

DATA LIBRARY

Woods Hole Oceanographic Institution

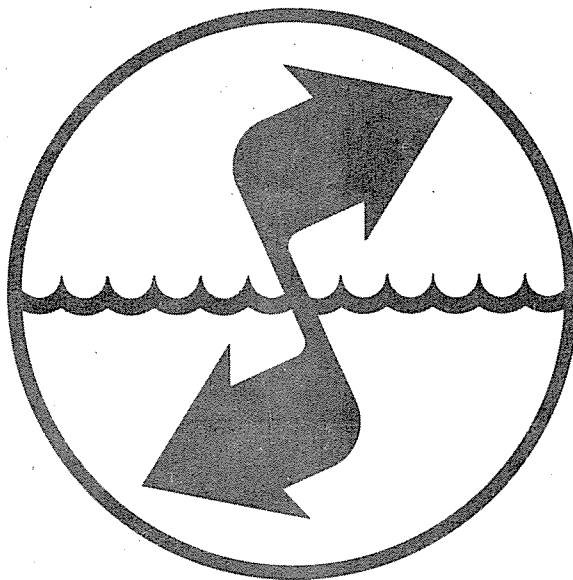
WHOI
1965
CC 4A+4B
C.2

U.S. PROGRAM IN BIOLOGY
INTERNATIONAL INDIAN OCEAN EXPEDITION

FINAL CRUISE REPORT
ANTON BRUUN CRUISES 4A and 4B
OCEANOGRAPHIC DATA
BATHYTHERMOGRAPH POSITIONS
STATION LISTS for BIOLOGICAL COLLECTIONS

INTERNATIONAL

INDIAN

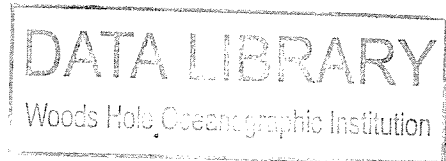


OCEAN

EXPEDITION

WOODS HOLE OCEANOGRAPHIC INSTITUTION

JANUARY, 1965



U. S. PROGRAM IN BIOLOGY

INTERNATIONAL INDIAN OCEAN EXPEDITION

Final Report: R/V ANTON BRUUN, Cruises 4A and 4B

CONTENTS

- Cruise track, R/V ANTON BRUUN, Cruise 4A (Figure 1).
- Cruise track, R/V ANTON BRUUN, Cruise 4B (Figure 2).
- Itinerary, Cruise 4A (Table 1).
- Itinerary, Cruise 4B (Table 2).
- Key to abbreviations (Table 3).
- Summary of activities, Cruise 4A (Table 4).
- Reduced oceanographic data, Cruise 4A.
- Special chemical determinations, Cruise 4A.
- Bathythermograph positions, Cruise 4A.
- Biological log - plankton collections, Cruise 4A.
- Biological log - miscellaneous collections, Cruise 4A.
- Biological collecting stations, Cruise 4B.
- Physical and chemical determinations, Cruise 4B.

- Methods and techniques, with references (APPENDIX I).
- List of participants, Cruise 4A (APPENDIX II).
- List of participants, Cruise 4B (APPENDIX III).

U. S. PROGRAM IN BIOLOGY

INTERNATIONAL INDIAN OCEAN EXPEDITION

Final Report: R/V ANTON BRUUN, Cruises 4A and 4B

Introduction

Cruise IV of the ANTON BRUUN was planned as a three-month multi-disciplinary exploration of the Arabian Sea during the fall of 1963. The interests of applicants for the cruise ranged from chemistry and microbiology to the taxonomy, distribution, and biochemistry of the large invertebrates and fishes. In addition, Cruise IV was scheduled as one of the cooperative cruises with the Bureau of Commercial Fisheries, U. S. Fish and Wildlife Service, whose personnel had planned an intensive bottom-trawling program to determine the distribution and abundance of commercially valuable species of benthic fishes and invertebrates on the continental shelf around the periphery of the Arabian Sea.

Because of the broad scope of the program, the large number of qualified applicants who wished to take part, and the fact that some of the planned activities were mutually exclusive in terms of geographical area, shipboard space, etc. it was decided to split Cruise 4 into two sections, both to work in the Arabian Sea but each with different objectives, scientific programs, and personnel.

