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U.S. PROGRAM IN BIOLOGY

INTERNATIONAL INDIAN OCEAN EXPEDITION

FINAL CRUISE REPORT
ANTON BRUUN CRUISE I

VOLUME 1 (of 2)
OCEANOGRAPHIC DATA

INTERNATIONAL INDIAN OCEAN EXPEDITION

Woods Hole Oceanographic Institution
ATLAS - GAZETTEER COLLECTION

WOODS HOLE OCEANOGRAPHIC INSTITUTION

JULY, 1964

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U. S. PROGRAM IN BIOLOGY
INTERNATIONAL INDIAN OCEAN EXPEDITION

Final Report: ANTON BRUUN Cruise 1.

The following report, in two volumes, presents the reduced oceanographic, chemical, and biological data, bathythermograph positions, and station lists for biological collections taken during Cruise 1 of the ANTON BRUUN in the Bay of Bengal during March-May, 1963, as a part of the International Indian Ocean Expedition. The cruise track is shown in Figure 1. Tables 1-3 respectively give the cruise itinerary with port calls, a summary of the types of scientific activities carried out during the cruise, and a list of the techniques employed with references.

A narrative report of Cruise 1 including the list of participants, related shore activities, and preliminary scientific results was issued as News Bulletin No. 2 of the U. S. Program in Biology, IIOE, dated July, 1963.

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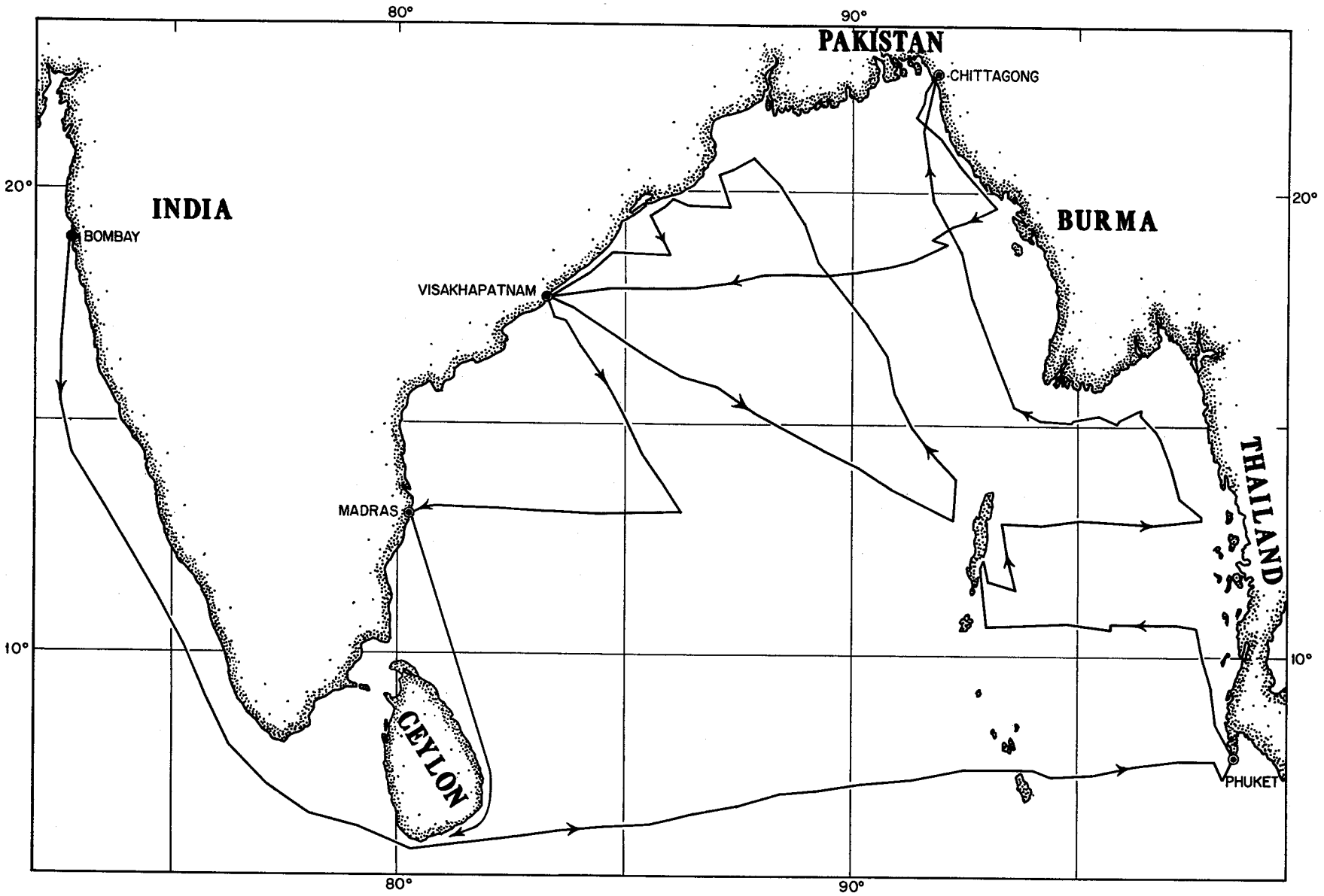

Fig. 1. Cruise track - R/V ANTON BRUUN Cruise 1.

