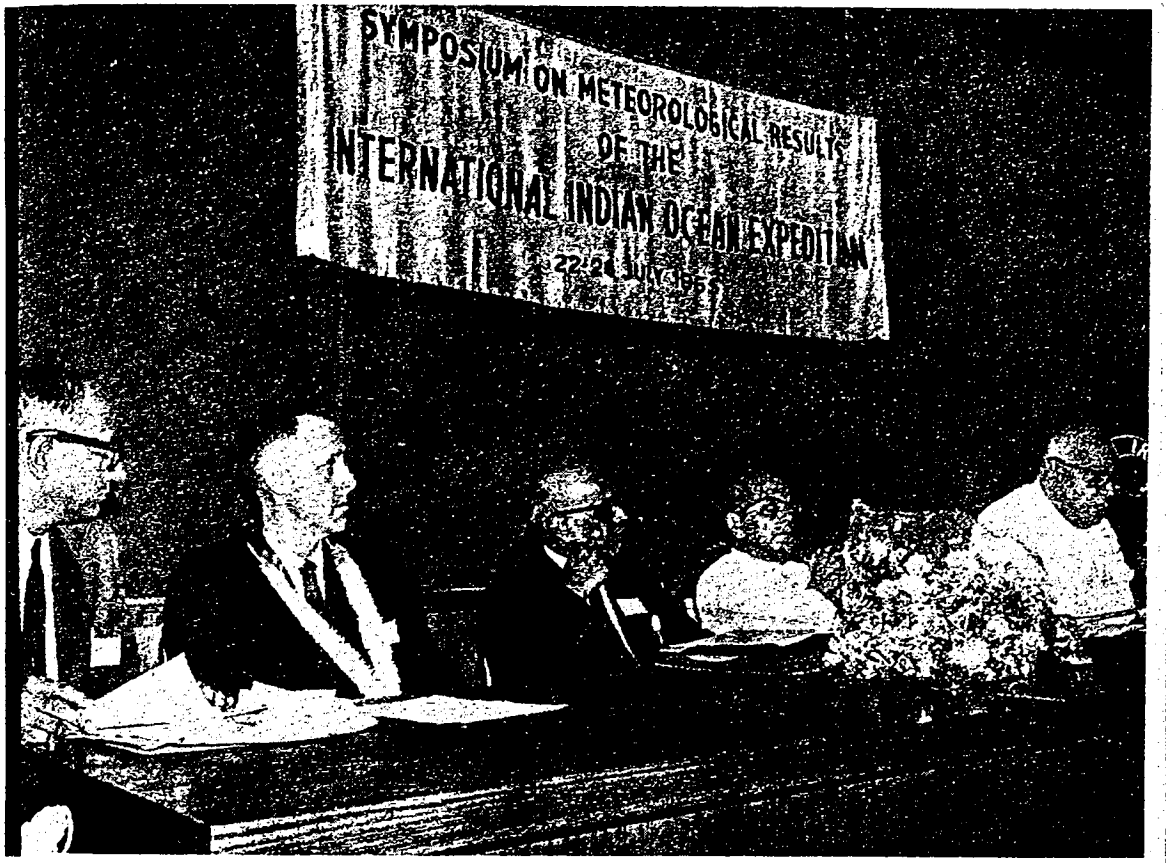
INTERNATIONAL INDIAN OCEAN EXPEDITION

NEWSLETTER

INDIA

Vol. III No. 2

September, 1965



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THE INDIAN NATIONAL COMMITTEE ON OCEANIC RESEARCH
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COVER PHOTO

Symposium on the Meteorological Results of the International Indian Ocean Expedition. *Right to Left:* Dr. P. V. Cherian, Governor of Maharashtra delivering the inaugural address, Shri N. Kanungo, P. R. Krishna Rao, Dr. C. S. Ramage, Shri C. R. V. Raman.

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NEWSLETTER

INDIA

Vol. VI No. 2 SEPTEMBER, 1965

INDIAN PROGRAMME

Scientific Cruises of INS Kistna

INS Kistna commenced her XXVIII Scientific cruise from Calcutta on 29th April, 1965 with a complement of 12 scientists under the leadership of Dr. C.B. Murty of the Directorate of Scientific Research (Navy). In this cruise, 35 stations were occupied off the east coast of India between the mouth of Mahanadi and Visakhapatnam. Details of observations undertaken during this cruise are as follows:

B.T. Station	–	14
Hydro-station over shelf.	–	10
Hydro stations beyond shelf (Max. 1200 m deep)	–	11
Geological station	–	22
Radiosonde ascents	–	3
Surface Meteorological Observations	–	Every three hrs. beginning at 0230 hrs.

Underway, observations during this cruise indicated that the general direction of the surface current was northerly to north-easterly. According to the programme, *INS Kistna* was to occupy five hydrographic sections between the mouth of Mahanadi and Kakinada and six geological sections over the shelf between Gopalpur and Bhimilipatnam. But this plan could not be fully implemented owing to certain troubles developed by engine. Geological collections were made at all the shallow water stations and during the four sections occupied across the shelf between Gopalpur and Bhimilipatnam.

The preliminary analysis of the observations during this cruise shows a general increase of surface temperature and decrease of surface salinity away from the coast. This as well as high salinity and low temperature remained nearly constant while the salinity indicated a slight increase towards the south.

The sea surface temperatures were, in general, lower than the air temperatures over the shelf region, the maximum difference being 3.7°C at station 753 south of Gopalpur. In the more offshore region sea temperatures were slightly higher. 260 water samples were collected for salinity and oxygen determination which were carried out on board and about 130 water samples collected and preserved for nutrient analysis. In general salinity values showed a slight decrease in the surface layers upto 20 to 30m. except off Gopalpur where the depth of this layer of salinity decrease was only of the order of 5 m. A sub-surface salinity maximum was observed at depth 300 to 500 m.

The oxygen concentration in the surface layer down to 15 m. was of the order of 4 to 5 ml/litre at 50 m. The zone of oxygen minimum with concentration between 0.12 to 0.22 ml/litre was found at depth between 200 to 1000 m. Due to large wire angles some of the corer/or snapper operations were not successful during this cruise.

The cruise was completed at Visakhapatnam on 5th May, 1965.

INDIAN OCEAN BIOLOGICAL CENTRE ERNAKULAM

During the quarter ending 31st August '65 the centre had received 48 plankton samples from the research vessel *Koyo Maru* of Japan and 12 samples from Dodo cruises of *Argo* (USA). Processing of the samples at ths centre has been steadily continued. Among the total number of 207 samples processed during the said period, 53 are from R. V. *Meteor* (Germany) 40 from *Pioneer* (USA) and 47 from *Gascoyne* and 67 from *Diamantina* of Australia. Altogether 1044 samples have been fully processed by the beginning of September 1965 when the total number of samples received at the centre was 1795.

Details regarding the receipt and processing of samples from ships belonging to the various participating countries are given below.

Sr.No.	Ship	Country	No. of samples received.	No. of samples processed
1.	Diamantina	Australia	143	143
2.	Gascoyne	„	63	47
3.	INS Kistna	India	359	191
4.	R. V. Varuna	„	71	—
5.	R. V. Conch	„	6	—
6.	Umitaka Maru	Japan	48	48
7.	Oshoru Maru	„	84	—
8.	Koyo Maru	„	48	—
9.	Zulum	Pakistan	22	—
10.	Gilchrist	South Africa	142	—
11.	Africana	„	24	—
12.	Argo	U.S.A.	94	94
13.	Argo (Do Do)	„	12	—
13.	Anton Bruun	„	261	222
15.	Pioneer	„	40	40
16.	Vityaz	U.S.S.R.	50	—
17.	Discovery	U.K.	206	206
18.	Meteor	West Germany	122	53
		TOTAL	1795	1044

Participants of the Symposium on Meteorological Results of IIOE visiting the Instrumentation Division of India Meteorological Department at Poona

INTERNATIONAL METEOROLOGICAL CENTRE, BOMBAY

The programme of work at the Centre continued to shift from data processing to research. Collections of data and the daily map analysis are continued during the current year on a slightly reduced scale. An intensive checking and processing are applied to 1963 and 1964 data, preparing them for research and atlas compilation. This work will not be extended to 1965 data. Duplicates of punch cards are bing despatched from International Meteorological Centre to the University of Hawaii where they will be transferred to magnetic tape.

Copies of kinematically analysed charts for seven levels from the surface through 100 mb. for 12 GMT, 7th July, 1963 have been distributed to cooperating countries to illustrate the volume of data available from the Indian Ocean region.

