NATIONAL INSTITUTE OF OCEANOGRAPHY
Wormley, Godalming, Surrey.

MOORED CURRENT METER RECORDS

Discovery Cruise 20 Oct-Dec 1967

N.I.O. Moorings 012, 013, 014, 015, 016.

W. J. GOULD

N.I.O. INTERNAL REPORT NO. A42
(November 1969)

NATIONAL INSTITUTE OF OCEANOGRAPHY
Wormley, Godalming, Surrey.

MOORED CURRENT METER RECORDS

Discovery Cruise 20. Oct-Dec 1967

N. I. O. Moorings 012, 013, 014, 015, 016

W. J. GOULD

N. I. O. INTERNAL REPORT NO. A42
(issued November 1969)

CONTENTS

			Page
Preface			2
The Current Meter Moorings			2
Acknowledgments			9
Analysis of the current meter data			10
	Plessey data		10
	Bergen data		10
	Braincon data		11
Mooring	012		13
		01201	14
		01202	17
		01203	20
		01204	21
Mooring	013		22
		01301	23
		01302	26
		01303	29
		01304	30
Mooring	014		31
		01401	32
		01402	35
		01403	38
		01404	41
Mooring	015		42
		01501	43
		01502	46
		01503	47
		01504	50
		01505	53
		01506	54
Mooring	016		57
		01601	58
		01602	61
		01603	62
		01604	65
		01605	66
		01606	69
References			72

Preface

This report presents current meter data obtained during Cr. 20 of R. R. S. Discovery to the Bay of Biscay in the period October 20th to December 18th 1967 (fig. 1) (see also N. I. O. Cruise Report CR. 20). In addition to presentation of the data an outline will be given of the types of mooring used in this work and also details of the computing procedures used in the preparation of this data.

The Current Meter Moorings

The moorings used were typical N. I. O. deep water moorings; in this cruise two basic types were used. Three moorings (nos. 012, 013, 014) employed subsurface buoyancy and the other two (015, 016) (figs. 5, 6) used surface floats. Fig. 4 shows one of the subsurface moorings.

The moorings were laid "anchor first" from the stern of R. R. S. Discovery, the mooring wires having been cut to length, connected together, pre-tensioned and wound on to the main trawl winch drum. Instruments were connected into the mooring line as it was paid out over the starboard "A" frame.

The mooring anchors were made up of lengths of anchor chain. Acoustic releases and command pingers were manufactured at N. I. O. (Harris 1969), all wires were multistrand, galvanised of 6 and 4 mm. diameters.

The wire lengths were terminated with hard eyes made with aluminium Talurit Sleeves, shackles were seized with soft galvanised wire and all stainless/galvanised junctions were insulated. Swivels were also used in the moorings.

Wire was replaced by braided terylene line below the lowest current meter in order to save weight. The buoyancy consisted of assemblies of two or three aluminium alloy cylinders giving lifts in water of 890 lb and 1050 lb respectively. All moorings were marked at the surface with

Fig. 1

Survey Area Cruise 20.

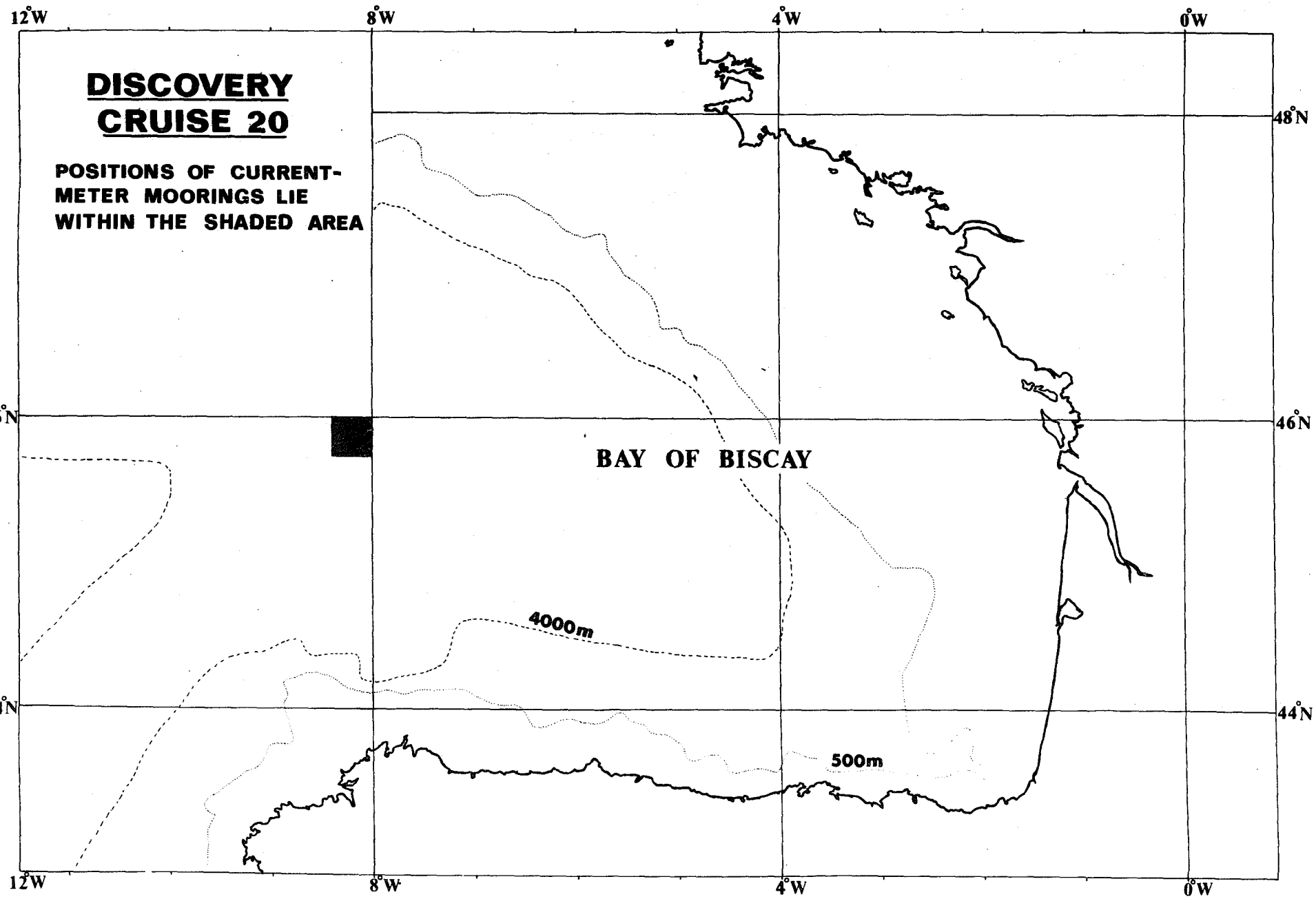

DISCOVERY
CRUISE 20
POSITIONS OF CURRENT-METER MOORINGS LIE WITHIN THE SHADED AREA
12°W
8°W
4°W
0°W
48°N
46°N
44°N
BAY OF BISCAY
4000m
500m

Fig. 2

Mooring Positions Cruise 20

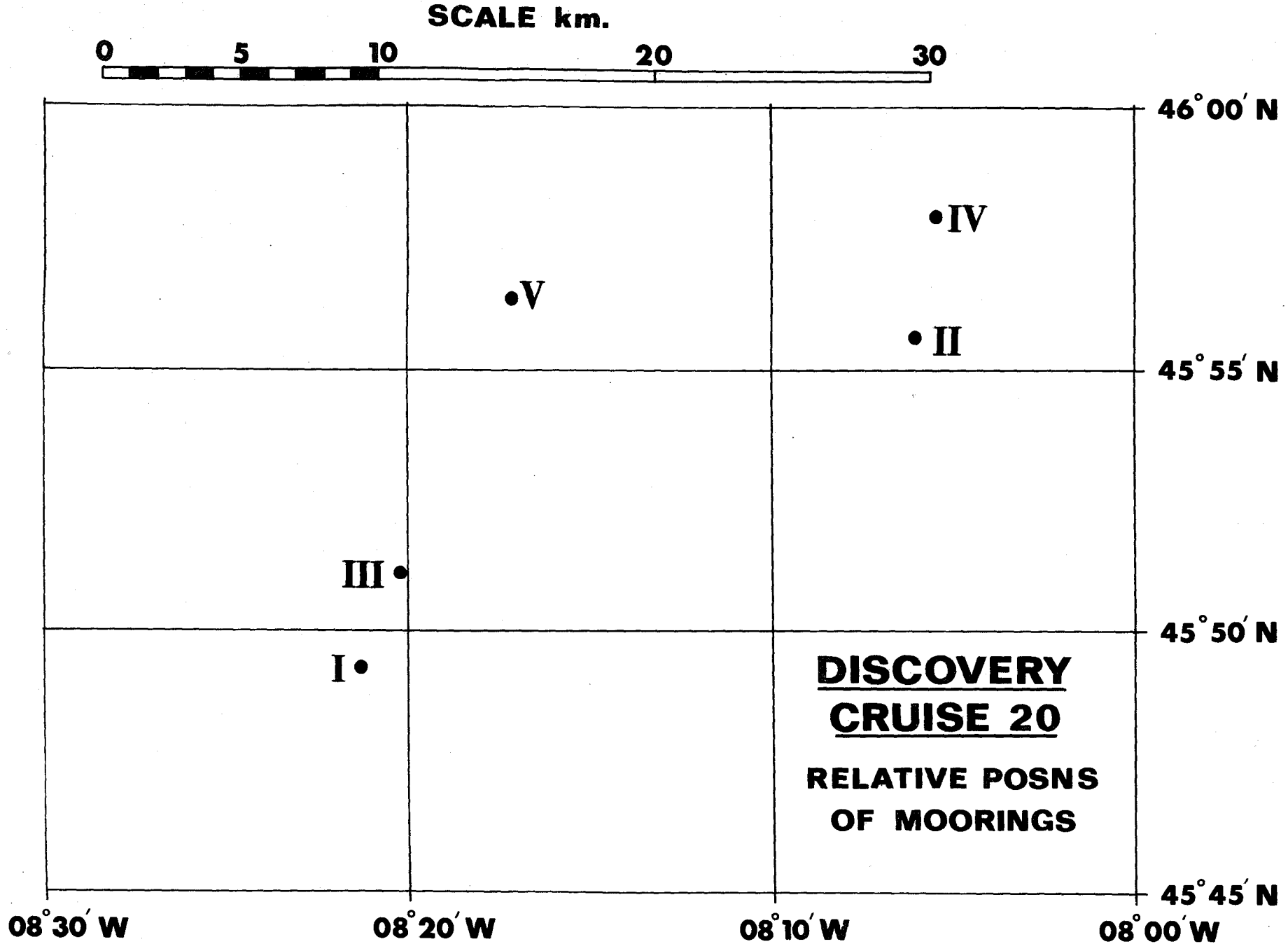
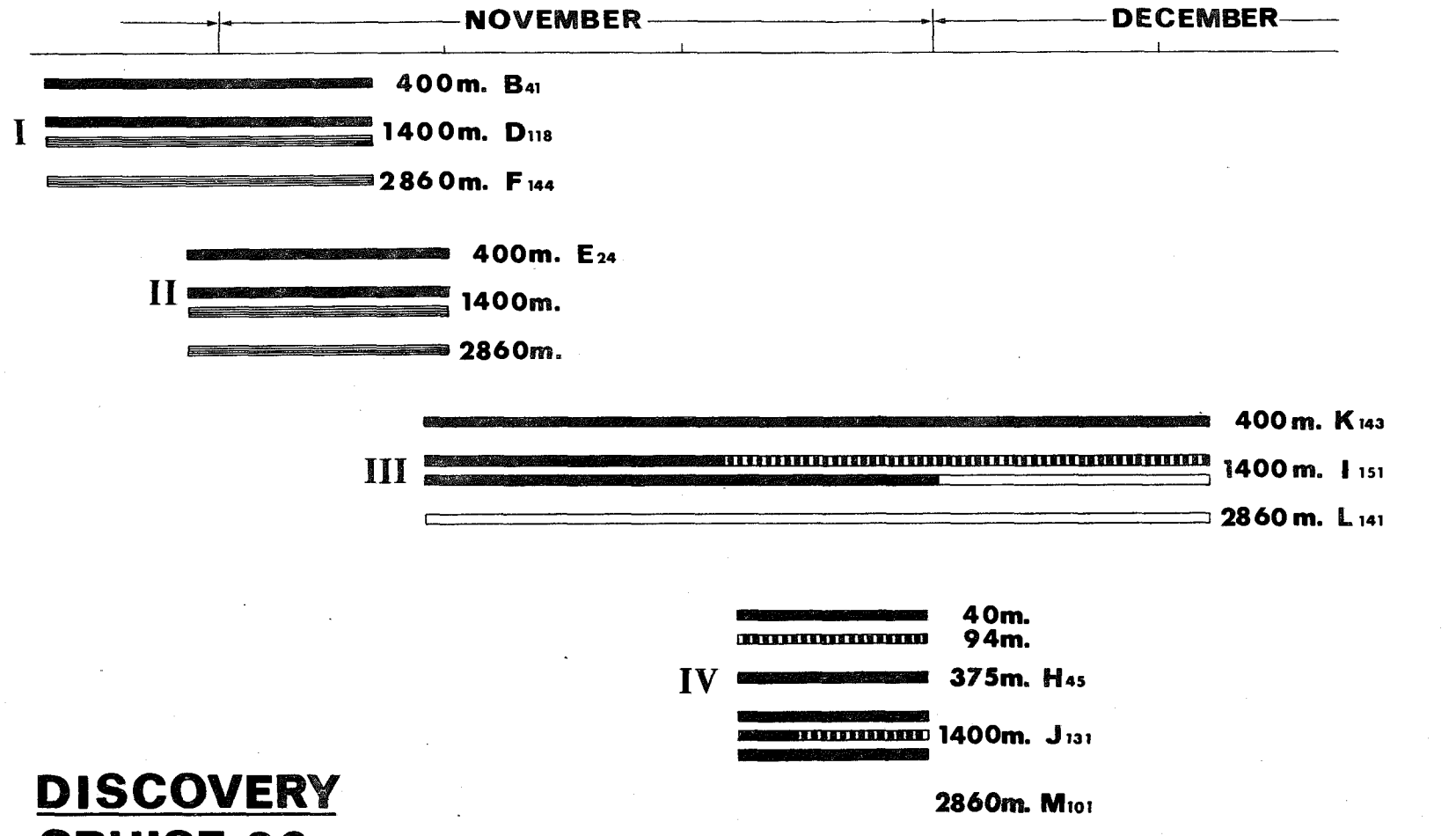

SCALE km.
0
5
10
20
30
46°00′ N
45°55′ N
45°50′ N
45°45′ N
08°30′ W
08°20′ W
08°10′ W
08°00′ W
IV
V
II
III
I
DISCOVERY
CRUISE 20
RELATIVE POSNS
OF MOORINGS

