I.O.S.

R R S DISCOVERY
CRUISE 124

9th – 18th JANUARY 1982

TRIALS CRUISE FOLLOWING CONVERSION WORK

CRUISE REPORT NO 129
1982

NATURAL ENVIRONMENT RESEARCH COUNCIL
INSTITUTE OF OCEANOGRAPHIC SCIENCES

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Institute of Oceanographic Sciences,
Brook Road, Wormley, Godalming,
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ITINERARY

Departed Immingham	9th January 1982
Arrived Barry	18th January 1982

SCIENTIFIC PERSONNEL

J. Armstrong	Donkin & Co., Engineer
M.P. Burnham	I.O.S.
C.H. Clayson	I.O.S.
R.H. Edge	I.O.S.
Q.J. Huggett	I.O.S.
R.E. Kirk	I.O.S.
G.V. Lodge	I.O.S.
B.S. McCartney	I.O.S.
R.D. Peters	I.O.S.
H.S.J. Roe	I.O.S.
J.S.M. Rusby - PSO	I.O.S.
P.J. Schultheiss	I.O.S.
R.F. Wallace	I.O.S.
P.E. Weaver	I.O.S.
R.A. Wild	I.O.S.

SHIP'S OFFICERS

P.H.P. Maw	Master
P.J. Macdermott	Chief Officer
S. Sykes	2nd Officer
G.P. Harries	3rd Officer
A.E. Coombes	Chief Engineer
T.A. Rees	2nd Engineer
R. Cotter	3rd Engineer
G. Gimber	4th Engineer
N. Davenport	5th Engineer
T.J. Comley	5th Engineer
P.E. Edgell	Electrical Engineer
R. Overton	Purser
C.A. Langley	Radio Officer

OBJECTIVES

The cruise was designed as a sea trial and 'shake-down' period following the conversion and refit work carried out from October 5th to December 23rd 1981 at Humber Graving Dock, Immingham.

Apart from the usual annual marine and scientific refit tasks, considerable conversion work was carried out to 'Discovery' during this period, in order to fit her for the more demanding work in deeper water required by the radioactive waste commissions of the Department of the Environment.

The major tasks carried out during the conversion were the installation of:

1. A new main traction winch with twin storage drums aft,
2. A 15-ton crane-davit on the starboard quarter, particularly to handle the 50-foot Driscoll corer,
3. Auxiliary davits and support brackets for this corer,
4. a new 200 kW motor alternator set in the main motor room aft to provide 3-phase AC power (not discussed in this report),
5. a White-Gill bow thruster with directional flow to give greater precision and manoeuverability on station (not discussed in this report).

This report briefly describes the trials undertaken in the Bay of Biscay between the 9th to the 18th January 1982 to test the new equipment under operational conditions. A primary task was to use the new winch and warps to service the Driscoll corer and the RMT-8 net. The opportunity was also taken to carry out other work, including the calibration of the ship's EM logs, the running of the modified midships hydraulic winch and the operation of the electric winch which had been fitted with new spooling gear. The ship's track during this period is given in Figure 1.

PERFORMANCE OF TRACTION WINCH SYSTEM, INCLUDING STORAGE WINCHES AND HYDRAULIC POWER PACK

The individual components of the whole system were load and pressure tested at the factory before despatch. After installation, and the completion of the hydraulic and electric distribution circuits, the hydraulic circuits were flushed and the complete system tested, which included sequence testing of the hydraulic valves from the Moog controls in the winch control room. On satisfactory completion of these tests, the two warps, one for coring and one for fishing, were reeled onto their respective storage winches below deck. During the reeling a certain amount of running difficulty was experienced, mainly because hydraulic pressures etc. had not been set up adequately beforehand, due to lack of time. The last test before sailing included a dynamic load test in which the traction winch, reeved through the Schat crane-davit, was used to haul in a 15-ton weight from the quay at slow speed.

The winch system was subsequently used at sea intensively over a period of three days when the Driscoll corer and RMT net were deployed.