Table 1. Cruise 1 Itinerary

Departure	Date	Arrival	Date
Bombay, India	3/12/63	Phuket, Thailand	3/22/63
Phuket	3/23/63	Chittagong, E.Pakistan	4/3/63
Chittagong	4/4/63	Vizagapatnam, India	4/11/63
Vizagapatnam	4/14/63	Vizagapatnam	4/25/63
Vizagapatnam	4/28/63	Madras, India	5/3/63
Madras	5/4/63	Bombay	5/10/63

Table 2. Summary of Scientific Activities, Cruise 1, showing number of stations occupied each leg for the different types of work.

Cruise Leg	Stations				
	Oceanographic[1]				
	Complete	Surface Obs. only	Bottom Trawl	Dredge	Sediment
Bombay-Phuket	5	26	5	0	0
Phuket-Chittagong	25	5	18	15	2
Chittagong-Vizagapatnam	21	0	10	4	12
Vizagapatnam-Vizagapatnam	23	3	0	7	14
Vizagapatnam-Madras	18	0	0	0	2
Total	92	34	33	26	30

1. Hydrography, chemistry, primary productivity, plankton tows

Table 3. Methods and Techniques employed on Cruise 1 with references.

1. Navigation: Celestial navigation and dead reckoning. Corrected positions taken from smooth navigation plots.

2. Bottom depth: Precision Echo Sounder Recorder (Alpine Geophysical Assoc.). Note - Continuous records taken throughout Cruise 1 have been turned over to Dr. Bruce Heezen, Lamont Geological Observatory.

3. Bathythermograph observations: Taken on arrival at each station and at intervals of 1 hour or less between stations. Records deposited with National Oceanographic Data Center, Washington, D.C.

4. Temperature and depth: Paired protected and unprotected deep-sea reversing thermometers. Reliability of depth calculations shown on relative scale of 1 (high) - 3 (low).

5. Water samples
   a) Chemistry: Teflon-coated Nansen bottles (Balauf Mfg. Co., Washington, D.C.).
   b) Productivity and pigments: Large volume, all-plastic (lucite) water sampler designed by D.W. Menzel, Woods Hole Oceanographic Institution, Woods Hole, Mass.

6. Salinity: Inductance-type salinometer (Autolab Industries, Sydney, Australia).

7. Dissolved oxygen: Winkler method, biniodate standard.

8. Phosphate: Murphy, J. and J.P. Riley. 1962. A modified single solution method for the determination of phosphate in natural waters. Anal. Chim. Acta 27: 31-36.

9. Nitrite: Rider, B.F. and M.G. Mellon. 1946. Colorimetric determination of nitrites. Ind. Engin. Chem. Anal. Ed. 18: 96-99.

10: Nitrate: Mullen, J.B. and J.P. Riley. 1955. The spectrophotometric determination of nitrate in natural waters, with special reference to sea water. Anal. Chim. Acta. 12: 464-480.

11: Mullen, J.B. and J.P. Riley. 1955. The colorimetric determination of silicate with special reference to sea and natural waters. Ibid. 12: 162-175.

12. Plankton pigments:

a) Richards, F.A. with T.G. Thompson. 1952. The estimation and characterization of plankton populations by pigment analysis. II. A spectrophotometric method for the estimation of plankton pigments. J. Mar. Res. 11: 156-172

b) Creitz, G.I. and F.A. Richards. 1955. _____ III. A note on the use of "millipore" membrane filters in the estimation of plankton pigments. Ibid. 14: 211-216.

c) Whatman GF/C glass fiber filters used in place of millipore filters.

d) Data for chlorophyll[a] only reported here. Optical densities of acetone extracts A/C Richards with Thompson may be obtained on request from J. H. Ryther, Woods Hole Oceanographic Institution, Woods Hole, Mass.

13. Primary production:

a) C-14-technique, basically as in: Steemann Nielsen, E. 1952. The use of radioactive carbon (C^{14}) for measuring organic production in the sea. J. Cons. Internat. Explor. Mer. 18: 117-140.

b) Millipore HA type membrane filters used throughout. Filters rinsed with 10 ml 0.01 N HCl in 3% NaCl.

c) Simulated <u>in situ</u> measurements: Water samples collected from depths of penetration of 100, 50, 25, 10, and 1% incident light. Samples with C^{14} added incubated for 24 hours on deck in water cooled lucite cylinders covered with neutral density (wire mesh) filters to simulate <u>in situ</u> light intensities.

d) Artificially-illuminated measurements: Samples from same depths as in (c) incubated for 4 hours at approximately 1000 foot candles from fluorescent lamps.

e) Dark bottle C^{14} uptake subtracted from light bottle values for each depth and for both sets of measurements (c and d).

