NATIONAL INSTITUTE OF OCEANOGRAPHY
Wormley, Godalming, Surrey.

"DISCOVERY" CRUISE 25 REPORT

(25th January - 28th March 1969)

DEEP WATER FORMATION IN NW MEDITERRANEAN
("MEDOC 1969")
TRIALS AND USE OF SHIPBOARD COMPUTER

N.I.O. CRUISE REPORT NO. 25
(issued June 1969)

CONTENTS

AIMS

The main purpose of this cruise was to contribute to a cooperative study of formation of deep water in the NW Mediterranean ("MEDOC 1969"). It was also the first cruise after the ship's computer had been fitted, and bringing it into operation was a major item in the scientific programme.
Subsidiary aims included further long-term current measurements in the Bay of Biscay, and observations of the Mediterranean outflow SE of Cape St. Vincent.

NARRATIVE

Left Aberdeen	25th January
Arr. Gibraltar	3rd February
Left. "	
Arr. Toulon	13th February
Left "	15th "
Arr. Toulon	3rd March
Left "	5th "
Arr. Barry	28th March.

"Discovery" sailed from Aberdeen after a refit during which the computer had been installed and extensive improvements made to the arrangement and size of laboratory spaces. After a smooth passage down the North Sea and English Channel, during which the worst of the post-refit chaos was cleared up, an attempt was made on 29th January to recover mooring No 26, laid on 4th November 1968 from HMS "Hydra" near 47°30'N, 8°20'W. The mooring was released successfully, but on recovery the wire was found to have pulled out of its termination just above the current meter. Dragging was unsuccessful, and passage was continued to the middle of the Bay of Biscay, where another mooring (No 27) was laid on 30th January. That mooring sank immediately, due to collapse of the subsurface floats at less than half the expected depth. This unexpected weakness of the subsurface floats was confirmed by testing one of those recovered from No 26 mooring, during the passage towards Gibraltar. It failed at 300m. depth. Tests were made of various items of acoustic equipment for moorings, and a trial lowering was made of the underwater camera, before arriving at Gibraltar.

Having taken on fuel and collected equipment landed there from HMS "Hydra", "Discovery" left Gibraltar on passage for 42°N, 5°E, near the area of maximum surface density located by "Hydra" in mid-January. This seemed the most promising area for the onset of deep water formation. Strong NW winds (50 kts) caused slow progress and the area was not reached until late on 6th February. A line of TSD and water sampling stations was started, and radio contact was made with the "Jean Charcot" and "Atlantis II". Next day the weather improved and two moorings were laid, with four current meters in each, in an area of high surface density where the "Atlantis II" was working with rotating floats measuring vertical motion. The wind increased from the NW again next day, when two neutrally buoyant floats were laid, and water sampling stations were worked instead of using the TSD which had become defective. Water sampling and float tracking continued, with interruptions by bad weather, until 12th February, when the weather improved sufficiently for a third mooring to be laid. Navigation depended almost entirely on satellite fixes, the moored buoys being only intermittently visible on the radar in the poor weather. The moorings were placed on either side of a front with well mixed dense water to the north and stratified water to the south. After two further hydrographic stations in the mixed water, course was set for Toulon.

The four other ships taking part in "MEDOC 1969" at that time - "Atlantis II", "Jean Charcot", "Bannock" and "Origny" were also in Toulon, and plans were made for further study of the well mixed water.

Leaving on 15th February, a reference station was worked just south of Toulon, and "Discovery" then returned to the patch of dense well mixed water. The wind increased to 50 knots, too rough to risk the TSD which had been repaired. Work was resumed early on 17th February with a detailed TSD survey of part of the well mixed area and its southern boundary. Adiabatic temperature gradients were found extending from the surface to more than 2 km depth in some places. The moored buoys were recovered and re-laid in more suitable positions in relation to the patch of mixed water. Six neutrally buoyant floats were laid, at a nominal depth of 500m, and were tracked until 25th February. A section of TSD and hydrographic stations was then worked from north to south through the area, and four more floats started, two at 500m which confirmed the cyclonic shear indicated by the previous floats, and two at 1500m which moved anticyclonically. The three moorings were recovered and seven more TSD dips made before returning to Toulon on 3rd March.

"Atlantis II" came in the same day and further discussions of the programme took place. "Discovery" sailed on 5th March, returning to the same area to find that the dense water had been covered by 100-500m. of less dense water. There had been no cold strong winds since 17th February, and it seemed that the downward mixing and active formation of new deep water had come to an end. During the next 12 days, the process of sinking and southward spreading of the dense water was observed by means of more TSD dips, re-laying the three moorings (one of which was picked up and re-laid yet again) and tracking 8 more neutrally buoyant floats. On 12th March, in the course of this float tracking an acoustic signal was found and mistakenly identified as a beacon on one of the moorings that was suspected of having gone adrift, and several hours were spent in trying to recover it, before it was recognized as coming from one of the Woods Hole rotating floats. By that time the "Atlantis II" had left the area. The motion at 500m depth was predominantly anti-cyclonic this time, with some southward component. Work continued in the area until 17th March, ending with a TSD section southwards as far as 41°N, after which "Discovery" set course towards the Straits of Gibraltar.

A buoy was anchored and several TSD stations worked, on 20th - 21st March near 36° 40'N, 8° 30'W, in the neighbourhood of a bay in the continental slope. The purpose of these observations was to determine whether the core of the highly saline Mediterranean outflow water followed round the curve of the bay. During the passage northward, two lowerings were made with the midwater camera. It had been intended that a near-bottom mooring, with one current meter, should be laid in the middle of the Bay of Biscay, but the deep buoyancy sphere leaked slightly on test and the mooring was not laid. On 25th March, two moorings, each with one current meter, were laid near 47° 30'N, 8° 20'W and left out for subsequent recovery in June. Another unsuccessful attempt was made at dragging for the remains of No. 26 mooring, and passage was resumed towards Barry, where "Discovery" arrived for the first time on 28th March.