Fig. 3

Current meter records and performance



DISCOVERY CRUISE 20

MOORING AND FLOAT DURATIONS

- GOOD RECORD
- RECORD UNRELIABLE
- RECORD NOT SENSIBLE
- NO RECORD

Fig. 4

N. I. O. Mooring 013
Discovery Cruise 20 Lay II

DISCOVERY CRUISE 20
BUOY LAY NO 013

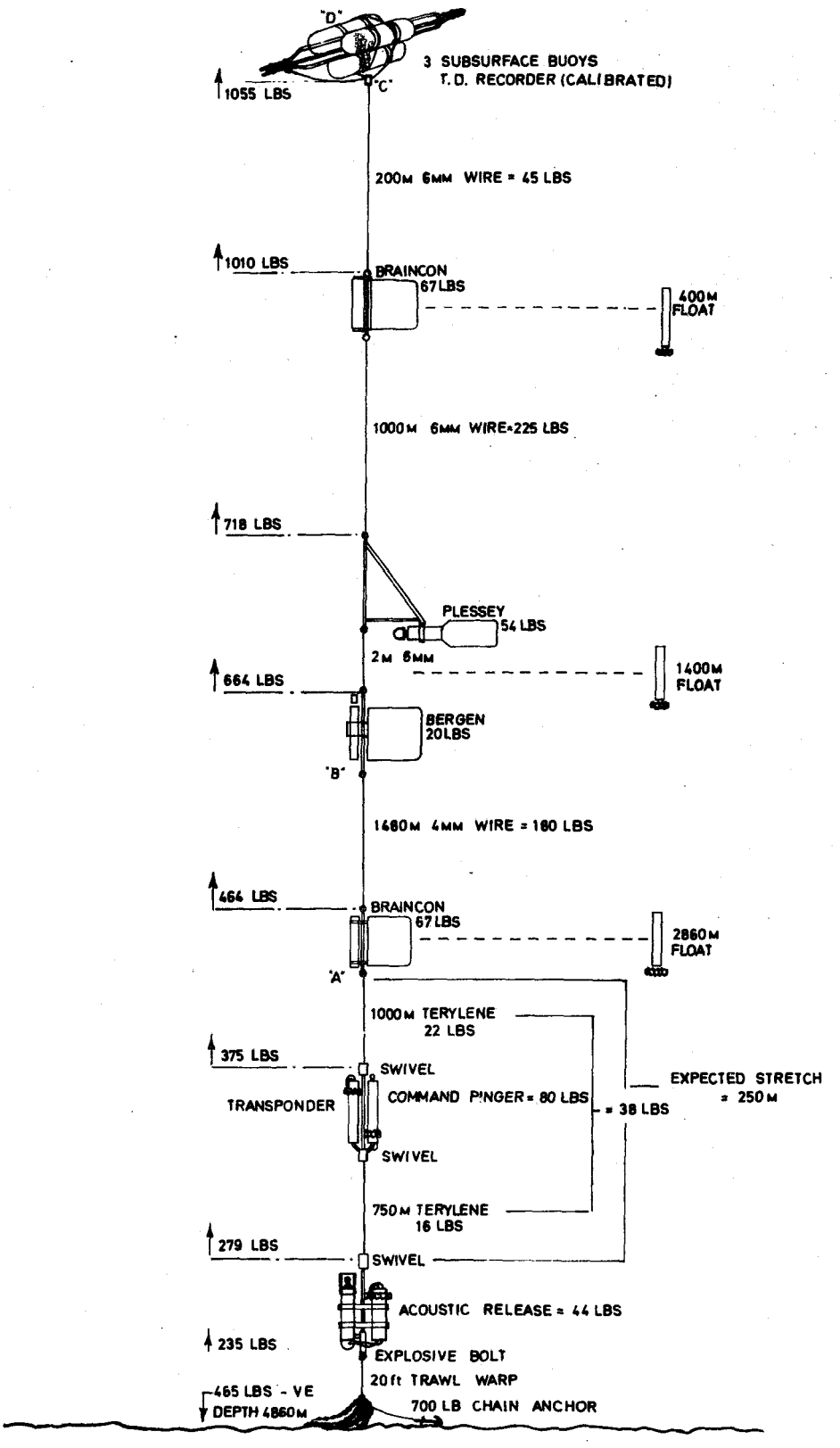


Fig 5

N. I. O. Mooring 015
Discovery Cruise 20 Lay IV

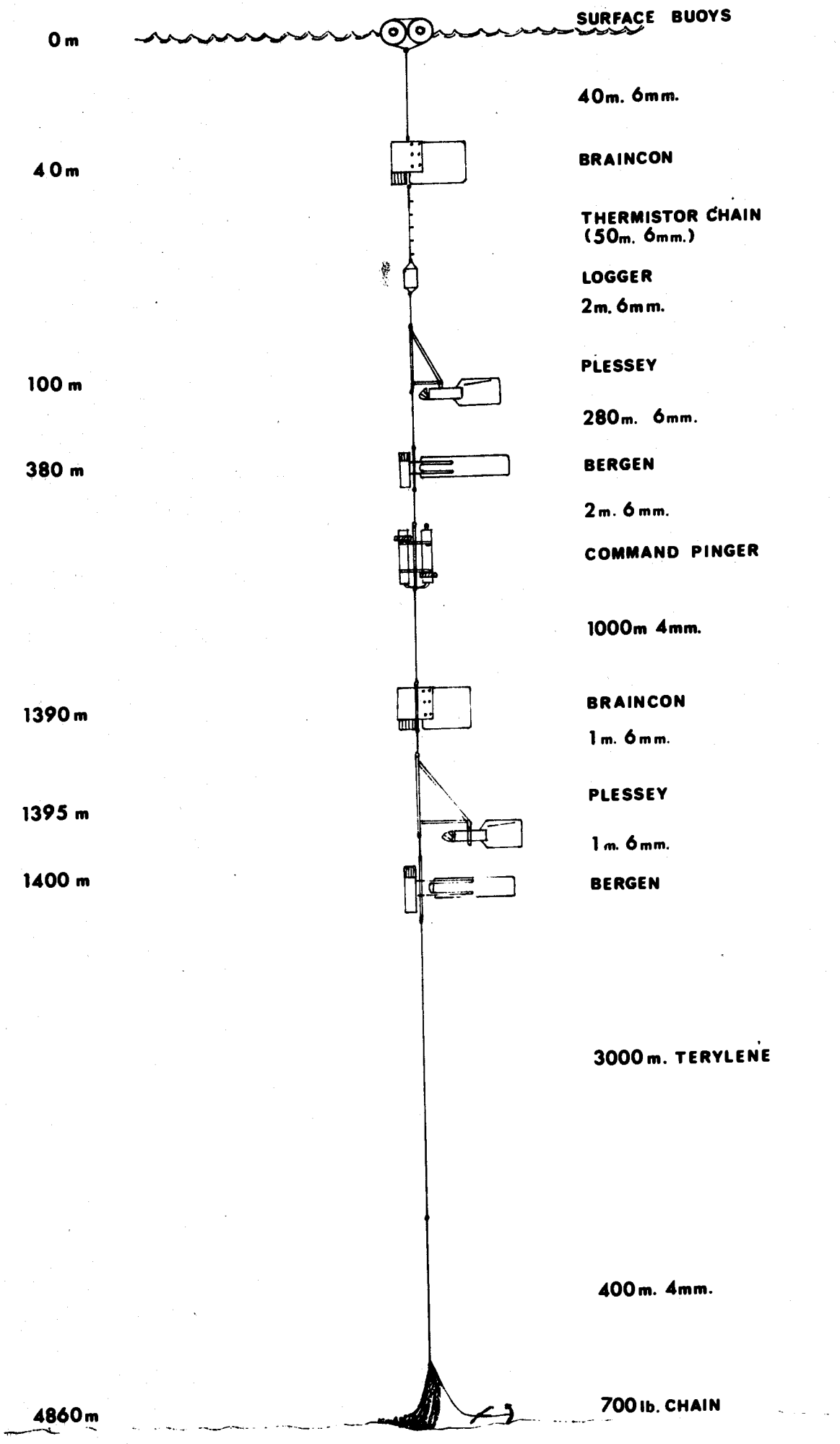
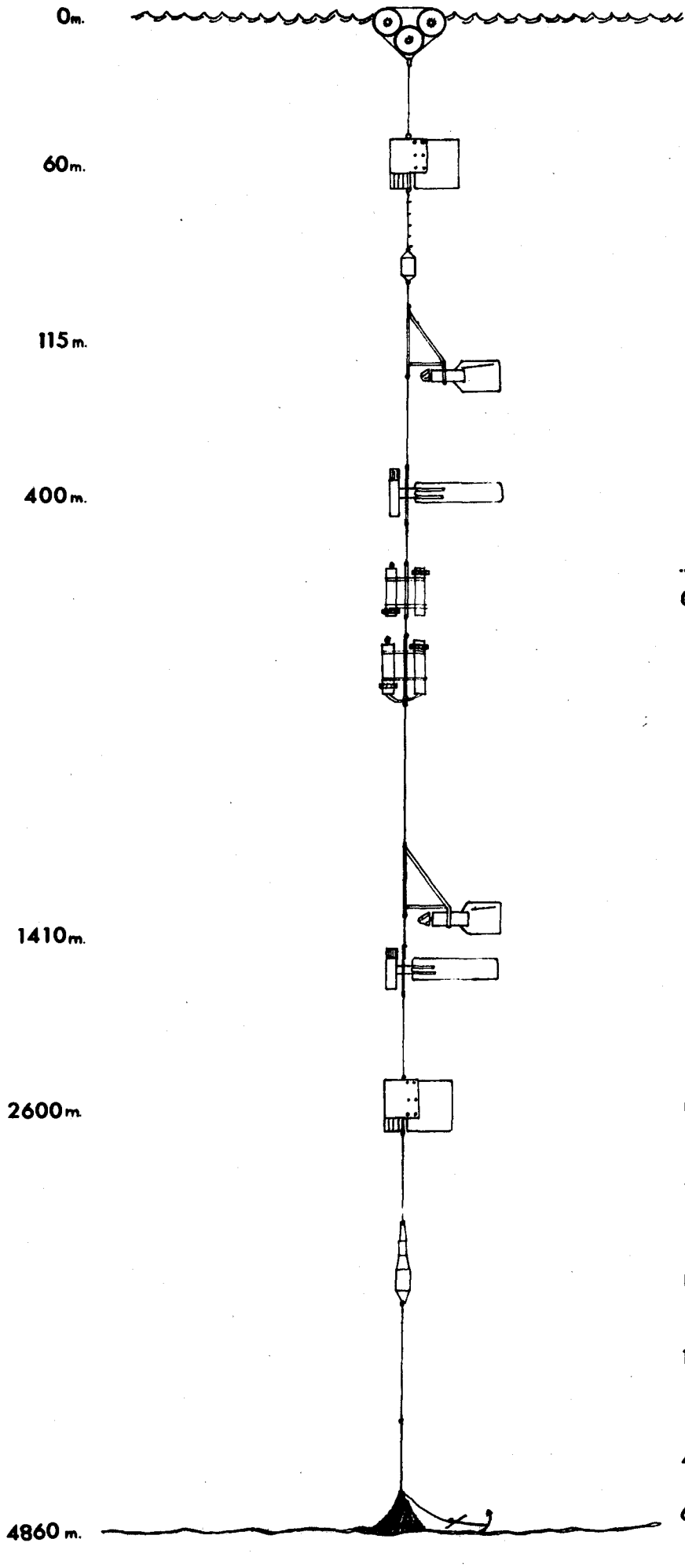

0 m
SURFACE BUOYS
40m. 6mm.
40 m
BRAINCON
THERMISTOR CHAIN
(50m. 6mm.)
LOGGER
2m. 6mm.
PLESSEY
100 m
280m. 6mm.
380 m
BERGEN
2m. 6mm.
COMMAND PINGER
1000m 4mm.
1390 m
BRAINCON
1m. 6mm.
PLESSEY
1395 m
1m. 6mm.
1400 m
BERGEN
3000 m. TERYLENE
400 m. 4mm.
4860 m
700 lb. CHAIN

Fig. 6

N. I. O. Mooring 016
Discovery Cruise 20 Lay V


0m.
SURFACE BUOYS
60 m. 6 mm.
60m.
BRAINCON
THERMISTOR CHAIN
LOGGER
2 m. 6 mm.
115 m.
PLESSEY
280 m. 6 mm.
400 m.
BERGEN
2 m. 6 mm.
"E" TYPE PINGER
(DEPTH TELEMETER)
COMMAND PINGER
1000 m. 4 mm.
PLESSEY
1410m.
2 m. 6 mm.
BERGEN
1180 m. TERYLENE
2600m.
BRAINCON
840 m TERYLENE
MAGNETOMETER
1300m TERYLENE
400m. 4mm.
600 lb CHAIN
4860 m.

streamlined dhan buoys attached by 6 mm. galvanised wire to the main buoyancy. The dhan buoys carried radar reflectors, lights and pennants for position fixing of nearby stations. The use of surface dhan buoys also enabled moorings to be recovered in the event of failure of the acoustic releases.

Acknowledgments

The Plessey current meters used on this cruise were loaned by the Fisheries Laboratory, Lowestoft to whom our thanks are due.
Dr. J. C. Swallow has given many words of advice during the preparation of this report and Miss R. Howarth has helped with the computing.

Analysis of the current meter data

In view of the fact that the N. I. O. programme of moored current meter observations was not, at the time of this study, in a position to deal systematically with large amounts of data there have been modifications to the procedures used during the preparation of the data presented here.

The three types of current meter each required a different processing routine.

Plessey data

These were read on the Plessey tape reader at the Fisheries Laboratory, Lowestoft. The data thus converted from binary form was run on the University of London Atlas computer with N. I. O. Program 96 (Hinde 1967) to produce a line-printer output of values of current speed and direction together with time series plots of these two variables. The output data were stored on magnetic tape.

Spurious values (for example due to dead-space crossings and poor compass performance) were corrected using N. I. O. Program 98 (Hinde 1968) and the corrected data used as an input with the Atlas version of N. I. O. Program 122 (Hinde iii) which gave true N-S, and E-W components of current speed together with cumulative displacement values at 10 minute intervals for the production of progressive vector diagrams.

All Plessey current meter analyses were performed on the U. L. Atlas Computer.

Bergen Data (Aanderaa 1964)

Initially the Lowestoft Plessey tape reader was used to produce seven track data tapes from the $\frac{1}{4}$" magnetic tape data, but although this was found to be satisfactory in some cases, difficulties were encountered. These stemmed from the fact that Plessey data had end of block markers at the end

of each cycle of recordings. These are not produced with the Bergen data and caused data bits to be missed from some blocks. This fault was at times so persistent that analysis was impossible from these records. Where records were good the analysis proceeded in a similar manner to that of the Plessey data via N. I. O. Programs 96/B, 98 and 122 (Hinde 1967, 1968, iii).

Those tapes which could not be read on the Plessey reader were read in Bergen by Ivar Aanderaa who produced a printout of the data. This data was punched into I. B. M. cards and then run at the N. I. O. on the IBM 1800 computer. It is now standard practice to process all current meter data on this computer.

The programs used on the 1800 computer are CRANO (N. I. O. Program 111) (Hinde i) for the conversion to speed, direction and temperature values, ERCO (N. I. O. Program 114) (Hinde ii) for correction of poor data and GPVD (N. I. O. Program 122) (Hinde iii) for the computation of N-S, E-W components and coordinates for progressive vector diagrams.

It is projected to build a Bergen tape reader which will produce $\frac{1}{2}$" computer compatible magnetic tape from the $\frac{1}{4}$" Bergen tape and thus input the data direct to the IBM 1800.

Braincon Data

The data from the Braincon current meter are recorded on 16 mm. film in an analogue form; the lengths and positions of concentric arcs of a circle being measures of current speeds and directions over the recording cycle.

These data were read, frame by frame on a 3M microfilm reader printer with a graticule fixed on the projection screen. The angular data were then punched onto IBM cards and analysis performed on the 1800 computer using program BRCA (N. I. O. Program 178) (Hinde iv). The output from this program gives current speed, true direction, current meter tilt direction, N-S and E-W components of speed and progressive vector diagram coordinates.

Note

The diagrams presented here were all drawn by hand but in the future it is proposed to prepare diagrams on an automatic plotter (from August 1969).

No corrections have been made in the computation or presentation of Bergen or Plessey data for deviations from the nominal sampling period. The Braincon data reduction program incorporates a correction for such errors. Times indicated on the diagrams are integral numbers of nominal sample periods from the time origin.

Mean speeds and directions referred to in the text are derived from the progressive vector diagrams and are "virtual displacement" values.

MOORING NUMBER 012 (Lay I)

POSITION (fig. 2) 45° 49' .3N 08° 21' .3W

TIME SET (fig. 3) 2040Z 24-X-67

TIME RECOVERED (fig. 3) 0930Z 7-XI-67

WATER DEPTH 4854m.

INSTRUMENTS

Record Number	Nominal Depth	Current Meter Type	Records
01201	400	Bergen	S. D. T.
01202	1400	Plessey	S. D.
01203	1400	Braincon	S. D.
01204	2860	Braincon	S. D.

Comments on mooring

When recovered neither the acoustic release nor the command pinger was in working order, both units have flooded via the camera plug sockets in the end caps. The mast and radar reflector were missing from the dhan buoy but the complete mooring was recovered by hauling in on the dhan buoy line.

The fins on both Braincon current meters had been torn away.

Record 01201

True depth 350m.

Current meter Bergen 47

Sample Period 10 mins.

Record begins 0837Z 24-X-67

Record ends 1406Z 7-XI-67

Time keeping Lost 20 mins.

Length of useful record 327 hours

Conversion equations

Speed	$= 2.7380\ (N_1 - N_2)$	$+ 0.00$ cm/sec
Direction	$= 0.351\ (N_D)$	$+ 10.50$ °T
Temperature	$= 0.0250\ (N_T)$	$+ 0.68$ °C

Comments on record

The Current meter performed well on all three channels. There was poor contact on the 128 bit pin in the encoder which produced some spurious readings which were most noticeable in the speed channel. These poor values were corrected using ERCO.

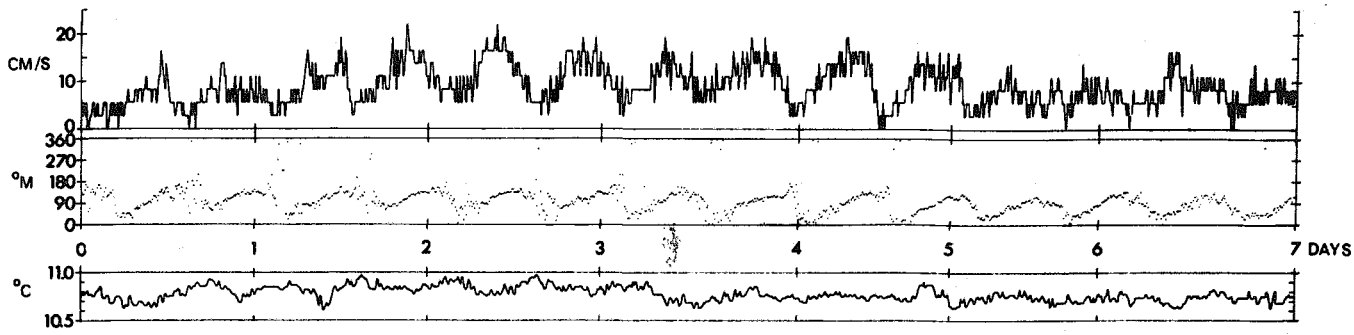
The record shows well marked semi-diurnal variations in current speed and direction but fluctuations in the temperature record are small and do not show any obvious periodicity.

Mean speed 14.5 cm/sec

Dir. 075 °T

Fig. 7

Speed, direction and temperature. 01201
Bergen 47
Time origin 2107Z 24-X-67


CM/S
20
10
0
360
270
°M
180
90
0
0
1
2
3
4
5
6
7 DAYS
°C
11.0
10.5

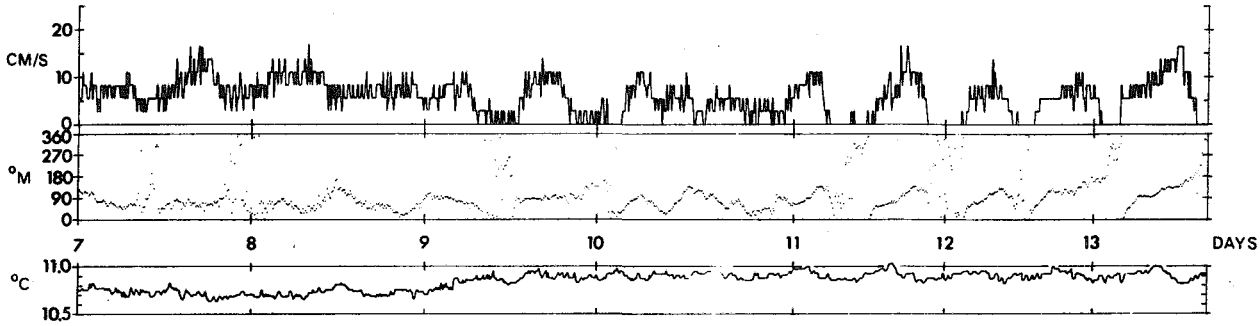
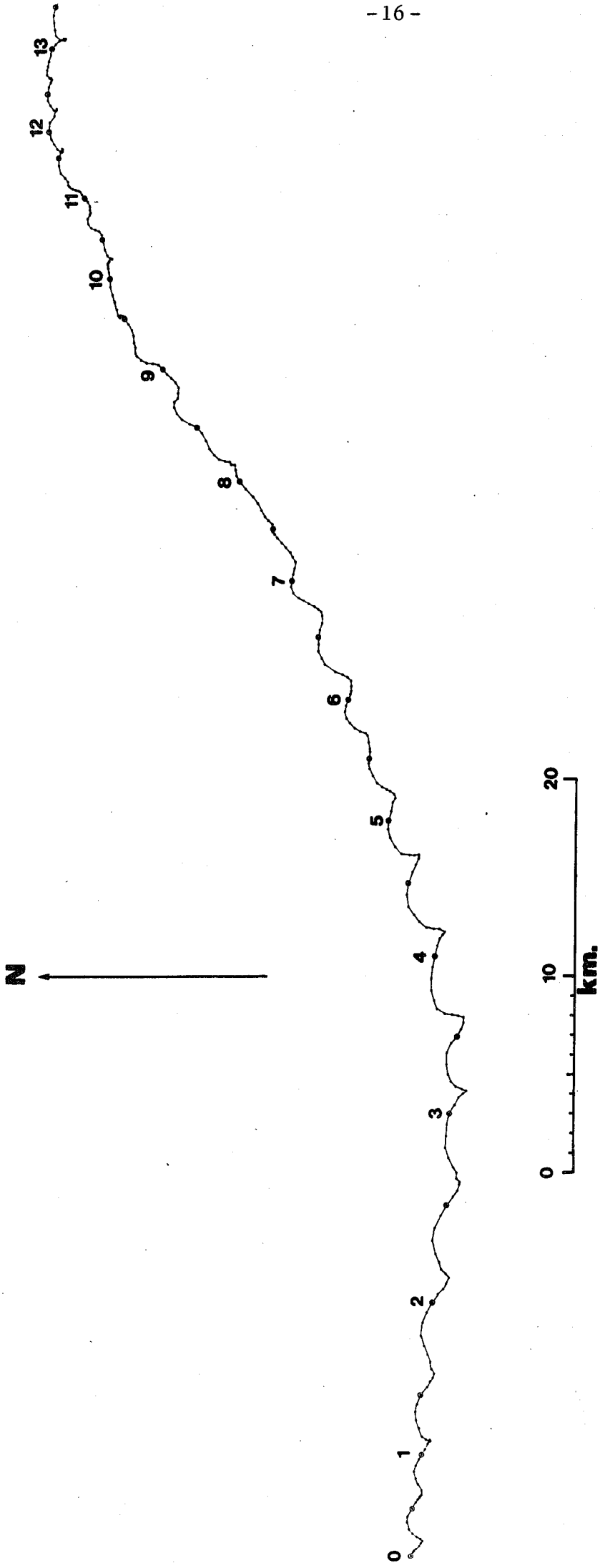

CM/S
20
10
0
360
270
°M
180
90
0
7
8
9
10
11
12
13
DAYS
°C
11.0
10.5

Fig. 8

Progressive vector diagram. 01201
Bergen 47
Time origin 2107Z 24-X-67
(Numbered days from origin)


N
0
1
2
3
4
5
6
7
8
9
10
11
12
13
0
10
20
km.

