

Intergovernmental oceanographic commission

information
paper

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UNESCO/NS/IOC/INF - 45

FOREWORD

Since distribution of IIOE Information Paper No. 3, in June 1963, information has accumulated in this Office which is incorporated in the present paper. As the Expedition is now in its most active phase, this issue contains information on certain important findings which came as a result of various cruises.

At the end of October 1963, two important meetings will take place in Paris: these are the Meeting of the SCOR Executive Committee and the Meeting of the Bureau of the Intergovernmental Oceanographic Commission. It is expected that the problems concerning the IIOE will be discussed there. One of them will be the preparation of the IIOE Co-ordinators Meeting on 22-24 January 1964. It is anticipated that the next issue of this Information Paper will inform readers concerning results of the October meetings and will also give more information concerning the exchange of data and scientific findings resulting from the IIOE.

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Unesco Office of Oceanography
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IIOE INFORMATION PAPER
No. 4

1. Exchange of information and data

1.1 As announced in the Information Paper No. 1, and subsequently repeated in No. 2, the Office of Oceanography, Unesco, is planning to reproduce and distribute bound copies of collected reprints of the Expedition. However, the number of reprints received to date by the Office is still insufficient for making up the first volume. The Office is currently undertaking steps to obtain those reprints which would ensure representative selection of papers in the first volume and permit publishing it in the beginning of 1964.

1.2 Cruise Reports

(1) A cruise report of Commandant Robert Giraud (France), from 3 July to 19 October 1962 has been received from the National IIOE Co-ordinator of France. The track of her cruise is essentially the same as reported in the IIOE Track Chart distributed previously (U.S. Hydrographic Office, H.O. 17.138-C).

The following is an extract of the report (translated from French):

Participation by France in the International Indian Ocean Expedition

(Cruise report of naval ship Commandant Robert Giraud, by M. Menache)

I. According to the programme approved by the National Committee on Oceanic Research of France, the naval ship Commandant Robert Giraud was able to carry out hydrographic observations and dynamical studies in the north-western region of the Indian Ocean from 3 July to 19 October 1962.

A similar expedition by the same vessel had been carried out in the summer (Southern Hemisphere) of 1960, but from South to North and the main effort had been placed on studies in the Mozambique Channel.

The choice of the region in the north-western part of the Indian Ocean and the period of measurement were made in order to ensure that the observations were made during the lull of the south west monsoon; it was particularly strong in 1962 and was observed then to latitude of 8° south. The work was very difficult from the north of the Gulf of Aden to latitude of 6° S. North of the latitude 7° N. the monsoon was very strong, with winds of 50 knots and seas of 5 to 6.

II. Programme of work and apparatus

The scientific programme of the expedition was established with due regard to the international programme by the Physical Oceanographic Laboratory of the

Museum of Natural History in close contact with the author of this report. It was designed to study the currents and the hydrography in the north-western Indian Ocean where the current system, as well as the properties of sea-water, indicate considerable fluctuations owing to the effect of the monsoon.

III. The specialists who participated in the Expedition are the following:

Mr. Menache: Research Director of the O.R.S.T.O.M.

Mr. Gerard: Assistant Physical Oceanographer at the Centre of Oceanography and Fisheries of Nasy-Bé (O.R.S.T.O.M.)

Mr. Crepon: Physical Oceanography, Assistant at the Laboratory of Physical Oceanography of the Museum.

Mr. Rueff: E.O.R. of the Navy.

IV. Following observations were carried out during the 15,567 mile voyage:

One hundred and eleven (111) hydrographic stations forming 19 sections between the Gulf of Aden and latitude of 25° S; 2,250 water-samples for salinity determination and 2,250 temperature measurements;

recording of surface currents with GEK during about 50% of the total cruise, particularly in the Mozambique Channel: total of 61 GEK current measurements;

113 temperature recordings by bathythermograph;

16,400 cards and current floats releases;

meteorological observations at each hydrographic station.

It should be noted that Commandant Robert Giraud has occupied two reference stations, the locations of which had been defined at the Lourenco-Marquez meeting on 30 April to 2 May 1962 (Discovery II Stations No. 1575 at 18°39'2S - 41°35'4E and No. 1581 at 07°41'1S, 44°14'1E).

The preliminary results of the surface temperature analysis indicate evidence of important upwelling along the African coast near 8°N. The processing of data are now undertaken at Nosy-Bé.

(11) The French National Co-ordinator has informed us that the fifth cruise of Commandant Robert Giraud was accomplished during January and February 1963 in the area from the east of the Gulf of Aden to the north of the Red Sea. Cruise report is expected.

(iii) Summaries of Cruises received from the Australian National Co-ordinator for the following:

HMAS GASCOYNE G 1/63 17 January to 17 February 1963

HMAS DIAMANTINA Dm 1/63 28 March to 27 April 1963

On both operations, observations had been made along 110° E from 10° S to 32° S (see IIOE Information Paper No. 3, p. 3)

The following table is an extract of the summary reports.

<u>Ships</u>	GASCOYNE G 1/63	DIAMANTINA Dm 1/63
Scientific Personnel:	B. Newell (Cruise Leader)	D. Tranter (Cruise Leader)
	F. Davies	F. Boland
	C. Ho (Malaya)	N. Dyson
	T. Khan (Pakistan)	J. Faget (New Caledonia)
	A. Magnier (New Caledonia)	K. Fleming
	T. Middleton	J. Prothero
	B. Scott	

<u>Stations</u>	35	54
bathythermograph	35	36
subsurface hydrology	31	36
surface hydrology	35	36
primary production	35	36
particulate carbon	35	36
pigments	35	54
zooplankton	35	19
mid-water trawls	76	

Hydrology

Salinity	517 samples	583 samples
Oxygen	417 "	438 "
Inorganic phosphate	418 "	439 "
Total phosphate	324 "	349 "
Nitrate	404 "	439 "

Primary Production

Incubated and filtered	246	762
Particulate carbon	174	180

<u>Pigments</u>	210	216
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Zooplankton

IOS net	67	72
Clarke Bumpus net	129	144
High speed sampler	-	32

Micronekton

Mid-water trawls	16	19
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(iv) A cruise report has been received from the South African National Coordinator for the following cruise:

NATAL Cruise 8 from 11 February to 8 March 1963

Sixty-eight BT, eight coring and six mid-water trawl stations were occupied. Continuous echo-sounding and surface water temperature measurements were made. A sea mount was discovered at Lat. $33^{\circ}13'S$, Long. $43^{\circ}45'E$ with a depth of 10 fathoms.

A consolidated summary of South African contributions to the International Indian Ocean Expedition has been received from Mr. G.H. Oosthuizen of the South African Council for Scientific and Industrial Research. This is reproduced in Annex I.

(v) En route from the United States to Bombay R.V. Anton Bruun made observation along an unscheduled oceanographic section of 13 stations in the Arabian Sea between Aden and Bombay.

Standard hydrographic casts were made to 1400 m. Measurements were carried out for primary productivity, phyto-plankton pigments, particulate carbon, nitrogen and phosphorus. Vertical plankton were made tows with the IOS net and a fine mesh net. In addition oblique tows with a series of pressure-operated opening and closing plankton nets, designed by Dr. Bé were also made. Hourly bathythermograph observation and continuous echo-sounding were undertaken.

(vi) Summary of the scientific results obtained during the 35th Research Cruise of Vityaz in the Indian Ocean is given below as abstracted from recently published (in Russian) cruise report by Professor P.L. Bezrukov in "Oceanology" (vol. III, No. 3, 1963).

The 35th Cruise of VITYAZ

(Summary of scientific results)

The 35th cruise of VITYAZ took place during the period of the summer monsoon from 23 June 1962 to 23 November 1962. The cruise track of VITYAZ is included in the charts (Annex III). Major scientific tasks of the expedition were the following:

1. Characteristics of the surface and deep water circulation in the tropical zone of the Indian Ocean during the summer monsoon; processes of turbulent mixing;
2. Study of oceanic frontal zones;
3. Zonal structure of the ocean along the meridional section 91°E;
4. Hydro-optical characteristics of the water masses;
5. Study of the geological structure of the bottom, and sediment thickness by acoustic and seismo-acoustic methods;
6. Distribution of sediments and mineral resources of the ocean bearing upon its geological history;
7. Primary production;
8. Study of the biological structure of the ocean and locating new fishing grounds;
9. Chemical processes in the ocean;
10. Radio-activity analyses.

Apart from these problems, the research vessel VITYAZ took part in international intercalibration work on methods of hydrochemical analysis and primary production in Perth, Australia, and carried out comparison of performances of different kinds of plankton nets.

The scientific leader of the expedition was Professor P.L. Bezrukov, marine geologist. The scientific party aboard ship comprised 59 persons. Thirteen foreign scientists from Indian Ocean countries (four of them Unesco fellows) took part in the expedition. The Professor of the Rumanian Academy of Sciences, E.A. Pora, also participated.

During the cruise the following work was done:

- | | |
|--|--------------|
| 1. Total length of cruise | 20,800 miles |
| 2. Total length of echo-sounding tracks | 19,100 miles |
| 3. Total number of stations | 137 |
| comprising | |
| (a) stations with temperature and salinity
determinations | 120 |

(b) stations deeper than 2000 meters	83
4. Number of buoy stations with current measurements, mostly of one-day duration	17
5. General number of current measurements (from 50 to 2500 meters	124
6. Bathythermograph measurements	124
7. Gradient wind measurements from drifting buoy	14
8. Hydro-chemical analyses	
(a) stations with sampling for hydro-chemistry	107
(b) total number of analyses	11,161
9. Number of samples for radio-activity analysis	140
10. Number of stations with hydro-optical measurements .	111
11. Sediment samples taken by corers	70
12. Grab samples	50
13. Stations with seismo-acoustic chain	111
14. Seismo-acoustic sections with number of explosions from 4 to 36	13
15. Number of bottom photographs	10
16. Number of samples for suspended matter	17
17. Bottom trawlings	14
18. Pleuston samples	141
19. Plankton net catches	582
20. Isaacs Kidd trawl catches	34
21. Deep catches by ring trawls	8
22. Nansen bottles samplings of phytoplankton	760
23. Primary production measurements	1,191

24. Fish catches by various means	475
25. Solar radiation measurements	505
26. Standard meteorological observations	187
27. Upper air soundings with radio sondes	183

Main scientific findings of the cruise can be summarized as follows:

System of water circulation in the region was found to be very different from that in the period of the winter monsoon. It comprises the following major elements:

- (a) the weak current caused by westerly winds occupying a wide zone south of 10°S ;
- (b) the tradewind current between 5° and 10°S ;
- (c) the monsoon current north of 5°S .