SCIENTIFIC PERSONNEL

1-3	Mr. J. Berry	N.I.O.	1-2	Mr. R. Dickson (Lowestoft)
1-3	Mr. D. Brown	"	1-4	Mr. T. Fitton (RVU)
1-4	Mr. J. Crease	"	1-3	Mr. A.F.G. Fiuza (U. of Southampton)
3-4	Mrs. P. Edwards	"	2-3	Mr. D. Halpern (M.I.T.)
3	Dr. M. Fasham	"	4	Dr. J.G. Harvey (U. of East Anglia)
1-4	Mr. D.I. Gaunt	"	1	Mr. W.S. Morgan (Vickers)
1-4	Mr. W.J. Gould	"	1-4	Mr. P.T. Owen (RVU)
3	Mr. M.J. Harris	"	1-3	Mr. B. Spatz (IBM)
1-2	Mr. B.J. Hinde	"	1-3	Mr. M. Whale (IBM)
4	Miss R. Howard	"		
1-3	Mr. M.J. McCartney	"		
4	Mr. J.A. Moorey	"		
1-3	Mr. B.D. Page	"		
1-3	Mr. T. Sankey	"		
1-4	Mr. J. Sherwood	"		
1-2	Mr. N.D. Smith	"		
1-4	Dr. J.C. Swallow	"	Principal Scientist	
4	Mr. R.H. Taplin	"		
4	Mr. M.J. Tucker	"		

1...25 Jan - 3 Feb.
2... 3 - 13 Feb.
3...15 Feb - 3 Mar.
4... 5 - 28 Mar.

NOTES ON EQUIPMENT AND OBSERVATIONS

For fuller details on any of these items, consult the persons named

1. COMPUTER (Crease, Hinde)

The installation of the IBM 1800 computer took place in the 2nd week of January amid the last minute chaos of the refit. Power was not available for the system until the day before sailing (apart from a brief temporary supply from the C.L.O.R.I.A. generator). However, no adverse effects of the transportation were noted.

During the first 3 legs of the cruise N.I.O.'s computer engineers were trained in maintenance and diagnostics on the 1800 by Mr. M. Whale of I.B.M. In spite of some bad weather the course was completed. How successful it was remains to be seen as in fact the 1800 system has been remarkably fault free, running for 24hrs a day for many days, even in heavy weather.

The only really unreliable peripheral equipment has been the off line Dura tape preparation and reproduction set, which was largely unserviceable except for the listing of paper tape output.

The on-line acquisition of data was tested out on the following observations (in between training periods)

a) Satellite navigator - no problems arose with this interface. Reliable fixes were obtained and errors that arose were due to need for manual intervention through lack of a complete program set.

b) Analogue inputs from ship's log, anemometer, wet/dry bulb temperatures. These were all basically satisfactory but suffered in usefulness through lack of calibration data.

c) Digital inputs from Echo-sounder console, crystal clock, gyro compass. The echo-sounder console worked well and all data was filed on disk. Some improvements are required for ease of operation. The digital clock and gyro both suffered from troubles in the interfaces supplied. The clock was not used at all and the gyro was intermittently malfunctioning so recourse was had to the computer's internal clock and an analogue gyro compass.

The cruise provided plenty of opportunity for first hand experience for all of us with the problems of discipline in wiring practice on board ship; avoidance of earth loops in the system and noise spikes on digital lines.

The adaption by Mr. Spatz of IBM of the TSX monitor system to operate with paper tape was successful and we have no reason to regret the decision to operate with paper tape rather than cards.

In summary, the system hardware proved reliable at sea. Our engineers were trained and the software appears capable of satisfying our needs.

2. ECHO SOUNDING (Swallow, Tucker)

Soundings were recorded every 10 mins. whenever this could be done without interference to other acoustic work. Several minor faults were repaired with less than 2 hours' total loss of soundings.

3. ELECTROMAGNETIC LOG (2 components) (Smith, Swallow, Tucker)

An analogue record of the two components of speed and ship's heading was made continuously throughout the cruise, and in the later part the speed components were logged by the computer. Both components of speed were calibrated relative to a radar buoy attached to a surface drogue. The sensing head was found to be free from corrosion and fouling when examined at the end of the cruise, and it was left in place for the following cruise.

4. METEOROLOGICAL RECORDING (Crease, Mrs. Edwards)

The routine observations made by the ship's officers were supplemented by Assmann psychrometer readings every 6 hours while in the NW Mediterranean, and by recording the outputs of resistance thermometers (wet and dry, port and starboard), and the solarimeter, on the Speedomax recorder.

5. MOORINGS AND CURRENT METERS (Gaunt, Gould)

After the misfortunes to the Biscay moorings on the way out, those in the Mediterranean were relatively successful. Their performance is summarized in Table II. All the Mediterranean moorings had surface buoys in addition to the main subsurface float, and these survived some severe storms without damage other than loss of two radar reflectors. Three Plessey current meters, borrowed from the Fisheries Laboratory, Lowestoft, were used on the first three Mediterranean moorings, and all three were lost, each for a different reason, through failures of parts of the meter or suspension frame, not of the moorings themselves.

6. NEUTRALLY BUOYANT FLOATS (Swallow)

Twenty-one floats were used in the Mediterranean work, and all but one gave useful results. The pulse generating circuits had been improved and had a much more stable repetition rate, greatly simplifying the problem of searching for floats. Acoustic ranges of well over 5 miles were regularly obtained in the nearly isothermal water. Particulars of the floats used are given in Table III.

7. TEMPERATURE-SALINITY-DEPTH PROBE (Sankey, Swallow, Tucker)

The type 9006 sea unit and all the recording equipment had been in use on board HMS "Hydra" in January, and was picked up by "Discovery" at Gibraltar. After only a few lowerings, the depth gauge became defective and could not be repaired on board. The new type 9040 sea unit had a very large depth-dependent error in salinity and high noise level. A replacement depth gauge for the type 9006 was borrowed from Liverpool and fitted at Toulon on 14th February; this worked well for the rest of the cruise. The 9040 sea unit was later found to have its depth compensation for salinity connected wrong way round, and worked satisfactorily when this was rectified. Calibration was effected by reversing a water bottle, attached just above the sea unit, at some depth on each lowering, and by reversing another water bottle on a separate wire at 10m depth when the sea unit was at that depth during recovery.

8. UNDERWATER CAMERA (Smith, Moorey)

This experiment was an attempt to detect salt fingers by photographing a pattern of black and white lines through approximately 2m of water, with the camera and flash cycling automatically. Lowerings were made on three occasions in the Atlantic, through the depth range of the Mediterranean outflow water. For the first two lowerings the camera was arranged horizontally, in the third one it was pointed downwards.

9. WATER SAMPLING AND ANALYSIS (McCartney, Moorey, Sankey, Swallow)

Twenty-seven hydrographic stations were worked, in addition to the check samples collected with the TSD. Temperature, salinity and dissolved oxygen were determined on these stations. Salinities were measured on an Autolab conductivity bridge which suffered from intermittent faults and gave values for the deep water systematically higher than those obtained by the "Jean Charcot", though in fairly good agreement with those of the "Atlantis II". In view of the uncertainties, duplicates were drawn from nearly all salinity samples at stations 6809 onwards for measurement at N.I.O. on the thermostat salinometer.

