OCEANOGRAPHICAL OBSERVATIONS
IN THE INDIAN OCEAN IN 1963
H.M.A.S. *DIAMANTINA*
Cruise Dm6/63

OCEANOGRAPHICAL CRUISE REPORT NO. 30

DIVISION OF FISHERIES AND OCEANOGRAPHY
COMMONWEALTH SCIENTIFIC AND INDUSTRIAL
RESEARCH ORGANIZATION, AUSTRALIA 1969

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MELBOURNE, 1969

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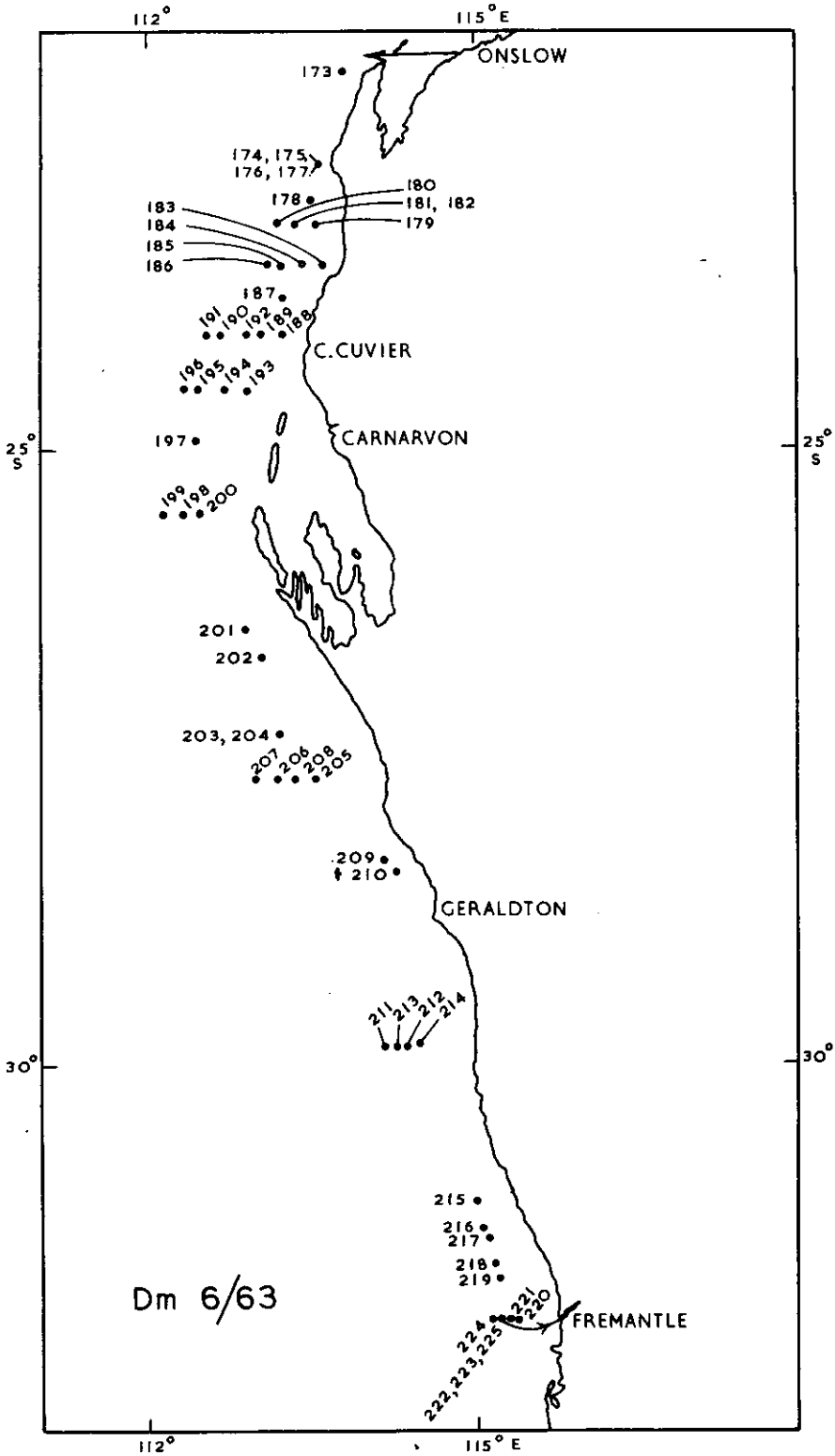

Fig. 1. Track chart Cruise Dm. 6/63

OCEANOGRAPHICAL CRUISE REPORT

No. 30

Oceanographical Observations in the Indian Ocean in 1963

H.M.A.S. Diamantina

Cruise Dm6/63

October 5-12, 1963

I. INTRODUCTION

This report records the data collected during the sixth cruise in 1963 of H.M.A.S. Diamantina, Royal Australian Navy oceanographical frigate.

Objectives

To find late larval stages of the western crayfish (Panulirus longipes cygnus) and to measure their distribution and density.

To determine whether there are any deep-water prawns breeding near the edge of the continental shelf.

To sample sediments on the shelf.

To examine the hydrological conditions on and adjacent to the continental shelf.

Itinerary

The cruise began at Onslow on October 5, and a series of traverses was occupied across the continental shelf. The cruise ended at Fremantle on October 12 (Fig. 1).

Scientific Personnel

R.G. Chittleborough (Cruise Leader)
E. Barker, Western Australian Fisheries Department
M. Farrand, CSIRO Division of Applied Mineralogy
R.W. George, Western Australian Museum
J. Klye
B. Scott
R.J. Slack-Smith, Western Australian Fisheries Department
L.R. Thomas

Midwater trawl, beam trawl, and dredge samples were examined for crayfish larvae by R.G. Chittleborough and L.R. Thomas. Prawns taken with the same equipment were collected by R.J. Slack-Smith and E. Barker. R.W. George collected crabs taken

by beam trawl and dredge. M. Farrand and R.W. George operated the grab to sample bottom sediments. Bottom photographs were taken by R.G. Chittleborough and L. Thomas. Water samples were collected, and salinity, oxygen, and phosphate analyses were done in the ship's laboratory, by J. Klye. Nitrate analyses were done at Cronulla by J. Klye.

The data were processed under the direction of W. Hedge, using computer programmes designed by A.D. Crooks. The track chart was prepared for publication by R. Breach.

II. WORK ACCOMPLISHED

Fifty-three stations were worked (Dm6/173/63-Dm6/225/63). Surface and subsurface hydrology samples were collected at 13 stations. Sediments were collected at 41 stations and bottom photographs were taken at 9 stations. Midwater trawling was done at 6 stations, beam trawling at 9 stations and dredging at 8 stations.

