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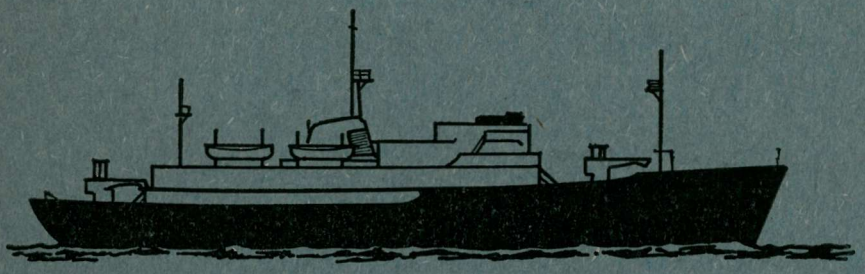

R.R.S. DISCOVERY

CRUISE 15 REPORT

OCTOBER - NOVEMBER 1966

BIOLOGY OF SLOPE AREAS

N. I. O. CRUISE REPORT SERIES: CR. 15

NATIONAL INSTITUTE OF OCEANOGRAPHY

Wormley, Godalming, Surrey.

"DISCOVERY" CRUISE 15 REPORT

(7th October - 28th November, 1966)

BIOLOGY OF SLOPE AREAS

N.I.O. CRUISE REPORT SERIES: CR 15

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SCIENTIFIC PERSONNEL

Mr. M.V. Angel	N.I.O.	
Mr. J. Badcock	N.I.O.	
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Mr. R. Bowers	N.I.O.	
Dr. M.R. Clarke	N.I.O.	(Scientist in Charge)
Dr. F. Culkin	N.I.O.	Joined in Madeira
Mr. R. Dobson	N.I.O.	
Dr. J. Green	N.I.O.	
Mr. C.M.H. Harrisson	N.I.O.	
Mr. P. Herring	N.I.O.	
Mr. P. Laval	Villefranche	
Dr. A. Locket	Institute of Ophthalmology, London.	
Mr. N. MacLeod	N.I.O.	
Mr. J. Mazza	Marseilles	Joined in Madeira
Dr. G. Maul	Funchal Museum	Joined and left in Madeira
Mr. N. Moss	N.I.O.	
Dr. N. Runham	Bangor	
Mr. A. Thompson	Bristol University	Left in Casablanca
Mr. R. Wild	N.I.O.	

ABBREVIATIONS

EMT	Engel's Midwater Trawl
IKMT	Isaacs-Kidd Midwater Trawl
N113	Net with mouth = 1 sq. m.
N70	Plankton net used obliquely (N70B) or vertically (N70V)
N50	Phytoplankton net with mouth = 50 cm. in diameter
NN	Neuston net
FRN	Free rise net with mouth = 30 ft. diameter
W/B	Water bottles (used for hydrographic sampling)
Bacteriological W/B	Niskin or Zobell samplers
Chlorophyll W/B	7.5 litre water bottles
BT	Bathythermograph
CDB(E)	Electrical catch dividing bucket
PES	Precision echo sounder
U/C	Underwater camera

PRINCIPAL OBJECTS

1. The collection and study of animals occurring above the slopes of the Azores, Madeira, Fuerteventura and Morocco. Catch volumes and preliminary sorting to be done on board.

2. A study of the variation between replicate hauls of the N113H and N70V at selected depths to aid in the evaluation of results obtained on the SOND cruise of 1965, to compare previous similar work done at 30°N 23°W and to facilitate the planning of future sampling.

3. Sampling at the principal area studied during the SOND cruise to find any marked differences in faunal composition between the years.

4. Experiments in the operation of the EMT and the free rise net (F.R.N.)

ITINERARY

R.R.S. "Discovery" sailed from Plymouth at 0900 hrs 7.x.66. The asdic was lowered while in the Sound and the P.E.S. was lowered just outside the bar. The ship proceeded to 50°N 04°55'W where an echo sounding run was started which continued over the slope edge to 48°N 09°W. The ship then proceeded to 40°N 20°W. En route, the P.E.S. was taken in because the transducer had leaked and was later replaced by another transducer. At 0800 hrs 11.x.66 the ship reached 40°N 20°W. The main warp and both the trawl warps were retensioned. Work at the station (6100) included Chlorophyll W/B's, N50V, bacteriological sampling (Niskin and Zobell), calibration of the CDB(E), DGP and the Depth pinger; all power on board was gradually turned off while underwater recordings of the ship's noise were made. Worsening weather prevented the use of the Engel's Midwater Trawl (EMT) and the ship proceeded towards the Azores at 2203 hrs 11.x.66. At 0912 hrs 12.x.66 weather conditions were good enough for trawling and experiments with the EMT were commenced at 1145 hrs. It proved possible to take in the cod end and empty it without pulling in the whole trawl and three successive hauls were made. Chlorophyll W/B samples were taken and the ship left the position (39°02.8'N 21°28.6'W) at 0742 hrs 13.x.66 having completed three stations (6101-6103).

At 0045 hrs 14.x.66 a sheltered position South of Sao Miguel in the Azores was reached. Five days were spent in this area and the work included eight EMT's, one IKMT, one N113, one N70B, a day and a night series of NF70V's to 1000 m, sixteen replicate hauls of NF70V's to 100 m, a repetitive series of NN's consisting of twelve tows, two carbon ^{14} W/B casts, two chlorophyll W/B casts, four bacteriological W/B casts, a W/B cast to 1000 m and three U/C casts. All together nineteen stations (6104-6122) were completed and the ship steamed towards Madeira at 0918 hrs 19.x.66. The oceanic station, half way between the Azores and Madeira, at 35°10'N 21°20'W, was reached at 1025 hrs 20.x.66. A chlorophyll W/B cast, a bacteriological W/B cast, a U/C cast and trials with a plastic NN were completed but worsening weather and sea conditions prevented further work at the station (6123); the ship left the position at 1922 hrs 20.x.66 and proceeded to sheltered water North of Madeira.

North of Madeira, just sufficient sheltered water existed to do EMT hauls parallel with the coast and eight days were spent in the area during which bad weather prevented work for only twentyone hours. During the eight days, ten stations (6124-6133) were completed and work included seven EMT's, one IKMT, one N113, one N70B, one chlorophyll W/B cast, two N50V, a 600 mesh net haul, two bacteriological W/B casts and calibrations of the Depth pinger, CDB(E), DGP and hydrostatic release gears. At 0730 hrs 25.x.66 the ship moved to the South of Madeira and called briefly at Funchal to pick up Dr. Maul.