Record 01202

True depth 1350 m.

Current meter Plessey 172

Sample Period 10 mins.

Record begins 1720Z 24-X-67

Record ends 1437Z 7-XI-67

Time keeping Lost 20 mins.

Length of useful record 325 hours

Conversion equations

Speed = $0.5760\ (N_1 - N_2) + 0.00$ cm/sec

Direction = $0.351\ (N_D) + 10.50$ °T

Comments on record

There was some evidence of erratic performance of the compass channel. In several cases there was larger scatter in the direction values even during periods of strong steady currents.

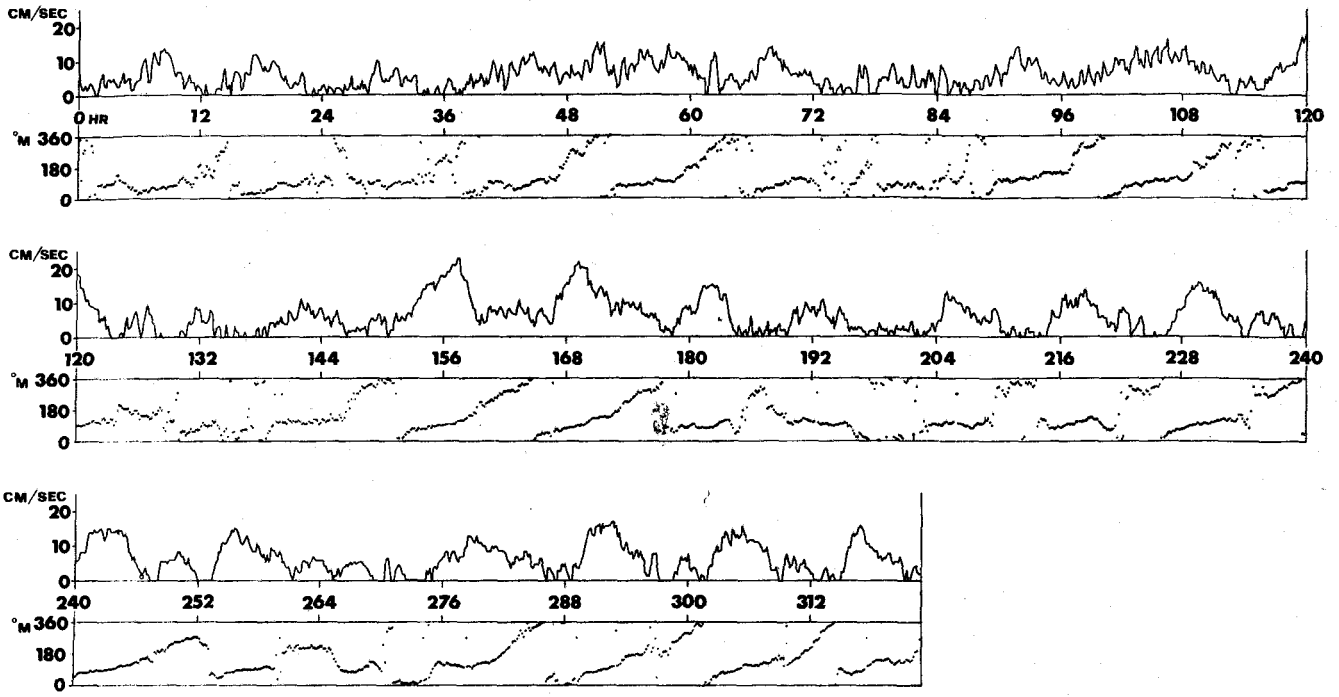
This scatter produced a large number of values of 270° and 315°M. The encoded values corresponding to these directions did not produce spurious speed values, seeming to indicate that the fault lay in the compass itself rather than in the encoder. The poor values were edited out before the production of the progressive vector diagram.

Mean speed 3.6 cm/sec

Dir. 078 °T

Fig. 9

Speed and direction 01202
Plessey 172
Time origin 2300Z 24-X-67

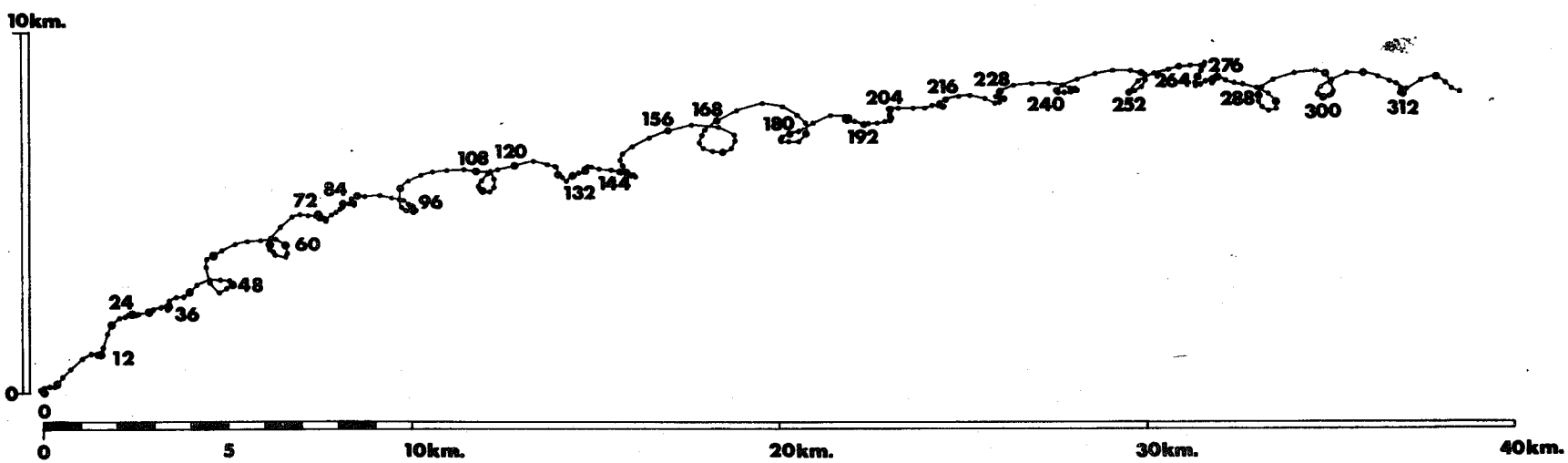


DISCOVERY CRUISE 20

PLESSEY 172, 1400 m, LAY 1

Fig. 10

Progressive Vector diagram 01202
Plessey 172
Time origin 2300Z 24-X-67
(Numbered hours from origin)



DISCOVERY CRUISE 20

PLESSEY 172, 1400m, LAY 1

ORIGIN 2300 GMT 24.X.67

Record	01203
True depth	1353 m.
Current meter	Braincon 114
Sample Period	20 mins.
Record begins	1006Z 24-X-67
Record ends	1526Z 7-XI-67
Time keeping	Gained 1 hour
Length of useful record	see below

Comment on record

This current meter was recovered with a broken fin. The likely cause of breakage seems to be the high speeds encountered when the meter is being launched.

When the mooring is laid "anchor first" the lower edge of the fin, which is largely unsupported, leads the rest of the fin through the water and, due to its lack of support, tearing can commence. This is unlikely to happen if the mooring is laid "buoy first", as the meter can then fall through the water with the fin trailing behind the body.

No analysis beyond a preliminary reading was undertaken.

Record	01204
True depth	2812 m.
Current meter	Braincon 111
Sample Period	20 mins.
Record begins	0942Z 24-X-67
Record ends	1341Z 7-XI-67
Time keeping	No gain or loss
Length of useful record	see below

Comments on record

The current meter functioned correctly but the fin was broken (see 01203). No analysis was undertaken.

MOORING NUMBER 013 (Lay II) (Fig. 4)

POSITION (fig. 2) 45° 55. 6'N 08° 06. 5' W

TIME SET (fig. 3) 1750Z 30-X-67

TIME RECOVERED (fig. 3) 1115Z 10-XI-67

WATER DEPTH 4860m.

INSTRUMENTS

Record Number	Nominal Depth	Current Meter Type	Records
01301	400	Braincon	S. D.
01302	1400	Bergen	S. D. T.
01303	1400	Plessey	S. D.
01304	2860	Braincon	S. D.

Comments on mooring

The acoustic release and command pinger worked correctly and the mooring was recovered in the proper manner. The mast and radar reflector were missing from the dhan buoy.

There was damage to the fins on both the Plessey meter and the lower Braincon meter.

Record	01301
True depth	410 m.
Current meter	Braincon 116
Sample Period	20 mins
Record begins	1448Z 26-X-67
Record ends	1925Z 11-XI-67
Time keeping	No gain or loss
Length of useful record	260 hours

Comments on record

The current meter worked well, the main characteristics of the record being a predominantly semi-diurnal variation in current speed between extremes of 32.0 and 2.5 cm/sec.

The overall direction of flow was very close to 060 °T with a small semi-diurnal variation.

Mean speed was 15.7 cm/sec.

Dir. 060 °T

Fig. 11

Speed and direction 01301
Braincon 116
Time origin 1900Z 30-X-67

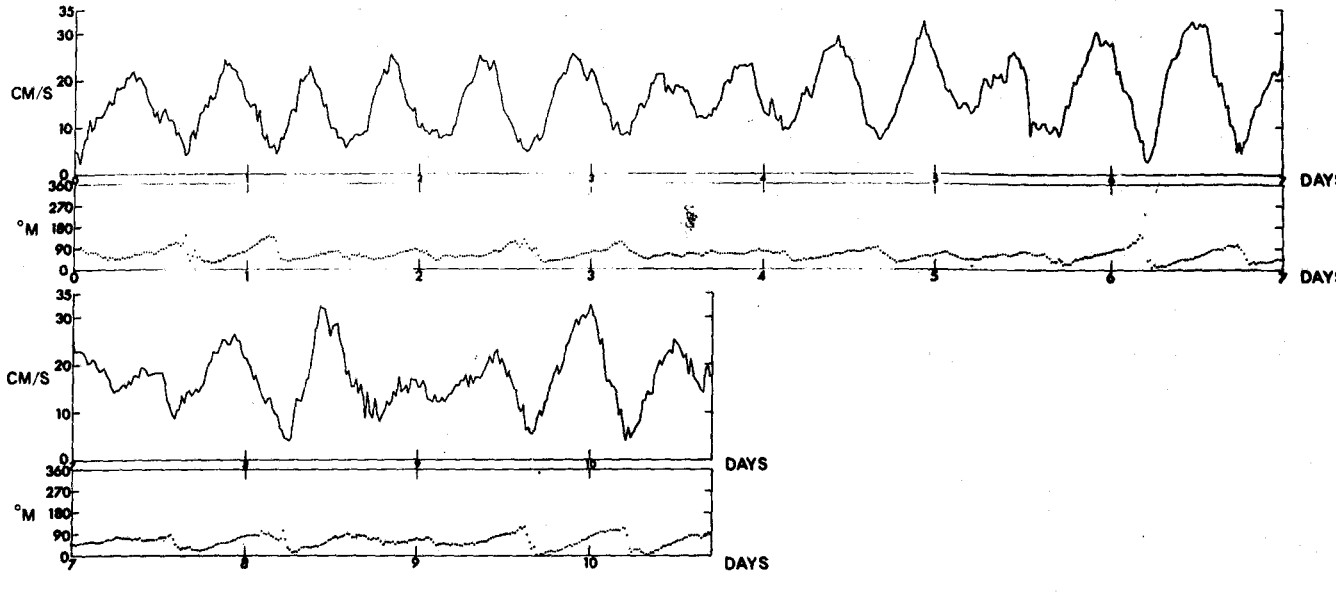
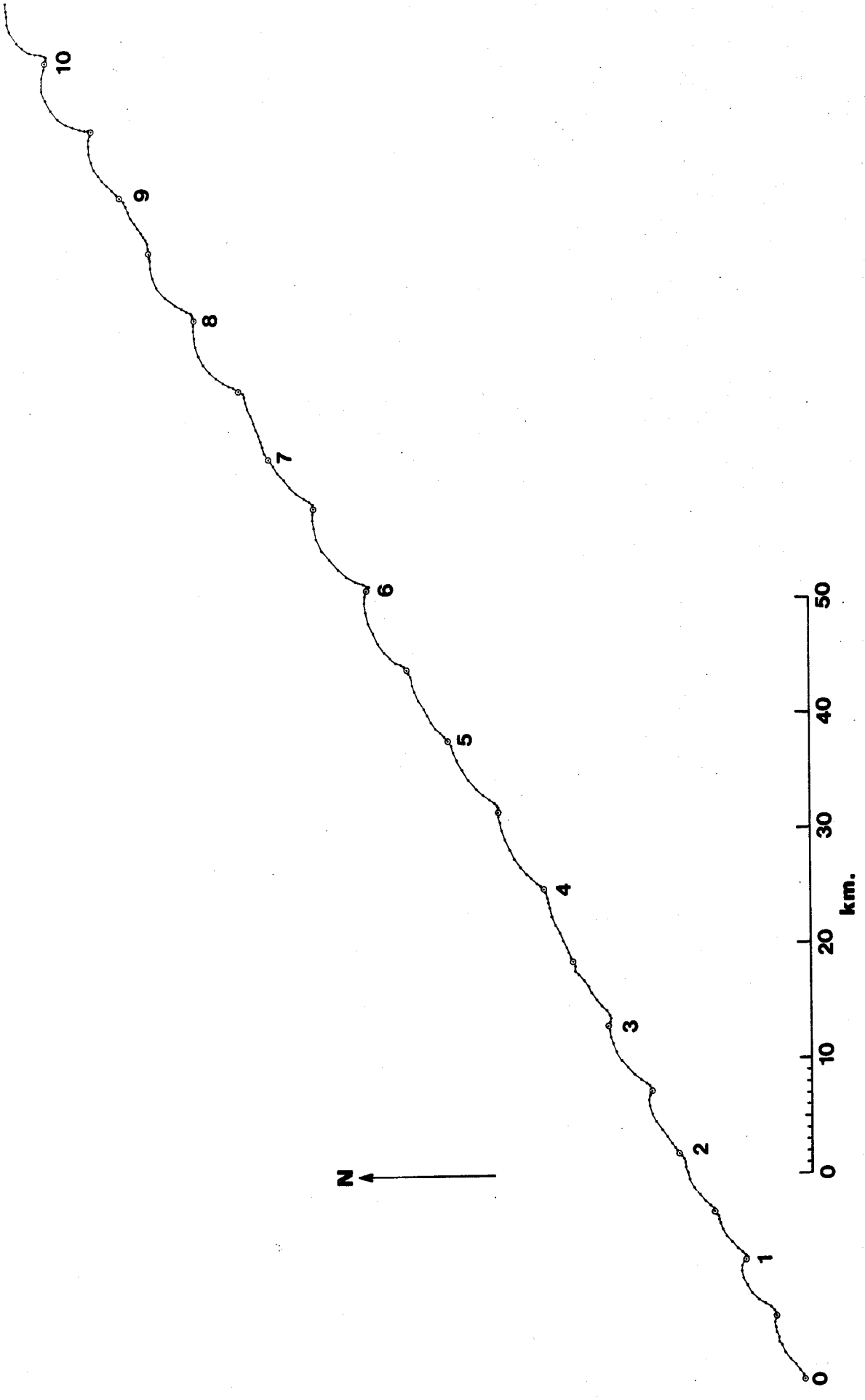

CM/S
35
30
20
10
0
DAYS
°M
360
270
180
90
0
1
2
3
4
5
6
7
DAYS
CM/S
35
30
20
10
0
DAYS
°M
360
270
180
90
0
7
8
9
10
DAYS

Fig. 12

Progressive Vector diagram 01301
Braincon 116
Time origin 1900Z 30-X-67
(Numbered days from origin)


0
1
2
3
4
5
6
7
8
9
10
N
0
10
20
30
40
50
km.

Record	01302
True depth	1412 m.
Current meter	Bergen 45
Sample Period	10 mins.
Record begins	1550Z 25-X-67
Record ends	1524Z 10-XI-67
Time keeping	No gain or loss
Length of useful record	261 hours

Conversion equation

Speed = $2.7380\ (N_1-N_2) + 0.00$ cm/sec

Direction = $0.351\ (N_D) + 10.5$ °T

Temperature = $0.0250\ (N_T) + 0.68$ °C

Comments on record

The behaviour of all channels was generally good. Current speeds were in the range 0 to 20 cm/sec giving a displacement mean value of 3.4 cm/sec in direction 011 °T.

