SHACK 71:

RRS Shackleton
Scotia Sea
Geophysics
December 1971 - March 1972

Cruise Report of Proceedings

Part 1. Summary of Aims and Proceedings

Shackleton left Barry on 1st November and is expected to arrive back in port on 6th April. The area of interest has been that part of the Southern Ocean known as the Scotia Sea and the main programme commenced after leaving Montevideo on 6th December and finished on 8th March. The main objective of the cruise was to continue geophysical investigations in the Scotia Sea, formerly carried out by the department on Shackleton when she was in service with B.A.S.

In addition to the geophysical work, measurements of the distribution of certain halogenated hydrocarbons in the atmosphere were made by Prof. J.E. Lovelock on the voyage from Barry to Montevideo. Chemical analyses of hydrogen and carbon monoxide in the air and sea water were made by a group from the Max Planck Institute at Mainz during the first part of the cruise (1st Nov.- 6th Jan.). The ship also carried two zoologists from the Department of Oceanography at Southampton for the complete voyage: their programme included collections of specimens of Antarctic fauna and flora for trace element analysis with special emphasis on the study of krill (E. superba).

Sea and weather conditions for the area were better than average for the first part of the cruise and average for the latter half. Little time was completely lost due to bad weather but the programme had to be radically revised since pack ice covered much of the south Scotia Ridge over which a number of important surveys had been planned. The programme was further curtailed by the late departure of the ship from Barry and by unscheduled or unexpectedly long stops in Dakar, Montevideo and Punta Arenas.

The geophysical investigations had two main aspects Magnetometer profiles were run with the aim of mapping magnetic lineations in the Scotia Sea and recognising spreading centres. On the basis of data obtained on this and previous cruises dredge hauls were made at selected sites to obtain rocks for dating purposes Some detailed magnetic surveys there done. Equally important was the continuation of surveys of raised areas in the

Scotia Sea and of the Scotia Ridge itself. With the assistance of HMS Endurance 8 reversed seismic refraction profiles were shot over certain of the elevated parts of the ocean floor, and gravity and magnetic surveys carried out. Other work done included a reconnaissance of the South Georgia continental shelf, surveys at a number of sites chosen for drilling as part of the 1974 JOIDES programme and landings in South Georgia and on Annenkov Island for the collection of geological specimens, mainly for palaeomagnetic studies,

Detailed discussion of behaviour of equipment etc. is given below but to summarise it can be said that the LaCoste gravimeter, the R.V.B. Barringer magnetometer? and the Kelvin Hughes deep echo sounder worked well and suffered only minor faults, Birmingham seismic refraction equipment gave no trouble though difficulties were experienced in keeping in touch with HMS Endurance during the two ship work, The Birmingham sonobuoy equipment (manufactured by G. & E. Bradley) proved to have an unexpectedly short range, though this had worked satisfactorily in previous years. No obvious fault could be found. The only serious failure was that of the Birmingham profiler system. The inboard electronics worked satisfactorily but great trouble was experienced with air guns.

Part 2. Comments on ship and Equipment

We have obtained first-class geophysical data for more than 95% of the time spent at sea, This fact should be set against the comments below, which emphasize the faults in the hope of eliminating some before the next cruise. The engineers and electrician in partucular have provided Facilities for scientific work against a back-ground of repeated emergencies more appropriate to sea trials or a shakedown cruise.

N.B. These comments cover many items, the faults on which are better specified by the reports of the department concerned. Our interest is in the effect of the faults on the scientific programme.

1. The Ship (a) Some basic items listed in the original specification available to senior scientists before the cruise have been altered, Maximum scientific complement is now 14, and

a scientist planning a cruise can rely on having only 28 days' fuel oil (145 tons) and 25 days' water (162 tons accessible) although consumption of both varies with the weather and the type of work.

(b) Manning. A smaller but more skilled deck crew would serve better the needs of future cruises; our demands on them were small, That we carried a skilled carpenter with no previous experience at sea as Netman undoubtedly benefitted the ship on this first cruise, and did not upset the scientific work greatly since other crew members rigged nets, linen, buoys etc. Scientific interests on future cruises however would be better served by employing a more conventional netman/rigger or deck mechanic .