The maximum measured speed of the monsoon current was 180 cm per second towards the east. Under this current a deep westward counter-current was found with a maximum speed of about 70 cm per second.

Geological studies during the 35th cruise of VITYAZ were particularly extensive. The region of the so-called Mary Augustine Bank between Sunda Strait and Australia was studied and though the position of this Bank indicated on the map was not confirmed, two steep underwater mountains rising from depths of 5500 m to 2474 m and 3726 m were found and scientists considered that the existence of a shallow bank in this region is not impossible.

Two deep underwater troughs were followed, one along 30° - 32°S towards the west from Australia with maximum depth of 5761 m and another, called the Chagos Trough, previously discovered by the 33rd cruise of VITYAZ, with maximum depth of 5408 m.

Analysis of data collected during three cruises of VITYAZ and also during some other expeditions led to the conclusion of the existence in the north east part of the Indian Ocean of a vast meridional ridge running from the south eastern part of the Bay of Bengal to 32° - 34°S covering a distance of 2600 miles.

Considerable work was done on the sediments and also on ferro-manganese nodules, the distribution of which in the Indian Ocean is shown on the enclosed map.

The ichthyological group obtained during the cruise a very good collection of deep water and pelagic fishes comprising no less than 325 species of 115

families. Other results of fisheries studies may lead to certain conclusions concerning future grounds for tuna fishing. Particularly extensive were collections of pleuston.

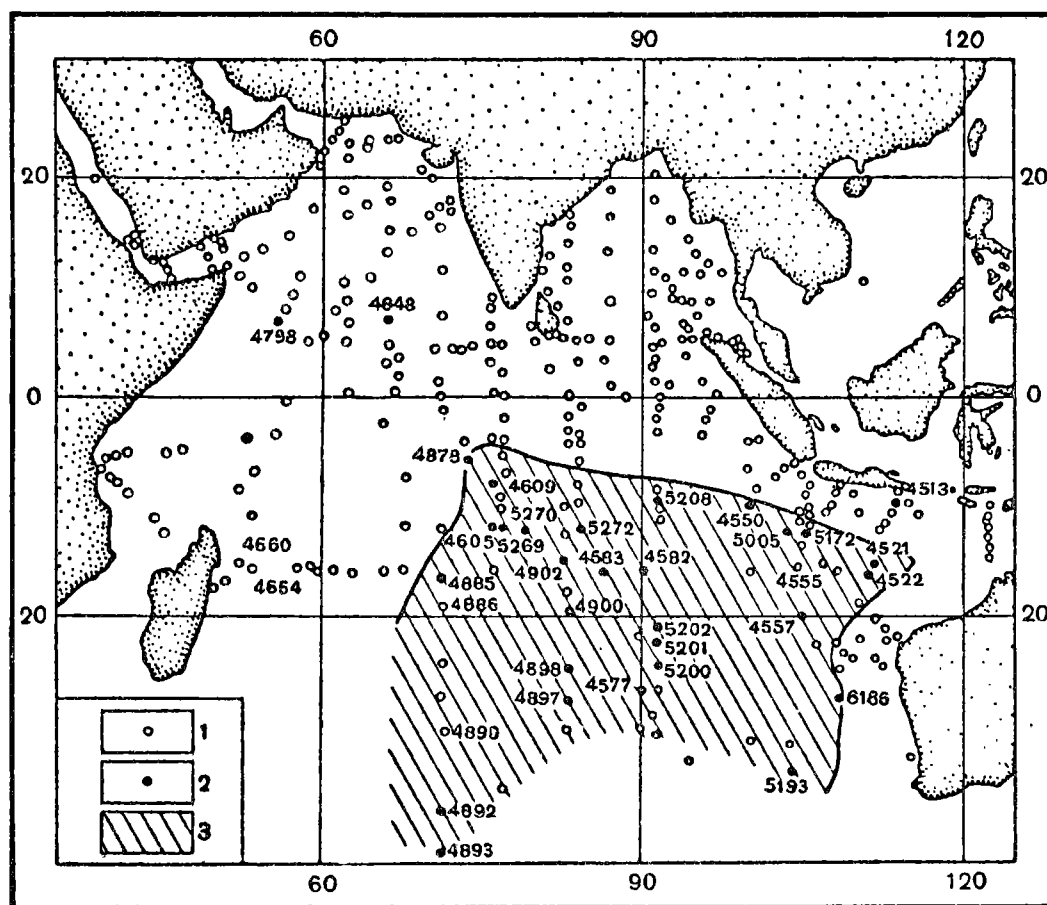


Fig.1. Distribution of ferro-manganese nodules in the Indian Ocean

1. Stations where nodules were not observed
2. Stations at which nodules were found
3. Area where nodules are widespread

1.3 Cruise Plans

(i) Cruise plans have been received from the National Co-ordinator for the following cruises:

HMAS DIAMANTINA Cruise 2/63 6 May to 6 June 1963.

HMAS DIAMANTINA Cruise 3/63 9 July to 9 August 1963.

During the cruises, observations will be made along 110°E from 32°S to 10°S and at two Reference Stations No. 1 (32° S 11 1° 50'E) and No. 2 (9° S, 105° E). The objects are similar to those for Gascoyne 1/63, i.e.:

- (a) To determine zooplankton biomass, primary production, pigments, particulate carbon and micronekton abundance along the 110°E meridian.
- (b) To examine the environmental factors likely to influence these biological properties, and the interrelation of these properties with particular reference to the dynamics of the production.
- (c) To investigate long and short wave radiation.

(ii) A cruise plan has been received from the Indonesian National Co-ordinator for the following:

R.I. JALANIDHI Cruise 2/1963 6 to 26 June 1963

During this cruise, an area approximately 400 miles of the coast of Sumatra from Sunda Strait to Padang is to be examined with the following objectives:

- (a) To determine physical and chemical properties of the sea.
- (b) To take plankton samples and reference collection.
- (c) To explore certain near-shore areas for fisheries.

Meteorological observation including hourly synoptic and aerological observations (radio-sonde and pilot-balloon ascent) are also scheduled.

(iii) A track chart for R.V. Kistna in June to October 1963 has been received from the Indian National Co-ordinator. This track is incorporated in the "New and Revised IIOE Tracks". (Annex III.)

2. Meteorological Observation

2.1 The office of the International Scientific Co-ordinator for Meteorology is issuing a newsletter; as the distribution is rather limited, some articles in the May and August issues are reproduced here.

International Indian Ocean Expedition - Meteorology Programme

"News from the Scientific Director's Office" No. 5, May 1963

(Extract)

The past two months have seen a steady increase in the number of weather reports from merchant ships. Meteorological Services and airline companies are sending a mass of manuscript and "hard copy" synoptic data to the International Meteorological Centre where back plotting and microfilming will soon start.

The U.S. Weather Bureau's Research Flight Facility, operating out of Bombay under a National Science Foundation grant flew 18 highly successful scientific missions during May.

STAFF

Five professional assistants have joined the India Meteorological Department staff at IMC; Mr. J.H. Maloney of the U.S. Weather Bureau has arrived in Bombay to handle the meteorological observing programmes aboard U.S. oceanographic vessels.

U.S. WEATHER BUREAU RESEARCH FLIGHT FACILITY (RFF)

On 30 April four aircraft of the RFF (two DC-6's, one W-57, one W-26) arrived in Bombay where they are to be based until mid-July. At an inaugural ceremony at Santa Cruz airport on 2 May, invited guests and the press were shown over the aircraft and were briefed on their sophisticated and complex meteorological equipment. The first scientific flight was made on 5 May when a DC-6 aircraft combined with the Anton Bruun to measure the low-level wind profile at an ocean station south of Madras. Since then, two more profile flights were made over the Anton Bruun, all four aircraft surveyed a pre-monsoon situation in the Bay of Bengal on the 11th, the W-26 flew five, and a DC-6 one, sea breeze and land breeze sections through Bombay, the W-57 made two high-level round trip flights between Bombay and Gan along the 73°E meridian and the DC-6's in sorties on the 16th, 22nd and 24th, investigated a near-equatorial disturbance as it moved northward and intensified into a severe tropical cyclone. The eye penetration on the 22nd was the first ever made by an aircraft over the North Indian Ocean; on the 24th, maximum winds of 104 knots and an eye sea-level pressure of 947 mb were recorded. IMC and India Meteorological Department (IMD) meteorologists participated in almost every flight. During June and July the RFF will explore the Bay of Bengal and Arabian Sea monsoons and the doldrum belt between

Gan and Singapore. I hope to give a more detailed account, including information on measurements and observations, in a later newsletter.

SATELLITES

The National Weather Satellite Centre in Washington D.C. generously co-operated with us by programming TIROS V and TIROS VI extensively to photograph the clouds in the regions of RFF activity. The coded nephanalyses indicate that the photographs will most importantly complement data obtained by the aircraft.

For the first time, at the request of Project Mercury headquarters, the IMC provided Indian Ocean weather and wave analyses and forecasts for Major Cooper's 22-orbit flight.

INTERNATIONAL METEOROLOGICAL CENTRE

The analysis programme is running smoothly. Since 27 March daily map discussions have helped improve the analyses and are pointing the way to fruitful research.

Several scientists who completed the computer programming courses are busily engaged in writing data processing programmes in preparation for the IBM 1620 computer. Now that arrangements for the UN Special Fund grant are complete, the computer should be operating at IMC and the first Special Fund experts have taken up their posts by the end of the year.

A new radio receiver supplied by IMD and better aerial arrays have improved reception of synoptic broadcasts. After successful tests, Nairobi began regular transmission of facsimile analyses and prognoses on 7 May.

