

NATIONAL INSTITUTE OF OCEANOGRAPHY
WORMLEY, GODALMING, SURREY

NEUTRALLY BUOYANT FLOATS

Serial Nos. 40 - 58

June - October 1959

TABLES AND DIAGRAMS

G. F. CASTON
and
J. C. SWALLOW

N.I.O. INTERNAL REPORT No. D. 4

August 1970

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Tables of times and positions.
Diagrams showing trajectories
and components of displacement.

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Introduction

During the period June 1959 to August 1960, a total of 79 neutrally buoyant floats were tracked for periods varying from 1 to 38 days in the deep water near Bermuda, in a joint Woods Hole - N.I.O. project. These float data will be presented in 4 volumes, of which this is the first. Only brief accounts of these observations have been published so far (Refs 1 and 2). All but 3 of the measurements reported in this volume were made from the R.V. "Aries", serial nos. 54, 56 and 57 were done from the R.V. "Crawford". Most of the floats were of N.I.O. design, similar to those described in Ref.3, but two of them (original designations V1 and V2) were built by G.H. Volkmann at Woods Hole. The observations at sea were made by J. Crease and J.C. Swallow with various colleagues from Woods Hole, of whom G.H. Volkmann and J.R. Barrett took part in most cruises.

This report contains the results from the 19 floats used during June to October 1959. Tables of times and positions and components of displacement are given with as much accuracy as is justified by the navigation. "Nominal depths" are those for which the floats were loaded, mostly 2000 and 4000 metres. "Observed depths" were calculated in the manner described in Ref.4; "S.D." and "S.D.(mean)" are the standard deviation of a single depth observation and the standard deviation of the mean.

In most cases, simple straight lines have been fitted to the north-south and east-west displacements plotted as functions of time, and combined to give mean velocities. Where a single straight line looked unrealistic, the fixes have been subdivided and two pairs of lines fitted. No attempt has been made to fit tidal or other oscillations to the tabulated displacements.

Two batches of floats were made up initially; long-life floats (A,B,C) fitted with clocks and extra batteries (Ref.3) with an expected life of several months, and ordinary floats with a battery life of 2 or 3 weeks. After the first few observations had shown that speeds in the deep water were relatively high and variable, the remaining long-life floats were converted to ordinary ones and re-numbered before use. Later, all the results have been re-numbered again in chronological order, as listed below.

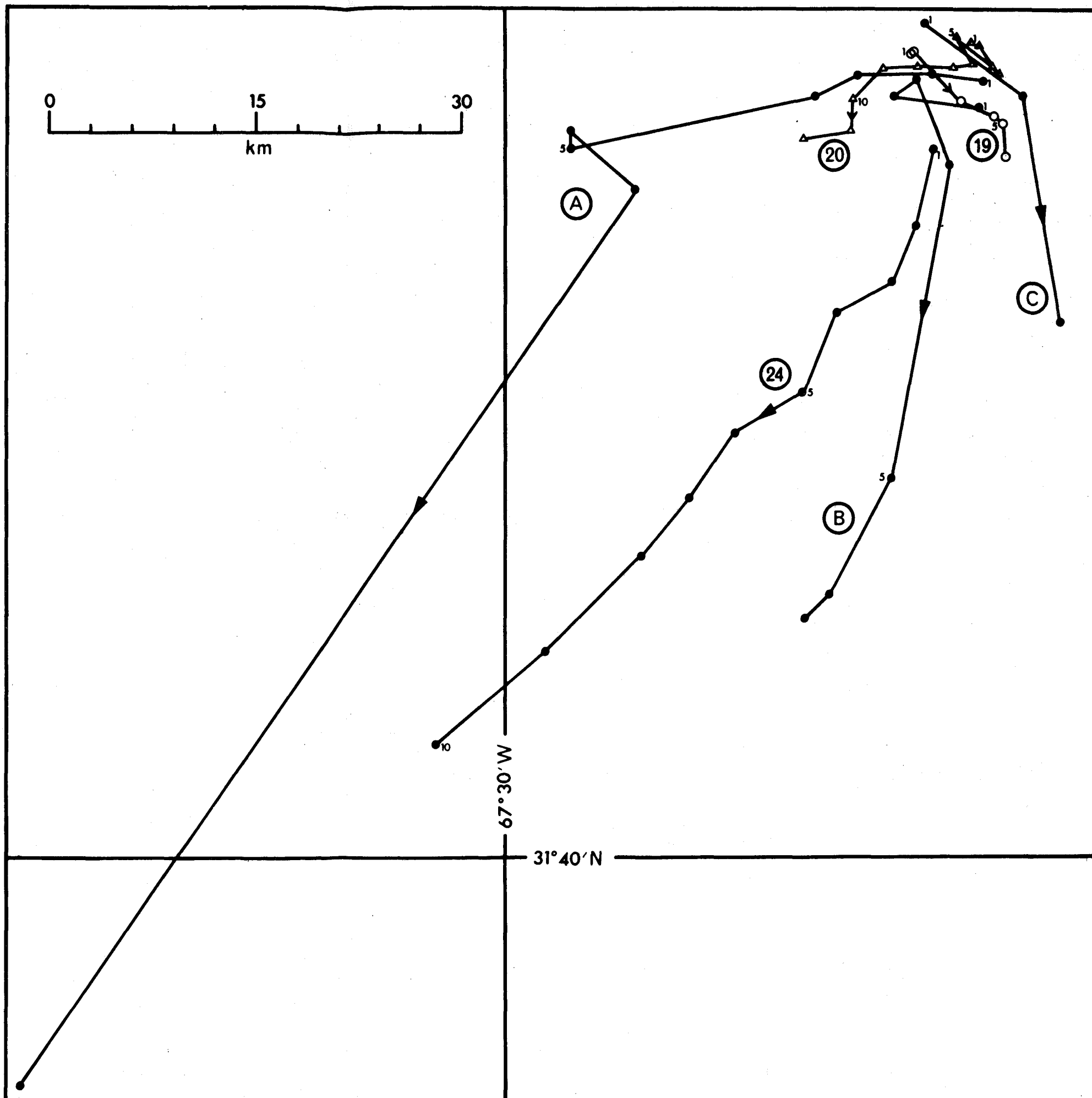
LIST OF FLOATS

Serial No	Original Designation	Date and Time Laid
40	20	1208/22.VI.1959
41	A	1202/23.VI.1959
42	B	0837/24.VI.1959
43	19	2317/8.VII.1959
44	C	0736/11.VII.1959
45	24	2338/25.VII.1959
46	23	0900/8.VIII.1959
47	38	1055/9.VIII.1959
48	22	1640/25.VIII.1959
49	37	1608/26.VIII.1959
50	39	1655/28.VIII.1959
51	35	1230/12.IX.1959
52	42	1258/12.IX.1959
53	40	1330/12.IX.1959
54	36	1512/15.X.1959
55	VI	0915/16.X.1959
56	30	1315/16.X.1959
57	34	1242/24.X.1959
58	V2	1000/26.X.1959

REFERENCES

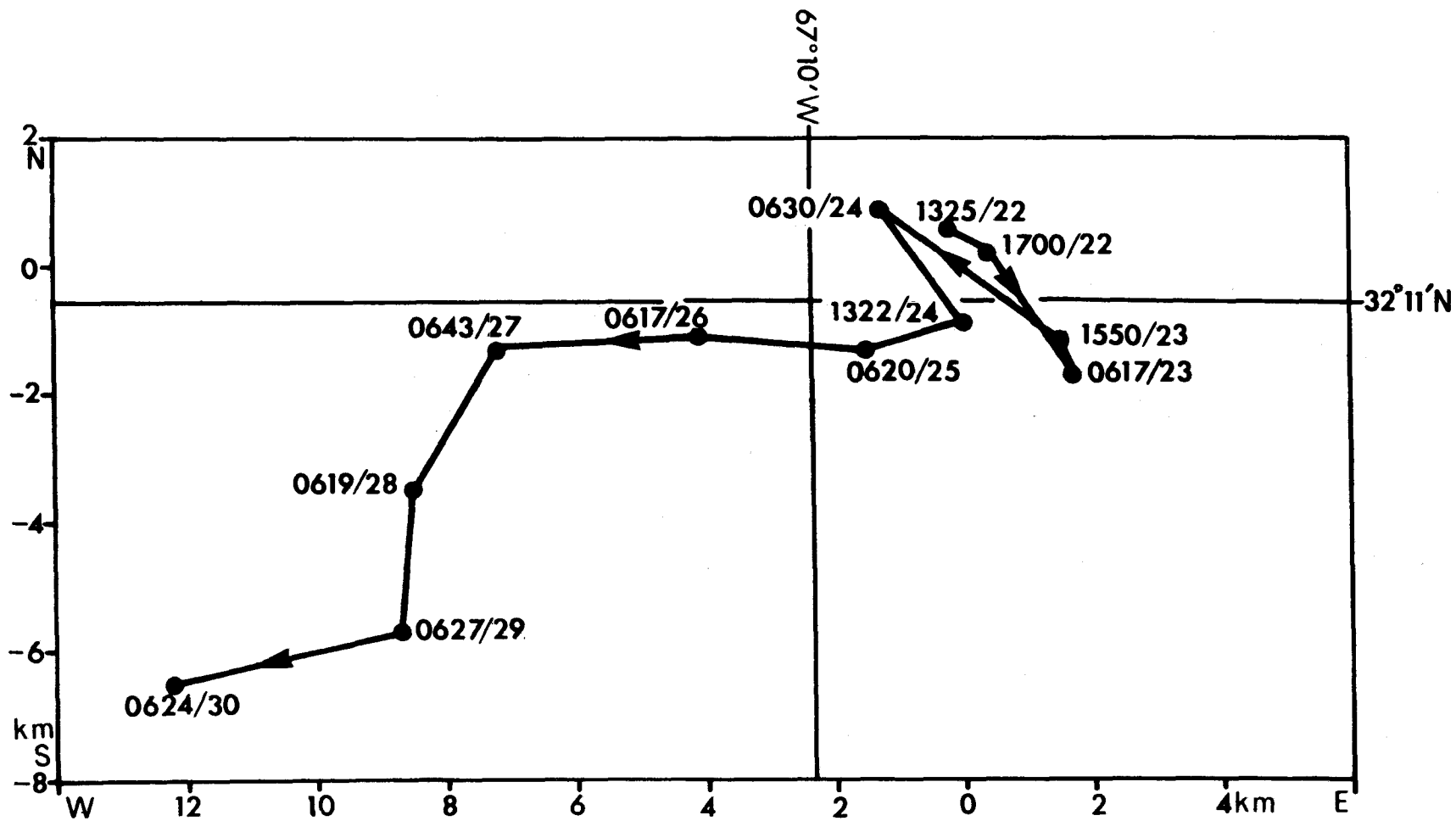
1. Swallow, M. 1961 Measuring deep currents in mid-ocean. New Scientist, Vol.9, pp.740-743.
2. Crease, J. 1962 Velocity measurements in the deep water of the Western North Atlantic. Journal of Geophysical Research, Vol. 67, No.8, pp.3173-3176.
3. Swallow, J.C. and B.V. Hamon, 1960 Some measurements of deep currents in the Eastern North Atlantic. Deep-Sea Research, Vol.6, pp. 155-168.
4. Swallow, J.C. and L.V. Worthington 1961 An observation of a deep countercurrent in the Western North Atlantic. Deep-Sea Research, Vol. 8, pp. 1-19.

FLOAT DESIGNATIONS: 20(laid 1208/22.VI.1959), A(laid 1202/23.VI.1959), B(laid 0837/24.VI.1959), 19(laid 2317/8.VII.1959), C(laid 0736/11.VII.1959), 24(laid 2338/25.VII.1959).



SERIAL NO: 40

FLOAT DESIGNATION: 20 Date and time laid: 1208/22.VI.1959



FLOAT DESIGNATION: 20

Date and time laid 1208/22.VI.1959

Position laid: 32° 11'.3N
67° 08'.6W

Displacement origin: 32° 11'.3N
67° 08'.6W

Navigation based on: Loran A

Estimated accuracy of positions: ± 1 km (relative)

Depth(m):	Nominal	Observed	S.D.	S.D.(mean)
	2000	1816	± 390	± 78

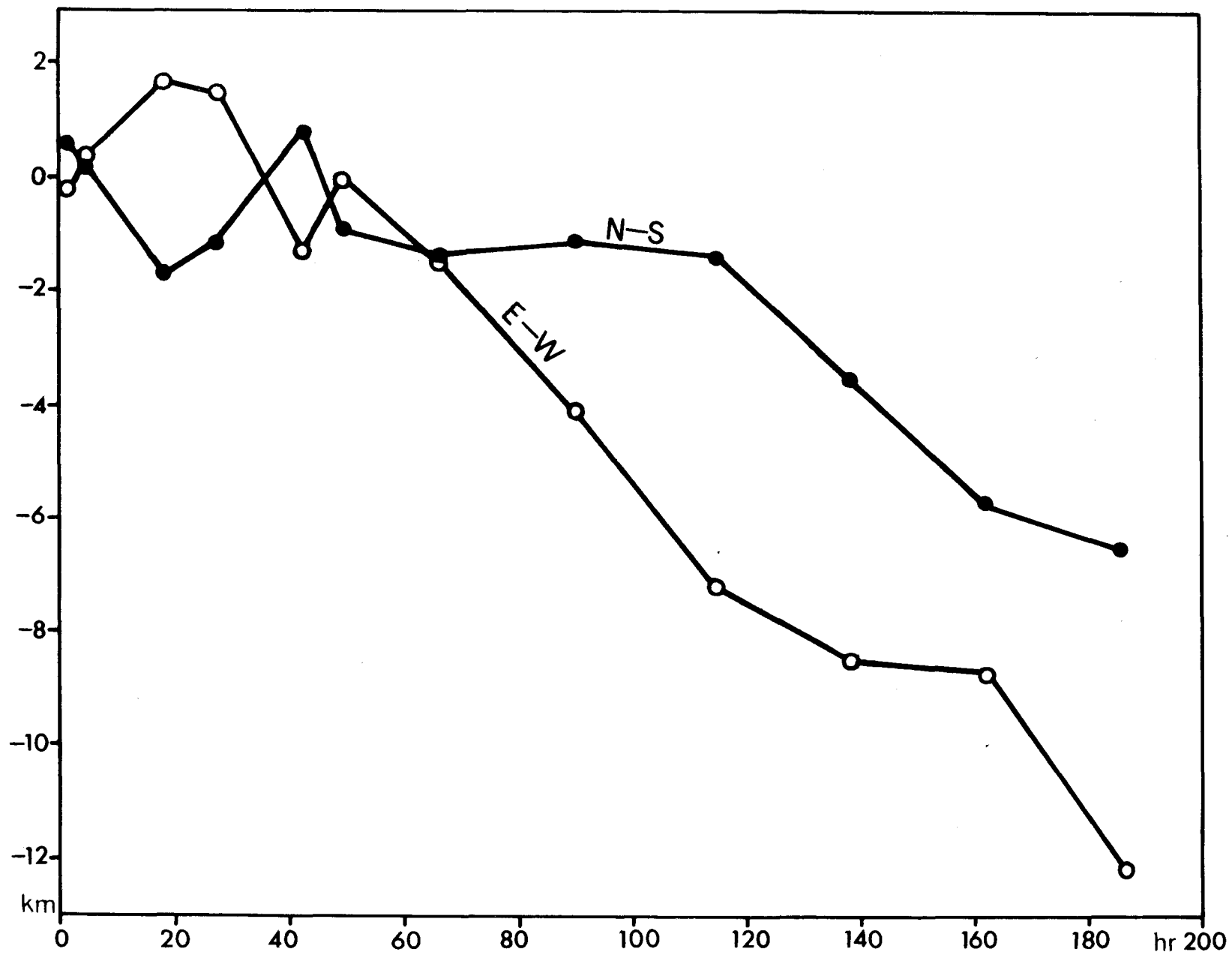
Fix No.	Date	Time GMT -4	Fix Position		Hours Since Laid (t)	Displacement(km)		Residuals	
			Lat.N.	Long.W.		+E-W x	+N-S y	x	y
1	22.VI	1325	32°11'.6	67°08'.7	1.3	-0.2	+0.6	-2.0	+0.7
2	22.VI	1700	32°11'.4	67°08'.3	4.9	+0.4	+0.2	-1.1	+0.4
3	23.VI	0617	32°10'.4	67°07'.5	18.2	+1.7	-1.7	+1.1	-1.3
4	23.VI	1550	32°10'.7	67°07'.7	27.7	+1.5	-1.1	+1.5	-0.7
5	24.VI	0630	32°11'.8	67°09'.4	42.4	-1.3	+0.9	-0.4	+1.5
6	24.VI	1322	32°10'.8	67°08'.6	49.3	+0.0	-0.9	+1.5	-0.2
7	25.VI	0620	32°10'.6	67°09'.5	66.2	-1.5	-1.3	+0.9	-0.4
8	26.VI	0617	32°10'.7	67°11'.2	90.2	-4.1	-1.1	0.0	0.0
9	27.VI	0643	32°10'.6	67°12'.8	114.6	-7.2	-1.3	-1.5	+0.2
10	28.VI	0619	32°09'.4	67°14'.1	138.2	-8.5	-3.5	-0.2	-0.2
11	29.VI	0627	32°08'.2	67°14'.2	162.3	-8.7	-5.7	+1.3	-0.6
12	30.VI	0624	32°07'.8	67°16'.4	186.3	-12.2	-6.5	-0.7	+0.4

Fitted lines:
$$\left. \begin{aligned} x &= -0.066t + 1.8 \\ y &= -0.012t - 0.1 \end{aligned} \right\} \text{Fixes } 1 - 9$$

Mean velocity = 1.9(± 0.4)cm/sec, 260(± 7)°T

$$\left. \begin{aligned} x &= -0.064t + 0.4 \\ y &= -0.074 + 6.9 \end{aligned} \right\} \text{Fixes } 9 - 12$$

Mean velocity = 2.7(± 0.4)cm/sec, 221(± 8)°T

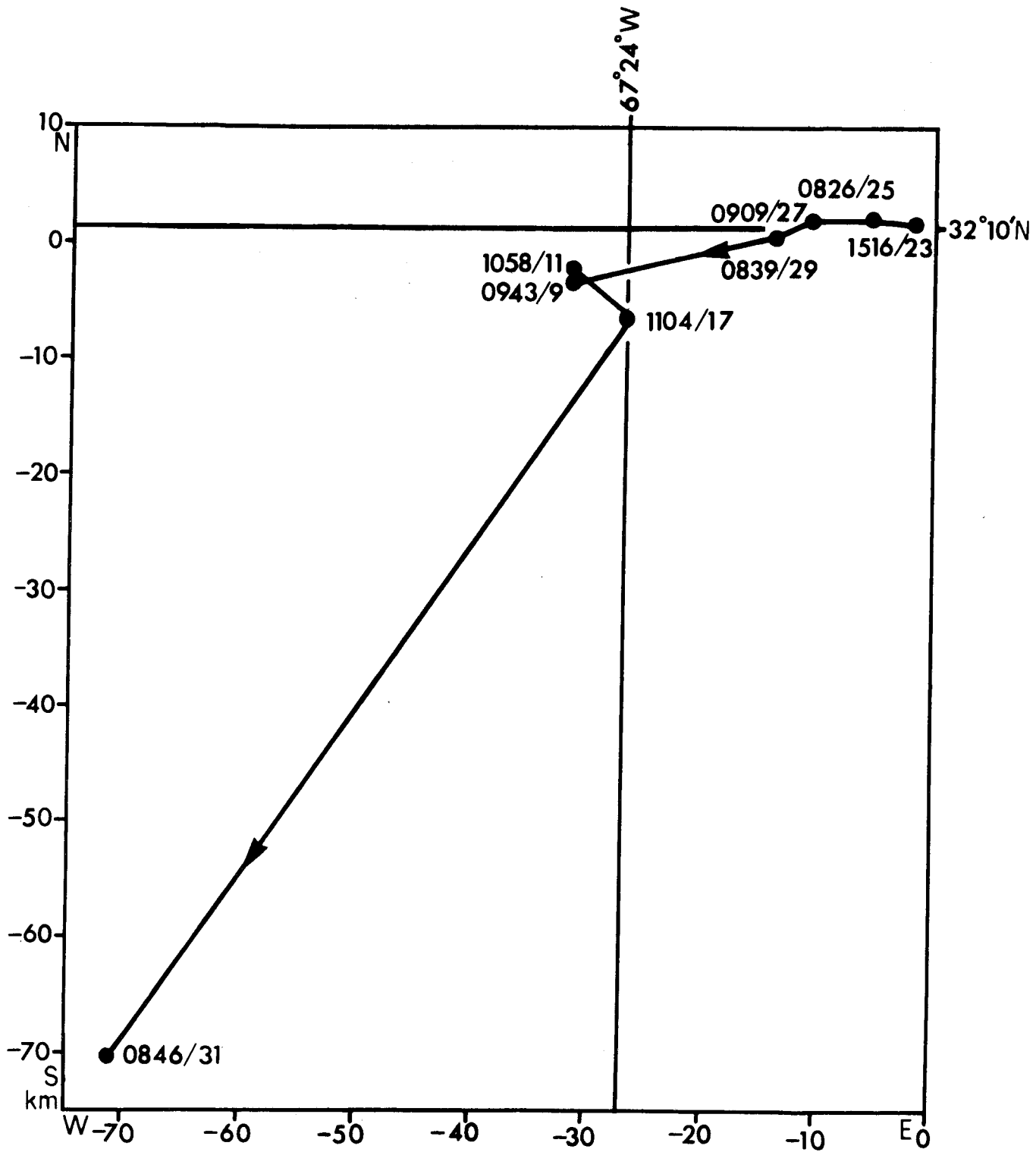


FLOAT DESIGNATION: 20 Date and time laid: 1208/22.VI.1959.