Large samples (approx 5l.) of surface water were collected at six stations for pesticide analysis by the Government Chemist.

Tables and Figures.

Table I. Station List

Abbreviations - LWB: large water bottle
TSD: temperature-salinity-depth probe
UWC: underwater camera
WB: hydrographic station

II MEDOC 1969 Moorings
III MEDOC 1969 Neutrally Buoyant Floats

Fig.1. Track Chart

Figs. 2 - 5 MEDOC 1969 Station Positions.

Symbols - ✕ : Surface water sample
✕ : Hydrographic station
Z : TSD lowering
△ : Moored buoy

Lines with arrows on them represent float trajectories, see Table III.

TABLE I

CRUISE 25 STATION LIST

Stn. No.	Date	Time (GMT+1)	Lat.	Long.	Gear Used
6741	25/I	1100-1115	57°09·4'N	02°02·0'W	LWB (Surface
6742	29/I	0534-2242	47°37·4'N	08°22·2'W	Mooring No.26 (recovery)
6743	30/I	0710-2255	46°00·0'N	08°14'W	Mooring No.27 (lost) LWB (surface)
6744	2/II	0758-1624	36°28'N	08°36'W	U.W.C., Acoustic tests
6745	5/II	1030-1210	39°24'N	01°47·8'E	T.S.D.
6746	6/II	2048-	41°41·54'N	04°28·1'E	T.S.D., WB
	7/II	-0201			
6747	7/II	0309-0506	41°48·6'N	04°36·4'E	T.S.D.
6748	7/II	0609-0748	41°55·8'N	04°45·3'E	T.S.D.
6749	7/II	0848-1209	42°03·7'N	04°51·3'E	T.S.D., WB.
6750	7/II	1400-1800	41°50·8'N	05°15·3'E	Mooring No.28 laid
6751	7/II	1908-2337	41°41·0'N	05°06·2'E	Mooring No.29 laid
6752	8/II	0132-0450	41°52·7'N	05°14·7'E	WB, T.S.D. (defective)
6753	8/II	0634-1043	41°41·9'N	05°04·0'E	WB
6754	8/II	1352-1642	41°49·6'N	05°02·9'E	WB
6755	8/II	1748-1930	41°43·1'N	05°13·1'E	WB (surface)
6756	9/II	0745-0757	42°01·8'N	04°49·7'E	WB (surface)
6757	9/II	1453-1817	41°42·1'N	05°12·4'E	WB
6758	10/II	0840-1150	41°57·5'N	04°45·0'E	WB
6759	10/II	1800-2056	41°46·8'N	04°57·8·E	WB
6760	11/II	0127-0447	41°55·4'N	04°54·1'E	WB
6761	11/II	0625-0923	42°03·0'N	04°52·0'E	WB
6762	11/II	1026-1249	42°09·6'N	04°51·1'E	WB
6763	11/II	2347-0512	41°43·6'N	04°45·8'E	WB, acoustic tests
6764	12/II	0600-0812	41°49·0'N	04°43·7'E	WB
6765	12/II	0918-1211	41°49·8'N	04°57·8'E	Mooring No.30
6766	12/II	1245-1453	41°49·7'N	04°59·7'E	WB
6767	12/II	2025-2228	42°07·0'N	04°43·0'E	WB
6768	15/II	1553-1748	42°50·6'N	05°57·5'E	WB, LWB (surface)
6769	17/II	0258-0545	42°08·2'N	05°06·2'E	T.S.D.
6770	17/II	0622-0800	42°02·8'N	05°05·6'E	T.S.D.
6771	17/II	1105-1237	41°57·3'N	05°05·1'E	T.S.D.
6772	17/II	1311-1442	41°51·8'N	05°05·8'E	T.S.D.
6773	17/II	1515-1650	41°46·2'N	05°06·8'E	T.S.D.
6774	17/II	1726-1909	41°40·6'N	05°08·1'E	T.S.D.
6775	17/II	2000-2146	41°39·6'N	05°21·0'E	T.S.D.

6776	17/II 18/II	2231- -0002	41°45·1'N	05°21·8'E	T.S.D.
6777	18/II	0054-0226	41°50·2'N	05°20·8·E	T.S.D.
6778	18/II	0309-0436	41°55·2'N	05°21·3'E	T.S.D.
6779	18/II	0522-0639	42°00·0'N	05°19·6'E	T.S.D.
6780	18/II	0720-0845	42°04·4'N	05°17·8·E	T.S.D.
6781	18/II	0932-1102	42°09·6'N	05°17·3'E	T.S.D.
6782	18/II	1301-1434	42°09·2'N	04°50·2'E	T.S.D.
6783	18/II	1526-1655	42°04·1'N	04°50·1'E	T.S.D.
6784	18/II	1742-1900	41°59·2'N	04°50·5'E	T.S.D.
6785	18/II	1938-2205	41°54·8'N	04°52·0'E	T.S.D.
6786	18/II	2247-0029	41°50·0'N	04°54·1'E	T.S.D.
6787	19/II	0109-0243	41°45·1'N	04°55·1'E	T.S.D.
6788	19/II	0313-0452	41°45·1'N	04°50·0'E	T.S.D.
6789	19/II	0538-0658	41°52·0'N	04°50·1'E	T.S.D.
6790	19/II	0748-0856	41°59·4'N	04°49·4'E	T.S.D.
6791	19/II	0951-1147	42°06·4'N	04°48·8'E	T.S.D.
6792	19/II	1923-2149	41°41·2'N	05°06·9'E	Acoustic tests
6793	20/II	0020-0314	41°40·6'N	05°33·9'E	T.S.D.
6794	20/II	0415-0610	41°47·5'N	05°33·8'E	T.S.D.
6795	20/II	0718-0913	41°53·4'N	05°32·4'E	T.S.D.
6796	20/II	1003-1127	42°00·3'N	05°32·0'E	T.S.D.
6797	20/II	1336-1712	41°58·6'N	05°01·3'E	Mooring No.31 laid
6798	20/II 21/II	2200- -0120	41°56·5'N	05°01·2'E	T.S.D.
6799	21/II	0503-0630	42°09·6'N	05°00·9'E	T.S.D.
6800	21/II	0731-0855	42°03·7'N	05°00·5'E	T.S.D.
6801	21/II	0938-1220	41°59·0'N	05°01·9'E	T.S.D.
6802	21/II	1332-1623	41°52·1'N	04°48·0'E	Mooring No.32 laid
6803	22/II	0056-0246	41°55·4'N	04°48·2'E	T.S.D.
6804	22/II	0950-1138	41°50·8'N	04°45·5'E	T.S.D.
6805	22/II	1344-1416	41°41·4'N	05°04·8'E	Mooring No.33 laid
6806	22/II	1942-2135	41°55·9'N	05°04·7'E	T.S.D.
6807	23/II	0537-0737	41°57·5'N	05°01·8'E	WB
6808	23/II	1727-1924	41°42·0'N	05°07·8'E	WB
6809	25/II	1532-1858	42°14·4'N	04°53·6'E	T.S.D., WB
6810	25/II	1942-2324	42°08·2'N	04°57·6'E	T.S.D., WB
6811	26/II	0008-0418	42°03·7'N	04°59·0'E	T.S.D., WB
6812	26/II	0453-0906	41°59·1'N	04°59·0'E	T.S.D., WB
6813	26/II	1423-1816	41°55·1'N	05°01·2'E	T.S.D., WB
6814	26/II	2145-	41°53·2'N	05°01·4'E (start)	T.S.D., (several dips)
	27/II	-0500	41°51·2'N	05°00·6'E (end)	