At the second meeting of the IIOE coordination group it was decided that the United States would also be responsible for the physical and chemical occeangraphy atlas in addition to the IIOE Meteorological atlases. This will also be prepared at the University of Hawaii and thereby considerable efficiency could be gained for both projects which will share a large and sophisticated automatic curve plotter designed to minimise subjective hand analysis of data. The Scientific Coordinator for IIOE Meteorological Programme has informed the IIOE coordination group regarding the Meteorological Monograph Series which would be published by the East-West Centre Press at the University of Hawaii under the sponsorship of the U.S. National Science Foundation. The first monograph would appear towards the end of the current year. He welcomes inquiries from potential contributors to the Series.

The following were the topics at the symposium on "Problems of Tropical Meteorology" held in New Delhi on 23-24 March, 1965.

D.R. Jones — Usefulness of kinematic analysis in equatorial and tropical regions of the world with special reference to flow patterns representative of active and weak monsoons.

C.R.V. Raman — Interaction between lower and upper tropical troposphere, and some broad features of the general circulation over the Indian Ocean and adjoining tropical region.

The papers relating to the Indian Ocean Meteorology presented at the combined session of American geophysical Union—American Meteorological Society meeting held in Washington D.C. on 19.4.65 are listed below.

F.I. Badgley : Energy exchange at the Oceanic Surface.

A.F. Bunker : Preliminary analysis of large-scale air-sea interaction over the Indian Ocean.

J.A. Colon : Some aspects of the equatorial circulations and cyclone formation in the northern Indian Ocean.

C.M. Dixit : A synoptic study of typical active monsoon and 'Break' conditions over India during June-July, 1964.

D.J. Portman : Measurements to determine the heat and water vapour exchange at the air-sea interface.

C.S. Ramage : The summer atmospheric circulation over the western Arabian Sea.

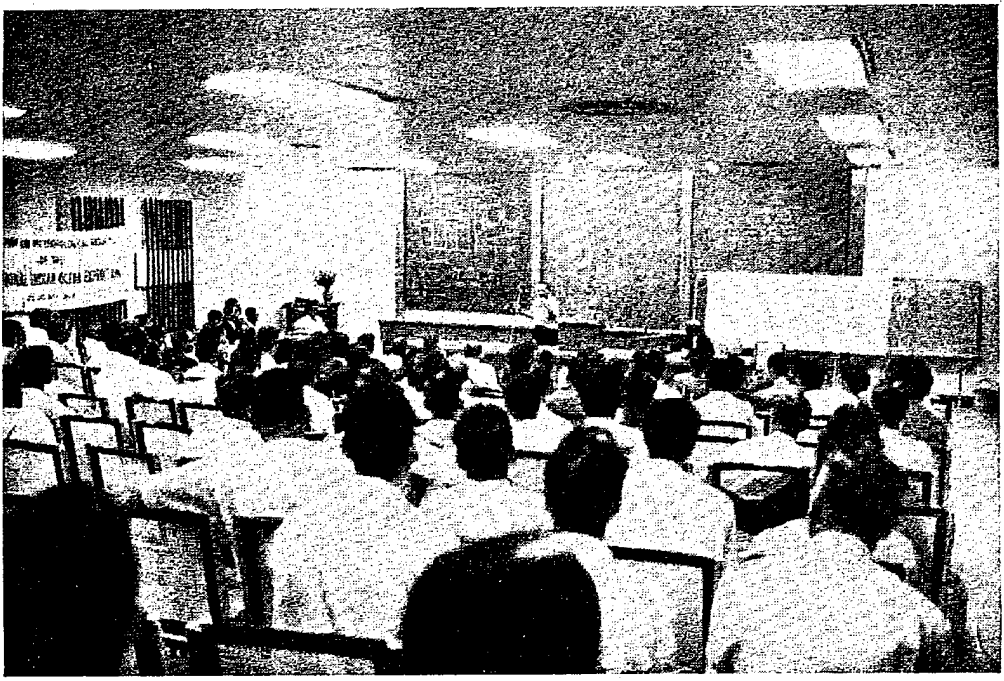
Besides, Lt. Col. F.A. Miller presented a paper on the data processing and dissemination on the International Indian Ocean Expedition at a WMO/IUGG Symposium on Metcorological data processing held in Brussels from 2–5 July, 1965.

Microfilmed sets (each of 20 rolls) of international Meteorological Centre analysed synoptic charts are mailed to co-operating meteorological services who have requested for them. The sets comprise daily charts for 00 and 12 G.M.T. for the two years 1963 and 1964 at the levels: surface 850 mb. 700 mb. 300 mb; 200 mb. and 100 mb.

Mr. D.R. Jones, Chief of the WMO/Special Fund Mission left India on 8 June 1965. His place as Chief of Mission has been taken by Mr. Francis P.W.H.O.

INDIAN OCEAN PHYSICAL OCEANOGRAPHY CENTRE, ERNAKULAM.

The Indian Ocean Physical Oceanography Centre is engaged on various aspects of physical Oceanography, such as physical and dynamical studies on the sea water, studies on bottom topography and geology, beach erosion, accretion and sand movements, coastal currents, storm surges and sea level variations, wave refraction and statistical studies on the chemical and physical characteristics of sea water. A report on



Dr. Rama of the Tata Institute of Fundamental Research, Bombay presenting his paper on the Radon measurements during the Symposium on the Meteorological Results of IIOE

the progress made during the one year period-July 1964 to June 1965-is given here.

In the field of physical Oceanography data collected during the cruises 15 to 28 of INS *Kistna* have been subjected to a systematic processing. Preliminary results had already been reported along with cruise reports.

So far, 147 samples of bottom sediments have been collected using the corer and snapper from different scientific cruises of INS *Kistna*. As a result of the analysis of the sediment samples of 17th and 18th cruises for distribution of total phosphate samples the following results have been outlined.

1) there is wide variation in the phosphate concentration not only from station to station but also in the different layers at each station. The depth variation of phosphate at each station does not show any systematic trend.
2) the sediments north of Masulipatnam area are found to have concentrations of phosphate ranging from 0.19% to 0.01% while the sediments between Masulipatnam and Madras have values between 0.05% to 0.001%.

In the investigations on storm surges and sea level variations along the Indian coasts a new method has been developed for obtaining a residual sea level after filtering the astronomical effect on the observed tide data. The residual sea level is being studied in relation to the residual wind in case of some typical storms.

From the analysis of data obtained from the earlier studies under the sea water sample scheme along the west coast the following results have been obtained. The annual variation of the surface water temperature was found to be about 5°C near Calicut and 2°C near Ratnagiri. The surface salinity has a maximum annual variation of 6‰ off Mangalore and a minimum of 2‰ at Trivandrum

The major scientific activity of the centre relates to the study of coastal and nearshore oceanography of the Kerala coast for understanding the erosion and sedimentation problems. For this purpose eight stations were fixed, five in Cochin area viz. Narakkal, Elankunnapuzha, Ochanthuruth, Saudi and Manasserry, and three in Aleppey region viz. Thumboli. Punnappra, and Purakkad. Among the studies are included the effects of artificial structures, such as sea walls and groynes, on the stability of the beaches in their immediate vicinity at Narakkal and Manasserry which are within sea wall and groyne zone and at Elankunnapuzha and Saudi which are situated south and north of sea wall and groyne zone respectively. Four more observation stations were chosen in areas where there are no groynes and sea walls in order to obtain comparative data.

The observational programme in all the eight points is as follows:

1) measurement of beach profiles at close time intervals (weekly observations)
2) collection of sand samples from the different zones of the beach for a study of the variations in the characteristics of beach material from time to time.
3) collection of data on waves such as wave period, direction of approach, breaker height etc. and
4) collection of meteorological data such as wind force, direction etc.

So far 260 beach profiles have been taken and 1,600 sand samples collected from all the eight stations for a study of the characteristics of the beach material.

The study indicates that the periods of erosion and accretion are not same and are quite varying in all these eight points. The profiles seem to be stable at Ochanthuruth, Saudi, Thumboli, Punnappra and Purakkad. The waves have been found to be strong

in all places except at Ochanthuruth, Saudi, and Punnappra. The presence of mud-bank has been attributed to the weak wave action at Punnappra. No conclusion could be drawn regarding the effect of artificial structures such as sea walls and groynes on the stability of beaches in their immediate vicinity as the data available at present are insufficient.

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REPORTS FROM OTHER COUNTRIES

VII and VIII Cruises of Anton Brunn. U.S.

Reports in respect of cruises VII and VIII of US. Research Ship Anton Bruun have been received. The following is the summary of the same.