The bad weather having abated, work was then continued to the South of Madeira. Five days were spent in this region during which fourteen stations were completed (6134-6147) and the work included three EMT's, two IKMT's, one series of N113, one haul with three N113's on one warp, two carbon^{14} casts, one chlorophyll W/B cast, a 600 mesh net cast, two bacteriological W/B casts, one W/B cast, four U/C casts, an FRN trial and calibrations of flowmeters and hydrostatic release gears were completed. At 0500 hrs 30.x.66 the asdic plate was taken up and the P.E.S. was taken inboard; the ship then entered Funchal harbour. At Funchal Dr. Maul left the ship while J. Mazza of Marseilles and F. Culkin of N.I.O. joined the ship.

"Discovery" departed from Funchal 1800 hrs 1.xi.66 and sailed direct to the southern end of Fuerteventura in the Canary island group. The ship arrived in a small bay to the South-east of the island at 0550 hrs 3.xi.66 and most of the work was carried out within a circle of five miles diameter. This bay was the centre of operations during the 1965 SOND cruise but, although hydrological conditions were similar on the present cruise, considerable differences in the fauna were noted. During a nine day period in the area 32 stations (6148-6179) were completed and the work included nine EMT's, three IKMT's, twentyeight N113's, three hauls with three N113's on one warp, a series of N113's to study the vertical distribution of carotenoids, a day and a night series of N70V's, a replicate series of sixteen NF70V's to 100 m, one N70B, two carbon^{14} casts, three chlorophyll W/B casts, five bacteriological W/B casts, three W/B casts, two U/C casts, recordings of ship's noise was made while all engines were progressively turned off and calibrations of the depth pinger were completed. At 0600 hrs 12.xi.66 the ship left the Fuerteventura area for Casablanca. While on course to Casablanca a fairly distinct surface discontinuity was encountered and about an hour was taken to investigate it (St. 6180) before resuming course for Casablanca which was reached at 0900 hrs 14.xi.66. Here, Mr. A. Thompson left the ship.

Upon leaving Casablanca at 0900 hrs 16.xi.66 the ship proceeded to the edge of the Moroccan shelf about N.W. of Casablanca and five days were spent investigating the slope and the shelf edge during which sixteen stations (6181-6196) were completed. Work included seven EMT's, six IKMT's, four N113's, two hauls with three N113's on one warp, one replicate series of sixteen NF70V hauls, one N70B, one carbon^{14} cast, five chlorophyll W/B casts, a 600 mesh net haul, two W/B casts and one U/C cast were completed. In this area a scattering layer was found on the shelf edge near the bottom and some of the work was directed towards a study of this. Work also included a study of the distribution of animals with respect to the thermocline. At 1000 hrs 21.xi.66 the ship left the Moroccan region and sailed to 36°N 10°W.

The ship arrived on position at 0200 hrs 22.xi.66 and two days were spent in this oceanic area during which eight stations (6197-6204) were completed. Work in the region included three E.M.T's, four IKMT's, four N113's, one N70B, one repetitive series of NN's, one chlorophyll cast and one W/B cast. At 0800 hrs 24.xi.66 the ship sailed for Plymouth. A sounding run across the shelf edge from 47°28'N 7°W to 50°N 4°12'W was completed for Mr. Stride. The asdic was taken up and the P.E.S. fish taken inboard when off Plymouth. The ship entered Plymouth at 1700 hrs. 28.xi.66.

Besides the work outlined above BT dips and seechi disc readings were done and very numerous surface hauls with the NN and a meter net, several N113 hauls and several IKMT hauls were made to obtain living animals for physiological work.

SCIENTIFIC PROJECTS

1. Engel's Midwater Trawl (M.R. Clarke)

Forty hauls were done with this large midwater trawl and much experience in handling the gear has been gained. The first few hauls showed that it was quite possible to take the cod end in over the stern of the ship without taking in the rest of the net. This proved to be a great advantage because a series of hauls was possible without the labour of pulling the trawl in, laying it out (a very long and tedious business) and shooting it again.

A haul could be started less than thirty minutes after the previous haul had been completed. During the early part of the cruise the catch was badly damaged; many oceanic fish lost a large proportion of their scales. Thirty feet of the long, narrow cod end was then cut off and the 7 mm mesh lining was moved forwards so that it lined the new cod end thus formed. This modification facilitated handling, reduced the proportion of the catch caught in the larger netting and greatly improved the condition of the catch.

The mouth area of the trawl at different towing speeds was calculated from echo-sounder traces obtained by using a 30 K.c. headline transducer. This was used on the footrope looking upwards, on the headrope looking downwards and on one of the otter boards looking sidewards at the other board. Thus, a direct measure of the vertical spread of the net was obtained and horizontal spread was estimated from a knowledge of the spread of the otter boards.

The trawl was used in all weather conditions up to a wind speed of 30 knots with quite a heavy swell. Under the worst conditions the load on the warps did not exceed six tons with 900 m of wire out and at a towing speed up to 3.7 knots.

The maximum depth reached was 640 m and the maximum speed was 5 knots. On one occasion the net and otter boards were towed along a muddy bottom without mishap.

Catch

Sorting and voluming of the catch was completed on board. Volumes varied from 62 mls to 47,237 mls but the former figure is suspect because a tear in the net was discovered soon after the haul. The number of animals in the catch varied from 23 to 11,007 but again the former figure is suspect. The mean volume of animals in the catch varied from 0.78 ml to 105.5 ml and the maximum volume of any one animal was 6300 mls.

The mean catch volume was largest off the Azores and in descending order of magnitude there followed North Madeira, South Madeira, Fuerteventura, an oceanic station at 39° 02.8'N 21°28.6'W an oceanic station at 36°N 10°W and Morocco. Some Moroccan volumes were probably reduced because of a tear in the net. The mean catch volume of the two day hauls was one third of the mean volume of the night hauls. In all areas except off Morocco the hauls at 100-200 m depth produced about twice the volumes of those fished at 450-600 m depth. Catch volumes apparently increase with increase in towing speed from 2.0 - 2.5 knots to 2.6 - 2.9 knots but no evidence was found that further increase in speed gave larger catch volumes.

Animals in the catches were very diverse and many bizarre and rare animals were caught. The three principal groups were fish, cephalopods and decapods in descending order of volume and numbers, although large catches of euphausiids, mysids and Pyrosoma were also taken. Fish included individual catches of 1600 horse mackerel, 2700 boar fish, 204 trumpeter fish, over 5000 myctophids, an electric ray, two sharks, an oar fish, a new species of deal fish, 405 cyclothone and a large angler fish. A maximum of 195 cephalopods, 133 decapods, 694 Pyrosoma and 75 Phronima were taken in individual hauls.

2. Comparison between nets (M.R. Clarke)

Oblique hauls of the EMT, IKMT, N113 and N70 were compared on four occasions. The catch volume per 100 cubic metres of water filtered was much greater in the small finer mesh nets than in the larger coarser mesh nets; the catch volume per minute fished was greater the larger the net.