A record 122 ship reports for the North Indian Ocean were received at IMC on 6 May.

Additionally, since the last newsletter, manuscript, "hard copy" or published synoptic data are being sent to us by Australia; Mauritius, the United Kingdom, and U.S. Fleet Weather Facility, Sangley Point, Philippines. The United Arab Republic and the airlines BOAC, Lufthansa and TWA are also mailing aereps and aircraft cross-sections.

International Indian Ocean Expedition Meteorology Programme

News from the Scientific Director's Office No. 6, August 1963

(Extract)

June and July have been dominated by the wide-ranging data collecting flights made by the U.S. Weather Bureau and Woods Hole Oceanographic Institution research aircraft. Preliminary research findings by the International Meteorological Centre were reported on at a day-long seminar on 1 August.

STAFF

A Professional Assistant, five Scientific Assistants, a clerk and four radio mechanics (two on transfer from the U.S. programme) have joined the India Meteorological staff at IMC; the University of Michigan team based at IMC now comprises three scientists - Mr. K.P. MacKay, Mr. H.K. Soo and Mr. A.A. Waqif. During the past six months they have installed radiation measuring units at Bombay, Karachi, Mombasa, Plaisance (Mauritius), Rodriguez, Fort Dauphin (Madagascar), Grand Comore and Mahé (Seychelles), and on the research vessels Anton Bruun, Atlantis II and Te Vega. Five new Senior observers were appointed under the U.S. Programme, for microfilming, drafting and data processing.

RESEARCH AIRCRAFT

On 12 June, the four aircraft of the U.S. Weather Bureau's Research Flight Facility (RFF) were joined by a newly outfitted C-54 operated by Woods Hole Oceanographic Institution (WHOI) and especially instrumented for air-sea interaction studies. Mr. Andrew Bunker, Chief Scientist, headed the technical and scientific crew of nine. Between 1 June and the departure of the WHOI aircraft on 11 July and the RFF on 18 July, the planes flew 56 scientific missions. WHOI (7 flights) concentrated on the Arabian Sea monsoon, and in particular, turbulence associated with speed maxima in the low-level winds; the RFF (49 flights) staged out of Madras and Bangkok to probe the active Bay of Bengal monsoon, flew from Bombay to Gan to Singapore and return to make a detailed study of the East Indian Ocean equatorial regions, flew along low-level streamlines from Bombay to Nairobi and back with refuelling stops at Aden, and surveyed the equatorial regions of the West Indian Ocean from Nairobi. On many of the operations the aircraft flew at 1500 feet and at the 850, 700, 500, 300 and 200 mb levels. During July, the RFF combined with WHOI in an intensive examination of the fluctuating monsoon over the East Arabian Sea.

RFF planes were displayed at Bangkok, Singapore, Nairobi and Gan. On 15 July one of the DC-6's was inspected at Delhi by Prime Minister Nehru, four cabinet ministers and other senior Indian Government officials, who were also taken on brief demonstration flights. In all, the five research aircraft gathered data for more than 460 hours and carried no fewer than 70 visiting meteorologists on their scientific missions. Enthusiastic and efficient aid from aviation authorities all over the region backed up the operation. Active research on the data is already under way.

Once again weather satellites, including the new TIROS VII frequently photographed clouds over regions where the research aircraft were operating.

INTERNATIONAL METEOROLOGICAL CENTRE

Propagation troubles seriously affected reception of the Canberra RTT broadcasts, although the position improved somewhat when a high speed teleprinter, generously lent by the U.S. Navy began recording some of the same

information retransmitted from Guam. Contents of the Nairobi RTT broadcasts increased and a special Cairo-Bombay point-to-point circuit ensured regular reception of synoptic data from North Africa.

Ships' reports, particularly from the Southern Indian Ocean via Mauritius, most gratifyingly continue to increase. On 11 July, IMC charts showed a total of 302 reports, 127 from the North Indian Ocean, 57 from the South Indian Ocean and 118 from the West Pacific. The research vessels Anton Bruun, Discovery, Kistna and Vema made surface weather reports.

First programmes for the IBM 1620 have been tested on a similar computer at the Physical Research Laboratory in Ahmedabad. Ship and rawinsonde observations are being recorded on punch cards; punching machines used include two lent by first Weather Wing, USAF.

On 1 August, the United States National Science Foundation and Information Service sponsored a seminar attended by 47 meteorologists at which staff members of IMC presented "Preliminary results and future plans of the IIOE Meteorology Programme". Brief introductory talks were followed by general and often spirited discussions. The topics treated included upper air climatology, computer processing of data, central Indian and Peninsula thunderstorms, synoptic oscillations of transition season highs over Arabia, equatorward extension of troughs in the upper westerlies, land and sea breeze circulations of the Indian peninsula, atmosphere-ocean interaction over the Arabian Sea, the Bay of Bengal monsoon, and monsoon definitions.

In addition, seven seminars by visitors and staff members have been given since the last newsletter.

MARINE AUTOMATIC WEATHER STATION (NOMAD)

On 23 June, NOMAD was unloaded at Madras, assembled by Messrs. Smith and Maloney and moored in the Madras Boat Harbour. Meteorological and port officials gave valuable help. The equipment will be test run prior to the boat being towed to its Bay of Bengal anchorage.

GERMAN METEOROLOGICAL PROGRAMME

Professor Dr. H.U. Roll, Director of Deutscher Wetterdienst Seewetteramt in Hamburg, has kindly provided me with the following information:

"German merchant vessels equipped with certified meteorological instruments make weather observations when plying in the Indian Ocean as they do in other maritime regions. On the average 20 observations per day are supplied by them in log-books. It can be assumed that a certain portion of these observations has already been transmitted to Indian coastal radio stations. The observations received in log-books are checked and transferred into punch-cards. It is anticipated that, starting with 1 January 1964, the weather observations made by

German ships in the Indian Ocean north of 15°S will be dispatched to India in accordance with Res.5.31/a of the Fourth WMO Congress.

The German Research Vessel 'Meteor II', now under construction, will take part in the IIOE during the winter 1964-1965. Her main working region will be the Arabian Sea. She will be equipped with a complete shipboard weather station including various meteorological instruments, radio receivers, a facsimile apparatus, and a radar set for both rawind findings and for locating precipitation areas. This station will be staffed with one scientific officer and about three technicians. It will carry out surface observations, radiosonde ascents and rawind measurements. Perhaps also measurements of air-sea interaction will be possible. In addition, synoptic charts will be regularly drawn as a basis for the daily meteorological advice given to the ship's captain and to the scientific leader of the expedition."

STEREO CLOUD PHOTOGRAPHY FROM AIRCRAFT

Response to my request for 35 mm stereo pairs has recently most encouragingly increased, notably from Royal Air Force crews flying between Aden, Gan and Singapore. The quality and content of the photos are excellent and will valuably supplement other data, particularly from satellites.

2.2 Mr. F. Morley of the Office of the Minister for Science, the United Kingdom, has provided us with the following information concerning the meteorological activities of British ships:

"I am writing with regard to paragraph 4 on page 3 of the I.O.C. IIOE Information Paper No. 3 which mentions that some research vessels have not been transmitting surface weather observations. While it is hoped that full observations from British ships have been received, it might be worth sending you the following brief summary of the current meteorological activities of British ships:

- (1) All British research ships participating in the IIOE are carrying out the normal duties of a selected ship for surface observations. RRS Discovery is also making radiosonde ascents once a day and regular radiation measurements. Her wind observations are made by carefully sited anemometers.
- (2) All British Selected Merchant Ships have been instructed, as part of the WMO plan, to pay special attention to qualitative precipitation observations - recording in their log-books the intensity of precipitation and time at which it begins and ceases.

- (3) Considerable success has been achieved in recruiting auxiliary ships for making simple surface observations in the area."

3. The activity at the Indian Ocean Biological Centre, Ernakulam, South India

From the middle of August 1963, 492 plankton samples have been received at the Centre. Countries which have contributed samples and the number of samples received is as follows: Australia (62), India (185), Japan (20), South Africa (58), U.S.A. (167). A further total of 252 samples have been sent from Australia, Japan and South Africa but have not as yet been received. Forty-eight samples from the last cruise of the Vityaz are also expected.

Sorting of samples started in April of this year when the curator (Dr. Vagn K. Hansen) joined the Centre. Sorting commenced, according to a preliminary standard, with samples which were not taken with the Indian Ocean Standard Net (IOSN). By the middle of August 1963, 114 samples had been processed according to this schedule. Final sorting of these samples will be done when sufficient experience and laboratory facilities are available, after which the IOSN samples will be processed. In this connexion only about 30 per cent of the laboratory equipment purchased by Unesco has been received although all orders for equipment requested have been placed.

It is noted that only about 60 per cent of the samples sent to the Centre for sorting have been taken with the IOSN. This has been attributed to the loss of an unexpectedly high number of IOSN during operation. In order to avoid a too great proportion of samples taken by nets other than the IOSN or a reduction of the number of samples in toto, the expeditions are asked to carry a greater number of spare IOSN than is the case for other vertical net types. As mentioned in the IIOE Information Paper No. 2, page 4, assistance in the procurement of IOSN can be obtained from the Office of Oceanography, Unesco. For ships calling at Indian ports, extra nets can be supplied by communication with: The Curator, Indian Ocean Biological Centre, Ernakulam-6, South India (Cable: Oceanology, Ernakulam Telephone: 2306).

Contributors of the IOSN plankton samples for the Indian Ocean Biological Centre are requested to report as far as possible:

- (1) displacement volumes of the samples;
- (2) lapse of time from when the haul was taken until the displacement volume was measured;
- (3) the volume of water filtered.

Further, in order to facilitate the planning of the work at the Centre, the IIOE national co-ordinators are asked to arrange that the curator of IOBC will be informed on the approximate number of samples which have been taken in 1963 and will in future be taken (recommended frequency of hauls: 1 haul per night station).

4. IIOE Cruise after 1 January 1963 and tracks

The table in Annex II shows the IIOE cruises after 1 January 1963 compiled from information received by the Secretariat to date. Some of these may be obsolete by now and any correction and/or additions should be sent to the Office of Oceanography, Unesco.

