JR01:

RRS James Clarke Ross
Antarctic Peninsula and Weddell Sea
Geophysics and Physical Oceanography
February 1992 - March 1992

Natural Environment Research Council

British Antarctic Survey

Cruise Report

RRS *James Clark Ross*

Cruise JCRO 1
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Geophysics and Physical Oceanography
Antarctic Peninsula and Weddell Sea

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1. **SUMMARY** (PFB)

Cruise JCR01 occupied 35 days, from 5th February to 1lth March 1992, Port Stanley to Port Stanley. It met some objectives, but not others. The ship behaved extremely well in some respects but, temporarily we hope, also revealed its limitations. Ice was a nuisance, but the weather was generally very good.

The cruise comprised a series of objectives that survived from the original cruise conception, that could be accomplished

(a) without use of the 30-tonne traction winch (ie preventing coring, dredging), that had not been accepted;
(b) without RVS technical support (ie no MCS, SCS or gravity, no mooring redeployment).

The main objectives were a deep-tow boomer survey of the Antarctic Peninsula outer shelf off Anvers Island , and recovery of 2 sets of current meter moorings (our own and Prof T D Foster’ s) with associated CTD casts.

The boomer survey, undertaken with the aid and collaboration of BGS Edinburgh, was highly successful. Recovery of Prof Foster’ s moorings failed completely, not from our own actions but probably because of faults in the deployed acoustic releases and/or their power supply. Two out of three of our own moorings were recovered, and a total of 23 complementary CTDTr (conductivity-temperature-depth-transmissivity) stations were occupied. In addition a successful 10-day trial deployment of a remote-recording earthquake seismometer was completed on Byers Peninsula, Livingstone Island, and a suite of surface- and deep-water samples were filtered for a study of suspended sediments. Several days of magnetic data were recorded, on routine passage in the Scotia Sea and on a specific transect of the northern Weddell Sea, to assist studies of regional tectonic evolution. ADCP data were also obtained where conditions permitted.

This was a maiden scientific cruise, undertaken following late delivery and a rushed and incomplete equipment trial. The absence of certain key items of equipment, and financial considerations, severely constrained the range of science that could be attempted. These factor may explain a pre-occupation in this Report with equipment performance and defects, at the expense of reports of scientific achievement. The biggest limitation was in use of the winches: even the 10-tonne (CTD and 6mm hydro) winch was not operating properly, and needed much care on the part of the ship’ s engineers. The 30-tonne winch was not available. We had no information on winch system design and setting-up or test facilities, and aspects of the system as provided were not up to specification.

As maiden cruises go, it may have been relatively successful. We benefitted considerably from the friendly and skilled help of the entire ship’ s company, for whom, as for us, most of the work was made more difficult for being undertaken for the first time on a new ship. We hope that by next season the missing facilities will be in place, the defects found will all have been corrected, and we shall be able to exploit the ship’ s full range. When she is finished, *RRS James Clark Ross* will be an excellent research platform.

2. **NARRATIVE** (PFB)

The ship left Port Stanley on day 036 (5th February) and made a swift crossing of Drake Passage, collecting magnetic data and 10 kHz and 3.5 kHz bathymetry on passage. Rob Larter was picked up from Teniente Marsh after completing a 3-week Geophysics cruise aboard BIO ***Hesperides as*** invited guest. We then anchored off Byers Peninsula am 8th early on day 039 and deployed a remote-recording earthquake seismograph, for noise trials (part of B6211).

The next 9 days were spent on Deep-Tow Boomer survey of the outer continental shelf off Anvers Island (B6152), aimed at describing the discrete glacial sediment sequences that correspond to the most recent glacial/interglacial cycle. This aim was achieved for the topset beds on the shelf, and the cause of a rather poor definition of foreset beds was established as the extremely rough gullied topography of the upper-middle slope. The relation between the supply of ice and sediment inshore, which varies considerably along strike, and the apparent uniformity of shelf edge sediment supply, should become clear from detailed examination of the profiles. An excellent data set has been acquired, which Lieve Vanneste and Rob Larter will work up.

The equipment worked extremely well, once the cause of 50 Hz noise had been established (Cathodic Protection! - see section 3). While this problem was being diagnosed (overnight 040-l and 041-2), 3.5 kHz and magnetic survey lines were run NW to the continental rise and back, to augment existing data (B6211).

On the one day of bad weather we were able to gain sufficient shelter in Bismarck Strait (overnight 043-4) to examine the deep trough that occupies its western half, using the 3.5 kHz profiler, to investigate its origin. This brief and opportunistic examination was inconclusive, but we prefer a glacial to a neotectonic origin for the trough, on the grounds that there were no thick sediments visible within it. These would be expected if recent tectonic subsidence had exceeded the depth reached by grounded ice during the last glacial maximum (as in Bransfield Strait, for example).

After the main survey was complete, we returned to Byers Peninsula on the morning of day 050, via short but illuminating Deep-Tow Boomer survey of an isolated submarine till tongue north of Smith Island. This feature provides a simple model for some of the more complicated terrain in the main Anvers margin area.

The recovered seismograph had recorded successfully, including at least one event that, from P-S separation, could have originated at Deception Island. Much has been and will be learned about deployment and environmental effects.

We left Byers Peninsula on day 050 for the northern Weddell Sea. The next task was to attempt to recover Dr T D Foster's (Ted's) array of moored current meters. We had offered to do this when Ted's original cruise (aboard the ***Nathaniel B Palmer,*** delayed in construction!) was cancelled. In this task, unfortunately, we did not succeed.

We met the pack ice at about 63°S 53°W early on day 051 and remained in it for the next 12 days. Throughout this time, unless the ice was very light, we travelled only between about 0430 and 2100, and either undertook CTD stations or "parked" in a floe at night. This was reasonable practice: the ice performance of the ship is impressive, but its safe application depends upon moderate visibility. At this time, only 1 of its 3 searchlights was working.

Briefly (though the effort and agony were certainly not brief) we dragged for the first, shallow-water mooring (a), which had a 900m ground line. Three well-defined crossings of the nominal position failed to collect anything, and our best guess was that the mooring has migrated north with the prevailing current.

We then tried to recover 2 other moorings, including Oceano acoustic releases, but failed. At the first (Mooring c), we tried ranging on the release, using 2 independent deck command units and transducers, but without success. The ship then shifted sufficient ice floes to create an area of open water (1.5km radius) big enough to guarantee that we would see anything that reached surface, and we attempted release. We saw nothing, however, and decided to move to the next mooring (d). There also the ranging exercise failed. Having only the 6mm wire available, dragging in deep water (2600 metres) was not a viable option because of the low SWL, and Ted, rather than occupy more time, suggested we end the attempt. We did in fact stay in the area for a further 24 hours, measuring a CTD transect up the N Weddell Sediment Drift (part of B6151) while consulting Oceano UK agents. A multichannel seismic reflection profile (Line 14) acquired on the ***Discovery 1984-5*** cruise had revealed a sediment drift on the NW slope of the Weddell Sea, and we had hoped to investigate this further using the deep-tow boomer. This year there was far too much ice even to contemplate using the boomer, but we were able to occupy a set of CTD stations on the slope, mainly to measure the distribution of suspended sediment in a relatively high-energy environment, close to a likely bottom-water source area. From Oceano UK we learned that we had acted correctly throughout, and there was nothing more we could try, so we abandoned the moorings with acoustic releases and made one more unsuccesful attempt to drag for the shallow Mooring (a), on day 055 We believe that either the acoustic releases or their batteries are faulty, and the only remaining method of recovery is by dragging with a much heavier and stronger wire than presently we have available.

The ship then headed for our own Weddell Sea moorings (B6151) farther east, moving through virtually solid pack at a steady 7 knots. An attempt at a magnetometer line along a flow line of Powell Basin opening was abandoned because the ship' s stem offered insufficient protection from ice to the magnetometer cable.

The ship' s satellite ice/weather receiver had failed just before our entry into the ice, and the interpreted ice distribution maps produced weekly by the US NPOC were showing only tentative distributions because of poor visibility. However, it seemed likely that ice cover over our own moorings, significantly farther east, would be less dense.

Mooring recovery was planned within 2 CTD transects: the main mooring/core transect running from the South Orkney block well into the Weddell Sea contained 2 moorings (I and III) and 12 CTD stations, and a shorter transect of Jane Basin farther north included Mooring VIII. We arrived at the northern end of the main transect late on day 057.

The first 4 CTD stations went reasonably well, except for a need for winch repairs that prolonged one, and Mooring I was reached early pm on day 058. This mooring had an IOS release below an Oceano release, giving greater flexibility and improved chances of recovery.

After a fruitless attempt to range using the Oceano command unit, the mooring was successfully located and released (using the IOS command unit built into the PES Mk 4, and the towed fish), and was recovered complete.

Six more CTD stations were occupied successfully before arrival at Mooring III on day 060. On this mooring the Oceano release had been placed beneath the IOS release, making its correct operation more important This time it was found possible to range on the Oceano release, by varying the depth in the water of the dunking transducer. This went against all advice received, but worked. However, it did not appear possible to release the mooring using the same method. Eventually the IOS release was tried but with similar results: the release could be contacted, and precisely located, but the mooring would not rise from the seabed. The attempt was finally abandoned, and the remaining CTD stations along the transect were completed overnight.

The western end of the Jane Basin transect was not reached until pm on day 061, because of slow progress in dense pack. 3 CTD stations were occupied over the next half day (despite winch drive problems) and Mooring VIII was reached early on day 062. On this mooring, the IOS release was beneath the Oceano release. However, contact with the IOS release could not be made, although the Oceano command unit successfully ranged on and located the mooring. Efforts to activate the Oceano release were under way when the mooring rig was spotted at the surface, the IOS release having activated despite the lack of acoustic response. The Oceano release, fortunately, had once more not operated, so both units were, recovered. A report of lab tests on the 2 recovered Oceano releases is included in this Report.

By now there was much concern about the continued performance of the CTD winch, fundamentally because of overheating, so the CTD stations on the remainder of the transect were prioritised, and in the event only 2 of the 3 were attempted.

The ship departed early on day 063, heading northeast for the start of a magnetic transect of the NW Weddell Sea, along lines carefully chosen on the basis of Geosat altimetry (B6212). Because of ice, the magnetometer could not be streamed until late that afternoon, about 40 nm along the line. Magnetic survey continued over the next 3 days, in open water with winds force 4 to 7 and a moderate swell (the first for 2 weeks). This was undemanding, routine survey and gave the opportunity for those who had been heavily involved in the CTD/Mooring programme to recover.

The remaining tasks for the cruise were recovery of some diatom ooze for flume studies (B6151), and a deep-tow boomer reconnaissance of Bruce Bank, followed by a call at Signy Base to pick up summer-visiting scientists for transport to Port Stanley. However, shortly before arrival at the diatom ooze site we were informed of a leak in the main generators' sea-water cooling supply pipes. On the evidence of reports of a previous, similar leak in the auxiliary generator's cooling system, which had revealed systematic corrosion at welded flanges, it was decided to head directly for Port Stanley for examination and repair at the end of the ooze dredge, cancelling the deep-tow boomer survey and the Signy call. Dredging for sediment was attempted using two pipe dredges hung in series on the 6 mm hydrographic wire, with a chain weight just above the upper one. The water depth was 2850 m. During veering a power failure occurred (0015-0023/068) and the winch was stopped for half an hour. Total station time was 3 hours and one bucketful of ooze was obtained. The ship departed the ooze site westward early on 8th March (068), streaming the magnetometer with the aim of obtaining useful magnetic data along minimally diverted tracks across the Scotia Sea (B6153).

The ship made slow progress at first into a head sea, and the PES and 3.5 kHz records became very poor because of aeration beneath the hull. On day 069 the weather improved and the ship made better speed Scientific watchkeeping was ended at 4pm on day 070, just to the north of the Falkland Trough. The weather worsened rapidly that evening, the short period of the steep sea apparently overcoming the ship's motion stabilisers, so that we experienced perhaps the most violent rolling of the ship's short life.

The ship tied up alongside FIPASS shortly after 0700 (local) on day 071 (11th March), 1992.

3. **DEEP-TOW BOOMER SURVEY** (RDL)

3.1 Introduction

A modified HUNTEC deep-tow boomer (DTB) and digital recording system were loaned from the British Geological Survey (BGS) for the duration of this cruise. The DTB was operated by Colin Brett and Dave Smith from BGS, Edinburgh. After some initial technical problems had been overcome (see Section 3.3) the DTB performed well, and over 1000 km of boomer profiles were collected in the main survey area, on the continental shelf and upper slope to the W of Anvers Island (see inset to track chart). The principal objective of this survey was to obtain a dataset which will enable us to test and refine existing models of glacial-interglacial sedimentation on the Antarctic continental shelf and slope (part of BAS Project B6152 "Antarctic shelf-slope-rise sediment transport"). This was the first time a DTB has been used anywhere around the Antarctic. The area surveyed had previously been studied using a variety of other marine geophysical techniques, and the Cenozoic tectonic history and long-term glacial history are fairly well understood. Thus we are privileged to have a unique dataset, the general context of which is already quite well established. It is anticipated that analysis of this dataset will provide insights which are relevant to understanding the development of many parts of the Antarctic continental margin.

The start and end times and positions of the main DTB lines are listed in Table 1 (N.B. this table does not include data acquired while turning and on short transits between lines). The majority of these data (Lines 2-21, over 900 km) were collected during two periods of almost continuous data acquisition, between days 042 and 049. The survey was interrupted for a period of about 29 hours by bad weather on days 043-4. During this time we took shelter in Bismarck Strait, SW of Anvers I, and ran several 3.5 kHz profiler lines across it. Before the cruise Bismarck Strait had been considered, along with several other inner-shelf basins, as a possible DTB survey target in the event of bad weather. However, the 3.5 kHz profiles revealed that the area of ponded sediments in Bismarck Strait, which is at greater than 1400 m depth, is only about 4 km across. It was not considered worth deploying the boomer to profile across such a small feature.

