

I.O.S.

MOORED CURRENT METER RECORDS

by

M. J. HOWARTH AND S. G. LOCH

IRISH SEA 5 SEPT — 14 OCT 1972

ICOT MOORINGS 20 — 24

DATA REPORT NO. 3

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Table of Contents

Introduction	1
Current meters	4
Current meter moorings	5
Data processing	8
Format	9
Mooring	20
	21
	22
	23
	24
	13
	32
	48
	64
	80

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Introduction

This report describes the results from ICOT moorings 20 - 24. Four of the five rigs were deployed in an array between Dublin and Holyhead (see map and table 1) and consisted of three Bergen meters each (Aanderaa, 1964) whilst the fifth was in the St. George's Channel and contained four Plessey meters. Rigs J, G and M (moorings 20, 22 and 24) were in the same position as rigs maintained a year earlier during BISOP 1971. The latter was a co-operative experiment with current meters deployed by both the Fisheries Research Laboratory, Lowestoft and Bidston. In fact, Lowestoft was responsible for rigs J, M and two meters on G and Bidston for the other two meters on rig G (Howarth and Loch, 1973). The Plessey meters were on loan from the Research Vessel Base, Barry and we would also like to thank Peter Hughes of Liverpool University Oceanography Department for the loan of one Bergen meter which was the top meter of mooring 22.

Hence, sixteen current meters were deployed on the five rigs, resulting generally in data of good quality. There were, however, six failures which meant that only 76% of the maximum possible data was returned.

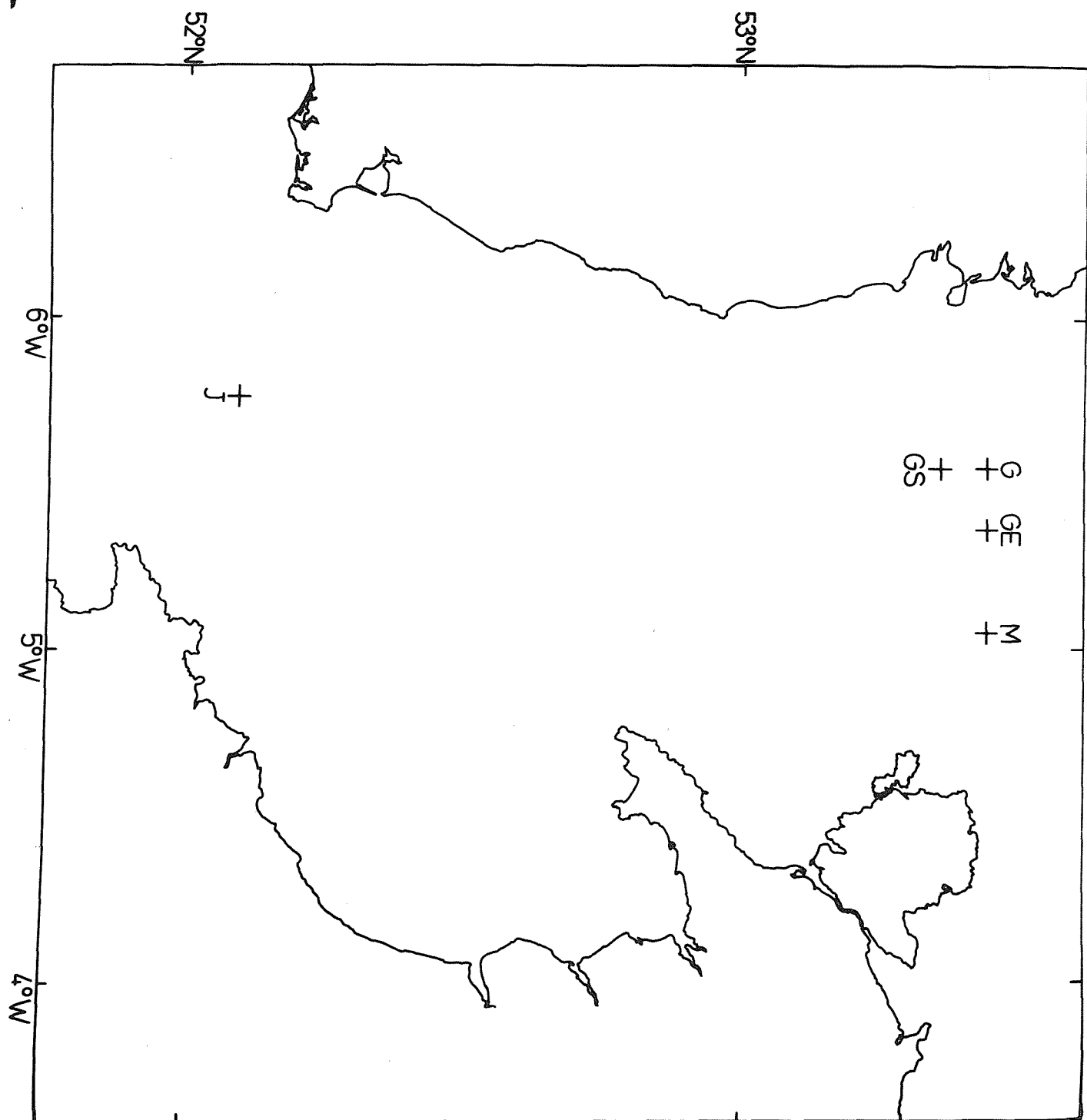


TABLE 1
Summary of current meter
deployment, times and positions

Mooring Number	Rig	Latitude	Longitude	Water depth below chart datum (m.)	Day launched	Day Recovered	Height of meter above sea floor (m)	Tape No.	Meter type
20	J	52°05'N	05°46'W	91	5 Sept 1972	14 Oct 1972	71 SSW 46 SSW 27 SSW 6 —	33/1 27/1 34/1 16/1	Plessey Plessey Plessey Plessey
21	GS	53°21'N	05°33'W	76	6 Sept 1972	10 Oct 1972	66 N 40 N 7 N doubtful	417/3 415/3 212/6	Bergen Bergen Bergen
22	G	53°26'N	05°33'W	78	6 Sept 1972	9 Oct 1972	68 S 42 S 7 S	406/3 160/5 532/1	Bergen Bergen Bergen
23	GE	53°26'N	05°22'W	83	6 Sept 1972	10 Oct 1972	72 N 46 S 7 N	416/3 530/1 531/1	Bergen Bergen Bergen
24	M	53°26'N	05°03'W	95	6 Sept 1972	9 Oct 1972	79 NE 53 NE 7 Doubt	213/5 533/1 214/6	Bergen Bergen Bergen

Current meters

Both Bergen and Plessey current meters record onto magnetic tape, at fixed sampling intervals, the current direction and integrated rotor count and Bergen meters also record temperature. In addition, the top meter at each of the four stations between Holyhead and Dublin was equipped with a pressure sensor. The sampling interval for all of the meters was 10 mins and was controlled in eight of the Bergen meters by quartz-crystal clocks rated at ± 2 secs/day and by electro-mechanical clocks in the remaining meters. Inevitably in a five to six week period these latter clocks were not precisely accurate and a timing error, usually less than half an hour, occurred which was corrected, where necessary, by linear interpolation. These timing errors were determined by comparing the number of samples recorded with the times of starting and stopping. The meters were started and stopped on board ship at the same time as pre- and post-cruise checks were performed on them.

All meters were calibrated before their launch and after their recovery. The thermistors were calibrated over the range -2°C to 20°C , the Bergen compasses every 10° with particular attention to the dead-space and the Plessey compasses every 20° . The speed sensors were tested over the range 0 to 150 cm/sec in the wave tank at Wormley. The pressure sensors were calibrated over the range 0 to 13.5 bars above atmospheric pressure.

In all, sixteen records were obtained as all the meters were recovered. There were, however, six failures. Two Plessey meters had faults; in one the clock stopped after it had collected ten days' data and in the other the tape jumped out of its guide after acquiring one day's data. Of the four failures occurring in Bergen meters, two were caused by the rig interfering with the meter's operation at times of high current speed and two by faulty reading of the compass.

Current meter moorings

A schematic diagram of the mooring arrangement is shown in figure 1. It is a standard shelf seas rig and reduces the effects of surface waves on the meters. The current meters are attached to a taut line supported by a sub-surface buoy (Bergen meters by splicing their spindles into the line and Plessey meters via an 'A' frame clamped onto the line). In this experiment four different types of sub-surface buoy were used :-

- A) A bullet shaped buoy about 1.1 m long and 0.65 m in diameter made from high density polyurethane foam in a fibreglass shell approx. 1 cm thick. It has a buoyancy of 160 kg and is manufactured by Cosalt Ltd.
- B) A solid spheroid about 1 m in diameter made from a heterogeneous mix of syntactic foam and 38 mm diameter pressure resistant spheres all inside a fibreglass casing. It has a buoyancy of 225 kg and is manufactured by Slingsby Sailplanes Ltd.
- C) A free-flooding spheroid about 1 m in diameter made from a hollow fibreglass shell containing 38 mm diameter pressure resistant spheres encased in a net. The shell is perforated to render the buoy free-flooding. It has a buoyancy of 225 kg and is manufactured by Slingsby Sailplanes Ltd.
- D) Three hollow aluminium spheres about 0.5 m in diameter and approx. 100 kg buoyancy each, giving a total of 300 kg buoyancy when attached to the rig.

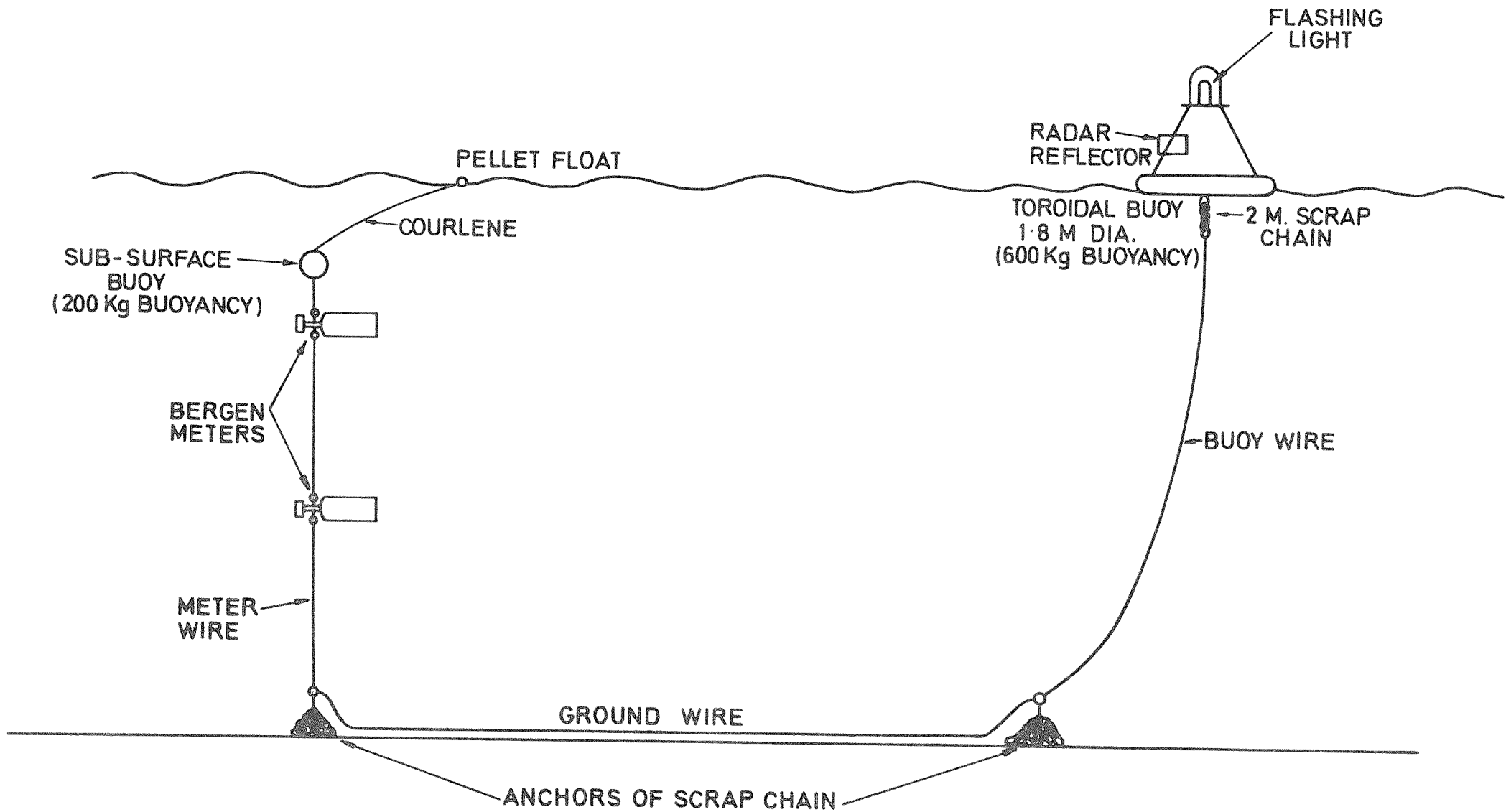
The position of the rig is marked by a toroidal surface buoy supporting a radar reflector and a flashing light. Two scrap chain anchors were used, one of 700 kgs under the surface buoy and one of 450 kgs below the sub-surface buoy. A wire rope of 8 mm diameter galvanised, flexible steel was used for the line supporting the meters, 12 or 16 mm wire for the ground line (approx. 200 m long) and the line to the surface toroid. A 2 m length of scrap chain was attached to the bottom of the surface buoy to give it some form of stability, but despite this the buoys overturned several times.

The rigs were deployed by first launching the subsurface float, then the meters and the meter anchor, paying out the ground line, the anchor under the surface buoy, the surface buoy line

and finally launching the surface buoy. This procedure was reversed for recovery. Snap shackles were used, where possible, to minimise handling problems and generally to speed up both launch and recovery. Where snap shackles were not used connections were made by $\frac{5}{8}$ in D shackles with $\frac{3}{4}$ in pins and reciprocal bearing swivels.

The R.R.S. John Murray was used for all operations and the skill and experience of her master and crew contributed greatly to the success of the programme.

FIGURE 1. MOORING SYSTEM (SCHEMATIC)



Data processing

The data on the magnetic tapes from the Bergen meters was translated at Bergen and from the Plessey meters at Lowestoft onto punched paper tape which was input into the Institute's IBM 1130 computer. Errors in the data were discovered by noting either discontinuities in the records or consecutive readings with the same value; the most common errors being :-

- (a) a large change in direction between adjacent readings at times of reasonable speed (> 25 cm/sec). This is probably caused by the meter's encoder misreading the compass.
- (b) The rotor count going backwards. This often occurs when the rotor potentiometer is in its dead-space.

Errors of type (b) were corrected and the meter calibrations were then used to calculate the temperature and the North (true) and East components of velocity. Because the meter integrates the rotor count but records instantaneous directions, some further averaging was necessary to derive a simultaneous reading of speed and direction. Consider three adjacent readings of rotor count and direction at times t_1 , t_2 , t_3 . The value for speed and direction at t_2 was derived by associating the speed given by the rotor count at t_3 minus that at t_1 with the instantaneous measurement of direction at time t_2 .

After the components of velocity had been calculated errors of type (a), which were more common than those of type (b), were corrected using a cubic spline routine on each velocity component.

Format

The report is split into sections, one for each mooring, each section beginning with a page of mooring details showing :-

Mooring number	:	ICOT reference number
Position of rig	:	Station identification letter, latitude and longitude
Depth of water	:	from the appropriate Admiralty Chart
Tidal heights	:	from the tidal predictions for the nearest port giving the heights above chart datum of the
mean high water springs		MHWS
mean high water neaps		MHWN
mean low water springs		MLWS
mean low water neaps		MLWN
Meter information	:	the meter number, the type of meter, the height of the meter rotor above the anchor.
Time of set	:	the time that the surface buoy was released from the ship.
Time of recovery	:	the time that the surface buoy was brought on board the ship
Mooring	:	any additional information on the mooring

Another page of information is included before the results from each meter. This contains :-

Meter information	:	manufacturer and meter identification number
Tape number	:	identification of the record
Times	:	the times when the meter was started and stopped together with the calculated timing error and the total number of readings
Length of useful record	:	times of start and end of velocity time series, total length of useful data
Comments	:	Comments on the meter, its behaviour and the quality of the record.

The results are displayed in five graphs produced on a Computer Instrumentation Limited 6011 plotter linked to the Institute's IBM 1130 computer. The diagrams are :-

- 1) A plot of the temperature, pressure (if appropriate) and the North and East components of velocity against time. The whole data series obtained (10 minute values in this case) is used as the input for this graph. The lines on the time axis indicate midnight (0000 GMT)
- 2) Histograms of speed and direction. Plots of the percentage of the data which lie within a certain interval of speed or direction. The direction histogram is split into intervals of 18° , the speed range is flexible depending on the maximum speed recorded.
- 3) A scatter diagram of the North component of velocity against the East component. The scale is in cm/sec, each dot representing a reading of the meter. The eccentricity of the tidal ellipse is clearly indicated, showing the contrast between the almost rectilinear tidal stream in the upper layers and the noticeably elliptical motion nearer the bed. This diagram is particularly useful in revealing malfunctions in the meter's compass or in the rig itself.
- 4) Two progressive vector diagrams. One uses the same data as diagram 1; the other uses the data averaged over a period of 24 hrs 50 mins (two tidal cycles) to remove most of the tidal signal and hence show the residual movement more clearly. For any record, the scale (in kms) and orientation are the same for both graphs. A drift of 1 km/day is equivalent to a residual speed of 1.16 cm/sec. The crosses mark mid-day (1200 GMT) each day. Care is needed in interpreting these graphs, they indicate the time variation of the current vector at the meter and not the path of a particle.

Acknowledgements

The authors would like to thank Mr A J Harrison for the care he has taken in looking after the instruments, the marine operations section for the help they have given in launching and recovering the instruments and the computer operators for their patience and help in running our programs.

References

- Aanderaa, I. 1964 A recording and telemetering instrument.
Nato subcommittee on oceanographic research.
Tech. report 16 - fixed buoys project.
- Howarth, M.J. and Loch, S.G. 1973 Moored current meter records. Irish Sea
28 Aug - 11 Oct 1971. ICOT moorings 8-12.
ICOT Data Report 3.

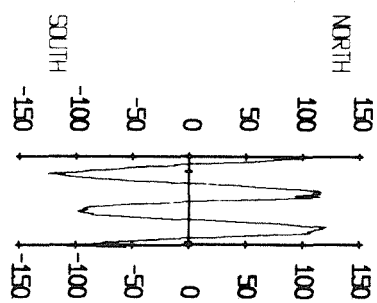
Mooring number : 20
 Position of rig : Lat 52°05'N Long 5°46'W (rig J)
 Depth of water : 91 m below chart datum
 Tidal heights, in metres : MHWS MHWN MLWN MLWS
 above chart datum,
 at Fishguard 4.7 3.4 1.9 0.8

Meter	Type	Height above sea floor (metres)	Recording interval (min.)
33	Plessey	71	10
27	Plessey	46	10
34	Plessey	27	10
16	Plessey	6	10

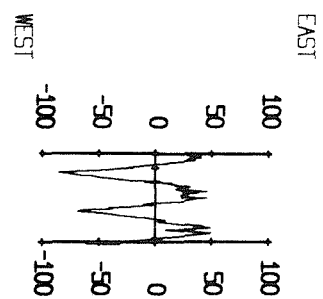
Rig set : 18.44 GMT 5 Sept.1972 from
 R.R.S. John Murray
 Rig recovered : 09.21 GMT 14 Oct.1972 from
 R.R.S. John Murray
 Mooring : Standard. The Plessey meters were
 on loan from the Research Vessel
 Base, Barry and the sub-surface
 buoy was composed of three aluminium
 spheres, also on loan from Barry.
 Comments : The rig was successfully launched at
 the first attempt in a calm sea.
 Before it was recovered the pellet
 floats marking the sub-surface buoy
 were seen to be too close to the
 surface buoy and, indeed, the surface
 and sub-surface buoy anchors came to
 the surface together leaving the
 ground line in a big lopp. The
 meters appeared to be undamaged.

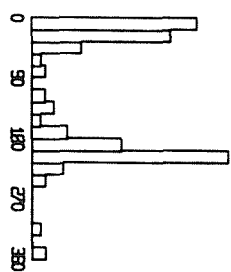
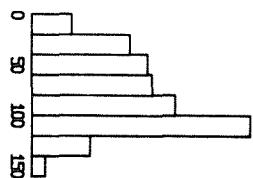
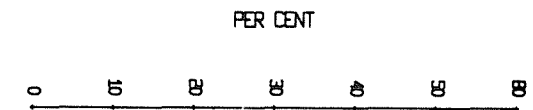
Meter	:	Plessey 33
Tape number	:	33/1
Meter started	:	18.07.58 GMT 4 Sept 1972
Meter stopped	:	15.53.28 GMT 14 Oct 1972
Total number of readings	:	331
Timing error	:	-
Start of useful record	:	18.58 GMT 5 Sept 1972
End of useful record	:	00.58 GMT 7 Sept 1972
Length of useful record	:	30 hours
Comments	:	When the meter was opened after recovery the tape was no longer passing over the tape head or the capstain drive and an incorrect amount of tape had transported

VELOCITY IN CM/SEC



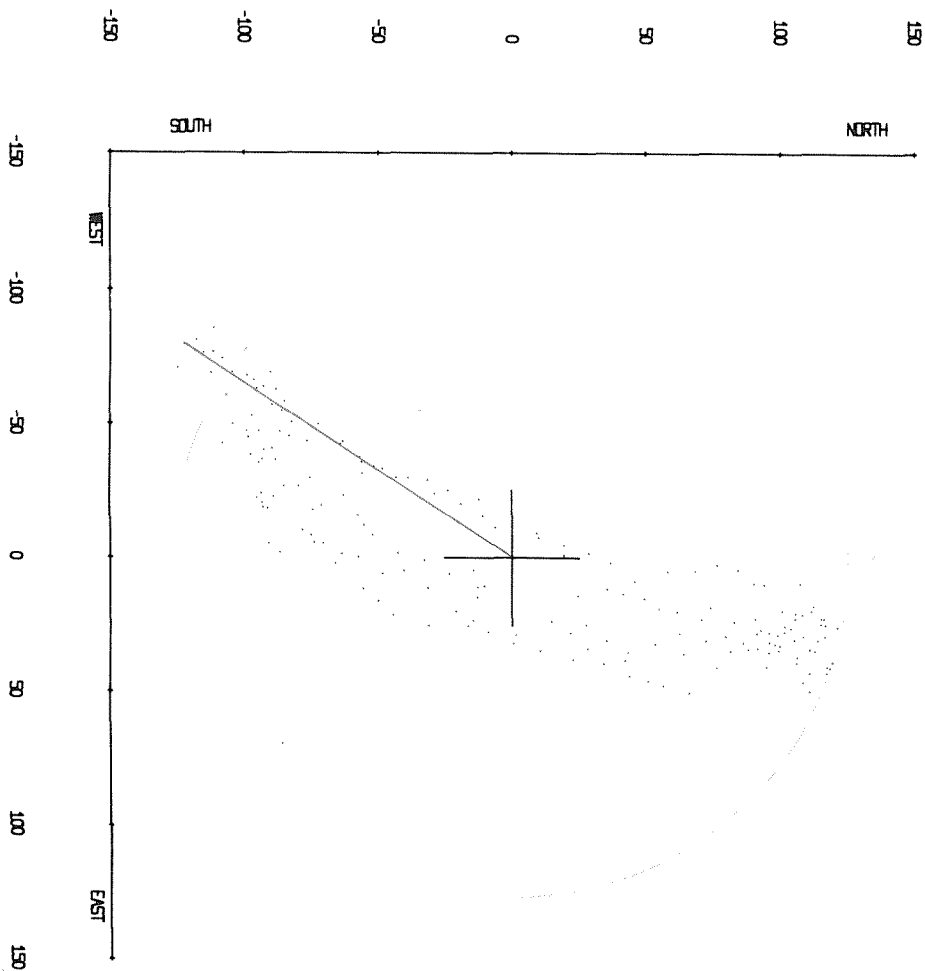
6TH SEP 72

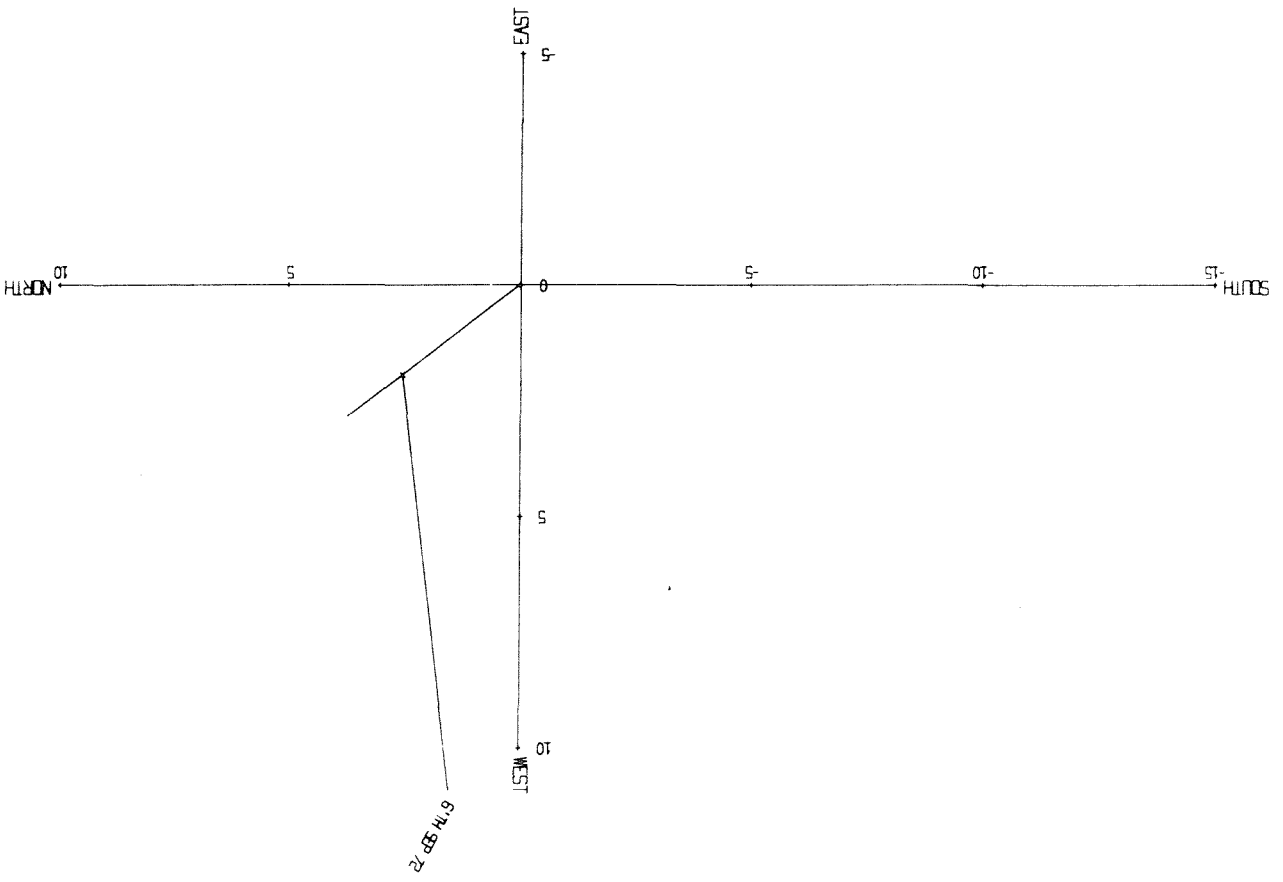
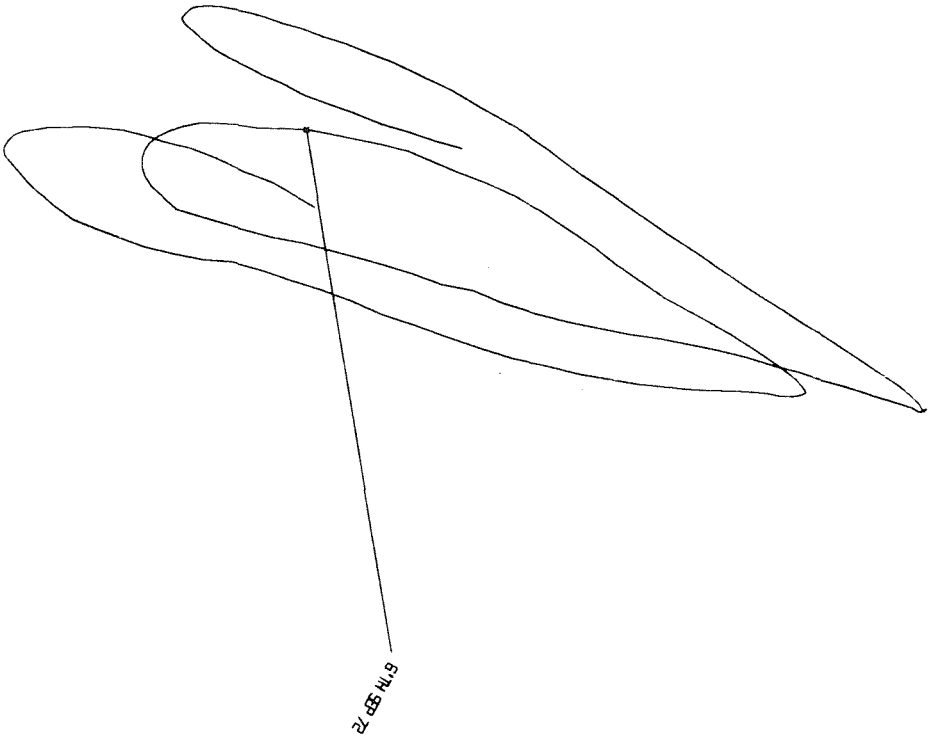




SPEED IN CM/SEC

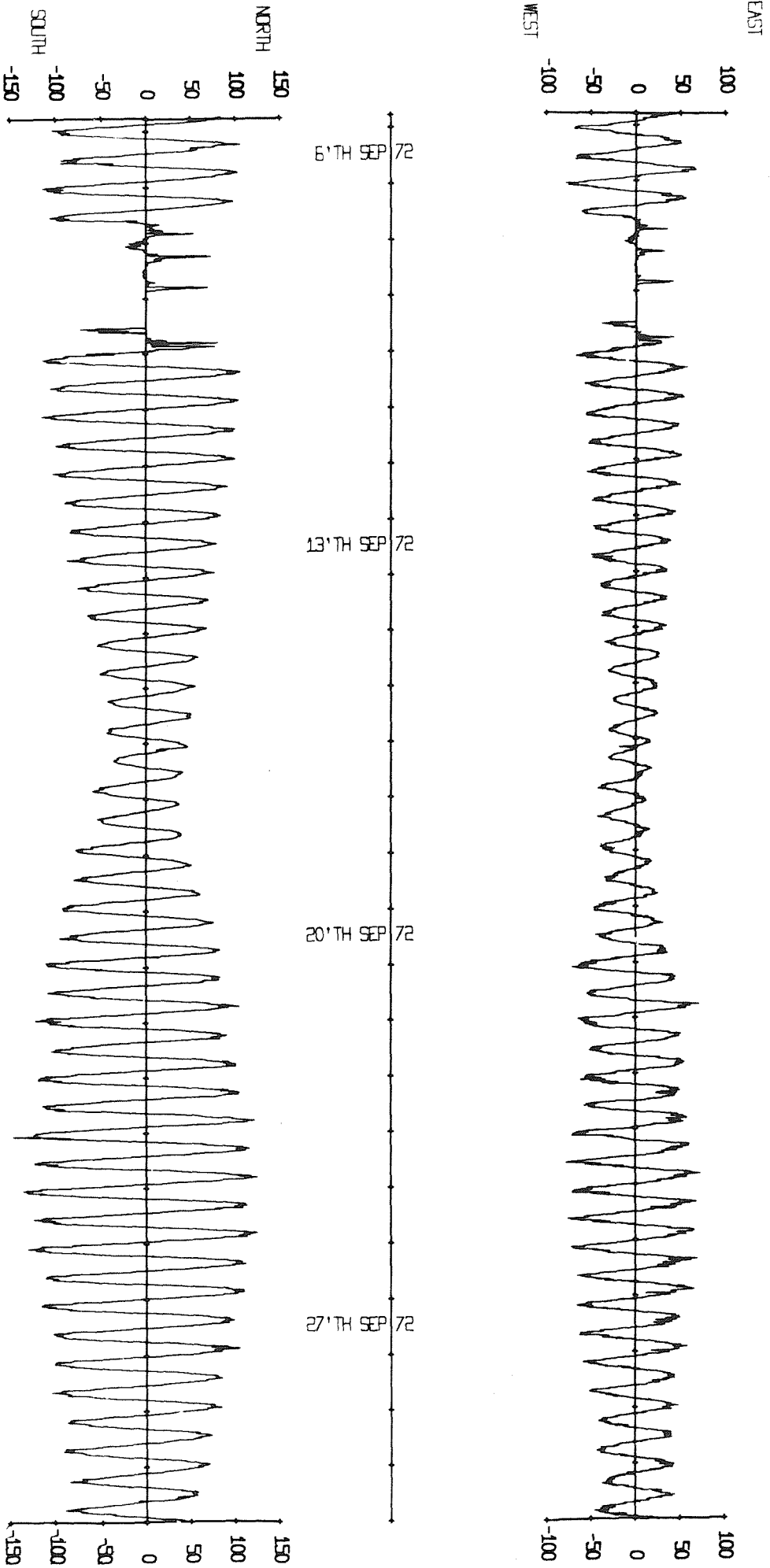
DIRECTION



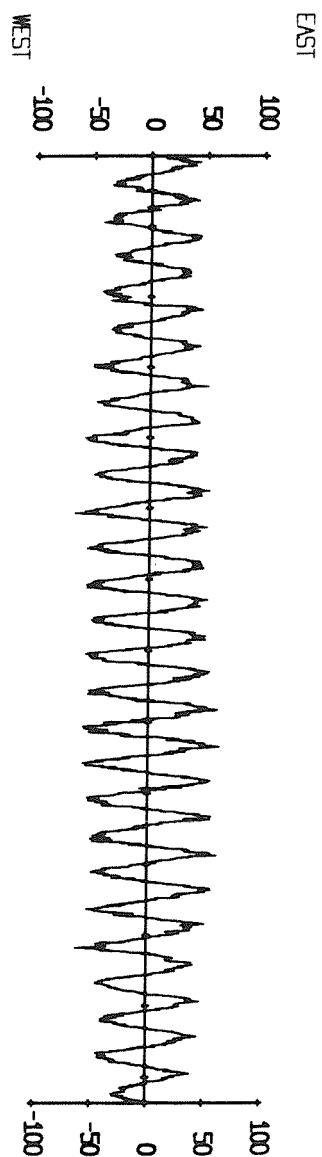
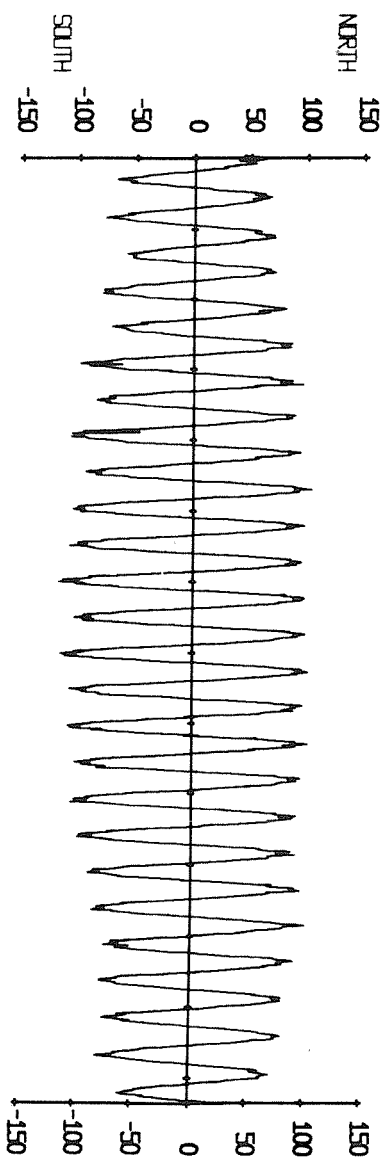