6815	27/II	0516-0908	41°49·9'N	05°01·3'E	T.S.D., WB
6816	27/II	1956-2355	41°44·8'N	05°01·4'E	T.S.D., WB
6817	28/II	0040-0426	41°40·2'N	04°59·8'E	T.S.D., WB
6818	28/II	0517-0850	41°35·4'N	05°00·5'E	T.S.D., WB
6819	1/III	2236-0021	41°42·6'N	04°48·1'E	T.S.D.
6820	2/III	0047-0210	41°47·5'N	04°48·6'E	T.S.D.
6821	2/III	0724-0900	41°52·0'N	04°41·2'E	T.S.D.
6822	2/III	1005-1152	41°52·1'N	04°54·7'E	T.S.D.
6823	2/III	1842-2001	41°52·1'N	04°48·3'E	T.S.D.
6824	2/III	2049-2227	41°59·9'N	04°49·9'E	T.S.D.
6825	2/III	2310-0023	42°06·9'N	04°49·9'E	T.S.D.
6826	5/III	1605-1738	42°30·6'N	04°58·5'E	T.S.D.
6827	5/III	1824-1959	42°24·2'N	04°59·2'E	T.S.D.
6828	5/III	2043-2222	42°18·1'N	04°58·2'E	T.S.D.
6829	5/III	2312-	42°11·2'N	04°57·7'E	T.S.D.
	6/III	-0045			
6830	6/III	0129-0309	42°03·6'N	04°57·7'E	T.S.D.
6831	6/III	0354-0545	41°55·4'N	04°57·8'E	T.S.D.
6832	6/III	0630-0850	41°48·4'N	04°57·2'E	T.S.D.
6833	6/III	0938-1135	41°42·3'N	04°56·0'E	T.S.D.
6834	6/III	1456-1743	42°18·1'N	04°55·1'E	Mooring No.34 laid
6835	6/III	1838-1957	42°14·6'N	04°54·6'E	T.S.D.
6836	6/III	2044-2227	42°08·0'N	04°56·4'E	T.S.D.
6837	6/III	2215-	42°00·7'N	04°57·4'E	T.S.D.
	7/III	-0118			
6838	7/III	0153-0355	41°53·0'N	04°58·5'E	T.S.D.
6839	7/III	0440-0653	41°45·7'N	04°59·7'E	T.S.D.
6840	7/III	0737-0927	41°38·3'N	04°59·8'E	T.S.D.
6841	7/III	1410-1640	42°05·6'N	04°56·0'E	Mooring No.35 laid
6842	7/III	2105-2312	41°35·7'N	04°56·5'E	T.S.D.
6843	8/III	0007-0238	41°28·7'N	04°57·7'E	T.S.D.
6844	8/III	0324-0515	41°21·6'N	04°59·1'E	T.S.D.
6845	8/III	0604-0750	41°14·3'N	05°0·6'E	T.S.D.
6846	8/III	0819-0922	41°17·9'N	05°0·6'E	T.S.D.
6847	8/III	1433-1804	41°55·7'N	04°53·2'E	Mooring No.36 laid
6848	9/III	1402-1458	41°52·8'N	04°52·8'E	T.S.D.
6849	10/III	0824-0954	42°25·5'N	04°57·2'E	T.S.D.
6850	10/III	1036-1204	42°19·7'N	04°56·6'E	T.S.D.
6851	10/III	1244-1417	42°13·6'N	04°56·6'E	T.S.D.
6852	10/III	1501-1638	42°07·3'N	04°56·6'E	T.S.D.
6853	10/III	1720-1852	42°01·2'N	04°59·5'E	T.S.D.

