INTERNATIONAL INDIAN OCEAN EXPEDITION

NEWSLETTER

Vol. III No. 3 INDIA December, 1965

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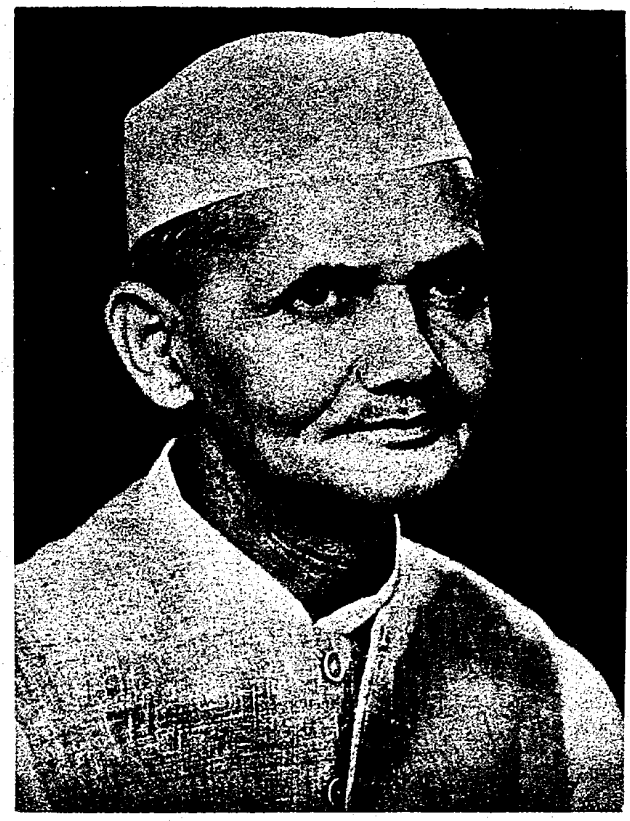

The late Prime Minister & the President of the Council of Scientific & Industrial Research—Shri Lal Bahadur Shastri

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INTERNATIONAL INDIAN OCEAN EXPEDITION

NEWSLETTER

INDIA

Vol. III No. 3 DECEMBER, 1965

INDIAN PROGRAMME

Field activities connected with India's participation in International Indian Ocean Expedition have come to a close by December 31, 1965. INS Kistna, the main participating ship, after completing 28 scientific cruises in the Indian Ocean has returned to her normal duties.

The National Institute of Oceanography, whose draft plan was accepted by the Governing Body of the CSIR in May, 1965, is to start functioning from January 1, 1966, taking over all the units and activities of the Indian Programme of International Indian Ocean Expedition. Dr. N. K. Panikkar, Director, Indian Programme of the IIOE has taken over as Director of the National Institute of Oceanography.

INDIAN OCEAN BIOLOGICAL CENTRE, ERNAKULAM

The Centre steadily continues to process the international collections of zooplankton samples under the supervision of the UNESCO Curator, Dr. E. Brinton, who took charge in the second week of October, 1965.

During the period, September-December 1965, 50 samples collected during the cruises VII and VIII of *Anton Bruun* have been received at the Centre. Samples processed during these months come to a total of 209. This includes 70 samples from *R. V. Meteor* (Germany) 73 samples from Anton Bruun (U.S.) 12 samples from *Argo* (U.S. Dodo Cruise) and the remaining from *INS Kistna* (India). Re-checking and in some cases, re-sorting of the earlier samples sorted (from *INS Kistna* cruises II-XIV) are now being carried out for the purpose of standardising both the sorted material and the data scheme.

At present 1253 samples have been fully processed and stored at the Centre where a total of 592 samples remain unsorted.

Three of the Junior Scientific Assistants working at the Centre were promoted to the Senior rank and two of the Senior Laboratory Attendants were promoted as Junior Scientific Assistants. Steps are being taken to increase the staff strength of the Centre.

INTERNATIONAL METEOROLOGICAL CENTRE, BOMBAY

The growing pace of research at the Centre was reflected in the papers presented at the Symposium on the Meteorological Results of IIOE held in Bombay. Detailed proceedings of the symposium will be issued soon.