The RVB policy of having technicians accompany their scientific equipment is an excellent one,

(c) Stowage. There is plenty of room for stowing equipment in the holds, but inadequate facilities. The for'ard hold and the 'tweendecks of the main hold can be used, although the hatch on the main hold leaks in heavy weather A few storage bins in the for'ard hold and plenty of ringbolts in deck, bulkheads and deckheads would improve things. The for'ard hold can be locked.

The use of permanent drum mountings aft for cables to be streamed astern should be ex-tended, on the shelter deck or elsewhere.

(d) Explosives stowage. The for'ard magazine is excellent although access is difficult. In our opinion it should not be used simultaneously for stowage of ship stores (keg and Canned beer; detergents etc,) if only because its security is impaired, since more people need access.

The two magazines on the foredeck were inadequate for our detonators and primers, Although the amounts we had aboard were exceptionally large such a situation could recur.

A small ready-use locker aft would be an advantage.

We fired the charges (up to 200 lb) from a small wooden platform bolted to the bulwark rail on the poopdeck, If as large, or larger charges are to be fired in future, consideration must be given to making about4 feet of the after bulwarks to hinge inboard at a 1evel of about 30" from the deck as base for a larger platform at a more convenient height. A deck-level chute fitted at the after doors is considered unsage.

(e) Main deck aft. The extension to the poopdeck has given much more room for handling gear, but has reduced the speed which the ship is prepared to make into a head sea, since water hitting the descending underside of the deck causes the entire ship to "ring"

2. Laboratory and scientific Equipment

(a) Echo ounder, Kelvin Hughes MS 26J. Gave little trouble in operation. Thorough examination in Punta Arenas early January revealed that Kelvin Hughes could have done little overhaul before installation. Still badly affected (noisy) by main Winches and gives very poor trace at less than 5 knots (cavitation?). In present receiver location, plug-in module cannot be changed. Should be retained aboard as standby for PDR

(b) Gravimeter, LaCoste-Ronberg. An excellent machine, working superbly throughout except when clamped in bad weather. Meter drift undetectable (<1 mgal in 3 months), Sensor gave much better records when moved from "gravimeter room" (portside 'tweendeck of main hold) to refrigerator flat (lower, further aft and on the centre line). Ship's radio transmissions, particularly on 8 MHz. break through badly on all traces, heaters etc, despite screening all long leads, In its present location, the sensor should have additional protection.

(c) Magnetometer Barringer Gave excellent records throughout. Trouble, intensifying towards end of cruise, with waterproofing of outboard cable connection. Also possible bottle fluid contamination (precession envelope pinching but not bad enough to risk fluid change since we were not certain that suitable liquids were on board. Used throughout in preference to our own (Cambridg Consultants Ltd) magnetometer as anomalies much better defined. Interface developed by Birmingham technician (A. Wiggin) between parallel BCD output at magnetometer and Facit 4070 punch, will be made available to RVB when tidied up etc.

(d) Satellite Navigator Magnavox 702C/HP. Gave good fixes throughout. Became very hot since positioned in one corner of radio room which is poorly ventilated. Access for servicing very poor

Power supply changed and Self Test unit fault extant. Birmingham spare Teletype and punch not needed.

Teleprinter greatly affected by frequency changes in ship's 50 Hz supply printing rubbish if not on 50.4-+ 0.2 Hz on indicator in AC room. AC frequency varies with load outside these limits. Would strongly recommend Sat,Nav. is run from the Transipack 2 kVa crystal-controlled static inverter originally used aboard this ship and on HMS Endurance. N.B "stabilised" 50 Hz AC is not frequency stabilised. Would recommend also that the Sat.Nav. be moved down into the Main Lab. for ease of servicing, cooling and because it is still essentially a scientific instrument, needing to be understood rather than a "black box" for bridge use. In this case, suggest offline print-out facility on bridge.

(e) E.M. Log. An obvious advantage, but out of commission or operating uncalibrated for much of the cruise owing to the difficulty of making a waterproof joint at the sensing head. Very badly sited with respect to the A-frame, having to be retracted for safety every time this was in use for bottle, dredge, net, core or buoy mooring stations when it would have been particularly useful in assessing ship drift. An additional summing repeater sited in the Main Lab. would be valuable.