The system veered and hauled the 20 mm 18 x 7 strand coring warp well. Synchronisation of storage drum braking with the winch was good at all speeds, but there were occasions when back tension was lost when going from the haul to veer modes. This was partly due to the indifferent operation of the mechanical accumulator on the low-tension side. Veering speeds were limited to about 0.8 m/s with high corer loads of about 10 - 12 tons due to hydraulic cavitation, aggravated by the large dynamic loading observed (see 'Handling and operation of the Driscoll corer', Section D). Hauling speeds were also limited to about 0.4 m/s at high loads by the horsepower limiting circuits responding to these same dynamic loads.

The system did not cope as well with the 6-strand tapered fishing warp, which is not torque-balanced. On the 'outboard' side it performed well, with no tendency to produce twisted wire, but on the low-tension side its performance was poor (see section 'Handling of the midwater trawl'). On a number of occasions the warp jumped off the accumulator wheel, this occurred three times when operating the net when going from the haul to veer mode. It appeared that the wire had some low residual torsion left on the low-tension side, sufficient for it to 'climb-out' of the accumulator pulley. A serious example of this occurred after the bare warp had been streamed astern and was then hauled in from 10,000 to 6,500 metres, the residual torsion on the low-tension side being sufficient to twist the warp and cripple it, resulting in the loss of 6,500 metres of rope (see relevant section at the end of this report).

As a result of the experience gained during the three days operational use of the winch system a number of improvements need to be made:

1. A rope guard should be fitted around the accumulator wheel,
2. When using the tapered warp a high back tension needs to be maintained to avoid kinking,
3. The response time of the accumulator when going from haul to veer should be decreased considerably,
4. Sprung rollers should be mounted on the traction drums (available),
5. An hydraulic accumulator should be fitted to the main pump lines to limit pressure fluctuations when fishing and coring,
6. A mechanical accumulator should be fitted on the high-tension side during Driscoll coring operations.

The automatic reeving gear worked perfectly on the coring warp, but had trouble coping with the tapered warp. This was partly due to the initial poor lay of the tapered warp on its storage drum compounded by any residual torsion remaining in the warp when it was later retrieved. It is planned to improve the directional control of the automatic reeving gear by increasing the length of the mechanical sensing unit.

The hydraulic power pack worked faultlessly throughout the cruise with no sign of contamination in the valve spools etc.

The care taken in flushing all peripheral components such as the winch and storage reels before installation, as well as the power pack and distribution piping individually before final correction, had clearly paid dividends.

(R.H. Edge & J.S.M. Rusby)

CRANE-DAVIT PERFORMANCE

The crane-davit, built by Schat Davits Ltd., had been statically tested to 30 tons and dynamically to 15 tons before it was mounted on 'Discovery'. At the end of the refit it was again tested, both in slewing and luffing, using the dedicated hydraulic circuit from the main hydraulic power pack installed for the winch system. The luffing action was correct but trouble was experienced in slewing. This was traced to an 'hydraulic lock' problem in the central hydraulic slip-ring assembly, and was temporarily overcome by replacing the slip-ring by flexible hoses.

During the cruise the crane-davit performed well and demonstrated the comparative ease with which both the Driscoll corer and RMT 1+8 net could be handled. Smoother slewing operation, particularly when handling side loads, was obtained by increasing the drive pressure from 1000 to 1600 psi. The mounting position is good for deploying both the corer and the nets.

(R.H. Edge & J.S.M. Rusby)

DISCOVERY DYNAMOMETER SYSTEM

During the Discovery refit, and the following trials cruise, a new dynamometer system was installed. This was to cope with the extra load and wire length on the new traction and auxiliary winches. Installation involved fitting new junction boxes and re-routing wiring to the new winch control room. The electronics were fitted and connected, and redesigned displays placed in the plot, bridge and electronics lab. Displays were also mounted in the winch driver's console. Prior to the cruise the load cell and

D.C. amplifier were set up and calibrated with a load of 15 tons.

During the cruise the load monitoring system and wire out counters performed well and useful records of coring and net trawling operations were obtained. The 'rate' of wire monitor proved to be a little over-sensitive to variations of wire speed and modifications will be made to rectify this.

(R.E. Kirk)

HANDLING AND OPERATION OF THE DRISCOLL CORER

Two coring stations were carried out with the Driscoll corer, which effectively tested the handling and winching equipment and the operation of the corer.