The Secretariat has also received some announcements of planned and completed ship tracks for IIOE which are not incorporated into the map "Indian Ocean - Oceanographic Cruise Tracks Scheduled" published by the U.S. Hydrographic Office (H.O. 17.138-C, September 1962) and distributed by the former Co-ordinator Mr. R.G. Snider. These tracks are presented on the charts of Annex III. Copies of the map H.O.17.138-C mentioned above are still available from the Office of Oceanography, Unesco, upon request.

5. Handling of Explosives in Indian Ports for IIOE Vessels

The Director of the Indian Programme for IIOE has provided us with information concerning the special considerations of the Indian Government for handling of explosives in Indian ports. The following is an extract from his letter of 24 June 1963.

"In continuation of my letter of even number dated 16 August 1962, the procedure to be followed by the visiting ships at the ports in India in regard to the handling of explosives is as follows:

Visakhapatnam: No objection to Research Vessels carrying explosives in connexion with this programme entering the port provided all safety precautions are observed as laid down in the Port Rules.

Kandla: The ships carrying significant quantities of explosives are not permitted to berth alongside other ships but will have to stay at anchorage in stream as a special case. The loading and shipment or handling of explosives at the port is prohibited except for safety fuses and authorized explosives of the fire works class.

Cochin: Ships carrying explosives are not ordinarily permitted to enter the port. But as a special case permission should be obtained from the Conservator of the port. For the handling of the explosives, the conditions laid down in the Government of India Explosives Rules, 1940, should be strictly observed.

Madras: The explosives arriving by ships at Madras are discharged at the outer roads, as distinct from the enclosed harbour, where a special anchorage has been earmarked for this purpose. The explosives are normally discharged into lighters and brought to the eastern outer arm of the enclosed harbour and loaded direct into powder wagons for transit. If, however, there is any delay in the availability of wagons, the cargo remains in the barges under strict watch until they are loaded into wagons for onward dispatch.

The handling of explosives at this port is to be done in accordance with the Rules laid down by the Government.

Calcutta: The handling of explosives at this port is to be done in accordance with the Rules laid down by the Government.

Bombay: All explosives as well as vessels transporting them are prohibited entry into the Bombay docks. Supplies are handled in the stream by the Navy and cleared through Trombay Pier. Combustibles and explosives for signalling purposes only are, however, allowed on board any vessels in docks as provided in our docks Bye-law No. 106, subject to compliance with the provisions relating to their storage aboard the vessel and other precautions prescribed in the Bye-law. It would be necessary to know in advance what kind of explosives and combustibles the research vessel will be carrying.

Ships likely to enter Indian ports with explosives may be advised to have with them copies of Rules relating to handling of explosives in the various ports. I am confident that the concerned shipping agents will be able to provide them."

6. Special Customs Facilities and Courtesies

INDIA. From Secretary, Indian National Committee on Oceanic Research, of 17 September 1963*

"In continuation of my letter of even No. dated 20 March 1963, addressed to Dr. Wooster regarding customs free entry of equipment and other goods brought into India by foreign participants in connexion with their participation in the Expedition, I write to inform you that at our instance the Reserve Bank of India vide their letter No.EC.DH.XA.125R/89-63 dated 12 September 1963, have exempted the foreign participants from obtaining a "No Objection Certificate" from them for reshipment of goods, collected materials etc., and equipment brought into India in connexion with the International Indian Ocean Expedition, after availing the customs free entry of these goods, on production of a certificate from the Indian National Committee on Oceanic Research.

* For the previous letter of 20 March 1963, see supplement to the IIQE Information Paper No. 2 (Doc. INF/42-A).

This may be circulated amongst the National Committees and other interested organizations who may like to avail of the various facilities like customs free entry of the scientific equipment etc. This information may be added to your 'News Bulletin'."

7. Tide-gauges in the Indian Ocean

By the letter of 31 August 1963, Dr. N.K. Panikkar, Director of the Indian Programme of the IIOE, informed the Secretariat, that a tide gauge has been recently installed at the Minicoy Islands.

8. Miscellaneous

8.1 National IIOE Co-ordinators

In Annex B of the Information Paper No. 2 the names of IIOE National Co-ordinators are listed. Some of these were tentatively listed without any official confirmation from the persons concerned. To date confirmations from respective governments have been received for the following National Co-ordinators:

<u>Australia</u>	Dr. G.H. Humphrey
<u>Ceylon</u>	Dr. V. Basnayake

8.2 Publications

(1) North West Indian Ocean Bathymetric Charts contoured by Dr. A.S. Laughton have been received from N.I.O. A note from Dr. Laughton which was attached to the charts is reproduced here.

North West Indian Ocean Bathymetric Charts

The following contoured 1:1,000,000 charts of the bathymetry of the North West Indian Ocean are enclosed as a contribution to the International Indian Ocean Expedition.

131, 158, 159, 188, 189, 219, 220, 249, 250, 251, 279, 280

These charts have all been revised in August 1963 and supersede those previously circulated. They are based on the July 1963 issue of the Collected Sounding Sheets of the Hydrographic Department, Admiralty, which now include some cruises of R.V. Atlantis, Vema, Eastwind and Vityaz as well as the 1962-1963 cruises of H.M.S. Owen and H.M.S. Dalrymple and other British ships.

A mosaic of a photographically reduced version of these charts is being prepared and will be circulated when available (1:3,500,000).

The chart of the Gulf of Aden shows very clearly the North East-South West faults first noticed by the John Murray expedition. The topography strongly suggests that the major fault is transcurrent with a North East displacement of the eastern side of about 70 miles.

The Amirantes Trench is now shown to be at least 250 miles in length, some of it being filled with sediment and showing as a negative gravity anomaly.

The survey by H.M.S. Owen of the North West end of the Carlsberg Ridge has shown the continuation of the fault suggested by Matthews (Nature, 198, 950-952, 1963) across the ridge dividing an essentially magnetic ridge from non-magnetic continental seamounts. The survey by H.M.S. Dalrymple has shown how the John Murray Ridge connects with Matthews' fault.

Another feature of interest is the sounding of 3173 fathoms (corrected), in a small trench on the line of this fault. This is the deepest sounding yet obtained in the North West Indian Ocean.

The north east flank of the Carlsberg Ridge appears to be bordered by a trough of considerable length.

Further copies of the 1:1,000,000 charts will not be available from N.I.O. until January 1964 since the master copies will be at sea. However the copies of the reduced chart will be available.

A.S. Laughton"

(11) Bathymetric Magnetic and Gravity Investigations H.M.S. Owen 1961-1962

Bathymetric magnetic and gravity profiles by H.M.S. Owen during her cruise in the Indian Ocean 1961-1962 are published as "Admiralty Marine Science Publication" Number 4, by the Hydrographic Department Admiralty. It contains Explanation of profiles, Profiles Track Chart and Profile index. This publication will be distributed by the Admiralty; however, about 100 copies of it will be distributed by the Office of Oceanography; Unesco, among institutions and agencies of countries participating in IIOE.

(111) Field Guide to the Birds of the Indian Ocean

The Smithsonian Institution has published (February 1963) the "Preliminary Guide to the Birds of the Indian Ocean"; copies have been sent to participants in the IIOE as well as to Indian Ocean ornithologists. The Institution has recently published an addenda to the Guide. Persons requiring a copy of the Guide as well as the addenda for research purposes may contact:

SMITHSONIAN INSTITUTION
United States National Museum
Washington 25, D.C., U.S.A.

8.3 Ceylon Committee for the International Indian Ocean Expedition

From information received in the letter of 5 August 1963 from the Permanent Secretary, Ministry of External Affairs, the present composition of Ceylon Committee for the IIOE is as follows:

(a) Representatives of the Ceylon Association for the Advancement of Science:

1. Dr. V. Appapillai
2. Mr. L.A.D.I. Ekanayaka

(b) Representative of the University of Ceylon:

Dr. M.S. Thambiah

(c) The Port Commissioner

(d) The Director of Fisheries

(e) The Director of Meteorology

(f) The General Secretary, Ceylon Association
for the Advancement of Science (Convenor of
the Committee).

(g) Representative from the Navy - The Captain of
the Navy.

(h) Representative from the Geological Survey
Department - Mr. C.H.L. Sirimanne.

Mr. A.N.S. Kulasinghe has represented the Port Commissioner at Committee Meetings.

Dr. A.C.J. Weerakoon is invited to participate in Committee Meetings.

9. United Kingdom IIOE Programme, Newsletter No. 3, September 1963

United Kingdom IIOE Programme, Newsletter No. 3, published by the Royal Society, has been recently received by this Office. Since distribution of this newsletter is limited to U.K. laboratories, it is reproduced here for wider distribution (Annex IV).

ANNEX IINTERNATIONAL INDIAN OCEAN EXPEDITIONSOUTH AFRICAN CONTRIBUTIONSUMMARY OF CRUISE REPORTS

1. The South African contribution to this expedition commenced in June 1961, when the Research Vessel AFRICANA II of the Division of Sea Fisheries carried out a cruise (251) from Lourenco Marques across the Mozambique channel to the southern end of Madagascar, thence to 28°00'S., 50°00'E. and to 32°00'S., 53°E. from whence she proceeded to Mauritius to land a hospital case. From Mauritius direct to 39°00'S., 56°00'E., thence to 38°00'S., 59°00'E., and back to vicinity of East London.

1.1 During this cruise the following disciplines were investigated: temperature and salinity 32 stations, oxygen 32, phosphates 32, zooplankton 32, phytonplankton 17, primary production 16, gravity corer 9, beam trawl and blanket net 1. Continuous observations were made of birds, mammals and surface fish, waves, sea-surface temperatures, local weather (radiosonde balloons were launched at 26 stations), and bottom contours (echo soundings).

2. In April 1962, S.A.S. "NATAL" commenced a series of nine cruises, each of approximately three weeks duration.

2.2 Cruises 1, 4, 6, and 7 commenced at Durban, thence through 34°00'S., 40°00'E., 36°30'S., 36°00'E., and back to the coast at 32°00'S., 29°00'E. - thence to Port Elizabeth then out to 40°30'S., 32°30'E., and through 40°S., 30'E. to Cape Agulhas.

