAR025         0.69971     0.67026     0.73124     0.72465     0.72374     0.80321     0.73678     0.91491     [illegible] [illegible]
VAR026         0.70790     0.69132     0.75766     0.74187     0.72866     0.77326     0.73201     0.91451     [illegible] 0.89425
VAR027         0.59764     0.50412     0.60708     0.62464     0.59039     0.72568     0.67011     0.86031     0.74610     0.81046
VAR028         0.69110     0.64929     0.70061     0.71658     0.73104     0.81797     0.72051     0.91725     [illegible] 0.92306
VAR029         0.71110     0.67010     0.72563     0.72466     0.69216     0.77643     0.75645     0.91475     [illegible] 0.87096
VAR030         0.67124     0.64714     0.68788     0.68527     0.66230     0.76213     0.72221     0.85607     [illegible] 0.92455
VAR031         0.64446     0.61998     0.69444     0.66235     0.65721     0.80354     [illegible] 0.89084     0.78742     0.90254
VAR032         0.63331     0.62423     0.67670     0.67215     0.65267     0.67967     [illegible] 0.81943     0.78519     0.81057
VAR033         0.62290     0.62105     0.68667     0.67617     0.64547     0.70777     [illegible] [illegible] [illegible] 0.85717
VAR034         0.62100     0.59976     0.72066     0.67516     0.70440     [illegible] [illegible] [illegible] [illegible] 0.92392
VAR035         0.75991     0.70057     0.75619     0.70632     0.73390     0.75278     [illegible] [illegible] [illegible] [illegible]
VAR036         0.75470     0.70063     0.79791     0.74875     0.80286     0.76074     [illegible] [illegible] [illegible] [illegible]
VAR037         0.70043     0.67297     0.76513     0.71837     0.73480     0.70603     [illegible] 0.91863     [illegible] [illegible]
VAR038         0.61320     0.50563     0.66422     0.61452     0.69040     0.67548     [illegible] 0.75284     [illegible] [illegible]
VAR039         0.61465     0.61457     0.65427     0.65535     0.61199     0.69036     [illegible] 0.77819     [illegible] [illegible]
VAR040         0.70360     0.67474     0.73174     0.74966     0.62049     0.60868     [illegible] 0.72870     [illegible] [illegible]
VAR041         0.72940     0.73036     0.79140     0.77613     0.68115     0.70622     [illegible] 0.75760     [illegible] [illegible]
VAR042         0.71350     0.60319     0.72936     0.71834     0.61085     0.77138     [illegible] 0.73497     [illegible] [illegible]


                VAR011      VAR012      VAR013      VAR014      VAR015      VAR016      VAR017      VAR018      VAR019      VAR020

VAR001         0.71673     0.67073     0.66767     0.72105     0.67067     0.76046     [illegible] 0.75100     0.71937     [illegible]
VAR002         0.65050     0.62753     0.56252     0.54476     0.57407     0.69701     [illegible] 0.73352     0.67515     [illegible]
VAR003         0.68769     0.68033     0.65375     0.61796     0.61210     0.75459     [illegible] 0.76311     0.71065     [illegible]
VAR004         0.67305     0.69936     0.62945     0.62215     0.60947     0.77011     [illegible] 0.72480     0.72746     [illegible]
VAR005         0.63053     0.65073     0.57496     0.60315     0.58664     0.76052     [illegible] 0.73517     0.69881     [illegible]
VAR006         0.70963     0.76946     0.82583     0.77351     0.68145     0.81636     [illegible] 0.77506     0.73376     [illegible]
VAR007         0.70180     0.71151     0.65364     0.63591     0.60118     0.75840     [illegible] 0.70205     0.77950     [illegible]
VAR008         0.76614     0.80935     0.77738     0.74515     0.71402     0.88624     [illegible] 0.89701     0.89756     [illegible]
VAR009         0.81080     0.82802     [illegible] 0.75864     0.73173     0.89136     [illegible] 0.78819     0.78550     [illegible]
VAR010         0.80146     0.79827     0.77508     0.71910     0.68186     0.86385     [illegible] 0.89865     [illegible] [illegible]
VAR011         1.00000     0.85983     0.77117     [illegible] 0.74565     0.80192     [illegible] 0.77350     [illegible] [illegible]
VAR012         0.85983     1.00000     [illegible] 0.83751     [illegible] 0.84031     [illegible] 0.76745     0.81302     [illegible]
VAR013         0.77807     [illegible] 1.00000     0.82575     [illegible] [illegible] [illegible] 0.75526     [illegible] [illegible]
VAR014         0.82610     0.83751     [illegible] 1.00000     0.62717     [illegible] [illegible] [illegible] [illegible] [illegible]
VAR015         0.74563     [illegible] [illegible] [illegible] 1.00000     [illegible] [illegible] [illegible] [illegible] [illegible]
VAR016         0.80192     0.84031     [illegible] [illegible] [illegible] 1.00000     [illegible] [illegible] [illegible] [illegible]
VAR017         0.80057     [illegible] 0.75551     [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]
VAR018         0.77350     0.76745     0.71524     [illegible] 0.73652     [illegible] [illegible] 1.00000     [illegible] [illegible]
VAR019         0.80603     0.81302     0.71517     [illegible] 0.77573     [illegible] [illegible] [illegible] 1.00000     [illegible]
VAR020         0.80773     0.86305     0.76107     [illegible] 0.73840     [illegible] [illegible] [illegible] [illegible] [illegible]
VAR021         0.77715     [illegible] 0.75791     [illegible] 0.76359     [illegible] [illegible] [illegible] [illegible] [illegible]
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FACTUIAL ANALYSES OF STATIONS                                                         01/09/75        PAGE    5
FILE    NONAME    (CREATION DATE = 01/09/75)

              VAR011     VAR012     VAR013     VAR014     VAR015     VAR016     VAR017     VAR018     VAR019     VAR020
VAR022       0.79162    0.79325    0.75188    0.75103    0.73971    0.84371    0.88400    0.89288    0.92362    0.93398
VAR023       0.72367    0.73281    0.73035    0.73063    0.69098    0.85482    0.84152    0.86238    0.89351    0.81652
VAR024       0.77353    0.70015    0.73017    0.72636    0.71610    0.88449    0.84660    0.90535    0.87120    0.85653
VAR025       0.81367    0.77740    0.73778    0.79322    0.74574    0.90425    0.88302    0.90227    0.88905    0.90900
VAR026       0.78104    0.79958    0.70043    0.77060    0.74272    0.85093    0.86348    0.85507    0.90214    0.87764
VAR027       0.75310    0.76206    0.70095    0.68550    0.62689    0.83253    0.86296    0.84095    0.91076    0.89951
VAR028       0.70690    0.71702    0.71923    0.73771    0.68950    0.87005    0.83206    0.84971    0.84702    0.81717
VAR029       0.78023    0.71098    0.70694    0.67206    0.67701    0.79364    0.86626    0.90599    0.92605    0.89001
VAR030       0.73061    0.75530    0.75721    0.68226    0.74710    0.83050    0.87260    0.92995    0.92470    0.83342
VAR031       0.73706    0.79092    0.75974    0.71492    0.66539    0.86515    0.83822    0.87175    0.90279    0.84818
VAR032       0.72074    0.75321    0.73364    0.58730    0.71977    0.78084    0.75275    0.84357    0.81721    0.80109
VAR033       0.80060    0.86017    0.76750    0.70711    0.75599    0.83190    0.85150    0.85761    0.93044    0.89064
VAR034       0.58027    0.62139    0.64071    0.52455    0.71314    0.70556    0.63515    0.73612    0.76751    0.73337
VAR035       0.89007    0.80015    0.60740    0.60775    0.72690    0.90652    0.69313    0.83744    0.89500    0.91766
VAR036       0.81724    0.82101    0.77750    0.84305    0.72006    0.89476    0.78748    0.75481    0.79257    0.85775
VAR037       0.83790    0.83033    0.85137    0.75326    0.70079    0.90327    0.87500    0.87638    0.89300    0.91796
VAR038       0.74317    0.76722    0.78531    0.71192    0.68629    0.84263    0.74702    0.76251    0.77285    0.80146
VAR039       0.71262    0.77244    0.75340    0.83026    0.61939    0.73762    0.71132    0.82464    0.73522    0.73062
VAR040       0.68605    0.75906    0.72713    0.70372    0.67161    0.68548    0.63906    0.72334    0.67572    0.68034
VAR041       0.74636    0.70037    0.76336    0.76360    0.71460    0.77778    0.73002    0.76974    0.72249    0.76260
VAR042       0.61977    0.60220    0.72777    0.64331    0.65728    0.69590    0.59575    0.80749    0.61249    0.87116

