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"DISCOVERY" CRUISE 34 REPORT

2-28 June 1970

Air-Sea Interaction observations near Weather Station "J" ("JASIN") and Trial Moorings on the Continental Slope

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CR 34

CONTENTS

Purpose of Cruise	Page	1
Narrative		1
List of Scientific Participants		3
Notes on Equipment and Observations		3
1. Radiosondes		3
2. "LOCATE" wind measuring system		3
3. Surface meteorological observations		3
4. Navigation methods		4
5. TSD and water sampling observations		4
6. Near-surface drogues		4
7. Shear spar		4
8. Current meter moorings		5
9. Magnetometer and E/S profiles.		5
List of Tables and Figures - Abbreviations		7
Station List		8-9
List of Moored Current Meter Records		10
List of Near-Surface Drogue Results		11
List of Balloon Launches		12-13
Fig. 1. Track Chart		
2. Stations near OWS "J"		

Purpose of Cruise 34

The main purpose of this cruise was to cooperate with HMS "Hecla" and OWS "Cumulus" in preliminary trials of equipment and methods, in preparation for the proposed Royal Society air-sea interaction project in 1972. This preliminary trial was given the name "JASIN". The most important item of the trials on board the "Discovery" was the evaluation of the 'LOCATE' system for wind measurement, by comparison with observations from the Selenia radar on board 'Cumulus'. Most of the other equipment used was not new, and observations with it were aimed at exploring the situation in that area, and providing material needed to assess the feasibility of achieving the aims of the main experiment. The only new oceanographic equipment tried was the shear spar.

Subsidiary aims on this cruise were to lay and recover test moorings on the continental slope going down into the Bay of Biscay, to attempt recovery of a lost tide gauge on La Chapelle Bank, and to record magnetic field and bathymetry on passage.

Narrative

Left Barry	1730Z/2	June
Arr. test mooring area	0020/4	June
Left " " "	0045/6	"
Arr. OWS 'J' area	1549/8	"
Left " " "	1215/23	"
Arr. test mooring area	0200/26	"
Left " " "	1454/27	"
Arr. Southampton	0930/29	"

On leaving Barry, course was set for the test mooring site on the continental slope, near 47° 30'N, 8° 20'W. Arriving there early on 4th June, acoustic releases and command pingers were tested. An attempt was also made to pressure-test a new spherical subsurface float, but there was too much swell and the test had to be abandoned. Mooring 057 was then laid, in 2000m depth, with a single current meter and a new type of non-rotating wire. The mooring was let go at 1317/4th and the ship then set course for La Chapelle bank, where an acoustic search was made for a lost tide gauge (laid at the end of Cruise 31) until Decca positions became unreliable. Overnight, a TSD section was made down the continental slope towards the test mooring position. Returning then to La Chapelle Bank, the lost tide gauge was dragged for, unsuccessfully. The drag brought up some wreckage, a piece of plate weighing about $\frac{1}{2}$ ton, but there was no sign of the tide gauge sphere or its baseplate. Returning then to the test mooring area, the section was extended by one more TSD dip, and early on 6th June course was set towards ocean weather station 'J'.

E/S and magnetometer observations were made on passage, and several stops were made for calibrating depth-telemetering pingers and testing acoustic releases. The 10-m. long shear spar was launched once for practice, without any sensors. It proved easy to handle and appeared to be very steady in the water. On arrival in the neighbourhood of OWS 'J', a 10-mile triangle was surveyed so that suitable positions (not too steeply sloping bottom) could be chosen for the three current meter moorings. The survey was completed by the afternoon of 9th June, and three moorings ('X', 'Y' and 'Z') laid by p.m. 11th June, with TSD dips and near-surface drogue tracking interspersed with the mooring work.
CR 34 OWS 'Cumulus' had arrived in the area in the evening of 10th June, and co-operative tracking of radiosondes began next morning.

HMS 'Hecla' arrived a.m. 11th June and that evening a series of ½-hourly TSD dips was started. These observations were maintained for 2 days, with the ships nominally at the corners of a 5 mile triangle centred on buoy 'J' that had been anchored by 'Hecla' in the middle of the moored current meter triangle. Having completed that series early on 14th June, 'Discovery' resumed drogue tracking and deep TSD dips, with occasional radiosonde flights. Passing close by 'Y' buoy, it was noticed that a surface float carrying a current meter was missing, and a search was made downstream without success. The shear spar was tried for ½ hr. in the afternoon of 15th June, and 'Discovery' cooperated with 'Hecla' in photographing smoke trails from rockets. A similar programme was followed on 16th June.