Routine collection and analysis of the data from the Indian Ocean region and the checking and processing of the main body of IIOE data for the years 1963 and 1964 are regularly continued. Also progressing at the Centre, is the preparation of preliminary numerical analysis of surface marine and upper air meteorological data which are to be published in the IIOE Meteorological Atlases. Computer programmes have been developed over the past six months at the University of Hawaii for processing and analys-

ing IIOE Meteorological data which have been punched on cards. The first programme checks surface, marine and upper air observations and averages each observed parameter, the second prepares the data for analysis and the third controls an electronic curve plotter which draws isopleths of the analysed scalar quantity. Check runs are now being made of the analysis—curve plotter programmes with averaged surface marine observations for all months of 1963. In sequence the programme is as follows:

(1) Interpolate the scattered data to a regular five-degree grid using a five point system. Each value is weighted inversely according to distance from the required grid point. The presence of land masses is taken into account. (2) Analyse data at the evenly-spaced grid points using a two-dimensional quadratic interplolation. (3) Determine isopoints over a fine mesh grid for use by the curve-plotter. (4) Direct the curve plotter in drawing the isopleths.

Interplolation procedure for one parameter requires about five minutes on the IBM 7040, and the consequent analysis covering the whole of the Indian Ocean, occupies the curve plotter for eight minutes. As the programmes are made more efficient, these times will be reduced.

During the IIOE a variety of radiation measurements have been made from ships, aircrafts, land stations and satellites. Although most of the measurements were designed for special small scale experiments yet, in combination they might provide valuable insights into the scale of ocean-atmosphere interaction. The centre is interested to receive radiation data from those who have such programme so as to compare and distribute to the users in the form of print—outs, card decks or data tapes.

REPORTS FROM OTHER COUNTRIES

AUSTRALIA

Report on the cruise G. 1/63 of H.M.A.S. Gascoyne

A report including the analysis of the data collected during the cruise G.1/63 of H.M.A.S. *Gascoyne* has been received from the Division of Fisheries and Oceanography, CSIRO Australia. This cruise was undertaken during Jan-Feb. 1963 with the objective of examining the environmental factors likely to influence the biological properties and the inter-relations of these properties with particular reference to dynamics of production. The cruise commenced from Fremantle, occupying a number of stations along 110°E meridion—also covering SCOR/UNESCO reference stations 1 and 2—arrived at Singapore and then returned to Fremantle without much deviation from the same track.

35 stations were accupied during this cruise with activities like bathythermograph lowering surface hydrology, primary production, particulate carbon, pigment determination and zooplankton sampling. Subsurface hydrology samples were collected at 31 stations and microplankton samples were collected at 16 stations.

A description of the method of collection and analysis of the samples has been given in the report. According to that, water temperatures were taken with protected and unprotected deep sea reversing thermometers with accuracy considered to be plus/minus 0.03°. An inductive salinometer was used for the measurement of salinity. Standard Winkler method (Jacobsen, Robinson and Thompson 1950) was used for dissolved oxygen and for inorganic phosphate the method of Atkins (1923) was followed. Nitrate was determined at Cronulla by the strychnidine method of Rochford (1947).

For particulate carbon estimation six litres of sea water was collected by means of a twin sampler (Jitts 1964) and passed through Whatman GF/C glass paper filter. These filters were returned to Cronulla for estimation by a method of Dal Pont and Newell (1963).

Primary Production: Water samples were poured into 300 ml pyrex bottles and incubated *insitu*, in simulated *insitu* incubator or in artificial constant light of 1100 ft candles. Geiger counting was done with a windowless counter. The method followed was of Dyson

et al (1965). For pigment determination samples were taken with a plastic sampler and filtered through HA Millipore filters. The filters were placed in glass tubes and stored in metal desiccators over silica gel and further analysis was carried out at Cronulla using a method given by Humphrey (1960) with slight modification.

Zooplankton sampling during this cruise consisted of vertical hauls through the upper 200 m. with Indian Ocean Standard Net and also horizontal tows within the 200—0m stratum with Clarke-Bumpus samplers.

The wire angle averaged 20° and never exceeded 40°. The length of the wire paid out to place the IOSN at 200 m varied from 200-260 m. with a mean of 214 m. The sampling is done in duplicate and one sample is sent to IOBC, Ernakulam and the other is kept at Cronulla. Biomass determination was carried out in the shore laboratory one month after the end of the cruise.