SERIAL NO: 40

SERIAL NO: 41

FLOAT DESIGNATION: A Date and time laid: 1202/23.VI.1959



FLOAT DESIGNATION: A

Date and time laid: 1202/23.VI.1959

Position laid: 32° 09'.3N
67° 06'.9W

Displacement origin: 32° 09'.3N
67° 06'.9W

Navigation based on: Loran A

Estimated accuracy of positions: ± 1 km (relative)

Depth(m): Nominal Observed S.D. S.D.(mean)
 2000 1908 ± 500 ± 126

Fix No.	Date	Time GMT -4	Fix Position		Hours Since Laid (t)	Displacement(km)		Residuals	
			Lat.N.	Long.W.		+E-W x	+N-S y	x	y
1	23.VI	1516	32°10'.2	67°08'.1	3.3	-1.9	+1.7	+3.5	-0.9
2	25.VI	0826	32°10'.5	67°10'.4	44.4	-5.6	+2.2	+1.9	+0.2
3	27.VI	0909	32°10'.4	67°13'.9	93.2	-10.9	+2.0	-0.9	+0.7
4	29.VI	0839	32°09'.5	67°15'.9	140.6	-14.1	+0.4	-1.7	-0.2
5	9.VII	0943	32°07'.4	67°27'.1	381.7	-31.7	-3.5	-6.9	-0.6
6	11.VII	1058	32°08'.2	67°27'.1	431.0	-31.7	-2.5	-4.3	+1.3
7	17.VII	1104	32°05'.8	67°24'.0	575.1	-26.9	-6.5	+8.0	-0.7
8	31.VII	0846	31°31'.2	67°52'.4	908.8	-71.3	-70.6	omitted	

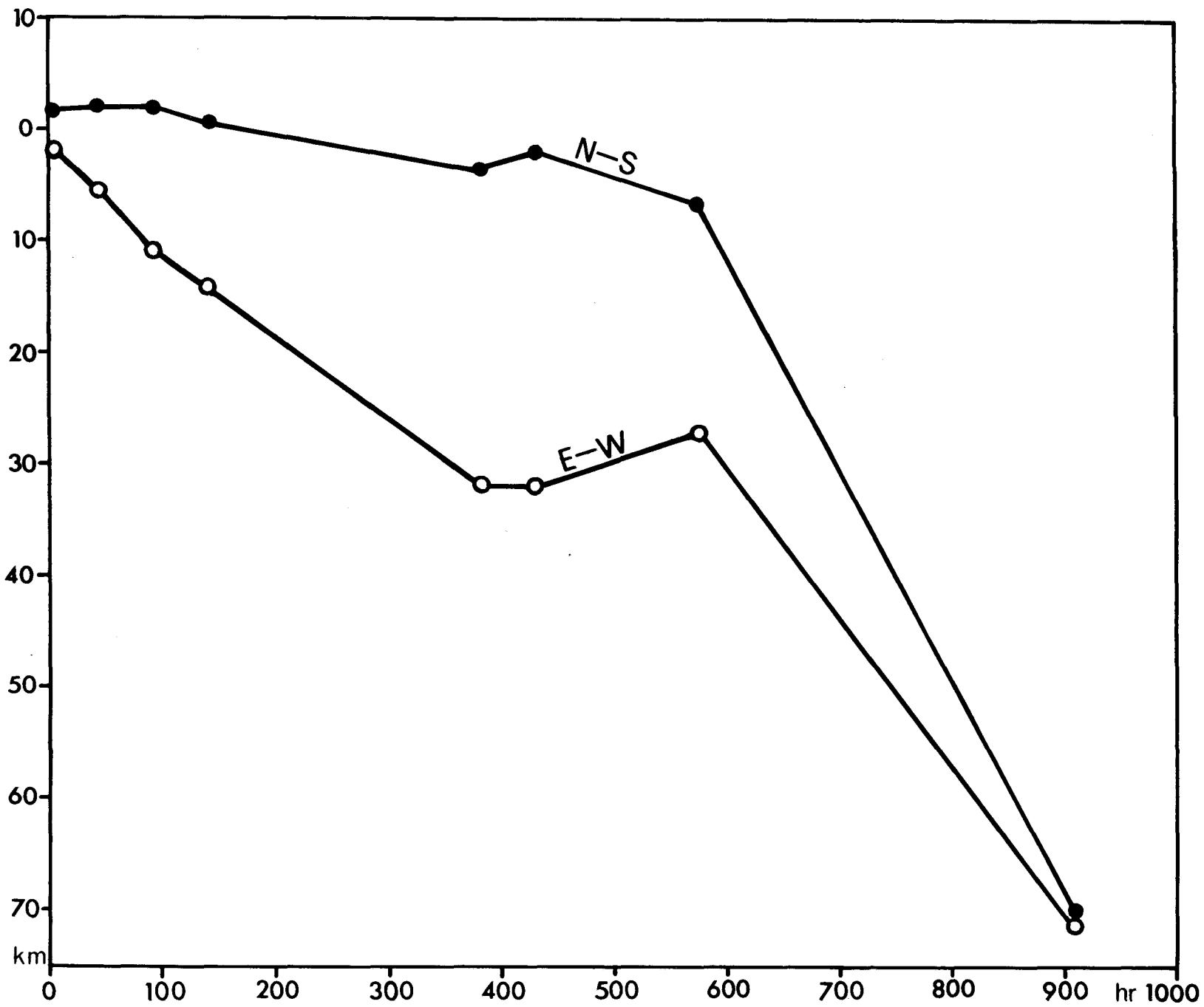
Fitted lines: $x = -0.068t - 2.4$
 $y = -0.066t + 11.6$ } Fixes 1-8

Mean velocity = $2.6(\pm 0.4)$ cm/sec, $226(\pm 7)^\circ T$
 $x = -0.052t - 5.2$
 $y = -0.015t + 2.6$ } Fixes 1-7

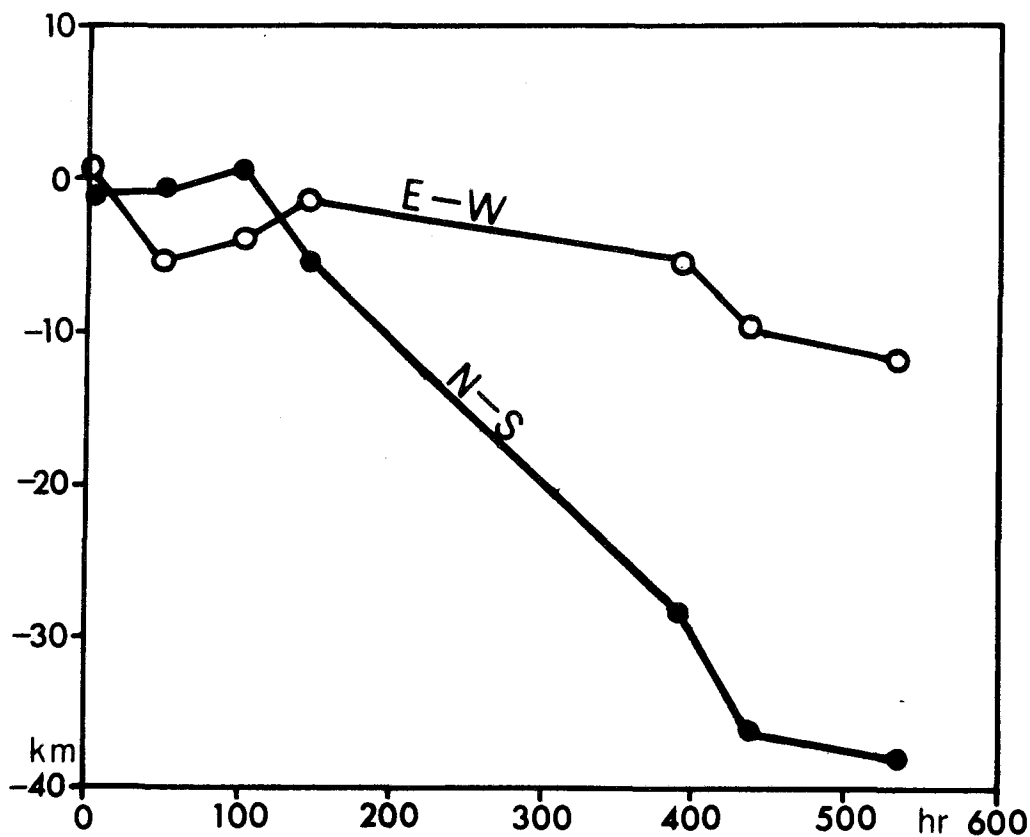
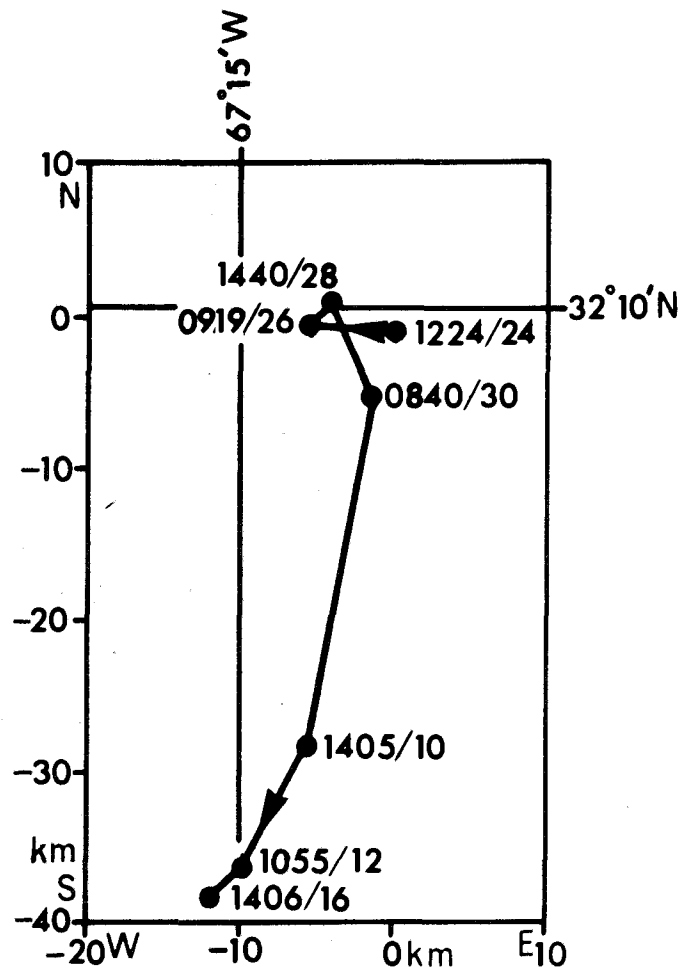
Mean velocity = $1.5(\pm 0.3)$ cm/sec, $254(\pm 2.5)^\circ T$

Mean velocity, fixes 7-8 = 6.5 cm/sec, $215^\circ T$

FLOAT DESIGNATION: A Date and time laid: 1202/23.VI.1959.



FLOAT DESIGNATION: B Date and time laid: 0837/24.VI.1959



FLOAT DESIGNATION: B

Date and time laid 0837/24.VI.1959

Position laid: 32° 09'.8N
67° 08'.6W

Displacement origin: 32° 09'.8N
67° 08'.6W

Navigation based on: Loran A

Estimated accuracy of positions: ± 1 km (relative)

Depth(m): Nominal Observed S.D. S.D.(mean)
 3000 2791 ± 380 ± 110

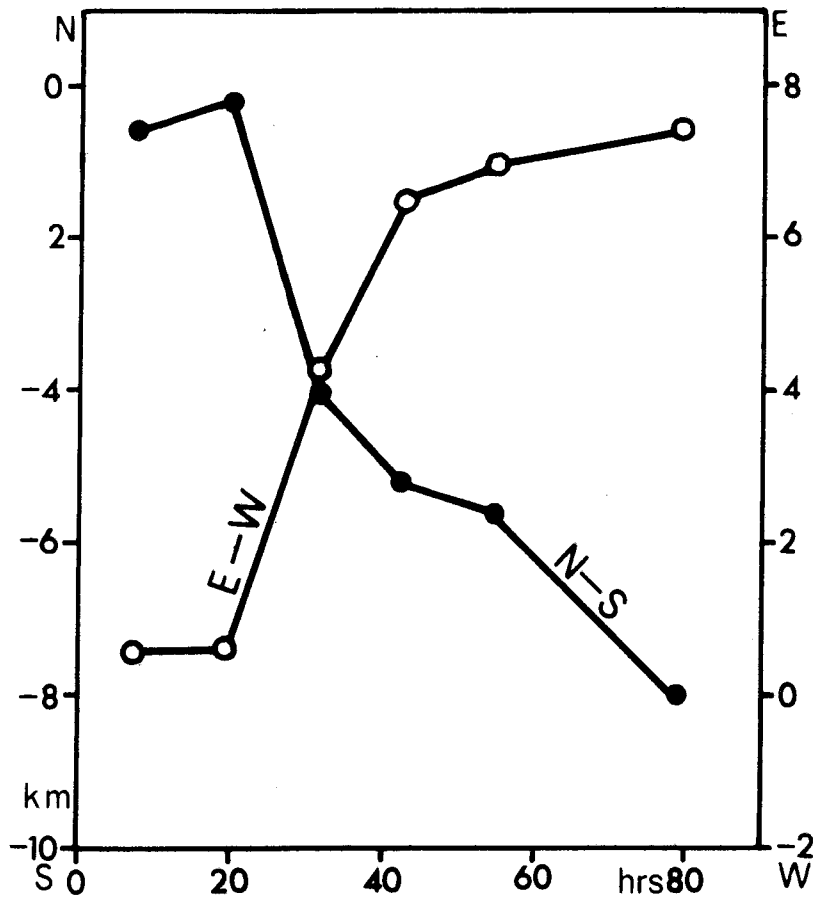
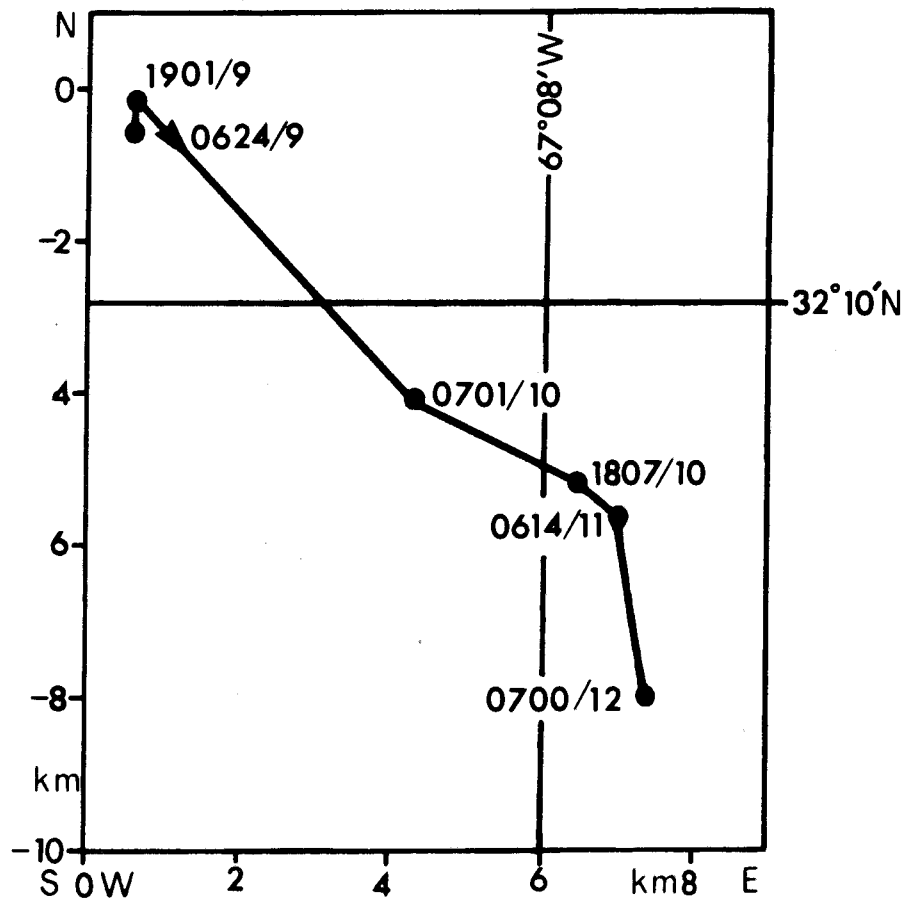
Fix No.	Date	Time GMT -4	Fix Position		Hours Since Laid (t)	Displacement(km)		Residuals	
			Lat.N.	Long.W.		+E-W x	+N-S y	x	y
1	24.VI	1224	32°09'.1	67°08'.3	3.8	+0.6	-1.3	+1.9	-4.8
2	26.VI	0919	32°09'.5	67°12'.3	48.7	-5.7	-0.6	-3.5	-0.6
3	28.VI	1440	32°10'.2	67°11'.2	102.1	-4.1	+0.7	-1.1	+5.2
4	30.VI	0840	32°06'.9	67°09'.6	144.1	-1.5	-5.4	+2.4	+2.6
5	10.VII	1405	31°54'.6	67°12'.3	389.5	-5.7	-28.2	+2.6	0.0
6	12.VII	1055	31°50'.2	67°15'.0	434.3	-10.0	-36.2	-0.9	-4.3
7	16.VII	1406	31°49'.2	67°16'.3	533.5	-12.0	-38.2	-1.1	+1.9

