

Intergovernmental oceanographic commission

information
paper

10

UNESCO/NS/10 C/INF - 65

FOREWORD

There is only one more year left before the official close of the International Indian Ocean Expedition. As everyone well knows scientific research in the Indian Ocean will continue for many years to come. However, the time approaches when it will be necessary to summarize our scientific experience of six years of co-ordinated research. Various symposia on the national and international level will help us to do so. The Royal Society held one such symposium in Cambridge on 12 November this year. It was devoted to the geology and geophysics of the North West Indian Ocean. Another symposium on geology and geophysics of the Indian Ocean will be held during the 22nd Geological Congress in New Delhi in mid-December.

The Office of Oceanography of Unesco would welcome information on any national or international symposia planned in connexion with the IIOE for 1965 or 1966. This information will be promulgated through this bulletin.

unesco

Unesco Office of Oceanography
Paris, December 1964

IIOE INFORMATION PAPER No. 10

1. Actions required by National Co-ordinators

1.1 The Secretary of IOC dispatched to National Co-ordinators of the IIOE on 10th July 1964, Circular Letter No.70 enclosing a "List of Actions Required by the Report of the International Co-ordination Group for IIOE". The list is reproduced below.

List of Actions Requested by the Report
of the International Co-ordination Group for IIOE
22-24 January 1964

For a National Co-ordinator

1. Information to be sent to the Secretary of IOC for inclusion in an IIOE Information Paper:

- a) Cruise plans and cruise reports with an indication of their distribution. (Reports p.2, II, 1; IIOE Inf. Pap. No.6, p.2)
- b) Abstracts of findings (prepared by the authors of the reports) with cruise reports. (Reports p.2, II, 1; IIOE Inf. Pap. No.6, p.2)
- c) Track charts showing stations, dates, types of observation. (Reports p.4, II, 1; IIOE Inf. Pap. No.6, p.2; No.8, Annex ..)
- d) List of observations made by laboratories at SCOR/UNESCO Reference Stations and at what depths. (Report p.9, V, 1; IIOE Inf. Pap. No.1, p.6; No.2, p.4; No.6, p.3)
- e) Details on IIOE Internship Radio Communications (Report p.8, IV, 3; IIOE Inf. Pap. No.6, Annex IV)

2. Information to be sent to the Curator of IOBC:

- a) Approximate number of IOSN samples which the country expects to send to the Centre by the end of 1964. (Report p.5, III, 1; IIOE Inf. Pap. No.6, p.2)
- b) A list of competent plankton experts interested in IIOE materials (Report p.5, III, 1; IIOE Inf. Pap. No.6, p.3)

3. Information to be sent to SCOR:

Locating people in each country interested in atlas work and inform the SCOR Working Group on Atlases accordingly (Report p.11, VI, 2)

4. Reprints to be included in the "Collected Reprints":

To send five copies of scientific articles on the Indian Ocean, with the author's permission and the statement for publisher's clearance. (Report p.12, VI, 4; IIOE Inf. Pap. No.1, p.1; No.6, p.3)

5. For appropriate national organizations:

- a) To stress to the national meteorological services the importance of treating data from IIOE cruises and of urging them to send surface and upper air data to WDC's for Oceanography with the minimum of delay. (Report p.4, II, 4; IIOE Inf. Pap. No.6, p.2)
- b) To request appropriate national organizations to correspond with Prof. Ramage about the proposal for meteorological programme. (Report p.8, IV, 2; IIOE Inf. Pap. No.6, Appendix III)

For interested national bodies

1. Submission of IIOE data to WDC's (Report p.11, VI, 1; IIOE Inf. Pap. No.6, p.1)
 - a) Data from cruises completed by the end of 1963 to be submitted by the end of 1964.
 - b) Data from cruises taking place during 1964 and 1965 to be submitted by the end of 1966.
2. Despatch of plankton samples to the IOBC (Report p.5, III, 1; IIOE Inf. Pap. No.6, p.3)
 - a) When plankton samples are despatched to the IOBC, two copies of a list of station numbers and number of samples, together with a chart of station positions, should be sent.
 - b) Whole catch from IOSN haul to be preserved and sent to IOBC. No organism should be discarded.
3. All institutions are encouraged to send copies of their manuals of oceanographic methods and techniques to Unesco, (Report p.9, V, 2).

1.2 Extracts of the comments we have received to date from National Co-ordinators are reproduced below.

Australia (From Dr. G. F. Humphrey, Australian National Co-ordinator for the IIOE).

"My comments on these tasks relevant to Australia are as follows:

For the National Co-ordinator

1. (a) Cruise plans and summaries are already sent regularly to you. A copy of the Distribution List is enclosed.
- (b) It is not our practice to prepare abstracts of findings. After the cruise summary the scientists assemble the data

which are then passed to the Australian Oceanographic Data Centre for despatch to the World Data Centres in Moscow and Washington as provisional data. The scientists then work with the data, make any corrections needed and then compile Oceanographical Cruise Reports, several volumes of which have already been distributed throughout the world by C.S.I.R.O. and AODC.

(c) Track charts have already been sent to you.

(d) A list of observations made at SCOR-UNESCO Reference Stations is enclosed.

(e) Intership radio communication between our ships and those of the other countries working in the south-east Indian Ocean (Indonesia, Japan, U.S.A. and U.S.S.R.) has not been a problem.

2. (a) By December 31, 1963 a total of 201 samples of zooplankton had been sent to IOBC. It is expected that 50 samples will be sent in 1964.

(b) The material required by Australian experts is phyllosoma and puerulus larvae of crayfish. Such material should be sent to Dr. R. G. Chittleborough, C.S.I.R.O. Regional Laboratory, Nedlands, Perth, W. Australia.

4. Copies of reprints are already sent to you.

For Interested National Bodies

1. (a) Provisional data for 1963 will probably be sent to WDC's by the end of 1964 or early in 1965. Oceanographical Cruise Reports will not be distributed until 1966.

(b) The schedule for 1964 and 1965 data will be similar to that in (a).

2. These requirements for sending samples to IOBC are being met.

3. There are no Australian manuals on oceanographic methods and techniques. Such information is in Oceanographical Cruise Reports and scientific papers."

South Africa (From Mr. G. H. Oosthuizen, Science Co-operation Division, South African Council for Scientific and Industrial Research).

"We have already taken the action required with the exception of Item 3 of the list. I am, however, enquiring whether anybody in this country would be interested in participating in atlas work and shall inform the SCOR Working Group accordingly.

"With reference to Item VI(1) on page 7 of the summary report of the meeting of the Co-ordination Group, referring to plans for the remainder of the IIOE, I must unfortunately inform you that the proposed cruise to the Madagascar Ridge has had to be cancelled. We have been informed by our Naval Hydrographic Office that the SAS "NATAL" suffered severe damage in a storm during its August IIOE cruise as a result of which all further IIOE cruises planned for 1964 have had to be cancelled."

2. Exchange of Data and Information

2.1 Cruise Reports

(1) Australia

H.M.A.S. DIAMANTINA

Summaries of the H.M.A.S. DIAMANTINA Cruises Dm 3/64 and 4/64 have been received from the Australian National Co-ordinator. Following is an extract of these summaries and station maps appear in Annex I; for details of programme, please refer to IIOE Information Paper No.9, 3.4 Cruise Plan.

Cruise Dm 3/64. 4 May - 15 June, 1964.

Scientific Personnel

H. R. Jitts (Cruise Leader)
J. Klye
C. Middleton
B. Scott
J. Stevenson, C.S.I.R.O. Division of Meteorological Physics
D. Subba Rao
P.N.A. Nirun, Royal Thai Navy (Bangkok to Singapore)

Itinerary

4/4/64	1300	Departed Fremantle
18/5/64	0800	Arrived Singapore
21/5/64	1230	Departed Singapore
24/5/64	0930	Arrived Bangkok
26/5/64	1230	Departed Bangkok
29/5/64	0830	Arrived Singapore
31/5/64	0830	Departed Singapore
12/6/64	0800	Arrived Fremantle

Programme

Station

67 stations	Dm3/104/64 - Dm3/170/64
	Bathythermograms at 34 stations
	Subsurface hydrology 45 stations

Primary production	65 stations
Pigments	65 stations
Zooplankton	10 stations
Phytoplankton	52 stations

Java Upwelling Region

Between May 9 and 14, Stations 108 to 135 were occupied in a pattern of thirteen positions in a radius of 52 miles centred at 10°S and 110°E. Between June 3 and 8 this pattern was repeated with Stations 145 to 170. These stations were all occupied at 0700, 1000, 1300, 1600 or 1900 hours LMT.

Cruise Dm 4/64. 20-29 July, 1964.

Scientific Personnel

T. R. Cowper (Cruise Leader)
J. Klye
L. Thomas
C. Saunders, University of W.A.

Itinerary

20/7/64	1500	Departed Fremantle
29/7/64	1000	Arrived Fremantle

Programme

Stations

39 stations	Dm4/171/64 - Dm4/209/64
	Subsurface hydrology at 39 stations
	Sediment sampling 29 stations
	Bottom photography 10 stations
	Bottom dredging 7 stations
	Midwater trawling 8 stations
	Zooplankton 7 stations

(2) Portugal

N.H. ALMIRANTE LACERDA

The Summary of the N.H. ALMIRANTE LACERDA Cruise AL 2/64 has been received from the National Co-ordinator for the II OE. The following is an extract of the Summary and the station map appears in Annex I.

Cruise AL 2/64. 7 September - 1 October 1964.

Scientific Personnel.

Comdr. (EH) A. Sousa Leitão (cruise leader)
Lieut. comdr. C. Saldanha Albuquerque
" " J. Costa Salema

Lieut. comdr. J. Brandão Pereira
" " A. José Rogado
" " J. Ponce Álvares
Lieutenant N/R M. Monteiro Fiadeiro
Midshipman N/R J. Pereira Brito
Dr. J. Tello Pacheco.

Itinerary

7/9/64	1405	Departed Lourenço Marques
15/9/64	0910	Arrived Beira
18/9/64	1412	Departed Beira
27/9/64	0640	Arrived Nacala
28/9/64	1607	Departed Nacala
1/10/64	0658	Arrived Mocimboa da Praia
1/10/64	1305	Departed Mocimboa da Praia
1/10/64	2335	Arrived Porto Amélia
6/10/64	0032	Departed Porto Amélia
9/10/64	1905	Arrived Lourenço Marques

Programme

Stations

Surface sampling	...	...	45 stations
Bathythermograms (up to 270m)	...	...	124 stations
Subsurface sampling	...	...	45 stations
Plankton net hauls	...	...	44 stations
Bottom samples (cores and orange peel)			27 stations

Station notes

Analysis made on board:

Salinity (inductive salinometer)
Oxygen
Inorganic phosphate

Analysis in laboratory at Lourenço Marques:

Total phosphorous
Silicate
Nitrite
Nitrate

Echo sounding continuously

Zooplankton

Indian Ocean Standard net haul from 200m (2 hauls in each station).

