SHACK 73:
RRS Shackleton
Scotia Sea
Geophysics
November 1973 - March 1974

RRS Shackleton Cruise 7/73

University of Birmingham Antarctic Reasearch Group

October 1973 to April 1974

1. Scientific Personnel

D.H. Griffiths	Birm. U.	11.1.74	to 16.3.74
P.F. Barker	"	9.11.73	16.3.74
P. Simpson	"	13.10.73	16.3.74
G.V. Popejoy	"	13.10.73	16.3.74
C.P. Brett	"	13.10.73	5.1.74
I.A. Hill	"	5.11.73	16.3.74
R.A. Jahn	"	9.11.73	16.37.4
J. Burrell	"	9.11.73	16.3.74
A.D. Saunders		11.1.74	12.2.74
R.J. Moorey	IOS Wormley	11.1.74	12.2.74
D. Lewis	RVB	13.10.73	12.1.74
M.G. Beney	"	13.10.73	12.1.7
S.J. Jones	"	11.1.74	16.3.74
P.J. Mason	"	11.1.74	16.3.74
M.D. Harris	Nature Conservancy	13.10.73	9.11.74

Ship Personnel

G.H. Selby Smith	Captain
P.H. Warne	Ch. Officer
B.A. Graham	2nd "
P. Coombs	3rd "
R. Johnstone	Ch. Engineer
P. Stone / A. Lennox	2nd "
M. Dicker / H. Peck / K. Gabitas	3rd "
H. Davies / J, O'Keefe	4th "
J. Lewis / P. Sharpe	Elec. Officer
A. Landry	Radio "
R. Cridland	Catering "
L. Haggis	Bosun

The relief of engineer and electrical officers took place in Montevit 11th Jan. 1974.

2. Introduction

In general, the Antarctic cruise of RRS Shackleton followed its cruise plan and was highly successful, Its major objectives, the DS! site surveys, the Falkland Is. survey and Weddell Sea reconnaissance were all carried out. The eight Deep Sea Drilling Project site survey were extremely important, since the immensely powerful tool of deep coring is unlikely to be available again in the Scotia Sea in the fo seeable future. 'The holes are all serving our purpose to unravel the structural history of

The Scotia Sea, one of the most complicated in the world, and it was to our own considerable advantage to make a good Job of the preliminary surveys of the drilling sites. Because of a rearrangement of the drilling programme, some site surveys had to be complete by Christmas. Widely distributed though these sites were, this was done and-the other sites surveyed in leg 4, after the Falkland Is. work. The drawback was that in meeting the time deadlines, we spent more time on passage between sites than would have been necessary hed we been able to do all the work in our own time. Thus our track-charts look a little like cook's Tours of the Scotia Sea.

We count the Falkland Is. survey, commissioned by the Foreign office a success also. The reflection profiling went well, despite hydrophone array problems in the latter part of the survey, and the two-ship seismic programme (which HMS Endurance), though short, told us much about Burdwood Bank. Thus during leg 2 (the first Scotia Sea leg) the necessary four DSDP sites were surveyed, others being deferred, and a start was mdde on the Falkland Is. survey, which also occupied leg 3 and included the 2-ship seismic period. During leg 4 the remaining DSDP sites were surveyed and a dredging programme across the Sandwich spreading centre and TSD profile across the south Scotia Ridge (IOS Wormley-John Moorey) were carried out. Actual time in the Weddell Sea luring leg 5 was reduced slightly, in favour of spending more time in the east Scotia Sea; this was proved to be a good move since the Weddell Sea data was not as easy to understand as it could have been, and a eriod cf assessment is needed to optimise the benefit of any further sea time spent there, Besides the main programmes noted 'above, some bottom water samples from the Scotia and Weddell Seas were obtained for tritium analysis by Dr Baxter of the Chemistry Department, Glasgow Jniversity and support was given to the continued operation of 8irmingham's seismological station on South Georgia and the installation of a complementary station on Signy I., South Orkney Is.

Much less trouble than in 1971-2 was experienced with ship's and scientific equipment and the helpfulness of the entire ship's company has been overwhelming. The British Antarctic Survey in Port Stanley and South Georgia have again devoted time and facilities to easing our logistic problems.

A narrative is given in the next section, and followed by comments on the operation of particular items of scientific: and ship's equipment. Station lists and an analysis of how our time was spent are also given, and the track charts are presented by kind permission of Bob Graham whose originals we used in the interpretation of the copies appended to this report.

3. Narrative

Leg 1 Barry to Montevideo 13 Oct to 9 Nov 1973

Scientific personnel aboard on this leg were occupied mainly in setting up equipment for later legs. Between 3oN and 15°S however, a continuous magnetic, gravity and bathvmetric profile measured for Dr ,J.W. Jones of the-Geology Dept., U.C.L., and ornithological observations made by Dr M.P. Harris.