3. Performance of the N113 (A. de C. Baker)

In order to estimate the variation in samples taken with the N113 a series of ten 1 hour horizontal tows were made off Fuerteventura. To find a depth that would provide workable numbers of the groups that could be sorted on board three N113 were fished on the same warp at 450, 500 and 550 m. From an inspection of these samples 550 m was chosen as a suitable depth for the repeated hauls. It was decided to work within a circle of five miles diameter close enough inshore to obtain land bearings to fix the positions of the start and finish of the hauls and to tow from West to East. This was possible for all but St. 6161 which, due to increasing wind, was worked from East to West. The net was used with a catch dividing bucket in conjunction with the Depth Pinger to monitor the depth of tow and the time and depth of the flap operation.

Mean depths for the ten tows varied between 580 m and 529 m and the length of tow between 1.4 and 2.2 miles.

The volumes were measured and the following animals counted by P. Laval. Cyclothone sp., Fish (other than Cyclothone), Sagitta lyra, Euphausia hemigibba and Vibilia armata. The volumes and counts have been corrected for a two mile tow and the means and coefficients of variations worked out for each group. These are shown in the table. In each case the coefficient of variation is very high, the lowest being 26.8% for S. lyra and the highest 172% for Vibilia armata, the latter is presumed to have a very patchy distribution.

Repeated N113 hauls

Catch corrected to two mile tow

Station No.	Series	Length of tow	Mean depth	Volumes ml.	Cyclothone sp.	Other fish	Sagitta lyra.	Euphausia hemigibba	Vibilia armata
6155	1	1.8	560	100	28	30	79	62	79
"	2	1.8	549	122	81	6	51	59	42
"	3	1.8	548	82	58	43	70	141	301
6156	1	2.1	529	101	61	36	97	131	122
"	2	2.2	536	88	53	5	47	61	26
"	3	2.0	550	45	57	3	51	64	25
"	4	2.2	580	18	18	9	28	0	0
6161	1	1.9	560	46	19	14	49	46	8
6176	1	1.7	551	44	35	20	49	19	4
"	2	1.4	546	56	41	14	58	84	16
			Mean	67	43	16	54	60	55
			Coefficient of variation	46.6	48.4	82.5	26.8	66.0	172

These results suggest that counts of the larger animals taken in one hour tows with the N113 should be treated with considerable caution. Variation in the catches of the smaller animals in the N113 will be examined on return to the N.I.O.

In order to determine the catch taken on the short oblique parts of a horizontal tow with the N113 fitted with a CDB, three hauls were made to 550 m then hauled immediately and the catch taken in the deep bucket analysed. The means for each group in these three catches have been expressed as percentages of the mean catch taken in the ten standard hauls to 550 m with the following results:

Volume	Cyclothone	Other fish	S. lyra	E. hemigibba	V. armata
4.5%	9.2%	7.8%	11.2%	11.2%	0%

Thus, although these figures are higher than would be expected on the basis of the time spent on the oblique tows (about 3%) they are still well within the variation found between samples.

During the SOND cruise in 1965 some of the samples were taken on a course out from the coast of Fuerteventura into progressively deeper water. It was thought that this might have affected the catches in some way; to test this a series of four one hour tows at 550 m were worked at intervals out to about 18 miles off the coast. The samples have yet to be analysed but the volumes are well within the variation found at the inshore stations.

Three oblique tows fished to test for the retention of deep material in the net so that it passes into the shallow bucket have yet to be analysed.

4. Vertical nets NF70V (M.V. Angel)

Three series of 16 repeated 100-0 m hauls were made to assess the repeatability of these nets. At two stations, a day and a night series of hauls at 100 m intervals down to a depth of 1000 m were made. These hauls will be used to analyse the depth distribution of the small Conchoecia (Ostracoda) species which are too small to be adequately sampled by the N113.

5. Neuston Net (M.R. Clarke)

Two series with the NN were completed for Mr. P.M. David. The net was continually used to collect small surface animals for physiological experiments.

6. Physical conditions and animals

a) Hydrographic stations were done in each area studied. Off Fuerteventura Temp/Sal. curves were very similar to those obtained in 1965 but a number of differences were noted in the faunal composition.

b) Thermocline studies (M.V. Angel).

The success of the depth pinger, in not only giving a continuous and precise measure of depth of fishing but also indicating the flap operation of the catch dividing bucket, made it worth attempting a preliminary study on the effects of the thermocline on animal distributions.

At each of two stations off the Moroccan shelf three series of three N113H on a single warp were towed for one hour. The depth of the thermocline was measured using bathythermographs. The middle net with an electrical CDB and the pinger was fished just below the thermocline. The lower net, also fitted with an electrical CDB fished 20 m below the middle net. The upper net fitted with an ordinary bucket fished 20 m above the middle net, 10-15 m above the top of the thermocline.

Subjectively the catches looked very different. The lower nets caught larger sized animals, and there seemed to be aggregations of Myctophids and Decapods just below the thermocline, i.e. in the middle nets.

However, sorting two of the series into major groups has shown little indication of animals either aggregating at or being limited by the thermocline.

Time has only allowed a superficial specific analysis of one group, the Ostracoda. Four species occurred only above the thermocline:- Conchoecia porrecta, C. spinirostris, C. curta and C. elegans. Three species had the top limits to their vertical distributions at the thermocline:- Conchoecia acuminata, C. parthenoda, and C. spinifera. Three species had the top limits to their vertical distributions below the thermocline:- Conchoecia imbricata, Macrocypridina castanea and Halocypris inflata. Five species were found at all three levels:- Conchoecia bispinosa, C. oblonga, C. daphnoides, C. magna and C. subarcuata.

The thermocline at the two stations was relatively weak with a temperature change of about $2\frac{1}{2}^{\circ}$C. It would seem that this was not a physical barrier to many species. The aggregation of certain species at the thermocline could be caused by the accumulation of seston at the density discontinuity. If such an accumulation does occur, there would be a rich food zone for filter feeding animals at the thermocline, and hence indirectly for predators.

The belief by many tuna long-liners that tuna feed extensively at or about the thermocline, indicates this project could have economic as well as scientific implications.