6854	10/III	1931-2107	41°55·2'N	04°56·3'E	T.S.D.
6855	10/III	2147-2320	41°55·5'N	04°48·6'E	T.S.D.
6856	11/III	1617-1932	41°43·5'N	04°57·4'E	Mooring No. 37 laid
6857	13/III	1015-1154	41°56·8'N	04°56·0'E	T.S.D.
6858	13/III	1235-1403	42°00·5·N	05°03·7'E	T.S.D.
6859	13/III	1441-1615	42°04·2'N	05°11·1'E	T.S.D.
6860	13/III	1653-1833	42°07·9'N	05°18·3'E	T.S.D.
6861	13/III	1916-2050	42°01·8'N	05°19·4'E	T.S.D.
6862	13/III	2140-2328	41°55·9'N	05°20·4'E	T.S.D.
6863	14/III	0003-0138	41°58·1'N	05°14·6'E	T.S.D.
6864	14/III	0559-0743	41°42·4'N	05°03·7'E	T.S.D.
6865	15/III	2138-2325	42°04·3'N	04°50·3'E	T.S.D.
6866	16/III	0010-0135	42°12·3'N	04°49·0'E	T.S.D.
6867	16/III	0233-0356	42°18·6'N	04°58·2'E	T.S.D.
6868	16/III	0454-0635	42°15·3'N	05°09·4'E	T.S.D.
6869	16/III	0728-0855	42°09·7'N	05°00·0'E	T.S.D.
6870	16/III	1314-1445	41°48·4'N	04°56·8'E	T.S.D.
6871	16/III	1658-1837	41°43·5'N	04°57·4'E	T.S.D.
6872	16/III	1924-2110	41°35·6'N	04°59·2'E	LWB (surface), T.S.D.
6873	16/III	2155-2354	41°27·7'N	05°00·8'E	T.S.D.
6874	17/III	0045-0350	41°19·7'N	05°02·6'E	T.S.D.
6875	17/III	0437-0700	41°13·1'N	05°04·0'E	LWB (surface) T.S.D.
6876	17/III	0743-0908	41°06·5'N	05°05·4'E	T.S.D.
6877	17/III	1010-1148	40°56·2'N	05°07·2'E	T.S.D.
6878	20/III 21/III	0825- -1710	36°40·6'N	08°33·4'W	Mooring No.38
6879	20/III	1437-1542	36°44·9'N	08°28·5'W	T.S.D.
6880	20/III	1638-1748	36°40·0'N	08°32·2'W	T.S.D.
6881	20/III	1759-1917	36°39·6'N	08°32·2'W	T.S.D.
6882	20/III	1941-2104	36°37·5'N	08°32·5'W	T.S.D.
6883	20/III	2153-2342	36°32·7'N	08°32·8'W	T.S.D.
6884	21/III	0043-0336	36°26·2'N	08°33·2'W	T.S.D.
6885	21/III	0436-0730	36°19·4'N	08°33·9'W	T.S.D., UWC
6886	21/III	0944-1102	36°34·2'N	08°36'8'W	T.S.D.
6887	21/III	1158-1310	36°36·9'N	08°29·5'W	T.S.D.
6888	21/III	1405-1513	36°33·3'N	08°26·0'W	T.S.D.
6889	24/III	0135-0452	45°02·4'N	08°43·5'W	UWC
6890	25/III	0915-1122	47°34·0'N	08°19·8'W	Mooring No. 39 laid
6891	25/III	1439-1728	47°43·6'N	08°02·1'W	Mooring No. 40 laid
6892	25/III	1901-2054	47°33·9'N	08°01'OW	LWB (surface)

TABLE II

MEDOC 1969 MOORINGS

DAYS	NIO Serial No.	No. for Cruise	TIME Laid (GMT+1)	DATE Laid	TIME Recovered	DATE Recovered	Nominal Depth (m)	Meter	Remarks
14 x 3 = 42	28	I	1735	7.II	1850	21.II	20	P	Lost meter
							100	Be	Good data
							300	Be	Good data
							1500	Br	Data apparently good
12 x 1 = 12	29	II	2230	7.II	1630	19.II	20	P	Lost meter
							100	Be	Data good
							300	Be	Tape fault. No data
							1500	Br	Data lost in processing
8 x 3 = 24	30	III	1211	12.II	1840	20.II	20	P	Lost meter
							100	Be	Good data
							300	Be	Good data
							1500	Br	Data apparently good
8 x 1 = 8	31	IV	1713	20.II	1525	28.II	100	Be	Tape fault. No data
							300	Be	Good data
							1550	Br	Data lost in processing
							2200	Br	Data lost in processing
9 x 3 = 27	32	V	1622	21.II	1735	2.III	100	Be	Good data
							300	Be	Good data
							1500	Br	Data apparently good
7 x 2 = 14	33	VI	1615	22.II	1356	1.III	100	Be	Tape fault. No data
							300	Be	Good data
							1500	Br	Data apparently good
5 x 4 = 20	34	VII	1740	6.III	1142	11.III	100	Be	Good data
							300	Be	Good data
							900	Be	Good data
							1500	Br	Data apparently good
9 x 3 = 27	35	VIII	1638	7.III	1015	16.III	100	Be	Good data
							300	Be	Good data
							1500	Br	Data apparently good
7 x 3 = 21	36	IX	1756	8.III	1041	15.III	100	Be	Good data
							300	Be	Good data
							900	Br	Data lost in processing
							1500	Br	Data apparently good
5 x 4 = 20	37	X	1931	11.III	1525	16.III	100	Be	Good data
							300	Be	Good data
							900	Be	Good data
							1500	Br	Data apparently good

$\sum$ 215 days.