On 17th June, 'Discovery' and 'Cumulus' tracked radiosondes regularly every 2 hours, while surface drogue tracking and TSD dips were continued as convenient. That series of radiosondes was completed a.m. 18th, and that afternoon the three ships started a series of shallow TSD dips at 15 min. intervals starting from closely spaced positions and gradually drifting apart whilst lying-to. That continued until late in the evening, and 'Discovery' made further deep TSD dips independently overnight. During these, the surface buoy of 'Y' mooring was noticed adrift, and was later recovered; the rest of the mooring was confirmed to be still in place. Then the buoy of 'Z' mooring disappeared, and in the afternoon of 19th June that mooring was recovered. The surface buoy had pulled under and flooded, but the rest of the mooring was undamaged. Further drogue work continued in weather too bad for TSD dips (winds over 30 knots).

By daylight on 20th June the weather had improved, and another series of 2-hourly radiosondes started, combined with drogue work, shear spar trials and smoke trail photography. That afternoon the surface buoy of 'X' mooring disappeared, though the rest of the mooring was confirmed to be in place. After transferring P.K. Taylor to the 'Cumulus' and taking E. Bouws on board in exchange, TSD work was continued overnight.

'X' mooring was recovered next day, 21st June, intact except for the missing surface buoy. That was followed by more drogue work and smoke rocket photography. Overnight, several shallow TSD dips (50m) were made whilst maintaining station near a surface drogue. The third mooring 'Y', was then recovered (a.m. 22nd June) and a final trial of the shear spar was made. That afternoon 'Hecla' transferred a dan buoy to 'Discovery' and then left the area. In the evening 'Discovery' and 'Cumulus' made a series of closely spaced TSD dips to 100m, at 10 min. intervals. Overnight, 'Discovery' made 4 more deep TSD dips. The dan buoy from 'Hecla' was then anchored as a temporary navigation aid for 'Cumulus', and after a final drogue trial 'Discovery' left the area at 1215/23rd June.

E/S and magnetometer records were collected on passage, and acoustic release units were re-tested. Mooring 057 was recovered a.m. 26th, and re-laid (as mooring 061) later that day. The TSD section up the slope through the mooring position was re-occupied, and 3 dips were made with the abyssal Pisa. Winds were too strong and variable for another attempt at dragging for the lost tide gauge, which had been intended, and course was set for Southampton.

List of scientific participants

Mr. J.R. Berry	N.I.O.	Prof. H. Charnock	U. of Southampton
Mr. J.W. Cherriman	"	Mr. R. O'Doherty	"
Mr. J. Crease	"	Mr. P.K. Taylor	"
Mrs. P. Edwards	"	(transferred to 'Cumulus' 20.VI.)	
Mr. J. Gross	"	Mr. H. Dooley	DAFS Aberdeen
Mr. M.J. Harris	"	Mr. E.J.S. Fowler	Met. Office
Mr. T.P. Lindsay	"	Mr. E. Bouws	K.N.M.I.
Mr. G.K. Morrison	"	(transferred from 'Cumulus' 20.VI.)	
Mr. E.G. Pitt	"		
Mr. N.D. Smith	"		
Dr. J.C. Swallow	"	Principal Scientist	
Mr. R. Wild	"		

Professor H. Charnock was in charge of the combined scientific work of the three ships.

Notes on Equipment and Observations

1. Radiosondes (Charnock, Taylor, O'Doherty)

Radiosonde ascents of two kinds were made.
(a) Single balloon ascents into the stratosphere, using the U.S. 403 MHz sonde or Graw sondes. These were timed so as to allow comparison with the routine observations made from OWS 'Cumulus' using the British Mk II sonde and the Selenia radar.

The 403 MHz sonde was tracked by the 'Discovery' LOCATE equipment and often by that in 'Cumulus' also.
(b) Double balloon ascents to about 800 mb, using the 403 MHz sonde. These used a release to separate the upper balloon at a predetermined pressure. The lower balloon and the sonde (and frequently a radar reflector) then sank slowly, its buoyancy being adjusted by careful filling using a domestic gasmeter.