14. Incident Radiation: Eppley 50-junction pyrheliometer recorded on Leeds and Northrup Speedomax recorder. Records mechanically integrated with planimeter to give daily radiation. Radiation data refer to 24 hour period of simulated <u>in situ</u> productivity value (i.e. for 24 hours following arrival on station).

15. Biological sampling gear: See key immediately preceding station lists for biological collections.

16. Plankton displacement volume: Taken only for Indian Ocean Standard Net 200 m. vertical hauls. Volume measured on "squeeze-dried" plankton by displacement in volumetric cylinder.

17. Meteorological observations: Taken by member of International Indian Ocean Meteorology Programme. (Dr. Colin Ramage, Scientific Director).

ERRATUM

Silicate values should be reduced by 8%.

SURFACE OBSERVATIONS

R/V ANTON BRUUN CRUISE 1

Station No.	Date	Time	Latitude	Longitude	Sal.‰	PO_4-P µgA/L	NO_3-N µgA/L	NO_2-N µgA/L	SiO_3-Si µgA/L	Chl.a µg/L	C^{14} uptake at 1000 f.c. µgC/L/d	BT No.
13A	13 Mar 63	1200	16°40'N	72°36'E	33.956	0.39	0.46	0.015	7.20	0.72	206.86	-
13B	"	1800	15°30'N	72°33'E	33.641	0.09	0.66	0.012	6.01	0.42	59.33	141
13C	14 Mar 63	0005	14°24'N	72°51'E	34.187	0.31	0.33	0.017	4.22	0.23	76.22	147
13D	"	0600	13°19'N	73°30'E	33.926	0.36	0.33	0.032	3.46	0.24	32.18	153
13E	"	1155	12°17'N	74°06'E	33.680	0.22	0.33	0.012	6.53	0.38	64.74	159
13F	"	1805	11°16'N	74°45'E	33.682	µ	3.34	0.029	2.82	0.43	108.25	165
13G	15 Mar 63	0002	10°11'N	75°17'E	33.689	0.25	0.26	0.004	3.71	0.27	111.01	171
13H	"	0600	9°04'N	75°48'E	33.704	0.31	0.33	0.010	5.63	0.02	13.09	177
13I	"	1200	8°00'N	76°20'E	33.943	0.94	0.20	0.029	1.66	0.11	18.24	183
13J	"	1800	7°10'N	77°06'E	33.810	0.18	0.20	0.017	1.94	--	7.76	189
13K	16 Mar 63	0000	6°34'N	78°04'E	33.957	0.96	0.20	0.020	1.78	0.01	1.84	195
13L	"	0600	6°13'N	79°09'E	34.103	0.25	0.72	0.042	3.46	0.02	12.21	201
13M	"	1200	5°47'N	80°14'E	34.096	0.27	0.33	0.017	2.69	0.01	11.06	207
13N	"	1800	5°53'N	81°25'E	33.910	0.28	0.06	0.020	2.69	0.02	2.38	212
13O	17 Mar 63	0030	6°01'N	82°30'E	33.908	0.13	0.06	0.010	3.84	0.02	13.67	218
13P	"	0600	6°09'N	83°29'E	33.870	0.33	--	0.015	--	0.02	14.67	224
13Q	"	1200	6°15'N	84°30'E	33.877	0.32	--	0.022	--	0.01	3.07	230
13R	"	1800	6°19'N	85°30'E	33.815	0.30	--	0.034	3.71	0.02	5.22	236
13S	18 Mar 63	0001	6°32'N	86°32'E	34.362	0.29	--	0.024	--	0.01	7.95	242
13T	"	0600	6°43'N	87°26'E	34.118	0.28	--	0.024	--	µ	3.53	247
13U	"	1200	6°57'N	88°29'E	33.502	0.13	--	0.039	2.05	0.01	3.46	253
13V	"	1800	7°03'N	89°09'E	33.425	0.13	--	0.054	2.69	0.04	7.03	259
13W	19 Mar 63	0002	7°11'N	90°10'E	33.702	0.15	--	0.039	4.09	0.05	18.47	265
13X	"	0600	7°20'N	91°16'E	33.061	0.16	--	0.039	3.71	0.04	10.91	271
13Y	"	1200	7°30'N	92°27'E	33.054	0.14	--	0.054	2.69	0.03	12.36	277
13Z	"	1800	7°16'N	93°41'E	33.153	0.27	--	0.024	--	0.12	4.42	
41A	31 Mar 63	0008	15°13'N	95°23'E	32.864	--	--	--	--	--	--	
43A	1 Apr 63	1800	15°24'N	93°32'E	32.344	0.11	0.06	0.044	2.18	0.04	0.76	417
43B	2 Apr 63	0000	16°28'N	93°06'E	32.086	0.06	0.18	0.047	0.90	0.12	1.93	423
43C	"	0600	17°37'N	92°41'E	31.368	0.07	0.31	0.061	2.43	0.44	2.68	429
43D	"	1206	18°43'N	92°14'E	28.778	0.19	0.37	0.039	5.76	0.72	4.82	435
43E	"	1810	19°45'N	91°49'E	31.071	0.05	0.46	0.007	3.07	0.99	17.72	441