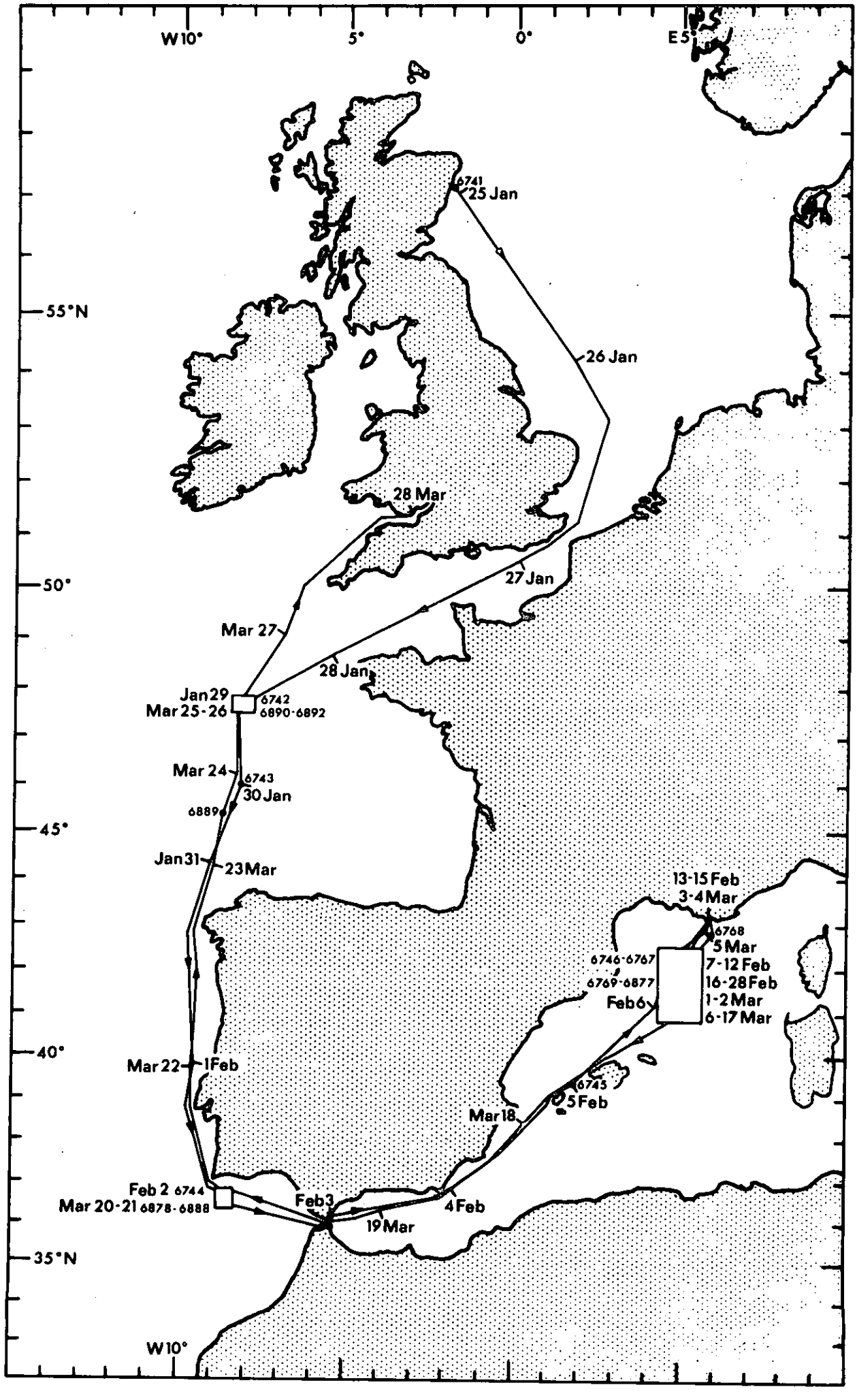
P = Plessey
Be = Bergen
Br = Braincon

"Data apparently good" means that the record has been developed and looks O.K. but has not been read yet.