Micronecton sampling, more correctly termed as mid-water trawl programme consisted of oblique tows through the upper 200 m layer with a 5 ft. Issacs-Kidd midwater trawl. The trawl was fitted with a depth recorder (Hamon, Tranter and Heron 1963) and lowered from the stern while the ship's speed was 2 kt. and increased to 5 kt. when the trawl was clear of the ship. After 600 meters of wire had been paid out the ship's speed was adjusted at 3kt. then another 100 m was also paid out.

In the laboratory the net volumes of biological samples were measured by displacement and the taxa was pooled into 4 main categories: (1) Gelatinous organisms (2) Planktonic organisms of relatively small size (3) Macroplanktonic organisms (4) Micronectonic organisms. The categories 3 and 4 which predominate in mid-water trawl samples are not clearly distinguished. Detailed results are expected to be published separately. The dry weight was obtained by keeping the samples at 60° in an oven until the weight remained constant. A table of this conversion factors is given in the original report.

Plan for Cruise 3/65 of H.M.A.S. *Diamantina*

According to the cruise plan received here from the CSIRO Division of Fisheries and Oceanography H.M.A.S. *Diamantina* is due to undertake a cruise between 25-10-65 and 6-11-65 from Fremantle. In this cruise a series of traverses have been planned between latitudes 24° and 34°S to study the distribution and growth of larval stages of the western Australian crayfish. The hydrological condition and circulation of water masses off the western Australian coast will also be investigated.

46 stations are expected to be occupied during the cruise which will cover a track of 2850 miles under the leadership of J. Bannister. N. Dyson, W. Prothero and L. Thomas are the other scientists nominated to work on board this time.

GERMANY

The first phase of the cruise of R.V. *Meteor* (Germany) in the Indian Ocean was completed at Cochin on February 14, 1965. Details regarding the underway observations during this part of the cruise was published in the earlier issues of this Newsletter. During the second phase of the cruise also the ship surveyed the Indian and Pakistan coasts carrying out the routine programme described earlier. After the call at Bombay, radio-sonde ascents were discontinued, physical and chemical oceanography was reduced, as geophysical investigations were given more emphasis. A helicopter was taken on board *Meteor* and as planned earlier a joint seismic programme was conducted with the Indian ship *INS Kistna*. This work mostly conducted in the Gulf of Cutch and Gulf of Cambay, gave excellent results. The seismograms obtained during the work are being studied by German and Indian scientists. The Moho-discontinuity found in a relatively low depth off the shelf is one of the preliminary observations made during this work.

During the cruise between Cochin and Karachi the oxygen content of the waters between 200 m

and 900 m was found to be extremely low with a minimum of 0.04 ml/l, but nowhere the H_2S occurred. The phytoplankton of the water increased from south to north. Bottom trawling in depth between 30 and 100 m on the shelf yielded good catches of sizeable fish in which a few species appeared in great numbers.

At Karachi the scientific leadership of the cruise was taken over by Prof. E. Siebold from Prof. G. Dietrich and the main working group on board thereafter represented by marine geologists and geophysicists. A close network of stations were covered in the Gulf of Oman across the continental slope with magnetic, gravimetric and seismic measurements and geological studies of the sediments. The in- and out-flow of watermass from Persian Gulf proved to be similar to those in the strait of Bab-el-Mandeb. The continuous recordings of temperature and transparency from surface to bottom showed a remarkable and complicated sandwich-like structure of the layering. On March 23, *Meteor* met the *Atlantis* II (US). In the Persian Gulf the microtopography of the bottom was investigated with a television camera connected with a photocamera. About 500 controlled photographs could be taken. Apart from the sampling work some typical properties of soil mechanics as well as pH, alkalinity, SiO_2 and PO_4 content of the interstitial water were determined on board.

On April 23, 1965 at port Djibouti, the Scientific leadership was taken over by G. Bohnecke. On way to Hamburg the continuous routine measurements were made with echosounder, magnetometer, gravimeter, surface temperature recorder, surface transparency recorder, meteorological data recorder and radioactivity recorder of the surface water.

During her return trip *Meteor* investigated the second hot salty water hole which was discovered by Atlantis II in the Central Red Sea. The echosounder indicated the upper boundary of salty water by distinct signals. Records of temperature from surface to the bottom showed three different layers. 58.2°C was measured close to the bottom. The water seemed to be very turbid.

On May 18, 1965 the 24500 mile cruise of R.V. Meteor in the Indian Ocean came to a close at Hamburg. A total number of 385 stations were covered during the whole of this cruise.