During this survey it became apparent that it is necessary to make a relatively large allowance for set, to stay on line in even a moderate cross wind, presumably because of the high superstructure of the ship. This often resulted in a large feather angle on the boomer cable. Such feathering may cause problems on future Marine Geophysics cruises when a range of towed equipment is employed (e.g. multichannel seismic streamer, 4 airgun beams, 2 independently towed airguns and a magnetometer).

3.2 Preliminary Results

The DTB data reveal a detailed acoustic stratigraphy in the Holocene sediments over the mid-shelf region. However, the rather poor subsurface penetration on many lines across the outermost shelf is disappointing. It had been realised during the planning of this survey that the outermost shelf was likely to be a difficult environment for the DTB, because the sediments there have been compacted by the overburden of ice at times of glacial maxima and there has been very little interglacial sedimentation. This is why we had planned to supplement the boomer lines with high-resolution airgun seismic data. Unfortunately, this component of the survey had to be abandoned because of the decision to withdraw funding for RVS technical support on this cruise.

DTB lines along the upper continental slope also show little subsurface penetration, suggesting that the underlying sediments contain a high proportion of coarse-grained material. These lines also reveal that some areas of the slope are dissected by regularly spaced gullies which increase in amplitude down slope. If previous slope surfaces were similarly gullied, this partly explains why foreset reflectors, which are observed on multichannel seismic reflection lines, are so poorly imaged beneath the outermost shelf on the boomer records.

In several places acoustic facies units up to 30 m thick and with few internal reflections were observed to thin to less than 5 m, within a distance of about 1 km, when going from SE to NW across the shelf. On some lines weak reflections within these units suggest that the low-angle slopes ($<2°$) at their edges may have been formed by progradation. Our working hypothesis is that these units are till sheets (or "till deltas") deposited at the base of, and in front of the grounding line of, a thinning ice sheet. Two short lines collected late on day 049, on the shelf to the N of Smith Island, crossed a similar but better developed feature. This feature had recently been discovered during a multichannel seismic reflection survey by the Spanish research vessel BIO ***Hesperides.*** Here the till sheet has a maximum thickness of over 100 m and the boomer data show clear evidence of foreset deposition beneath the concave slope which marks its edge.

3.3 Operations (CPB)

The BGS deep-tow boomer equipment was placed onboard RRS ***James Clark Ross in*** Grimsby in early November 1991 and was mobilised in Port Stanley commencing 2 February 1992. With the ship's Deck Engineer engaged in other ship duties throughout the port call no mechanical assistance was forthcoming and hence the mobilisation was slower than expected. Excellent assistance was provided throughout by the scientific bosun John Summers.

The mobilisation went smoothly with the exception of the low pressure hydraulic oil feed pipe on the winch power pack which ruptured on power-up. However a temporary repair permitted a test deployment of the fish whilst alongside. The deployment was reasonably straightforward but would have been easier if both sections of the A-frame could be moved at the same time. This would mean that the block could be maintained at a constant height throughout the deployment/recovery.

After the ship had sailed from Stanley on 5th February (day 036) the Deck Engineer was able to devote more of his time to the system and assisted in the repair of the above mentioned hydraulic pipe and in connecting the sea water cooling. The system was test fired on deck and by the day 037 was ready to go with the exception of the hydraulic pipe which was still under process of repair.

On day 038 the first opportunity to deploy and test the system underway was taken as the vessel sailed from Marsh base. The system fired fine but both hydrophone channels suffered from very large amplitude 100 Hz noise.

On the day 039 the vessel anchored off Byers Peninsula: investigation of the noise problem was commenced, and occupied the whole day. The noise was found to be caused by excessive 50 Hz which swamped the hydrophone preamplifiers causing them to distort the signal thus making it appear as 100 Hz. By late evening it was concluded that the system was fine and that the noise was due to the ship not being a good earth. The noise only appeared when the fish was in the water, or when an earth lead connected to the fish was placed in the water. Discussion with the ship's Electrician the following day revealed that the ship **has no sea earth.** The resistance between the laboratory "earth" and the sea was measured at approximately 400 Ohms instead of a few Ohms. The cathodic protection system was switched off and the measured resistance reduced to approximately 200 Ohms. Within itself the ship was earthed to the same point but "floating" above the sea. When the boomer was deployed it acted as a sea earth for the ship and hence the noise. A large steel hawser was bolted to the deck and streamed astern to act as a sea earth. This reduced the resistance between the deck and the sea to 18 Ohms and removed the noise problem. This earth problem requires a better solution for future scientific cruises involving towed equipment.

Survey operations commenced in the evening of day 040, but the boomer failed after approximately 2 hours when it ceased firing. It was found that the HV was shorting to the sea from the junction of the sparker cable and the main pot in the towfish. This was repaired but on testing before deployment it was found that the pitch, roll and depth indicators were giving meaningless readings. The cause of this was traced to a failure of one of the hydrophone amplifier boards in the laboratory console which was dragging down the power supply to the other sensors. Boomer operations were recommenced during the evening of the day 041 after a test deployment of the CTD probe The DTB system operated for approximately six hours before failing again, the symptoms suggesting an ingress of water in one of the main connectors. However this was found not to be the case and further investigation of the problem on the day 042 found that the fish Attitude Sensor Unit housing had itself leaked slightly. This housing had been opened during the previous fault investigation. The unit was cleaned out and reassembled with new o-rings.

Survey operations restarted in the afternoon of day 042 and thereafter ran without further technical problems until the survey was completed on day 049 with one break for poor weather. 23 lines, totalling just over 1000 km, were completed on the continental shelf and upper slope W of Anvers Island, the data being of good quality throughout. With the exception of the first line, all data were recorded digitally on Exabyte tape using the BGS DAMP system. In the evening of day 049 the system was redeployed north of Smith Island and two more lines were completed, the second of these in poor sea conditions.

Table 1: DEEP-TOW BOOMER LINES

LINE	TIME (GMT)	LATITUDE	LONGITUDE	DIST. (KM)
1	1525/040	63°59.5'S	64° 56.0'W	
	1728/040	63°53.0'S	65°10.0'W	16.6
1A	0000/042	63°55.8'S	65°04.2'W	
	0406/042	63° 42.4'S	65° 31.2'W	33.2
2	1845/042	63°42.3'S	65° 42.9'W	
	2225/042	63°53.7'S	65°19.0'W	28.8
3	2330/042	63°55.3'S	65°26.4'W	
	0320/043	63°43.9'S	65°49.4'W	28.3
4	0430/043	63°46.7'S	65°54.2'W	
	1550/043	64° 22.7'S	64° 41.9'W	88.8
5	1558/043	64° 23.4'S	64° 41.3'W	
	1808/043	64° 35.1'S	64° 46.0'W	22.0
6	1822/043	64° 35.5'S	64° 48.4'W	
	2020/043	64° 27.6'S	65°04.2'W	19.3
6A	0100/045	64° 35.6'S	64° 47.8'W	
	1430/045	63°52.8'S	66° 14.2'W	105.5
7	153 1/045	63°50.7'S	66° 08.1'W	
	1935/045	64°04.2'S	65°42.5'W	32.6
8	2030/045	64°01.6'S	65°36.2'W	
	0033/046	63°47.0'S	66° 04.1'W	35.3
9	0158/046	63°48.5'S	65°56.1'W	
	0440/046	63° 55.0'S	66° 14.3'W	19.1
10	0553/046	63°55.4'S	66° 13.1'W	
	1115/046	63°43.2'S	65°28.9'W	42.6
11	1210/046	63°46.2'S	65°23.0'W	
	0036/047	64° 28.2'S	66° 51.0'W	105.5
12	0230/047	64° 29.6'S	66° 36.2'W	
	0559/047	64° 17.3'S	67°02.5'W	31.0
13	0709/047	64° 20.1'S	67° 05.7'W	
	1244/047	64° 38.6'S	66° 25.5'W	47.0

14	15 15/047	64° 33.2' s	66° 08.4' w	
	2115/047	64° 13.3' s	66° 51.7' w	50.6
15	22221047	64° 14.2' S	66° 44.6' w	
	0050/048	64° 21.6' s	67° 04.0' W	20.8
16	02001048	64° 22.4' S	67° 04.0' W	
	0445/048	64° 13.9' s	66° 43.4' w	22.9
17	0625/048	64° 13.0' s	66° 47.8' W	
	0925/048	64° 20.7' S	67° 05.2' W	20.0
18	1159/048	64° 16.4' S	66° 54.2' W	
	1645/048	64° 31.7' s	66° 20.5' W	39.1
19	1708/048	64° 31.2' S	66° 17.3' w	
	1822/048	64° 25.8' S	66° 15.6' W	10.1
20	1855/048	64° 24.7' s	66° 20.9' W	
	2203/048	64° 31.1' s	66° 46.0' W	23.4
21	2245/048	64° 28.6' S	66° 48.9' W	
	0315/049	64° 14.8' S	66° 12.3' W	38.9
	0630/049	64° 00.9' s	66° 02.1' w	27.0
	0915/049	63° 54.6' S	65° 38.2' W	22.7
	1050/049	63° 47.3' S	65° 36.4' W	13.6
	1217/049	63° 44.1' S	65° 24.0' W	11.8
22	211 1/049	62° 48.9' S	62° 53.0' W	
	2252/049	62° 44.7' S	62° 37.1' W	15.6
23	2252/049	62° 44.7' S	62° 37.1' W	
	0109/050	62° 45.2' S	62° 53.4' W	13.9
			TOTAL	986.0

4. TEMPORARY SEISMIC STATION DEPLOYMENT (RDL)

4.1 Introduction

A temporary seismic station was deployed on Byers Peninsula, Livingston Island on 8 February (day 039) and uplifted on 19 February (day 050). This trial deployment was intended to provide information essential to formulating a proposal for deployment of a local network of similar stations in a future season. Such a network would make an important contribution to understanding the neotectonics of southern Bransfield Strait. Recent marine geophysical investigations indicate that this is an area of considerable tectonic interest, which is poorly served by the existing global seismograph networks. A local seismograph network would reduce uncertainties in epicentre location and focal depth, provide additional constraints on focal mechanisms, and detect smaller magnitude earthquakes than those which are recorded teleseismically.

This trial deployment was intended to provide information on:

1) the logistics of establishing stations;
2) the ambient noise problems;
3) the trigger parameters required to record events of interest.

4.2 Equipment

The seismic station consisted of the following equipment:

Teledyne Geotech PDAS-100
PDAS-100 40-Mbyte hard disk unit (in temperature-regulated box)
3 x Willmore MkIIIA seismometers
Mini-ABSOLYTE type 12-5000 sealed lead-acid battery
BPR1 charge regulator
4 x BP 320 solar panels

The battery was trickle-charged over several days on board ship, using one of the Famell 1A power supplies from the Electronics Workshop.

4.3 Deployment and uplift

A permit was obtained for landings on Byers Peninsula, which is listed as a Site of Special Scientific Interest (SSSI). For both deployment and uplift the ship kept station about 2 miles off South Beaches, at about 62°42'S, 60°04'W On both occasions two Humber inflatable boats with outboard motors carried the equipment and a shore party of 6 people to a landing site near Sealer Hill, at the western end of South Beaches. In addition to the shore party 2 people travelled in the Humbers and stood by the boats while the shore party was working.

The equipment was carried about 800 m inland to reduce swell noise. For the purpose of this trial it was not essential to know the exact location of the station, but from a bearing through the landing site from the ship, the approximate distance inland, and by reference to charts of the area, the station location is estimated to have been 62°40’00”S, 61°06'55"W with a 95% confidence circle of about 250 m radius. The station was on a raised beach about 40 m (± 10m) above sea level.

The seismometers were set up as a 3-component set in a small hole dug with a mattock. They were seated on compacted soil and covered with an up-turned wooden box. The vertical seismometer was connected to PDAS channel 1, the north-south seismometer was connected to channel 2, and the east-west one was connected to channel 3.

For this trial it was not necessary for the PDAS clock to be precisely synchronised with an external standard. The PDAS clock was manually synchronised (to within 0.5s) with the ship’s scientific clock at about 0200 Z on day 039. When checked again at 1710 hours on day 051, the PDAS clock was found to be 2.0 - 2.5s slow with respect to the scientific clock, which had remained a constant 8s slow relative to the GPS clock.

Once everything had been set up, the boxes containing the PDAS, the hard disk and the battery and regulator were covered with a PVC tarpaulin which was held down with rocks.

Deployment took about 3 hours from the time the Humbers left the ship until they returned. Uplift took only 2 hours.

4.4 Recording strategv

Most seismic energy in events of interest was expected to be below 10 Hz. However, for this trial deployment the sample rate was set to 50 samples per second, allowing detection of frequencies up to 25 Hz and thus evaluation of the frequency content of events and ambient noise over a broader waveband. Data were recorded in gain-ranging mode in a 16-bit format The 40 Mbyte hard disk would allow continuous simultaneous recording of 3 channels in this format for about 40 hours. In order to sample the ambient noise over an extended period of time the PDAS was set up to record for a period of 5 minutes every hour, starting on the hour. This schedule would have filled the hard disk in 20 days. In addition to these periods of timed recording, event detection parameters were set up and scheduled to start operating at 1200 hours on 14 February (day 045). The PDAS was not operated in event detection mode immediately because a poor choice of parameters could have caused the hard disk to fill up within 2 days. The short-term-average over long-term-average (STA/LTA) detector algorithm was used with the following parameters.