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STATION NO. 14
CRUISE NO. 1
VESSEL *R/V ANTON BRUUN*
DATE 19-III-63
RELIABILITY OF DEPTH 1

LAT. 07°27'N
LONG. 94°21'E
DEPTH 2048 M
TIME 2208 hrs.
WIND Force 3, Dir. 24

PRIMARY PROD. .04 g C /m²/day
EXT. COEFF. (k) 0.09
RADIATION 290 g.cal./cm²/day
ZOOPLANKTON VOL.
IOSN STD. TOW 20.0 ml./m.²

DEPTH	TEMP.	SAL. ‰	O_2 ml./l.	PO_4-P µgA/l.	NO_3-N µgA/l.	NO_2-N µgA/l.	SiO_3 Si µgA/l.
1	27.85	32.897	4.66	--	0.1	0.04	4.2
24	27.74	32.887	4.64	0.04	0.1	0.05	5.1
48	27.60	32.932	4.53	0.07	0.1	0.07	3.1
73	26.14	33.940	3.54	0.41	7.0	0.40	7.0
97	22.83	34.334	1.99	1.06	16.6	0.12	16.5
121	18.91	34.575	1.11	1.58	22.3	0.06	27.0
145	16.23	34.786	0.70	1.87	23.5	0.06	32.0
194	12.41	34.961	0.63	2.18	27.7	0.04	42.0
291	11.11	35.042	0.87	2.17	--	0.03	39.0
388	10.30	35.036	0.81	2.28	28.2	0.04	47.1
486	9.66	35.020	0.75	2.37	29.7	0.04	55.2
584	9.05	35.006	0.85	2.44	27.3	0.04	61.0
682	8.11	34.979	0.94	2.60	29.9	0.05	74.0
780	7.47	34.953	1.16	2.61	31.9	0.05	80.0
879	6.56	34.929	1.32	2.65	32.3	0.03	90.2
978	6.27	34.911	1.45	2.66	29.3	0.05	95.3

DEPTH	Chl. a µg/l.	INSITU C^{14} µgC/l./d.	C^{14}-1000 fc µgC/l./d.
1	0.01	0.09	0.69
8	0.05	0.17	1.31
15	u	0.72	0.88
26	0.09	1.42	0.50
52	0.04	0.377	--

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STATION NO. 15
CRUISE NO. 1
VESSEL R/V ANTON BRUUN
DATE 20-III-63
RELIABILITY OF DEPTH 1

LAT. 07°27'N
LONG. 95°20'E
DEPTH 2250
TIME 0757 hrs.
WIND Force 11 kn. 282°
Code Force 4, Dir. 28

PRIMARY PROD. .16 g C /m²/day
EXT. COEFF. (k) 0.06
RADIATION 306 gcal./cm²/day
ZOOPLANKTON VOL.
IOSN STD. TOW 8.0 ml./m.²

DEPTH	TEMP.	SAL. ‰	O_2 ml./l.	PO_4-P µgA/l.	NO_3-N µgA/l.	NO_2-N µgA/l.	SiO_3 Si µgA/l.		
1	27.80	32.906	4.48	0.15	0.9	--	4.5		
23	27.80	32.895	4.55	0.20	0.6	--	3.9		
45	27.77	32.899	4.54	0.14	0.5	--	4.1		
68	27.59	33.024	4.53	0.15	1.0	--	5.7		
91	22.40	34.216	1.98	1.13	19.8	--	18.3		
113	17.35	34.717	0.73	1.88	28.6	--	28.7		
136	14.56	34.883	0.87	2.07	32.2	--	37.9		
181	12.20	35.000	0.81	2.20	35.8	--	41.2		
272	11.25	35.044	0.89	2.25	36.6	--	39.2		
362	10.58	35.047	0.94	2.26	37.3	--	44.6		
455	10.00	35.030	0.91	2.35	35.6	--	51.5		
543	9.60	35.045	0.65	2.48	37.7	--	54.5		
636	9.03	35.012	0.81	2.57	38.6	--	62.9		
730	8.23	34.981	0.91	2.60	40.5	--	69.8		
824	7.47	34.965	1.86	2.67	41.1	--	81.2		
919	6.57	34.931	1.23	2.68	40.6	90.5	90.5		

DEPTH	Chl. a µg/l.	INSITU C^{14} µgC/l./d.	C^{14}-1000 fc µgC/l./d.	
1	0.15	0.7	15.0	
12	0.08	1.4	17.3	
23	0.08	3.6	8.8	
33	0.11	3.0	14.1	
72	u	1.8	0.81	

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STATION NO. 16
CRUISE NO. 1
VESSEL *R/V ANTON BRUUN*
DATE 20-III-63
RELIABILITY OF DEPTH

LAT. 7°31'N
LONG. 96°11'E
DEPTH 772 M
TIME 2101 hrs.
WIND 2 kn., var. div.

