International Indian Ocean Expedition
RRS Discovery
Cruise 3 Report

Oceanographic work in the Western Indian Ocean
15 February to 28 September 1964

Prepared on behalf of
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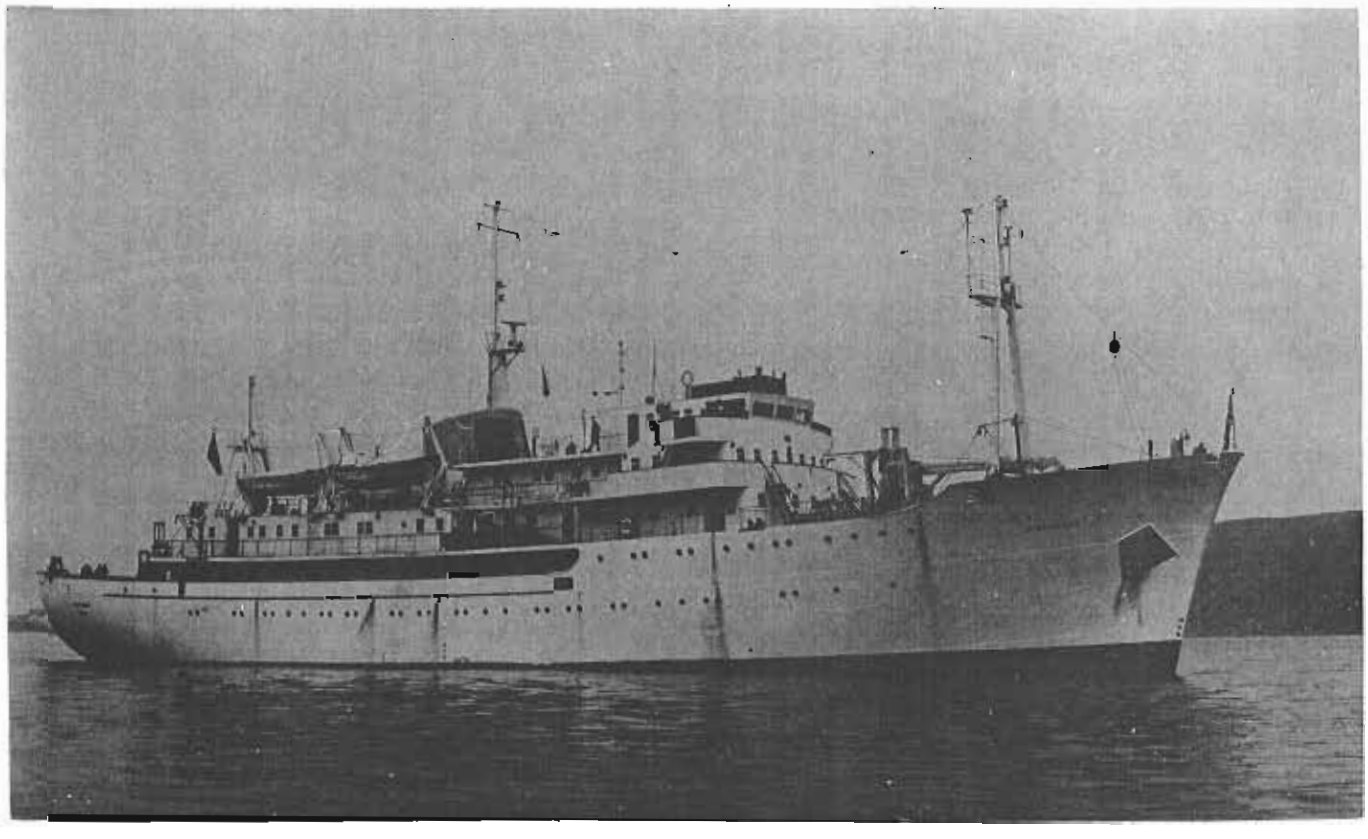

The Royal Research Ship 'Discovery'

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Introduction

The Royal Research Ship 'Discovery' has now completed its part of the U.K. contribution to the International Indian Ocean Expedition, having returned to Plymouth at the end of September 1964 after working for some six months in the Western Indian Ocean.

With most of the data still to be processed, it is too early for any extensive discussion of results, but the station list and track charts in this report indicate the amount of work accomplished and some of the more striking observations are described briefly.

The programme followed fairly closely that outlined in United Kingdom I.I.O.E. Newsletter no. 4, issued in January 1964. This involved substantial changes from the programme proposed in September 1962, and it is pleasant to report that as the work progressed there was never any reason to regret the change of plan.

Considered simply as a contribution to the physical oceanographic survey of the area, more stations were occupied in a shorter time, and more work done on each station than was originally planned. During 1964, 'Discovery' occupied 291 water-sampling stations in the Indian Ocean in 154 days at sea. Alternate deep and shallow stations were worked with, typically, 32 sampling depths to 4000 metres and 22 depths to 1200 metres.

Beyond that, the change to north-south sections and increased effort south of the equator allowed the work to be concentrated on more clearly-defined physical features. Less work was done in the northern part of the Arabian Sea, a difficult area to survey adequately without full-time use of an in-situ salinometer, because of the patchiness and thin layering of the high-salinity water. Instead, more effort was devoted to the equatorial current system, especially the equatorial undercurrent, and the Somali current. Fortunately, these two currents, and the area of cold upwelled water off the Somali coast were particularly well-developed at the times they were being examined.

A full programme of biological observations was carried out as planned, for the most part simultaneously with the water sampling and current measuring. In addition, 38 trawling stations were occupied, and special studies were made off the Arabian coast (where one of the 1963 sections was occupied twice more in other seasons) and off the Somali coast in the cold upwelling water.

1. PLYMOUTH TO ADEN, 15 February to 4 March 1964

Very little station work had been planned for the passage out, in an attempt to save time in case the equatorial undercurrent might have disappeared if the ship's arrival at the equator was delayed too late in the spring. Three stations were worked, to familiarize everyone with some of the more routine observations and for checking chemical methods, before reaching Port Said on 26 February. Then a short hydrographic section of 5 stations was worked in the northern part of the Red Sea, north of 20° N, to look for signs of winter overturning between surface and deep water, but no evidence of instability was found. One of these stations, 5247, was in a deep basin just south of the position where the 'Atlantis II' had found abnormally hot salty water near the bottom in 1963 (Miller 1964). Slight but significant departures, in temperature and salinity of the bottom water, from the normal Red Sea deep values, indicated overflow and mixing from the small basin sampled by 'Atlantis II' into the larger basin to the south (Charnock 1964). Two deep trawls, and a brief stop for collection of sargassum weed, completed the station work up to Aden. Continuous echo-soundings were obtained on passage, using the new tadpole-shaped transducer "fish" which towed satisfactorily even at 14 knots, the minimum speed of the ship.

2. ADEN TO MAURITIUS, 7 March to 5 April 1964

The first stop after leaving Aden was at SCOR/UNESCO Reference Station No. 12. Observations similar to those on a typical deep station were made; with small variations, these became settled into the following routine:

a) Water bottle casts (3):

(i) Eleven bottles out to 250 m, plus bathythermograph on the same wire, the bottle spacing being chosen according to the depth of the thermocline;
(ii) Eleven bottles, at 300, 350, 400 m then every 100 m to 1200 m;
(iii) A deep cast with bottles at 1400, 1600, 1800, 2000 m then every 300 m to 3200 m followed by every 400 m to within 400 m of the bottom.

Temperature and salinity were observed at all the above depths, but chemical analyses were carried out on a more limited scale:

Dissolved oxygen at all depths to 1400 m, then at alternate sampling depths;
Inorganic phosphate and nitrate to 500 m, with phosphate at alternate greater depths;
Silicate at alternate depths from surface to bottom.

b) Samples for bacteriological analysis at 0, 50, 100, 250, 500 and 1000 m.

c) Current-shear measurements to 200 m depth, using a pair of direct-reading current meters with attached temperature-salinity-depth probe.

(d) Chlorophyll measurements at 0, 20, 40, 60, 80 and 100 m.

(e) Vertical haul with 50 cm diameter fine mesh net (N50V) from 100 to 0 m.

(f) Vertical haul with 70 cm diameter 200 μ mesh zooplankton net, metered for depth and flow (NF70V) in layers 50 to 0, 100 to 50, 200 to 100, 500 to 200, 1000 to 500 m.

(g) Vertical haul with the Indian Ocean Standard Net (IOSNV) from 200 to 0 m.

(h) A 15-minute tow at 5 knots with the Neuston net (NN).

Not all these observations were made at every deep station; on the equatorial sections vertical nets were fished only at selected stations, as indicated in the list, with chlorophyll sampling and phytoplankton hauls at intermediate stations. Sampling depths for chemical nutrients were varied from time to time, but the total number of analyses per station remained about the same. At shallow stations, water sampling was limited to the two casts (i) and (ii), to 1200 m.

From the reference station course was set for Hasikiya, the most westerly of the Kuria Muria Islands, arriving there in the morning of 10 March. A small party landed to collect biological specimens, while the ship made the first station of a line running offshore, repeating one of the sections worked in July 1963. The shore party found few birds nesting, very little guano (too much rain in the S.W. monsoon ?), but brought back, among other specimens, a small collection of excellent rock oysters.

The ship then steamed S.E. working stations initially at 10 mile intervals, opening out gradually to 40 mile spacing: altogether 9 stations out to 15° N, 58° 15'E.

The inshore water was still quite green, and about 1° C cooler than the offshore surface water even at this season (early March). There were signs of plenty of life in the water near the coast, though the plankton volumes were only about 1/3rd of those found in the upwelling season in 1963.

After the S.E. section, a southerly course was set and two stations per day were occupied, alternately deep and shallow, with an extra deep one in the trench near 12½° N, 58° 15'E, found by H.M.S. 'Owen'. The southward section was moved back across to 58° E longitude and continued at the same station spacing to 5° N, when the interval was closed up to 60 miles, then 30 miles from 3° N. On this north-south section, vertical nets were fished at 120 mile intervals, with chlorophyll and phytoplankton observations at intermediate stations at the same spacing.

Approaching the equator, the first signs of strong current shear came at 2½° N, and the undercurrent became apparent at 1½° N. At 1° N, a buoy was

anchored and currents measured for 24 hours, with the undercurrent clearly present. Since it was uncertain how long the undercurrent would last, a quick section was made across the equator to $1\frac{1}{2}^\circ$ S, doing only a single cast of water bottles to 350 m, and current-shear profile to 200 m, every 30 miles. This was completed by 20 March, when 'Discovery' returned to the equator to anchor a buoy and make more current measurements. Neutrally-buoyant floats were used here, at 1000 m and 2000 m depth, as they had been at 1° N a few days before, in addition to the current meters. Two more anchored-buoy stations of shorter duration, using current-meters and surface drogues, were then occupied at 1° S and $2\frac{1}{2}^\circ$ S, to define more clearly the width of the undercurrent.

The section was then continued southwards, opening out the station spacing to 40 miles between 3° S and 9° S. About 4° S, lanes of sargassum weed were encountered, and as the ship passed from the westward north equatorial current into the eastward countercurrent, the change to greener water after the very clear blue on the equator was noticable. Three more anchored-buoy stations were occupied at 9° S, $11\frac{1}{2}^\circ$ S and 15° S, where weak variable currents were found at all depths, with no clear signs of the south equatorial current.

From 15° S, stations were worked at 60 mile intervals southwards, to Mauritius.

The main features of the temperature, salinity and oxygen profiles were already familiar, but the close station spacing allowed more detail to be seen. There is a well-marked salinity maximum in the equatorial undercurrent, apparently fed from the northern part of the Arabian Sea. In the intriguing zone in the deep water near 10° S where the Gulf of Aden water seems to meet the Antarctic Intermediate water, it is hard to see how this latter water mass can be connected to the shallower low-salinity relatively-high-oxygen water found farther north.

Of the current measurements, the most striking were those in the equatorial undercurrent, where eastward speeds of over two knots were measured at 75 m depth, with a 1-knot westward surface current. A brief account of these and the later observations of the undercurrent has already been published (Swallow 1964). The deep current measurements using neutrally-buoyant floats on this section showed movements in various directions with an average speed of about 6 cm/s, at 1000 and 2000 m.

The silicate estimations again confirmed the presence of very high concentrations in the deep water of the Arabian Sea, some 40 μg ats Si/l greater than the deep waters further south. In the surface layer, however, all the nutrients were at very low concentrations and at many stations nitrate appeared to be completely absent from the surface water.

Biologically the section was noteworthy for the paucity of life. The

phytoplankton appeared to be concentrated between depths of 60 and 80 m at al stations but even at these depths the quantities were very low and showed only a local increase in the vicinity of the equatorial undercurrent. The zooplankton abundance was also markedly low and decreased rapidly southwards from the Arabian Sea. There was quite a pronounced increase, however, at 1° N and, although this seemed to be the case at all depths sampled, it may be associated with the active circulation of the upper layers in the equatorial region.

One particularly interesting and very rare find on this cruise was a large Pyrosoma - like mass of jelly which upon examination proved to be an egg-mass belonging to an Oegopsid squid.

Much of the near-surface zooplankton had a deep blue colour, and an abundant haul of a copepod, Pontella fera, afforded an opportunity for study of the blue pigment. A note on this will shortly be published (Herring 1965).

Except for a few hours when the pulse power amplifier was being repaired, continuous echo-soundings were obtained, and the towed fish looked as good as new when recovered on arrival at Mauritius. On this and the three subsequent tracks in the neighbourhood of Mauritius, small diversions were made in order to collect useful lines of soundings for R.L. Fisher (Scripps Institution of Oceanography) who was working on the bathymetry of that region.

Good weather was experienced all the way to Mauritius, with a maximum wind speed of 25 knots and mostly less than 10 knots. The usual surface weather observations were made, supplemented by continuous recordings of wet and dry bulb temperature, total incident radiation and net radiation flux. Radiosonde flights were made almost daily. The sea-surface thermograph was run continuously, and hourly bathythermograph dips were made along most of the tracks, half-hourly off the Arabian coast and within 3° of the equator.

Station summary (Aden to Mauritius):

60 water-sampling stations (33 to the bottom)
80 current-shear profiles (28 were within radar range of anchored buoys, giving true currents)
11 neutrally-buoyant floats followed for periods ranging from 14 to 62 hours
24 series of vertical net hauls (NF70V)
24 fine mesh net hauls (N50V)
22 chlorophyll profiles
21 bacteriological sampling stations
7 trawls (Isaacs-Kidd)
15 Indian Ocean standard net hauls (IOSNV)
38 Neuston net tows (NN)

3. MAURITIUS TO COCHIN, 10 April to 8 May 1964

From Mauritius an easterly course was set, past Rodriguez Island, with stations 90 miles apart, as far as 20° S, 67½° E, where the ship was turned north. The longitude 67½° E had been chosen for the second north-south section since it passes well clear of any shallow water and crosses the Vema Trench, the deepest known part of the Western Indian Ocean. The weather was poor, with force 6 easterly winds, and the average speed dropped to 10½ knots instead of the 11½ knots maintained from Aden to Mauritius.

Working northwards on 67½° E, the station spacing was closed to 60 miles, and at 15° S a buoy was anchored for 24 hours' current measuring. As usual two neutrally-buoyant floats were laid, loaded for 1000 and 2000 m, and were tracked alternately with working water bottles, vertical nets, current meters and surface current drogues. Continuing northwards, the station spacing was closed to 40 miles, then 30 miles, and two more anchored buoy stations were occupied at 12° S and 9° S. The latter station was just south of the Vema Trench, and a deep cast of water bottles in it showed adiabatic conditions below 4600 m, with a potential temperature of about 1.25° C and relatively high oxygen (>4 ml/l). Again, the current measurements showed little sign of the south equatorial current. The weather was variable as the ship worked northwards, but beyond 6° S the wind began to blow more steadily from the west, about force 4, and the surface currents converged into an eastward flow on the equator; a situation quite different from that on the equator a month before, at 58° E, where the surface current was westward and winds were light and variable. On this section, currents were measured relative to anchored buoys at 1° intervals across the equator, from 2° S to 2° N. There was still an equatorial undercurrent, with an eastward maximum velocity at 70 m depth, centred on 1° S. Its maximum speed exceeded two knots, with about 1½ knots in the same direction at the surface. This provided the first real test of the new streamlined anchored dan-buoys, and no trouble was experienced with the buoy dragging or being pulled under. The ordinary cylindrical dan-buoy and string of elliptical floats, in use the previous year, would almost certainly have been lost in such a current.

From 2° N, the section was continued as far as 8½° N where another day was spent in current measuring relative to an anchored buoy, followed by a straight passage to Cochin without further water sampling.

The salinity and oxygen profiles again showed in good detail the complicated nature of the deep water region near 10° S. The low salinity near-surface water associated with the south equatorial current was clearly visible even though the direct current measurements were variable there. Calculations of geostrophic flow through the section have not yet been made, but they should show the equatorial currents quite clearly. Enough deep current observations were made to allow reasonable limits to be put on the choice of reference levels, in calculating near-surface geostrophic currents.

Again, the deep currents were variable, with a mean speed of about 7 cm/s, though an eastward flow of more than twice that speed was observed at 1000 m depth at 9° S, which may be significant. Although the deep current vectors appear scattered, it is interesting to notice that the mean of the dozen observations so far at 1000 m points towards ESE (spreading of Gulf of Aden water?) and the mean direction of the 2000 m vectors is north-east (northward spreading of deep water?).