(3) U.S.A.

R.V. ANTON BRUUN

The Final Cruise Report of R.V. ANTON BRUUN Cruise 2, 22 May to 23 July 1963 has been received by the Office. The Report contains station lists of plankton collections, bathythermograph positions and reduced oceanographic, chemical and biological data for Cruise 2. It also includes the cruise tracks, the itinerary with ports of call, a summary of the types of scientific activities carried out during the cruise and a list of the techniques employed. Since a narrative report of Cruise 2 was issued as "News Bulletin No.3 of the U.S. Program in Biology, IIOE", and the abstract was published in the IIOE Information Paper No.6, only Table 3 of the said report, "Methods and Techniques employed on Cruise 2 with references" is reproduced below.

Methods and Techniques employed on
Cruise 2 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 2 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" 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: Steeman Nielsen, E. 1952. The use of radioactive carbon (C¹⁴) 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 10ml. 0.01 N HCl in 3% NaCl.
 - c) Simulated in situ measurements: Water samples collected from depths of penetration of 100, 50, 25, 10 and 1% incident light. Samples with C¹⁴ added incubated for 24 hours on deck in water cooled lucite cylinders covered with neutral density (wire mesh) filters to stimulate in situ 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 C¹⁴ uptake subtracted from light bottle values for each depth and for both sets of measurements (c and d)

14. Incident Radiation: Eppley 50-junction pyrliometer 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 in situ 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 200m. 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).

2.2. Cruise Plans

Australia

Following is an extract of a cruise plan which has been received from the Australian National Co-ordinator for the IIOE; the track chart is shown in Annex II of this issue.

H.M.A.S. DIAMANTINA Cruise D4/64 20 July - 1 August, 1964.

Area

As shown on track chart (Annex II)

From Fremantle a series of traverses across the continental shelf between North-West Cape and Cape Naturaliste and to Fremantle.

Objectives

To study the distribution and growth of late larval stages of the Western Australian crayfish (Panulirus cygnus).

To sample sediments on the continental shelf.

To examine the hydrological conditions of water masses on, and adjacent to the continental shelf.

Stations

At Position Stations (Traverses) shown on the chart.

Work at Stations:

Traverses: Hydrological sampling to a maximum depth of 500m for temperature, salinity, oxygen and inorganic phosphate.
Indian Ocean standard net haul from 200m.
Oblique tow by midwater trawl from 200m. to surface.
Bottom photography and dredge in 110-130m.
Sediment sampling on the shelf by Petersen grab.

Personnel:

T. R. Cowper (Cruise Leader)
J. Klye
L. Thomas
C. Saunders, University of W.A.

Itinerary:

Depart Fremantle	July 20
Arrive Fremantle	August 1

Sampling and Observations:

Hydrology

Nansen bottle sampling for temperature, salinity, oxygen and inorganic phosphate.

Zooplankton

Indian Ocean Standard net haul from 200m off the continental shelf.

Micronekton

Oblique tow from 200m to surface by midwater trawl off the continental shelf.

Horizontal tow at selected depth.

Benthos

Bottom photography and bottom dredge in 60-70fm.

Geology

Sediment sampling on the continental shelf by Petersen grab.

Laboratory Work:

Shipboard:

<u>Hydrology</u>	Salinity, oxygen and inorganic phosphate determinations.
<u>Zooplankton</u>	Concentration and storage of samples.
<u>Micronekton</u>	Concentration and storage of samples.
<u>Benthos</u>	Sorting and preservation.
<u>Geology</u>	Examination and storage of sediment samples.

Perth:

<u>Micronekton</u>	Examination of particular taxa.
<u>Benthos</u>	Examination of particular taxa.

Cochin (I.O.B.C.):

<u>Zooplankton</u>	Taxonomic studies.
--------------------	--------------------

H.M.A.S. DIAMANTINA CRUISE 5/64, 10 August - 12 September, 1964

Area:

As shown on track chart (Annex II)

From Fremantle to SCOR-UNESCO Reference Station 1, to SCOR-UNESCO Reference Station 2, thence to Cocos Island and Singapore.

From Singapore to SCOR-UNESCO Reference Station 2, to Christmas Island thence to Position Station 7, SCOR-UNESCO Reference Station 1 and Fremantle.

Objectives:

To study the distribution of suspended particulate material from surface to bottom in the eastern Indian Ocean and the relation of this material to the hydrological system.

To study the differences in chemical composition of this material in relation to depth and latitude.

To investigate long and short wave radiation.

Stations:

At Reference and Position Stations shown on chart, and at Drift Stations (1100 to 1900 hours S.M.T.) between Reference Station 2 and Singapore.

Reference Stations northbound and all Position Stations
are to start at 0800 hours S.M.T.

Work at Stations:

Reference Stations: (1 : 32°S., 111°50'E. in 5000m
2 : 9°S., 105°E.)

Hydrological sampling to the bottom for
temperature, salinity, oxygen, nitrate,
inorganic phosphate, and total phosphorus
(filtered and unfiltered).

(Northbound only) Sampling to the bottom
for particulate carbon, nitrogen, carbohydrate
and phosphorus.

Zooplankton sampling to 200m by Indian Ocean
standard net.

Wind speed, air temperature, and sea and
sky state observations.

Position Stations: Hydrological sampling to the bottom for
temperature, salinity, oxygen, nitrate,
inorganic phosphate, and total phosphorus
(filtered and unfiltered).

Sampling to the bottom for particulate
carbon, nitrogen, carbohydrate and phosphorus.
Zooplankton sampling to 200m by Indian Ocean
standard net.

Wind speed, air temperature, and sea and sky
state observations.

Drift Stations: Sampling to 1.0% light level depth for primary
production for in situ and simulated in situ
incubation.

Personnel:

B. Newell (Cruise Leader)
G. Dal Pont
J. Klye
J. Prothero
B. Scott
J. Stevenson C.S.I.R.O. Division of Meteorological Physics.

Probable Itinerary:

Depart Fremantle	August 10
Arrive Cocos Island	August 21
Depart Cocos Island	August 22

Arrive Singapore	August 27
Depart Singapore	August 31
Arrive Christmas Island	September 3
Depart Christmas Island	September 4
Arrive Fremantle	September 12

Sampling and Observations:

Hydrology:

Nansen bottle sampling to the bottom.

1. South of 20°S: 0, 25, 50, 75, 100, 150, 200, 300, 500, 700, 900, 1100, 1300 and 1500m and then at 500m intervals to the bottom.

2. North of 20°S: As for 1. with additional samples at 125, 250 and 400m.

Samples for temperature, salinity, oxygen, nitrate and inorganic phosphate at all depths. Samples for filtered and unfiltered total phosphorus at 0, 50, 100, 200, 300, 500, 700, 900, 1100, 1300 and 1500m and then at 500m to bottom.

5 litre bulk samples for particulate carbon, nitrogen, carbohydrate and phosphorus at 0, 25, 50, 75, 100, 150, 200, 300, 500, 700, 1100, 1500, 2000, 3000 and 5000m.

Physics:

Bathythermograph cast to 274m.

Echo sounding continuously.

Meteorological reports on station.

Zooplankton:

Indian Ocean Standard Net haul from 200m daily, where practicable.

Primary Production: Twin 6 litre samples at 0, 25, 50, 75, 100 and 150m for in situ measurements at Drift Stations, for incubation in a simulated in situ bath on deck and for incubation at 1100 foot candles in a fluorescent light bath.

Laboratory Work:

Shipboard:

Hydrology:

Salinity, oxygen, inorganic phosphate and total phosphorus.

Zooplankton: Concentration and storage of samples.

Primary Production: Incubation in simulated in situ and fluorescent baths; filtration, Geiger and scintillation counting of samples.

Cronulla:

Hydrology: Nitrate, particulate carbon, nitrogen, carbohydrate and phosphorus.

Cochin: (I.O.B.C.)

Zooplankton: Taxonomic studies.

H.M.A.S. GASCOYNE Cruise G 5/64, 19-31 August, 1964

Area:

As shown on track chart (Annex II).

From Cairns through Torres Strait, and then a series of section lines in the Gulf of Carpentaria to Darwin.

Objectives:

To study the penetration of phosphate-rich upwelled water from the eastern Arafura Sea into the Gulf of Carpentaria.

To test sediment sampling techniques.

Stations:

At the Position Stations shown on chart, and at Periodic Stations.

Work at Stations:

Position Stations: Hydrological sampling to the bottom for temperature, salinity, oxygen, nitrate, inorganic phosphate, particulate phosphate and total phosphorus. Sediment sampling as time permits.

Periodic Stations: Sediment sampling by Barcoo sampler while underway.

Personnel:

D. Rochford (Cruise Leader)
F. Davies
N. Dyson
K. Fleming
J. Kaulback (Bureau of Mineral Resources).

Probable Itinerary:

Depart Cairns	August 19
Arrive Darwin	August 31

Sampling and Observations:

Hydrology: Nansen bottle sampling at 0, 10, 20, 30, 40, 50, 75 and 100m and then at 25m intervals to the bottom for temperature, salinity, oxygen, nitrate, inorganic phosphate, particulate phosphate and total phosphorus.

Geology: Sediment sampling by Barcoo sampler.

Laboratory Work:

Shipboard:

Hydrology: Salinity, oxygen, inorganic phosphate, particulate phosphate and total phosphorus determinations.

Geology: Examination and storage of sediment samples.

Cronulla:

Hydrology: Nitrate determination.

Germany:

R.V. METEOR

The revised schedule and tracks of R.V. METEOR have been received by the Office, which supersede the schedule and the track chart show in the last issue of this information paper. The revised schedule is reproduced below and the revised track chart in Annex II of this issue.