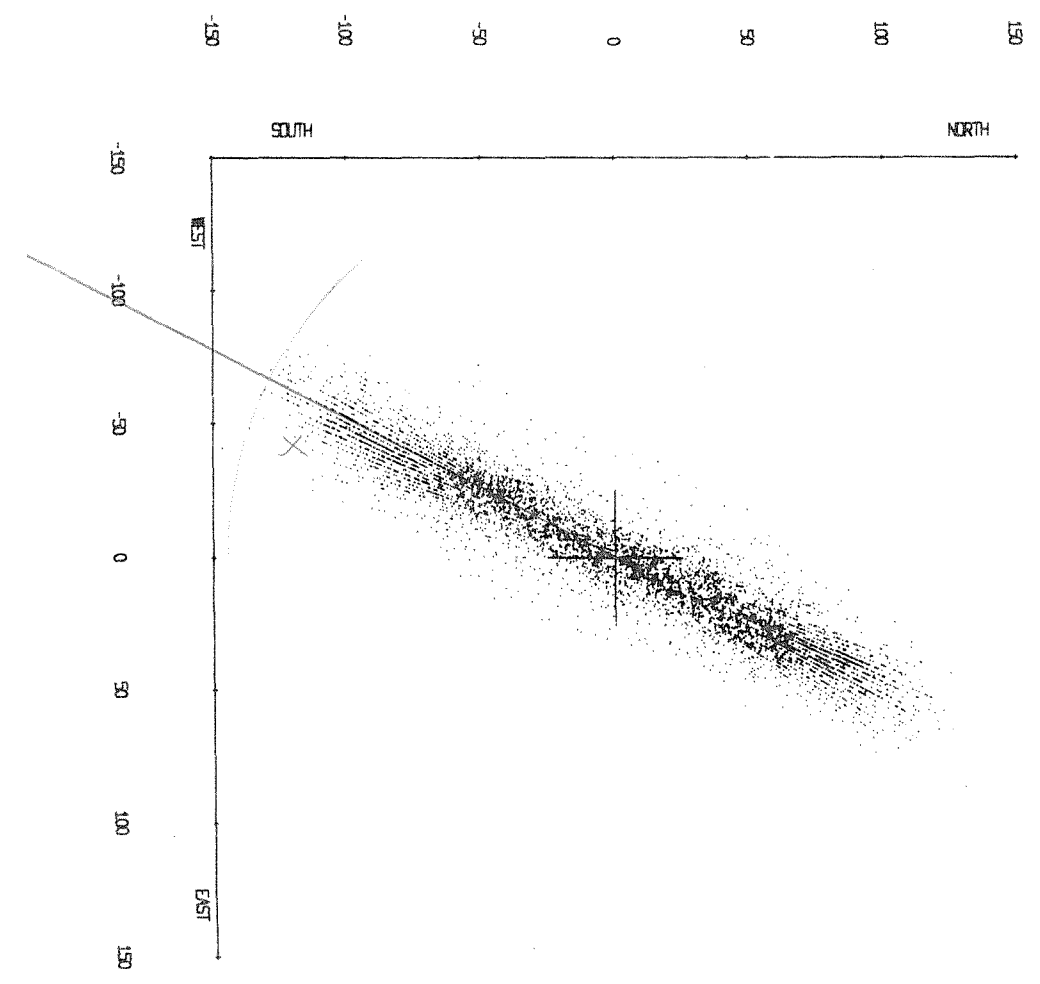
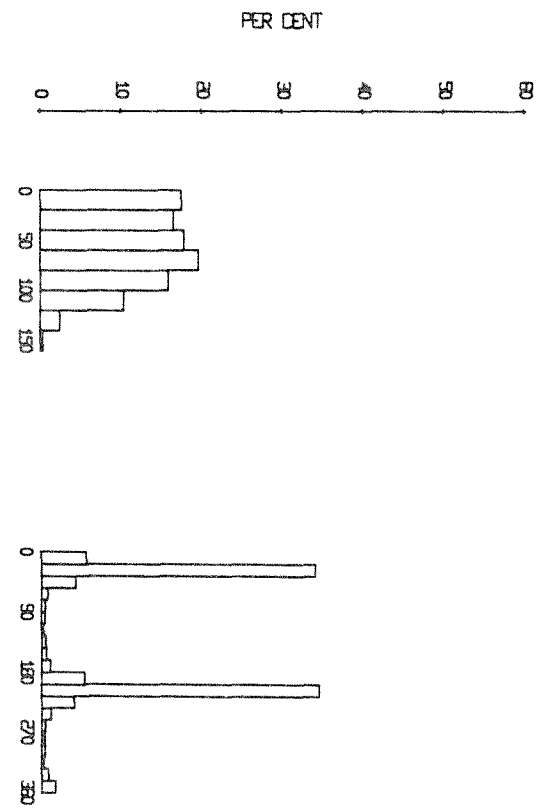
Meter	:	Plessey 27
Tape number	:	27/1
Meter started	:	18.23.22 GMT 4 Sept 1972
Meter stopped	:	08.37.30 GMT 15 Oct 1972
Total number of readings	:	5841
Timing error	:	54 mins 08 secs slow
Start of useful record	:	18.54 GMT 5 Sept 1972
End of useful record	:	09.07 GMT 14 Oct 1972
Length of useful record	:	926 hours
Comments	:	No corrections for the timing error have been applied to the data shown here. The bad velocity record between 12.00 on 7 Sept and 24.00 on 9 Sept is caused by the rotor jamming. For this period the meter appears to be free to turn as the direction record seems normal.

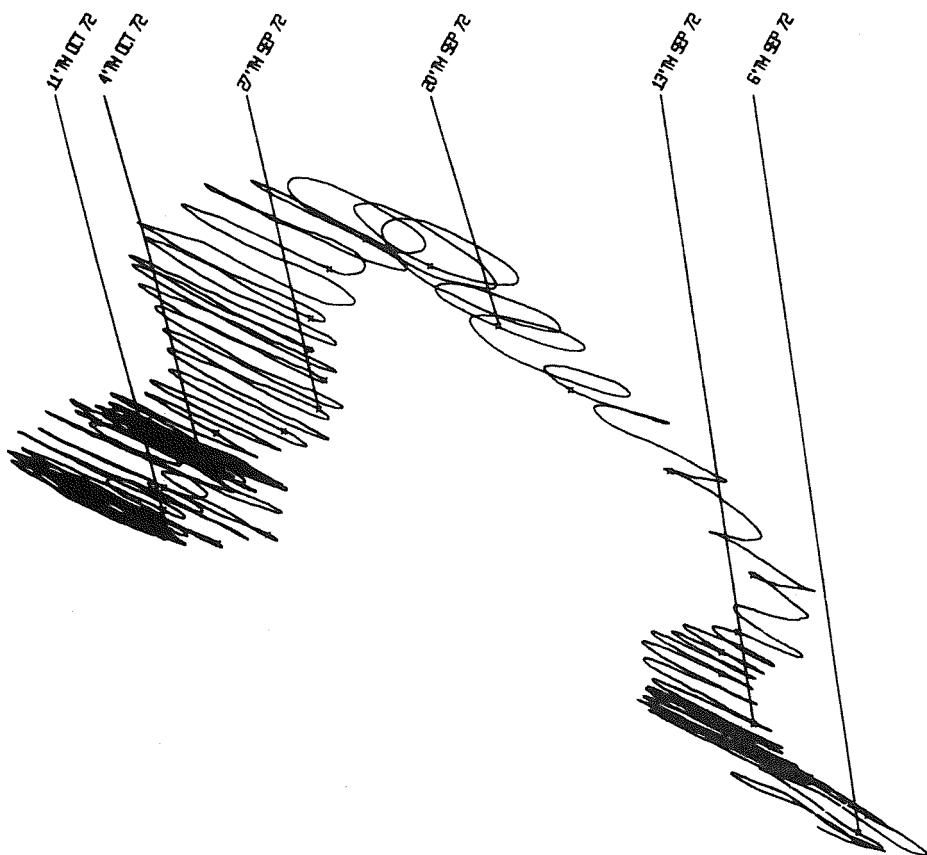
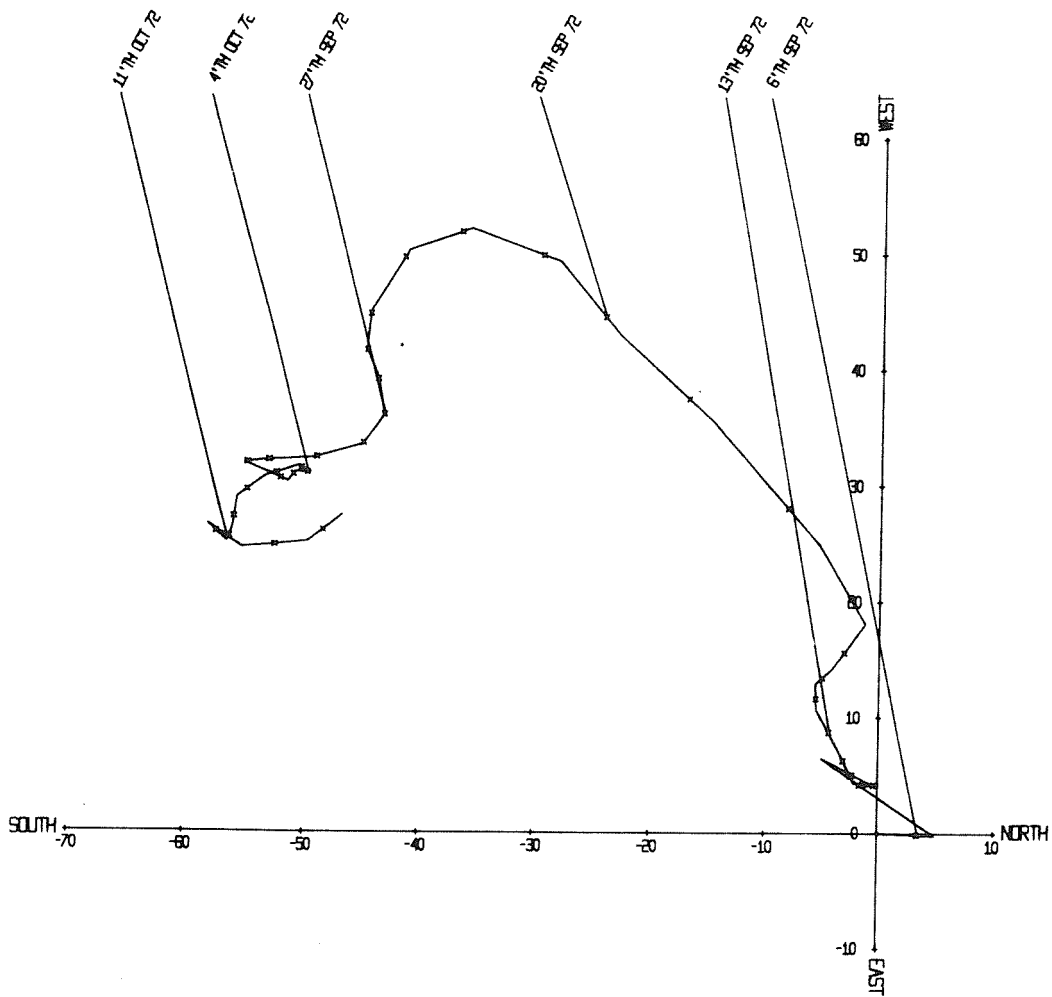
VELOCITY IN CM/SEC



VELOCITY IN CM/SEC



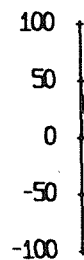




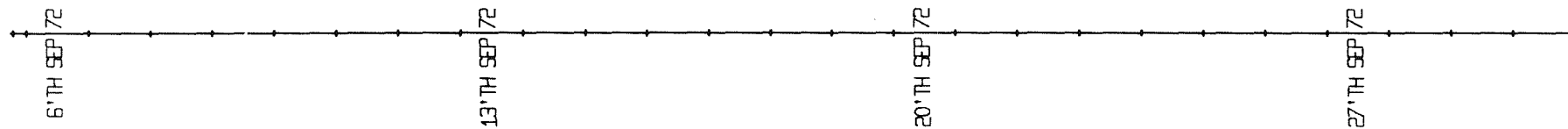
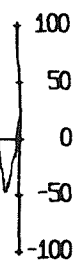
Meter	:	Plessey 34
Tape number	:	34/1
Meter started	:	17.35.05 GMT 4 Sept 1972
Meter stopped	:	20.47.11 GMT 14 Oct 1972
Total number of readings	:	5780
Timing error	:	2 mins 06 secs slow
Start of useful record	:	18.55 GMT 5 Sept 1972
End of useful record	:	09.07 GMT 14 Oct 1972
Length of useful record	:	926
Comments	:	Good record

VELOCITY IN CM/SEC

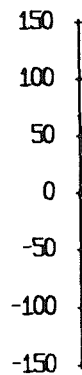
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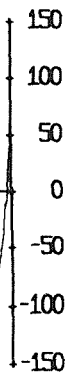
WEST



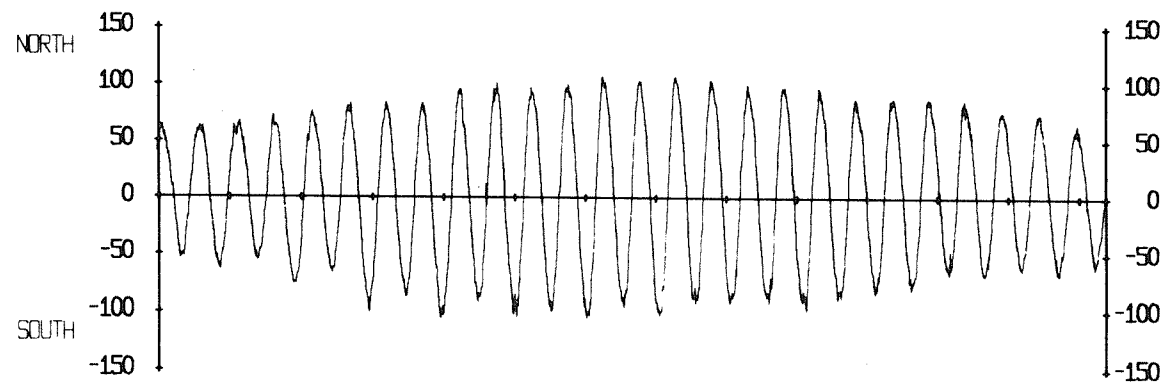
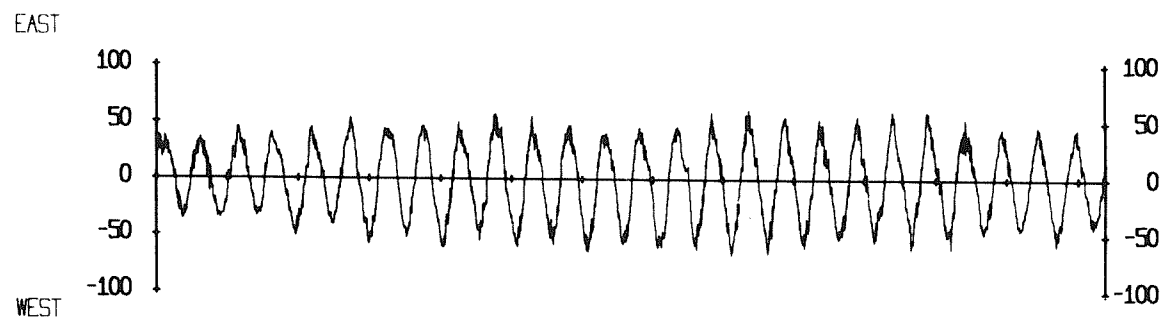
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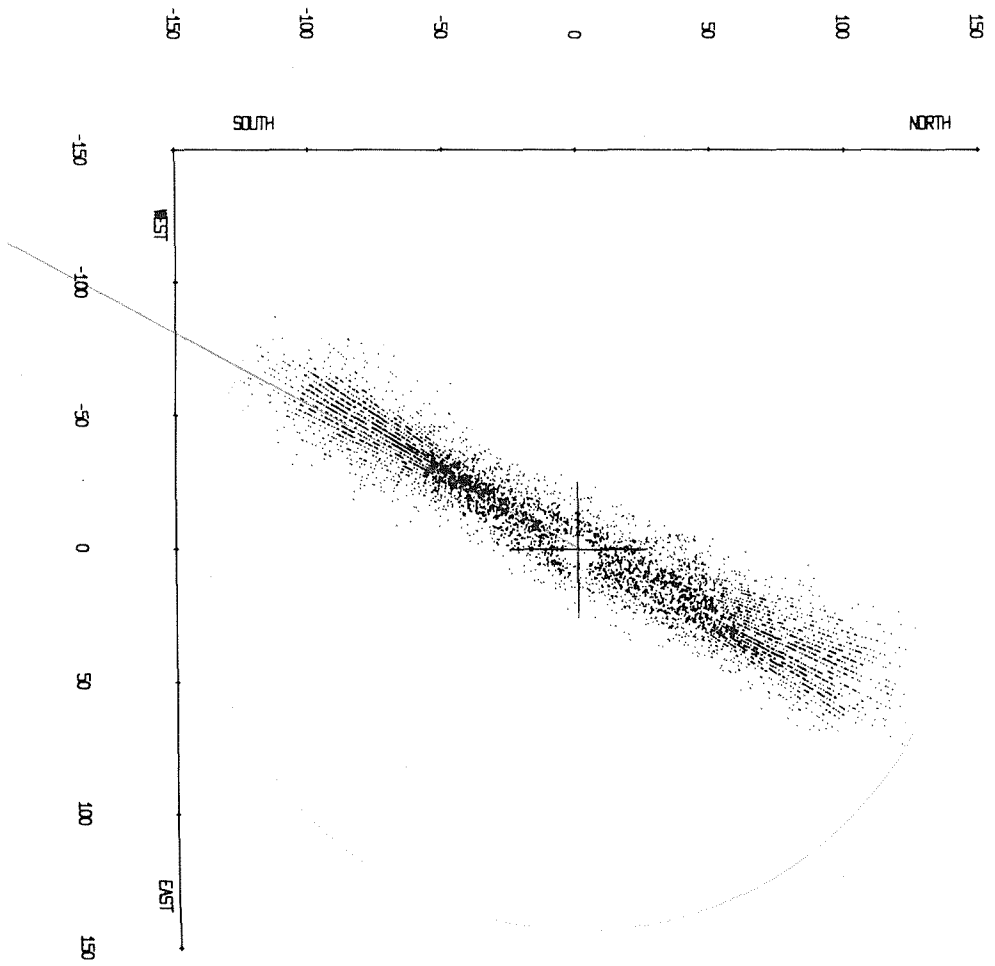
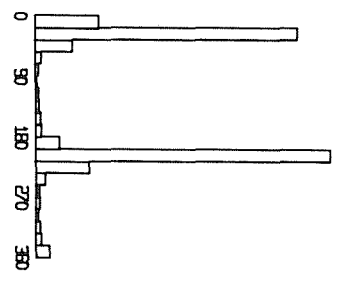
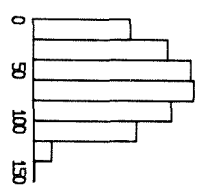
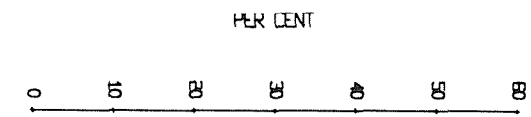


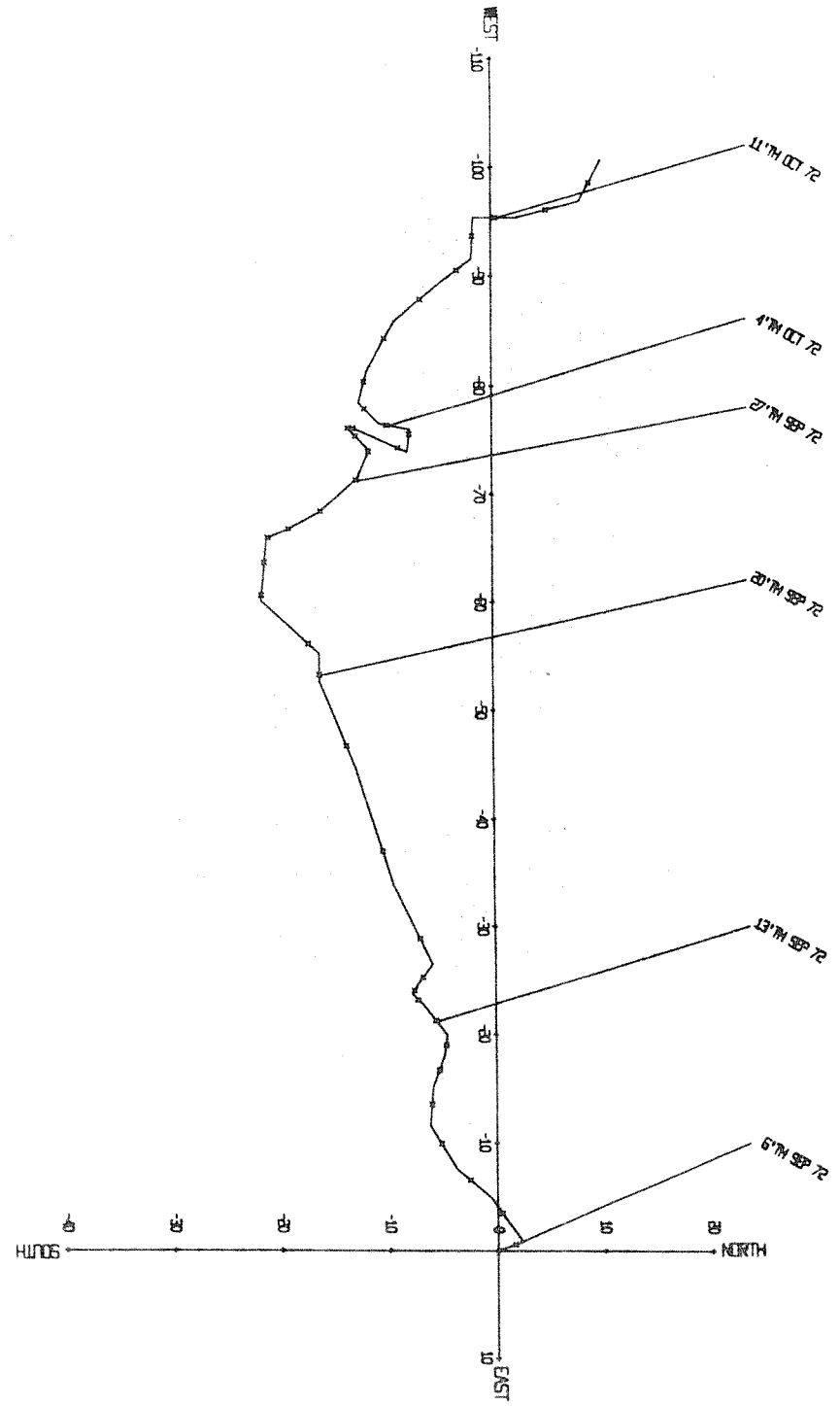
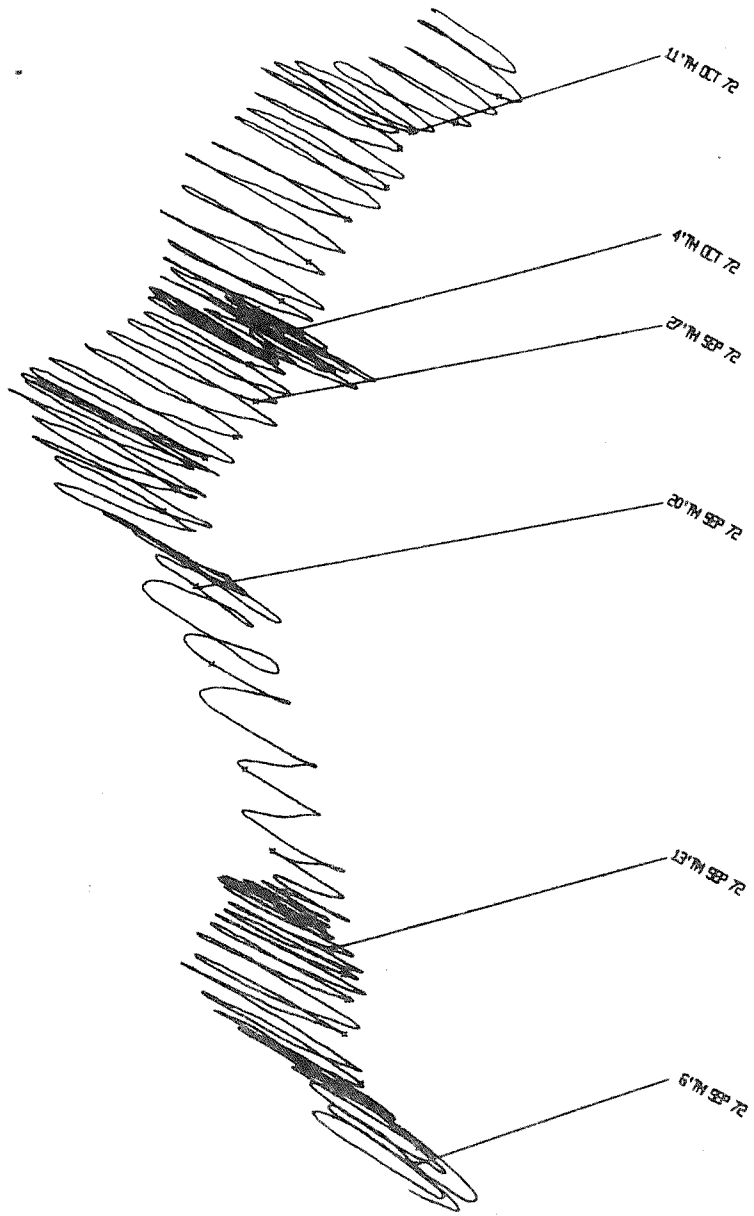
SOUTH



VELOCITY IN CM/SEC

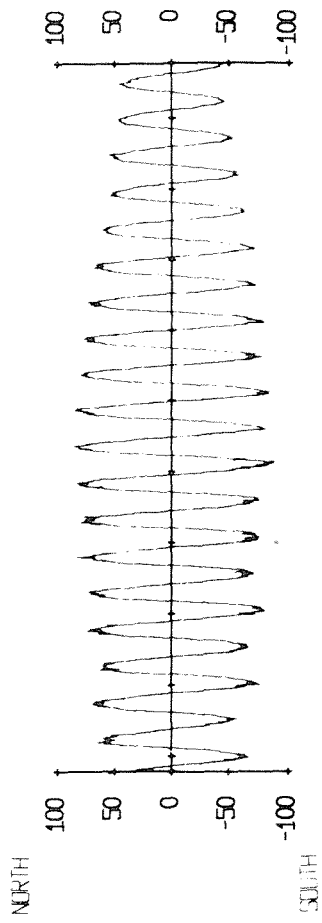
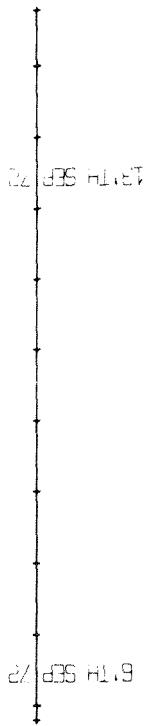
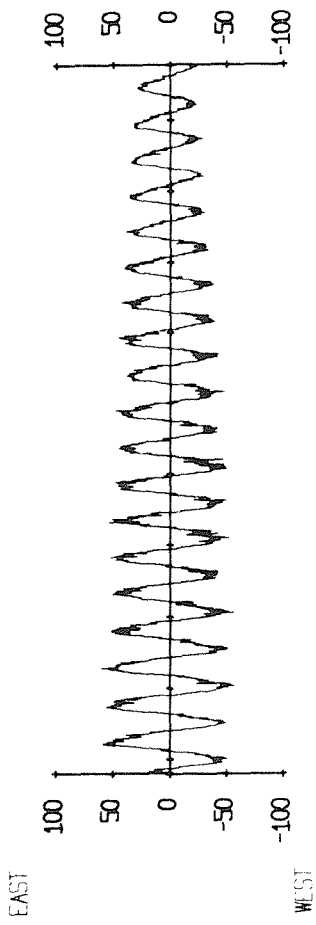


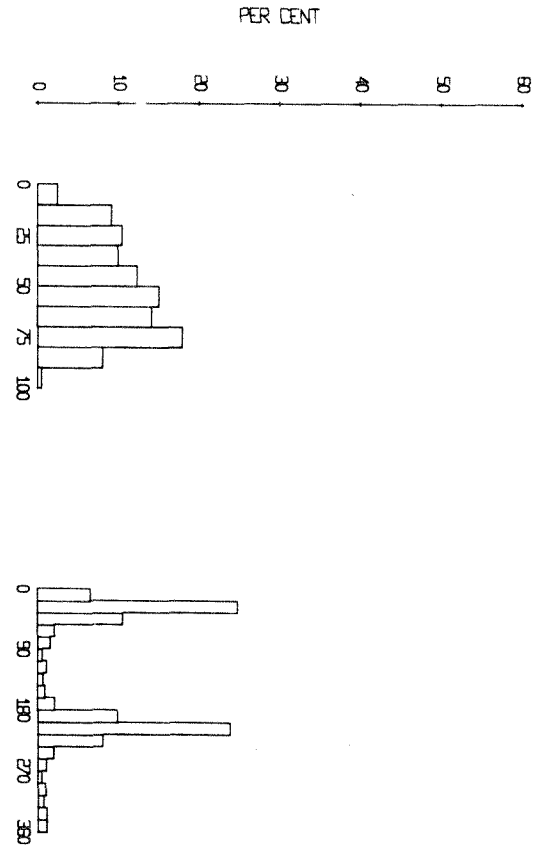




Meter	:	Plessey 16
Tape number	:	16/1
Meter started	:	17.47.58 GMT 4 Sept 1972
Meter stopped	:	-
Total number of readings	:	1592
Timing error	:	-
Start of useful record	:	18.58 GMT 5 Sept 1972
End of useful record	:	18.48 GMT 15 Sept 1972
Length of useful record	:	240 hours
Comments	:	When the meter was opened after recovery a small amount of sea-water was found inside, the clock had stopped and the tape transport was equivalent to about 10 days operation. Otherwise the record was good.

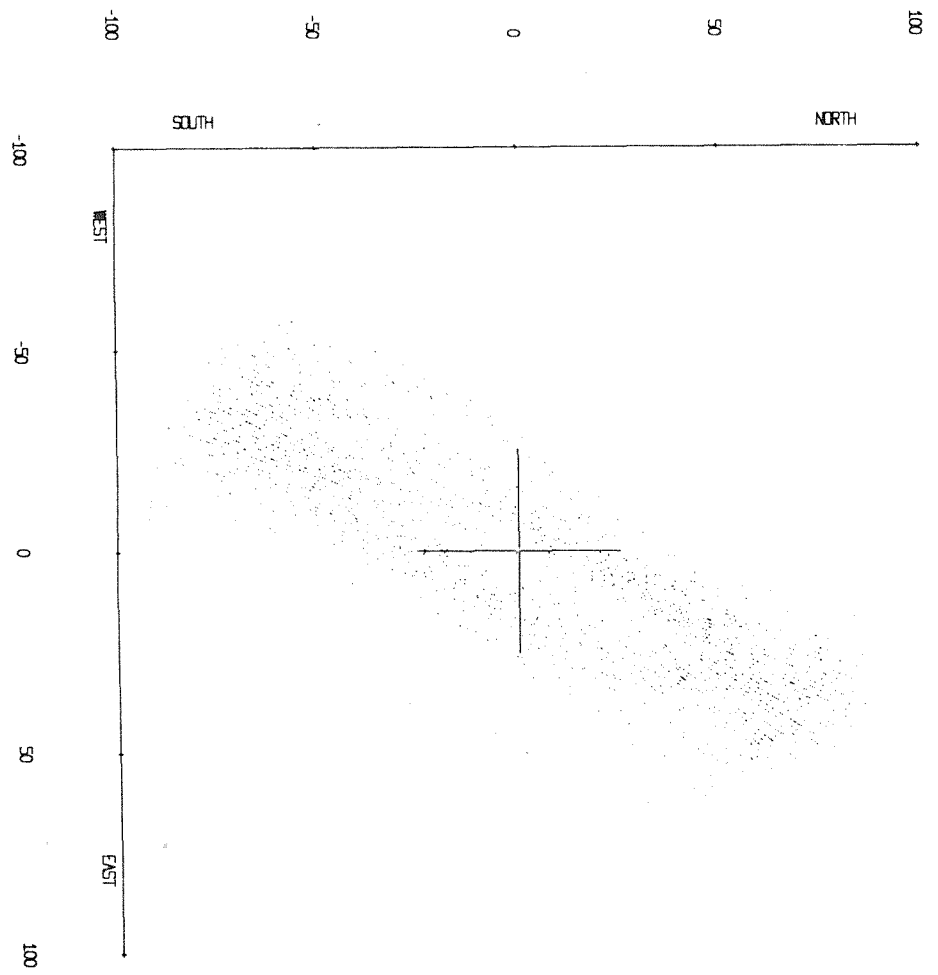
VELOCITY IN W/SEC

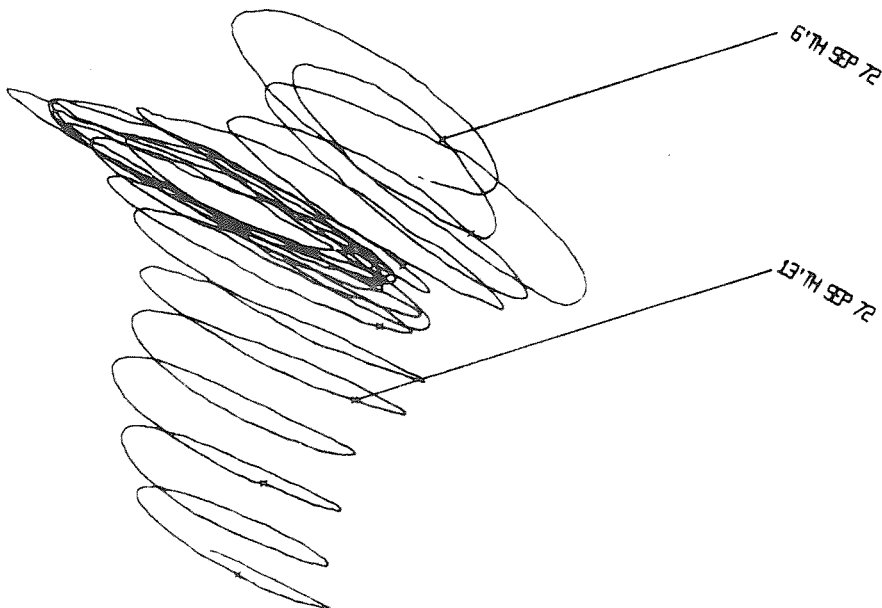
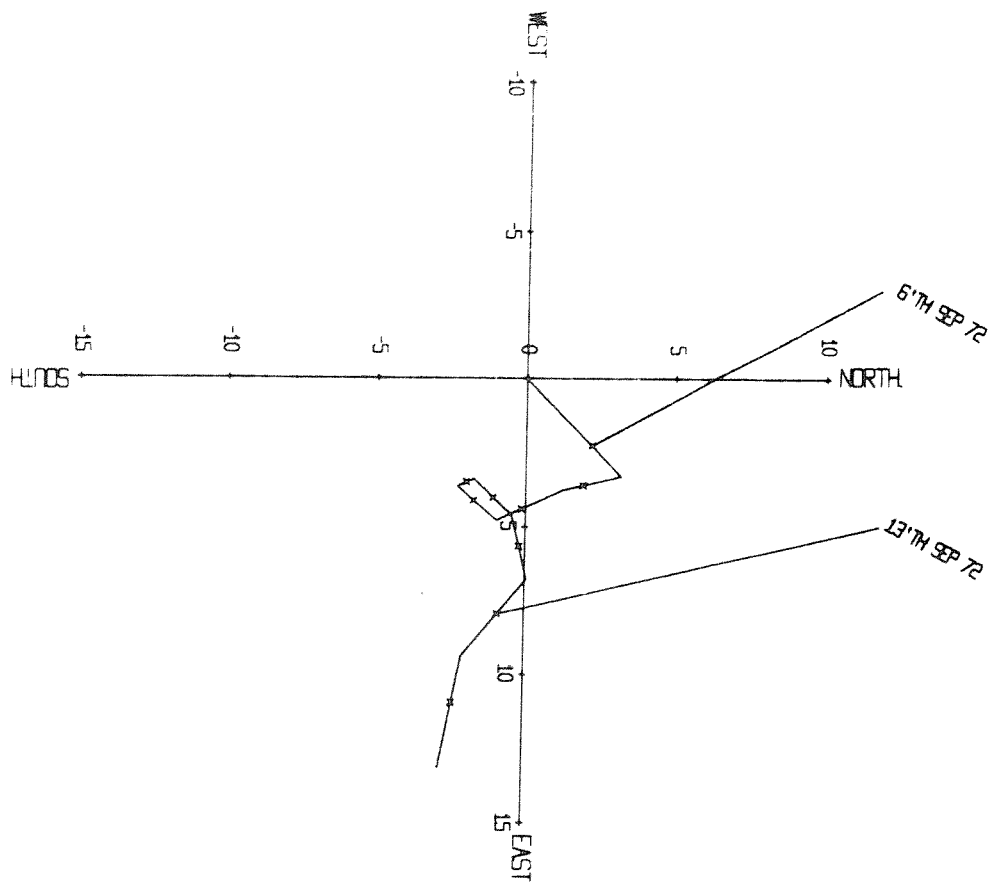




SPEED IN MI/SEC

DIRECTION





Mooring number : 21
 Position of rig : Lat 53°21'N Long 5°33'W (rig GS)
 Depth of water : 76m below chart datum
 Tidal heights, in metres : MHWS MHWN MLWN MLWS
 above chart datum,
 at Dublin 3.9 3.2 1.2 0.3

Meter	Type	Height above sea floor (metres)	Recording interval (min.)
417	Bergen	66	10
415	Bergen	40	10
212	Bergen	7	10

Rig set : 08.27 GMT 6 Sept 1972
 from R.R.S. John Murray
 Rig recovered : 06.40 GMT 10 Oct 1972
 from R.R.S. John Murray
 Mooring : Standard. The sub-surface buoy
 was a free-floating Slingsby and
 the top meter was equipped with
 a pressure transducer.
 Comments : The rig was successfully launched and
 recovered at the first attempt, both
 times in calm water.