(f) Sparker, E. G. & G. Used at 1 to 4 kjoules occasionally on last leg of cruise, giving good data, High charging rates immediately after discharge upset main AC generators. To share this surge rather than for any increase in mean current, a second generator was started up for 4 kjoule operation.

(g) Flexotir hydrophone array and Winch. The flexotir array never produced reflections as good as those received by the small E. G. & G. 264B array, Initially there were broken leads and water leakage problems but after eliminating these, good records were still not obtained. Little time was available to investigate further but possible contributory causes (decreasing likelihood and importance) were (1) pickup of ship's electrical noise on cable (2) wrong buoyancy (3) a further fault,

The flexotir winch would not haul in the cable unaided even when the ship only just had steerage way on.

(h) Airgun Profiler. The major failure of the cruise. Birmingham supplied 6 new triggerable guns (Durham pattern) and 2 old free-running guns (Lamont pattern) run from 2 shipboard compressors each of ~12 cu ft/min free air capacity. Reflected arrivals (via 264B or Flexotir) were recorded on a TDR 4000 1" FM tape deck and a Mufax facsimile recorder. Also, R.D. Bradley provided a trigger unit which allowed the triggerable guns to be fired from the E. G. & G. recorder, as a standby. The new guns eventually gave satisfactory bangs on deck but never in the water and the old guns provided such data as were acquired before they too finally failed. Reasons for this wholesale failure are unknown, except that the pistons of the old guns may now be too corroded to be efficient.

The Mufax switching logic was affected by ship's electrical noise.

(i) 2 Ship Seismic equipment. Birmingham supplied GTR 200 amplifiers and filters, Con. Elec. UV Recorder, TDR 4090 tape recorder, receiving from 4 EVP7 hydrophones on 1800 ft of cable from the ship, HMS Endurance firing. 8 reversed lines achieved in very poor weather conditions (20 - 35 knots). If sea noise had been less, the ranges would probably have been limited by shipboard electrical noise.

(j) Sonobuoys, G. & E. Bradley. 3 lines only were shot, right at the end of the cruise because so little time was available. Maximum range achieved after re-tuning receivers and transmitters was 5 miles. We cannot explain this short range but consider that for other cruises a large directional aerial array (Yagi?) should replace the simple 1/4 wave upright bolted to the after mast. Buoys were laid from the crane, the mooring wire leading through a meter block on the A-frame, and recovered similarly. No lights were fitted onto the buoy, but one was successfully recovered after dark in mid-ocean by homing from 1 mile onto the direct wave from a 1 kjoule spark.

(k) Lab.radar, Decca RM 729A gave fixes on danbuoys to greater ranges than bridge radar, but was subject to variable range and bearing errors. Interfered slightly with bridge radar

(1) Clocks. The electric clocks installed in each lab. were useless, gaining up to 20 mins per day on 50 Hz or stabilised 50 Hz supplies. A small chronometer (k320 sec per day) and stop watch borrowed from the bridge were used for watchkeeping purposes.

(m) Course recorder and Gyro. Ship's gyro and autopilot worked well throughout the cruise. The lab. course recorder never worked and was out of circuit for the last two legs of the cruise after one of the gyro rotary converters failed. A lab. course recorder is regarded as essential, as a check on and permanent record of, listed course alterations.

(n) Lab. Facilities. The labs. are roomy, light and generally well-equipped. The following criticisms are mostly minor .

(1) Deck surface is slippery when wet.

(2) No eyebolts were found to fit the deck sockets in rough or main labs.

(3) The main lab. should not be used as a through passage between saloon and upper deck,

(4) A light table additional to the chart table would be very useful.

(5) The bookshelves provided accept none of the standard format manuals, scientific journals etc. Paperbacks yes.

6) The after waterproof doors to rough and main labs., the main lab. side door and the rough lab. skylights, all leak in heavy weather or when hosed down,

(7) There is much vibration in the labs. particularlt at the after end. Could some modular, asaptable form of shockmounting pbe produced or, alternatively all users advised to shockmount their own equipment?

(8) Tools, small components etc. We can wholeheartedly praise the RVB provision of tools, test equipment, small electronic components specific spares and oddments such as plastic tape and paper towels.