Pre-event length:	30s
Post-event length	30s
Max event length:	60s
Voting logic:	2 out of 3 channels must trigger for detection
STA time constant:	2s
LTA time constant:	30s

Bandpass filter lower comer (for detection, not recording):	2 Hz
Bandpass filter upper comer (for detection, not recording):	15 Hz
STA/LTA trigger ratio:	4.0
STA/LTA de-trigger ratio:	2.0
Updating LTA:	disabled

The following parameters apply to both timed recording periods and detected events:

ADC calibration interleave:	disabled
Preamp gain:	10 (full scale = 100 mV)
Low-cut filter (0.01 Hz):	enabled

4.5 Preliminarv results/backinp up data

During the period of operation the PDAS recorded data for all 254 scheduled 5-minute periods. It also detected 13 events from the time the event detector started operating (1200 Z on day 045) until the system was uplifted (1100 Z on day 050). In total about 23 Mbytes of data were stored on the hard disk. These data were copied from the PDAS hard disk to the hard disk on a Toshiba 3100 SX laptop computer using the PCOPY program in the PDAS setup computer software. The PDAS setup computer DRANGE program was used to convert the data files from gain-ranged format to 32 bit integer format. Because all the output files from this procedure are double the size of the input files, and the laptop had only a 40 Mbyte hard disk, the data were copied, de-gain-ranged and backed up in three batches (days 039-042, 043-046 and 047-050). Both raw data files and de-gain-ranged files were backed up to DC6OOA data cartridge tapes using the “Parallel Stream” backup device on board ship. This should have been a fairly quick procedure, but data could not be transferred from the parallel port of the Toshiba 3100SX to the Parallel Stream device. The reason for this problem has not yet been established, but it meant that the backups had to be made through the serial port of the Laptop, requiring many hours to complete data transfer.

Data recorded during some of the timed recording windows, and events, were displayed on board using DADiSP signal analysis software. Some of the events have clear P and S-wave arrivals separated by about the right amount for them to have originated on Deception Island, which has been very seismically active recently. Other events have characteristics typical of near-surface ice or rock fracture (crevasse movement/freeze-thaw), and others may be due to human disturbance (one is certainly caused by the shore party approaching the station to uplift it). Most of the energy in the events thought to represent local earthquake actvity is below 6 Hz. Timed recording windows are also generally dominated by low frequencies(< 10 Hz).

The measured output voltage of the ABSOLYTE battery after the station had been uplifted was only 12.47 V, compared with > 13.2 V when it was deployed. The regulator would have disconnected the battery if its output had fallen below 10.8 V, to save it from long-term damage. There are two likely explanations for the low output voltage after uplift:

1. The station was uplifted at about 0800 local time, so the battery would have been near the low point in its daily cycle, before the solar panels began charging. Unfortunately the amplitude of the daily cycle was not monitored.

2. There had been a fresh fall of snow at some time during the ten days between deployment and uplift, so it is likely that the solar panels were covered for some of the time.

Overall this trial has been very successful. We have established that the combination of equipment used can be set up on an Antarctic island in a few hours and can operate effectively without manual intervention for a period of several weeks. We have sampled the ambient noise regularly over a period of ten days. This will enable determination of event detector parameters which will avoid recording the noise and yet be sensitive to any local seismic activity.

4.6 Lessons for the future

1. The soil on Byers Peninsula proved very difficult to compact sufficiently to allow good coupling between the seismometers and the ground. The ideal solution to this problem would be to make a concrete raft, but this would be time consuming and probably would not be permitted in an Antarctic SSSI.

2. If several stations are set up in a future season it will be necessary to establish their exact locations. A hand held GPS receiver will be required.

3. If several stations are operated it will also be necessary to synchronise the PDAS clocks with an external standard (e.g. GPS or Omega).

4. **The** solar panels could be tilted by about 30” when they are set up in future, so that a thin layer of snow will tend to slide off. The soil excavated to make the hole for the seismometers could be used to build a bank if no natural inclined surface is available.

5. If several stations are deployed a faster backup procedure will be necessary. The communication problem between the Toshiba 3100SX and the Parallel Stream device needs to be overcome, or one of these items must be replaced,

6. An additional seismometer as an outstation could be used to prevent recording of noise caused by human disturbance.

Acknowledgements

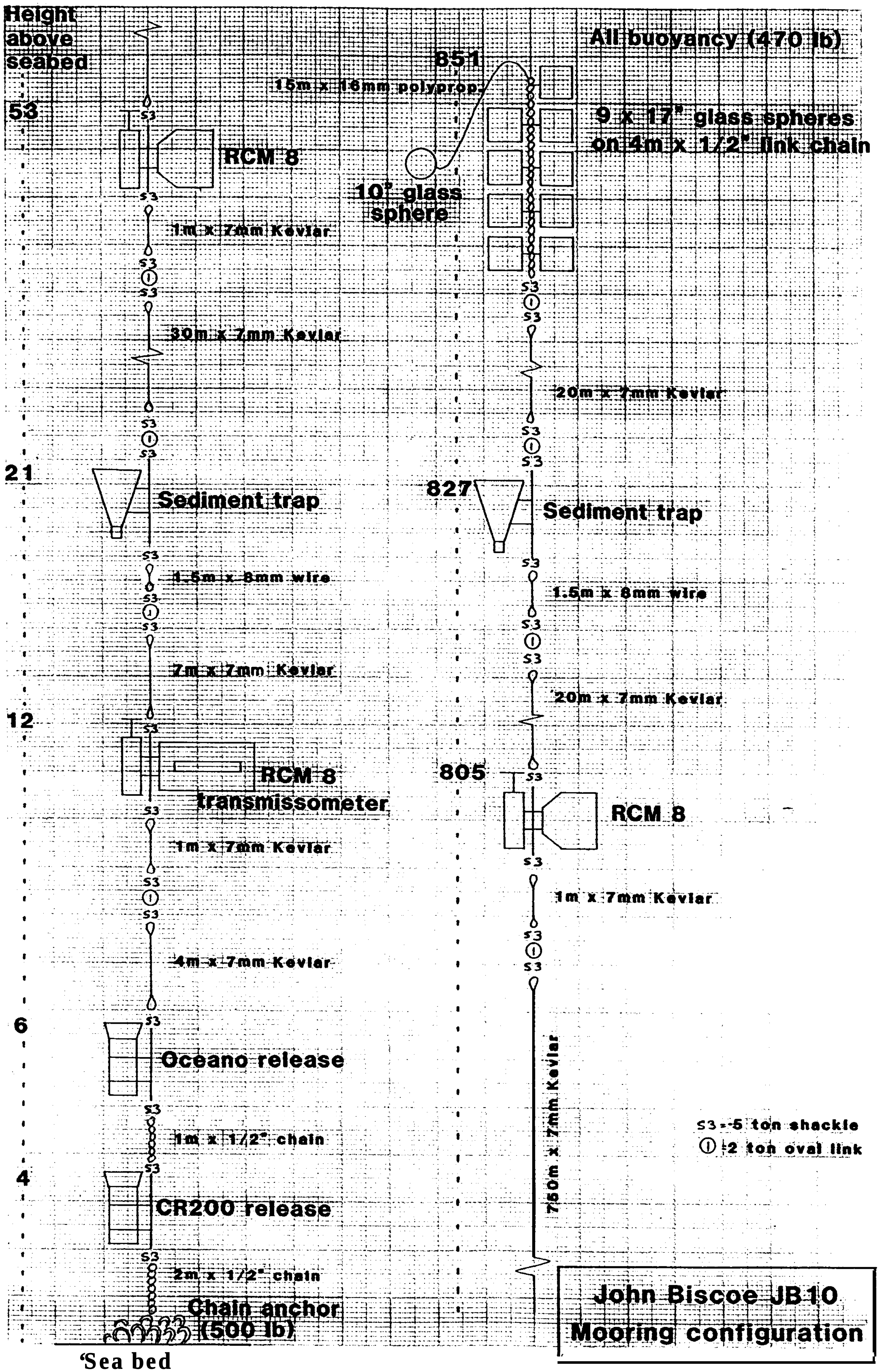
A large number of people have contributed in various ways to the planning, execution and equipment used on this trial deployment. Ed Mowse built the box for the battery and regulator, complete with connector panel for wiring everything together. He also terminated the seismometer leads and inserted damping resistors. Vsevelod Afanasyev designed and built the temperature-regulated box for the PDAS hard disk. Ed King organised the purchase of the solar panels and charge regulator, specified the requirements for the hard disk box and had a hand in planning the trial deployment. Richard Hunter extracted the equipment from the ship's scientific hold in Port Stanley, prepared it for deployment and helped to generate the PDAS configuration file. The PDAS (serial no. 093) was loaned to BAS by Leicester University. Paul Denton checked it was in good working order before it was handed over. Peter Maguire gave advice on recording strategy and on generation of PDAS configuration files. The seismometers were loaned to BAS by the NERC Geophysical Equipment Pool. Neil Spriggs and Andrew Haston of Teledyne have been very helpful in answering questions and provided a new set of PDAS software disks at short notice when a problem was discovered with the set of copied disks at BAS. Finally, I would like to thank the members of the two boat and shore parties for transporting all the equipment safely from the ship to the deployment site and back again.

5. CURRENT METER MOORINGS

5.1 U of Ca moorings (TDF)

Polar Duke 1991 Moorings

During JAMES CLARK ROSS cruise 001 we attempted retrieving three of the current meter moorings that were set out by POLAR DUKE in 1991. We arrived at the site of mooring (a) at 63-17S, 52-24W on 20 February and made one attempt to grappel for the ground line attached to the mooring before nightfall. Two more attempts at grappling were made on 21 February. Although moderate ice and some problems with the winch slowed operations, the grapnels should have passed over the estimated position of the ground line. Evidently, the mooring and ground line drifted while sinking during deployment or ocean currents caused the relatively light mooring to shift position. Due to the great amount of shiptime required to carry out grappling operations we decided to attempt to retrieve mooring (c), which had an acoustic release. We arrived at the site of mooring (c) at 63-30S, 51-05W late afternoon on 21 February. We were not able to establish contact with the acoustic release using both our own and BAS's deck units. Since we had problems ranging on these acoustic releases, but were successful in activating the release mechanism when we deployed them in 1991, we decided to wait until the morning of the 22nd and try releasing this mooring. On the 22nd the ship moved most of the icefloes about a half nautical mile from the position of the mooring. The release command was given, but after waiting much longer than the expected rise time for this mooring, the floats did not appear. We then proceeded to 63-368, 50-32W to try to retrieve mooring (d) which again had an acoustic release. Repeated tries to range on this acoustic release using both deck units were unsuccessful. Our contacts with the British agent for the Oceano acoustic releases by FAX, and then by telephone, on 23 February did not produce any new ideas for activating the releases. Subsequent failure of the Oceano releases to activate properly on the BAS moorings seems to indicate that the problem was probably in the release units. Before leaving the vicinity of the current meter moorings we made a final attempt to grappel for mooring (a). The attempt to drag over a slightly different course was thwarted by a combination of wind and ice, and the grapnels did not retrieve the mooring. At this point it did not seem worthwhile to continue either further grappling, given the ice and winch difficulties, or further attempts using the acoustic releases due to the lack of response from the releases and the moderately heavy ice cover. The cooperation of the scientific party and the ship's company in the retrieval operations was outstanding. I greatly appreciated their efforts despite the lack of success.



Height above seabed
53
RCM 8
1m x 7mm Kevlar
30m x 7mm Kevlar
21
Sediment trap
1.5m x 8mm wire
7m x 7mm Kevlar
12
RCM 8 transmissometer
1m x 7mm Kevlar
4m x 7mm Kevlar
6
Oceano release
1m x 1/2" chain
4
CR200 release
2m x 1/2" chain
Chain anchor (500 lb)
Sea bed
All buoyancy (470 lb)
851
15m x 16mm polyprop.
9 x 17" glass spheres on 4m x 1/2" link chain
10" glass sphere
20m x 7mm Kevlar
827
Sediment trap
1.5m x 8mm wire
20m x 7mm Kevlar
805
RCM 8
1m x 7mm Kevlar
750m x 7mm Kevlar
S3 - 5 ton shackle
① 2 ton oval link
John Biscoe JB10 Mooring configuration

5.2 BAS Moorings (CJP, MEB, MP)

5.2.1 Operations

Two moorings (I and VIII) were recovered complete, but we were unable to recover mooring III. Poor performance of the acoustic releases resulted in the search and release procedures taking longer than usual (Table 2, compare cruise reports of Discovery 172 and JB10/3), but once the floats had been sighted the ship grappled and recovered each mooring in only 1½ hours.

Mooring I had the IOS CR200 as the lower of the two releases (Fig. 1). There was about 3/10 pack in the mooring area, but it was necessary to deploy the PES fish to communicate with the mooring: the ship thus had to manoeuvre with caution. We were unable to range on the Ckeano release, but the CR200 started transmitting when commanded on channel 1 (320 Hz). We conducted a box-type search in the usual way, steaming S then E then N and using the positions of closest approach to locate the mooring accurately (Fig. 2a). The ship hove to on the mooring site and we spent a total of 24 minutes transmitting on channel 2 before release occurred. The ascent rate was about 60 m/min. The floats were sighted at a distance of ½ mile by the Mate.

The ship was manoeuvred alongside the floats using joystick control and the mooring was recovered on the after deck using both Gilson winches. The starboard winch took up the main mooring line through the central block on the stern gantry, and the port winch was used for stopping off using a small block hung on the port side of the gantry.

Both sediment traps had collected about half a bottle (100 ml) of mostly organic material. This was transferred to glass bottles and stored in a refrigerator. The three current meters were allowed to warm up slowly in the wet lab. Overnight one meter (9418), which had leaked, blew the bottom off its pressure housing. The other two meters had each recorded for nearly 1 year (Table 3).