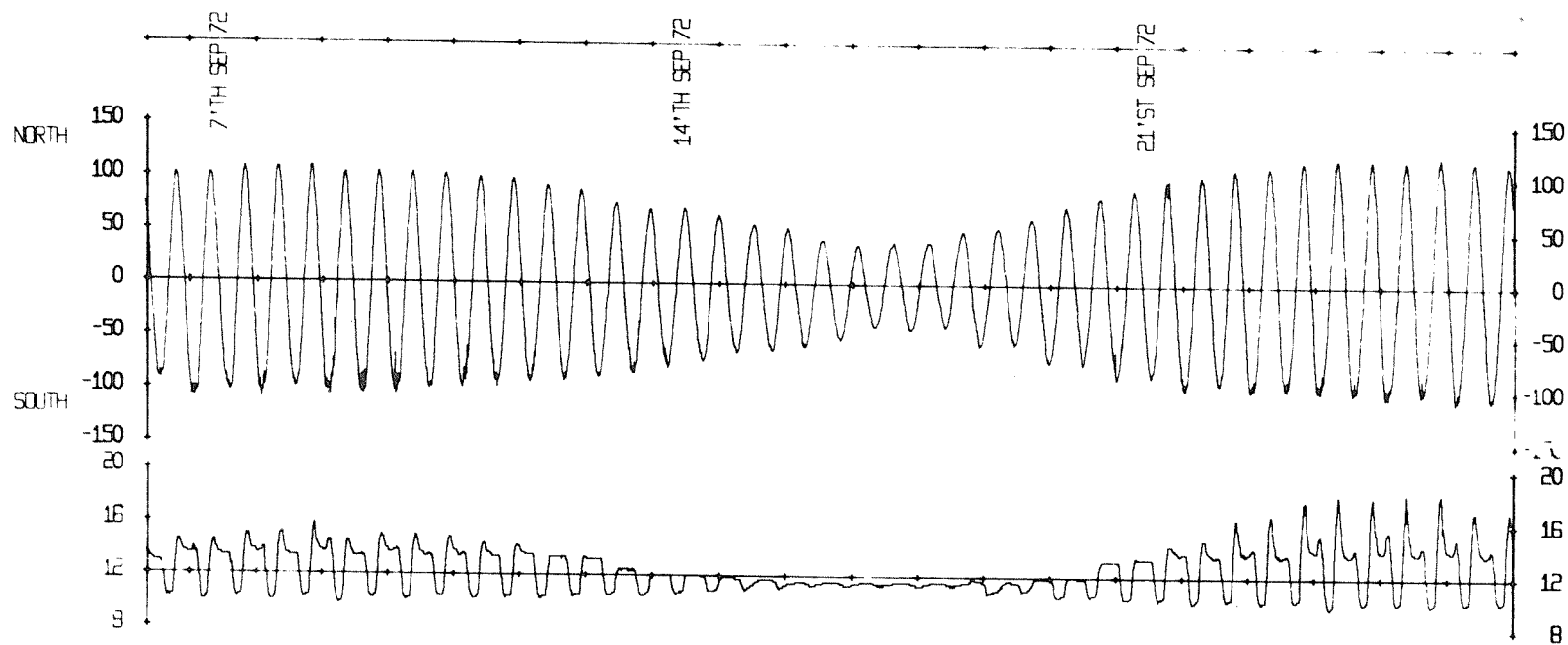
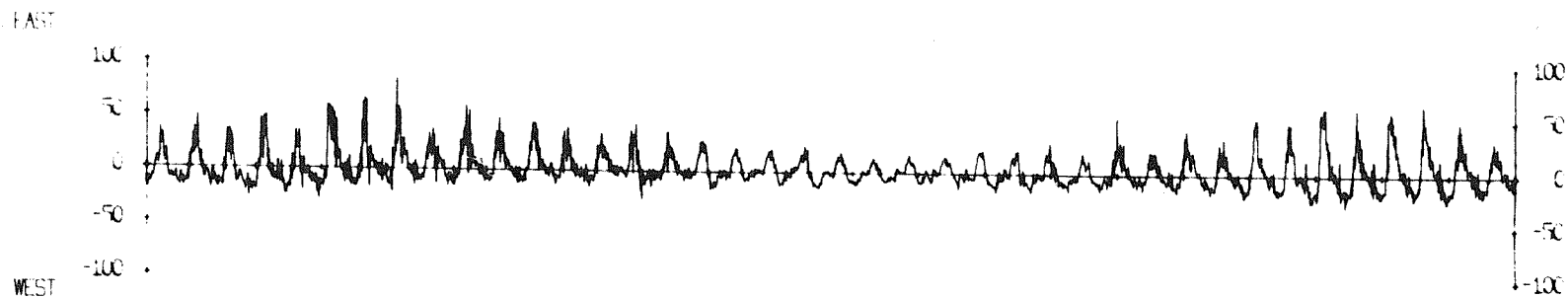
Meter	:	Bergen 417
Tape number	:	417/3
Meter started	:	12.40.00 GMT 5 Sept 1972
Meter stopped	:	08.19.21 GMT 11 Oct 1972
Total number of readings	:	5159
Timing error	:	39 secs fast
Start of useful record	:	08.40 GMT 6 Sept 1972
End of useful record	:	06.20 GMT 10 Oct 1972
Length of useful record	:	814 hours
Comments	:	Good record. This meter was fitted with a quartz-crystal clock and a pressure transducer. Its spindle was designed and made at Bidston.

VELOCITY IN CM/SEC

PRESSURE IN

TEMPERATURE IN °C

METRES OF WATER

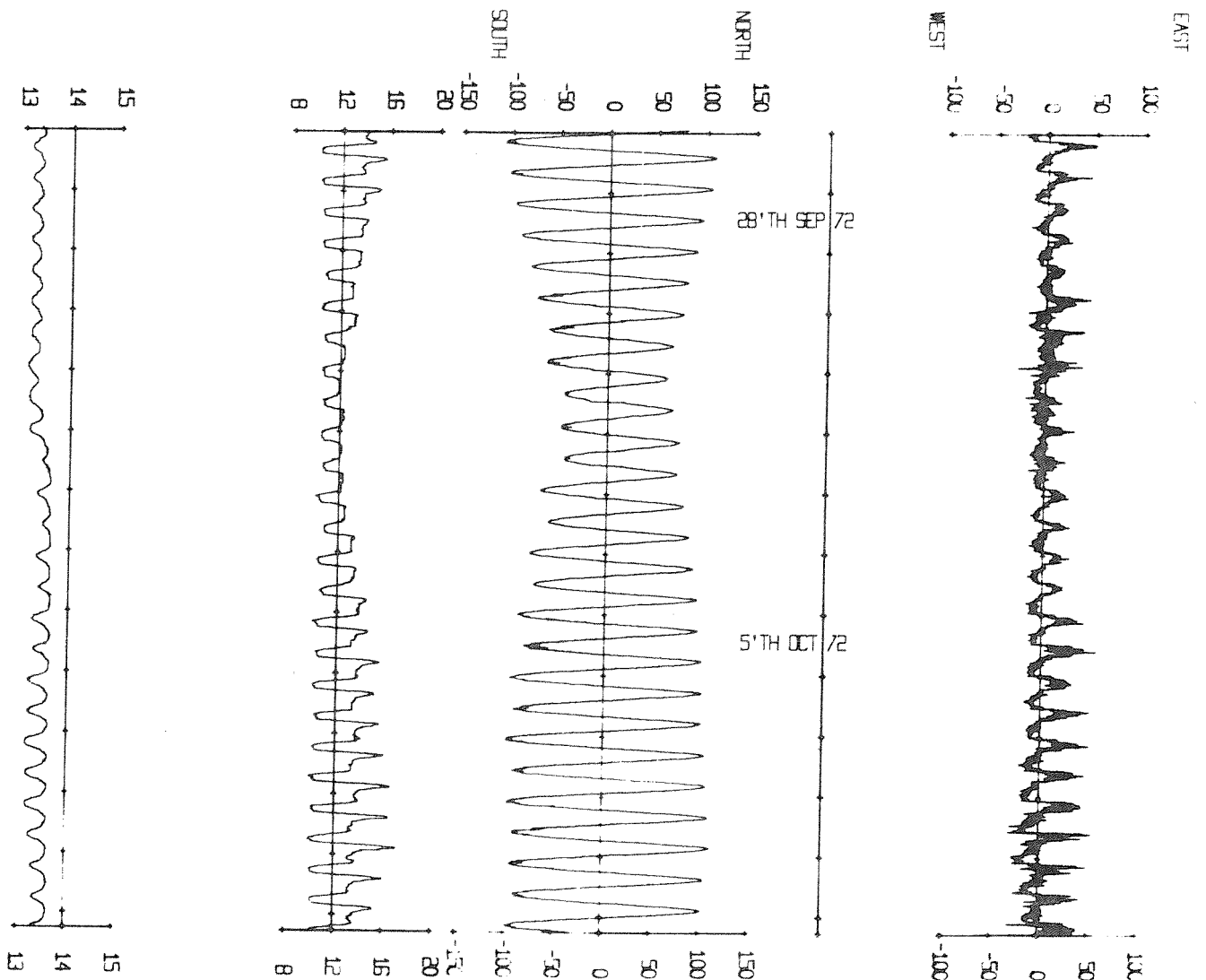


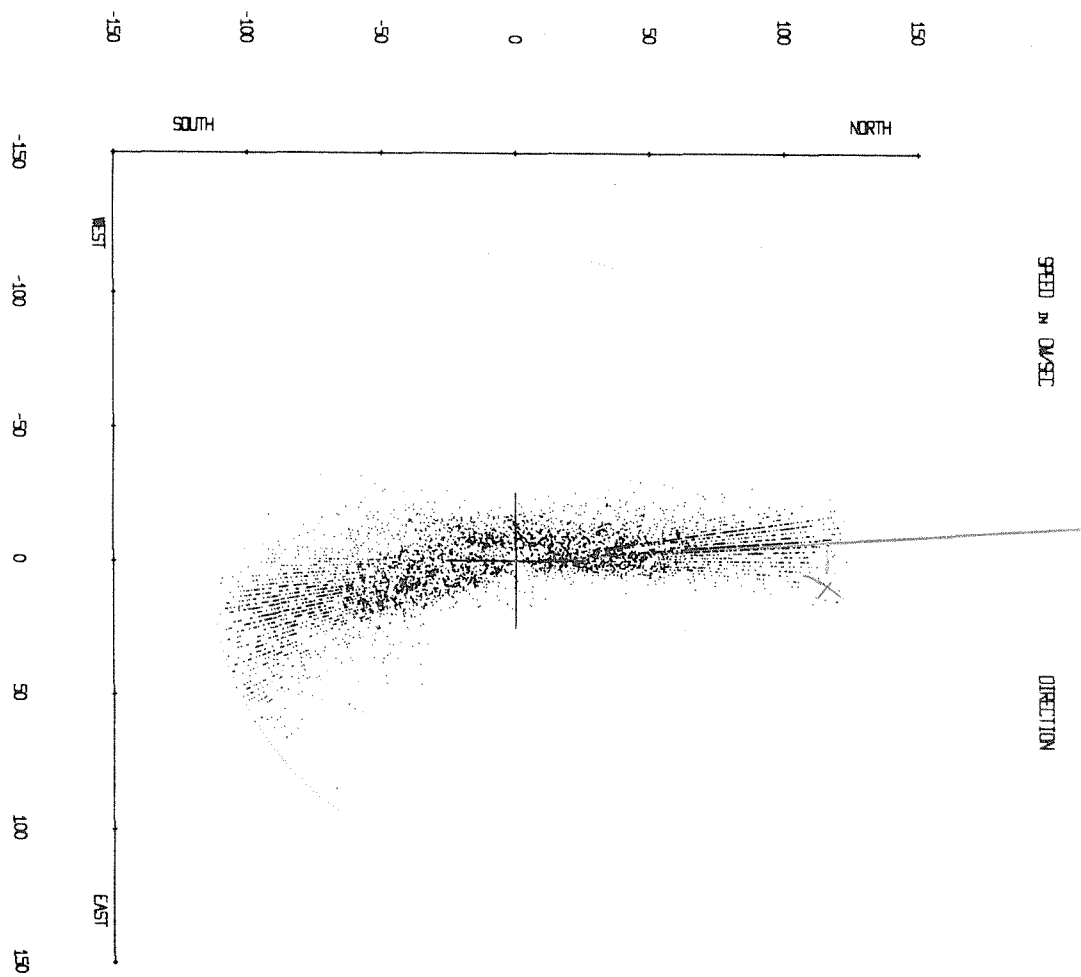
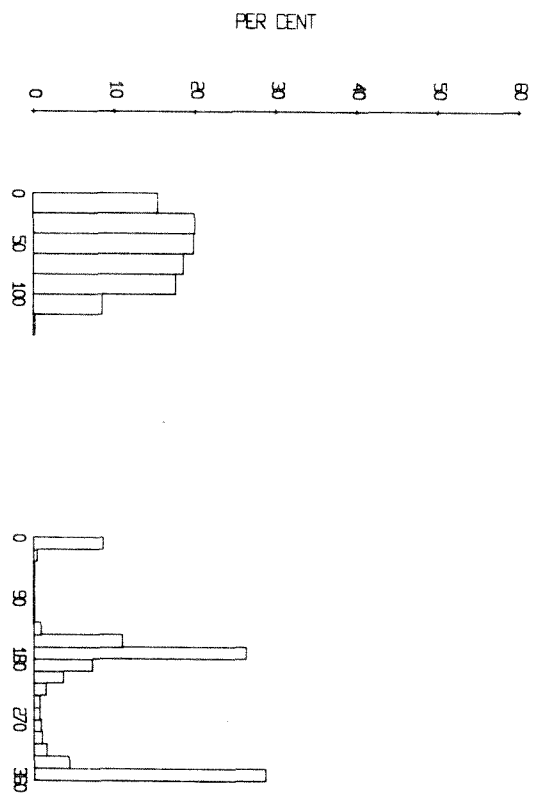
TEMPERATURE IN DEG C

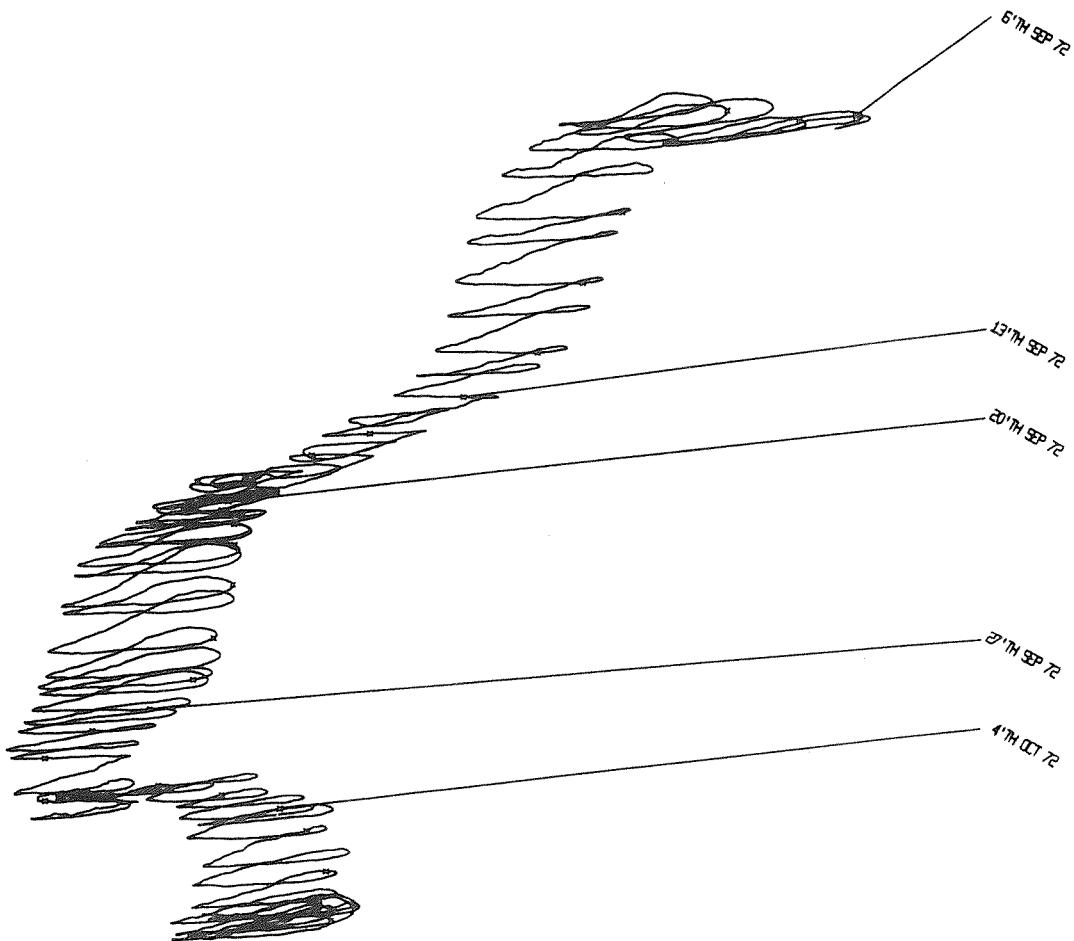
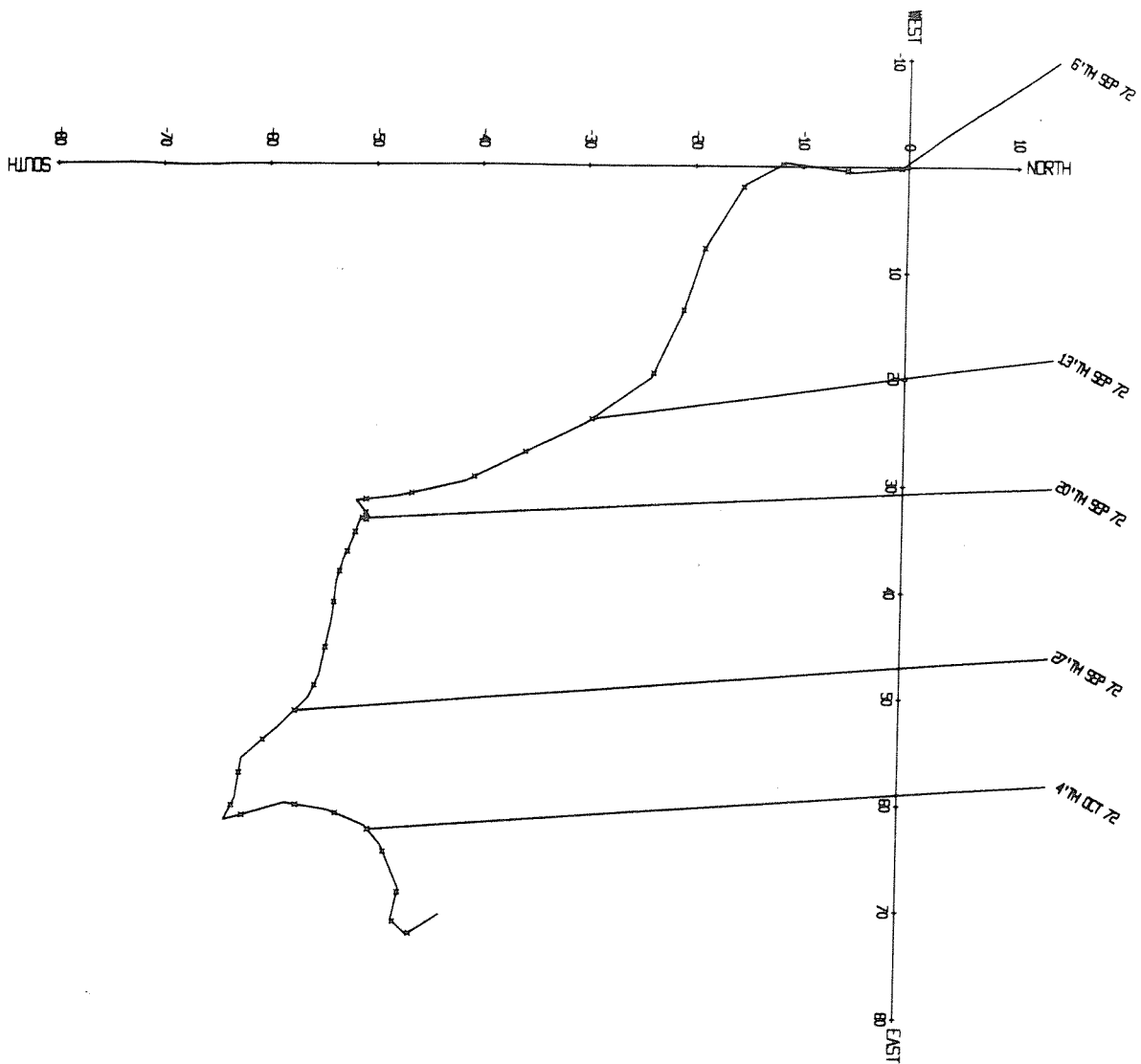
PRESSURE IN

VELOCITY IN CM/SEC

METRES OF WATER

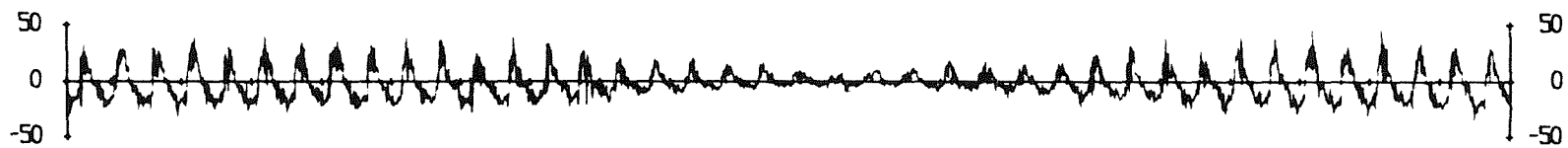




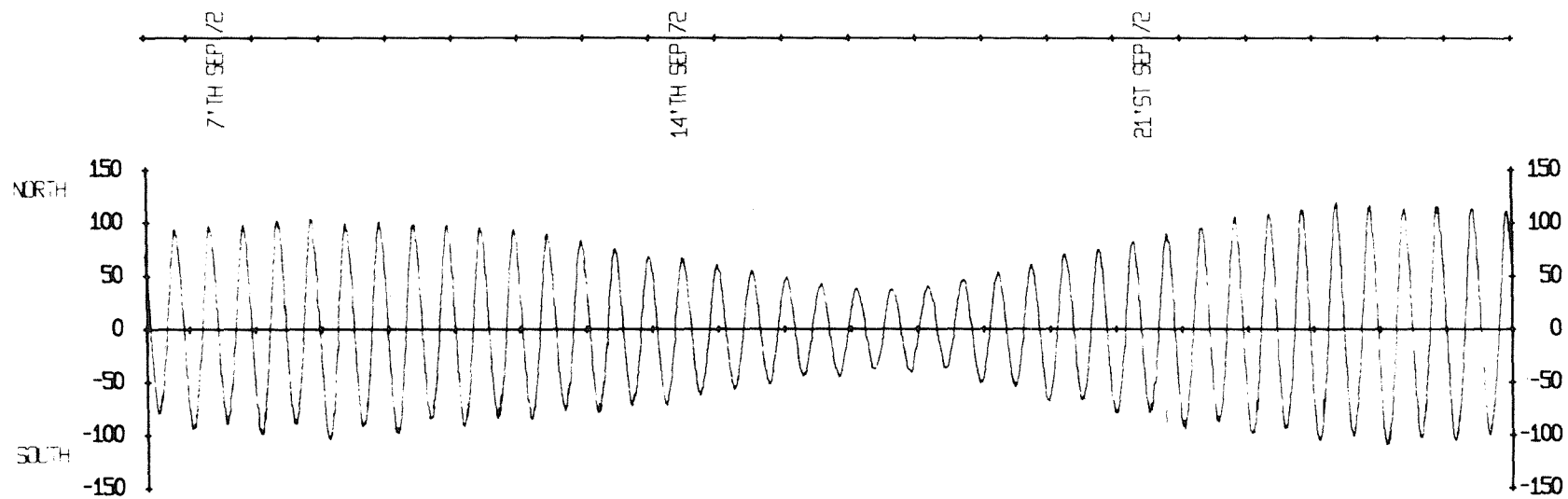


Meter	:	Bergen 415
Tape number	:	415/3
Meter started	:	10.37.56 GMT 5 Sept 1972
Meter stopped	:	11.55.32 GMT 11 Oct 1972
Total number of readings	:	5192
Timing error	:	7 mins 36 secs slow
Start of useful record	:	08.38 GMT 6 Sept 1972
End of useful record	:	06.26 GMT 10 Oct 1972
Length of useful record	:	814 hours
Comments	:	Good record. No corrections for the timing error have been applied to the data shown here.