Both cruise VII and VIII were primarily devoted to benthic biology. A variety of gear like Trigger corer, bottom snapper, different types of trawls, grabs, and dredges were used during the cruises for trawling operations and for sampling smaller invertebrates and sediments. As on earlier cruises, the observations in the different stations included measurement of temperature, salinity, dissolved oxygen, phosphates, nitrite, nitrate, silicate, particulate carbon, light penetration, phytoplankton, pigments, primary productivity, IIOE standard zooplankton tows and multiple depth vertical plankton hauls. Underway studies included meteorological observations, bathythermograph observations and continuous bathymetric recording.

CRUISE VII: The cruise VII was undertaken towards east of South Africa and south of Madagascar and covered in all four sections viz.

a) between Durban and Tulear
b) Between Europa Island and Lourenco Marques.
c) between Durban and Walter shoals.
d) between Natal Deep and Lourenco Marques.

A total number of 233 bottom samples were obtained from approximately 100 stations. The adopted procedure involved taking cores, a grab sample, and a trawl sample at each station with mud or silt type of sediments and in rocky areas rock dredge was used.

One core from each station was quick frozen in upright position for study of sediments and organisms in a completely undisturbed conditions. The grab, trawl and dredge samples were screened using nested stainless steel screen (3 and 4 ft.) with meshes ranging from very coarse to 0.7 mm. in order to separate the silt and clay from the larger invertebrate organisms.

An important experiment on board the ship is the use of Hubbard pinger in conjunction with most of the bottom sampling gear. The advantages found in using the pinger are (1) it permitted the operator to follow the progress of the gear on the bottom on the ship's precision echo-sounder and (2) it served to indicate the successful tripping of the grab and avoided the raising of the grab to the surface for visual inspection of its failure to close.

In addition to usual oceanographic programme extensive collections at the coral reef, mangrove swamp and shore areas around Tulear and Lourenco Marques were also carried out.

CRUISE VIII: In this cruise the area of operation was confined to Mozambique channel between Durban and Mombasa and the adjacent coastal waters of Africa, Madagascar and the Comores Islands.

The highlights of the cruise are:—

1) The largest catches consisting of market size shrimp (Hymenopenaeus) and lobsters (Nephrops) were made at

stations 396B and 369C off Lourenco Marques and Mozambique at a depth of 450 meters.

2) A catch of very large penaeid shrimps from station 421C off Formosa Bay, Kenya in 240 meters were made, which suggested that the area may have an exploitable fishery.

3) A new method of lining has been experimented in which nine lines each consisting of about 50 baited hooks and one fish trap were set on the bottom at depths ranging from 640 to 2150 meters. After a predetermined interval magnesium links released the anchor weights and glass floats returning the lines to the surface. By this means a total of seven sharks, two chimaeras and one teleost all adults were taken. Radar targets and spreader vanes for these lines were made of sheet aluminium and they have been reported to have worked well. It has also been reported that the method showed considerable promise as a means of catching larger specimens than normally possible with conventional gear and of fishing in areas inaccessible to trawl.

4) Besides, some special studies were also carried out viz.

   a) Metabolic studies of euphausiids and planktonic shrimp in relation to temperature and pressure.

   b) Effects of temperature on the respiration of pteropods, chaetognaths and siphonophores and activity of euphausiid lactate dehydrogenase were also studied.

   c) A variety of fishes were collected by handline in shallow water (20-60 meters) especially off Northwest Madagascar. Included in these efforts was the tagging and release of about 75 sharks.

   d) Rotenone collections of fishes were made at Chesterfield Island off the North western coast of Madagascar, and samples of invertebrates were collected there and on Banc du Castor, off Northern Madagascar, by Scuba diving.

Scientific cruises of M. V. Geronimo of the Bureau of the Commercial Fisheries, Biological Laboratory, Washington. D.C.

Information has been received from the U.S. Bureau of Commercial Fisheries Regarding the cruise V and VI of M.V. *Geronimo*. During the cruise V vessel carried out a survey of the distribution of tuna schools and studied the properties of the environment during the upwelling season off shore from Senegal-Liberia, during 10 February to 2 March 1965. Similar work has been carried out south of Ghana and Togo between 14 and 30 of March, 1965. A total of 137 tuna schools was observed and samples of tuna were caught from 23 of them.

Another mission during this cruise was to measure direct current in the Gulf of Guinea and also to survey the oscillations in the Atlantic equatorial undercurrent. A total of 4 direct current measurement stations were occupied. Parachute drogue tracking further confirmed the existence of the westward-flowing Guinea under current.

The cruise VI of *Geronimo* has planned to undertake between 21 July and 13 November, 1965 Chief mission during this cruise will be to investigate the distribution and biology of fishes suitable for use as live tuna bait and to study the distribution and biology of surface tunas and other pelagic predators together with measurements of the physical and biological environ-

ment in (a) the waters surrounding the Antelles Island (b) the waters of the upwelling region adjacent to the coasts of Venezuela and Columbia (c) waters north of Houndras and east of the Yucatan peninsula. The cruise is expected to be completed in four legs: Norfalk-Puerto Rico, Purto Rico-Trinidad, Trinidad-curacao, Curacao-Jamaica, and Jamaica—Miami.

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EXTRACTS FROM SCIENTIFIC PAPERS

Production composition and Distribution of organic matter in the western Arabian Sea.

Based on the data collected during the cruise 4A of *Anton Bruun* in the western Arabian Sea J.H. Ryther and D.W. Menzel have discussed in this paper the various aspects of the production composition and distribution of organic matter in the said area. The physical structures and chemical characteristics of the central basin of Arabian Sea have been graphically studied in comparison with similar profiles for the North Atlantic. The Arabian Sea in contrast to Sargasso Sea is permanently and strongly stratified near the surface with a gradient of 10-15°C in the upper 200 m. Nutrient levels in the Arabian Sea increase sharply with depth, beginning very near the surface and fertile waters lie close to, if not within the limits of euphotic layer (50-100 m. in the central basin.) It has been roughly estimated that the nutrient concentration in the Arabian Sea is about twice those in the North Atlantic. This high nutrient level in the proximity of the surface sets the stage for increased biological productivity for which monsoons provide the energy required. The oxygen concentration of Arabian Sea, also drops sharply below the euphotic zone in mirror image to nutrient distribution.

Inverse relationship between high surface nutrient and productivity and low concentration of dissolved oxygen in the underlying waters is a common aspect of fertile marine areas. Sinking of organic matter below the euphotic zone, their subsequent decomposition and oxidation and the vertical replacement of this nutrient laden water by the strong offshore winds blowing parallel to the coast are the dynamic processes observed along Somali and Arabian coasts. However, the factors causing the upwelling are complex and undoubtedly vary seasonally as well as locally. According to the observation of the authors the rates of production (5.7 and 6.4. g. carbon/m^2/day) obtained off the Gulf of Oman are higher than ever before reported for Indian Ocean. While these rates were extraordinary and represent bloom conditions, the mean production rates for all 40 stations worked out was 1.5 and for 30 Arabian Sea stations 1.8 g/carbon/m^2/day, a level which is of an order of magnitude greater than that of oceans as a whole.

Productivity in relation to organic matter.

The relationship between carbon assimilation and total and particulate carbon is obviously non-linear and found to be highly scattered suggesting the presence of variable quantities of dead or detrital carbon in the particulate matter. But the relation of carbon assimilation to the living carbon (phytoplankton) is mostly linear with a few exceptions. Based on the observation that the difference between the living and total carbon as being equivalent to detrital carbon, the authors attribute the patchy distribution of life in the Arabian Sea to the amount of organic matter which varies from

one area to another. The living phytoplankton represents not more than 10 to 20 percent of the total organic matter with fluctuations. At a few stations of phytoplankton blooms, 60 percent of the total carbon for the whole of euphotic zone was composed of living carbon.

The authors point out that the superfluous production in the tropics may create an imbalance between it and the animal populations which become inadequate to consume the former. An appreciable fraction of it sinks below the euphotic zone and thereby decompose utilizing oxygen. According to the authors the relationship of minimal carbon: chlorophyll (35:1) is likely to be affected by the presence of dead cells which would be in no way different from the detritus mentioned earlier (J. H. Ryther and D. W. Menzel. Deep Sea Research Vol. 12, No. 2: 1965)

Filtration ratio, Variance of samples and Estimated distance of haul with Indian Ocean Standard Net

The filtration ratio of Indian Ocean Standard Net was reported as 0.70 (*Umitaka Maru*) and 0.72 (*Oshoru Maru*) by Motoda *et. al.* in 1963. Further work in this direction on board *Umitaka Maru* and *Oshoru Maru* gave the results 0.86 and 1.0 respectively. High values obtained by experiments on board *Oshoru Maru* was probably due to the fact that experiment with net was made at a station when the angles of wire were considerably great (15 to 24°). The filtration ratio of the Indian Ocean Standard Net may therefore be presumed as 0.7 – 0.9.