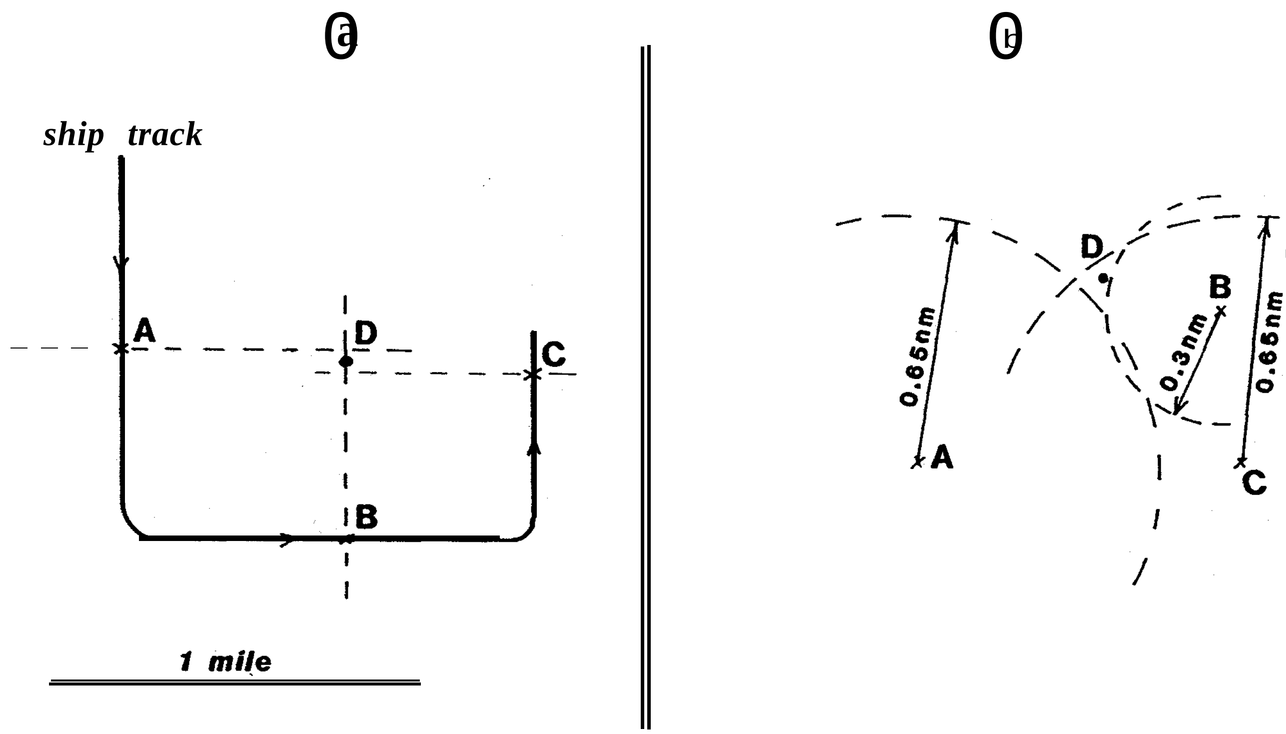
Both pyros had fired on the IOS release Further tests on the Oceano release are described below.

It is important to emphasise that during any of the attempts made to operate or communicate with any of the releases, the ship had been thoroughly silenced beforehand. The main engines were idle, none of the thrusters were in operation, also that all the ship's echo sounders were off (both scientific and navigation) as were the ADCP and Doppler log.

Fig. 1 Positions of instruments and sediment traps on moorings I and VIII, deployed from RRS ***John Biscoe*** in 1990. Mooring III is the same except that the Ckeano release is the lower of the two.

Fig. 2(a) Box survey for a mooring with an IOS CR200 release. By monitoring the relative position of the release on the PES, positions of closest approach A, B, C are obtained. At each of these positions the ship is beam-on to the site. The mooring site is therefore at D.

Fig. 2(b) Search for a mooring with an Oceano release. When the ship is at A the range (in metres) is converted to a horizontal distance (knowing the water depth), hence a range circle. Similarly at B and C. The mooring is where the circles intersect, i.e. at D.



Eight and a half hours were spent attempting to recover mooring III in approx l/10 pack. The Oceano release was the lower of the two and at this site we at last found out how to obtain a range. Instead of the transducer being as deep as possible, it should be held only 4-5 m below the sea surface (find optimum depth by experiment), We obtained three consistent ranges from three different ship positions, and the drift of the ship could even be measured over a short period (Note that with all engines and thrusters stopped, ship drift “on station” is appreciable). Knowing the water depth, the ranges can be converted to horizontal distances and the position of the mooring determined (Fig. 2b).

The ship hove to on the mooring site and for 30 minutes we tried to release the Oceano unit. We tried the release code many times, enable followed by release, and probably all other possibie combinations. However the range remained constant showing that the mooring was still at the seabed.

Table 2

Mooring Recovery

Mooring I 058/92

1625	**Start** search
1808	Hove-to at 63° 09.3'S, 42° 41.5'W
1836	Release commands
1900	Released
1948	Surfaced
2004	Sighted
2028	Grappled at 63° 09.2'S, 42° 41.2'W
2140	Inboard

Mooring III 060/92

1145	Start search		
1225	Range 4606)	63° 56.23'5	40° 59.28'W
1231	Range 4805) on Oceano release	63° 56.05'	41° 01.39'
1324	Range 4574)	63° 55.98'	40° 59.26'
1405	Closest approach, range 4567, 63° 55.83'S, 40° 59.68' W		
1417 - 1515	Transmitting to IOS release		
1546 - 1908	Transmitting to IOS release		
1915 - 2010	Trying to release Oceano		

Mooring VIII 062/92

1103	start search		
1109-50	Tranmitting to IOS release		
1155	Range 3350)	62° 04.38'S,	40" 36.04'W
1208	Range 3493) on Oceano release	62° 04.55'	40" 36.85'
1229	Range 3358	62° 04.79'	40" 35.45'
Best estimate of posi n 62° 04.58'S, 40° 35.68'W			
1245 - 1305	Transmitting to IOS release		
1310 - 30	Trying to release Oceano		
1332	Surface - sighted		
1356	Grappled at 62° 04.5'S 40° 35.6'W		
1500	Inboard (IOS release fired)		

We then deployed the PES fish and after an hour's continual transmission to the CR200 on both channel 1 and channel 2 we identified a faint return on channel 1. The fish had to be recovered because of ice while the ship returned to the mooring site (having drifted away). The Ocean0 release was tried again without success. The PES fish was m-deployed and after nearly 1½ hours' tranmission we obtained a return on channel 2; we continued trying to fire the release using longer and longer blasts on channel 2, and varying the transmit frequency by 1,2 and 3 Hz in case the release filters had drifted slightly. At 1907(Z) we gave up and returned the CR200 to channel 1 and allowed it to time out. We spent a further hour trying the Oceano release, again without success.

A possible reason for failure is that one or more of the floats imploded during deployment of this mooring (from the ***John Biscoe*** in 1990) and that there is not enough buoyancy left to raise the mooring to the surface. The return observed from the CR200 was a multiple, fuzzy echo corresponding to the seabed and sub-bottom reflectors: this would occur if the release were lying on its side rather than pointing upwards as intended. It was not considered safe to drag for a mooring in 4500 m of water using the 6 mm wire, but we hope to drag for it next season using a suitable wire. At least we know where it is.

Mooring VIII, like Mooring I, had the IOS CR200 as the lower relase. There was very little ice in the area (a few growlers and bergy bits) so this time the PES fish was not at risk when deployed. We transmitted on channel 1 using the separate IOS deck command unit, as well as the ACMS module in the PES Mk IV, but observed no response. We successfully ranged on the Oceano release, located the mooring site precisely and hove to the ship on this site. Transmission to the CR200 on channel 2, followed by channel 1 and frequencies close either side of channel 1, still produced no apparent response. We then tried to release the Oceano unit but we had drifted off station and could not obtain reproducible ranges, so the ship moved back on site. 3/4 hour after we transmitted on channel 2, the buoys were spotted on the surface about 1 cable astern of the ship, by the 3rd officer.

The rig was recovered in the same way as Mooring I. Both sediment traps had collected about 300 ml of mostly organic material. Unfortunately, although all three current meters were apparently in good condition the data return was very poor, only the bottom meter having recorded a year's worth of data (Table 3). Both acoustic releases were recovered, the CR200 still having one live pyro which was immediately disarmed on deck. Evidently, although both sets of pinger batteries were dead, the pyro-release batteries still worked.

5.2.2 Current Meter Data Retrieval

When the current meter bodies were opened up to retrieve the data, the DSU on RCM9418 was found not to contain any data and the Lithium battery had gummed up the bottom half of the DSU and the locking pins. The DSU could not be removed from the recording unit so was left in place and eventually replaced inside its casing.

On opening the other casings, 4 out of the remaining 5 DSUs appeared to contain some 10 bit words and the fifth contained nothing. For full details see Table 3.

Table 3 **RCM8 DSU 2990E INFORMATION**

Rig & Position	Current Meter Identifier	DSU Serial Number	No. 10-bit words	Days
I (800m up)	9911	2796	49514	329.5
I (50 m up)	9418	1675	-	-
I (10 m up)	9904	2799	51857	345
VIII (800m up)	9909	2797	163	-
VIII (50 m up)	9419	1679	-	-
VIII (10 m up)	9903	2795	51690	344

Meter 99 11 recorded pressure, high-resolution temperature, direction and speed. Meter 9904 and 9903 recorded temperature, transmissivity, direction and speed.

Good data was obtained from only 3, the fourth showed 163 10 bit words consisting mainly of rows of 0007s. These may be the first part of the time record stamped every 24 hours, but there was no actual data recorded The amount of data stored raises several questions particularly in the light of information supplied by Ted Foster whose current meters also use expanded DSUs (rather than magnetic tapes).

Procedure for downloading data

1) Remove main body of recording unit from its casing. Amount of data stored in memory is displayed on the LED display.

2) Wait for one hour after removal to see if the DSU is still recording, which would be evidenced by the incrementation of 6 digits on the LED display. None were still recording so it was not necessary to note the switch off time. The locking pins were released to remove the DSU.

3) The stored data could then be read by connecting the DSU via a DSU reader (2995) to the RS-232C port of an IBM pc compatible computer, in this case a

Viglen III. The reconnection from the current meter to the powered DSU reader should be made within 2 minutes to prevent any data loss due to insufficient power in the DSU internal batteries.

4) A data reading program is supplied by Aanderaa....P3059, which had been installed on the hard disk of the Viglen. It is menu driven and fairly straightforward, (refer to manual for further details) enabling data transfer to any drive , displaying of selected data records, setting and displaying the real time clock, resetting the DSU, self-checking of the display and RAM or (EEPROM) and erasure of the DSU.

Data was transferred to the c: disk of the pc initially under a directory \RCM8 and backed up on 2 floppies. Data transfer does **NOT** erase the data from the DSU. The DSU can then be remounted in its casing. The sequential ASCII data files were then transferred to a SUN workstation for preliminary editing. P3059 also has the option for dataplotting and printing in engineering units but the calibration constants were not available on board.

Data Storage Capacity

All DSUs were expanded...suffix E, but some had serial numbers less than 2700 which means that they had RAM not EEPROM according to updated Aanderaa documentation supplied by Ted Foster. Also it appears that a lot of customers who bought DSUs had problems with the earlier versions and data loss due to insufficient battery life. (possibly the cause of data loss on RCM9419 and RCM9418 had it survived !)

It was envisaged in 1990 when the current meter moorings were deployed by RVS technicians that data would be recorded for approx. 2 years. This has evidently not been the case, with the maximum amount of data stored being just short of a year. It is therefore important that we establish the reasons for this before redeploying meters in the future.

5.2.3 **Investigation into the release failures**

Obviously the Oceano system was the first to receive attention due to the apparent failure of equipment made by a company that is so well regarded generally.

Both releases were tested, having been stored on deck to maintain the low temperature. This involved interrogating them using the deck unit and monitoring their response. (The units still work in air, but the range is wrong because of the different speed of sound in water and in air.) Both releases functioned in the same manner on deck as they did in the water, ie they could be ranged on any of the four codes but not released. They were then brought into the Wet Lab to warm up: if the problem was battery related, when the units had warmed up they might behave differently. This however was not the case; two days later, they still didn't work.

Both units were then opened and examined.

Serial Number 43
Mooring site CM1

The condition of the electronics looked excellent, no sign of any corrosion or water ingress.

The two PP3 9v batteries were removed and their terminal voltage measured. For both the ***Kodak Extralife Alkaline the measured*** voltage was approx 30mV as flat as a battery could be! Two fresh cells were substituted, and the release tested again. This time everything worked correctly, the release mechanism turning in response to the transmitted code and acknowledging on completion.

Further tests were conducted in the area of the batteries to see if it was possible to discover the reason that the batteries had died. The steady state (motor not turning) current being drawn from the replacement batteries was measured as 3lpA. Without circuit diagrams and data about this type of battery it is impossible to judge if this is acceptable or not.

Serial Number 42
Mooring site CM3

The two 9v batteries were removed and replaced. As expected the release now functioned correctly, releasing as instructed etc. The surprise came when the battery terminal voltage was measured: both old batteries measured approx 8.9V !? These batteries were then re-installed, the release still worked! This was not only surprising but also confusing. A few possibilities came to mind, but without further information no solid conclusion could be arrived at.

1. Some form of electrical 'hang-up' had occurred, disconnecting the batteries had reset this state, allowing the release to function correctly afterwards.

2. One of the battery connections was not properly made.

3. ***The*** original batteries, although not dead, were partially discharged. It is possible that the release mechanism was stiff and/or corroded and that the old batteries didn't have enough power to overcome this. The new batteries did, and managed to turn the mechanism and dislodge the corrosion. When the release had been operated once, the old batteries could then cope.

Number 3 seems like the most likely of the three.

The steady-state current was measured as ***0.25*** **µA,** a factor of >100 less than the previous release. This is very significant and might be the cause of the flattened batteries in the first Oceano. Without circuit diagrams it was impossible to pursue the problem further.

6. CTD STATIONS AND EQUIPMENT (MEB, PW, CJP

6.1 Introduction

The CTD was operated with numerous additional instruments, on this cruise. Use of a large intrument frame, loaned by the School of Marine Science at Bangor, enabled us to use an RVS pinger and a BAS transmissometer in addition to the usual 12 bottle rosette, which itself was complemented by the use of two digital reversing thermometers lent to us by RVS.