2.2.1 During each of these cruises the following disciplines were observed - continuous echo sounding, hydrographic stations 37 in number (hydrology (37)), zooplankton (37), phytoplankton (25), coring, nuclear physics, meteorology, ornithology, bathythermograph dips. Sea surface temperatures, observations made by University of Cape Town and S.A. Navy Hydrographic Department.

2.3 Cruise 2 commenced at Simonstown and covered an area to the south east of Cape Agulhas to approximately 38°S., 26°E., during which geological coring was carried out, observations made for seismic refraction and the gravity metre was operated. Continuous echo sounder recordings, sea surface temperature readings and 34 bathythermograph dips made. Meteorological observations. Geological observations by University of Cape Town, seismic refraction and gravity metre operated by Bernard Price Institute and remainder by S.A. Naval Hydrographic Department.

2.4 Cruise 3 commenced at approximately 32°S., 30°E., thence to 34°30'S., 34°30'E., to 35°40'S., 28°30'E. to Port Elizabeth, during which geological coring was carried out, observation made for seismic refraction and the gravity metre operated - continuous echo sounder recordings, sea surface temperatures readings and 23 bathythermograph

dips. Meteorology geological observations by University of Cape Town. Seismic and gravity metre operated by Bernard Price Institute, and remainder by S.A. Naval Hydrographic Department.

2.5 Cruise 5 commenced at Durban then passed through various stations en route to 32°30'S, 43°30'E., then a zigzag course to the northward to 27°00'S., 44°E. and then to 26°S., 34°E. and back to Durban.

During this cruise the following was carried out: Longline tunny fishing - 8 stations - midwater trawling 8 stations. Surface trolling, nuclear physics - night light stations - bathythermograph dips - surface temperature recordings, current observations at longline stations - 14 radiosonde stations in addition to normal meteorological observations. The South African Museum at Cape Town made the observations for fish productivity and nuclear physics and the S.A. Naval Hydrographic Department undertook the remainder.

2.6 Cruise N/N. This was an additional cruise hence no number being appended to it. It commenced at Simonstown and covered an area south of the Agulhas Bank and over the Agulhas Plateau, thence to 40°30'S., 29°30'E. to 40°30'S., 34°00'E., followed by a zigzag course up the ridge extending south west from the Mozambique Terrace to 36°30'S., 34°30'E., and thence to Mossel Bay via the Africana Sea Mount 37°00'S., 29°00'E. During this cruise the main aim was ocean soundings but 108 bathythermograph-dips were taken, also 10 grabs, 10 cores, and continuous gravimetric and thermograph recordings were made - also five midwater trawls. Meteorological observations. Bernard Price Institute made the gravimetric observations - the South African Museum the midwater trawls, the University of Cape Town the grabs, two cores, and the S.A. Naval Hydrographic Department the remainder.

2.7 Cruise 8 was a repeat of cruise 5 but commenced at Simonstown thence direct to 32.15°S., 35°30'E. and the zigzag course up the Madagascar Ridge commenced at 37°00'S., 44°00'E. A spectacular underwater peak was discovered on the Madagascar Ridge in 33°13'S., 43°49'E. - depth 10 fathoms, named the "Walters Shoals".

In all the S.A.S. "NATAL" steamed approximately 36,000 miles during the course of the nine cruises.

3. Research Ship AFRICANA II carried out another cruise (263) in June-July 1962. From Port Elizabeth to Marion Island - thence a zigzag course to Crozet Islands, up to 36°30'S., 41°30'E., and then towards East London, finally returning to Port Elizabeth. A search was made for the Slot van Chapelle in 36°30'S., 41°30'E., but without success.

3.1 During this cruise the following disciplines were investigated: temperature and salinity 23 stations, oxygen 21, phosphate 20 (total phosphorus 6), zooplankton 23, phytoplankton 12, phytoplankton productivity measurements 15 and gravity coring at two stations. Continuous observations were made of birds, mammals and surface fish, waves, sea-surface temperatures (thermograph), local weather and bottom contours (echo sounding).

4. Research Ship AFRICANA II carried out a third cruise (273) in April 1963, from Cape Town to Marion Island and back to Cape Town. The same disciplines as for Cruise 2 were carried out on the outward passage, but the return passage was made in haste due to a tragic drowning fatality at Marion Island.

Research Ship AFRICANA II steamed approximately 13,500 miles during the course of the three cruises.

5. In addition to the above cruises - short cruises were made on the Agulhas Bank by the "John D. Gilchrist", a small research vessel operated by the University of Cape Town, and the four vessels of the Division of Sea Fisheries have carried out routine cruises along the South African coast.

6. This summary has been prepared by the S.A. Naval Hydrographic and Oceanographic Research Department from Consolidated Cruise Reports.

The S.A. Naval Hydrographic and Oceanographic Research Department,
c/o Fleet Mail Office,
SIMONSTOWN.

27 August 1963.

DATES OF CRUISES BY S.A.S. NATAL:

Cruise No. 1:	2 to 24 April 1962
Cruise No. 2:	7 to 24 May 1962
Cruise No. 3:	4 to 22 June 1962
Cruise No. 4:	2 to 24 July 1962
Cruise No. 5:	6 to 30 August 1962
Cruise No. 6:	1 to 22 October 1962
N/N Cruise:	5 to 22 November 1962
Cruise No. 7:	7 to 29 January 1963
Cruise No. 8:	11 February to 8 March 1963.

ANNEX II

SHIP SCHEDULE FOR IIOE (1963-1965)

Annex II

COUNTRY	SHIP	PERIOD	DISCIPLINES AND ITEMS OF OBSERVATION	TRACK
Australia	Gascoyne	17/I-17/II/63	Do1-5, 7, 8; Ps1, 2a, b, g, 4, 5.	(3)
	Diamantina	28/III-28/IV/63	ditto	(3)
	ditto	6/V-6/VI/63	ditto	(3)
	ditto	9/VII-9/VIII/63	ditto	(3)
	ditto	4/IX-28/IX/63	ditto	---
France	R. Giraud	XII/62-III/63	Do1, 2, 3, 7; Cm1, 4.	(1)
	small ship	1963	Fr.	---
	Calypso	XII/62-III/63	Do1, 2, 3, 8; Cm.	(1)
Germany	new ship	X/ -III/	Do; Ps; Mt; Gg.	(1)
India	Bangada	IX/62-III/63	Fr.	---
	Kistna	10-29/I/63	Do1-8; Cm. Ps1, 2, 5. Ph1; Ch2; Fr1, 2; Gg1, 4-7; Mt2.	} (1)
	ditto	5-16/II/63	ditto	
	ditto	21/II-9/III/63	ditto	
	ditto	14-22/III/63	ditto	
	ditto	VI/63-X/63	ditto	(3)
	Varuna	XII/62-II/63	Do; Fr.	---
	ditto	II-V/63	ditto	---
Indonesia	Jalanidhi	1-7/IV/63	Do1-5; Ps1, 2e. Cm1; Ab.	(3)
	ditto	6-26/VI/63	Do1-5, 7, 8; Cm1. Ps1, 2; Ab1; Fr2; Gg1.	(2)
	ditto	-----	ditto	(1)
Japan	Umitaka-Marui	29/X/62-11/II/63	Do1-8; Cm1, 2, 4; Ps1, 2a, c-f, 4-6. Fr3. Gg1, 2a. Mt3.	(2)
	ditto	XI/63-II/64	may be similar as above	(1)
	Koyo-Marui	24/X/62-18/II/63	Do1-8; Cm1, 2; Ps1, 2a-c, 5, 7; Fr1; Mt1-3.	(2)
	ditto	XI/63-II/64	may be similar as above	(1)
	Kagoshima-Marui	XI/63-II/64	may be similar as above	(1)
	Oshoro-Marui	17/XI/62-12/II/63	Do; Cm; Ps; Fr;	(3)
Pakistan	Zulfiquar	I/63-V/63	Do1-8; Cm; Ps1, 2, 5; Ch1, 3, 4; Gg1; Mt2, 3.	(1)
	ditto	X/63-II/64	ditto	---
	ditto	1964	-----	---
	Madagar	I-IV/63	Do1-8; Cm; Ps1, 2, 5; Ch3; Ab. Fr1, 2; Gg1, 2a; Mt2, 3.	---
	ditto	X-XII/63	ditto	---