From their earlier work it can be said that the variance of samples in 0-200 m haul with Indian Ocean Standard Net was found as follows.

Standard deviation percentage:	– 99% fiducial limit-30-75% displacement 40-66% (wet weight)
Standard deviation–percentage	95% fiducial limit-18-45% displacement 21-40% (wet weight)

Distance of haul in vertical sampling.

Based on the data collected on board *Oshoru Maru* and *Kagoshima Maru* the authors propose a method of estimation of distance of haul of plankton net in vertical haul. It has been found that newly plotted data generally satisfy the filtration line previously drawn.

$$Y = 0.482 x + 130$$

where Y is the length (m) of wire cable extended along for the net to reach 200 m depth and X is the volume (m^3) of water filtered by the net that originally calculated by the flow meter readings.

Under water wire angles

Using an under water wire clino-meter an experiment was made to observe the line of wire cable underwater when the ship was drifting considerably due to wind. Norpac plankton net with sinkers was repeatedly lowered to the depth by running out the wire cable as a length of 200 meters, one underwater wire clino-meter was attached to different positions on the wire cable each time. The results indicate that the wire cable suspending the plankton net and sinker did not extend in a straight line, but curved to certain degree. The position of the net is shown to be about 184 m. depth. If the depth at which net was positioned is simply estimated by length of wire run out and angle of wire on deck it amounts to approximately 112 m.

showing thereby that the usual procedure of calculating the actual depth by applying the angle correction to length of wire paid out does not always give the true depth.
(Sigeru Motoda and Keisuke Osawa, Informn. Bull. Planktol. Japan No. 11 (1964)

Method for Extraction of Trace Elements from sea water.

A simple technique for the extraction of trace elements present in sea water has been described by the authors. The technique is mainly based on the adsorption of the elements on ferric hydroxide. A matrix of finely dispersed ferric hydroxide gel using fibrous jute or spongin as the frame work is constructed, through which water can flow freely. This matrix is towed through sea water permitting an *in situ* extraction of elements from large quantities of water.

Four elements present in concentration ranging from about Ca 10^{-4} to 10^{-9} g/l of sea water have been extracted from a few hundreds of tons of coastal waters. In the beryllium and silicon extracts, the radio activities due to cosmic ray–produced isotopes Be^{7} and Si^{32} have been measured.

The technique described here might prove valuable for studying the distribution and isotopic composition of several trace elements present in sea water as well as other waters. Originally the method was developed for the routine measurements of Si^{32} activity in ocean water. The extraction seems to be effective not only for silicon but also for aluminium, titanium, beryllium and other trace elements.

The chemical extraction of Silicon and other elements from towed material was carried out by first dipping in 1:1 HCl and then dehydarting in HCl to make Si^{32} insoluble. In the case of jute they were first burnt in a stream of air and the ash was digested in 1:1 HCl. Further extraction and purification of the elements was carried out by standard chemical procedures.

First the experiment was conducted at Bombay and was analysed only for stable silicon and radionuclide of Be^{7}. Then another experiment was conducted off Mandapam to include the measurement of radioactivity of Si^{32}.

(D. Lal, J. R. Arnold and B.L.K. Somayajulu, Geochimica Et Cosmochimica Acta Vol. 28, 1964)

Interaction of the Summer Monsoon Air with the Arabian Sea.

The meteorological observations obtained aboard a C-54Q aircraft while making soundings and traverses over the Arabian Sea in August and September 1964 are being reduced and analyzed. The observations consisted of: temperatures and humidities from psychrographs and drop-sondes, winds from Doppler radar readouts, direct and reflected short wavelength solar radiation, lapsed-time cloud photographs, turbulence and fluctuations of temperature and water vapour. The recordings have been converted to mixing ratios, potential temperatures, precipitable water, infrared radiation fluxes atmospheric absorptions of visible radiation, wind profiles and air trajectories across the Arabian Sea, turbulent wind components and turbulent transports of heat and water vapour.

Examination of these data reveals several characteristics of the monsoon system and their relation to land, sea, and air interactions and radiational imbalance. The wind observations show that a strong low-level thermal wind jet is formed off the coast of Somalia. Its maximum value of about 25 meters per second is attained at the top of a 1,000 meter thick layer of air cooled by contact with cold upwelling water. As the air mass

moves downwind, loss of heat to the sea continues. However, since heat is brought down from aloft by turbulent transfer, and more heat is absorbed directly from the sun than is lost by infrared radiation, the lowest air is warmed during its passage over the Arabian Sea. As the coldest air is warmed the horizontal temperature gradient decreases and the jet's maximum volue decreases. The decrease of the wind velocity produces a convergence in the lowest layer over the eastern half of the Arabian Sea. The convergence, in turn, produces uplifting of the air. Since the air mass is (conditionally) unstable, shower activity is initiated east of 60° E. This shower activity carries water vapour to greater heights in the atmosphere and produces the many layers of clouds that are characteristics of the monsoon sky.

A heat budget for three trajectories of air flowing across the Arabian Sea has been constructed. The budget shows that at all level's (below 600 mbs) and for all three trajectories water vapour is being transported upward and sensible heat is being transported downward by turbulence and convection. Total rainfall along a trajectory can be computed if one assumes a ratio between water vapour flux and precipitation. Precipitation amounts of about 1 mm per day are required to balance the heat budget. (Andrew F. Bunker W.H.O.I. (USA) Symposium on Meteorological Results of IIOE, Bombay July 1965.)

Evaporation from the Arabian Sea and the Indian South-west Monsoon.

The data collected and analysed principally during the last two years under the meteorology programme of the IIOE suggest that some of the early concepts about the Arabian Sea branch of the Indian South-West monsoon and the supply of moisture to it need a radical revision.

The flow pattern over the south Indian Ocean indicated by the monthly streamline analysis does not favour a large transport of air across the equator into the Arabian Sea during the height of the monsoon. Average values of vorticity centred along 74° E for the month of July indicate a decrease of cyclonic vorticity in the southern hemisphere as the air moves towards the equator from the axes of cyclonic vortices located along roughly 5° S. The divergence associated with this feature is a possible reason for the extreme dryness of the air over the equator, inferred by the aerological data during the height of the monsoon.

The computed values of the water vapour flux across the lateral boundaries of nearly rectangular Arabian Sea box indicate that the transport of water vapour from the southern hemisphere across the southern boundary of the box along the equator is a half or third of the transport across the eastern boundary of the box roughly along the west coast of India (practically along 75° E) during the monsoon. They also indicate a change in the direction of the flux from year to year across the western boundary of the box along 42° E, following the change in the location of the cyclonic vortex in the neighbourhood of Gulf of Aden (i.e., an eastward position of the vortex or its associated axis would result in an inflow, while a westward position of the vortex would result in an outflow). The value of the net outward flux or the flux divergence deduced from the computed fluxes across the later boundaries of the box show that the contribution of water vapour through evaporation from the Arabian Sea is significant.

The magnitudes of the evaporation computed from the various empirical cum theoretical formulae are found to be significantly less than the evaporation deduced from the flux computations, when the precipitation over the

sea area as well as the upward flux through the 450 mb lid (the top of the box) are considered. It is also seen that the evaporation from the droplets associated with the breaking waves is not negligible as assumed in the derivation of aerodynamic formulae, but it makes an appreciable contribution to the total evaporation from the Arabian Sea surface. These obviously provide the salt nuclei necessary for the formation of rain drops in the regions of adequate ascent.

From the above findings the monsoon moist air-mass seems to be produced by the evaporation over the Arabian Sea and the convective processes leading to the upward transport of moisture occuring over the eastern portion of the Arabian Sea, inspite of there being some air of southern hemispheric origin in the monsoon air-mass. (P.R. Pisharoty I.T.M; Poona. Symposium on the Met. Res. of IIOE Bombay; July 1965).

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NOTES AND NEWS

Prospects for Offshore Oil

Every year more oil is discovered than is used and today the world reserves stand at 35 years of supply, says Dr. T. E Gaskell in his article. (New Scientist Vol. 27 No. 454, 1965). The author is highly optimistic about the potentiality of offshore areas in the economic production of oil. The possible offshore oil producing areas of the world are 6 million square miles which according to Dr. Lewis G. Weeks is capable of producing 100,000 million tons of oil, i.e. about one quarter of the total petroleum available in the world. Already 16 percent of the world production comes from the underwater oil fields and the figure is increasing as more and more areas are explored. This potentiality becomes further enhanced if the slope areas where the continents join the ocean are also taken into account. These areas are considered to be very rich in recent sediments in which petroleum content may be greater than elsewhere.