Leg 2 Montevideo to Port Stanley 13 Nov to 11 Dec 1973

The ship sailed a day late, having had to repair a port, stove in by a tug assisting her departure on 12th. Data collection started at 47°S Latitude, reached on 18th Nov., but before that-the ship spent seven hours hove to on 15th tensioning the dredge wire and 18 hours on 16th and 17th working on the hydrophone streamers and flexotir winch motor, which failed with a streamer outboard. On 19th the short hydro phone array and Bolt guns were tried out for the first time, and a profile obtained from ~49°S to the northern margin of the S. Georgia shelf, with in places 4 secs of sediment penetration On recovering the gun and array the ship headed at full speed for Grytviken, reached pm 22nd Nov. There the ship watered, and unloaded stores for the earthquake recording station installed at the BAS base from RRS Shackleton in 1971-L. By this time the ship was 4 days behind schedule and the decision was made to defer survey of three DSDP sites around the S. Sandwich Is until Leg 4; also, satellite ice reports suggested that the necessary tracks could well cross streamers cf loose pack ice Thus the ship headed west out of Grytviken pm 23rd, spending a day on sparker survey of a sedimentary basin near the south-west corner of the South Georgia shelf (found in 1971-2) before heading southwest at full speed towards a DSDP site north of the South Orkney Is. Since just north of South Georgia we had been coming across isoiated icebergs, some of huge extent but visible on radar and easily avoidable, By now however the ship was slowing to 5 or 6 knots during darkness, lest she collide with one of the associated bergy bits or growlers, which were not visible on radar and could be seen by eye at night only at a short distance. At 2300/25th, the reflection profiler was streamed at the start of such a night slow-down (~56°S), to obtain a long approach profile to the DSDP site. The sub-sediment interface between there and the elevated block on which the site (36/5) lies looked very like the top of oceanic layer 2, though oceanic magnetic anomalies were absent, The site itself was reached ~ 0300/27th and, with the assurance of further satellite ice reports, two more days were spent in reconnaissance of the area, including a line across the S. Orkneys trough to 60°S 10's. This was followed by a successful dredge haul of seeming oceanic basalt from a scarp on the extreme western end of the elevated block, and a rather indifferent first attempt at an oblique reflection profile on the drill site, using air gun and sonobuoy, late pm 29th Nov.

The ship then headed west for the next DSDP site at full speed, vi the small ocean basin centred on 59½°S, 49°W, the magnetic profile confirming symmetry about a north-south axis. 'Beyond the Shackleton Fracture Zone the ship turned SSW for a reflection profile across the South Shetland trench, part of a survey of DSDP site 35/9. Then, pm 3rd Dec, the first of two Bransfield Strait reflection profiles was steamed using for the first time the 300 cu. in. air gun with wave-shape kit; firing became irregular at pressures above 1200psi, so these lines and the subsequent zigzag across the trench on the way north (pm 4th and am 5th Dec) were shot under less than optimal conditions, However, the DSDP site survey showed clearly the oceanic sediments and underlying layer 2 dipping beneath a sediment pond at the trench axis, which it was required to do, and the Bransfield Strait profiles penetrated to the base of the sediments in the central trough. The weather blew up during these lines, for the first time since before South Georgia, and abated only slightly on the way to the next DSDP sites, 36/1 and 36/2 in the northwestern part of Drake Passage towards Cape Horn. A single reflection profile sufficed for 36/2, since the

magnetic anomaly orientations were well-known, but a more detailed survey was necessary at This was completed at about 2 kts in a Force 9 gale am 8th Dec and the ship was able to turn east and run before the wind, towards the southern end of Burdwood Bank in 60°W After some hours spent hove to calibrating the profondimeter, a reflection profile northwards across Burdwood Bank and the Falkland Trough was started, using the 6 channel array and 300 cu in gun with WSK, (fired consistently at 2000 psi by use of a smaller orifice than specified). This was completed by 1900/10th Dec, firmly on acoustic: basement at the northern margin of the Trough and the ship turned for Port Stanley, which was reached at 1000/11th Dec, An unexpexted finding of the reflection profile had been the opacity of much of Eurdwood Bank, penetration having been confined to the northernmost 15 miles. The last two active sections of the hydrophone array were giving very poor signals by the time the profile ended and it was decided to exchange them for those on the short array at the earliest opportunity.

Leg 3 Port Stanley to Montevideo, 14th December 1973 to 10th January -1974

Having fuelled and watered, the ship saiied north-about Cast Falkland from Stanley, pausing late pm 14th to change the last two active sections of the hydropnone array in poor weather. The sparker was streamed pm 15th for a traverse through the Jason Is but nc penetration of the (Carboniferous age) sediment was achieved, probably in part because of the unfavourable array geometry. With the source changed to a 300cu in gun with WSK, the line was continued south-westward as planned, until a request for assistance from MV Monsuwen, aground in Keppel Sound, West Falkland, caused its abandonment pm 16th Dec. Two hours later, however, the request was cancelled the gear re-streamed and the profile resumed in worsening weather towards the Falkland - Argentine median line. Good reflection data were obtained despite Force 9 winds at times, with the ship able to make only~2½ kts, from the median line eastward, then south onto Burdwood Bank. Here, pm 19th Dec, the gun was recovered, spark arrays streamed and the hydrophone array brought in to 80 m of cable, but still without effective penetrat-ion of the upper layers of the Bank., Later that day, five out of six channels of the array failed. Cn recovery the tow cable was found to have been damaged at 80 m, snd it was thought that rapid slewing of the ship after the last of a series of gyro failures had caused it to foul the side of the shute on which it lies while being towed, despite its having been constrained directly inboard of this by a dinghy strop, The remainder of the profiling was deferred while the long array was -transferred to the old tow cable and spring section, a 10 hour job. Then the ship headed for tht southern margin of Burdwood Bank, where a 4 fathom scarp had been seen on this largely flat block, during the traverse steamed at the end of Leg 2. This feature was reconnoitred further, and a successful dredge station, yielding a hard dark lime-stone, was followed by a split-shot sonobuoy refraction line. With the weather worsening a similar small feature at the northern end of Burdwood Sank was examined and two dredge stations, a mile apart, yielded a shelly limestone and a hard grit. It being too rough for a sonobuoy Line, the airgun and long hydrophone array were streamed and the profil-ing resumed, firstly onto the northern margin of the Falkland Trough then east along the Trough axis and south in 58°W longitude onto Burdwood Bank. At the southern end of this line (noon 24th Dec) the hydrophone channels again failed, immediately after an increase in speed /a daily engineroom requirement whenprofiling at 5 kts, to clean out exhaust valves/. The array was found to have parted at the inboard end of the