The transmissometer was used with the CTD for the first time and this was facilitated by the special battery pack housing designed by Steve Bremner.

On initial installation, the lead used to provide the electrical termination at the end of the CTD cable was found to be open circuit. This had been caused when the wire was wound into the traction winch room during gear trials. Fortunately there was one spare cable and connector combination which suited the job and this was used instead.

The new external battery housing for the transmissometer was wired up and charged up and the various instruments bolted to the frame. It was necessary to mount the rosette on studding so that there was sufficient clearance between the bottom of the frame and the bottles. The transmissometer was mounted vertically, adjacent to the CTD itself.

CTD stations were grouped in three transects (see track chart and Table 4). Stations 53-58 on the NW Weddell Sea slope were to investigate suspended sediment on this margin. Stations 59-70 on the main mooring transect, and stations 71-76 on a line through mooring VIII, were designed to yield volume transport estimates.

The CTD casts were nearly all performed in flat calm conditions, many being conducted in gaps in the pack, it being necessary to fend off large floes from the ship as they drifted towards, and frequently engaged, the wire. Despite the calm conditions, there were certain difficulties in deploying the instrument - these were caused by the lack of vision afforded the winch driver when operating the gantry. Indeed, one incident resulted in the loss of one of the frame legs when the package was dragged horizontally across the deck by the winch driver. The unpredictability of the winch control system was also a factor in that case.

The one “fault” with the Neil Brown system occurred when either a particle of ice or some oil (which dripped constantly from the gantry hydraulics) found its way into the conductivity sensor. We will never know what caused the problem but it was cured with a cup of hot, soapy water.

Table 4

CTD stations

	Lat.S	Long. W	Corr. depth	Time on station
912 CTD 053	64° 13.5’	51” 50.5’	2686	2343/053 - 0220/054
054	64” 05.8’	52° 09.5’	2388	0945 - 1220/054
055-6[1]	63” 57.3’	52° 21.0	1661	1430 - 1702/054
057	63” 49.1’	52° 39.7’	1068	1840 - 2000/054
058	63” 41.1’	52° 52.7’	732	2200/064 - 0006/055
059	62° 25.95’	43” 3 1.8’	1319	2000 - 2127/057
060	62° 34.75’	43” 18.6	2842	22501057 - 0123/058
061[2]	62” 45.9’	43” 06.7’	3330	0330 - 1040/058
062	62° 57.85’	42° 54.2 ’	3592	1158 - 1446/058
063	63” 09.5’	42° 41.5’	3793	2225/058 - 0137/059 **Rig I**
064	63” 17.0’	42° 25.5’	3832	1012 - 1305/059
065	63” 24.1’	42° 05.8’	3773	1435 - 1729/059
066	63” 31.0’	41” 44.5’	4536	1930 - 2254/059
067	63” 39.5’	4 1” 30.8’	4552	0018 - 0337/060
068[2]	63” 47.65’	41” 13.8’	4484	0620 - 1025/060
069	63” 54.8’	41” 00.3’	4541	2025 - 2345/060 **Rig III**
070	64” 04.3’	40° 42.6’	4636	0150 - 0521/061
071	61” 47.3’	41” 26.4’	2014	1920 - 2114/061
072[2]	61” 53.25’	41” 05.2’	3612	2225/061 - 0449/062
073	61” 58.95’	40° 50.6’	3498	0711 - 1003/062
074[2]	62° 04.85’	40° 35.9’	3280	1525 - 1845/062 **Rig VIII**
075	62” 16.15’	40° 01.9 ’	3250	2040 - 2327/062
076[3]	62° 21.35’	39° 42.1’	2892	0130 - 0420/063

Notes:

1. Additional cast no. allocated because an additional bottle sample was taken near the surface.
2. Problems with the 10-ton winch delayed these casts
3. CTD disk full - cast halted while partial backup carried out.

6.2 Operation

The operation of the CID is much easier than on previous ***(John Biscoe)*** cruises as, once the bottles have been cocked and the thermometers set, the deployment is controlled by one of the deck crew and one other, leaving the operator in immediate contact with the winch driver in the control room

The EG&G acquisition software can be set up such that very few parameters need to be input on station before the cast can proceed. These are water depth, position and graphical display depth scale. The input depth was the corrected PES depth. Normally the deck unit readings with the CTD on deck, at the sea surface, at the bottom, at the surface and on deck again were recorded on paper to check for drift or pressure effects on the sensors. The veer rate of the CTD was 30m/min for the first 200m and 60m/min thereafter.

The pinger-bottom separation, displayed on the Elonex PC connected to the PES (using 1 second sweep), was monitored and the instrument package lowered to 10m above bottom in most instances, except when drifting towards shallower areas or with a heavy swell. The down cast logging was stopped at the bottom before any bottles were fired If for any reason the cast is stopped on the way down, logging can either be temporarily suspended or stopped altogether and, when restarted at the same depth, the remaining section of the cast can be appended to the first part without automatically updating the cast number, which is what would normally happen.

6.3 Water bottle samples

Before the first station all the bottles were thoroughly rinsed and checked for leaks. Samples were taken for suspended particulate matter, oxygen - 18 ratios and salinity calibration. The last were taken at 3 or 4 different depths over as wide a spread of salinity values as possible, but not usually where the salinity gradient appeared large. When firing a bottle the ctrl-F3 keys were pressed to mark the position in the data file and on screen, and then the rosette was fired manually. No data are received from the CTD at this stage and a warning message appears on the screen. Often spurious marks are added to the display, making it hard to read, and a chunk of bad data is stored in the up-cast file which must be edited out if it is to be used. Generally up-cast data are not used in the final data processing, but provide a useful backup if problems occur in the down cast. The Rosette bottle files created for each bottle did not always contain good data, possibly because a bottle was fired too soon after the previous one.

At the end of each cast all the bottles were normally removed from the rosette and placed in the inboard rack in the water-bottle annexe. $^{18}0$ and salinity samples were taken from the bottle taps. Samples for SPM were taken by removing the bottom end from each bottle, to collect any particles that might have settled past the tap. It was necessary to remove disintegrating rubber sheaths from the bottle springs because they were shedding tiny black flecks inside the bottles.

Anomalous salinity values were measured on some samples from a bottle with no upper tap. This was changed but we need more water bottles as there are now no complete spares.

6.4 **Reversing Thermometers**

Digital reversing thermometers lent by RVS were used to calibrate the temperature sensor. On the first few casts it became evident that the cage containing the thermometer was not turning over completely when the bottle closed, but getting caught and recording the temperature at a point slightly higher in the water column. This difficulty arose partly because the cages fixed to the water bottles were the wrong size for the digital thermometers and the correct cages had to be attached to them. The resulting arrangement was more likely to snag on something. Unfortunately there was no way of checking the pressure at which the cage turned properly. Use of an unprotected mercury reversing thermometer, i.e. one whose capillary tube is open to the water in conjunction with the digital would have provided an exact pressure (hence depth) value at which the temperature was recorded.

The bottles carrying reversing thermometers could only be placed in certain positions on the rosette, because of the configuration of the instrument frame (which is designed for slightly smaller bottles). We used positions 2 and 10. At most stations the reversing thermometers agreed with the CID ttemperature values to within 0.002°C (position 2) or 0.005-0.008°C (position 10).

6.5 **Data logging and display**

At the start of each cast the level A lead had to be inserted into the Interface unit to start logging, but often the logging would fail, and need reinitialising or resetting (see section 10). Fortunately the EG&G software logged data without problems virtually every time. Back-ups were made on data cartridges of all the casts and some of the raw binary data transferred to a SUN for processing. Ted Foster wrote a number of programs to analyse the data and plot sections and profiles of variables. The EG&G software also includes post-processing facilities and plotting routines. Now full colour plots can be directed to the HP 7475 plotter in the data prep. room from the CID logger (courtesy of MP and BJL). An immediate screen-dump facility was available for the cast, onto an Epson LQ550 printer.

6.6 **Surface and CTD water samples**

The opportunistic study of near-surface phytoplankton was continued during JCROl by filtering water samples obtained from the uncontaminated seawater supply. This year we obtained samples from the sites of the Anvers shelf cores (see Discovery 172), and from numerous sites within and at the edge of the pack ice (Table 4). Each sample of up to 51 was filtered through a preweighed Sartorius polycarbonate filter of 0.4 **µ** pore size using a vacuum pump. In some cases the filter clogged and the flow rate became unacceptably slow before the whole sample had passed through.

Although in theory both the seawater pumps can be controlled from the main lab,

Table 5 **Surface water samples**

SAMPLE	TIME/DATE	LAT. S	LONG. W	VOLUME	
1	0105/045	64°35.3'	64° 48.3'	21	near cores 46 & 47
2	0408/045	64°26.3'	65°09.1'	21	" " 8 & 49
3	0630/045	64° 18.8'	65°26.3'	21	core 51
4	0935/045	64°08.4'	65°45.9'	21	553
5	0615/046	63° 54.3'	66° 10.2'	2.51	shelf break
6	1905/050	62° 39.1'	58° 29.5'	51	Bransfield Strait
7	2337/050	62° 27.0	56° 26.8'	51	" "
8	0428/05 1	62° 14.6'	54° 37.8'	2.51	
9	1143/05 1	62° 54.6	53° 19.7'	41	
1Oa)	1730/05 1	63° 17.2'	52° 23.7'	(11	Foster **mooring (a)**
11b)		"		(11	
11	1455/055	63° 17.2'	52° 24.4'	51	Foster **mooring (a) rpt**
12	2355/055	62° 57.9'	51° 34.3'	51	Powell Basin
13	1343/056	62° 43.4'	50° 14.7'	2.51	" "
14	1727/056	62° 36.4'	49° 17.5'	51	" "
15	1840/056	62° 36.2'	49° 03'	51	" "
16	1850/056	62° 36.1'	49° 01'	51	" "
17	235OP56	62° 28.9'	47°57.4'	4.31	" "
18	1122/057	62° 26.0	46° 16.2'	3.81	edge of Powell Basin
19	15 16/057	62° 26.7'	44°59.9'	3.81	S edge of SOM
20	1740/063	62° 06.0'	36° 40.9'	11	N Weddell pack
21	2025/063	62° 22.4'	36° 02.2'	1.11	just beyond pack
22	1645/064	64°00.2'	28°27.6'	1.41	
23	2040/064	64°30.8'	27° 16.1'	0.61	
24	0025/065	65°00.6'	26° 11.0	1.31	
25	0835/065	64°29.7'	23°25.3'	51	
26	1355/065	64° 00.1'	21° 13.1'	51	
27	1842/065	63°30.2'	21°06.0'	51	
28	2335/065	62° 47.0'	21°53.4'	51	
29	0615/066	62° 18.6'	23°58.6'	4.61	
30	115/066	62° 04.4'	26°00.3'	51	
31	1530/066	62°03.6'	27°58'	41	
32	0030/067	61°38.1'	31°54.2'	11	
33	1520/067	60° 15.1'	36° 12.8'	51	Discovery Bank
34	2045/067	59°36.0'	37° 15.4'	51	
35	0322/068	59° 09.2'	37° 55.2'	51	Mooring VI (ooze sample)
36	1 100/068	59°03.5'	40° 09.8'	51	Scotia Sea

Notes: 1. Samples 14, 15 and 17 to 22 are bucket samples, the rest were obtained from the uncontaminated seawater supply.

2. Samples lOa, 10b 20-24, 31 and 32 clogged the filter.

problems were encountered in practice mainly because of air-locks forming in the system. The relief valve/orifice plate problem at the aft end of the line (see Scientific Equipment Trials report p.29) has still not been rectified, and both pumps had to be run to provide sufficient cooling water for the deep-tow boomer winch power pack. In dense pack ice the seawater pumps could not be used at all because of problems with ice and air entering the system (Note that&l the ship's seawater intakes suffered from ice). Sampling was therefore done by bucket over the stern. In open water it was necessary either to keep one pump running continuously to prevent airlocks developing, or to visit the transducer space at least once a day to vent the pump. This requires rectification.

Preliminary examination of the filters has revealed abundant diatoms and a wide variety of species.

CTD water samples were filtered for suspended particulate matter using preweighed nuclepore-type polycarbonate filters of 0.4 μ pore size. The ship's tap water was not clean enough for rinsing the filters, so the prefiltered supply from the darkroom was used (the Elgastat water purifier was not working). No problems arose with the filtering equipment.

7. OTHER EQUIPMENT

7.1 **Winches and Wires** (PFB, CJP)

7.1.1 The situation at the start of Cruise JCROl was as follows:

(a) The main 30-tonne traction winch was not available to us. Only the steel coring warp and the tapered (trawl) warp were wound on. The coring warp had been tried out on the way south to Madeira, with manufacturer's representatives in charge of operations, but a runaway loss of traction during veer had ended all hopes of our being able to use this winch for coring during the cruise. The Long Piston Corer, which had successfully undergone handling trials off Falmouth just beforehand, was dismantled and its handling system put ashore in Stanley.

(b) The Brattvag twin-warp trawl winch and wires, and the biological winch for use with them, had not been tested at all, so were unavailable to us.

(c) The lo-tonne winch, carrying a CTD wire and 6mm hydrographic wire, available to us. The winch was as vulnerable to the same loss of traction as the 30-tonne winch, having been designed using the same erroneous assumptions, but it was considered that our use of it, with appropriate care, would not approach the same critical condition. Our use of the lo-tonne winch was agreed by SHS and Anderson-Caley, without prejudice to the many defects that remained to be remedied on both winch systems.

(d) The winches on deck had been tested and could be used, but lack of a measure of wire out and wire tension limited the circumstances under which they could be used: they were not considered a substitute for the lo-tonne winch, except in dire emergency.

(e) Use of the lo-tonne winch was to be monitored in detail, using the Seametrix winch monitoring system, so that the circumstance of any malfunction could be reconstructed.

