

5/11/68

Report on "John Murray" Cruise, 7/68

13-19 June, 1968

Liverpool University, Department of Oceanography

Irish Sea

1. Scientific Personnel

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2. Objectives of cruise

1. To carry out diffusion experiments, using a continuous release of Rhodamine B dye as a tracer, and giving particular attention to the rate of vertical dispersion under given conditions.
2. To make observations of the environmental conditions in which the diffusion takes place, in particular the temperature and salinity distribution and currents.
3. To study the distribution of pigments in phytoplankton in various conditions by a thin layer chromatographic method in which the first part of the determination is carried out on board ship.
4. To obtain water samples from a series of stations for trace element analysis in the laboratory ashore.

The intention was to carry out the experiments in the vicinity of two central stations:

- A. Off Red Wharf Bay, Anglesey: 53°24'N, 4°08'W.
- B. Between the Isle of Man and Cumberland: approx. 54°21'N, 3°55'W.

As the length of the cruise was cut from 10 days to 6 days and a mishap causing some further loss of time occurred in the middle of the cruise, all the work was done in the vicinity of position A.

3. Narrative

The University personnel and their equipment embarked in R.R.S. "John Murray" at Liverpool and the ship sailed at 14.30 on 13 June, 1968. On arrival at position A off Red Wharf Bay at 19.30, a Roberts Buoy was laid in a depth of 30 m. and attached to its anchor by a 100 fm. ground line was a moored current meter assembly. The Plessey recording current meter was maintained at a height of 13 m. above the bottom by a submerged float. The ship then anchored nearby and a series of current measurements was made overnight, for a period of 12½ hours, using a Kelvin-Hughes direct reading current meter (DRCM). Readings were taken at half-hourly intervals at depths of 5, 10, 15, 20, 25 and 30 m.

On the morning of 14 June, the dye release buoy was moored in a position 0.6 ml bearing 195° from the Roberts buoy. The first release was started at 10.40 at a depth of 2m. and two pairs of marker buoys were laid in positions

approximately 0.5 and 1 ml. downstream of the source and straddling the visible plume. Sampling runs were then made across the plume at the 0.5 ml. section but no recording was obtained. It was found that the dye had run out too quickly, due to a leaky connection and no data were obtained from this release.

After replacing the dye container on the buoy, another discharge was started, also from 2m. depth, at about 15.00. Three pairs of marker buoys were laid, at approximate distances 0.5, 1.0 and 1.5 ml. from the source, and between 16.30 and 19.30 a number of successful traverses were made at each of the three sections. The water was sampled by a hose pipe, whose inlet was kept at the required depth by attaching it to a heavy, streamlined weight towed from the hydrographic winch. The water passed continuously through a Turner model 111 fluorometer and the output was recorded on a TOA Polyrecorder. The procedure was to tow across the plume at a constant sampling depth and then to raise or lower the inlet to the next sampling depth for a return run across the plume. At the end of the experiment the marker buoys were recovered (but not their moorings) and the ship was anchored for the night. Prior to the second release, temperature and salinity measurements at a series of depths were made with an Electronic switch-gear T-S bridge and samples taken with the insulating water bottle as a check. At least one such series of measurements was made each day for correlation with the dye experiments.

On 15 June, two more dye releases were made. The first started at 09.50, at a depth of 5m., and six traverses, at various depths, were made across the plume at a distance of approximately 0.5 ml. downstream. During this experiment no marker buoys were laid and navigation was by Decca only. Attempts to make traverses on a section about 1 ml. downstream were unsuccessful, as the plume could not be located.

The second release on 15 June was started at 15.45, also at 5m., and two marker buoys, with recoverable moorings, were laid in the plume at approximately 0.7 and 1.4 ml. downstream from the source. A number of successful traverses were made at each section, sampling at depths of 3, 5 and 7m.

At 19.30 an unidentified obstruction struck the hydrographic wire but cleared itself, only to move astern and foul the ship's propeller. Speed was seriously reduced and the ship went to anchor in Dulas Bay. On the following day, 16 June, a team of divers from Holyhead succeeded in removing the obstruction, believed to be a fishing net and length of wire, and reported that no damage had been done.

Scientific operations were resumed at 16.45 on 16 June when a dye release was started, at a depth of 5m. From 18.15 to 21.00, a series of traverses were made at sections 0.7 and 1.4 ml. downstream, marked by buoys laid in the plume. In this experiment sampling runs were made at 5 depths, from 1 to 10 m., on the first section and at six depths, from 5 to 12m, on the second section.

On 17 June, two further dye releases were carried out, again at 5m, starting at 05.10 and 12.05 respectively. In the first experiment, all the traverses were made at the same distance downstream, as far as possible, in order to study the variability of conditions in a given section. Traverses in two sections were made in the second experiment, but the discharge stopped earlier than had been planned, due to a loss of dye when the container was being fitted to the buoy.

From 17.00 on 17 June to 05.10 on 18 June, a second series of current measurements at various depths was made at half-hourly intervals, using the DRCM.

Two more dye releases were made on 18 June, each at a depth of 3m., and successful series of traverses were carried out in each case. The procedure adopted was to lay marker buoys in the plume at two distances from the source and to make traverses at three depths (1, 3 and 5m.), in one section and then the other, alternatively.