Two sets of double balloon observations were made with ascents at intervals of about 2 hours for periods of up to 24 hours.

2. 'LOCATE' wind measuring system (Charnock, Taylor, O'Doherty)

Tests of the LOCATE system for windfinding were made by tracking balloons simultaneously by the LOCATE in 'Discovery', the LOCATE in 'Cumulus' and the Selenia radar in 'Cumulus'. Two ascents were also followed using the 'Discovery' navigational radar.

The LOCATE system was also tested by using a sonde mounted on the radar tower of 'Discovery'. This was tracked by the LOCATE sets in 'Discovery' and 'Cumulus' and the indicated velocities compared with those determined from the ship's log.

3. Surface meteorological observations (Mrs. Edwards, Fowler, Pitt)

The routine meteorological observations, normally made by the Deck Officers, were intensified to hourly intervals during the time that the ship was near O.W.S. 'J'. For air temperatures, an Assmann psychrometer was used. In addition, continuous records were made of dry air temperature, dry-wet difference, and solarimeter output, on the meteorological Speedomax. Sea surface temperatures were read from a Met. Office 'limpet' sensor and

bridge, and from a quartz thermometer mounted inside the hull. Comparisons were made between these and various bucket thermometers (standard Met. Office pattern, Crawford bucket, ordinary leather bucket + surface thermometer).

4. Navigation methods (Crease, Berry, Lindsay)

Navigation was based primarily on satellite fixes, though Decca was used to some extent in the region of the test mooring site and closer inshore. In the weather station area, radar fixes were taken every 10 mins. whenever possible on one or more of the dan buoys attached to the current meter moorings, or on the central buoy 'J' anchored by 'Hecla'. Positions for the moorings were derived from the mean of a number of satellite + radar fixes. Surface currents were computed from the D.R. derived from the 2-component log between selected satellite fixes, and these agreed well in most cases with the drogue observations.

5. TSD and water sampling observations (Morrison, Crease, Charnock, Dooley, Swallow)

The 9040 sea unit was used throughout the earlier part of the cruise, but after striking the side during heavy rolling it was found to have leaked slightly. The 9006 sea unit was brought into use whilst the 9040 was being repaired. Both units suffered intermittently from noise in the salinity output. Calibration was effected as usual with a reversing bottle immediately above the sea unit on each cast, except when rapid sequences of shallow dips were being made, and with a separate bottle alongside the unit at 10m depth. Salinities were measured on board using an Autolab salinometer, and duplicates were collected for measurement on the thermostat salinometer in the laboratory. Twenty-three casts to 2000m were made in the weather station area, to give some indication of the general distribution of density and to allow geostrophic current profiles to be calculated. Several sequences of loweringsmade to shallower depths, usually in cooperation with the other two ships, in an attempt to delineate the small scale features of the upper few hundred metres of water.

6. Near-surface drogues (Swallow, Cherriman, Harris, Dooley)

The drogues most commonly used consisted of a canvas cross 1·7 m^2 in area with a plastic tubular frame, supported by an elliptical float with approx. 3m of recovery line. A sound source in a tube 1m long was suspended just below the drogue frame; this allowed the drogue to be detected at a range of 1-2 mls and approached until sighted visually (usually at about 0·1 ml., the surface float being about half submerged). Patterns of drogues (up to a maximum of 6) were tracked through the mooring area, set for depths in the range $1\frac{1}{2}$ to $10\frac{1}{2}$m. Most of them moved northwards at speeds of the order of $\frac{1}{2}$ knot. The only significant change from northward flow at the surface was observed during 16-17 June when a somewhat slower westward current was indicated. This apparently began several hours before an increase of wind from the north, and appears to have been quite unrelated to it.

Trials were made with parachute drogues attached to radio beacons, built to the Aberdeen design. Only very short ranges ($\frac{1}{2}$ ml) could be obtained from the radio beacons; the reason for this remains obscure.

CR 34

7. Shear spar (Smith, Wild, Crease, Swallow)

This new instrument was designed to measure shear in the upper 10m

of water. It consisted of a vertical spar 10m long, with a doughnut float attached by gimbals at the top, and a weight at the bottom. It carried three 2-component electromagnetic log sensors, at depths of 1m, 4, and 10m. Power was supplied to these, and signals returned, via a multicore cable. It was put out and recovered using the fwd. crane and proved much easier to handle than had been feared, and appeared very stable in the water. Signals were recorded both by data logger on paper tape and directly by computer, at a sampling rate of 2 per sec.