(old) spring section. The Dahn-buoy float was soon sighted and the array recovered. There being little that could be done before either this (old) spring section or the new cable had been repaired, the ship sailed for Port Stanley a half-day earlier than had been planned. Th ship anchored near Sparrow Cove for Christmas lunch then went alongside the Public Jetty. Peter Simpson joined HMS Endurance as liaison man for the forthcoming 2-ship seismic refraction work. With some much thicker nylon line acquired from HMS Endurance, a shortened 60 m-long spring section could be made; the old section was dismantled and the rope and conductors re-threaded before the ship sailed a.m. 27th. Th (new) cable having been soldered also, the long hydrophone array was re-rigged at sea that afternoon, and a reflection profile down to the starting position of the first two-ship refraction line commenced. A trial speed increase to 7½ kts after 20 miles caused all the soldered joints to fail, however, and the planned profile had to be abandoned, Instead a magnetic and gravity profile to the same position was stean arriving 1800/28th. After several hours spent balancing refraction hydrophones and cables, scientific work stopped and the ship drifted overnight.

The first half line, in the Falkland trough, was shot the following morning (29 Dec) after small initial difficulties over shot instant ccmmunication, and reversed during the afternoon. HMS Endurance then had to return to Port Stanley, having found she had insufficient fuse aboard to shoot more than one more half line. Shackleton's engineers seized the opportunity of repairing and curing a cracked cylinder head in the main engine; the ship drifted overnight 29/30th then steamed 15 miles, laid a sonobuoy and fired an oblique reflection profile with buoyed airgun at 1½ kts on bowthruster while the main engine repair was examined. The other half line was steamed more conventionally and the ship then made for the second two-ship 1: on the northern slope of Burdwood Bank, This was shot during 30th Dec the second half in rapidly deteriorating weather. For the next two days both ships could do little but steam around in the vicinity of next line, we acquiring some rather poor quality gravity and magnetic data. However the weather improved on 3rd Jan, and the remaining the lines were shortened and shot quickly on 3rd and 4th. By our persisting, HMS Endurance agreed to re-shoot the second part of line and this was complete by 0200/5th, Both ships sailed by separate routes to Port Stanley, where we stayed long enough to disembark a c; and transfer Colin Brett to RRS Bransfield for passage to the B.A.S. base at Signy I, where he was to set up a seismological station to complement that at South Georgia. Peter Simpsor returned aboard wit equipment, data sheets etc from Endurance. A magnetic and gravity 1 northwards across the Falkland platform and into the Argentine Basin was terminated at 46½°S and the ship was alongside at Montevideo by 1100/10th Jan, having meanwhile successfully tested the repaired sho spring section for an hour at 9.5 knots

Leg 4 Montevideo to Port Stanley 13th January to 10th February 197

In Montevideo the ship exchanged engineers and RVB technicians, and three scientists joined. Carnea 21 oil for the old spring section was acquired, the spare hydrophore cable and airgun tools arrived, b no airgun spares, The ship sailed 1100/13th Jan, headed for Shag Ro but, apart from trials of the towed salinometer, no scientific work done until a.m. 17th Jan at 47°S when magnetic and gravity profiling started. After encountering unexpectedly a 20 nm-long tabular iceberg

at 52°S the regime of slowing for darkness was recommended on 18th Jan, Shag Rocks were left to port 0800/19th and that afternoon a reflection **profile** across the DSDP site 36/4, on a N-S ridge south 0f S. Georgia was started, Profiling was coatinued to the first of a series of dredge stations across the Sandwich spreading centre, started‘at noon on 21st Jan. Ten dredge stations were occupied in all, in nearly four days; of these five were good, yielding abundant'oceanic lavas, but the others either were empty or contained only erratics. Among these were two attempted in Force 9 winds; possible as far as ship handling was concerned but lacking knowledge of or control over the dredge path. Reflection profiling was then continuous from the last dredge site (1½ million year old crust) eastward past, Zavadovski I and across the S. Sandwich trench, to 21° 3O'W (0900/27th), and then back westward across the trench again, between Candlemas and Saunders Is (where two humpback whales approached to within 30 yards of the ship) to about 29°W (3 million year old crust). This long profile was designed to find three DSCP sites 36/8 on the flanks of the spreading centre, 36/7 somewhere on the slope between island arc and trench, and 36/6 in the South Atlantic east of the trench. Of these, only the first is difficult to locate, the sediments close to the Islands being curiously opaque, perhaps because of a high volcanogenic component, but since the hole was designed largely to sample basement, the success of the dredge programme has greatly reduced its importance, and it probably will not be drilled.