JAPAN'S PARTICIPATION IN IIOE

Three Japanese vessels, *Umitaka Maru*, *Koyo Maru*, and *Oshoru Maru* have participated in the IIOE during the southern summer of 1962-63 and *Kagoshima Maru* joined this fleet during the next summer. Hydrographic observations, *in situ* primary production measurements, Zooplankton sampling, micronecton sampling and exploratory tuna long line fishing were the major activities undertaken on board these vessels. H. Niino and T. Chiba in 1962-63 and J. Seno and Y. Yoshida in 1963-64 were leaders during the cruises of *Umitaka Maru* and *Koyo Maru* respectively. Cruise of *Kagoshima Maru* was led by Captain Ueda in 1963-64. A complement of 7-10 scientists of various disciplines of oceanography used to work on board each vessel during these cruises.

Total number of stations occupied with various measurements by all these vessels during 1962-63 and 1963-64 has been given-below:

	1962-63	1963-64
Temperature and salinity	45	94
Oxygen	53	83
pH.	53	83
Phosphate	53	83
Total phosphorus	53	83
Nitrate	28	64
Nitrite	8	53
Silicate	48	83
Rare elements	—	39
Bacteria	19	12
Submarine light intensity	16	62
Primary production *in situ*	22	47
Primary production simulated *in situ* exp.	10	61

Primary production tank exp.	38	89
Chlorophyll	44	105
Microplankton	45	88
IOSN Hauls	93	94
Juday net deep haul	6	22
Deep horizontal hauls with 5-7 Nets	—	7
160cm net sub-surface haul	33	21
130cm larvae net surface haul	—	74
Issacs-kidd haul or similar operation	20	23
High speed sampling	70	63
Tuna long line	30	47
Otter trawl	23	31

R. R. S. DISCOVERY (U.K.)

Early in September 1965 *DISCOVERY* again sailed to take part in an international venture, this time in the North Atlantic. Scientists from the United States, Brazil and Portugal, along with a team from the National Institute of Oceanography and the Universities and Fishery laboratories of the United Kingdom are taking part in a cooperative venture to study animal life in the sea, with particular emphasis on the use of acoustic methods for detecting animals.

The expedition has been given the somewhat inelegant, but apt, title *SOND Cruise.* On the cruise it is intended to use echosounders operating at 7 different frequencies, all of which may be used at the sametime by towing the echosunders alongside the ship. The readings from them can be linked through an integrating device, and will be recorded on high speed recorders for detailed analysis at a later date.

The detections of fish and whales by echosounding are well known applications of this techniques, but this cruise will be mainly concerned with much smallar organisms, the planktonic animals. For nearly 20 years it has been known that certain layers in the sea reflect sound and some, if not all, of these layers are probably of biological origin. It is hoped that this very detailed survey will give a better understanding of these layers, which, in turn, may tell much about the distribution and behaviour of the animals in the sea, and of the physical structure of the water, internal waves, density currents and so on.

In addition to the acoustic records, the scientists will make measurements of the physical and chemical properties of the water, while carefully—monitored biological sampling will enable them to examine the population of animals ranging in size from a few thousands, of a milimeter upto the smaller fish and squid. They will do this by means of a wide range of nets and trawls which can be lowered closed to a given depth, opened there and then closed again before they are hauled up. Telemetering depth guages and flow meters which will give a constant check on the behaviour of the nets and experiments will be employed with a new acoustic system for controlling the nets by sound signals.

A wide variety of smaller projects will also be undertaken, among them are the studies of the frequency and intensity responses of the eyes of various animals to natural and artificial light.

(Discovery, 26 (10) : 7, Oct. 1965)

EXTRACTS FROM SCIENTIFIC PAPERS

Cyclonic Voticities on either side of equator and their Implications.

Existence of two distinct trough systems with embedded cyclonic vorticities in the lower and middle troposphere has been found on either side of the equator as a result of analysis of the massive meteorological data collected during the IIOE. The equatorial Indian region has been found characterised by westerlies. The occurrence of warm water over the oceanic region appear to be connected with the intensity of the double troughs as well as cyclogenesis therein. This has been further supported by the aircraft data and the oceanic island upperwind data. Existence of independent systems of cyclonic vorticities in the two hemispheres separated by a band of westerlies has been found in the streamline analysis chart for 700 mb. during January and July.

