U.S. PROGRAM IN BIOLOGY

INTERNATIONAL INDIAN OCEAN EXPEDITION

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NARRATIVE REPORT: ANTON BRUUN CRUISE 6

INTERNATIONAL INDIAN OCEAN EXPEDITION

WOODS HOLE OCEANOGRAPHIC INSTITUTION

DECEMBER, 1964

CRUISE VI - R.V. ANTON BRUUN

CRUISE PERIOD: 15 May - 16 July, 1964

AREA OF OPERATION: Western Central Indian Ocean, South along the 65°E. meridian from 18°N. to 40°S.

ITINERARY:

May 15, 1964	Depart Bombay
May 17	Occupy Station 328
June 11	Arrive Mauritius
June 21	Depart Mauritius
July 5	Occupy Station 354
July 16	Arrive Durban

OBJECTIVES OF CRUISE AND PRELIMINARY RESULTS:

The general objectives of this cruise were to supply further material and data essential to an understanding of the biology and ecology of the western Indian Ocean, and to take collections of bathypelagic organisms for zoogeographical and systematic study. The station plan (Figure 1) called for collections and observations at two-degree intervals along the 65° E. meridian, 18° N. to south of 40° S., a line transecting several characteristic water masses. The plan of work at each station specified a "standard" program of plankton sampling, productivity measurement, and the analysis of certain physical and chemical factors; and midwater tows for larger bathypelagic organisms using a ten-foot Isaacs-Kidd Midwater Trawl (IKMT) with accessory equipment.

Within the limitations imposed by weather during the second leg, this station pattern was satisfactorily accomplished. Complete or nearly complete stations were made between 18° N. and 20° S. (the latitude of Mauritius), and but one station was wholly missed from 22° S. to 40° S. Although work south to 44° S. had been planned, seas south of 41° S. were sufficiently rough to split plankton nets, part hanging lines on the IKMT, and make work from any outboard platform both dangerous and ineffective.

