

9/3/67

OCEANOGRAPHY DEPARTMENT, UNIVERSITY OF LIVERPOOL

Report of cruise (LUDO VI) in R.R.S. "John Murray"

30th August-2nd October, 1967

Mediterranean

Cruise intentions

Two projects were to be carried out:

1. An air-sea interaction investigation, involving a detailed study of temperature and salinity structure in the surface layer in relation to certain meteorological parameters, in a limited area over a period of several days.
2. An investigation of two features found previously in the Mediterranean water:
 - (a) Double peaks in the temperature and salinity profiles;
 - (b) Step-function changes in temperature and salinity at the lower boundary of the Mediterranean water.

The proposed track chart, a copy of which is attached, was drawn up to include several lines of stations, relating to the survey aspect of the Mediterranean water investigation, and positions for time series of observations in connection with both projects.

Three phases of the cruise

For practical convenience the cruise was divided into three phases, with calls at Lisbon between Phases I and II and between II and III. The actual periods of these phases were:

Phase I	:	30 August - 11 September
Phase II	:	15-23 September
Phase III	:	26 September - 2 October

Personnel

The following scientific personnel took part:

K.F. Bowden	(Phase I only)
R.I. Tait	(Phase I only)
M.R. Howe	(Phase II and III only)
J. Murphy	(Phase II and III only)
C. Garside	
N.M. Lynn	
G.W. Neal	
P.M. Hughes	

Phase I

Proposed scientific programme

- (a) To occupy Stations 1 to 12 (see attached chart) and make lowerings with the Hytech salinity-temperature-depth (S-T-D) probe to 1500m at each in connection with the Mediterranean water investigation;
- (b) To carry out air-sea interaction experiments in an area near Station H, remaining in the vicinity of an anchored buoy for about 3 days and then following a buoy drifting with the surface water for a further 3 days.

Narrative

R.R.S. "John Murray" sailed from Plymouth at 1200 hours BST on 30 August and arrived at Station 1 at 0600 GMT on 1 September. The slip-ring winch, which had been supplied by the University and installed on the after-deck for this cruise, was tested with a weight attached to the end of the cable instead of the S-T-D probe and several minor faults were found and remedied. The S-T-D probe was then attached and two successful lowerings were made, to 1500m and 300m respectively. The work at Station 1 was completed at 1415 GMT. Stations 2 to 12 were then worked as planned. At each the S-T-D probe was lowered to 1500m and back, the operation taking about 1½ hours.

Station 12 was completed at 1030 on 5 September. Some hours were then spent searching for a bank, shown on the chart with a minimum depth of 923 fm., as a suitable area for mooring the air-sea interaction (A.S.I.) buoy, but in fact no soundings of less than 2,000fm could be found in the area. It was decided to postpone laying the buoy until the following day and in the meantime Station 24 was worked. An attempt to lay the buoy on 6 September had to be abandoned, however, because freshening winds made conditions too difficult and the ship went to shelter in Lagos Bay. Since the strong wind persisted, the ship remained at anchor on 7 September and sailed at 0900 on 8 September.

On the way back to the area for the buoy work, Stations 41, 30, 30A, 29 and 28 were occupied, in that order. While raising the probe at Station 30A the diesel engine driving the winch failed when the probe was still at 250m. After 2 hours, as the fault had not been remedied, the cable and probe were recovered by using the capstan. The engine was eventually restarted about 5 hours after the breakdown.

On 9 September (in position $36^{\circ}17'N$, $9^{\circ}25'W$) the A.S.I. buoy was launched, at the second attempt, attached to a parachute drogue 10m below the surface. The intention was to allow the buoy to drift with the surface water for 2 or 3 days while working a close pattern of S-T-D stations around it. Unfortunately, it proved impossible to get satisfactory radar echoes from the buoy so as to maintain contact with it during the night. The ship therefore remained near the buoy for a period of 6 hours only, while probe dips to 100m were made at half-hourly intervals, and the buoy was then recovered. It was found that water had leaked in through a faulty seal and no reliable recordings had been made after the first hour or so.

Two more S-T-D stations, 27 and 26, were worked during the night, but at 0530 on 10 September one of the main engines had to be stopped due to a broken casting in the cooling system. It was not possible to make a repair at sea and so the ship set course for Lisbon on one engine, at a speed of 5-6kt. and berthed there at 0630 on 11 September.

Summary of Phase I

During this phase two days of working time were lost due to bad weather and another two due to the engine breakdown and early return to port. Partly for this reason but partly because of instrumental problems the air-sea interaction part of the programme was severely curtailed, although it did provide a useful trial of the A.S.I. buoy. On the other hand, a total of 19 S-T-D stations, including 7 scheduled for Phase III, were worked. At all of these satisfactory temperature and salinity profiles, usually to a depth of 1500m, were obtained and many showed features of particular interest in the Mediterranean water.

Phase II

Dr. M.R. Howe and Mr. J. Murphy joined the ship on September 13 to replace Professor K.F. Bowden and Dr. R.I. Tait who returned to U.K. on September 14.