              VAR021     VAR022     VAR023     VAR024     VAR025     VAR026     VAR027     VAR028     VAR029     VAR030
VAR001       0.70087    0.69322    0.73027    0.73635    0.69971    0.70798    0.59706    0.64116    0.71110    0.67724
VAR002       0.73721    0.66917    0.66943    0.73572    0.67620    0.69132    0.50417    0.64069    0.67710    0.64706
VAR003       0.77265    0.70771    0.74109    0.78083    0.73124    0.75766    0.60708    0.71661    0.72513    0.68786
VAR004       0.70037    0.76332    0.71960    0.77694    0.72945    0.74577    0.62462    0.71058    0.72460    0.69527
VAR005       0.75353    0.69322    0.73385    0.77036    0.72376    0.76868    0.59658    0.73064    [illegible] 0.66230
VAR006       0.75062    0.70975    0.71306    0.82017    0.80321    0.77326    0.72501    0.84797    0.77693    0.76213
VAR007       0.77765    0.76101    0.74050    0.77966    0.73870    0.73201    0.67611    0.72830    0.75145    0.72270
VAR008       0.92267    0.95329    0.92075    0.92415    0.91491    0.90454    0.60153    0.91725    0.91175    0.89607
VAR009       0.87030    0.82082    0.82768    0.86276    0.83850    0.82214    0.74218    0.81393    0.80587    0.88018
VAR010       0.89094    0.90902    0.83007    0.93326    0.90289    0.89425    0.81064    0.92898    0.87144    0.82456
VAR011       0.77715    0.79162    0.72367    0.77353    0.81367    0.78104    0.75310    0.70690    0.78023    0.73061
VAR012       0.77001    0.79325    0.73281    0.70015    0.77740    0.79958    0.76206    0.71702    0.71098    0.75530
VAR013       0.89751    0.75188    0.73035    0.73017    0.73778    0.70043    0.70095    0.71923    0.70694    0.75721
VAR014       0.88350    0.75103    0.73063    0.72636    0.79322    0.77060    0.68550    0.73771    0.67206    0.68226
VAR015       0.76339    0.73971    0.69098    0.71610    0.74574    0.74272    0.62689    0.68950    0.67701    0.74710
VAR016       0.86393    0.84371    0.85482    0.88449    0.90425    0.85093    0.83253    0.87005    0.79364    0.83050
VAR017       0.84919    0.88400    0.84152    0.84660    0.88302    0.86348    0.86296    0.83206    0.86626    0.87260
VAR018       0.89000    0.89288    0.86238    0.90535    0.90227    0.85507    0.84095    0.84971    0.90599    0.92995
VAR019       0.89720    0.92362    0.89351    0.87120    0.88905    0.90214    0.91076    0.84702    0.92605    0.92470
VAR020       0.88403    0.93398    0.81652    0.85653    0.90900    0.87764    0.89951    0.81717    0.89001    0.83342
VAR021       1.00000    0.93358    0.88916    0.96910    0.95299    0.93544    0.90437    0.88403    0.89714    0.90585
VAR022       0.93358    1.00000    0.89456    0.91052    0.94393    0.91007    0.92508    0.89226    0.92244    0.92913
VAR023       0.88916    0.89456    1.00000    0.97655    0.89155    0.92354    0.85159    0.94900    0.85157    0.94107
VAR024       0.96910    0.91052    0.97655    1.00000    0.94074    0.89111    0.84273    0.90300    0.86737    0.96422
VAR025       0.95299    0.94393    0.89155    0.94074    1.00000    0.94383    0.91350    0.91720    0.88579    0.88940
VAR026       0.93544    0.91007    0.92354    0.89111    0.94383    1.00000    0.90652    0.91693    0.85565    0.88367
VAR027       0.90437    0.92508    0.85159    0.84273    0.91350    0.90652    1.00000    0.88671    0.84630    0.89414
VAR028       0.88403    0.89226    0.94900    0.90300    0.91720    0.91693    0.88671    1.00000    0.86432    0.92033
VAR029       0.89714    0.92244    0.85157    0.86737    0.88579    0.85565    0.84630    0.86432    1.00000    0.89642
VAR030       0.90383    0.92913    0.94107    0.96422    0.88940    0.88367    0.89414    0.92033    0.89642    1.00000
VAR031       0.88787    0.90017    0.92001    0.80715    0.90154    0.91517    0.85700    0.87669    [illegible] [illegible]
VAR032       0.84062    0.87438    0.78500    0.84010    0.82370    0.72448    [illegible] 0.76579    [illegible] [illegible]
VAR033       0.92760    0.92709    0.85034    0.88546    0.90610    0.88765    0.89071    0.81644    [illegible] [illegible]
VAR034       0.82391    0.76479    0.77065    0.70012    0.78131    0.80567    0.75131    0.87184    [illegible] [illegible]
VAR035       0.87123    0.89442    0.85991    0.82241    0.90427    0.90163    0.82435    0.81818    [illegible] [illegible]
VAR036       0.83473    0.80411    0.81988    0.82710    0.85549    0.80376    0.84502    0.77750    [illegible] [illegible]
VAR037       0.91144    0.92070    0.85795    0.90755    0.92068    0.85358    0.87771    0.82035    [illegible] [illegible]
VAR038       0.79907    0.78313    0.73017    0.79730    0.82071    0.78024    0.73086    0.86541    [illegible] [illegible]
VAR039       0.77310    0.79259    0.79536    0.70788    0.79187    0.89460    0.68865    0.80664    [illegible] [illegible]
VAR040       0.68092    0.75372    0.79105    0.73647    0.70450    0.68607    [illegible] 0.85304    [illegible] [illegible]
VAR041       0.60257    0.77317    0.72775    0.81427    0.82106    0.60572    [illegible] 0.71600    [illegible] [illegible]
VAR042       0.69327    0.60024    0.77332    0.73512    0.69121    0.65648    [illegible] 0.71370    [illegible] [illegible]
```

```
            VAR031     VAR032     VAR033     VAR034     VAR035     VAR036     VAR037     VAR038     VAR039     VAR040

VAR001     0.86662    0.83331    0.62296    0.62186    0.75991    0.73476    0.70643    0.61328    0.61465    0.70588
VAR002     0.81990    0.82623    0.62105    0.59076    0.70057    0.70623    0.67297    0.58363    0.61457    0.67474
VAR003     0.89468    0.87070    0.68287    0.72800    0.75811    0.79791    0.76503    0.66622    0.65427    0.73076
VAR004     0.88253    0.87213    0.67917    0.67512    0.76032    0.74875    0.71837    0.66452    0.65331    0.76346
VAR005     0.85721    0.85207    0.66567    0.70640    0.73396    0.80282    0.73482    0.69040    0.61909    0.62049
VAR006     0.80358    0.87907    0.70177    0.69268    0.75276    0.74074    0.70003    0.67526    0.69116    0.80808
VAR007     0.88050    0.80903    0.69012    0.68370    0.75600    0.73351    0.74297    0.62895    0.67126    0.77549
VAR008     0.89084    0.81943    0.66710    0.78994    0.86912    0.83340    0.90643    0.79484    0.70019    0.72070
VAR009     0.78722    0.70379    0.60668    0.74358    0.86490    0.90401    0.89977    0.80001    0.71653    0.69596
VAR010     0.90250    0.81057    0.65717    0.72392    0.87600    0.80572    0.86635    0.75209    0.70519    0.80045
VAR011     0.75702    0.72074    0.60866    0.58849    0.89087    0.81724    0.83796    0.74317    0.71262    0.68405
VAR012     0.79092    0.73321    0.66917    0.62139    0.88613    0.86181    0.83633    0.72922    0.77244    0.73508
VAR013     0.75974    0.73304    0.76750    0.64071    0.86749    0.77750    0.85137    0.78531    0.75340    0.72713
VAR014     0.71492    0.50730    0.70711    0.52455    0.90773    0.84305    0.75330    0.71192    0.63126    0.70372
VAR015     0.88339    0.71977    0.75569    0.71314    0.72890    0.72008    0.79975    0.66629    0.61939    0.67101
VAR016     0.80513    0.70084    0.63190    0.70552    0.90696    0.89476    0.90327    0.84563    0.73762    0.68508
VAR017     0.85022    0.73273    0.65550    0.63515    0.80313    0.70748    0.87500    0.76782    0.71134    0.63966
VAR018     0.87173    0.84357    0.65701    0.73612    0.83744    0.73481    0.87630    0.76251    0.82464    0.74336
VAR019     0.90279    0.81721    0.53044    0.76791    0.69580    0.79257    0.89300    0.77285    0.73542    0.67572
VAR020     0.86010    0.80709    0.59064    0.73557    0.91720    0.83773    0.91790    0.80140    0.73862    0.66036
VAR021     0.88987    0.84002    0.52700    0.82391    0.67023    0.85473    0.91044    0.79907    0.77510    0.68092
VAR022     0.90807    0.87438    0.53719    0.76479    0.89420    0.80491    0.92610    0.78583    0.79299    0.73578
VAR023     0.92000    0.70300    0.65034    0.77645    0.85991    0.81588    0.85715    0.73007    0.71134    0.71009
VAR024     0.89783    0.84910    0.68548    0.76902    0.86490    0.86778    0.90755    0.75730    0.79306    0.73097
VAR025     0.90154    0.82320    0.50418    0.78031    0.90427    0.85969    0.92004    0.82877    0.79107    0.70450
VAR026     0.91392    0.72448    0.68765    0.80467    0.90163    0.80376    0.85397    0.70024    0.69460    0.66027
VAR027     0.85783    0.70902    0.69170    0.73436    0.82435    0.74978    0.87710    0.73841    0.68111    0.61453
VAR028     0.87087    0.70379    0.60644    0.67469    0.81800    0.70756    0.83939    0.85561    0.60764    0.69304
VAR029     0.92093    0.80303    0.69652    0.61160    0.83187    0.75800    0.90772    0.75341    0.61142    0.67040
VAR030     0.94397    0.89248    0.61106    0.73335    0.83414    0.73550    0.90170    0.73769    0.61362    0.73268
VAR031     1.00000    0.84358    0.62537    0.62007    0.85740    0.77301    0.90310    0.75800    0.62510    0.73123
VAR032     0.84350    1.00000    0.68232    0.75861    0.77233    0.70083    0.92001    0.72809    0.61134    0.72805
VAR033     0.92357    0.80232    1.00000    0.82347    0.90284    0.83434    0.94100    0.83829    0.61109    0.68451
VAR034     0.80907    0.73040    0.62347    1.00000    0.72363    0.80481    0.81705    0.77730    0.68105    0.62578
VAR035     0.85740    0.77233    0.50264    0.72303    1.00000    0.93481    0.89031    0.83670    0.75212    0.73543
VAR036     0.77301    0.70083    0.63634    0.66681    0.93481    1.00000    0.85710    0.82767    0.67719    0.65310
VAR037     0.90310    0.92001    0.64166    0.81769    0.86031    0.85716    1.00000    0.86180    0.64745    0.70843
VAR038     0.75060    0.70009    0.63726    0.77636    0.81676    0.86167    0.86100    1.00000    0.66871    0.56016
VAR039     0.82310    0.91114    0.61166    0.68665    0.75856    0.67720    0.84742    0.80381    1.00000    0.78112
VAR040     0.73123    0.72003    0.68451    0.62776    0.73543    0.65310    0.70684    0.52810    0.76112    1.00000
VAR041     0.77330    0.70891    0.66654    0.66615    0.81030    0.70758    0.70131    0.61277    0.70060    0.79748
VAR042     0.88407    0.83014    0.62430    0.66753    0.84193    0.65365    0.80931    0.52240    0.69190    0.87441