TABLE 1

WORK DONE AT EACH STATION

Stn No.	Hydrology Surface to Depth (m)	Sediments	Bottom Photography	Benthos 1	Benthos 2	Micro-nekton
173	125	+	+	+	+	+
174		+				
175		+				
176		+				
177		+				
178				+		
179		+				
180		+				
181	250					+
182	125		+	+	+	
183		+				
184		+				
185		+				
186		+				
187				+	+	
188		+				
189		+				
190		+				
191	250	+				+
192	125		+		+	
193		+				

Stn No.	Hydrology Surface to Depth (m)	Sediments	Bottom Photography	Benthos 1	Benthos 2	Micro-nekton
194		+				
195		+				
196		+				
197		+			+	
198		+				
199	250	+				+
200	120	+	+		+	
201		+				
202		+				
203		+				
204		+		+	+	
205		+				
206		+				
207	250					+
208	100	+	+	+	+	
209		+				
210		+				
211		+				
212						
213	500					
214	125		+	+		
215		+				
216		+				
217		+	+			
218		+				
219		+				
220						
221		+				
222		+				
223		+				
224	460					+
225	125	+	+		+	

Benthos 1 Dredge
2 Beam trawl

III. METHODS OF COLLECTION AND ANALYSIS OF SAMPLES

1. Physics

Temperature.—Water temperatures were taken with deep-sea reversing thermometers: protected thermometers with a range of -2° to $30^{\circ}C$, and unprotected thermometers with a range of

either -2° to 30°C or -4° to 60°C. Temperatures are considered accurate to ±0.03 degC.

Thermometric Depth.—Depth calculations were made by the method described by Pollak (1950) and are considered accurate to ±15 m at depths greater than 1000 m, and to 1% at depths less than 1000 m.

Sigma-t.—Sigma-t values were computed from temperature and salinity values using the equations of Knudsen (La Fond 1951).

2. Chemistry

Salinity.—Salinity was measured on board with an inductive salinometer (Brown and Hamon 1961).

Dissolved Oxygen.—A version of the standard Winkler method was used to determine the amount of dissolved oxygen in the sea-water samples. The version used is a modification of that described by Thompson and Robinson (1939) and differs in some respects from the revision by Jacobsen, Robinson, and Thompson (1950). Potassium iodate was used at the iodometric standard and the reagents necessary to fix the oxygen in solution were used at different concentrations (Rochford 1963). Duplicate titrations were made on approximately every tenth sample. Saturation values were computed using the simpler of the equations given by Richards and Corwin (1956) -

$$O_2\ (\%\ \text{Satn.}) = \frac{O_2\ (\text{ml/l}) \times (33.5 + T^\circ C) \times 100}{332.4 - (1.854 \times S‰)}\ .$$

Inorganic Phosphate.—The method of Atkins (1923) was used with 1 ml molybdate reagent (300 ml 10% w/v ammonium molybdate and 100 ml 50% v/v sulphuric acid) and 0.1 ml 1% w/v stannous chloride diluted afresh from a 40% stock solution in hydrochloric acid, which was kept under paraffin. The reagents were dispensed automatically by a piston dispenser.

Standard phosphate solutions were made up in distilled water. At air temperatures less than 25°C, analyses were carried out in batches of 10; readings were begun within 10 min of adding reagents, and completed within 10 min. At air temperatures greater than 25°C, batches of 6 were analysed; readings were begun within 5 min of adding reagents, and completed within 7 min. Each batch was compared with a distilled water blank and a 0.65 µg-atom/l standard in a Hilger Spekker absorptiometer using 4 cm cells and Ilford 608 filters. Each day a

complete calibration was made using standards up to 3.25 µg-atom/l. Results are given as µg-atom/l with no correction for salt error and are precise to ±10% for values less than 0.5 µg-atom/l and to ±5% for higher values. To correct for salt effects the results given should be multiplied by 1.15.

Total Phosphorus.—100 ml samples were drawn from the Nansen bottles into 150 ml Pyrex conical flasks, 0.2 ml of 72% v/v perchloric acid was added, and digestion at 200°-250°C carried out immediately on a sand tray. After evaporation of water, heating was continued until fuming of the salt residue commenced. The samples were then allowed to cool and 100 ml of distilled water and 2 drops of 2% w/v phenolpthalein were added. If alkaline, perchloric acid was added until a slight acidity persisted. The flasks were allowed to stand for about 24 hr to allow the salts to dissolve. Phosphate was then determined as described above for inorganic phosphate. Results are given as µg-atom/l with no correction for salt error. To correct for salt effects the results given should be multiplied by 1.15.

Nitrate.—After collection, water samples were stored in 50 ml plastic bottles and preserved with 0.5 ml of saturated $HgCl_2$. Nitrate was determined at Cronulla by the strychnidine method (Rochford 1947). The reagent was prepared by adding 0.64 g strychnidine to a litre of nitrate-free sulphuric acid. Five ml of this reagent were added, with minimum agitation, to 5 ml sea-water or standard nitrate solution. The standards were made up in a mixture of equal volumes of artificial sea-water and nitrate-free sulphuric acid. The standards and samples were shaken to distribute the reagent, and the colour developed for 2 hr. The solutions were read in a Unicam SP 600 spectrophotometer at a wavelength of 530 nm using a 5 mm cell. Samples with an absorbance greater than that of the standard corresponding to 14.4 µg-atom/l were diluted with artificial sea-water/sulphuric acid mixture before reading. Results are given in µg-atom/l.

3. Micronekton

The midwater trawl or micronekton sampling consisted of oblique tows through the upper 200 m with a 5-ft Isaacs-Kidd midwater trawl, a scaled-down version of the 6-ft trawl (King and Iversen 1962; Aron 1960).

No flowmeter was used. The trawl was fitted with a depth recorder (Hamon, Tranter, and Heron 1963) and lowered from the stern while the ship's speed was 2 kt. When the trawl was clear

of the ship, speed was increased to 5 kt and the wire was paid out at 40–50 m/min under a constant and minimum tension. After 600 m of wire had been paid out the ship's speed was reduced to 3 kt and further adjusted according to the reading of a tension gauge. A final 100 m was then paid out making the total 700 m. After 5 min the wire was retrieved at a winch speed of 9 m/min. Tows were made at approx. 2200 h. The paying-out period averaged 15 min and the retrieval period 80 min.

The net was washed from outside into the bucket which was then removed from the net. The net was checked for organisms caught in the meshes (e.g. leptocephali); these were removed. Phyllosoma and puerulus larvae were sorted from the samples on board, and the remainder of the samples was stored in neutralized 10% formalin in plastic bottles; larger organisms were stored separately. Samples are held at Perth.

4. Benthos

Beam Trawl.—A beam trawl was towed on the sea floor at 2–3 kt for periods ranging from 14–40 min at stations indicated in Table 1.

Dredge.—A triangle dredge (1 m sides) was towed on the sea floor in a similar manner to the beam trawl.

Benthic material was sorted on board; crabs, crayfish, and crayfish larvae were removed and the remainder of the samples was sorted into phyla and sent to the Western Australian Museum.

5. Geology

Sediments.—Sediments were sampled using the Petersen grab. The samples were used in a study of the foraminifera of the continental shelf (Betjeman 1965). Subsamples were analysed for phosphate content by the CSIRO Division of Applied Mineralogy (CSIRO Aust. 1964).

Bottom Photographs.—Bottom photographs were taken at the stations indicated in Table 1, using the Ewing suspended camera as described in CSIRO Aust. (1967). Copies of the photographs were made available to the Geology Department of the University of Western Australia to assist in the interpretation of sediment analyses.

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IV. DATA

Hydrology data were processed in a C.D.C. 3600 Computer. An explanation of the headings used is given at the beginning of each part, except for hydrology, where it is at the beginning of the surface listing.