Cruise IV-A included the basic program of hydrography, chemistry, and plankton biology, with extra sampling time provided for additional work in chemistry and microbiology. The basic program included 40 hydrographic casts, usually to the bottom, for determination of temperature, salinity, dissolved oxygen, phosphate, nitrite, nitrate, silicate, primary productivity, and chlorophyll. Three types of plankton samples were taken: (1) vertical tows from 200 meters with an Indian Ocean Standard Net, (2) vertical tows from 200 meters with a

micro-plankton net, and (3) an oblique series from depth intervals of 2000-1000, 1000-500, 500-250, 250-125, and 125-0 meters with the Bé multiple plankton sampler.

Special studies on Cruise 4A included sampling for dissolved and particulate organic carbon, dissolved and particulate organic nitrogen, particulate phosphorus, and particulate iron, dissolved molybdenum, culture and isolation of nitrifying bacteria, uptake of N^{15} -tagged atmospheric nitrogen, nitrate, and ammonia, enrichment cultures of phytoplankton to study limiting factors to their growth, and sampling for larval and adult scombroid fishes.

Cruise IV-A consisted for the most part of sections from the central part of the Arabian Sea into and normal to the coast. Because of time limitations, the work was concentrated in the Western Arabian Sea.

Cruise IV-B consisted almost exclusively of shallow-water bottom trawling with a Gulf-of-Mexico shrimp trawl on the continental shelf from Bombay to Aden. In addition, some dredging, set-lining, hand-lining, and dip-netting were carried out. Basic hydrographic stations were not made on Cruise IV-B but surface and bottom measurements of temperature, salinity, dissolved oxygen, and phosphate were made routinely at each trawling station.

Reference is made to U. S. Program in Biology, I.I.O.E., News Bulletins 5 and 6 (Narrative reports of Cruises IV-A and IV-B) for a more detailed description of the work accomplished on these two cruises.