	6183 #3			6193 #1		
	Upper	Middle deep	Lower deep	Upper	Middle deep	Lower deep
Fish						
Myctophids	7	18	2	13	25	2
Chauliodus	0	3	0	0	4	1
Others	0	3	3	0	0	0
Larvae	41	26	21	115	120	22
Decapods						
Adults	11	54	35	3	11	14
Larvae				71	12	7
Chaetognaths	221	178	156	700+	432	317
Squid	0	2	3	3	6	2
Heteropods	0	0	2	3	2	0
Pteropods	12	1	10	38	13	9
Amphipods	9	24	39	60	35	71
Euphausiids	194	240	472	552	306	282
Polychaetes						
Tomopterids	18	2	3	4	1	6
Others	0	2	1	3	0	0

c) Discontinuities (M.R. Clarke)

A number of surface discontinuities were passed between 31°47'N 10°10'W and Casablanca and the first of these was briefly studied. It was found that the water on the northern side of the feature was sinking while that to the south was stationary. The water on the two sides differed in surface temperature by 0.5°C but bathythermographs showed no difference between the two water masses. NN hauls showed no concentration of small animals in the region of sinking but the northern water contained fish eggs while the southern did not. Several trawlers lay near the feature and a distinct scattering layer was present on the bottom at 80-200 fms. Later an identical layer was observed on the P.E.S. and asdic on the edge of the Morrocan shelf at 34°17'N 08°00'W. A brief investigation of the layer was carried out using the P.E.S., B.T., Chlorophyll W/B's, the IKMT, the EMT and two hydrographic casts were made. The IKMT fished in the layer caught very little other than euphausiids and bottom animals. Further hauls with the IKMT and the EMT over the slope suggest that the shelf living animals extend, on the bottom, into water of 290 fm. depth. Surface discontinuities were again present above the scattering layer and the asdic showed a large amplitude "wave" in a thin midwater scattering layer.

7. New gear

Depth telemetering pinger

This device proved of great value for monitoring the depth of nets and for showing when the catch dividing bucket operated. Mr. Bowers provided the following notes.

This is based on a 'D' type pinger with a 2 second period. The ping from the 'D' type pinger triggers a monostable flip-flop whose period is determined by the voltage on the wiper of a potentiometer. The potentiometer wiper is moved by a bourden pressure tube, and thus the period of the flip-flop is proportional to pressure, and then depth, of the pinger. When the flip-flop returns to its original state another ping is sent out. Thus two pings are transmitted in every 2 second period; the interval between the pings being proportional to depth. Since the 2 second period is precisely controlled, the pings may be received on the E/S fish and recorded on the E/S recorder using a 2 second sweep speed. The pulse length of the 2 second period ping may by changed by a switch on the Catch Dividing Bucket when the flap operates and thus flap operation may be recorded simultaneously with depth on the recorder.

Free rise net

A 30 foot diameter free rise net was tested. This net sank to 1000 m, released the chain sinker and then rose at about one knot to the surface. The net was seen immediately after it surfaced. While getting the net inboard the ring holding the mouth open was very badly damaged and most of the catch was lost. The trial was useful as it gave precise information on the drag of the net and the rate of rise, experience was gained in handling a large net over the side of a vessel and faults in the design were recognised and can now be rectified. The few animals which were caught were in excellent condition and of comparable size to those taken with an IKMT.

8. Fishes (C.M.H. Harrisson)

The sampling carried out with trawls showed certain regional differences between the mesopelagic species taken in the North, and those from the south of the area. Among the myctophids Electrona rissoi occurred at

the oceanic station at 40°N 20°W, and at the Azores, Myctophum selenops was taken at stations South and East of Madeira, while the two species Ceratoscopelus maderensis and C. townsendi appeared, from a cursory examination of the samples, to occupy the Northern and Southern sectors respectively.

Comparing the 40°N 20°W station with catches made off Sao Miguel, there appeared to be fewer oceanic fishes, and large numbers of predominantly coastal forms like Macrorhamphosus gracilis, and Capros aper were taken in the Engel's trawl. There was considerable evidence that the Azores area round Sao Miguel was one of high productivity. Echo traces of compact shoals were common in the top 100 metres after dusk, and the Engel's trawl yielded large catches of Trachurus when fished in the same layer. These horse mackerel shoals probably appeared closer to the surface by day, and large numbers of dolphins and gulls (Larus argentatus) were seen pursuing fish on several occasions.

Similar catches were made off Madeira. Trachurus trachurus taken during the daytime had their stomachs packed with small crustacea and also contained some pteropods. Scomber japonicus (colias), southern mackerel were also taken, and may have been mixed among the horse mackerel shoals. Numbers of Chiasmodon niger and the voracious looking Scombrolabrax heterolepis were additions to the catch as was Diplospinus multistriatus, an unusually large specimen of which occurred in an Engel's haul. Dr. G.E. Maul, who joined the ship at Funchal gave valuable help, and compiled a detailed faunal list from a deep Isaacs-Kidd haul made off Ribeira Brava to compare with observations made during a dive in the French bathyscaphe 'Archimede' at the same spot some months before.

At Fuerteventura sampling yielded material comparable to that taken on the SOND cruise. Some interesting leptocephali turned up in various of the nets, and a fine specimen of Scopelosaurus lepidus from the EMT had an unusual parasite in its right eye. As in 1965, a Gempylus serpens was taken at night on a handline, and two more specimens of the apparently new trematode were found in its stomach. A magnificent lernaeid had established itself in the mid dorsal region, with only its egg sacs showing above the skin. When the parasite was dissected out it was found to have almost entirely replaced the Z-shaped area of a dorsal muscle segment, filling the space between the two muscle septa. In a deep Isaacs Kidd haul to 1000 m there was a cetunculid fish which was kept alive for several hours at 13°C.

Crossing to the Moroccan coast, a sunfish was seen on its side at the surface on the cold side of some slicks apparently indicating slight upwelling. The temperature difference across the boundary was less than a degree, however, and as the ship approached, the fish righted itself and dived, sculling with its opposed dorsal and anal fins. A visit was payed to the fish marked in Casablanca, where the chief species of economic importance appeared to be the sardine (Sardina pilchardus), a variety of sparid fishes, gurnards, and albacore (sensu lato) though presumably mid-November is not the season for the latter off Morocco. In addition some very large sciaenids (Johnius ?) were seen together with a huge wreckfish (Polyprion). Boxes of large congers, various small gadids and morays also contained assorted extras such as small weaver fishes (Trachinus), and there were some beautifully marked Morone punctata as well as a few large shads (Alosa).

Throughout the whole cruise area, the little silvery myctophid Gonichthys coccoi was common in surface hauls with the neuston at night, but it was a surprise to catch a specimen of the gonostomatid Valenciennellus tripunctulatus with this same apparatus in broad daylight at the station on the Moroccan shelf. Catches of fishes with the EMT may have seemed poorer due to the fact that the net became badly torn at this point. An Isaacs Kidd haul to 2000 m. yielded a fine brotulid, numbers of Gonostoma bathyphilum and some large black gulper eels (Eurypharynx), in good condition.

The last station occupied, in deep water off the Gulf of Cadiz, was made memorable among fish catches by the capture of an unusually large anglerfish of the genus Himantolophus. Large specimens of Argyropelecus gigas reached 16 cms. S.L., and were bigger than any yet seen from off Fuerteventura.