The lo-tonne winch was used for 25 deployments of the CTD wire and 5 of the 6mm wire, to depths ranging from 1200m to 4700m. The fastest wire speed achieved was 60m/minute (the maximum desirable for CTD stations). Usually, the wire was veered at 30m/min for the first 200m.

The wire could not be veered with an outboard load smaller than ca. 150Kg, because of the high back-tension. The back-tension was not stable when veering, and fluctuated rapidly over a wide range of values, exceeding 1000kg against a nominal 400kg target back-tension. The method of setting the target back-tension was not known, so values for each wire were assumed to be those used during trials by Anderson-Caley.

The reason the winch would not veer with a low outboard load was that the load provided insufficient traction for the drive to operate against the back-tension. This is the slip condition in reverse. The powered rollers were used over the first 100m on veer, to maintain the outboard tension, but proved barely effective: one roller was badly grooved because it had not been correctly located, and remained pressed against the wire even when nominally open.

The back-tension fluctuation was less on haul (and gave an approximate indication of the target value) than on veer, but was still considerable. We remain convinced that the back-tension feedback loop is not operating correctly: load cell variations (used also by the monitor system - see below) are far too rapid and extreme to represent ship motion or to either represent or be responded to by any other component of the system. These variations may be spurious: they may then be at the root of some of the hydraulic oil overheating that was apparent during the CTD transects, if hydraulic by-pass valves activated within the feedback loop prevent the regular cycling of some of the oil through the cooling parts of the circuit. This is mainly conjecture, however: there was no information on board on the nature of the hydraulic circuits and controls, a major shortcoming.

During operations, several significant problems were encountered and solved by Dave Alan 2/E and Keith Rowe, Elec'n. These were:

042/92. Changeover of control from WR to WCR prevented by misalignment of spooling gear. Reset.
043/92. Heave compensators extending after hydraulics were shut down. Also, No 1 PP boost, pilot filters changed.
044/92. During CTD test, salt water showered on many fittings including control console: line washing/drying gear attached for haul. O/B accumulator bank isolating valve shut when system is shut down, to prevent compensator motion: not an ideal solution.
045/92. PP room cleaned: 150 litres T37 added to tank, 3 pilot line filters changed, hydraulic hoses re-routed.
055/92. TW would not go to local control: TW brake pressure switch was not indicating brake off. Dismantled, checked, reconnected - OK. During previous nights CTDs, "brake on" light was not illuminated when wire stopped.
057/92. TW brake pressure switch faulty - changed for spare. On examination, switch was fully wound back - seems wrong range for the job. New one was set to 200 bar minimum. NOTE some fittings for this switch had to be taken from the 30-T system.
058/92. Bad oil leak from manifold block: CTD stoppered off at 3200m power pack shut down. 3 O-ring seals blown on face between 3 Motor directional control valve, relief valve slice and manifold block. Poorly machined plate. Fitted seals taken from spare S/Solenoid directional valve of 30-T system. 125 litres T37 added.
059/92. 3 Motor counterbalance valve block leaking - from plug in test gauge fitting. Rectified.
061/92. Found 3 Motor counterbalance valve block cracked: replaced from 30-T system, but valve changed. Made and fitted blanking plate to 30-T valve block.
Seal blew in 4 Motor resolver drive shaft with CTD at 2600m. Stoppered off. Hydraulics very hot: 70°C plus on motor casings. Found O-ring damaged by high temperature. Replaced.
Erratic veer speed, related to high back-tension: possible hydraulic short-circuiting,

aggravating cooling problem. **Winches would be worse in tropical conditions.**
062/92. Defective **3** Motor counterbalance valve replaced from 30-T winch, but drum valve block is being over-pxessurised by speed changes.
066/92. Tested **3** Motor off-line - stalling. Haul/veer PCB swapped with 30-T equivalent and reset ramp bias and scale. Cured stalling.
067/92. Speed matched with new PCB and made successful test run. Winch ran more smoothly and temperatures were lower.

These were heroic efforts, and we were fortunate to have this quality of technical support. **There is a shortage of spares and of technical information concerning all aspects of hydraulic design, control, setting up and test parameters.**

7.1.2 **Seametrix Winch Monitor**

All deployments were logged using the Seametrix system. This performs a monitor function **only.** It accepts the output of load cells measuring inboard (back-) and outboard tension, and of shaft encoder counters measuring drum rotation (wire speed) and thence cumulative wire out. It accepts input from the ship's clock, an inclinometer and (optionally) echo sounder. The software logs these data on diskette and (through a Level A module) on the shipboard computer. It presents data on a monitor screen and issues alarm messages when preset conditions are met.

Data were logged on to diskette at 1 second intervals, providing a detailed record of deployments. The system worked well throughout, and we have only a few minor niggles about the software function.

1. Almost all alarms can be cancelled, but not the "Clamp Wire" alarm, which comes on and stays on when the wire is hauled above a specified depth (say, 50m). Since it cannot be cancelled it is still there at the start of the next deployment, and prevents the wire out from being zeroed, unless one exits completely from the program, which means replacing all the default data settings. This is a nuisance and a source of confusion and delay. And why "Clamp Wire"? Why not a once-only "Zero Approaching" alarm?

2. As on trials, life was made miserable by frequent "Back-Tension" alarms. This is all tied in with the likely malfunction of the back-tension feedback loop. As things stand, there is no evidence whatever that the momentary increase in back-tension needed to set off the alarm is either detrimental to the wire or a valid measurement. What is needed is an alarm that is really significant, that flags a condition giving real cause for alarm, not one that tends to make one ignore ALL alarms. It should also be possible to vary the noise level of an alarm, other than by pasting paper over it.

3. We are promised (a) source code and (b) a complete system manual. The manual should include instruction on how to load executable code derived from the source code, since at present the programs reside in write-protected memory.

7.1.3 Note on CTD stations

At each station we recorded maximum wire out, corrected PES depth and CTD-calculated depth (from pressure measurement) when the instrument was at maximum depth. Pinger-bottom echo separation was used to measure height above the seabed (usually 10 m). At nearly all station depths from 700 m to 4600 m, the PES depth and CID depth agreed to within 10 m (the PES depth being greater). The maximum wire out was always **less** than this, by 40-50 m at the deep sites. This indicates an error in the wire-out meter.

7.2 Echo Sounders (CJP,MP)

7.2.1 Fish cables

The cables on both the 10 kHz and 3.5 kHz fish were changed before the ship left Port Stanley (IOS having supplied cables which were too short - see Trials report). This task took nearly 4 man-days, largely because of the need to file the castings on each fish to fit the cable terminations. The cables were not direct replacements of those originally supplied.

The fairings of both fish cables were damaged during deployment and recovery, because of poor sheave design on the gantry.

7.2.2 IOS Precision Echo Sounder

6) The PES was run using the hull-mounted transducer for most of the cruise. The fish was used during the deep-tow boomer survey (2330/041 to 0225/044 and 0030/045 to 0200/050) and while searching for moorings. At 1645 on day 064 the PES fish was deployed in a moderate sea to see if it would give a less noisy record than the hull transducer. It did not. From 1057/065 until 1130/066 the fish was left out but not used for transmission: on trying it again it produced a lot of noise with no signal, so was recovered at 1215/066.

In general the fish performed better during JCR0l than on Equipment Trials because the longer tow cable allowed it to tow deeper. However, at full speed in even a moderate sea it was still affected by aeration from the bow-wave. This problem can only be solved by lengthening the cable still more or by moving the PES gantry lower down on the ship or further aft.

In rough weather (wind force 7-8 on the port bow) on day 068 even the hull transducer was defeated by aeration under the hull, and the bottom echo was intermittent. This is to be expected. Also to be expected were bands of

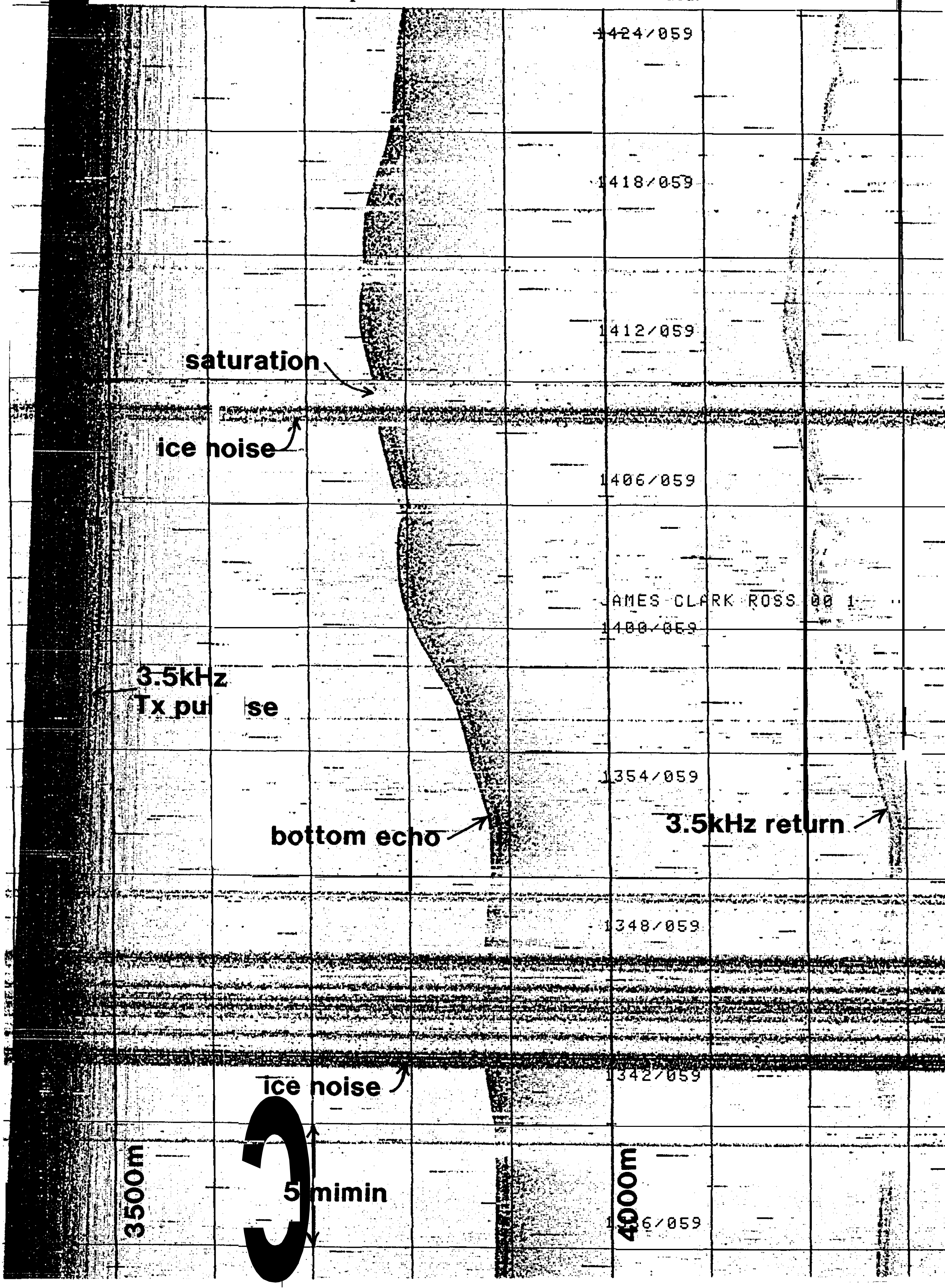


Figure 3. Effect of ice-breaking noise on PES analogue record. The ship was in 3/10 pack near CTD station 65. The breaking of each floe or group of floes is pacied up by the hull-mounted transducer, and is followed by a period of saturation of up to 1 minute when no echo is recorded.

noise when the ship was breaking ice (Fig. 3). The hull transducer coped remarkably well with such rough treatment.

(ii) The PES itself performed well in both echo-sounding and acoustic command mode. The PES clock gained 4-5 seconds per day (because of variations in mains frequency?) and had to be reset regularly. The array depth control is uncalibrated, not easy to set up and very easy to adjust by mistake when switching the gating on or off. This is not an improvement on the PES MkIII.

The beam steering unit was not tested.

(iii) The Waverley recorder was switched on at 1700/036 and the paper drive failed at 0040/037. At 2044/041 the spare board kindly lent by BGS was fitted and the Waverley performed generally well thereafter. Its main fault was in the paper drive and takeup, which are sufficiently out of alignment that the paper is wound on in alternating spirals to left and right. This requires rectification. Another fault is that the depth marks are printed incorrectly if a delay time is introduced. Depths were measured at the 5-minute annotated time marks generated by the Waverley's internal clock, this being much more accurate than the PES clock.

(iv) The Elonex computer was generally reliable. One depth mark (300 m from start of sweep) was faint or dotted. Synchronisation of the screen display was wiped out during periods of ship's MF radio transmission. The magnetometer, sited next to the Elonex PC, also gave erroneous readings at these times, and the problem with the Elonex probably arises from the proximity of the magnetometer cables at the back of the bench.

7.2.3. 3.5 kHz Profiler

(i) The 3.5 kHz was also run using the hull-mounted transducer most of the time, the fish only being used from 1450/039 to 2330/041. The hull transducer is very powerful and is scarcely affected by ship speed in calm weather: in rough weather, like the PES, the echo is obliterated by aeration under the hull. The 3.5 kHz is slightly less sensitive to icebreaking noise than the PES, i.e. the bottom echo survives for more of the time and the subsequent period of saturation is shorter.

A very noticeable effect of the hull transducer on the analogue record is the presence of reverberations of the transmission pulse. These are prominent on all centre-triggered programs and when the programmer is off. In the latter case the automatic gain control always renders the seabed echo visible, but on some of the programs listed in the manual the seabed disappears completely in the reverberations. By experiment we found a number of alternative combinations of Transmit, Gate and Receive on the Raytheon programmer, to suppress the reverberations. The manual has been amended accordingly.

