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reference to the Laboratory.

CRUISE REPORT

F.R.S. "Explorer"

22nd August - 10th September, 1968.

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Narrative

"Explorer" sailed from Aberdeen at 23.30 hours on the 22nd August, and proceeded to a deep water station north of Flugga. Trawling commenced on the 23rd using a mid-water gear and continued in excellent weather conditions until the 28th. "Explorer" then steamed to shallower waters off Balta Sound. Instrument tests were carried out in this area, including full scale trials using a 48 ft bottom trawl, until the 30th. The ship then steamed for Lerwick where she docked early on the morning of the 31st. Water was taken aboard and scientific equipment consigned from Aberdeen was received.

The ship left Lerwick at 07.30 hours on the morning of the 1st September. After a short run of deep water tests the ship returned to Balta Sound where work with the bottom trawl was continued. In fine weather conditions this part of the programme was completed by the 4th September, when the ship steamed for Lerwick and docked there at 19.45 hours. Personnel changes were effected.

"Explorer" left Lerwick on the afternoon of 5th September and returned to the deep water station north of Flugga. Instrument trials there using the mid-water trawl were continued until the 9th when the ship steamed for Aberdeen where "Explorer" docked at 14.30 hours on the 10th September.

Instrumentation Trials

1. General

The main objective of the cruise was to carry out full scale trawling trials using a number of prototype instruments. Particular attention was to be paid to the production of signals from these instruments suitable for direct interfacing to a digital computer. The trials were divided into two parts - those made in deep water using a mid-water trawl, and those with a bottom trawl fished in 60-70 fathoms of water. In the former case the clear oceanic water off the Continental Shelf provided the best possible conditions for acoustic data transmission. Further, the risk of damage to the prototype instrumentation was less on the mid-water trawl because of the absence of ground contact. Once experience had been gained in these conditions the more severe environment (in terms of mechanical shock and the acoustic properties of the sea) presented by the bottom trawl could be investigated.

2. Net Telemeter

The prototype instruments used with the net telemeter comprised two load cells, for measuring wire strains, and two ultrasonic transducers for measuring the distance between points on the net. These were connected by cable to a control and transmitter unit which was attached to the centre of

the headline. The latter transmitted information obtained from the instruments to the ship, using an acoustic link. Signals were reliably transmitted across the link with the transmitter up to 2,400 ft away from the ship. It was found that the random amplitude variations in the acoustic signal received at the ship were much greater in shallow water, compared with the deep water case, due to multipath effects. However, the rise and fall times of the pulsed signals were not noticeably affected by the depth.

After initial problems with the system had been overcome both load cells were made to work satisfactorily on both the midwater and bottom gears. Also the distance measuring transducers were shown to work correctly into the telemeter system with the load cells disconnected. However, it was found that the load cells and distance transducers would not work satisfactorily together, because of interference in the control and transmitter unit between signals going to the two types of instrument. Further development work in the laboratory will be required to rectify this fault. Signals from the underwater instruments were transmitted by the telemeter, and recorded on the ship, at various rates up to and including the design figure of one reading per second. Even higher speeds were investigated and it was shown that in good conditions a rate of three readings per second is feasible.

3. Warp Telemeter

In the case of instruments mounted on the otterboards, an alternative to an acoustic link is to transmit data to the ship using an electrical conductor embedded in the warp core. A new pair of warps with such a conductor in them was fitted on "Explorer" prior to the cruise.

The underwater transmitter used with this system operates on a novel principle, in that it is only necessary to clamp the transmitter to the outside of the warp to produce detectable signals at the ship terminal. That is, it is not necessary to have a direct physical connection between the transmitter and the inner electrical conductor of the warp, which greatly simplifies the instrument handling procedure during shooting and hauling operations.

At first the transmitter was connected to the outboard end of one warp, which was then streamed behind the ship. Excellent signals were received by the shipboard equipment, which proved the feasibility of the technique. Later, the transmitter was connected to the warp and used successfully with the midwater trawl. The quality of the signals received at the ship via the warp conductor was much superior to that obtained from the net telemeter acoustic link, as the former were not subject to random amplitude variations.

A number of mechanical problems arose in the investigation of the warp transmission technique. At the outboard end the inner conductor has to be electrically connected to the warp steel, and some difficulty was experienced in making a durable connection at this point. After a few trials, a technique for making this connection was developed which gave satisfactory results for the remainder of the cruise. However, a more extended series of tests involving a much larger number of hauls will be necessary to test the strength of this method of connection fully.

Conclusions

The development of 'on-line' trawl instrumentation will be continued in the light of the experience gained during this cruise. It is expected that the instruments will be produced in their final form, ready for the installation of the computer based data logging system on "Explorer" early next year.

D. N. MACLENNAN
6th December, 1968.