9. Cephalopods (M.R. Clarke)

These were not identified on board but among the 1706 specimens caught in the EMT a number of rare species were seen. These include numerous Todarodes sagittatus, large ones of which are not caught at the surface in the latitudes fished; Taningia danae which is known only from whale stomachs except for two larval specimens taken in nets; a large unidentified gelatinous octapod; numerous Phasmatopsis of which only six specimens have been reported; Bathothauma lyroma a rare taoniid with stalked eyes; Histioteuthis bonellii only rarely taken in nets but important in the diet of sperm whales; numerous Enoploteuthis and several chiroteuthids. The presence of Taningia danae, Histioteuthis bonellii and Ommastrephes caroli is the samples in particularly encouraging as they are very rare in samples taken with smaller nets; we seem at last to be taking some of the common but very elusive species. Spirula and Heteroteuthis were again taken but the latter in very small numbers compared with 1965. This year was notable for the small numbers of Liocranchia. A deep IKMT caught a Vampyroteuthis and surface nets caught a number of Onychia.

10. Decapods (P. Herring)

Attempts have been made to rear 1st stage larvae from the eggs of about ten species of decapod. Considerable success has been achieved, living larvae having been obtained from almost all these species. Most of these eggs were reared in vitro after removal from the female, but simultaneous attempts to rear egg-bearing females until the eggs hatched also proved successful in a few cases. For successful hatching in vitro the eggs must be separated from each other and the surrounding adhesive material, and comparatively few reared in each vessel. It is inferred that the metabolic rate of the embryos is fairly high, and that they require a high level of oxygen in the surrounding water and/or rapid removal of their excretory products. While developing on the pleopods of the female both these requirements will be met. The temperature at which the eggs will develop is not critical, normal development occurring over the range 8-18°C, but at the lower end of the range the rate of development is so slow that the chances of bacterial or protozoan infection are high. The development time of individual eggs was very much longer than anticipated, those of all the species investigated taking upwards of three weeks (at 10-14°C), and one batch of eggs, already considerably developed when obtained, only hatched 4½ weeks later.

The comparative ease with which several species can be reared opens up the way, for biochemical and physiological investigation of the developmental processes in these species. Time did not permit the attempted rearing of most of the larvae through one or more of their moults, although two species were successfully maintained through their first moult.

11. Euphausiids (A. de C. Baker)

A notable feature of the euphausiids taken on the cruise was the abundance of Meganyctiphanes norvegica. It was taken in very large numbers at two stations (6102 and 6103) to the NE of the Azores, at the oceanic station to the west of the straits of Gibraltar and off the Moroccan slope. Although it has been found before in the first two areas mentioned there have previously been only small numbers. The Moroccan slope area is further south than any previous "Discovery" records and probably, than any published observations, certainly in such abundance.

Reproduction:

Specimens of mature euphausiids were preserved for examination and sectioning back at the N.I.O. and spermatophores were dissected out of males. It was found that when the spermatophores of Euphausia hemigibba were removed the sperm mass was exuded almost immediately. Female E. hemigibba are very rarely found carrying spermatophores but with a large sperm mass in the thelycum and it is presumed that the spermatophore is never firmly attached to the thelycum as in the majority of species but is held in place while the sperm mass is exuded.

Spermatophores found attached to female euphausiids have the proximal lobe very darkly tanned. Tanning of this part was found to take place within two or three minutes of dissecting the spermatophores out of males and at the same time a swelling of the bulb took place and a glutinous substance was exuded along with a small quantity of sperm.

12. Ostracods (M.V. Angel)

Attempts were made to keep 14 species of Conchoecia alive. Little success was achieved especially with the deeper living species. The rapid growth of bacterial scums over the animal seemed to be one of the main detrimental factors. Even so, individuals of the species Conchoecia bispinosa were kept alive for periods up to eleven days, and many laid eggs. This widespread species seems the most suitable for future experiments.

Observations were also made on the swimming and feeding of these animals. Certain species rapaciously attacked chaetognaths in the hauls. It was apparent that they can cause rapid deterioration in standard plankton hauls if the catches are not preserved quickly.

Six species of Conchoecia were observed to produce bioluminescence from glands in the carapace. The identification of these glands may prove a useful taxonomic characteristic.

Four specimens of Gigantocypis were kept alive for short periods in the constant temperature laboratory. One specimen was successfully persuaded to feed on a piece of chaetognath, and previous inferences on their method of feeding proved wrong.

13. Pteropods and Heteropods (N. Runham)

Thirteen species of Heteropoda and twentyone species of thecosome Pteropoda were collected and identified. Seven species of Gymnosome Pteropoda were collected of which four were identified. The majority of the above Pteropoda and a few of the Heteropoda were fixed in a variety of fixatives for future studies on their anatomy and histology. Egg masses at various stages of development and very young animals were obtained for two of the Thecosomata.

Six species of as yet unidentified Nudibranchs were collected, together with the eggs of one species which laid them in the laboratory.

Pieces of mantle of eight species of cephalopod were deep frozen and also fixed for later histological and histochemical study. Pieces of arm were similarly treated for a study of the mode of secretion of the sucker rings and pieces of digestive gland and pancreas for their histology.

Attempts were made to study the rate of radula secretion in the animals collected but only the veligers of Nassarius incrasstus could be kept alive for a sufficient length of time.

14. Insects (M.V. Angel)

Twelve hour suction trap samples were collected for Dr. R.A. French of Rothampstead. Insects were generally only caught in close proximity to land. The most notable catches were taken off Madeira after the violent squalls of the evening of 22nd October. Neuston net hauls collected on the 24th were packed with dead insects. Fortyeight hours after the squalls the numbers of animals caught in the suction trap returned to the usual low level.

The Robinson light trap was run on four nights, but caught few insects. However, it will be a useful instrument to have on board if mass migration of insects are encountered on future cruises.

15. Animal pigments (P. Herring)

A large number of species of both surface-living and deepwater animals have been collected and deep-frozen, in order to study their carotenoid pigments. The blue carotenoproteins of the surface-living species will be compared with those of previously investigated animals from this habitat, particularly those of various species of pontellid copepod. Analysis of the red and purple pigments of some of the deep-water decapods and mysids is expected to yield valuable information on the relationship between these pigments and those of the surface fauna. In addition to species collected for the above reasons, a number of other animals have been accumulated with a view to the analysis of their specific carotenoids, and their location within the animal, particularly the eyes of copepods. Two species of offshore isopod have been collected for comparison between their pigments, and those of the two littoral species of the same genus, which have been described in the literature.

Following earlier work on the depth distribution of the carotenoid pigments of the smaller zooplankton, and its relation to the ambient light intensity, two series of samples of plankton from different depths have been obtained, and the subsequent analysis of these samples will show whether the conclusions drawn from the earlier work are justified.

Samples of the eggs of different species of decapod crustacea have also been deep-frozen for pigment analysis, the interesting feature of these animals being that, with one exception, they all produce a purple yolk carotenoprotein, in marked contrast to the blue and green carotenoproteins of shallow water species. Investigation of these pigments may provide further information on the causes and effects of the marked differences in carotenoid metabolism between animals at the surface, and those in deeper water.