PRIMARY PROD. 18 g C /m²/day
EXT. COEFF. (k) --
RADIATION 389 g.cal./cm.²/day
ZOOPLANKTON VOL.
IOSN STD. TOW 18.0 ml./m.²

DEPTH	TEMP.	SAL. ‰	O_2 ml./l.	PO_4-P µgA/l.	NO_3-N µgA/l.	NO_2-N µgA/l.	SiO_3 Si µgA/l.		
1	27.98	32.937	4.03	0.09	--	0.05	16.5		
24	27.91	32.917	4.19	0.08	--	0.07	4.5		
48	27.92	32.973	4.02	0.07	0.5	0.04	4.4		
72	27.25	33.347	4.07	0.11	u	0.08	4.5		
96	21.07	34.412	1.37	1.37	22.5	0.09	17.4		
120	15.68	34.809	0.67	1.96	31.9	0.11	42.6		
144	13.86	34.910	0.68	2.14	33.9	0.04	38.4		
193	12.46	34.995	0.85	2.17	38.0	0.07	36.7		
289	11.21	35.030	0.65	2.29	38.4	0.06	38.9		
385	10.58	--	0.85	2.34	23.4	0.05	44.8		
482	9.63	35.035	1.12	2.48	30.5	0.06	52.5		
578	8.90	35.017	0.87	2.55	39.1	0.06	59.9		

DEPTH	Chl. a µg/l.	INSITU C^{14} µgC/l./d.	C^{14}-1000 fc µgC/l./d.	
1	0.02	1.3	0.4	
12	u	2.2	0.9	
24	0.07	1.5	1.4	
36	0.10	4.0	0.5	
74	0.10	1.7	2.8	

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STATION NO. 17
CRUISE NO. 1
VESSEL *R/V ANTON BRUUN*
DATE 21-III-63
RELIABILITY OF DEPTH 1

LAT. 07° 40' N
LONG. 97° 09' E
DEPTH 370 M
TIME 0411 hrs.
WIND light, variable (code 99)

PRIMARY PROD. .09 g C /m²/day
EXT. COEFF. (k)
RADIATION 389 g.cal./cm²/day
ZOOPLANKTON VOL.
IOSN STD. TOW 12.0 ml./m.²

DEPTH	TEMP.	SAL. ‰	O_2 ml./l.	PO_4-P µgA/l.	NO_3-N µgA/l.	NO_2-N µgA/l.	SiO_3 Si µgA/l.		
1	28.04	32.938	4.05	0.23	--	0.04			
25	27.93	32.909	3.98	0.26	--	0.04			
50	27.87	32.974	4.06	0.26	--	0.04			
75	24.51	32.922	2.42	0.93	--	0.29			
100	19.93	33.930	1.35	1.66	--	0.09			
125	15.28	34.526	0.75	2.18	--	0.05			
150	13.95	34.916	0.62	2.34	--	0.03			
200	12.26	34.998	0.57	2.41	--	0.03			
300	11.04	35.038	0.70	2.46	--	0.05			

DEPTH	Chl. a µg/l.	INSITU C^{14} µgC/l./d.	C^{14}-1000 fc µgC/l./d.	
1	0.01	0.9	5.9	
12	"	1.5	9.8	
24	0.02	0.6	8.1	
36	0.03	0.8	7.3	
74	0.10	2.2	7.0	

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STATION NO. 18
CRUISE NO. 1
VESSEL *R/V ANTON BRUUN*
DATE 21-III-63
RELIABILITY OF DEPTH 1

LAT. 07° 41' N
LONG. 97° 59' E
DEPTH 155 M
TIME 1315 hrs.
WIND 07 kn., dir. 091°

PRIMARY PROD. .14 g C /m²/day
EXT. COEFF. (k) 0.07
RADIATION 478 g.cal./cm²/day
ZOOPLANKTON VOL.
IOSN STD. TOW 30.0 ml./m.²

DEPTH	TEMP.	SAL. ‰	O_2 ml./l.	PO_4-P µgA/l.	NO_3-N µgA/l.	NO_2-N µgA/l.	SiO_3 Si µgA/l.
1	28.37	33.021	4.73	0.09	--	0.05	4.4
10	28.03	32.977	4.81	0.10	--	0.05	3.6
25	27.98	32.996	4.83	0.11	--	0.04	3.1
35	27.92	33.005	4.82	0.10	--	0.04	4.0
50	23.50	33.760	3.41	0.67	--	0.19	13.0
75	20.52	34.233	2.18	1.26	--	0.20	19.0
100	19.75	34.299	2.01	1.34	--	0.20	22.8
110	19.55	34.297	2.04	1.37	--	0.20	20.6

DEPTH	Chl. a µg/l.	INSITU C^{14} µgC/l./d.	C^{14}-1000 fc µgC/l./d.
1	u	2.6	11.5
10	0.02	5.7	15.2
20	0.06	0.6	7.7
33	0.16	2.5	12.1
66	0.41	0.9	29.3