A further dredge station on the spreading centre at 57½°S was followed by a trial TSD staion which suffered from a stranded wire close to the inboard end, making water bottle sampling difficult by impeding the messenger. Shortly after this (am 30th Jan) the airgun and short array were again streamed for a profile westward across the western margin of the Sandwich spreading centre, finishing in 37½°w at 0400 1st Feb, because of a shortage of time, The margin here, as further north, looks like a sequence of tilted blocks of oceanic crust, with a western dip slope and a steep east-facing scarp. Successive spreading episodes? The ship then continued westward at best speed which was not great because of persistent strong headwinds. Signy I was reached late pm 2nd Feb and an hour spent examining the seismometer pit and recording arrangements which Colin Bret had organised at the BAS base, before heading for the middle of the north-south TSD profile along 49°W Seven stations to 2000 m maximum were completed in a line southward from 60° 30'S to 61° 50'S, from pm 3rd Feb to noon 4th, in steadily deteriorating weather After being hove to until 0600/5th Feb, a reflection profile was run northward for the small basin between the Graham Land and S. Orkney blocks, onto the south Scotia Ridge. The latter was virtually opaque, but the way acoustic basement within the basin was depressed northwards' suggests the occurrence of a period of decoupling between basin and ridge. The northern part of the TSD profile, comprising a further six stations, was complete by midnight, 6/7th Feb and a magnetic and gravity profile across the Scotia Sea was started. In 54° 20'S (noon 8th Feb) a full 6-fold CDP reflection profile to Port Stanley commenced, using the repaired long array and 300 cu inch gun with WSK. As before, the north Scotia Ridge (Burdwood Bank equivalent) was opaque, but a very good section with 3 secs penetration was obtained from the Falkland trough to within 59 miles of Port **Stanley.** Such a great thickness of well-bedded sediments in this region was unexpected and is. of great interest,. The repaired long array behaved well, except that Channel 2 failed during a 9 knot engine-room speed increase.

At first on arrival in Stanley (0800/10th Feb) Shackleton went alongside, then (pm 10th) to anchor and finally (pm 11th) back alongside, so

that main engine repairs could start. These were complete sooner than estimated and by am 14th the ship had taken sufficient water and could leave. Two scientists disembarked, and a party was thrown in saloon and lab., to thank those in Stanley who had helped Us.

Leg 5 Port Stanley to Montevideo 14th February to 15th March 1974

On leaving Stanley the long array was streamed in rough weather, and a further channel (3) lost. It seemed better, however, to accept 4 working channels at this stage of the cruise than to attempt to change cables and connectors so a profile was run close to that obtained on the way into Stanley, tying in the reflectors more closely with rocks seen ashore and extending again to the Falkland trough, where up to 5 seconds sub-bottom penetration was seen. The weather being too rough for a sonobuoy line, the ship headed at full speed for the eastern tip of Burdwood Bank (0500/16th Feb) and thence ~110°T on a track designed to avoid fracture zones while examining the central Scotia Sea magnetic sequence. In this we were successful until 1500/17th (48°W); however, when examined, the trend of this fracture zone showed it was not part of the tectonic regime we had been studying hitherto, but possibly a later feature. A further diversion was made in 42°W to examine the orientation of some large magnetic anomalies, before breaking off (0500/20th) to head for the south Scotia Ridge and Weddell Sea, The IOS towedsalinometer had been out-board since Burdwood Bank, but from now on, south of the Antarctic Convergence, it was recovered each night and streamed again at first light

The south Scotia Ridge was reached 2000/20th and a reflection profile run across its northern part until 1300/21st (61° 15'S), the data suggesting that the elevation and roughness of the ridge in this region is a relatively recent feature, The remainder of the ridge, also rough and elevated, was crossed at full speed, the ship heading at 161°T into the Weddell Sea. The Antarctic Circle was crossed at~0300/23 and at 67° 20'S the first of a series of cross-tracks and parallel lines was streamed, to assess magnetic anomaly orientation. This attempt had not been made further north because of the occurrence of elevated features like seamounts, among the sediments which it was considered would disturb the oceanic anomalies. The results of the survey, which continued to 0600/25th were confusing; several times anomalies were seen, with orientations between 070° and 110° but none were of any great extent and it appeared that the evolution of the Weddell Sea may not have been simple, It was therefore decided to use the remaining time in completing the traverse and examining the nature of the south-eastern, Caird Coast margin. In extremely bad weather with strong easterlies making life uncomfortable, the ship made what headway it could the next two days in the general direction On two occasicns'it was necessary to heave to, to clear the main engine fuel lines of rubbish stirred up from the tank bottoms by rolling, and several times also the ship was hove to for meals. Because of the bad weather no record of the bottom was being received using the hull transducer of the PDR, and the towed fish was streamed pm 25th Feb, resulting in a vast improvement, As the Caird Coast was approached, the number of isolated tabular bergs increased, and -0800/27th the towed fish cable was severed at the waterline by a growler associated with one of them. Later on the density of brash ice and small growlers increased enormously, and the magnetometer was recovered and EM log retracted (1100/27th), the line being completed onto the continental shelf with only gravimeter and PDR in operation. Abou miles of 3 to 5 ohtas pack ice lay before the ice-shelf and this was skirted in moving southwest to start the return line. In passing through a thin streamer of this the Bergen log may have been damaged and forepeak Plate rivets sprung. The chosen start position on the shelf could not be