The quantities of plankton on this section were again low, particularly south of 10° S. Northwards from about 6° S they increased threefold, however, but there was no evidence of the maximum just north of the equator which was found at 58° E. If anything, in fact, the biomass at the equator was below the average level for the section.

On this section the chemical estimations of dissolved oxygen were supplemented by in situ measurements made with a lead - silver oxygen electrode. Profiles were taken to a depth of 150 m at about fifteen stations and good agreement was found between the methods. The profiles showed a small but distinct maximum of oxygen content on the north side of the equatorial undercurrent.

Continuous echo-sounding and meteorological records were maintained as before, and bathythermograph dips were made hourly on passage. Radiosonde flights were made almost daily.

Station summary (Mauritius to Cochin):

51 water-sampling stations (29 to the bottom)
71 current-shear profiles (29 were within radar range of anchored buoys, giving true currents)
14 neutrally-buoyant floats followed for periods ranging from 12½ to 33 hours
16 series of vertical net hauls (NF70V)
17 fine mesh net hauls (N50V)
20 chlorophyll profiles
22 bacteriological sampling stations
9 trawls (Isaacs-Kidd)
15 Indian Ocean Standard net hauls (IOSNV)
32 Neuston net tows (NN)

4. COCHIN TO SEYCHELLES, 12 to 16 May, 19 May to 9 June 1964

During 'Discovery''s stay in Cochin, some essential electrical repairs were made to the fan cooling the main propulsion motor. There were several changes in scientific complement (see Table 1), involving some changes in the kinds of work that could be done. Bacteriological sampling ceased with the departure of Miss Kirtley, but the physical and chemical programmes were strengthened by the arrival of the three Australians: B.V. Hamon brought

his new temperature-salinity-depth recorder, and D.J. Rochford and F. Davies, besides contributing to the chemical analyses, made a series of inter-calibrations between Australian and N.I.O. analytical methods (Rochford 1964). Soon after commencing work westwards along 10°N, it became evident that further repairs were needed, and the ship returned to Cochin, sailing finally on 19 May. The reference station at 10°N, 74½°E was occupied that evening, and the westward section was continued out to 67½°E at 90 mile spacing. To regain some of the time lost in repairs, the section towards Ras al Madraka on the Arabian coast was omitted, as was the bathythermograph survey, which had been planned to look for centres of upwelling between there and the Kuria Muria Islands. Instead the ship worked from 10°N, 67½°E towards 15°N, 58°15'E, by way of the reference station at 12°N, 63°E. Winds were light and mainly westerly, and the current-shear observations showed generally weak variable relative currents. The temperature-salinity-depth recorder (TSD) was used at nearly all stations, and showed many small features in the salinity profiles, not revealed by water sampling, especially in the near-surface high-salinity water but also throughout its depth range of 1500 m.

From 15°N, 58°15'E, biological observations were intensified as the section off the Arabian coast, previously w ed in March, was re-occupied. The wind increased to 15 to 20 knots from the south-west, but decreased again near the coast; the bathythermograph profile showed little evidence of upwelling as Kuria Muria Bay was approached on 27 May. Nevertheless, the plankton hauls, which had increased in size steadily across the Arabian Sea, were relatively rich at the inshore stations. Leaving the coast, a southward course was set for 10°N, 58°E, with stations spaced 90 miles apart from 14°N. From 10°N, the station spacing was gradually reduced until from 3°N across the equator the interval was 30 miles. Around 10°N, the current-shear observations showed eastward relative movement at the surface; possibly this indicated an eastward extension of the Somali current which, by then, had started to flow. The fine structure in salinity shown by the TSD, although generally repeatable in successive dips on the same station, showed little signs of correlation between stations. Some closely-spaced dips were made in an attempt to investigate the scale of patchiness of the salinity distribution, but these were limited by lack of time.

A telemetering current-meter, developed by the Christen Michelsen Institute, Norway, and lent by the Geophysical Institute at Bergen, had been used on several occasions earlier in the cruise to provide a deep reference level for the shallower current-shear profiles. Both it and the TSD were designed to be used on the ordinary hydrographic wire, transmitting their data acoustically to hydrophones connected to recorders in the ship. The quality of records from both instruments was limited by ship noise, especially from the bow propeller, and was much improved by eliminating the acoustic link and lowering both together on a long length of 4-core armoured electric cable. This combination of instruments was brought into use on most deep stations, from 5404 onwards. Current-shear

measurements were made with it, usually between the surface and 200, 500, 1000 and 1500 m, and sometimes when small sudden changes of temperature and salinity were revealed by the TSD. However, no strong deep current shear associated with these changes was noticed.

On this second crossing of the equator at 58°E, current measurements were made relative to an anchored buoy at 1° intervals of latitude from 2°N to 3°S. An undercurrent was still present, but was weaker (about 1½ knots) and centred at about 1½°S. The surface currents tended to diverge from the equator, with only weak east-west components. There was no time for deep current measurements with neutrally-buoyant floats on this section. The last anchored-buoy station was occupied on 7 June and the section was continued southwards to 5°S before heading for the Seychelles Island.

Comparing this section on 58°E with the corresponding part of the previous one, surface salinities had increased, in places by nearly 0.5°/₀₀, and the tongue of high-salinity water extending from the north at about 75 m depth was more pronounced, but the salinity maximum associated with the equatorial undercurrent was weaker. Below about 300 m, little change can be seen in any of the profiles of measured properties, even minor features being reproduced in a manner that gives confidence in their reality. However, these are only the first impressions; the relationships between the different observed properties have hardly been looked at yet, apart from keeping a continuous plot of potential temperature against salinity for the deep water, as a check on the quality of the observations. Much remains to be done in relating these measurements to those of other ships.

At the night stations on this cruise it proved possible to catch quite a number of squid. They seem to belong to two species of Symplectoteuthis which judging by the frequency of their occurrence in the stomach contents of predators must play an important part in the economy of the region. Many larval Ommastrephids found in the plankton net hauls may belong to the same species.

Station summary (Cochin to Seychelles):

49 water-sampling stations (27 to the bottom)
54 current-shear profiles (11 within radar range of anchored buoys, 7 with Bergen current meter)
41 stations where TSD was used (some with more than one dip)
22 series of vertical net hauls (NF70V)
26 fine mesh net hauls (N50V)
25 chlorophyll profiles
7 trawls (IKMT)
12 Indian Ocean standard net hauls (IOSNV)
28 Neuston net tows (NN)

Continuous echo-sounding and meteorological recording as before.

Daily radiosondes, twice daily near the Arabian coast.
Hourly bathythermograph dips, half-hourly near the Arabian coast.

5. SEYCHELLES TO MAURITIUS, 12 June to 3 July 1964

The plan, on leaving the Seychelles, was to return to the equator at 58° E, working along it to 67½° E and then to turn south to re-occupy the section already worked in that longitude in April.

An extensive Trichodesmium bloom was encountered on the way north from the Seychelles, and samples were collected for chemical nutrient analyses.

Since the undercurrent had been so much weaker and more asymmetrical on the previous crossing, two short sections of alternate shallow stations and TSD dips were quickly made across the equator at 58° E (2° S to 1° N) and at 60° E (1° N to 1° S), to see whether the current was changing rapidly in strength, or meandering. No buoys were anchored, the Bergen meter being used to extend the current-shear profile into the (presumably) slow-moving deeper water. On both sections, the undercurrent seemed to be much the same as it had been two weeks before on 58° E. Returning to the equator at 61° E, the section was continued along it at 60-mile station spacing.

The undercurrent appeared to be slowing down towards the east. At the same time the wind changed from being light and variable to a steady south-easterly force 4 to 5. There also seemed to be a decrease in the quantity of plankton eastwards along the equator.

Approaching the north-south section, a diversion was made to 1° N, and from there the usual routine of alternate deep and shallow stations was resumed, with a 30 or 40 mile spacing. Longitude 67° 25'E was followed to give a slightly different sounding track from the previous section. The south equatorial current, much more clearly defined than before, was encountered between 6° and 7° S. It seemed important to try to determine whether there was any deep flow in the direction of this strengthened westward current, since that could account for some features of the salinity and oxygen distribution at depths of a few hundred metres, and so, although time was short, three anchored-buoy stations were included in the section, using neutrally-buoyant floats, at 8° S, 11° S and 13° S. With one exception these showed only weak movement in the deep water; although the calculations of geostrophic flow through the section have not yet been made, there seems to be little westward movement below 200 m.

The exceptional deep current observation was one of 22 cm/s eastward at 1000 m depth at 8° S, about three times the r.m.s. speed at that depth. The only comparable observation was the 16 cm/s eastward current found at 9° S the previous time this section was worked. Perhaps there is a significant eastward flow, at about 1000 m depth, round the southern end

of the Chagos bank. It could not be just Gulf of Aden water since there is no tongue of high salinity deep water to be seen extending eastwards there; it may be a mixture of Gulf of Aden and Antarctic Intermediate water.

Shortage of time necessitated the termination of the southward section at 15° S and a straight run was made from there to Mauritius.

Mr Hamon left the TSD recorder on board for use after his departure, but his generosity was poorly repaid as it was lost in an accident after only six more stations.

Station summary (Seychelles to Mauritius):

43 water-sampling stations (15 to the bottom)
47 current-shear profiles (7 within radar range of anchored buoys, 25 with Bergen current meter)
6 neutrally-buoyant floats
14 series of vertical net hauls (NF70V)
13 fine mesh net hauls (N50V)
12 chlorophyll profiles
48 temperature-salinity-depth profiles (TSD)
3 trawls (IKMT)
16 Indian Ocean standard net hauls (IOSNV)
17 Neuston net tows (NN)

Continuous echo-sounding.
Continuous meteorological recording including usual daily radiosondes.
Hourly bathythermograph observations, except on passage from 15° S to Mauritius.

6. MAURITIUS TO MOMBASA, 9 July to 28 July 1964

Sailing from Mauritius, scheduled for 7 July, was delayed due to modifications to the lubricating and cooling systems on the main engines, and by underwater repairs to the log. The latter were unsuccessful, however, as the cause of the trouble (a tube protruding beneath the hull which had become bent, most probably by collision with a whale) could not be removed and had to be cut off and sealed. Besides that, the gyro compass went wrong, and with both log and gyro out of action little surface-current information could be extracted from the ship's track.

The weather was poorer than usual with about 30-knot winds from south-east, as the ship worked northwards, making minor diversions from the 57° 40'E meridian. Stations were worked at 60 mile spacing to 15° S, then every 40 miles, taking longer than usual as the heavier weather caused more malfunctions and some damage to the water bottles, and several casts had to be repeated. No serious trouble was encountered, however, until station

5487, when the armoured electric cable carrying the Bergen meter and TSD became tangled with the deep cast of water bottles and was cut through. Three wires had been worked simultaneously throughout the cruise - water bottles on the forward winch, current meters on the small winch amidships, and vertical nets aft - only rarely did the wires cross and then without serious damage. The current-shear measurements in that region around 13° S, showed large fluctuations as if strong internal waves were present; these could have caused unusual variable stray on the wires, and the resultant loss.

Some surface-current information was obtained from towed electrodes (GEK) which were brought into use after the loss of the Bergen meter, although it had been intended to save these for the Somali current. As in the previous month on 67½° E, the south equatorial current was clearly present, and the south-west winds moderated to 20 to 25 knots towards the northern end of the section. Time had been set aside in the programme for visiting some of the smaller islands and despite the delays it was hoped to achieve at least one landing. However, at each island landing was impracticable because of the weather. Cargados shoals, and then Agalega, were passed without diverting from the northward section; from 6° 40'S the ship worked westward, then southward, making a section between the Seychelles bank and the Farquhar Islands.

The latter were sighted in the morning of 19 July, but conditions for landing were unsuitable, and the section was continued towards Cape Amber, at the northern end of Madagascar. The south equatorial current was found running strongly north-west here; stations were worked at closer intervals and, about 40 miles off Madagascar, a buoy was anchored for a day's current-measuring. The surface current was 2 knots, decreasing to about 1 knot at 200 m, but a neutrally-buoyant float at 1000 m moved north-west at only 5 cm/s (0.1 knot). Again, this deep observation should serve as a useful reference velocity in calculating geostrophic flow at other depths, but the calculations have not yet been made. The anchored buoy held its position well in the 2-knot current, with a 30-knot wind coming from the same direction.

From Cape Amber it had been intended to work northward to the latitude of Mombasa, and then westward, but shortage of time necessitated heading almost directly for a point 300 miles offshore from Mombasa, since the section close to the African coast seemed the most important. The course went close to Astove and Aldabra Islands, but the weather was still unsuitable for landing. From 44° E in towards Mombasa, a section of 9 stations was worked, at intervals decreasing from 60 to 10 miles. The weather had improved and when the coast current was reached there was enough time in hand for another anchored-buoy station, about 60 miles offshore. There the surface current was 1½ knots, slightly east of north, and a neutrally-buoyant float at 1200 m depth (only 200 m off the bottom) moved north-east at 19 cm/s (nearly 0.4 knot). Closer inshore the surface current increased to about 2 knots and maintained that value to within 10 miles of the coast. The current-meters showed that in general the speed decreased to about half the surface value at 200 m depth.

Biological work on the section northward from Mauritius continued as before with vertical net hauls at stations approximately 120 miles apart. At several trawling stations, trials were made of an experimental catch-dividing bucket. Approaching the coast, vertical net work was intensified as in the Arabian coast stations, and it was at these stations that the first signficant increase in plankton volume from the low oceanic levels took place.

Station summary (Mauritius to Mombasa):

38 water-sampling stations (25 to the bottom)
46 current-shear profiles (12 within radar range of anchored buoys, or the coast, 6 with Bergen meter)
2 neutrally-buoyant floats
18 series of vertical net hauls (NF70V)
15 fine mesh net hauls (N50V)
15 chlorophyll profiles
6 temperature-salinity-depth profiles (TSD)
7 trawls (IKMT)
15 Indian Ocean standard net hauls (IOSNV)
18 Neuston net hauls (NN)

Continuous echo-sounding and meteorological recording.
Daily radiosondes.
Hourly bathythermograph observations.

7. MOMBASA TO ADEN, 2 August to 23 August 1964

During this period 'Discovery' worked with the U.S. research vessel 'Argo' in the Somali current. At Mombasa, there were several changes in the scientific party, but only one of these involved any new work. With the prospect of poor weather off the Somali coast, celestial navigation might have been limited, and none of the existing radio aids covered that area. The anchored buoys which had been used were not expected to hold in more than a 3-knot current 200 m thick, and that might well have been exceeded. To improve on this situation, D.P. Keily brought with him an experimental navigation aid, in which the phases of radio signals from existing very low frequency transmitters were recorded continuously, with sufficient accuracy to provide a useful measure of changes in the distances between the ship and each transmitter (Stanbrough & Keily 1964). At Mombasa, a replacement for the lost Bergen current meter was generously supplied at short notice by the Geophysical Institute, but this was unfortunately also destined to be lost at one of the stations in the Somali current.

The planning of the first part of the survey was guided by the observations of the 'Atlantis II' in 1963, which indicated a broad countercurrent offshore beyond the main Somali current, much weaker in speed but comparable to it

in volume transport. Besides short sections across the coastal current, longer ones were planned for both ships, out to at least 300 miles, to look for the countercurrent again.

The two ships worked separately along sections planned to cover the area as thoroughly as time would permit, and only once were in sight of each other, although in daily radio contact. The programme had to be cut in several places, however, since the very high speed of the current slowed down the work considerably - at times only 2 or 3 knots over the ground could be made good on passage, and stations took much longer when only one wire could be worked at a time.

In the event, the 'Discovery''s sections amounted to two short lines of 5 stations each, out from the coast at 1° N and 3° N across the main current to 60 to 70 miles offshore, and two longer sections, each of 10 stations, from $4\frac{1}{2}$° N out for 300 miles to $3\frac{1}{2}$° N, 53° E, and back from that position to the coast near $8\frac{1}{2}$° N.

A quick passage was made from Mombasa to 1° N, with a favourable current increasing from 2 to over 3 knots, according to the GEK. At the first station, within 10 miles of the coast, combined current-meter observations and radar fixes indicated a surface current of 4.2 knots. At the two inshore stations, the current-shear was too strong for more than one wire to be used at a time, but decreased farther out.

Radar fixes on the coast were possible out to 20 miles offshore; the very low frequency navigation aid gave one reliable relative position-line, using signals from the Rugby transmitter, but reception of the American stations over a longer west-east path was disturbed too much by unpredictable fluctuations.

On the second short section, the current was weak at the shallow inshore station, but the rest of the section was similar to the first, with a 4-knot current decreasing away from the coast. As might be expected so near the equator, there were no signs of upwelling at the inshore ends of these sections. At $4\frac{1}{2}$° N, there was again a relatively weak current at the inshore station (about 2 knots), but ten miles farther out the current was running at six knots, with four knots of shear between the surface and 100 m depth. Some difficulty was experienced in getting the water bottles to close properly; although the ship could be manoeuvered to keep the wire vertical at the surface, there must have been quite large wire angles below, which together with the drag of the current made the messengers slide more slowly down the wire and reduced their impact on the water bottles.

The strength of the current also proved quite a problem for the net work owing to the great drag of the nets in the water. Only by making rapid alterations in ship's speed as the nets passed through the layer of greatest change in current shear could anything like a vertical haul be maintained.