The temperature record shows large fluctuations of semi-diurnal period. Around days 5 and 6 there appears to be an increase in the mean temperature.

Fig. 13

Speed, direction and temperature 01302
Bergen 45
Time origin 1800Z 30-X-67

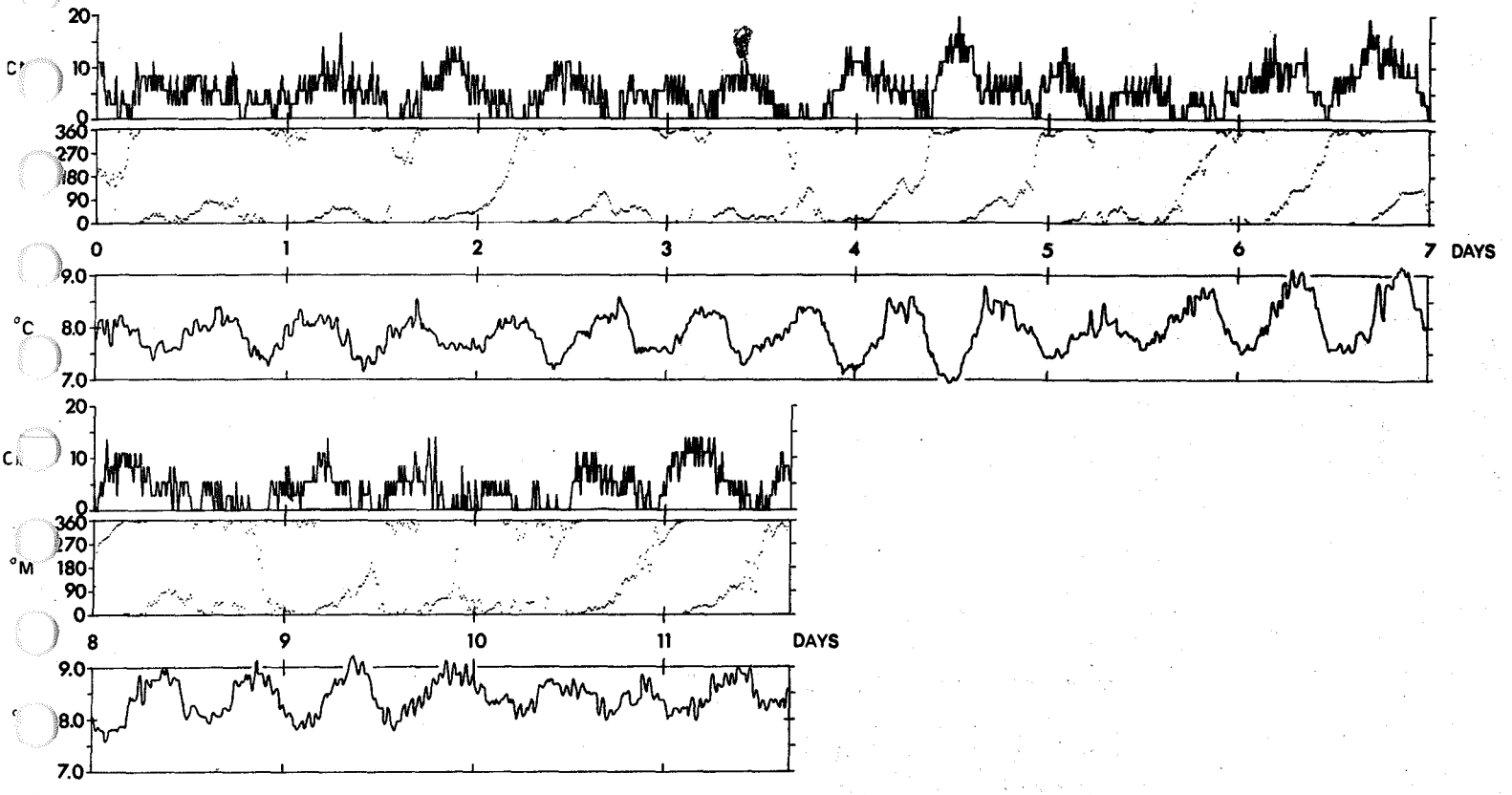
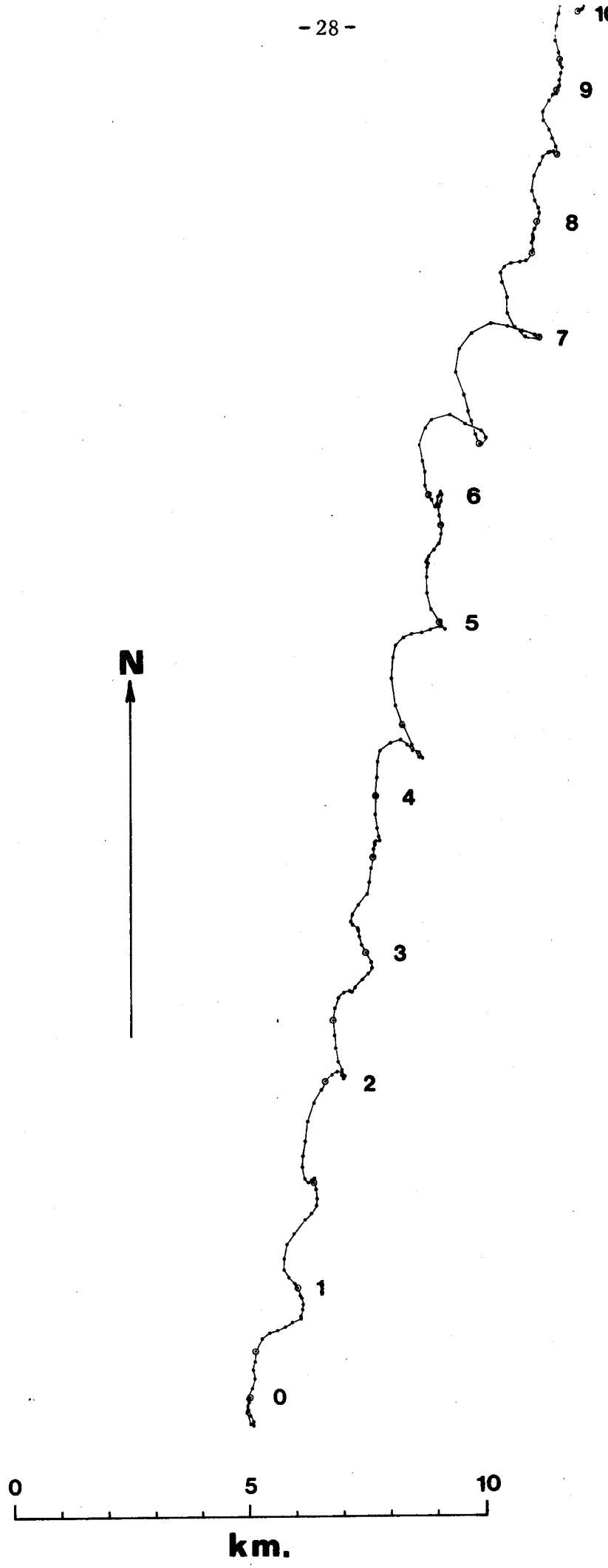

20
10
0
360
270
180
90
0
0
1
2
3
4
5
6
7 DAYS
9.0
8.0
7.0
°C
20
10
0
360
270
180
90
0
°M
8
9
10
11
DAYS
9.0
8.0
7.0

Fig. 14

Progressive vector diagram 01302
Bergen 45
Time origin 1800Z 30-X-67
(Numbered days from origin)


10
9
8
7
6
5
N
4
3
2
1
0
0
5
10
km.

Record	01303
True depth	1414 m.
Current meter	Plessey 253
Sample Period	10 mins.
Record begins	1502Z 26-X-67
Record ends	1530Z 10-XI-67
Time keeping	No gain or loss
Length of useful record	See below

Comments on record

The fin was missing when the current meter was recovered. The position of the fin clamp and the damage to the leading edge of the small part of the fin that remained seemed to indicate that the fin had fouled the suspension frame and that this was the probable cause of breakage. The forces involved seemed to have been quite severe as the fin clamp had been pushed almost an inch along the pressure case of the current meter.

From the record it appeared that this damage had occurred during launching. The current directions throughout the record showed very little variation, possibly caused by the meter being in the wrong attitude and so jamming the compass. The speed channel showed long periods of zero values and in some cases the rotor count had changed in the wrong sense. This may have been caused by the loss of the fin but could also indicate a failure of the encoder or the rotor potentiometer.

No further analysis was attempted.

Record	01304
True depth	2897 m.
Current meter	Braincon 112
Sample Period	20 mins.
Record begins	1451Z 26-X-67
Record ends	0930Z 11-XI-67
Time Keeping	see below
Length of useful record	see below

Comments on record

The current meter was recovered with a broken fin. The meter had otherwise worked well but no analysis was undertaken.

MOORING NUMBER 014 (Lay III)

POSITION (fig. 2) 45° 51.1'N 08° 20.2'W

TIME SET (fig. 3) 1330Z 9-XI-67

TIME RECOVERED (fig. 3) 1150Z 12-XII-67

WATER DEPTH 4854 m.

INSTRUMENTS

Record Number	Nominal Depth	Current Meter Type	Records
01401	400	Bergen	S. D. T.
01402	1400	Plessey	S. D.
01403	1400	Bergen	S. D. T.
01404	2860	Braincon	S. D.

Comments on mooring

The dhan buoy from this mooring was lost. When recovery was attempted the acoustic release failed to operate. The command pinger indicated that the mooring was still in position and an attempt was made to drag for it using grapnels on the main trawl warp.

The mooring was retrieved complete and undamaged.

Record	01401
True depth	350 m.
Current meter	Bergen 44
Sample Period	10 mins.
Record begins	2024Z 7-XI-67
Record ends	1522Z 12-XII-67
Time keeping	Gained 30 mins.
Length of useful record	792 hours

Conversion Equation

Speed = $2.7380\ (N_1-N_2) + 0.00$ cm/sec.

Direction = $0.35\ (N_D) + 10.50$ °T

Temperature = $0.0250\ (N_T) + 0.68$

Comments on record

Apart from some stretches where the temperature record wäs poor, showing a very large scatter of points, and also one or two bad direction values the current meter worked well.

Speeds showed an overall increase during the period of the record from a range of 0 to 15 cm/sec from the origin to day 12 to 5 to 25 cm/sec around day 22.

Mean speeds were, Day 0 to 12 5.1 cm/sec 043°T

Day 12 to 32 10.1 cm/sec 000°T

Fig. 15

Speed, direction and temperature
Bergen 44
Time origin 1430Z 9-XI-67

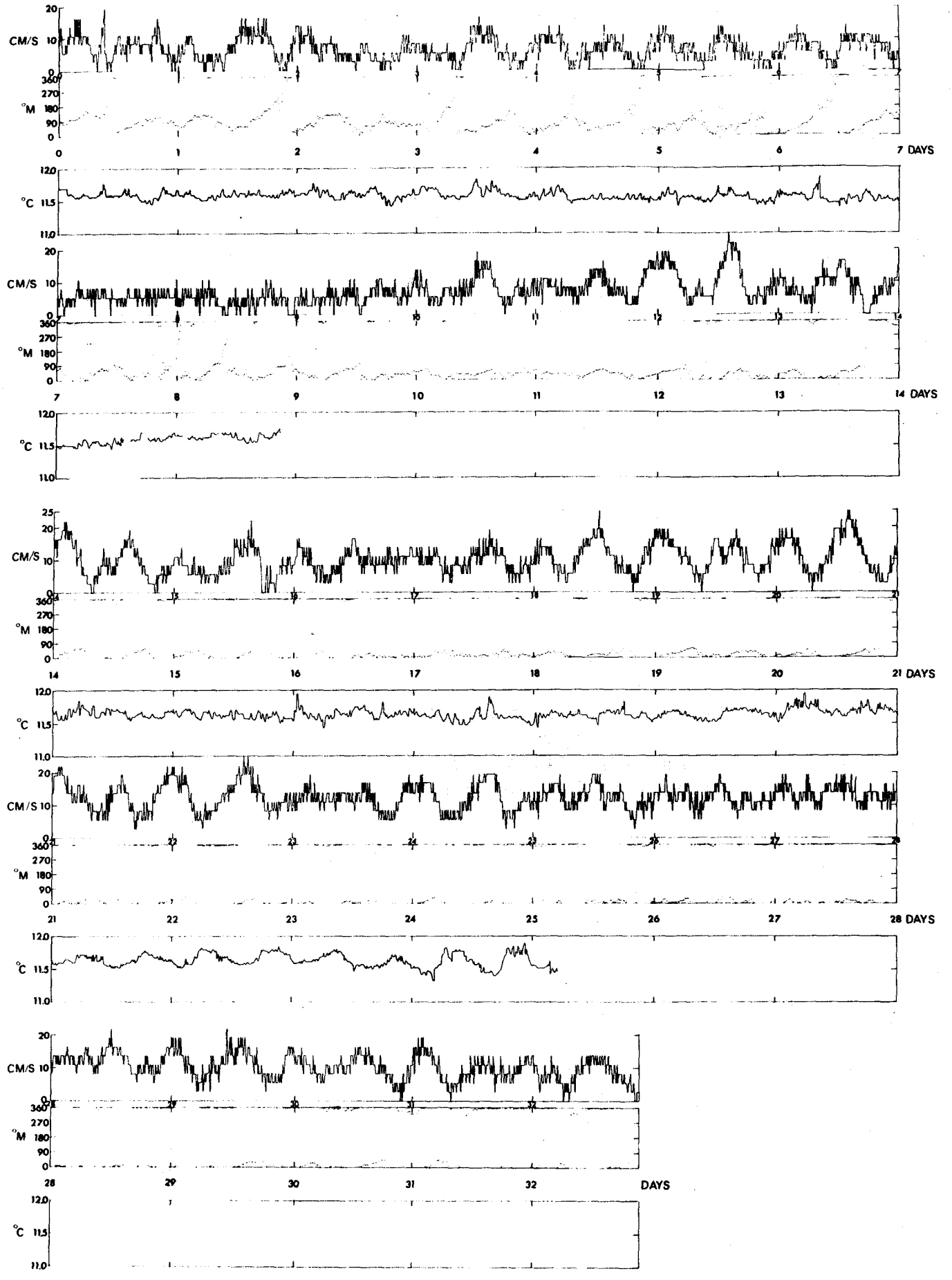
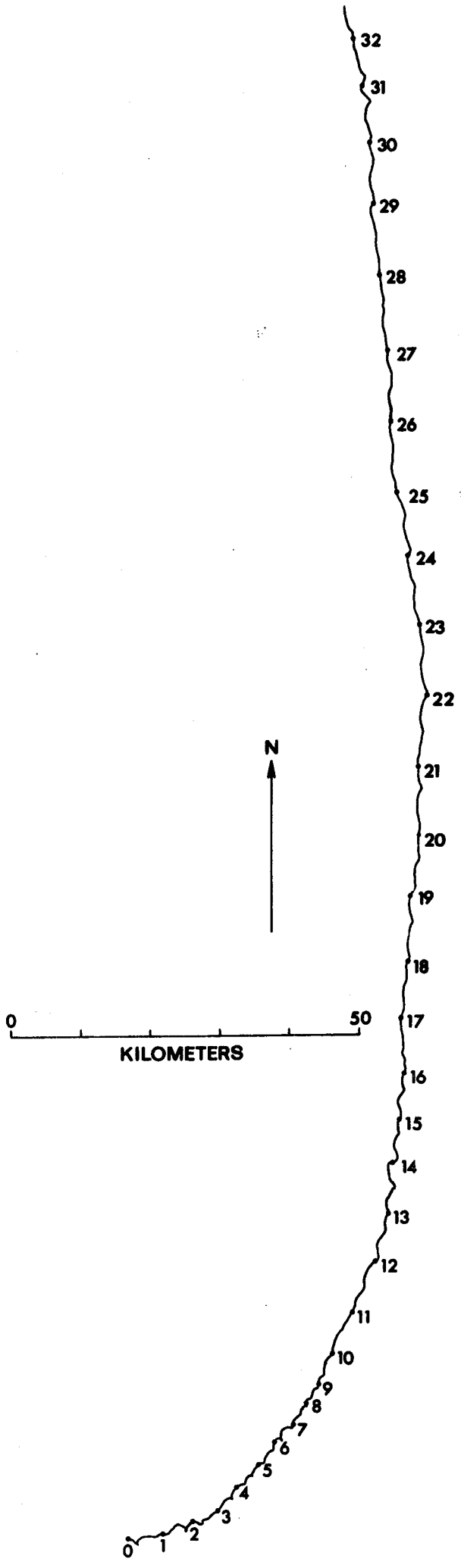

CM/S
°M
°C
0
1
2
3
4
5
6
7 DAYS
7
8
9
10
11
12
13
14 DAYS
14
15
16
17
18
19
20
21 DAYS
21
22
23
24
25
26
27
28 DAYS
28
29
30
31
32
DAYS

Fig. 16

Progressive vector diagram 01401
Bergen 44
Time origin 1430Z 9-XI-67
(Numbered days from origin)


32
31
30
29
28
27
26
25
24
23
22
N
21
20
19
18
0
50
17
KILOMETERS
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0

Record	01402
True depth	1350 m
Current meter	Plessey 421
Sample Period	10 mins.
Record begins	0856Z 9-XI-67
Record ends	1541Z 12-XII-67
Time keeping	No gain or loss
Length of useful record	291 hours

Conversion Equation

Speed = $0.5760\ (N_1-N_2) + 0.00$ cm/sec

Direction = $0.351\ (N_D) + 10.50$ °T

Comments on record

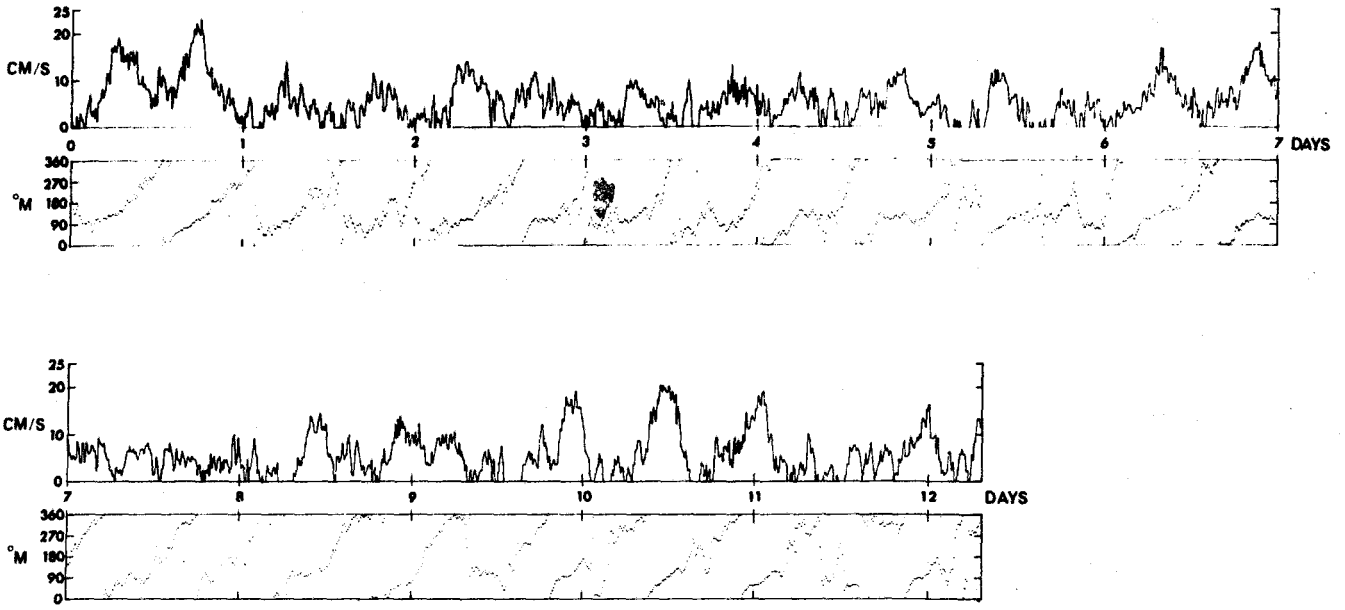
When recovered it was found that the top of the fin was missing and the remainder had been twisted and pushed along the pressure housing (see 01303).