DATA

PART 1

HYDROLOGY

SURFACE SAMPLES

EXPLANATION OF HEADINGS

Parts 1 and 2	Hydrology
STATION	Gives the station identification. For example, Dm6/173/63 signifies the 173rd station worked by Diamantina in 1963, on her 6th cruise for that year
DATE	Given as day/month/year
TIME	Given in Zone Time, and is the time at the beginning of the first cast. The code letter used for the time zone follows the time. Zone Time throughout the cruise was Western Australian Standard Time, GMT +8 hr, Code H
LATITUDE LONGITUDE	Given in degrees and minutes
SONIC DEPTH	Given in metres, measured at standard sound velocity of 800 fm (1463 m) per second
AIR TEMP. WET DRY	Air temperatures recorded from wet and dry bulb thermometers in °C
WIND DIR. SP.	Wind direction and speed are coded using Tables 8 and 9 in U.S. Navy Hydrogr. Office (1955)
ANEM. HEIGHT	The average height of the anemometer above sea level, given in metres
CLOUD TYPE AMT.	Cloud type and amount are coded using Tables 2 and 3 in U.S. Navy Hydrogr. Office (1955)
WEA.	Weather is coded using Table 1 in U.S. Navy Hydrogr. Office (1955)
VIS.	Visibility is coded using Table 4 in U.S. Navy Hydrogr. Office (1955)
SEA DIR. AMT.	Sea direction and amount are coded using Tables 5 and 8 in U.S. Navy Hydrogr. Office (1955)

SWELL DIR. AMT.	Sea swell direction and amount are coded using Tables 6 and 8 in U.S. Navy Hydrogr. Office (1955)
BAROM. or ATMOS. PRESSURE	Atmospheric pressure given in millibars
WIRE ANGLES CAST1 CAST2 CAST3	Wire angles are measured at the surface and expressed in degrees for each cast
CAST	Gives the cast number
DEPTH	Sampling depth, given in metres
TEMP.	Sea temperature recorded in °C
SALINITY	Given in parts per thousand
SIGMA-T	Sigma-t to 2 decimal places
OXYGEN	Given in ml/l
OXYGEN % SAT.	Oxygen percentage saturation
INORG. P	Inorganic phosphorus, given in µg-atom P/l
TOTAL P	Total phosphorus, given in µg-atom P/l
NITRATE	Given in µg-atom N/l

*, ***, or a blank indicate no data available

CRUISE	STATION NUMBER	YR.	MTH.	DAY	TIME	LATITUDE	LONGITUDE	TEMP.	SALINITY	WIND DN.	WIND AMT.	SEA DN.	SEA AMT.	SWELL DN.	SWELL AMT.	WEA.	VIS.	BAROM.
6	173	63	10	5	2210	H 21 50	S 113 53	E 23.8	34.99	19	5	19	2	19	1		8	1015.0
6	174	63	10	6	1110	H 22 41	S 113 34	E		19		19	2	20	4	01	7	1015.9
6	175	63	10	6	1145	H 22 41	S 113 32	E		19	4	19	2	19	4	00	7	1014.5
6	176	63	10	6	1226	H 22 42	S 113 28	E		21	5	21	2	19	1	00	7	1014.4
6	177	63	10	6	1319	H 22 41	S 113 25	E		21		20	2	19	4	00	7	1014.1
6	178	63	10	6	1500	H 22 52	S 113 29	E		21	5	22	2	20	4	00	7	1013.1
6	179	63	10	6	1830	H 23 05	S 113 34	E		19	5	19	3	19	4	00	7	1013.5
6	180	63	10	6	2000	I 23 05	S 113 21	E		17	5	19	3	19	4		7	1015.0
6	181	63	10	6	2055	H 23 05	S 113 11	E 23.3	35.09	17	5	19	3	19	4		7	1015.2
6	182	63	10	6	2350	H 23 05	S 113 24	E 22.9	35.05	15	5	20	3	18	1		8	1015.5
6	183	63	10	7	0815	H 23 25	S 113 36	E		13	4	18	2	22	1	00	7	1017.5
6	184	63	10	7	0918	H 23 25	S 113 26	E		13	4	18	2	22	1	00	7	1017.9
6	185	63	10	7	1030	H 23 25	S 113 14	E		14	4	14	2	19	1	00	7	1017.3
6	186	63	10	7	1120	H 23 25	S 113 09	E		15	5	13	3	18	4	00	8	1016.2
6	187	63	10	7	1345	H 23 39	S 113 12	E		20	5	20	3	19	1	00	8	1015.0
6	188	63	10	7	1830	H 24 03	S 113 15	E		19	4	19	3	20	4	00	8	1017.3
6	189	63	10	7	1945	H 24 03	S 113 02	E		19	3	19	3	20	1	00	8	1018.0
6	190	63	10	7	2145	H 24 04	S 112 39	E		17	4	17	3	19	1	00	8	1018.1
6	191	63	10	7	2245	H 24 04	S 112 33	E 22.7	35.15	17	4	17	3	20	1		8	1017.9
6	192	63	10	8	0240	H 24 04	S 112 52	E 22.4	35.17	15	5	17	2	19	1		7	1017.1
6	193	63	10	8	0900	H 24 37	S 112 55	E		15	4	15	2	19	1	00	8	1019.0
6	194	63	10	8	1025	H 24 37	S 112 41	E		15	4	15	3	20	1	00	8	1018.6
6	195	63	10	8	1150	H 24 37	S 112 26	E		15	4	15	3	17	1	00	8	1018.0
6	196	63	10	8	1235	H 24 37	S 112 21	E		13	4	14	2	17	4	00	7	1017.8
6	197	63	10	8	1555	H 24 59	S 112 27	E		18	4	18	2	16	1	00	7	1016.1
6	198	63	10	8	1945	H 25 30	S 112 22	E		18	5	18	3	16	4	00	8	1016.9
6	199	63	10	8	2215	H 25 30	S 112 09	E 21.7	35.29	15	4	21	3	16	4	00	7	1017.9
6	200	63	10	9	0110	H 25 31	S 112 29	E 21.5	35.29	16	5	16	3	21	1		8	1015.0
6	201	63	10	9	0925	H 26 28	S 112 53	E		99	0			17	1	01	7	1015.6
6	202	63	10	9	1130	H 26 47	S 113 01	E		22	1			18	1	01	7	1014.1
6	203	63	10	9	1345	H 27 19	S 113 14	E		23	3	23	2	21	1	01	8	1014.0
6	204	63	10	9	1430	H 27 19	S 113 16	E		23	4	23	2	21	1	01	8	1014.0
6	205	63	10	9	1910	H 27 40	S 113 32	E		20	6	20	4	22	4	03	8	1016.5
6	206	63	10	9	2100	H 27 40	S 113 12	E		19	5	19	4	21	1	02	8	1017.9
6	207	63	10	9	2215	H 27 40	S 113 00	E 21.1	35.38	17	6	18	4	21	1		8	1018.0
6	208	63	10	10	0130	H 27 40	S 113 20	E 20.8	35.39	15	5	18	4	21	1		7	1018.0
6	209	63	10	10	1135	H 28 25	S 114 09	E		14	6	14	3	18	1	00	7	1022.0
6	210	63	10	10	1235	H 28 32	S 114 16	E		15	5	15	3	19	1	00	7	1021.4
6	211	63	10	10	1950	H 29 50	S 114 11	E		18	5	18	4	20	4	00	7	1023.8
6	212	63	10	10	2050	H 29 50	S 114 23	E		11	5	14	3	17	4	00	7	1024.5