TABLE III

MEDOC 1969 DISCOVERY NEUTRALLY BUOYANT FLOATS

Serial No.	Time Laid (GMT+1)	Date	Nominal Depth (m)	Approximate Start Position N	E	Time Last Fix (GMT+1)	Date	Approximate End Position N	E
18	0710	8.II	800	41°42'	5°04'	1539	12.II	41°48'	4°55'
24	0716	8.II	1500	41°42'	5°04'	2051	11.II	41°42'	5°03'
22	2316	21.II	500	41°55'	4°48'	2040	24.II	42°02'	4°28'
2	0006	22.II	500	41°49'	4°50'	sank steadily to bottom (leaked?)			
10	0645	22.II	500	41°49'	4°44'	1301	28.II	41°51'	5°10'
26	1810	22.II	500	41°56'	5°03'	1318	25.II	42°00'	4°42'
6	1856	22.II	500	41°56'	4°56'	0823	25.II	41°55'	5°13'
16	1538	23.II	500	41°42'	5°07'	0223	25.II	41°38'	5°19'
28	1637	23.II	500	41°42'	5°00'	0053	25.II	41°39'	5°08'
1	1759	28.II	1500	41°55'	4°48'	1249	2.III	41°52'	4°52'
27	1851	28.II	1500	41°50'	4°45'	1614	2.III	42°02'	4°45'
13	1934	28.II	500	41°50'	4°45'	1238	2.III	41°52'	4°53'
5	2024	28.II	500	41°55'	4°48'	1419	2.III	42°00'	5°02'
11	1855	8.III	500	42°03'	4°56'	1934	15.III	41°45'	4°52'
23	1939	8.III	500	42°09'	4°56'	0856	15.III	42°12'	4°48'
3	2025	8.III	500	42°15'	4°55'	0732	15.III	42°05'	4°55'
14	2108	8.III	500	42°21'	4°55'	0130	15.III	42°02'	5°18'
25	1229	9.III	500	41°53'	4°52'	1859	15.III	41°44'	4°55'
17	1315	9.III	500	41°59'	4°53'	0352	15.III	42°10'	5°18'
4	0450	14.III	500	41°47'	5°03'	2002	14.III	41°45'	5°00'
20	0527	14.III	500	41°43'	5°07'	1640	15.III	41°36'	5°08'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0°
E5°
55°N
50°
45°
40°
35°N
W10°
6741
25 Jan
26 Jan
28 Mar
27 Jan
Mar 27
28 Jan
Jan 29
Mar 25-26
6742
6890-6892
Mar 24
6743
30 Jan
6889
Jan 31
23 Mar
13-15 Feb
3-4 Mar
6768
5 Mar
6746-6767
6769-6877
7-12 Feb
16-28 Feb
1-2 Mar
6-17 Mar
Feb 6
Mar 22
1 Feb
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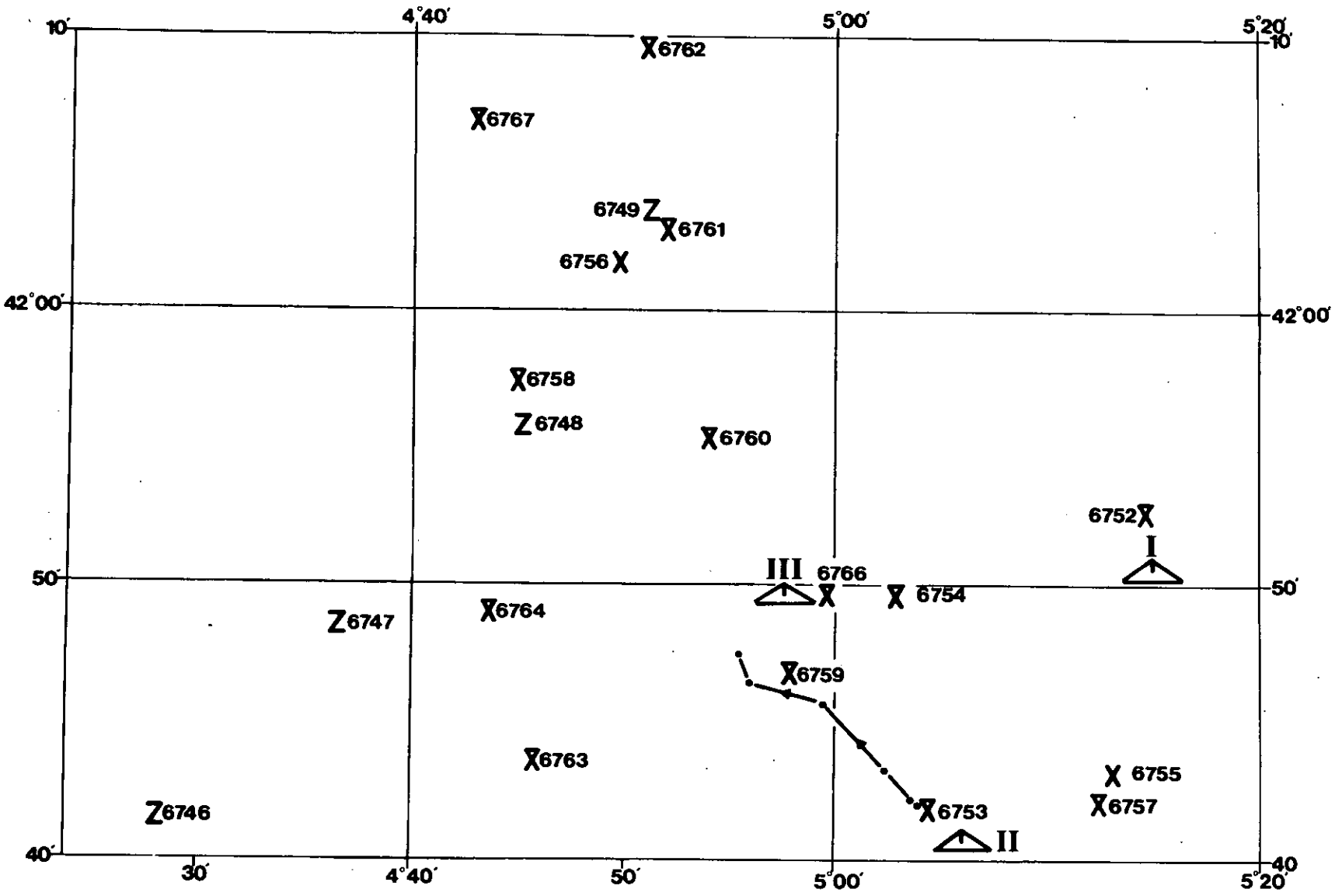
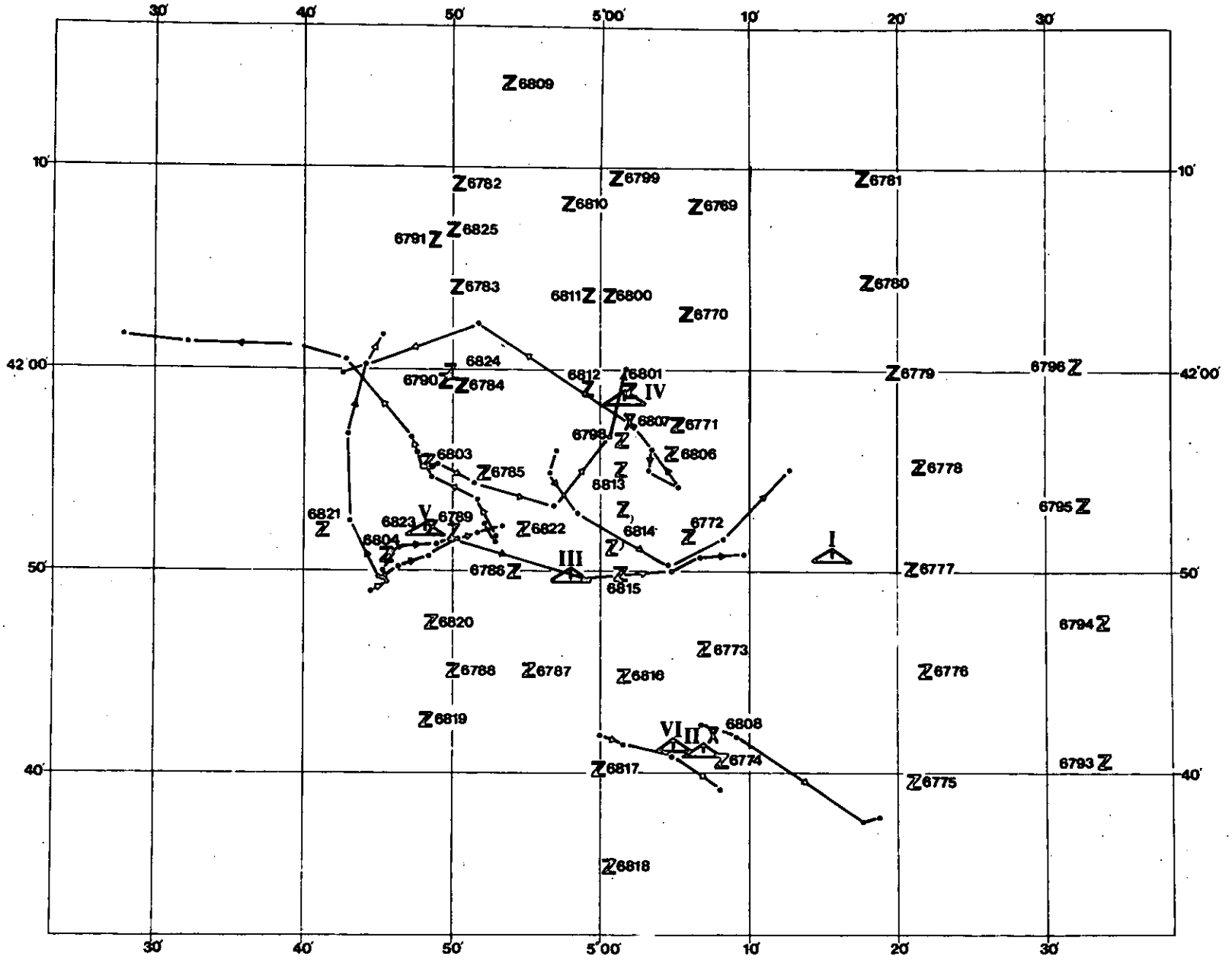
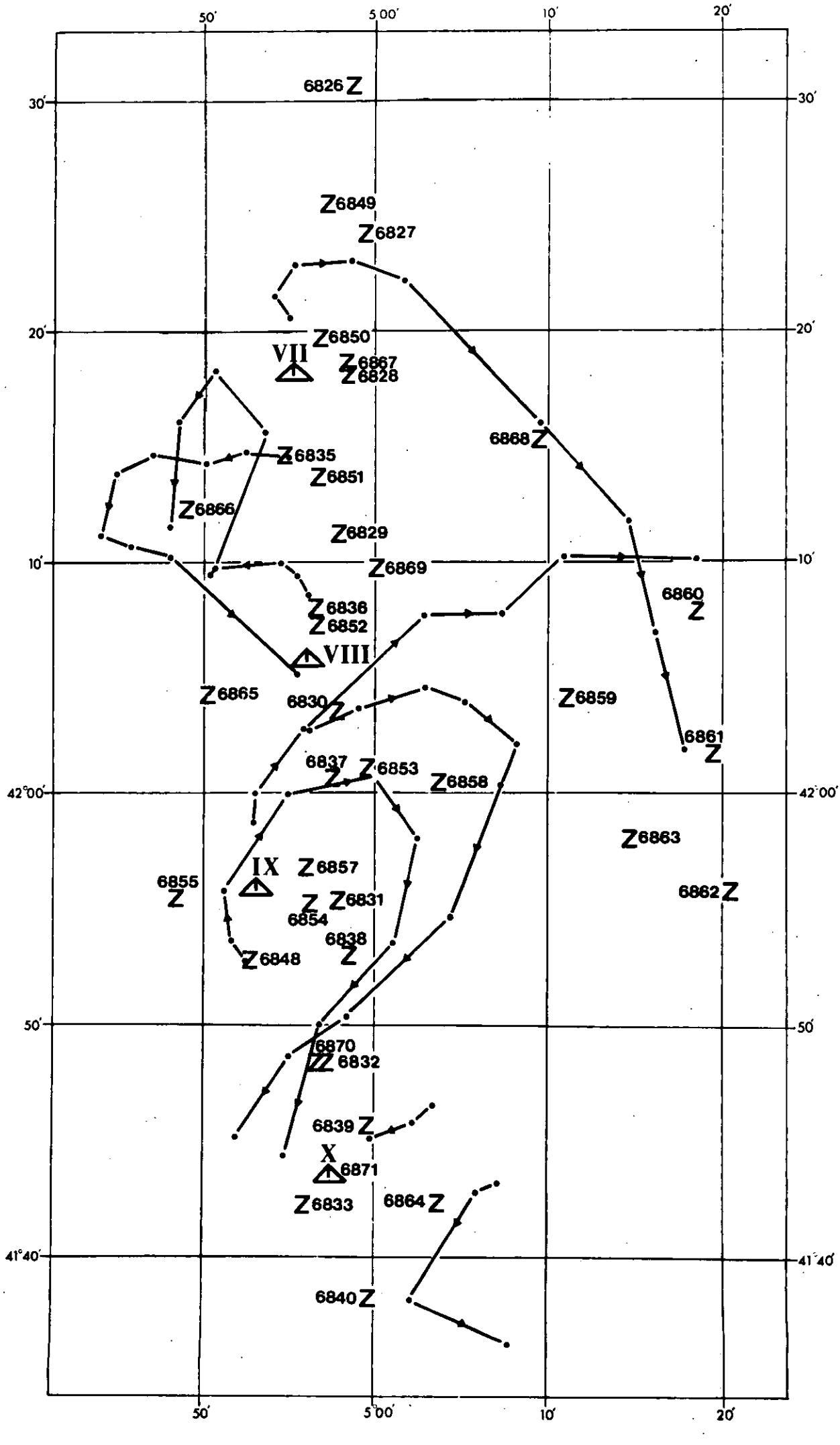
Feb 2 6744
Mar 20-21 6878-6888
Feb 3
4 Feb
19 Mar