Schedule of R.V.METEOR

	<u>Naut. miles</u>	<u>Stations</u>	<u>Days</u>	<u>Date</u>
Hamburg - Naples	2620	3	11	29.10.1964 - 9.11.1964
Naples	-	-	2	9.11.1964 - 11.11.1964
Naples - Suez	1250	3	5	11.11.1964 - 16.11.1964
Suez	-	-	1	16.11.1964 - 17.11.1964
Suez - Aden	1300	10	6	17.11.1964 - 23.11.1964
Aden	-	-	3	23.11.1964 - 26.11.1964
Aden - Aden (Bab el Mandeb)	1000	26	17	26.11.1964 - 13.12.1964
Aden	-	-	1	13.12.1964 - 14.12.1964
Aden - Mombassa	2760	64	33	14.12.1964 - 16. 1.1965
Mombassa	-	-	5	16. 1.1965 - 21. 1.1965
Mombassa - Cochin	2800	28	20	21. 1.1965 - 10. 2.1965
Cochin	-	-	3	10. 2.1965 - 13. 2.1965

	Naut. miles	Stations	Days	Date
Cochin - Bombay	960	17	9	13. 2.1965 - 22. 2.1965
Bombay	-	-	3	22. 2.1965 - 25. 2.1965
Bombay - Karachi	720	16	15	25. 2.1965 - 12. 3.1965
Karachi	-	-	3	12. 3.1965 - 15. 3.1965
Karachi - Kuwait	2500	-(1)	26	15. 3.1965 - 10. 4.1965
Kuwait	-	-	3	10. 4.1965 - 13. 4.1965
Kuwait - Aden	2120	-	9	13. 4.1965 - 22. 4.1965
Aden	-	-	2	22. 4.1965 - 24. 4.1965
Aden - Suez	1300	-	5	24. 4.1965 - 29. 4.1965
Suez - Hamburg	3650	-	13	29. 4.1965 - 12. 5.1965
	22980	167	195	

(1) Many shallow stations.

U.S.S.R.

R.V. VITYAZ

Following is a tentative itinerary of the VITYAZ Cruise; this cruise is principally for geology and geophysics.

<u>Port of Call</u>	<u>Date</u>
Singapore	10 - 12 October, 1964
Colombo	25 October - 5 November 1964
Addu Atoll	-
Port Louis, Mauritius	-
Fremantle	-
Tokyo	-

Zanzibar

MANIHINE

A letter from the Director of the East African Fisheries Organization addressed to the Secretary of IOC, indicates that a series of training cruises of the MANIHINE started in September 1964, and a comprehensive cruise will be carried out from Zanzibar to the Seychelles during the period of 9 November - 1 December 1964. The first IIOE cruise is scheduled from January to March 1965. Following is the preliminary itinerary:

Depart:	Zanzibar	11 January
Arrive:	Seychelles	21 January
Depart:	Seychelles	25 January
Arrive:	Mombassa	2 February

Depart:	Mombassa	5 February
Arrive:	Mogadiscio	9 February
Depart:	Mogadiscio	12 February
Arrive:	Aden	24 February
Depart:	Aden	1 March
Arrive:	Zanzibar	20 March

2.3 Oceanographic Cruises to the Antarctic part of the Indian Ocean since 1959

Dr. G. de Q. Robin, Secretary of SCAR of ICSU has forwarded to this office, a summary of oceanographic cruises in the South Indian Ocean since 1959, compiled by the SCAR Working Group on Oceanography. This summary is reproduced in Annex III.

2.4 Corrections to the "List of IIOE Cruises" which appeared in IIOE Inf. Paper No.8, Annex II

<u>Country</u>	<u>Ship</u>	<u>For</u>	<u>Read</u>	<u>In Column</u>
AUSTRALIA	Diamantina	20/VII-3/VIII/64	20-29/VII/64	PERIOD
EAST AFRICA	Manihine	Two cruises in 1965	11/I-20/III/64	PERIOD
GERMANY	Meteor	1/X/64-14/IV/65	29/X/64-12/V/64	PERIOD
PORTUGAL	Lacerda	IX-X/64	7/IX-1/X/64	PERIOD

Addition:

<u>Country</u>	<u>Ship</u>	<u>Period</u>	<u>Disciplines</u>	<u>Track</u>
AUSTRALIA	Gascoyne	19-31/VIII/64	Dol-5,8;Gg2	(3)

Deletion:

According to information received from the South African National Co-ordinator (see #1.2 of this issue), four listed cruises of the SAS NATAL in 1964 have had to be cancelled.

3. Meteorology Programme.

News from the Scientific Director's Office, IIOE Meteorology Programme, No.12, August 1964 and No.13, October 1964, have been received. The following is an extract of this newsletter:

From "News from the Scientific Director's Office, No.12, August 1964".

"Activities at the International Meteorological Centre are at their peak. Nine meteorological rockets have been successfully fired from the Sonmiani and Thumba ranges in the joint IQSY/IIOE programme. The Woods Hole Oceanographic Institution's research aircraft is back on its third visit to the Indian Ocean.

International Meteorological Centre

Staff

Mr. J. R. Nicholson left Bombay on 30 July. He will spend the next year in the Department of Geosciences, University of Hawaii on research begun while in Bombay and will continue to supervise many segments of data collection and processing.

Mr. Ernest Hovmoller, U.N. expert in Climatology, arrived at IMC on 3 July. He will divide his time between the Institute of Tropical Meteorology, Poona, and IMC.

Staff at IMC comprises 96 from the India Meteorological Department, 25 employed under the United States programme, and 2 United Nations experts. The total of 123 includes 27 professionals and 24 assistant professionals.

Data processing has been considerably accelerated since the last news. The back-plotting backlog is being reduced, microfilming and card punching are up-to-date and error checking of ship and aerological observations is well in hand.

Training

Four officers of the Indian Navy have received training at IMC. On 30 July Messrs. Hau and Tuyen, meteorologists from Viet Nam, sponsored by the United States Agency for International Development, began a three months' tour at IMC.

Meteorological Rocket Programme

Since the first launch at Sonmiani in March, Pakistan reports further successes on 15 April, 20 May, 18 June and 14, 15 and 16 July. The Indian National Committee for Space Research reported firings on 14 and 16 July at the Thumba range (8°38'N, 76°57'E).

The nine rockets so far launched have provided upper wind measurements in a layer extending on the average from 23km to 57km.

Research Aircraft

The Woods Hole Oceanographic Institution's DC-4 aircraft carrying the team directed by Mr. A. F. Bunker, returned on 9 August for a third IIOE operation. During the visit which will last about one month, the team will probe the Arabian Sea monsoon, equatorial weather south of India, and make detailed measurements over the Somali Current.

Publications

Could recipients of this news please provide me with references to published papers and reports directly or indirectly related to the IIOE meteorology programme so that I can list them in future issues?"

From "News from the Scientific Director's Office, No.13, October 1964"

"At the International Meteorological Center, data processing into various forms useful for research is proceeding rapidly. Excellent pictures were obtained by the ground equipment at IMC from the short lived NILBUS weather satellite. The Woods Hole Oceanographic Institution's research aircraft returned to the United States after successfully completing its third Indian Ocean mission.

International Meteorological Center

Staff

Lt. Col. F. R. Miller left Bombay on 5 September. For the next year he will continue his investigations as a member of the IIOE meteorology group at the University of Hawaii.

Mr. C. R. V. Raman spent three weeks during August and September as a consultant to the WMO sponsored inter-regional seminar on Advanced Tropical Meteorology in Manila. He lectured on the general circulation, synoptic models and methods of analysis and prognosis in the tropics. Lt. Col. J. C. Sadler lectured on satellite meteorology at the same seminar.

Map plotting of 1963 data is now almost complete. A microfilm camera provided under the U.N. special fund program has been put into operation. It will be used primarily to photograph analyzed IIOE weather charts beginning with 1 January 1963. Microfilmed copies of this series will be distributed on request to meteorological services which have supplied data to IMC.

Ships' data for 1963, now entered on punch cards, have been given preliminary processing. Similar processing of upper air data has begun. The Japan Meteorological Agency has sent nearly 7,000 punch cards containing data from research and other vessels operating in the Indian Ocean, the first such consignment to be received under IOC sponsored arrangements. Manuscript copies of aircraft reports continue to be received in increasing quantities. The Pakistan Meteorological Service sent an especially important consignment of over 5,000 reports on microfilm covering the period February 1963 to April 1964.

The current analysis program at IMC uses aircraft reports extensively. Facsimile charts which are now being received for four levels, twice-daily from Guam are also helping analysis. During the daily map discussion computer calculated divergence and vorticity for the northern Indian Ocean are compared with the distribution of other meteorological variables.

During May and August the computer section assisted physical oceanographers of the ANTON BRUUN in processing data while in the field. Two oceanographers and IMC programmers wrote a Fortran program for detailed computations based on physical and chemical observations made on board the ANTON BRUUN. Approximately 36,000 complex computations have been made from 4,500 observations taken at different ocean depths.

Since the last News, five seminars have been held.

Research Aircraft

From 9 August to 9 September the Woods Hole Oceanographic Institution's c 54 research aircraft under the direction of Mr. A.F. Bunker observed winds, temperatures, humidities, clouds, turbulence and turbulent fluxes over the Indian Ocean during a period in which the southwest monsoon was decreasing in strength. Most of the flights were made out of Bombay, however, between 28 August and 1 September the western part of the Arabian Sea and in particular the region of the Somali current were surveyed at a time when the United Kingdom research vessel Discovery was also investigating the current. The 13 scientific flights totaled 108 hours during which 57 successful dropsoundings were made. The observations were importantly supplemented by excellent time-lapse movies made on Royal Air Force transport aircraft flying between Aden, Gan and Singapore and also by the superb television photographs relayed from the NIMBUS weather satellite. The pictures received on the APT equipment in Bombay from NIMBUS showed well defined cloud distribution over southern Asia and as far south as the equator. These significantly contributed to the analysis program at IMC.

Publications on IIOE Meteorology (I)

Colon, J.A., 1964: On interactions between the southwest monsoon current and the sea surface over the Arabian Sea. Ind. J. Meteor. & Geophys., 15, 183-200.

Ramage, C. S., 1962: The United States meteorology program for the International Indian Ocean Expedition. Bull. Amer. Meteor. Soc., 43, 47-51.

_____, 1963: International Indian Ocean Expedition; meteorological research goes to sea. Mar. Obs., 33, 74-76.

_____, 1964: Relations between weather, winds and pressures in low latitudes. Nature, 201, 1206-1207.

_____, 1964: Meteorology in the International Indian Ocean Expedition. Explorers J., 76-82.

_____, 1964: International Indian Ocean Expedition, progress in meteorology. Mar. Obs., 33, 130-132.

Ramamurthy, K.M., and R. N. Keshavamurthy, 1964: Synoptic oscillations of Arabian anticyclones in the transition season. Ind. J. Meteor. & Geophys., 15, 227-234.

Raman, C.R.V., 1964: Monsoon definitions. Ind.J. Meteor. & Geophys., 15, 235-238.

Stevenson, J., 1964: A meteorological study during the International Indian Ocean Expedition. Mar. Obs., 33, 132-133.

4. Observations at SCOR-UNESCO Reference Stations

At the IIOE Co-ordination Group Meeting, which was held at Unesco House on 22-24 January 1964, National Co-ordinators were requested to send a list of observations made by laboratories at SCOR-UNESCO Reference Stations and at what depths. These lists would then be published in this Information Paper (see IIOE Inf. Pap. No.6, p.3). To date, a list has been received only from the Australian National Co-ordinator. The observations which were made by Australian ships at the SCOR-UNESCO Ref. Sts. No.1 (Lat. 32°00'S, Long. 111°50'E) and No.2 (Lat. 9°00'S, Long. 15°00'E) are shown in Annex IV.