The handling system during launch and recovery, involving the Schat crane-davit, the corer bucket and the auxiliary davits, worked well. No trouble was experienced in controlling the corer, even under moderate swell conditions. In the vertical condition this was due to the corer head being close up to the crane-davit arm with the tube well damped by the water. The corer head could be manoeuvred with precision by the crane-davit, both in and out of the bucket. During rotation of the barrel the sliding clamps and auxiliary davits worked well allowing the corer to be deployed and stowed safely. As a result of the trials it was decided that the bucket should be capable of being locked in the vertical and horizontal positons, and a small modification made to the form of the barrel support brackets to allow the barrel to move laterally during assembly.

Lowering was carried out at about 0.8 m/s and it was found that considerable live loading occurred. On the first attempt the system pre-triggered at 3150 metres, when a sharp bang was heard on the after deck. On retrieval it was found that there were no defects so it is assumed that the load on the trigger arm was reduced by the pilot corer kiting due to high displacements of the warp. The pinger traces at the time showed a surprising 10 - 20 metre oscillation under a swell amplitude of only 2 - 3 metres. For the second attempt the pilot corer was loaded with an additional 200 pounds of weight and the exercise repeated. It was lowered intact to near the seabed at 0.8 m/s for the first 4700 metres and the speed then reduced to 0.5 m/s for the final 100 metres. During this lowering similar oscillations of the pinger occurred with significant live-loading. The successful triggering of the corer was first identified on the dynamometer record, and this was confirmed by a sudden descent of about 9 metres on the pinger record. There was no indication aft from the appearance of the warp. No unusually large force was noted during the initial period of hauling, and from this, and the form of the pinger record, it seemed likely that the corer had either toppled or made only a partial penetration. Loads recorded during this period were: a mean load of 9.5 ± 2.5 tons just prior to tripping, just after tripping 8 tons and a load of 10.5 ± 2.5 tons as the corer was leaving the bottom. A peak load of 14.9 tons occurred very soon after the corer was off the bottom but it is not clear if this was the direct result of some pull-out force. When the corer was retrieved it was found that a gradual bend of 40^{o} had occurred between the second and third sections of the barrel. About 11 feet of sediment was recovered, and from this, and the bend, it looked as if the corer had entered the seabed at an angle, so preventing full penetration, and that the head had then bent down to the ground. A substantial amount of sediment was found adhering to one side of the head and in the well holding the pinger.

The pinger monitoring system used worked very well. This consisted of one pinger in the head looking down, and a second one clamped 50 metres up the wire looking upwards. Depth control off the seabed was mainly carried out with the lower one, while the upper one acted as a useful monitor for pre-triggering since the pulse interval between the two would increase when this happened due to the increased separation distance.

The winch was limited in veering speed by the fluctuating loads involved. If the speed exceeded about 0.8 m/s then cavitation occurred in the oil flow. This problem could be alleviated by the fitting of an oil accumulator. Similarly it would be desirable to fit a mechanical accumulator to reduce the high values of live loading observed.

(P.E. Weaver, R.H. Edge & J.S.M. Rusby)

HANDLING OF THE MIDWATER TRAWL

The RMT 1+8 trawl was fished on Cruise 124 to evaluate changes in handling techniques due to the new winch and davit system. The trawl was launched and recovered as if it were the multiple RMT 1+8 system, i.e. with the weight bar adjacent to the capstan and the monitor stand by the aft rail.

An initial handling trial was carried out when hove-to off Spithead and the load of the trawl was transferred from the crane to the warp and vice versa very successfully - the davit was swung to the centre of the ship's rail for the transfer of the crane hook and then turned to starboard, and vice versa. This initial trial demonstrated that there was sufficient width on the after deck between the port A-frame and the new davit for midwater trawling with the RMT 1+8 systems.

The nets were fished three times, twice with 800 metres of warp out and once with 7000 metres of wire. On each occasion the transfer of the net to and from the davit was accomplished relatively easily, although the crane wire caught around the davit lamp the first time the trawl was recovered. This fouling was subsequently avoided by turning the davit to starboard as soon as the net was transferred, and so moving it out of the way. The potential problem of the trawl warp twisting and kinking between the hauler and the net, as happened with the previous winch, proved to be virtually non-existant during the fishing tests. On each occasion the net was recovered with the necessary slack wire between the davit and the net swivel, and on each occasion there was no trouble with the twisting wire.