Despite the slow progress along the section, full series of observations were made as usual, with alternate deep and shallow stations, and a current-shear profile to 1000 m with the new Bergen meter at the deep stations. It had been intended to anchor a buoy for current-measuring at one of these stations, but it seemed unwise to attempt this until the sixth station, some 150 miles offshore. Surface drogues there moved at about 1 knot towards north-east, and a neutrally-buoyant float at 1000 m showed a south-eastward current of about 0.4 knot. The section was continued eastward, without a clear indication of a countercurrent from the shear measurements or from the GEK (though the readings seemed doubtful by then as the ship was approaching the magnetic equator), until station 5542, 300 miles offshore. With weaker currents the working of three wires at once was resumed, but on this last station of the section the second Bergen meter was unfortunately lost when the two forward wires became tangled.

Towards the end of the section a slight southward set was experienced and although time was short it seemed worthwhile briefly to anchor a buoy to determine the presence of the countercurrent.

There was indeed a surface current of about 1 knot to the south-west, and a neutrally-buoyant float showed little movement at 1000 m. Heading north-west back towards the coast, a north-eastward set from the main current soon appeared and it seemed that the countercurrent was not as extensive as it had been in 1963.

So far, no deep current measurements had been made below the main current itself, and although evidently most of the shear was in the top 200 m there could still be substantial flow at greater depths. In an attempt to settle this question, a buoy was anchored again as the ship came back into the main current, and neutrally-buoyant floats were laid, loaded for 1000 and 2000 m. The surface current was nearly 3 knots, and after about six hours the buoy broke its mooring wire and started drifting rapidly. Fortunately this happened after the evening stars had been observed; the buoy was recovered, contact regained with the floats and this was maintained until the morning stars had been observed. Again, the floats showed very little movement in the deep water.

The current shear increased as the coast was approached, being strongest about 20 miles offshore where radar fixes were just possible. The surface current there was 7 knots, with 5 knots of shear between the surface and 200 m. Approaching the coast the current decreased, and at the same time the sea surface temperature dropped, to 15° C.

The absence of upwelling and the well-developed thermocline farther south meant that the surface waters there contained very low concentrations of nutrients, yet there is no doubt that the average biomass of both phyto-plankton and zooplankton were substantially greater than the general oceanic level. In the cold water, however, the nutrient levels at the surface inshore

were much higher, consistent with the depth of origin of the upwelled water.

It had been planned that the area of cold water should form the subject of the second part of the co-operative programme with the 'Argo', and the thermograph was watched with interest, when it dropped as low as 13.2° C on the way northward along the coast towards Ras Mabber. At the same time, many dead fish were seen, floating in long lanes, and samples were collected. Most of them were puffer fish, and it seemed likely that they had been killed by a sudden invasion of cold water. More dead fish were later found farther north, and an account of the mortality has been submitted for publication (Foxton 1965).

'Argo' was met off Ras Mabber, a spare bathythermograph was transferred and plans were made for the survey of the cold water area. It was agreed that 'Discovery' should continue northwards to Ras Hafun, and make sections north-eastwards from there towards Socotra, and then back westwards to Cape Guardafui.

Surface temperatures remained below 20° C on the first section out to 100 miles offshore, and currents in the cold water were relatively weak and variable but predominantly northward. The section was terminated near 53° E when the cold water had already been passed. The weather had been better than expected on the Somali coast, with generally force 6 winds and good visibility, but on the section across towards Guardafui it deteriorated and slowed down progress. Four stations were occupied, and showed warm water on the surface, not moving very much, with indications of northward movement in the cold water below.

In the region of coldest surface water there was little evidence of much growth of plankton and indeed it was only further north in the region where the cold waters were seemingly mixing with the warmer surface waters coming round Cape Guardafui from the Gulf of Aden that abundant quantities of plankton were found. Clupeoid larvae occurred in large numbers in the plankton hauls in that region. A more unusual feature of this area was the almost complete absence of sea birds which are generally so characteristically abundant in upwelling regions.

From Cape Guardafui course was set directly for Aden, with continuous echo-sounding as usual, and hourly bathythermograph dips, instead of the half-hourly observations which had been the rule in the cold water area.

Station summary (Mombasa to Aden):

43 water-sampling stations (35 to the bottom)
45 current-shear profiles (19 with radar fixing on land or anchored buoy, 7 with Bergen meter)
6 neutrally-buoyant floats
42 series of vertical net hauls (NF70V)

41 fine mesh net hauls (N50V)
53 chlorophyll profiles
22 Indian Ocean standard net hauls (IOSNV)
65 Neuston net tows (NN)

Continuous echo-sounding and meteorological recording.
Daily radiosonde flights.

8. ADEN TO ADEN, 26 August to 7 September 1964

It had been intended to return to the Arabian coast during this period, to look for upwelling in the neighbourhood of the Kuria Muria Islands and to make further chemical and biological observations on the growth and decay of plant and animal life in the upwelling water, to supplement the work of the previous year. It seemed likely, however, that such observations could equally well be made in the cold water off the Somali coast, and by returning there a better contribution to the combined survey of the cold water area would be possible. Moreover, it was felt that a chance might occur to measure the deep water movement under the fastest part of the Somali current. Fortunately, the strongest current had been found in deep water within radar range of the coast, and it was thought probable that floats could be tracked there without having to anchor a buoy. Such observations would be particularly useful in estimating the total transport of water in the current.

Accordingly, plans were changed, and 'Discovery' returned to the cold water area, by way of the reference station in the Gulf of Aden previously worked in March. Seven station positions were chosen, spread throughout the cold water from north to south, where it was hoped to find successive stages in the chemical and biological cycles associated with the upwelling. Four of these stations were occupied as the ship worked south-west from a point 30 miles off Ras Hafun down towards Baia del Negro near 8° N. As before, the coldest water was found near Ras Mabber, but temperatures were slightly higher than before. 'Discovery' then returned to the position of station 5551, where the 7-knot current had been observed, and laid two neutrally-buoyant floats, about 5 miles apart in an east-west direction, loaded for 1000 m depth. This time the surface current was 6 knots, and the floats were tracked for 22 hours, fixing the ship relative to the coast by radar. Water samples were taken between fixes on the floats, and much of the time was spent steaming slowly back against the 6-knot current to regain position after every stop for an observation. There was very little movement at 1000 m, one float remained almost stationary and the other moved slightly south.

The ship then headed northward in a series of zigzags, making half-hourly bathythermograph dips to delineate the edge of the current and the boundary of the cold water. Near 10° N the current turned eastward; the ship closed on Ras Hafun for a land fix and then ran out eastwards to occupy the fifth special station in the cold water.

In order to find out something of what happened to the current after it turned eastward, course was set south-east, then south, until the ship had run out of the cold water and into the current again just beyond 53° E. The current seemed likely to be too fast for anchoring a buoy, and the ship was well out of radar range of the coast, but it was possible to measure the surface current by launching a drogue attached to a buoy and tracking it relative to an acoustic marker laid on the sea floor. The surface current was 4.7 knots, slightly south of east. Soon after recovering the drogue and setting course northwards, the thermograph showed the expected drop in temperature on leaving the currents, but this was followed quickly by a very sharp rise of temperature, of 7° C; next morning's stars showed that the ship had been set north-westwards. The cold water seemed to be drawn out into a narrow filament near $9\frac{1}{2}$° N, 54° E, with opposing currents in the warm water on either side.* Shortage of time prevented further investigation of this strange situation; the two remaining stations were occupied, one in the warm water to the east at about 11° N, the other in the northern part of the cold water, and then the ship headed for Aden.

Station summary (Aden to Aden):

10 water-sampling stations (all to the bottom)
10 current-shear profiles (5 with radar)
2 neutrally-buoyant floats
8 series of vertical net hauls (NF70V)
8 fine mesh net hauls (N50V)
8 chlorophyll profiles
1 trawl IKMT)
1 Indian Ocean standard net haul (IOSNV)
64 Neuston net hauls (NN)

Hourly bathythermograph observations on passage, half-hourly off the Somali coast.
Continuous echo-sounding and meteorological recording.
Daily radiosondes.

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* Two days later, the M.V. 'Border Pele' passed through the same area, fortunately in daylight. The Master, Captain E.L. Lloyd, reported sighting a continuous line of breakers running NW-SE. Passing through the disturbance, the ship's head was deflected in a manner consistent with the suspected strong current-shear, and a drop in sea surface temperature was observed. (Personal communication from Cdr. L.B. Philpott, Marine Branch, Meteorological Office).

9. ADEN TO PLYMOUTH, 7 September to 28 September 1964

Three stations were occupied during the return passage through the Red Sea, in the deep basins near 20° to 21° N where abnormally hot salty water might be found (Miller 1964, Charnock 1964). The first two showed nothing unusual but at the third one, station 5580, extremely high temperatures and salinities (over 44° C, 270 parts per thousand) were found in the lowest 150 m in a small basin some 2200 m deep (Swallow & Crease 1965). Chemical analysis of the very salty water is continuing at Liverpool and at the National Institute of Oceanography; first impressions are that it is unlikely to be volcanic in origin, more probably it may be due to solution of salt deposits in the sea floor.

Two stations were worked in the Mediterranean, and one in the Bay of Biscay, to provide chemical data for comparison with observations to be made about six weeks later by the F.S. 'Meteor'. Bathythermograph observations were made hourly in the southern Red Sea, and across the Bay of Biscay, and continuous echo-soundings and meteorological records were taken on passage as usual.

Acknowledgements

A cruise of this kind is very much a co-operative enterprise. Of the scientific party, about half were from the National Institute of Oceanography and half from other laboratories; altogether 35 scientists from 15 different organizations were involved. Material help was given from several sources: the Fisheries Laboratory at Lowestoft lent a salinometer, a spectrophotometer and a direct-reading current meter, as well as providing facilities for thermometer calibration. The provision of two current-meters (both unfortunately lost) by the Geophysical Institute and the Christen Michelsen Institute, Bergen, is gratefully acknowledged. H.M.S. 'Owen' kindly left some much-needed wire, anchors and bathythermograph slides at Mauritius as well as supplementing the equatorial undercurrent observations (Swallow 1964).

Thanks are due also to many colleagues at the National Institute of Oceanography who designed and produced new equipment for the cruise at short notice. The echo-sounding fish, streamlined dan-buoy, hydrophones and much of the electronic equipment for the neutrally-buoyant floats were all new designs, and all proved successful.

The work at sea was made much easier by the helpful way in which Captain R.H.A. Davies, and the officers and crew of the R.R.S. 'Discovery' co-operated in the scientific observations.

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Table 1. Scientific staff

part of cruise			
2 - 9	M.V. Angel	Biology	University of Bristol
1 - 9	R.S. Bailey	Ornithology	University of Oxford*
1 - 9	D.G. Bishop	Electronics	N.I.O.+
4 - 6	R. Bowers	Electronics	N.I.O.+
1 - 9	P.G. Brewer	Chemistry	University of Liverpool
7 - 8	E.I. Butler	Chemistry	Marine Biological Association, Plymouth
1 - 3	H. Charnock	Physical oceanography	N.I.O.+
4 - 6	M.R. Clarke	Biology	N.I.O.+
1 - 9	J. Cox	Meteorology	Meteorological Office, Bracknell
6 - 9	J. Crease	Physical oceanography	N.I.O.+
3, 7, 8	[a] R.I. Currie	Biology	N.I.O.+
1 - 3	P.M. David	Biology	N.I.O.+
4 - 5	F. Davies	Chemistry	C.S.I.R.O., Cronulla
3 - 9	A.E. Fisher	Biology	N.I.O.+
6 - 9	P. Foxton	Biology	N.I.O.+
6 - 9	C.L. Gulliver	Physical oceanography	N.I.O.+
4 - 5	B.V. Hamon	Physical oceanography	C.S.I.R.O., Cronulla
2 - 9	P.J. Herring	Biology	University of Cambridge
7 - 9	F.H.F. Hinds	Physical oceanography	Hydrographic Department‡
1 - 3	P.G.W. Jones	Chemistry	Fisheries Laboratory, Lowestoft
7	D.P. Keily	V.l.f. navigation	Massachusetts Institute of Technology
1 - 3	B. Kirtley (Miss)	Bacteriology	N.I.O.+
1 - 9	M.J. McCartney	Chemistry	N.I.O.+
1 - 3	J.A. Moorey	Electronics	N.I.O.+
1 - 6	R.G. Munns	Physical oceanography	Woods Hole Oceanographic Institution
2 - 5	R.A.G. Nesbitt	Soundings, physical oceanography	Hydrographic Department‡
7	A. Poling	V.l.f. navigation	U.S. Coast and Geodetic Survey
4 - 6	K.V. Ramam	Physical oceanography	Indian Naval Physical Laboratory, Cochin
4 - 5	D.J. Rochford	Chemistry	C.S.I.R.O., Cronulla
7 - 9	M.L. Somers	Electronics	N.I.O.+
1 - 3	A.R. Stubbs	Electronics	N.I.O.+
1 - 9	[b] J.C. Swallow	Physical oceanography	N.I.O.+
7	P. Tchernia	Physical oceanography	Laboratoire d'Oceanographie, Mus d'Histoire Naturelle, Paris
1 - 9	G. Topping	Chemistry	University of Liverpool

* Edward Grey Institute of Field Ornithology, University of Oxford
\+ National Institute of Oceanography, Wormley, Surrey
‡ Hydrographic Department, Ministry of Defence: Navy

Note: a Principal scientist for parts 7 and 8
b Principal scientist for parts 1 to 6, and 9

Table 2. Summary of observations

Total number of stations = 344
Water sampling and current observations at 306 of these
Biological observation at 275 of these

type of observation	number of separate observations
chemical analysis:	over 27,000
salinity	ca. 8,000
oxygen	ca. 7,000
phosphate	ca. 5,000
nitrate	ca. 4,000
silicate	ca. 3,000
chlorophyll sample	954
surface net haul	258
vertical net haul:	
N50V	181
NF70V	620
IOSNV	167
trawl (IKMT)	38
bathythermograph dip	2,138
current-shear profile	351
neutrally-buoyant float	41
anchored-buoy station	31
surface weather observation	1,135
radiosonde ascent	139
echo-sounding track	ca. 28,000 miles

Table 3. Key to station list

Key to type of observation:

WB	Water bottle
DRCM	Direct-reading current meter
CD	Current drogue
BCM	Bergen current meter
FNB	Neutrally-buoyant float
NN	Neuston net
NNL	Large Neuston net
NN3	3-layer net
NH	Hand net
LH	Hand lines
N50V	50 cm diameter vertical net (phytoplankton)
NF70V	70 cm diameter vertical net with flowmeter
IOSNV	Indian Ocean standard net, fished vertically
IOSNB	Indian Ocean standard net, fished obliquely
IKMT	Isaacs-Kidd midwater trawl
CDB	Catch-dividing bucket
DGP	Pressure-recording depth gauge
DNI	Depth of net indicator
Chlor.	Chlorophyll samples
Bact.	Bacteriological samples
TSD	Temperature-salinity-depth recorder
GEK	Towed electrodes
D.B.	Dan-buoy

The positions given in table 4 are (unless otherwise stated) the mid-points of stations. Where there was a large movement, as on some of the Somali coast stations, beginning and end positions are given. At anchored-buoy stations, where many observations were made within radar range, the mean position of the buoy itself is tabulated. The only exception is station 5580, where the water-sampling position is given instead of the buoy position.

Time zones are indicated:

Z = G.M.T.
A = G.M.T. + 1 hour
B = G.M.T. + 2 hours
C = G.M.T. + 3 hours
D = G.M.T. + 4 hours
E = G.M.T. + 5 hours
[* represents half hour to be added to G.M.T.
+ represents quarter hour to be added to G.M.T.]

Table 4.