Fitted lines: $x = -0.018t - 1.24$

$y = -0.082t + 3.9$

Mean velocity = $2.3(\pm 0.2)$ cm/sec, $192(\pm 3)^\circ T$

FLOAT DESIGNATION: 19 Date and time laid: 2317/8.VII.1959



FLOAT DESIGNATION: 19

Date and time laid: 2317/8.VII.1959

Position laid: 32° 11'.5N
67° 11'.8W

Displacement origin: 32° 11'.5N
67° 11'.8W

Navigation based on: Loran A

Estimated accuracy of positions: ± 1 km (relative)

Depth(m):	Nominal	Observed	S.D.	S.D.(mean)
	4000	3169	± 550	± 130

Fix No.	Date	Time GMT -4	Fix Position		Hours Since Laid (t)	Displacement(km)		Residuals	
			Lat.N.	Long.W.		+E-W x	+N-S y	x	y
1	9.VII	0624	32°11'.2	67°11'.5	7.1	+0.6	-0.6	-0.4	-0.2
2	9.VII	1901	32°11'.4	67°11'.4	19.7	+0.6	-0.2	-1.7	+1.5
3	10.VII	0701	32°09'.3	67°09'.1	31.7	+4.3	-4.1	+0.7	-0.9
4	10.VII	1807	32°08'.7	67°07'.7	42.8	+6.5	-5.2	+1.7	-0.9
5	11.VII	0614	32°08'.5	67°07'.3	54.9	+7.0	-5.6	+0.9	0.0
6	12.VII	0700	32°07'.2	67°07'.1	79.7	+7.4	-8.0	-1.5	+0.4

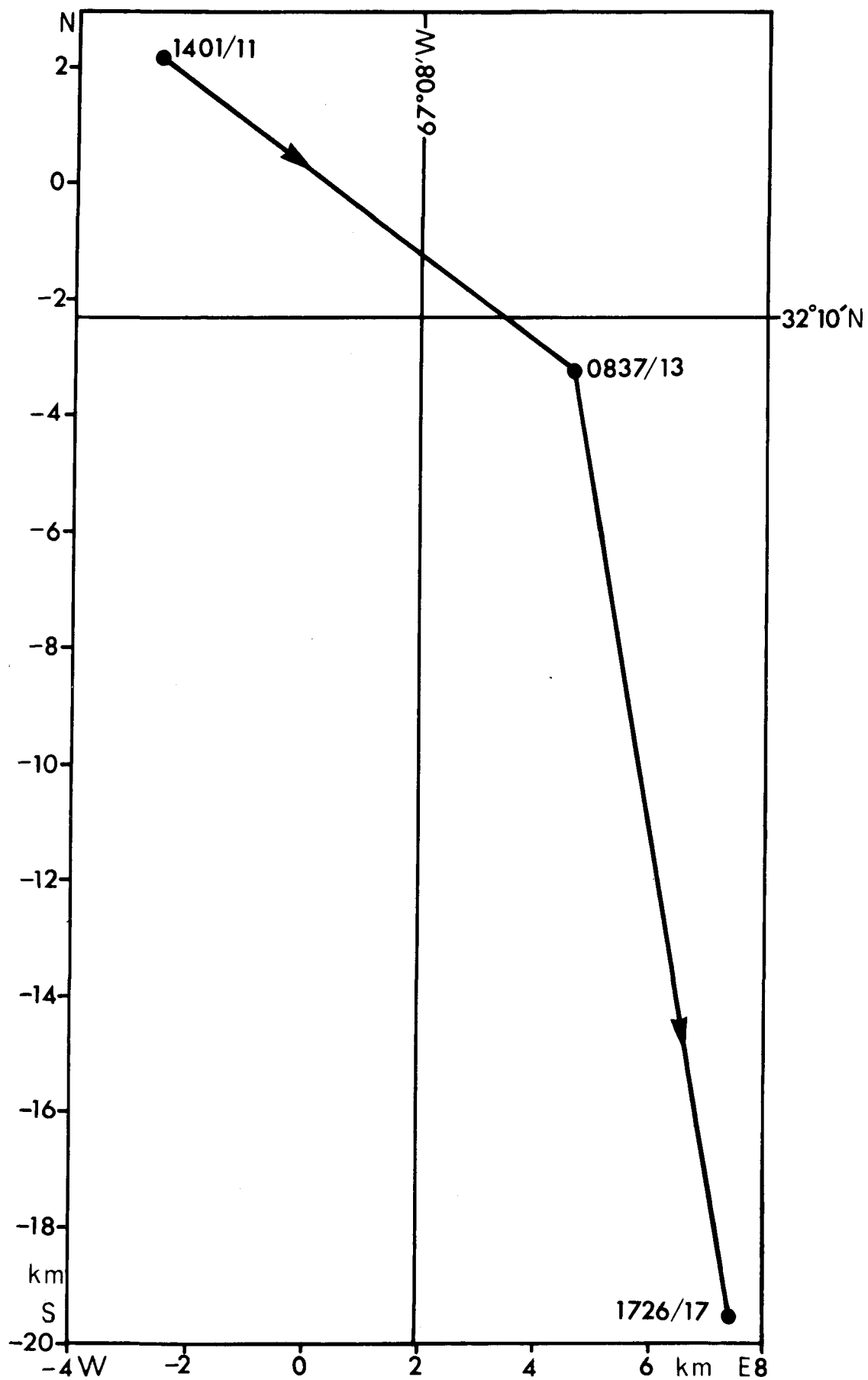
Fitted lines: $x = + 0.109t + 0.1$

$y = - 0.111t + 0.4$

Mean velocity = $4.3(\pm 0.6)$ cm/sec, $136(\pm 5)^\circ T$

SERIAL NO: 44

FLOAT DESIGNATION: C Date and time laid: 0736/11.VII.1959



SERIAL No: 44

FLOAT DESIGNATION: C

Date and time laid: 0736/11.VII.1959

Position laid: 32° 11'.2N
67° 09'.2W

Displacement origin: 32° 11'.2N
67° 09'.2W

Navigation based on: Loran A

Estimated accuracy of positions: $\pm 1\text{km}$ (relative)

Depth(m): Nominal Observed S.D. S.D.(mean)
 4000 2916 ± 700 ± 260

Fix No.	Date	Time GMT -4	Fix Position		Hours Since Laid (t)	Displacement(km)		Residuals	
			Lat.N.	Long.W.		+E-W	+N-S	x	y
1	11.VII	1401	32°12'.4	67°10'.9	6.4	-2.6	+2.2	-1.9	-0.4
2	13.VII	0837	32°09'.5	67°06'.3	49.0	+4.6	-3.2	+2.8	+0.6
3	17.VII	1726	32°00'.7	67°04'.5	153.8	+7.4	-19.5	-0.7	-0.2

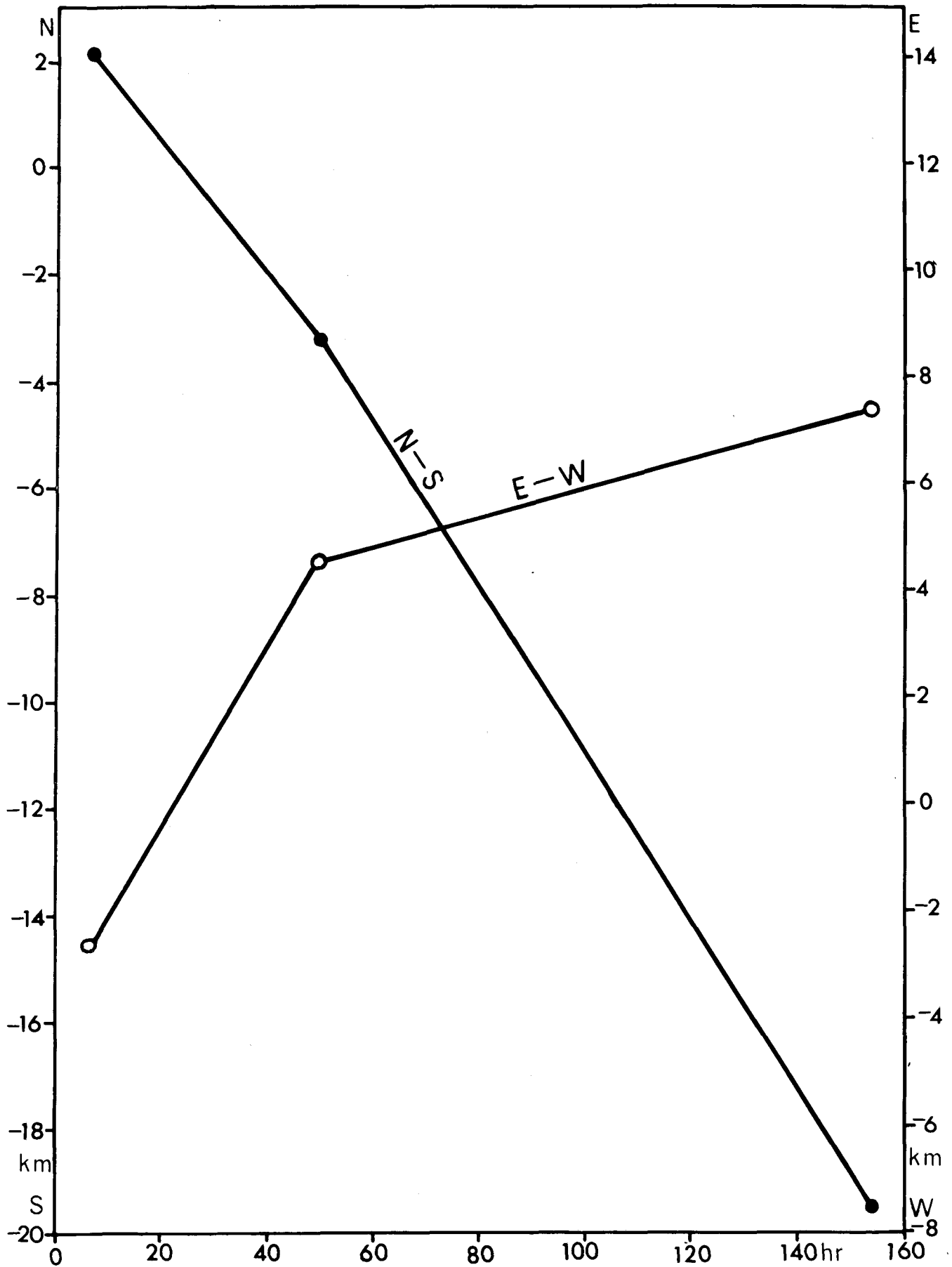
Fitted lines: $x = + 0.060t - 1.1$

$y = - 0.149t + 3.5$

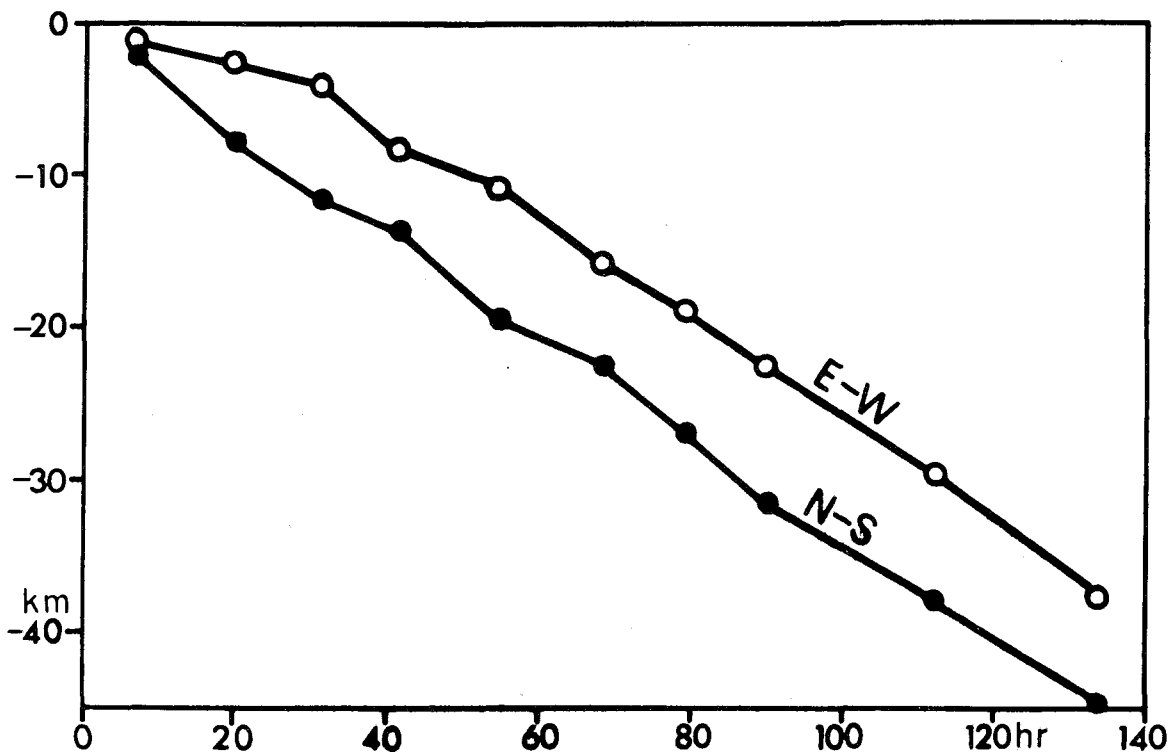
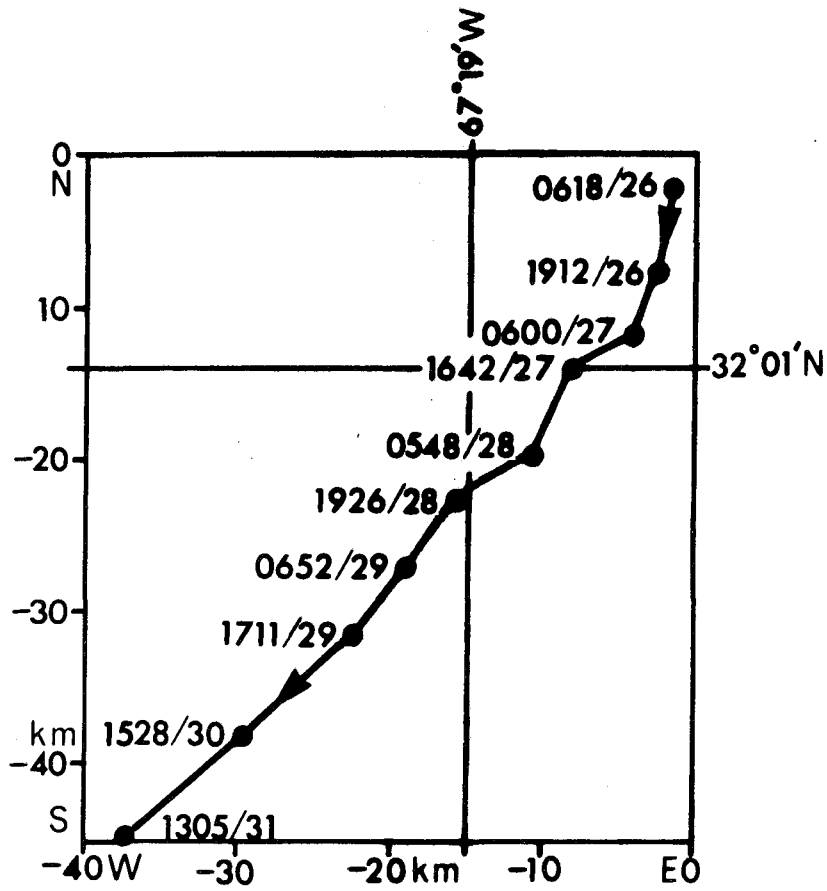
Mean velocity = $4.5(\pm 0.4)\text{cm/sec}$, $158(\pm 11)^\circ\text{T}$

SERIAL NO: 44

FLOAT DESIGNATION: C Date and time laid: 0736/11.VII.1959.