CRUISE	STATION NUMBER	YR.	MTH.	DAY	TIME	LATITUDE	LONGITUDE	TEMP.	SALINITY	WIND DN.	WIND AMT.	SEA DN.	SEA AMT.	SWELL DN.	SWELL AMT.	WEA.	VIS.	BAROM.
6	213	63	10	10	2200	H 29 50 S	114 17 E	20.2	35.52	16	5	14	3	18	4		7	1025.1
6	214	63	10	11	0115	H 29 50 S	114 24 E	20.4	35.51	15	5	15	3	21	1		8	1024.5
6	215	63	10	11	1110	H 31 02 S	115 00 E			10	4	09	3	12	4	00	7	1026.6
6	216	63	10	11	1245	H 31 19 S	115 03 E			14	4	14	3	20	4	00	7	1026.0
6	217	63	10	11	1330	H 31 22 S	115 05 E			14	4	14	3	20	4	00	7	1025.8
6	218	63	10	11	1510	H 31 32 S	115 11 E			15	4	15	3	19	4	00	7	1025.0
6	219	63	10	11	1615	H 31 39 S	115 14 E			18	5	18	3	18	4	00	7	1028.5
6	220	63	10	11	1930	H 32 00 S	115 24 E			13	3	13	3	20	1	00	7	1027.5
6	221	63	10	11	2000	H 32 00 S	115 21 E			11	3	11	3	20	1	00	8	1027.7
6	222	63	10	11	2150	H 32 00 S	115 14 E			11	3	11	3	20	1	00	8	1027.2
6	223	63	10	11	2125	H 32 01 S	115 12 E			11	3	11	3	20	1	00	8	1027.0
6	224	63	10	11	2205	H 32 00 S	115 09 E	19.5	35.61	12	3	12	3	21	1		8	1027.1
6	225	63	10	12	0045	H 32 00 S	115 16 E	19.3	35.54	09	7	07	3	13	4		7	1025.5

DATA

PART 2

HYDROLOGY

DEEP STATIONS

STATION	DATE	TIME	LATITUDE	LONGITUDE
DM 6/ 173/63	5/10/63	2210 H	21 50 S	113 53 E

SONIC DEPTH	AIR TEMP. WET	AIR TEMP. DRY	WIND DIR.	WIND SP.	ANEM. HEIGHT	CLOUD TYPE	CLOUD AMT.	VIS.	SEA DIR.	SEA AMT.	SWELL DIR.	SWELL AMT.	ATMOS. PRESSURE	WIRE ANGLES CAST1	CAST2	CAST3
137	23.9	21.7	19	5	16	0	0	8	19	2	19	1	1015.0	10	*	*

CAST	DEPTH	TEMP.	SALINITY	SIGMA-T	OXYGEN	OXYGEN % SAT.	INORG. P	TOTAL P	NITRATE
1	0	23.75	34.988	23.73	5.12	106	0.18	***	0.0
1	25	23.41	35.158	23.95	5.16	106	0.17	***	0.0
1	50	22.81	35.249	24.20	4.97	101	0.21	***	0.0
1	75	22.49	35.226	24.27	4.82	97	0.28	***	0.1
1	100	22.18	35.287	24.40	4.71	95	0.35	***	0.5
1	125	22.08	35.308	24.45	4.72	95	0.36	***	0.5

STATION	DATE	TIME	LATITUDE	LONGITUDE
DM 6/ 181/63	6/10/63	2055 H	23 05 S	113 11 E

SONIC DEPTH	AIR TEMP. WET	AIR TEMP. DRY	WIND DIR.	WIND SP.	ANEM. HEIGHT	CLOUD TYPE	CLOUD AMT.	VIS.	SEA DIR.	SEA AMT.	SWELL DIR.	SWELL AMT.	ATMOS. PRESSURE	WIRE ANGLES CAST1	CAST2	CAST3
280	20.8	23.3	17	5	16	6	1	7	19	3	19	4	1015.2	10	*	*

CAST	DEPTH	TEMP.	SALINITY	SIGMA-T	OXYGEN	OXYGEN % SAT.	INORG. P	TOTAL P	NITRATE
1	0	23.32	35.092	23.93	5.06	104	0.22	***	0.0
1	25	23.29	35.078	23.93	5.06	104	0.17	***	0.0
1	50	23.21	35.077	23.95	5.07	104	0.22	***	0.0
1	75	22.84	35.071	24.05	5.11	104	0.24	***	0.0
1	100	22.14	35.129	24.30	4.63	93	0.30	***	0.5
1	125	21.22	35.309	24.69	4.77	94	0.28	***	0.4
1	150	20.49	35.429	24.98	4.53	88	0.36	***	1.5
1	200	18.36	35.588	25.65	4.44	83	0.47	***	2.5
1	250	16.02	35.588	26.21	4.93	88	0.47	***	3.0

STATION	DATE	TIME	LATITUDE	LONGITUDE
DM 6/ 182/63	6/10/63	2350 H	23 05 S	113 24 E

SONIC DEPTH	AIR TEMP. WET	AIR TEMP. DRY	WIND DIR.	WIND SP.	ANEM. HEIGHT	CLOUD TYPE	CLOUD AMT.	VIS.	SEA DIR.	SEA AMT.	SWELL DIR.	SWELL AMT.	ATMOS. PRESSURE	WIRE ANGLES CAST1	CAST2	CAST3
130	20.6	22.2	15	5	16	0	0	8	20	3	18	1	1015.5	0	*	*

CAST	DEPTH	TEMP.	SALINITY	SIGMA-T	OXYGEN	OXYGEN % SAT.	INORG. P	TOTAL P	NITRATE
1	0	22.92	35.053	24.02	5.04	103	0.15	***	0.4
1	25	22.89	35.043	24.02	5.11	104	0.17	***	0.0
1	50	22.45	35.091	24.18	4.99	101	0.18	***	0.0
1	75	22.11	35.177	24.34	4.71	95	0.28	***	0.2
1	100	22.23	35.307	24.41	4.67	94	0.23	***	0.1
1	125	21.02	35.311	24.75	4.41	87	0.35	***	0.5

STATION	DATE	TIME	LATITUDE	LONGITUDE
DM 6/ 191/63	7/10/63	2245 H	24 04 S	112 33 E

SONIC DEPTH	AIR TEMP. WET	AIR TEMP. DRY	WIND DIR.	WIND SP.	ANEM. HEIGHT	CLOUD TYPE	CLOUD AMT.	VIS.	SEA DIR.	SEA AMT.	SWELL DIR.	SWELL AMT.	ATMOS. PRESSURE	WIRE ANGLES CAST1	CAST2	CAST3
302	19.6	22.2	17	4	16	0	0	8	17	3	20	1	1017.9	0	*	*