SEA

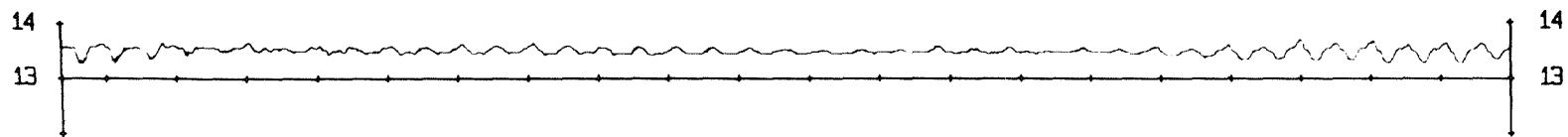


WIND

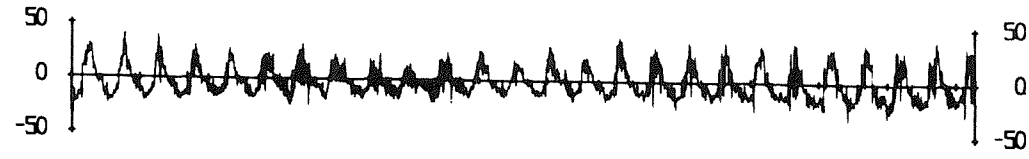


VELOCITY IN CM/SEC

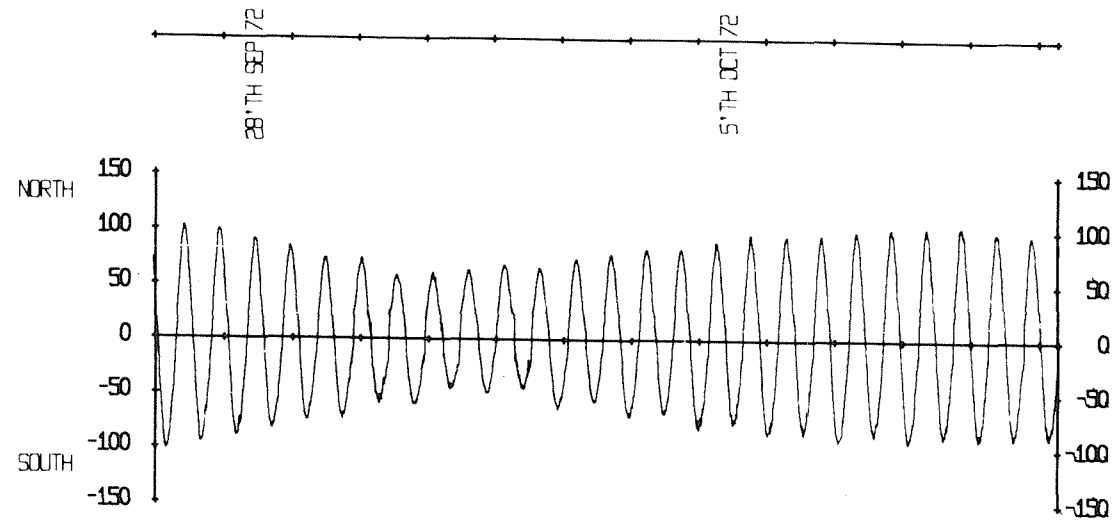
WAVE ANGLE



EAST

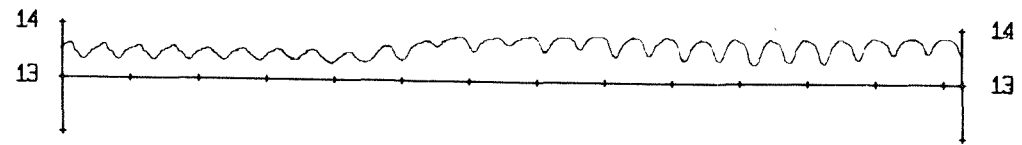


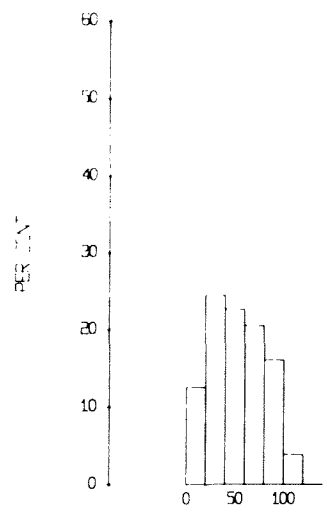
WEST



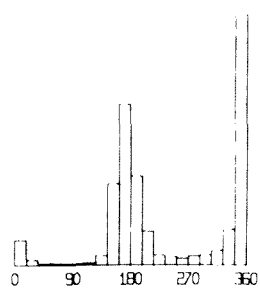
VELOCITY IN CM/SEC

TEMPERATURE IN DEG C

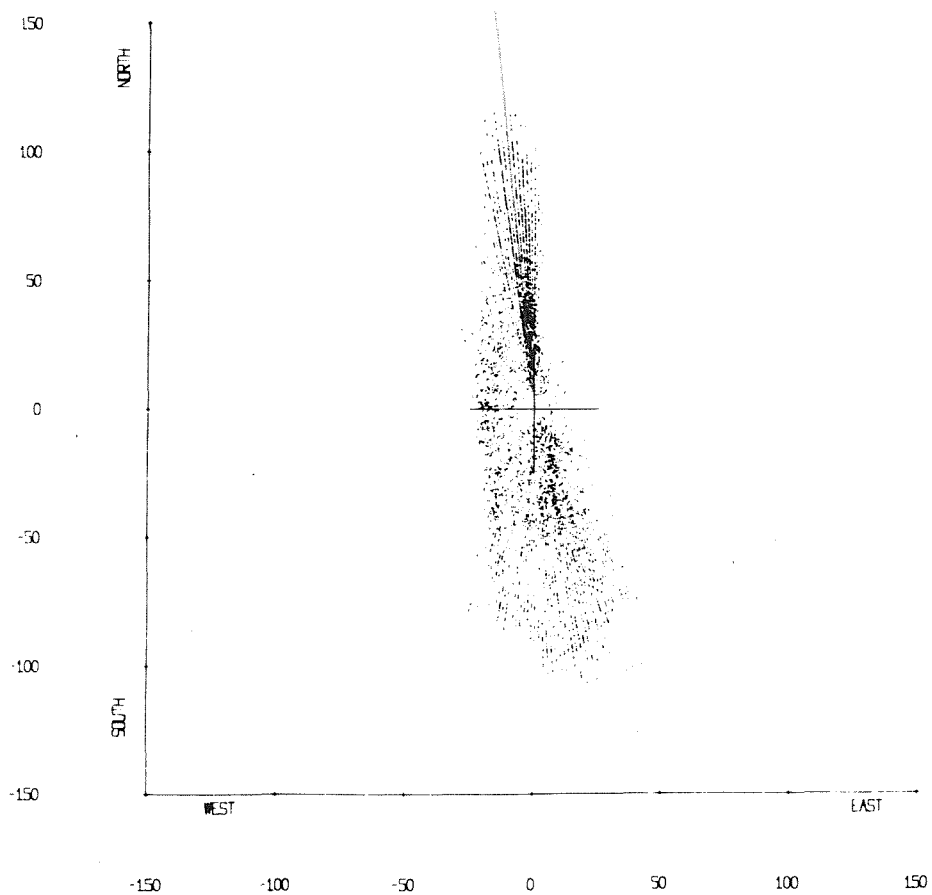


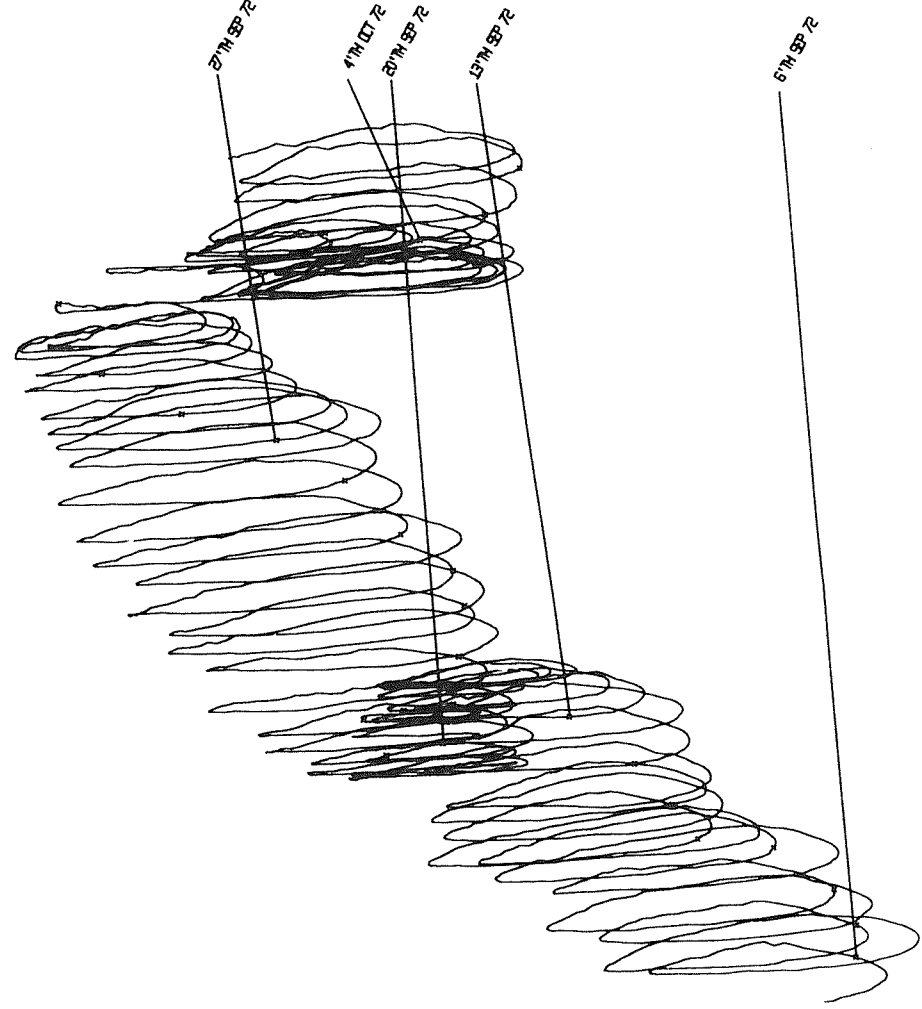
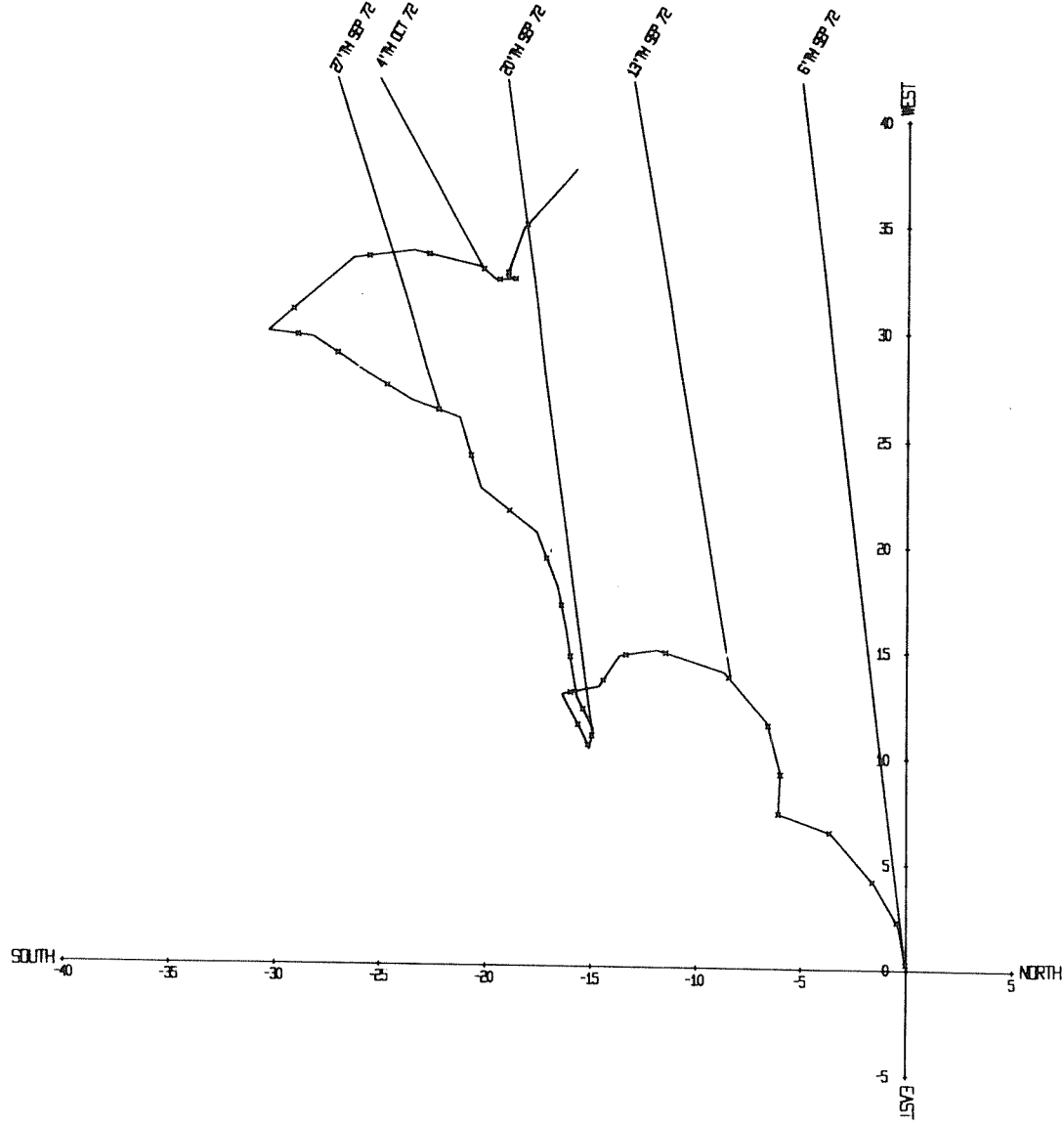


SPEED IN OM/SEC



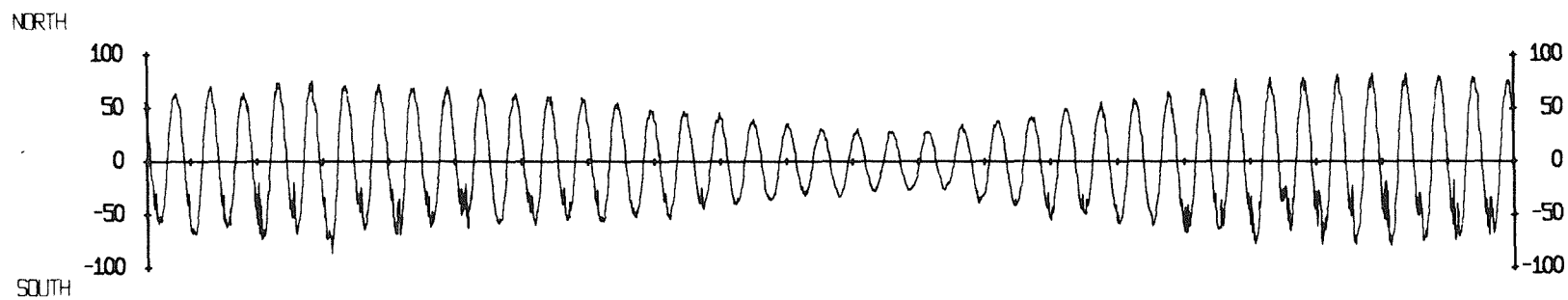
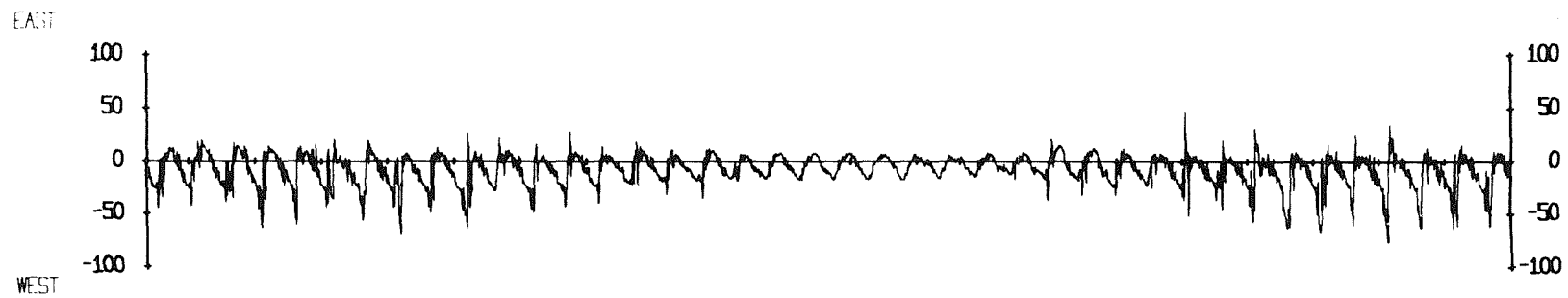
DIRECTION



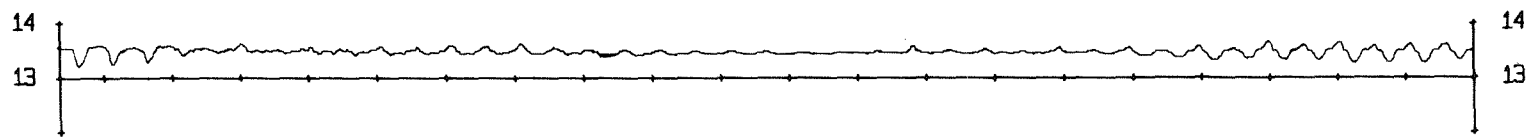


Meter	:	Bergen 212
Tape number	:	212/16
Meter started	:	09.19.27 GMT 5 Sept 1972
Meter stopped	:	10.06.55 GMT 11 Oct 1972
Total number of readings	:	5190
Timing error	:	2 mins 32 secs fast
Start of useful record	:	08.40 GMT 6 Sept 1972
End of useful record	:	06.27 GMT 10 Oct 1972
Length of useful record	:	814 hours
Comments	:	The velocity record is suspect at times of peak currents during spring tides when the rig appears to interfere with the operation of the meter.

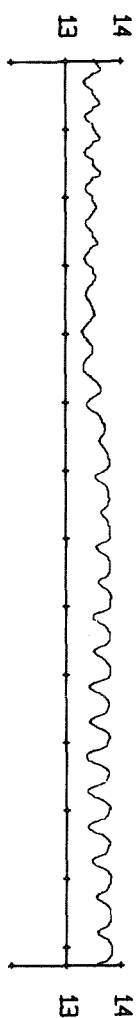
VELOCITY IN CM/SEC



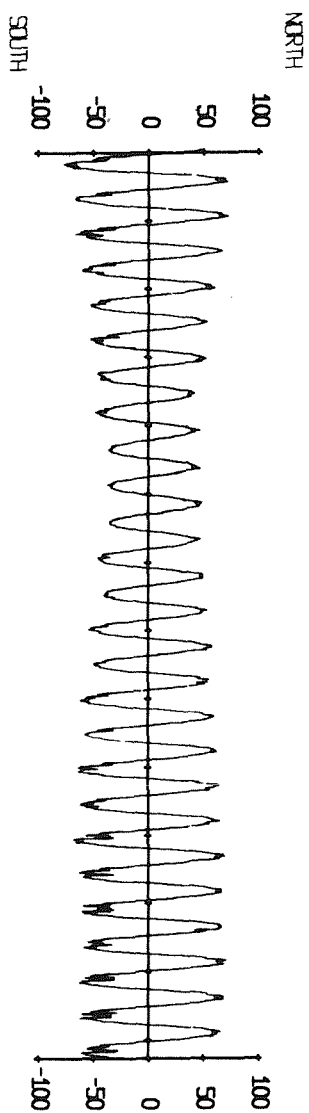
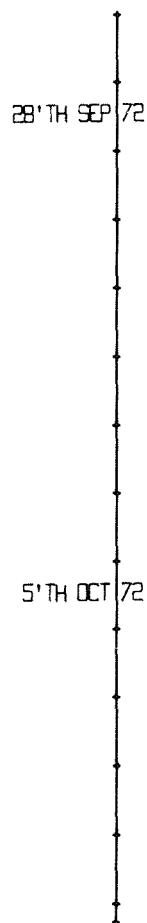
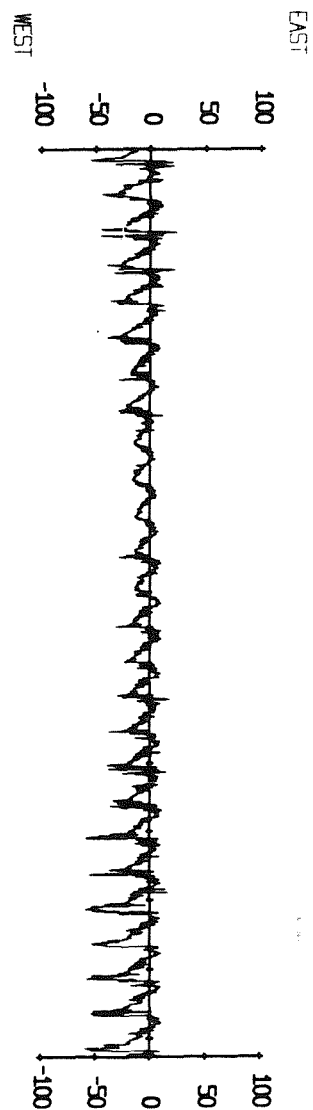
TEMPERATURE IN DEG C

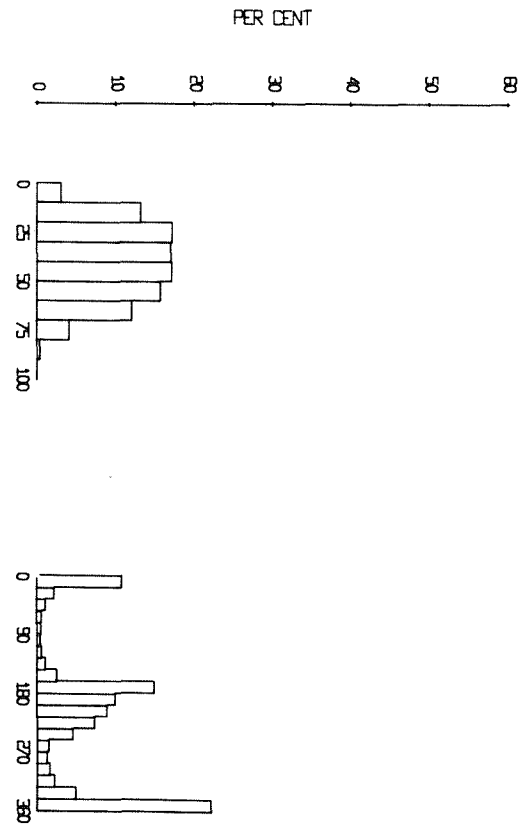


TEMPERATURE IN DEG C



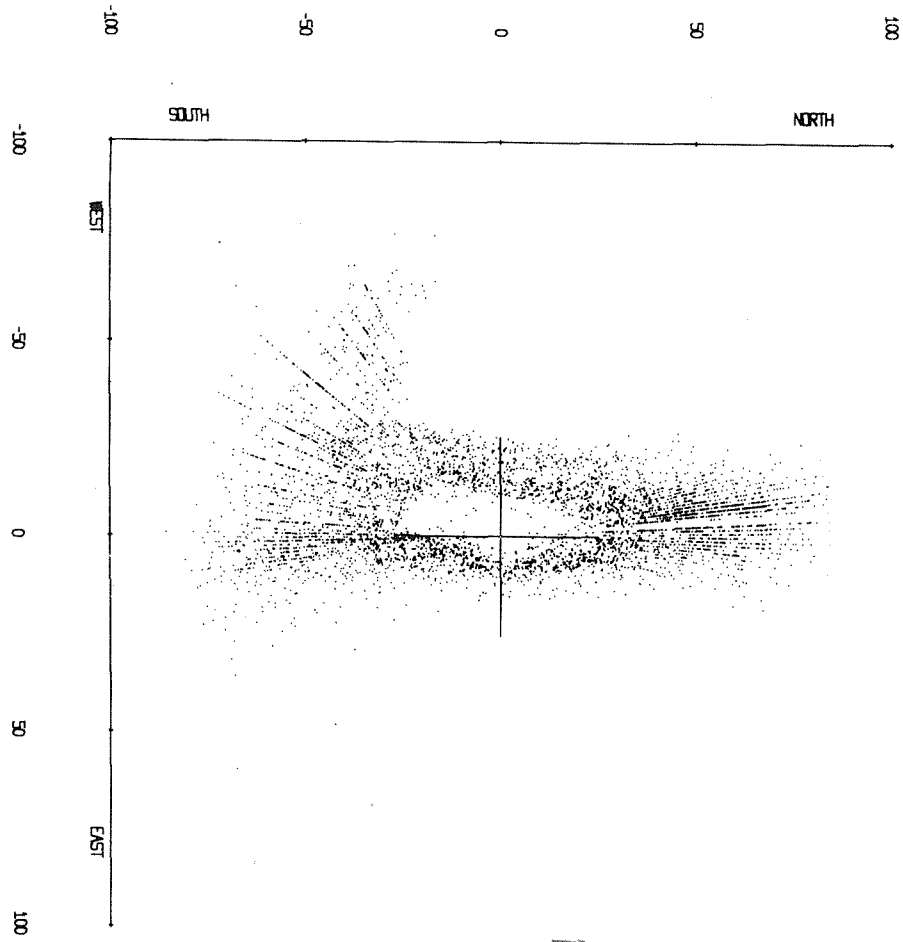
VELOCITY IN CM/SEC



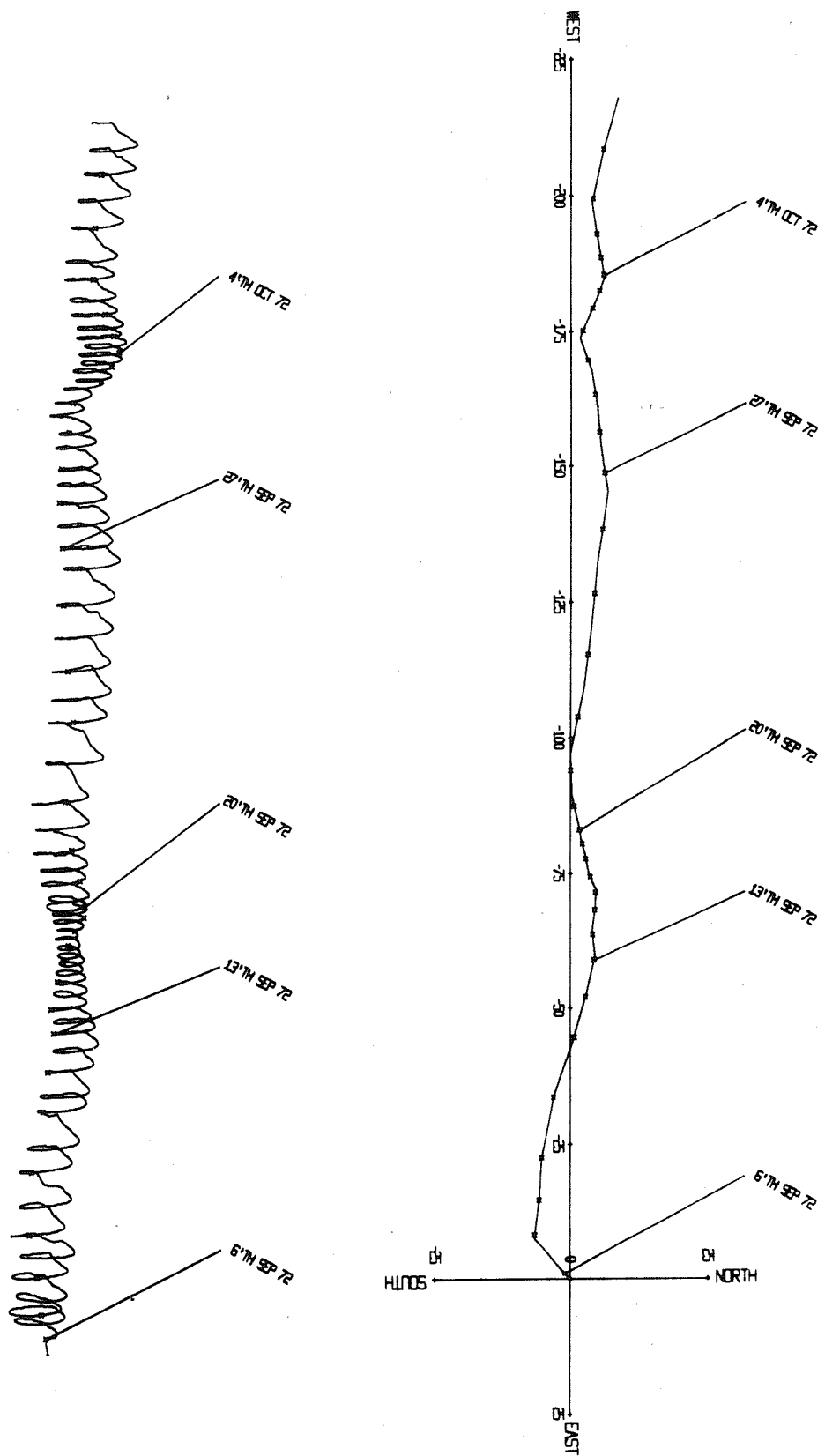


SPEED IN CM/SEC

DIRECTION



poor record



Mooring number : 22
 Position of rig : Lat 53°26'N Long 5°33'W (rig G)
 Depth of water : 78 m below chart datum
 Tidal heights, in metres : MHWS MHWN MLWN MLWS
 above chart datum, 3.9 3.2 1.2 0.3
 at Dublin

Meter	Type	Height above sea floor (metres)	Recording interval (min.)
406	Bergen	68	10
160	Bergen	42	10
532	Bergen	7	10

Rig set : 10.36 GMT 6 Sept 1972
 from R.R.S. John Murray
 Rig recovered : 16.52 GMT 9 Oct 1972
 from R.R.S. John Murray
 Mooring : Standard. The sub-surface buoy was a solid Slingsby and the top meter was equipped with a pressure transducer.
 Comments : The rig was successfully launched at the first attempt in calm seas, and recovered at the second attempt (the first attempt was at 15.30 on 9 Oct) in force 5-6 winds.

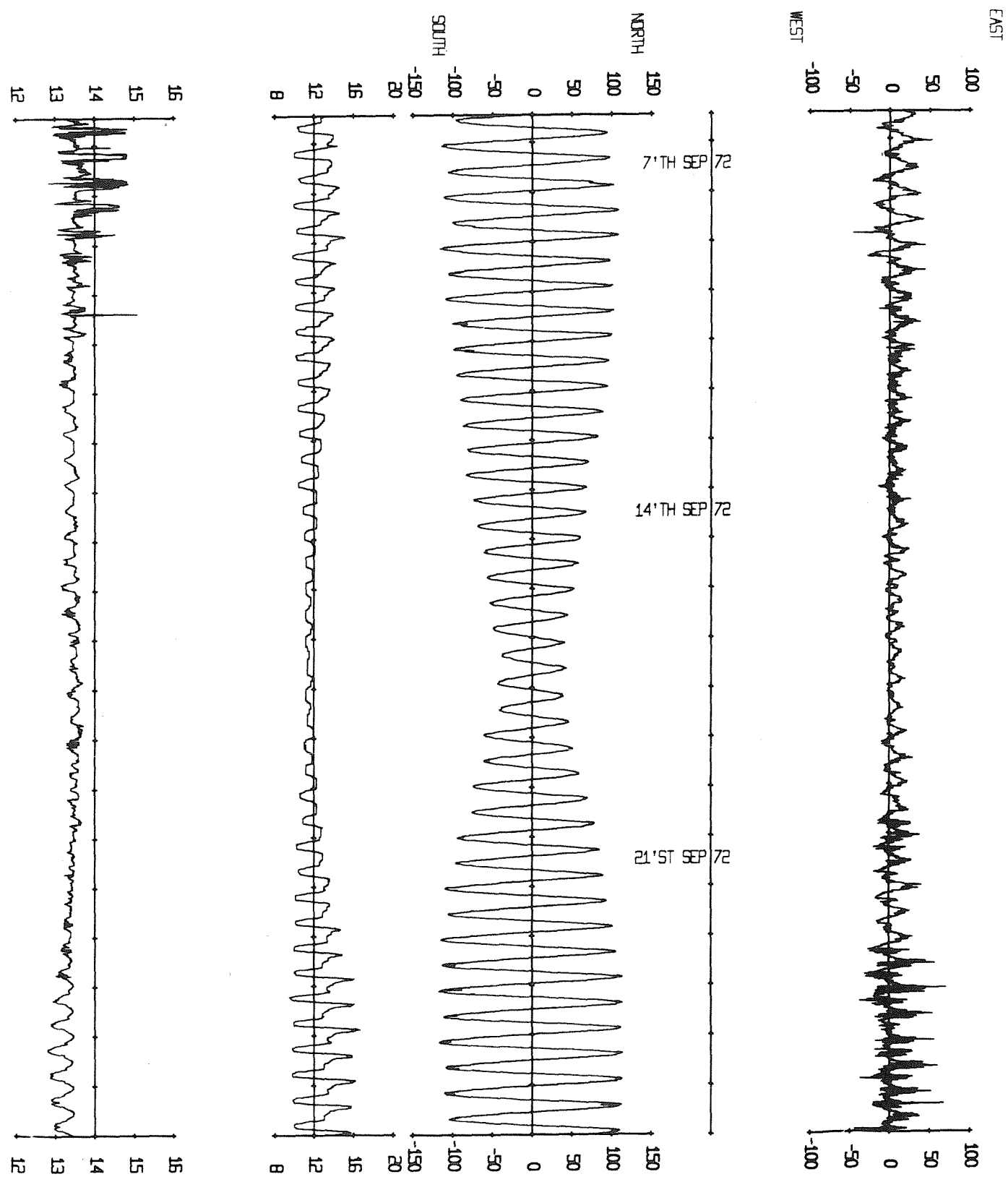
Meter	:	Bergen 406
Tape number	:	406/3
Meter started	:	10.30.02 GMT 5 Sept 1972
Meter stopped	:	05.08.44 GMT 14 Oct 1972
Total number of readings	:	5585
Timing error	:	1 min 18 secs fast
Start of useful record	:	10.50 GMT 6 Sept 1972
End of useful record	:	16.39 GMT 9 Oct 1972
Length of useful record	:	798 hours
Comments	:	Good record. This meter was fitted with a quartz-crystal clock and a pressure transducer and was on loan from the Department of Oceanography, Liverpool University.

TEMPERATURE IN DEG C

PRESSURE IN

VELOCITY IN CM/SEC

METRES OF WATER

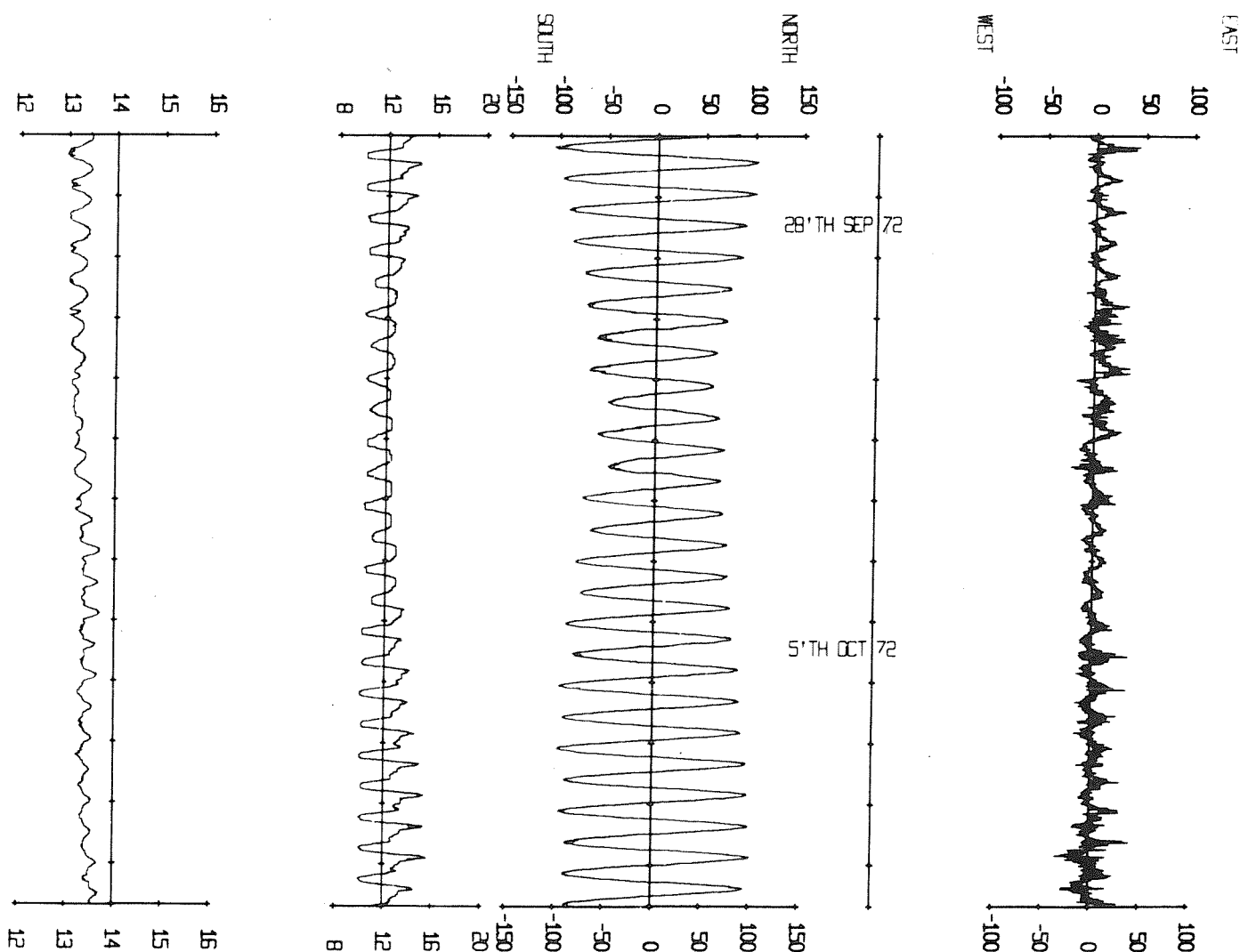


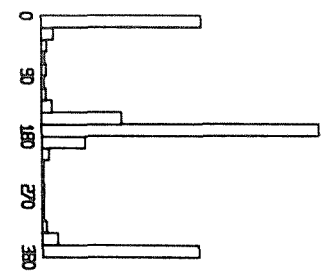
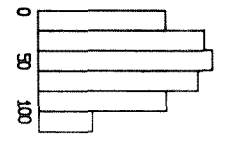
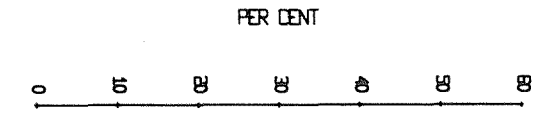
TEMPERATURE IN DEG C