There is, however, a problem further forward in the system, starting at the traction winch. Each time the net was used the wire either jumped off the accumulator sheave or off the traction drums. This jumping occurred when there was slack wire in the system or when the direction of the winch was changed. On the last haul it happened when the net was being recovered, half out of the water, and in any sort of rough sea serious damage to the net would probably have occurred.

The jumping of the warp was alleviated by clamping it with the dynamometer wheel before it entered the hauling drums and would be further relieved by fitting pressure rollers on top of the hauling drums and a guard around the accumulator wheel.

As it is at present the winch system is not flexible enough for normal biological trawling. Problems occur whenever the winch is stopped and the direction of the winch changed. It was also disappointing that on the deep tow the winch was unable to haul faster than 0.5 to 0.6 m/s until there was less than 4000 metres of warp out. This means that deep hauls will take appreciably more ship time than before.

Assuming that the winch problems can be solved, the handling of midwater trawls from 'Discovery' will ultimately be easier than before. The transfer from davit to crane is easy and much better than the previous technique of bringing the nets around the stern of the ship. The non-twisting of the warp during three fishing tests is also a great improvement on the previous system.

A few alterations would facilitate gear handling aft and the changing over of the warps:

1. The sheave that feeds the storage drums in the lower hold needs more clearance. At present it is impossible to pull either the hard eye on the trawl warp or the coring termination through this when changing warps.

2. The light on the davit is in the wrong place for net handling. It needs guarding so that the crane wire cannot catch behind it; it also shines directly into the eyes of both the crane driver and the person controlling the operation. Two guarded lights are needed, one each side of the davit, with the facility to turn one, or both, off when not required.
3. A dynamometer read out of at least 'wire-out' is desirable near the aft rail, as is an emergency stop button for the winch/davit system (Note: this is fitted by the davit console - JSMR).
4. Whenever possible removal of the port A-frame would give significantly more space aft - an important consideration for the multiple net.
5. There are now far too many bolt heads sticking up out of the after deck. Nets will catch and tear on those. They should be replaced by flush plugs.

(H.S.J. Roe)

MIDSHIPS WINCH AND FORWARD HYDRAULIC MAIN

Several modifications had been made to the winch during the refit, mainly to improve operation and to ensure the safety of gear and personnel. Principally these were:

1. The installation of a larger and stronger platform to take the heavier payloads now required. The platform can be operated hydraulically either from the hydraulic main supply via a solenoid controlled valve or by means of a hand pump.
2. The addition of an auxiliary drive wheel for use in an emergency retrieval (the hydraulic motor for this is available but it was not possible to test the system for lack of flexible pipes - not bought due to lack of money).
3. The replacement of the hand brake by an automatic hydraulic brake.
4. The reinstatement of the free wheel system to allow wire to be pulled off manually.
5. The addition of motor feed line filters.

In addition a new strain-gauge shackle was fitted to measure wire tension, and the ring main pump was fitted with a sequence valve to prevent over-speeding and the tripping of the pump motor due to excessive flow demands.

The hydraulic brake was adjusted and tested up to the full torque capability of the winch motor, and the speeds of the A-frame and platform rams were adjusted. The motor case pressure was set up to the recommended valve and it was found that it required several minutes running before it built up to this pressure and stabilised. During the period of the winch test the hydraulic main was run for three hours. 400 metres of wire were paid out and recovered satisfactorily whilst performance figures were taken. No faults occurred during the running.

The strain gauge circuits were adjusted to match the sensitivity of the new load shackle and the wire overload circuit was set up and connected with the system. The conductor cable termination was remade and tested.

(R.F. Wallace, C.H. Clayson)

ELECTRIC HYDROGRAPHIC WINCH

During the refit this winch had been fitted with a Lebus grooved spool and the traverse gearing adjusted to suit the latest size of armoured conductor cable. It had also been generally refurbished.