CAST	DEPTH	TEMP.	SALINITY	SIGMA-T	OXYGEN	OXYGEN % SAT.	INORG. P	TOTAL P	NITRATE
1	0	22.65	35.154	24.17	5.18	105	0.20	***	***
1	25	22.61	35.149	24.18	5.17	105	0.25	***	0.0
1	50	22.60	35.148	24.18	5.19	105	0.24	***	0.0
1	75	22.36	35.154	24.25	5.14	104	0.24	***	0.0
1	100	22.04	35.214	24.39	5.13	103	0.28	***	0.0
1	125	21.55	35.217	24.53	4.66	93	0.45	***	0.3
1	150	20.50	35.395	24.95	4.48	87	0.45	***	0.9
1	200	19.15	35.587	25.45	4.57	87	0.43	***	0.5
1	250	14.92	35.504	26.40	5.26	92	0.57	***	3.4

STATION	DATE	TIME	LATITUDE	LONGITUDE
DM 6/ 192/63	8/10/63	0240 H	24 04 S	112 52 E

SONIC DEPTH	AIR TEMP. WET	AIR TEMP. DRY	WIND DIR.	WIND SP.	ANEM. HEIGHT	CLOUD TYPE	CLOUD AMT.	VIS.	SEA DIR.	SEA AMT.	SWELL DIR.	SWELL AMT.	ATMOS. PRESSURE	WIRE ANGLES CAST1	CAST2	CAST3
130	20.0	21.7	15	5	16	0	0	7	17	2	19	1	1017.1	10	*	*

CAST	DEPTH	TEMP.	SALINITY	SIGMA-T	OXYGEN	OXYGEN % SAT.	INORG. P	TOTAL P	NITRATE
1	0	22.41	35.174	24.26	5.15	104	0.23	***	0.0
1	25	22.38	35.167	24.26	5.12	103	0.23	***	0.0
1	50	22.30	35.163	24.28	5.08	102	0.26	***	0.1
1	75	21.83	35.180	24.42	4.75	95	0.38	***	0.9
1	100	21.35	35.232	24.60	4.51	89	0.43	***	1.6
1	125	21.06	35.292	24.72	4.45	88	0.47	***	***

STATION	DATE	TIME	LATITUDE	LONGITUDE
DM 6/ 199/63	8/10/63	2120 H	25 30 S	112 09 E

SONIC DEPTH	AIR TEMP. WET	AIR TEMP. DRY	WIND DIR.	WIND SP.	ANEM. HEIGHT	CLOUD TYPE	CLOUD AMT.	VIS.	SEA DIR.	SEA AMT.	SWELL DIR.	SWELL AMT.	ATMOS. PRESSURE	WIRE ANGLES CAST1	CAST2	CAST3
285	18.9	20.6	15	4	16	0	0	7	21	3	16	4	1017.9	*	*	*

CAST	DEPTH	TEMP.	SALINITY	SIGMA-T	OXYGEN	OXYGEN % SAT.	INORG. P	TOTAL P	NITRATE
1	0	21.67	35.293	24.55	5.27	105	0.17	***	0.0
1	25	21.56	35.287	24.58	5.31	106	0.15	***	0.0
1	50	20.45	35.471	25.02	5.43	106	0.15	***	0.1
1	75	19.61	35.615	25.35	4.76	91	0.29	***	1.3
1	100	19.01	35.679	25.55	5.54	105	0.17	***	0.1
1	125	18.51	35.731	25.72	5.49	103	0.18	***	0.0
1	150	18.28	35.778	25.81	5.31	99	0.23	***	0.2
1	200	17.64	35.804	25.99	5.14	95	0.26	***	0.4
1	250	16.41	35.730	26.23	5.35	96	0.32	***	***

STATION	DATE	TIME	LATITUDE	LONGITUDE
DM 6/ 200/63	9/10/63	0110 H	25 31 S	112 29 E

SONIC DEPTH	AIR TEMP. WET	AIR TEMP. DRY	WIND DIR.	WIND SP.	ANEM. HEIGHT	CLOUD TYPE	CLOUD AMT.	VIS.	SEA DIR.	SEA AMT.	SWELL DIR.	SWELL AMT.	ATMOS. PRESSURE	WIRE ANGLES CAST1	CAST2	CAST3
130	18.9	20.6	16	5	16	0	0	8	16	3	21	1	1015.0	*	*	*

CAST	DEPTH	TEMP.	SALINITY	SIGMA-T	OXYGEN	OXYGEN % SAT.	INORG. P	TOTAL P	NITRATE
1	0	21.48	35.287	24.60	5.31	105	0.17	***	0.0
1	25	21.44	35.289	24.61	5.31	105	0.17	***	0.0
1	50	21.29	35.289	24.65	5.35	106	0.15	***	0.0
1	75	20.70	35.401	24.90	5.25	103	0.24	***	0.0
1	100	19.90	35.548	25.22	4.85	94	0.24	***	0.7
1	120	19.52	35.580	25.35	5.01	96	0.27	***	0.8

STATION	DATE	TIME	LATITUDE	LONGITUDE
DM 6/ 207/63	9/10/63	2215 H	27 40 S	113 00 E

SONIC DEPTH	AIR TEMP. WET	AIR TEMP. DRY	WIND DIR.	WIND SP.	ANEM. HEIGHT	CLOUD TYPE	CLOUD AMT.	VIS.	SEA DIR.	SEA AMT.	SWELL DIR.	SWELL AMT.	ATMOS. PRESSURE	WIRE ANGLES CAST1	CAST2	CAST3
265	16.1	18.9	17	6	16	6	3	8	18	4	21	1	1018.0	10	*	*

CAST	DEPTH	TEMP.	SALINITY	SIGMA-T	OXYGEN	OXYGEN % SAT.	INORG. P	TOTAL P	NITRATE
1	0	21.09	35.376	24.78	5.36	106	0.12	***	1.2
1	25	21.08	35.372	24.77	5.36	106	0.21	***	1.0
1	50	20.93	35.374	24.82	5.39	106	0.21	***	1.4
1	75	20.43	35.463	25.02	5.21	101	0.20	***	0.1
1	100	20.03	35.510	25.16	5.15	100	0.21	***	1.2
1	125	19.80	35.609	25.30	5.42	104	0.19	***	0.1
1	150	19.36	35.636	25.43	5.12	98	0.28	***	0.2
1	200	18.72	35.709	25.65	5.19	98	0.28	***	1.0
1	250	18.19	35.733	25.80	5.15	96	0.32	***	1.5

STATION	DATE	TIME	LATITUDE	LONGITUDE
DM 6/ 208/63	10/10/63	0130 H	27 40 S	113 20 E

SONIC DEPTH	AIR TEMP. WET	AIR TEMP. DRY	WIND DIR.	WIND SP.	ANEM. HEIGHT	CLOUD TYPE	CLOUD AMT.	VIS.	SEA DIR.	SEA AMT.	SWELL DIR.	SWELL AMT.	ATMOS. PRESSURE	WIRE ANGLES CAST1	CAST2	CAST3
128	14.3	17.8	15	5	16	8	2	7	18	4	21	1	1018.0	*	*	*

CAST	DEPTH.	TEMP.	SALINITY	SIGMA-T	OXYGEN	OXYGEN % SAT.	INORG. P	TOTAL P	NITRATE
1	0	20.81	35.390	24.86	5.39	106	0.14	***	0.1
1	25	20.79	35.388	24.86	5.37	105	0.17	***	0.1
1	50	20.76	35.386	24.87	5.36	105	0.19	***	0.1
1	75	20.35	35.433	25.02	5.14	100	0.21	***	0.0
1	100	19.83	35.502	25.21	4.89	94	0.30	***	1.6