PRESSURE IN

VELOCITY IN CM/SEC

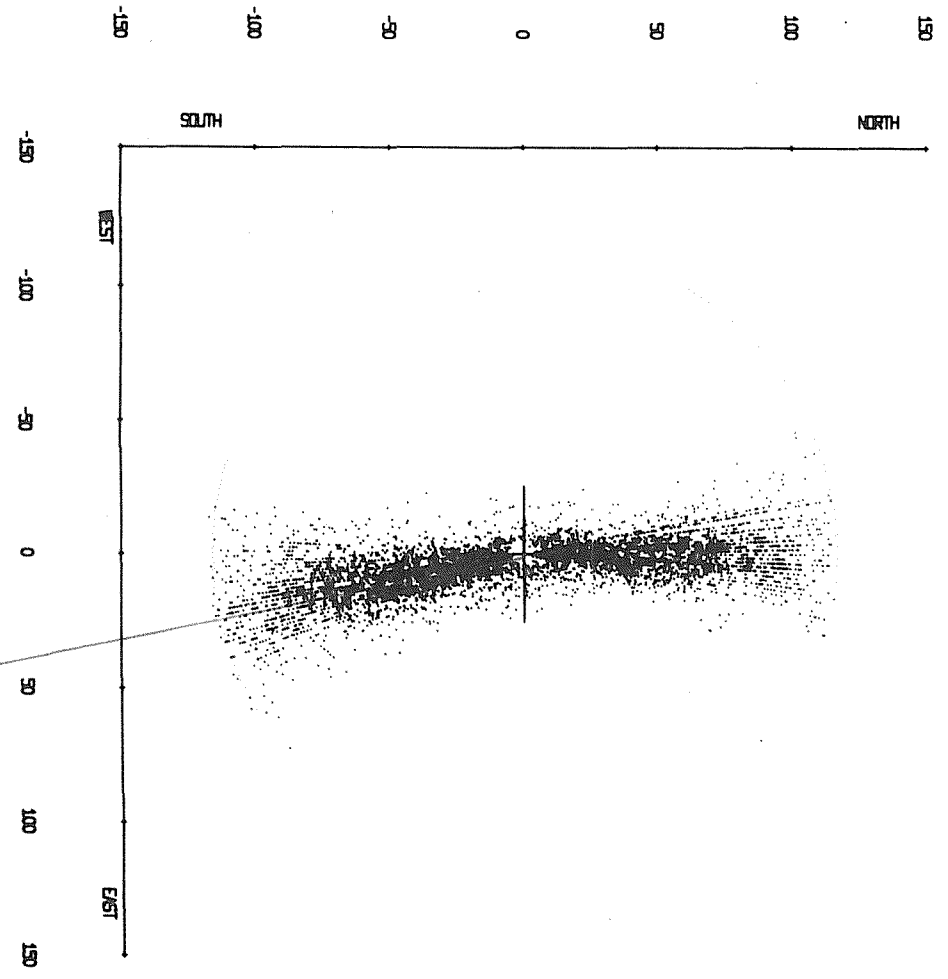
METRES OF WATER

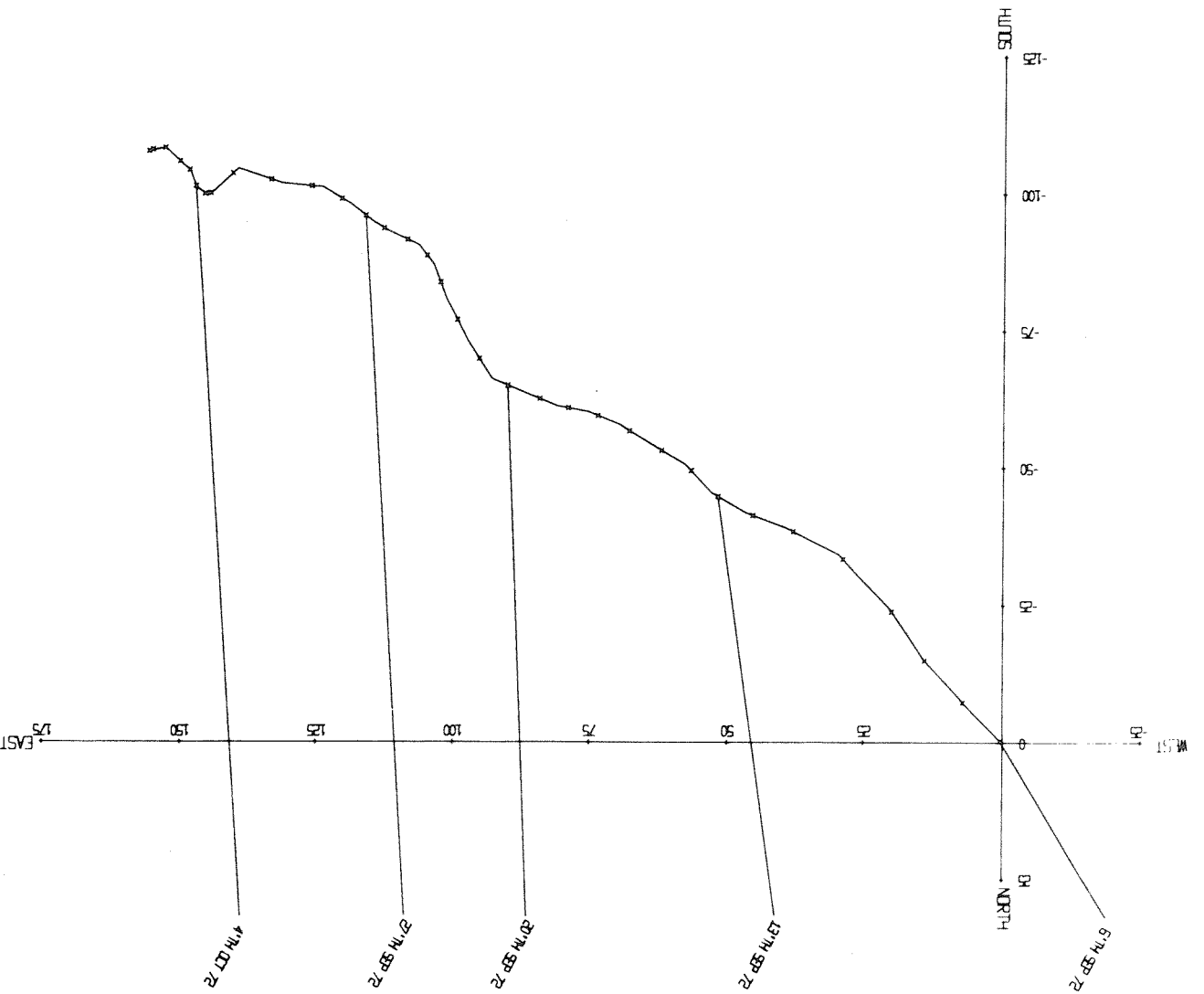
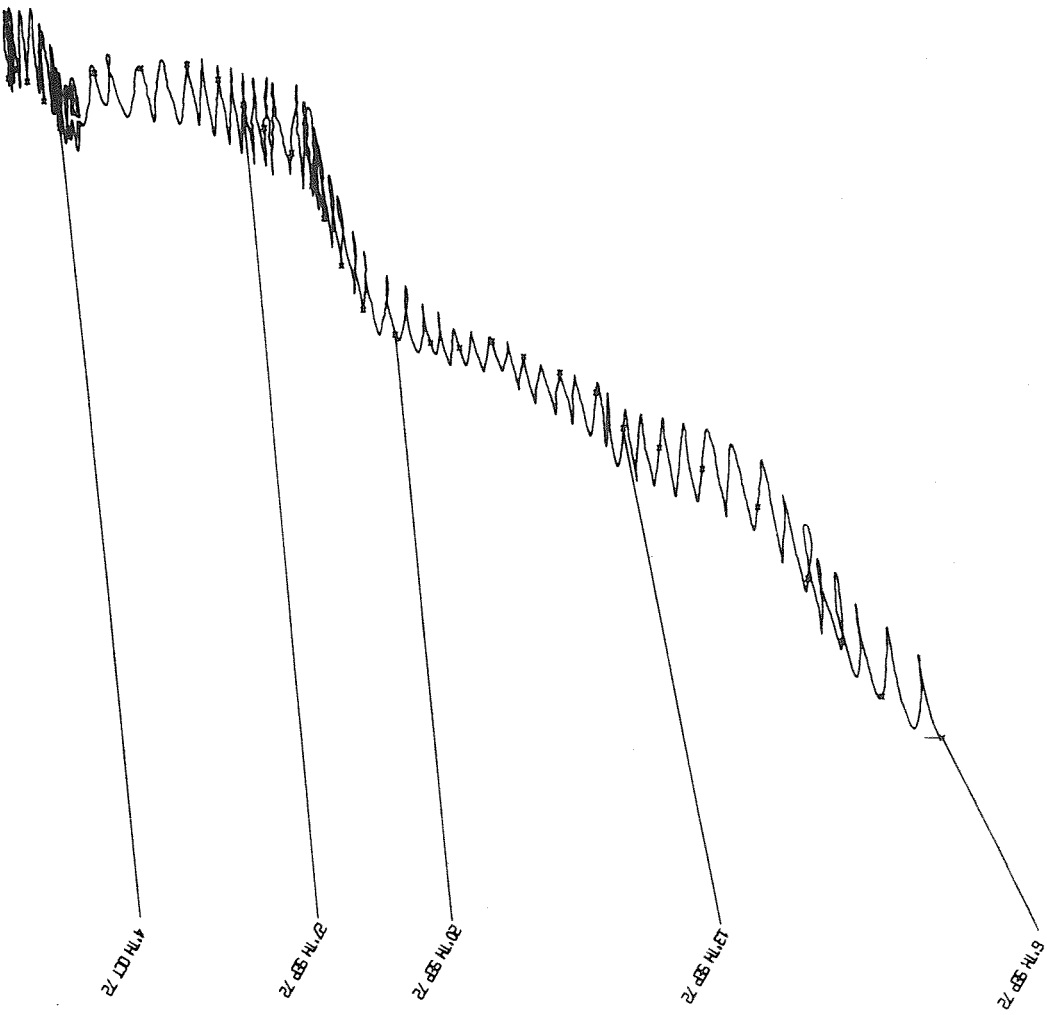




SPEED in KNOTS

DIRECTION

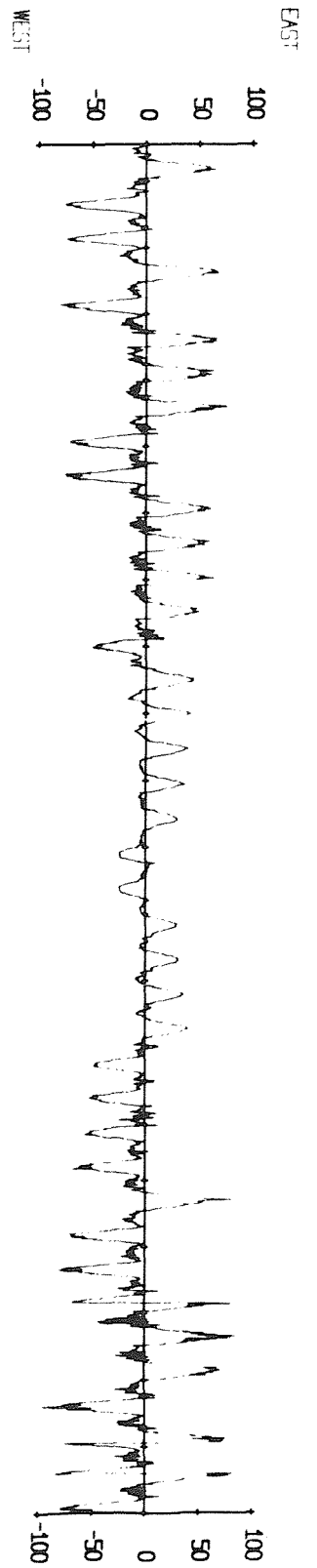
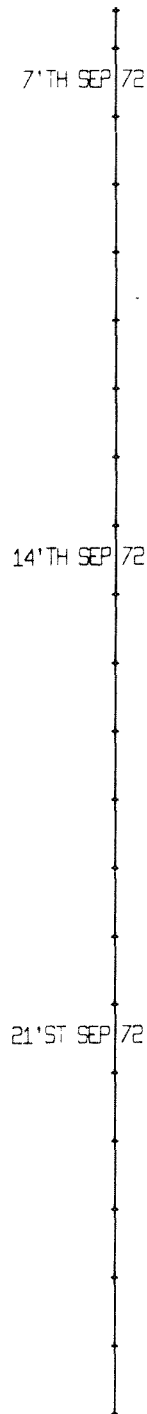
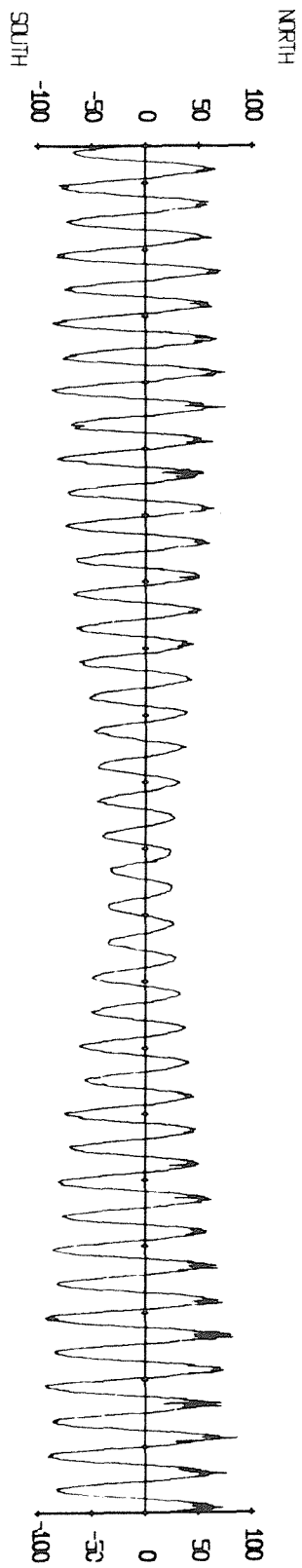
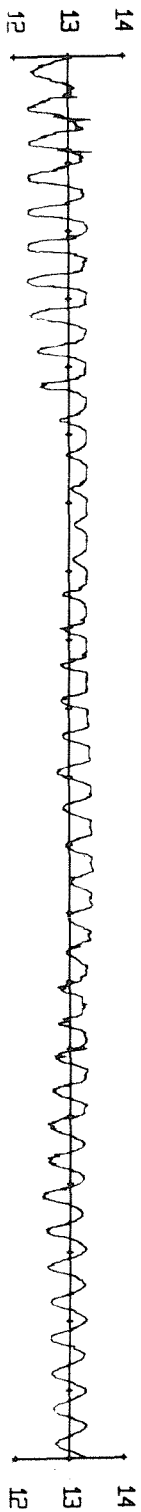




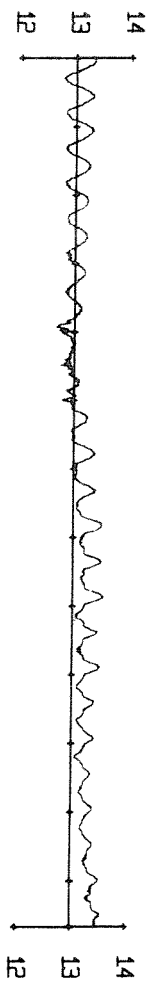
Meter	:	Bergen 160
Tape number	:	160/5
Meter started	:	08.56.46 GMT 5 Sept 1972
Meter stopped	:	19.00.50 GMT 13 Oct 1972
Total number of readings	:	5530
Timing error	:	34 mins 04 secs slow
Start of useful record	:	10.48 GMT 6 Sept 1972
End of useful record	:	16.40 GMT 9 Oct 1972
Length of useful record	:	798 hours
Comments	:	The compass appears to be operating incorrectly when measuring north going currents. No corrections for the timing error have been applied to the data shown here.

TEMPERATURE IN DEG C

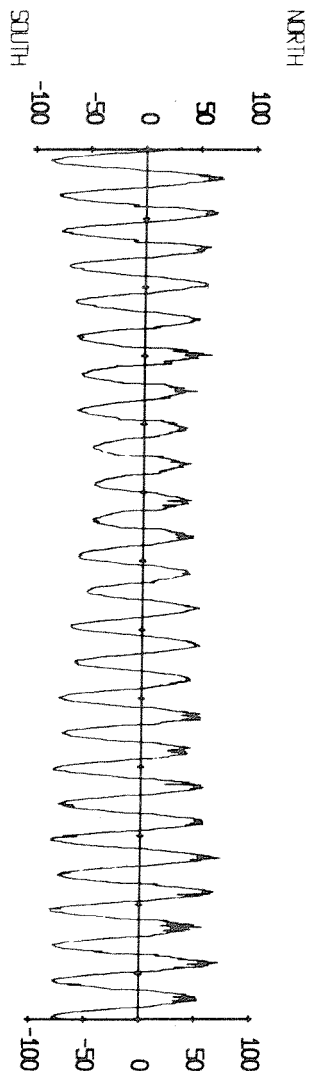
VELOCITY IN CM/SEC



TEMPERATURE IN DEG C

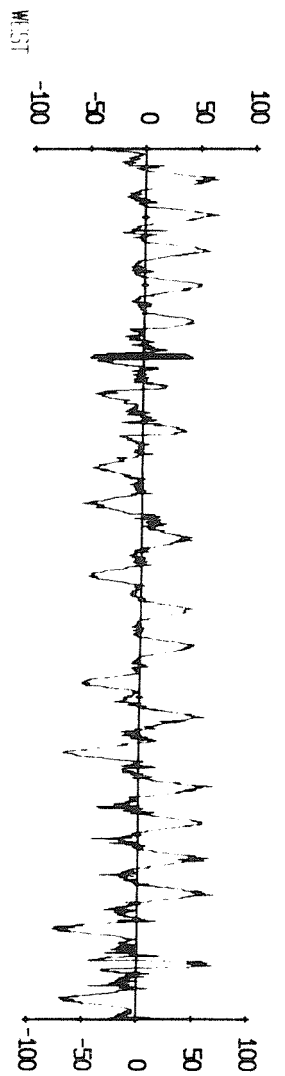


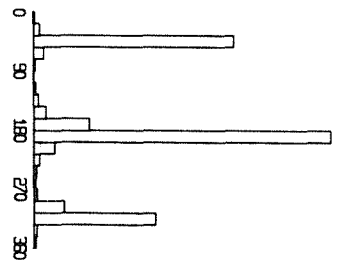
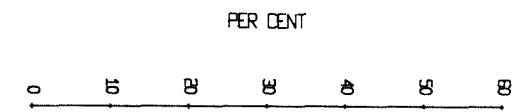
VELOCITY IN CM/SEC



28'TH SEP 72

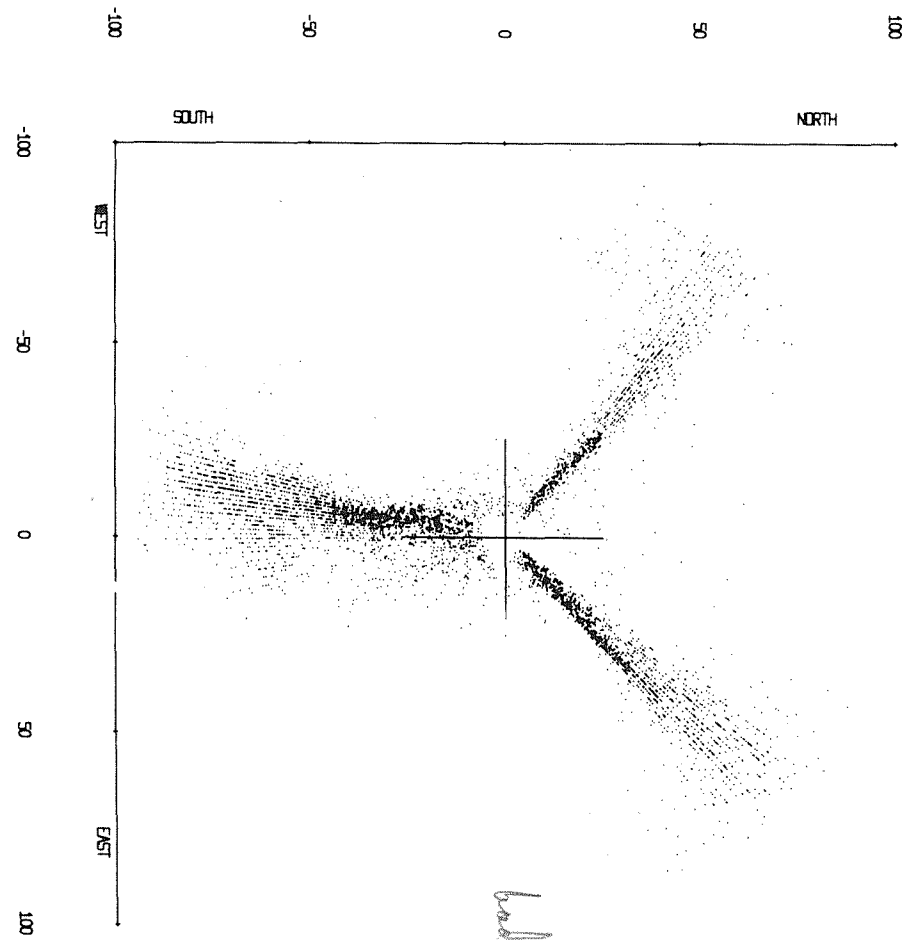
5'TH OCT 72

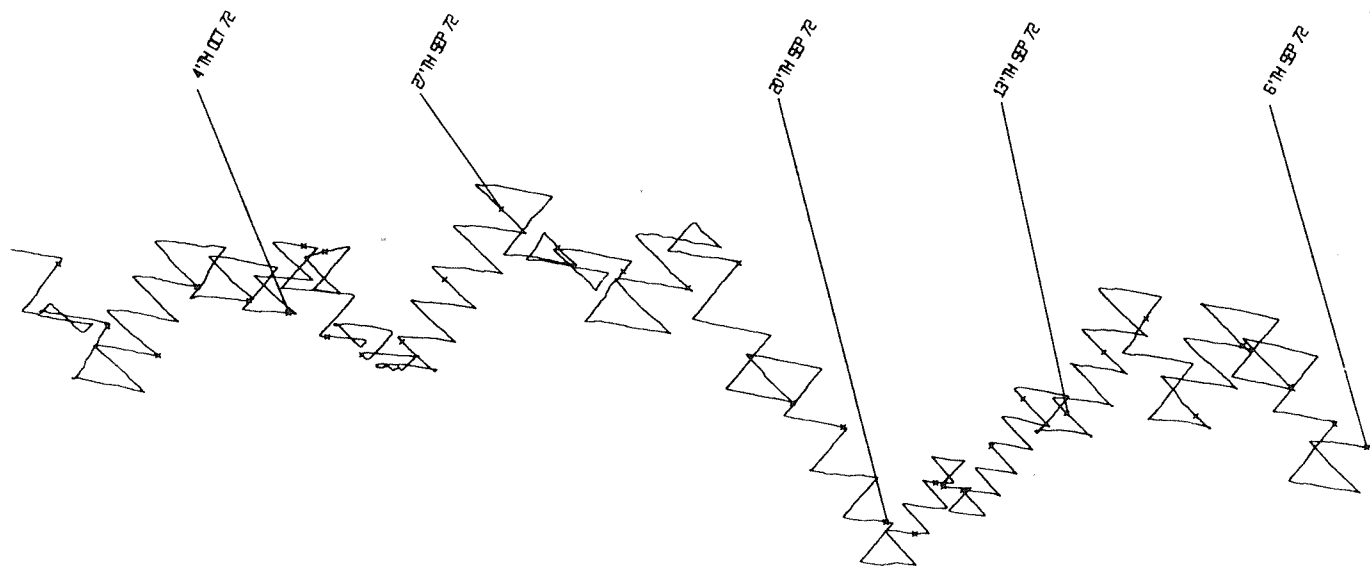
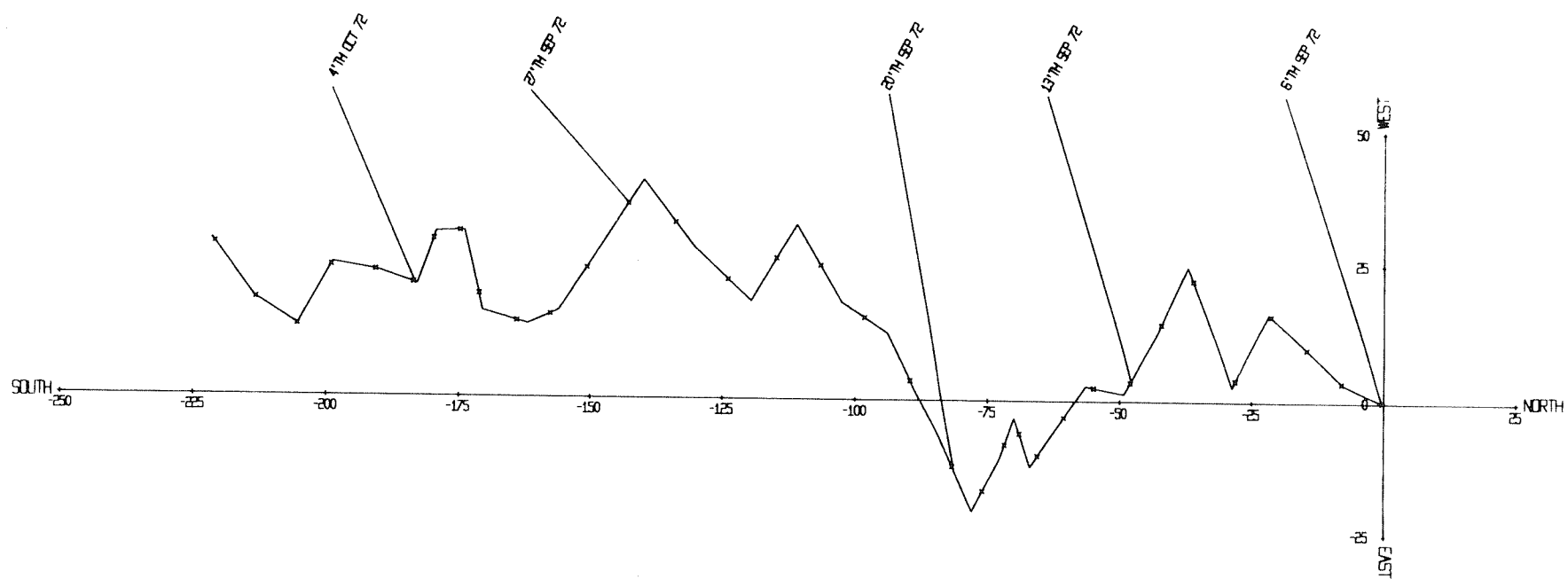




SPEED IN KM/SEC

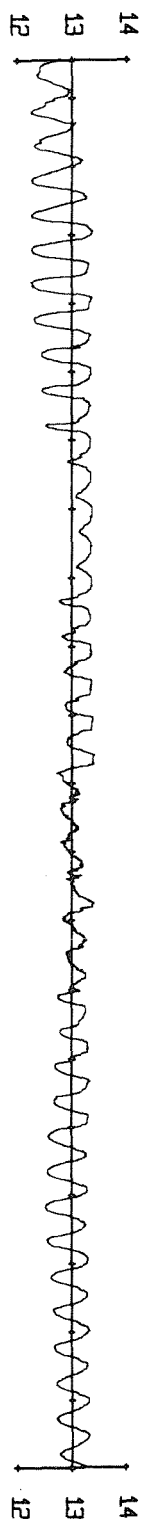
DIRECTION



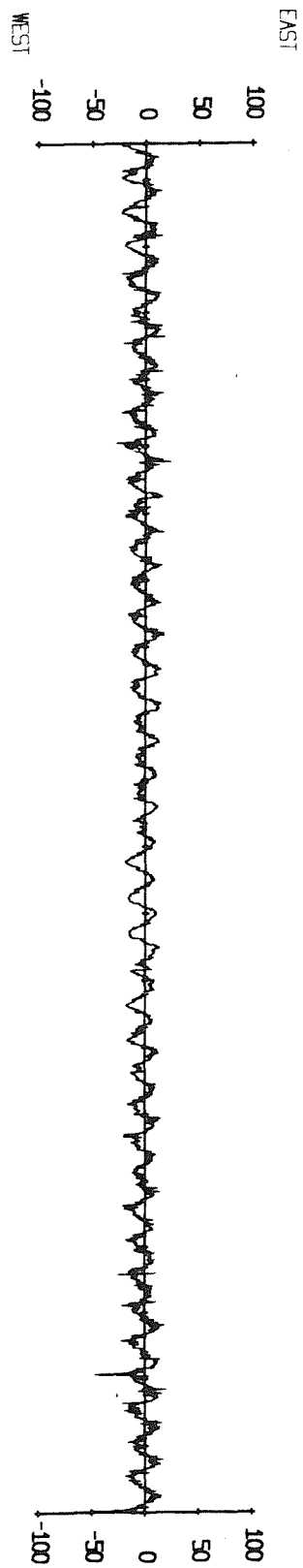
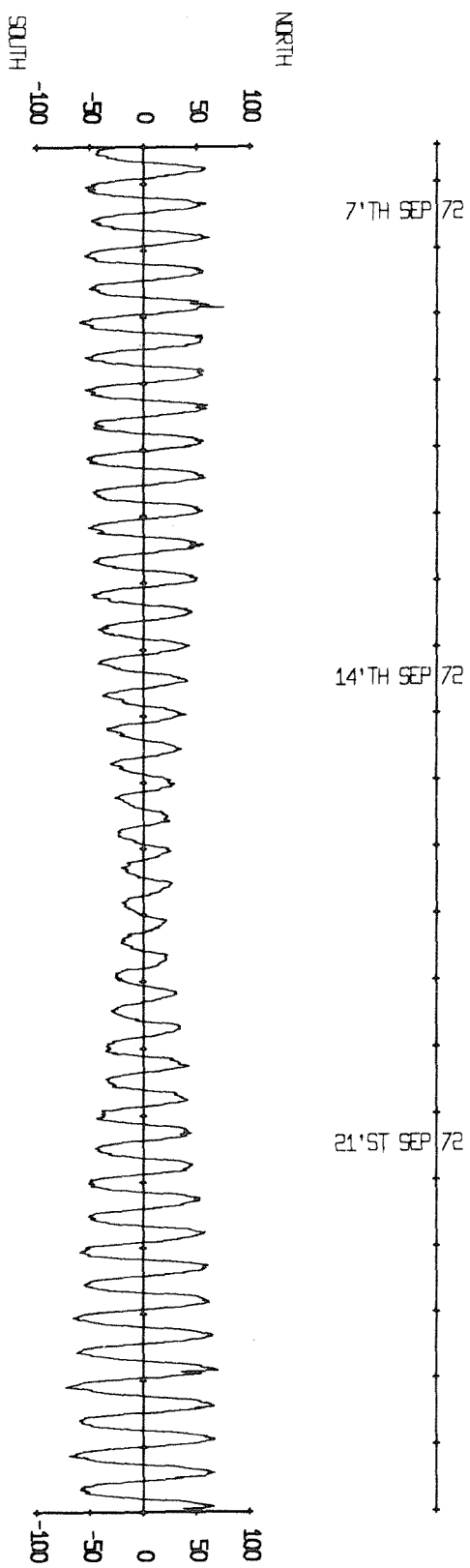


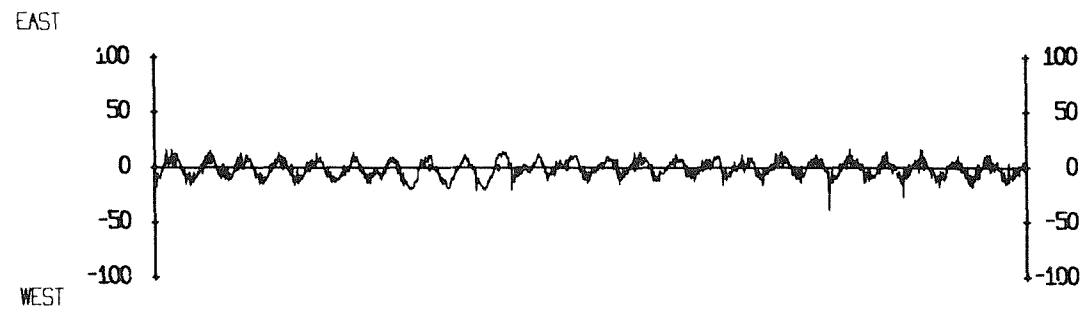
Meter	:	Bergen 532
Tape number	:	532/1
Meter started	:	13.00.01 GMT 5 Sept 1972
Meter stopped	:	18.09.43 GMT 10 Oct 1972
Total number of readings	:	5072
Timing error	:	18 secs fast
Start of useful record	:	10.50 GMT 6 Sept 1972
End of useful record	:	16.40 GMT 9 Oct 1972
Length of useful record	:	798 hours
Comments	:	Good record. This meter was fitted with a quartz-crystal clock.

TEMPERATURE IN DEG C

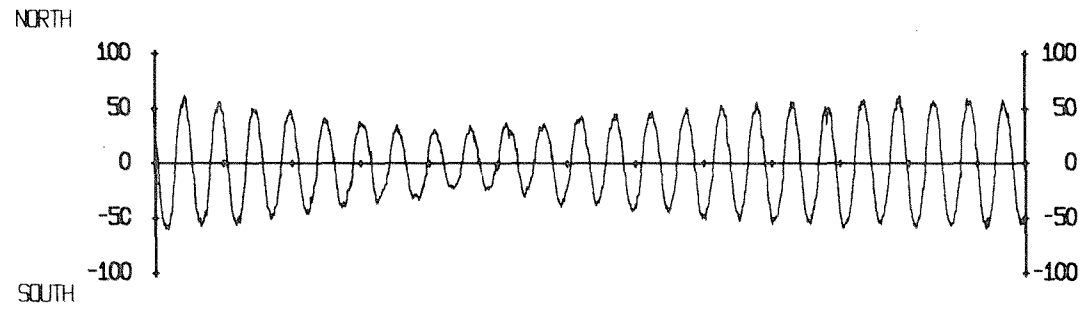


VELOCITY IN CM/SEC

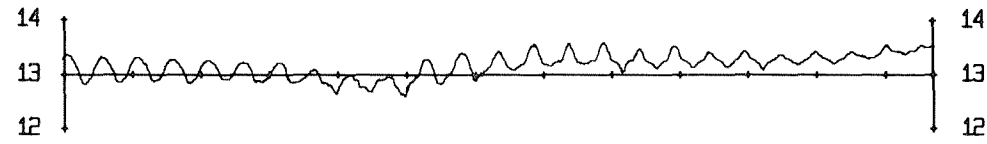


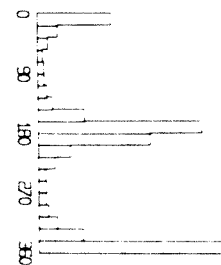
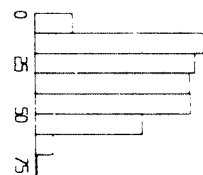
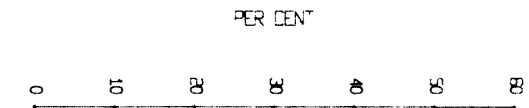


VELOCITY IN CM/SEC



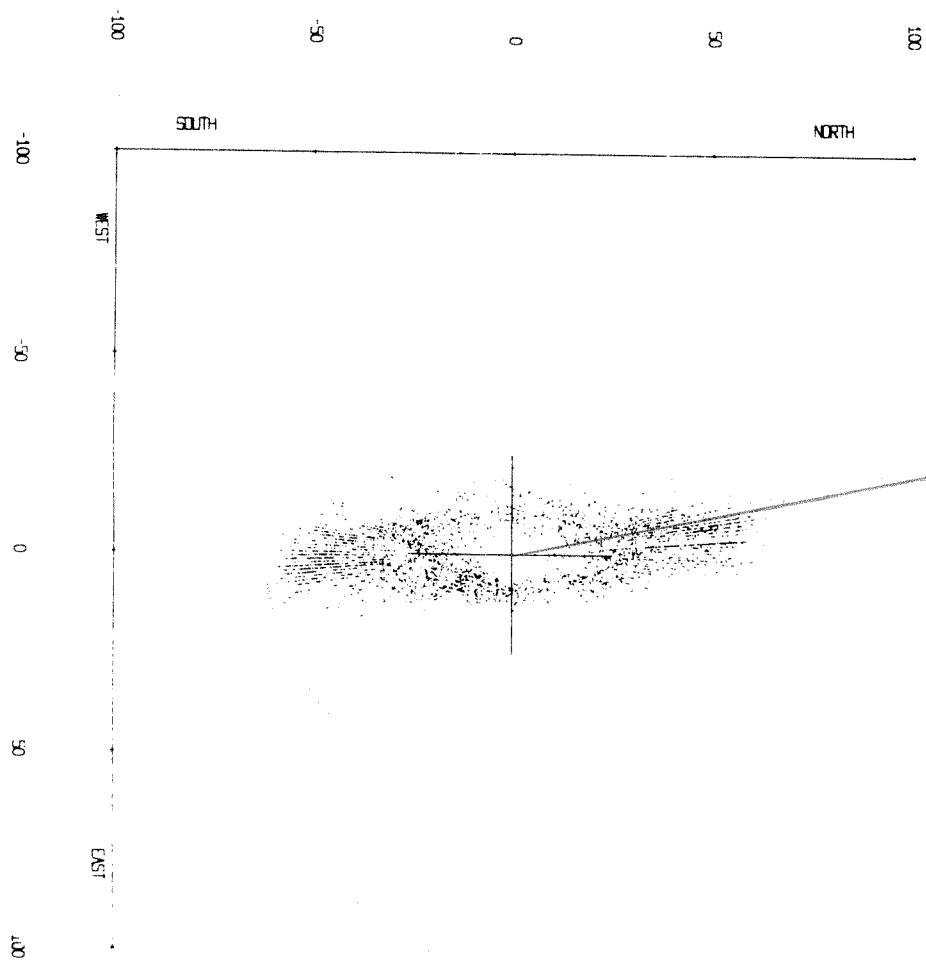
TEMPERATURE IN DEG C

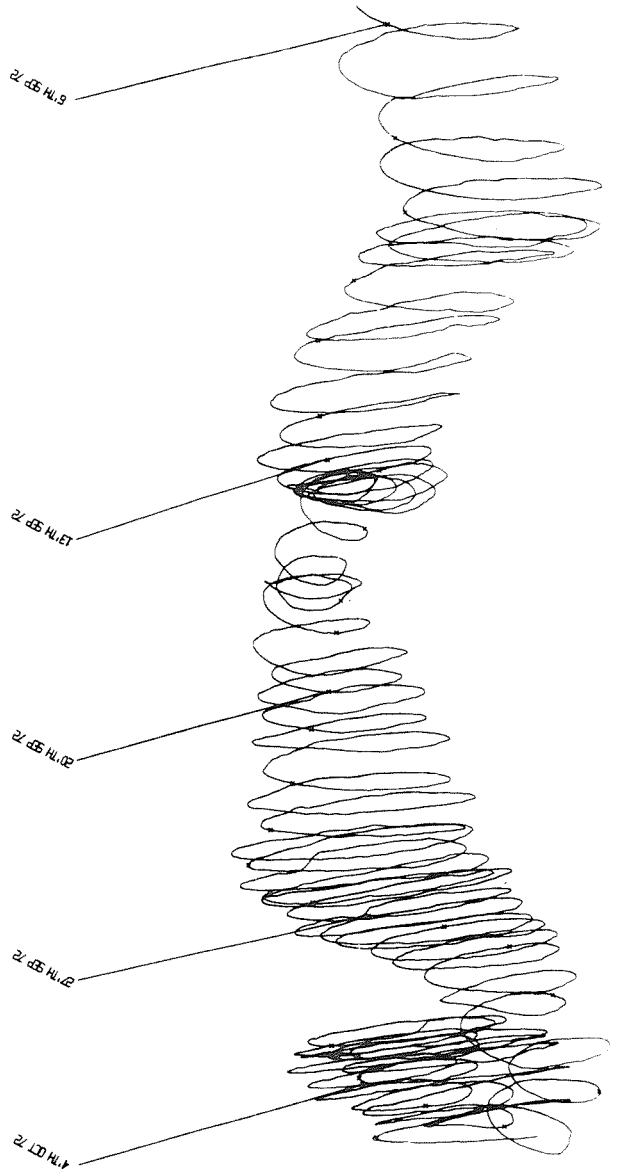
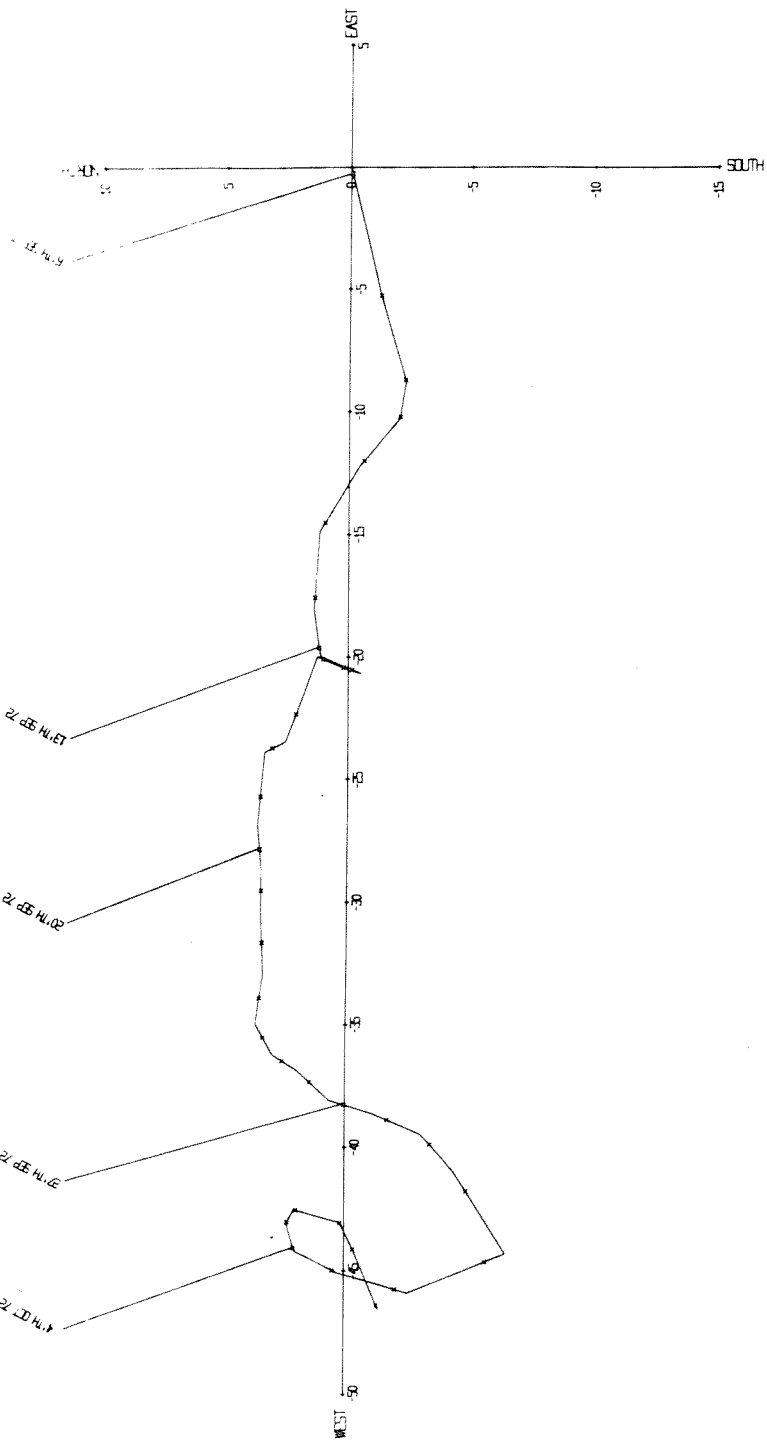




SPEED IN KNOTS

DIRECTION





Mooring number : 23
 Position of rig : Lat 53⁰26'N Long 5⁰22'W (rig GE)
 Depth of water : 83 m below chart datum
 Tidal heights, in metres : MHWS MHWN MLWN MLWS
 above chart datum,
 at Holyhead 5.1 3.9 1.4 0.2

Meter	Type	Height above sea floor (metres)	Recording interval (min.)
416	Bergen	72	10
530	Bergen	46	10
531	Bergen	7	10

Rig set : 12.59 GMT 6 Sept 1972
 from R.R.S. John Murray
 Rig recovered : 12.30 GMT 10 Oct 1972
 from R.R.S. John Murray
 Mooring : Standard. The sub-surface buoy
 was a Cosalt and the top meter
 was equipped with a pressure
 transducer.
 Comments : The rig was successfully launched
 and recovered at the first attempt
 in calm seas. A N.I.O. type off-
 shore tide gauge was deployed near
 this rig.