FLOAT DESIGNATION: 24 Date and time laid: 2338/25.VII.1959



FLOAT DESIGNATION: 24

Date and time laid: 2338/25.VII.1959

Position laid: 32° 08'.4N
67° 09'.5WDisplacement origin: 32° 08'.4N
67° 09'.5W

Navigation based on: Loran A

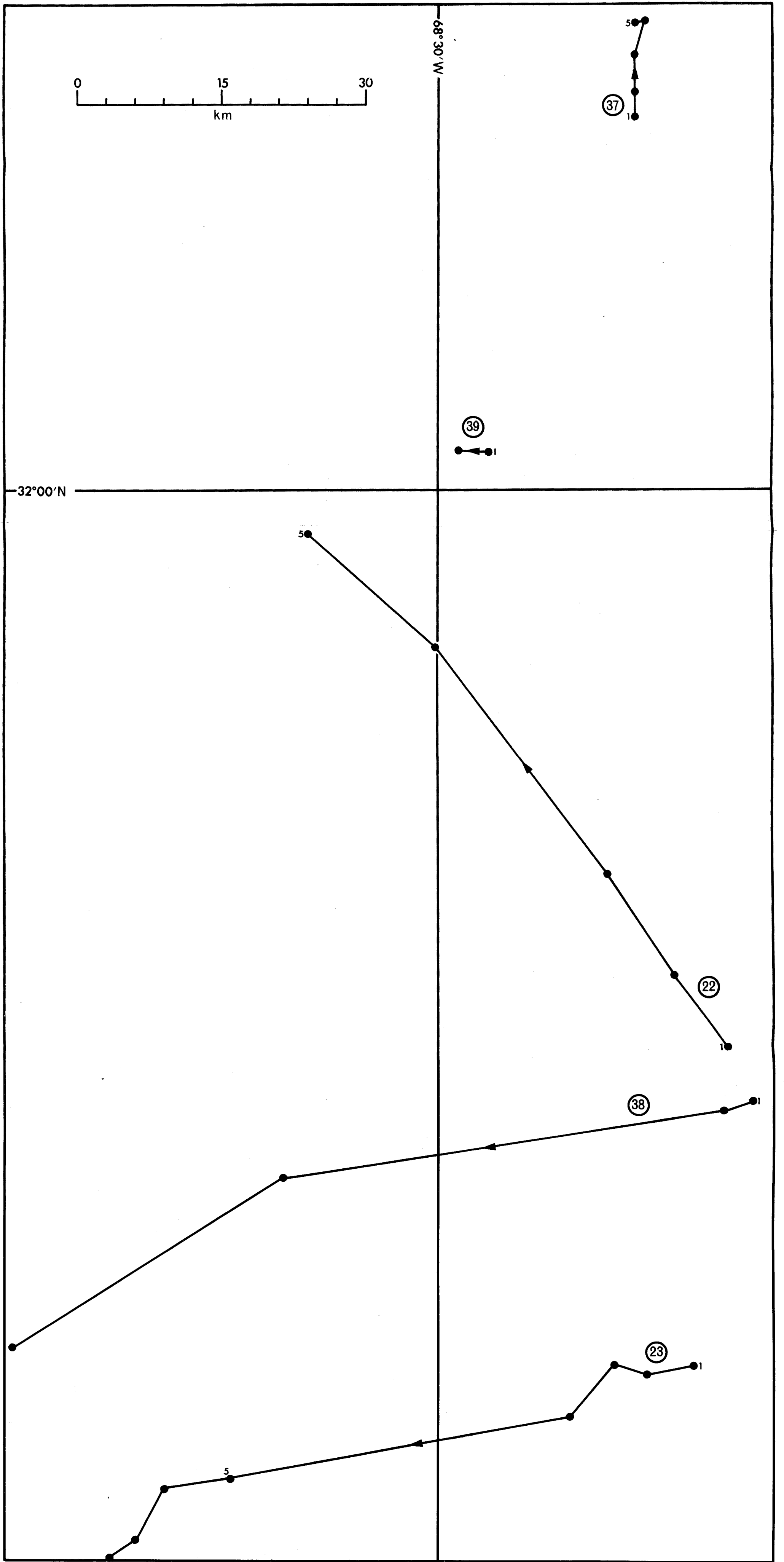
Estimated accuracy of positions: ± 1 km (relative)

Depth(m):	Nominal	Observed	S.D.	S.D.(mean)
	4000	3533	± 660	± 170

Fix No.	Date	Time GMT -4	Fix Position		Hours Since Laid (t)	Displacement(km)		Residuals	
			Lat.N.	Long.W.		+E-W x	+N-S y	x	y
1	26.VII	0618	32°07'.3	67°10'.3	6.7	-1.3	-2.0	-2.8	+0.9
2	26.VII	1912	32°04'.3	67°11'.1	19.6	-2.6	-7.6	-0.4	-0.4
3	27.VII	0600	32°02'.1	67°12'.1	30.4	-4.1	-11.7	+1.3	-0.9
4	27.VII	1642	32°01'.0	67°14'.8	41.1	-8.3	-13.7	+0.2	+0.7
5	28.VII	0548	31°57'.8	67°16'.3	54.2	-10.7	-19.6	+1.7	-0.9
6	28.VII	1926	31°56'.3	67°19'.5	67.8	-15.7	-22.4	+0.7	+0.9
7	29.VII	0652	31°53'.8	67°21'.5	79.3	-18.9	-27.1	+0.7	0.0
8	29.VII	1711	31°51'.5	67°23'.8	89.6	-22.4	-31.3	+0.4	-0.7
9	30.VII	1528	31°47'.9	67°28'.2	111.9	-29.5	-38.0	-0.2	0.0
10	31.VII	1305	31°44'.2	67°33'.2	133.5	-37.2	-44.8	-1.7	+0.4

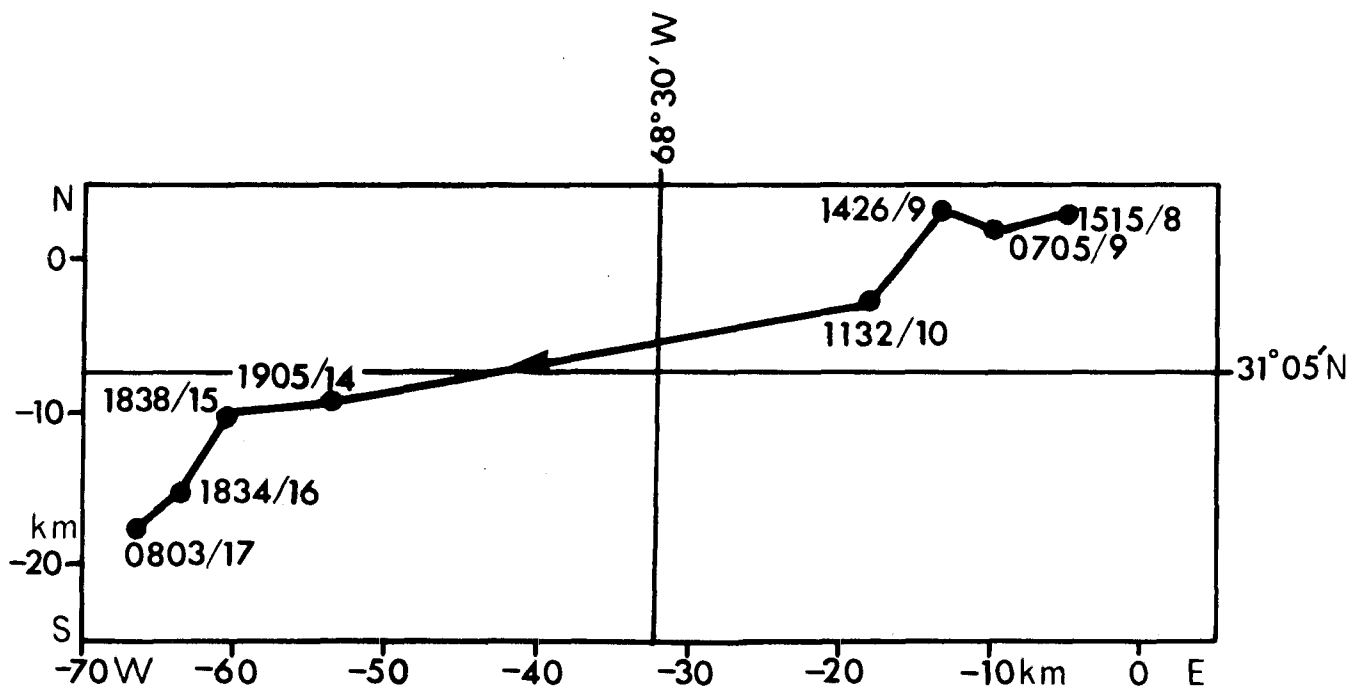
Fitted lines: $x = -0.292t + 3.4$ $y = -0.333t - 0.7$ Mean velocity = $12.3(\pm 0.3)$ cm/sec, $221(\pm 1.0)^{\circ}T$

FLOAT DESIGNATIONS: 23(laid 0900/8.VIII.1959), 38(laid 1055/9.VIII.1959), 22(laid 1640/25.VIII.1959), 37(laid 1608/26.VIII.1959), 39(laid 1655/28.VIII.1959).



SERIAL NO: 46

FLOAT DESIGNATION: 23 Date and time laid: 0900/8.VIII.1959.



FLOAT DESIGNATION: 23

Date and time laid: 0900/8.VIII.1959

Position laid: 31° 08'.8N
68° 10'.0W

Displacement origin: 31° 08'.8N
68° 10'.0W

Navigation based on: Loran A

Estimated accuracy of positions: ± 1km (relative)

Depth(m):	Nominal	Observed	S.D.	S.D.(mean)
	2000	2159	±640	±150

Fix No.	Date	Time GMT -4	Fix Position		Hours Since Laid (t)	Displacement(km)		Residuals	
			Lat.N.	Long.W.		+E-W x	+N-S y	x	y
1	8.VIII	1515	31°10'.4	68°13'.2	6.2	-5.0	+3.0	+0.7	-0.6
2	9.VIII	0705	31°09'.9	68°16'.3	22.1	-10.0	+2.0	+0.6	0.0
3	9.VIII	1426	31°10'.5	68°18'.5	29.4	-13.5	+3.2	-0.7	+1.9
4	10.VIII	1132	31°07'.4	68°21'.3	50.5	-18.0	-2.6	+1.1	-2.0
5	14.VIII	1905	31°03'.8	68°43'.7	154.1	-53.4	-9.3	-3.0	+0.9
6	15.VIII	1838	31°03'.3	68°48'.1	177.6	-60.4	-10.2	-2.8	+2.2
7	16.VIII	1834	31°00'.4	68°50'.0	201.6	-63.4	-15.6	+1.5	-0.9
8	17.VIII	0803	30°59'.4	68°51'.8	215.1	-66.3	-17.4	+2.8	-1.5

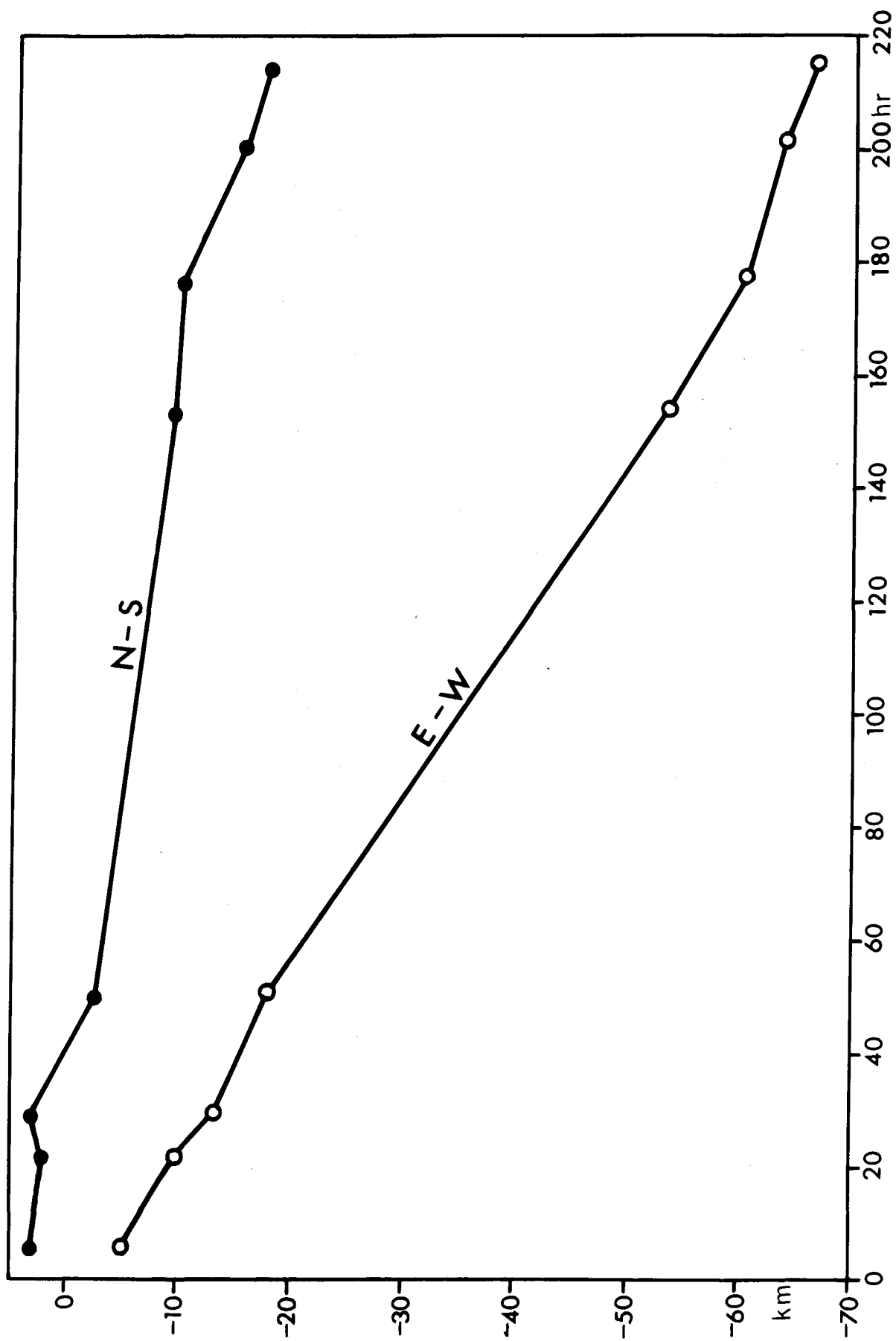
Fitted lines: $x = -0.303t - 3.8$

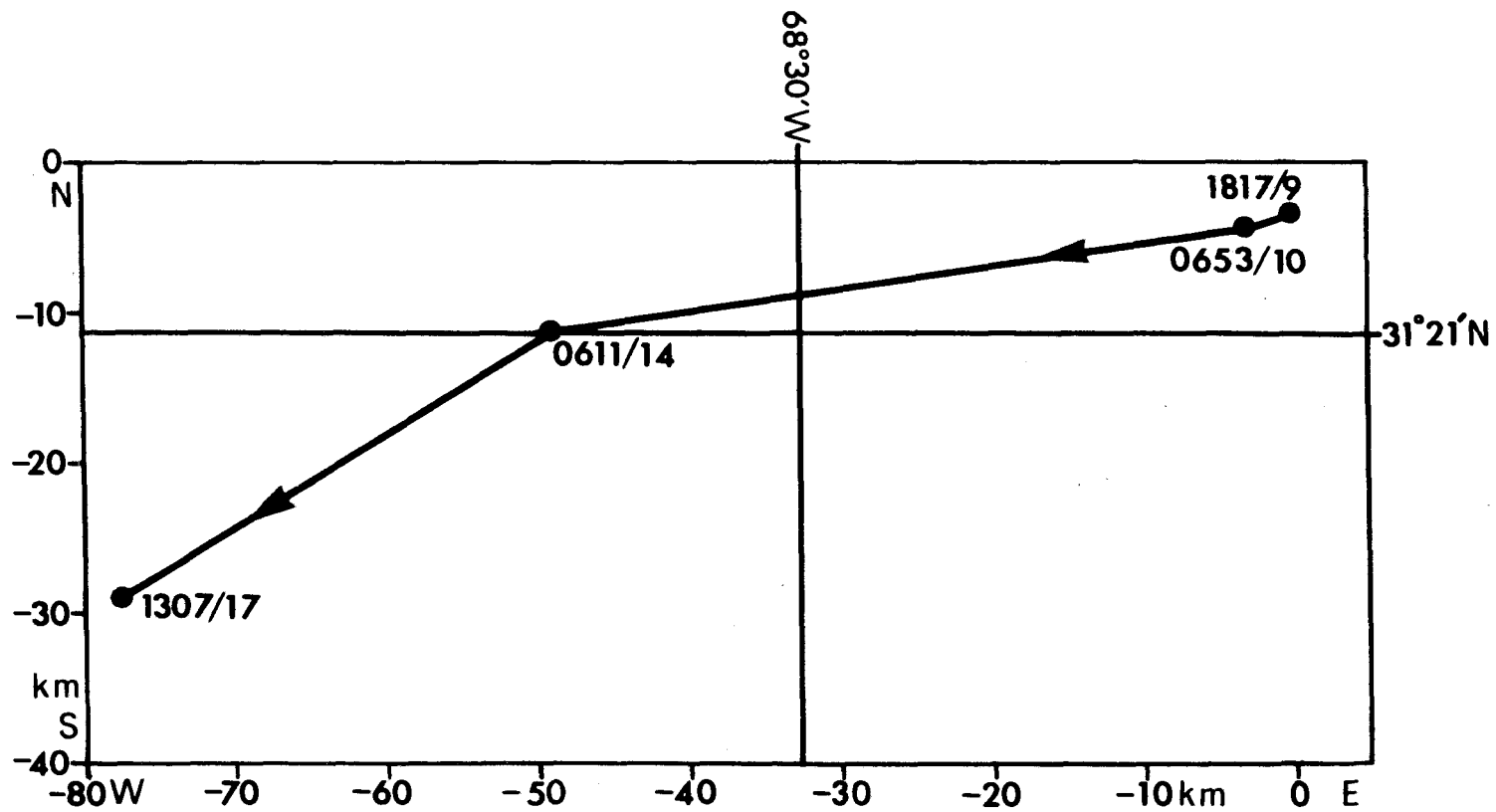
$y = -0.093t + 4.1$

Mean velocity = 8.8(±0.3)cm/sec, 253(±1.1)°T

SERIAL NO: 46

FLOAT DESIGNATION: 23 Date and time laid: 0900/8.VIII.1959





FLOAT DESIGNATION: 38 Date and time laid: 1055/9.VIII.1959.

SERIAL NO: 47

FLOAT DESIGNATION: 38

Date and time laid: 1055/9.VIII.1959

Position laid: $31^{\circ} 27'.1N$
 $68^{\circ} 09'.3W$

Displacement origin: $31^{\circ} 27'.1N$
 $68^{\circ} 09'.3W$

Navigation based on: Loran A

Estimated accuracy of positions: ± 1 km (relative)

Depth(m): Nominal Observed S.D. S.D.(mean)
 2000 2306 ± 500 ± 180

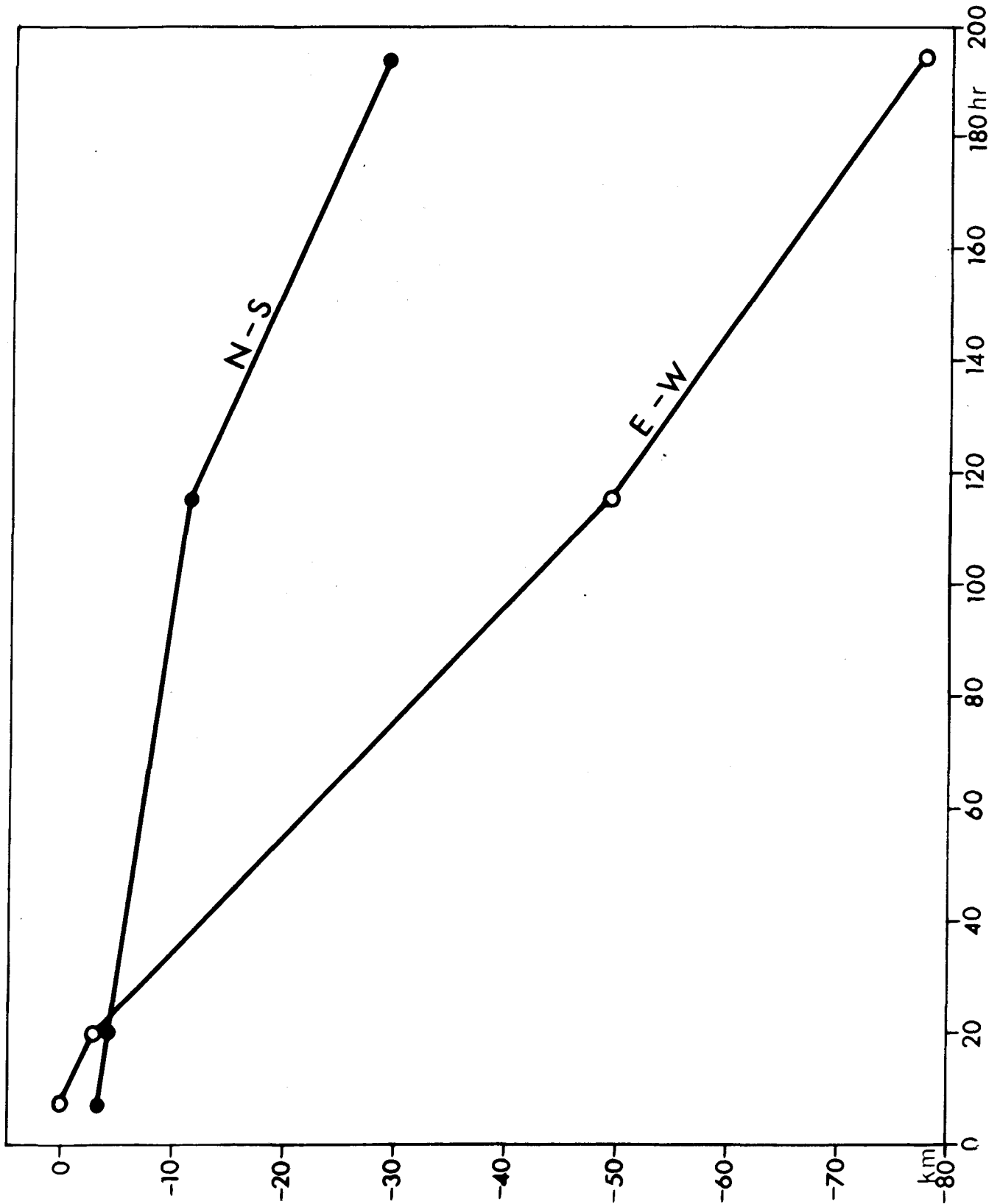
Fix No.	Date	Time GMT -4	Fix Position		Hours Since Laid (t)	Displacement(km)		Residuals	
			Lat.N.	Long.W.		+E-W x	+N-S y	x	y
1	9.VIII	1817	$31^{\circ} 25'.2$	$68^{\circ} 09'.3$	7.4	0.0	-3.5	-0.4	-1.5
2	10.VIII	0653	$31^{\circ} 24'.8$	$68^{\circ} 11'.2$	20.0	-3.0	-4.3	+2.0	-0.6
3	14.VIII	0611	$31^{\circ} 21'.0$	$68^{\circ} 40'.3$	115.3	-49.1	-11.3	-3.5	+4.8
4	17.VIII	1307	$31^{\circ} 11'.4$	$68^{\circ} 58'.2$	194.2	-77.5	-29.1	+1.9	-2.8