Proposed scientific programme

To locate and study in some detail a series of stratified layers associated with the Mediterranean water at a depth of about 1400m, which were believed to exist in the vicinity of Station L ($34^{\circ}20'N$, $13^{\circ}30'W$).

Narrative

R.R.S. "John Murray" sailed from Lisbon at 1730 GMT on 15 September. To supplement further the survey data in Phase I, Stations 14, 15, 16, were worked on the way to Station L. All stations involved the use of the S-T-D probe to 1500m. After Station 15 it was found that the probe cable had suffered badly from twisting in the upper 50m and this was re-terminated and tested before proceeding with the programme.

The search for the layers then commenced, and stations were worked every 20 miles (8 stations) to Station L. Some indication, but not conclusive, of the existence of the layers was evident in several of the probe traces and it was decided to continue the search in an easterly direction towards the Straits of Gibraltar.

After a further 4 stations in this direction a sufficiently good series of layers were located to justify a more detailed study, and for this purpose a marker buoy was set in position ($34^{\circ}24'N, 12^{\circ}03'W$).

At 2030 on September 18 two experiments were commenced with the ship maintaining position at the marker buoy. In the first, the S-T-D probe was lowered to 1500m every 3 hours to study any changes that might occur in the stratified layers. In addition to this, every hour the probe was also lowered to 100m as part of a heat budget experiment. The small scale temperature and salinity changes in the surface layers were recorded, together with hourly meteorological data which included incident solar radiation (solarimeter), total net radiation (radiation balance meters), wet and dry bulb thermometers, wind speed and direction.

While the observations were proceeding a parachute drogue was launched at 1130 on September 19 to determine the water velocity associated with these layers at a depth of 1350m. The progress of the drogue was plotted from radar fixes and the above programme of observations was continued until 0830 on September 20. At this time the final position of the drogue was fixed relative to the marker buoy before recovering the float, and beginning a new experiment.

By 1115 of September 20 two parachute drogues had been released near the marker buoy at depths of 1000m and 1350m. The experimental procedure consisted of lowering the probe to 1500m every 3 hours while the ship maintained a position alongside the deep drogue (1350m). The movement of this drogue, and hence the particular series of layers under observation, was again plotted by means of radar fixes relative to the marker buoy. So also was the movement of the drogue at 1000m.

This programme proceeded until 1330 on September 21 when the probe lowerings were completed. The final positions of the two drogues were then fixed and by 1500 hours the two floats and the marker buoy had been recovered.

A course was then set for Lisbon to include Stations 25, 24 and 23, which were part of the Phase I survey, and also another 5 stations were worked between ($34^{\circ}33'N$, $11^{\circ}42'W$) and ($36^{\circ}7'N$, $10^{\circ}28'W$) to provide further evidence of the extent of the deep layers.

The ship berthed at Lisbon at 1500 hours GMT on September 23.

Phase III

Proposed programme

To locate and study a feature of the temperature profile which takes the form of two distinct maxima between the depths of 700 and 1200m. This feature was previously observed in an area off Cape St. Vincent (Discovery cruise 1966).

Narrative

R.R.S. "John Murray" sailed from Lisbon at 1000 hours on September 26. Seven stations were completed at 10 mile intervals to a position $37^{\circ}09'N$, $09^{\circ}58'W$, at which a marker buoy was laid by 0955 on September 27. The particular feature under investigation was located at this position and as before, the S-T-D probe was lowered repeatedly to study any short term changes in the profiles. At first the probe was lowered to 1500m every 2 hours but due to gradual deterioration of the cable the timing was changed to every 4 hours.

Two parachute drogues were also launched at depths of 650m and 1150m and tracked as before by radar fixes relative to the marker buoy.

At 0530 on September 28 it was decided that the cable supporting the probe had deteriorated to such an extent that further use might result in the loss of the instrument, and so this part of the experiment was terminated. The drogues, however, were tracked until 1230 on September 28 and then the floats were recovered.

Having also recovered the marker buoy the scientific programme was regarded as complete and R.R.S. "John Murray" proceeded to Plymouth. The original intention of working several stations on the return route was also abandoned due to the condition of the S-T-D probe cable.

The ship berthed at Millbay Dock at 1600 hours BST on October 2.

Conclusion

In general the aims of the scientific programme were accomplished most satisfactorily. Although the operation of the A.S.I. buoy during Phase I was not entirely successful, this project is still at the experimental stage and the experience was useful with regard to improving the instrumentation for future work. However, the hydrographic observations made with the S-T-D probe were completely successful and produced much valuable data. Indeed it was particularly pleasing that the special features under investigation in Phases II and III were indeed located without too great a delay, and that a detailed study was completed without interruption, as planned in the original programme.

Finally, we wish to acknowledge the co-operation of the Master, Captain M.J. Perry, Officers and Crew of the R.R.S. "John Murray" throughout the cruise.

20 October, 1967.

K.F. Bowden
M.R. Howe