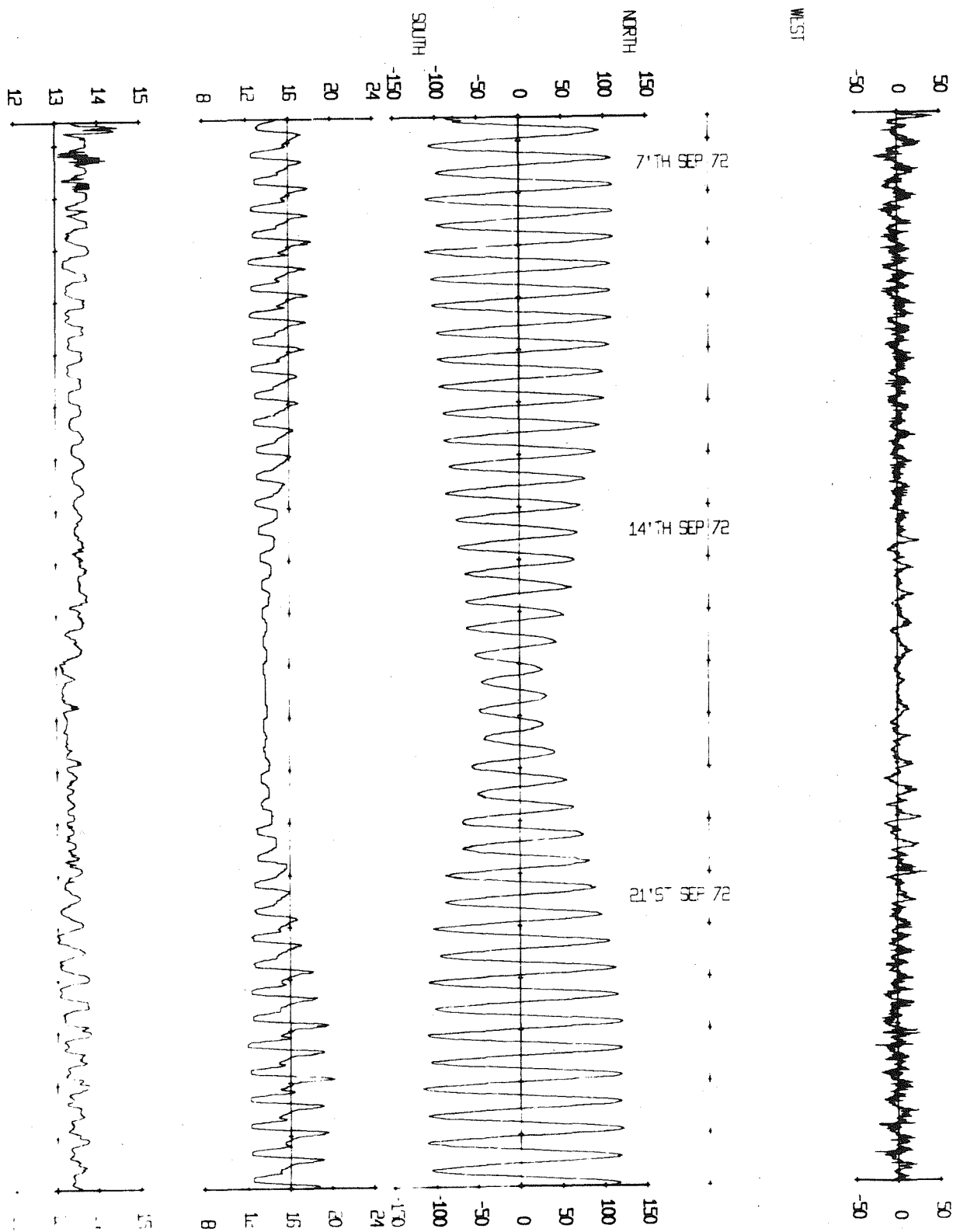
Meter	:	Bergen 416
Tape number	:	416/3
Meter started	:	11.29.52 GMT 6 Sept 1972
Meter stopped	:	15.44.02 GMT 13 Oct 1972
Total number of readings	:	5355
Timing error	:	5 mins 50 secs fast
Start of useful record	:	13.10 GMT 6 Sept 1972
End of useful record	:	12.14 GMT 10 Oct 1972
Length of useful record	:	815 hours
Comments	:	<p>Good record. This meter was fitted with a quartz-crystal clock and a pressure transducer. It was intended to be the top meter on rig GS but was dropped onto the ship's deck during the launch of GS, smashing its rotor and bending its rotor guard. The rotor guard was straightened and a new rotor installed.</p> <p>On recovery it was noticed that its spindle was bent and this probably occurred during the recovery. No timing corrections have been applied to the data shown here.</p>

TEMPERATURE IN DEG C

PRESSURE IN

VELOCITY IN CM/SEC

METRES OF WATER

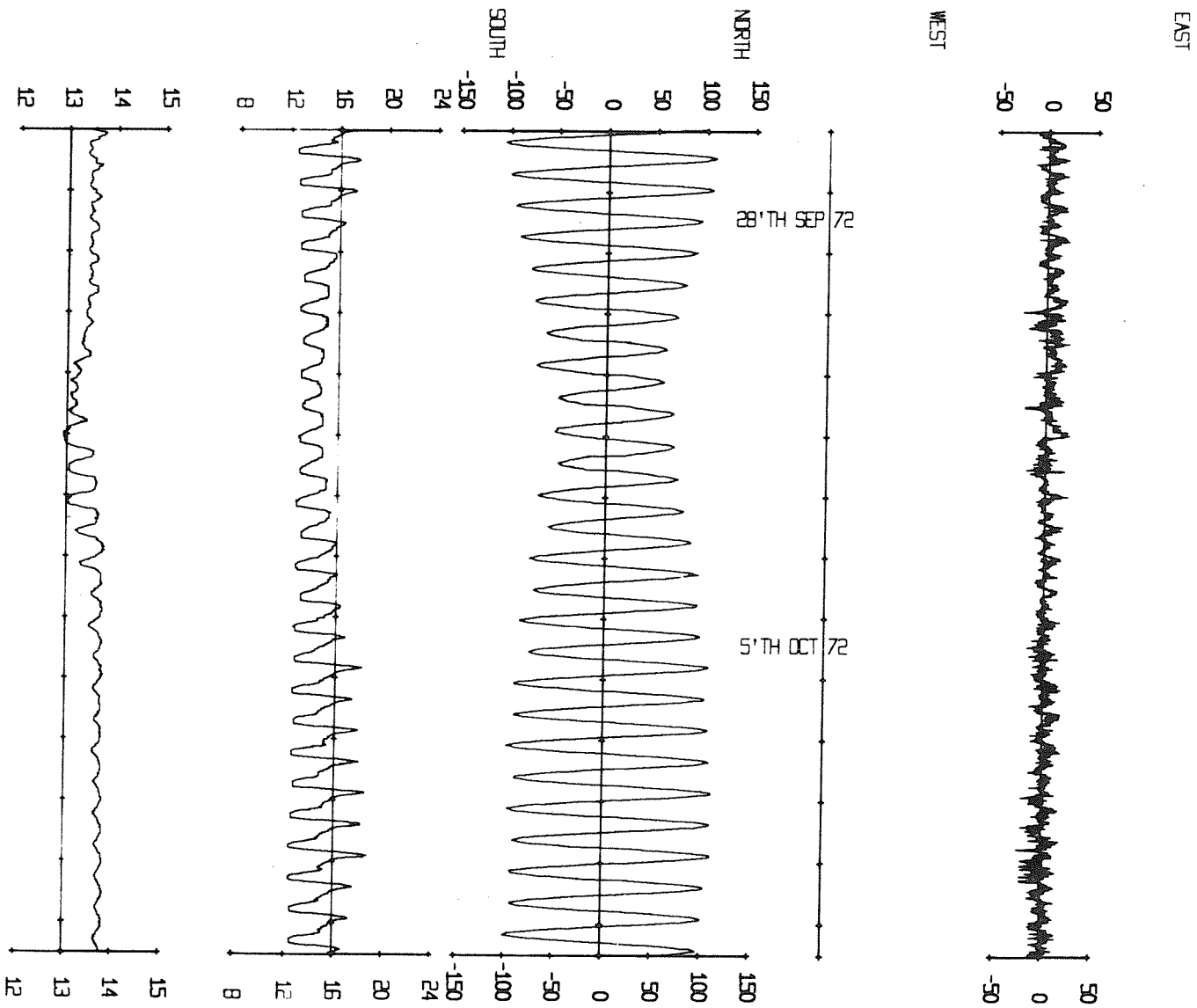


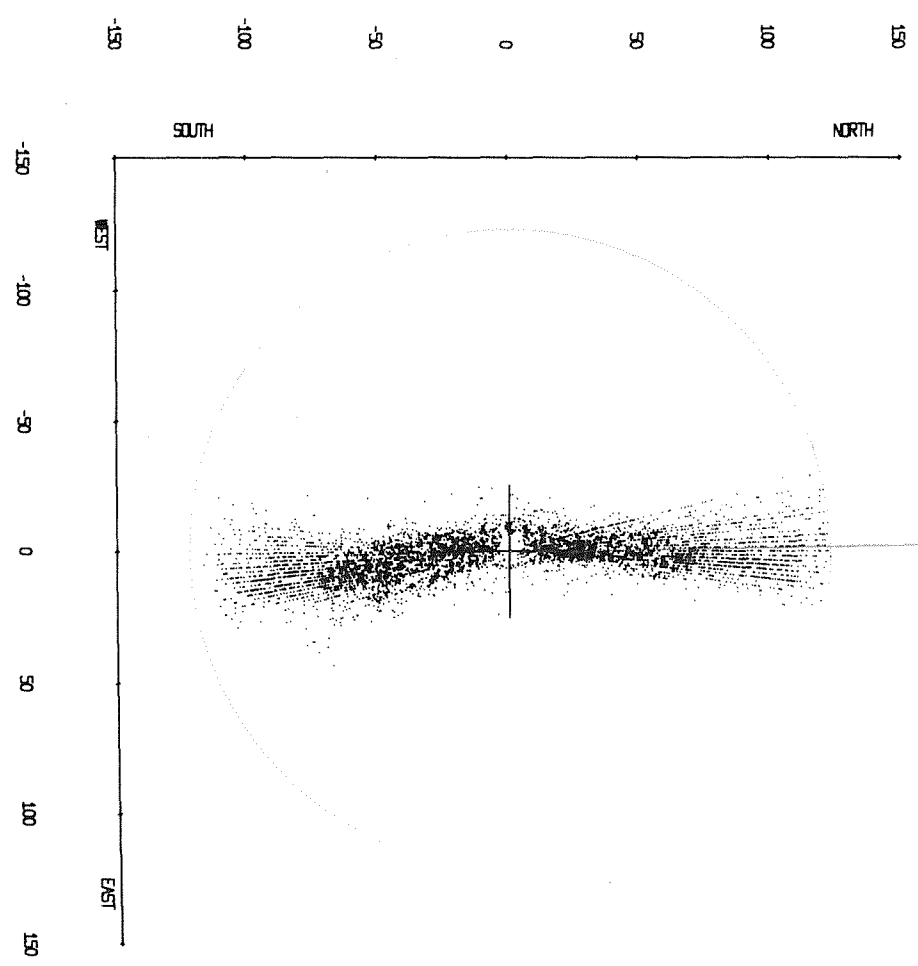
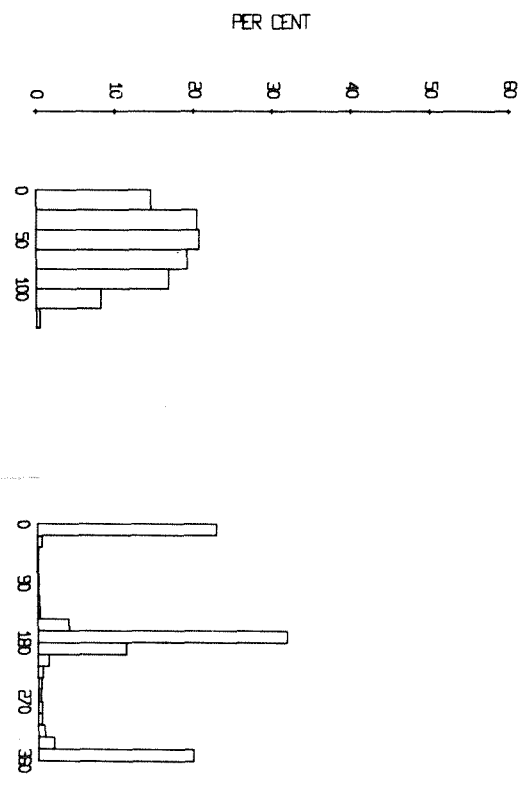
TEMPERATURE IN DEG C

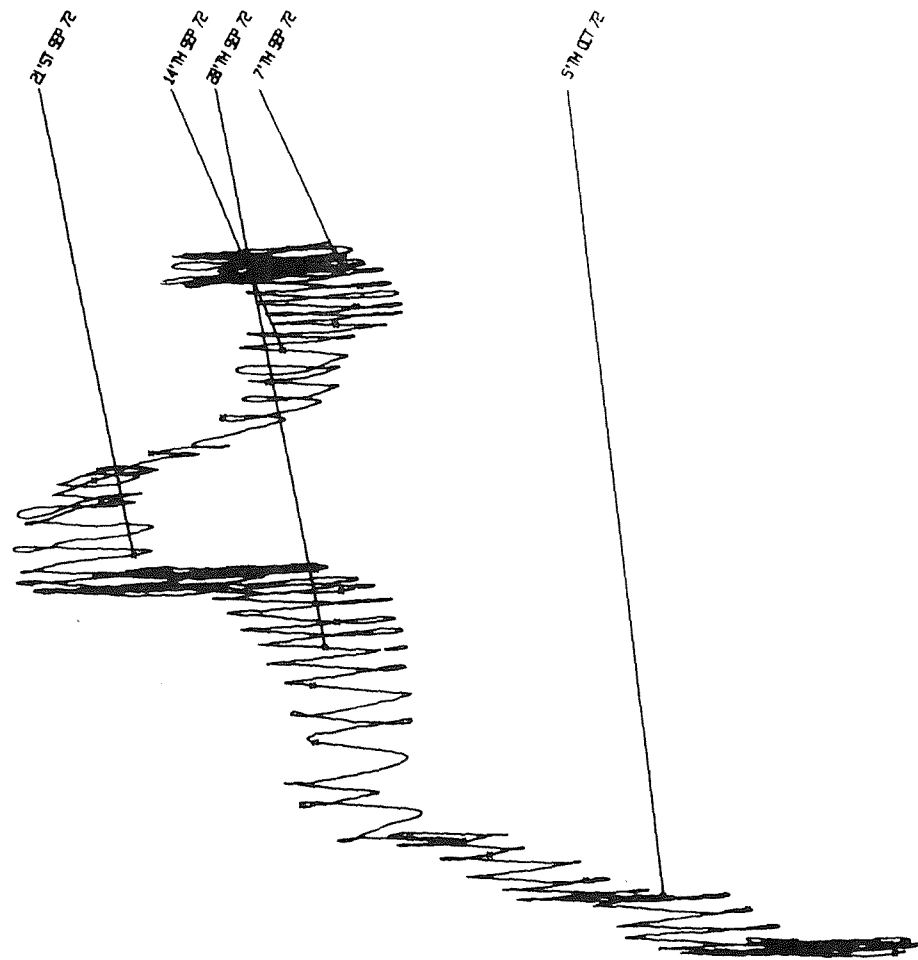
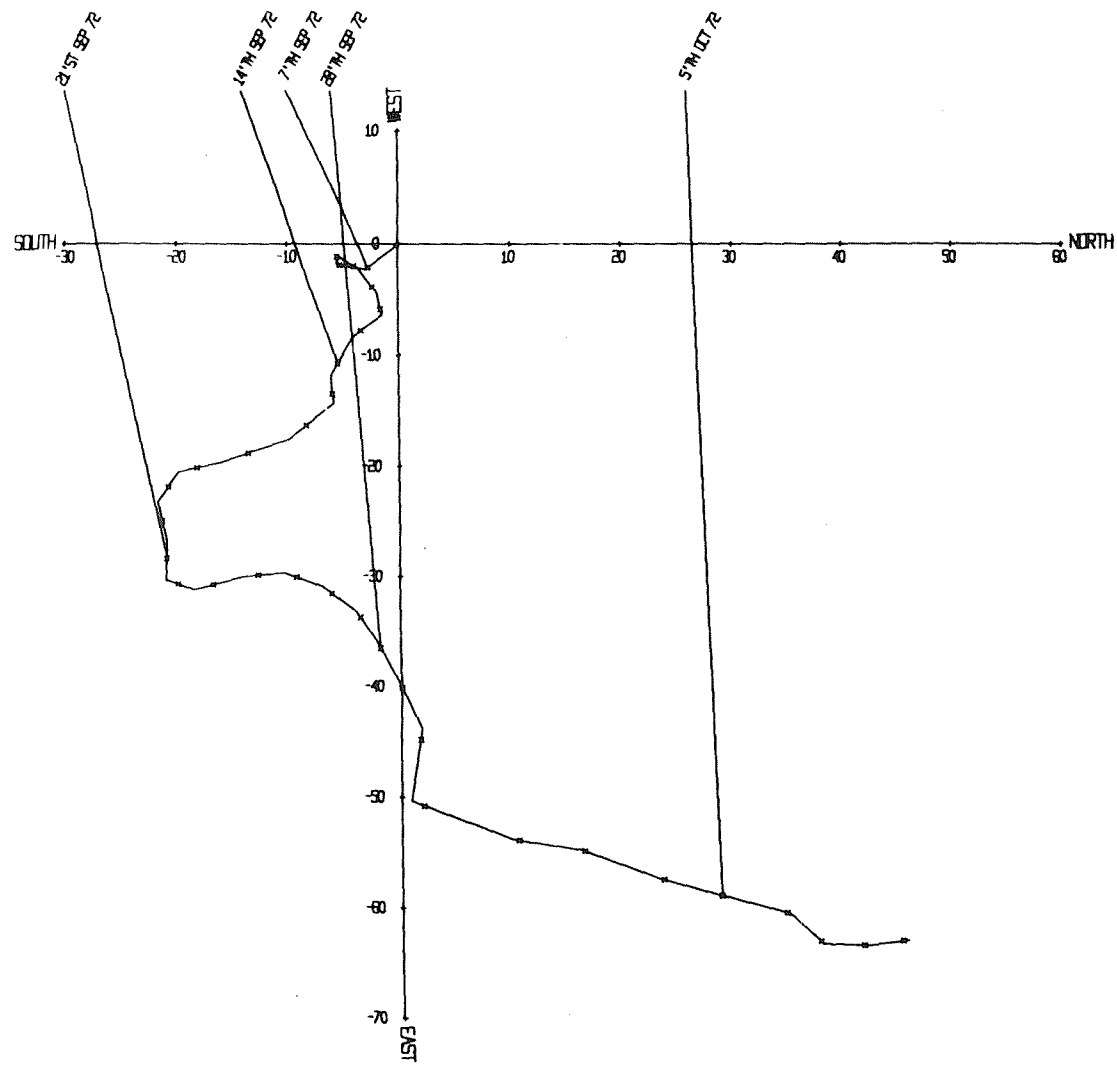
PRESSURE IN

VELOCITY IN CM/SEC

METRES OF WATER



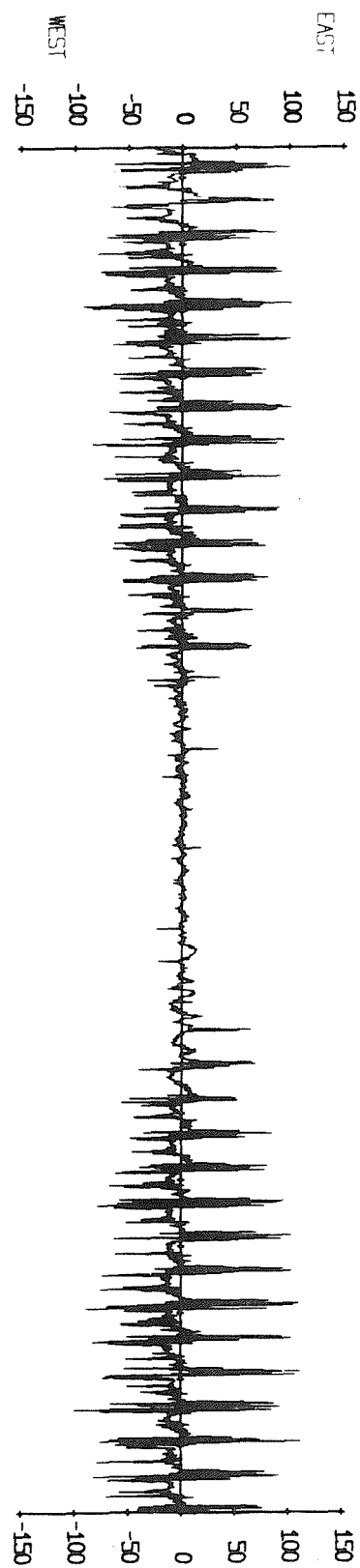
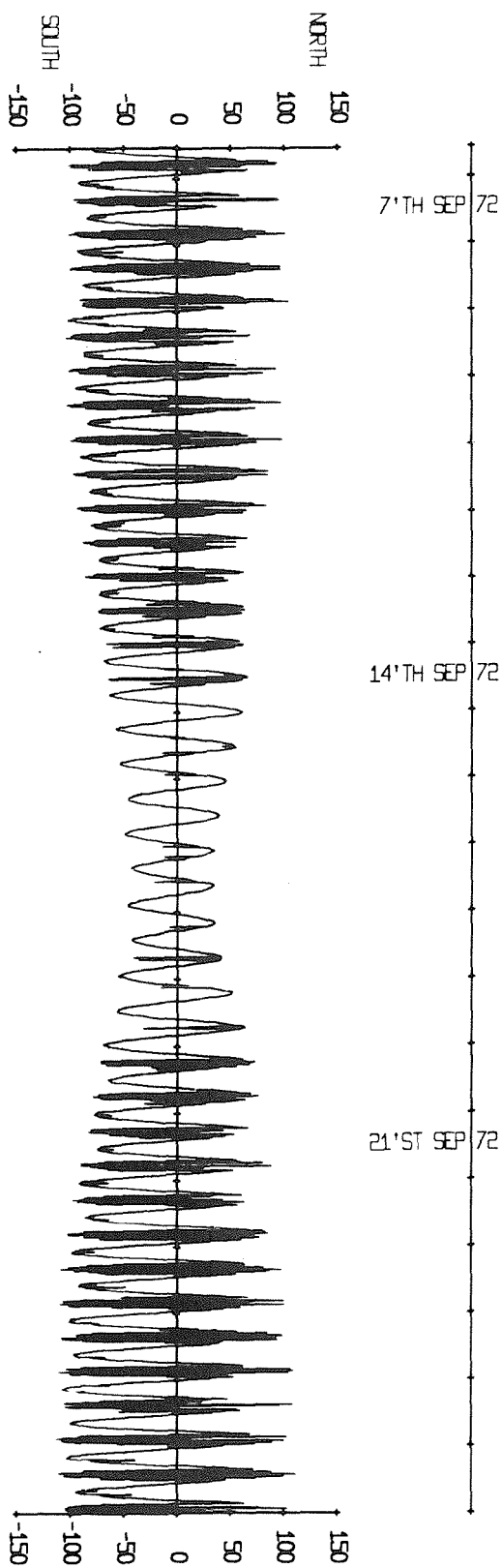




Meter	:	Bergen 530
Tape number	:	530/1
Meter started	:	12.40.00 GMT 5 Sept 1972
Meter stopped	:	15.28.28 GMT 10 Oct 1972
Total number of readings	:	5058
Timing error	:	1 min 32 secs fast
Start of useful record	:	13.10 GMT 6 Sept 1972
End of useful record	:	12.19 GMT 10 Oct 1972
Length of useful record	:	815 hours
Comments	:	<p>This meter was fitted with a quartz crystal clock. After recovery it was noticed that the rotor was loose on its shaft and so the speed record might be an underestimate of what occurred.</p> <p>The compass appears to be operating incorrectly for north going currents. This fault might be due to a poor compass dead-space.</p>

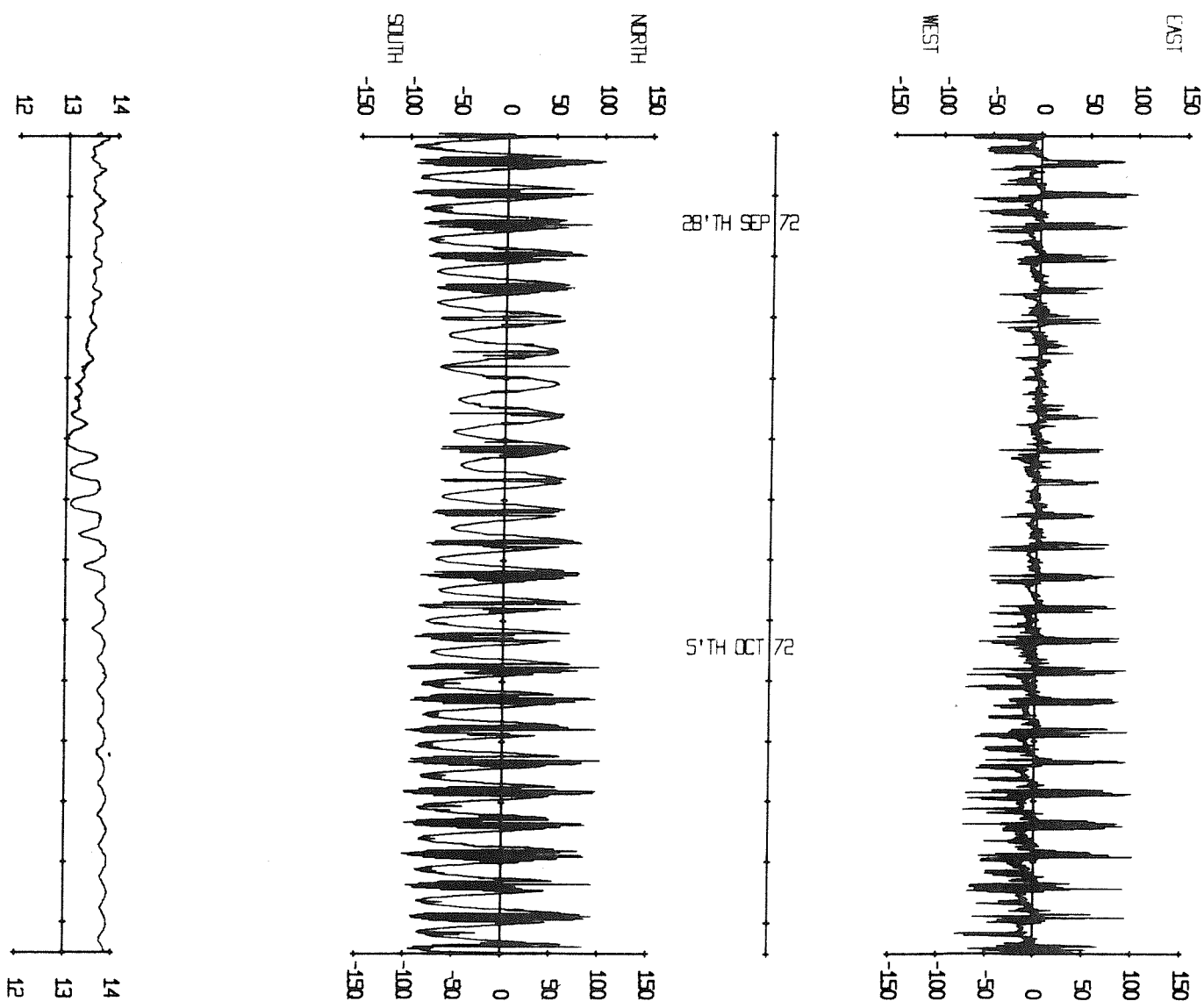
TEMPERATURE IN DEG C

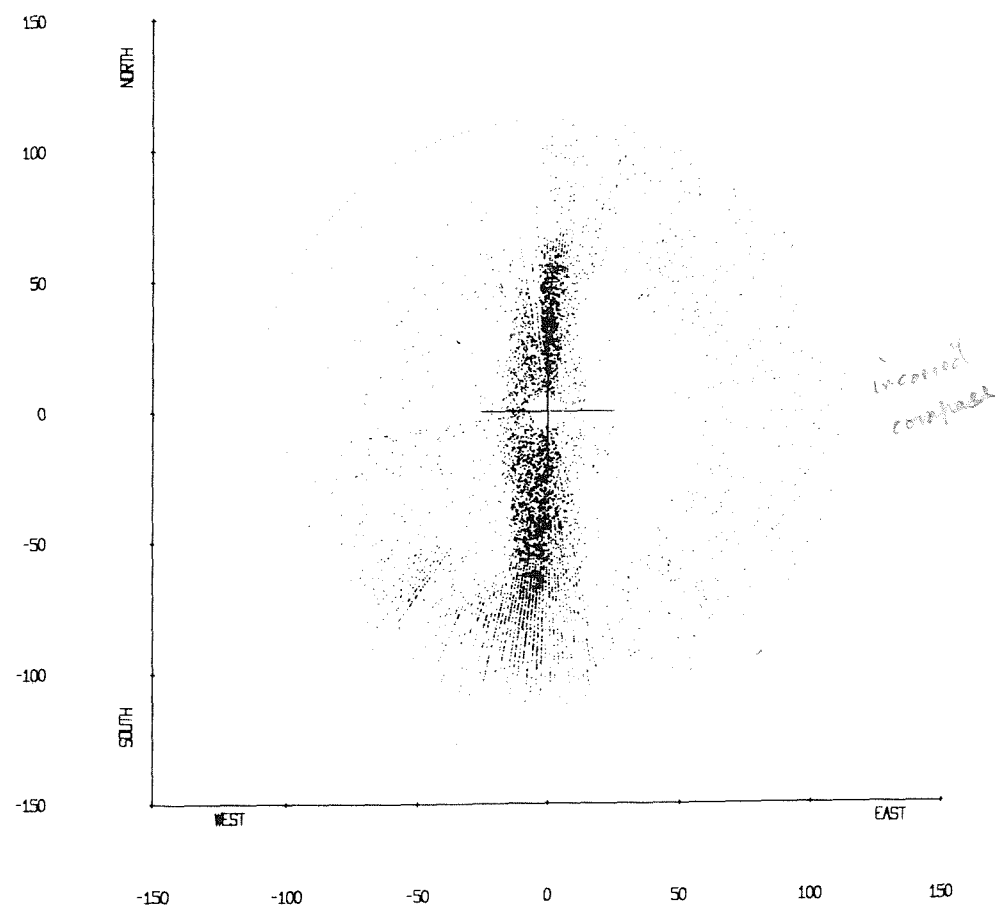
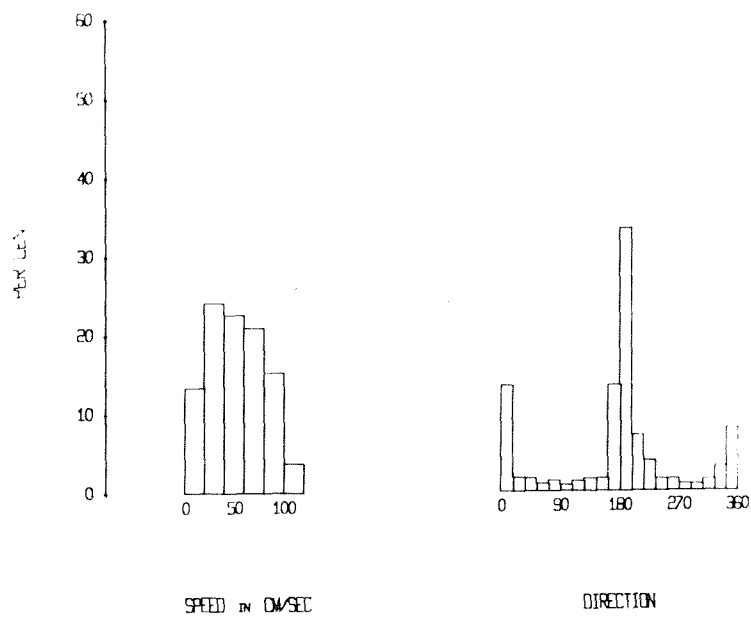
VELOCITY IN CM/SEC