            VAR041     VAR042

VAR001     0.72940    0.71358
VAR002     0.73058    0.68319
VAR003     0.79120    0.72938
VAR004     0.77403    0.70034
VAR005     0.80010    0.61083
VAR006     0.78069    0.77038
VAR007     0.77495    0.70493
VAR008     0.73000    0.73457
VAR009     0.78701    0.70924
VAR010     0.79359    0.73108
VAR011     0.74252    0.61979
VAR012     0.78031    0.60220
VAR013     0.78358    0.72777
VAR014     0.78360    0.64331
VAR015     0.71400    0.63278
VAR016     0.77770    0.69350
VAR017     0.73800    0.59315
VAR018     0.78977    0.60729
VAR019     0.72349    0.61059
VAR020     0.78080    0.67714
VAR021     0.80237    0.69327
VAR022     0.77301    0.60029
VAR023     0.72773    0.67338
VAR024     0.83170    0.73372
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FACTORIAL ANALYSES OF STATIONS                                              09/09/75          PAGE     7
FILE   NONAME    (CREATION DATE = 09/09/75)


                VAR041      VAR042

VAR025         0,82002     0.67021
VAR026         0,80372     0.65048
VAR027         0,72080     0.66020
VAR028         0,72000     0.70376
VAR029         0,71310     0.64302
VAR030         0,79056     0.70809
VAR031         0,77330     0.60807
VAR032         0,70891     0.65016
VAR033         0,78054     0.62430
VAR034         0,69909     0.60753
VAR035         0,81030     0.64093
VAR036         0,76750     0.63345
VAR037         0,78153     0.60936
VAR038         0,68277     0.54246
VAR039         0,78090     0.69390
VAR040         0,69940     0.87441
VAR041         1,00000     0.88275
VAR042         0,88275     1.00000

SQUARED MULTIPLE CORRELATIONS CANNOT BE FOUND.
INITIAL ESTIMATE OF COMMUNALITIES IS MAXIMUM OFF-DIAGONAL ELEMENT OF CORRELATION MATRIX.
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FACTUIAL ANALYSES OF STATIONS                                                                          01/09/75          PAGE    8
FILE    NONAME    (CREATION DATE = 01/09/75)

VARIABLE   EST COMMUNALITY                   FACTOR         EIGENVALUE   PCT OF VAR    CUM PCT
VAR001           0.84336                        1           33.04663        78.7         78.7
VAR002           0.95330                        2            1.91137         4.6         83.2
VAR003           0.95330                        3            1.18637         2.8         86.1
VAR004           0.94342                        4            1.04128         2.5         88.5
VAR005           0.91331                        5            0.76931         1.8         90.4
VAR006           0.86739                        6            0.59722         1.4         91.8
VAR007           0.93002                        7            0.57551         1.4         93.2
VAR008           0.93001                        8            0.43395         1.0         94.2
VAR009           0.90401                        9            0.33675         0.8         95.0
VAR010           0.93001                       10            0.30308         0.7         95.7
VAR011           0.89007                       11            0.26223         0.6         96.3
VAR012           0.88013                       12            0.23617         0.6         96.9
VAR013           0.86106                       13            0.19768         0.5         97.4
VAR014           0.90775                       14            0.19480         0.5         97.8
VAR015           0.82009                       15            0.15693         0.4         98.2
VAR016           0.90092                       16            0.14850         0.4         98.5
VAR017           0.93035                       17            0.11250         0.3         98.8
VAR018           0.91993                       18            0.10307         0.2         99.1
VAR019           0.93046                       19            0.07862         0.2         99.2
VAR020           0.93398                       20            0.07110         0.2         99.4
VAR021           0.95299                       21            0.05945         0.1         99.5
VAR022           0.94393                       22            0.04866         0.1         99.6
VAR023           0.94906                       23            0.04132         0.1         99.7
VAR024           0.94976                       24            0.03126         0.1         99.8
VAR025           0.95299                       25            0.03007         0.1         99.9
VAR026           0.94303                       26            0.02105         0.1         99.9
VAR027           0.92308                       27            0.01368         0.0        100.1
VAR028           0.94906                       28            0.01026         0.0        100.1
VAR029           0.92095                       29            0.00675         0.0        100.1
VAR030           0.94399                       30            0.00000         0.0        100.1
VAR031           0.94399                       31            0.00000         0.0        100.1
VAR032           0.92001                       32            0.00000         0.0        100.1
VAR033           0.94106                       33            0.00000         0.0        100.1
VAR034           0.82391                       34            0.00000         0.0        100.1
VAR035           0.93401                       35            0.00000         0.0        100.1
VAR036           0.93401                       36            0.00000         0.0        100.1
VAR037           0.94106                       37           -0.00000        -0.0        100.1
VAR038           0.86106                       38           -0.00000        -0.0        100.1
VAR039           0.91114                       39           -0.00000        -0.0        100.1
VAR040           0.89948                       40           -0.00000        -0.0        100.1
VAR041           0.89948                       41           -0.00000        -0.0        100.1
VAR042           0.88775                       42           -0.00000        -0.0        100.1

CONVERGENCE REQUIRED   2 ITERATIONS
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APPENDIX 8

A 8.1

Values of MONTHLY TOTALS OF TOTAL SOLAR RADIATION IN MILLIWATT hours/Sq Cm

at ALDERGROVE

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1969	1312	3120	5507	11421	13632	16924	15092	11602	6966	3887	2185	1175	
1970	1567	4081	7044	9629	12265	15465	11400	11442	7727	3803	2236	1361	
1971	1935	2806	5831	9642	13438	13181	14970	9555	8848	4296	2079	1173	
1972	1376	3045	6831	11040	12481	13887	13881	10035	8962	4453	1994	1254	
1973	1095	3475	7333	10835	12531	15284	12902	10677	8184	4330	1894	1212	
1974	1528	2807	6604	12444	13246	15863	11798	11854	7450	4559	2457	1113	
1975	1627	3301	8072	11008	16850	19319	14433	12969	7523	4401	2393	1148	
1976	1636	2885	6253	11968	12133	15407	13396	14953	7237	4383	2437	1396	
1977	1987	2980	6275	10530	15866	15908	14633	12728	7241	4449	2475	1209	
1978	2065	3231	6724	10260	11784	13042	12970	9551	6921	5208	1845	1290	
1979	1885	3391	6535	9642	13817	13794	11845	11459	7731	4399	2127	1404	
1980	1673	2916	5293	11468	16082	11708	12523	10087	6850	4606	2212	1267	
1981	1631	2792	6126	11175	12691	13797	12490	1141·7					
1982													
10 years average 1969-78	1603	3173	6647	10878	13723	15433	13547	11537	7706	4407	2199	1233	mWHr/Cm²
10 years average daily	51·7	113·3	214·4	362·6	442·7	514·4	437·0	372·2	256·9	142·2	73·3	39·8	mWHr/Cm²
10 years average daily	44·5	97·4	184·4	311·8	380·7	442·4	375·8	320·1	220·9	122·3	63·0	34·2	Cal/cm²
	Average daily		251·7 mWHr/Cm²		= 216·5 Cal/cm²								

Authority and Remarks 1 mWHr/SqCm ≃ 0·86 Cal/Sq Cm. (15°C gram Cal

APPENDIX 9

Ian R Jenkins

A 9.1

IRELAND, EAST COAST – BELFAST

Lat. 54° 36′ N. Long. 5° 55′ W.