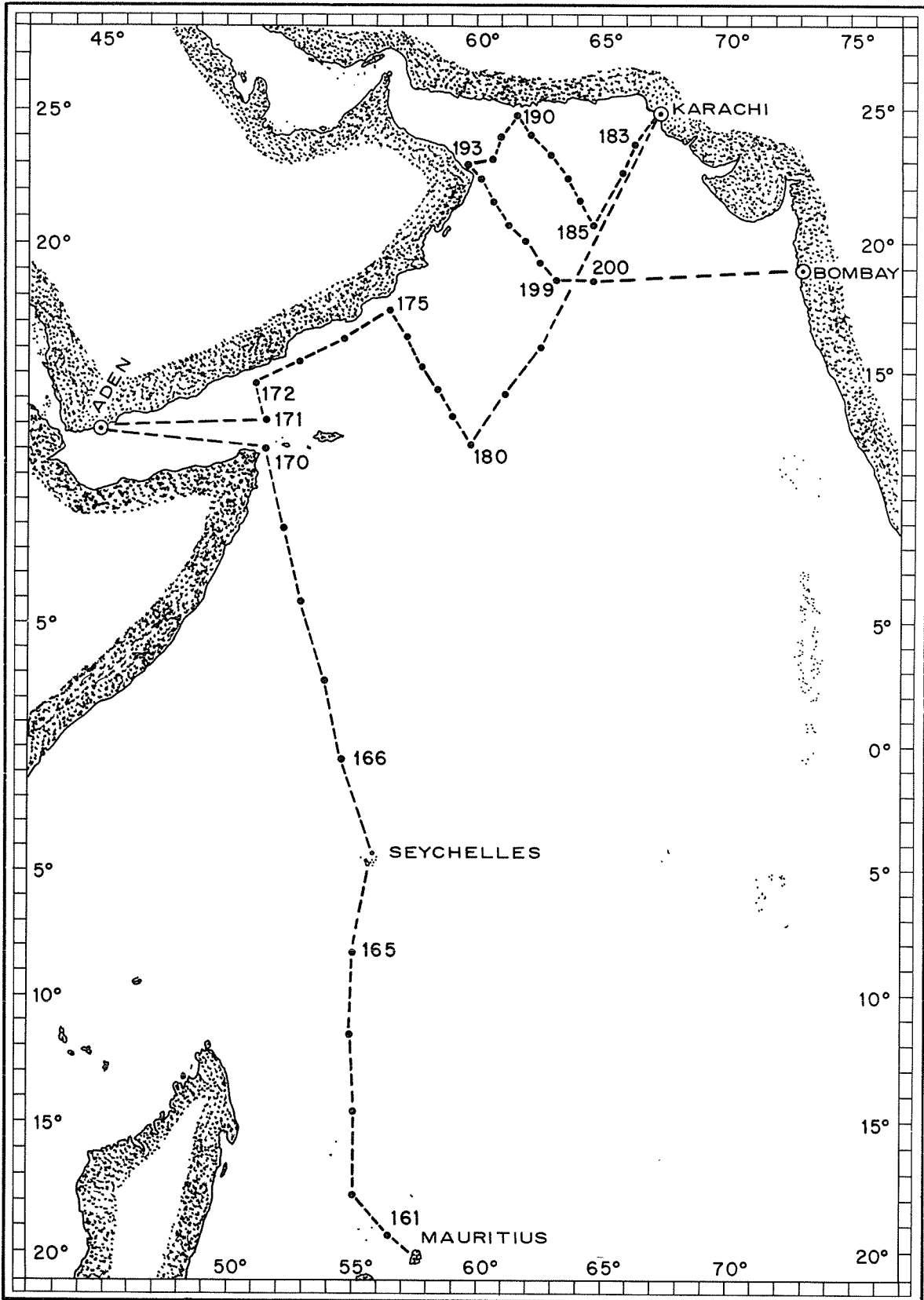


Fig. 1. Cruise track, R/V ANTON BRUUN, Cruise 4A

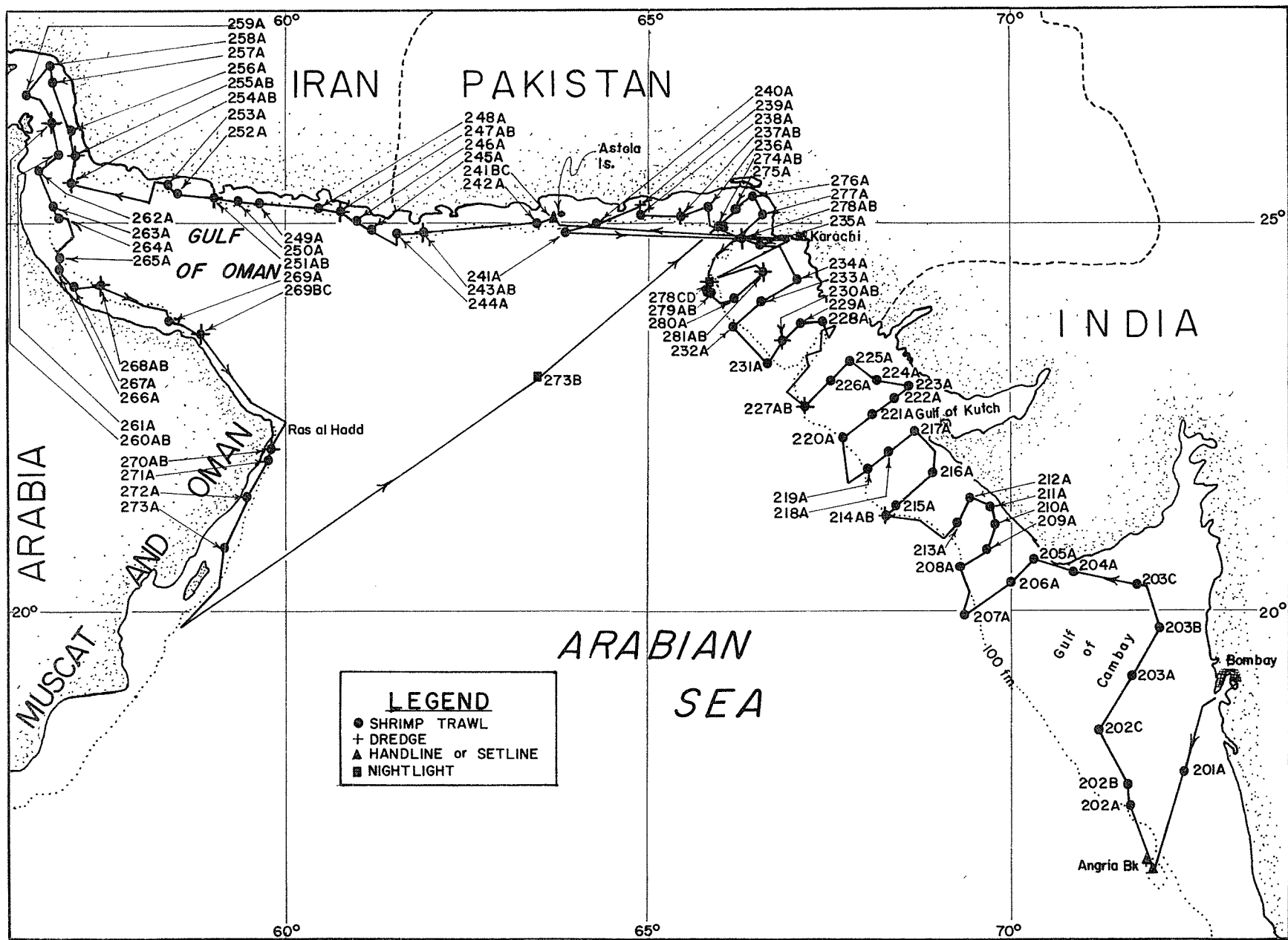


Fig. 2. Cruise track, R/V ANTON BRUUN, Cruise 4B

Table 1.

Itinerary, Cruise 4A

September 25, 1963	Departed Port Louis, Mauritius
September 25 - October 1	Occupied Stations 161-165
October 1	Arrived Port Victoria, Seychelles
October 4	Departed Port Victoria
October 4-10	Occupied Stations 166-170
October 10	Arrived Aden
October 12	Departed Aden
October 12-24	Occupied Stations 171-182
October 24	Arrived Karachi
October 28	Departed Karachi
October 28 - November 8	Occupied Stations 183-200
November 8	Arrived Bombay, India - End of Cruise 4A

Table 2.

Itinerary, Cruise 4B

November 12, 1963	Departed Bombay, India
November 13-22	Occupied Stations 201-241
November 23	Arrived Karachi, Pakistan
November 26	Departed Karachi
November 27 - December 9	Occupied Stations 242-281
December 10	Arrived Karachi

Table 3.

Key to Abbreviations

A. PLANKTON NETS AND TYPES OF TOWS

IOSN: Indian Ocean Standard Net
113 cm diameter
0.33 mm mesh aperture

75-M-25: 75 cm diameter
0.064 mm mesh aperture (No. 25 mesh)

75-M-3: 75 cm diameter
0.333 mm mesh aperture (No. 3 mesh)

BE-3: Be multiple plankton sampler
70.7 cm X 70.7 cm (square opening)
0.333 mm mesh aperture (No. 3 mesh)

M-0: 1 meter diameter
0.6 mm mesh aperture (No. 0 mesh)

FT-20: 1 foot diameter
0.076 mm mesh aperture (No. 20 mesh)

V: Vertical

H: Horizontal

Q: Oblique

B: OTHER SAMPLING GEAR AND ACCESSORIES

GME: Gulf of Mexico shrimp trawl
(40 foot lead line)

DIP: Dip net

DR: Dredge

HND: Hand line

NL: Night light