5. Indian Ocean Biological Centre

5.1 International Collections at IOBC (From the Curator's Semi-Annual Report, 1 April - 31 October 1964, submitted to Unesco)

Since April 1964 308 samples have been received bringing the present collections to 1,355 samples from the following countries:

Country	Total No. of samples	No. of samples taken with non-standard net	Percentage of samples with non-standard net
Australia	206	16	7.8
India	386	149	38.6
Japan	109	0	0
U.K.	98	0	0
South Africa	166	166	100
U.S.A.	372	1	0.3
U.S.S.R.	50	5	10
Total	1,387	337	24.3

84 samples from R.V. Discovery are underway and a similar batch from South Africa will be shipped in the near future. On September 23, we received samples from the Atomic Energy Department Bombay; the samples were non-standard collections from INS Kistna, Cruise 1.

According to information received, approximately 900 samples will be received from IIOE Participants in the future.

The "coverage" of the Indian Ocean of 1168 samples is shown in Annex V; positions for 187 samples have not been received so far.

The gaps in the Madagascar region will be filled in by samples sent from Madagascar, EAMPRO (Zanzibar) and the U.S. Biological Programme. A better "coverage" of the area south of 10°S and between 80°-110°E may be made by the USSR expedition.

By October 1, 1964, 431 samples had been sorted; the rate of sorting has been retarded as expected, because of various difficulties. Catalogues, charts and lists of samples are under preparation and will be published in the Indian Newsletter for IIOE.

6. Special Custom Facilities and Courtesies

6.1 Tax-free Fuel Oil at Cochin

The Indian National Co-ordinator has informed this Office that pursuant to the request of the Indian National Committee on Oceanic Research, the Kerala State Government has granted exemptions from the levy of sales tax on the sales of fuel oil to all the visiting ships calling at Cochin, who are participating in the IIOE. The Government's Notification in this connection is as follows:

Taxes - Sales Tax - Sale of high speed diesel oil and other fuel oil to the visiting ships participating in the International Indian Ocean Expedition - Exemption.

REVENUE (H) DEPARTMENT

G.O.MS 650/64/Rev.

dated 29.9.1964

- Read:- 1. From the Member Secretary, INCOR and Director Indian Ocean Expedition, New Delhi-1, letter No.13/INCOR/64(15) dated 7.6.1964.
2. From the Board of Revenue letter No.C4-24177/64/TX dated 27.7.64.

ORDER

The Government consider that the sale of high speed diesel oil and any other fuel oils to the authorities of the visiting ships participating in the International Indian Ocean Expedition should be exempted from sales tax.

2. The superintendent, Government presses is requested to publish the appended notification in the next issue of the Gazette after giving a S.R.O. number. He is also requested to supply 300 copies of the printed notification to the Secretary (Taxes) Board of Revenue, 75 copies to the Accountant General, 30 copies to the Committee on Sub-ordinate legislation and 30 copies to Revenue (E) Department, Secretariat.

(By order of the Governor)
N. GOPALASWAMY
Secretary to Government.

To

The Superintendent of Government Presses.
The Secretary (Taxes) Board of Revenue.
The Accountant General (This order issues with the concurrence
of Finance Department - vide U.O.No.29387/64/BG2/Fin.
dt.25.7.64).
The Finance Department, The Director of Public Relations.
The Secretary, Indian National Committee on Oceanic Research,
CSIR Building, Rafi Marg, New Delhi (with CL)

forwarded / By order,

sd/- P.P. Mathulla
Superintendent

APPENDIX

NOTIFICATION

S.R.O. No. /64

In exercise of the powers conferred by section 10 of the Kerala General Sales Tax Act, 1963 (Act 13 of 1963), the Government of Kerala having considered it necessary in public interest so to do, hereby make an exemption in respect of the tax payable under the said Act on the sale of high speed diesel oil and any other fuel oils to the authorities of the visiting ships participating in the International Indian Ocean Expedition.

By Order of the Governor
R. GOPALASWAMY
Secretary to Government

7. Miscellaneous

7.1 National Co-ordinator - U.S.A.

The United States Permanent Representative to Unesco has informed the Secretary of IOC that Dr. Richard Bader, Programme Director for Oceanography, National Science Foundation has replaced Dr. John Lyman as U.S. Co-ordinator for the IIOE.

7.2 Recent Publications Concerning IIOE

(1) SCOR-UNESCO Chemical Intercalibration Tests. Results of 2nd Series, R.S. VITYAZ, August 2-9, 1962. By D. J. Rochford.

SCOR's publication of the above, with the IIOE emblem on the front cover was received by the Office and has been sent to National Co-ordinators

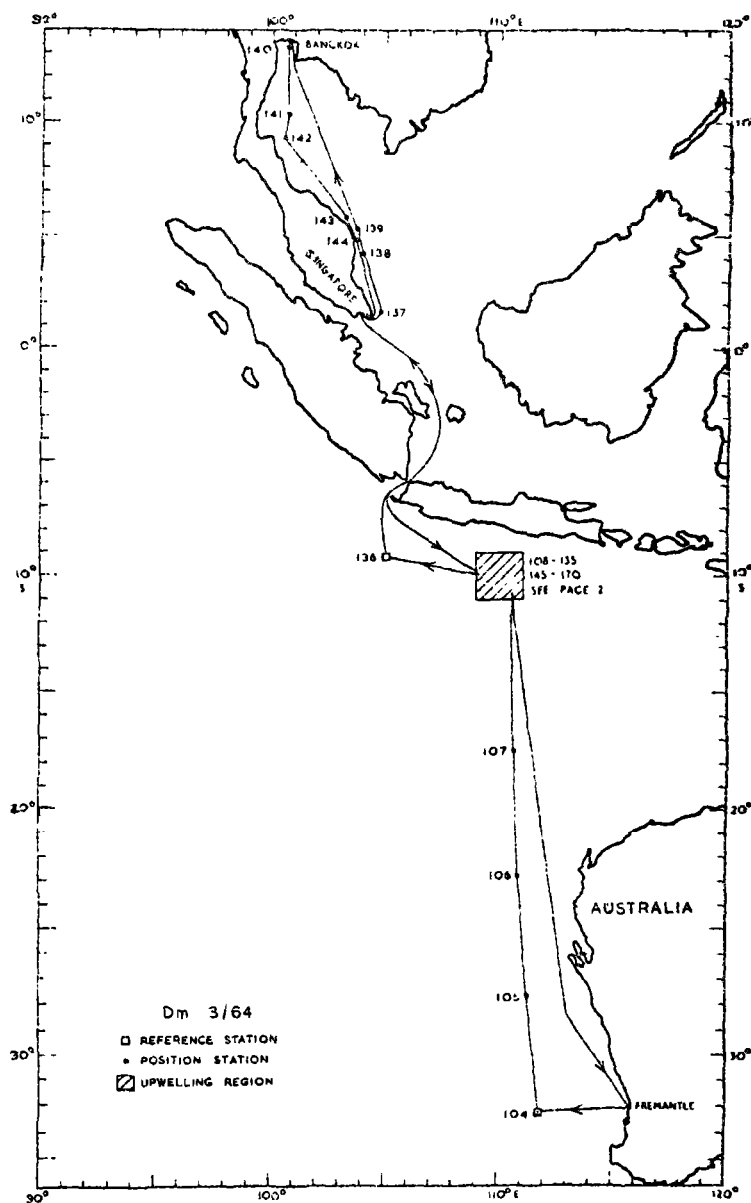
for IIOE. It contains (a) Apparatus and techniques employed for the intercalibration tests, (b) results of the tests with tables and figures, (c) conclusion, (d) recommendations of the Group, (e) references and (f) appendix, Statistical Analysis. A limited number of this publication is available to interested institutes and scientists from the Office of Oceanography, UNESCO, on request.

(2) Filtration Ratio, Variance of Samples and Estimated Distance of Haul in Vertical Hauls with Indian Ocean Standard Net. By S. Motoda and T. Tomiyama. Information Bulletin on Planktology in Japan, No.11, July 1964 (in Japanese with Summary, Tables and Figures in English).

This paper provides basic knowledge for quantitative comparison of plankton data, sampled by IOS-net. It is suggested that scientists interested in this paper should contact Prof. S. Motoda direct at Hokkaido University, Hakodate, Japan.

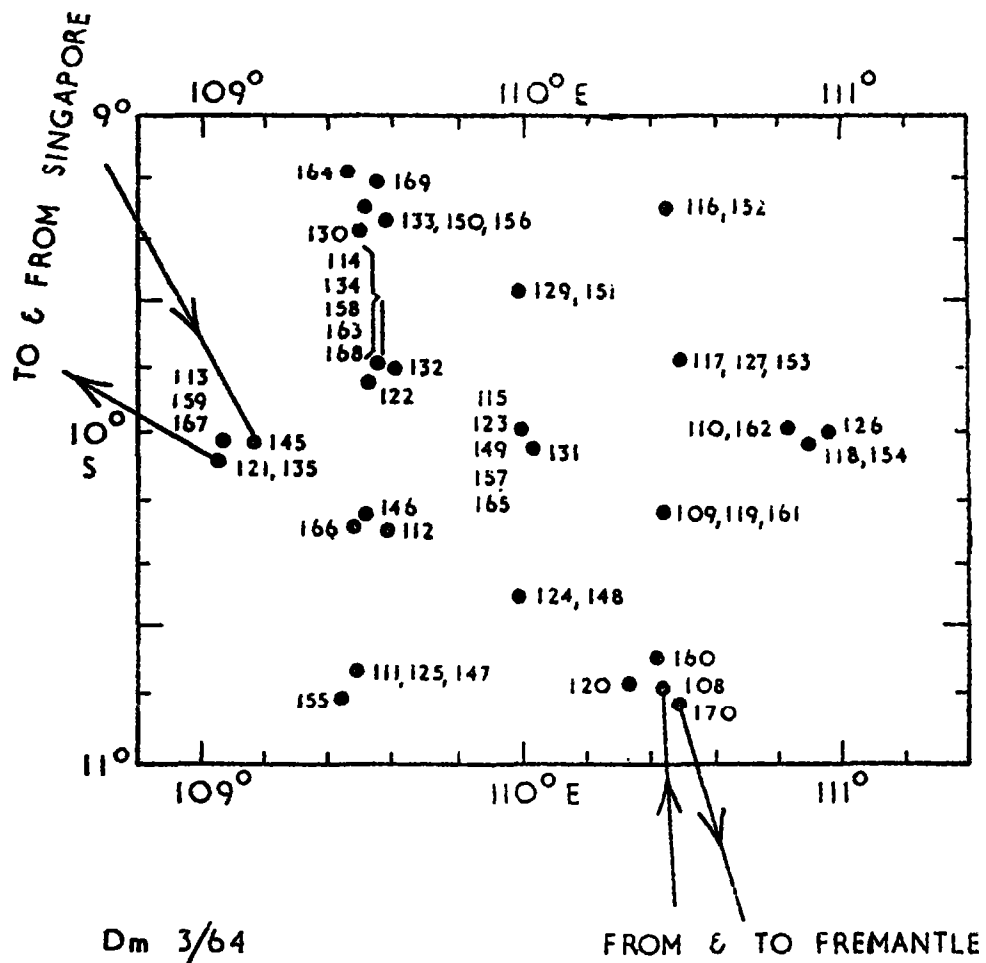
(3) The International Indian Ocean Expedition, Progress in Meteorology. By C. S. Ramage. The Marine Observer, July 1964.