Station list

1. PLYMOUTH TO ADEN

station no.	date	time (L.M.T.) and zone	position	depth (m)	wire out (m)	type of observation						comments
5239	16/2	1412 - 2024Z	46° 25.0'N 08° 05.0'W	4707	3300	WB						[station 'Cavall']; two deep casts for practice and checking salinometer
5240	22/2	0400 - 0754A	37° 38.0'N 06° 00.0'E	2812	2805	WB						testing flowmeters for vertical nets, and 0_2 probe
5241	25/2 26/2	2130 - 0018B	32° 53.7'N 27° 44.8'E	3132	3100	WB	DRCM	NN				
5242	29/2	0000 - 0136B	25° 23.1'N 35° 35.2'E	893	810	WB						start of northern Red Sea section
5243	29/2	0806 - 0918B	24° 16.0'N 36° 21.9'E	1180	1000	WB						
5244	29/2	1524 - 1654B	23° 10.4'N 37° 02.1'E	1346	1200	WB						
(5245)	29/2 1/3	2030 - 0120B	22° 48.9'N 37° 26.2'E			IKMT	CDB					
5246	1/3	0354 - 0454B	22° 17.0'N 37° 32.2'E	923	910	WB						
5247	1/3	1124 - 1548B	21° 07.3'N 38° 10.4'E	2394	2457	WB						abnormal deep water near this station
(5248)	1/3	1900 - 2230B	20° 33.1'N 38° 22.6'E			IKMT	CDB					
5249	2/3	0115 - 0300B	20° 04.2'N 38° 27.3'E	2150	2000	WB						end of Red Sea section
(5250)	2/3	1330 - 1400B	18° 19.1'N 39° 39.3'E			NH						collecting sargassum weed

2. ADEN TO MAURITIUS

5251	8/3	1706 - 2212C*	13° 12.5'N 50° 19.0'E	3600	3400	WB	DRCM	NN	N50V	NF70V	IOSNV Bact.	SCOR/UNESCO Reference Station no. 12
5252	10/3	0800 - 1418D	17° 28.1'N 55° 38.2'E	71	62	WB	DRCM	N50V	NF70V	Bact.		second station of Arabian coast section; shore collecting at Hasikiya
5253	10/3	1730 - 1820D	17° 40.0'N 55° 33.2'E	56	50	WB	DRCM	N50V	NF70V	Chlor.	Bact.	closest inshore station of Arabian coast section
5254	10/3 11/3	2012 - 0034D	17° 23.1'N 55° 47.0'E	2610	2600	WB	DRCM	NN	N50V	NF70V	Chlor. Bact.	
5255	11/3	0248 - 0800D	17° 05.5'N 55° 54.5'E	3043	2900	WB	DRCM	NN	N50V	NF70V	Bact.	
5256	11/3	0930 - 1636D	16° 51.3'N 56° 10.0'E	3358-3390	3250	WB	DRCM	NN	N50V	NF70V	Chlor. Bact.	
5257	11/3	1842 - 2236D	16° 34.1'N 56° 36.0'E	2050	1200	WB	DRCM	NN	N50V	NF70V	Bact.	
5258	12/3	0118 - 0836D	16° 13.1'N 56° 58.0'E	3961	3900	WB	DRCM	NN	N50V	NF70V	Chlor. Bact.	
5259	12/3	1206 - 1454D	15° 44.0'N 57° 25.3'E	3985	1200	WB	DRCM	NN	NH	N50V	NF70V Bact.	
5260	12/3 13/3	2118 - 0256D	14° 59.1'N 58° 13.1'E	3840	3808	WB	DRCM	NN	NH	N50V	NF70V Chlor. Bact.	last station of Arabian coast section
5261	13/3	0724 - 0954D	14° 08.3'N 58° 19.7'E	3228	1200	WB	DRCM	NN	N50V	Chlor.		

station no.	date	time (L.M.T.) and zone	position	depth (m)	wire out (m)	type of observation						comments
5262	13/3 14/3	1854 - 0200D	12°36.0'N 58°15.0'E	5698	5600	WB	DRCM	NN	NF70V	IOSNV		in a deep trench; three casts of water bottles
5263	14/3	0800 - 1000D	11°28.6'N 58°04.5'E	4155	1200	WB	DRCM	NN	N50V	Chlor.		
(5264)	14/3	1600 - 2006D	10°16.0'N 57°56.0'E			IKMT	CDB	DGP				
5265	14/3 15/3	2242 - 0312D	09°38.3'N 57°57.5'E	2862	2850	WB	DRCM	NF70V		IOSNV		
5266	15/3	0942 - 1306D	08°17.5'N 57°57.3'E	3978	1200	WB	DRCM	NN	N50V	Chlor.	Bact.	
5267	15/3 16/3	2042 - 0118D	06°44.9'N 57°59.5'E	3841	3600	WB	DRCM	NN	NF70V	IOSNV		
5268	16/3	0942 - 1430D	05°09.8'N 57°59.0'E	4473	4400	WB	DRCM	NN	N50V	Chlor.		
5269	16/3	2036 - 2312D	03°59.3'N 57°59.0'E	4711	1200	WB	DRCM	NN	NF70V	IOSNV		
5270	17/3	0436 - 1106D	03°02.7'N 57°55.9'E	4771	4802	WB	DRCM	Bact.				
5271	17/3	1354 - 1654D	02°30.8'N 57°57.2'E	5046	1200	WB	DRCM					
(5272)	17/3	1800 - 2048D	02°13.7'N 57°52.3'E			IKMT	CDB					
5273	17/3 18/3	2112 - 0148D	02°05.0'N 57°53.5'E	4120	4000	WB	DRCM	NNL				
5274	18/3	0500 - 0730D	01°31.7'N 57°54.4'E	4730	1200	WB	DRCM					
5275	18/3 19/3	1012 - 1136D	01°02.0'N 57°59.0'E	4730	4600	WB Chlor.	DRCM Bact.	FNB	N50V	NF70V	IOSNV	D.B. I
5276	19/3	1424 - 1630D	00°31.0'N 58°00.0'E	4735	1200	WB	DRCM					
5277	19/3	1854 - 2012D	00°02.0'N 58°01.2'E	4645	350	WB	DRCM	NNL				first station of short shallow section across equator
5278	19/3 20/3	2300 - 0012D	00°29.1'S 58°00.5'E	4713	350	WB	DRCM	NNL				
5279	20/3	0300 - 0412D	00°56.5'S 57°58.5'E	4555	350	WB	DRCM					
5280	20/3	0654 - 0812D	01°26.5'S 57°57.3'E	4517	350	WB	DRCM	NNL				end of short section, returning to equator
5281	20/3 21/3	1542 - 2318D	00°00.3'N 58°00.5'E	4610	4400	WB	DRCM	FNB	NNL	IOSNV	Bact.	D.B. II
5282	22/3	0148 - 0412D	00°27.1'S 58°00.5'E	4715	1200	WB	DRCM					
5283	22/3	0706 - 1848D	00°58.0'S 57°59.0'E	4556	4400	WB	DRCM	NH	NF70V	Chlor.		D.B. III
5284	22/3 23/3	2136 - 0006D	01°29.2'S 57°59.1'E	4521	1200	WB	DRCM	NNL				
5285	23/3	0236 - 0648D	01°56.7'S 57°57.2'E	4450	4400	WB	DRCM					
5286	23/3	0912 - 1742D	02°25.5'S 57°53.4'E	4398	1200	WB	DRCM	N50V	Chlor.	Bact.		D.B. IV
(5287)	23/3	1842 - 2300D	02°37.5'S 57°54.6'E			IKMT	CDB					

station no.	date	time (L.M.T.) and zone	position	depth (m)	wire out (m)	type of observation						comments
5288	24/3	0042 - 0506D	03°06.2'S 57°57.8'E	4323	4000	WB	DRCM	NNL	NF70V	IOSNV		
5289	24/3	0754 - 1124D	03°41.3'S 58°03.0'E	4164	1200	WB	DRCM	NNL	N50V	Chlor.		
(5290)	24/3	1215 - 1227D	03°56.0'S 58°05.0'E			NH						collecting sargassum weed
5291	24/3	1430 - 1806D	04°20.8'S 58°03.9'E	4052	4000	WB	DRCM					
5292	24/3 - 25/3	2124 - 0006D	04°55.8'S 58°03.8'E	3990	1200	WB	DRCM	NNL	NF70V	IOSNV	Bact.	
5293	25/3	0324 - 0642D	05°32.3'S 58°03.0'E	2813	2800	WB	DRCM					
5294	25/3	1029 - 1224D	06°13.6'S 57°59.2'E	1181	1200	WB	DRCM	NNL	N50V	Chlor.		
5295	25/3	1648 - 1936D	07°01.4'S 57°57.8'E	1460	1450	WB	DRCM	NNL	NF70V	IOSNV		
5296	25/3 - 26/3	2248 - 0112D	07°39.3'S 58°00.5'E	1535	1200	WB	DRCM	NNL	Bact.			
5297	26/3	0454 - 0748D	08°18.0'S 57°58.4'E	3090	3050	WB	DRCM					
5298	26/3 - 27/3	1118 - 1300D	08°53.2'S 57°53.4'E	3385	3200	WB IOSNV	DRCM Chlor.	FNB	NNL	N50V	NF70V	D.B. V
5299	27/3	1600 - 1942D	09°26.0'S 57°58.3'E	3630	3600	WB	DRCM	NNL				
5300	27/3 - 28/3	2242 - 0100D	10°02.1'S 58°00.6'E	3838	1200	WB	DRCM	Bact.				
5301	28/3	0400 - 0736D	10°35.2'S 58°02.5'E	3907	3900	WB	DRCM					
5302	28/3	0942 - 1242D	11°01.4'S 58°01.0'E	4116	1200	WB	DRCM	NNL	NF70V			
5303	28/3 - 29/3	1530 - 1818D	11°31.5'S 57°57.9'E	4219	4000	WB	DRCM	FNB	N50V	IOSNV	Chlor.	D.B. VI
(5304)	29/3	1842 - 2300D	11°36.0'S 57°53.6'E			IKMT	IOSNB					
5305	30/3	0048 - 0242D	11°56.1'S 57°57.3'E	4266	1200	WB	DRCM					
5306	30/3	0530 - 0942D	12°24.5'S 57°57.3'E	4298	4300	WB	DRCM					
5307	30/3	1300 - 1548D	12°59.5'S 57°58.0'E	4294	1200	WB Chlor.	DRCM Bact.	NNL	N50V	NF70V	IOSNV	
5308	30/3	1924 - 2312D	13°38.1'S 57°55.5'E	2901	2900	WB	DRCM	NNL				
5309	31/3	0254 - 0448D	14°18.0'S 57°53.5'E	3523	1200	WB	DRCM					
5310	31/3 - 3/4	0848 - 1048D	14°59.8'S 58°01.1'E	4050	4000	WB NF70V	DRCM IOSNV	FNB IOSNB	NN Chlor.	IKMT Bact.	N50V	D.B. VII
5311	3/4	1600 - 1730D	15°58.7'S 58°00.0'E	4080	1200	WB	DRCM	N50V	IOSNV	Chlor.		
(5312)	3/4	1900 - 2248D	16°20.0'S 57°53.9'E			IKMT						
5313	4/4	0154 - 0636D	16°56.0'S 58°05.2'E	3530	3505	WB	DRCM	NF70V	IOSNV	Bact.		
5314	4/4	1248 - 1500D	18°00.0'S 58°15.7'E	3782	1200	WB	DRCM	NN	N50V	IOSNV	Chlor.	

station no.	date	time (L.M.T.) and zone	position	depth (m)	wire out (m)	type of observation						comments
(5315)	4/4	1600 - 1812D	18°13.3'S 58°09.1'E			IKMT						
5316	4/4 5/4	2200 - 0006D	18°57.0'S 57°51.1'E	1181	1200	WB	DRCM	NNL	NF70V			end of southward section on 58° E
3. MAURITIUS TO COCHIN												
5317	10/4	2212 - 0248D	19°50.2'S 58°31.8'E	4470	4400	WB	NNL					start of eastward section from Mauritius; DRCM being repaired
5318	11/4	1148 - 1348D	20°00.0'S 60°01.8'E	3904	1200	WB	NNL					
5319	11/4 12/4	2218 - 0206D	19°47.3'S 61°24.4'E	3780	3600	WB	DRCM	NNL				
5320	12/4	1112 - 1318D	19°35.5'S 62°59.8'E	763	792	WB	DRCM	NNL				
5321	12/4 13/4	2130 - 0100D	19°49.8'S 64°24.9'E	2853	2800	WB	DRCM	NNL				
5322	13/4	1024 - 1236D*	20°14.0'S 65°56.9'E	2350	1200	WB	DRCM	NNL				
(5323)	13/4	1600 - 1948D*	20°02.2'S 66°35.0'E			IKMT	CDB					
5324	14/4	0042 - 0512D*	20°00.0'S 67°28.9'E	3300	3210	WB Chlor.	DRCM Bact.	NN	N50V	NF70V	IOSNV	start of northward section on 67°30'E
5325	14/4	1250 - 1450D*	18°33.6'S 67°30.8'E	3003	1200	WB	DRCM	Chlor.	Bact.			
5326	14/4 15/4	2355 - 0250D*	17°01.8'S 67°33.3'E	3021	2905	WB Chlor.	DRCM Bact.	NN	N50V	NF70V	IOSNV	
5327	15/4	0830 - 1036D*	15°59.0'S 67°28.2'E	3801	1200	WB	DRCM	NN	Chlor.			
5328	15/4 16/4	1524 - 1824D*	14°59.7'S 67°29.0'E	3040	2900	WB IOSNV	DRCM Chlor.	CD Bact.	FNB GEK	N50V	NF70V	D.B. VIII
5329	16/4 17/4	2154 - 0024D*	14°18.0'S 67°35.0'E	2926	1200	WB	DRCM	IOSNB	Chlor.			
5330	17/4	0406 - 0800D*	13°39.3'S 67°40.0'E	3740	3750	WB	DRCM	NN	NF70V	IOSNV		
5331	17/4	1118 - 1400D*	12°59.1'S 67°26.0'E	2970	1200	WB	DRCM	NN	N50V	Chlor.		
(5332)	17/4	1600 - 2000D*	12°37.2'S 67°21.8'E			IKMT	CDB					
5333	17/4	2000 - 2336D*	12°31.8'S 67°25.2'E	2842	2800	WB	DRCM					
5334	18/4	0218 - 0700D*	12°03.5'S 67°26.2'E	3542	3610	WB	DRCM	IKMT	Bact.			
5335	18/4 19/4	0700 - 1124D*	12°02.5'S 67°25.3'E			DRCM	CD	FNB	NN	Chlor.	Bact.	D.B. IX
5336	19/4	1424 - 1848D*	11°31.7'S 67°29.3'E	3300	3200	WB	DRCM	NN	NF70V	IOSNV		
5337	19/4	2106 - 2306D*	11°03.2'S 67°29.6'E	3257	1200	WB	DRCM	NN				
5338	20/4	0148 - 0524D*	10°31.8'S 67°29.6'E	3610	3600	WB	DRCM					
5339	20/4	0806 - 1012D*	10°03.0'S 67°29.3'E	3855	1200	WB	DRCM	NN	Bact.			

station no.	date	time (L.M.T.) and zone	position	depth (m)	wire out (m)	type of observation						comments
5340	20/4	1300 - 1630D*	09°34.6'S 67°34.3'E	3419	3200	WB	DRCM	NN	N50V	NF70V	IOSNV	
5341	20/4 21/4	1845 - 2254D*	09°08.7'S 67°34.0'E	6180	6200	WB Bact.	DRCM	CD	FNB	NF70V	Chlor.	D.B. X; deep water sampling in Vema Trench; 0_2 probe used
5342	22/4	0212 - 0518D*	08°29.6'S 67°29.7'E	2882	2900	WB	DRCM					
5343	22/4	0754 - 1006D*	08°02.8'S 67°30.5'E	2347	1200	WB	DRCM	NN				
5344	22/4	1306 - 1724D*	07°28.5'S 67°29.3'E	4188	4000	WB	DRCM	NN	NF70V	IOSNV	Bact.	
5345	22/4 23/4	1900 - 0024D*	06°58.0'S 67°31.1'E	3133	1200	WB	DRCM	IKMT	CDB			
5346	23/4	0312 - 0642D*	06°27.4'S 67°32.4'E	4170	4200	WB	DRCM					
5347	23/4	0906 - 1100D*	05°59.6'S 67°32.6'E	2834	1200	WB	DRCM	NN	N50V	Chlor.		
5348	23/4	1336 - 1654D*	05°28.8'S 67°32.2'E	3616	3600	WB	DRCM	NN	NF70V	IOSNV	Bact.	
5349	23/4	1930 - 2142D*	04°56.0'S 67°32.8'E	4162	1200	WB	DRCM	NN	N50V	Chlor.		
5350	24/4	0054 - 0430D*	04°18.7'S 67°31.7'E	3535	3550	WB	DRCM	N50V	Chlor			0_2 probe used
5351	24/4	0742 - 1048D*	03°37.3'S 67°30.2'E	2950	1200	WB	DRCM	NN	NF70V	GEK		
5352	24/4	1348 - 1830D*	02°58.7'S 67°33.2'E	3600	3700	WB GEK IKMT	DRCM	NN	N50V	Chlor.	Bact.	
(5353)	24/4	1900 - 2330D*	02°40.8'S 67°40.5'E									
5354	25/4	0042 - 0306D*	02°24.8'S 67°43.0'E	2834	1200	WB	DRCM	Bact.				
5355	25/4 26/4	0542 - 1106D*	01°51.4'S 67°46.9'E	2169	2200	WB NF70V WB	DRCM IOSNV DRCM	CD Chlor. Bact.	FNB Bact.	NN	N50V	D.B. XI
5356	26/4	1336 - 1654D*	01°30.7'S 67°33.6'E	2840	1200							
5357	26/4 27/4	1936 - 0830D*	01°00.8'S 67°40.4'E	3740	3600	WB	DRCM	CD	N50V	Chlor.	Bact.	D.B. XII
5358	27/4	1118 - 1430D*	00° 29.6'S 67°41.7'E	3341	1200	WB	DRCM	NN	Bact.			
5359	27/4 29/4	1724 - 1018D*	00°02.5'S 67°35.1'E	2600	2600	WB N50V WB	DRCM NF70V DRCM	CD IOSNV NN3	FNB IKMT Bact.	NN3 Chlor.	LH Bact.	D.B. XIII
5360	29/4	1324 - 1918D*	00°29.5'N 67°32.2'E	3770	1205							
5361	29/4 30/4	1954 - 0800D*	00°55.5'N 67°28.3'E	3200	3200	WB	DRCM	CD	N50V	Chlor.		D.B. XIV
5362	30/4	1054 - 1254D*	01°26.0'N 67°30.8'E	3321	1210	WB	DRCM	Bact.				
5363	30/4 1/5	1618 - 1942D*	01°59.7'N 67°31.0'E	3200	3200	WB IOSNV WB	DRCM Chlor. DRCM	CD Bact. Bact.	FNB	N50V	NF70V	D.B. XV
5364	1/5 2/5	2230 - 0042D*	02°27.8'N 67°30.1'E	2820	1200							
5365	2/5	0354 - 0706D*	02°57.3'N 67°32.9'E	3833	3800	WB	DRCM	Chlor.				