Computation for two degree grids along 75°E and 85°E from 900 to 1000 mb. indicates strong anticlockwise vorticity (positive) near 22°N in the northern hemisphere and another strong clockwise vorticity (negative) 5°S in the southern hemisphere typyfying the dual troughs. The distribution of moisture content, mean cloud cover, precipitation and rainfall in the northern and southern Indian Ocean depends on the independent migration of cyclonic vorticities in two hemispheres. Daily analysis data over the Malaysian—Indonesian area show a distinct region of high pressure near the equator separating the trough system in the two hemispheres.

TIROS nephanalysis has brought to light the occurrence of distinct zones of Cb activity in association with the troughs. The intervening zone between the two troughs is typified by scattered clouds and clear skies. The occurrence of the persistent and strong westerlies over the equator seems to be the direct consequence of semipermanent existence of cyclonic vorticities on either side.

In the summer the trough moves away from the equator, in winter it lies close to the equator and during the transition months an intermediate position is taken.

The circulation in each hemisphere is determined largely by the trough system in the hemisphere. The crossing over and estension of air of one hemisphere to another across the equator has been found to be much smaller than that earlier thought of i.e. the air that appear to cross the equator from winter to summer hemisphere and *vice-versa* seems confined to the equatorial region only.

The distribution of land and sea, the evaporative cooling occuring over the preferred regions on account of strong southerly trades in the northern hemisphere and strong southerly monsoon current and northerly trades in the northern hemisphere coupled with the zenithal march of the sun results in zones of warm water in the two hemispheres over the Indian Ocean region. The occurrence of a well marked low level heat source augmented by influx of moisture from the neighbouring sea areas helps keep the lower atmosphere over these zones in the two hemispheres continuously warmer than over the adjacent seas. This probably contribute to the occurrence, orientation and maintenance of distinct troughs one in each hemisphere. Once a trough is formed, owing to weak winds and less evaporative loss, the warmth of the underlying ocean surface continues to maintain itself.

If the above postulation stands the test of time, the concept of single convergence zone between the trades of the two hemispheres, seasonally migrating from one hemisphere to the other and carrying the weather along with it requires radical revision (C.R.V. Raman Symposium on the Met. Res. of IIOE, Bombay 1965).

Ionian Sea Submarine Canyons and the 1908 Messina Turbidity current

A prominent system of submarine canyons has been discovered in the Ionian Sea south of the Strait of Messina. The canyons are from 2 to 5 miles wide and over 100 fathoms deep. Below the base of the continental slope, the canyons widen and develop flat floors as they extend southward 150 miles across a large cone to the Messina Abyssal Plain.

On December 28, 1908, the Strait of Messina experienced a severe earthquake whcih devastated the city of Messina and near-by communities. Of the eight submarine cables which linked Italy and Sicily within the area of maximum intensity, only two were damaged. Ten hours after the quake a cable from Malta to Zante parted 120 miles to the south in 1800 fathoms depth at a point where the cable crossed the submarine canyon leading from the Strait to the abyssal plain. The earthquake apparently generated a slump which continued as a turbidity current breaking two successive cables as it travelled downslope through the canyon at an average speed of 12 knots. The tsunami which swept repeatedly in against the surrounding coasts appears to have also been produced by the slump and the turbidity current. The cables lying in the shallower parts

of the Strait, although directly within the epicentral area, did not break because the strong currents through the Strait had removed essentially all the unconsolidated sediments.

Multiple sub-bottom echoes, observed beneath the canyon floors and beneath the abyssal plain and otherwise absent from the cone, are reflections from coarse-grained layers of sediment deposited by turbidity currents. Cores from within the canyons contain graded beds of sands and silts. Cores from isolated topographic locations show a correlatable pelagic record of stagnations and tephra falls. (William B. F. Ryan and Bruce C. Heezen, submitted to the Bull of the Geol. Soc. of America).

Distribution of Potassium, Uranium and Cobalt in Sea Water

An understanding of the distribution of various elements in the marine environment becomes essential since many of these are accumulated in marine organisms in considerable amounts and have radio—active isotopes with low permissible concentration in sea water. The result of an attempt in this direction have been presented in a paper by Viswanathan *et al* of the Health Physics Division, Atomic Energy Establishment, Trombay.