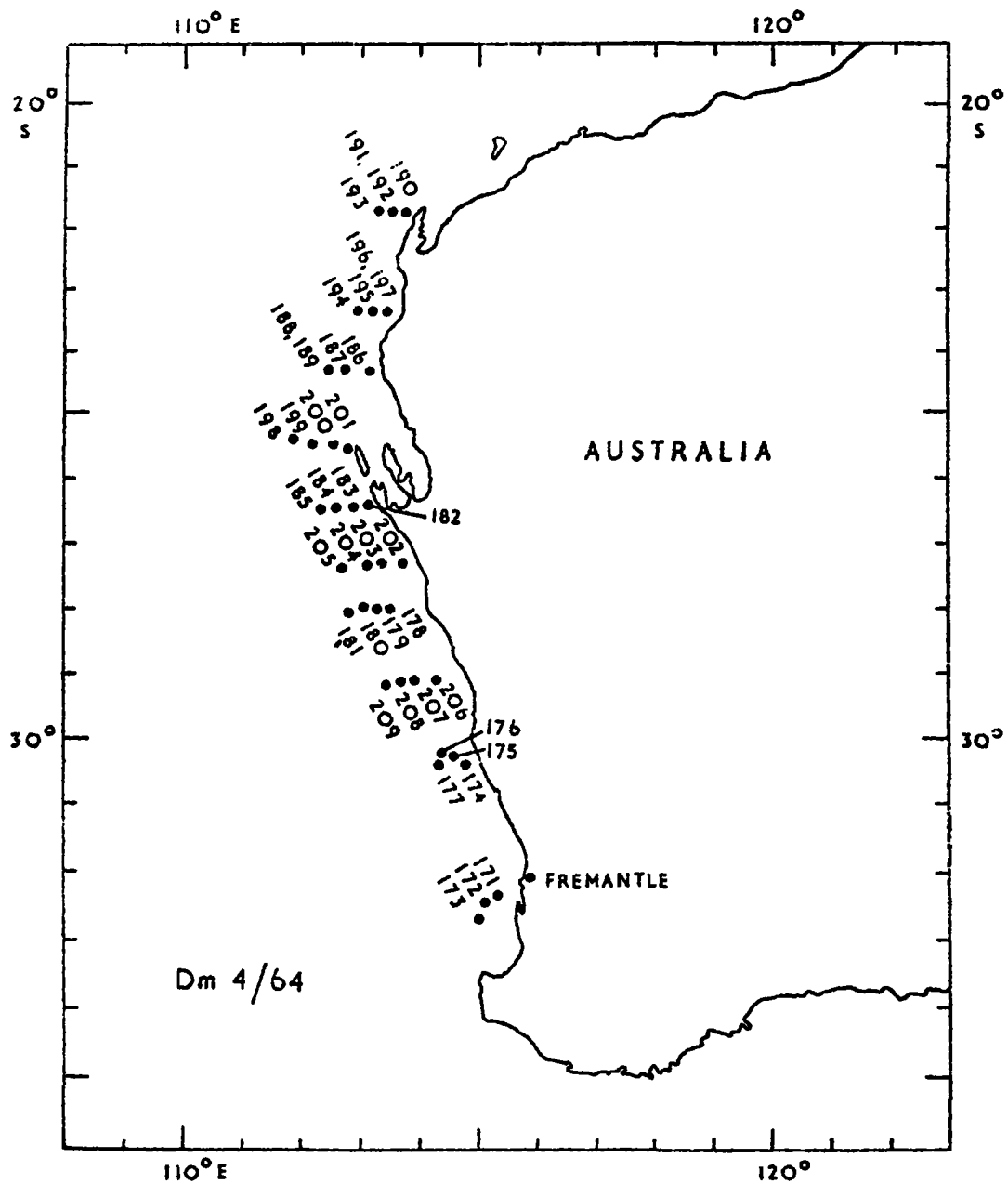
This article gives a general idea of the meteorological programme of the IIOE for mariners, particularly those who are interested in meteorological work on a merchant ship.