(ii) The 3.5 kHz annotator tended to print time signals and hourly messages erratically, particularly during the early part of the cruise. This was cured either by resetting the annotator, or by removing the annotator board, flexing it slightly, making sure all the IC's were seated correctly and then re-installing it and resetting it. The clock gained 4-5 seconds per day, as did the PES clock.

It was necessary to use the 3.5 kHz as an echo sounder during the early part of the cruise while the PES Waverley recorder was out of action. While interpolating 5-minute times between the 6-minute time marks, it was noticed that the paper speed varied between the different program cycles. This problem largely disappeared later in the cruise.

(iii) The Raytheon line-scan recorder was generally reliable. Five stylus needles were replaced during the cruise. On day 067 some type of synch error appeared. The seabed echo jumped to a shallower position (about 1.5 cm on the chart paper $\equiv$ 25 m $\equiv$ 33 ms) and the paper drive step motor made a buzzing noise. This could be temporarily cured by switching the Raytheon off and then on again, but soon recurred. Several of the boards were changed and the motor removed and cleaned, but no specific fault was found. The fault became less frequent and ceased on day 069.

7.3 Navigation (RJH)

Navigational data were obtained from the following devices:

Trimble 4000 GPS locator
EM log
Doppler Log
Gyro

Each instrument was logged by the 'ABC' logging system. GPS fixes were taken every 30 seconds and provide the core of the navigational data. Relative motion data from the Gyro and EM and Doppler logs were processed using the Level C routine 'RELMOV'. If time gaps of greater than 30 seconds occurred in the GPS fixes then the ship's track was dead-reckoned across the time gap using these data. This process was controlled using the Level C routine 'BESTNAV'. In the past, navigational data from other sources such as transit satellites, Loran etc have also been used to supplement GPS fixes. To what extent each device was used to produce the final navigational data-set was controlled by a Kalman filter. This applies a weighting to each instrument, the heaviest weighting going to the most reliable source (usually GPS). Today, however, good GPS coverage is available virtually 24 hours a day. Time gaps of greater than 30 seconds in the GPS data were fairly rare on this cruise and these only extended over periods of a few minutes. It was therefore not necessary to log data from the Kalman filter.

The Trimble 4000 GPS locator has two output ports. One of these was dedicated to the ABC logging system whilst the other was connected to the ship's Voyage Management System (VMS). This system consists of two PCs, one master device in the wheelhouse and a secondary one in the UIC room. Both devices display real-time navigational data such as ship's position, velocity etc. Before each survey period a series of way-points was entered into the VMS. These could also be displayed together with the ship's true position. Way-points entered into the master instrument in the wheelhouse were used to guide the ship's auto-pilot. This system proved very successful, the secondary instrument in the UIC room providing a very useful aid to watch-keeping.

A hard copy record of each GPS fix was printed out every 30 seconds on a printer in the UIC room. This also proved useful as a watch-keeping tool, the records being used to hand-plot the ship's position every 30 minutes on large scale charts.

Level C routines such as 'TRACKPLOT' and 'LIVENAV' were used throughout the cruise to produce annotated charts of the ship's track.

7.4 **Scientific Clock** (MP)

Very early in the cruise it was noticed that the *Remote Junction boxes,* part of the Radiocode clock system, were not functioning at all. These Junction boxes contain a relay which is energised at regular intervals (period and duration setable using front panel controls) under the control of the master clock system on the Bridge. Basic fault finding pointed at the fault being within the Bridge unit. Investigation could go no further since removing the clock would stop all the scientific data acquisition. All the shipbome data logging uses this clock as the master reference.

When the ship arrived at Marsh base there was a period when no data logging was required. The clock *(sub-master* on the bridge) was dismantled and the fault found to be a cable that had become disconnected inside.

A spare *Sub-muster* is required on board the ship. If the clock died in the middle of a cruise then the whole of the data logging system could be put out of action by one simple fault. The clock system does seem to be the 'weak link' in the logging system. All the other components have some level of redundancy built in.

7.5 ADCP (MEB, PW)

The ADCP was set running as soon as possible after leaving the Fallclands to check its correct operation, before a calibration run across Burdwood Bank which was shallow enough to be able to run in bottom track mode (200-300m deep). The ship speed was reduced to 8 knots for approx. one hour on a straight course to enable a series of 20 minute runs to be made. The faster the speed, the lower the percentage of good data returned. Data were recorded straight onto floppies and should have been recorded on the level ABC system but this did not seem to be reliable or very straightforward. It became evident that data was being recorded in bottom track mode but not properly in water track mode.

Data were collected across Drake Passage, including the Polar Front which is of particular interest to other members of BAS, and thereafter whenever practicable. Areas of particular interest were where known fronts occur and at the continental shelf edge, for instance in the boomer survey areas where the track was along and across the shelf and the ship speed moderate and steady.

On passage in thick ice the ADCP was switched off, and in rough weather or at high speed, as in these cases the data return was negligible. When the ship was stationary it was also switched off. It was run either in bottom-track mode, with 64 8-metre bins and a 120-second ensemble time, or in water-track mode with 128 8-metre bins and a 300-second ensemble time.

The ADCP transducers are mounted offset 45" to fore-and-aft, which is apparently unusual but has advantages in terms of error distribution. However, only the main ADCP function software includes a means of recognising this offset. As matters stand, the offset prevents use of the pitch/roll/heave compensator and prevents presentation of a valid estimate of ship velocity to the Bridge repeater. A software modification is required to remedy both defects.

7.6 Metlogger (PW)

In mid January (two weeks or so before the Geophysics cruise) the system was turned on and found to be working correctly. It was run in stand alone mode as the level B was not operating at that time.

At the end of January, when the ship was in Drake passage, all the instruments on the foremast stopped working. The fault could not be investigated until arrival in Stanley, so was turned off. When investigated, the Vector Instruments anemometer had developed a fault and was virtually shorting out the 15V supply that supplies the masthead instruments. As it was not possible to repair the anemometer (the internal electronics being epoxy encapsulated), it was disconnected and the system operated without it. Just prior to departure from Port Stanley the Vaisala humidity sensor started giving unrealistic readings. Further investigation showed the sensor head to be salt encrusted, which is not really surprising considering that the sensor has to be relatively exposed in order to work. The problem could not be remedied, so humidity remained unlogged.

The system was connected to the Met Office hull temperature sensor via the scientific data wiring, which enabled us to get close to the appropriate junction box in the wheel house. This is the sensor that we want to use for sea temperature measurement for the Metlogger (as it doesn't require constant running of the uncontaminated seawater pump), but the Met Office display unit (in the wheel house) has to be kept on channel 5 for the sensor to read and for us to log it. Inevitably people occasionally forget to switch it back to channel 5 after viewing other parameters, which results in some lost data.

Before the next scientific cruise we need to replace parts for the two faulty instruments, obtain advice on methods of protecting the humidity sensor (without invalidating the readings) and find an alternative method of logging sea temperature that is independent of the Met Office display unit.

7.7 **Autosal** (MEB)

Setting up the autosal was described in the trials report It was refilled with tap water before the ship left Stanley. This water had originated from Wallsend and was full of brown particles which will not harm the analysis, but mean that the tank should be cleaned out or an anti-bacterial agent added to prevent further growth and possible damage.

The lab temperature did not vary very much over the analysis period, staying at around 17.5-18.5 deg C, so the water bath temperature was kept at 18 deg C.

Several problems were encountered. Firstly the pumps stopped working twice. This was fixed quite quickly, but the pumps may need overhauling on return to Cambridge. The other problem was one of standardization drift which occurred on long runs with frequent readings taken. The drift was so large that the correction to zero was at times in the region of 100 (normally it should be kept to less than 20). One reason for this may be the slight change in bath temperature brought about by the lights flashing every time the function switch was moved, This will inevitably increase the bath temperature on a long run, particularly when the temperature is close to ambient and the lights not cycling very often.

Values which are obviously wrong will be discarded in the final analysis and may be traced back to leaking bottles or other attributable causes.

There appears to be an offset of approx. 0.04 in salinity between autosal values and those from the deck unit, which will need to be input as calibrations to the data.

7.8 **Magnetometer** (PFB)

A Varian V75 magnetometer was provided on loan by RVS, including 2 fish and tow cables, and 2 Servoscribe chart recorders. The magnetometer was streamed whenever possible on passage between work areas, and for one specific transect in the northern Weddell Sea.

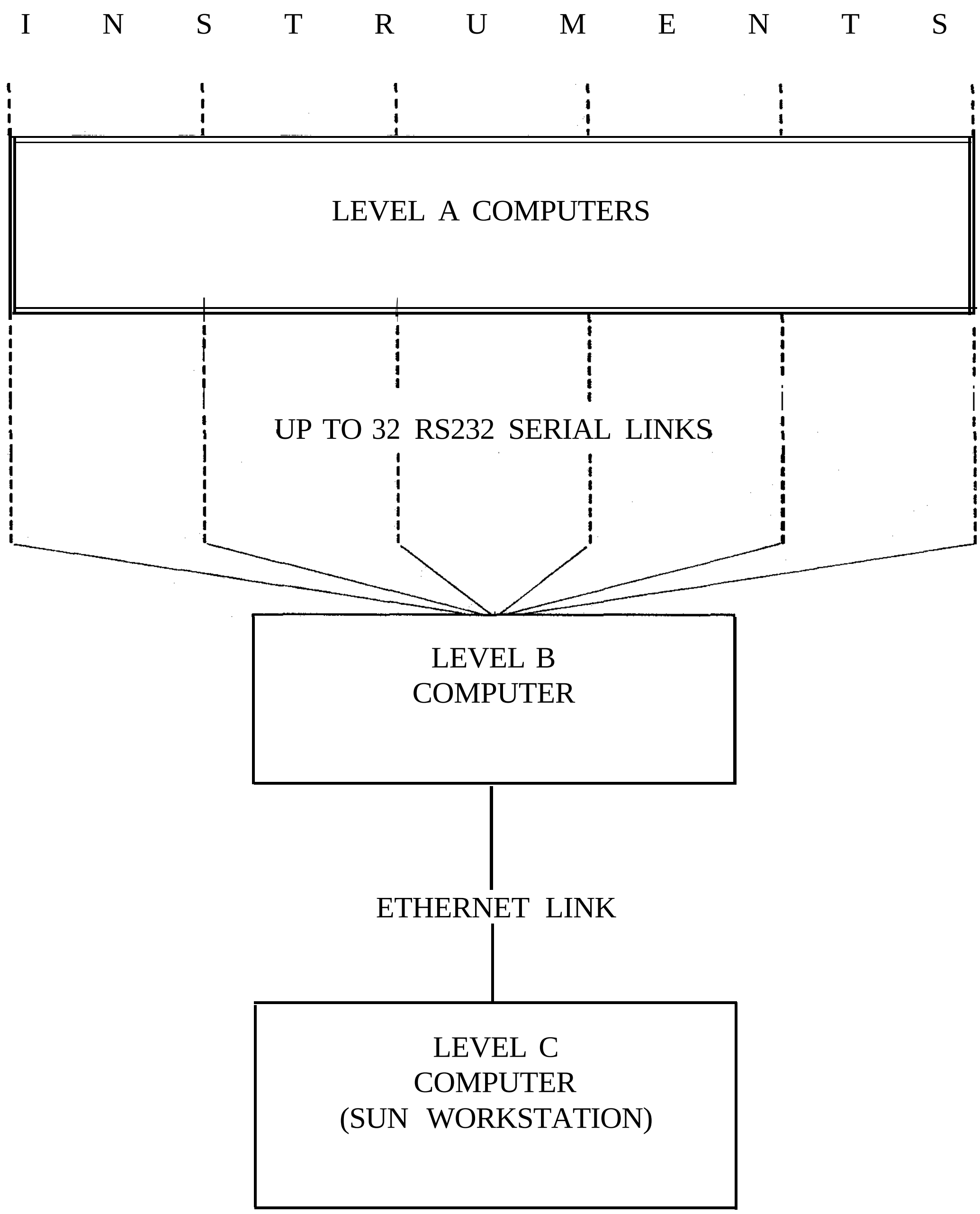
Problems were minor: the deck connection had to be dried and greased at intervals of a few days to remove salt water, and a connector at the back of the lab unit was re-soldered once. The breadth of the noise envelope on the measured field value increased in a following sea (as the bottle corkscrewed presumably) and also (reversibly, and mysteriously) at high speed. The system is vulnerable to MF radio interference. However, only one fish and cable were used, and were in good condition when brought inboard for the final time.

8. COMPUTER REPORT

8.1 Performance of the ABC Data Acquisition System (DIR)

8.1.1 Introduction

During the cruise the ABC data acquisition system was run almost continually to log data from various instruments on the ship. A block diagram of the structure of the system is shown below:



The Level A and Level B computers were specially constructed for use in the data acquisition system. Level A machines are based around a Motorola 68000 processor and are used to acquire data directly from individual instruments, the data are then checked and converted into a standard format for transmission to the Level B archiving computer via RS232 serial links.

The Level B machine is based around a Motorola 68030 processor and two intelligent serial input cards each of which is controlled by a Motorola 68020 processor and is capable of handling sixteen serial inputs simultaneously. Level B is therefore capable of handling inputs from up to 32 different Level A's simultaneously. It is also equipped with two 100 Megabyte hard disk drives and two 150 Megabyte tape cartridge drives.

The incoming data are first buffered in the Level B's memory and then transferred to two 65 Megabyte buffers on the two mirrored hard disks. From there it is sent to one of the two tape drives for archiving and, via an ethernet interface, to the Level C computer where further processing of the data is carried out.

8.1.2 Instruments logged and data acquired at Level C during the cruise

DOPPLER LOG:
This instrument gives the ship's speed over the ground or through the water by measuring the doppler shift of returning energy from a 150 kHz sound transmission.