station no.	date	time (L.M.T.) and zone	position	depth (m)	wire out (m)	type of observation						comments
5366	2/5	1048 - 1236D*	03°37.9'N 67°36.1'E	3402	1200	WB	DRCM					
5367	2/5	1654 - 2248D*	04°18.0'N 67°36.6'E	3777	3800	WB Chlor.	DRCM	N50V	NF70V	IOSNV	IKMT	
5368	3/5	0206 - 0418D*	04°51.7'N 67°33.1'E	3985	1205	WB	DRCM	Bact.				
5369	3/5	0948 - 1354D*	05°43.8'N 67°32.7'E	4621	4400	WB	DRCM	N50V	NF70V	IOSNV	Chlor.	
5370	3/5	2130 - 2336D*	07°00.7'N 67°30.0'E	4431	1200	WB	DRCM	NN				
5371	4/5 - 5/5	0906 - 1842D*	08°31.3'N 67°29.1'E	4500	4400	WB IOSNV NN	DRCM Chlor IOSNB	CD IKMT	FNB DGP	N50V	NF70V	D.B. XVI; end of northward section on 67°30'E
5372	5/5	1918 - 2242D*	08°33.2'N 67°42.0'E			NN	IKMT					
5373	7/5	0000 - 0324E*	09°25.0'N 72°43.5'E									sampling Trichodesmium bloom
5374	7/5	1212 - 1230E*	09°44.2'N 74°34.2'E									sampling Trichodesmium bloom
5375	7/5	1436 - 1506E*	09°48.2'N 75°00.7'E									

4. COCHIN TO SEYCHELLES

5376	12/5 - 13/5	2300 - 0106E*	10°00.3'N 75°18.4'E	1957	1200	WB	DRCM					start of section westward along 10°N
5377	13/5	0648 - 0836E	10°02.8'N 74°13.0'E	2448	1200	WB	DRCM					
5378	13/5	1530 - 1824E	09°59.2'N 72°56.1'E	1975	1800	WB	DRCM	NN	N50V	NF70V		NF70V 100-50 m catch lost
5379	14/5	0124 - 0312E	09°58.3'N 71°45.7'E	2587	1200	WB	DRCM					
5380	14/5	0942 - 1855E	10°03.0'N 70°37.2'E	3935	4000	WB	DRCM	BCM	IOSNV			returned to Cochin for repairs
5381	19/5 - 20/5	2218 - 0148E*	09°57.0'N 74°27.2'E	2491	2500	WB	DRCM	NN	LH	IOSNV		SCOR/UNESCO Reference Station no. 6
5382	21/5	0730 - 0936D*	09°58.3'N 69°01.5'E	4521	1200	WB	DRCM	N50V	Chlor.	TSD		resumed westward section
5383	21/5	1818 - 2300D*	09°58.8'N 67°31.8'E	4457	4400	WB TSD	DRCM	NN	LH	NF70V	IOSNV	start of north-west section
5384	22/5	0836 - 1024D*	10°40.7'N 66°03.5'E	4365	1200	WB	DRCM	N50V	Chlor.	TSD		
5385	22/5 - 23/5	2030 - 0012D*	11°19.3'N 64°32.0'E	4301	4000	WB	DRCM	NN	NF70V	IOSNV	TSD	
5386	23/5	1042 - 1354D*	12°02.0'N 63°00.0'E	4274	4000	WB	DRCM	Chlor.	TSD			SCOR/UNESCO Reference Station no. 8
5387	23/5 - 24/5	2136 - 0106D*	12°42.8'N 61°46.5'E	4252	4000	WB TSD	DRCM	NN	LH	NF70V	IOSNV	
5388	24/5	0836 - 1100D+	13°31.3'N 60°39.4'E	4250	1200	WB	DRCM	NN3	N50V	Chlor.	TSD	
5389	24/5	1842 - 2224D+	14°13.3'N 59°27.2'E	4236	4000	WB TSD	DRCM	NN3	LH	NF70V	IOSNV	
5390	25/5	0600 - 0818D	14°58.2'N 58°13.7'E	3886	1200	WB TSD	DRCM	NN	N50V	NF70V	Chlor.	start of section in towards Arabian coast

station no.	date	time (L.M.T.) and zone	position	depth (m)	wire out (m)	type of observation						comments
5391	25/5	1436 - 1836D	15°45.7'N 57°26.3'E	4100	4000	WB	DRCM	NN	N50V	NF70V	TSD	
5392	25/5	2236 -	16°17.5'N 56°51.7'E	4086	1200	WB Chlor.	DRCM TSD	NN	LH	N50V	NF70V	
	26/5	0100D										
5393	26/5	0348 - 0912D	16°43.8'N 56°25.0'E	3578	3500	WB	DRCM	NN	N50V	NF70V	TSD	
5394	26/5	1136 - 1354D	16°50.7'N 56°05'4'E	2725	1200	WB TSD	DRCM	NN	N50V	NF70V	Chlor.	
5395	26/5	1554 - 2142D	17°08.0'N 55°48.1'E 17°11.5'N 55°45.0'E	2672	2600	WB IKMT	DRCM DGP	NN DNI	N50V TSD	NF70V	IOSNB	
5396	26/5	2254 -	17°17.9'N 56°33.2'E	1672	1600	WB TSD	DRCM	NN	N50V	NF70V	Chlor.	
	27/5	0200D										
5397	27/5	0248 - 0600D	17°24.5'N 55°25.0'E	2390	1200	WB	DRCM	NN	N50V	NF70V	TSD	
5398	27/5	0654 - 0742D	17°30.6'N 55°18.2'E	36	31	WB IKMT	DRCM	N50V	NF70V	Chlor.		Kuria Muria Bay, inshore end of Arabian coast section
(5399)	27/5	2000 - 2306D	15°33.2'N 55°56.8'E									
5400	28/5	0830 - 1154D	14°01.2'N 56°30.0'E	2700	2600	WB TSD	DRCM	NN	N50V	NF70V	IOSNV	NF70V net lost
5401	28/5	2012 - 2248D	12°41.7'N 56°57.0'E	3658	1200	WB	DRCM	LH	N50V	Chlor.	TSD	
5402	29/5	0900 - 1342D	11°09.5'N 57°30.5'E	4676	4400	WB Chlor.	DRCM TSD	NN	N50V	NF70V	IOSNV	
5403	29/5	2206 -	09°42.0'N 58°01.2'E	3749	1200	WB	DRCM	LH	TSD			start of southward section at 58
	30/5	0024D										
5404	30/5	0800 - 1906D	08°20.3'N 57°59.0'E 08°00.5'N 57°58.6'E	3890	3610	WB IOSNV	DRCM Chlor.	BCM TSD	NN	N50V	NF70V	repeated dips with TSD
5405	31/5	0018 - 0306D	06°58.8'N 57°58.3'E	3877	1200	WB	DRCM	LH	TSD			
5406	31/5	0800 - 1142D	06°00.8'N 57°57.4'E	3797	3600	WB Chlor.	DRCM TSD	NN	N50V	NF70V	IOSNV	
5407	31/5	1648 - 1830D	05°02.7'N 57°58.7'E	4188	1200	WB	DRCM	N50V	Chlor.	TSD		
5408	31/5	2218 -	04°20.8'N 57°58.0'E	4442	4400	WB IOSNV	DRCM Chlor.	NN TSD	LH	N50V	NF70V	
	1/6	0212D										
5409	1/6	0536 - 0724D	03°41.7'N 57°59.2'E	4627	1200	WB	DRCM	N50V	Chlor.	TSD		
5410	1/6	1054 - 1448D	03°00.5'N 58°00.7'E	4727	4400	WB	DRCM	NN	N50V	Chlor.	TSD	
5411	1/6	1736 - 2336D	02°30.4'N 58°01.0'E 02°26.2'N 58°01.3'E	4901	1200	WB Chlor.	DRCM TSD	N50V	IKMT	DGP	DNI	
5412	2/6	0136 - 1730D	02°02.4'N 58°03.4'E	4316	4300	WB IOSNV	DRCM TSD	CD	BCM	NN	NF70V	D.B. XVII
5413	2/6	1930 -	01°37.4'N 58°00.7'E	4737	1200	WB	DRCM	N50V	IKMT	Chlor.	TSD	
	3/6	0112D	01°29.2'N 57°59.5'E									
5414	3/6	0330 - 1812D	01°05.2'N 57°59.4'E	4709	4700	WB	DRCM	CD	BCM	NN	TSD	D.B. XVIII
5415	3/6	2030 -	00°39.1'N 58°03.3'E	4737	1200	WB	DRCM	N50V	IKMT	Chlor.	TSD	
	4/6	0242D	00°32.1'N 58°04.0'E									
5416	4/6	0536 - 1824D	00°02.1'N 58°01.7'E	4631	4600	WB TSD	DRCM	CD	BCM	NN	NF70V	D.B. XIX

station no.	date	time (L.M.T.) and zone	position	depth (m)	wire out (m)	type of observation	comments
(5417)	4/6	2000 - 2306D	00°18.6'S 58°04.2'E			IKMT	
5418	4/6	0012 - 0306D	00°32.0'S 58°06.1'E	4645	1200	WB DRCM N50V Chlor. TSD	
5419	5/6	0606 - 1812D	01°00.0'S 58°02.8'E	4552	4400	WB DRCM CD BCM NN TSD	D.B. XX
(5420)	5/6	2000 - 2248D	01°25.0'S 58°06.9'E			IKMT	
5421	6/6	0006 - 0300D	01°35.9'S 58°09.5'E	4426	1200	WB DRCM N50V Chlor. TSD	
5422	6/6	0606 - 1824D	02°08.0'S 58°10.0'E	4389	4400	WB DRCM CD BCM NN NF70V IOSNV TSD	D.B. XXI
5423	6/6	2048 - 2300D	02°31.5'S 58°02.3'E	4371	1200	WB DRCM LH Chlor. TSD	
5424	7/6	0200 - 1200D	03°06.3'S 58°07.2'E	3072	2700	WB DRCM CD BCM NN TSD	D.B. XXII
5425	7/6	1524 - 1754D	03°41.6'S 57°59.5'E	4170	1200	WB DRCM N50V Chlor. TSD	
5426	7/6 - 8/6	2148 - 0112D	04°21.4'S 57°59.0'E	4047	4000	WB DRCM TSD	
5427	8/6	0518 - 0654D	05°03.0'S 57°57.0'E	3639	1200	WB DRCM N50V Chlor.	
		5. SEYCHELLES TO MAURITIUS					
(5428)	12/6	2036 - 2100D	03°12.7'S 56°24.0'E	4122		WB [surface]	near-surface sampling in Trichodesmium bloom
5429	13/6	0754 - 1300D	01°59.3'S 58°07.1'E	4390	1200	WB DRCM BCM NN NH N50V NF70V IOSNV Chlor. TSD TSD	start of short section across equator at 58° E
(5430)	13/6	1536 - 1642D	01°31.7'S 58°06.2'E			WB DRCM BCM NN LH N50V Chlor. TSD TSD	
5431	13/6	1924 - 2242D	01°01.4'S 58°11.1'E	4563	1200	WB DRCM BCM NN N50V NF70V IOSNV Chlor. TSD TSD	
(5432)	14/6	0142 - 0300D	00°32.2'S 58°03.3'E			WB DRCM BCM NN TSD	end of 58° E section
5433	14/6	0542 - 0918D	00°01.0'S 58°05.6'E	4499	1200	TSD	
(5434)	14/6	1236 - 1336D	00°29.7'N 57°59.3'E			WB DRCM BCM NN NF70V IOSNV TSD TSD	start of short section at 60° E
5435	14/6	1630 - 1918D	00°57.3'N 57°56.8'E	4735	1200	WB DRCM BCM NN LH TSD TSD	
(5436)	15/6	0106 - 0206D	00°58.0'N 58°56.0'E			WB DRCM BCM NN NF70V TSD	end of 60° E section
5437	15/6	0806 - 1200D	00°56.2'N 59°59.7'E	4552	1210		
(5438)	15/6	1442 - 1542D	00°29.2'N 60°00.8'E				
5439	15/6	1830 - 2148D	00°00.7'S 60°00.8'E	4583	1200		
(5440)	16/6	0036 - 1036D	00°31.0'S 60°02.0'E				
5441	16/6	0430 - 0848D	01°01.7'S 60°03.1'E	4634	1200		

station no.	date	time (L.M.T.) and zone	position	depth (m)	wire out (m)	type of observation						comments
5442	16/6	1636 - 1942D	00° 01.8'S 61° 02.0'E	4614	1200	WB TSD	DRCM	BCM	NN	LH	IOSNV	section along equator
5443	17/6	0118 - 0318D	00° 03.5'S 61° 59.5'E	4261	1200	WB	DRCM					
5444	17/6	0854 - 1218D	00° 06.7'S 62° 57.9'E	4265	1210	WB TSD	DRCM	BCM	NN	NF70V	IOSNV	
5445	17/6	1712 - 1848D	00° 03.0'S 63° 46.5'E	3784	1200	WB	DRCM	IOSNV				
5446	18/6	0024D - 0412D*	00° 05.0'S 64° 45.0'E	3957	1200	WB IOSNV	DRCM TSD	BCM	NN	LH	NF70V	
5447	18/6	1000 - 1148D*	00° 07.0'S 65° 47.0'E	3667	1200	WB	DRCM	N50V	IOSNV			
5448	18/6 19/6	2230 - 0218D*	00° 54.7'N 67° 17.9'E	2375	2300	WB	DRCM	BCM	LH	TSD		start of section southwards, nominally 67° 25'E; cast net
5449	19/6	0530 - 0718D*	00° 25.2'N 67° 16.5'E	2597	1200	WB	DRCM					
5450	19/6	1000 - 1342D*	00° 03.1'N 67° 25.1'E	3261	3200	WB IOSNV	DRCM Chlor.	BCM TSD	NN	N50V	NF70V	
5451	19/6	1712 - 1842D*	00° 28.2'S 67° 25.6'E	2752	1200	WB	DRCM					
5452	19/6 20/6	2212 - 0130D*	00° [illegible]'S 67° 25.3'E	2526	2500	WB TSD	DRCM	BCM	LH	N50V	Chlor.	
5453	20/6	0454 - 0624D*	01° 27.0'S 67° 24.5'E	3572	1200	WB	DRCM					
5454	20/6	1042 - 1448D*	01° 57.8'S 67° 22.8'E	2348	2450	WB IOSNV	DRCM Chlor.	BCM TSD	NN	N50V	NF70V	
5455	20/6	1842 - 2024D*	02° 35.0'S 67° 22.9'E	3012	1200	WB	DRCM	LH				
5456	21/6	0001 - 0412D*	03° 11.0'S 67° 22.5'E	3104	3200	WB TSD	DRCM	BCM	LH	N50V	Chlor.	
5457	21/6	0736 - 0942D*	03° 42.0'S 67° 24.1'E	2820	1200	WB	DRCM	TSD				
5458	21/6	1342 - 1754D*	04° 22.7'S 67° 24.6'E	3173	3200	WB TSD	DRCM	BCM	NN	NF70V	IOSNV	
5459	21/6 22/6	2200 - 0024D*	05° 02.9'S 67° 25.8'E	4322	1200	WB	DRCM	LH	N50V	Chlor.	TSD	
5460	22/6	0442 - 0854D*	05° 43.2'S 67° 26.1'E	3819	3600	WB	DRCM	BCM	TSD			
5461	22/6	1224 - 1500D*	06° 19.3'S 67° 25.3'E	4186	1200	WB	DRCM	NN	NF70V	IOSNV	TSD	
5462	22/6	1930 - 2312D*	07° 01.2'S 67° 20.5'E	3020	2900	WB TSD	DRCM	BCM	LH	N50V	Chlor.	
5463	23/6	0218 - 0442D*	07° 31.4'S 67° 22.9'E	2730	1200	WB	DRCM	TSD				
5464	23/6 24/6	0806 - 1342D*	08° 03.3'S 67° 19.0'E	2776	2750	WB	DRCM	CD	BCM	FNB	TSD	D.B. XXIII
5465	24/6	1648 - 1906D*	08° 32.0'S 67° 22.8'E	3328	1200	WB	DRCM	NN	NF70V	IOSNV	TSD	
(5466)	24/6	2000 - 2248D*	08° 43.8'S 67° 21.0'E			IKMT						
5467	25/6	0100 - 0618D*	09° 06.8'S 67° 17.7'E	6170	4400	WB	DRCM	BCM	N50V	Chlor.	TSD	