H.M.A.S. DIAMANTINA

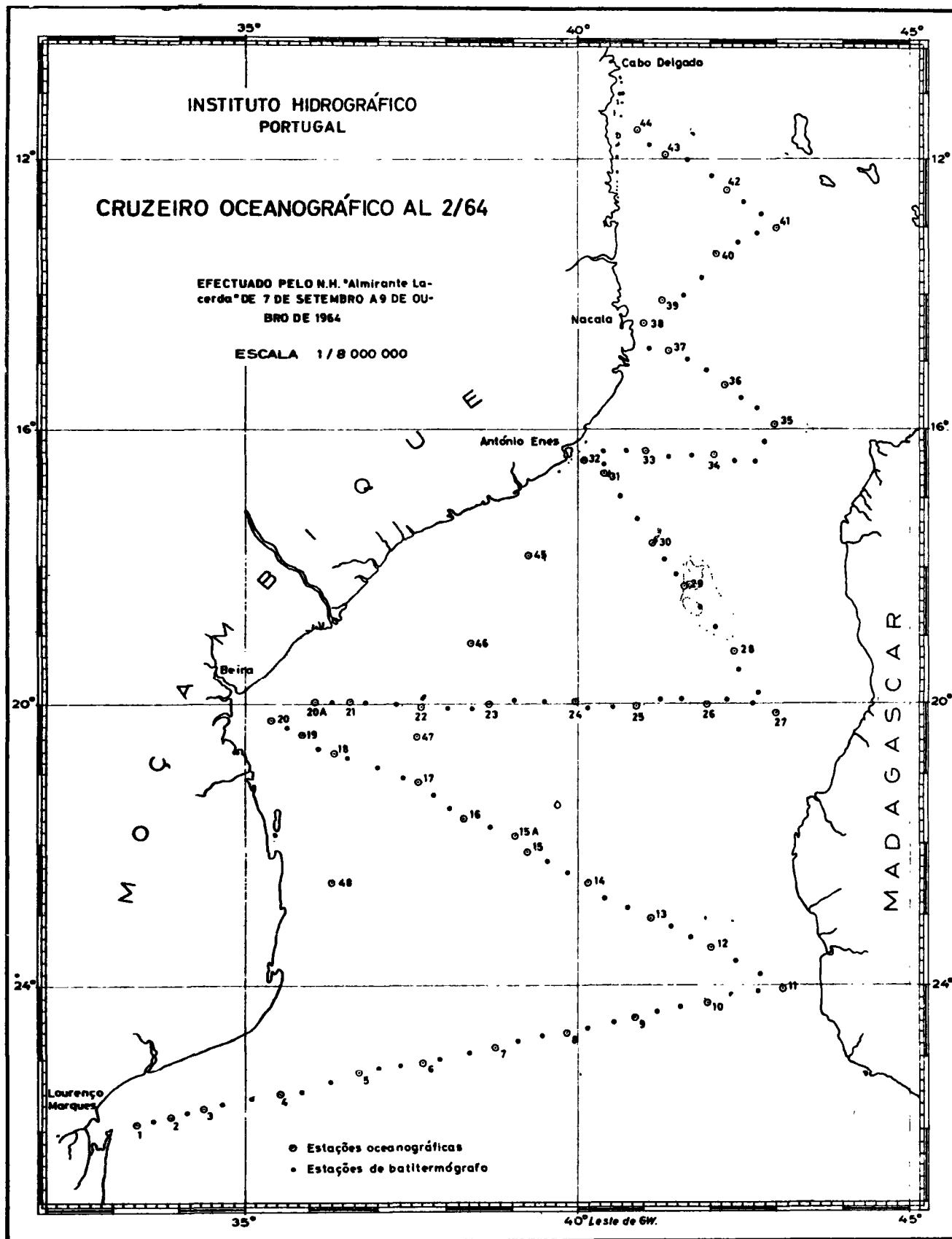
May 4 - June 6, 1964

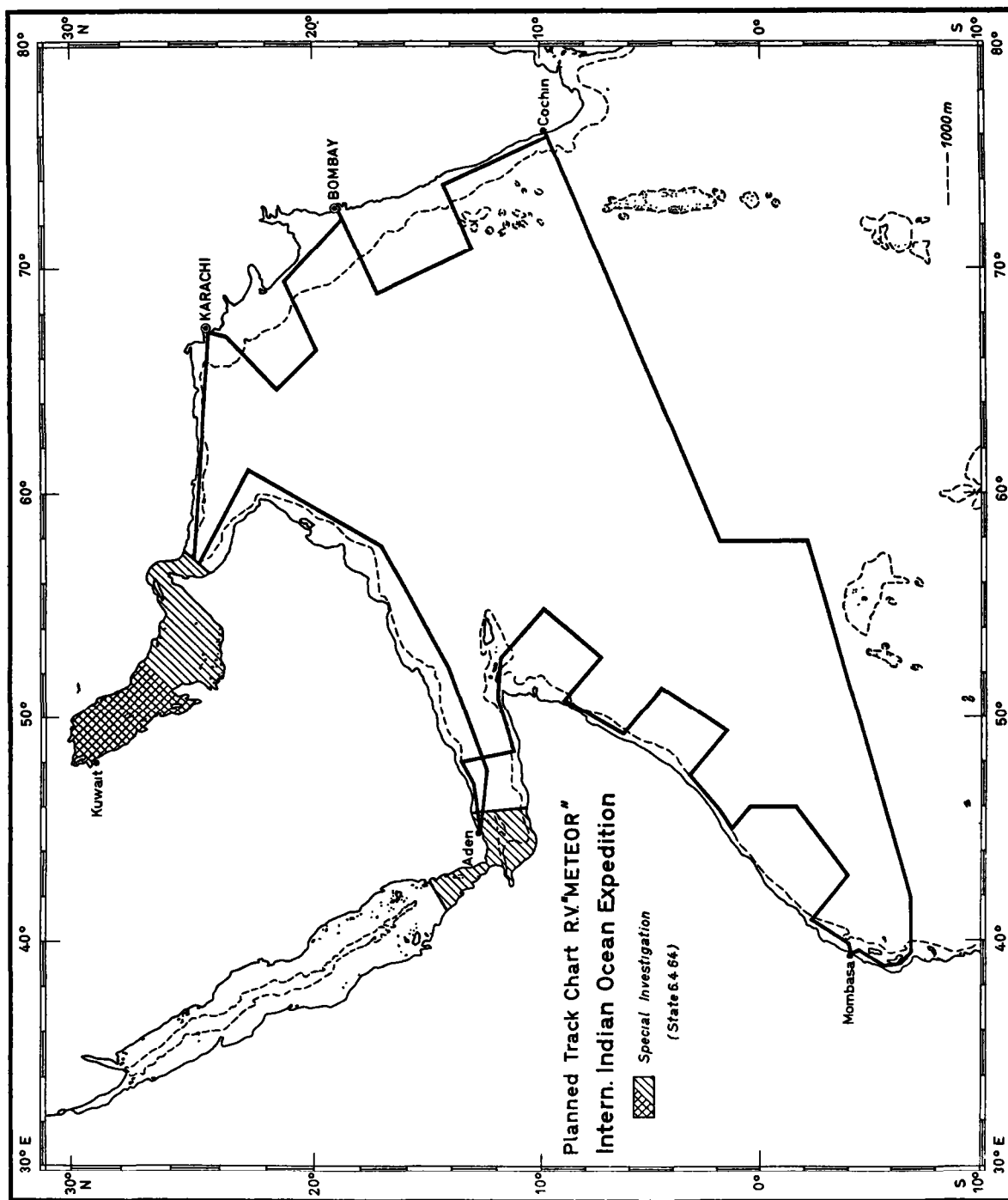


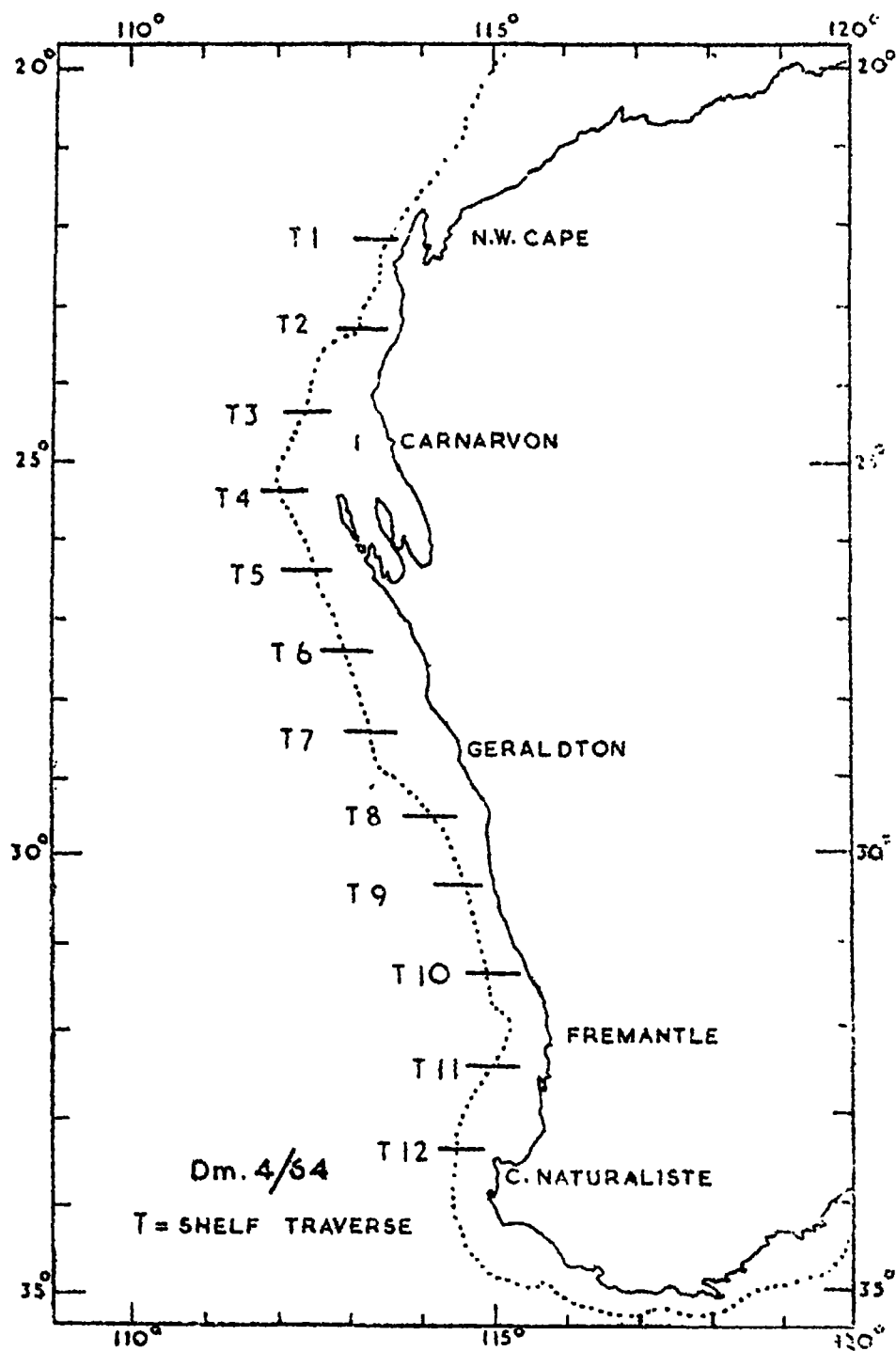


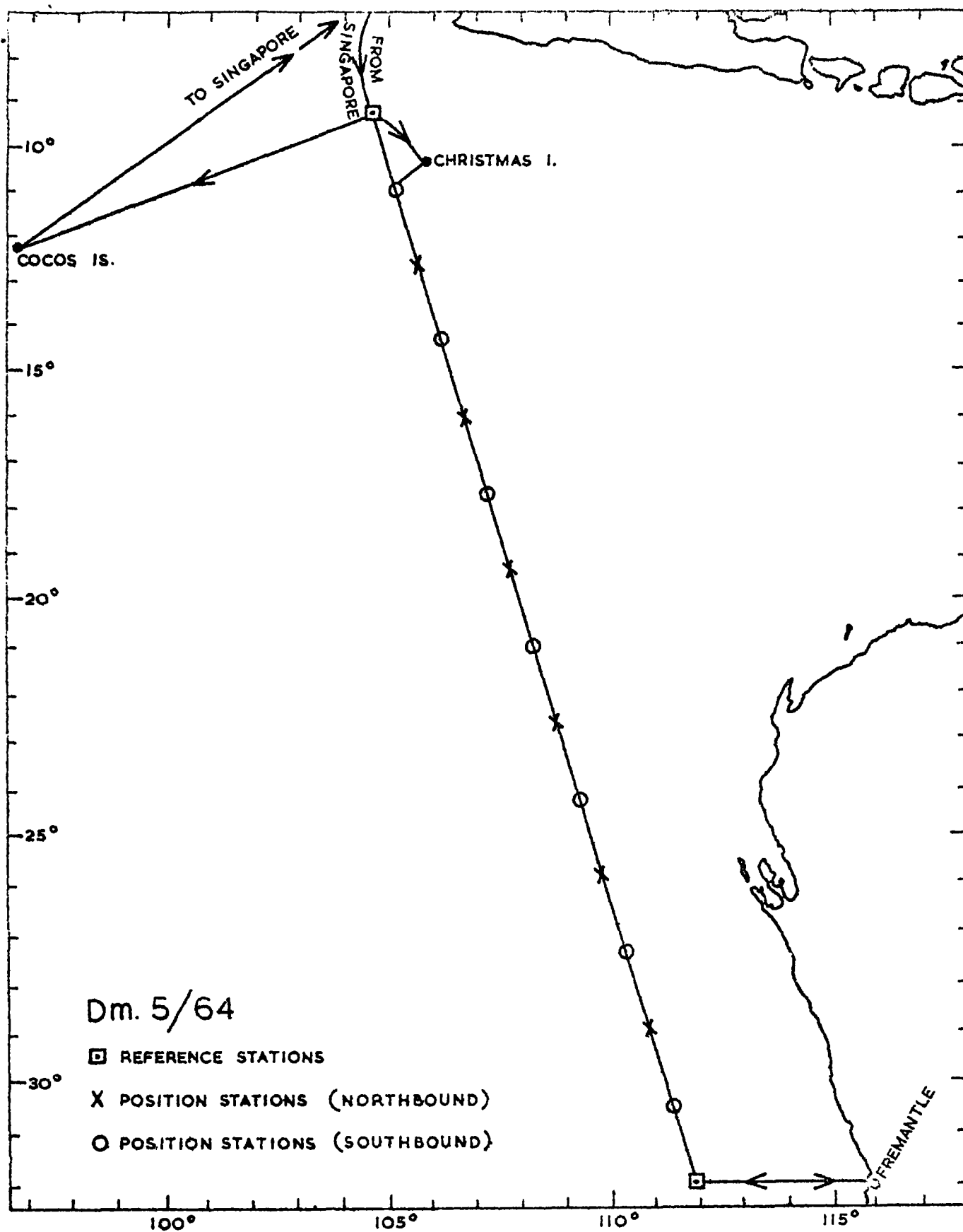
H.M.A.S. DIAMANTINA

July 20 - 29, 1964.









Oceanographic Cruises to the Antarctic in the Indian Ocean Since 1959

SHIP	AREA	DATE	PROGRAMME	OPERATING AGENCY/ RESPONSIBLE AUTHORITY	
Japan	SOYA	Cape Town - Syowa	November 1959 to April 1960 November 1960 to April 1961 October 1961 to April 1962	Do Mt Gg (Gg-magnetometer only) Antarctic Section National Science Museum	
UMITAKA MARU	Fremantle - 65°S - Cape Town	November 1961 to February 1962	Do Cm Fr Ps Gg	Tokyo University of Fisheries	
USSR	OB	Cape Town - Mirny - Lazarev	December 1959 to March 1960 December 1960 to March 1961 December 1961 to March 1962	Do Gg Ps Cm Do Gg Ps Cm Do Gg Ps	Arctic and Antarctic Research Institute, Leningrad
Belgium	ERIKA DAN	Cape Town - Roi Baudouin (Breda Bay)	December 1959 to February 1960 December 1960 to February 1961	Do Ps Ab Do Ps Ab	Laboratoire d'Océanographie Institut Royal des Sciences Naturelles de Belgique
South Africa	POLARHAV	Cape Town - SANAE Base	February 1961	Do	Department of Zoology University of Cape Town
U.S.A.	VERMA	Cape Town - 50° - 60°S	December 1959	Do Gg	Lamont Geological Observatory

Do - Descriptive Oceanography; Cm - Current measurements; Fr - Fisheries Research; Ps - Plankton Studies;
Ab - Biology Studies; Gg - Geology & Geophysics; Mt - Upper Air Studies.