TIME ZONE: G.M.T. TIMES AND HEIGHTS OF HIGH AND LOW WATERS YEAR 1975

JANUARY.

	Time	m	Ft.		Time	m	Ft.
1 W	0040	3·5	11·5	16 Th	0109	3·2	10·4
	0643	0·6	1·9		0657	0·8	2·7
	1304	4·0	13·1		1323	3·5	11·4
	1913	0·3	1·0		1932	0·7	2·2
2 Th	0133	3·5	11·4	17 F	0146	3·1	10·3
	0734	0·6	2·1		0735	0·9	2·8
	1355	4·0	13·1		1359	3·4	11·2
	2006	0·4	1·2		2011	0·7	2·4
3 F	0226	3·4	11·3	18 Sa	0224	3·1	10·1
	0827	0·7	2·4		0813	0·9	3·0
	1447	3·9	12·8		1435	3·3	10·9
	2101	0·5	1·6		2052	0·8	2·6
4 Sa	0321	3·3	10·9	19 Su	0304	3·0	9·9
	0923	0·9	2·8		0853	1·0	3·2
	1543	3·7	12·3		1514	3·2	10·5
	2200	0·7	2·2		2136	0·9	2·9
5 Su	0420	3·2	10·5	20 M	0347	3·0	9·7
	1025	1·0	3·4		0938	1·1	3·6
	1645	3·5	11·6		1559	3·1	10·1
	2304	0·9	2·8		2227	1·0	3·3
6 M	0528	3·1	10·1	21 Tu	0438	2·9	9·4
	1138	1·2	3·8		1033	1·2	3·9
	1757	3·4	11·0		1656	3·0	9·7
					2328	1·1	3·6
7 Tu	0014	1·0	3·2	22 W	0542	2·8	9·3
	0646	3·0	10·0		1142	1·2	4·1
	1257	1·2	3·9		1809	2·9	9·5
	1912	3·3	10·7				
8 W	0123	1·0	3·4	23 Th	0038	1·1	3·6
	0757	3·1	10·2		0655	2·9	9·5
	1405	1·1	3·6		1300	1·2	3·8
	2017	3·3	10·7		1925	3·0	9·7
9 Th	0222	1·0	3·3	24 F	0144	1·0	3·3
	0853	3·2	10·6		0801	3·1	10·1
	1500	1·0	3·2		1407	1·0	3·2
	2110	3·3	10·7		2027	3·1	10·1
10 F	0310	1·0	3·2	25 Sa	0239	0·9	2·8
	0938	3·4	11·0		0854	3·3	10·8
	1545	0·9	2·8		1501	0·7	2·4
	2154	3·3	10·7		2118	3·2	10·6
11 Sa	0351	0·9	3·0	26 Su	0327	0·7	2·3
	1018	3·4	11·3		0941	3·5	11·6
	1625	0·8	2·5		1548	0·5	1·6
	2235	3·3	10·7		2204	3·4	11·0
12 Su	0429	0·9	2·9	27 M	0411	0·6	1·9
	1055	3·5	11·4		1027	3·7	12·2
	1702	0·7	2·3		1633	0·3	1·0
	2313	3·2	10·6		2250	3·4	11·3
13 M	0506	0·8	2·7	28 Tu	0456	0·5	1·5
	1132	3·5	11·5		1112	3·9	12·7
	1739	0·7	2·2		1719	0·2	0·6
	2351	3·2	10·5		2336	3·5	11·5
14 Tu	0542	0·8	2·7	29 W	0541	0·4	1·3
	1209	3·5	11·6		1159	4·0	13·1
	1816	0·6	2·1		1806	0·1	0·4
15 W	0030	3·2	10·4	30 Th	0025	3·5	11·6
	0620	0·8	2·7		0627	0·4	1·2
	1246	3·5	11·5		1247	4·0	13·2
	1854	0·7	2·2		1854	0·2	0·5
				31 F	0114	3·5	11·6
					0715	0·4	1·3
					1337	4·0	13·1
					1944	0·2	0·8

FEBRUARY

	Time	m	Ft.		Time	m	Ft.
1 Sa	0204	3·5	11·4	16 Su	0148	3·1	10·1
	0805	0·5	1·7		0738	0·7	2·3
	1427	3·9	12·8		1400	3·3	10·7
	2036	0·4	1·3		2011	0·7	2·2
2 Su	0255	3·4	11·1	17 M	0225	3·0	10·0
	0858	0·7	2·2		0817	0·8	2·5
	1520	3·7	12·1		1436	3·2	10·4
	2130	0·6	2·1		2053	0·8	2·5
3 M	0348	3·2	10·6	18 Tu	0306	3·0	9·9
	0956	0·9	2·9		0900	0·9	2·8
	1617	3·4	11·3		1520	3·1	10·1
	2229	0·9	2·9		2141	0·9	3·0
4 Tu	0449	3·1	10·1	19 W	0353	2·9	9·6
	1105	1·1	3·5		0953	0·9	3·1
	1726	3·2	10·5		1613	2·9	9·6
	2339	1·1	3·5		2240	1·0	3·4
5 W	0606	3·0	9·7	20 Th	0453	2·9	9·4
	1227	1·2	3·8		1101	1·0	3·4
	1845	3·0	10·0		1724	2·8	9·3
					2354	1·1	3·6
6 Th	0056	1·2	3·8	21 F	0609	2·9	9·4
	0727	3·0	9·8		1224	1·0	3·4
	1344	1·1	3·6		1851	2·8	9·3
	1958	3·0	9·9				
7 F	0203	1·1	3·7	22 Sa	0113	1·0	3·4
	0831	3·1	10·1		0728	3·0	9·9
	1444	0·9	3·1		1342	0·8	2·7
	2055	3·0	10·0		2005	3·0	9·7
8 Sa	0256	1·0	3·4	23 Su	0218	0·9	2·8
	0921	3·2	10·6		0831	3·2	10·6
	1530	0·8	2·6		1441	0·6	1·9
	2141	3·1	10·2		2102	3·1	10·3
9 Su	0339	0·9	3·0	24 M	0309	0·7	2·2
	1003	3·3	10·9		0922	3·5	11·4
	1609	0·7	2·2		1531	0·3	1·1
	2220	3·1	10·3		2150	3·3	10·8
10 M	0416	0·8	2·7	25 Tu	0356	0·5	1·5
	1039	3·4	11·1		1009	3·7	12·1
	1644	0·6	1·9		1616	0·2	0·5
	2257	3·1	10·3		2235	3·4	11·1
11 Tu	0450	0·7	2·4	26 W	0439	0·3	1·1
	1114	3·4	11·2		1055	3·8	12·6
	1718	0·5	1·8		1701	0·0	0·1
	2331	3·1	10·3		2320	3·5	11·4
12 W	0524	0·7	2·2	27 Th	0523	0·2	0·8
	1148	3·4	11·2		1141	3·9	12·9
	1751	0·5	1·7		1746	0·0	0·0
13 Th	0006	3·1	10·2	28 F	0005	3·5	11·5
	0557	0·7	2·2		0608	0·2	0·7
	1221	3·4	11·1		1228	3·9	12·9
	1825	0·5	1·7		1831	0·1	0·2
14 F	0040	3·1	10·2				
	0630	0·6	2·1				
	1254	3·4	11·0				
	1859	0·5	1·8				
15 Sa	0114	3·1	10·2				
	0703	0·7	2·2				
	1326	3·3	10·9				
	1934	0·6	1·9				