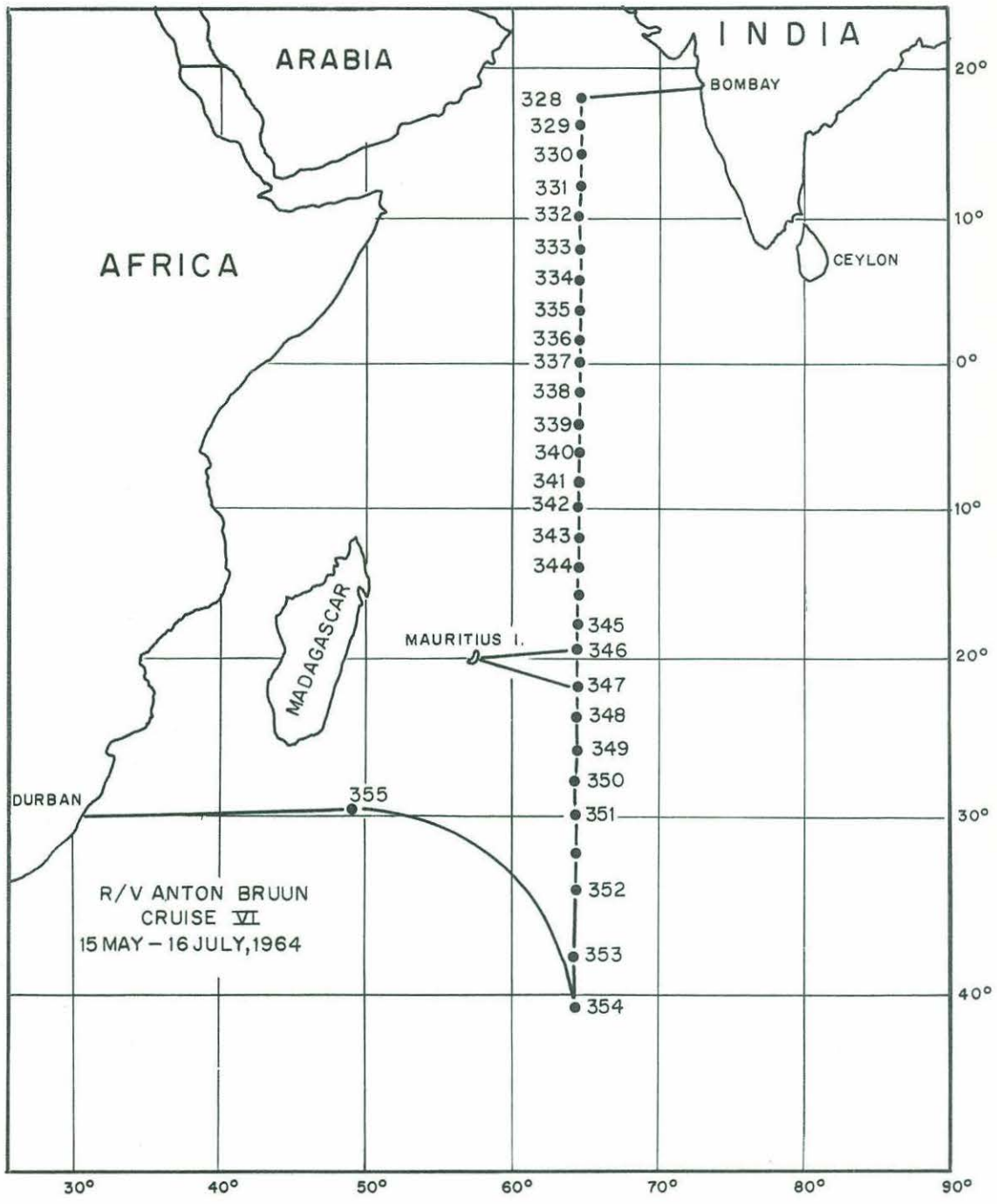

Figure 1 - Cruise track and station positions

Winds during the entire second part of the cruise were rarely below gale force and regularly above 50 m.p.h. with correspondingly high seas.

Each "standard" station included a hydrographic cast to 2000 meters with samples taken from 200, 300, 400, 500, 600, 700, 800, 900, 1000, 1100, 1200, 1400, 1700, and 2000 m, and at 5-7 shallower depths spaced with respect to the thermocline. Analyses were made for temperature, salinity, dissolved oxygen, nitrate, nitrite, phosphate and silicate and a sample was saved for subsequent determination of dissolved organic carbon. Additional water samples were taken with an all-plastic water sampler for the analysis of primary productivity using the C-14 technique, for phytoplankton pigments, and for particulate organic carbon. Depths of sampling for this purpose corresponded to levels of 100, 50, 25, 10, and 1 percent of incident radiation. Two vertical tows, one for microplankton, the other with the Indian Ocean Standard Net, were made from 200 meters to the surface. The former have been deposited with the Smithsonian Oceanographic Sorting Center, Washington, D. C. and the latter with the International Biological Center, Cochin, India.

Oblique plankton tows from several depth intervals were not taken by the "Bé-type" pressure operated closing nets which had been used on previous cruises. In place of these, a series of vertical plankton hauls were made from 12 stations with the British NV-70 closing net from depth intervals of 0-100, 100-200, 200-500, 500-1000, and from 1000 meters to as near the bottom as possible at intervals of every thousand meters. This work was carried out under the supervision of Dr. George Grice and the samples so obtained have been returned to his laboratory at the Woods Hole Oceanographic Institution. Following the removal of certain groups of plankton from the samples, they will be deposited with the Smithsonian Oceanographic Sorting Center.

Sixty-one hauls with the IKMT were completed. Each used, with questionable reliability, a catch dividing device designed to separate the shallow from the deep catch during a single lowering of the net. Depth recording instruments were also used; these vindicated the use of depth computed from wire length and angle at least for tows made in intermediate or shallow waters. Two hauls were generally made at each station, one in very deep water, the second at a shallower level determined by the location of sound-scattering layers shown by the precision graphic recorder or the depth of the thermocline. The volume of each catch, vertebrate and invertebrate, was taken after initial fixation. A comparison of those from shallow and from deep tows, and of both with similar volumes obtained during the IKMT program of Cruise III (a 60° E. N-S transect) was begun aboard by Dr. D. M. Cohen. The study shows promise and will be continued with the incorporation of plankton volumes and productivity data from the two cruises. Detailed observations and figures of the luminous organs of deep-sea stomiatoid and ceratioid fishes were made by D. W. Bourne. The examination of fresh material has revealed an intracacy of structure, material and optical properties far less apparent in long-preserved material. This work, too, will continue subsequent to the cruise.