The conductor cable termination was remade and two trials of the winch carried out using this cable so as to check the general operation and performance of the spooling system. A maximum of 2000 metres of wire was paid out in these trials. The spooling was a considerable improvement over previous performance but was spoiled by the traverse. The latter reversed about 6 - 12 mm short of the forward end of the spool with the result that each layer missed one or two turns at this end on hauling in; the wire thus became progressively out of phase with the traverse. This may be largely due to the offset of the deckhead sheave relative to the plane through the middle of the spool; this results in side loading which varies from near zero at the aft end of the traverse to a maximum at the forward end. Any free play or flexibility could account for the observed problem. It is proposed to mount a new sheave in a more central position in an attempt to eradicate this.

The electrical system was checked out and a few minor faults with the wiring of the alarm systems and with the emergency brake circuit were cleared. The winch ran satisfactorily off the new 200 kVA generator and was found to be virtually silent on deck due to elimination of wire snatching which occurred with the old spooling. The work put in by members of the I.O.S. refit team is gratefully acknowledged.

(C.H. Clayson)

CALIBRATION OF ELECTROMAGNETIC LOGS

Both Port and Starboard logs were calibrated simultaneously by the acoustic transponder technique developed on Cruise 116.

First a 10 KHz transponder was deployed, freely floating at a depth of 10 metres determined by a line with distributed rigid expanded P.V.C. buoyancy blocks up to the surface, with a further 20 metres of stray line and a couple more low-windage blocks. The ship then steamed head-to-wind for approximately one mile at which point a second transponder was similarly deployed. These drifting transponders formed a baseline; though subject to small variations in length the baseline was continuously monitored acoustically. The transponders were interrogated by the precision echo-sounder and the acoustic responses recorded on the Mufax display.

Six runs were made at speeds between 3 and 11 knots, keeping as close as possible to the transponder line, steaming alternately into and with the wind. In the event one of the runs was not usable because the ship strayed too far from the line.

Two drift runs were made, the ship laying-to near the line with the wind on the starboard beam for 20 minutes, then on the port beam similarly. These last two runs enabled the athwartship sensitivities to leeway to be determined. During the calibrations the wind blowing from the south freshened slightly from about 18 knots to 23 knots. Finally the ship was vectored to each transponder in turn and they were recovered by grapnel and line.

Normally the data for this exercise would be logged on the IBM 1800 Computer, but since this was not manned on this cruise, the data was logged manually; this reduced the sampling rate and increased the variance but should not have introduced any bias. The digital displays on the front panels of the electronics were read. The end results are the four factors by which the indicated fore/aft and port/starboard components of both logs must be multiplied to obtain the correct speeds. Also the counts per nautical mile for the HP 2100 interface for the Bridge Satnav system were determined.

(B.S. McCartney)

MONITORING OF THE FRANCIS BEACON

Being in the approximate area of the Francis Beacon a short fast detour was made to listen to the beacon on Thursday 14th January. The beacon evidently switched on at 10.00 hrs but we were too far away to see it at the 10 knot approach speed. At 10.36 we reduced to 8 knots for quieter listening and the beacon was first heard at a slant range of about 4 miles. By 11.00 we were close to overhead the beacon from which a good bottom echo was received showing that the pinger was 50 metres above the sea bed. The beacon switched off at a time of 11 hours and 6 seconds.

(B.S. McCartney)