Fitted lines: $x = -0.427t + 3.6$

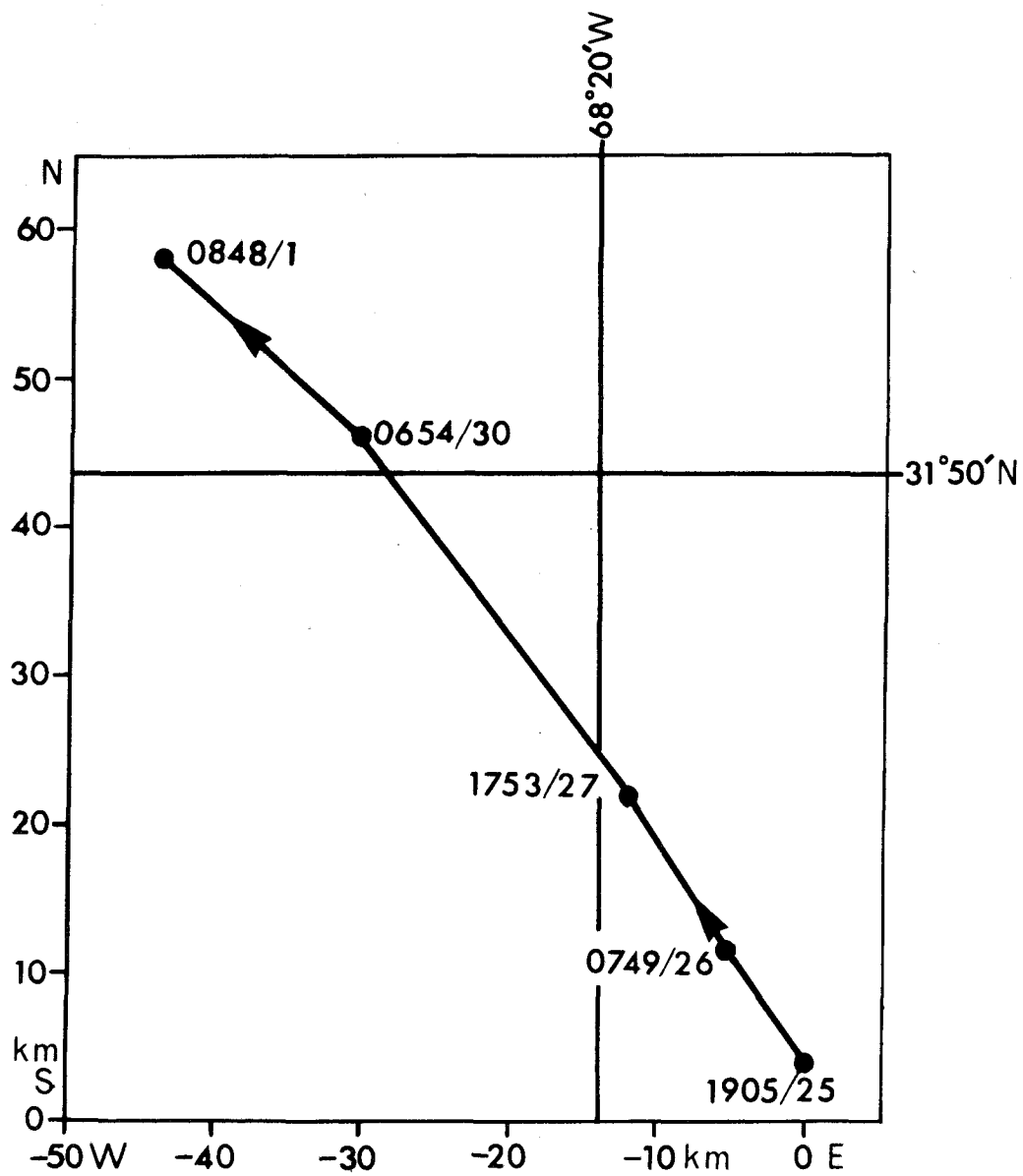
$y = -0.130t - 1.1$

Mean velocity = $12.4(\pm 0.6)$ cm/sec, $253(\pm 3)^{\circ}T$

FLOAT DESIGNATION: 38 Date and time laid: 1055/9.VIII.1959



FLOAT DESIGNATION: 22 Date and time laid: 1640/25.VIII.1959



SERIAL No: 48

FLOAT DESIGNATION: 22

Date and time laid: 1640/25.VIII.1959

Position laid: $31^{\circ} 26' .4N$
 $68^{\circ} 11' .0W$

Displacement origin: $31^{\circ} 26' .4N$
 $68^{\circ} 11' .0W$

Navigation based on: Loran C

Estimated accuracy of positions: $\pm 0.2km$ (relative)

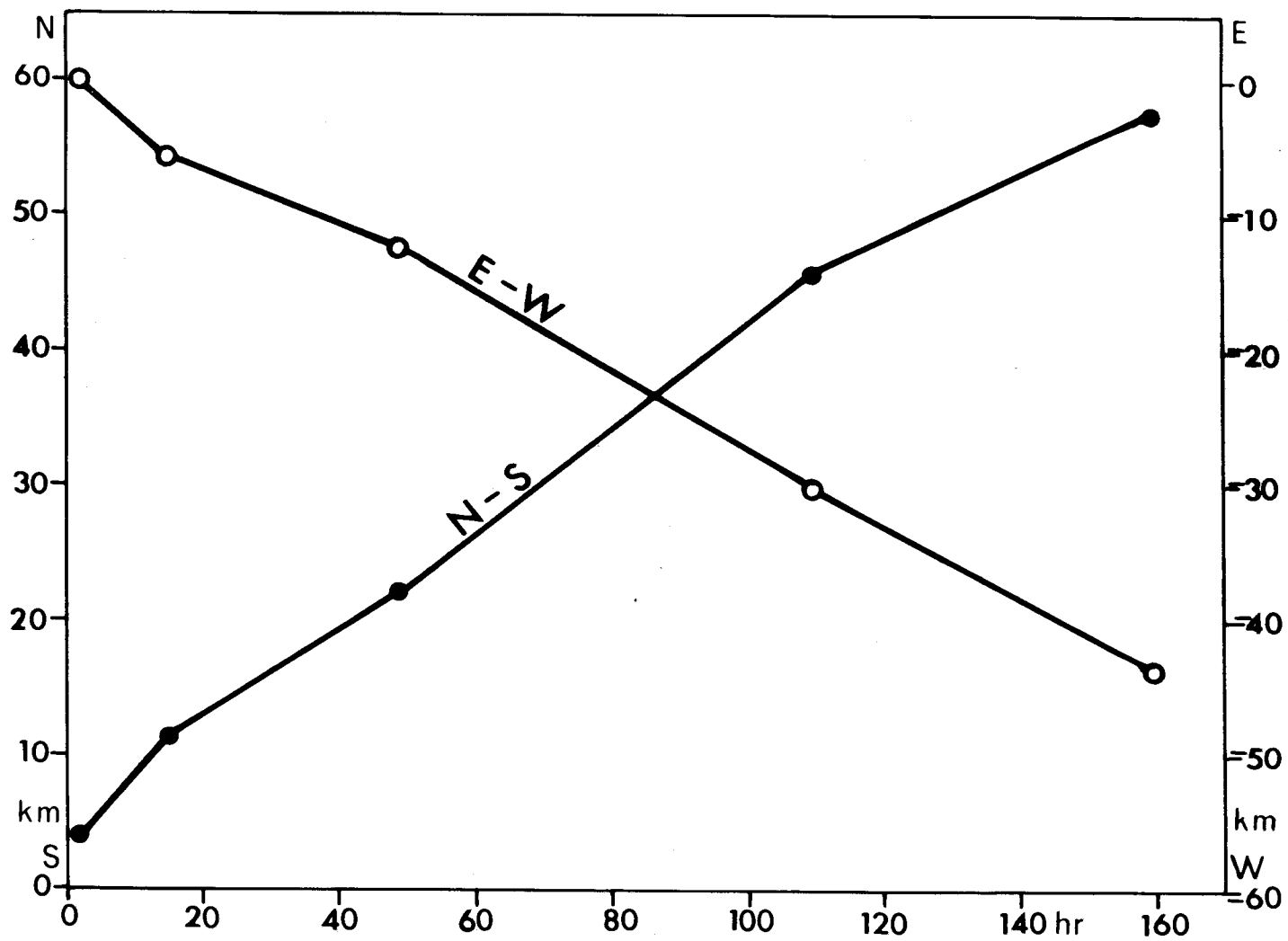
Depth(m):	Nominal	Observed	S.D.	S.D.(mean)
	2000	2148	± 590	± 210

Fix No.	Date	Time GMT -4	Fix Position		Hours Since Laid (t)	Displacement(km)		Residuals	
			Lat.N.	Long.W.		+E-W x	+N-S y	x	y
1	25.VIII	1905	$31^{\circ} 28' .5$	$68^{\circ} 11' .0$	2.4	0.0	+3.9	+0.7	-2.0
2	26.VIII	0749	$31^{\circ} 32' .6$	$68^{\circ} 14' .6$	15.1	-5.7	+11.5	-1.7	+1.1
3	27.VIII	1753	$31^{\circ} 38' .3$	$68^{\circ} 18' .8$	49.2	-12.2	+22.1	+1.3	0.0
4	30.VIII	0654	$31^{\circ} 51' .2$	$68^{\circ} 30' .2$	110.2	-30.2	+46.0	-0.2	+3.2
5	1.IX	0848	$31^{\circ} 57' .6$	$68^{\circ} 38' .7$	160.1	-43.7	+57.8	-0.2	-2.2

Fitted lines: $x = - 0.272t - 0.01$

$y = + 0.343t + 5.2$

Mean velocity = $12.2(\pm 0.5)cm/sec, 322(\pm 1.3)^{\circ}T$



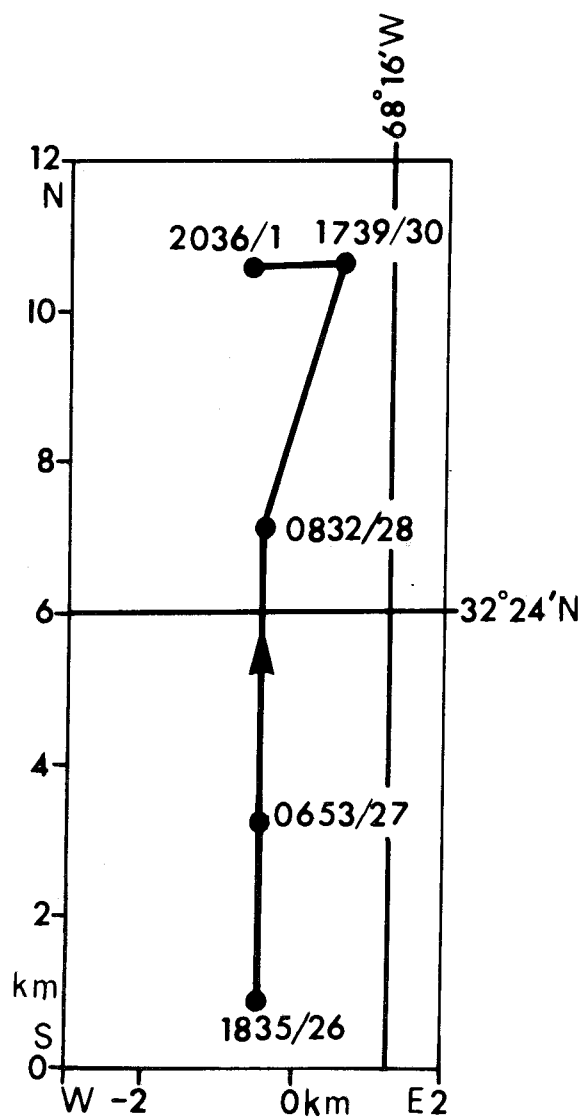
FLOAT DESIGNATION: 22

Date and time laid: 1640/25.VIII.1959.

SERIAL NO: 48

SERIAL NO: 49

FLOAT DESIGNATION: 37 Date and time laid: 1608/26.VIII.1959.



FLOAT DESIGNATION: 37

Date and time laid: 1608/26.VIII.1959

Position laid: $32^{\circ} 20'.7N$
 $68^{\circ} 16'.8W$

Displacement origin: $32^{\circ} 20'.7N$
 $68^{\circ} 16'.8W$

Navigation based on: Loran C

Estimated accuracy of positions: $\pm 0.2km$ (relative)

Depth(m):	Nominal	Observed	S.D.	S.D.(mean)
	2000	1900	± 420	± 150

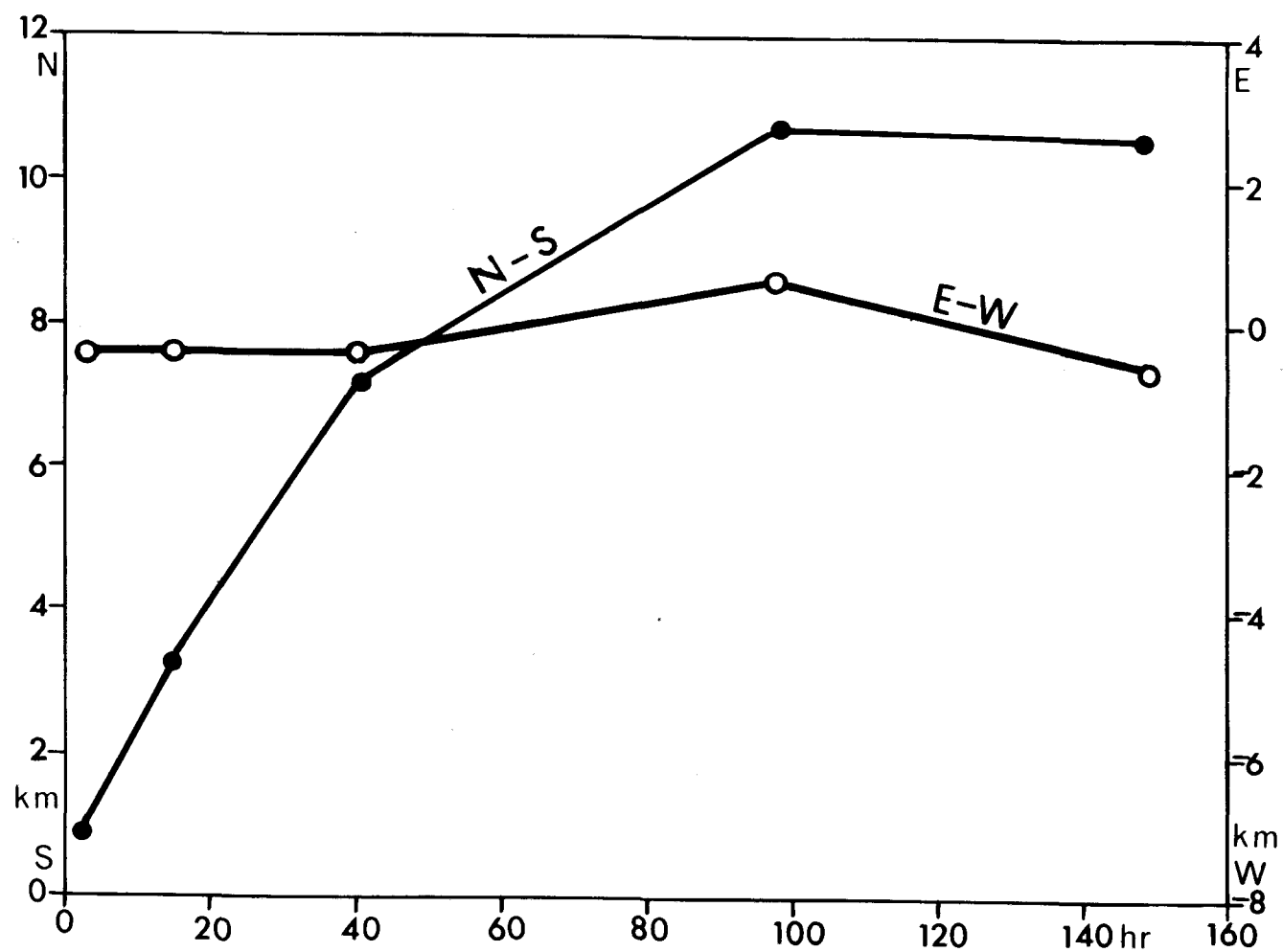
Fix No.	Date	Time GMT -4	Fix Position		Hours Since Laid (t)	Displacement(km)		Residuals	
			Lat.N.	Long.W.		+E-W x	+N-S y	x	y
1	26.VIII	1835	$32^{\circ} 21'.2$	$68^{\circ} 17'.0$	2.5	-0.4	+0.9	+0.2	-1.1
2	27.VIII	0653	$32^{\circ} 22'.5$	$68^{\circ} 17'.0$	14.8	-0.4	+3.3	0.0	+0.2
3	28.VIII	0832	$32^{\circ} 24'.6$	$68^{\circ} 17'.0$	40.4	-0.4	+7.2	-0.2	+1.5
4	30.VIII	1739	$32^{\circ} 26'.5$	$68^{\circ} 16'.4$	97.5	+0.6	+10.7	+0.2	-0.6
5	1.IX	2036	$32^{\circ} 26'.4$	$68^{\circ} 17'.1$	148.5	-0.6	+10.6	omitted	