SET: Set line

C: INSTITUTIONS

SOSC: Smithsonian Oceanographic Sorting
Center, U. S. National Museum,
Washington, D. C.

IOBC: Indian Ocean Biological Center
Ernakulam
Cochin, India

MCZ: Museum of Comparative Zoology
Harvard University
Cambridge, Massachusetts

Table 4

Summary of Activities, Cruise 4A (cont.)

Date	Sta.	Position		Hydro Cast	Plankton Tows						Prim. Prod.	Particulate & Dissolved C, N, & Fe	N ¹⁵ nitrogen cycle studies
		Latitude	Longitude		IOSN	75M25	BE-3	75M3	M-0	FT-20			
25/26-IX-63	161	19° 14' S	56° 33' E	x	x	x	x				x	x	
26-IX	162	17° 38' S	54° 58' E	x	x	x	x		x		x	x	
27/28-IX	163	14° 53' S	55° 02' E	x	x	x	x				x	x	
28-IX	164	11° 34' S	54° 56' E	x	x				x		x	x	
30-IX	165	08° 14' S	55° 00' E	x	x		x				x	x	
5-X	166	00° 24' S	54° 33' E	x	x		x				x	x	
6-X	167	02° 45' N	53° 51' E	x	x		x				x	x	
7-X	168	05° 52' N	52° 56' E	x	x		x				x	x	
8-X	169	08° 57' N	52° 17' E	x	x		x				x	x	
9-X	170	12° 04' N	51° 31' E	x	x			x	x		x	x	
9-X	170A	12° 38' N	49° 06' E						x				
12-X	170B	12° 20' N	44° 51' E						x				
13-X	170C	12° 50' N	46° 39' E						x				
15-X	171	13° 11' N	51° 28' E	x	x		x				x	x	x
15-X	172	14° 44' N	51° 02' E	x	x			x	x		x	x	x
16-X	173	15° 27' N	52° 50' E	x	x			x	x		x	x	x
17-X	174	16° 27' N	54° 39' E	x	x			x	x		x	x	x
17/18-X	175	17° 26' N	56° 29' E	x	x			x	x		x	x	x
18-X	176	16° 29' N	57° 09' E	x	x			x	x		x	x	x
19-X	177	15° 18' N	57° 43' E	x	x		x				x	x	x
19-X	178	14° 21' N	58° 18' E	x	x			x	x		x	x	x
19/20-X	179	13° 12' N	58° 58' E	x	x		x				x	x	x
20-X	180	12° 15' N	59° 42' E	x	x			x	x		x	x	x
21-X	181	14° 09' N	61° 07' E	x	x		x				x	x	x
22-X	182	15° 58' N	62° 33' E	x	x			x	x		x	x	x