The invertebrates from the IKMT hauls will be sent to the Smithsonian Oceanographic Sorting Center, Washington, D.C.; the fishes to the Woods Hole Oceanographic Institution for preliminary identification and study jointly with those taken on Cruise III by specialists at Woods Hole and elsewhere. Ecological, systematic, and zoogeographic findings will be forthcoming, and some of the more important results cannot now even be predicted. But two catches are of obvious and unique zoological interest. First, the capture of a leptocephalus or larval stage of a deep sea eel, which is bright orange-red

in color in contrast to the absolute transparency of all other known eel larvae, which now number in the tens of thousands. The second exciting specimen is a metamorphosing eel, over a meter long, which seems referable on the one hand to the "giant leptocephalus" caught years ago by the Danish DANA and subject to world-wide public interest; and on the other hand to an adult nemichthyioid or snipe eel.

Relatively few marine mammals were seen, but the sea birds during the second half were numerous and magnificent. Notes were made by both permanent and participating scientists. These, together with documentary information such as photographs, will be forwarded to the Smithsonian Institution for verification and possible future use by the ornithologists of that institution.

Radiosonde baloons were released daily by Mr. Connors of the U. S. Weather Bureau and the resulting data telegraphed to appropriate shore stations. Important inshore collections of fishes were made in India and in Mauritius by both permanent and visiting scientists.

Major scientific activities carried out at each station are summarized in Table 1. Scientific personnel participating in Cruise VI are listed in Table 2.

Table 1. Summary of major scientific activities by station, Cruise VI, ANTON BRUUN (Station positions are tentative and refer to arrival time on station).

STA.	POSITION Lat.	Long.	MAX. DEPTH IKMT Haul(m)	PLANKTON HAUL N-70	Micro	IOSN	HYDRO.-CHEM. OBSERVATIONS	PRIMARY PRODUCTIVITY-PIGMENTS
328	18°02'N	65°08'E		x	x	x	x	x
328A	18°03'	65°05'	875					
328B	17°46'	65°02'	470					
329	15°36'	64°15'			x	x	x	x
329A	16°05'	65°01'	3200					
329B	15°48'	65°00'	565					
330	13°36'	65°13'		x	x	x	x	x
330A	14°08'	65°00'	630					
330B	13°58'	65°02'	2750					
331	11°28'	65°04'			x	x	x	x
331A	12°07'	65°00'	705					
331B	11°47'	65°01'	2500					
332	10°01'	65°01'		x	x	x	x	x
332A	09°56'	64°59'	3250					
332B	09°36'	64°56'	510					
333	07°56'	64°56'			x	x	x	x
333A	07°55'	64°55'	2850					
333B	07°33'	64°41'	940					
334	06°01'	64°59'		x	x	x	x	x
334A	06°01'	64°59'	700					
334B	05°48'	64°57'	2870					
335	03°58'	65°02'			x	x	x	x
335A	04°02'	65°03'	950					
335B	03°46'	65°05'	2575					
336	02°01'	65°03'		x	x	x	x	x
336A	02°03'	65°04'	705					
336B	01°50'	65°06'	1250					
337	00°30'S	65°08'			x	x	x	x
337A	00°03'N	65°00'	525					
337B	00°14'S	65°03'	2250					