Fitted lines: $x = +0.001t - 0.3$)
 $y = +0.065t + 2.6$ } Fixes 1-5

Mean velocity = $1.8(\pm 0.5)cm/sec, 001(\pm 4)^{\circ}T$

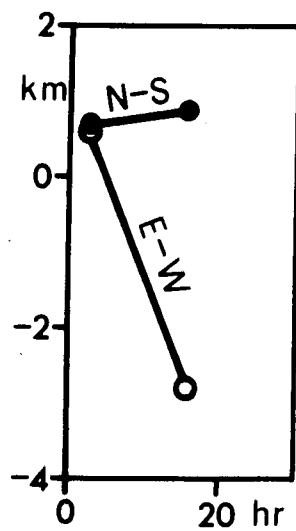
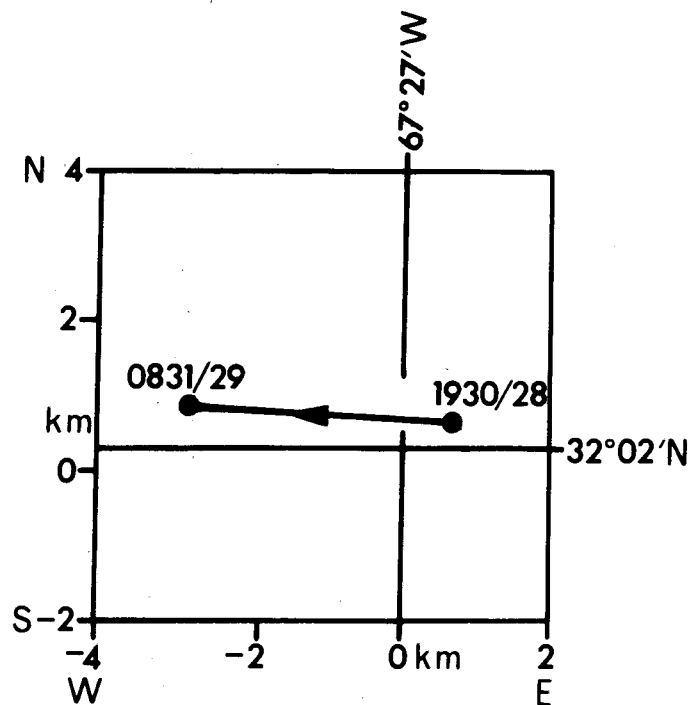
$x = +0.011t - 0.6$)
 $y = +0.099t + 1.7$ } Fixes 1-4

Mean velocity = $2.8(\pm 0.5)cm/sec, 006(\pm 1.3)^{\circ}T$



FLOAT DESIGNATION: 37 Date and time laid: 1608/26.VIII.1959

FLOAT DESIGNATION: 39 Date and time laid: 1655/28.VIII.1959



SERIAL No: 50

FLOAT DESIGNATION: 39

Date and time laid: 1655/28.VIII.1959

Position laid: 32° 01'.8N
67° 27'.0W

Displacement origin: 32° 01'.8N
67° 27'.0W

Navigation based on: Loran C

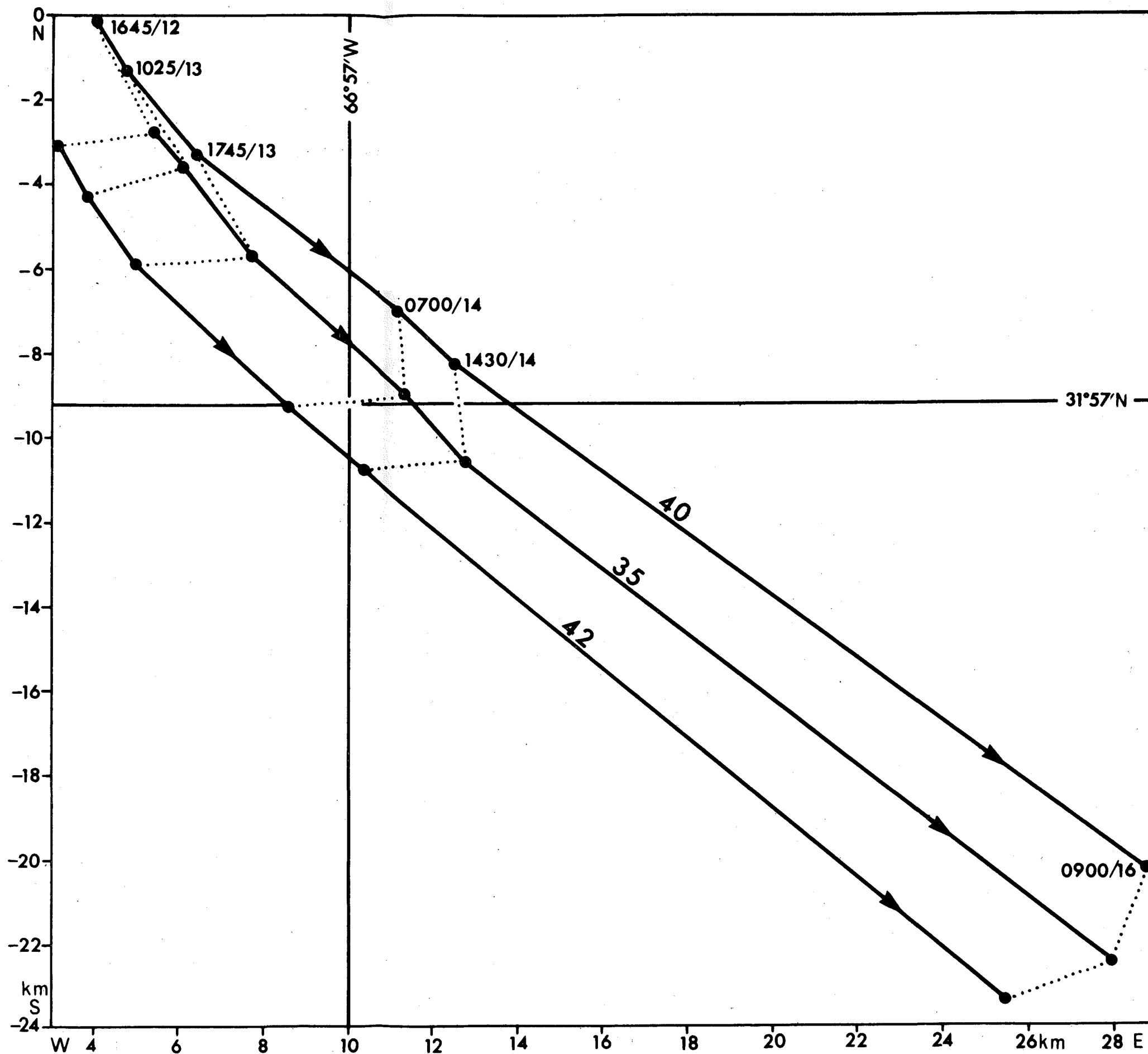
Estimated accuracy of positions: ± 0.2 km (relative)

Depth(m):	Nominal	Observed	S.D.	S.D.(mean)
	2000	1906	± 100	± 100

Fix No.	Date	Time GMT -4	Fix Position		Hours Since Laid (t)	Displacement(km)	
			Lat.N.	Long.W.		+E-W x	+N-S y
1	28.VIII	1930	32°02'.2	67°26'.7	2.6	+0.6	+0.7
2	29.VIII	0831	32°02'.3	67°28'.8	15.6	-2.8	+0.9

Mean velocity Fix 1-2 = 7.5 cm/sec, 274°T

FLOAT DESIGNATIONS: 35(laid 1230/12.IX.1959), 42. (laid 1258/12.IX.1959), 40 laid 1330/12.IX.1959).



FLOAT DESIGNATION: 35

Date and time laid: 1230/12.IX.1959

Position laid: 32° 02'.0N
67° 03'.4W

Displacement origin: 32° 02'.0N
67° 03'.4W

Navigation based on: Loran C

Estimated accuracy of positions: ± 0.2 km (relative)

Depth(m):	Nominal	Observed	S.D.	S.D.(mean)
	2000	1836	± 270	± 67

Fix No.	Date	Time GMT C4	Fix Position		Hours Since Laid (t)	Displacement(km)		Residuals	
			Lat.N.	Long.W.		+E-W x	+N-S y	x	y
1	12.IX	1645	32°00'.54	66°59'.94	4.2	+5.4	-2.7	+3.2	-2.2
2	13.IX	1025	32°00'.04	66°59'.54	21.9	+6.1	-3.6	-0.9	+1.1
3	13.IX	1745	31°58'.95	66°58'.50	29.3	+7.7	-5.7	-1.3	+0.7
4	14.IX	0700	31°57'.15	66°56'.13	42.5	+11.4	-9.0	-1.1	+0.6
5	14.IX	1430	31°56'.28	66°55'.26	50.0	+12.8	-10.6	-1.9	+0.7
6	16.IX	0900	31°49'.90	66°45'.60	92.5	+28.0	-22.4	+2.0	-1.1

Fitted lines: $x = + 0.269 t + 1.1$

$y = - 0.235 t + 0.4$

Mean velocity = $9.9(\pm 0.8)$ cm/sec, $131(\pm 2.5)^\circ T$

FLOAT DESIGNATION: 42

Date and time laid: 1258/12.IX.1959

Position laid: 32° 01' .76N

Displacement origin: 32° 02' .00N

67° 05' .45W

67° 03' .40W

Navigation based on: Loran C

Estimated accuracy of positions: ± 0.2 km (relative)

Depth(m):	Nominal	Observed	S.D.	S.D.(mean)
	2000	1654	± 370	± 117

Fix No.	Date	Time GMT -4	Fix Position		Hours Since Laid (t)*	Displacement(km)		Residuals	
			Lat.N.	Long.W.		+E-W x	+N-S y	x	y
1	12.IX	1645	32°00' .40	67°01' .45	4.2	+3.1	-3.0	+3.3	-2.2
2	13.IX	1025	31°59' .70	67°01' .00	21.9	+3.8	-4.3	-0.7	+0.7
3	13.IX	1745	31°58' .80	67°00' .30	29.3	+4.9	-5.9	-1.7	+0.9
4	14.IX	0700	31°57' .00	66°57' .92	42.5	+8.6	-9.3	-1.5	+0.7
5	14.IX	1430	31°56' .15	66°56' .77	50.0	+10.4	-10.8	-1.7	+1.1
6	16.IX	0900	31°49' .4	66°47' .10	92.5	+25.4	-23.3	+2.0	-1.3

Fitted lines: $x = + 0.267 t - 1.3$

$y = - 0.240 t + 0.2$

Mean velocity = $10.0(\pm 0.8)$ cm/sec, $132(\pm 3)^\circ T$

* Hours since float designated 35 was laid

FLOAT DESIGNATION: 40

Date and time laid: 1330/12.IX.1959

Position laid: 32° 03' .44N
67° 04' .68W

Displacement origin: 32° 02'N
67° 03' .4W

Navigation based on: Loran C

Estimated accuracy of positions: ± 0.2 km (relative)

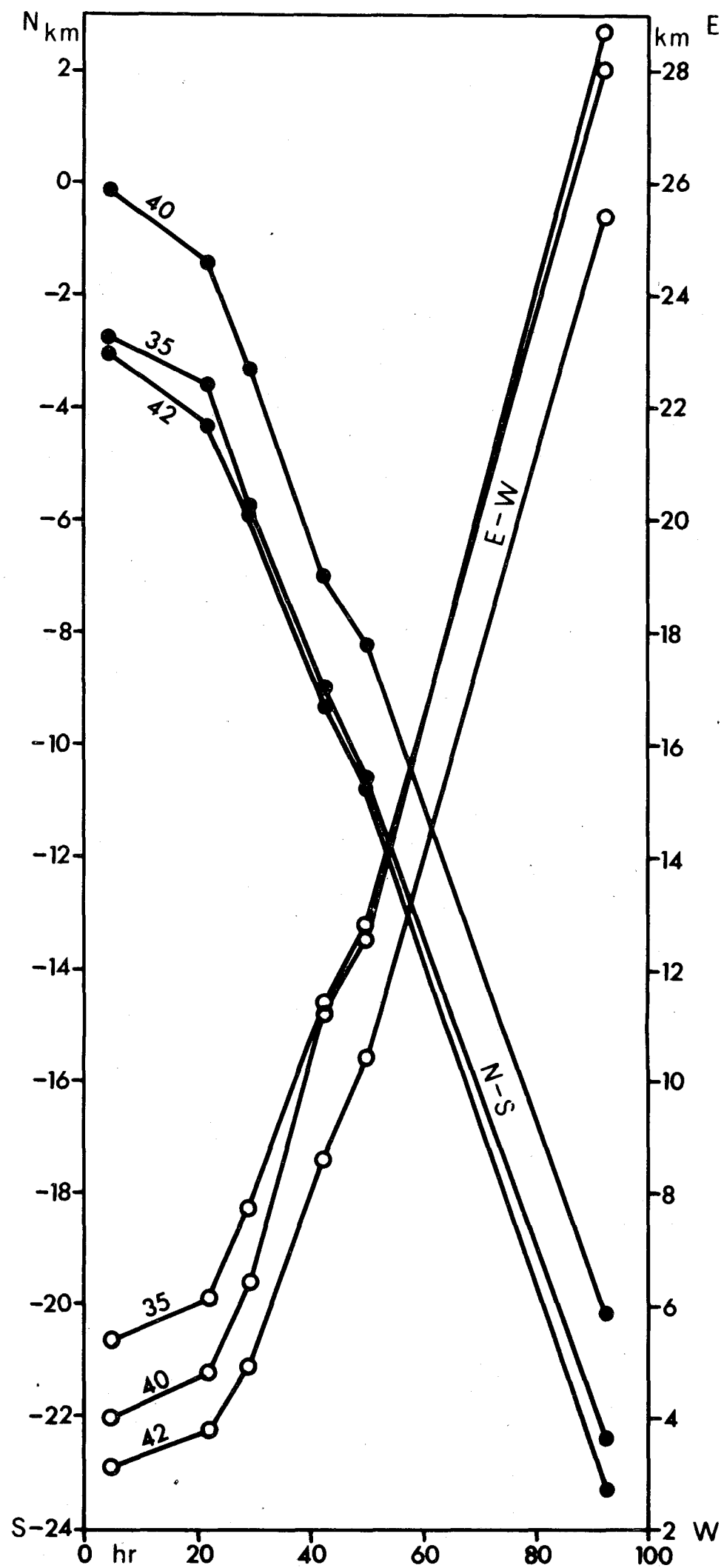
Depth(m): Nominal Observed S.D. S.D.(mean)
 2000 1754 ± 340 ± 104

Fix No.	Date	Time GMT -4	Fix Position		Hours Since Laid (t)	Displacement(km)		Residuals	
			Lat.N.	Long.W.		+E-W x	+N-S y	x	y
1	12.IX	1645	32°01' .95	67°00' .87	4.2	+4.0	-0.1	+3.3	-2.0
2	13.IX	1025	32°01' .22	67°00' .36	21.9	+4.8	-1.4	-1.1	+0.9
3	13.IX	1745	32°00' .20	66°59' .30	29.3	+6.4	-3.3	-1.7	+0.7
4	14.IX	0700	31°58' .24	66°56' .27	42.5	+11.2	-7.0	-0.7	+0.4
5	14.IX	1430	31°57' .60	66°55' .47	50.0	+12.5	-8.2	-1.7	+0.9
6	16.IX	0900	31°51' .10	66°45' .00	92.5	+28.7	-20.2	+1.9	-0.9

Fitted lines: $x = + 0.296 t - 0.6$

$y = - 0.238 t + 2.8$

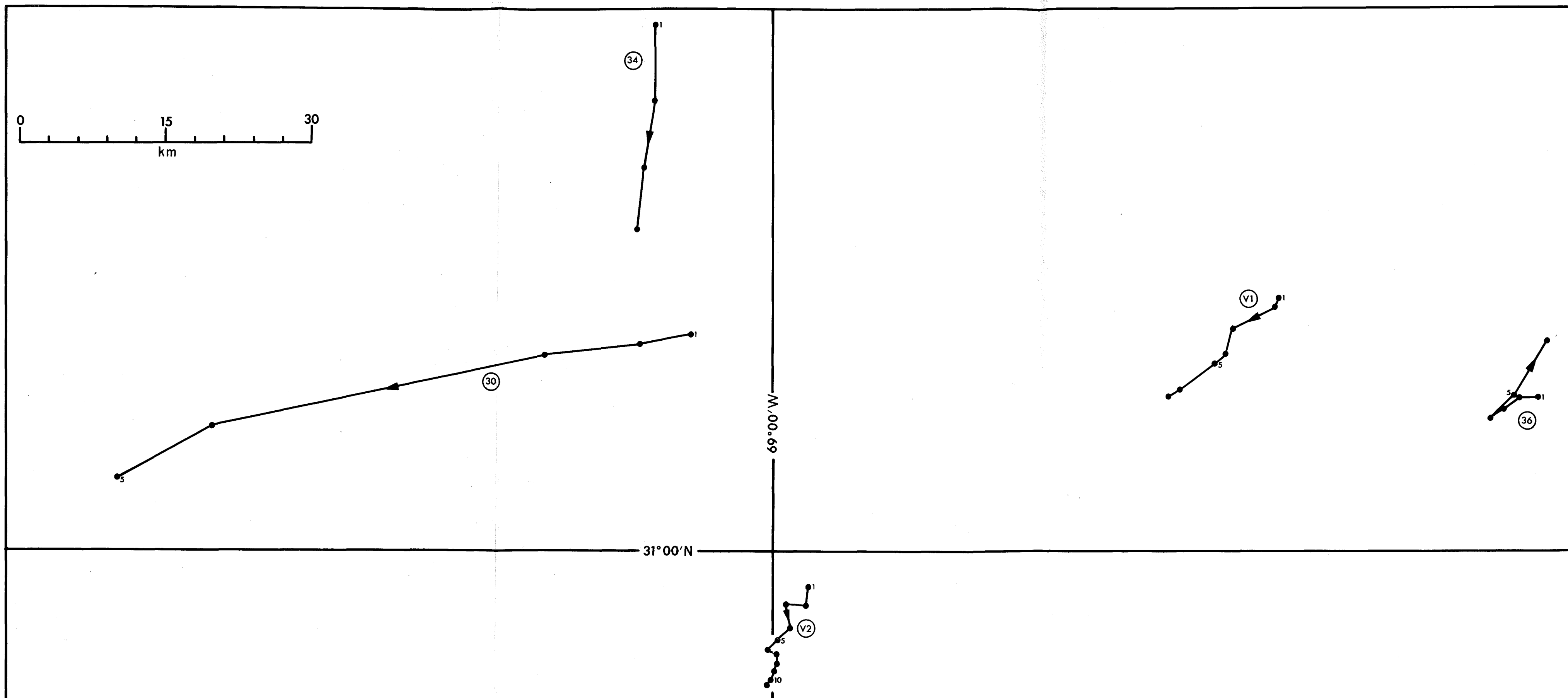
Mean velocity = $10.6(\pm 0.8)$ cm/sec, $129(\pm 2)^\circ T$