Describing the geological background of the origin of petroleum Dr. Gaskell says that sedimentary rocks, such as clays, shales and stones or limestones have been formed when material eroded from land is deposited in shallow water. In the course of earth's history small internal changes caused wrinkles in the crust and continents have wrapped and folded so that what is shallow sea bed today could be thrust up as mountains while what we know as land may become shallow water depositional area. Petroleum is formed by the decay of marine organisms trapped in the sea bed. The oil thus formed concentrates in suitable traps of limestone or sand stone from where it is exploited economically. Generally, the more recent (less than 100 million years) deposits are the most prolific, which may be due to the reason that older rocks have been subjected to so many changes during which they might lose much of their original oil.

Offshore oil Exploration in India

Some information relating to the 'Sea Oil' survey off the Indian coast has been published in the earlier issue of this Newsletter. The survey began in September 1964 under the Indo-Soviet economic and technical cooperation, on board the Soviet Seismic Ship *Akademic Arkhangelsky* which arrived here in August 1964. Dr. N. A. Kalinin, the eminent petroleum technologist (USSR) is of opinion that India has in land and in the offshore area a total recoverable reserve of six billion tons of oil and two trillion cubic meters of gas. During the 22nd International Geological Congress held in Delhi in 1964 So-

viet delegates headed by A. Vinogradov indicated that there are large possibilities of offshore oil reserves in India upto 50 meters from the surface.

The leader of the Indo-Soviet Seismic exploration Dr. Malovitsky holds the view,—from the experience gained—that 100,000 square kilometers of Indian shelf up to a depth of 100 meters are of practical interest from the point of view of oil and gas exploration. Under his leadership, despite the unfamiliar conditions, *Akademic Arkhangelsky* surveyed over 1400 km. of area within 48 days. Some of the deep-seated geological structures extending over a vast area are revealed as a result of this survey.

The present exploration has proved a great success and Soviet scientists as well as Oil and Natural Gas Commission (India) are now highly optimistic about the potential oil wealth beneath the sea bed and plans are in progress to undertake a further expanded offshore survey with the Soviet Cooperation.

Fish Spotting Balloons

Hot air balloons may provide a suitable low-cost substitute for the helicopters or aircraft used for fish spotting and other oceanographic observations. Its practical application was demonstrated in Feburary 1964 by the Bureau of Commercial Fisheries, Washington and Applied Science Division, Minneapolis, Minn. The experiment was conducted with a 52ft. diameter spherical balloon of of dacron sporting model equipped with an aluminium frame, and gondola capable of holding two persons. It was modified to keep superpressurised with an electric ducted fan in the narrowed neck. On board the 110 ft. boat M/V *Yaqui Queen* the balloon was first inflated by the fan with ambient air while resting over the stern. The propane burner which was in the balloon's neck was then started to heat the air and provide positive buoyancy. Control over the buoyancy was regulated by the operation of burner, and a thermistor in the balloon's top tells the pilot the gas temperatures (150°F for one man, 170°F for two men and 300°F for maximum safe limits) The craft was tethered by 5/8" nylon line controlled by hydraulic winch. Fuel and electric line wire carried to the ballon by separate lines. Propane gas bottles were also carried in the Gondola. (Geo-Marine Technology Vol. 1 No. 4, 1965): Total six ascents were made to 50' height.

The Aerostate Society of Australia since its formation in 1964 was aiming at introducing balloons for scientific observations. In July 1964 a 35 ft. balloon designed by the Society members made a manned flight at Parkes NSW. The Society is planning now to design better balloons equipped with remote-controlled TV which could serve a number of Vessels to locate schools of fish. According to the fishery biologists of La Jolla Fishery Oceanographic Centre, the next step in the balloon project is to design one with aerodynamic qualities, which can be towed by a tuna vessel without hindering its speed. (Aust. Fish. News Letter July, 1965)

Recovery of Gold From Sea Water

Presence of gold in sea water was first reported by the French chemist Proust in 1787. Following this an English Chemist Sonstadt in 1872 analysed it quantitatively and reported about 64 mg per ton of sea water. Since then a number of workers from various parts of the world contributed towards the knowledge on the quantity of gold available from sea water. Their data reveal that the gold content in sea water

varies from place to place and season to season.

Pressed by the need of the country after the world war a brilliant German chemist Dr. Fritz Haber and his team worked for the extraction of gold and found that its concentration seldom exceeds 0.001 mg per ton of sea water. Now we are in a better position to study the problem as the chemical technology and analytical skill have undergone revolutionary advancement and the sensitivity of measurements have improved considerably due to the application of radio-active tracers.

A group of investigators in Zurich including E. Baur and W. Stark 1942-43 attempted the commercial extraction of gold by its adsorption on sawdust. These scientists drew up a scheme for the production of 32 million francs of gold at a cost less than 7 million francs. It is surprising enough to note that their device was not practically implemented so far. Similar is the fate of 50 patents sold in America for the profitable extraction of gold.

As the problem still exists it would be interesting to study more about the source and nature of gold present in sea water. Scientists believe that gold accumulates in the ocean due to the washing of earth and by the volcanic action underneath. It is believed that gold exists in sea water in a colloidal state and is either taken up by organisms or deposited along with sediments. Because of the presence of excess Ozone and sodium chloride it is possible for gold to exist in the form of AuCl. Thus it becomes clear that sea beds are richer in gold content than the sea water.

Scientists are of view that economic extraction of gold becomes more feasible if a scheme is drawn up to extract other valuable rare elements along with gold.

Slicks Associated with Trichodesmium Blooms

Natural slick bands are apparently formed by the damping action of monomolecular layers of organic matter which have an effective strength of only few dynes/cm. and are visible against calm rippling waters. Recent studies have revealed that blooms of well defined and surfactant slicks were associated with dense patch of Trichodesmium. An experiment was conducted at the U.S. Naval Research Laboratory by spreading calibrated oils of Adams' variety to study whether the slicks were associated with the surfactant activity. This was done by throwing vials dipped in calibrated oil and noting the equilibrium spreading pressure of the mid portion of the rippled and slick areas.

The result of analysis indicated that their activity against polysaccharide is of interest due to known ability of blue green algae to excrete appreciable quantity of these substances. It also seems possible that slicks associated with Trichodesmium may be due to at least in part to the surfactant property of excreted carbo-hydrate. The occurrence of large blooms of Trichodesmium in tropical and sub tropical oceanic waters and the ease of its detection and handling may make it an ideal test organism for examining the algal excretion of organic compounds and their role in surface slicks.

The work in this direction was undertaken during the 10th cruise of *R. V. Trident* in the Sargasso Sea by John Mc N. Siebarth and John T. Coner (Nature No. 4973, 1965)

Direct Measurement of Volume Transport In the straits of Florida

Dr. W. S. Richardson (Miami) has pro-

duced a simple device to measure directly the average current velocity through the entire water column. The measurements are performed at several location across the straits and the resultant transports are then integrated to provide the total volume flow through the straits. A free instrument is dropped into the sea at a precisely known location. The device descends at a known rate of 2 meters per second. Either at a determined depth (pressure release) or on the bottom contact (tipped balance) weights are automatically released and the instrument is then free to rise at a rate of 2 m.p.s. Precise location of the instruments reappearance on the surface is noted. The device itself photographically records time and temperature against pressure. Distance between the drop and resurface points (x) constitutes average velocity times the depth of water column. Volume transport is expressed as follows.

$$T = S_0^d Vd \quad Z = \frac{XD}{t}$$

V = Horizontal velocity.
Z = Depth
t = Time of run
D = Weight — drop Depth
X = Deflection

The operation of the instrument requires only a small vessel.

Richardson's direct transport measurements do not tally well with geostrophic calculations deduced from hydrographic stations simultaneously performed by Mr. Saul Borida. Mr. Borida's analysis of horizontal velocities and configuration indicates a bi-axial current structure and a total northerly transport of about 20 million meters per second. Dr. Richardson's measurements indicates a uni-axial current pattern and a northerly transport of 30-35 million Cu-ft. per sec. The discrepancies may be due to the sub surface counter-currents which are currently being investigated.

(Geo-Mar. Tech. Vol. I No. 4.1965)

New Link in Marine Food-chain

An unsuspected supply of food for marine life has been found by three American Scientists, Drs. W. H. Sutcliff, E. R. Baylor and Prof. G. Riley. This previously unknown link in the marine food chain is a population of non-living organic and inorganic particles which are constantly being created on airbubbles in the sea. When the bubbles burst at the surface, they release particles sufficiently large to provide a significant source of food for the very small animals—the zooplankton which swarm in the surface waters of the sea.