MARCH

	Time	m	Ft.		Time	m	Ft.
1 Sa	0052	3·5	11·5	16 Su	0042	3·1	10·1
	0654	0·2	0·8		0634	0·5	1·7
	1316	3·9	12·7		1255	3·2	10·4
	1919	0·2	0·7		1900	0·5	1·7
2 Su	0139	3·5	11·4	17 M	0116	3·1	10·2
	0743	0·3	1·1		0710	0·5	1·7
	1405	3·7	12·2		1329	3·2	10·4
	2008	0·4	1·3		1938	0·6	1·9
3 M	0227	3·4	11·1	18 Tu	0153	3·1	10·2
	0833	0·5	1·7		0749	0·5	1·8
	1456	3·5	11·6		1408	3·1	10·2
	2059	0·6	2·1		2020	0·7	2·3
4 Tu	0318	3·2	10·6	19 W	0235	3·1	10·1
	0929	0·7	2·4		0835	0·6	2·1
	1551	3·3	10·8		1454	3·0	10·0
	2156	0·9	2·9		2108	0·8	2·7
5 W	0414	3·1	10·1	20 Th	0323	3·0	9·9
	1035	0·9	3·0		0929	0·7	2·4
	1656	3·0	9·9		1549	2·9	9·6
	2303	1·1	3·6		2207	1·0	3·2
6 Th	0524	2·9	9·6	21 F	0422	3·0	9·7
	1156	1·0	3·4		1037	0·8	2·7
	1814	2·9	9·4		1658	2·8	9·2
					2322	1·1	3·5
7 F	0022	1·2	3·9	22 Sa	0536	2·9	9·6
	0649	2·9	9·4		1158	0·8	2·7
	1316	1·0	3·3		1826	2·8	9·1
	1932	2·8	9·3				
8 Sa	0137	1·2	3·8	23 Su	0046	1·0	3·4
	0802	3·0	9·7		0658	3·0	9·9
	1418	0·9	2·8		1318	0·7	2·2
	2033	2·9	9·5		1945	2·9	9·5
9 Su	0235	1·0	3·3	24 M	0156	0·9	2·8
	0857	3·1	10·1		0807	3·2	10·6
	1506	0·7	2·3		1420	0·5	1·5
	2121	3·0	9·8		2045	3·1	10·1
10 M	0319	0·9	2·8	25 Tu	0250	0·6	2·0
	0940	3·2	10·4		0902	3·4	11·3
	1545	0·6	1·9		1511	0·2	0·8
	2159	3·0	10·0		2133	3·2	10·6
11 Tu	0356	0·7	2·4	26 W	0338	0·4	1·4
	1017	3·2	10·6		0951	3·6	11·9
	1619	0·5	1·5		1556	0·1	0·3
	2234	3·1	10·1		2217	3·4	11·0
12 W	0429	0·6	2·0	27 Th	0421	0·3	0·9
	1050	3·3	10·7		1036	3·7	12·2
	1651	0·4	1·4		1639	0·0	0·1
	2307	3·1	10·1		2300	3·4	11·2
13 Th	0500	0·6	1·9	28 F	0504	0·2	0·6
	1122	3·2	10·6		1121	3·7	12·3
	1722	0·4	1·3		1722	0·1	0·2
	2338	3·1	10·1		2343	3·4	11·3
14 F	0531	0·5	1·8	29 Sa	0548	0·2	0·5
	1153	3·2	10·5		1206	3·7	12·2
	1754	0·4	1·4		1806	0·2	0·5
15 Sa	0009	3·1	10·1	30 Su	0028	3·5	11·4
	0602	0·5	1·7		0633	0·2	0·7
	1223	3·2	10·5		1254	3·7	12·0
	1826	0·5	1·5		1852	0·3	0·9
				31 M	0114	3·4	11·3
					0720	0·3	1·0
					1343	3·5	11·5
					1939	0·5	1·6

IRELAND, EAST COAST — BELFAST

Lat. 54° 36′ N. Long. 5° 55′ W.

A 9. 2

TIME ZONE: G.M.T.

TIMES AND HEIGHTS OF HIGH AND LOW WATERS

YEAR 1975

APRIL

	Time	m	Ft.		Time	m	Ft.
1 Tu	0201	3·4	11·1	16 W	0129	3·2	10·5
	0811	0·5	1·5		0730	0·5	1·5
	1433	3·4	11·0		1349	3·1	10·1
	2030	0·7	2·3		1956	0·7	2·3
2 W	0250	3·3	10·7	17 Th	0214	3·2	10·6
	0906	0·6	2·1		0819	0·5	1·6
	1527	3·1	10·3		1438	3·0	9·9
	2125	0·9	3·0		2047	0·8	2·7
3 Th	0344	3·1	10·2	18 F	0304	3·2	10·5
	1008	0·8	2·6		0915	0·6	1·9
	1627	2·9	9·6		1535	2·9	9·6
	2228	1·1	3·6		2147	0·9	3·1
4 F	0446	3·0	9·7	19 Sa	0403	3·1	10·3
	1122	0·9	3·0		1022	0·6	2·1
	1739	2·8	9·1		1643	2·8	9·3
	2343	1·2	3·9		2259	1·0	3·4
5 Sa	0604	2·9	9·4	20 Su	0512	3·1	10·1
	1239	0·9	3·0		1138	0·7	2·2
	1856	2·7	9·0		1804	2·8	9·3
6 Su	0100	1·2	3·8	21 M	0020	1·0	3·3
	0722	2·9	9·4		0631	3·1	10·2
	1342	0·8	2·6		1254	0·6	1·9
	2001	2·8	9·2		1924	2·9	9·5
7 M	0202	1·0	3·3	22 Tu	0132	0·9	2·8
	0822	3·0	9·7		0743	3·2	10·6
	1432	0·6	2·1		1357	0·4	1·4
	2050	2·9	9·5		2026	3·0	10·0
8 Tu	0250	0·9	2·8	23 W	0230	0·6	2·1
	0908	3·0	10·0		0841	3·4	11·2
	1513	0·5	1·7		1449	0·3	0·9
	2130	3·0	9·8		2115	3·2	10·5
9 W	0328	0·7	2·3	24 Th	0319	0·5	1·5
	0946	3·1	10·2		0931	3·5	11·6
	1548	0·4	1·4		1535	0·2	0·6
	2205	3·0	10·0		2158	3·3	10·9
10 Th	0402	0·6	2·0	25 F	0403	0·3	1·1
	1020	3·1	10·2		1016	3·6	11·7
	1620	0·4	1·3		1617	0·2	0·6
	2237	3·0	10·0		2240	3·4	11·1
11 F	0433	0·5	1·8	26 Sa	0445	0·3	0·9
	1052	3·1	10·2		1101	3·6	11·7
	1651	0·4	1·3		1659	0·2	0·8
	2308	3·1	10·1		2322	3·4	11·2
12 Sa	0503	0·5	1·7	27 Su	0528	0·2	0·8
	1122	3·1	10·1		1146	3·5	11·5
	1722	0·4	1·4		1742	0·3	1·1
	2339	3·1	10·1				
13 Su	0534	0·5	1·6	28 M	0005	3·4	11·3
	1153	3·1	10·1		0613	0·3	1·0
	1755	0·5	1·5		1233	3·4	11·2
					1826	0·5	1·6
14 M	0012	3·1	10·2	29 Tu	0051	3·4	11·3
	0608	0·5	1·5		0700	0·4	1·2
	1227	3·1	10·1		1321	3·3	10·9
	1831	0·5	1·7		1913	0·6	2·0
15 Tu	0048	3·2	10·4	30 W	0138	3·4	11·2
	0647	0·4	1·4		0751	0·5	1·6
	1305	3·1	10·2		1411	3·2	10·5
	1911	0·6	2·0		2003	0·8	2·5

MAY

	Time	m	Ft.		Time	m	Ft.
1 Th	0226	3·3	10·9	16 F	0159	3·4	11·2
	0844	0·6	2·0		0808	0·4	1·3
	1503	3·1	10·1		1428	3·1	10·2
	2056	0·9	3·0		2033	0·8	2·6
2 F	0317	3·2	10·5	17 Sa	0251	3·4	11·2
	0941	0·7	2·4		0905	0·5	1·5
	1558	2·9	9·6		1525	3·0	10·0
	2154	1·0	3·4		2132	0·9	2·9
3 Sa	0412	3·1	10·1	18 Su	0348	3·4	11·1
	1045	0·8	2·7		1008	0·5	1·7
	1700	2·8	9·2		1629	3·0	9·8
	2300	1·1	3·7		2239	1·0	3·2
4 Su	0518	2·9	9·6	19 M	0452	3·3	10·8
	1152	0·8	2·7		1117	0·6	1·9
	1809	2·8	9·1		1742	2·9	9·6
					2353	1·0	3·2
5 M	0012	1·2	3·8	20 Tu	0606	3·3	10·7
	0631	2·9	9·4		1228	0·6	1·9
	1257	0·8	2·6		1859	3·0	9·8
	1916	2·8	9·2				
6 Tu	0118	1·1	3·5	21 W	0106	0·9	3·0
	0737	2·9	9·5		0719	3·3	10·8
	1350	0·7	2·3		1332	0·5	1·7
	2010	2·9	9·4		2003	3·1	10·1
7 W	0211	0·9	3·1	22 Th	0208	0·8	2·5
	0829	3·0	9·7		0821	3·4	11·0
	1435	0·6	1·9		1427	0·5	1·5
	2054	3·0	9·7		2055	3·2	10·5
8 Th	0254	0·8	2·6	23 F	0300	0·6	2·0
	0911	3·0	9·8		0912	3·4	11·2
	1513	0·5	1·7		1514	0·4	1·4
	2131	3·0	9·9		2140	3·3	10·8
9 F	0330	0·7	2·3	24 Sa	0346	0·5	1·7
	0946	3·0	9·9		0959	3·4	11·2
	1547	0·5	1·6		1557	0·5	1·5
	2205	3·1	10·1		2222	3·4	11·1
10 Sa	0403	0·6	2·0	25 Su	0430	0·5	1·5
	1019	3·0	10·0		1043	3·4	11·1
	1620	0·5	1·6		1639	0·5	1·7
	2237	3·1	10·2		2303	3·4	11·2
11 Su	0435	0·5	1·8	26 M	0512	0·4	1·4
	1051	3·0	10·0		1127	3·3	10·9
	1653	0·5	1·7		1720	0·6	1·9
	2310	3·2	10·4		2345	3·4	11·3
12 M	0509	0·5	1·6	27 Tu	0556	0·5	1·5
	1126	3·1	10·1		1213	3·3	10·7
	1729	0·5	1·8		1804	0·7	2·2
	2347	3·2	10·6				
13 Tu	0547	0·5	1·5	28 W	0030	3·4	11·3
	1204	3·1	10·1		0642	0·5	1·6
	1808	0·6	1·9		1301	3·2	10·5
					1850	0·8	2·5
14 W	0027	3·3	10·9	29 Th	0116	3·4	11·3
	0629	0·4	1·3		0730	0·5	1·8
	1247	3·1	10·2		1349	3·1	10·3
	1851	0·6	2·1		1938	0·8	2·7
15 Th	0111	3·4	11·1	30 F	0203	3·4	11·2
	0716	0·4	1·2		0820	0·6	2·0
	1336	3·1	10·3		1438	3·1	10·1
	1940	0·7	2·3		2028	0·9	3·0
				31 Sa	0250	3·3	10·9
					0912	0·7	2·2
					1528	3·0	9·8
					2119	1·0	3·3