With the length of cable available, it seemed that the spar was too much influenced by the presence of the ship; the shear observed depended strongly on the ship's manoeuvres. In an attempt to get the spar into undisturbed water, for the final trial it was fitted with a sail (a spare drogue) and the ship was manoeuvred so that the spar was towing the ship downwind. It really needs a longer cable (2 or 3 ship-lengths, say) or perhaps radio telemetering.

8. Current meter moorings (Cherriman, Harris, Gross, Swallow)

The test mooring (057) on the continental slope had a number of new features. The main buoyancy was a 4ft diameter steel sphere and the wire was Brunton's 8mm non-rotating. Two deep buoyancy units made of 'Vicast' giving a total lift of 160 lbs were included 20m above the release, and a single Bergen current meter, sampling every 5 mins,, at 300m depth. Two test moorings had been intended, but the other 4ft sphere had been damaged in attempting to lower it for a pressure test. On recovery after 3 weeks all the components of mooring 057 were in good condition except for slight birdcaging of the 8mm wire at the bottom of the bight lifted by the deep buoyancy unit on recovery. Only that length and three short strops were changed in re-laying it as mooring 061.

The three moorings in the weather station area (058-060) had to have their wires measured after tensioning and the ship carefully manoeuvred into the right depth of water, to ensure that the shallow current meters were as close as possible to their intended depths. The main buoyancy was subsurface (nominally 40m depth) with a slack polypropylene line to a dan buoy at the surface. They all went slightly deep, the estimated depths of the nominally 50m current meters being 65, 64 and 58m.

Mooring 060 had an extra current meter, suspended 10m below a surface float attached to the dan buoy. That current meter and its float were lost; the wire connecting them to the dan buoy was found to have frayed through. Of the three surface dan buoys, two broke adrift due to fraying of the 5 ton polypropylene line near the surface buoy, and one pulled under and presumably had leaked, since the current does not appear to have been particularly strong then.

All the releases and command pingers used worked satisfactorily, but only after careful testing and some repairs.

Of the 11 Bergen meters used on the cruise, one was lost, one produced no data, and one gave a short record. Neither of the two Braincon meters used worked satisfactorily; one gave no record and the other ran for only 3 days.

9. Magnetometer and E/S profiles (Crease, Swallow)

CR 34

These were run on passage out to the weather station and back. Sampling was at 10min. intervals, with the computer actuating the

magnetometer directly and with manual input from the echo sounder.

The track was computed from the 2-component log output, adjusted to fit selected satellite fixes, and automatic plots of magnetic field and bathymetry were made on 1:1million scale.

List of Tables and Figures

Table 1. Station List
2. List of Moored Current Meter Records
3. List of Near-Surface Drogues
4. List of Balloon Launches.

Fig. 1. Track Chart showing noon positions

2. Station positions near O.W.S. 'J', 9-23 June 1970. Symbols used are Z. - TSD + WB, ▲ : - CM mooring, S: - shear spar.

Abbreviations

Sat.	Satellite fix during station
Int. Sat.	Position interpolated between satellite fixes
Mean Sat.	Mean of many satellite fixes transferred using radar
X, Y, Z	Position depending on stated mean positions of moorings X, Y or Z, using radar.
J	Position depending on Hecla's mean position of J buoy (52°33'·8N, 20°00'·7W) + radar
CM	Current meter mooring
Pisa	Abyssal current indicator
SS	Current shear spar
TSD	Temperature-salinity-depth probe
WB	Water bottles