The discovery came when it was demonstrated in the Laboratory that organic particles could be reconstituted from dissolved organic matter by adhesion to airbubbles in the water, and that continued bubbling resulted in the build-up of larger clumps or particles. Thus the one-way process whereby the microscopic plants—the phytoplankton—assimilate simple inorganic chemicals and use them to produce living matter and are then consumed by the zooplankton is not apparently the whole story. Certainly when animals and plants die and begin to sink to the bottom their food value is not lost to surface animals as was previously assumed, until bacterial breakdown has reduced them to a form suitable for assimilation once more by the phytoplankton at the beginning of the marine food chain.

Physical Forces In Marine Fouling

About 140,000 species live at the bottom of the sea and at least 110,000 of them are inhabitants of shallow water, says the Da-

nish marine biologist Gunnar Thorson. The behaviour of these animals at the juncture of their leaving larval stage and settling down to a particular substratum is very important in view of the economic aspects like oyster fisheries, marine fouling and allied effects. The settlement of this larvae is being done by special organs and the influence of sunlight is also profound in this regard. The impact of light can be further emphasised, for in the diffusely lit sea it signifies the presence of a solid object to settling stages which usually have only simple light reception. The Juxta-position of light and shade is probably one of the important stimulus to the settlement of the larval stages.

In an interesting study of this problem, P.A. Board and T.M. Collins have observed physical forces which the settling stages meet as they approach a solid boundary. The drag of the solid boundary is transmitted to the fluid, bringing the fluid to rest on the boundary. Flow velocity increases from boundary out into fluid. This change of velocity across larvae causes a force of spinning which increases as the boundary is approached. The larvae finds it difficult to anchor themselves. The authors made their four-year study of these forces in the conduits of the coastal power stations and their results are of great value in understanding the effect of marine fouling along the sea shore. It demonstrates the effect of fluid shear alignments to the flow, unusual modes of growth and close competition among animals uniquely associated in total darkness and reveals the inadequacy of the design and Construction of Conduits. Also it has been proved that the shear is one of the major factors determining the settlement of larvae of the bottom living invertebrates (Discovery Vol. XXVI, No. 5 1965)

Angria Bank Expedition

The Directorate of Fisheries, Maharashtra state conducted an expedition to the Angria Bank, a submerged Coralline area of 150 sq. miles lying 76 miles south west of Ratnagiri. The depth of the sea varies from 120 to 300 fathoms around the Bank whereas the Bank itself is very shallow with a depth range of 8-15 fathoms. Major objective of the expedition was to study the fishery potentiality of the area with observations on the physico-chemical factors influencying it. The Atomic Energy Establishment, Trombay collaborated in this expedition during which, estimations of natural and fall out radioactivity were undertaken.

The expedition commenced from Bombay on 21 Nov. 1964 and the voyages were undertaken in five different phases as follows: (1) Bombay–Ratnagiri (2) Ratnagiri –Angria Bank (3) on and around Angria Bank (4) Angria Bank–Ratnagiri (5) Ratnagiri-Bombay. Seven mechanised vessels of the Fisheries Department were commissioned for this work which lasted for about two weeks. Of these three were equipped for various types of fishing, two exclusively for hydrobiological investigations, one for the conveyance of provisions and another one for guidance. Besides, three trawlers (private) owned by the fishermen of Ratnagiri also participated in this venture for some time. Twelve scientists from the Fisheries Department and two from the Atomic Energy Establishment took part in the expedition.

A summary of stations occupied with various activities and samples collected are given below.

1.	*Bathythermograph*	— 45 Stations.
2.	*Dredge collection*	— 42 „
3.	*Plankton haul*	— 46 „

4. *Sea water samples at different depth for phosphates Oxygen and Salinity* — 200 Stations
5. *Determination of natural and fall out radioactivity.*

A (a) Water samples 13 each of 115 litres.
(b) Sediment samples 23
(c) Plankton 23

B Radio nuclides to be determined in the above mentioned samples.

(a) Caesium	—	137
(b) Strontium	—	90
(c) Ruthenium	—	106
(d) Iron	—	55
(e) Zinc	—	65
(f) Manganese	—	54
(g) Cobalt	—	60
(h) Cerium	—	144

6. *Fishing*

Trawl hauls	—	32
Shark longline	—	8
Surface gill net	—	6
Tuna longlines	—	1

The processing of these data is underway and hence it is impossible to make any conclusions at this stage. However some of the observations during the expedition helps to make a preliminary assessment of the potentiality of the fishing ground. Over 9,090 kg. of fish were caught during this work. On and around the bank shark and tuna lines form the most efficient gear. Perches were also caught in good numbers and it is expected that this sort of fishing may prove commercially successful whereas the results of trawling in this area—found limited upto 25 fathom line-was not encouraging.

Plankton was noted for the paucity of crustacean larvae whereas medusae were abundant. Fish catch comprised of about 60 different species. Some very sharp thermoclines were encountered *en route* from Bombay to Ratnagiri (source: Report on the Angria Bank Expedition, 1964—Directorate of Fisheries, Maharashtra State, India)

New Unesco Curator for Indian Ocean Biological Centre

Dr. E. Brinton has been appointed as the new UNESCO Curator in the place of Dr. Vagn Kr. Hansen whose tenure of office in this capacity expired in February, 1965. Dr. Brinton arrived in India on 18.10.1965. He visited the Directorate of Indian Ocean Expedition and the Data Centre at New Delhi.

Symposium on the Meteorological results of International Indian Ocean Expedition

A symposium on the meteorological results of the International Indian Ocean Expedition was organised by India Meteorological Department and the Indian National Committee on Oceanic Research under the cosponsorship of World Meteorolgical Organisation and UNESCO. The inauguration of this five day symposium was done by Dr. P.V. Cherian, Governor of Maharashtra on 22nd July 1965 at the Tata Institute of Fundamental Research. Scientists from various parts of world actively participated and presented a number of papers during various sessions met under five separate groups as follows:

1. Air-Sea Interaction studies.
2. General circulation
3. Tropical cyclones
4. Satellite Meteorology
5. Morphology of the monsoons and synoptic model for the tropics and monsoon forecasting.

In addition to the presentation of papers there were lectures by specially invited

scientists on topics relating to Indian Ocean meteorology.

Fish Landing Along Kerala Coast

A report received from the Directorate of Fisheries. Kerala (India) reveals the trend of fish landing at various centres along the coast. Total marine fish landing along the entire coast comes to the tune of 123723 M. tons during the quarter Jan-Mar 1965. Of these 13404·1 M. tons of oil sardines and 4444·2 M. tons of Mackerel were landed at three major centres in the Calicut region alone. Preliminary biological observation on these species indicate that length frequency of sardine varies between 9 and 17 and that of Mackerel between 18 and 2o cm. Similar data have been collected for other commercial fishes such as. Synagris, platycephalus, Tuna, Balistis, Caranx and Cybium.

The Marine Biological station at West Hill in Calicut and the Marine Survey station at Vizhinjom are the Centres functioning under the Fisheries Department of Kerala state tackling the various research problems concerning the local fishery. (source: Directorate of Fisheries. Kerala state)

THE SECOND INTERNATIONAL OCEANOGRAPHIC CONGRESS

It has been decided to hold the second International Oceanographic Congress in Moscow during 30 May to 9 June 1966. The programme committee for the Congress met in Moscow on 13-14 May 1965 and discussed about the items to be included in the programme. According to this the opening plenary Session will be held on Monday 30 May, 1966.

The programme of the Congress includes plenary Sessions, sectional meetings and symposia. There will be six days with morning plenary sessions (10 AM to 1 PM) and at each session four lectures lasting about 45 minutes will be delivered with simultaneous interpretation into English, French, Spanish and Russian. Sectional meetings will be on the following aspects.

3. Marine Geology and Mineral Re-
2. Ocean and Life.
1. Ocean and Atmosphere.
   sources.
4. Oceanography of Indian Ocean.

Of these first three sectional meetings will be conducted simultaneously whereas the fourth one will be held separately during morning and afternoon so as to allow scientists of various fields to attend. Several symposia might also be held concurrently during the time between sectional meetings. Part of the time of the sectional meetings will be spent on questions to invited lectures, discussions on morning lectures, and presentation of papers. A total number of 225 papers will be presented in addition to the papers expected to be presented during symposia.

Detailed prospectus of the congress will soon be widely circulated by the U.S.S.R. Arrangements Committee.