STA.	POSITION Lat.	Long.	MAX. DEPTH IKMT Haul(m)	PLANKTON HAUL N-70	Micro	IOSN	HYDRO.-CHEM. OBSERVATIONS	PRIMARY PRODUCTIVITY-PIGMENTS
338	02°38'S	65°01'E		x	x	x	x	x
338A	02°00'	64°54'	528					
338B	02°20'	64°54'	1650					
339	04°40'	65°02'			x	x	x	x
339A	04°01'	65°00'	615					
339B	04°14'	65°02'	2080					
340	06°00'	65°10'		x	x	x	x	x
340A	05°54'	65°10'	2250					
340B	05°55'	64°48'	750					
341	08°00'	64°59'			x	x	x	x
341A	08°00'	65°00'	2820					
341B	07°56'	65°14'	504					
342	09°58'	64°55'		x	x	x	x	x
342A	09°57'	64°55'	525					
342B	10°01'	64°19'	2250					
343	12°12'	65°29'			x	x	x	x
343A	12°10'	64°54'	800					
343B	12°11'	64°11'	1930					
344	14°11'	65°17'		x	x	x	x	x
344A	13°57'	65°05'	880					
344B	14°03'	65°11'	3080					
345	16°10'	64°50'						x
345A	15°57'	64°46'	2100					
345C	18°09'	64°48'	800					
345D	18°05'	65°10'	2500					
345E	17°58'	65°34'	120					
346	19°23'	65°30'					x	x
346A	19°24'	65°30'	2600					
347	22°06'	64°55'		x	x	x	x	x
347A	22°11'S	64°53'	2500					
347B	22°34'	64°55'	855					

STA.	POSITION Lat.	Long.	MAX. DEPTH IKMT Haul(m)	PLANKTON HAUL N-70	Micro	IOSN	HYDRO.-CHEM. OBSERVATIONS	PRIMARY PRODUCTIVITY-PIGMENTS
348	24°61'S	64°00'E			x	x	x	x
348A	24°03'	65°00'	3500					
348B	24°22'	64°50'	164					
348C	24°29'	64°50'	1100					
349	26°06'	64°58'		x	x	x	x	x
349A	26°06'	64°58'	780					
349B	26°24'	65°02'	1470					
350	28°28'	65°03'				x	x	x
350A	27°52'	64°55'	680					
350B	28°05'	64°58'	1750					
351	30°06'	64°58'				x	x	x
351A	29°30'	64°56'	592					
351B	29°45'	64°58'	1710					
351C	31°25'	65°08'	540					
351D	31°45'	65°08'	1786					
352	34°34'	64°55'					x	x
352A	33°53'	64°55'	1428					
352B	34°14'	64°58'	750					
353	37°58'	64°59'				x	x	x
353A	37°59'	64°56'	2394					
353B	38°15'	64°45'	975					
354	40°47'	64°27'					x	x
354A	40°48'	65°03'	1650					
354B	40°51'	64°49'	885					
355	29°38'	49°23'		x	x	x	x	x
355A	29°38'	49°21'	212					
355B	29°26'	49°10'	1438					
355C	29°29'	48°43'	3100					

Table 2. Scientific Personnel: (*-Bombay to Mauritius only, **-Mauritius to Durban only)

Chief Scientist:	Giles W. Mead Museum of Comparative Zoology, Harvard University; and Woods Hole Oceanographic Institution
Participating Scientists:	E. Bertelsen** Marinbiologisk Laboratorium, Denmark
	Donald W. Bourne Woods Hole Oceanographic Institution and M.C.Z., Harvard University
	Daniel M. Cohen U.S. Bureau of Commercial Fisheries
	George D. Grice* Woods Hole Oceanographic Institution
	Richard L. Haedrich* Woods Hole Oceanographic Institution and M.C.Z., Harvard University
	C. P. Lee U. S. Bureau of Commercial Fisheries
	Basil Nafpaktitis** M.C.Z., Harvard University
	Jorgen Nielsen* Universitetes Zoologiske Museum, Denmark
	Shigeru Yano U. S. Bureau of Commercial Fisheries

Permanent Scientific Staff:

Andrew Bakun	-	Chemical Oceanographer
Peter Connors	-	Meteorologist
Mark M. Jones	-	Chemical Oceanographer
Kevin G. Jones	-	Electronics Specialist
John R. Hall	-	Biological Oceanographer
Alan K. Pease	-	Physical Oceanographer
Bruce A. Rogers	-	Biological Oceanographer