part 3 trial stations

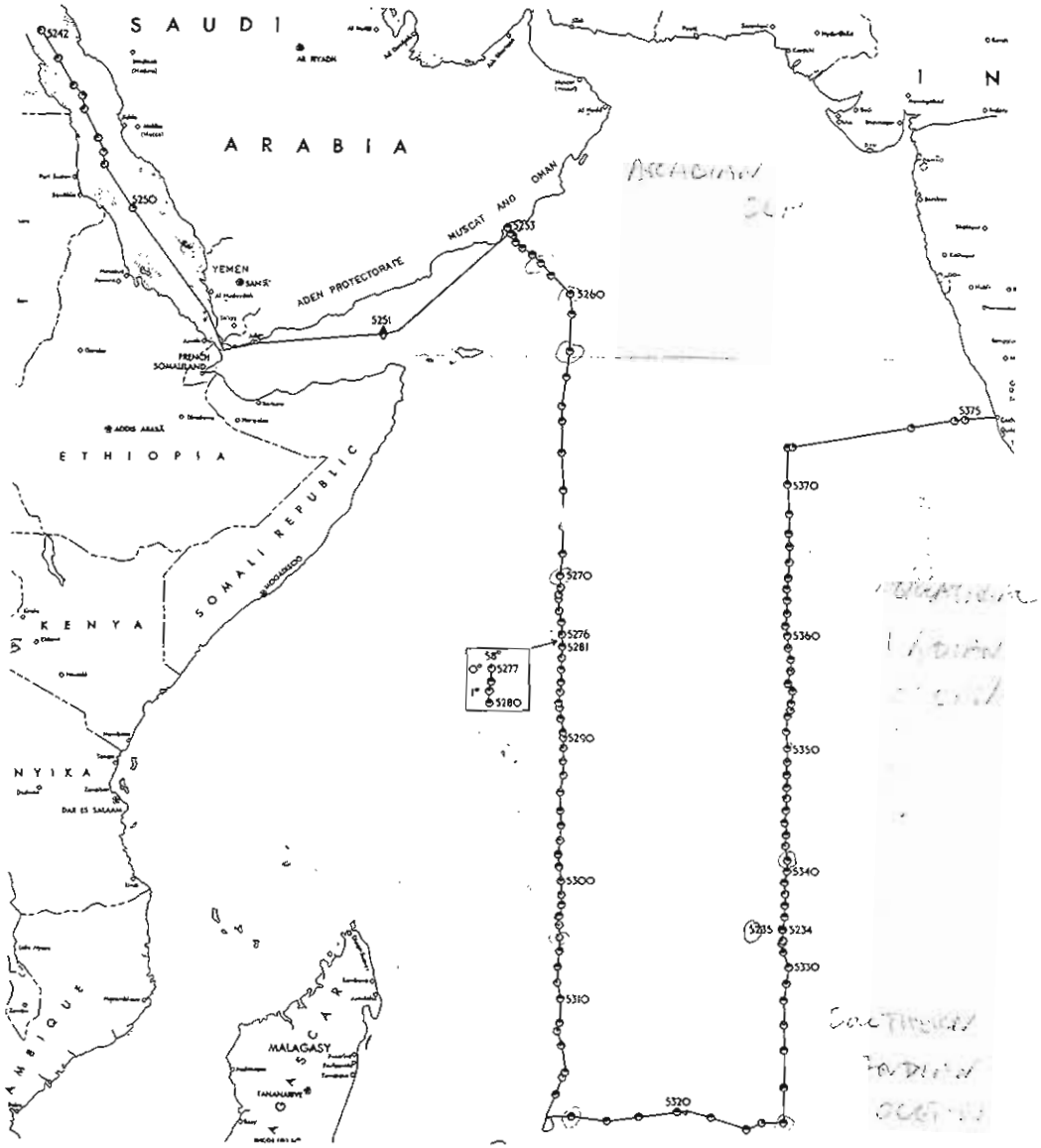
station no.	date	time (L.M.T.) and zone	position	depth (m)	wire out (m)	type of observation						comments
5468	25/6	0954 - 1212D*	09°36.0'S 67°14.3'E	4005	1200	WB	DRCM	TSD				
5469	25/6	1554 - 2154D*	10°02.3'S 67°24.4'E 10°05.0'S 67°22.0'E	3386	3200	WB	DRCM	BCM	IKMT	DGP	TSD	
5470	26/6	0048 - 0336D*	10°34.2'S 67°19.0'E	2626	1200	WB	DRCM	NN	NF70V	IOSNV	TSD	
5471	26/6 27/6	0648 - 1330D*	11°03.9'S 67°18.3'E	3696	2900	WB	DRCM	BCM	CD	FNB	TSD	D.B. XXIV
5472	27/6	1606 - 1800D*	11°30.6'S 67°23.0'E	3316	1200	WB	DRCM	TSD				
5473	27/6 28/6	2118 - 0048D*	12°03.4'S 67°21.6'E	3745	3600	WB	DRCM	BCM	N50V	Chlor.	TSD	
5474	28/6	0406 - 0624D*	12°36.8'S 67°18.4'E	2504	1200	WB	DRCM	NN	NF70V	IOSNV	TSD	
5475	28/6 29/6	1042 - 1148D*	13°03.7'S 67°24.2'E	2857	2900	WB	DRCM	CD	BCM	FNB	TSD	D.B. XXV
5476	29/6	1500 - 1654D*	13°40.0'S 67°23.8'E	3733	1200	WB	DRCM	TSD				
(5477)	29/6	2000 - 2248D*	14°11.7'S 67°22.0'E			IKMT	DGP	DNI				
5478	29/6 30/6	2330 - 0412D*	14°22.3'S 67°20.1'E	2842	2800	WB TSD	DRCM	BCM	NN	NF70V	IOSNV	
5479	30/6	0830 - 1030D*	15°02.4'S 67°25.3'E	2835	1200	WB	DRCM	N50V	Chlor.	TSD		terminated southward section; set course for Mauritius
6. MAURITIUS TO MOMBASA												
5480	9/7 10/7	1930 - 0206D	18°47.3'S 57°37.4'E	2697	2300	WB TSD	DRCM	BCM	LH	N50V	Chlor.	start of section northwards, nominally 57°40'E
5481	10/7	0654 - 1148D	18°06.8'S 58°03.8'E	3675	3600	WB TSD	DRCM	BCM	NN	NF70V	IOSNV	
5482	10/7	1830 - 2236D	17°06.1'S 58°19.0'E	2963	2900	WB	BCM	LH	N50V	Chlor.	TSD	DRCM being repaired
5483	11/7	0600 - 1136D	15°59.6'S 57°38.0'E	4140	4000	WB	BCM	NN	NF70V	IOSNV	TSD	
5484	11/7	1530 - 1736D	15°21.3'S 57°36.0'E	4182	1200	WB	DRCM	N50V	Chlor.			
5485	11/7 12/7	2112 - 0242D	14°47.1'S 57°37.0'E	4314	4000	WB IOSNV	DRCM TSD	BCM	LH	NN	NF70V	
5486	12/7	0642 - 0900D	14°06.3'S 57°39.2'E	4219	1200	WB	DRCM					
5487	12/7	1424 - 1736D 1736 - 2230D	13°14.9'S 57°41.0'E 13°08.8'S 57°42.5'E	4318	4000	WB DGP	DRCM Chlor.	DCM TSD	N50V	IKMT	CDB	TSD and BCM lost on the station
5488	13/7	0124 - 0442D	12°41.8'S 57°39.7'E	4252	1200	WB	DRCM	NN	IOSNV			
5489	13/7	0900 - 1312D	12°02.1'S 57°40.5'E	4301	4000	WB	DRCM					
5490	13/7	1924 - 2206D	11°21.8'S 57°41.4'E	4215	1200	WB	DRCM	N50V	Chlor.			
5491	14/7	0230 - 0654D	10°44.0'S 57°41.4'E	4142	4000	WB	DRCM	NN	NF70V	IOSNV		
5492	14/7	1118 - 1300D	10°08.1'S 57°42.1'E	4036	1200	WB	DRCM					

station no.	date	time (L.M.T.) and zone	position	depth (m)	wire out (m)	type of observation						comments
5493	14/7	1730 -	09° 22.0'S 57° 47.9'E	3615	3600	WB	DRCM	N50V	IKMT	CDB	DGP	
	15/7	0112D	09° 15.9'S 57° 48.2'E			Chlor.	GEK					
5494	15/7	0500 - 0742D	08° 36.2'S 57° 56.2'E	3292	1200	WB	DRCM	NN	NF70V	IOSNV		
5495	15/7	1154 - 1542D	07° 59.2'S 58° 01.7'E	2990	2900	WB	DRCM	GEK				
5496	15/7	1936 - 2130D	07° 21.9'S 57° 58.0'E	2743	1200	WB	DRCM	N50V	Chlor.			
5497	16/7	0118 - 0418D	06° 40.8'S 57° 56.0'E	1423	1400	WB	DRCM	NN	LH	NF70V	IOSNV	end of northward section
						GEK						
5498	16/7	1700 -	06° 49.7'S 55° 42.3'E	3580	3600	WB	DRCM	IKMT	DGP	DNI	GEK	start of section south-west towards Madagascar
	17/7	0136D	06° 50.9'S 55° 34.9'E									
5499	17/7	0636 - 1018C*	07° 28.8'S 54° 48.8'E	3575	1200	WB	DRCM	N50V	Chlor.	GEK		
5500	17/7	1548 - 2030C*	08° 02.9'S 54° 02.0'E	4043	4000	WB	DRCM	NN	NF70V	IOSNV	GEK	
5501	18/7	0200 - 0430C*	08° 36.5'S 53° 12.3'E	2030	1200	WB	DRCM	N50V	Chlor.	GEK		
5502	18/7	1112 - 1706C*	09° 10.6'S 52° 20.3'E	3864	3600	WB	DRCM	NN	NF70V	IOSNV	GEK	
5503	18/7	2312 -	09° 46.1 S 51° 36.0'E	3729	1200	WB	DRCM	N50V	Chlor.	GEK		
	19/7	0424C*										
5504	19/7	1312 - 1600C*	10° 30.0'S 50° 49.3'E	3175	1200	WB	DRCM	GEK				
5505	19/7	1830 - 2148C*	10° 43.6'S 50° 23.8'E	1588	1600	WB	DRCM	NN	LH	NF70V	IOSNV	
						GEK						
5506	20/7	0042 - 0348C*	11° 04.7'S 50° 06.8'E	2855	1200	WB	DRCM	GEK				
5507	20/7	0648 -	11° 19.0'S 49° 41.7'E	3088	2900	WB	DRCM	FNB	GEK			D.B. XXVI
	21/7	1036C*										
5508	21/7	1500 - 1730C*	11° 49.2'S 49° 23.0'E	830	800	WB	DRCM	NN	NF70V	IOSNV		off Cape Amber, Madagascar; GEK being repaired
(5509)	21/7	1930 - 2248C*	11° 26.8'S 48° 58.2'E			IKMT	CDB	DGP	DNI			
5510	22/7	0600 - 1224C*	10° 31.0'S 47° 46.9'E	4155	4000	WB	DRCM					
5511	23/7	0600 - 1054C	08° 23.2'S 45° 29.2'E	4222	4000	WB	DRCM	GEK				
(5512)	23/7	1900 - 2224C	07° 09.0'S 44° 43.3'E			IKMT	CDB	DGP	DNI			
5513	24/7	0530 - 1006C	06° 17.0'S 43° 59.0'E	4215	4000	WB	DRCM	IKMT	CDB	DGP	DNI	
		1006 - 1500C	06° 09.6'S 43° 57.8'E			GEK						
5514	24/7	2306 -	05° 38.0'S 42° 48.9'E	3799	1200	WB	DRCM	NN	N50V	NF70V	IOSNV	section in towards Mombasa
	25/7	0306C				Chlor.	GEK					
5515	25/7	0736 - 1136C	05° 16.0'S 42° 04.7'E	3369	3200	WB	DRCM	NN	NF70V	IOSNV	GEK	
5516	25/7	1524 - 1830C	04° 57.2'S 41° 27.5'E	2750	1200	WB	DRCM	NN	N50V	NF70V	IOSNV	
						Chlor.	GEK					
(5517)	25/7	1900 - 2236C	04° 49.5'S 41° 16.0'E			IKMT	DGP	DNI				
5518	25/7	2336 -	04° 39.6'S 41° 01.2'E	1759	1900	WB	DRCM	NN	NF70V	IOSNV	GEK	
	26/7	0412C										

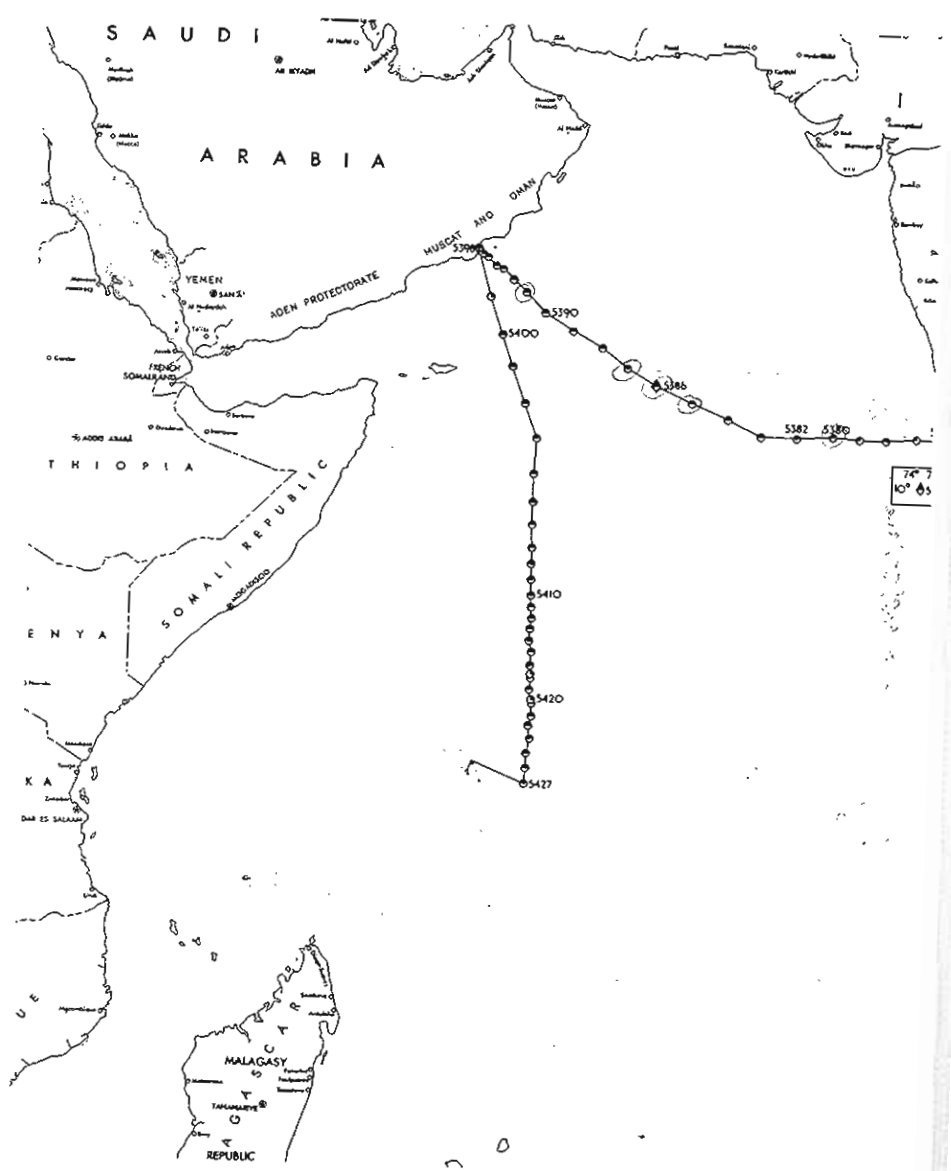
station no.	date	time (L.M.T.) and zone	position	depth (m)	wire out (m)	type of observation						comments
5519	26/7 27/7	0700 - 1612C	04° 23.2'S 40° 35.5'E	1451	1400	WB IOSNV	DRCM IKMT	FNB Chlor.	NN GEK	N50V	NF70V	D.B. XXVII
5520	27/7	1800 - 2030C	04° 20.4'S 40° 19.7'E	1017	1000	WB Chlor.	DRCM GEK	NN	N50V	NF70V	IOSNV	
5521	27/7 28/7	2320 - 0240C	04° 09.9'S 40° 03.7'E	763	800	WB Chlor.	DRCM GEK	NN	N50V	NF70V	IOSNV	NF70V and catch lost
5522	28/7	0430 - 0606C	04° 03.8'S 39° 54.9'E	480	450	WB	DRCM					end of section (off Mombasa)
7. MOMBASA TO ADEN												
5523	4/8	0625 - 0906C	00° 59.6'N 44° 00.0'E 01° 03.2'N 44° 05.2'E	209	225	WB Chlor.	DRCM	NN	N50V	NF70V	IOSNV	start of section at 1° N across Somali current
5524	4/8	1114 - 1540C	00° 52.1'N 44° 07.0'E 00° 57.8'N 44° 14.8'E	946	950	WB	DRCM	NN	N50V	NF70V	Chlor.	NF70V lost on this station
5525	4/8	1814 - 2324C	00° 47.0'N 44° 13.1'E 00° 54.7'N 44° 19.8'E	1441	1410	WB NF70V	DRCM IOSNV	BCM Chlor.	NN	LH	N50V	
5526	5/8	0318 - 0730C	00° 31.0'N 44° 23.0'E	2184	2300	WB	DRCM	NN	N50V	NF70V	Chlor.	
5527	5/8	1048 - 1402C	00° 11.2'N 44° 30.8'E	3072	2900	WB Chlor.	DRCM	NN	N50V	NF70V	IOSNV	end of section
5528	6/8	1024 - 1254C	02° 57.0'N 46° 42.0'E 02° 59.2'N 46° 47.0'E	68	55	WB Chlor.	DRCM	NN	N50V	NF70V	IOSNV	start of section at 3° N
5529	6/8	1336 - 2040C	02° 58.0'N 46° 52.0'E 03° 12.1'N 47° 10.8'E	1390- 1030	900	WB Chlor.	DRCM	BCM	NN	N50V	NF70V	
5530	7/8	0130 - 0518C	02° 58.4'N 47° 06.0'E 03° 07.2'N 47° 16.0'E	1480	1200	WB Chlor.	DRCM	NN	N50V	NF70V	IOSNV	
5531	7/8	0830 - 1348C	02° 54.7'N 47° 29.8'E 03° 02.3'N 47° 38.1'E	2964	1200	WB	DRCM	NN	N50V	NF70V	Chlor.	
5532	7/8	1530 - 2128C	02° 48.8'N 47° 45.7'E 02° 54.1'N 47° 49.3'E	3005	2900	WB IOSNV	DRCM Chlor.	BCM	NN	N50V	NF70V	end of section
5533	8/8	0642 - 0936C	04° 26.3'N 48° 02.3'E 04° 28.5'N 48° 07.0'E	84	80	WB Chlor.	DRCM	NN	N50V	NF70V	IOSNV	start of section at 4½° N
5534	8/8	1030 - 1600C	04° 28.8'N 48° 15.0'E 04° 45.4'N 48° 26.0'E	243	290	WB	DRCM	NN	N50V	NF70V	Chlor.	
5535	9/8	0100 - 0806C	04° 28.4'N 48° 42.9'E 04° 44.9'N 48° 54.1'E	1437	1450	WB IOSNV	DRCM Chlor.	BCM	NN	N50V	NF70V	
5536	9/8	1200 - 1905C	04° 25.1'N 49° ~~14.3'E~~ 09.4'E 04° 34.0'N 49° ~~10.7'E~~ 17.4'E	2524	2600	WB Chlor.	DRCM	BCM	NN	N50V	NF70V	
5537	10/8	0130 - 0730C	04° 00.0'N 49° 39.0'E 04° 12.3'N 49° 41.5'E	3325	1200	WB Chlor.	DRCM	NN	N50V	NF70V	IOSNV	
5538	10/8 11/8	1318 - 1320C	03° 57.6'N 50° 24.2'E	4305	4400	WB N50V	DRCM NF70V	CD Chlor.	BCM	FNB	NN	D.B. XXVIII
5539	11/8	1800 - 2230C	03° 57.6'N 51° 03.0'E	4898	1200	WB Chlor.	DRCM	NN	N50V	NF70V	IOSNV	
5540	12/8	0424 - 1018C	03° 49.0'N 51° 50.9'E	5108	4800	WB Chlor.	DRCM	BCM	NN	N50V	NF70V	
5541	12/8	1342 - 1754C	03° 46.0'N 52° 22.1'E	4433	1200	WB IOSNV	DRCM Chlor.	BCM	NN	N50V	NF70V	
5542	12/8 13/8	2300 - 0400C	03° 37.9'N 52° 56.3'E	5128	5200	WB	DRCM	NN	N50V	NF70V	Chlor.	BCM lost on this station; end of section
5543	13/8	0900 - 1150C	04° 12.9'N 52° 35.2'E	4973	1200	WB Chlor.	DRCM	NN	N50V	NF70V	IOSNV	start of section north-west towards 8½° N