16. Luminescence (P. Herring)

Luminescence was noted in the amphipod Scina, a phenomenon apparently hitherto undescribed in this group of crustacea. A more detailed examination was made of the principal sites of luminescence in one species of this genus, and histological material prepared for investigation of the organs concerned. The phenomenon was also noted in two other species of this genus.

17. Chemical constituents (F. Culkin)

Specimens of euphausiid, decapod, myctophid, various squids, copepods, chaetognaths, mysids and salps have been frozen for protein, carbohydrate and total lipid estimation. Samples of squid liver, jelly, body fluid, pancreas and brain have been collected and deep frozen for fatty acid analysis.

18. Eyes of Fish and Cephalopods (A. Locket)

Collection and preservation of the eyes of some of the animals encountered during the cruise has been carried out.

The eyes have in some cases been preserved whole with a view to their examination with the naked eye and the low power microscope. The general structure thus demonstrated will be further investigated by the examination of microscopic sections of parts of suitably preserved eyes. In addition to these investigations material from many animals has been processed so that sections of retina can be examined in the electron microscope and an attempt made to understand the fine structure of that organ in various groups of animals from shallow and deep environments.

Records of the living appearance of some of the animals caught have been made by photography in colour and black and white, by cinematography and by sketches.

Attempts were made to record electroretinograms from fishes and squid, but these were unsuccessful. Further experience with the equipment used, using hardy coastal or freshwater fish, would probably enable such records to be made.

Retinae from a number of animals were removed in dark-adapted conditions, and deep-frozen. Attempts will be made to extract and study visual pigments from these in the laboratory.

The examination of transparent organs and tissues with the slit-lamp microscope was undertaken, but the technique was found to be rather unsuitable for shipboard conditions.

19. Bacteria (A. Thompson)

Samples were taken from five stations, three on the slopes of the Azores, Madeira and Fuerteventura (Canary Islands) and two oceanic stations one North of the Azores and the other between the Azores and Madeira. Poor weather conditions curtailed the programme at both oceanic stations and insufficient data was recorded. The full programme was carried through on the other stations and the following preliminary observations made.

Four types of samplers were used: those developed by Zobell, Cobet and Niskin and a prototype constructed in the Bacteriology Department, Bristol University. For reliability of action the Niskin sampler was preferred, it is also the largest and most reliably uncontaminated sample. Experiments with the Bristol prototype show that it has immense potential for development as an even more reliable fully automated sampler.

Samples were taken with the particular intention of isolating luminous species. Preparatory work ashore had shown the necessity for incubating cultures at 20°-24°C and examining them after 18-24 hrs. Kriss, Zobell and other workers mention incubation times of 4-5 days. This is suggested as the reason for their not reporting the occurrence of luminous species as often as the samples on this trip have shown. It is now evident that the ratio of luminous to total species isolated will vary between the limits 1 : 100, 1 : 1000 depending on depth of sample, time of day and other factors.

Samples taken of fish gut contents have shown that the occurrence of luminous species is much more common in this environment than in sea water. Approximately 70% of gut samples produced luminous species. It is suggested that the variation in the distribution of luminous species to the total is dependent on both the proximity of the sample to the scattering layer and the density of this scattering layer. Fifty pure isolates of luminous species have been refrigerated and brought to England where it is intended that they will be classified and freeze dried as the foundation of a collection. It is hoped that a full investigation of the distribution of the different genera amongst the different types of fish and areas of water sampled will be of ecological significance.

20. Phytoplankton (J. Green).

Determinations of the chlorophyll content of the water as a measure of the standing crop of phytoplankton, and determinations of the rate of primary production, as measured by the photosynthetic uptake of carbon^{14} were made at stations off the Azores, Madeira, Fuerteventura and Morocco. Samples were taken using a very fine "600" mesh net hauled vertically, and by centrifugation of the water to observe the species present.

Chlorophyll concentrations in the upper 100 metres were generally low, being in the order of 0.2 mg/m^3, with maxima between 40 and 60 metres. The low chlorophyll concentrations indicated poor phytoplankton floras and this was confirmed by the sampling methods which frequently gave samples in which no phytoplankton was detectable. Notable exceptions were Stations 6142 off S. Madeira where a number of Dinoflagellate species were collected and Station 6194 off Morocco where there was a high surface concentration of μ-flagellates. Samples of water from these stations, and others, were used to set up laboratory cultures of the phytoplankton.

The rates of carbon fixation as determined by C^{14} uptake were also low. An estimate for Station 6175 off Fuerteventura, for example, showed a rate of photosynthesis of 1.7 mg C/m^3/hr at the surface, rising to 4.7 mg C/m^3/hr at 40 metres and falling to 0.3 mg C/m^3/hr at 100 metres.

21. Underwater camera

The underwater camera was lowered on twelve occasions and photographs were obtained twice. At Station 6135, 52 photographs of a squid Todarodes sagittatus were obtained and the specimen was also caught, the first time anything has been caught with the camera. At Station 6154 one photograph of a 4 ft shark was taken. The quality of nearly all the photographs was good.

Conventions in Report Station List

Sounding: Corrected depth in metres;
Minimum and maximum depths recorded if continuous soundings were taken;
Figures in ( ) are approximate.

Times: Local time on a 24 hour system.
Overall starting and finishing times for a station are given.

Sampling: Abbreviations used are given on page 1.
Hydrographic W/B's used in carbon^{14} analysis are indicated by (C^{14}).
N70 nets fitted with a flow-meter are indicated by NF70.
V, B or H following a net abbreviation indicate vertical, oblique or horizontal hauls.
NP(600) = phytoplankton net.

Figures in ( ) preceeding a gear abbreviation indicate the number of samples or observations made with the gear at that station and the depth following is the maximum depth sampled. Where more than one net was used on one warp [ ] are used.