occupied, but a start was made ~1900/27th on a reflection profile headed ~340°T across the lower part of the dontinental margin, At about 2100/27 the ship had to slow to 2-5 kts to pass through an area of dense growlers and brash but the towed lines were considered safe, being towed astern, sinking deep at that speed and being protected by the width of the ship, The reflection profile was continued to 1000/28th and followed by a water bottle station to obtain Antarctic Bottom Water for Dr. Baxter and IOS, in 72°S. The next few days were occupied in steaming a course reciprocating that of the outward track at LO to 30 miles distance, with a diversion to cross the survey near 68°S, again made uncomfortable by a beam sea, caused by westerly winds of up to Force 9 speed. Passage was interrupted at 2200/2nd March in 65° 40'S for a second bottling station, occupied at night so as to lose less distance, then continued on a reciprocal track to 62° 40'S when (2100/3rd) it was thought necessary, for lack of time, to break off and head northeast for the Sandwich spreading centre, The elevated bodies seen on entry to the Weddell Sea were seen again on our return track, and may in fact turn out to be ridges, striking ~070°T, nearly parallel to the magnetic anomalies. Their origin provoked much discussion onboard and is still unknown. At about this time it was decided to shorten the scientific programme in order to reach Montevideo two or three days early, to hasten repatriation of a crew member on compassionate grounds. It was agreed that the scientific programme had been so successful to date that this would not be seriously detrimental.

The aim of the work planned around the southern end of the spreading centre was to date the magnetic anomalies there and then to dredge twice from close to the centre, Shortage of time, and a fog which persisted for several days and slowed the ship considerably, compromised the first of these aims; anomaly identification is uncertain and the strike unknown, since only one east-west track was steamed, but two successful dredges were carried out, on or very close to the spreading centre, at 60°S end 59.5°S. On leaving the second of these (0900/6th March), slow passage was made (fog) direct to South Georgia, the salinometer being towed in daylight and clear weather. On arrival at South Georgia (1000/8th March) an attempt to box off the hole in the forepeak tank was deferred until Piontevideo, but about 30 tons of fuel and some water were taken, seismological spares were landed and magnetic tapes and paper records from the same source taken on board, On leaving (1730/8th March) the planned sonobuoy line off Willis I was abandoned and course set for Montevideo, A dense icefield near 53° 30'S caused diversions overnight, and fog continued to delay the ship until 48° 30'S. A magnetic and gravity profile was terminated at 47°S (0900/11th) and the salinometer, which had been outboard since 0600/9th, was recovered. Good time was made on the remainder of the run to Montevideo which was reached at 2230/14th March,

4. Cruise Statistics

Cruise length,	Barry to Barry		179 days (est)
Time in port -	alongside		16 5
	at anchor		3'
		total	19.5
Time south of 47°S			104 days
Considering only this time, Time alongside or at anchor			10 days

Time incapacitated by engine or scientific breakdown	3 days
Hove to completely for bad weather	3½ days
	16½ days

Total useable scientific time (= 104 - 16½) = 87½ days
Station time 7½ days
Passage time 80 days

During time on passage, the following data were acquired

Magnetics	75½ days
Gravity	74 days
Reflection profiling	31 days

Gravity down-time is largely caused by rough weather, magnetics down-t: largely by short runs between stations when to stream the magnetometer was not thought worthwhile. Reflection profiling time is limited because of the time penalty incurred (5-6 knots maximum speed for firs class records). The above times have not all been translated into distance, but, for example, 21,300 km of magnetic profile and 7,300 km seismic reflection profile were steamed.

5 Scientific and Ship's Equipment Performance

1. Magnavox 702c/HP Satellite Navigator, Worked well throughout and from our point of view ideally located in the lab. Agree with bri watchkeepers however that a display unit of some kind actually on bridge would be a great advantage.

2. Lacoste-Romberg Gravimeter. Worked well throughout, although some component failures have occurred. Unexplained 5-15 min long 30 mg offsets have not occurred since axis gyro was changed. Spring ten: ion diplay needs servicing.

3. Barringer Magnetometers. Main magnetometer worked well throughout: fewer fish changes than in 1971-2 as a result of eliminated outboa connectors. "Shallow water" instrument unused, except chart recorder used as standby and for tensionmeter display during dredgi (q.v.).

4. Kelvin Hughes MS38 PDR. Worked well until last 2-3 days when chair drill failed. Towed fish much more quiet than hull transducer, le cavitation and less affected by noise from generators, winches and bow thrust. Hull transducer virtually useless for pinger monitorir on dredge, TSD etc. stations. No effective standby sounder on boar MS26J and other bridge sounder virtually useless. N.B. There is no point in getting a Kelvin Hughes man to pronounce on the MS26J's performance in Barry Docks; if it is going to be repaired the repai should be tested in 2000 fms, but probably it is better to replace with new deep bridge-mounted sounder, able to fulfil both navigational and scientific roles.