The decoded data tape showed that the first 291 hours of data were of good quality but thereafter an encoder fault made the data invalid.

The progressive vector diagram shows a marked change in direction around days 8 and 9 from 102°T to 040°T. Mean speeds over the two sections being 2.9 cm/sec and 2.2 cm/sec respectively. The dominant periodic motion is semi-diurnal and well defined rotatory patterns are seen.

Fig. 17

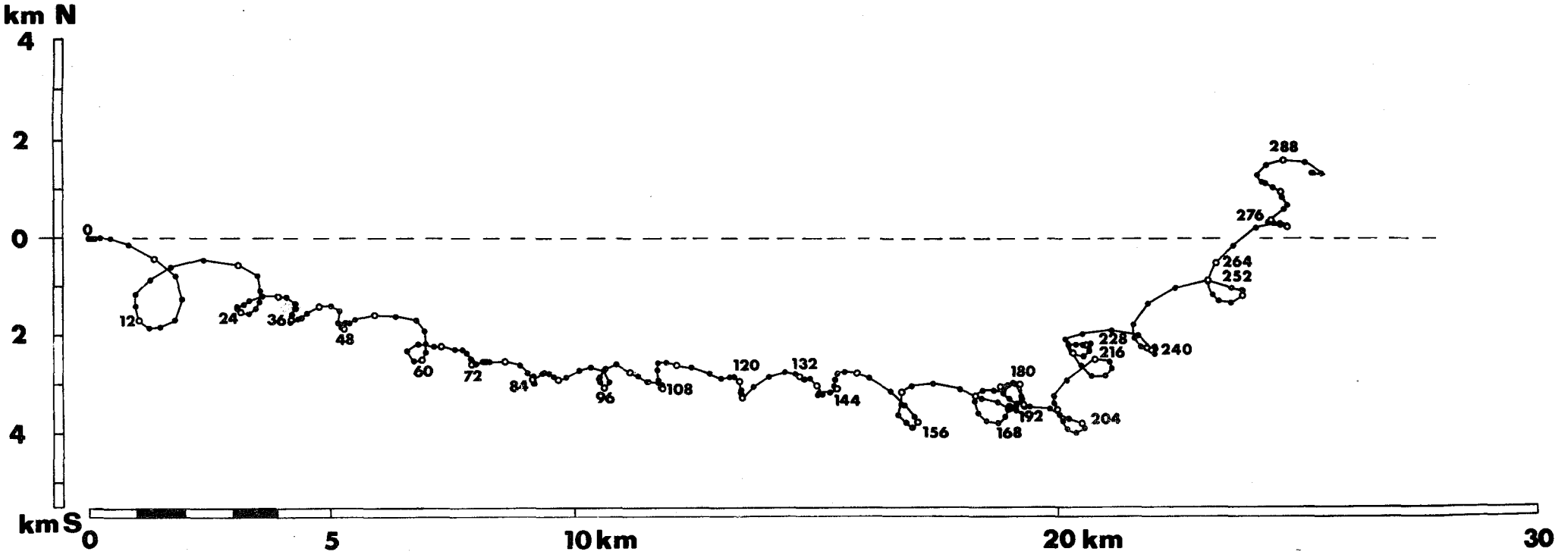
Speed and direction 01402
Plessey 421
Time origin 1436Z 9-XI-67


CM/S
25
20
10
0
0
1
2
3
4
5
6
7 DAYS
°M
360
270
180
90
0

CM/S
25
20
10
0
7
8
9
10
11
12
DAYS
°M
360
270
180
90
0

Fig. 18

Progressive vector diagram 01402
Plessey 421
Time origin 1436Z 9-XI-67
(Numbered hours from origin)



DISCOVERY CRUISE 20

PLESSEY 421, 1400m, LAY 3

ORIGIN 1436 G.M.T. 9/XI/67

Record	01403
True depth	1353 m.
Current meter	Bergen 48
Sample Period	10 mins.
Record begins	1921Z 7-XI-67
Record ends	See below
Time keeping	See below
Length of useful record	518 hours

Conversion Equation

Speed = $2.7380\ (N_1-N_2) + 0.00$ cm/sec

Direction = $0.351\ (N_D) + 10.50$ °T

Temperature = $0.0250\ (N_T) + 0.68$ °C

Comments on record

When recovered the clock battery was flat. The total length of record obtained was 518 hours. The cause of the battery failure is now thought to be a fault in the solenoid winding mechanism of the clock which causes the battery to be short circuited.

The record obtained was of good quality apart from a period around day 6 when for about 12 hours zero current speed was recorded. This could have been caused by dirt in the rotor gearbox which jammed the mechanism until dislodged by vibration.

A pronounced semi-diurnal variation is in evidence in the records for all three channels - other noteable features are extremely sudden changes of current speed (particularly decreases) e.g. day 16 and day 12 and a series of unusual step-like changes in temperature between days 7 and 10.

The change in mean direction around day 9 is similar to that on record 0120Z from 095°T, 2.0 cm/sec to 023°T, 1.7 cm/sec.

The difference in mean direction may well be accounted for by the damage to the fin on the Plessey meter.

Fig 19

Speed, direction and temperature 01403
Bergen 48
Time origin 1300Z 9-XI-67

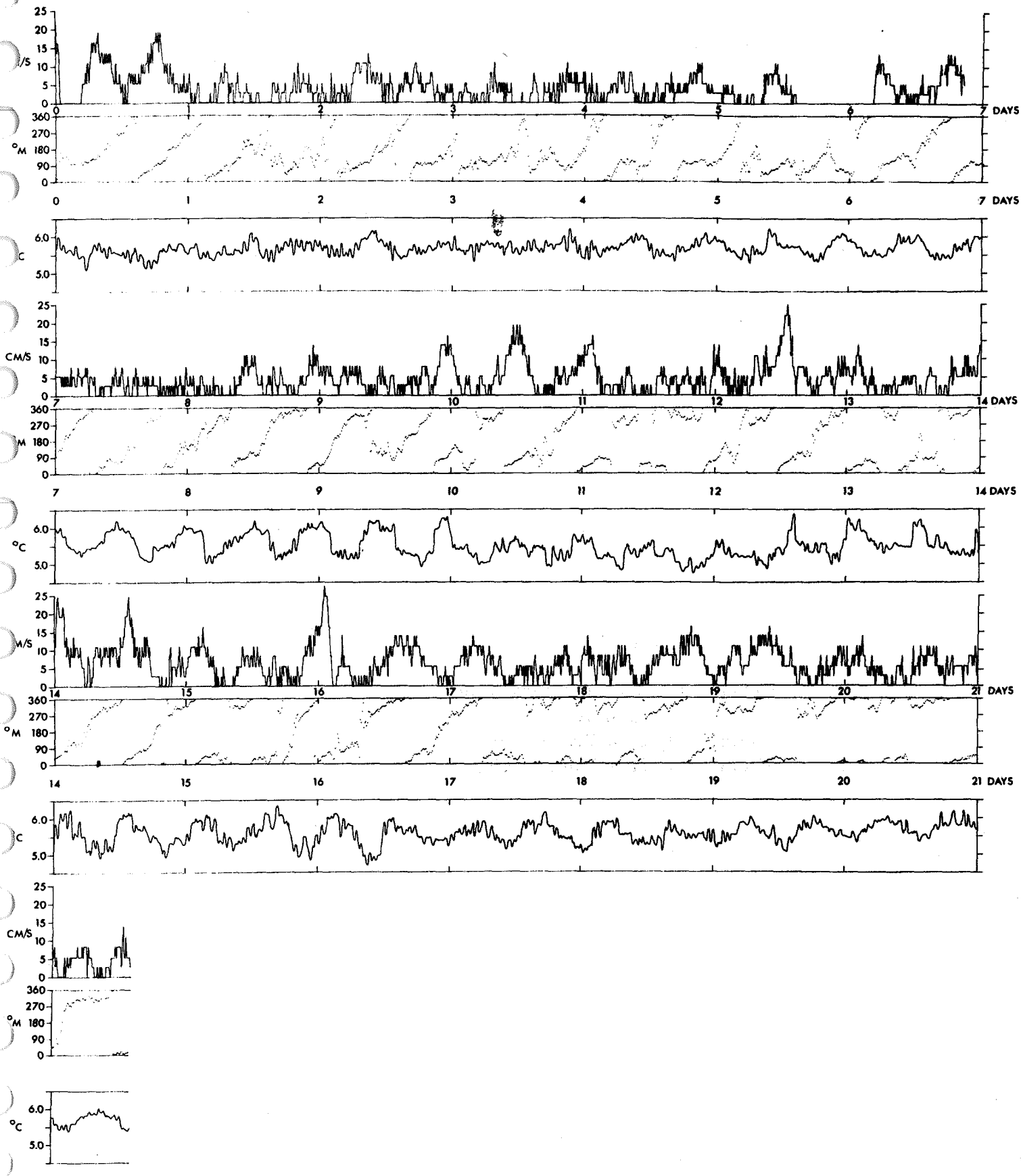
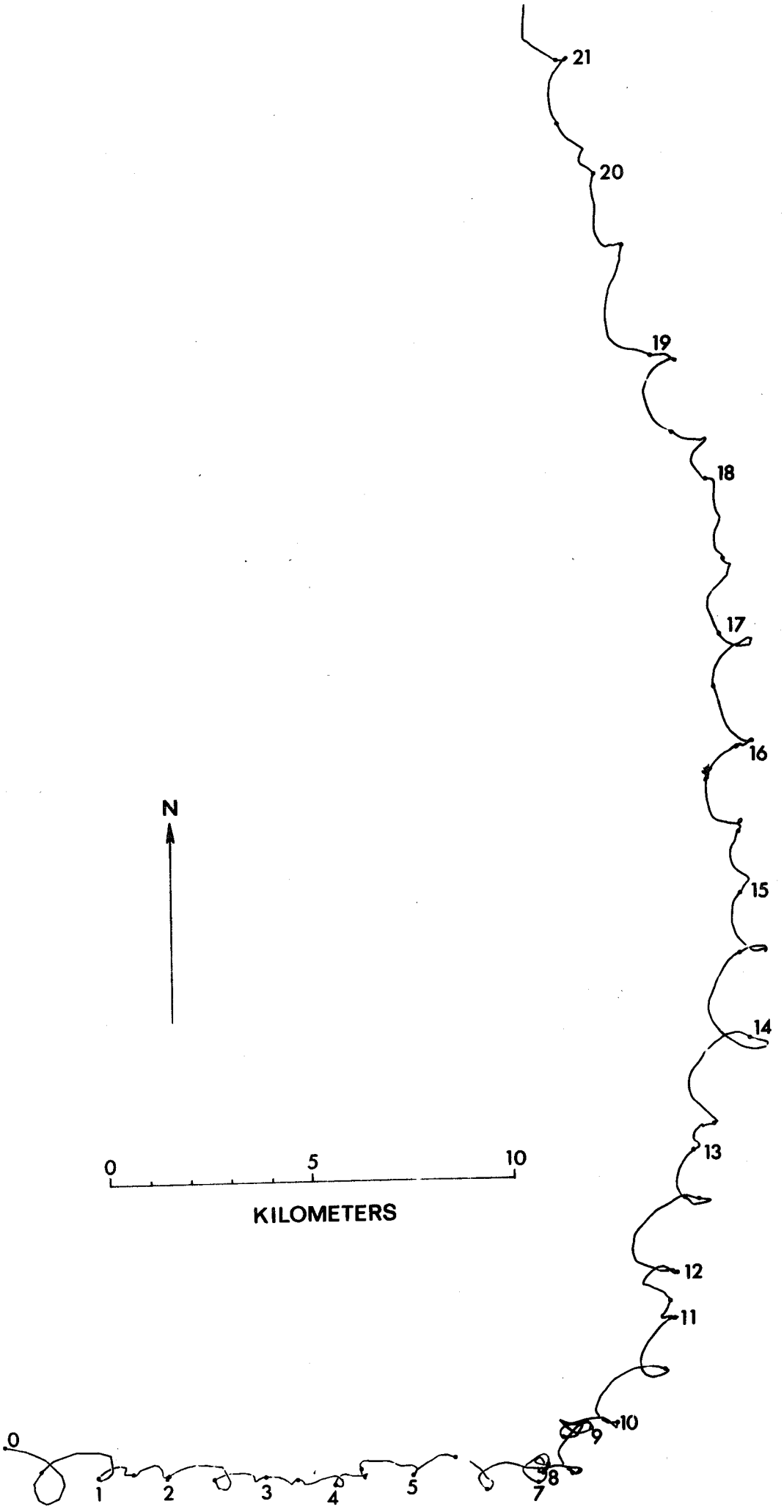

CM/S
°M
°C
DAYS

Fig. 20

Progressive vector diagram 01403
Bergen 48
Time origin 1300Z 9-XI-67
(Numbered days from origin)


21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
0
1
2
3
4
5
N
0
5
10
KILOMETERS

Record	01404
True depth	2812 m.
Current meter	Braincon 115
Sample Period	20 mins.
Record begins	0915Z 9-XI-67
Record ends	see below
Time keeping	see below
Length of useful record	see below

Comments on record

There was some malfunction of the film wind mechanism resulting in the exposure of only 79 frames. These covered the beginning and end of the time that the meter was in use, for the remainder no data were obtained. No analysis was therefore possible.

The fin had been strengthened and was not damaged.

MOORING NUMBER 015 (Lay IV) (Fig. 5)

POSITION (fig. 2) 45° 57.9'N 08° 05.5'W

TIME SET (fig. 3) 1616Z 23-XI-67

TIME RECOVERED (fig. 3) 1055Z 30-XI-67

WATER DEPTH 4825m.

INSTRUMENTS

Record Number	Nominal Depth	Current Meter Type	Records
01501	40	Braincon	S. D.
01502	94	Plessey (Liverpool)	S. D.
01503	375	Bergen	S. D. T.
01504	1400	Braincon	S. D.
01505	1400	Plessey	S. D.
01506	1400	Bergen	S. D. T.

Comments on mooring

This was the first of the surface buoyancy moorings (fig. 5). A thermistor chain with self contained data logger was attached to the mooring between 40 and 100 m. depth. This instrument was the property of A. Hecht of the University of Liverpool. No analysis will be given here.

In view of the fin breakages on previous Braincon meters the fins on these metres were strengthened with $\frac{1}{4}$" polythene sheet bolted through the original fin.

Record	01501
True depth	40 m.
Current meter	Braincon 116
Sample Period	20 mins.
Record begins	1135Z 23-XI-67
Record ends	1628Z 1-XII-67
Time keeping	See below
Length of useful record	128 hours (see below)

Comments on record

The last part of this record was lost due to a processing fault. A total of 36 hours of data were destroyed.

The current meter worked well. The most remarkable feature of the record is the increase in current speed from around 25 cm/sec to 40 cm/sec over a period of 9 hours during day 2. The fluctuations in speed are small and there is no marked tidal periodicity.

Mean speed 29.0 cm/sec

Dir. 020 °T

The fin on this meter had been strengthened and was not damaged.