STATION	DATE	TIME	LATITUDE	LONGITUDE
DM 6/ 213/63	10/10/63	2200 H	29 50 S	114 17 E

SONIC DEPTH	AIR TEMP. WET	AIR TEMP. DRY	WIND DIR.	WIND SP.	ANEM. HEIGHT	CLOUD TYPE	CLOUD AMT.	VIS.	SEA DIR.	SEA AMT.	SWELL DIR.	SWELL AMT.	ATMOS. PRESSURE	WIRE ANGLES CAST1	CAST2	CAST3
560	12.8	17.2	16	5	16	8	3	7	14	3	18	4	1025.1	*	*	*

CAST	DEPTH	TEMP.	SALINITY	SIGMA-T	OXYGEN	OXYGEN % SAT.	INORG. P	TOTAL P	NITRATE
1	0	20.15	35.521	25.14	5.42	105	0.19	***	0.3
1	25	19.88	35.561	25.24	5.46	105	0.17	***	0.0
1	50	19.11	35.666	25.52	5.49	104	0.17	***	0.7
1	75	18.25	35.679	25.75	5.47	102	0.22	***	0.2
1	100	17.88	35.760	25.90	5.24	97	0.26	***	0.7
1	125	17.45	35.758	26.00	5.29	97	0.28	***	0.5
1	150	16.82	35.745	26.15	5.58	101	0.19	***	0.0
1	200	15.85	35.687	26.33	5.55	99	0.27	***	0.9
1	250	14.73	35.540	26.46	5.50	96	0.45	***	2.4
1	300	12.92	35.262	26.63	5.61	94	0.58	***	6.6
1	400	9.92	34.810	26.84	5.91	92	0.92	***	15.6
1	500	8.73	34.640	26.90	5.67	86	1.14	***	26.1

STATION	DATE	TIME	LATITUDE	LONGITUDE
DM 6/ 214/63	11/10/63	0115 H	29 50 S	114 24 E

SONIC DEPTH	AIR TEMP. WET	AIR TEMP. DRY	WIND DIR.	WIND SP.	ANEM. HEIGHT	CLOUD TYPE	CLOUD AMT.	VIS.	SEA DIR.	SEA AMT.	SWELL DIR.	SWELL AMT.	ATMOS. PRESSURE	WIRE ANGLES CAST1	CAST2	CAST3
130	13.3	17.2	15	5	16	0	0	8	15	3	21	1	1024.5	*	*	*

CAST	DEPTH	TEMP.	SALINITY	SIGMA-T	OXYGEN	OXYGEN % SAT.	INORG. P	TOTAL P	NITRATE
1	0	20.40	35.508	25.06	5.05	98	0.18	***	0.1
1	25	19.96	35.511	25.18	4.99	96	0.16	***	0.2
1	50	19.03	35.551	25.45	5.49	104	0.18	***	0.0
1	75	19.02	35.564	25.46	5.35	101	0.17	***	0.1
1	100	18.83	35.643	25.57	5.30	100	0.18	***	0.0
1	125	18.50	35.684	25.69	5.36	101	0.21	***	0.0

STATION	DATE	TIME	LATITUDE	LONGITUDE
DM 6/ 224/63	11/10/63	2205 H	32 00 S	115 09 E

SONIC DEPTH	AIR TEMP. WET	AIR TEMP. DRY	WIND DIR.	WIND SP.	ANEM. HEIGHT	CLOUD TYPE	CLOUD AMT.	VIS.	SEA DIR.	SEA AMT.	SWELL DIR.	SWELL AMT.	ATMOS. PRESSURE	WIRE ANGLES CAST1	CAST2	CAST3
603	14.4	18.3	12	3	16	0	0	8	12	3	21	1	1027.1	10	*	*

CAST	DEPTH	TEMP.	SALINITY	SIGMA-T	OXYGEN	OXYGEN % SAT.	INORG. P	TOTAL P	NITRATE
1	0	19.53	35.611	25.37	5.43	104	0.30	***	0.7
1	24	19.51	35.567	25.34	5.34	102	0.30	***	1.0
1	49	19.09	35.596	25.47	5.40	103	0.31	***	0.6
1	73	18.44	35.640	25.67	5.40	101	0.21	***	0.3
1	97	17.72	35.692	25.89	5.28	98	0.23	***	0.4
1	121	17.35	35.714	25.99	5.35	98	0.27	***	0.2
1	145	17.10	35.719	26.06	5.37	98	0.28	***	0.6
1	193	16.52	35.727	26.20	5.42	98	0.31	***	0.5
1	239	16.01	35.697	26.30	5.47	98	0.32	***	1.2
1	285	14.29	35.488	26.52	5.45	94	0.49	***	***
1	374	9.27	34.772	26.92	5.69	88	1.09	***	18.8
1	460	8.63	34.630	26.91	5.49	83	1.24	***	20.1

STATION	DATE	TIME	LATITUDE	LONGITUDE
DM 6/ 225/63	12/10/63	0045 H	32 00 S	115 16 E

SONIC DEPTH	AIR TEMP. WET	AIR TEMP. DRY	WIND DIR.	WIND SP.	ANEM. HEIGHT	CLOUD TYPE	CLOUD AMT.	VIS.	SEA DIR.	SEA AMT.	SWELL DIR.	SWELL AMT.	ATMOS. PRESSURE	WIRE ANGLES CAST1	CAST2	CAST3
139	11.7	15.6	09	7	16	0	0	7	07	3	13	4	1025.5	0	*	*

CAST	DEPTH	TEMP.	SALINITY	SIGMA-T	OXYGEN	OXYGEN % SAT.	INORG. P	TOTAL P	NITRATE
1	0	19.29	35.544	25.38	5.40	103	0.27	***	***
1	25	19.31	35.556	25.38	5.39	103	0.25	***	***
1	50	19.26	35.559	25.40	5.40	103	0.28	***	***
1	75	18.82	35.577	25.53	5.31	100	0.27	***	***
1	100	18.49	35.621	25.64	5.31	100	0.33	***	***
1	125	17.74	35.695	25.89	5.34	99	0.31	***	***

DATA

PART 3

CRAYFISH LARVAE

EXPLANATION OF HEADINGS

Part 3	Crayfish Larvae
STN	Gives the station number
DATE	Given as day/month/year
LATITUDE LONGITUDE	Given in degrees and minutes
TIME	Given in Zone Time, and is the time at the beginning of the tow. The code letter for the time zone follows the time. Zone Time throughout the cruise was Western Australian Standard Time, GMT +8 hr, Code H
DURATION	Duration of tow given in minutes
DEPTH	Sampling depth given in metres

A blank indicates no crayfish larvae in sample

MIDWATER TRAWL SAMPLES

STN	DATE	LATITUDE	LONGITUDE	TIME	DURATION	DEPTH	PHYLLOSOMA		PUERULUS	
							Panulirus longipes cygnus	Scyllarids	Panulirus longipes cygnus	Scyllarids
173	5/10/63	21 50 S.	113 46 E.	2225 H	95	200–0		11	1	
181	6/10/63	23 05 S.	113 11 E.	2200 H	90	200–0		9		
191	7/10/63	24 04 S.	112 33 E.	2245 H	60	200–0		2		
199	8/10/63	25 30 S.	112 08 E.	2200 H	60	200–0		1		
207	9/10/63	27 40 S.	113 00 E.	2200 H	60	200–0		19		
224	11/10/63	32 00 S.	115 09 E.	2235 H	60	200–0				