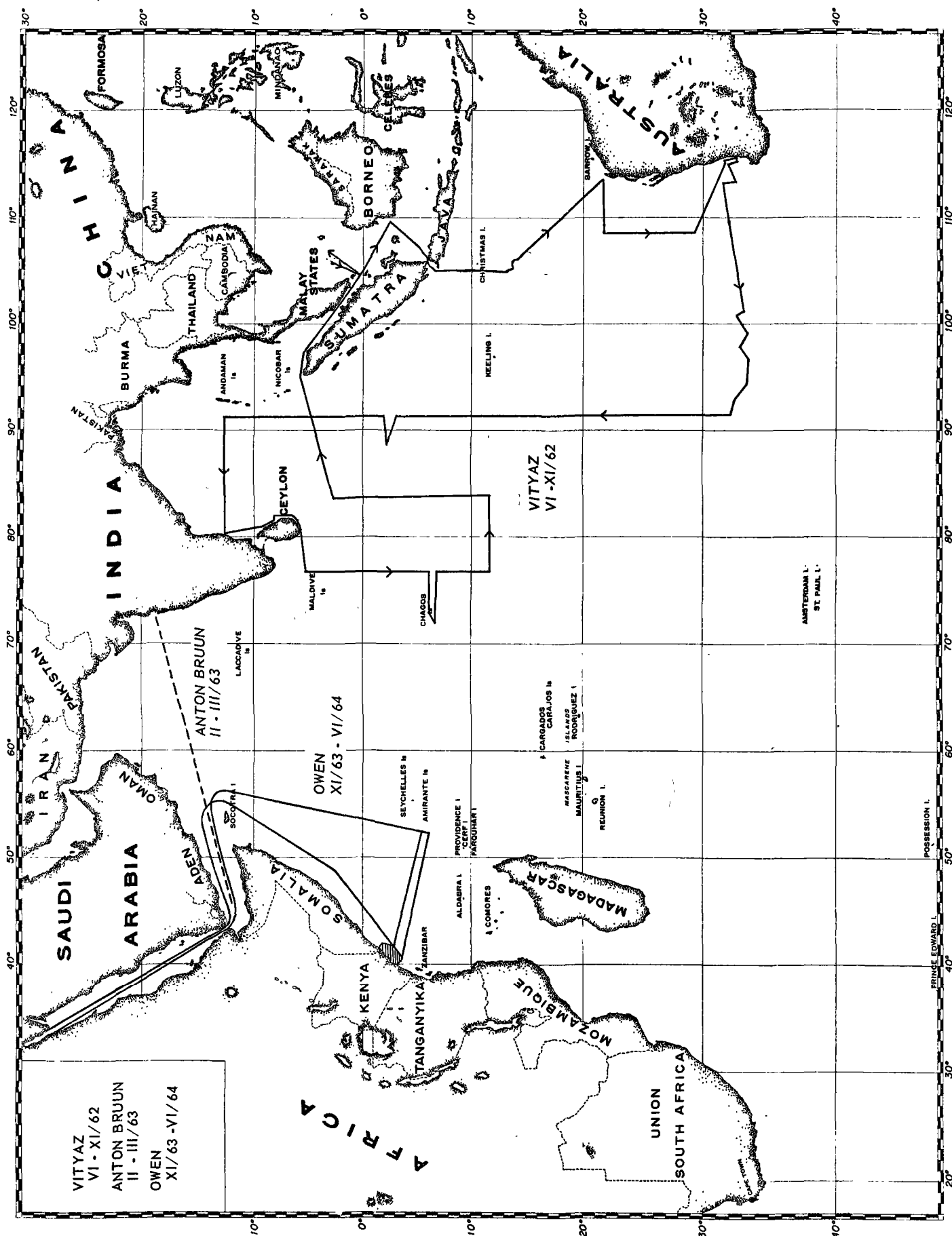
Portugal	Lacerda ditto	VIII-IX/63 II-III/64	Do1-5,7,8;Cm1;Ps1,2c,d,4;Ph2;Ab;Fr1;Gg1,2a,Mt1,2. ditto	(1) (1)
South Africa	Natal ditto	7-29/I/63 11/II-8/III/63	Do1-8;Ps1,2a,4,5;Ch4. ditto	(1) (1)
	Africana II	III-V/63	Do1,3-5,7,8;Ps1,2a,4,5;Ch3,4;Fr1.Gg7;Mt1.	(1)
Thailand	Oceanogr.V.II	XII/62-I/63	Do1-4,7;Cm.Ps1,2;Fr2;Gg1,2b;Mt1.	(1)
U.K.	Discovery III ditto	31/V-20/VIII/63 23/VIII-10/XII/63	Do1-5,7,8;Cm1-3;Ps1,2,4,5;Ch;Ph2;Fr6;Gg6,7;Mt1,2. Gg1,2a,4-9 (topography, photograph); Mt1,2.	(1) (2)
	ditto	10/I/64-30/IV/64	Do1-5,7,8;Cm1-3;Ps1,2a,c,d,4;Fr6;Gg6,7;Mt1,2.	(2)
	ditto	2/V/64-11/VI/64	Do1-5,7,8;Cm2,3;Ps1,2a,c,d,4;Fr6;Gg6,7;Mt1,2.	(2)
	ditto	13/VI/64-20/IX/64	Do1-5,7,8;Cm1-3;Ps1,2a-f,3-5,8;Fr6;Gg6,7;Mt1-3.	(2)
	Dalrymple	IX/62-V/63	Ab1;Gg1,2b,3,7;Mt1.	---
	Owen	11/XI/62-16/V/63	Gg4,6,7,9 (topography); Mt1.	(2)
	ditto	X/63-VI/64	Gg;Mt.	(3)
	Manihine	20/I/64-30/III/64	Do1-5,7,8;Ps1,2a,b,d-f,3-5;Fr1;Mt3.	(3)
U.S.A.	A.Bruun	8/III-7/V/63	Do1-5,7,8;Ps1,2a,d,4,5;Ab1;Fr.1-3;Mt2.	(1)
	ditto	24/II-4/III/63	Do1-5,7,8;Ps1,2,a,d,4,5.	(3)
	ditto	17/V-22/VII/63	Do1-5,7,8;Ps1,2a,d,4,5;Fr1,2,3;Mt2.	(1)
	ditto	1/VIII-16/IX/63	Do1-5,7,8;Ps1,2a,b,d,4,5;Mt2.	(1)
	ditto	27/X-1/XII/63	Do1-5,7,8;Ps1,2a,d,4,5;Ab1;Fr3;Mt2.	(1)
	ditto	1/I-28/III/64	Do1-5,7,8;Ps1,2a,d,4,5;Fr1,4;Mt2.	(1)
	ditto	9/IV-1/VI/64	Do1-5,7,8;Ps1,2a,b,d,4,5;Mt2.	(1)
	ditto	12/VI-26/VII/64	Do1-5,7,8;Ps1,2a,d,4,5;Fr2;Gg1,2b.	(1)
	ditto	6/VIII-25/IX/64	Do1-5,7,8;Ps1,2a,d,4,5;Ab1;Fr2;Mt2.	(1)
	ditto	3/X-25/XI/64	Do1-5,7,8;Ps1,2a,b,d,4,5;Fr2;Mt2.	(1)
	Argo	14/III-15/V/64	Do1-5,7,8;Cm2,3;Gg6,7.	(1)
	ditto	18/V-7/VI/64	Do1-5,7,8;Gg1,4-7.	(1)
	Atlantis II	1/VII-19/XII/63	Do;Cm;Gg.	(2)
	ditto	I-V/65	Do;Cm;Gg.	(1)
	Chain	IX/63-III/64	Do;Gg.	(1)
	ditto	IX/64-III/65	Do;Gg.	(1)
	Conrad	1963	-----	---
	Pioneer	II-IX/64	Do1-5,7,8;Gg1,2a,6,7,9 (photograph)	(1)
	Serrano	I-II/63	-----	(1)
	S.F. Baird	II-V/64	Gg3,5,6 and others	---
	Te Vega	X-XII/63	Ps;Gg.	(1)
	ditto	II-IV/64	Ps;Gg.	(1)
	ditto	IV-IX/64	Ps;Fr;Gg.	(1)
	Vema	20/VI-14/X/63	Do1-5,7,8;Ps1,2,6;Ch4;Ph2;Ab;Gg1-7,9 (photograph)	---

LEGEND

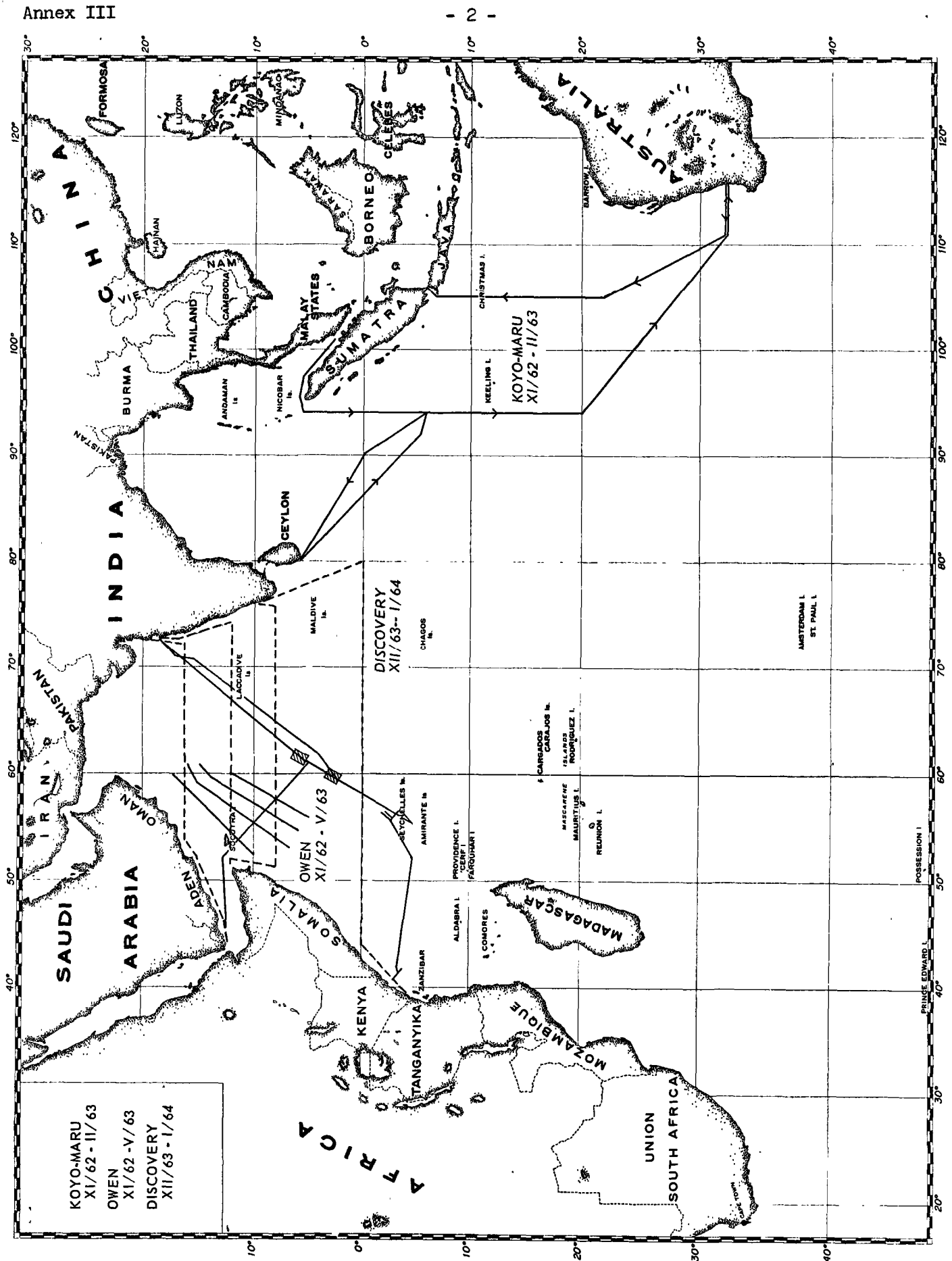
Do	<u>Descriptive oceanography</u>	Ab	<u>Biological study in deep layer</u>
1	Temperature with reversing thermometer	1	Benthic sample
2	Temperature with BT	2	Bottom photography
3	Salinity		
4	Oxygen	Ph	<u>Physical study</u>
5	Naturient salts	1	Sound velocity
6	pH	2	Turbidity
7	Bathymetry		
8	Surface weather observation at the station	Ch	<u>Chemical study</u>
		1	H ₂ S
		2	CO ₂
Cm	<u>Current measurement</u>	3	Trace elements
1	with GEK	4	Radio-activity & isotops
2	with current metre		
3	with Swallow float or drougue	Fr	<u>Fisheries research</u>
4	with drift-bottle	1	Experimental fishing
		2	Fish sampling
Ps	<u>Plankton study</u>	3	Bionomics
1	Phyto-plankton	4	Gear experiment
2	Zoo-plankton	5	Tagging
a	Indian Ocean Standard net	6	Visual observation
b	Isaacs-Kidd midwater trawl		
c	Vertical haul with closing net	Gg	<u>Geology and Geophysics</u>
d	Oblique haul	1	Coring
e	Horizontal haul	2a	Dredging
f	High-speed surface sampler	b	Grabbing
g	Clarke-Bumps sampler	3	Sparker
3	Larva net	4	Seismic study
4	Pigments	5	Heat flow
5	Primary production, standing crops	6	Gravity
6	Micro-biology	7	Magnetism
7	Marine bacteria	8	Drilling
8	DSL	9	others (specify)
		Mt	<u>Meteorology</u>
		1	Synoptic observation
		2	Upper-air observation
		3	Radiation & energy exchange