Table 4

Summary of Activities, Cruise 4A

Date	Sta.	Position		Hydro Cast	Plankton Tows						Prim. Prod.	Particulate & Dissolved C, N, & Fe	N ¹⁵ nitrogen cycle studies
		Latitude	Longitude		IOSN	75M25	BE-3	75M3	M-O	FT-20			
28/29-X-63	183	23°43'N	66°21'E	x	x			x	x		x	x	x
29-X	184	22°33'N	65°50'E	x	x		x			x	x	x	x
30-X	185	20°39'N	64°41'E	x	x			x	x	x	x	x	x
30-X	186	21°31'N	64°06'E	x	x		x			x	x	x	x
31-X	187	22°23'N	63°32'E	x	x			x	x		x	x	x
31-X	188	23°19'N	62°50'E	x	x		x				x	x	x
1-XI	189	24°00'N	62°04'E	x	x			x	x		x	x	x
1-XI	190	24°48'N	61°37'E	x	x			x	x		x	x	x
1/2-XI	191	23°57'N	60°58'E	x	x		x				x	x	x
2-XI	192	23°08'N	60°32'E	x	x			x	x	x	x	x	x
2-XI	193	22°48'N	59°34'E	x	x			x	x		x	x	x
3-XI	194	22°22'N	60°05'E	x	x			x	x	x	x	x	x
3-XI	195	21°31'N	60°41'E	x	x		x			x	x	x	x
4-XI	196	20°44'N	61°15'E	x	x			x	x		x	x	x
4-XI	197	20°02'N	62°00'E	x	x		x				x	x	x
5-XI	198	19°17'N	62°29'E	x	x			x	x		x	x	x
5-XI	199	18°31'N	63°08'E	x	x		x				x	x	x
6-XI	200	18°32'N	64°39'E	x	x			x	x		x		

REDUCED DATA

U. S. PROGRAM IN BIOLOGY - INTERNATIONAL INDIAN OCEAN PROGRAM

STATION NO. 162
 CRUISE NO. 4A
 VESSEL Anton Bruun
 DATE 26-IX-63

LAT. 17° 38'S
 LONG. 54° 58'E
 DEPTH 4480
 TIME 1406-1827 hrs.
 WIND Force 4 Dir. 14

SECCHI DISK -- m.
 EXT. COEFF. (k) 0.05
 RADIATION 421 gcal./cm.²/day
 PLANKTON VOL.
 IOSN STD. TOW 4.0 ml./m.²