SCOR-UNESCO REFERENCE STATION NO.1 : POSITION - LATITUDE 32°00'S., LONGITUDE 111°50'E.

H.M.A.S. DIAMANTINA (Dm) AND GASCOYNE (G)

STATION NO.	DATE	BT	HYDROL.	PR. PROD.	FIG.	PHYTOPL.	ZOOPL.	MICROPL.
Dm 1/1/60	3/2/60	270	317	100	100	surf. HI 100	500 CB	-
1/114/60	22/3/60	270	4699	100	100	surf. HI 100	500 CB	-
2/115/60	12/7/60	270	4290	150	150	-	500 CB	-
3/350/60	17/10/60	270	4580	-	-	-	-	-
1/10/61	21/2/61	270	4378	150	150	150	500 CB	-
2/49/61	2/5/61	270	4182	-	-	150	500 CB	-
3/193/61	26/8/61	-	4703	150	150	150	250 CB	-
1/43/62	24/3/62	270	4402	150	-	150	250 CB	-
2/101/62	24/8/62	270	4305	-	-	-	200 IOS	-
3/102/62	25/9/62	270	3767	150	150	-	(200 IOS (200 CB	-
4/126/62	16/10/62	270	4147	150	150	-	(200 IOS (200 CB	200 MWT
4/161/62	12/11/62	270	3950	150	150	-	(200 IOS	-
1/54/63	27/4/63	270	4800 [±]	150	150	-	(200 CB (200 IOS	-
2/55/63	7/5/63	270	4404	150	150	-	(200 IOS (200 CB	-
3/89/63	10/7/63	270	4584	150	150	-	-	-
5/146/63	5/9/63	270	4500 [±]	150	150	-	200 IOS	-
2/63/64	25/3/64	270	4500 [±]	-	-	-	-	-
3/104/64	5/5/64	270	4500 [±]	-	-	-	200 IOS	-
5/210/64	11/8/64	270	4500 [±]	-	-	-	200 IOS	-
G 4/181/62	19/8/62	270	4360	150	150	-	(200 IOS (200 CB	200 MWT
4/217/62	16/9/62	270	surf. (S‰)	150	150	-	200 CB	-
1/1/63	18/1/63	270	4500 [±]	150	150	-	200 IOS	200 MWT
1/35/63	16/2/63	270	4500 [±]	150	150	-	(200 IOS (200 CB	-

The figures are depths in metres to which samples were taken. See notes.

List of Abbreviations: BT - Bathythermograph; Hydrol. - Hydrology; Pr. Prod. - Primary Production; Fig. - Pigments; Phytopl. - Phytoplankton; Zoopl. - Zooplankton; Micropl. - Microplankton; surf. - surface.

SCOR-UNESCO REFERENCE STATION NO.2 : POSITION - LATITUDE 9°00'S, LONGITUDE 105°00'E.

H.M.A.S. DIAMANTINA (Dm) and GASCOYNE (G)

STATION NO.	DATE	BT	HYDROL.	PR.PROD.	FIG.	PHYTOPL.	ZOOPL.	MICROPL.
Dml/33/62	17/3/62	270	5334	150	150	150	250 CB	-
2/87/62	17/8/62	270	5267	-	-	-	200 IOS	-
4/143/62	26/10/62	270	3962	150	150	-	-	-
4/144/62	3/11/62	270	3852	150	150	-	200 CB	-
1/36/63	7/4/63	270	5500 [±]	150	150	-	(200 IOS (200 CB	-
1/37/63	18/4/63	270	5800 [±]	150	150	-	(200 IOS (200 CB	200 MWT
2/72/63	16/5/63	270	5450	150	150	-	(200 IOS (200 CB	-
2/73/63	25/5/63	270	4950	150	150	-	(200 IOS (200 CB	-
3/106/63	19/7/63	-	5391	150	150	-	-	-
3/108/63	2/8/63	270	4747	150	150	-	-	-
5/157/63	11/9/63	270	5500 [±]	150	150	-	200 IOS	-
3/136/64	15/5/64	270	5000 [±]	-	-	-	200 IOS	-
5/217/64	18/8/64	270	5000 [±]	150	-	-	200 IOS	-
5/218/64	31/8/64	270	5000 [±]	-	-	-	200 IOS	-
G 4/199/62	29/8/62	270	5456	150	150	-	(200 IOS (200 CB	-
4/200/62	7/9/62	270	3969	150	150	-	200 CB	-
1/18/63	28/1/63	270	6000 [±]	150	150	-	(200 IOS (200 CB	200 MWT
1/19/63	7/2/63		6000 [±]	150	150	-	200 IOS	-

The figures are depths in metres to which samples were taken. See notes.

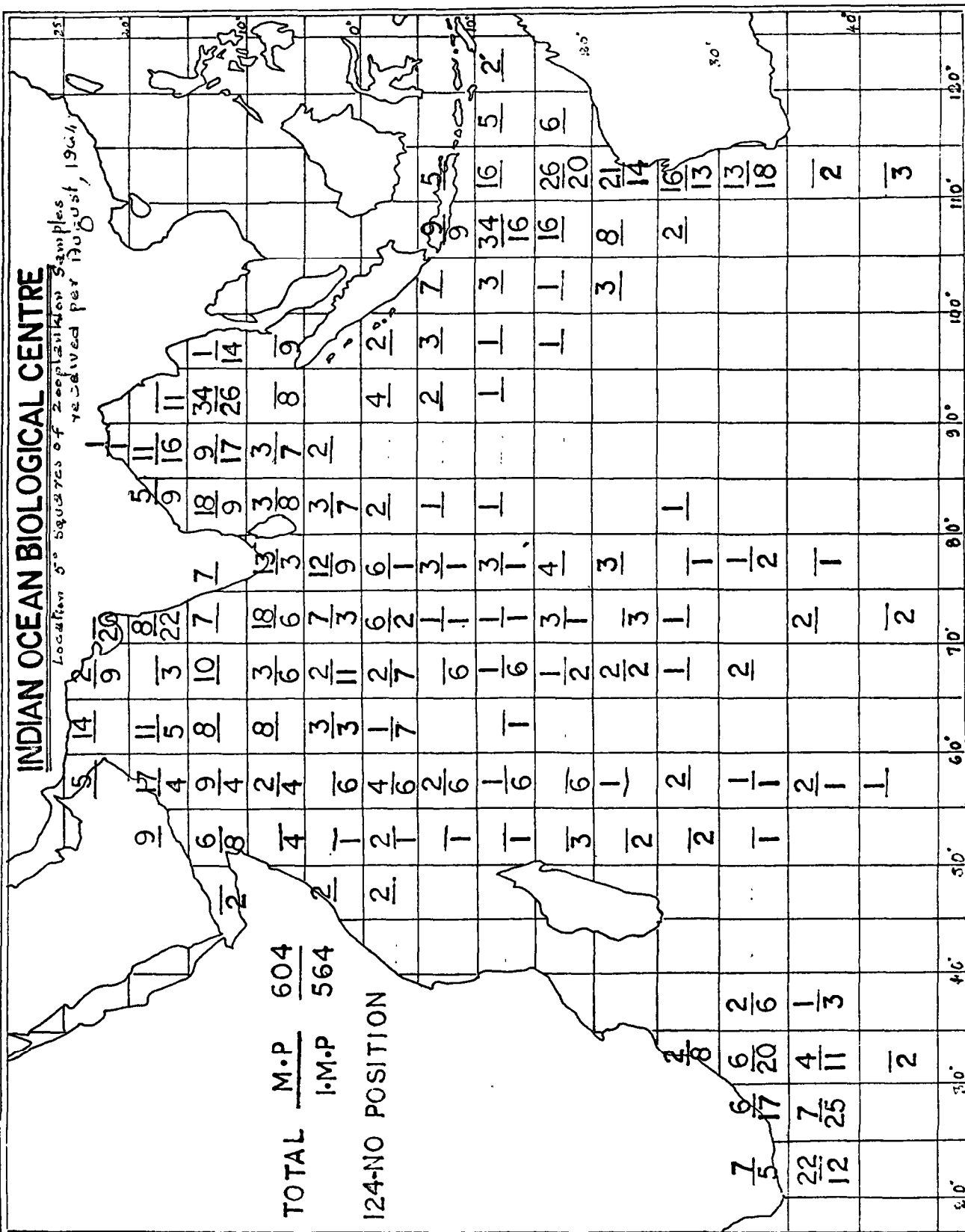
List of Abbreviations: BT - Bathythermograph; Hydrol. - Hydrology; Pr. Prod. - Primary Production;
Fig. - Pigments; Phytopl. - Phytoplankton; Zoopl. - Zooplankton;
Micropl. - Microplankton.

SCOR-UNESCO REFERENCE STATIONSNOTES

Details of the observations and of laboratory techniques made at all stations are listed in the Oceanographical Cruise Reports published by the Division of Fisheries and Oceanography of the C.S.I.R.O. Cruise Plans and Cruise Summaries show variations in standard sampling procedures.

The following comments amplify the column listings in the attached table.

- Bathythermograph: Wire depths given; corrected depths not available.
- Hydrology: Corrected maximum depths given where available; wire depths noted by asterisk (*).
 Samples for temperature, salinity, oxygen, nitrate, and inorganic phosphate at 0, 25, 50, 75, 100, 150, 200, 300, 500, 700, 900, 1100, 1300 and 1500m and at 500m intervals to the bottom.
 Samples for total phosphorus at 0, 50, 100, 200, 300, 500, 700, 900, 1100, 1300 and 1500m and then at 500m intervals to the bottom.
 At Reference Station No.2 additional samples were taken at 125, 250 and 400m.
- Primary Production: Samples at 0, 25, 50, 75, 100 and 150m. (Wire depths).
- Pigments: Depths as for Primary Production.
- Phytoplankton: Depths as for Primary Production. Surface sampling by modified Hardy Indicator tow (HI).
- Zooplankton: Maximum wire depths for Indian Ocean Standard net haul (IOS) and for Clarke Bumpus horizontal and oblique tows (CB)
- Micronekton: Maximum wire depth for Isaacs Kidd midwater trawl (MWT).