5. EG & G Sparker and sparker generator. Worked well when required. use is likely to be infrequent, it would be sensible to remove the generator battery to the battery box between periods of use to make starting easier. Worth considering if small Bolt guns would be mor convenient alternative for ships with permanent compressors.

6. Airguns and compressors. The compressors have worked happily all season, in tandem for most of the time and unloading at intervals. Since no spares were carried we were perhaps fortunate that they did not break down.

The two 1500 c Bolt guns (571 & 572) also worked very well, suffering only three breakdowns, one because the air filter disintegrated, one a solenoid valve seal failure and the third of unknown origin. Servicing has been regular, immediate, thorough and clean, and we think this essential to the continued operation of the guns.

For 80% of the time the guns were fired using the 300 cu in chamber with wave shape kit, the remainder using the 160 in chamber. With the wave shape kit in it is necessary to use the smaller orifice (P 1535-1A), and spring consumption is much higher. Broken springs can score mating surfaces, but with no noticeable effect on performance as yet. There is some suggestion that spring failure is hastened by the slow rate of supply of air to the gun after firing, limited by the 1/4" shipboard piping. An alternative is to have a small reservoir at the after end.

The towing assembly is adequate, apart from the gun bracket, which causes the towing strop to chafe The A-frame/crane arrangement for putting the gun in and out can and should be improved.'

A gun tool kit should include open ended spanners, hide mallet, pliers and a socket to fit the shuttle nut. Inhibisol may be an effective cleaning agent but dissolves human skin; an alternative may be available. Stowage and dismantling space for two guns in the rough lab. would be improved if the "horse" were moved aft by 18" or so, and the two magnetometer bottle racks replaced by a vertical gun mounting.

We submit a logbook of gun use and servicing, and suggest that it be continued on future cruises. Copies could be made available to intending users.

7 Geomecanique streamers and winch. These had much hard use and stood up well. The drawbacks of the incompatibility of some old and new units are by now well-exposed and as much as possible of this incompatibility should be eliminated. The location of the division between the two streamers on the drum was ideal but would have been much better as a solid-wall, since sections bulge through the gaps, distort and are trapped by the other streamer. An electric starter motor and more sensitive braking would undoubtedly make streamer handling easier and prolong streamer life, as would the replacement of the chute on the after rail by something such as soft, sprung rollers.

N.B. The existence of 200 m of cable and 100 m of spring section before the first active section makes the geomecanique array of limited use with the higher frequency spark array source; reflections are obtained in shallow water only from relatively flat-lying beds. It is essential for the examination of sediments which are likely to be more tightly folded to supply an additional hydrophone array of smaller dimensions.

8. Profiler recording and display. Reflection profiler data was passed through a multichannel Fortune amplifier with optional AGC recorded on the 1" Beli & Howell tape deck, displayed on one or both of the two EPC flat-bed chart recorders and monitored on a Bell & Howell U-V galvanometer recorder. All of this equipment worked well, such faults as were encountered being in the EPC's and being caused by dirty contacts. The distribution of (conducting!) carbon black around the interior o.f the EPC recorders, over all the circuitry, is a severe design fault in these recorders, and makes frequent cleaning essential.

9. 2 Ship seismic work. The receiving equipmeni ccmpriaed two EVP 7 hydrophones on 1800 ft of neutrally buoyant cable, a GTR 200 amplifier and filter set, UV recorder and bell & Howell tape deck all of which functioned well. Aboard HMS Endurance, the shooting ship, signals from a microphone in the shaft tunnel and a towed hgdrophone (frequency modulated) were transmitted on separate radio channels to Shackleton to establish the time of detonation of the charges. This arrangement was found tc be perfectly satisfactory provided HMS Endurance transmitted in double sideban mode. Shackleton's radio installation was entirely adequate. Five reversed lines were shot in all, two fewer than had been planned.

IO. Sonobuoys. Three sonobuoy lines were shot, one firing aquaflex out to 12 miles each way and the other two to shorter ranges (6-E miles) firing the 300 cu in airgun. Much more sonobuoy work had been planned, and this was the main casualty of time lost elsewhere, However, buoy performance was quite satisfactory and tile aquaflex gave very few misfires.

11. Dredging. Seventeen dredge stations were completed, twelve being successful. A pinger was put on the wire 200 to 300 m above the dredge for most lowerings and (with towed PDR fish only) was usually helpful; particularly useful was a permanent display of the tensiometer on the spare magnetometer chart recorder (8"/hou 1 volt full scale ≡ ~7500 lbs). It was easy to see, after a little practice, when the dredge hit bottom, when it snagged and when it lifted off, besides providing a permanent record of the station and obviating the fixed stare at the dials, which affect; some people for life afterwards. We have doubts however about t dredge design, and hope to devote some thought to the problem before the next cruise. We doubt the relevance in actual operating conditions of the nominal breaking strains of the weak links and would like to increase the strength of the 3- and 5-to links to 4 and 6 tons respectively.

12. E M Log. This gave constant trouble in the first part of the cruise. When the new head was fitted it operated uncalibrated f a while, but failed again when lowered on the way north through the Weddell Sea. The cause of this final defect is unknown as y since it cannot be extracted from its housingas some of the sea valve gear cog teeth are stripped.