TABLE I

CRUISE 34 STATION LIST

	Stn No	Date	Time (Z) Start	Time (Z) Finish	N Lat	W Long	Depending on	Gear Used	Remarks
	7300	4.VI	1120	1318	47°30'·9	8°23'·8	Sat.	CM	NIO mooring 057
	7301	5.VI	0010	0210	47°47'·8	8°00'·9	Sat.	TSD	580m wire out
	7302	"	0336	0501	47°38'·4	8°11'·9	Sat.	TSD	1460m
	7303	"	0603	0738	47°31'·4	8°22'·7	Int.Sat.	TSD	1912m
	7304	"	2310		47°25'·2	8°30'·8	Int.Sat.	TSD	2000m
		6.VI		0046					
	7305	"	0914	1200	48°13'·2	10°25'·8	Sat.	TSD	Calibrating depth telemetering pingers 250-350m
	7306	"	1554	1624	48°14'·0	11°19'·1	Sat.	TSD	
	7307	7.VI	2018	2116	50°30'·6	16°00'·4	Sat.	TSD	
	7308	9.VI	1945	2205	52°37'·7	20°00'·0	Mean.Sat.	CM	NIO Mooring 058 ('X')
	7309	10.VI	0306	0444	52°41'·2	19°59'·8	X	TSD	2000m
	7310	"	0836	1010	52°36'·6	19°55'·6	X	TSD	2000m
	7311	"	1052	1232	52°36'·2	20°04'·0	X	TSD	2000m
	7312	"	1702	1918	52°29'·5	19°53'·9	Mean.Sat.	CM	NIO Mooring 059 ('Z')
	7313	"	2131	2310	52°33'·0	20°01'·0	Z	TSD	2000m
	7314	11.VI	0145	0310	52°33'·6	19°57'·7	Z	TSD	2000m
	7315	"	0444	0614	52°33'·5	19°54'·1	Z	TSD	2000m
	7316	"	0748	0925	52°36'·6	19°55'·8	X	TSD	2000m
	7317	"	1515	1835	52°29'·5	20°09'·3	Mean Sat.	CM	NIO Mooring 060 ('Y')
	7318	"	2019		all within 1 ml of nominal pos. 52°34'·0 20°05'·3 most within ½ ml.		J	TSD	Calibration, then ½ hourly dips to 500m from 0030/12 to 0000/14 with some omissions, 89 ½ hourly dips in all, then recalibration.
		14.VI		0320					
	7319	"	0500	0632	52°30'·4	20°09'·5	Y	TSD	2000m
	7320	"	0810	0926	52°30'·3	19°53'·9	Z	TSD	2000m
	7321	15.VI	0342	0515	52°39'·1	19°54'·6	X	TSD	2000m
	7322	"	0722	0917	52°42'·7	20°07'·0	X	TSD	2000m
	7323	"	1525	1559	52°32'·1	19°57'·7	Z	SS	
	7324	16.VI	0035	0214	52°38'·8	19°59'·7	X	TSD	2000m
	7325	"	0726	0856	52°38'·2	20°01'·5	X	TSD	2000m
	7326	"	1419	1518	52°29'·2	20°01'·7	Z	SS	
CR34	7327	"	1805	1913	52°29'·2	20°05'·2	Y	TSD, WB	2 dips, 18m, 500m.