Fig. 21

Speed and direction 01501
Braincon 116
Time origin 1827Z 23-XI-67

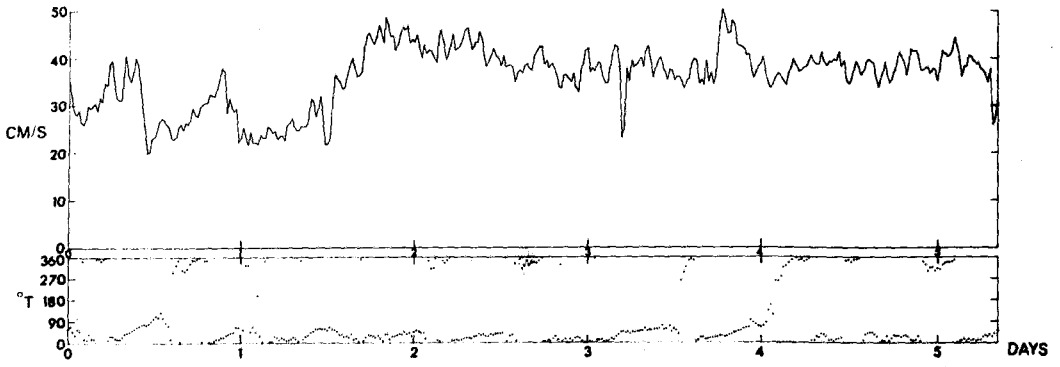
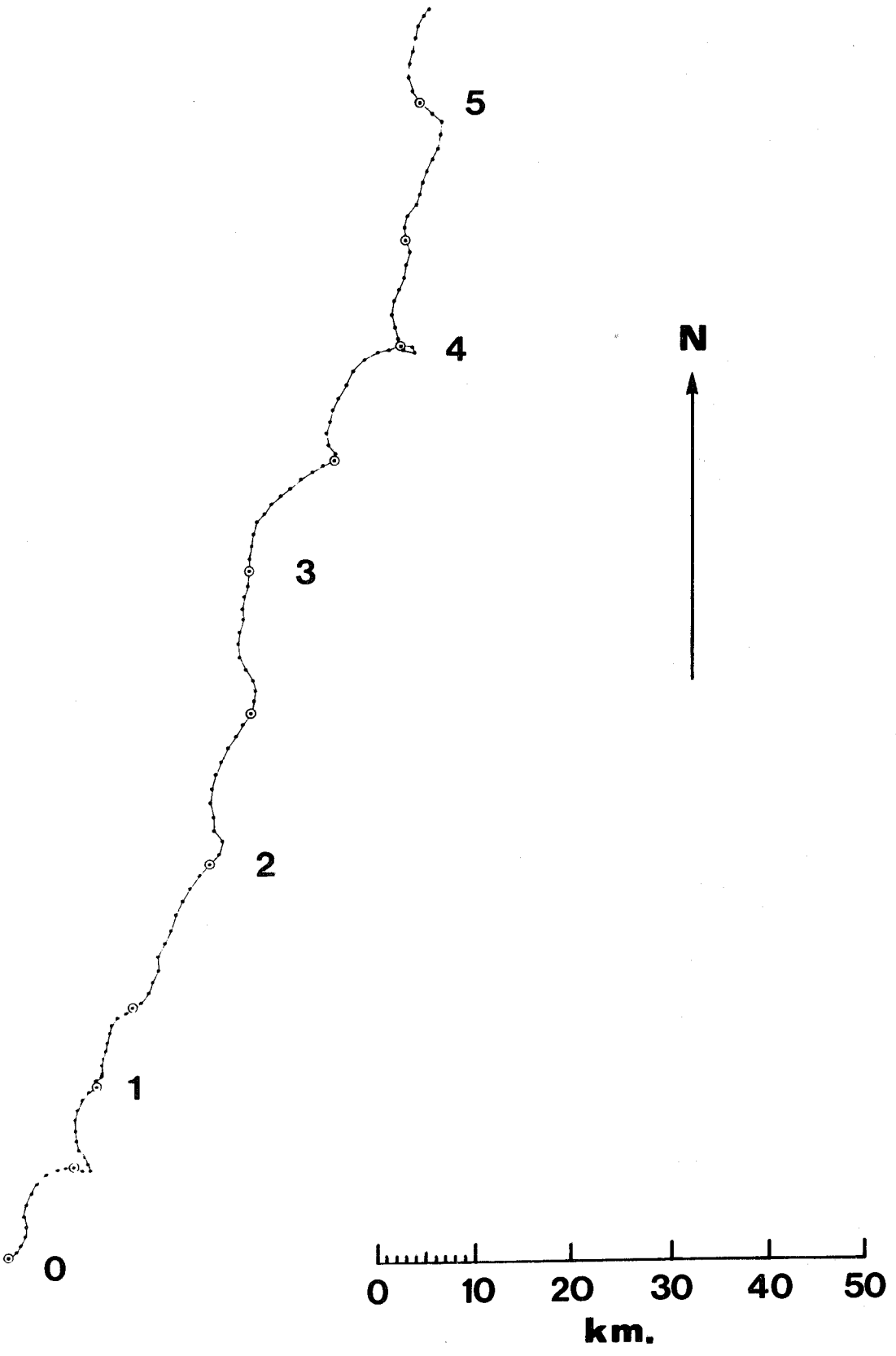

50
40
30
CM/S
20
10
0
360
270
°T 180
90
0
0
1
2
3
4
5
DAYS

Fig. 22

Progressive vector diagram 01501
Braincon 116
Time origin 1827Z 23-XI-67
(Numbered days from origin)


5
4
3
2
1
0
N
0
10
20
30
40
50
km.

Record	01502
True depth	93 m.
Current meter	Plessey (Liverpool)

(No analysis given here)

Record	01503
True depth	374 m.
Current meter	Bergen 47
Sample Period	10 mins.
Record begins	1131Z 22-XI-67
Record ends	0932Z 1-XII-67
Time keeping	No gain or loss
Length of useful record	165 hours

Conversion Equations

Speed = $2.7380\ (N_1-N_2) + 0.00$ cm/sec

Direction = $0.351\ (N_D) + 10.50$ °T

Temperature = $0.0250\ (N_T) + 0.68$ °C

Comments on record

The current meter worked well on all three channels. The increase in speed noted on record 01501 is visible here but its sharpness is masked somewhat by the tidal fluctuations which are more pronounced than in the shallower record. There is very little variation in current direction throughout the record.

Mean speed 19.2 cm/sec

Dir. 005 °T

Fig. 23

Speed, direction and temperature 01503
Bergen 47
Time origin 1610Z 23-XI-67

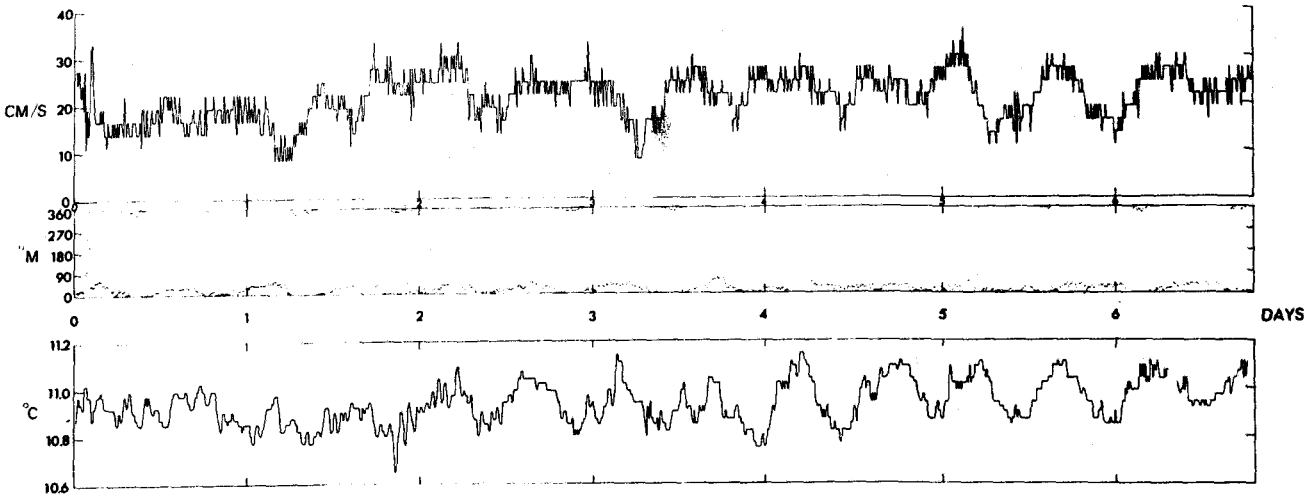
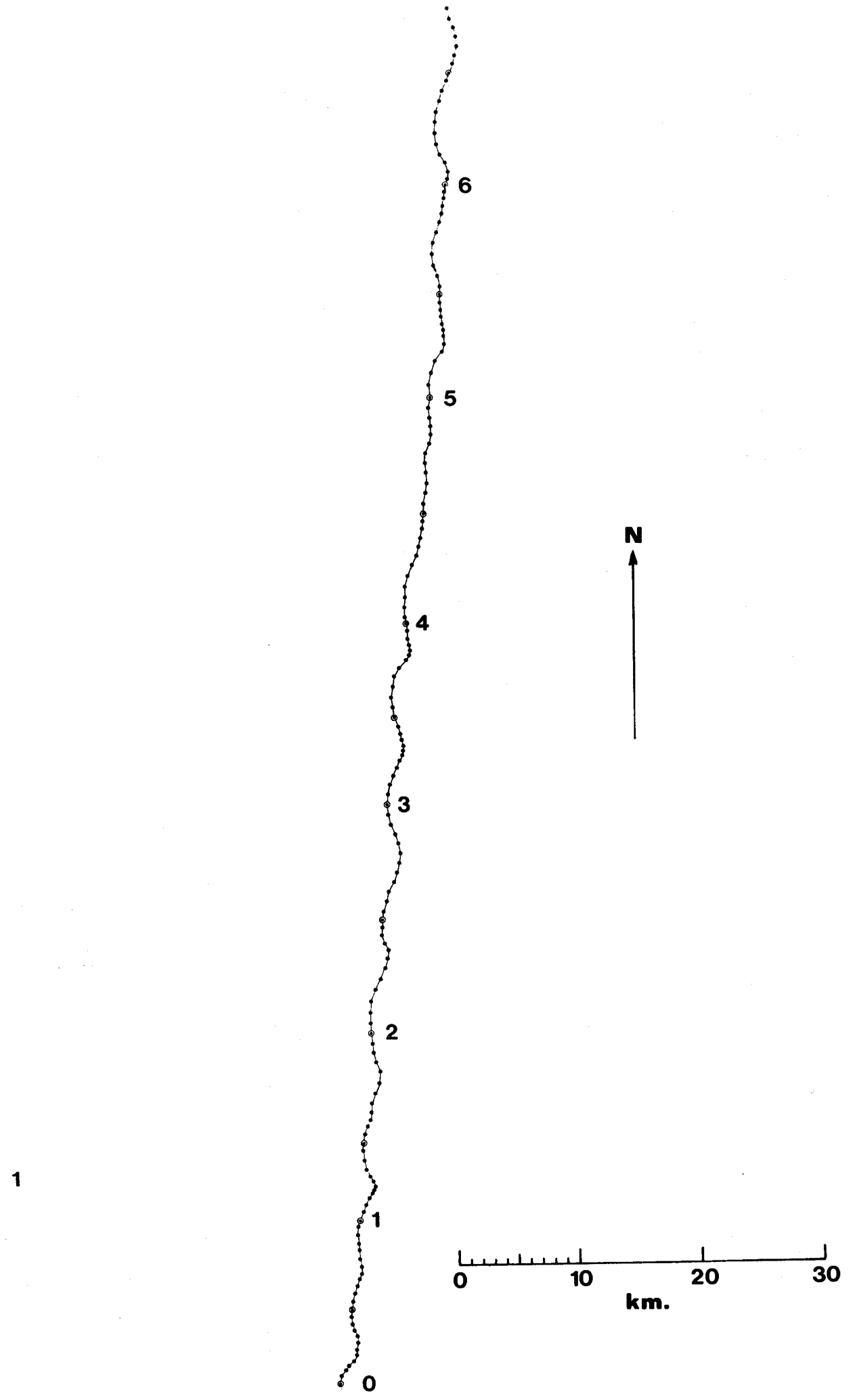

CM/S
40
30
20
10
0
°M
360
270
180
90
0
0
1
2
3
4
5
6
DAYS
°C
11.2
11.0
10.8
10.6

Fig. 23

Progressive vector diagram 01503
Bergen 47
Time origin 1610Z 23-XI-67
(Numbered days from origin)


6
5
4
3
2
1
0
N
0
10
20
30
km.

Record	01504
True depth	1379 m.
Current meter	Braincon 113
Sample Period	20 mins.
Record begins	1144Z 23-XI-67
Record ends	1622Z 1-XII-67
Time keeping	No gain or loss
Length of useful record	166 hours

Comments on record

The Current meter worked well. The fin had been stiffened to prevent breakage.

The record shows very similar features to the records 01501, 01503 but in this case the tidal fluctuations are most noticeable in the direction record.

Mean speed 7.8 cm/sec

Dir. 010°T

Fig. 25

Speed and direction 01504
Braincon 113
Time origin 1600Z 23-XI-67

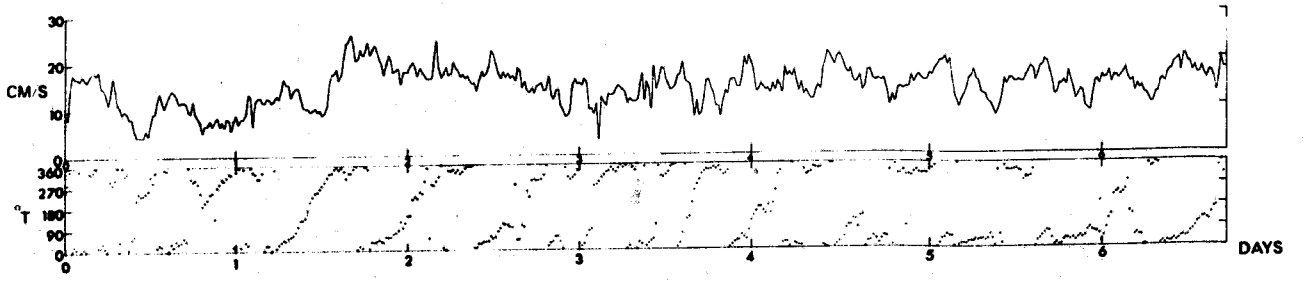
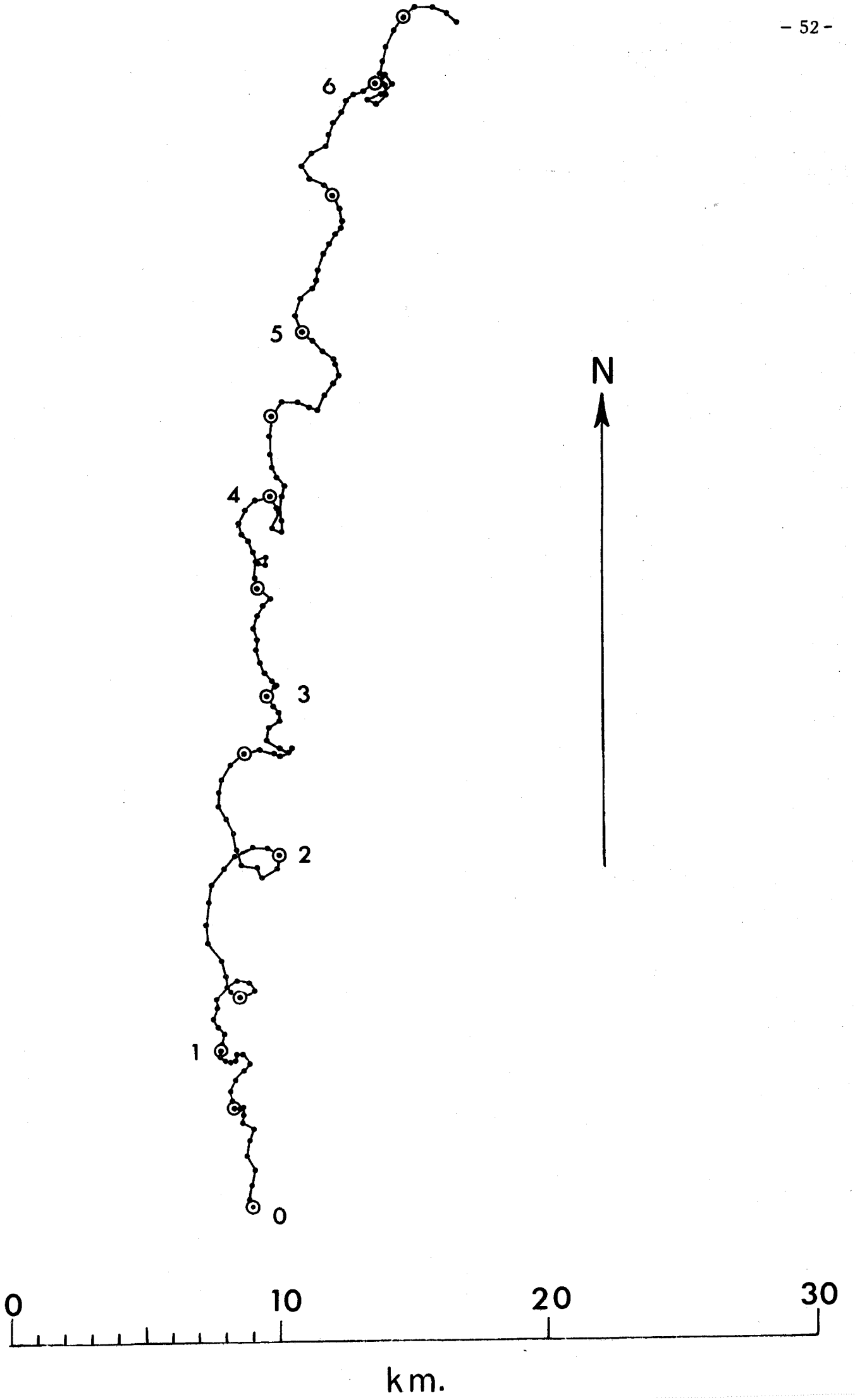

30
20
CM/S
10
0
360
270
°T
180
90
0
0
1
2
3
4
5
6
DAYS

Fig. 26

Progressive vector diagram 01505
Braincon 113
Time origin 1600Z 23-XI-67
(Numbered days from origin)


6
5
4
3
2
1
0
N
0
10
20
30
km.

Record	01505
True depth	1382 m.
Current meter	Plessey 172
Sample period	10 mins
Record begins	1040Z 23-XI-67
Record ends	0845Z 1-XII-67
Time keeping	See below

Comments on record

When recovered, the fin of this meter was found to be severely damaged. The fin clamp had been twisted and pushed along the meter body. (See 01303). The record, when translated, showed negative values of speed and very constant directions. These could be accounted for by the loss of the fin causing the meter to tilt violently. No further analysis was undertaken

Record	01506
True depth	1384 m.
Current meter	Bergen 45
Sample Period	10 mins.
Record begins	1027Z 22-XI-67
Record ends	0908Z 1-XII-67
Time keeping	No gain or loss
Length of useful record	166 hours

Conversion Equations

Speed = 2.7380 (N_1-N_2) + 0.00 cm/sec

Direction = 0351 (N_D) + 10.50 °T

Temperature = 0.0250 (N_T) + 0.68 °C

Comments on record

This record was paired with 01504. The general appearances of both the time series and progressive vector diagrams are similar and even small scale features can be related. However the overall values of speed and direction differ quite considerably.