MEDOC 1969 DISCOVERY 7-12 FEB



MEDOC 1969 DISCOVERY 17 FEB-2 MAR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20'
30'
20'
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VII
Z6867
Z6828
6868 Z
Z6835
Z6851
Z6866
Z6829
Z6869
6836 Z
Z6852
VIII
6860 Z
Z6865
6830 Z
Z6859
6861 Z
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6855 Z
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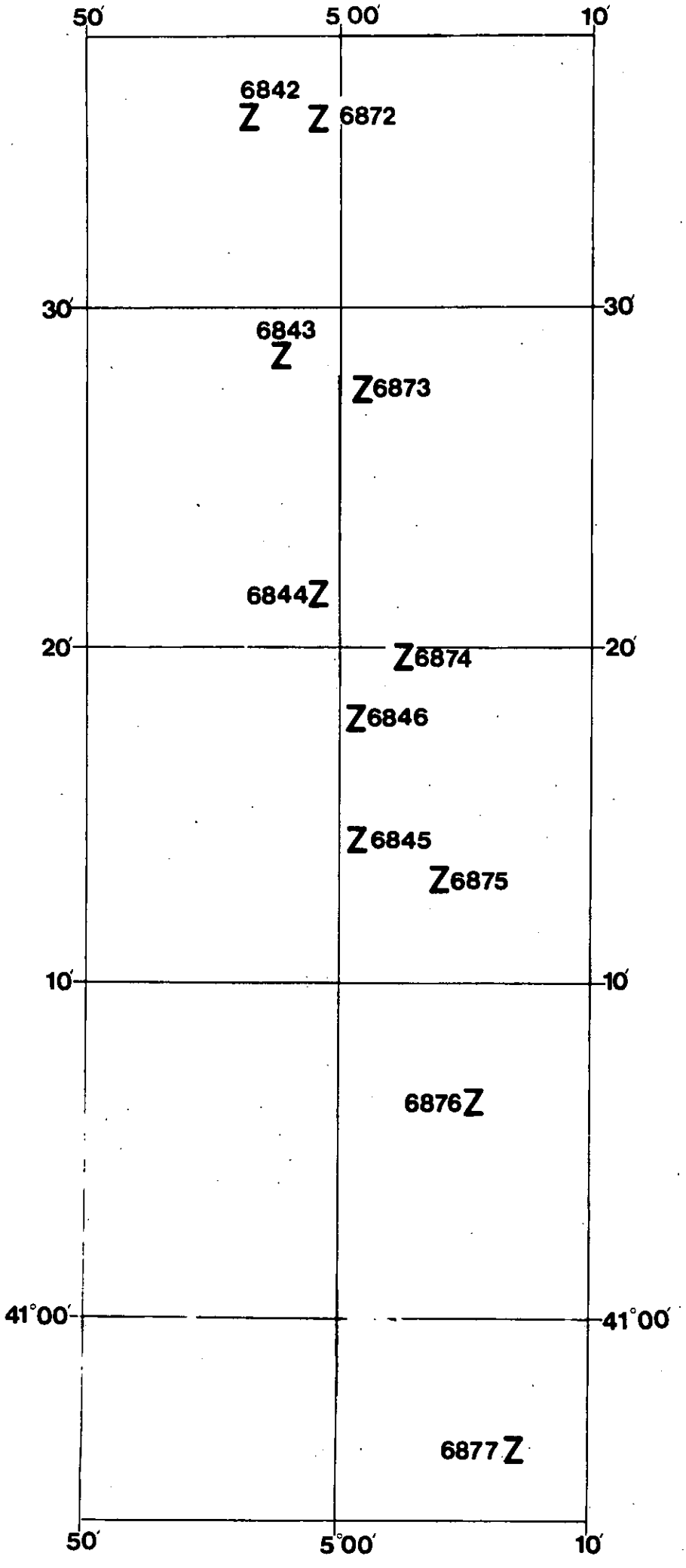
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