13. Mimco System. This was out of action on several occasions, each time because water entered one of the upper deck units. It is surprising that this situation has been allowed to persist for so long. Does no other cruise get bad weather? The units on the starboard side foredeck and port side break of bridge are those affected, the poopdeck set being protected at present by the hydrophone streamer drum. Cannot these units be changed for some more waterproof variety, since all are in useful positions?

14. Grsvimeter Room. We have found this space extremely useful, as a quiet room for working on data away from the distractions of the lab, and as being good quality stowage space for data. Could not this use be extended by putting in data storage racks or cupboards on the forward bulkhead and a drawing table on the bench? Both would have to be removeable so that the floorspace was available for more than one meter when necessary, and access would have to be restricted so that the air-conditioning remained effective.

15. Spare Parts. Most if not all items of scientific equipment carried on the ship are adequately supplied with spare parts, or duplicated completely. It is worth emphasizing here that the scientific programme can fail even more catastrophically on a long cruise such as this one, on account. of the breakdown of other, non-scientific items of ship's equipment. It is our opinion, for instance, that two gyros should be carried, each with spares, a spare bridge radar and echo sounder, and many more main engine spares. A series of cruises is imminent which involve long periods away from Barry, and parts without adequate manufacturers representation. The necessary money could turn out to have been well spent,

16. labs.

(1) It probably will not be long before parts of the rough and wet lab deck covering will need renewal. Despite all affirmation to the contrary, nearly all lab watertight doors still. leak and, since those forward are most vulnerable, a fair amount of water enters the wet lab and is lifting the vinyl tiles. Could the opportunity not be taken to replace these with a truly waterproof and non-slip surface? Similarly, the after end of the rough lab deck is suffering from air gun movement; renewal could again be done with non-slip material.

(2) We understand some rearrangement of main lab space will follow the imminent installation of a data logger there. Although you may never get--two users to agree, we think that some user consultation could take place at this time, since we have strung opinions about what constitutes a good watchkeeping area. There was near-unanimity on the views that the radar, light table and Mimco extension were wrongly situated, for example. The light table also looks vulnerable; much stronger, preferably frosted,- glass should be used. Something should also be done to resolve the rather obscure compromise whereby the lab door nearest the satnav has a notice saying that DTI regulations require it to be unobstructed, while it is kept locked and the stairway above used for lifebelt stowage.

These comments are now approaching the trivial; at this level we would put a request for facilities for exercise and the complaint that the legs came cff the plastic chairs if one sat on them. All in all, however, the cruise was a good one, and the facilities excellent, We make adverse comments only because we know that RVB is anxious to raise its standards higher still.

6. SHACKLETON STATIONS 1973-4 (Cruise 7/73)

STATION No.	START GMT	START DAY	STOP GMT	STOP DAY	LAT .S °	LAT .S '	LONG.W °	LONG.W '	TYPE
1017	0526	333	0850	333	59	11	46	39	DREDGE
1018	1326	333	0125	334	59	17	45	10	SBUOY REFLN
1019	1944	354	0008	355	54	41	60	3	DREDGE
1020	0052	355	0820	355	54	40	60	2	SBUOY REFRN
1021	1953	355	2104	355	53	57	60	9	DREDGE
1022	2139	355	2305	355	53	56	60	11	DREDGE
1023	1552	364	0219	365	53	30	60	13	SBUOY REFLN
1024	1042	021	1515	021	56	42	35	42	DREDGE
1025	2013	021	0030	022	56	32	34	20	DREDGE
1026	0512	022	0918	022	56	31	33	40	DREDGE
1027	1250	022	1524	022	56	30	32	57	DREDGE
1028	1750	022	2236	022	56	35	33	5	DREDGE
1029	3125	023	0620	023	56	30	32	25	DREDGE
1030	1053	023	1422	023	56	25	31	30	DREDGE
1031	1800	023	2329	023	56	23	31	30	DREDGE
1032	1400	024	1958	024	56	24	30	40	DREDGE
1033	2312	024	3621	025	56	23	30 30	18 0	DREDGE
1034	1754	029	2145	029	57	32			DREDGE
1035	2218	029	0540	033	57	30	30	13	T.S.D.
1036	1517	034	1716	034	60	31	49	0	T.S.D.
1037	1854	034	2023	034	60	48	49	I	T . S . D .
1038	2148	034	2354	034	60	55	49	0	T.S.D.
1339	2339	034	0241	035	61	I	48	58	T.S.D.
1040	0510	035	0717	035	61	14	49	3	T.S.D.
1041	0917	035	1119	035	61	30	49	0	T.S.D.
1042	1543	035	1805	035	61	44	49	0	T.S.D.
1043	0200	037	0305	037	60	21	49	2	T.S D.
1044	0552	037	0742	037	60	9	49	2	T.S.D.
1045	0924	037	1144	037	59	54	49	0	T.S D.
1046	1327	037	1541	037	59	37	48	57	T.S.D.
1047	1709	037	1922	037	59	23	49	1	T.S.D.
1046	2112	038	0009	039	59	7	49	7	T.S.D.
1049	1336	059	1630	059					WATER BOTTLES
1050	0135	062	0440	062	71	55	2413	72 30	WATER BOTTLES
1051	1125	064	1437	064	60	40	29	57	DREDGE
1052	0817	065	1145	065	59	29	29	59	DREDGE
1	1222	363	1638	353	53	25	60	54	2 SHIP REFRN
1R	2059	363	0100	364	53	31	59	57	
2R	0903	365	1304	365	53	46	60	0	
2	1731	365	2055	365	53	41	60	54	
5R	0910	003	1223	003	54	37	59	58	
5	1651	003	2059	003	54	28	60	32	
4	2355	003	0242	004	54	14	60	32	
4R	0825	004	1124	004	54	16	60	3	
3R	1440	004	1725	004	53	58	60	5	
3	2034	004	2331	004	53	55	60	36	
2	0201	005	0401	005	53	40	60	34	