DEPTH	TEMP.	SAL. ‰	O ₂	PO ₄ -P	NO ₃ -N	NO ₂ -N	NH ₃ -N	SiO ₃ -Si	DEPTH	Chl. a	INSITU C ¹⁴	C ¹⁴ -1000fc
			ml./l.	μgA/l.	μgA/l.	μgA/l.	μgA/l.	μgA/l.		μg/l.	μgC/l.d.	μgC/l.d.
1	22.95	35.165	5.16	0.19	0.6	0.01		4.2	1	0.05	1.8	9.2
15	22.95	35.153	5.37	0.18	0.4	0.01		4.1	14	0.03	2.9	8.6
25	22.85	35.155	5.35	0.18	0.3	0.01		4.0	28	0.05	2.3	8.2
50	---	35.154	5.24	0.18	0.7	0.01		2.8	47	0.05	1.3	9.3
74	22.09	35.294	5.08	0.20	2.5	0.18		4.1	94	0.14	u	0.5
99	21.63	35.374	4.74	0.27	2.4	0.16		5.0				
124	20.11	35.308	3.70	0.70	11.4	0.04		9.3				
149	19.51	35.504	4.40	0.50	5.0	0.02		7.0				
198	17.08	35.502	4.01	0.71	6.6	0.02		9.7				
207	---	35.455	3.99	0.73	11.3	0.01		10.1				
299	13.75	35.329	4.52	0.84	13.4	0.02		11.0				
399	12.21	35.153	4.79	0.96	16.3	0.01		10.2				
499	10.55	34.944	5.41	1.04	17.7	0.01		6.7				
599	9.19	34.760	5.18	1.29	22.0	0.01		10.4				
699	7.58	34.634	4.40	1.77	28.1	0.02		26.9				
799	6.41	34.604	3.74	2.15	35.3	0.01		47.6				
798	---	34.591	3.62	2.20	34.7	u		50.5				
898	5.30	34.612	3.29	2.39	39.3	0.01		67.4				
998	5.00	34.660	3.01	2.51	38.9	0.01		78.9				
1198	4.24	34.687	3.10	2.51	40.0	0.02		94.0				
1398	3.56	34.701	3.23	2.53	37.0	0.07		97.5				
1698	2.72	34.725	3.68	2.45	44.1	0.02		107.0				
1998	2.36	34.756	3.72	2.38	40.8	0.05		121.0				

REDUCED DATA

U. S. PROGRAM IN BIOLOGY - INTERNATIONAL INDIAN OCEAN PROGRAM

STATION NO. 163
 CRUISE NO. 4A
 VESSEL Anton Bruun
 DATE 27-IX-63

LAT. 14° 53'S
 LONG. 55° 02'E
 DEPTH 4316
 TIME 2153 hrs.
 WIND Force 4 Dir. 12

SECCHI DISK -- m.
 EXT. COEFF. (k) 0.06
 RADIATION 393 gcal./cm²/day
 PLANKTON VOL.
 IOSN STD. TOW 4.0 ml./m²

DEPTH	TEMP.	SAL. ‰	O ₂	PO ₄ -P	NO ₃ -N	NO ₂ -N	NH ₃ -N	SiO ₃ -Si		DEPTH	Chl. a	INSITU C ¹⁴	C ¹⁴ -1000 fc
			ml./l.	μgA/l.	μgA/l.	μgA/l.	μgA/l.	μgA/l.			μg/l.	μgC/l./d.	μgC/l./d.
1	24.19	35.283	5.39	0.28	1.1	0.03		4.4		1	0.11	17.3	6.6
15	24.20	35.277	5.46	0.29	1.1	0.04		4.0		14	0.10	21.0	5.1
25	24.19	35.279	5.56	0.34	0.9	0.04		4.1		28	0.13	17.9	5.7
49	---	35.272	5.52	0.25	0.9	0.03		2.8		47	0.17	4.9	5.2
74	23.86	35.202	5.42	0.25	0.8	0.03		2.8		94	0.18	0.0	4.2
99	23.36	35.138	5.25	0.26	0.9	0.04		3.7					
123	23.32	35.150	5.29	0.27	0.9	0.07		2.8					
148	21.47	35.217	4.35	0.62	8.3	0.21		8.2					
197	18.29	35.337	3.57	0.93	12.0	0.02		13.2					
190	---	35.238	3.49	0.89	12.0	0.03		12.2					
288	13.98	35.175	3.45	1.25	19.3	0.02		18.7					
384	11.95	35.064	3.55	1.39	22.4	0.01		19.7					
482	10.62	34.944	3.95	1.52	23.0	0.02		21.3					
580	9.46	34.828	3.84	1.70	25.6	0.02		26.4					
679	8.16	34.735	3.50	1.98	28.9	0.02		37.8					
778	7.13	34.744	2.73	2.33	37.7	0.02		57.0					
786	---	34.716	3.23	2.19	31.9	0.01		49.5					
887	6.52	34.725	2.69	2.44	37.8	0.02		66.3					
985	5.96	34.732	2.74	2.49	29.0	0.02		73.6					
1182	4.80	34.711	2.97	2.54	36.3	0.02		88.3					
1379	4.03	34.719	2.95	2.54	37.9	0.01		120.0					
1675	3.06	34.727	3.38	2.55	34.6	0.02		96.5					
1974	2.53	34.756	3.50	2.48	34.7	0.01		120.0					