station no.	date	time (L.M.T.) and zone	position	depth (m)	wire out (m)	type of observation						comments
5544	13/8 14/8	1518 - 0800C	04°15.4'N 52°39.4'E	5084	4800	WB	DRCM	FNB				D.B. XXIX
5545	14/8	1500 - 1748C	04°59.0'N 52°02.0'E	5104	1200	WB	DRCM	NN	N50V	NF70V	Chlor.	
5546	14/8 15/8	2318 - 0448C	05°40.0'N 51°41.5'E	5088	4800	WB Chlor.	DRCM	NN	N50V	NF70V	IOSNV	
5547	15/8	0900 - 1206C	06°15.6'N 51°23.0'E	4997	1200	WB	DRCM	NN	N50V	NF70V	Chlor.	
5548	15/8 16/8	1612 - 1036C	06°34.8'N 51°00.4'E	4980	5000	WB IOSNV	DRCM Chlor.	FNB	NN	N50V	NF70V	D.B. XXX (broke adrift, recovered)
5549	16/8	1648 - 2124C	07°00.8'N 50°33.2'E 07°15.0'N 50°45.1'E	3849	1250	WB	DRCM	NN	N50V	NF70V	Chlor.	
5550	17/8	0100 - 0900C	07°33.0'N 50°27.0'E 07°48.9'N 50°46.1'E	3007	3600	WB Chlor.	DRCM	NN	N50V	NF70V	IOSNV	
5551	17/8	1306 - 1824C	08°12.0'N 50°32.9'E 08°26.0'N 50°43.0'E	1569	2200	WB	DRCM	NN	N50V	NF70V	Chlor.	
5552	17/8 18/8	2130 - 0112C	08°36.0'N 50°34.0'E	1176	1250	WB Chlor.	DRCM	NN	N50V	NF70V	IOSNV	a few dead fish on surface
5553	18/8	0230 - 0400C	08°42.7'N 50°27.8'E	50	45	WB	DRCM	NN	N50V	NF70V	Chlor.	end of section; dead fish on surface
5554	18/8	2248 - 2400C	10°41.0'N 51°18.6'E	57	50	WB	DRCM	NN	N50V	NF70V	Chlor.	start of section from Ras Hafun towards Socotra
5555	19/8	0054 - 0230C	10°45.9'N 51°28.3'E	172	180	WB Chlor.	DRCM	NN	N50V	NF70V	IOSNV	
5556	19/8	0412 - 0700C	10°54.9'N 51°48.0'E	1618	2000	WB	DRCM	NN	N50V	NF70V	Chlor.	
5557	19/8	0848 - 1230C	11°08.8'N 52°07.5'E	2370	2300	WB Chlor.	DRCM	NN	N50V	NF70V	IOSNV	drifted through a front between blue and green water on station; repeated shallow observations
5558	19/8	1354 - 1706C	11°21.0'N 52°23.0'E	2357	2300	WB	DRCM	NN	N50V	NF70V	Chlor.	dead fish along line of demarcation
5559	19/8	1912 - 2206C	11°25.8'N 52°42.0'E	772	800	WB Chlor.	DRCM	NN	N50V	NF70V	IOSNV	
5560	19/8 20/8	2306 - 0100C	11°30.0'N 52°53.0'E	460	420	WB	DRCM	NN	N50V	NF70V	Chlor.	
5561	20/8	0206 - 0348C	11°38.1'N 52°57.4'E	291	160	WB Chlor.	DRCM	NN	N50V	NF70V	IOSNV	end of section
5562	20/8	1330 - 1712C	11°39.9'N 52°03.1'E	903	870	WB	DRCM	NN	N50V	NF70V	Chlor.	start section towards Cape Guardafui
5563	20/8	1912 - 2130C	11°36.1'N 51°52.6'E	717	700	WB Chlor.	DRCM	NN	N50V	NF70V	IOSNV	
5564	20/8 21/8	2236 - 0024C	11°35.5'N 51°43.3'E	304	300	WB	DRCM	N50V	NF70V	Chlor.		
5565	21/8	0142 - 0312C	11°37.1'N 51°34.0'E	88	75	WB Chlor.	DRCM	NN	N50V	NF70V	IOSNV	end of section
8. ADEN TO ADEN												
5566	27/8 28/8	2248 - 0124C	13°07.8'N 50°21.2'E	2489	2300	WB Chlor.	DRCM	NN	N50V	NF70V	IOSNV	SCOR/UNESCO Reference Station no. 12
5567	29/8	0630 - 1012C	10°13.2'N 51°50.0'E	1075	1100	WB	DRCM	N50V	NF70V	Chlor.		dead fish on surface

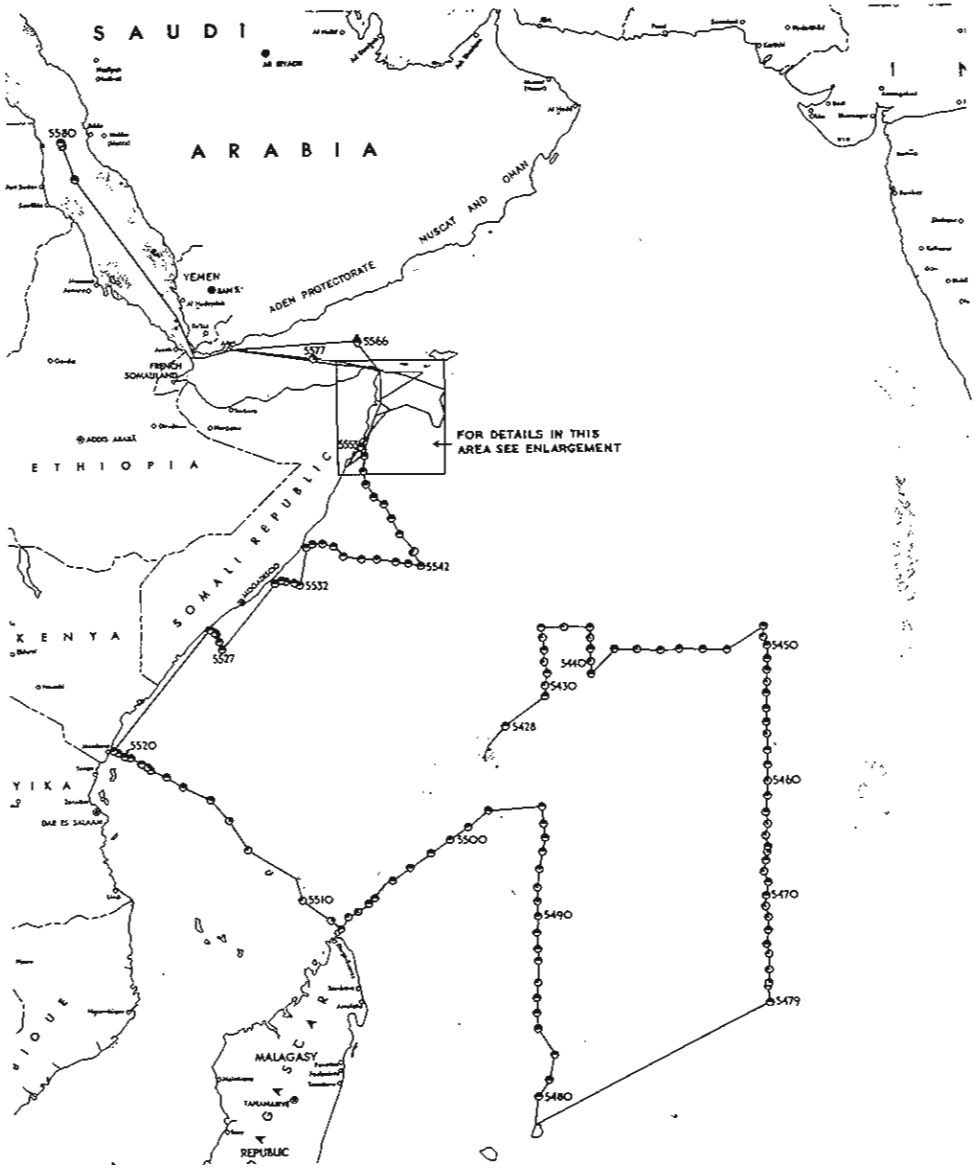
station no.	date	time (L.M.T.) and zone	position	depth (m)	wire out (m)	type of observation					comments
5568	29/8 30/8	2148 - 0048C	09°38.8'N 51°13.1'E	247	240	WB	DRCM	NN	N50V	NF70V	Chlor.
5569	30/8	1024 - 1212C	08°55.0'N 50°36.1'E	88	70	WB	DRCM	NN	N50V	NF70V	Chlor.
5570	31/8	0148 - 0254C	07°51.2'N 49°55.7'E	31	25	WB	DRCM	NN	N50V	NF70V	Chlor.
5571	31/8 1/9	0636 - 0600C	08°16.6'N 50°33.1'E 08°25.8'N 50°37.1'E	1531	2000	WB	FNB				deep current measurements under strong surface current
5572	1/9	0600 - 1306C	08°18.0'N 50°37.7'E 08°24.0'N 50°41.7'E	2377	2500	WB	DRCM				
5573	2/9 3/9	2330 - 0300C	10°31.2'N 52°22.2'E	3652	3600	WB	DRCM	NN	N50V	NF70V	IOSNV
5574	3/9	1242 - 1924C	09°36.0'N 53°15.8'E 09°30.3'N 53°49.7'E			Chlor.					
5575	4/9	0324 - 1100C	10°57.0'N 53°15.1'E 11°13.0'N 53°20.2'E	3720	3600	DRCM	CD				in strong eastward-flowing current
5576	4/9	1830 - 2036C	11°38.0'N 52°24.0'E	1306	1300	WB	DRCM	NN	N50V	NF70V	Chlor.
5577	5/9	2000 - 2400C	12°27.0'N 48°40.0'E 12°20.1'N 48°26.0'E			WB	DRCM	N50V	NF70V	Chlor.	
9. ADEN TO PLYMOUTH						IKMT					
5578	10/9	1312 - 1600C	19°51.0'N 38°36.2'E	2092	1500	WB	N50V	NF70V	Chlor.		IOSN towed horizontally
5579	11/9	0130 - 0412C	21°09.5'N 38°05.0'E	2339	2370	WB	N50V	NF70V	Chlor.		
5580	11/9	0512 - 1634C	21°17.2'N 38°01.5'E	2211	2225	WB	N50V	NF70V	Chlor.		D.B. XXXI; hot, salty water near bottom
5581	21/9	1318 - 1500A	37°38.8'N 05°59.1'E	2804	2700	WB					chemical observations for comparison with 'Meteor'
5582	22/9	1800 - 1942A	36°56.7'N 00°06.7'E	2701	2600	WB					
5583	26/9 27/9	2200 - 0154A	46°27.9'N 08°02.0'W	4696	4700	WB					repeat of station 5239



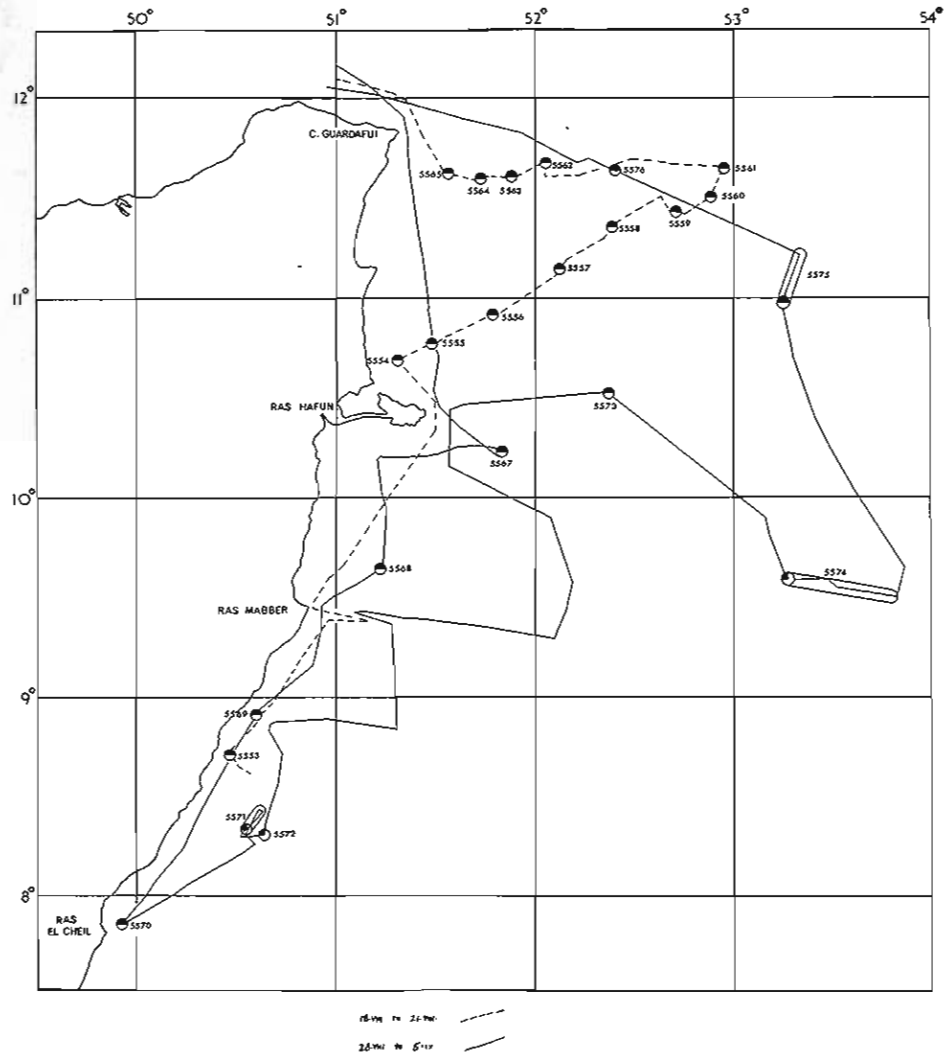
Red Sea to Cochin: 29 February to 7 May 1964