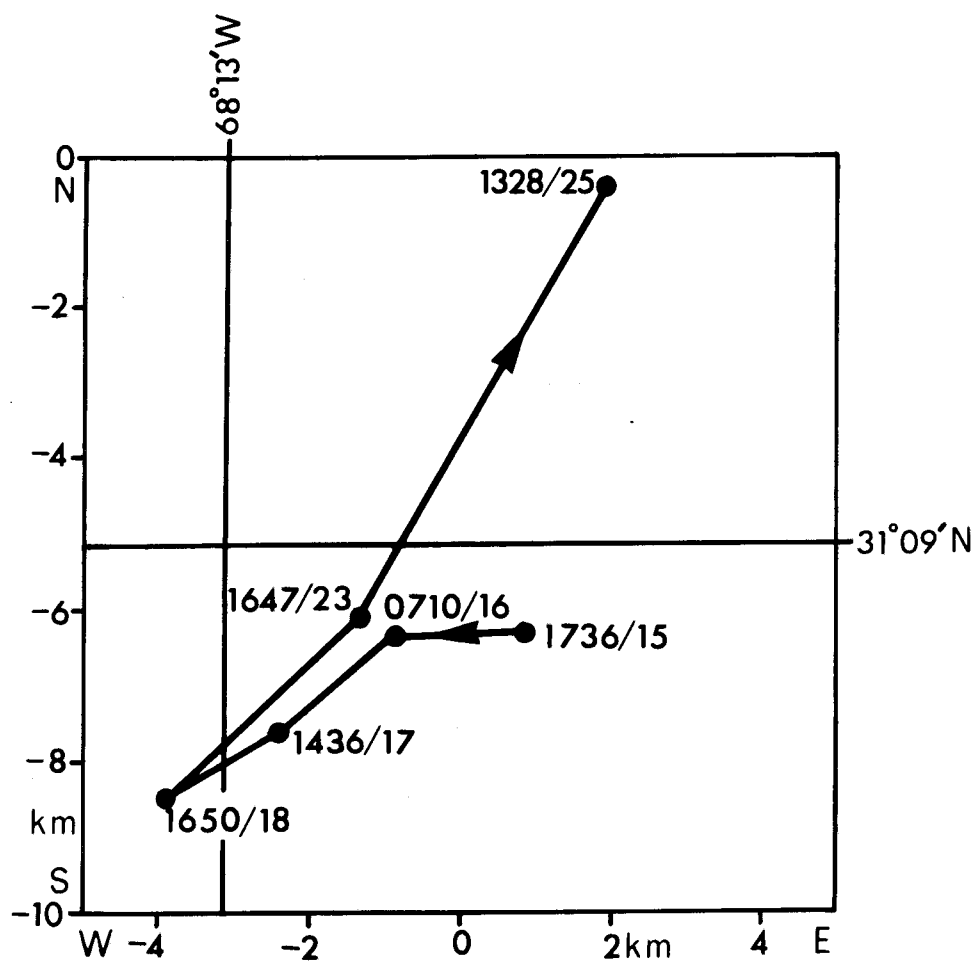
FLOAT DESIGNATIONS: 35(laid 1230/12.IX.1959),
42(laid 1258/12.IX.1959), 40(laid 1330/12.IX.1959).

SERIAL NOS: 51-53

FLOAT DESIGNATIONS: 36(laid 1512/15.X.1959), VI(laid 0915/16.X.1959), 30(laid 1315/16.X.1959), 34(laid 1242/24.X.1959), V2(laid 1000/26.X.1959).



FLOAT DESIGNATION: 36 Date and time laid: 1512/15.X.1959.



FLOAT DESIGNATION: 36

Date and time laid: 1512/15.X, 1959

Position laid: $31^{\circ} 11' .8N$

Displacement origin: $31^{\circ} 11' .8N$

$68^{\circ} 11' .0W$

$68^{\circ} 11' .0W$

Navigation based on: Loran A

Estimated accuracy of positions: $\pm 1\text{km}$ (relative)

Depth(m)	Nominal	Observed	S.D.	S.D.(mean)
	2000	2158	± 440	± 160

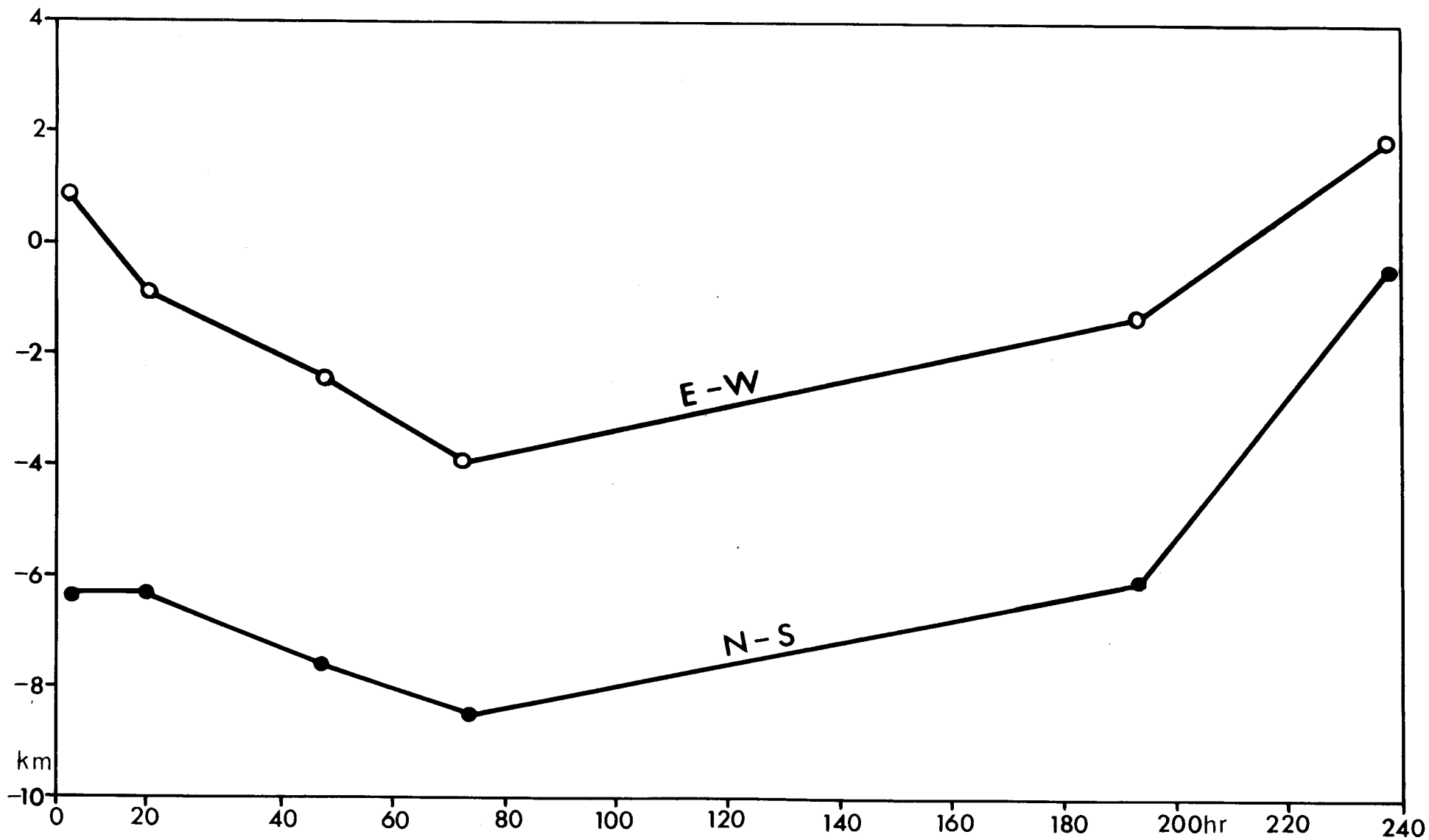
Fix No.	Date	Time GMT -4	Fix Position		Hours Since Laid (t)	Displacement(km)		Residuals	
			Lat.N.	Long.W.		+E-W x	+N-S y	x	y
1	15.X	1736	$31^{\circ} 08' .4$	$68^{\circ} 10' .3$	2.4	+0.9	-6.3	+0.4	-0.2
2	16.X	0710	$31^{\circ} 08' .4$	$68^{\circ} 11' .6$	16.0	-0.9	-6.3	-0.6	+0.2
3	17.X	1436	$31^{\circ} 07' .7$	$68^{\circ} 12' .6$	47.4	-2.4	-7.6	-0.0	0.0
4	18.X	1650	$31^{\circ} 07' .2$	$68^{\circ} 13' .5$	73.6	-3.9	-8.5	+0.2	0.0
5	23.X	1647	$31^{\circ} 08' .5$	$68^{\circ} 11' .9$	193.6	-1.3	-6.1	-0.9	-2.2
6	25.X	1328	$31^{\circ} 11' .6$	$68^{\circ} 09' .8$	238.3	+1.9	-0.4	+0.7	+1.7

Fitted lines:
$$\left. \begin{aligned} x &= -0.063t + 0.6 \\ y &= -0.033t - 6.0 \end{aligned} \right\} \text{Fixes 1-4}$$

Mean velocity = $2.0(\pm 0.2)\text{cm/sec}$, $242(\pm 1.4)^{\circ}T$

$$\left. \begin{aligned} x &= +0.032t - 6.6 \\ y &= +0.043t - 12.3 \end{aligned} \right\} \text{Fixes 4-6}$$

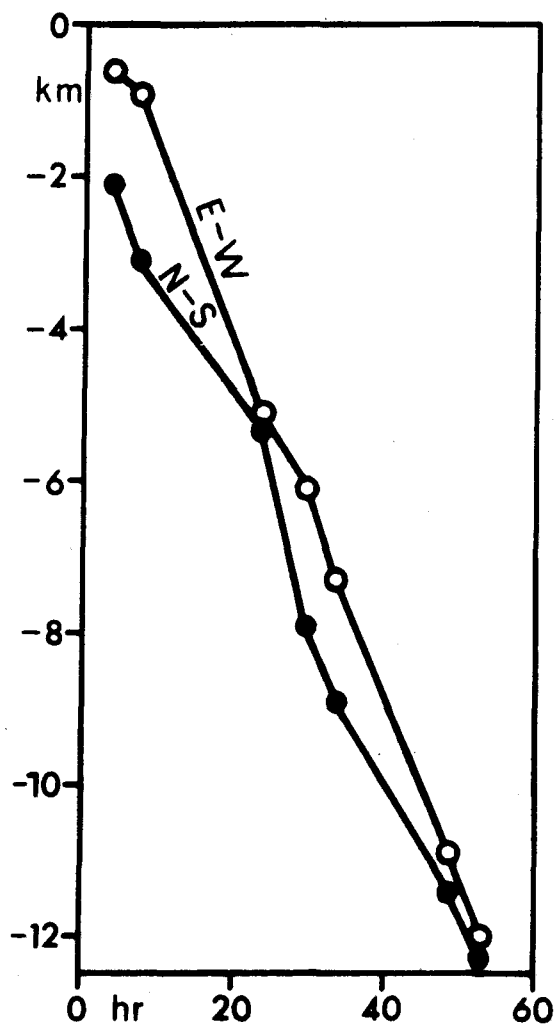
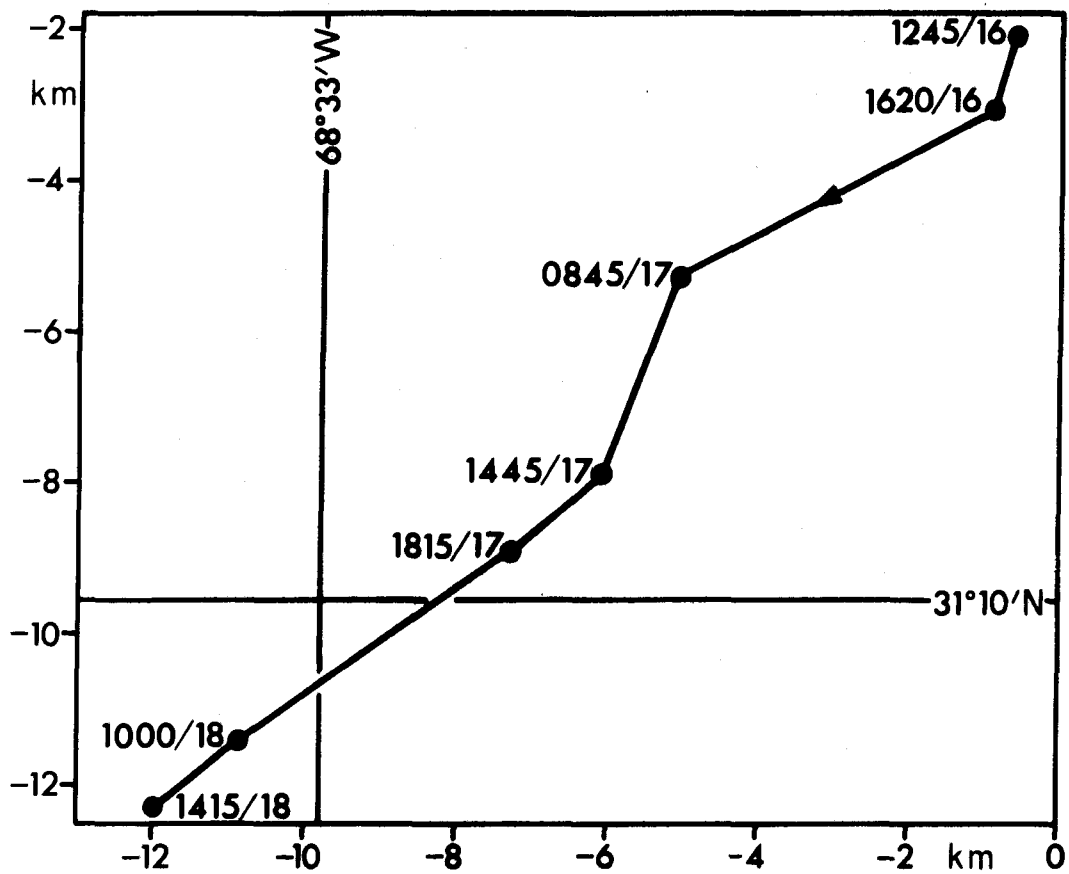
Mean velocity = $1.5(\pm 0.5)\text{cm/sec}$, $037(\pm 12)^{\circ}T$



Float Designation: 36 Date and time laid: 1512/15.X.1959

SERIAL NO: 54

FLOAT DESIGNATION: V1 Date and time laid: 0915/16.X.1959



FLOAT DESIGNATION: V1

Date and time laid: 0915/16.X.1959

Position laid: $31^{\circ} 15' .14N$
 $68^{\circ} 26' .81W$

Displacement origin: $31^{\circ} 15' .14N$
 $68^{\circ} 26' .81W$

Navigation based on: Loran C

Estimated accuracy of positions: ± 0.2 km (relative)

Depth(m): Nominal Observed S.D. S.D.(mean)
 2000 2006 ± 520 ± 170

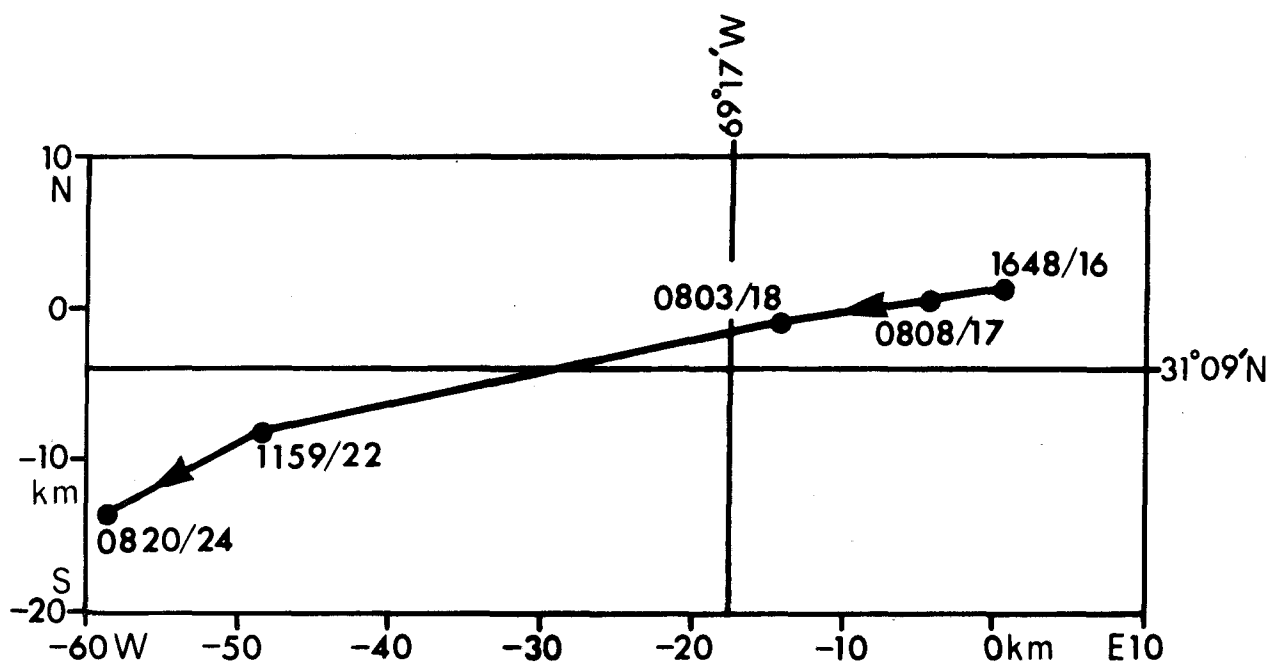
Fix No.	Date	Time GMT -4	Fix Position		Hours Since Laid (t)	Displacement(km)		Residuals	
			Lat.N.	Long.W.		+E-W x	+N-S y	x	y
1	16.X	1245	$31^{\circ} 14' .00$	$68^{\circ} 27' .14$	3.5	-0.6	-2.1	-0.4	0.0
2	16.X	1620	$31^{\circ} 13' .48$	$68^{\circ} 27' .36$	7.1	-0.9	-3.1	+0.2	-0.2
3	17.X	0845	$31^{\circ} 12' .26$	$68^{\circ} 30' .02$	23.5	-5.1	-5.3	-0.2	+0.9
4	17.X	1445	$31^{\circ} 10' .90$	$68^{\circ} 30' .65$	29.5	-6.1	-7.9	+0.4	-0.4
5	17.X	1815	$31^{\circ} 10' .35$	$68^{\circ} 31' .40$	33.5	-7.3	-8.9	0.0	-0.6
6	18.X	1000	$31^{\circ} 09' .00$	$68^{\circ} 33' .70$	48.7	-10.9	-11.4	0.0	0.0
7	18.X	1415	$31^{\circ} 08' .50$	$68^{\circ} 34' .40$	53.0	-12.0	-12.3	-0.2	0.0

Fitted lines: $x = - 0.234 t + 0.5$

$y = - 0.207 t - 1.4$

Mean velocity = $8.7(\pm 0.2)$ cm/sec, $229(\pm 1.5)^{\circ}T$

FLOAT DESIGNATION: 30 Date and time laid: 1315/16.X.1959.