REDUCED DATA

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

STATION NO. 19
CRUISE NO. 1
VESSEL *R/V ANTON BRUUN*
DATE 23-III-63
RELIABILITY OF DEPTH

LAT. 08° 29' N
LONG. 97° 29' E
DEPTH 60 M
TIME 1230 hrs
WIND 06 kn., dir. 180°

PRIMARY PROD. .13 g C /m²/day
EXT. COEFF. (k) 0.08
RADIATION 451 g.cal./cm.²/day
ZOOPLANKTON VOL.
IOSN STD. TOW 36.0 ml./m.²

DEPTH	TEMP.	SAL. ‰	O_2 ml./l.	PO_4-P µgA/l.	NO_3-N µgA/l.	NO_2-N µgA/l.	SiO_3 Si µgA/l.		
1	28.79	33.012	4.57	0.16	u	0.04	8.8		
10	28.55	32.981	4.69	0.11	u	0.03	10.7		
20	28.29	33.055	4.63	0.12	0.2	0.05	1.4		
30	28.14	33.100	4.67	0.17	0.3	0.07	1.6		
40	27.43	33.171	4.73	0.18	0.4	0.04	1.6		
50	25.25	33.428	3.85	0.44	6.5	0.34	2.5		

DEPTH	Chl. a µg/l.	INSITU C^{14} µgC/l./d.	C^{14}-1000 fc µgC/l./d.	
0	0.10	u	8.9	
9	u	3.0	16.1	
17	u	2.1	10.4	
29	0.99	u	7.0	
58	u	6.1	108.5	

REDUCED DATA

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

STATION NO. 20
CRUISE NO. 1
VESSEL *R/V ANTON BRUUN*
DATE 23-III-63
RELIABILITY OF DEPTH

LAT. 09° 13' N
LONG. 97° 51' E
DEPTH 64 M
TIME 1818 hrs.
WIND 10 kn., Dir. 241°

PRIMARY PROD. .11 g C /m²/day
EXT. COEFF. (k)
RADIATION 406 g.cal./cm²/day
ZOOPLANKTON VOL.
IOSN STD. TOW 48.0 ml./m.²

DEPTH	TEMP.	SAL. ‰	O_2 ml./l.	PO_4-P µgA/l.	NO_3-N µgA/l.	NO_2-N µgA/l.	SiO_3 Si µgA/l.		
1	28.97	32.974	4.45	u	0.9	0.03	3.7		
10	28.31	32.958	4.59	u	0.5	0.02	2.8		
20	28.28	33.023	4.74	u	0.3	0.02	2.2		
30	28.02	33.093	4.60	--	0.6	--	2.3		
40	26.77	33.264	4.34	0.08	1.3	0.08	4.6		
50	25.77	33.474	3.85	0.27	4.0	0.16	5.0		

DEPTH	Chl. a µg/l.	INSITU C^{14} µgC/l./d.	C^{14}-1000 fc µgC/l./d.	
0	u	1.4	0.2	
9	0.01	3.7	0.3	
17	0.02	u	2.3	
29	0.72	1.4	0.9	
58	0.07	3.0	5.5	

REDUCED DATA

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

STATION NO. 21
CRUISE NO. 1
VESSEL *R/V ANTON BRUUN*
DATE 24-III-63
RELIABILITY OF DEPTH 1

LAT. 09° 54' N
LONG. 97° 42' E
DEPTH 73 M
TIME 0121
WIND 5 kn., Dir. 045°

PRIMARY PROD. .23 g C /m²/day
EXT. COEFF. (k)
RADIATION 406 g.cal./cm²/day
ZOOPLANKTON VOL.
IOSN STD. TOW 720 ml./m.²

DEPTH	TEMP.	SAL. ‰	O_2 ml./l.	PO_4-P µgA/l.	NO_3-N µgA/l.	NO_2-N µgA/l.	SiO_3 Si µgA/l.			DEPTH	Chl. a µg/l.	INSITU C^{14} µgC/l./d.	C^{14}-1000 fc µgC/l./d.	
1	22.94	33.120	4.45	0.03	0.3	0.06	5.0			0	0.06	2.2	0.1	
10	28.43	33.085	4.49	0.02	0.3	0.05	3.5			9	0.09	0.9	1.5	
20	28.28	33.101	4.94	0.03	0.3	0.06	3.6			17	0.05	3.4	u	
30	27.82	33.238	3.48	0.02	0.3	0.05	4.5			29	-0.12	3.9	2.0	
40	27.75	33.351	4.40	0.06	1.1	0.10	4.1			58	0.58	3.9	u	
50	26.16	33.369	2.01	0.18	2.6	0.15	4.9							
60	24.38	33.760	3.20	0.58	9.9	0.63	7.3							

REDUCED DATA

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

STATION NO. 22
CRUISE NO. 1
VESSEL R/V ANTON BRUUN
DATE 24-III-63
RELIABILITY OF DEPTH 1

LAT. 10° 37' N
LONG. 97° 34' E
DEPTH 94 M
TIME 0726
WIND For. 08 kn.