JUNE

	Time	m	Ft.		Time	m	Ft.
1 Su	0339	3·2	10·5	16 M	0332	3·6	11·8
	1005	0·7	2·4		0950	0·5	1·5
	1620	2·9	9·5		1611	3·1	10·3
	2214	1·1	3·6		2217	0·9	2·9
2 M	0433	3·0	10·0	17 Tu	0432	3·5	11·4
	1102	0·8	2·7		1053	0·6	1·9
	1717	2·8	9·3		1717	3·1	10·1
	2315	1·2	3·8		2326	1·0	3·2
3 Tu	0535	2·9	9·6	18 W	0542	3·4	11·0
	1202	0·8	2·7		1201	0·7	2·2
	1820	2·8	9·2		1831	3·0	10·0
4 W	0021	1·2	3·8	19 Th	0040	1·0	3·2
	0641	2·9	9·4		0655	3·3	10·8
	1300	0·8	2·6		1308	0·7	2·3
	1920	2·9	9·4		1940	3·1	10·2
5 Th	0122	1·1	3·6	20 F	0148	0·9	3·0
	0742	2·9	9·5		0801	3·3	10·8
	1351	0·8	2·5		1407	0·7	2·4
	2011	2·9	9·6		2037	3·2	10·5
6 F	0213	1·0	3·2	21 Sa	0245	0·8	2·6
	0830	2·9	9·6		0857	3·3	10·8
	1435	0·7	2·2		1457	0·7	2·4
	2054	3·0	9·9		2125	3·3	10·8
7 Sa	0255	0·9	2·8	22 Su	0336	0·7	2·3
	0911	3·0	9·8		0945	3·3	10·8
	1514	0·6	2·1		1541	0·7	2·4
	2132	3·1	10·2		2207	3·4	11·0
8 Su	0332	0·7	2·4	23 M	0417	0·6	2·0
	0948	3·0	9·9		1029	3·3	10·7
	1551	0·6	2·0		1623	0·7	2·4
	2208	3·2	10·5		2248	3·4	11·2
9 M	0409	0·6	2·0	24 Tu	0459	0·6	1·9
	1024	3·1	10·1		1111	3·2	10·5
	1628	0·6	2·0		1703	0·8	2·5
	2245	3·3	10·8		2329	3·4	11·3
10 Tu	0448	0·5	1·7	25 W	0540	0·5	1·8
	1103	3·1	10·2		1155	3·2	10·4
	1707	0·6	2·0		1745	0·8	2·6
	2325	3·4	11·2				
11 W	0529	0·4	1·4	26 Th	0011	3·5	11·4
	1145	3·2	10·4		0623	0·5	1·8
	1749	0·6	2·0		1240	3·1	10·3
					1828	0·8	2·7
12 Th	0008	3·5	11·5	27 F	0054	3·5	11·4
	0614	0·3	1·1		0707	0·6	1·9
	1233	3·2	10·5		1325	3·1	10·2
	1835	0·6	2·1		1912	0·9	2·8
13 F	0055	3·6	11·8	28 Sa	0138	3·4	11·3
	0703	0·3	1·0		0752	0·6	2·0
	1324	3·2	10·6		1409	3·1	10·2
	1925	0·7	2·2		1957	0·9	2·9
14 Sa	0145	3·7	12·0	29 Su	0221	3·4	11·1
	0756	0·3	1·0		0837	0·6	2·1
	1417	3·2	10·6		1454	3·0	10·0
	2018	0·7	2·3		2042	0·9	3·1
15 Su	0237	3·7	12·0	30 M	0304	3·3	10·7
	0851	0·3	1·1		0923	0·7	2·3
	1512	3·2	10·5		1538	3·0	9·8
	2115	0·8	2·6		2128	1·0	3·4

IRELAND, EAST COAST — BELFAST

Lat. 54° 36′ N. Long. 5° 55′ W.

A 9.3

TIME ZONE: G.M.T.

TIMES AND HEIGHTS OF HIGH AND LOW WATERS

YEAR 1975

JULY

	Time	m	Ft.		Time	m	Ft.
1 Tu	0349	3·1	10·3	16 W	0412	3·5	11·6
	1012	0·8	2·6		1027	0·6	2·1
	1626	2·9	9·6		1649	3·2	10·4
	2219	1·1	3·7		2300	1·0	3·2
2 W	0439	3·0	9·8	17 Th	0518	3·4	11·0
	1105	0·9	2·9		1133	0·8	2·7
	1721	2·9	9·4		1800	3·1	10·1
	2317	1·2	3·9				
3 Th	0539	2·9	9·4	18 F	0016	1·0	3·4
	1204	0·9	3·1		0633	3·2	10·5
	1822	2·8	9·3		1244	0·9	3·1
					1916	3·1	10·1
4 F	0023	1·2	3·9	19 Sa	0131	1·0	3·3
	0646	2·8	9·3		0745	3·2	10·4
	1304	0·9	3·1		1349	1·0	3·2
	1923	2·9	9·5		2020	3·2	10·4
5 Sa	0126	1·1	3·6	20 Su	0233	0·9	2·9
	0747	2·9	9·4		0844	3·2	10·4
	1357	0·9	2·9		1443	0·9	3·1
	2015	3·0	9·9		2111	3·3	10·7
6 Su	0219	0·9	3·1	21 M	0323	0·8	2·6
	0837	3·0	9·7		0934	3·2	10·4
	1444	0·8	2·6		1530	0·9	3·0
	2100	3·2	10·4		2155	3·4	11·0
7 M	0305	0·8	2·5	22 Tu	0405	0·7	2·2
	0920	3·0	10·0		1017	3·2	10·4
	1526	0·7	2·4		1610	0·9	2·8
	2142	3·3	10·8		2235	3·4	11·2
8 Tu	0347	0·6	2·0	23 W	0444	0·6	2·0
	1001	3·1	10·3		1057	3·1	10·3
	1607	0·6	2·1		1648	0·8	2·7
	2223	3·4	11·3		2313	3·4	11·3
9 W	0429	0·4	1·4	24 Th	0522	0·6	1·9
	1044	3·2	10·5		1136	3·1	10·3
	1649	0·6	2·0		1727	0·8	2·6
	2305	3·6	11·8		2351	3·5	11·4
10 Th	0513	0·3	1·0	25 F	0600	0·5	1·8
	1129	3·3	10·7		1216	3·1	10·3
	1733	0·5	1·8		1805	0·8	2·6
	2350	3·7	12·2				
11 F	0559	0·2	0·7	26 Sa	0031	3·4	11·3
	1217	3·3	10·9		0639	0·5	1·8
	1819	0·5	1·8		1257	3·1	10·3
					1845	0·8	2·6
12 Sa	0038	3·8	12·5	27 Su	0110	3·4	11·2
	0647	0·2	0·6		0719	0·6	1·9
	1308	3·4	11·0		1337	3·1	10·2
	1909	0·5	1·8		1924	0·8	2·6
13 Su	0129	3·8	12·6	28 M	0148	3·4	11·0
	0738	0·2	0·7		0759	0·6	2·0
	1400	3·4	11·1		1416	3·1	10·2
	2001	0·6	1·9		2004	0·9	2·8
14 M	0220	3·8	12·6	29 Tu	0227	3·3	10·7
	0831	0·3	0·9		0840	0·7	2·3
	1453	3·4	11·0		1456	3·0	10·0
	2055	0·7	2·2		2045	0·9	3·1
15 Tu	0313	3·7	12·2	30 W	0306	3·1	10·3
	0927	0·4	1·4		0923	0·8	2·6
	1548	3·3	10·7		1539	3·0	9·8
	2153	0·8	2·7		2130	1·0	3·4
				31 Th	0350	3·0	9·9
					1011	0·9	3·0
					1626	2·9	9·5
					2222	1·1	3·7