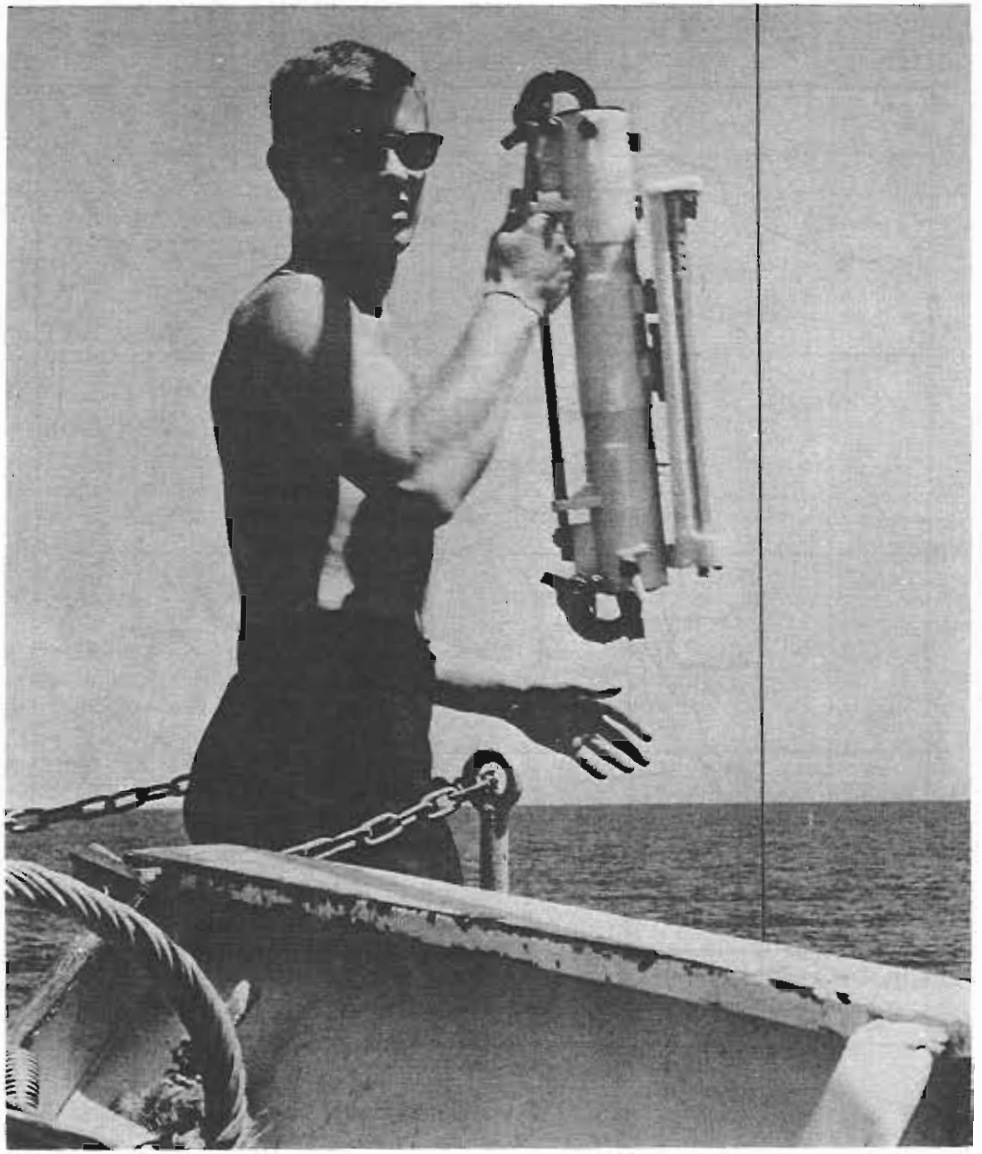
Cochin to Seychelles: 12 May to 8 June 1964



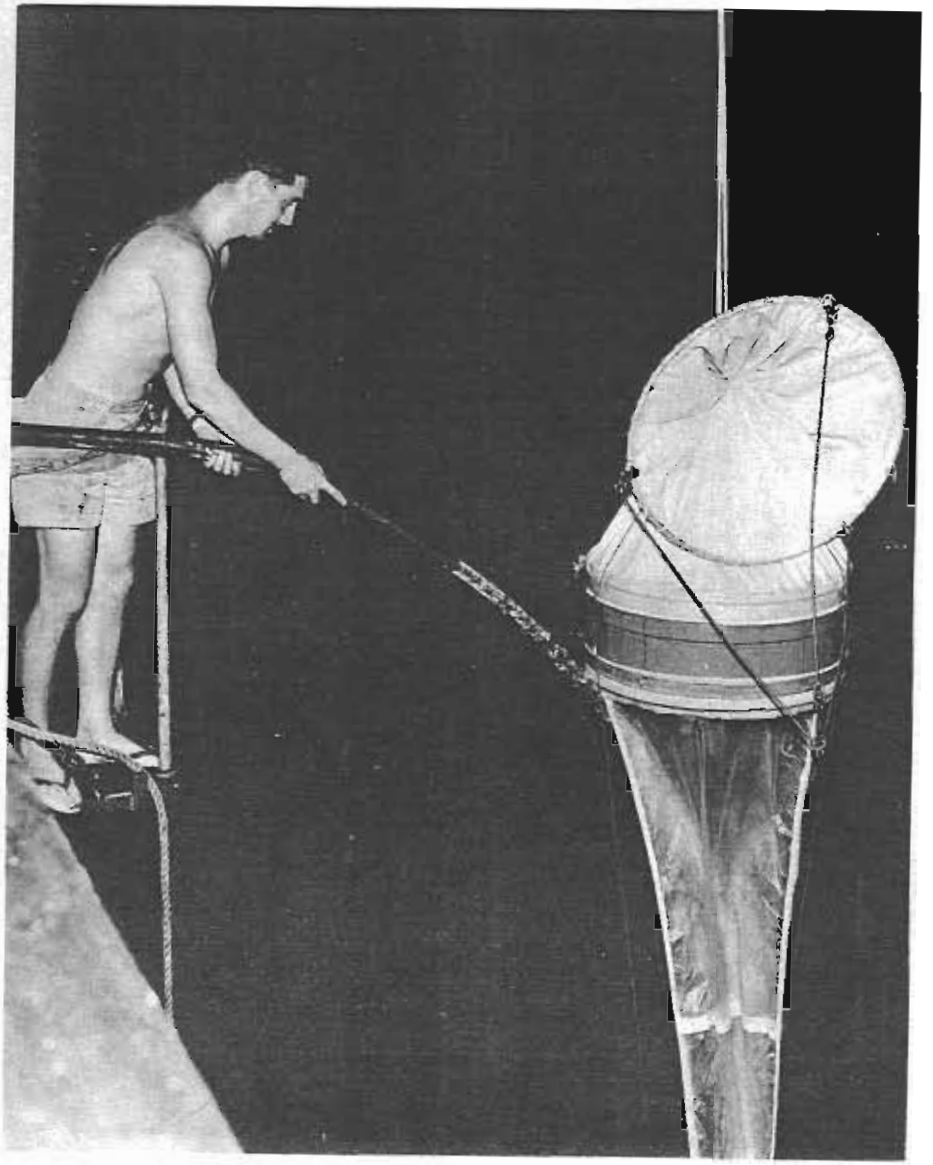
Seychelles to Red Sea: 12 June to 11 September 1964



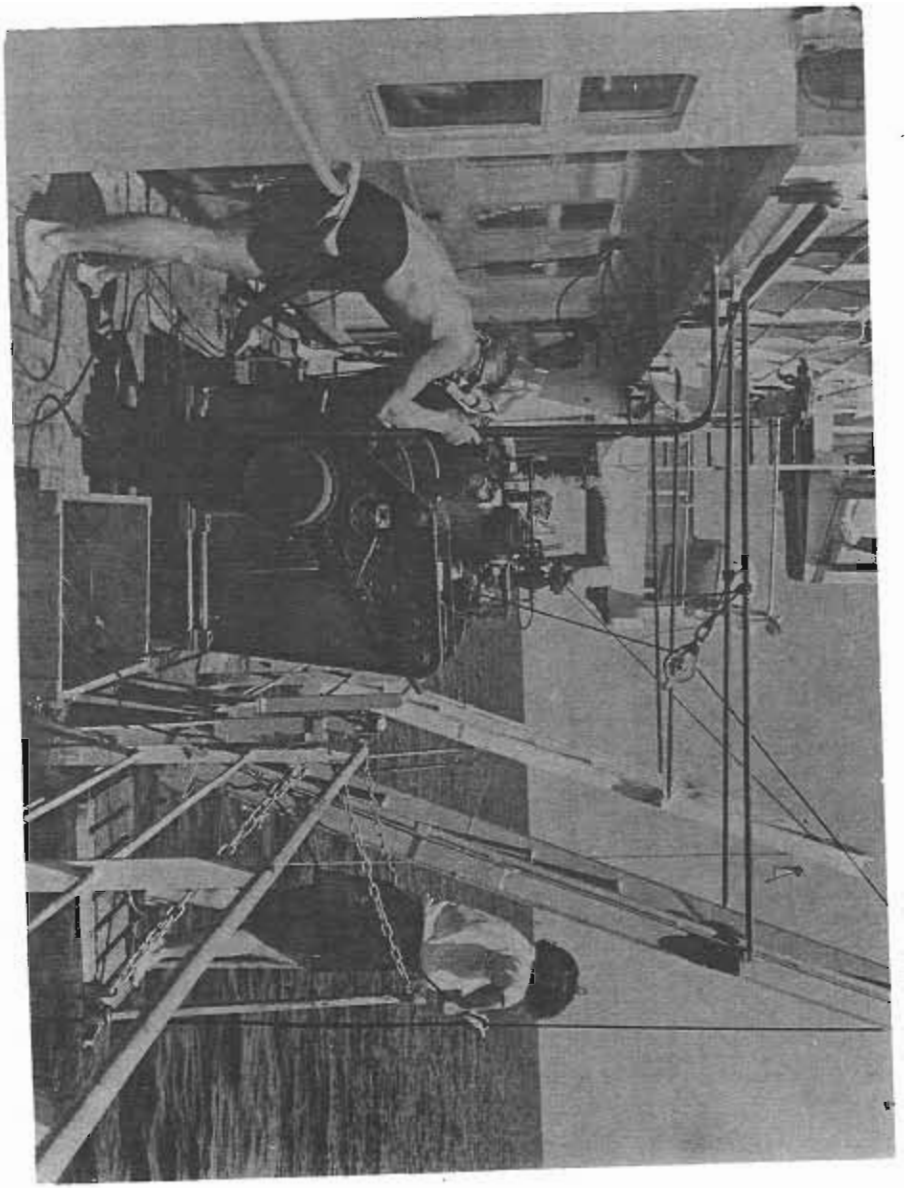
Cape Guardafui area: 18 August to 4 September 1964



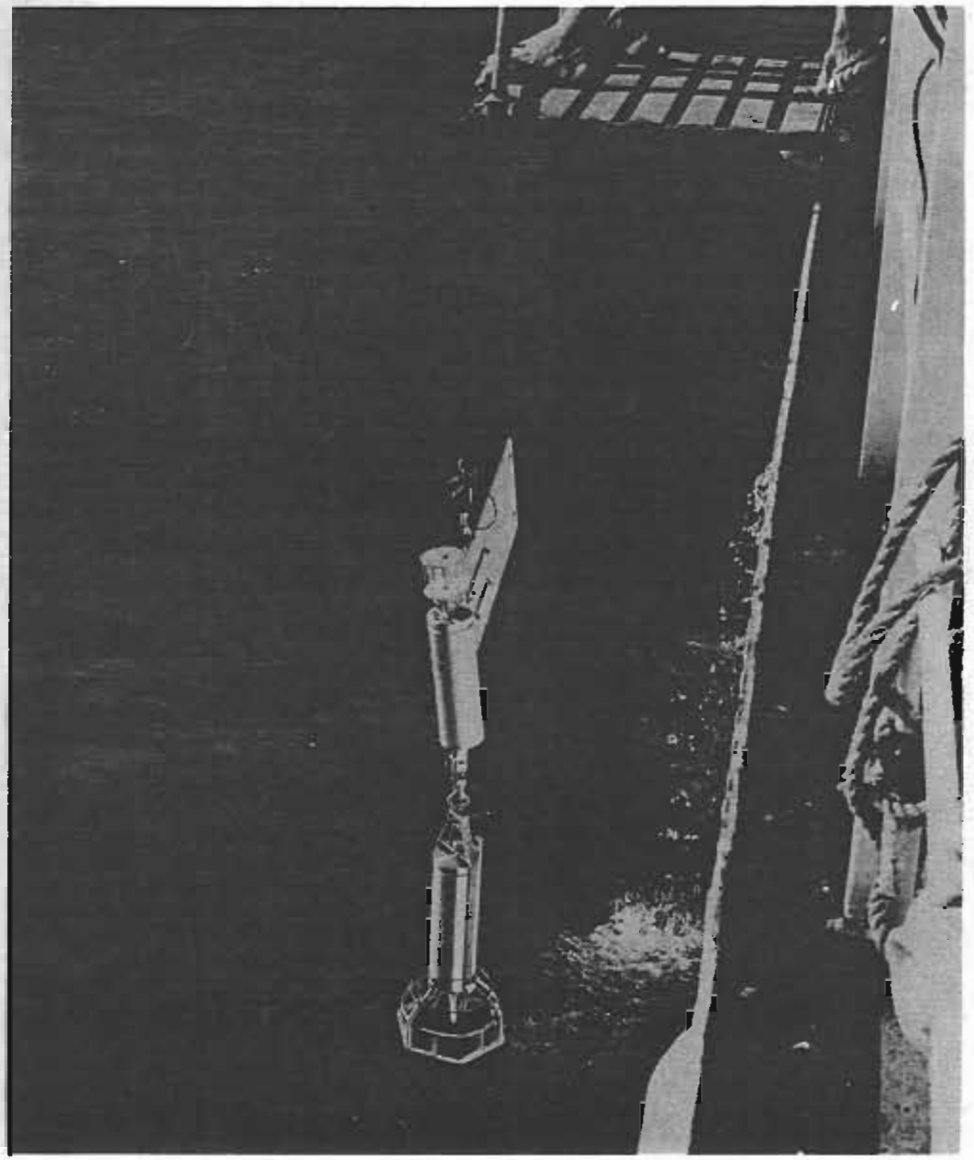
Removing closed water sampling bottle from the wire



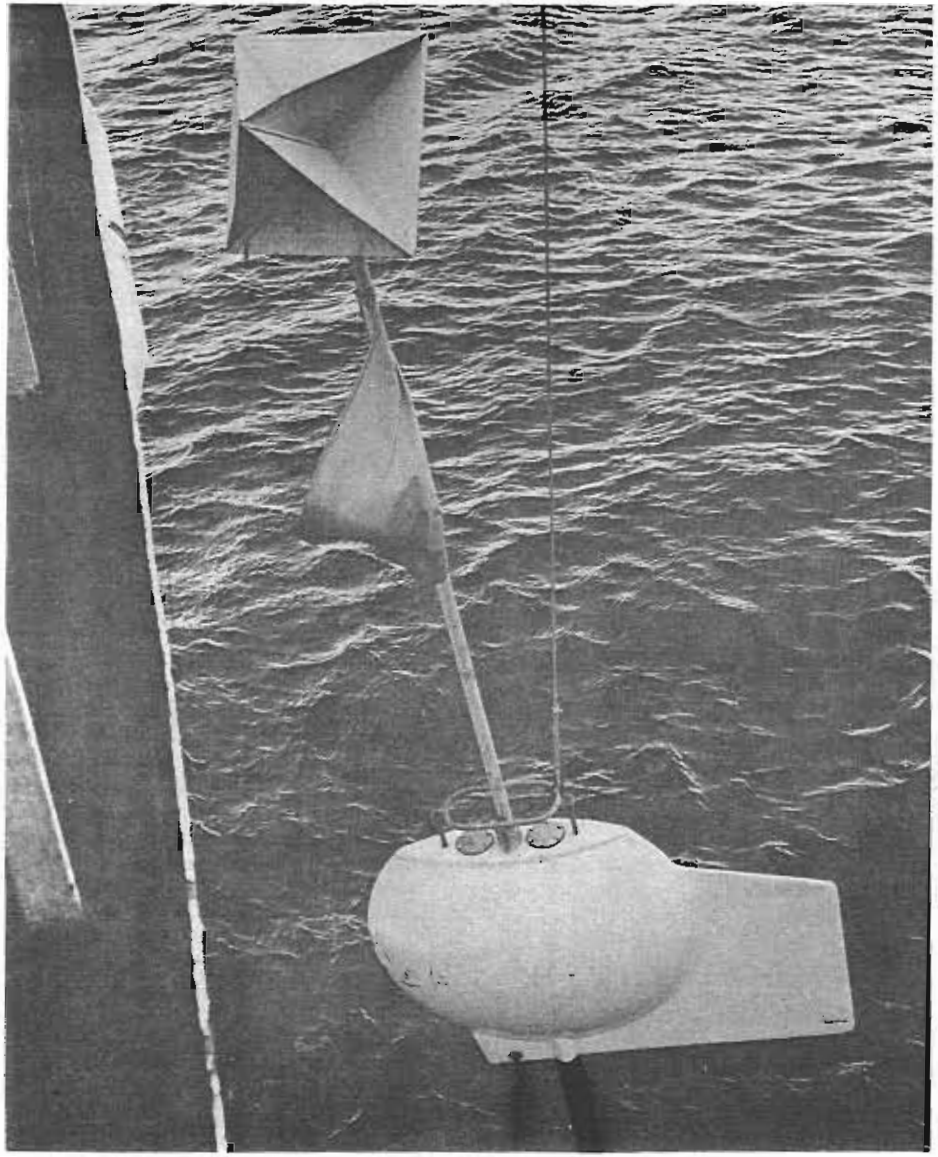
Washing down a closed plankton-sampling net



Lowering electric cable with wire carrying current meters



The Bergen current meter (above) and the Australian salinity-temperature-depth recorder being lowered together



Lowering a streamlined dan-buoy