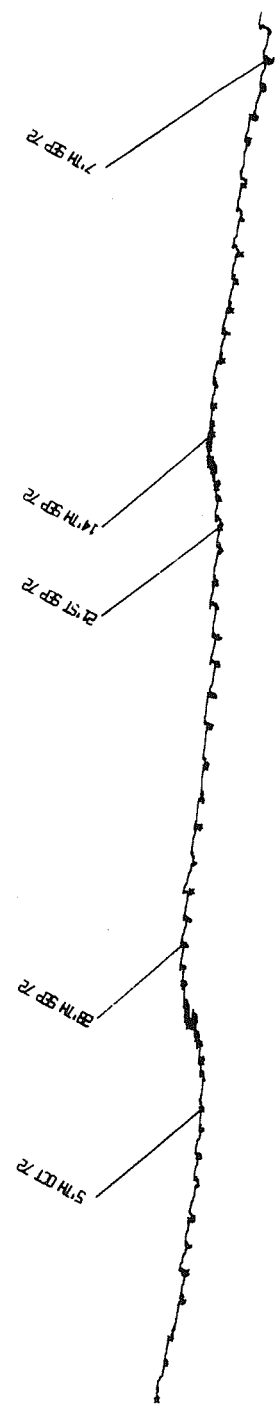
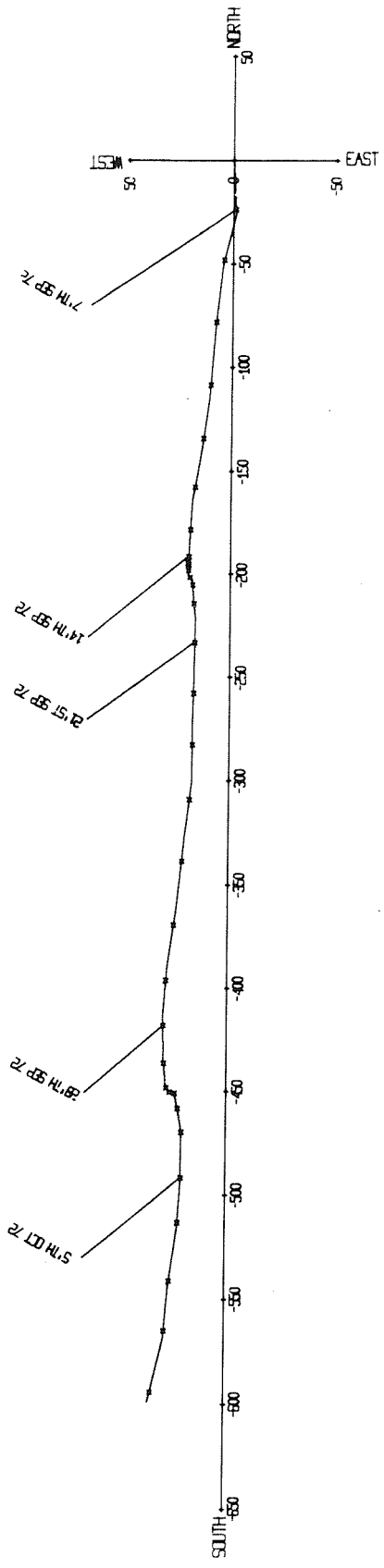


TEMPERATURE IN DEG C

VELOCITY IN CM/SEC

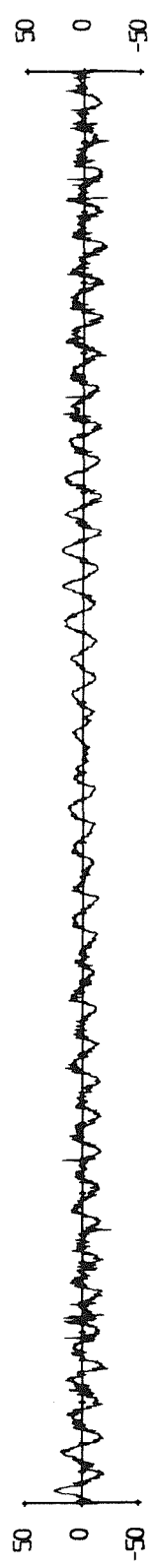




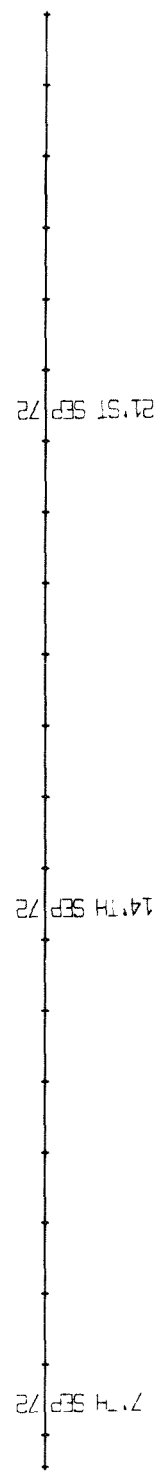


Meter	:	Bergen 531
Tape number	:	531/1
Meter started	:	13.00.01 GMT 5 Sept 1972
Meter stopped	:	17.19.07 GMT 10 Oct 1972
Total number of readings	:	5067
Timing error	:	54 secs fast
Start of useful record	:	13.10 GMT 6 Sept 1972
End of useful record	:	12.19 GMT 10 Oct 1972
Length of useful record	:	815 hours
Comments	:	Good record. This meter was fitted with a quartz-crystal clock.

EAST

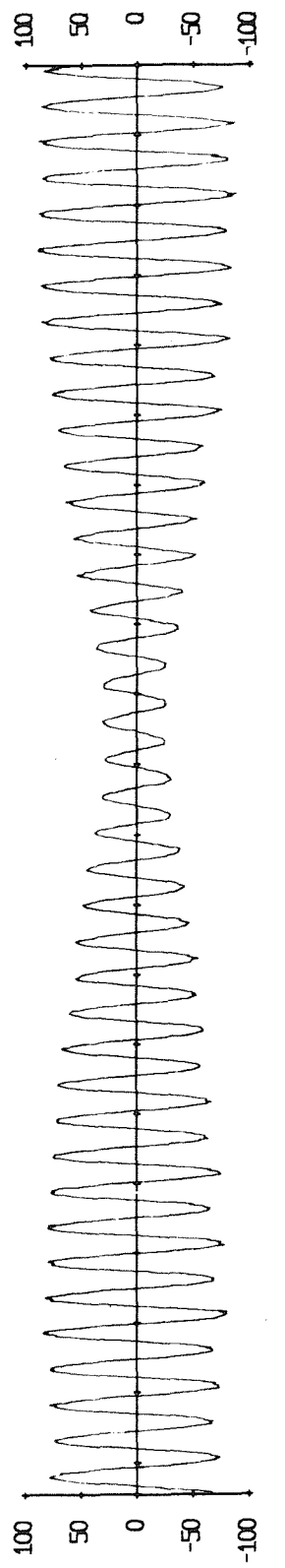


WEST



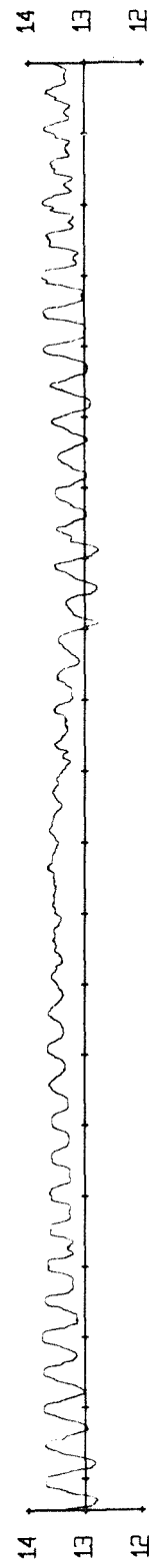
VELOCITY IN CM/SEC

NORTH



SOUTH

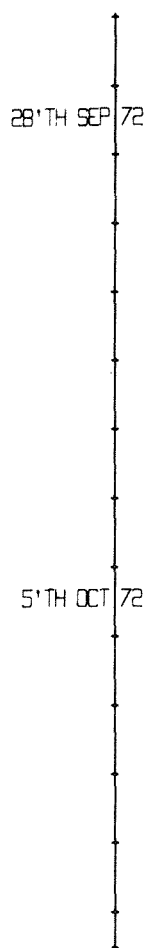
TEMPERATURE IN DEG C



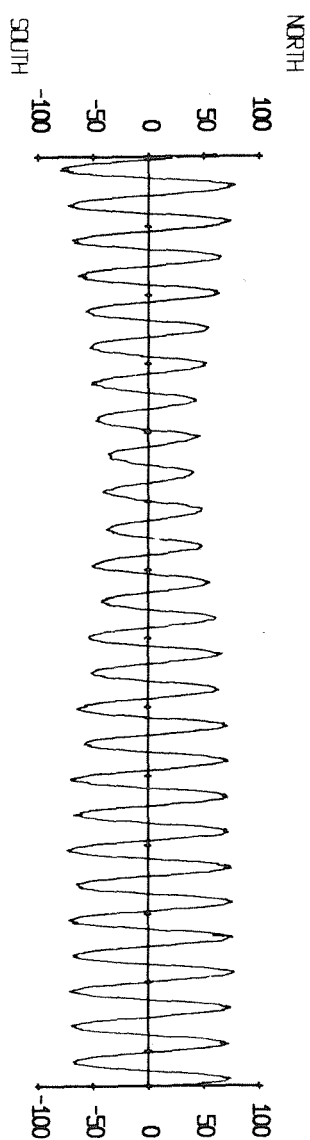
EAST



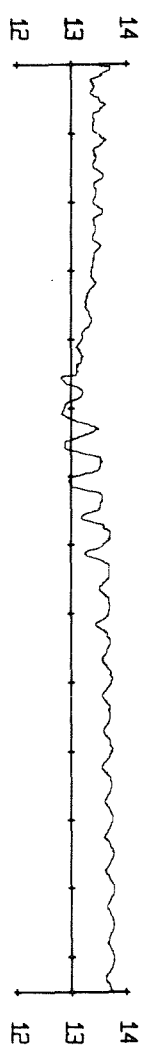
WEST

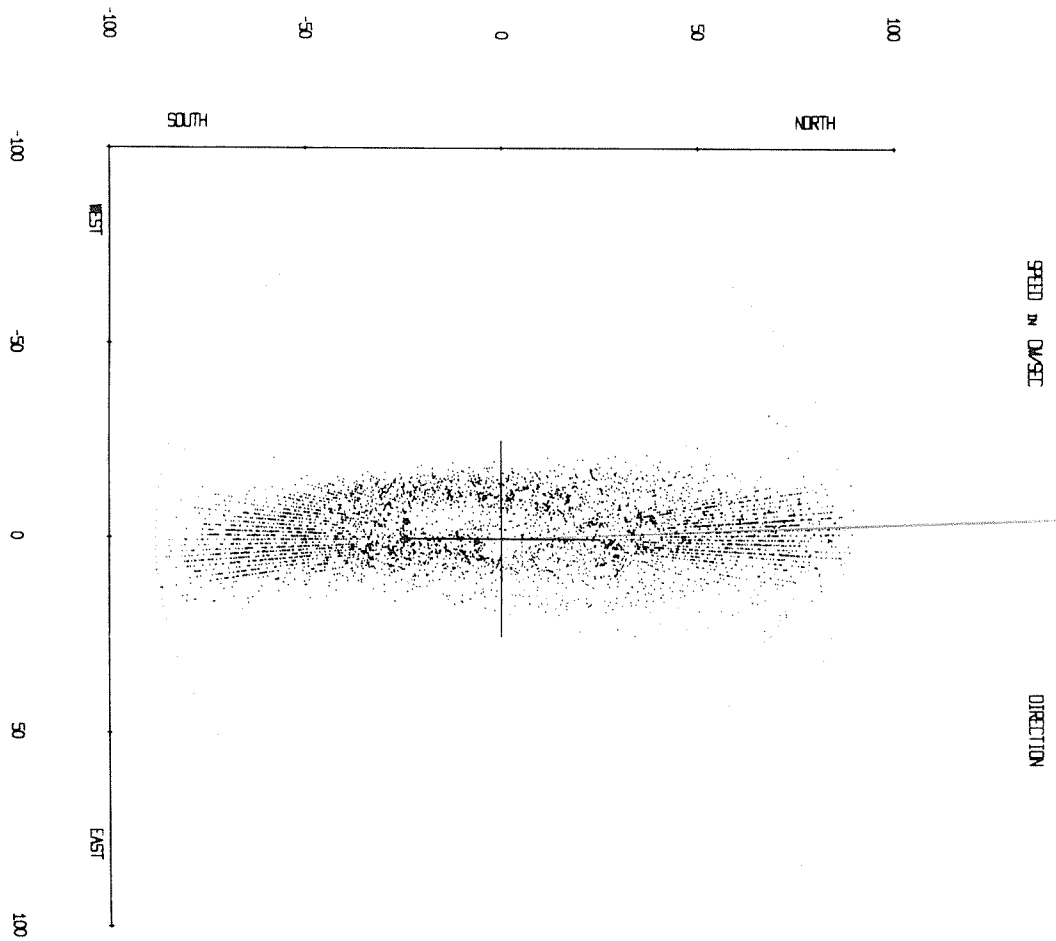
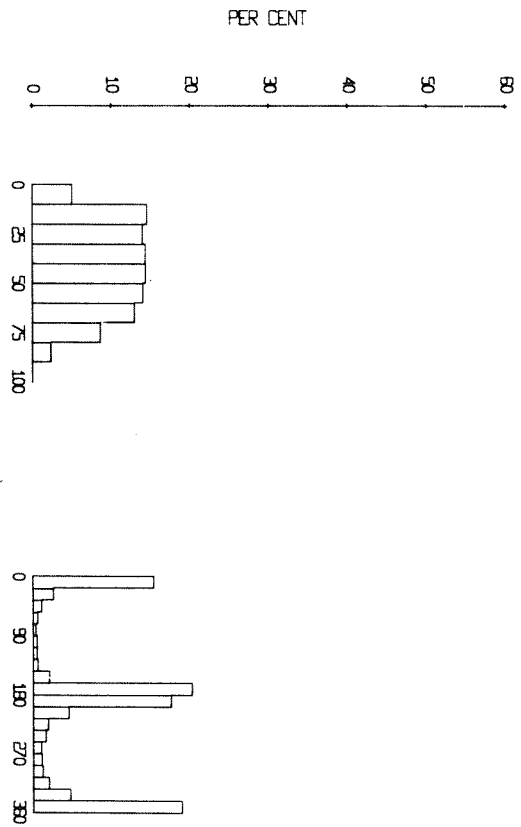


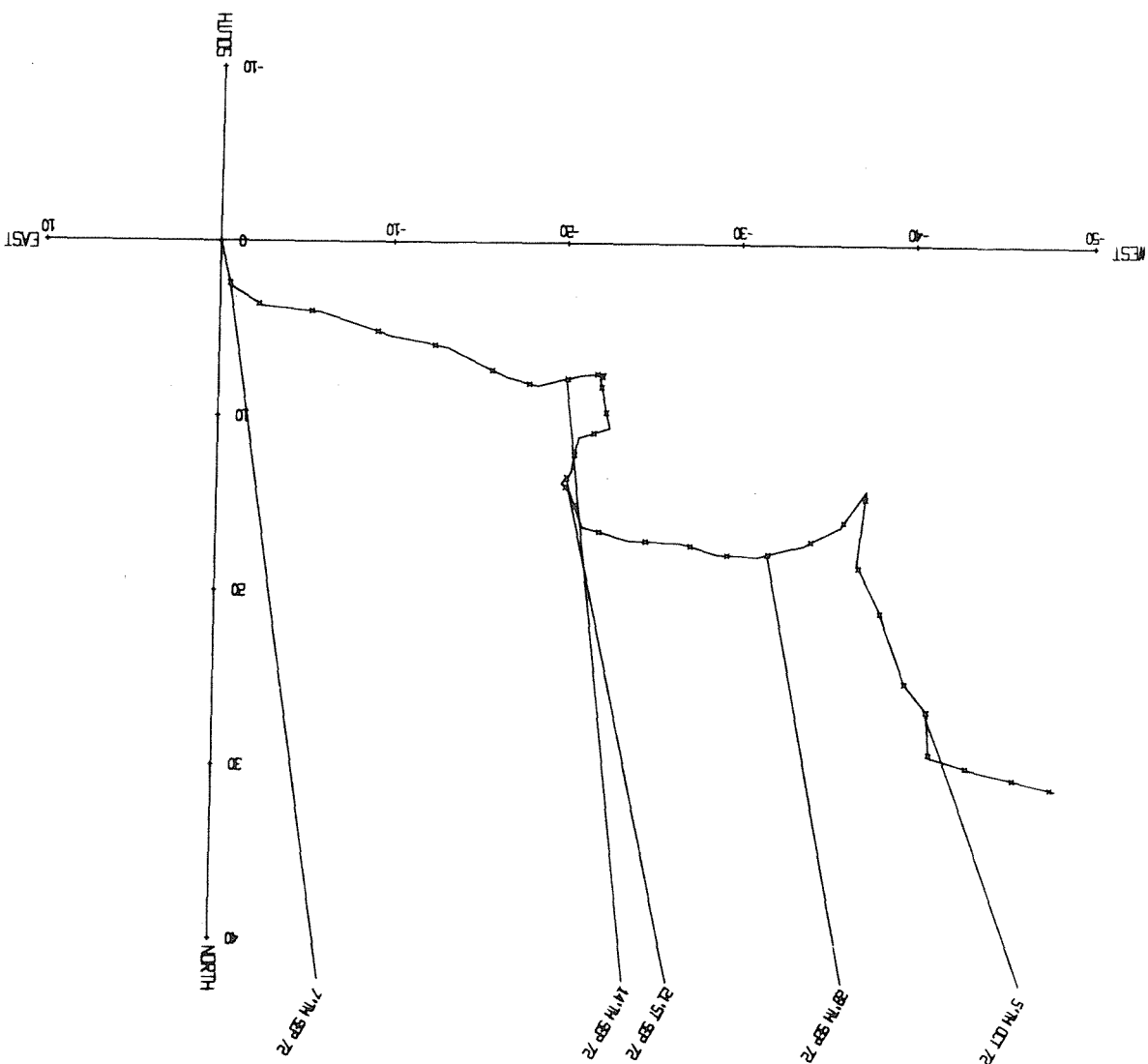
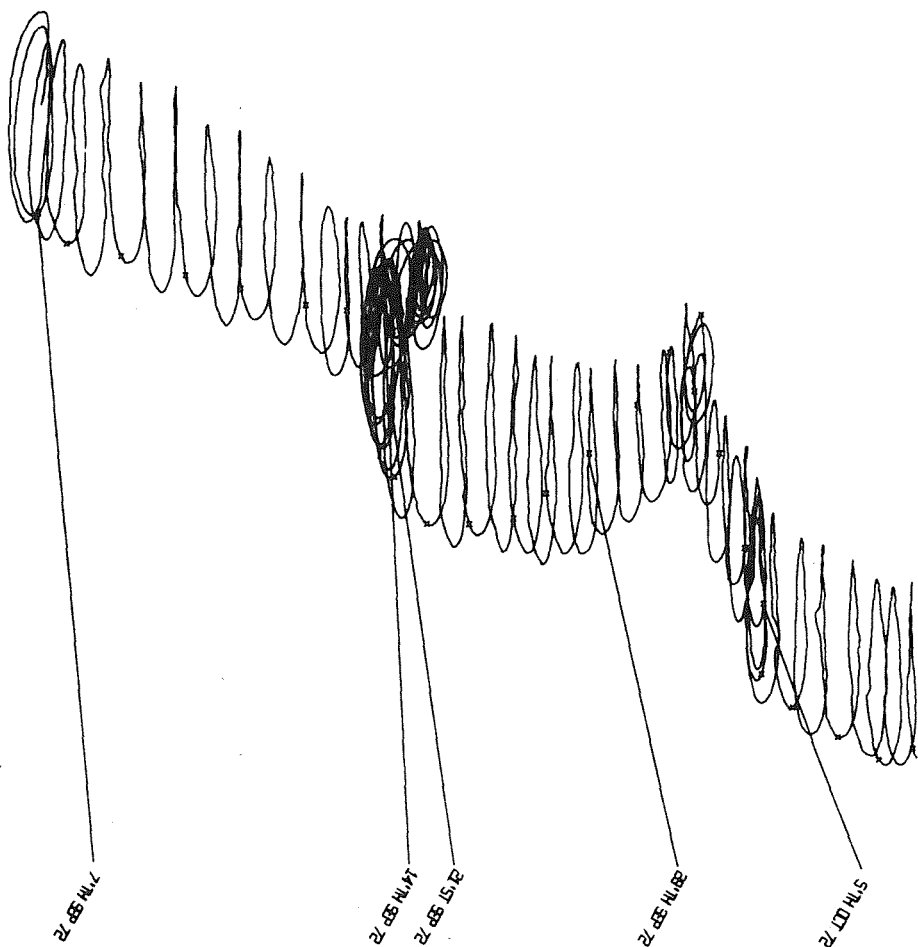
VELOCITY IN CM/SEC



TEMPERATURE IN DEG C







Mooring number : 24
 Position of rig : Lat 53°26'N Long 5°03'W (rig M)
 Depth of water : 95 m below chart datum
 Tidal heights, in metres : MHWS MHWN MLWN MLWS
 above chart datum,
 at Holyhead 5.1 3.9 1.4 0.2

Meter	Type	Height above sea floor (metres)	Recording interval (min.)
213	Bergen	79	10
533	Bergen	53	10
214	Bergen	7	10

Rig set : 19.15 GMT 6 Sept 1972
 from R.R.S. John Murray
 Rig recovered : 12.51 GMT 9 Oct 1972
 from R.R.S. John Murray
 Mooring : Standard. The sub-surface buoy
 was a Cosalt and the top meter
 was equipped with a pressure
 transducer.
 Comments : The rig was successfully launched
 and recovered at the first attempt.

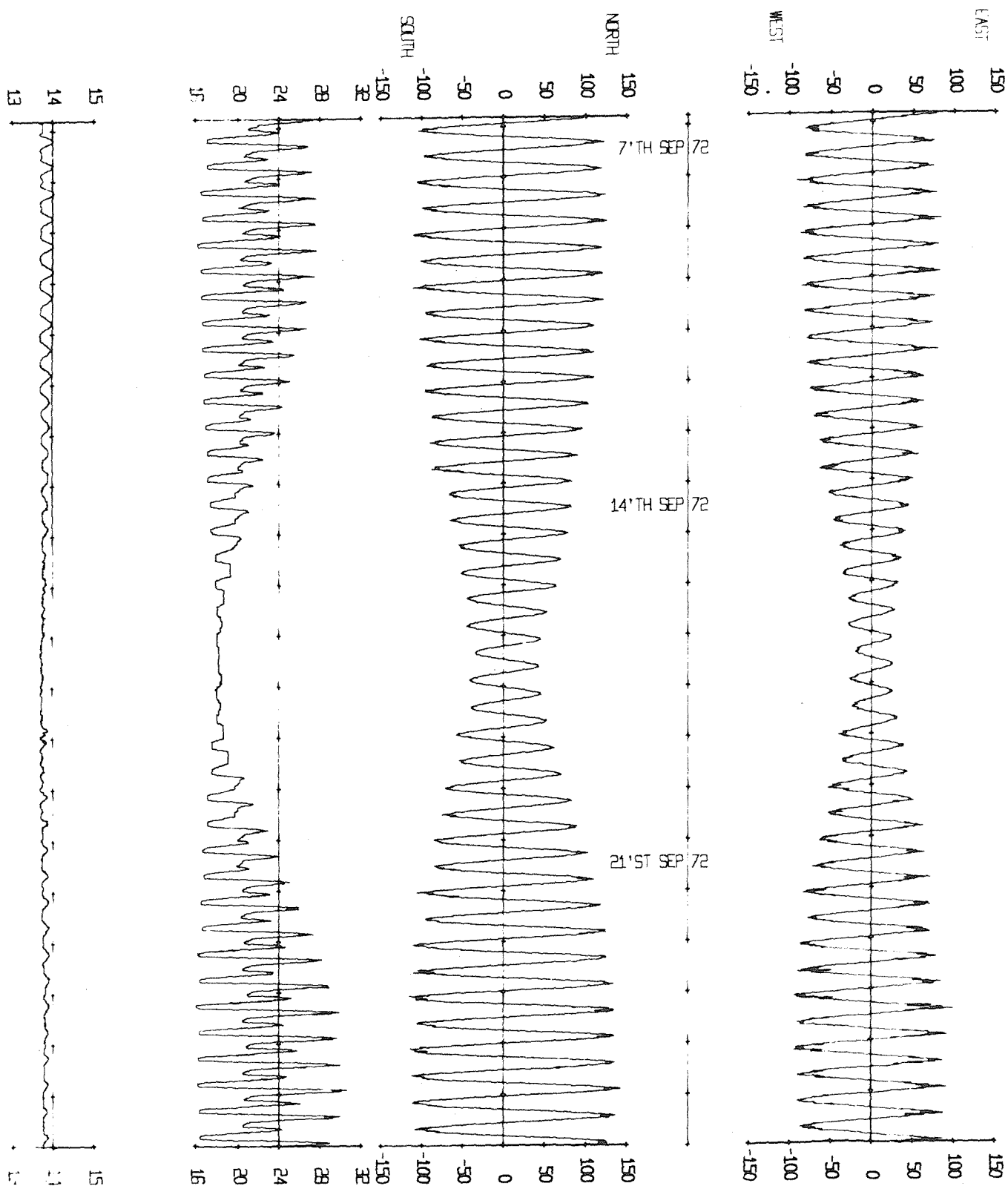
Meter	:	Bergen 213
Tape number	:	213/5
Meter started	:	09.51.02 GMT 5 Sept 1972
Meter stopped	:	20.00.20 GMT 10 Oct 1972
Total number of readings	:	5102
Timing error	:	42 secs fast
Start of useful record	:	19.31 GMT 6 Sept 1972
End of useful record	:	12.40 GMT 9 Oct 1972
Length of useful record	:	785 hours
Comments	:	Good record. This meter was fitted with a quartz-crystal clock and a pressure transducer.

TEMPERATURE IN DEG C

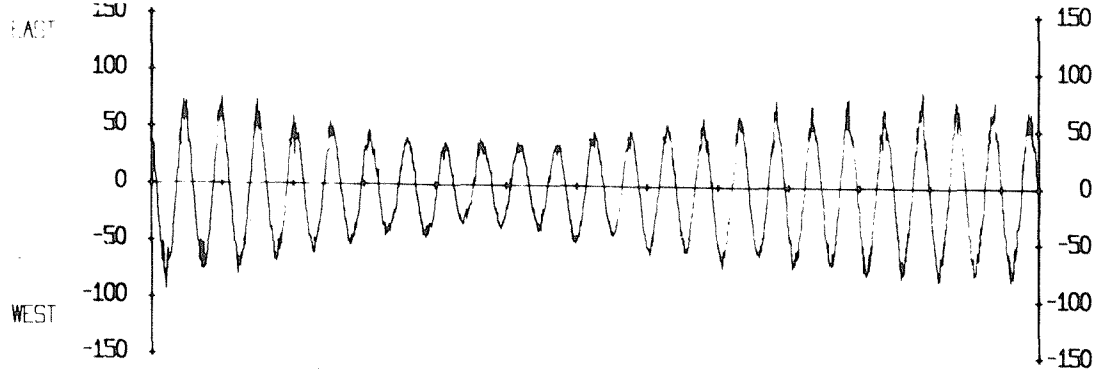
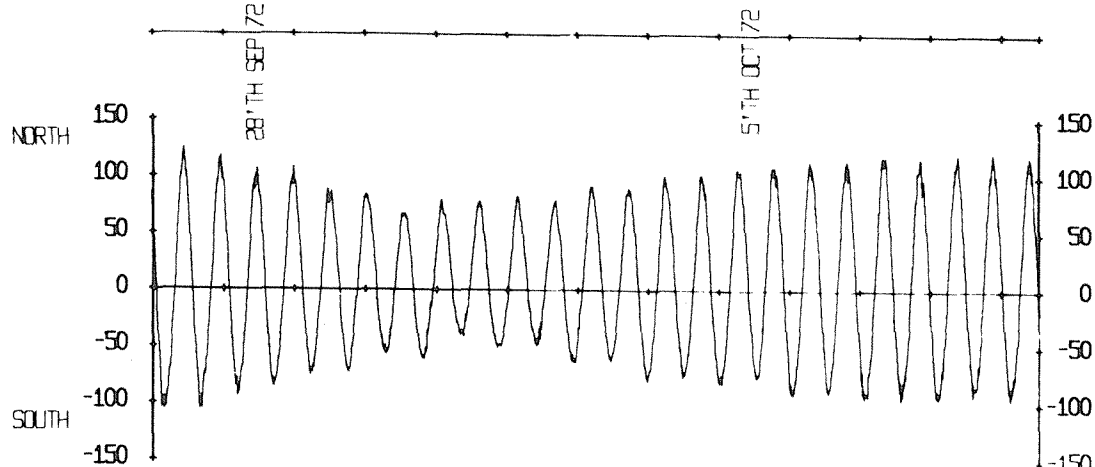
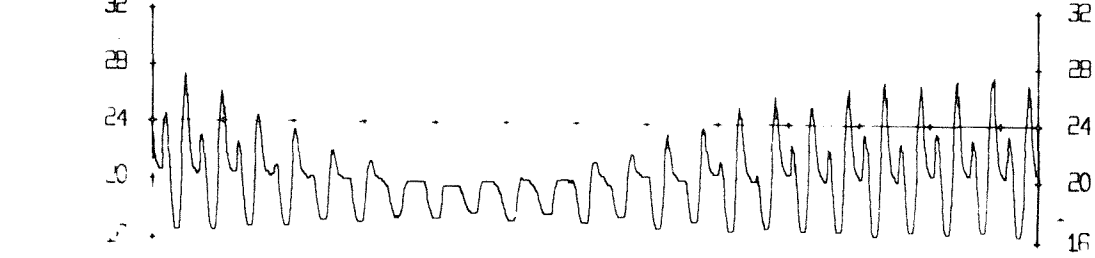
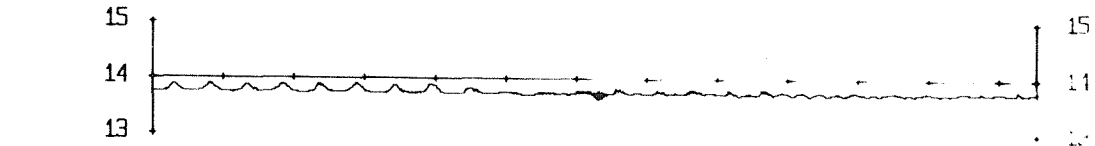
PRESSURE IN

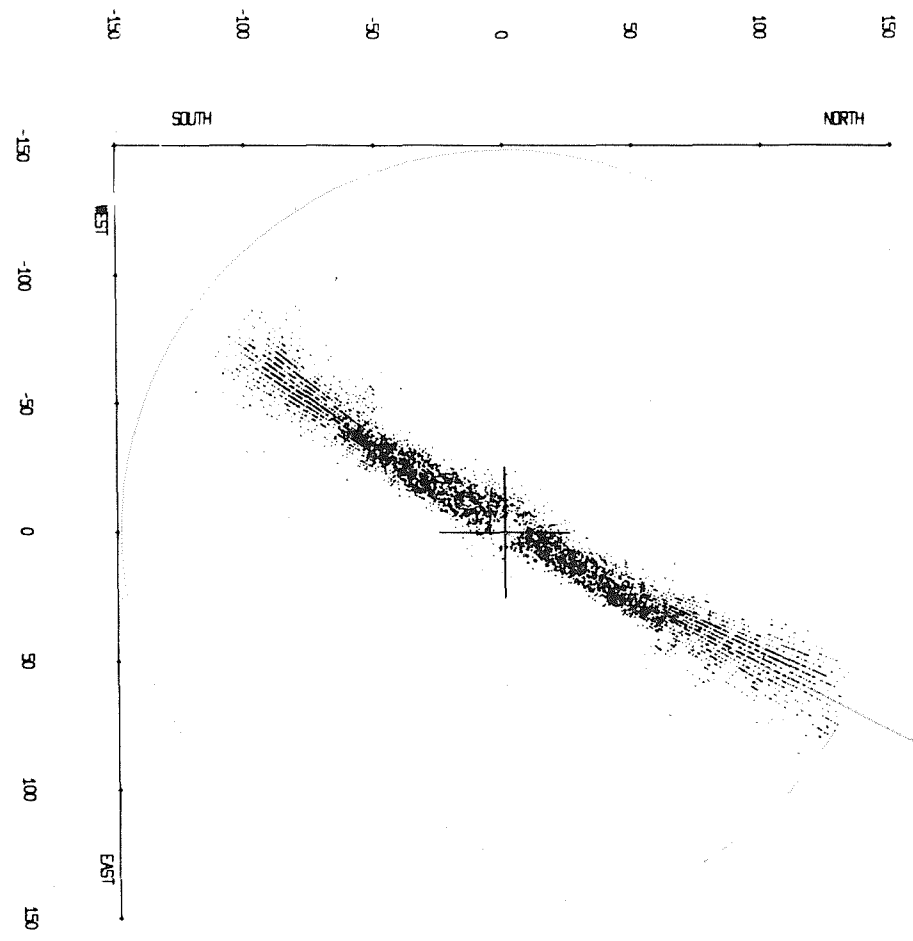
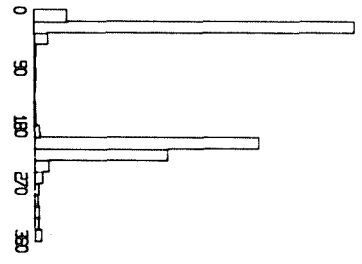
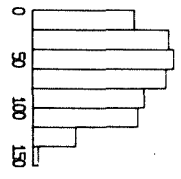
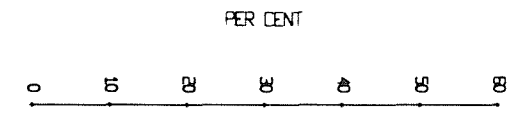
VELOCITY IN CM/SEC