AUGUST

	Time	m	Ft.		Time	m	Ft.
1 F	0442	2·9	9·5	16 Sa	0611	3·1	10·1
	1107	1·0	3·4		1220	1·1	3·7
	1724	2·9	9·4		1850	3·0	10·0
	2325	1·2	3·9				
2 Sa	0549	2·8	9·2	17 Su	0114	1·0	3·4
	1213	1·1	3·5		0729	3·0	9·9
	1831	2·9	9·5		1332	1·1	3·7
					2001	3·1	10·3
3 Su	0039	1·1	3·7	18 M	0218	0·9	3·0
	0703	2·8	9·2		0832	3·0	10·0
	1320	1·0	3·4		1430	1·1	3·5
	1937	3·0	9·8		2055	3·3	10·7
4 M	0146	1·0	3·2	19 Tu	0308	0·8	2·5
	0806	2·9	9·6		0921	3·1	10·2
	1416	0·9	3·0		1517	0·9	3·1
	2031	3·2	10·5		2140	3·4	11·0
5 Tu	0240	0·7	2·4	20 W	0350	0·6	2·1
	0857	3·0	10·0		1003	3·1	10·3
	1504	0·8	2·5		1556	0·9	2·8
	2118	3·4	11·1		2218	3·4	11·2
6 W	0326	0·5	1·7	21 Th	0426	0·5	1·8
	0943	3·2	10·5		1040	3·1	10·3
	1548	0·6	2·1		1632	0·8	2·6
	2202	3·6	11·8		2254	3·4	11·2
7 Th	0410	0·3	1·0	22 F	0500	0·5	1·7
	1026	3·3	10·8		1115	3·2	10·4
	1631	0·5	1·7		1707	0·7	2·4
	2246	3·7	12·3		2329	3·4	11·2
8 F	0454	0·2	0·5	23 Sa	0534	0·5	1·6
	1111	3·4	11·1		1150	3·1	10·3
	1715	0·4	1·4		1741	0·7	2·3
	2331	3·9	12·7				
9 Sa	0540	0·1	0·3	24 Su	0004	3·4	11·1
	1158	3·4	11·3		0609	0·5	1·7
	1801	0·4	1·3		1226	3·1	10·3
					1816	0·7	2·3
10 Su	0019	3·9	12·9	25 M	0039	3·3	10·9
	0627	0·1	0·3		0644	0·5	1·8
	1247	3·5	11·4		1302	3·1	10·3
	1849	0·4	1·3		1851	0·7	2·4
11 M	0109	3·9	12·9	26 Tu	0113	3·3	10·7
	0716	0·2	0·5		0720	0·6	2·0
	1338	3·5	11·4		1339	3·1	10·2
	1939	0·5	1·5		1928	0·8	2·5
12 Tu	0200	3·9	12·7	27 W	0149	3·2	10·5
	0807	0·3	0·9		0758	0·7	2·3
	1429	3·4	11·3		1416	3·1	10·1
	2032	0·6	1·9		2006	0·8	2·7
13 W	0253	3·7	12·2	28 Th	0226	3·1	10·2
	0901	0·5	1·6		0838	0·8	2·7
	1522	3·4	11·0		1456	3·0	10·0
	2129	0·8	2·5		2049	0·9	3·0
14 Th	0350	3·5	11·5	29 F	0308	3·0	9·9
	0959	0·7	2·4		0924	0·9	3·1
	1620	3·2	10·5		1541	3·0	9·8
	2235	0·9	3·1		2139	1·0	3·3
15 F	0455	3·3	10·7	30 Sa	0358	2·9	9·5
	1104	1·0	3·2		1019	1·1	3·5
	1729	3·1	10·1		1636	2·9	9·6
	2354	1·1	3·5		2242	1·1	3·6
				31 Su	0503	2·8	9·2
					1127	1·2	3·8
					1745	2·9	9·6

SEPTEMBER

	Time	m	Ft.		Time	m	Ft.
1 M	0001	1·1	3·5	16 Tu	0156	0·9	2·9
	0625	2·8	9·2		0813	3·0	9·8
	1244	1·1	3·7		1411	1·1	3·7
	1859	3·0	9·9		2033	3·2	10·6
2 Tu	0116	0·9	2·9	17 W	0246	0·7	2·4
	0740	2·9	9·5		0902	3·1	10·1
	1350	1·0	3·2		1459	1·0	3·2
	2003	3·2	10·6		2118	3·3	10·9
3 W	0216	0·6	2·1	18 Th	0327	0·6	2·0
	0837	3·1	10·1		0943	3·1	10·3
	1443	0·8	2·5		1538	0·8	2·7
	2055	3·5	11·4		2157	3·4	11·1
4 Th	0306	0·4	1·3	19 F	0402	0·5	1·6
	0925	3·3	10·7		1018	3·2	10·5
	1530	0·6	1·9		1612	0·7	2·4
	2142	3·7	12·1		2231	3·4	11·1
5 F	0351	0·2	0·6	20 Sa	0434	0·5	1·5
	1009	3·4	11·1		1050	3·2	10·5
	1613	0·4	1·4		1644	0·7	2·2
	2226	3·8	12·6		2303	3·4	11·0
6 Sa	0434	0·1	0·2	21 Su	0506	0·5	1·5
	1052	3·5	11·4		1123	3·2	10·5
	1656	0·3	1·0		1715	0·7	2·2
	2311	3·9	12·9		2335	3·3	10·8
7 Su	0518	0·0	0·0	22 M	0537	0·5	1·6
	1137	3·5	11·6		1155	3·2	10·5
	1741	0·3	0·9		1747	0·7	2·2
	2358	3·9	12·9				
8 M	0603	0·1	0·2	23 Tu	0007	3·2	10·6
	1224	3·6	11·7		0610	0·5	1·8
	1827	0·3	1·0		1229	3·2	10·4
					1820	0·7	2·3
9 Tu	0047	3·9	12·8	24 W	0040	3·2	10·5
	0651	0·2	0·6		0644	0·6	2·1
	1313	3·6	11·7		1304	3·2	10·4
	1916	0·4	1·3		1855	0·7	2·4
10 W	0138	3·8	12·4	25 Th	0114	3·1	10·3
	0740	0·4	1·2		0720	0·7	2·4
	1403	3·5	11·5		1340	3·2	10·4
	2009	0·5	1·7		1934	0·8	2·5
11 Th	0230	3·6	11·9	26 F	0151	3·1	10·2
	0833	0·6	2·0		0801	0·8	2·7
	1455	3·4	11·2		1421	3·2	10·4
	2106	0·7	2·4		2018	0·8	2·7
12 F	0327	3·4	11·1	27 Sa	0235	3·0	9·9
	0930	0·9	2·8		0847	1·0	3·2
	1552	3·3	10·7		1507	3·1	10·2
	2211	0·9	3·0		2110	0·9	3·0
13 Sa	0431	3·2	10·4	28 Su	0327	2·9	9·6
	1035	1·1	3·6		0942	1·1	3·6
	1658	3·1	10·3		1601	3·1	10·1
	2330	1·0	3·4		2213	1·0	3·2
14 Su	0547	3·0	9·8	29 M	0432	2·8	9·3
	1152	1·2	4·1		1051	1·2	3·9
	1818	3·0	10·0		1708	3·0	10·0
					2330	0·9	3·1
15 M	0051	1·0	3·3	30 Tu	0553	2·8	9·3
	0707	3·0	9·7		1211	1·2	3·9
	1310	1·2	4·0		1825	3·1	10·3
	1935	3·1	10·2				

IRELAND, EAST COAST — BELFAST

Lat. 54° 36′ N. Long. 5° 55′ W.

TIME ZONE: G.M.T.

TIMES AND HEIGHTS OF HIGH AND LOW WATERS

YEAR 1975

OCTOBER

	Time	m	Ft.		Time	m	Ft.
1 W	0048	0·8	2·7	16 Th	0216	0·8	2·5
	0715	2·9	9·6		0834	3·1	10·1
	1324	1·0	3·4		1431	1·0	3·4
	1936	3·3	10·8		2049	3·3	10·7
2 Th	0152	0·6	1·9	17 F	0258	0·6	2·1
	0817	3·1	10·2		0915	3·2	10·4
	1422	0·8	2·6		1513	0·9	2·9
	2033	3·5	11·6		2130	3·3	10·9
3 F	0245	0·3	1·1	18 Sa	0334	0·5	1·7
	0906	3·3	10·8		0951	3·2	10·6
	1510	0·6	1·9		1547	0·8	2·5
	2122	3·7	12·2		2204	3·3	10·9
4 Sa	0330	0·2	0·5	19 Su	0406	0·5	1·6
	0950	3·4	11·3		1024	3·3	10·7
	1554	0·4	1·3		1619	0·7	2·3
	2207	3·8	12·6		2236	3·3	10·8
5 Su	0413	0·1	0·2	20 M	0437	0·5	1·6
	1033	3·6	11·7		1055	3·3	10·7
	1637	0·3	1·0		1650	0·7	2·3
	2251	3·9	12·8		2307	3·3	10·7
6 M	0456	0·1	0·3	21 Tu	0508	0·5	1·8
	1116	3·6	11·9		1127	3·3	10·7
	1721	0·3	0·9		1721	0·7	2·3
	2337	3·9	12·7		2337	3·2	10·5
7 Tu	0540	0·2	0·5	22 W	0540	0·6	2·0
	1201	3·6	11·9		1159	3·3	10·7
	1807	0·3	1·0		1753	0·7	2·3
8 W	0025	3·8	12·4	23 Th	0009	3·2	10·4
	0625	0·3	1·0		0613	0·7	2·3
	1248	3·6	11·9		1234	3·3	10·8
	1855	0·4	1·3		1830	0·7	2·3
9 Th	0115	3·7	12·0	24 F	0045	3·1	10·3
	0713	0·5	1·7		0651	0·8	2·6
	1338	3·6	11·7		1312	3·3	10·9
	1947	0·5	1·8		1910	0·7	2·3
10 F	0208	3·5	11·5	25 Sa	0126	3·1	10·3
	0805	0·7	2·4		0732	0·9	2·8
	1429	3·5	11·5		1354	3·4	11·0
	2044	0·7	2·4		1957	0·7	2·4
11 Sa	0304	3·3	10·8	26 Su	0213	3·1	10·1
	0900	1·0	3·2		0820	1·0	3·2
	1524	3·4	11·0		1442	3·3	10·9
	2147	0·9	2·9		2050	0·8	2·6
12 Su	0405	3·1	10·2	27 M	0307	3·0	9·9
	1003	1·2	3·9		0916	1·1	3·6
	1626	3·2	10·6		1536	3·3	10·8
	2301	1·0	3·3		2153	0·8	2·7
13 M	0516	3·0	9·7	28 Tu	0410	3·0	9·7
	1117	1·3	4·3		1023	1·2	3·9
	1740	3·1	10·2		1640	3·3	10·7
					2305	0·9	2·8
14 Tu	0018	1·0	3·3	29 W	0526	2·9	9·6
	0634	2·9	9·5		1140	1·2	3·9
	1235	1·3	4·3		1754	3·3	10·8
	1858	3·1	10·2				
15 W	0124	0·9	3·0	30 Th	0020	0·8	2·5
	0742	3·0	9·8		0647	3·0	9·8
	1341	1·2	3·9		1256	1·1	3·5
	2001	3·2	10·5		1909	3·4	11·1
				31 F	0127	0·6	2·0
					0755	3·2	10·4
					1359	0·9	2·9
					2011	3·6	11·7