SUBJECT INDEX OF IIOE INFORMATION PAPERS Nos. 1 - 10

<u>Subject</u>	<u>No. of issue, section, subsection, (page), appendix[*]</u>
AFRICANA II	IV-I; V-3.2(10); V-III.
Air craft	VI-VI.
AL LACERDA	VI-4.2(7); IX-3.3(14); IX-IV; X-2.1(5); X-I.
Antarctic cruises	X-2.3(17); X-III.
ANTON BRUUN	II-7(14); IV-1.2(4); IV-III; V-3.2(9); V-III; VI-4.2(11); VI-4.3(20); VI-VI; VI-VII; VIII-1.2(5); VIII-VIII; X-2.1(7); II-7(13); VI-4.2(11); VI-VI; VI-VII.
ATLANTIS II	II-5(2); VI-4.3(22); VI-VII.
Australia	I-5.3(7); I-D; IV-8.1(18); VIII-2(17); IX-3.1(10); X-1.2(3); X-4(21); X-IV.
BANGADA	VI-4.1(6).
Bathymetry	IV-8.2(18); VI-4.5(24); VIII-1.4(16); VIII-6.2(21); VIII-8.1(22); VIII-V.
Bird observations	IV-8.2(19).
Burma	II-6.1(7).
Ceylon	I-5.3(11); II-5(5); III-6.2(6); IV-8.1(18); IV-8.3(20); VIII-1.1(1).
COM. ROBERT GIRAUD	IV-1.2(1); V-3.2(8); V-III.
CONCH	VI-4.1(6).
CONRAD	II-5(3); VI-VI.
Cruise plans	II-7(13); II-5(2); III-3.3(3); III-8(9); IV-1.3(9); V-3.3(13); VI-4.2(7); VIII-1.3(12); VIII-I; IX-3.4(15); X-2.2(9);
Cruise tracks (scheduled)	III-IV; IV-III; V-IV; VI-VI; VIII-VII; VIII-IX; IX-III; X-II.
DALRYMPLE	III-IV; IV-IV.

^{*}The first Roman numeral indicates number of the paper, the second Roman numeral (or capital letter) indicates an appendix. Other numerals indicate section, subsection and page no. (in brackets).

<u>Subject</u>	<u>No. of issue, section, subsection, (page), appendix</u>
Data, exchange of	I-1.2(2); I-B; II-2.1(3); II-C; VI-2(4); VI-I; VIII-1.4(16); VIII-2(17); IX-1.5(7); IX-3.1(9); IX-II.
DIAMANTINA	III-3.3(3); IV-1.2(3); IV-1.3(9); IV-III; V-3.2(11); V-3.3(13); V-III; VI-4.3(14); VI-VII; VIII-1.3(12); VIII-IX; IX-3.3(12); IX-3.4(15); IX-IV; IX-V; X-2.1(4); X-2.2(14); X-I.
Disciplinary Leaders, Reports of	III-1; III-II; V-I.
DISCOVERY	II-7(13); III-8(8); III-IV; IV-III; IV-IV; V-3.2(11); V-IV; VI-4.3(16); VI-V; VI-VII; V-3.2(11); VIII-6.2(21); VIII-8.2(22); VIII-IV.
DODO Expedition	VI-4.2(11).
East Africa	I-5.3(35); III-5(4).
EMUKA DAN	X-III.
Ethiopia	I-5.3(12).
France	VIII-2(18).
Fisheries aspects and F.S.L.	III-3(1); I-1; VII-III; IX-1.4(3); IX-II.
GASCOYNE	III-3.3(3); IV-1.2(3); IV-III; VI-4.3(14); VI-VII; VIII-1.2(5); VIII-1.3(13); VIII-VIII; VIII-IX; IX-3.3(14); IX-IV; X-2.2(14); X-II.
Geology and Geophysics	III-III; IV-8.2(18); VIII-8.1(22); VIII-X.
Germany	VIII-1.3(15); IX-3.2(10).
Gravity	II-6.3(8); III-III; IV-8.2(18).
HORIZON	VI-VII.
India	I-5.3(13); II-5(5); II-4(1); IV-5(16); IV-6(17); IV-7(17); V-3.1(5); V-4.2(17); V-4.3(17); VI-4.1(4); IX-3.2(10); X-6.1(22).
Indian Ocean Biological Centre	I-3(5); I-E; II-4(4); IV-3(15); VI-1.1(2); VI-3(4); VII-1(1); VII-II; VII-III; VIII-4(20); IX-5(20); X-5(21); X-V.
Indonesia	I-5.3(19).
Information, Exchange of	I-1.3(3); II-2.2(3); III-3.1(2); VI-1.1(2); IX-1.5(7).

<u>Subject</u>	<u>No. of issue, section, subsection, (page), appendix</u>
Intergovernmental Oceanographic Commission	I-A; II-1(1); II-A; III-2(1); V-1.1(1); VI-1.2(4); IX-1.1(1); IX-I.
International Co-ordination Group	V-1.2(2); VI-1(1); VI-I; IX-1.3(1); X-1.1(1).
International Meteorological Centre	(see Meteorology).
Iraq	I-5.3(20).
Italy	I-5.3(21).
JALANIDHI	IV-1.3(9); IV-III.
Japan	I-5.3(22); III-3.1(2); VI-4.1(4); VIII-1.1(1); VIII-5(21).
KAGOSHIMA-MARU	V-3.3(15); VIII-1.1(1); VIII-VIII.
KISTNA	IV-1.3(9); IV-III; V-3.1(5); VI-4.1(4); VI-VII; IX-3.2(11); IX-V.
KOYO-MARU	II-7(13); IV-III; V-3.3(15); VIII-1.1(2).
List of IIOE Cruises	IV-4(16); IV-II; V-3.4(17); V-II; VIII-7(22); VIII-II; IX-3.5(19); X-2.3(17); X-2.4(17); X-III.
Madagascar	I-5.3(23); II-6.3(8).
Magnetism	IV-8.2(18); VI-4.4(22); VIII-6.2(21).
Malaya (Malaysia)	III-6.1(4); IV-4.1(17); V-4.1(17); VI-6.1(34).
MANIHINE	II-5(3); IV-III; V-3.3(16); X-2.2(16).
Mauritius	I-5.3(25); II-6.2(7); II-6.5(10).
METEOR	VIII - 1.3(15); VIII-I; VIII-IX; IX-3.2(10); X-2.2(15); X-II.
Meteorology	II-6.2(7); II-6.5(10); III-3.4(3); III-4(3); IV-2.1(10); VI-1.1(2); VI-2.2(14); VI-4.5(24); VI-5(24); VI-II; VI-VIII; VIII-3(18); IX-4(19); IX-7.2(26); X-3(17); X-7.2(23).
Methods, observation/analysis	VIII-8.2(22); VIII-IV; X-2.1(7); X-7.2(23).
Mozambique	III-3.5(3).
NATAL	III-3.2(2); IV-1.2(4); VI-I; VIII-1.3(15); VIII-IX; X-1.2(3).

<u>Subject</u>	<u>No. of issue, section, subsection, (page), appendix</u>
National Committee for IIOE	IV-8.3(20).
National Co-ordinators	II-B; II'-2(1); III-5(4); IV-8.1(18); V-4.2(17); VIII-5(21); X-1.1(1); X-7.1(23).
National Newsletters	II-7(12); III-3.1(2); III-IV; IV-9(20); VI-IV; V-3.1(5); VI-4.1(4); VI-V; VIII-1.1(1); IX-3.2(10).
Netherlands	I-5.3(23).
OB	X-III.
OSHORO-MARU	IV-III; VIII-1.1(3); VIII-VIII.
OWEN	II-7(13); III-IV; IV-8.2(18); IV-III; IV-IV; VI-4.5(24).
Pakistan	I-5.3(27).
Participation of Countries	II-6.1(4); II-6.5(10); III-6.1(4); III-6.2(6).
Pennant	I-4(6).
PIONEER	VI-4.2(7); VI-VI.
Plankton	VI-4.5(24); VII-III; IX-7.1(24); X-5(21); X-7.2(24); X-V.
Portugal	III-5(4).
POLARHAV	X-III.
Programme of IIOE (General)	VI-1.1(1); VI-4.5(24); VI-III; VIII-6.2(21); IX-1.2(1); IX-7.2(25).
Radio Communications	II-6.2(7); III-8(8); VI-IV; VIII-1.4(16).
Reference Stations	I-2(3); I-D; I-E; II-3(4); V-3.3(16); VI-1.1(3); VIII-1.4(16); X-4(21); X-IV.
Reprints, collected	I-1.1(1); II-2.3(3); IV-1.1(1); VI-1.1(3); VIII-6.1(21); VIII-X.
Report of IIOE Cruise, Summary	III-3.2(2); IV-1.2(1); IV-I; V-3.2(8); VI-4.3(13); VIII-1.2(5); IX-3.3(12); X-2.1(4).
Scientific Committee on Oceanic Research	I-C; III-1(1); V-2(4); IX-2(8).
Seychelles	III-3.4(3); VI-4.4(22).
Singapore	I-5.3(29).

<u>Subject</u>	<u>No. of issue, section, subsection, (page), appendix</u>
Special Customs Facilities and Courtesies	I-5(6); II-5(5); II'-4(1); IV-5(16); IV-6(17); V-4.1(17); V-4.3(17); VI-6.1(34); X-6.1(22).
South Africa	I-5.3(31); VI-I; VII-1.4(16); VIII-2(18); X-1.2(2).
SOYA	X-III.
Station maps of achieved IIOE Cruises	III-IV; IV-IV; V-III; VI-VII; VIII-VIII; IX-IV; X-I.
Sudan	II-5(6).
Surface observations	VI-4.5(24).
Symbol	I-4(6)
TE VEGA	VI-4.2(13).
Thailand	II'-2(1).
Tide Stations	II-6.5(12); II-8.1(15); II-8.2(16); III-3.5(3); III-IV; IV-7(17); VIII-8.1(10); VIII-V; IX-6(20).
UMITAKA-MARU	II-7(13); V-3.3(15); VIII-1.1(5); VIII-VIII; X-III.
United Kingdom	I-5.3(34); II-8.1(15); III-3.2(2); III-IV; IV-2.2(14); IV-9(20); IV-IV; VI-4.1(6); VI-6.2(34); VI-V; VIII-1.1(5).
U.S.S.R.	II'-2(1); III-5(4); VI-III.
U.S.A.	VI-4.1(6); X-7.1(23).
Unusual phenomena	VIII-8.3(22); VIII-III; VIII-VI; IX-7.3(26).
VARUNA	V-3.1(5); VI-4.1(5); IX-3.2(10).
VEMA	VI-VI.
VITYAZ	IV-1.2(4); IV-III; VI-4.2(13); VI-VI; X-2.2(16); X-7.2(23).
Vulcanology	III-7(8); VI-6.2(34).
Whale observations	II-6.4(9).
World Data Centre	VIII-1.4(16); VIII-2(18); IX-3.1(9); IX-III.
Zulfiqar	VI-4.3(14); VI-VII.