LOSS OF 6500 METRES OF FISHING WARP

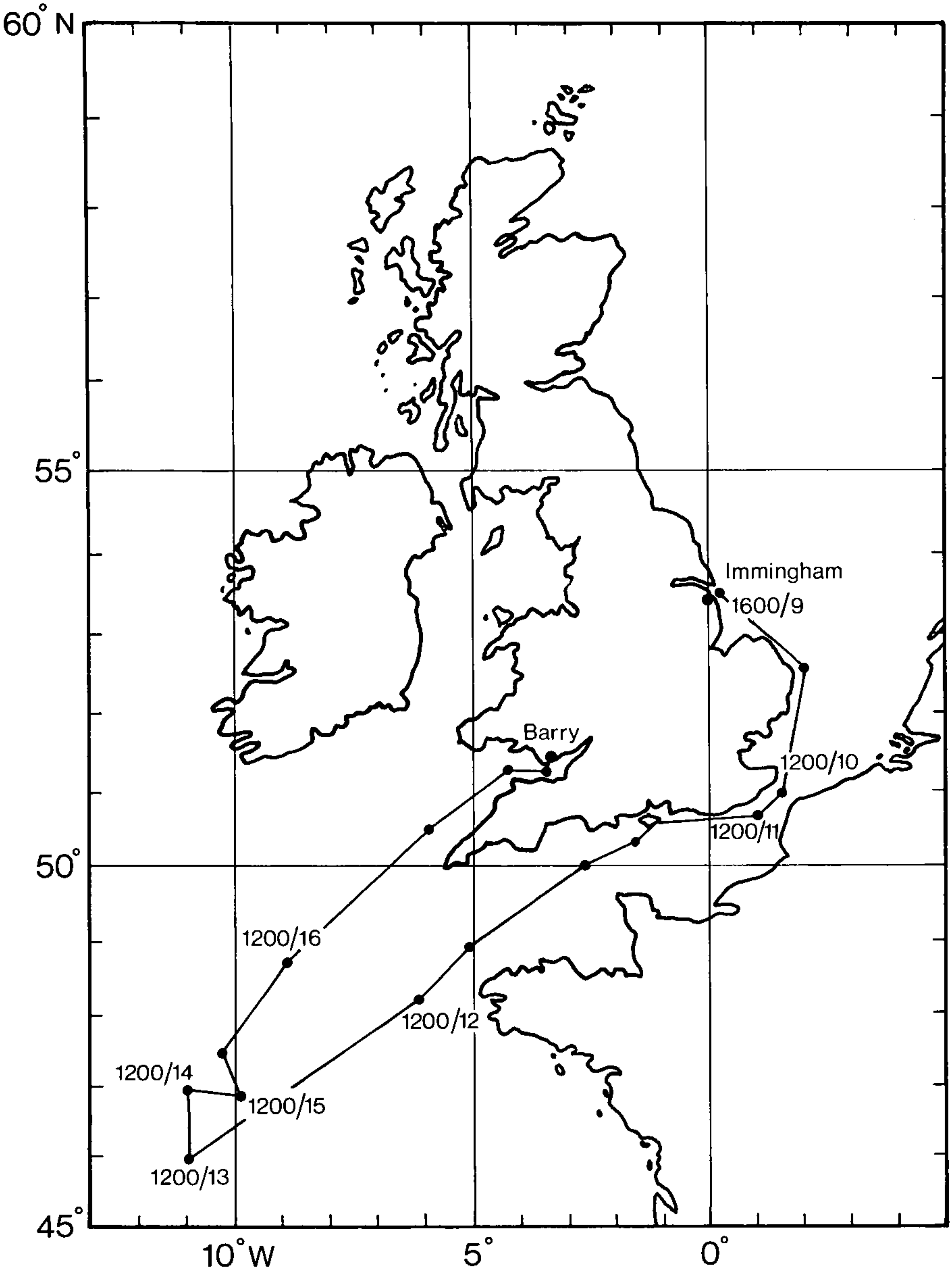
During the night of the 15th January the 15 km fishing warp was streamed behind the ship to enable the operation of the automatic reeling gear on the storage drums to be checked. Approximately 10,00 metres of warp was paid out at ship speeds between 7 and 8 knots. During hauling at a speed of 0.8 m/s peak dynamic loads of 5.5 tons were observed at the maximum warp length.

Whilst hauling-in the winch driver noticed that a kink had developed in the warp on the low-tension grooves of the winch barrels. The winch was stopped and in order to get a better view of the damage the warp was paid out slowly. As the wire was paid out the warp came off the accumulator sheave inboard. Back tension was then reduced in order to get some slack in the warp so that it could be put back on the sheave. As soon as the inboard load was reduced the kink on the low tension grooves of the traction drum 'birdcaged' and a second loop developed in the warp near the accumulator sheave. By this time the damage to the rope was severe and it was decided to cut it on the inboard side.

(J.S.M. Rusby, R.F. Wallace and M.P. Burnham)

ACKNOWLEDGEMENTS

Thanks are due to the Master of Discovery, Captain Peter Maw, and the officers and crew for their co-operation and help during this trials cruise.



TRACK CHART – DISCOVERY CRUISE 124.