7328	16.VI	2036	2120	52°29'·6	20°01'·2	Y	TSD, WB	2 dips, 18m, 500m,
7329	"	2234	2318	52°30'·9	20°03'·2	Y	TSD, WB	" " " "
7330	17.VI	1934		52°32'·8	20°04'·8	Y	TSD	Calibration, to 500m.
	18.VI		0504	52°29'·6	19°54'·1	Int. Sat		
7331	"	0958	1120	52°34'·0	20°02'·2	J	SS	
7332	"	1200	1230	52°34'·5	20°02'·1	J	TSD	400m
7333	"	1410		52°35'·2	19°58'·5	J	TSD	1/4-hourly dips through depth range 100 - 300m
	"		2025	52°43'·3	19°48'·9	Int.Sat.		
7334	"	2200	2337	52°34'·1	20°05'·4	J	TSD	3 dips, to 500m
7335	19.VI	0000	0200	52°34'·2	20°05'·1	X	TSD	2000m
7336	19.VI	0248	0410	52°38'·1	20°03'·9	X	TSD	2000m
7337	"	0505	0657	52°35'·7	19°59'·2	X	TSD	2000m
7338	"	1154	1335	52°32'·1	19°54'·5	J	TSD	2000m
7339	"	1929	2005	52°32'·1	20°06'·0	J	TSD	55m
7340	20.VI	0924	1110	52°39'·5	19°59'·3	X	SS	
7341	"	1700	1808	52°39'·4	20°01'·3	Int.Sat.	SS	
7342	"	2330		52°38'·5	20°03'·1	Sat.	TSD	2 dips, 500m, 2000m
	21.VI		0154					
7343	21.VI	0217	0400	52°38'·3	20°00'·2	Int.Sat.	TSD	2000m
7344	22.VI	0105	0242	52°34'·5	20°05'·0	Sat.	TSD	3 dips to 50m, 1 to 500m
7345	"	0315	0445	52°35'·7	20°08'·3	Sat.	TSD	3 dips to 50m, 1 to 500m
7346	"	1142	1415	52°30'·6	20°08'·2	Sat.	SS	
7347	"	1800		52°32'·2	20°01'·5	Int.Sat.	TSD	10-min dips to 100m
	23.VI		0008	52°38'·5	19°53'·9	Int.Sat.		(36 in all)
7348	"	0028	0207	52°38'·2	19°53'·5	Int.Sat.	TSD	2000m
7349	"	0306	0436	52°30'·2	19°53'·6	Sat.	TSD	2000m
7350	"	0542	0723	52°34'·2	20°04'·9	Sat.	TSD	2000m
7351	"	0814	0958	52°29'·7	20°08'·2	Int.Sat.	TSD	2000m
7352	26.VI	1014	1310	47°16'·8	8°43'·1	Sat.	TSD	2000m
7353	"	1800	2005	47°35'·1	8°16'·1	Sat.	CM	NIO Mooring 061
7354	27.VI	0408	0554	47°23'·5	8°33'·5	Sat.	TSD	2000m
7355	"	0736	0911	47°33'·7	8°16'·8	Sat.	TSD	2000m
7356	"	1015	1122	47°40'·5	8°05'·2	Int.Sat.	TSD	1100m
7357	"	1226	1454	47°48'·2	7°51'·8	Int.Sat.	(TSD (Pisa	525m 3 dips

TABLE 2

List of Current Meter Moorings, June 1970

Abbreviations - A: Aanderaa B: Braincon

NIO No	Stn No	Time/ Date Laid	Time/ Date Recovered	Current Meter	Nominal Depth (m)	Actual Depth	Remarks
057	7300	1318/4	0757/26	A 219	300	304	Good record
058	7308	2205/9	1129/21	A 155	50	65	" "
				A 154	100	115	Short record (Encoder fault)
				A 153	200	215	Good Record
059	7312	1918/10	1720/19	A 222	50	64	Good Record
				A 221	100	119	" "
				A 156	200	224	" "
060	7317	1835/11	1047/22	A 78	10	10	Meter lost (float went adrift)
				A 225	50	58	Good Record
				A 224	100	114	No record (battery failed)
				A 223	200	218	Good Record
				B 112	1000	1056	Film did not run.
				B 111	2000	2082	Short record (3 days approx)
061	7353	2005/26		A 220	300	283	Left down for later recovery