(9) Battery Chargers. The 2 chargers worked well when needed but there was considerable AC pickup on the long leads to the Main lab. We would recommend that the leads to the main and hydro labs, be screened and that a portable battery tray arrangement be provided to allow batteries used sith particularly sensitive equipment to be located nearby. Access to tthe charge tray is very poor.

3. Ship's Equipment - General

(a) Power supplies and ship's earth. These supplies coped well with all loads we gave them and are of interest mainly from the points of view of frequency stability and electrical noise. The labs' and ship's radio had a large noise problem. The gyrocompass rotary converter was one source of spikes, thyristors on the 50/60 Hz converter another. Also, probably because of the way the mains cables were laid and the use throughout of fluorescent lighting, there was much straight 50 Hz interference in the main lab. Provision of a minimal DC lab. lighting, with the facility of switching off all AC in the area of the labs. (a lab. switchboard) and a sea earth independent of the ship's hull, would allow much quieter conditions to be achieved when they became necessary e.g. 2-ship seismic work).

The frequency stability of the AC supply has already been mentioned. Some form of automatic stabilization is clearly required.

(b) Winches and A-frame. After several hydraulics failures on the way to Montevideo affecting mainly the ancillary chemical oceanography programmes the winches gave good service throughout the cruise, (1 core, 7 dredges, 6 bottle stations, 5 vertical bio. nets). The coring winch wire kinks readily unless tension is kept on, and the only shackles available for dredging tended to catch in the A-frame block, creating a dangerous situation. There were no accumulator springs with the hydro davit. The coring winch "wire cut" counter returned consistently 15-20% negative when the dredge was back inboard. The coring winch tensiometer read up to 8 times the SWL of the wire, an unnecessary precaution, and a lab-sited recording tensiometer would be extremely useful. No pingers compatible with the MS 26J echo sounder were available for dredging or coring.

Dredging from aft in deep water was abandoned after the first dredge when the wire cut a deep groove in the bulwarks below the starboard roller fairleads. The winch control communication head set system is not reliable, probably because of water in the deck console sockets.

The buoy mooring wire dispensers on the foredeck were adequate.

(c) After Crane and Capstan. This combination was used for handling air guns. Accidents on 2 occasions during these operations were contributed to by the very restricted outboard reach of the Atlas crane, although other primary factors were involved. On other occasions the airguns were damaged while suspended from the crane, by hitting the bulwarks. We would recommend either that the reach is extended or the crane replaced.

After fairleads, rollers, booms etc. provide a total towing width of about 12 m and on occasions up to 5 cables led astern at the same time quite successfully, although rudder angle on turning the ship was restricted to 10° as a precaution against tangling.

(d) Ship's Radio, The ship hires an IMR TX/RX set with 2 receivers, and owns an old Pedersen TX/RX Both sets were in use when firing a calibration line to the South Georgia seismological station and during the Z-ship seismic shooting. The Pederson set would not work on a mains supply, and only for hours on batteries. The main receivers were noisy and reception was poor. That model of receiver has been taken off the Post Office type approved list for SSB reception. The transmitter lacks SSB facilities and in the opinion of the RO is underpowered. The 50/60 Hz converter and gyro rotary converter noise affected the main receivers.

Radio transmissions interfered with virtually all scientific equipment, even putting faults onto some Max Planck Institute gear.

A permanently-wired lab. extension handset and two extension speakers would be most useful in any work involving ship and shore, or more than one ship. Similar temporary facilities were rigged during seismic shooting but are now dismantled.

A ship's internal communications terminal in the radio room would be useful.

(e) Interral Communications (Mimco) - works well except that in heavy weather water penetrates the upper deck terminals, causing oscillations which can be heard on all other terminals. A more waterproof upper deck terminal should be sought. As mentioned above, an additional terminal in the radio room would be useful, also a more portable lab. terminal..

(f) Zodiac Inflatable boats. These were found most useful for landings, although experience suggests that someone with a knowledge of the engine should be in the boat. With any sort of load (camping gear, rocks etc.) the boats are too heavy for three men to launch from a beach and should therefore be returned to the ship if they cannot safely be left ashore moored.

(g) The Racal Squadcal radios performed adequately.

4. Miscellaneous Points

(a) Air conditioning - essential for warm weather cruises, for labs. and accommodation.