PRIMARY PROD. .27 g C /m²/day
EXT. COEFF. (k)
RADIATION 389 g.cal./cm.²/day
ZOOPLANKTON VOL.
IOSN STD. TOW 300.0 ml./m.²

DEPTH	TEMP.	SAL. ‰	O_2 ml./l.	PO_4-P µgA/l.	NO_3-N µgA/l.	NO_2-N µgA/l.	SiO_3 Si µgA/l.
1	28.71	33.157	4.52	0.04	0.3	0.01	4.1
10	28.69	33.142	4.63	0.02	0.5	0.02	4.2
25	27.96	33.106	4.69	0.08	0.5	0.03	4.0
35	27.38	33.096	4.66	0.10	0.2	0.02	5.1
50	26.00	33.302	3.97	0.32	4.0	0.27	7.8
60	24.69	33.579	3.38	0.55	7.9	0.69	7.9
75	21.20	34.164	1.89	1.22	16.9	0.15	19.8

DEPTH	Chl. a µg/l.	INSITU C^{14} µgC/l./d.	C^{14}-1000 fc µgC/l./d.
0	0.38	12.2	23.5
9	--	12.7	14.3
17	0.16	0.9	17.7
29	0.12	4.0	5.6
58	0.41	1.2	6.1

REDUCED DATA

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

STATION NO. 23
CRUISE NO. 1
VESSEL R/V ANTON BRUUN
DATE 24-III-63
RELIABILITY OF DEPTH 1

LAT. 10° 39' N
LONG. 96° 35' E
DEPTH 384 M
TIME 2024 hrs.
WIND 7 kn., 342° dir.

PRIMARY PROD. .24 g C /m²/day
EXT. COEFF. (k)
RADIATION 343 g.cal./cm²/day
ZOOPLANKTON VOL.
IOSN STD. TOW 40.0 ml./m.²

DEPTH	TEMP.	SAL. ‰	O_2 ml./l.	PO_4-P µgA/l.	NO_3-N µgA/l.	NO_2-N µgA/l.	SiO_3 Si µgA/l.			DEPTH	Chl. a µg/l.	INSITU C^{14} µgC/l./d.	C^{14}-1000 fc µgC/l./d.	
1	29.53	32.869	4.55	0.04	0.1	0.03	4.5			0	0.08	1.2	0.2	
10	28.52	32.781	4.71	0.03	0.3	0.02	4.4			9	0.07	4.8	2.3	
24	27.42	32.867	4.67	0.10	u	0.03	3.7			17	0.06	5.1	u	
49	24.41	33.620	3.01	0.68	11.8	0.43	11.1			29	0.25	--	1.4	
73	21.58	34.159	2.35	1.21	20.7	0.13	20.6			58	0.26	3.2	u	
98	19.76	34.452	1.24	1.53	17.3	0.08	21.6							
122	16.01	34.786	0.55	2.00	32.5	0.07	30.9							
147	14.10	34.882	0.63	2.05	32.5	0.05	33.8							
172	12.54	34.967	0.63	2.22	37.9	0.04	37.3							
196	12.13	34.994	0.64	2.05	38.5	0.05	37.6							
245	11.45	35.014	0.57	2.15	41.0	0.07	39.9							
294	11.17	35.014	0.63	2.23	38.8	0.05	41.1							

REDUCED DATA

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

STATION NO. 24
CRUISE NO. 1
VESSEL R/V ANTON BRUUN
DATE 25-III-63
RELIABILITY OF DEPTH

LAT. 10° 36' N
LONG. 95° 39' E
DEPTH 2944 M
TIME 0605 hrs.
WIND 13 kn., dir. 270°

PRIMARY PROD. .18 g C /m²/day
EXT. COEFF. (k)
RADIATION 343 g.cal./cm²/day
ZOOPLANKTON VOL.
IOSN STD. TOW 18.0 ml./m²

DEPTH	TEMP.	SAL. ‰	O_2 ml./l.	PO_4-P µgA/l.	NO_3-N µgA/l.	NO_2-N µgA/l.	SiO_3 Si µgA/l.
1	29.01	32.843	4.53	u	--	--	6.3
24	28.53	32.796	4.68	u	--	0.03	5.5
49	26.68	32.124	4.19	0.12	u	0.05	6.0
73	24.91	34.125	2.79	0.67	16.4	0.27	9.9
91	20.65	34.364	1.51	1.29	23.2	0.08	19.1
122	16.52	34.743	0.86	1.80	32.8	0.04	28.3
146	14.07	34.897	0.75	2.01	34.1	0.05	31.5
195	12.70	34.975	0.72	2.05	41.4	0.04	34.8
293	11.30	35.017	0.67	2.21	38.3	0.07	38.2
390	10.43	35.020	0.76	2.25	43.8	0.06	39.0
488	9.60	35.008	0.03	2.36	39.4	0.05	47.9
585	9.05	34.996	0.77	2.36	45.5	0.04	53.8
683	8.37	34.975	0.92	2.45	44.7	0.05	61.0
780	7.67	34.955	1.10	2.42	44.0	0.05	69.0
878	7.01	34.931	1.32	2.37	44.8	0.04	76.3
978	6.54	34.919	1.58	2.42	44.9	0.03	82.1

DEPTH	Chl. a µg/l.	INSITU C^{14} µgC/l./d.	C^{14}-1000 fc µgC/l./d.
0	0.02	1.2	2.3
9	0.02	4.7	6.0
17	u	4.1	1.8
29	0.02	4.0	6.5
58	0.24	1.1	5.3

REDUCED DATA

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

STATION NO. 25
CRUISE NO. 1
VESSEL *R/V ANTON BRUUN*
DATE 26-III-63
RELIABILITY OF DEPTH

LAT. 10° 41' N
LONG. 94° 40' E
DEPTH 3074 M
TIME 0609 hrs.
WIND 6 km., 032° dir.