DREDGE SAMPLES

STN	DATE	LATITUDE	LONGITUDE	TIME	DURATION	DEPTH	PHYLLOSOMA		PUERULUS	
							Panulirus longipes cygnus	Scyllarids	Panulirus longipes cygnus	Scyllarids
178	6/10/63	22 52 S.	113 29 E.	1500 H	11	123		1		
182	7/10/63	23 05 S.	113 24 E.	0043 H	25	130		3		
208	10/10/63	27 40 S.	113 20 E.	0250 H	15	128		14		

BEAM TRAWL SAMPLES

STN	DATE	LATITUDE	LONGITUDE	TIME	DURATION	DEPTH	PHYLLOSOMA		PUERULUS	
							Panulirus longipes cygnus	Scyllarids	Panulirus longipes cygnus	Scyllarids
204	9/10/63	27 18 S.	113 16 E.	1540 H	18	99		1		

DATA

PART 4

SEDIMENTS

EXPLANATION OF HEADINGS

Part 4	Sediments
STATION	Gives the station identification. For example, Dm6/173/63 signifies the 173rd station worked by Diamantina in 1963, on her 6th cruise for that year
DATE	Given as day/month/year
LATITUDE LONGITUDE	Given in degrees and minutes
SONIC DEPTH	Given in fathoms, measured at standard sound velocity of 800 fm (1463 m) per second

SEDIMENT SAMPLES

STATION	LATITUDE	LONGITUDE	SONIC DEPTH	SAMPLING METHOD	DESCRIPTION OF SEDIMENT
Dm6/173a/63	21 00 S.	113 49 E.	150	Petersen Grab	Brown, calcareous silt
Dm6/173/63	21 50 S.	113 53 E.	70	Petersen Grab	Brown, calcareous silt
Dm6/175/63	22 41 S.	113 32 E.	102	Petersen Grab	Brown, silty, coarse- to medium-grained, skeletal calcarenite, dominantly fragments of foraminiferans and molluscs
Dm6/176/63	22 42 S.	113 28 E.	158	Petersen Grab	Brown, medium-grained, skeletal calcarenite
Dm6/177/63	22 41 S.	113 25 E.	206	Petersen Grab	Brown,? calcareous silt
Dm6/179/63	23 05 S.	113 34 E.	50	Petersen Grab	Greyish-brown, fine- to medium-grained, skeletal calcarenite
Dm6/180/63	23 05 S.	113 21 E.	99	Petersen Grab	Brown, coarse- to medium-grained, skeletal calcarenite
Dm6/183/63	23 25 S.	113 36 E.	33	Petersen Grab	Brownish-orange, fine- to medium-grained, skeletal calcarenite
Dm6/184/63	23 25 S.	113 26 E.	54.5	Petersen Grab	Brown, silty, fine- to medium-grained, skeletal calcarenite
Dm6/185/63	23 25 S.	113 14 E.	102	Petersen Grab	Brown, fine- to medium-grained shell sand
Dm6/186/63	23 25 S.	113 09 E.	152	Petersen Grab	Brown, silty, fine-grained, skeletal calcarenite
Dm6/188/63	24 03 S.	113 15.5 E.	30	Petersen Grab	Brown, medium-grained, skeletal calcarenite and algal Lithothamnium nodules with living crusts of red algae
Dm6/189/63	24 03 S.	113 02 E.	48	Petersen Grab	Brown, fine- to medium-grained, skeletal calcarenite

SEDIMENT SAMPLES

STATION	LATITUDE	LONGITUDE	SONIC DEPTH	SAMPLING METHOD	DESCRIPTION OF SEDIMENT
Dm6/190/63	24 04 S.	112 39 E.	100	Petersen Grab	Brown, fine- to medium-grained, skeletal calcarenite
Dm6/191/63	24 04 S.	112 33 E.	165	Petersen Grab	Brown, fine- to medium-grained, skeletal calcarenite
Dm6/193/63	24 37 S.	112 55 E.	39	Petersen Grab	Brown, fine- to medium-grained, skeletal calcarenite
Dm6/194/63	24 37 S.	112 41 E.	61	Petersen Grab	Greyish-brown, fine- to medium-grained, skeletal calcarenite
Dm6/195/63	24 37 S.	112 26.5 E.	100	Petersen Grab	Light-brown, fine-grained, skeletal sand
Dm6/196/63	24 37 S.	112 20.5 E.	160	Petersen Grab	Light-brown, fine- to medium-grained, skeletal sand
Dm6/197/63	24 59 S.	112 27 E.	71	Petersen Grab	Greyish-brown, silty, fine-grained, shell sand
Dm6/198/63	25 30 S.	112 22 E.	78	Petersen Grab	Brown, silty, fine- to medium-grained, shell sand
Dm6/199/63	25 30 S.	112 08.5 E.	156	Petersen Grab	Brown, fine- to medium-grained, skeletal sand
Dm6/200/63	25 31 S.	112 29 E.	71	Petersen Grab	Grey, silty, very fine-grained, calcareous (? skeletal) sand
Dm6/201/63	26 28 S.	112 53 E.	79.5	Petersen Grab	Grey, silty, very fine-grained, calcareous (? skeletal) sand
Dm6/202/63	26 47 S.	113 01 E.	85	Petersen Grab	Light-brown, silty, fine- to medium-grained, skeletal sand
Dm6/203/63	27 19 S.	113 14 E.	73	Petersen Grab	Light-brown, fine- to medium-grained, skeletal sand

SEDIMENT SAMPLES

STATION	LATITUDE	LONGITUDE	SONIC DEPTH	SAMPLING METHOD	DESCRIPTION OF SEDIMENT
Dm6/204/63	27 18.5 S.	113 16 E.	52	Petersen Grab	Light-brown, medium- to coarse-grained, skeletal sand
Dm6/205/63	27 40 S.	113 32 E.	38	Petersen Grab	Fine, well graded sand of shell fragments
Dm6/206/63	27 00 S.	113 12 E.	95	Petersen Grab	Grey, silty, fine-grained, skeletal sand
Dm6/208/63	27 40 S.	113 20 E.	70	Petersen Grab	Grey, silty, fine-grained, skeletal sand
Dm6/209/63	28 25 S.	114 09 E.	21	Petersen Grab	Dark-grey-speckled, fine- to medium-grained, skeletal sand
Dm6/210/63	28 32 S.	114 16 E.	22	Petersen Grab	Dark-grey-speckled, fine- to medium-grained, skeletal sand
Dm6/211/63	29 50 S.	114 11.5 E.	35	Petersen Grab	Speckled red and white, medium- to coarse-grained, skeletal calcarenite with fragments of bryozoans, molluscs, ? Homotrema sp.
Dm6/215/63	31 02 S.	115 00 E.	76	Petersen Grab	Brown, fine-grained, skeletal sand
Dm6/216/63	31 18.5 S.	115 03 E.	50	Petersen Grab	White, coarse-grained, poorly sorted, skeletal sand
Dm6/217/63	31 22 S.	115 05 E.	48	Petersen Grab	Algal Lithothamnium nodules with living algal crusts
Dm6/218/63	31 32 S.	115 11 E.	35	Petersen Grab	Speckled red and white, very coarse-grained, poorly sorted, skeletal calcarenite