Data logged: 46830848 bytes
Number of records: 2926544
Average logging rate: 1 record every 1.03 seconds

ELECTROMAGNETIC LOG:
This gives a reading of the ships speed through the water by measuring an electric current generated by seawater, which is a conductor, passing through a magnetic field.

Data logged: 13418624 bytes
Number of records: 1341248
Average logging rate: 1 record every 2.25 seconds.

GYROCOMPASS:
This simply gives a reading of the ships heading.

Data logged: 30285694 bytes
Number of records: 3027955
Average logging rate: 1 record every 1.00 seconds

GLOBAL POSITIONING SYSTEM (TRIMBLE):
This is a satellite navigation system which gives accurate readings of the position of the receiver antenna on the earth's surface.

Data logged: 7987544 bytes
Number of records: 114020
Average logging rate: 1 record every 26.52 seconds

MAGNETOMETER:
The magnetometer sensor is towed behind the ship and measures the strength of the earth's magnetic field. This instrument was only used for part of the cruise.

Data logged: 1511154 bytes
Number of records: 150501
Average logging rate: 1 record every 6 seconds

METEOROLOGICAL LOGGER:
This instrument logs various meteorological readings. Data are sent directly to Level B from the instrument-controlling PC which functions as a Level A.

Data logged: 2532460 bytes
Number of records: 48583
Average logging rate: 1 record every 62.22 seconds.

CTD (CONDUCTIVITY TEMPERATURE DEPTH):
The CTD is lowered into the ocean and provides readings of the above three variables as it descends. The Level A software for this application appears to be delicate and breaks down quite regularly. When this happens the Level A must be reset. Also, the CTD outputs 32 frames of 12 bytes of data per second; unfortunately the Level A only handles 1 frame per second and so many data are lost. However, ALL the data are logged on the PC connected to the instrument, so the ABC system can be regarded as a back-up system for this instrument, albeit not a very credible one at present.

Data logged: 7574717 bytes
Number of records: 222605

WINCH:
The performance of the ship's winches is monitored by the Seametrix winch monitoring system. This also acts as a Level A, passing information to Level B for logging. There appeared to be problems with this part of the system, as data were only logged occasionally.

Data logged: 383252 bytes
Number of records: 8 198

ACOUSTIC DOPPLER CURRENT PROFILER (ADCP):
This instrument uses the doppler shift of sound waves to determine the movement of water below the ship due to currents. This instrument is logged by a PC and also sends information directly to Level C via a serial link. Problems were encountered in logging data on Level C from this instrument when it was operating in deep water mode. Data were only logged on Level C when it was operating in shallow water mode. Fortunately all data were logged on the PC connected to the instrument.

8.1.3 Performance of the Level A's

The Level A computers connected to the navigation instruments were relatively trouble free throughout the cruise except for one incident when they raised alarms indicating that the time received by them from the ship's master clock had jumped. The alarms caused by this incident went on for some and were eventually cleared by resetting the Level A's. The clock was investigated and no indication of a time jump could be found. Also, the Level A attached to the CTD gave no alarm messages, which seemed to indicate that the error was related to only one group of Level A's All the navigation instrument Level A's are housed in the electrical locker on the Navigation Bridge Deck and connected to the same power socket. Some electrical work was underway at the time in this area and it is probable that the error was caused by a short interruption of the power supply to the Level A's.

The application software of the Level A connected to the CTD deck unit appeared to be somewhat unreliable and hung up quite regularly. These errors were usually cleared by resetting the unit. The deck unit was required to be left on between CTD stations and during these periods it generated spurious data. This was actually logged by the ABC system and so between stations it was necessary to remove the cable which carried data between the CTD deck unit and the Level A from the Level A input socket. The performance of this Level A was also very disappointing in that it could only handle data at the rate of one twelve byte frame every second while the CTD deck unit produced 32 such frames a second.

The Mark I Magnetometer Level A did not function correctly during the early part of the cruise but this was due to a faulty connection between the instrument and the Level A, and the problem was quickly rectified.

8.1.4 Level B Performance

During the cruise the Level B data archiving computer performed quite well but a few problems were encountered. Eight 150 Megabyte tapes were used to hold the data from the cruise, although not all of these were filled to capacity.

TAPE NUMBER	% FULL	REASON FOR TAPE CHANGE
1	4	Level B hung, needed reset.
2	100	Tape full.
3	29	Level B input card hung, needed reset.
4	5	Level B input card hung, needed reset.
5	8	Level B input card hung, needed reset.
6	45	Tape switched, partially overwritten.
7	100	Tape full.
8	42	Cruise ended.

Tapes 1,3,4 and 5 were only partially filled due to either the Level B main processor hanging or the Level B serial input card processor hanging. In both cases a reset of the entire Level B is required, as resetting the input card alone has no effect. This requires insertion of a new tape. The serial input cards do seem to be one of the weakest points on this system.

In the case of tape 6 the Level B software received an indication that the tape was full when only 45% of its nominal capacity had been used; this is not unusual. The software then tried to switch to the other tape drive but as no tape was in place it could not use this drive. It then switched back to the drive containing the full tape. At this point the software should have read the first block of the tape, discovered that it contained data from the current cruise and then refused to write to it. However error messages were issued by the software indicating that it had attempted to read the tape and could not; this occurred several times. The tape header was eventually read after several tries, but apparently incorrectly, and the tape was not identified by the software as being from the current cruise. Consequently the tape was partially overwritten. This mistake was noticed when less than 1% of the data had been overwritten, and the tape was removed by the operator. The remaining 44% of the data which was not overwritten can be recovered by first of all moving the tape to the first end-of-tape marker and then reading the data after this point. It is therefore recommended that both tape drives have tapes in them at all times, one tape is being written to and the other is available for switching should the software be unable to put further data on the current tape for any reason. This should avoid any problems with the software reading current tapes.

8.2 Central VAX Computing

8.2.1 Introduction

The main centralised user service was provided by a DEC VAX 4000/300 running VAX/VMS V5.4-2. This machine is slightly more powerful than the main VAX 6410 (BSVC in Cambridge. The user operating environment has been set up to emulate the Cambridge system and Cambridge users should find no difficulty using the JCR systems.

8.2.2 Application Packages and Compilers

Application packages available were: Oracle, SAS, Genstat, UNIRAS, UNIGKS, GRAFIX/GKS, Minitab. Compilers available were: C, Fortran, and Pascal.

Versions running during the cruise were those extant at Cambridge in September 1991. Upgrades to application and system software will be made whilst the ship is in the UK during UK summer.

Full sets of documentation were available for all packages and compilers.

8.2.3 **Printers**

Three central printers were available directly from the VAX.

i. DECLASER 2250 - a high quality monochrome A4 Postscript compatible laser printer. Access to this printer was gained through two print queue: SYS$LASER_PS for Postscript formatted files, and SYS$LASER_ANSI for normal ASCII text files. Jobs submitted to the queue SYS$LASER default to the SYS$LASER_ANSI queue.

ii. HP LASERJET III - a second high quality monochrome A4 laser printer. Not Postscript compatible. This printer was primarily intended for use from the Sun workstations but is available from the VAX on print queue SYS$ANSI. During the cruise it was used to produce plots generated in HPGL from a suit of Fortran programs developed by a user on one of the SUN Workstations.

iii. EPSON LQl050 - a 132 character wide dot matrix printer with continuous fanfold paper. This was the default printer available from queue SYS$PRINT.

8.2.4 **Plotters**

Two colour graph plotters were available.

i. ZETA A0 colour plotter - This device was shared between the Level C system and the VAX. To implement this a switch positioned above the spare Level B in the system rack in the computer room has to be toggled (position 1 for the Level C, position 2 for the Vax). This was necessary due to the requirement of the Level C software that output to the plotter should not be queued (to permit overlays). Output from the VAX can theoretically be queued but this has not yet been achieved. Output to this device from the VAX is sent using the VMS COPY command to device LTA3: eg.
copy <plotfile> lta3:

ii. HP 7475 A3/A4 colour plotter - This device was available from the VAX in eavesdrop mode only. Towards the end of the cruise a special cable was made to allow direct connection to the CTD PC to allow plotting from the CTD software. Since operation from the VAX (in eavesdrop mode) and from the CTD PC require different cables, access to both hosts cannot take place at the same time. To make this device available from a VAX queue will require an additional cable and switch, and software to switch the plotter between eavesdrop and direct mode.

8.2.5 **Accessing the VAX**

The VAX is generally available to the local area network with node name JRVA.

from PCs with Ethernet cards using PC-NFS. Access through DEC Pathworks should be possible in the future. Connection is made through Emulex Performance 400 terminal servers and at the "server>" prompt it is necessary to type c ***jrva*** to acquire the VAX. It is also possible to connect to any on the Sun workstations eg. c ***tcp basl.***

8.2.6 **Disk Space**

Approximately 350 megabytes was available for scientific user files, plus an additional 380 megabytes split between the Oracle database system and TMPO scratch area.

8.2.7 **Connectivity with Sun Workstations**

VMS/ULTRIX connection is installed and allows interactive logins between all Sun Workstations (including the Level C) and the VAX, as well as file transfer using FTP. No automatic method of transferring data straight from Level C into Oracle has yet been provided but this is seen as a high priority for future cruises.

8.2.8 **Communicating with Cambridge**

The BAS Antarctic Messaging System (SENDMSG) has been installed to allow "e-mail" type communication with HQ. All outgoing messages have to be approved by a releasing officer, either the Master or Principal Scientist.

SENDMSG messages are processed on the ship, and in Cambridge, in the same manner as FAX messages. All messages are given a registration number and unless they are of type Personal or Confidential are placed in circulation files at HQ. It is possible to send personal airletters by SENDMSG and these go directly to Cambridge without being seen by releasing officers.

Software was produced during the cruise to allow the transfer of bulk data files between Cambridge and the ship.

8.2.9 Hardware Problem

Service was interrupted for two days because of a faulty on/off switch. This was repaired by ISG and no further problem is anticipated.

9. CRUISE STATISTICS

Total cruise time, Stanley to Stanley 35.0 days

Deep-tow boomer survey	6.2 days
Deep tow boomer trials and repairs	2.0 days
CTD (time on station)	3.1 days
Moorings: BAS	0.7 days
T Foster	1.2 days
N Weddell magnetic survey	3.9 days
Ooze dredging	0.2 days
Anchored off Byers Peninsula	0.4 days
<u>Total scientific time</u>	17.7 days
Passage to and from Stanley	5.6 days
Passage between sites	8.7 days
Parked in ice overnight	2.2 days
Lost survey time due to weather	0.8 days
Whilst on passage: magnetometer	12.0 days total
ADCP	20.3 days
3.5 kHz profiler	19.5 days
10 kHz PES	31.4 days

10. CREW LIST

Officers:	N.A. Beer	Master
	M.J. Burgan	Chief Officer
	G.T. Hobbs	2nd Officer
	R. Jackson	3rd Officer
	S.J. Mee	Radio Officer
	J.P. Donnelly	Chief Engineer
	D. Alan	2nd Engineer
	R.A. Caldwell	3rd Engineer
	M. Inch	4th Engineer
	A.G. Ferguson	4th Engineer
	A.K. Rowe	ElectricaI Officer
	K.R. Olley	Catering Officer
crew:	J. W. Summers	Scientific CPO
	G.M. Stewart	Bosun
	A. Gill	Bosun’s Mate
	J.H. Williams	Seaman
	A.M. Bowen	Seaman
	C.A. Chalk	Seaman
	J.A. Dodd	Seaman
	A.L. Wilkinson	Seaman
	D.R. Summers	Motorman
	B.D. Smith	Motorman
	S. Hewitt	Chief Cook
	M. Davis	2nd Cook
	S.W. Tucker	Steward
	M. Weirs	Steward
	N.R. Greenwood	Steward
	M. Tushingham	Steward
Scientific Party:	P.F. Barker	PSO
	C.J. Pudsey	
	R.D. Larter	
	T.D. Foster	University of California
	C.P. Brett	BGS
	D.J. Smith	BGS
	M.E. Barber	
	R.J. Hunter	
	L.E. Vanneste	
	B.J. Lamden	ISG
	D. J. Richmond	ISG
	P. Woodroffe	ISG
	M.O. Preston	ISG
	J. Croall	Doctor

11. **Acknowledgements**

The requirements of a science cruise on a maiden voyage are inevitably more than usually difficult to fulfil. We owe a great deal to those at BAS HQ who helped us get to sea, particularly Kath Nicholson and Peter Jones, and to the very many people within the ship's company who went out of their way to ensure the success of this cruise. We are grateful also to RVS for arranging the loan of equipment despite the rather difficult financial circumstances.

We thank Eric Henderson of the Scottish Office, Agriculture and Fisheries dept. for the loan of a spare receiver board for an Oceano TT201 desk unit and Greg Phillips of IOS(DL) for the loan of a complete Oceano TT301 deck unit. Kelso Riddell at Oceano (UK) provided valuable after-sales service. BGS kindly lent us a board for the PES Waverley recorder from their spares stock.

Finally we are grateful to Margaret Riley who produced this report to a tight deadline with skill and enthusiasm.

JAMES CLARK ROSS 001
TRACK CHART
Mercator projection
Scale 1: 3,250,000 at 60° S
KEY
Ship track
10kHz bathymetry and 3.5 kHz profile
10kHz, 3.5kHz and magnetics
Position at 0000(z), Julian day 57
Deep-tow boomer line
DTB fish deployed but digital data not recorded
BAS mooring
T. Foster mooring
CTD station
Ooze sample
Falkland Is
Port Stanley
Tierra del Fuego
South Georgia
SCOTIA SEA
South Sandwich Is
South Orkney Is
JANE BASIN
WEDDELL SEA
King George I
Byers Peninsula
Smith I
Anvers I
Antarctic Peninsula
Inset:
scale 1: 1,000,000
at 60° S
64° S
67° W
66
65
2000m
50° S
55
60
65
65° W
60
55
50
45
40
35
30
25
20

Jcr_01 _magnetics