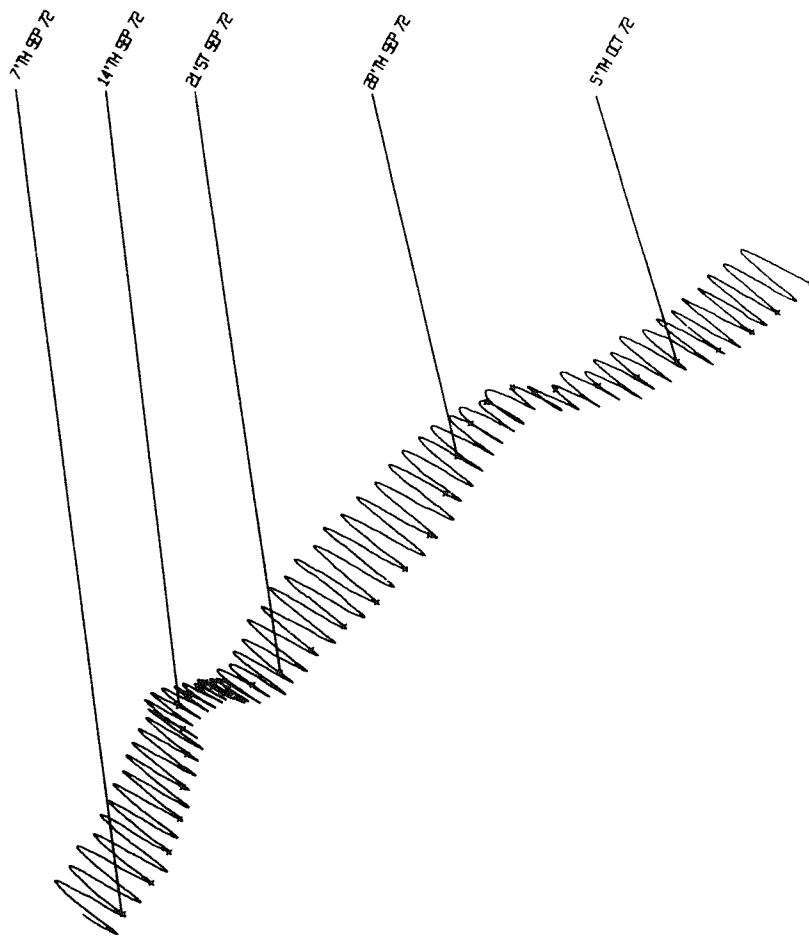
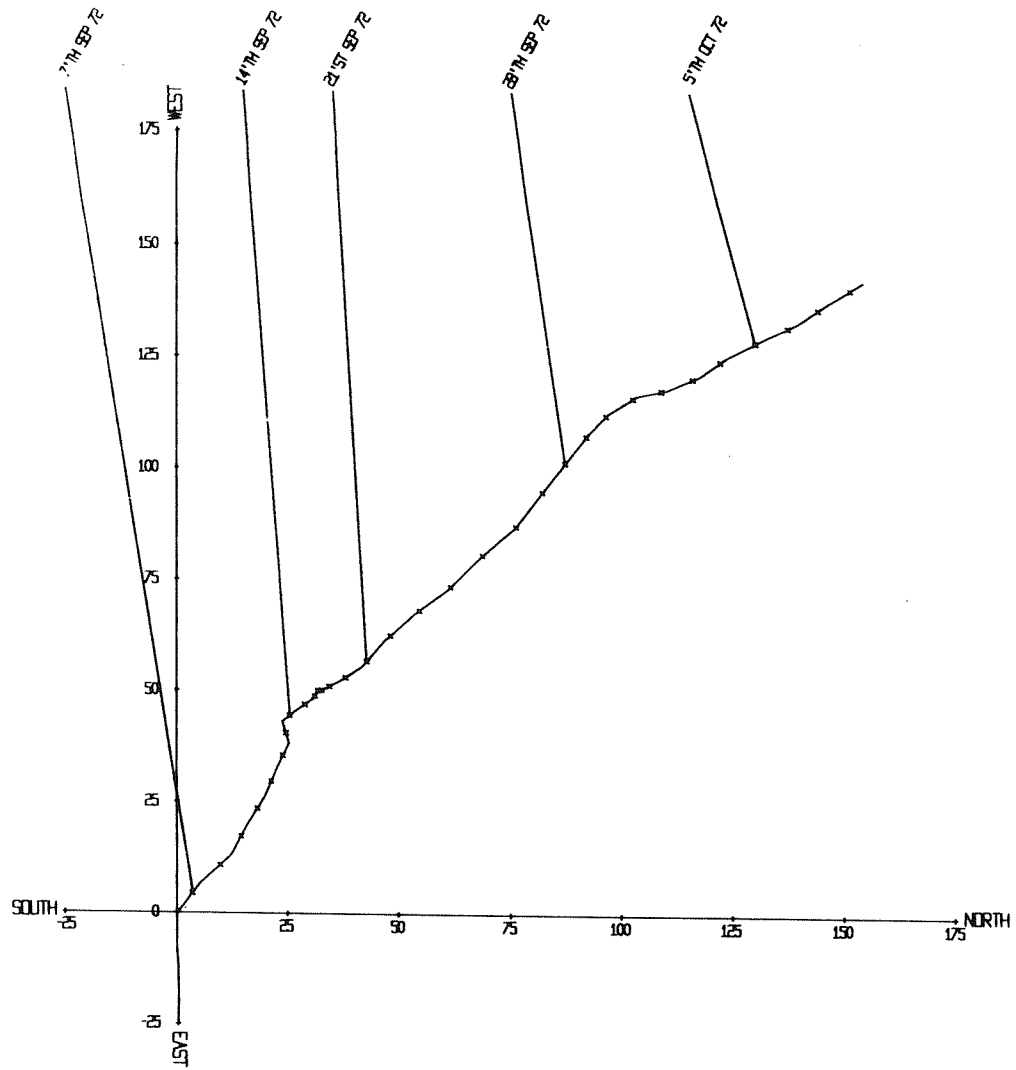
METRES OF WATER



TEMPERATURE IN DEG C PRESSURE IN METRES OF WATER VELOCITY IN CM/SEC

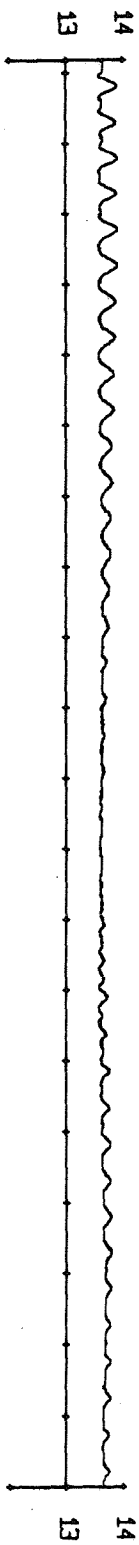




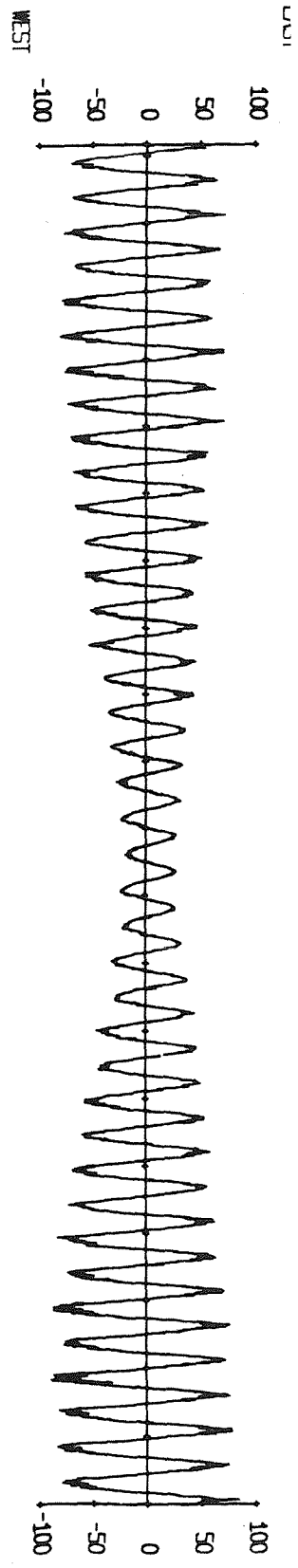
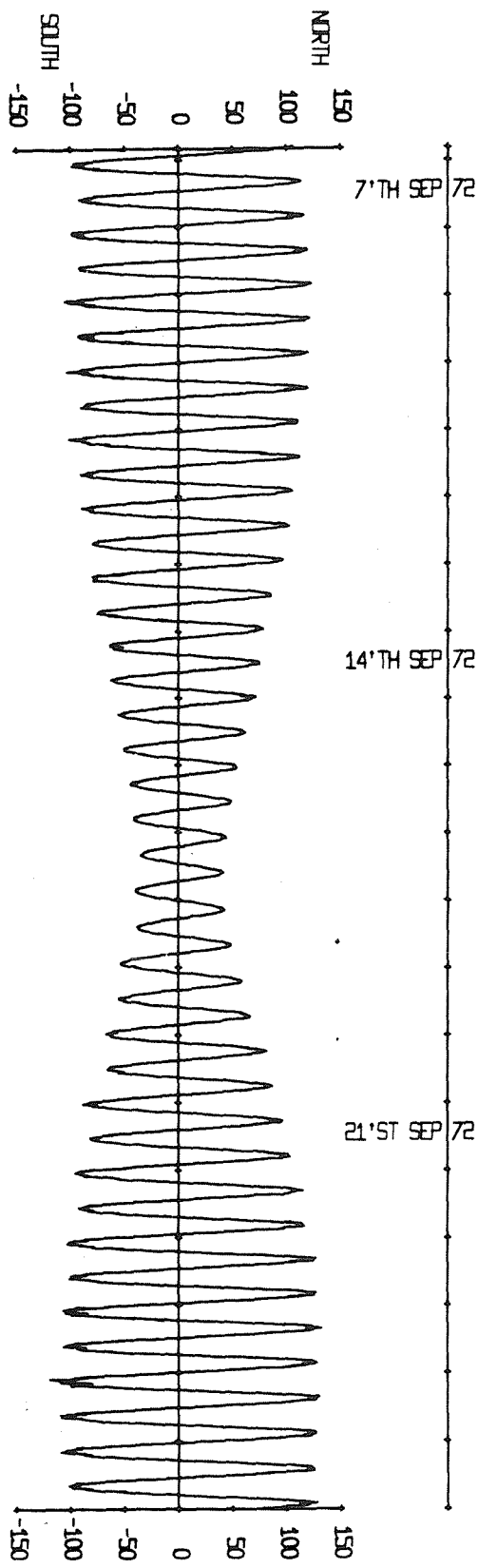


Meter	:	Bergen 533
Tape number	:	533/1
Meter started	:	13.20.00 GMT 5 Sept 1972
Meter stopped	:	19.00.36 GMT 10 Oct 1972
Total number of readings	:	5075
Timing error	:	36 secs slow
Start of useful record	:	19.30 GMT 6 Sept 1972
End of useful record	:	12.41 GMT 9 Oct 1972
Length of useful record	:	785 hours
Comments	:	Good record. This meter was fitted with a quartz-crystal clock.

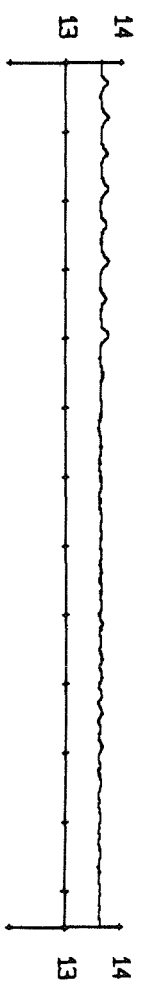
TEMPERATURE IN DEG C



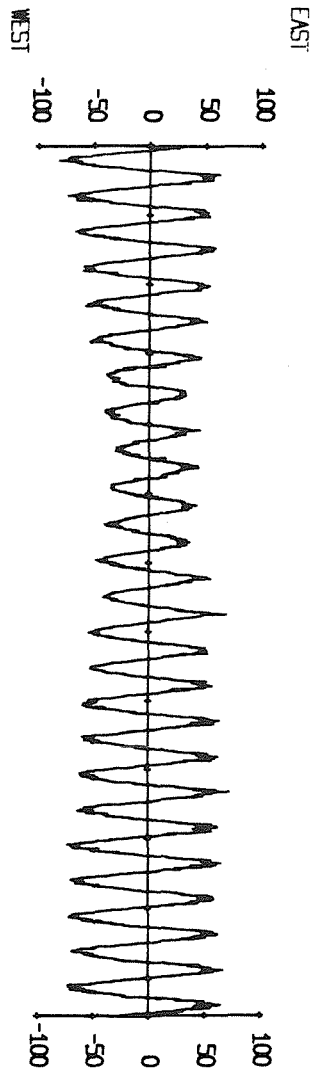
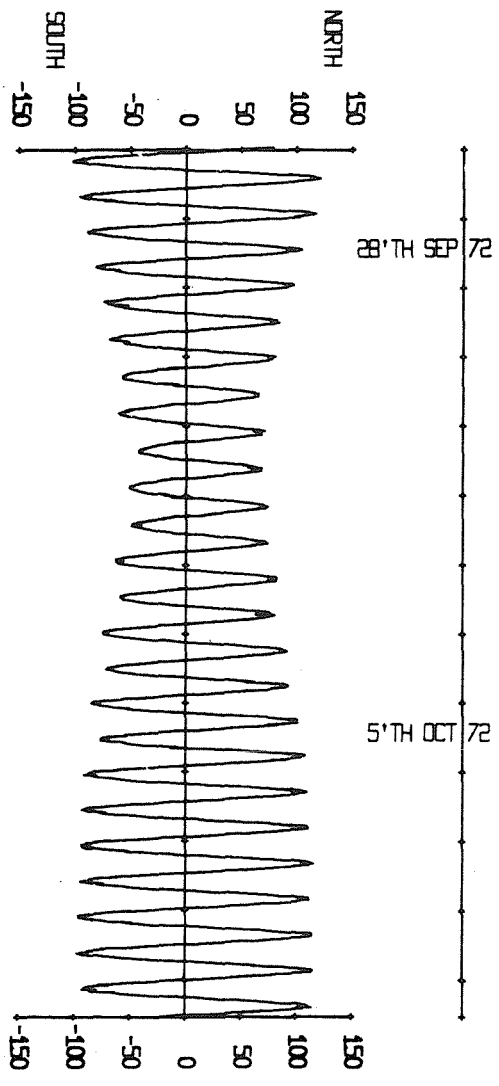
VELOCITY IN CM/SEC

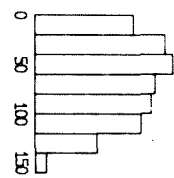
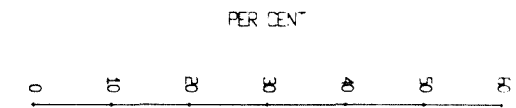


TEMPERATURE IN DEG C



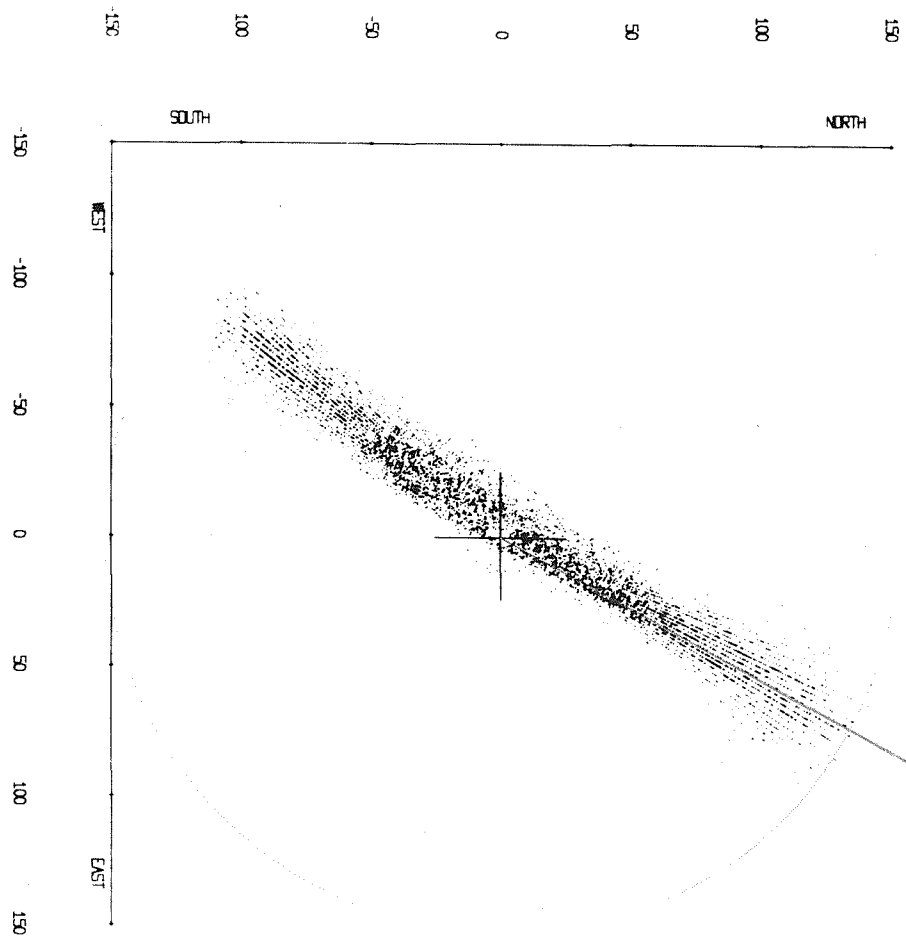
VELOCITY IN CM/SEC

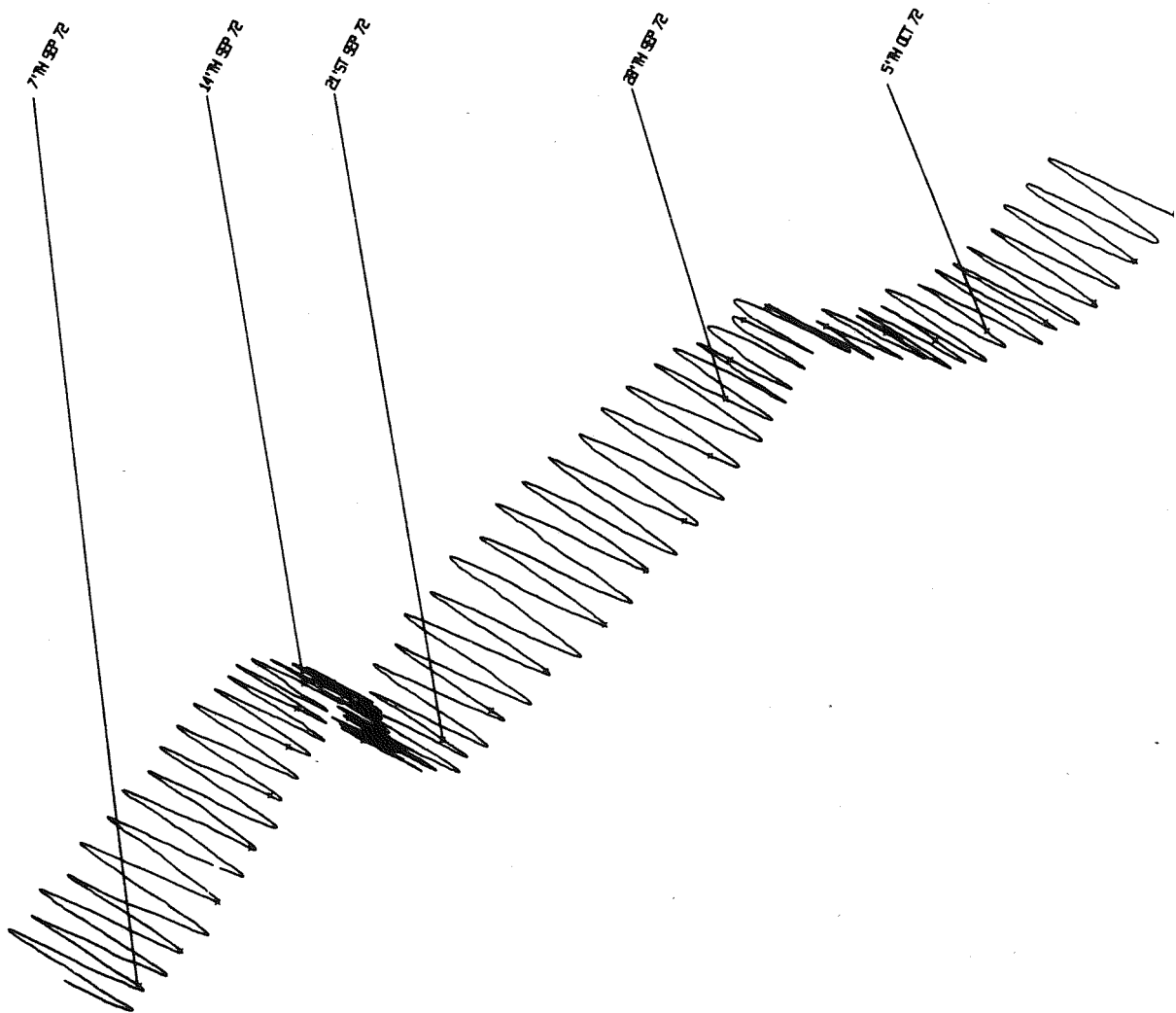
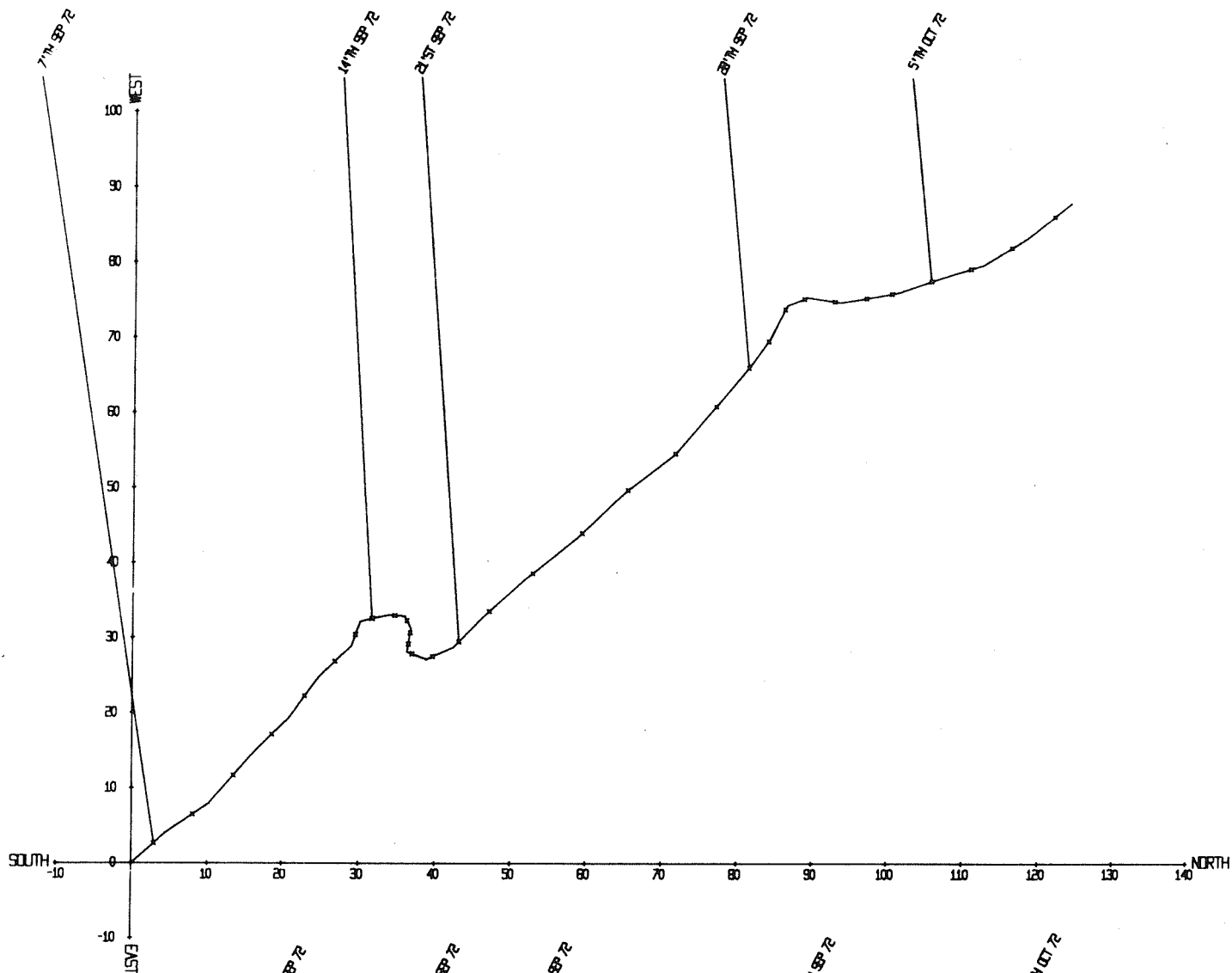




SPEED IN KNOTS

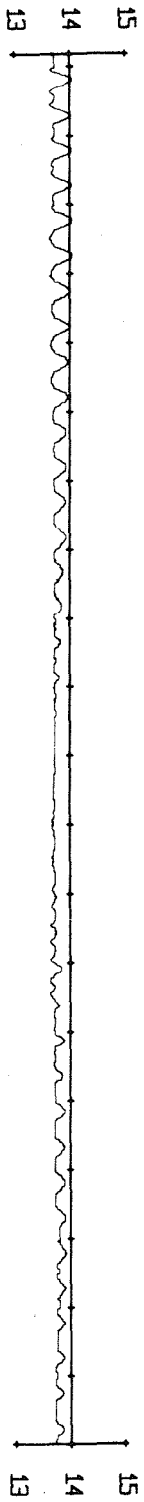
DIRECTION



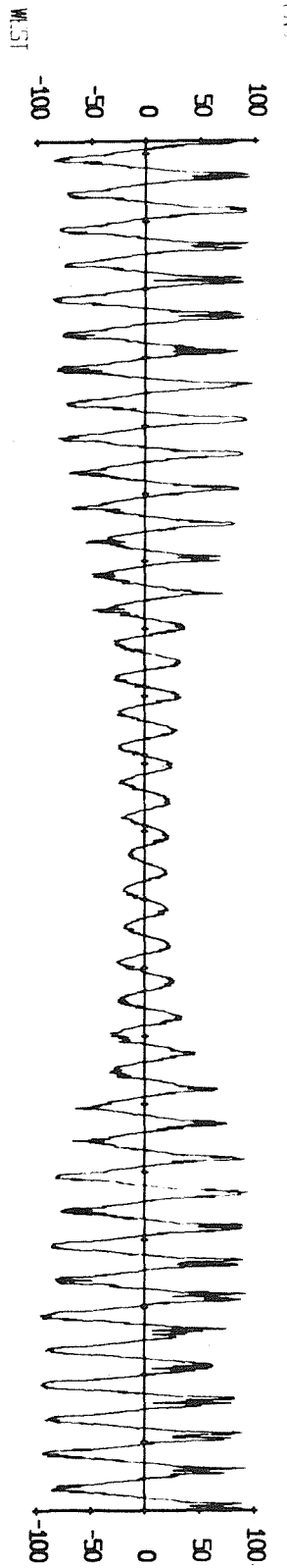
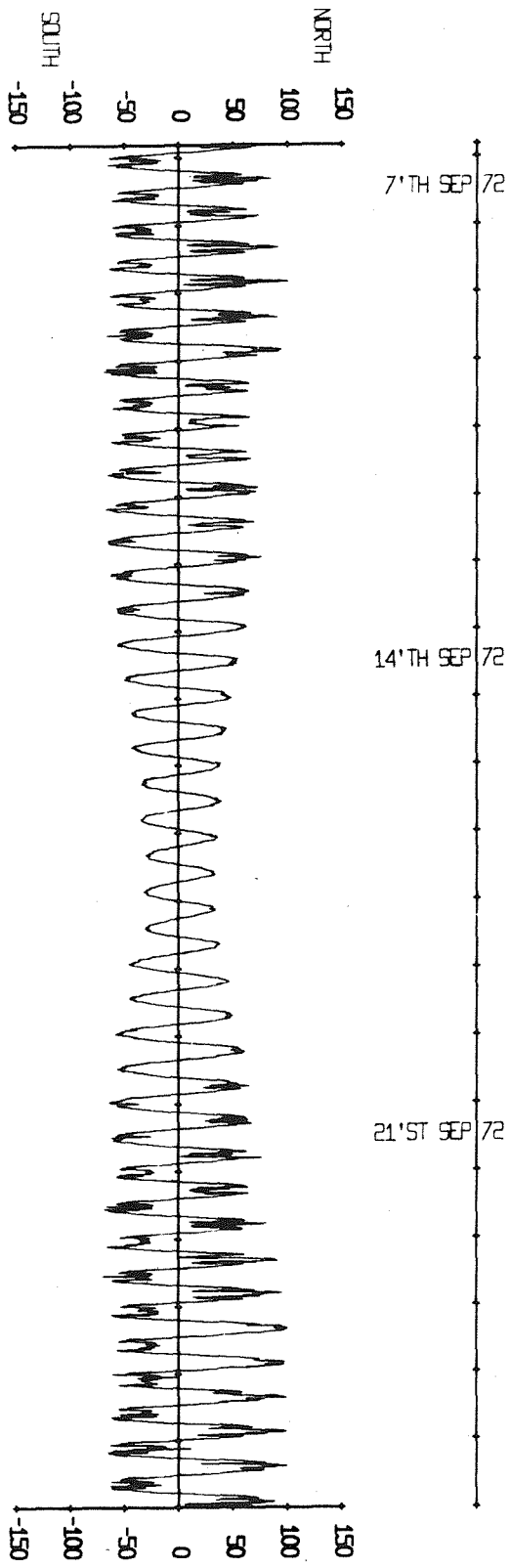


Meter	:	Bergen 214
Tape number	:	214/6
Meter started	:	10.09.54 GMT 5 Sept 1972
Meter stopped	:	17.58.59 GMT 13 Oct 1972
Total number of readings	:	5518
Timing error	:	19 mins 05 secs slow
Start of useful record	:	19.31 GMT 6 Sept 1972
End of useful record	:	12.39 GMT 9 Oct 1972
Length of useful record	:	785 hours
Comments	:	The velocity record is suspect at times of peak currents during spring tides when the rig appears to interfere with the operation of the meter. No corrections for the timing error have been applied to the data shown here.

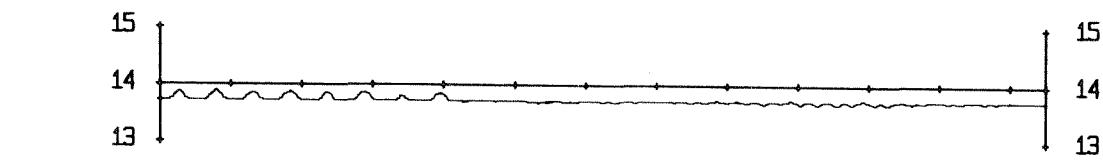
TEMPERATURE IN DEGS C



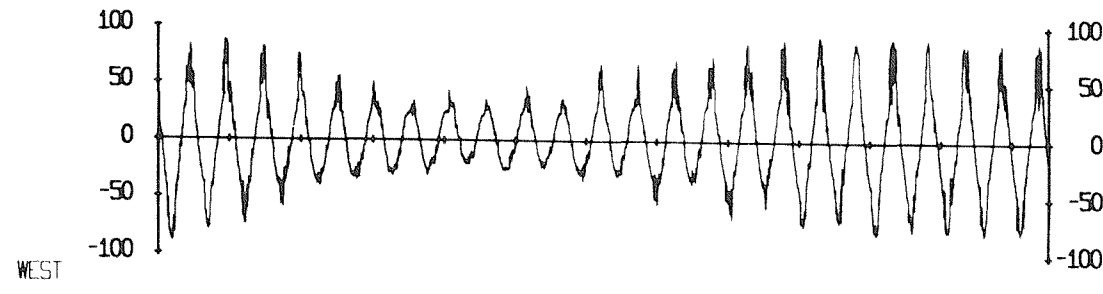
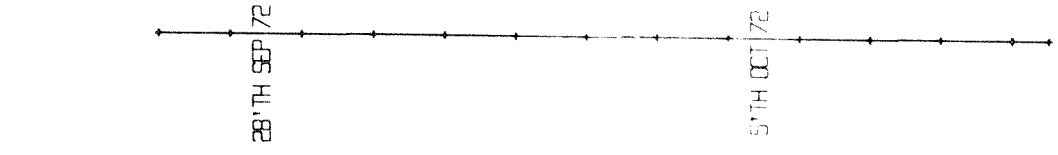
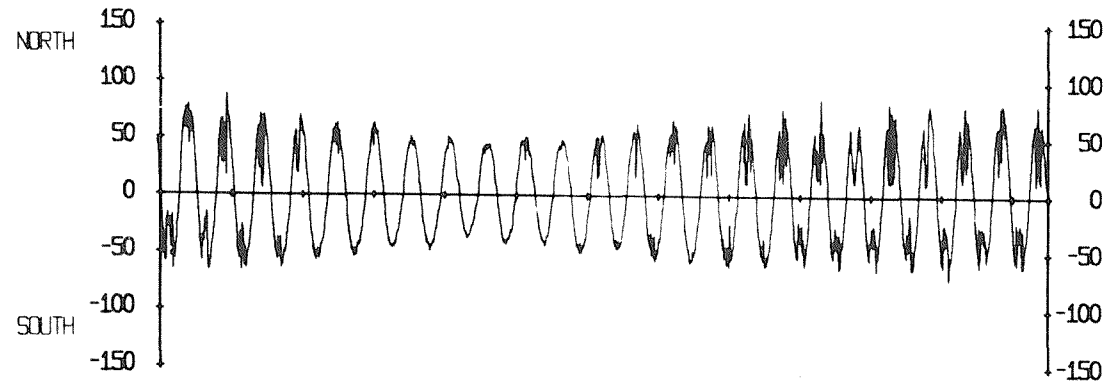
VELOCITY IN CM/SEC

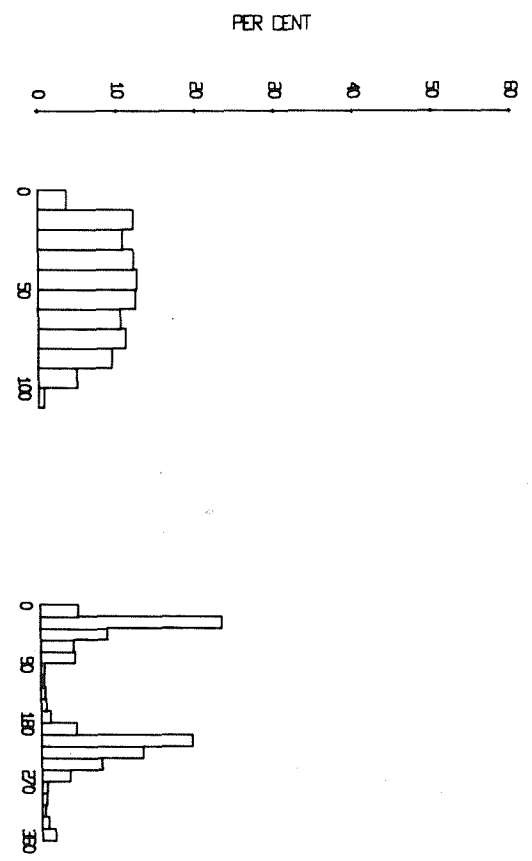


TEMPERATURE IN DEG C



VELOCITY IN CM/SEC





SPEED IN DM/SEC

DIRECTION