(b) Wet weather clothing provision good.

(c) Accommodation on lower deck (13 out of 14 scientists' berths) cramped for a long cruise.

(d) Mattresses thin and hard.

(e) Recreational space inadequate.

This report was discussed with the Captain before we left the ship in Montevideo and we submit it from Birmingham at his request.

P.F. Barker
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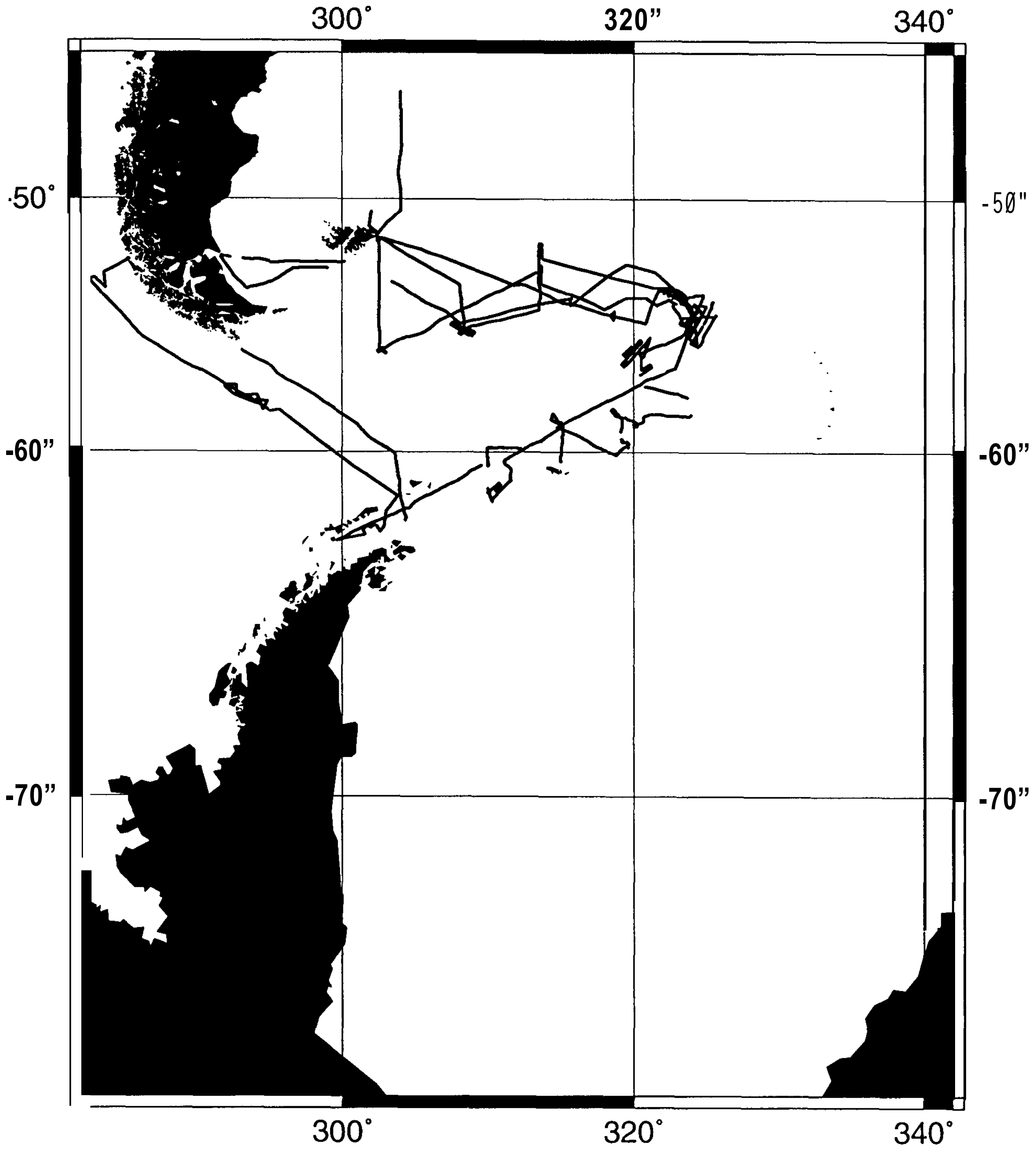

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