SERIAL No: 56

FLOAT DESIGNATION: 30

Date and time laid: 1315/16.X.1959

Position laid: 31° 11'.2N
69° 05'.7W

Displacement origin: 31° 11'.2N
69° 05'.7W

Navigation based on: Loran A

Estimated accuracy of positions: ± 1 km (relative)

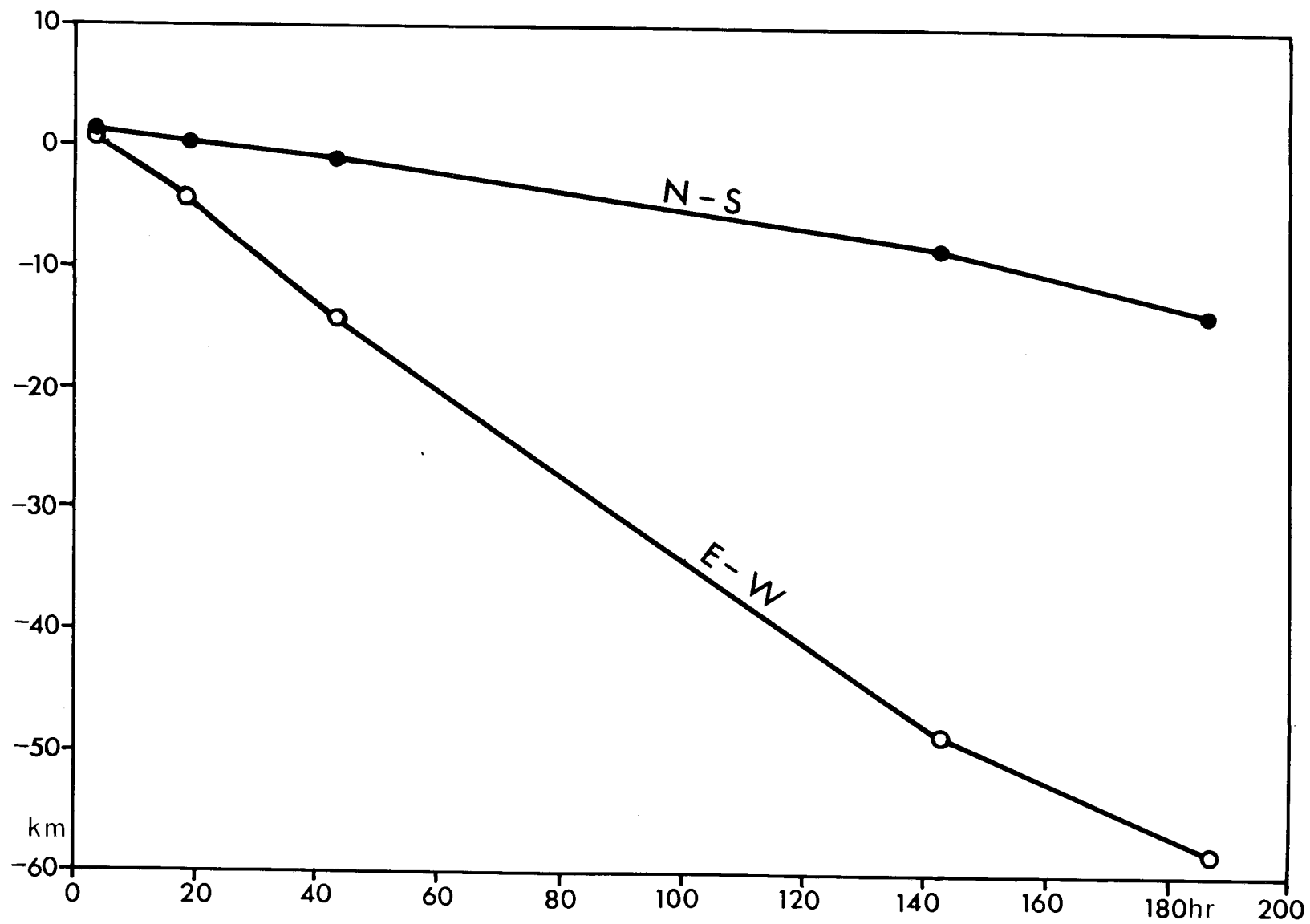
Depth(m):	Nominal	Observed	S.D.	S.D.(mean)
	2000	1883	± 500	± 140

Fix No.	Date	Time GMT -4	Fix Position		Hours Since Laid (t)	Displacement(km)		Residuals	
			Lat.N.	Long.W.		+E-W x	+N-S y	x	y
1	16.X	1648	31°11'.9	69°05'.3	3.5	+0.7	+1.3	+0.7	-0.6
2	17.X	0808	31°11'.4	69°08'.6	18.8	-4.3	+0.4	+0.9	-0.2
3	18.X	0803	31°10'.8	69°14'.8	42.8	-14.3	-0.7	-1.3	+0.6
4	22.X	1159	31°06'.8	69°36'.4	142.7	-48.7	-8.2	-2.6	+0.9
5	24.X	0820	31°04'.0	69°42'.7	187.0	-58.4	-13.3	+2.2	-0.7

Fitted lines: $x = -0.330 t + 1.0$

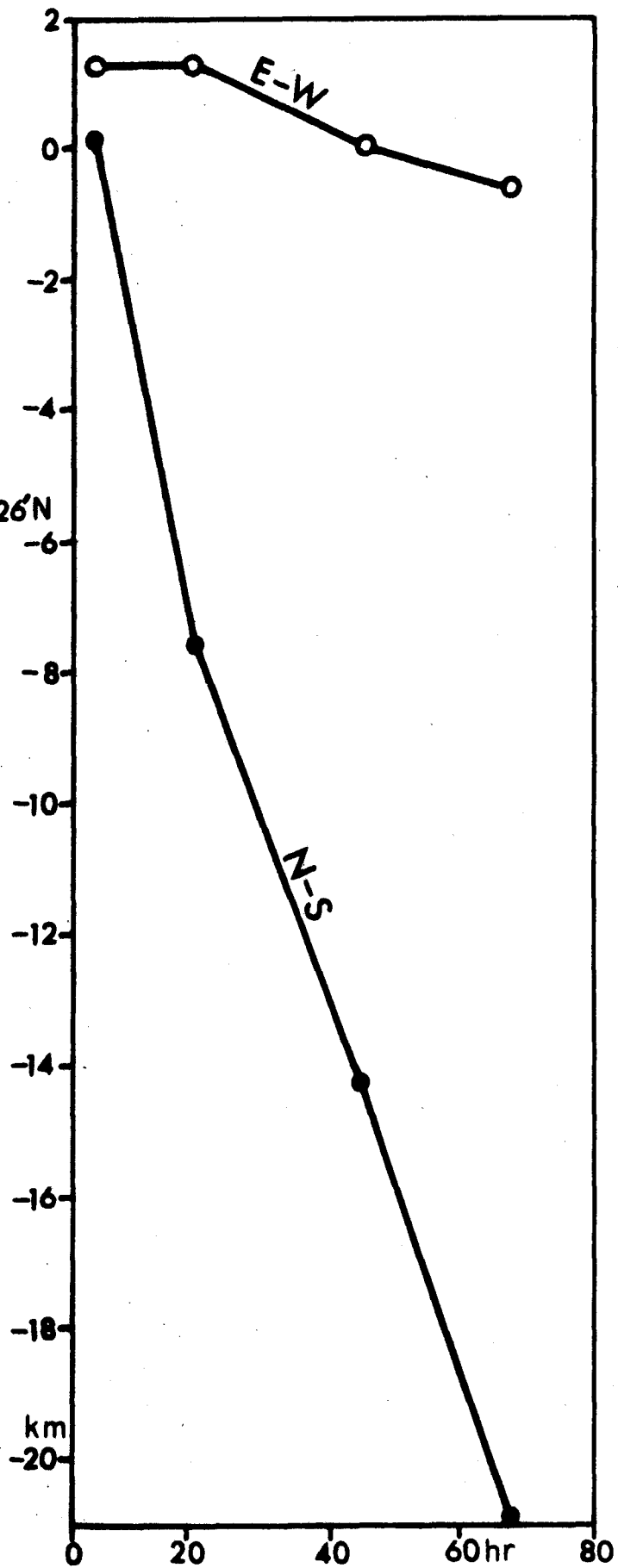
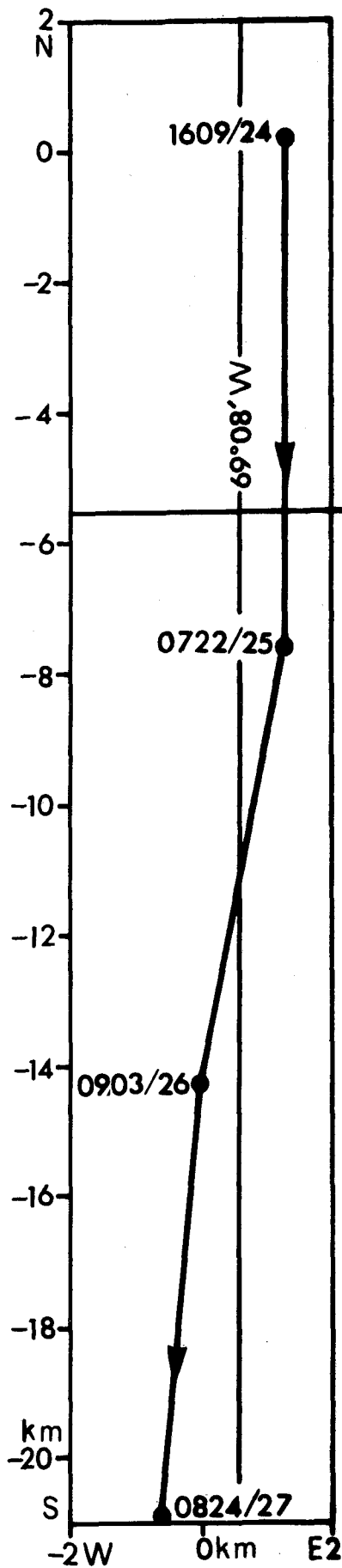
$y = -0.076 t + 2.1$

Mean velocity = $9.4(\pm 0.4)$ cm/sec, $257(\pm 0.6)^\circ T$



FLCAT DESIGNATION: 30 Date and time laid: 1315/16.X.1959

FLOAT DESIGNATION: 34 Date and time laid: 1242/24.X.1959



FLOAT DESIGNATION: 34

Date and time laid: 1242/24.X.1959

Position laid: $31^{\circ} 28'.9N$
 $69^{\circ} 08'.3W$

Displacement origin: $31^{\circ} 28'.9N$
 $69^{\circ} 08'.3W$

Navigation based on: Loran A

Estimated accuracy of positions: ± 1 km (relative)

Depth(m): Nominal Observed S.D. S.D.(mean)
 2000 2114 ± 370 ± 110

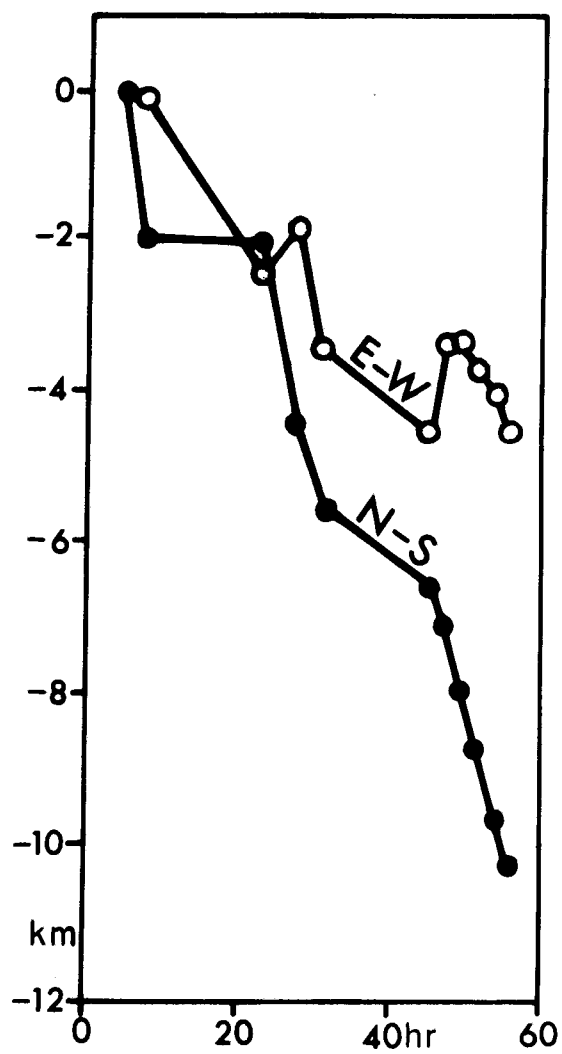
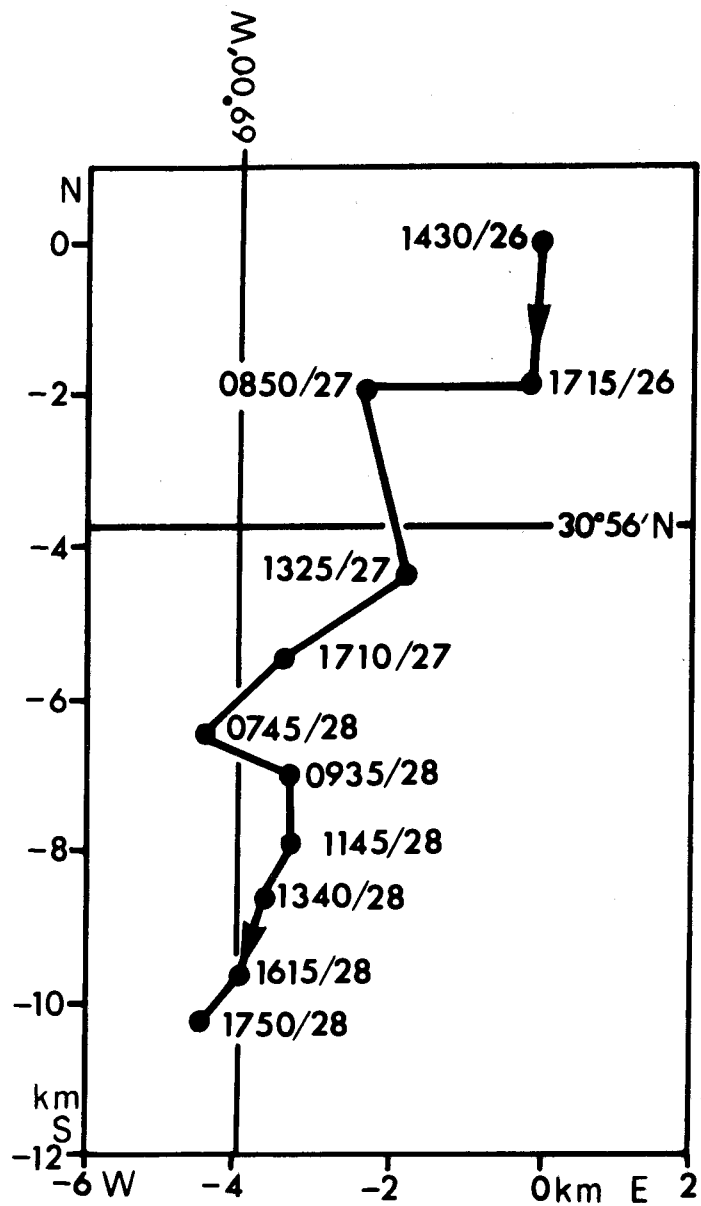
Fix No.	Date	Time GMT -4	Fix Position		Hours Since Laid (t)	Displacement(km)		Residuals	
			Lat.N.	Long.W.		+E-W x	+N-S y	x	y
1	24.X	1609	$31^{\circ} 29'.1$	$69^{\circ} 07'.6$	3.5	+1.3	+0.2	-0.2	+1.3
2	25.X	0722	$31^{\circ} 24'.9$	$69^{\circ} 07'.6$	18.7	+1.3	-7.6	+0.4	-1.7
3	26.X	0903	$31^{\circ} 21'.2$	$69^{\circ} 08'.3$	44.4	0.0	-14.3	-0.2	-0.2
4	27.X	0824	$31^{\circ} 17'.7$	$69^{\circ} 08'.7$	67.7	-0.6	-20.9	0.0	+0.6

Fitted lines: $x = -0.033 t + 1.6$

$y = -0.316 t - 0.04$

Mean velocity = $8.8(\pm 0.9)$ cm/sec, $186(\pm 0.8)^{\circ}T$

FLOAT DESIGNATION: V2 Date and time laid: 1000/26.X.1959



FLOAT DESIGNATION: V2

Date and time laid: 1000/26.X.1959

Position laid: $31^{\circ} 01' .8N^{*}$
 $68^{\circ} 58' .6W$

Displacement origin: $30^{\circ} 58' .05N$
 $68^{\circ} 57' .58W$

Navigation based on: Loran C

Estimated accuracy of positions: ± 0.2 km (relative)

Depth(m): Nominal Observed S.D. S.D.(mean)
 2000 1954 ± 460 ± 95

Fix No.	Date	Time GMT -4	Fix Position		Hours Since Laid (t)	Displacement(km)		Residuals	
			Lat.N.	Long.W.		+E-W x	+N-S y	x	y
1	26.X	1430	$30^{\circ} 58' .05$	$68^{\circ} 57' .58$	4.5	0	0	+0.4	+0.2
2	26.X	1715	$30^{\circ} 57' .00$	$68^{\circ} 57' .67$	7.2	-0.1	-1.9	+0.4	-1.1
3	27.X	0850	$30^{\circ} 57' .06$	$68^{\circ} 59' .10$	22.8	-2.4	-1.9	-0.6	+1.5
4	27.X	1325	$30^{\circ} 55' .68$	$68^{\circ} 58' .70$	27.4	-1.8	-4.4	+0.4	-0.2
5	27.X	1710	$30^{\circ} 55' .08$	$68^{\circ} 59' .72$	31.2	-3.4	-5.5	-0.9	-0.6
6	28.X	0745	$30^{\circ} 54' .52$	$69^{\circ} 00' .40$	45.8	-4.5	-6.5	-0.9	+0.9
7	28.X	0935	$30^{\circ} 54' .25$	$68^{\circ} 59' .68$	47.6	-3.3	-7.0	+0.4	+0.7
8	28.X	1145	$30^{\circ} 53' .76$	$68^{\circ} 59' .68$	49.7	-3.3	-7.9	+0.6	+0.2
9	28.X	1340	$30^{\circ} 53' .43$	$68^{\circ} 59' .90$	51.7	-3.7	-8.6	+0.4	-0.2
10	28.X	1615	$30^{\circ} 52' .85$	$69^{\circ} 00' .08$	54.3	-4.0	-9.6	+0.2	-0.7
11	28.X	1750	$30^{\circ} 52' .55$	$69^{\circ} 00' .44$	55.8	-4.5	-10.2	-0.2	-0.9

Fitted lines: $x = - 0.079 t + 0.05$

$y = - 0.175 t + 0.6$

Mean velocity = $5.3(\pm 0.4)$ cm/sec, $204(\pm 2)^{\circ}T$

* Based on one Loran-A reading