PRIMARY PROD. .06 g C /m²/day
EXT. COEFF. (k)
RADIATION 432 g.cal./cm.²/day
ZOOPLANKTON VOL.
IOSN STD. TOW 10.0 ml./m.²

DEPTH	TEMP.	SAL. ‰	O_2 ml./l.	PO_4-P µgA/l.	NO_3-N µgA/l.	NO_2-N µgA/l.	SiO_3 Si µgA/l.		
1	28.73	32.851	4.51	0.02	0.3	0.04	8.1		
25	27.73	32.705	4.83	u	0.2	0.03	3.6		
50	26.98	33.355	4.17	0.09	0.3	0.04	4.1		
75	24.18	34.021	2.66	0.73	12.2	0.14	10.5		
100	19.74	34.552	1.40	1.46	23.1	0.06	8.2		
125	17.69	34.710	0.88	1.82	24.7	0.04	25.3		
150	15.08	34.854	0.63	2.05	30.7	0.04	31.2		
199	12.59	34.973	0.57	2.24	33.6	0.03	37.6		
299	11.14	35.035	0.74	2.35	32.9	0.08	39.4		
399	10.23	35.030	0.71	2.46	37.5	0.03	46.9		
499	9.45	35.019	0.75	2.53	35.0	0.05	55.3		
598	8.85	35.003	0.86	2.56	36.4	0.02	60.7		
697	8.27	34.982	0.95	2.69	35.6	0.04	68.1		
797	7.67	34.965	1.08	2.69	39.6	0.04	75.8		
897	7.00	34.946	1.18	2.66	39.3	0.04	81.3		
997	6.46	34.927	1.39	2.73	34.4	0.03	89.2		

DEPTH	Chl. a µg/l.	INSITU C^{14} µgC/l./d.	C^{14}-1000 fc µgC/l./d.	
0	u	0.5	4.5	
9	0.05	1.5	0.5	
17	0.04	1.4	u	
29	0.03	0.6	23.8	
58	0.23	1.4	1.0	

REDUCED DATA

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

STATION NO. 26
CRUISE NO. 1
VESSEL *R/V ANTON BRUUN*
DATE 26-III-63
RELIABILITY OF DEPTH 1

LAT. 10° 39' N
LONG. 93° 49' E
DEPTH 2944 M
TIME 1250 hrs.
WIND 10 kn., 351° dir.

PRIMARY PROD. .02 g C /m²/day
EXT. COEFF. (k) 0.06
RADIATION 420 gcal./cm²/day
ZOOPLANKTON VOL.
IOSN STD. TOW 20.0 ml./m.²

DEPTH	TEMP.	SAL. ‰	O_2 ml./l.	PO_4-P µgA/l.	NO_3-N µgA/l.	NO_2-N µgA/l.	SiO_3 Si µgA/l.
1	29.30	32.712	4.36	u	0.7	0.02	--
24	28.56	32.771	4.80	u	0.5	0.04	3.7
47	27.62	33.058	4.66	0.01	0.3	0.04	3.1
71	26.88	33.652	4.29	0.13	0.4	0.06	4.1
95	23.47	34.209	2.30	0.93	17.5	0.16	13.1
118	13.59	34.916	0.63	2.19	36.7	0.05	34.8
142	12.98	34.949	0.59	2.25	36.3	0.08	38.0
189	11.54	35.002	0.58	2.35	45.5	0.04	41.2
284	10.62	35.023	0.63	2.42	39.8	0.04	43.6
379	9.91	35.017	0.74	2.50	45.7	0.04	50.6
474	9.41	35.008	0.74	2.53	39.9	0.06	53.6
568	8.97	34.992	0.82	2.59	43.4	0.03	60.3
664	8.52	34.985	0.87	2.61	46.4	0.04	66.2
759	7.78	34.965	1.03	2.64	50.1	0.04	74.5
855	7.27	34.942	1.11	2.69	39.8	0.05	80.3
950	6.81	34.929	1.27	2.70	39.6	0.05	84.8

DEPTH	Chl. a µg/l.	INSITU C^{14} µgC/l./d.	C^{14}-1000 fc µgC/l./d.
0	0.12	1.3	2.3
13	0.04	u	1.4
26	--	0.7	0.3
39	0.02	0.1	1.4
78	0.13	0.1	u