	01506	01505
Mean speed	10.8 cm/sec	(7.8 cm/sec)
		( )
Dir.	340°T	(010°T)

Fig. 27

Speed, direction and temperature 01506
Bergen 45
Time origin 1657Z 23-XI½67

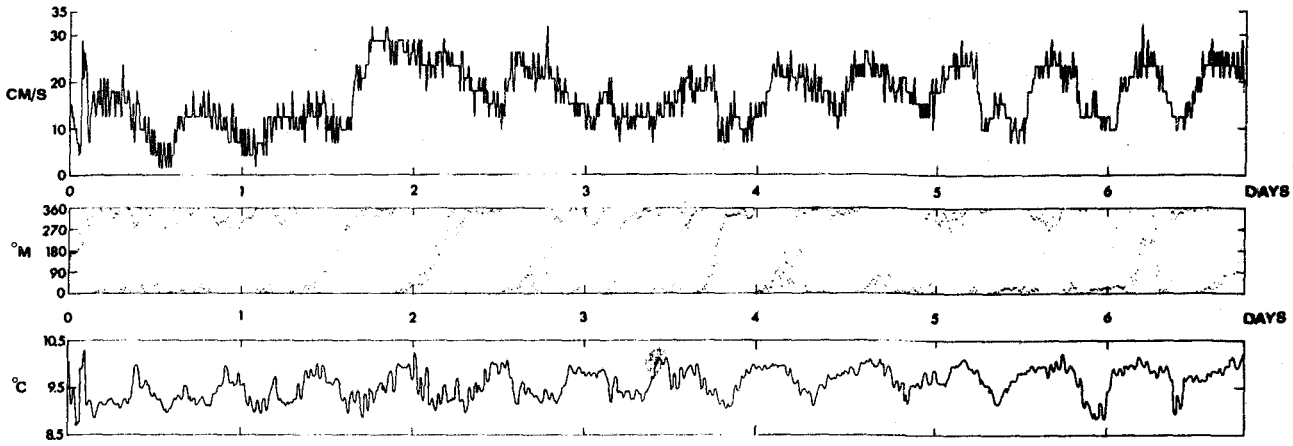
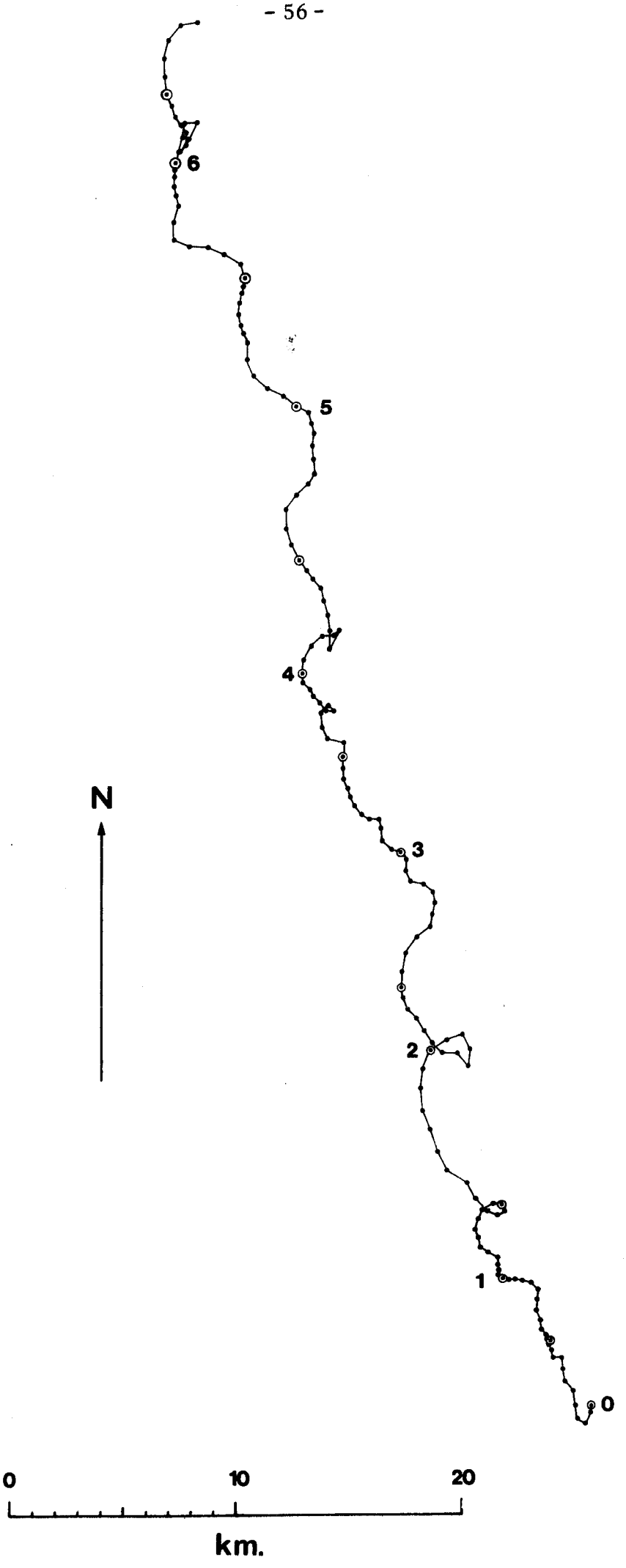

CM/S
35
30
20
10
0
0 1 2 3 4 5 6 DAYS
°M
360
270
180
90
0
0 1 2 3 4 5 6 DAYS
°C
10.5
9.5
8.5

Fig. 28

Progressive vector diagram 01506
Bergen 45
Time origin 1657Z 23-XI-67
(Numbered days from origin)


6
5
4
3
2
1
0
N
0
10
20
km.

MOORING NUMBER 016 (~~Lay~~ V) (Fig. 6)

POSITION (fig. 2) 45°56. 3'N 08°17. 0'W

TIME SET (fig. 3) 1457 Z 11-XII-67

TIME RECOVERED (fig. 3) 1422Z 15-XII-67

WATER DEPTH 4850 m.

INSTRUMENTS

Record Number	Nominal Depth	Current Meter Type	Records
01601	60	Braincon	S. D.
01602	115	Plessey (Liverpool)	S. D.
01603	400	Bergen	S. D. T.
01604	1410	Plessey	S. D.
01605	1410	Bergen	S. D. T.
01606	2600	Braincon	S. D.

Comments on mooring

Similar to 015 but with triple buoyancy unit and magnetometer in lower part of mooring. The Liverpool Plessey meter was missing when the mooring was recovered and the magnetometer was lost when the mooring line broke. The magnetometer was the property of the Department of Geodesy and Geophysics, University of Cambridge.

Record	01601
True depth	60 m.
Current meter	Braincon 111
Sample Period	20 mins.
Record begins	1431Z 11-XII-67
Record ends	1447Z 15-XII-67
Time keeping	No gain or loss
Length of useful record	96 hours

Comments on record

Due to eccentricity in the gearing for the rotor output the speeds are modulated with a signal of about 2 hour period. The only other periodic component seems to be one of about 2 days period. The progressive vector diagram gives further indication of the absence of semi-diurnal tidal fluctuations.

Mean speed 25.8 cm/sec

Dir. 000°T

Fig. 29

Speed and Direction 01601
Braincon 111
Time origin 1500Z 11-XII-67

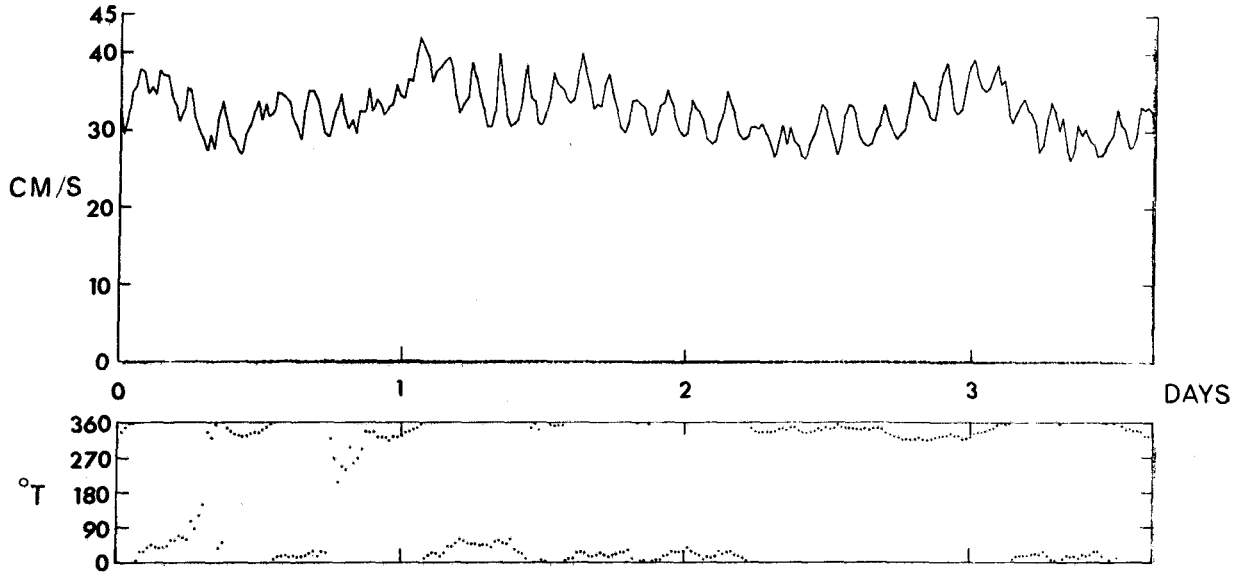
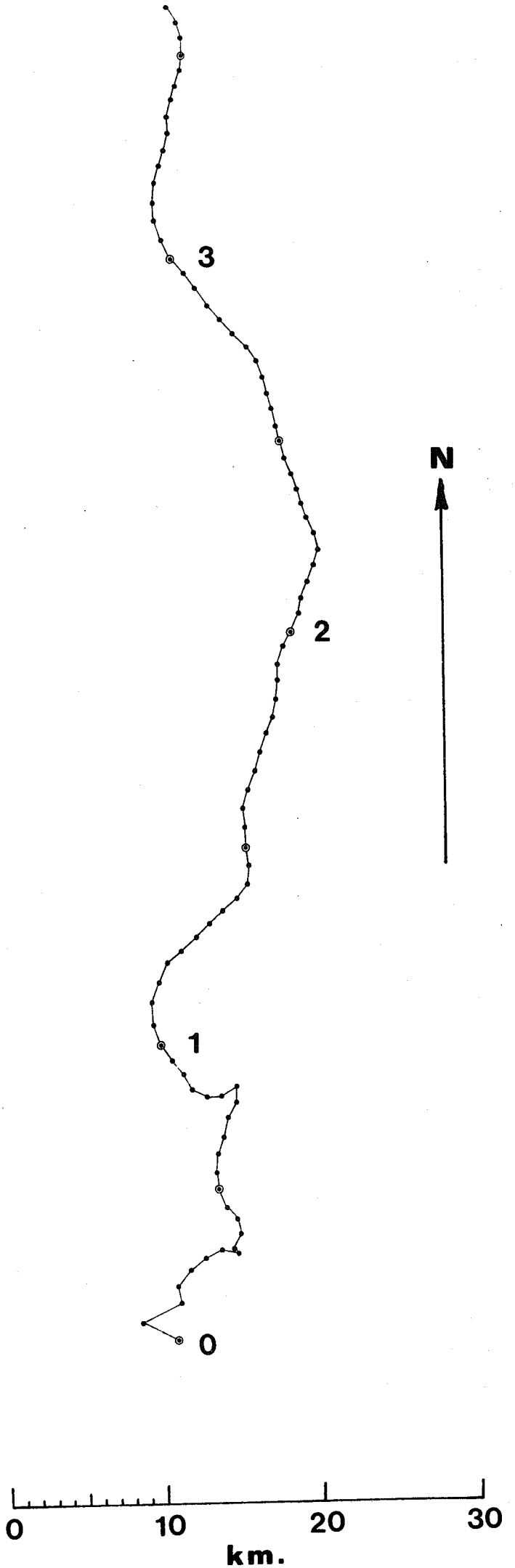

45
40
30
CM/S
20
10
0
0
1
2
3
DAYS
360
270
°T
180
90
0

Fig. 30

Progressive vector diagram 01601
Braincon 111
Time origin 1500Z 11-XII-67
(Numbered days from origin)


3
2
1
0
N
0
10
20
30
km.

Record	01602
True depth	112 m.
Current meter	Plessey (Liverpool)

(This current meter was lost)

Record	01603
True depth	393 m.
Current meter	Bergen 45
Sample Period	10 mins.
Record begins	1347Z 11-XII-67
Record ends	1515Z 15-XII-67
Time keeping	No gain or loss
Length of useful record	97 hours

Conversion Equation

Speed = $2.7380\ (N_1 - N_2) + 0.00$ cm/sec

Direction = $0.351\ (N_D) + 10.50$ °T

Temperature = $0.0250\ (N_T) + 0.68$ °C

Comments on record

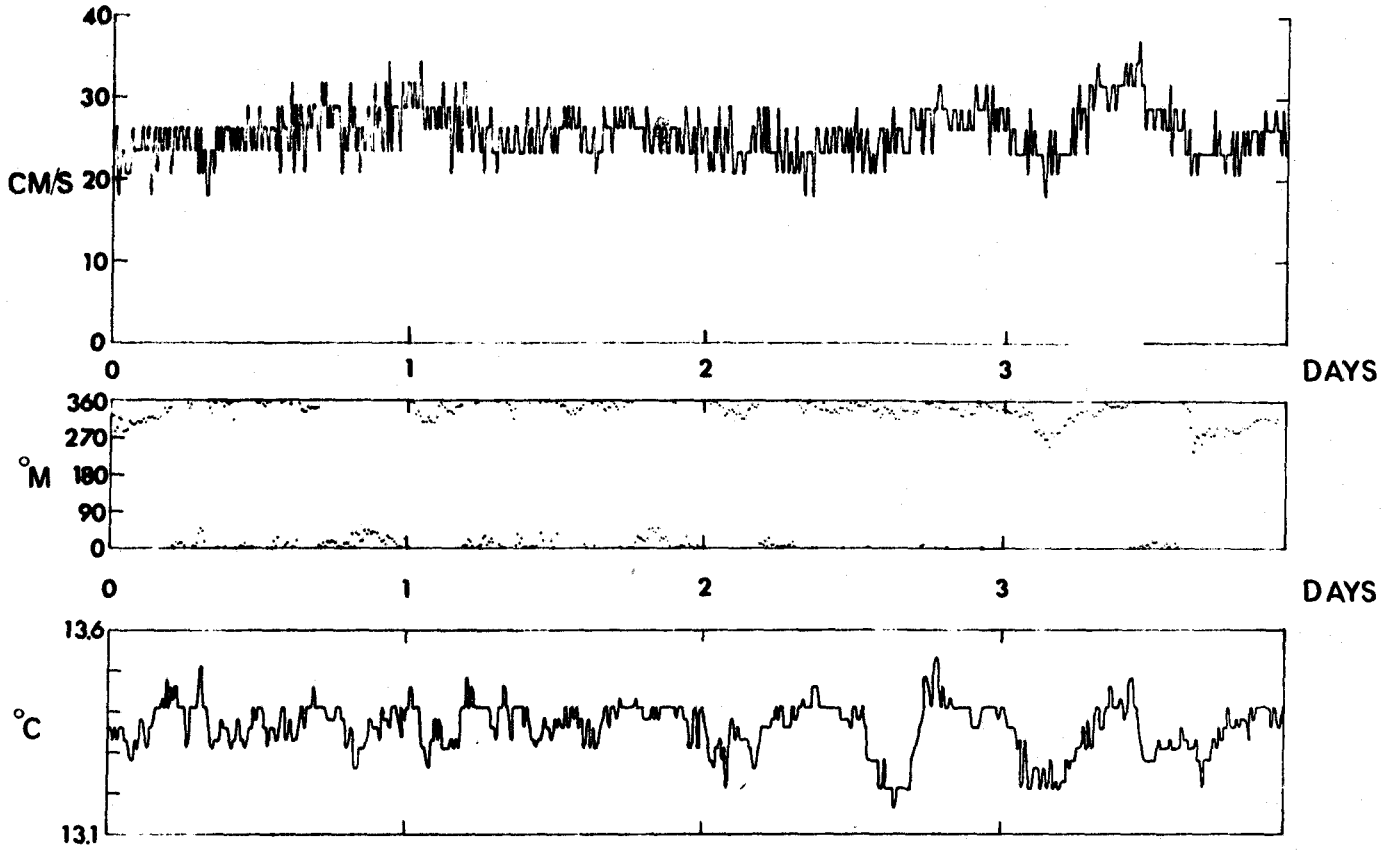
As in 01602 there is very little evidence of semi-diurnal periodicity in any of the three channels or in the progressive vector diagram.

Mean speed 22.0 cm/sec

Dir. 338°T

Fig. 31

Speed, direction and temperature 01603
Bergen 45
Time origin 1547Z 11-XII-67


40
30
CM/S 20
10
0
0
1
2
3
DAYS
360
270
°M 180
90
0
0
1
2
3
DAYS
13.6
°C
13.1

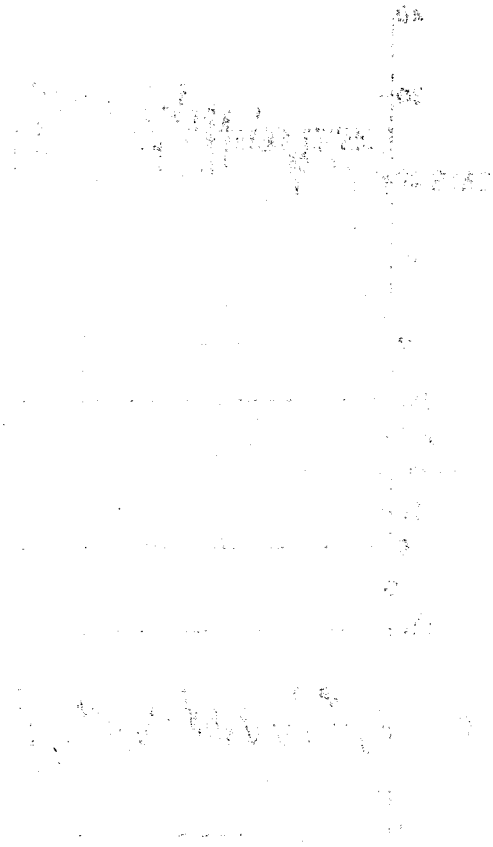
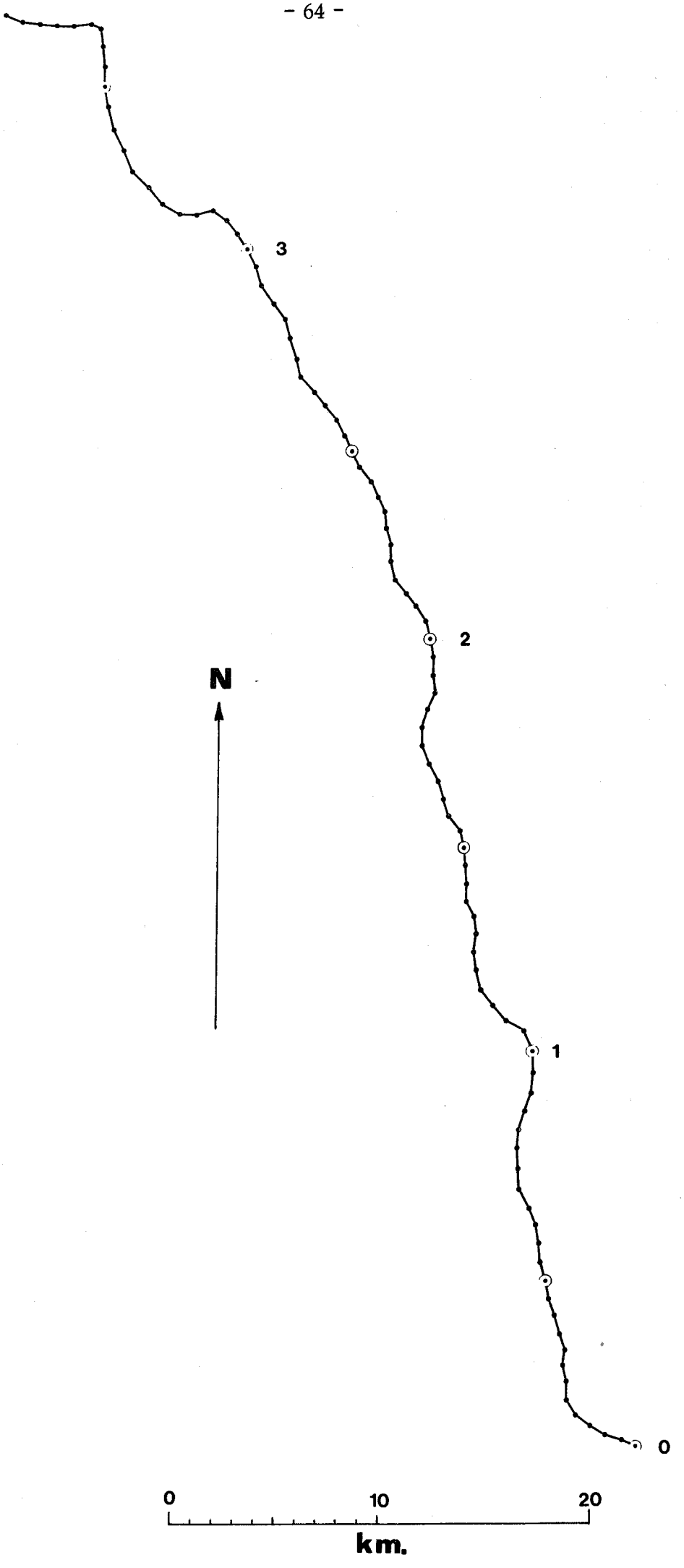


Fig. 32

Progressive vector diagram 01603
Bergen 45
Time origin 1547Z 11-XII-67
(Numbered days from origin)


3
2
N
1
0
0
10
20
km.