On the completion of these experiments, the marker buoys, the dye release buoy and finally the Roberts buoy were recovered. The Plessey current meter was still working when recovered and appeared to contain a record of current at 10 minute intervals over the full period of 5 days during which it was in position.

While the other work was in progress, samples for the study of phytoplankton pigments had been taken on a number of occasions. The water was sampled by pumping and the phytoplankton were separated by filtration. The pigments were recovered by solvent extraction and separated from one another by thin layer chromatography.

The plates were then stored in the deep freeze and brought to the laboratory at Liverpool for examination.

After keeping a rendezvous with the "Moray Firth IV" off the Skerries to transfer Mr. Bulled, the "John Murray" started on its return journey to Liverpool at 21.40. Stops were made at four stations at 5 mile intervals to collect water samples for trace element analysis.

The weather remained good throughout the whole of the cruise. At no time was the wind stronger than force 3 and for long periods it was almost calm. The weather was mostly fine and warm, although there was often a haze, reducing visibility to 2 or 3 miles.

The ship berthed at Liverpool at 06.45 on 19 June and the Liverpool personnel and equipment were disembarked.

4. Notes on performance of equipment

The main problems in the dye diffusion experiments arose in handling the Rhodamine B solution without causing spillage or leaks. For each discharge, approximately 20 lb. of 40% Rhodamine B solution in acetic acid (containing approximately 8 lb. of solid dye) was used, diluted with fresh water to 40 litres.

A length of plastic hose pipe was connected to a tap on the side of the container, and the end of the hose terminated in a jet with an orifice designed to allow the complete discharge to take about $3\frac{1}{2}$ hours. At the beginning of each experiment, the empty container had to be removed from the moored dye release buoy and jettisoned and a full container fitted in its place. After the first experiment, in which the "John Murray" was brought alongside the buoy, the operation was carried out from the motor boat. Even a slightly choppy sea produced difficulties and although skill was gained by experience, some spillage of dye solution into the boat and on to the clothing of those taking part in the operation nearly always occurred.

The method of sampling for the dye, by pumping water continuously through the fluorometer, worked satisfactorily throughout. Provided the towing speed did not exceed 3 knots, the depth of the inlet could be maintained at any desired depth, down to 12 m. Except on two occasions, when the dye ran out prematurely, the discharge continued for the full $3\frac{1}{2}$ to 4 hours intended. Usually the discharge was started about an hour after slack water and traverses across the plume were started about an hour later and continued for up to 3 hours.

The technique finally adopted, of dropping marker buoys in the plume at the desired distances downstream from the dye release buoy, was found to be a satisfactory way of carrying out traverses on given sections. The use of Decca navigator was extremely helpful in making the traverses, but not sufficient in itself without using marker buoys.

5. Preliminary notes on data obtained

Eight successful dye releases were made, three on flood tides and five on ebb tides. From 5 to 18 traverses of the plume were made on each release, usually divided between 2 sections and covering a series of depths. A first impression was that the vertical diffusion of the dye took place more slowly than expected. At a distance of about a mile from the source, the vertical extent of the plume was of the order of 5 to 10 m. and still considerably less than the depth of water. The temperature and salinity measurements indicated a slight but definite density gradient on most occasions, and the degree of stability present may have been sufficient to reduce the vertical diffusion appreciably. Another first impression was of the variability of the plume, due presumably to large scale turbulence, so that successive traverses of the same section at the same depth could give records which differed considerably. These and other features will be studied in the analysis of the fluorometer records in relation to the environmental conditions.

The Plessey current meter appeared to have functioned satisfactorily during the 5 day period, but this cannot be confirmed until the tape has been translated.

Station List

<u>Station No.</u>	<u>Date June</u>	<u>Time from</u>	<u>Time BST to</u>	<u>Lat. N</u>	<u>Long. W</u>	<u>Depth m.</u>	<u>Work done</u>
634	13	19.30	20.03	53°24.4'	4°08.5'	30	Roberts buoy laid with Plessey current meter.
635	13 14	21.00 -	- 09.30	53°23.8'	4°08.7'	32	Current measurements by DRCM at ½-hourly intervals.
636	14	10.45	19.30	53°24' (and vicinity)	4°08'	28	DD, TS, PP. (see below).
637	15	09.05	19.30	do.			DD, TS, PP.
638	16	16.45	21.00	do.			DD, PP.
639	17	05.00	15.30	do.			DD, TS, PP.
640	17 18	17.00 -	- 05.30	53°23.7'	4°08.0'	32	Current measurements by DRCM
641	18	06.00	10.45	53°24' (and vicinity)	4°08'	28	DD
642	18	11.00	11.30	do.			TS
643	18	12.55	18.30	do.			DD, Roberts buoy recovered.
644	18	22.30	22.40	53°27.3'	4°31.7'	39	Water sampling.
645	18	23.15	23.23	53°28.2'	4°23.5'	40	do.
646	19	00.00	00.07	53°28.8'	4°15.1'	39	do.
647	19	00.45	00.49	53°29.1'	4°06.4'	39	do.

Abbreviations: DD Dye diffusion experiments.
 TS Temperature and salinity observations.
 PP Phytoplankton pigments determination.

Acknowledgment

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