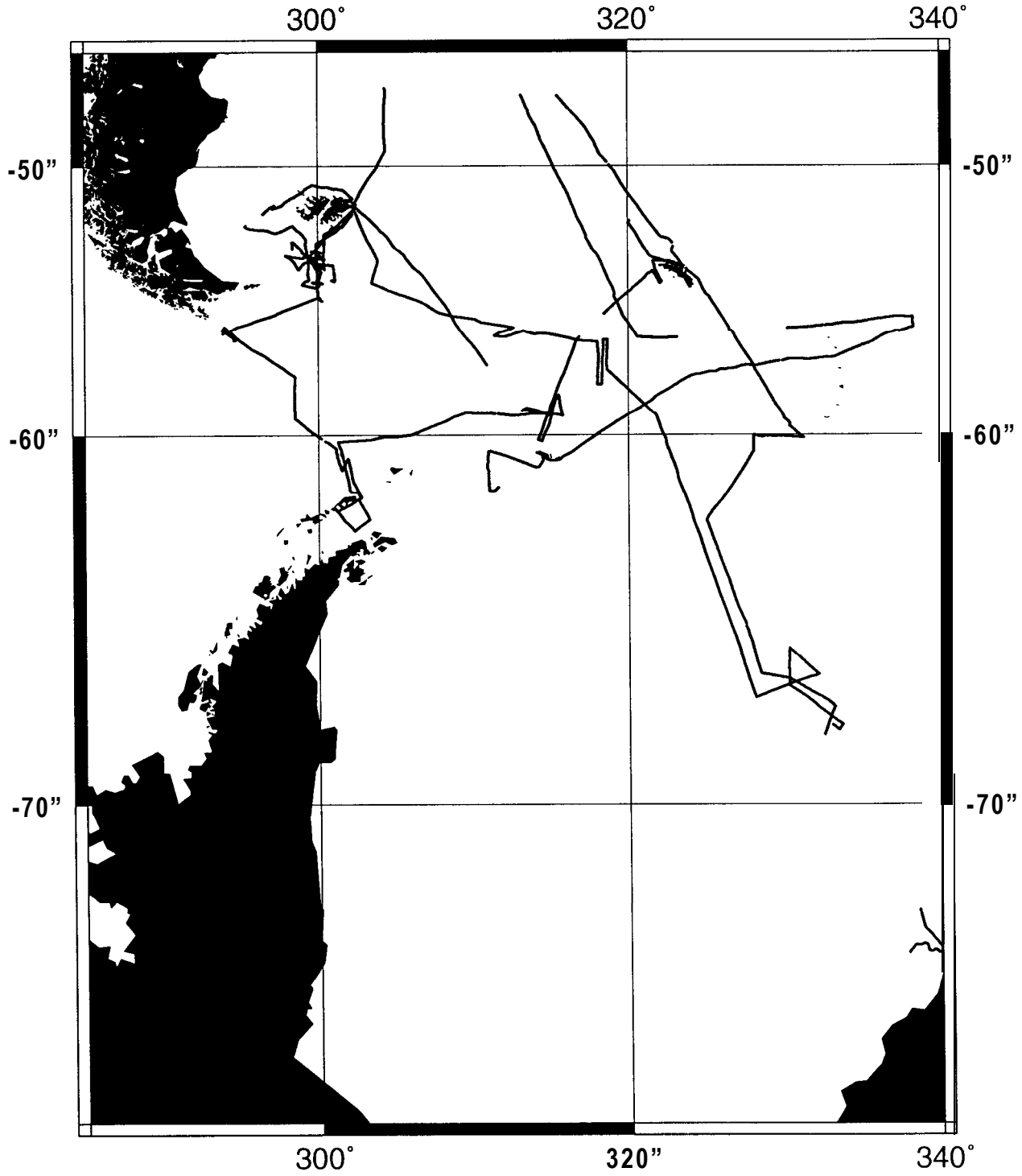
ACKNOWLEDGEMENTS

We owe a very considerable debt to the ship's officers and crew for all the assistance we received from them. This was cheerfully forthcoming at all times of the day and night, and in all circumstances of wind and weathar.

We thank Captain G. Selby-Smith for his help with many matters and his willing co-operation, and the deck officers particularly for their patience in dealing with our often difficult requirements. We also owe a great deal to the electrical and engineering staff who worked long hours on our behalf, and to the bosun and the deck crew for their efficient handling of the dredge and other equipment.

We also thank the catering staff for their unflagging services throughout the trip. Lastly we do not forget the cheerful assistance of RVB's technicians on board ship, and all those of the staff ashore who made a most successful cruise possible.

Shack-73gravity



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