Record	01604
True depth	1403 m.
Current meter	Plessey 172
Sample Period	10 mins.
Record begins	1300Z 11-XII-67
Record ends	1547Z 15-XII-67
Time keeping	See below
Length of useful record	See below

Comments on record

When recovered this instrument had a broken fin (see 01303). The record did not appear sensible and no analysis was carried out.

Record	01605
True depth	1406 m.
Current meter	Bergen 47
Sample Period	10 mins.
Record begins	1252Z 11-XII-67
Record ends	1549Z 15-XII-67
Time keeping	No gain or loss
Length of useful record	99 hours

Conversion Equations

Speed = $2.7380\ (N_1 - N_2) + 0.00$ cm/sec

Direction = $0.351\ (N_D) + 10.50$

Temperature = $0.0250\ (N_T) + 0.68$

Comments on record

The instrument performed well. Semi-diurnal variations are in evidence in both the direction and temperature records but are not clearly defined in the speed channel.

Mean speed 16.5 cm/sec

Dir. 335°T

Fig. 33

Speed, direction and temperature 01605
Bergen 47
Time origin 1445Z 11-XII-67

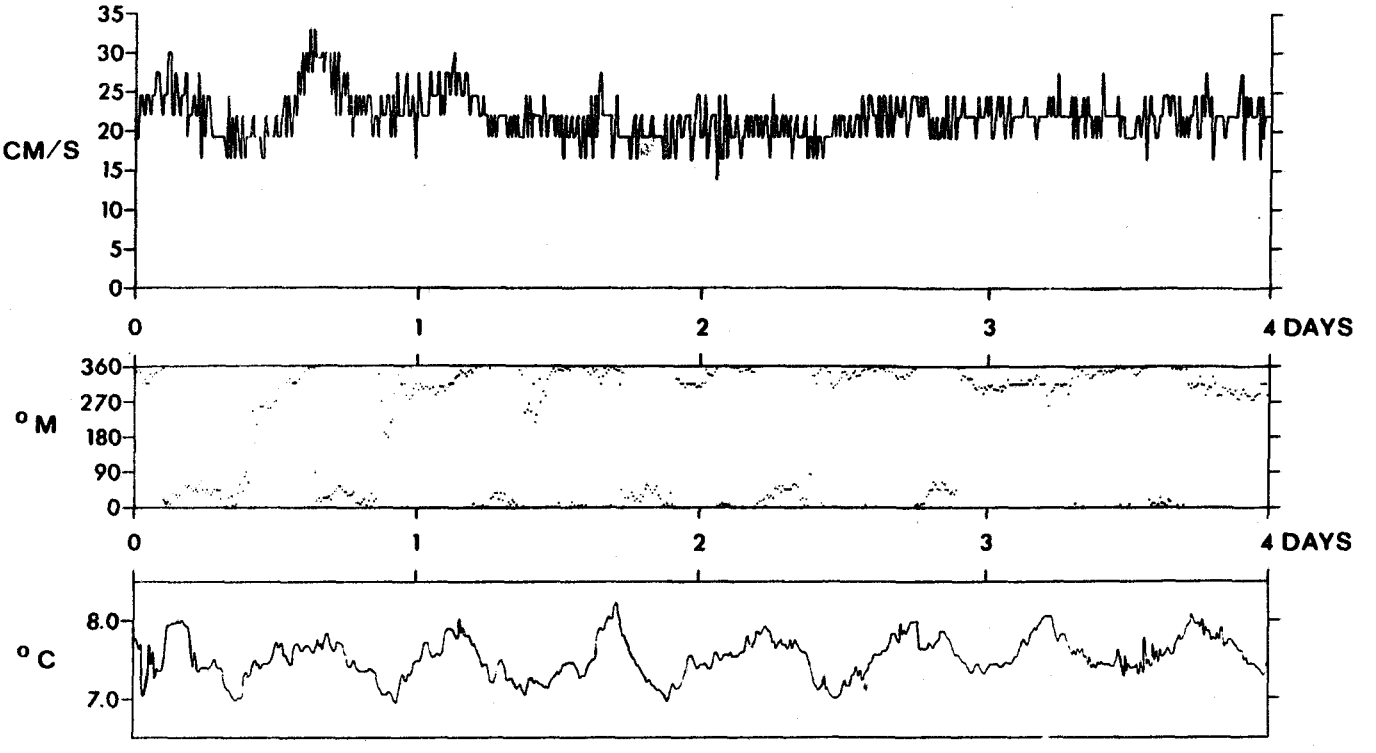
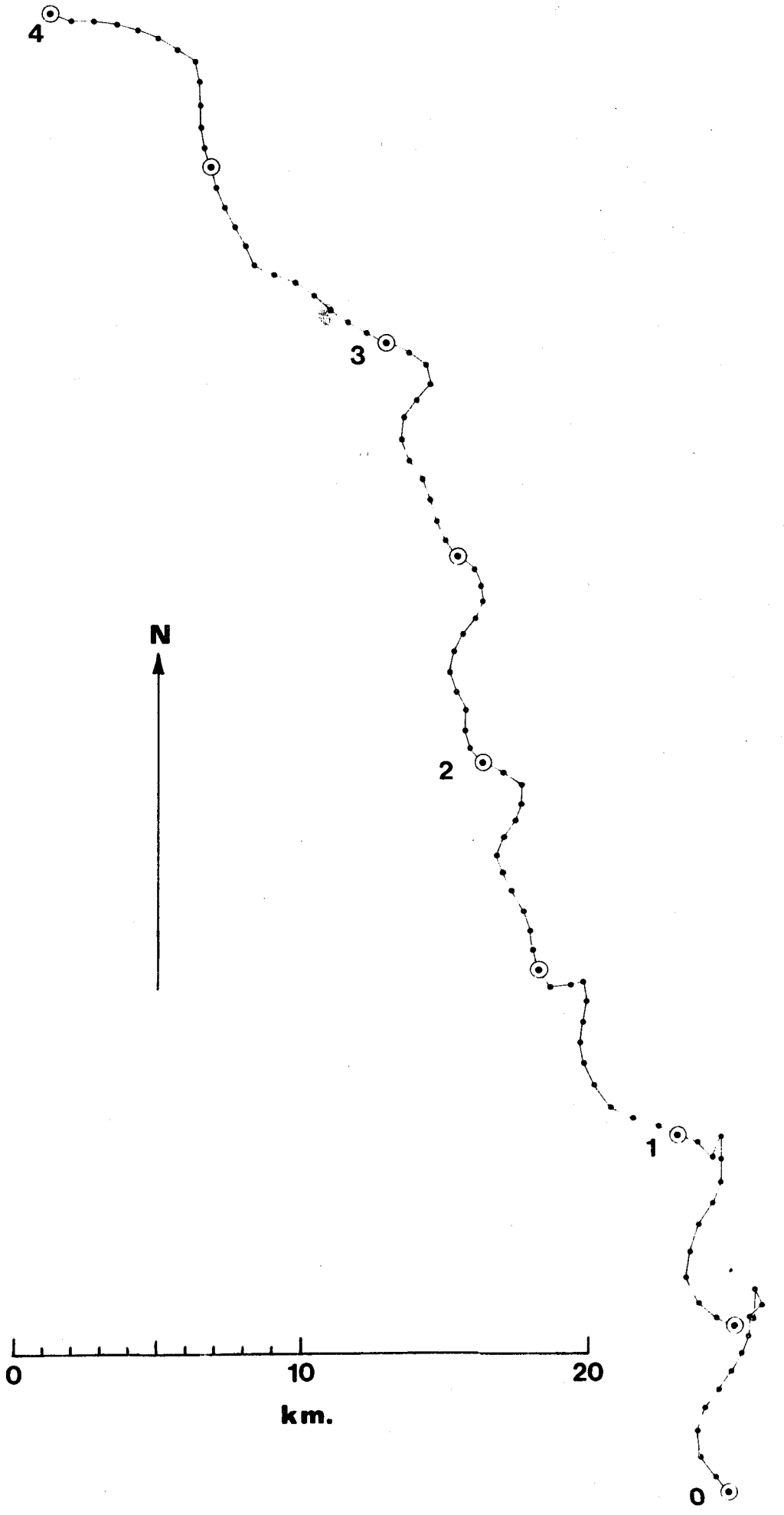

CM/S
35
30
25
20
15
10
5
0
0
1
2
3
4 DAYS
°M
360
270
180
90
0
0
1
2
3
4 DAYS
°C
8.0
7.0

Fig. 34

Progressive vector diagram 01605
Bergen 47
Time origin 1445Z 11-XII-67
(Numbered days from origin)


4
3
2
1
0
N
0
10
20
km.

Record	01606
True depth	2616 m.
Current meter	Braincon 114
Sample Period	20 mins.
Record begins	1156Z 11-XII-67
Record ends	1625Z 15-XII-67
Time keeping	No gain or loss
Length of useful record	100 hours

Comments on record

The fin on this meter had been strengthened. In this record the semi-diurnal tide is dominant and is clearly evident in both speed, direction and progressive vector diagram. The motion is predominantly rotatory with a small nett flow to the N. W.

Mean speed 1.4 cm/sec

Dir. 305°T

Fig. 35

Speed and direction 01606
Braincon 114
Time origin 1500Z 11-XII-67

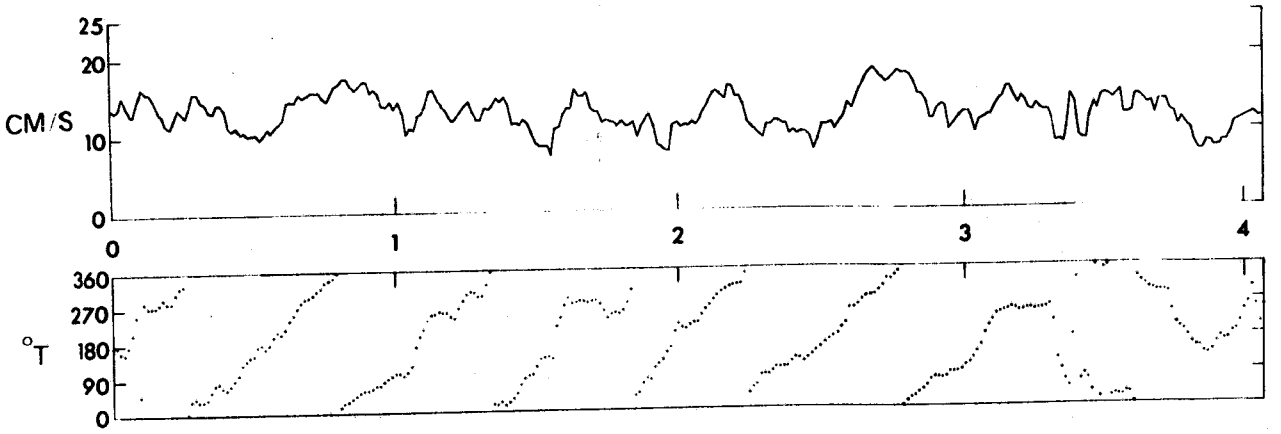
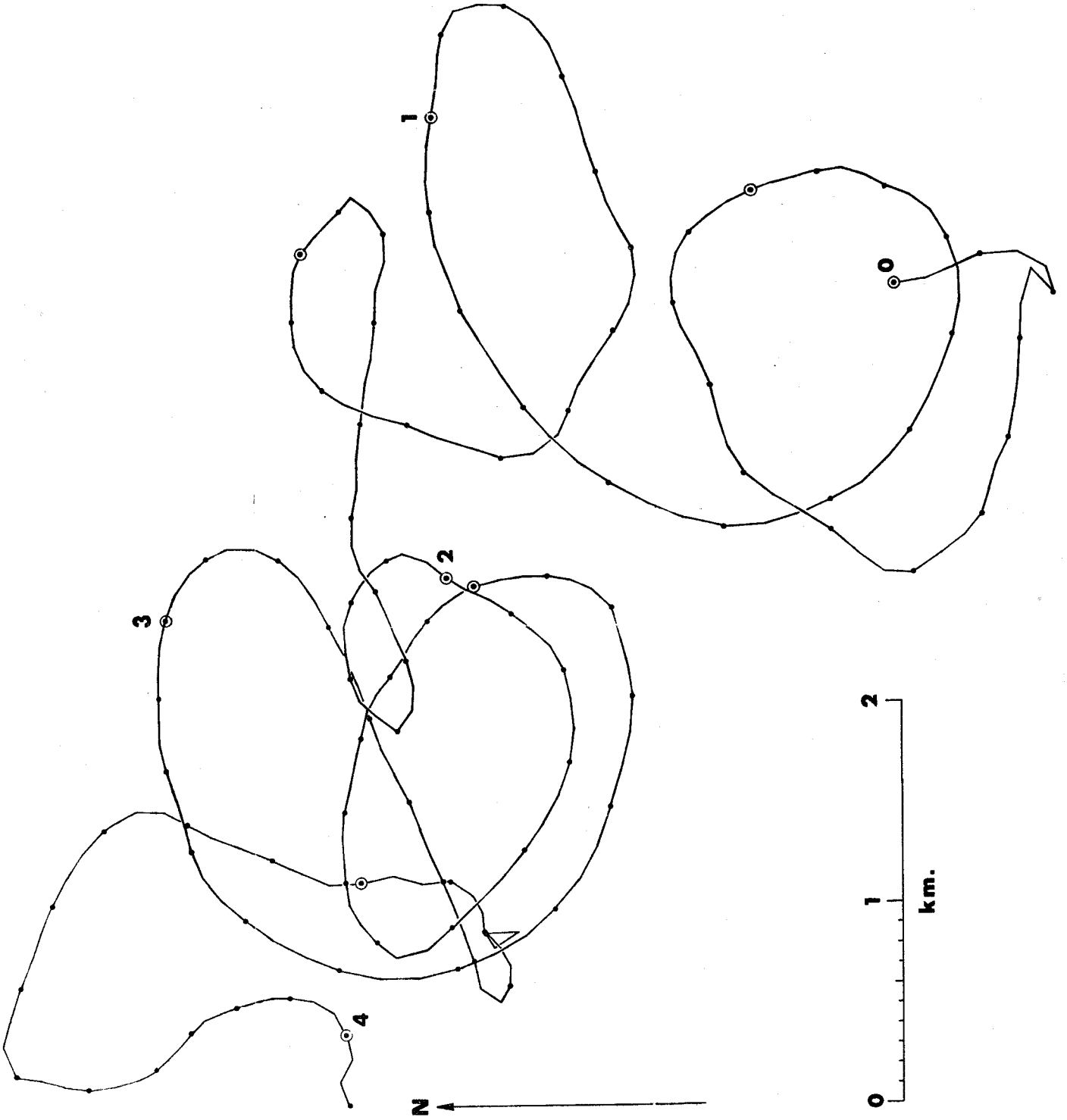

25
20
CM/S
10
0
0
1
2
3
4
360
270
°T
180
90
0

Fig. 36

Progressive vector diagram 01606
Braincon 114
Time origin 1500Z 11-XII-67
(Numbered days from origin)


0
1
2
3
4
N
0
1
2
km.

References

AANDERAA, I. R. (1964) A recording and telemetering instrument. Tech. Rep. NATO Sub-comm. Oceanogr. Res., (16).

HARRIS, M. J. (1969) Acoustic command system Technical Sessions Day 3 Oceanology International 69.

HINDE, B. J., Editor (1967) N. I. O. Computer Programs 9 N. I. O. Internal Report N. 9. October, 1967.

HINDE, B. J., Editor (1968) N. I. O. Computer Programs 10 N. I. O. Internal Report N. 10. November, 1968.

HINDE, B. J., Editor (i) N. I. O. Computer Programs 12 N. I. O. Internal Report N. 12. In Press.

HINDE, B. J., Editor (ii) N. I. O. Computer Programs 13 N. I. O. Internal Report N. 13. In Press.

HINDE, B. J., Editor (iii) N. I. O. Computer Programs 14 N. I. O. Internal Report N. 14. In Press.

HINDE, B. J., Editor (iv) N. I. O. Computer Programs 18 N. I. O. Internal Report N. 18 In Press.

N. I. O. Cruise Report Cr. 20. N. I. O. Cruise Report Series.