INTERNATIONAL BIOLOGICAL PROGRAMME

The Committee for Productivity of marine communities met in Rome on 2-3 February, 1965. The objective of the section was defined as the encouragement of the further development of marine biological sciences by the following:

a) Emphasizing the importance of marine biological research so that laymen in governments may appreciate its significance in studies of the modification of marine environments by man's activities and in the conservation and wise use of living marine

resources (b) Emphasizing to governments and universities the importance of training marine biologists since the magnitude of research problems will demand at least doubling of the present manpower within a period of five years (c) Encouraging existing programme of research on the identification, productivity and distribution of marine species, population and communities (d) Assisting in the establishment of modern marine biological research programmes in geographical areas where they are not in existence. (e) Fostering the exchange of information and ideas among scientists working on these problems (f) Defining present condition of the sea so that future changes including man's activities may be evaluated.

Ways of advancing these objectives were discussed and two resolutions were also passed by the Committee.

1. The Committee recommended that financial support be given by National Committees and international agencies to facilitate the pooling of equipment and manpower for approved programmes of International Biological Programme.
2. Having regard to the shortage of trained scientists and technicians in marine biology, specially in the developing countries, the Committee urged National Committees and international agencies to help to finance the training of personnel of one country aboard ships and in the laboratories of other countries.

Two working groups were established: one for considering the studies of the benthos and littoral communities and the other to consider the problems of development and intercomparision of methods. There was some discussion of the possibilities of setting up an international centre for the development and testing of methods for measuring plankton populations, environmental characteristics and productivity.

The Committee endorsed a programme which is centred around a study of food chains with special emphasis on seasonal variation particularly in regions easily accessible to man. It has been found essential that for further development, research proposals from scientists should be submitted immediately to National Committees or directly to Dr. Ketchum from countries where International Biological Programme National Committees have not been formed. Suggestions were also made for the collaboration of International Biological Programme with existing or proposed international projects in marine science especially those sponsored by UNESCO and FAO.

RECOMMENDATION OF THE SECOND MEETING OF THE INTERNATIONAL COORDINATION GROUP FOR THE INTERNATIONAL INDIAN OCEAN EXPEDITION

(Paris, 7—9 June, 1965)

Recommendation 1

The Coordination Group, having reviewed the work in the Indian Ocean accomplished to date, recognised that requests for additional observations, water samples or other material, may arise from different institutions and recommended that the IIOE Information Paper, as being the most appropriate vehicle, should be used for bringing such requests to the attention of organisations operating, or about to operate, in the Indian Ocean area.

Recommendation 2

IIOE Data Exchange

The Coordination Group, having considered

the summary of the current status of the IIOE data exchange, took note of the progress made in exchanging data of cruises accomplished by the end of 1963 and, particularly, the speedy direct exchange of bathymetric data between scientists and institutions concerned. The Group recommended that:

1) National Coordinators should make further efforts to ensure that deadlines established by the Group at its first meeting be met and that all kinds of exchangeable data be submitted as expeditiously as possible.

2) World Data Centres should modify their system of assessing their acquisitions in that not only cruises and stations be given as indicators, but also that the amount of the various kinds of exchangeable data acquired be established.

3) The Secretariat should find out which particular kinds of exchangeable data have not so far been exchanged with respect to those cruises for which certain oceanographic data have already been sent to World Data Centres.

4) The Secretary should find out, with the aid of the Permanent Service for Mean Sea Level, those Indian Ocean tide gauges which were operating during the IIOE and for which sea level data have yet been sent to the PSMSL. It would be useful to establish exactly on which dates the last data for each gauge were submitted and what has happened to the tide gauges since these dates.

The Secretary will then write to the National Coordinators concerned and will take any further steps required to provide necessary assistance and ensure steady progress in sea level data exchange.

5) National Coordinators should arrange that the FAO Fisheries Data Centre receives all the relevant material (fisheries data and information) as set out in IOC Resolution III-3 and in the ACMRR Recommendations.

Recommendation 3

The IIOE Collected Reprints

Having considered the information provided on this problem by the IOC Secretary, the International Coordination Group recommended:

1) That National Coordinators be requested to furnish to the IOC Secretariat each year a list of scientific papers based on results of the IIOE and published by scientists of that country. Following this, five copies of each paper should be furnished to the Unesco Office of Oceanography which, for bibliographic purposes, will furnish a complete list of such papers to FAO.

2) That from these papers a selection be made of scientific papers dealing with oceanography, meteorology, or fisheries biology.

3) That the papers selected should be reproduced in the Collected Reprints, other papers being listed by title and author's abstract or summary.

4) That where the International Coordinator has any question about the inclusion of a given paper he refers the paper to the appropriate member of an editorial board consisting of the SCOR disciplinary experts, the scientific coordinator for meteorology, and a fishery expert to be nominated by FAO.

5) That the Unesco Office of Oceanography, in cooperation with the FAO Fisheries Biology Branch, arrange to furnish upon request copies of papers not included in the Collected Reprints to libraries of marine laboratories or other institutional receipients of the Collected Reprints.

6) That the IIOE Collected Reprints be distributed to the libraries of marine and other appropriate laboratories throughout the world. Distribution to individuals was not considered necessary or desirable.

7) That consideration be given to the even-

tual preparation of a comprehensive annotated bibliograph of papers resulting from the IIOE.

Recommendation 4

IIOE Cruise and Data Reports

The Coordination Group, having considered and reviewd the problem concerning the preparation and publication of IIOE Data Reports, recommends the following:

1) That the data reports be prepared and published in chronological order. It appears that sufficient data is available to initiate preparation for the years 1959 through 1961. All those nations or institutions that have not submitted data for cruises conducted during this period should be strongly encouraged to do so at the earliest possible time.

2) The contents of the volumes should consist of data that can be reasonably tabulated and which are consistent with the IOC "Manual on International Oceanographic Data Exchange" in addition, information on accuracy, precision, methods, etc., should be included.

3) The Secretariat should contact World Data Centres A and B to determine if these centres are interested in preparing and printing the IIOE Data Reports.

4) An estimate of the cost of preparation and printing should be obtained from the World Data Centres which are interested and these centres should be requested to submit a proposal to the Secretariat for doing this work. The proposal should include suggested contents, format and mode of presentation etc.

5) Unesco should be responsible for the distribution of the Data Reports and should explore on the basis of the estimated cost of production the costs of such distribution and any other overhead costs associated with handling distribution and sales, submitting an estimate to the IOC Secretariat.

6) The Data Reports should not bear a copyright.

7) The National Coordinators should act as an editorial and advisory to the Secretariat until it is deemed necessary to have a smaller, specially appointed board of editors. All correspondence from the Secretariat to the National Coordinators on this subject shall have a time limit for reply. If no reply is received, it shall be assumed that the specific National Coordinator concurs with the plan put forth.

Recommendation 5

Disciplinary Experts of SCOR and the Scientific Director of the IIOE Meteorological Programme

The International Coordination Group, having discussed the reports of the SCOR Disciplinary Experts, Professors Krey, Zenkevich, Tchernia and Fisher, and of the Scientific Director of the IIOE Meteorological Programme, Professor Ramage, considers that these experts are providing to scientists, institutions and laboratories participating in the IIOE, an extremely valuable service, each in their own way, either through advice on planning field work, by compiling information showing the actual coverage of the Indian Ocean in each particular discipline, or by supplying scientists with lists of individuals actively engaged in scientific studies of the Indian Ocean within each particular discipline. The Group considers the importance of such work will further increase, in spite of the close of the IIOE field operations by the end of 1965.

Because the Disciplinary Experts and the Scientific Director of the IIOE Meteorological Programme have considerable knowledge of

the state of research on the Indian Ocean, the International Coordination Group recommends that these scientists formulate suggestions for action by IOC, Unesco, SCOR, WMO, and other interested international organisations, to ensure that the best use is made of data obtained through the cooperative efforts of countries which participated in the IIOE. In this way, participating and other laboratories would be helped to formulate future research programmes on the Indian Ocean.

Recommendation 6

Observations on reference stations

The Coordination Group agreed unanimously that observations on reference stations should be continued on a voluntary basis for as long a period of time as possible. The Group also recommended that in any presentation of the IIOE results those coming from the reference stations should be singled out. For example, a volume of station-diagrams for reference stations might be envisaged as a part of the Cruise and Data Reports series or the IIOE Atlases.