TABLE 3

List of drogues tracked June 1970

Drogue	Depth	Start Time/ Date	Position N	Position W	End Time/ Date	Position N	Position W	Mean Velocity cm/sec	Mean Velocity °T
A	1½	2251/9	52°38'·2	20°00'·2	0656/10	52°42'·8	20°00'·9	29·5	355
B	1½	2040/10	52°29'·5	19°57'·2	1147/11	52°39'·6	20°01'·5	35·4	345
C	1½	1000/14	52°30'·5	19°53'·8	0533/15	52°39'·6	19°55'·8	24·1	353
D	1½	1044/14	52°28'·6	20°00'·8	1537/14	52°31'·5	20°03'·2	34·6	335
E	1½	1130/14	52°30'·5	20°09'·4	0712/15	52°41'·8	20°07'·6	29·8	005
F	1½	1136/15	52°30'·1	20°04'·9	0616/16	52°41'·9	20°03'·8	32·6	003
G	10½	1224/15	52°29'·4	19°58'·8	1124/16	52°42'·6	20°02'·6	30·0	350
H	1½	1224/15	52°29'·4	19°58'·8	2158/15	52°34'·5	20°00'·6	28·0	348
I	10½	1301/15	52°29'·6	19°55'·3	1007/16	52°39'·3	19°59'·8	24·4	344
J	1½	1301/15	52°29'·6	19°55'·3	1415/15	52°30'·3	19°56'·4	38	317
K	1½	1356/16	52°28'·8	20°01'·1	0552/17	52°31'·3	20°07'·0	14·2	306
L	10½	1357/16	52°28'·8	20°01'·1	1020/17	52°32'·3	20°09'·8	16·1	303
RD1	2	1353/16	52°28'·7	20°01'·0	2009/16	52°30'·0	20°04'·5	20·5	301
M	10½	0138/17	52°31'·4	19°55'·9	1740/17	52°31'·3	20°04'·8	17·3	269
N	1½	0740/18	52°31'·6	20°02'·9	1135/18	52°34'·3	20°02'·6		
O	10½	"	"	"	1146/18	"	"	34·7	005
P	4½	"	"	"	1141/18	"	"		
Q	1½	1842/19	52°31'·0	20°03'·9	0824/20	52°35'·7	20°06'·8	19·5	339
R	10½	1842/19	"	"	2233/19	52°32'·0	20°05'·7	20·0	314
S	10½	1215/20	52°37'·6	19°58'·3	1406/20	52°38'·6	19°58'·4	25·0	358
T	1½	"	"	"	1401/20	52°38'·4	19°58'·3	23·2	002
U	1½	1646/20	52°38'·8	20°01'·6	1903/20	52°40'·5	20°02'·5	40·6	340
V	10½	"	"	"	1914/20	52°40'·8	20°02'·6	43·6	343
W	1½	1320/21	52°28'·2	20°01'·1	0515/22	52°37'·0	20°07'·7	31·0	335
RD2	2	1320/21	"	"	1610/21	52°29'·5	20°00'·5	23·6	015
X	1½	1116/22	52°30'·3	20°08'·7	1530/22	52°31'·8	20°08'·1	18·2	010
Y	10½	1116/22	"	"	1510/22	52°31'·6	20°08'·3	17·1	009
Z	1½	1129/23	52°32'·0	20°05'·1	1215/23	52°33'·0	20°04'·0	80*	034

Remarks - RD1 Radio drogue

RD2 Radio drogue

* Very short run

TABLE 4

DISCOVERY BALLOON LAUNCHES CRUISE 34 - JASIN

Abbreviations: DL = Discovery Locate
CL = Cumulus Locate
CR = Cumulus Radar

	LAUNCH NO.	TIME/DATE	NOTES	MAX. HT. mb		INDEX NO.
	D1	1655/9-6-70	Double balloon launch	835	DL	35
	D2	1633/10	Double	853	DL	36
	D3	1115/11	Single	107	DL,CL	37
	D4	1421/11	Double, Cumulus radar failed to lock on	820	DL, CL	38
	D5	1540/11	Double, lower balloon burst in flight	965	DL, CL	39
	D6	1850/11	Graw sonde launch, single balloon	-		G1
	D7	2305/11	Single	70	DL	40
	D8	0510/12	Single	51	DL	41
	D9	1110/12	Single	44	DL	42
	D10	1140/13	Single	38	DL,CL	43
	D11	1717/13	Single	31	DL,CL	44
	D12	1718/13	Graw, for comparison with D11	-		G2
	D13	1715/14	Graw	-		G3
	D14	1720/15	Graw	-		G4
	D15	1716/16	Graw	-		G5
	D16	0732/17	Double	875	DL,CL,CR	44b
	D17	0915/17	Double	866	DL,CL,CR	45
	D18	1120/17	Single	57	DL,CL	46
	D19	1324/17	Double, radar target went up, down and up again	825	DL,CL,CR	47
	D20	1510/17	Double	817	DL,CL,CR	48
	D21	1715/17	Graw	-		G6
	D22	1915/17	Double	788	DL,CL,CR	50
	D23	2109/17	Double	846	DL,CL,CR	51
	D24	2315/17	Single, no humidity signal	186	DL,CL	52
	D25	0112/18	Double, tracked on Discovery's radar	850	DL,CL,CR	53
	D26	0315/18	Double, tracked on Discovery's radar	853	DL,CL,CR	54
	D27	1730/19	Graw	-		G7
CR34	D28	1140/20	Single	60	DL,CL	55
	D29	1330/20	Double	832	DL,CL	56

D30	1515/20	Double, Selenia tracked sonde echo	804	DL,CL,CR	57
D31	1715/20	Graw	-		G8
D32	1915/20	Double	740	DL,CL	58
D33	2200/20	Double, but bottom balloon burst at launch	785	DL,CL	59
D34	1730/22	Graw	-		G9