Stn.	Position Lat. N.	Long. W.	Date (1966)	Sounding	Times	Sampling programme
6100	39°49.7'	20°00.0'	11/10	-	1532-1725	(2) W/B 7.5 to 25 m. N50V to 100 m. (6) Bact. W/B to 200 m.
6101	38°54.0'	21.55.5'	12/10	-	1145-1710	EMT to 560 m.
6102	38°54.0'	21°55.5'	12/10	-	1732-2254	EMT to 640 m.
6103	38°54.0'	21°55.5'	12/10 13/10	-	2345 -0742	EMT to 160 m. (6)W/B 7.5 to 100 m.
6104	37°36.3'	25°07.4'	14/10	-	0048-0840	(12) NN (repetitive hauls). (11) NF70V to 1000 m.
6105	37°36.0'	25°26.4'	14/10	-	1025-1100	(4) Bact. W/B to 265 m.
6106	37°36.6'	25°06.7'	14/10	-	1448-1856	(13) NF70V to 1000 m.
6107	37°38.7'	25°15.3'	14/10 15/10	328-1038	2035 -0215	EMT to 140 m.
6108	37°36.6'	25°40.6'	15/10	577-888	0305-0835	EMT to 110 m.
6109	37°37.7'	25°39.6'	15/10	-	1032-1715	(16) NF70V replicate hauls to 100 m. (7) W/B to 100 m. (7) W/B to 100 m (C^{14}) U/C at 500 m.
6110	37°38.8'	25°14.5'	15/10 16/10	93-118	2012 -0135	EMT to 115 m.
6111	37°39.1'	25°31.9'	16/10	111-207	0205-0915	EMT to 200 m.
6112	37°37.8'	25°38.6'	16/10	(640)	1057-1415	(6)W/B 7.5 to 100 m. (4) Bact.W/B to 300 m. U/C at 500 m.
6113	37°32.9'	25°38.4'	16/10	771-2186	1505-1838	(14)W/B to 600 m.
6114	37°36.5'	25°40.0'	16/10 17/10	871-1000	2036 -0355	IKMTB to 500 m. N113B to 500 m. N70B to 500 m.
6115	37°39.4'	25°37.8'	17/10	-	0830-1500	(7) W/B to 100 m. (4) Bact. W/B to 300 m. U/C at 500 m. (7) W/B to 100 m.(C^{14})
6116	37°34.5'	25°34.5'	17/10	-	1650-1750	(5) Bact. W/B to 900 m.
6117	37°35.5'	25°22.0'	17/10 18/10	1080	2010 -0330	EMT to 400 m.

Stn.	Position Lat. N.	Long. W.	Date (1966)	Sounding	Times	Sampling programme
6118	37°34'.9	25°34'.1	18/10	831-869	0350-0725	EMTB to 515 m. (6)W/B 7.5 to 100 m.
6119	37°34'.6	25°36'.2	18/10	(900)	0920-1549	U/C at 850 m.
6120	37°39'.0	25°37'.0	18/10	-	1615-1743	(4) Bact. to 300 m. (1) W/B 7.5 to 15 m.
6121	37°34'.3	25°22'.0	18/10 19/10	831-1245	2030 -0313	EMT to 500 m.
6122	37°37'.3	25°37'.8	19/10	621-745	0330-0910	EMT to 510 m.
6123	35°10'.0	21°20'.0	20/10	-	1042-1725	(6) W/B 7.5 to 100 m. (3) Bact. W/B to 300 m. U/C at 1000 m.
6124	32°59'.0	17°03'.3	21/10 22/10	2226-2555	2203 -0626	IKMTB to 435 m. (2) N113B to 420 m. N70B to 440 m.
6125	32°55'.4	17°01'.0	22/10	-	0918-1019	(2) N50V to 110 m. (3) Bact. W/B to 300 m. NNP.
6126	32°58'.6	16°54'.8	23/10	-	0856-1237	(4) Bact. W/B to 500 m. (2) NP(600) to 100 m. (5) W/B 7.5 to 100 m.
6127	32°55'.6	16°40'.3	23/10	1841-1988	1432-2046	EMT to 525 m.
6128	32°55'.4	16°52'.4	23/10	260-381	2150-2350	EMTB to 445 m.
6129	32°55'.2	16°54'.9	24/10	1579-1815	0019-0717	EMT to 430 m.
6130	32°54'.2	16°41'.8	24/10	1226-1871	0735-1455	EMT to 460 m.
6131	32°54'.0	17°02'.6	24/10	1223-1943	1524-2055	EMT to 350 m.
6132	32°55'.1	16°48'.6	24/10 25/10	1782-1977	2119 -0216	EMT to 165 m.
6133	32°55'.1	16°58'.2	25/10	1800-1996	0245-0700	EMT to 140 m.
6134	32°32'.4	16°53'.6	25/10	-	1325-1358	(6) W/B 7.5 to 100 m. (3) Bact. W/B to 300 m.
6135	32°34'.6	17°07'.6	26/10	-	0200-0755	(23) W/B to 1000 m. U/C at 500 m.
6136	32°33'.0	17°06'.6	26/10	2273	0940-1455	(6) W/B to 100 m.(C^{14}) (5) Bact. W/B to 1000 m. NF70V to 1500 m. Secchi Disc.

Stn.	Position Lat. N.	Long W.	Date (1966)	Sounding	Times	Sampling programme
6137	32°33'.6	17°06'.2	26/10 27/10	-	1802 -0900	FRN to 1000 m. U/C.
6138	32°33'.9	17°00'.2	27/10	-	1015-1843	(8) N113H. CDBE to 900 m.
6139	32°34'.0	17°01'.0	27/10 28/10	-	2015 -0136	IKMT to 810 m.
6140	32°34'.0	17°01'.0	28/10	-	0211-0715	IKMT to 435 m. NNP.
6141	32°34'.0	17°00'.2	28/10	-	0955-1110	/N113H x 3/ to 470 m.
6142	32°39'.0	17°10'.3	28/10	-	1425-1620	U/C at 500 m. NP (600) to 100 m.
6143	32°35'.2	17°08'.0	28/10 29/10	1692-2194	2040 -0107	EMT to 190 m.
6144	32°32'.0	16°53'.0	29/10	2146-3062	0230-0830	EMT to 280 m.
6145	32°35'.6	17°08'.2	29/10	1898-2628	1050-1336	(7) W/B to 100 m. (C^{14}). Secchi disc.
6146	32°37'.2	17°04'.8	29/10	669-697	1447-1700	U/C at 600 m. (7) W/B to 100 m. Secchi disc.
6147	32°40'.0	17°15'.8	29/10 30/10	1766-2048	2020 -0420	EMT to 330 m.
6148	28°03'.5	14°10'.8	3/11	1511-1593	0555-0650	N113. CDBE to 230 m.
6149	28°02'.0	14°08'.0	3/11	1594	0827-1318	(6) W/B 7.5 to 100 m. (13) NF70V to 1000 m.
6150	28°04'.2	14°08'.1	3/11	-	1430-1630	/N113H x 3/ to 500 m.
6151	28°04'.5	14°04'.2	3/11	-	1745-1927	IKMTB to 500 m.
6152	28°04'.2	14°07'.8	3/11	-	2152-2240	(5) Bact. W/B to 1000 m. (16) W/B to 1000 m. LH.
6153	27°55.8	14°07.3	4/11	1819	0020-0155	(16) W/B to 1000 m.
6154	28°04.4	14°03.8	4/11	-	0350-0615	U/C at 300 m.
6155	28°04.0	14°10.0	4/11 5/11	(972)	0915 -0700	(4) N113 CDBE repeated hauls to 550 m. (6) W/B 7.5 to 200 m. (12) NF70V to 1000 m. (16) NF70V repeated hauls to 100 m. (3) Bact. W/B to 300 m. U/C at 350 m. LH.