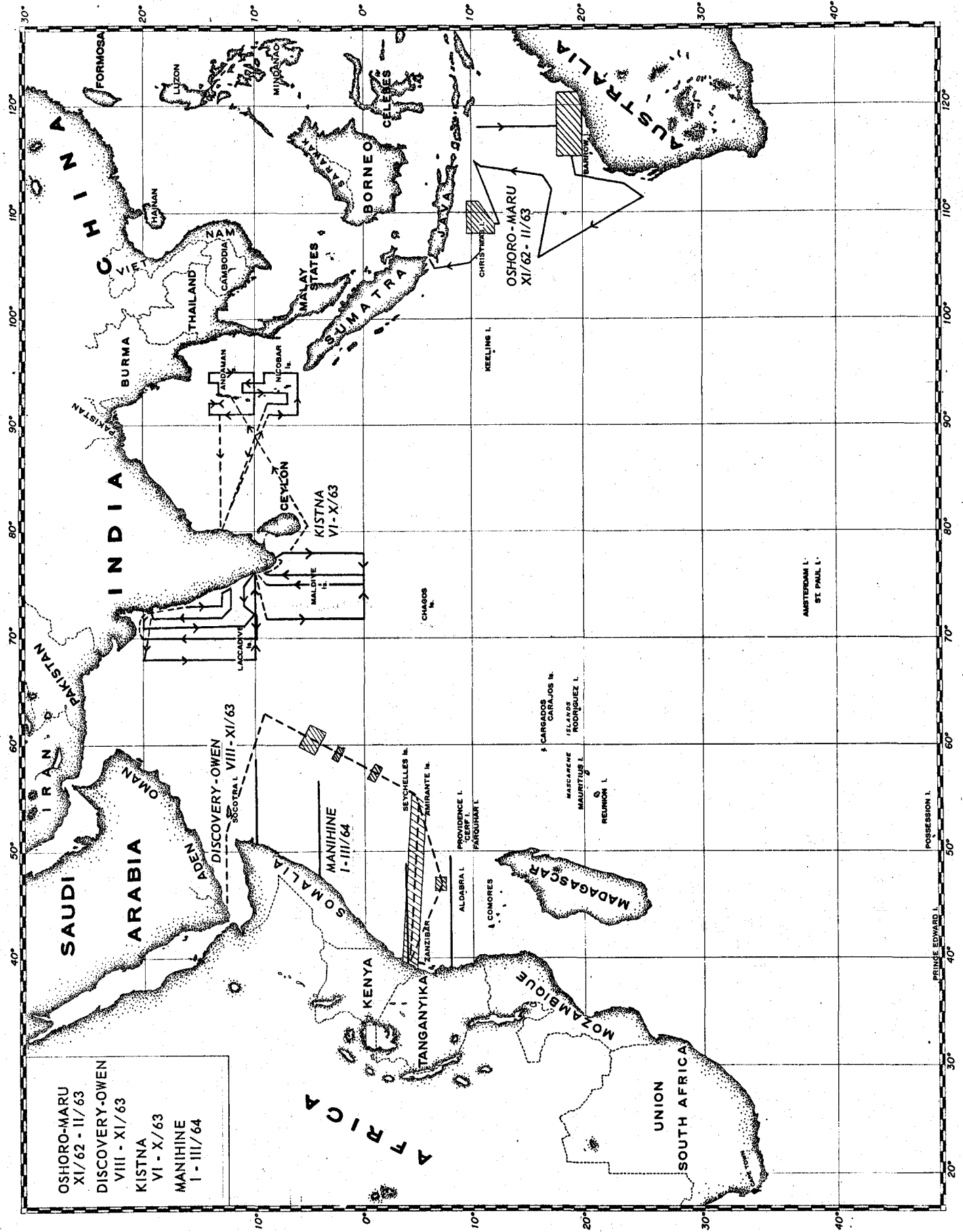
for Column TRACK

- (1) as it appears in the IIOE Track Chart (Sept.1962,H.O. 17,138-C).
- (2) different as it appears in the IIOE Track Chart.
- (3) does not appear in the IIOE Track Chart.



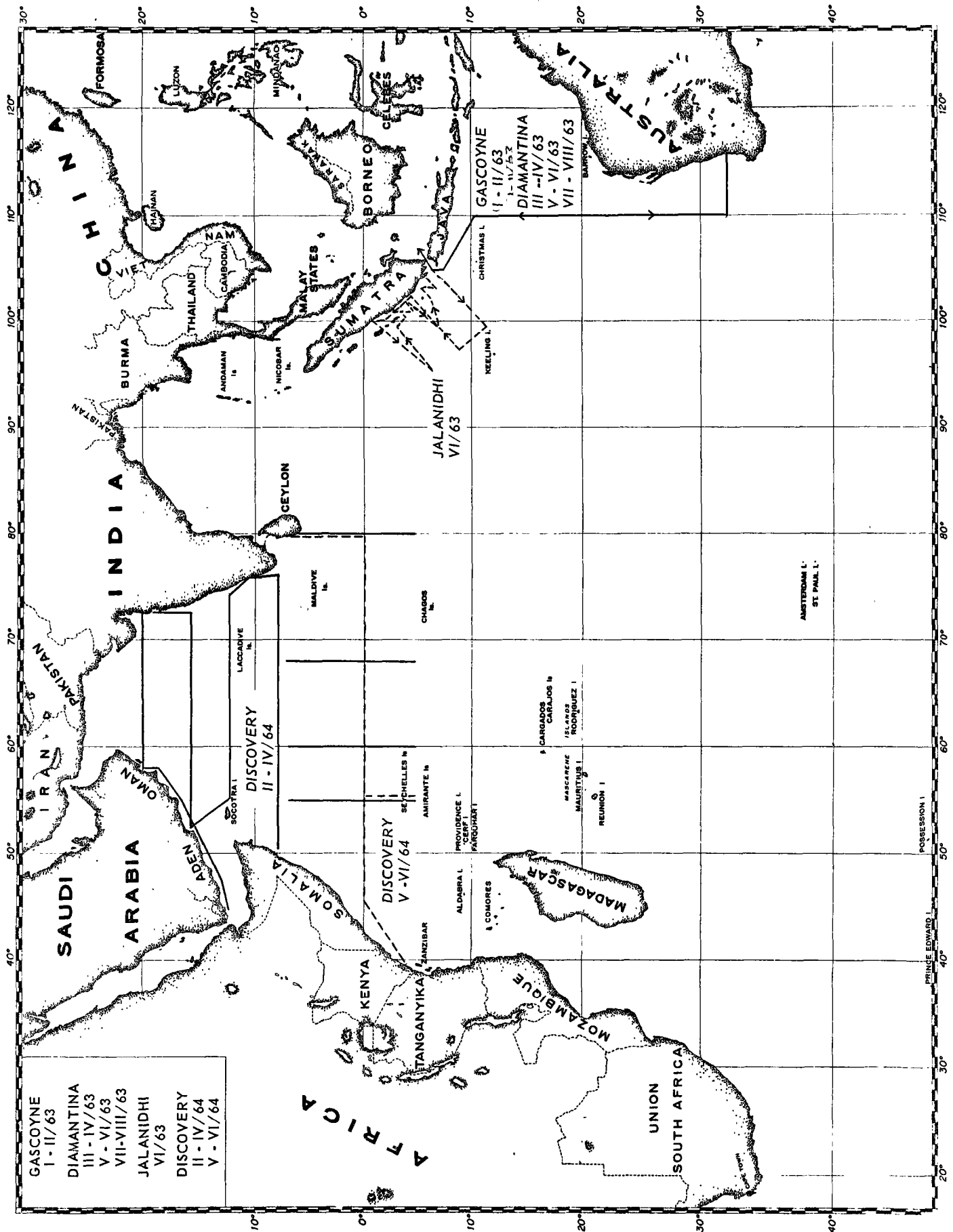
Annex III





Annex III

- 4 -



ANNEX IV

THE ROYAL SOCIETY

UNITED KINGDOM IOOE PROGRAMMESNEWSLETTER NO.3 SEPTEMBER 1963

1. R.R.S. DISCOVERY AND H.M.S. OWEN. Indian Ocean, August December 1963
by Dr. M.N. Hill, Department of Geodesy and Geophysics. Cambridge.