Three elements: Potassium, Uranium and Cobalt have been selected with reference to their distribution in Arabian Sea. An argentimetric method has been used for the estimation of Potassium after precipitating the element as Potassium tetraphenylboron (KTPB). Sea water samples collected during *INS Kistna's* Scientific Cruises have been utilised for this study. Potassium content of the surface waters gave a weighted average of 368 μ g/ml on analysing 90 samples.

Uranium was estimated using a flourimetric method essentially similar to the one described by Sandell (1959). The present authors observed uniformly high Uranium values along the longitude 62°E and near the mouth of River Indus. A weighted average of 2.56 mg/litre was obtained on analysis of 87 samples.

Estimation of cobalt was done by radioactivation analysis which was not applied before for the estimation of cobalt in sea water. The element was concentrated by coprecipitation and estimation in the precipitate was done by γ-spectroscopy on the basis of Co-59 (n-γ) Co-60 reaction. A mean percentage recovery value of 89.9 has been obtained. It is evident from the result that relatively small size sea water samples (1 litre) would suffice for the estimation of exchangeable cobalt in sea water if the element is first concentrated by coprecipitation, separated from other elements by ion exchange and then subjected to a neutron flux (Viswanathan et al, Jour. Indian Chem. Soc., Vol. 42 No. 1 1965).

Carbohydrate content in the surface waters of the Bay of Bengal.

The work of Lewis and Rakestraw (1955) who perfected the method for quantitative estimation of carbohydrates in sea-water forms the basis of our knowledge regarding the distribution of carbohydrates in sea water. These workers have recorded a carbohydrate content of 0.31 mg/l in the surface waters of the Pacific while in coastal lagoons the value was 0.79 mg/l.

During the Scientific cruise of *INS Kistna* surface water samples were collected from the Bay of Bengal for the determination of carbohydrate content and the results have been presented in a paper by T. Sreenivasagam. Carbohydrate value for the unfiltered samples ranges from 0.1 mg/l when taken away from shore (station 185) to 6.9 mg/l in the inshore region of Andamans (station 161). The same samples filtered through a bacterial filter gave the values 0.08 mg/l. and 0.53 mg/l. respectively.

Thus the highest values obtained from water samples collected from inshore regions of Madras, 0.42 mg/l. and Port Blair, 0.59 mg/l. On the other hand in the off shore regions it varies from 0.08 mg/l to 0.31 mg/l. From the values obtained from the filtered and unfiltered sampled it may be deduced that the quantity of particulate material in the surface waters of Bay of Bengal is consider-

able (Current Science, Vol. XXXIV. No. 20, Oct. 1965).

Studies on Photosynthesis and Chlorophyll in Eastern Indian Ocean.

All the four Japanese vessels participated in IIOE undertook the study of photosynthesis and chlorophyll. According to their observation photosynthetic rate as estimated by tank method was generally low except the regions of upwelling like South West Java Islands. West of 100°E the photosynthetic rate near the surface was 0.2—0.4 mg c/m³/hr to the north of 5°S while it was 0.1 mg c/m³/hr to the south of 5°S. East of 100°E it was larger than 0.4 mg c/m³/hr.

The depth of maximum photosynthetic activity (estimated by tank experiments) was found at 25 m in the north on 78°E line while it was at 50 or 75 m in the south. The depth of maximum photosynthetic activity was always deeper than the depth of production estimated by *in situ* experiments.

Daily primary production estimated by *in situ* experiments was generally 0.1—0.2 gc/m²/day. Comparatively high values 0.3—0.7 gc/m²/day were obtained to the south east of Java Islands. Daily primary production at 94° E. was generally higher in 1963-64 than in 1962-63.

Chlorophyll *a* content was generally very poor, being about 0.1 mg/m³ in the north and less than 0.05 mg/m³ in the south at the surface to the west of 100°E and about 0.05 mg/m³ at the surface to the east of 100°E. The depth of maximum chlorophyll was often observed in the lower part of the euphotic zone (50-125 m). The depth of maximum chlorophyll was 50-75 m in the equatorial region and 100-125 m in south. These depths correspond to the upper limit of thermocline. The chlorophyll distributed in these depths were those which had lost their photosynthetic ability as suggested by the results of tank experiments (Information Bulletin on Planktology in Japan No. 12,1965).