Stn.	Position Latn N.	Long. W.	Date (1966)	Sounding	Times	Sampling programme
6156	28°04.0'	14°07.2'	5/11	-	0757-2000	(4) N113 CDBE repeated hauls to 550 m. (3) W/B 7.5 to 1000 m. (for S'hampton Univ.)
6157	28°04.0'	14°12.3'	5/11	1372-1569	2055-0350	EMT to 140 m.
6158	28°05.0'	13°56.2'	6/11	1275-1395	0355-0831	EMT to 105 m.
6159	28°04.2'	14°09.6'	6/11	-	1050-1750	(4) N113 CDBE to 675 m.
6160	28°05.1'	14°05.4'	6/11 7/11	-	2024 -0629	(2) IKMTB to 1000 m. N113B to 500 m. N70B to 500 m.
6161	28°04.0'	14°08.8'	7/11	-	0730-1812	(6) N113 CDBE to 580 m.
6162	28°04.0'	14°01.1'	7/11 8/11	-	2040 -0130	N113 CDBE to 640 m.
6163	28°03.5'	14°11.3'	8/11	-	0230-0620	N113H to 600 m.
6164	28°05.3'	14°05.3'	8/11	-	0820-1814	(4) N113 CDBE repeated hauls to 600 m.
6165	28°00.0'	14°07.8'	8/11	-	2054-2235	EMTB to 510 m.
6166	28°05.2'	14°07.4'	8/11 9/11	-	2248 -0259	EMT to 100 m.
6167	28°06.0'	14°15.0'	9/11	-	0334-0701	EMT to 130 m.
6168	28°04.0'	14°03.4'	9/11	-	0846-1842	(3) Bact. W/B to 150 m. (7) W/B to 100 m. (C^{14}) (7) W/B to 100 m. (6) N113 CDBE to 700 m. Secchi disc.
6169	28°04.1'	14°03.8'	9/11	-	1952-2001	(2) Bact. W/B to 150 m.
6170	28°04.8'	14°03.5'	9/11 10/11	-	2036 -0233	EMT to 590 m.
6171	28°03.6'	14°06.5'	10/11	-	0300-0730	EMT to 355 m.
6172	28°03.8'	14°04.5'	10/11	-	0924-1824	(2) /N113H x 2 + N113H CDBE/ to 725 m.
6173	28°04.8'	14°04.0'	10/11 11/11	-	2033 -0214	EMT to 385 m.
6174	28°02.4'	14°09.0'	11/11	-	0231-0740	EMT to 150 m.
6175	28°04.0'	14°09.9'	11/11	-	1040-1046	(7) W/B to 100 m. (C^{14}) Secchi disc.

Stn.	Position Lat. N.	Long. W.	Date (1966)	Sounding	Times	Sampling programme
6176	28°03.9'	14°07.3'	11/11	(1302)	1047-1700	(2) N113 CDBE repeated hauls to 550 m.
Station 6177 omitted in error.						
6178	27°58.8'	13°57.0'	11/11 12/11	1549-1681	2020 -0256	/IKMT + N113H x 2/ to 1000 m.
6179	28°03.6'	17°41.5'	12/11	1489-1504	0354-0545	(6) W/B 7.5 to 100 m. (1) Bact. W/B to 1400 m. (3) W/B to 100 m. (Culture water)
6180	31°46.5'	10°10.2'	13/11	321-373	1042-1200	(4) NNP BT
6181	35°53.3'	08°06.7'	16/11	-	1305-1417	(6) W/B 7.5 to 100 m. (6) W/B to 150 m. BT.
6182	34°06.4'	08°16.0'	16/11	-	1555-1740	(16) W/B to 1000 m. BT.
6183	34°14.5'	08°03.0'	16/11 17/11	-	1950 -0115	(2) BT (3) /N113H + N113CDBE x2/ to 1050 m.
6184	34°17.5'	07°59.4'	17/11	1291-1390	0903-1430	/IKMT + N113H/ to 1180 m.
6185	34°23.3'	07°52.1'	17/11	-	1447-1805	/IKMT + N113H/ to 930 m.
6186	34°17.3'	08°00.0'	17/11	1447	2014-2154	EMTB to 500 m.
6187	34°17.3'	08°00.0'	17/11 18/11	1394-1470	2240 -0319	EMT to 570 m.
6188	34°17.3'	08°00.0'	18/11	1298-1486	0345-0834	EMT to 260 m.
6189	34°17.7'	08°00.2'	18/11	(1390)	0856-1645	(7) W/B to 100 m. (C^{14}) (16) NF70V repeated hauls to 100 m. (2) NP (600) U/C at 1050 m. (7) W/B to 100 m. Secchi disc.
6190	34°07.0'	07°56.3'	18/11 19/11	(713)	2027 -0110	EMT to 120 m.
6191	34°06.0'	08°02.0'	19/11	550-666	0135-0742	EMT to 425 m.
6192	34°21.3'	08°15.2'	19/11	2333-3311	1000-1853	(6) W/B 7.5 to 100 m. /IKMT + N113H/ to 1850 m.

Stn.	Position Lat. N.	Long. W.	Date (1966)	Sounding	Times	Sampling programme
6193	34°17'.0	08°00'.0	19/11 20/11	-	2217 -0749	IKMTB to 500 m. N113B to 500 m. N70B to 500 m. (3) BT. (6) W/B 7.5 to 100 m. (3) /N113H + N113 CDBE/ to 105 m.
6194	34°00'.8	07°57'.5	20/11	212/235	1144-1830	(2) IKMT to 200 m. (6) W/B 7.5 to 100 m.
6195	34°07'.0	07°56'.0	20/11 21/11	381-572	2016 -0002	EMT to 570 m.
6196	34°07'.0	07°56'.0	21/11	366-907	0123-1000	EMT to 160 m. (6) W/B 7.5 to 100 m. (12) W/B to 350 m.
6197	36°00'.0	10°00'.0	22/11	-	0205-0901	(15) NN series (6) W/B 7.5 to 100 m. W/B to 2000 m. (for S'hampton Univ.)
6198	36°00'.0	10°00'.0	22/11	-	0915-1905	/IKMT + N113H/ to 3150 m.
6199	36°30'.0	10°00'.0	22/11	-	1941-2102	EMTB to 510 m.
6200	36°48'.5	10°12'.0	22/11 23/11	-	2119 -0614	EMT to 550 m.
6201	36°41'.3	10°14'.1	23/11	-	0850-1424	/IKMT + N113H/ to 1500 m.
6202	36°38'.5	10°15'.8	23/11	-	1442-1900	/IKMT + N113H/ to 1000 m.
6203	36°28'.0	10°16'.5	23/11	-	2010-2253	IKMTB to 515 m. /N113B + N70B/ to 515 m.
6204	36°41'.0	10°11'.9	23/11 24/11	-	2343 -0730	EMT to 140 m. BT