Other use of LOCATE equipment

Index No.	Time/Date	Remarks
Track 1	0600-0900/14.VI.1970	During 14 June the LOCATE was tested by recording the signals from a radiosonde fastened to the rails of 'Monkey Island' of R.R.S. Discovery. Similar tests were conducted on the 15th with the sonde mounted on the after mast platform.
Track 2,3	1010-1115/14.VI.1970	
Track 4	1300-1400/14.VI.1970	
Track 5,6	1800-2310/14.VI.1970	
Track 7	0900-1515/15.VI.1970	

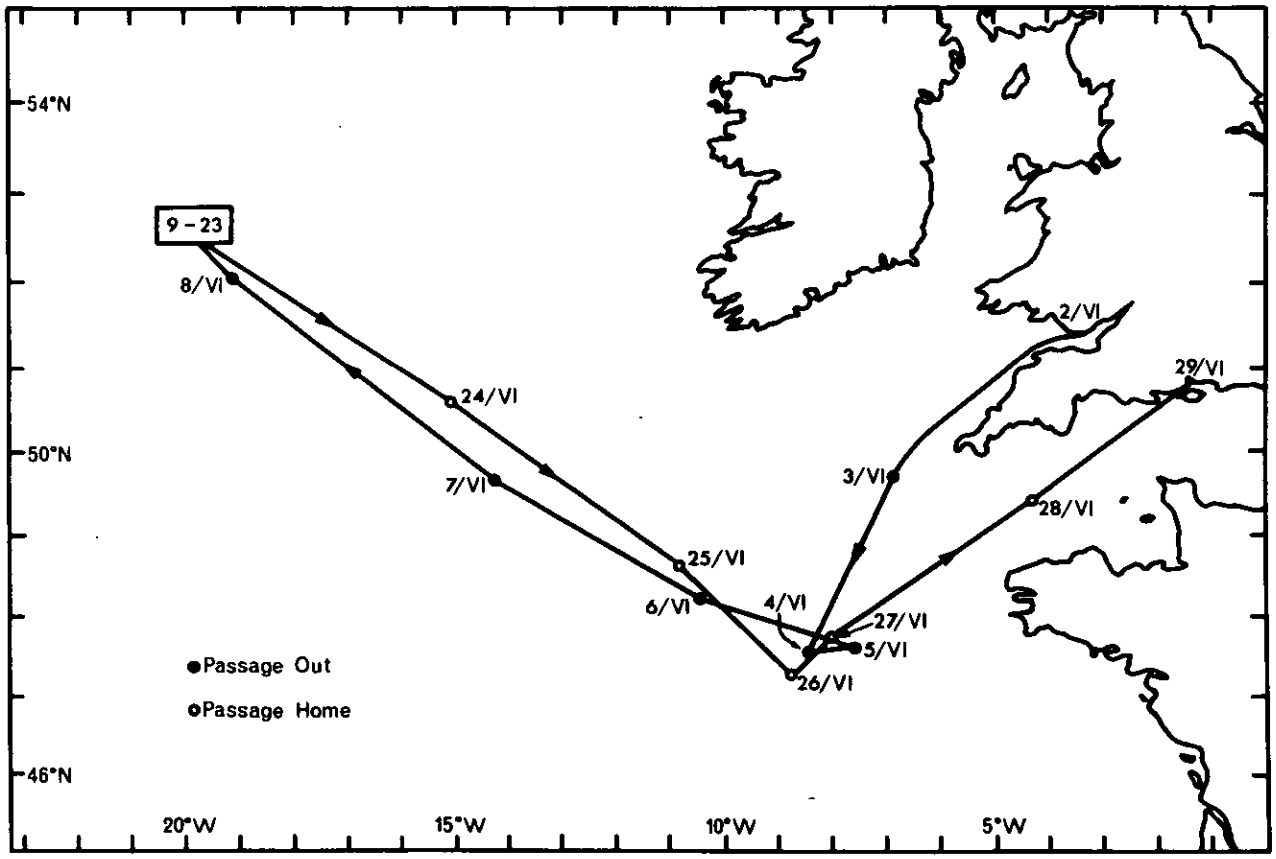

Fig.1 DISCOVERY CRUISE 34 Noon Positions

Fig.2 STATIONS 9-23 JUNE