Recommendation 7

Indian Ocean Biological Centre

Following a very full discussion of the draft report of the Consultative Committee of the Indian Ocean Biological Centre, the Coordination Group recommended that the Indian Council of Scientific and Industrial Research be approached with a view to assuring the continuity of the Centre and its staff after the end of the IIOE in order to provide:

a) a repository for the International Collections;
b) a permanent service for workers engaged on tropical studies, particularly in the resolution of taxonomic problems;
c) a centre for research on the plankton of the Indian Ocean;
d) training, both for Indian recruits to marine biology and for workers from other countries who wish to specialise in tropical marine plankton.

The Group welcomed the proposal of the Indian CSIR to build a permanent laboratory to house the Centre in Cochin and recommended that the Unesco Office of Oceanography should continue to support the Centre in the future through the provision of funds for a Curator and equipment, as well as training courses, visits of specialists to work at the Centre and for the scientific development through the provision of fellowships to members of the permanent staff. The Group further recommended that national support be encouraged in order to enable taxonomists and others to collaborate in the biographical study of the plankton of the Indian Ocean and especially in the recruitment of international teams to work at the Centre for various periods on specific aspects of the International Collections.

The Group endorsed the recommendation of the Consultative Committee that sampling with the Indian Ocean Standard Net should be continued after the end of the IIOE and that the samples should be sent to the Centre for sorting. The principal objectives would be to fill geographical gaps in the sampling during the IIOE, especially in the Southern Indian Ocean, and to build up a time-series of observations for ecological studies of the plankton in the Indian Ocean.

The Group recommended that libraries and individuals should be asked to donate duplicate volumes and papers to the Centre and to provide photo-copies of identification

keys and other works on taxonomy and biogeography. It welcomed the offer by the National Coordinator of the USSR to provide on request Russian identification keys in translation.

The Group recommended that duplicate copies of the completed sorting sheets be stored in the Office of Oceanography.

Recommendation 8

IIOE Atlases

The Coordination Group recommended that the project of IIOE Atlases should be divided into a number of subject sections. For each section an Editor should be appointed by IOC in consultation with SCOR. The IOC has to ensure that the home country of the Editor is willing to provide the salary of the Editor, along with the funds and technical assistance which are needed for the preparation of an Atlas. No decision with regard to the financing of the printing of the Atlases can be made at present.

The Editor would have the final decision in matters of presentation in the Atlases. He should be assisted in his work by an advisory board consisting of a small number of scientists who worked during the IIOE in that discipline. Much of this advice could be obtained by correspondence, but the Editor will probably need to visit laboratories and perhaps the advisory board might be convened for detailed consultation. It is recommended that Unesco provide funds for such travel.

Recommendation 9

IIOE Symposia

The Coordination Group recommends that all National Coordinators communicate to the IOC Secretariat in advance information on all the symposia, national or international, which are going to be held in their countries. This information will then be widely disseminated through the IIOE Information Paper and the International Marine Science Bulletin published by Unesco.

ADVANCED TRAINING IN OCEANOGRAPHY.

An advanced training course in oceanography is being organized at Bombay jointly by the Directorate of Indian Ocean Expedition (Council of Scientific & Industrial Research), India and UNESCO. This course will commence on 20th January 1966 and continue up to 7th March 1966. The first part of the course will be in general oceanography and the second in specialised branches.

Candidates from India and neighbouring countries will participate in this training. A joint team of leading oceanographers from India and abroad will conduct this course which includes lectures and practical work in various disciplines of oceanography.

Forthcoming meetings

1. Intergovernmental Oceanographic Commission Working group on Co-operative investigation of variability in the ocean is scheduled to meet in Paris on 2 November, 1965.
2. Intergovernmental Oceanographic Commission's 4th Session will be held from 3 to 12 November 1965 in Paris.

VISITORS

Indian Ocean Biological Centre, Ernakulam was visited by the following persons during the quarter ending 30th September, 1965.

1. Mr. Victor K. Mc. Elheny, European Correspondent of Science.

2. Shri Narayana Rao Koli, Managing Director, M.M. Shakarai Sangh, Bombay.
3. Dr. H. Srinivasa Rao, Former Chief Research Officer, Central Marine Fisheries Research Institute Mandapam.
4. Prof. J. Darbyshire, Marine Science Laboratory, Menai Bridge, Anglesey, U.K.
5. Mr. Uwe. Wilhelmi, University of Hamburg (Germany)
6. Mr. A.V. Westernhagan, University of Hamburg, (Germany).
7. Dr. S. Vasudev, College of Engineering, Trivandrum.

Mr. Sydney Marcus, of the National Oceanographic Data Centre, Washington, visited the Directorate and Data Centre of Indian Ocean Expedition, at New Delhi.

PUBLICATIONS RECEIVED

Jena Review No. 1, 1965.
Research & Industry (CSIR)
Vol. 10, Nos. 3 to 8, 1965.
Geo Marine Technology:
Vol. I Nos. 4 to 6, 1965.
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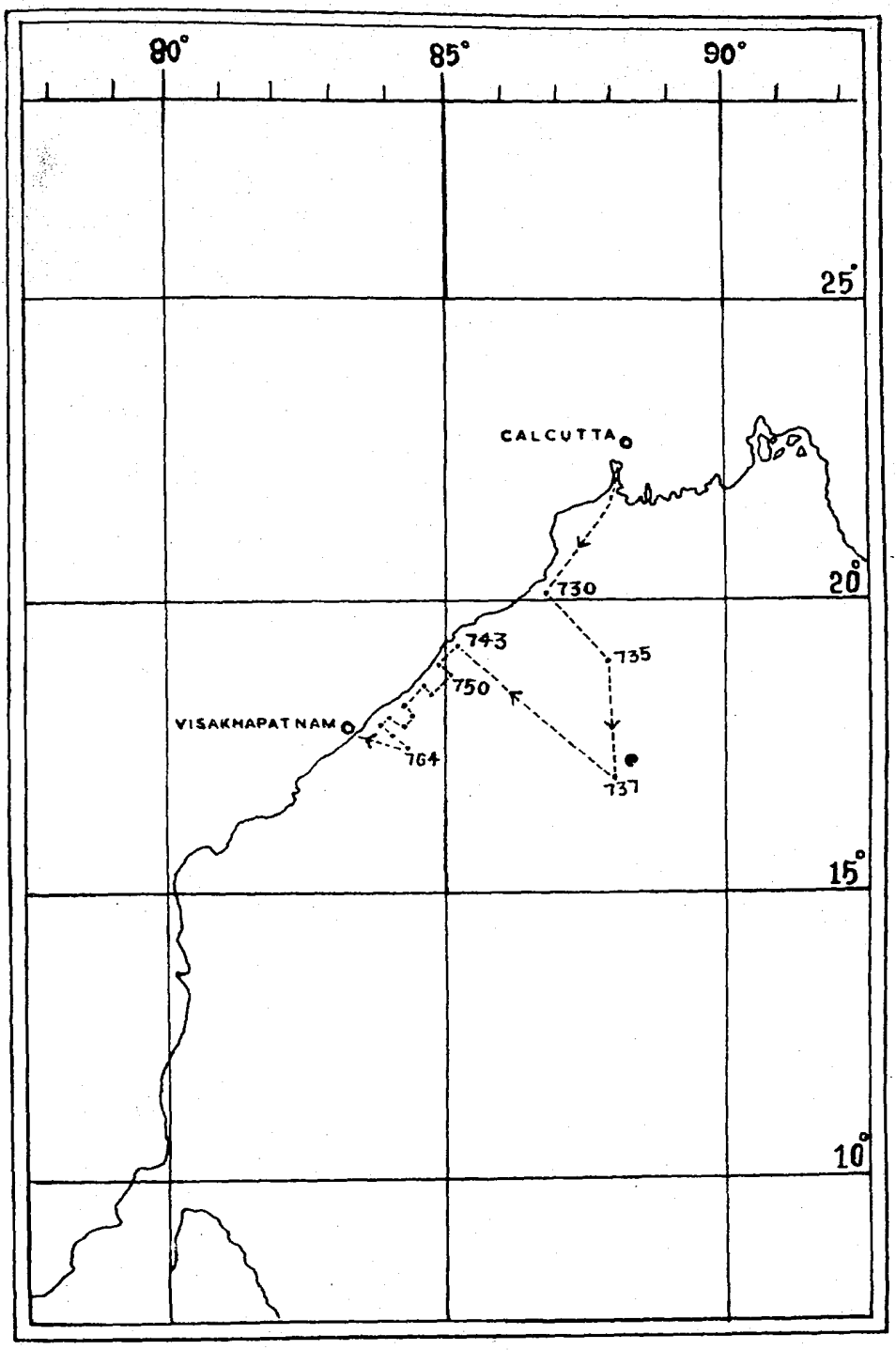

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