SEDIMENT SAMPLES

STATION	LATITUDE	LONGITUDE	SONIC DEPTH	SAMPLING METHOD	DESCRIPTION OF SEDIMENT
Dm6/219/63	31 38.5 S.	115 15 E.	31	Petersen Grab	Speckled red and white, very coarse-grained, skeletal calcarenite with small (3 cm) algal nodules
Dm6/221/63	32 00 S.	115 21 E.	50	Petersen Grab	White, fine- to medium-grained, skeletal calcarenite
Dm6/222/63	32 01 S.	115 14 E.	99	Petersen Grab	White, fine- to medium-grained, skeletal calcarenite
Dm6/223/63	32 00.5 S.	115 11.5 E.	220	Petersen Grab	Brown, silty, fine-grained, skeletal sand
Dm6/225/63	32 00.5 S.	116 16 E.	72	Petersen Grab	White, fine-grained, skeletal sand

OCEANOGRAPHICAL CRUISE REPORTS

1. Oceanographical observations in the Indian Ocean in 1959. H.M.A.S. *Diamantina* Cruises Dm1/59 and Dm2/59.
2. Oceanographical observations in the Indian Ocean in 1960. H.M.A.S. *Diamantina* Cruise Dm1/60.
3. Oceanographical observations in the Indian Ocean in 1960. H.M.A.S. *Diamantina* Cruise Dm2/60.
4. Oceanographical observations in the Indian Ocean in 1960. H.M.A.S. *Diamantina* Cruise Dm3/60.
5. Oceanographical observations in the Pacific Ocean in 1960. H.M.A.S. *Gascoyne* Cruises G1/60 and G2/60.
6. Oceanographical observations in the Pacific Ocean in 1960. H.M.A.S. *Gascoyne* Cruise G3/60.
7. Oceanographical observations in the Indian Ocean in 1961. H.M.A.S. *Diamantina* Cruise Dm1/61.
8. Oceanographical observations in the Pacific Ocean in 1961. H.M.A.S. *Gascoyne* Cruise G1/61.
9. Oceanographical observations in the Indian Ocean in 1961. H.M.A.S. *Diamantina* Cruise Dm2/61.
10. Oceanographical observations in the Indian and Pacific Oceans in 1961. H.M.A.S. *Gascoyne* Cruise G2/61.
11. Oceanographical observations in the Indian Ocean in 1961. H.M.A.S. *Diamintina* Cruise Dm3/61.
12. Oceanographical observations in the Pacific Ocean in 1961. H.M.A.S. *Gascoyne* Cruise G3/61.
13. Oceanographical observations in the Pacific Ocean in 1962. H.M.A.S. *Gascoyne* Cruise G1/62.
14. Oceanographical observations in the Indian Ocean in 1962. H.M.A.S. *Diamantina* Cruise Dm1/62.
15. Oceanographical observations in the Indian Ocean in 1962. H.M.A.S. *Diamantina* Cruise Dm2/62.
16. Oceanographical observations in the Pacific and Indian Oceans in 1962. H.M.A.S. *Gascoyne* Cruises G2/62 and G3/62.
17. Oceanographical observations in the Indian Ocean in 1962. H.M.A.S. *Gascoyne* Cruise G4/62.
18. Oceanographical observations in the Indian Ocean in 1962. H.M.A.S. *Diamantina* Cruise Dm3/62.
19. Oceanographical observations in the Pacific Ocean in 1962. H.M.A.S. *Gascoyne* Cruise G5/62.
20. Oceanographical observations in the Indian Ocean in 1962. H.M.A.S. *Diamantina* Cruise Dm4/62.
21. Oceanographical observations in the Indian Ocean in 1963. H.M.A.S. *Gascoyne* Cruise G1/63.
22. Oceanographical observations in the Indian Ocean in 1963. H.M.A.S. *Gascoyne* Cruise G2/63.
23. Oceanographical observations in the Indian Ocean in 1963. H.M.A.S. *Diamantina* Cruise Dm1/63.
24. Oceanographical observations in the Indian Ocean in 1963. H.M.A.S. *Diamantina* Cruise Dm2/63.
25. Oceanographical observations in the Indian Ocean in 1963. H.M.A.S. *Diamantina* Cruise Dm3/63.
26. Oceanographical observations in the Pacific Ocean in 1963. H.M.A.S. *Gascoyne* Cruise G3/63.
29. Oceanographical observations in the Pacific Ocean in 1963. H.M.A.S. *Gascoyne* Cruise G4/63.
30. Oceanographical observations in the Indian Ocean in 1963. H.M.A.S. *Diamantina* Cruise Dm6/63.
31. Oceanographical observations in the Pacific Ocean in 1963. H.M.A.S. *Gascoyne* Cruise G5/63.
32. Oceanographical observations in the Pacific Ocean in 1964. H.M.A.S. *Gascoyne* Cruise G1/64.
33. Oceanographical observations in the Indian Ocean in 1964. H.M.A.S. *Diamantina* Cruise Dm1/64.
34. Oceanographical observations in the Indian Ocean in 1964. H.M.A.S. *Gascoyne* Cruise G2/64.

OCEANOGRAPHICAL CRUISE REPORTS

(Continued)

35. Oceanographical observations in the Indian and Pacific Oceans in 1964. H.M.A.S. *Gascoyne* Cruise G3/64.
36. Oceanographical observations in the Indian Ocean in 1964. H.M.A.S. *Diamantina* Cruise Dm2/64.
38. Oceanographical observations in the Indian Ocean in 1964. H.M.A.S. *Diamantina* Cruise Dm4/64.
39. Oceanographical observations in the Pacific Ocean in 1964. H.M.A.S. *Gascoyne* Cruise G4/64.
40. Oceanographical observations in the Indian Ocean in 1964. H.M.A.S. *Diamantina* Cruise Dm5/64.
41. Oceanographical observations in the Indian Ocean in 1964. H.M.A.S. *Gascoyne* Cruise G5/64.
42. Oceanographical observations in the Pacific Ocean in 1964. H.M.A.S. *Gascoyne* Cruise G6/64.
43. Oceanographical observations in the Indian Ocean in 1965. H.M.A.S. *Gascoyne* Cruise G2/65.
44. Oceanographical observations in the Pacific Ocean in 1965. H.M.A.S. *Gascoyne* Cruise G3/65.
45. Oceanographical observations in the Pacific Ocean in 1965. H.M.A.S. *Gascoyne* Cruise G4/65.
46. Oceanographical observations in the Indian Ocean in 1965. H.M.A.S. *Gascoyne* Cruise G5/65.
49. Oceanographical observations in the Indian Ocean in 1965. H.M.A.S. *Diamantina* Cruise Dm2/65.
51. Oceanographical observations in the Indian Ocean in 1965. H.M.A.S. *Diamantina* Cruise Dm3/65.
53. Oceanographical observations in the Indian Ocean in 1966. H.M.A.S. *Diamantina* Cruise Dm1/66.
54. Oceanographical observations in the Indian Ocean in 1966. H.M.A.S. *Diamantina* Cruise Dm2/66.