NOVEMBER

	Time	m	Ft.		Time	m	Ft.
1 Sa	0222	0·4	1·4	16 Su	0302	0·7	2·2
	0847	3·4	11·0		0922	3·2	10·6
	1451	0·7	2·2		1520	0·9	3·0
	2102	3·7	12·2		2135	3·3	10·7
2 Su	0309	0·3	1·0	17 M	0338	0·6	2·0
	0933	3·5	11·5		0956	3·3	10·8
	1537	0·5	1·7		1553	0·8	2·7
	2149	3·8	12·4		2209	3·3	10·7
3 M	0353	0·2	0·8	18 Tu	0410	0·6	2·0
	1015	3·6	11·8		1029	3·3	10·9
	1620	0·4	1·4		1625	0·8	2·5
	2233	3·8	12·5		2240	3·2	10·6
4 Tu	0435	0·3	0·9	19 W	0442	0·6	2·1
	1057	3·7	12·0		1101	3·4	11·0
	1704	0·4	1·3		1657	0·7	2·4
	2318	3·7	12·3		2312	3·2	10·5
5 W	0518	0·4	1·3	20 Th	0515	0·7	2·3
	1141	3·7	12·1		1134	3·4	11·1
	1749	0·4	1·4		1732	0·7	2·3
					2346	3·2	10·5
6 Th	0005	3·7	12·0	21 F	0550	0·8	2·5
	0602	0·5	1·7		1211	3·4	11·3
	1227	3·7	12·1		1810	0·7	2·2
	1837	0·5	1·7				
7 F	0054	3·5	11·6	22 Sa	0024	3·2	10·5
	0649	0·7	2·3		0629	0·8	2·6
	1315	3·7	12·0		1251	3·5	11·5
	1928	0·6	2·0		1853	0·6	2·1
8 Sa	0146	3·4	11·2	23 Su	0108	3·2	10·5
	0739	0·9	2·8		0713	0·9	2·8
	1405	3·6	11·8		1335	3·6	11·7
	2022	0·7	2·4		1942	0·6	2·0
9 Su	0240	3·3	10·7	24 M	0157	3·2	10·5
	0832	1·0	3·4		0802	0·9	3·0
	1457	3·5	11·5		1423	3·6	11·8
	2121	0·9	2·8		2035	0·6	2·1
10 M	0336	3·1	10·2	25 Tu	0250	3·2	10·4
	0930	1·2	3·9		0856	1·0	3·3
	1553	3·4	11·0		1516	3·6	11·7
	2224	1·0	3·2		2134	0·7	2·3
11 Tu	0438	3·0	9·8	26 W	0350	3·1	10·2
	1034	1·3	4·2		0958	1·1	3·6
	1656	3·2	10·6		1616	3·5	11·5
	2333	1·0	3·3		2240	0·8	2·5
12 W	0548	2·9	9·6	27 Th	0458	3·0	10·0
	1147	1·3	4·4		1109	1·2	3·8
	1809	3·1	10·3		1726	3·4	11·3
					2351	0·8	2·5
13 Th	0039	1·0	3·2	28 F	0616	3·1	10·1
	0658	3·0	9·7		1225	1·1	3·7
	1257	1·3	4·2		1841	3·4	11·3
	1918	3·1	10·3				
14 F	0136	0·9	2·8	29 Sa	0100	0·7	2·3
	0756	3·0	10·0		0730	3·2	10·4
	1355	1·2	3·8		1335	1·0	3·3
	2014	3·2	10·5		1949	3·5	11·6
15 Sa	0223	0·8	2·5	30 Su	0200	0·6	2·1
	0842	3·1	10·3		0829	3·3	10·9
	1441	1·0	3·3		1433	0·9	2·8
	2058	3·2	10·6		2045	3·6	11·9

DECEMBER

	Time	m	Ft.		Time	m	Ft.
1 M	0251	0·5	1·8	16 Tu	0309	0·8	2·6
	0917	3·5	11·4		0927	3·2	10·6
	1522	0·7	2·3		1526	0·9	3·1
	2134	3·7	12·0		2141	3·2	10·4
2 Tu	0336	0·5	1·7	17 W	0345	0·8	2·5
	1001	3·6	11·8		1003	3·3	10·9
	1607	0·6	2·0		1601	0·8	2·7
	2219	3·7	12·0		2216	3·2	10·5
3 W	0418	0·5	1·8	18 Th	0419	0·7	2·4
	1043	3·7	12·0		1037	3·4	11·2
	1651	0·5	1·8		1636	0·7	2·4
	2303	3·6	11·8		2250	3·2	10·6
4 Th	0500	0·6	2·0	19 F	0455	0·7	2·4
	1125	3·7	12·1		1113	3·5	11·5
	1735	0·5	1·8		1714	0·6	2·1
	2348	3·5	11·5		2327	3·3	10·7
5 F	0543	0·7	2·3	20 Sa	0532	0·7	2·4
	1209	3·7	12·2		1152	3·6	11·8
	1820	0·6	2·0		1754	0·5	1·8
6 Sa	0036	3·4	11·3	21 Su	0008	3·3	10·8
	0628	0·8	2·6		0613	0·7	2·3
	1255	3·7	12·2		1233	3·7	12·2
	1908	0·6	2·1		1839	0·5	1·6
7 Su	0124	3·4	11·0	22 M	0054	3·3	10·9
	0715	0·9	2·9		0658	0·7	2·4
	1342	3·7	12·0		1319	3·8	12·4
	1958	0·7	2·4		1927	0·5	1·5
8 M	0214	3·3	10·7	23 Tu	0143	3·4	11·0
	0804	1·0	3·2		0746	0·8	2·5
	1430	3·6	11·8		1407	3·8	12·5
	2050	0·8	2·6		2019	0·5	1·5
9 Tu	0304	3·2	10·4	24 W	0234	3·3	10·9
	0855	1·1	3·6		0838	0·8	2·7
	1519	3·5	11·4		1459	3·8	12·4
	2144	0·9	2·9		2114	0·5	1·8
10 W	0357	3·1	10·1	25 Th	0330	3·3	10·7
	0949	1·2	3·9		0935	0·9	3·1
	1612	3·3	10·9		1555	3·7	12·0
	2242	1·0	3·2		2215	0·7	2·2
11 Th	0455	3·0	9·8	26 F	0431	3·2	10·4
	1049	1·3	4·3		1040	1·1	3·5
	1714	3·2	10·4		1700	3·5	11·6
	2345	1·0	3·3		2321	0·8	2·6
12 F	0600	2·9	9·6	27 Sa	0544	3·1	10·2
	1158	1·3	4·4		1155	1·1	3·7
	1824	3·1	10·1		1815	3·4	11·2
13 Sa	0047	1·0	3·3	28 Su	0033	0·9	2·8
	0706	3·0	9·7		0703	3·1	10·3
	1306	1·3	4·2		1312	1·1	3·6
	1929	3·0	10·0		1929	3·4	11·2
14 Su	0142	0·9	3·1	29 M	0139	0·9	2·8
	0802	3·0	10·0		0810	3·3	10·7
	1403	1·2	3·9		1418	1·0	3·2
	2022	3·1	10·2		2031	3·4	11·3
15 M	0229	0·9	2·8	30 Tu	0236	0·8	2·7
	0848	3·1	10·3		0905	3·4	11·1
	1448	1·1	3·5		1512	0·8	2·7
	2105	3·1	10·3		2123	3·4	11·3
				31 W	0324	0·8	2·6
					0950	3·5	11·5
					1558	0·7	2·4
					2209	3·4	11·3

The Queen's University of Belfast

It is hereby certified that

IAN RONALD JENKINSON

was admitted to the Degree of

Doctor of Philosophy

by The Queen's University of Belfast

on the fifteenth day of December 1983

Peter Froggatt.

Vice-Chancellor