On 23 August R.R.S. DISCOVERY (owned by the National Institute of Oceanography) sailed from Aden on the second stage of the work she is undertaking as part of the International Indian Ocean Expedition. (A brief report of the first stage, the first biological cruise, will appear shortly.)

This part of the work, which will be completed in early December, will be largely concerned with the geology and geophysics of the Ocean floor in the Arabian Sea. Ten scientists from the Department of Geodesy and Geophysics, Cambridge University and eight scientists from the National Institute of Oceanography will be taking part. The Principal Scientist will be Dr. M.N. Hill, F.R.S., from Cambridge.

The solution of several problems will be sought. These problems have been set by the reconnaissance surveys which have been possible thanks to the assistance given by the Hydrographer of the Navy in providing H.M.S. OWEN (Commander G.P.D. Hall, R.N., and subsequently Commander D.W. Haslam) during two seasons' work in the area.

(a) General

The main purpose of the expedition will be to obtain more evidence as to movements, during geological time, of the floor of the ocean and of continental blocks over this floor. Until recently it was generally accepted, although it was realized that considerable vertical movements of the crustal rocks of the Earth had occurred, that the rocks forming the crust of the Earth did not move far laterally. Now, more and more evidence is being collected showing that, in fact, there have been great sideways shifts within the sea floor itself and of continental masses across the sea floor. In the Arabian Sea there is a great opportunity of finding out more about these movements; indeed there is nowhere else where there is greater opportunity since such a wide variety of processes seem to have been operating in the area.

(b) The Carlsberg Ridge

This mountain ridge which is one of the most conspicuous features of the floor of the Arabian Sea is part of a world-wide system of mid-ocean ridges and is joined with the mid-Atlantic ridge round the south of Africa. It also joins with a ridge extending to the south and east to encircle Australia. Near its crest this ridge sticks up some 10,000ft above the sea floor on either side, but nowhere does it come closer than 2,000 to 3,000 ft from the surface of the sea. It is

usual to find in the centre of the ridge (and indeed other ridges) a medium valley; this valley which is usually about ten miles wide has steep slopes and in places its floor lies as much as 10,000 ft below the peaks on the sides. It is also usual to find the Earth's magnetic field in the vicinity of the valley is highly disturbed and that the flow of heat from the inside of the Earth is higher through the floor of the valley than is usual elsewhere in the oceans.

What forms these mid-ocean ridges, how old are they and why do they parallel the continental boundaries in so many parts of the world? How is it that at the northern end, the Carlsberg Ridge at first sight appears to disappear in Arabia?

These are some of the problems about which DISCOVERY hopes to gain information while working in the Carlsberg Ridge. Already we have many clues from OWEN's work. For example, it has been shown that big forces have dislocated the ridge near its northern end with horizontal displacements as much as a few hundred miles; there are strong suggestions that, towards the north, the ridge bends sharply to the west and passes into the Gulf of Aden and perhaps thence up the axis of the Red Sea. To date, however, we have not sampled the rocks of this part of the ridge although we believe that we shall find they are basalts and that the rugged relief of the ridge is largely caused by volcanoes and lava flows. We have to obtain an adequate collection of samples for petrological study and for age determination; we must also photograph the sea floor to find the distribution of the rock outcrops. Information will be obtained about the distribution of heat flow coming from the interior of the Earth at a number of points from the median valley outwards.

All this information could assist with confirming or otherwise the intriguing current, but somewhat speculative hypothesis that the mid-ocean ridges are lines along which rocks from deep down in the Earth flow towards the surface. Thence, sweeping all before them slowly move (say at a speed of 1 cm/yr) across the ocean basins to the continental boundaries where they sink again deep into the Earth.

(c) The Continental Borderland of Kenya and Tanganyika

Geologists, aided by information obtained from the oil companies, have long known that there is a great thickness (tens of thousands of feet) of sedimentary formation at the shoreline of East Africa. It now appears from the results obtained by OWEN during the past two years that this thick layer may be the result of the downwarping of the continental boundary during geological time. Indeed, it may be that the original continental boundary was originally several hundred miles seaward of where it is now. It is hoped that the joint work of DISCOVERY and OWEN using the seismic method of exploration (which involves firing chemical explosives in the sea and recording, at a distance, the waves from these explosions which have travelled through the sea floor) will be able to find more evidence as to whether or not this strip of ocean, which extends about half-way to the Seychelles, consists of foundered continental rocks. OWEN will be using 100 depth charges for this joint operation, and DISCOVERY will use 10 tons of explosive for single-ship and shorter range seismic operations.

Combined with this work, there will be coring of the soft sediments of the relatively smooth area between the Seychelles and the mainland, bottom photography, heat flow measurements and dredging of rocks from seamounts sticking up through the soft sedimentary cover.

(d) The Seychelles Bank

The rocks - to a large extent granite - outcropping on the Seychelles are unlike those found on ordinary oceanic islands; this characteristic has long been recognized and it has been suggested that these rocks, which are commonplace on land, perhaps represent a fragment of a continental block which at some geological time drifted through the western Indian Ocean. Dating of these granites by Dr. J.A. Miller and others at Cambridge shows them to be Pre-Cambrian. This is geologically very aged; about 500 million years have elapsed since they were emplaced whereas they had previously been supposed to be less than 100 million years old. This result is intriguing since no oceanic rocks as old as this have ever been found; again it suggests that in this region of the Indian Ocean processes which can be highly instructive about the past history of the Earth can be studied.

The Seychelles Bank is also of interest from the point of view of recent calcareous sedimentation taking place on it and samples will be collected to be studied by Professor J.H. Taylor of King's College, London.

(e) Manganese and Phosphoritic Nodules

During the expedition efforts will be made to find, by photography and dredging, the distribution of manganese and phosphoritic nodules which are likely to form on the sea floor in this area of the ocean. If present in abundance these nodules could have an important commercial value; the minerals in them contain elements of considerable rarity in this part of the world. Professor J.S. Webb of Imperial College will be studying the results obtained from this preliminary survey.

- (f) The scientific work will be the joint responsibility of the National Institute of Oceanography and of the Department of Geodesy and Geophysics, Cambridge. This co-operation would be impossible if it were not for the magnificent facilities provided by the National Institute of Oceanography and the Hydrographer of the Navy in the two ships, DISCOVERY and OWEN.

2. GEOPHYSICAL RECONNAISSANCE IN THE ARABIAN SEA BY HM SHIPS OWEN AND DALRYMPLE
By D.H. Matthews, Department of Geodesy and Geophysics. Cambridge.

The reconnaissance survey carried out by HM ships OWEN and DALRYMPLE is complete. The tracks of the two ships are shown in the accompanying figure. Both ships have made continuous records of soundings - of magnetic field. OWEN has made continuous measurements of gravity as well. Coverage is 90% complete on the tracks shown. DALRYMPLE's work has been confined to the Murray Ridge area in the Gulf of Oman and to passages thence to Aden and Addu Atol. The remaining tracks are those of HMS OWEN.

Profiles of bathymetry, gravity and magnetic field strength obtained by HMS OWEN during the season 1961-1962 have been published as Admiralty Marine Sciences Publication Number 4 Pt. 2 (Profiles). Part 1 (Text) will be published during September. The profiles have a horizontal scale of 1:1,000,000. Copies may be obtained from the Department of Geodesy and Geophysics, Cambridge University. Bathymetric and magnetic profiles obtained by OWEN during the season 1962-1963 have been drawn. Photocopies can be obtained from Dr. D.H. Matthews, Cambridge. Photocopies of detailed bathymetric and magnetic surveys of two areas of the Carlsberg Ridge (scale 1:100,000) are also available. Results obtained by HMS DALRYMPLE on passage are being prepared in a comparable form at the Imperial College of Science and Technology (Mr. P. Barker).

Results of more detailed work by HMS OWEN in the vicinity of the Seychelles, Aldabra and Agalega Atolls have not yet been worked up.

Publications:

Matthews, D.H. A major fault scarp under the Arabian Sea displacing the Carlsberg Ridge near Socotra. Nature. 198 pp. 950-952. 1963.

Vine, F.J. and Matthews, D.H. Magnetic anomalies over oceanic ridges. Nature. (in proof).

3. N.W. INDIAN OCEAN BATHYMETRIC CHARTS. By Dr. A.S. Laughton, National Institute of Oceanography

The following contoured 1:1,000,000 charts of the bathymetry of the N.W. Indian Ocean have been produced and a limited number distributed.

131,158,159,188,189,219,220,249,250,251,279,280.

These charts have all been revised in August 1963 and supersede those previously circulated. They are based on the July 1963 issue of the Collected Sounding Sheets of the Hydrographic Department, Admiralty, which now include some cruises of R.V. ATLANTIS, VEMA, EASTWIND and VITYAS as well as the 1962-1963 cruises of HMS OWEN and HMS DALRYMPLE and other British ships.

A mosaic of a photographically reduced version of these charts is being prepared (1:3,500,000).

The chart of the Gulf of Aden very clearly shows the N.E. - S.W. faults first noticed by the John Murray expedition. The topography strongly suggests that the major fault is transcurrent with a N.E. displacement of the eastern side of about 70 miles.

The Amirantes Trench is now shown to be at least 250 miles in length, some of it being filled with sediment and showing as a negative gravity anomaly.

The survey by HMS OWEN of the N.W. end of the Carlsberg Ridge has shown the continuation of the fault suggested by Matthews (Nature, 198 950-952, 1963) across the ridge dividing an essentially magnetic ridge from non-magnetic continental sea-mounts. The survey by HMS DALRYMPLE has shown how the John Murray Ridge connects with Matthews' fault.

Another feature of interest is the sounding of 3173 fathoms (corrected), in a small trench on the line of this fault. This is the deepest sounding yet obtained in the N.W. Indian Ocean.

The northeast flank of the Carlsberg Ridge appears to be bordered by a trough of considerable length.

Further copies of the 1:1,000,000 charts will not be available from N.I.O. until January 1964 since the master copies will be at sea. However, the copies of the reduced chart will be available.