NOTES AND NEWS

Colour of water masses:

The colour of the water masses especially that of the ocean has been the subject of considerable interest. Various colorimetric methods have been used for specifying the colour of the ocean water. Physical methods have also been used to specify the spectral distribution of the light at various depths or in various directions in ocean. In 1956 Le Noble described a new quartz spectrograph for studying the penetration of ultravoilet light into the sea. Hubbard and Richardson (1958-59) described a submersible photoelectric spectrometer of the Lithrow type. But none of these physical methods has made a point of specifying the colour of waters.

In this context Tyler in 1964 proposed the following steps to specify properly the colour of the ocean from a point within the ocean and to do so in the framework of modern colorimetry it is necessary first to specify the geometry of the lighting and measurement and to know the spectroradiometric composition of the flux falling on the water surface. Spectral output-input function of the water body for the specified lightning geometry should also be known. The output-input function is a physical property of the water body and is independent of the spectral distribution or ambient level of lightening. The out-put input function in this case is referred as reflected and symbol O_2 has been assigned to it. Symbol E_2 has been assigned to represent the spectro radiometric properties of the source. The colour of the ocean has been computed using standard colorimetric methods.

$$X = O_2 E_2 \bar{X} d_2$$
$$Y = O_2 E_2 \bar{Y} d_2$$
$$Z = O_2 E_2 \bar{Z} d_2$$

(where $\bar{X}$, Y, $\bar{Z}$ are the tristimulous values of the spectrum colours and X, Y, X, are the tristimulous values for the colour of the ocean.

It has been understood from the work of Tyler that major factor in the colour of the ocean is the

chlorophyll and other pigments contained in the planktonic organisms (Nature Vol. 202 No. 4939—1964).

Using the same tools and technique Tyler has recently made an attempt to determine the colour of the exceptionally clean water of the Crater lake. One objective of this work was to obtain output-input data on the "Purest" water that could be found. Such data could then serve as a standard against which to estimate the contamination of other waters. The following colorimetric specification has been obtained.

Dominant wave length = 483 mμ
Photometric brightness = 91.7 per cent
Purity = 56.0 per cent.

One of the interesting features of this method for determining colour of the ocean or a lake is the ability to make accurate comparisons of the colour of the remotely separated water bodies. For detection and estimation of specific pigments such as chlorophyll it is of course more useful to work directly from the output-input data rather than from the colour of the water.

Power from Tides

A limitless source of power has been discovered in the ocean tides, the ebb and flow of which are influenced by the cadence of celestial spheres. The amplitude of tide at some places is considerably large; ranging upto 40 ft on the French coast and 45 ft. near Nova Scotia. Suitably damming such locations and providing sluice gates, the tidal energy can be harnessed to generate power. Filling those basins thus formed by the natural flow of hightide, closing sluice gates until the tide has ebbed and then allowing the basin water to flow through turbines power is generated. Better devices are being evolved to exploit this source of energy with lesser capital expenditure.

The first large scale tidal power station with a capacity of 600 million KWH has been built on Rance Estuary in Brittany, France.

Tidal amplitudes vary widely around the world and in certain Bays and Estuaries it attains exceptional heights. In India the Gulf of Kutch and Gulf of Cambay are the localities noted for the potentiality of this new energy.

A New Device to Convert Sea water to Fresh water

A portable desalting unit with a capacity to produce 1400 gallons of fresh water a day was exhibited in Washington D.C. during the recent International Symposium on water distillation. The newly developed process based on the principle of "reverse osmosis," can reclaim waste, ocean or brackish water with the help of a chemical membrane. The semipermeable membrane used in the present device is 1/5000 inch thick and made of Cellulose acetate. The reversal of Osmosis is brought about by the application of pressure on one side of the membrance. According to an estimate, nearly 600 gallons of fresh water per day from each cubic foot of membrane can be produced at the cost of 25 to 30 cent per 1000 gallons.

Mr. Newby, Manager of the Reverse Osmosis Section of the General Atomic Division of the General Dynamics, San Diego, California says that the reverse osmosis process is relatively simple. The membrane, pressure tube and pump are the essential materials and the technique operates at ordinary room temperature. It requires only a small amount of energy which can be supplied by hand power, electricity, gas, diesel or steam. The power of biological membranes and glands of aquatic organisms including birds and mammals which are capable of desalting the water in their environment remains as a challenge to the scientist. The secrets of natural demineralisation is gradually being understood and more efficient methods are being evolved for the conversion of salt water into sweet water for the benefit of millions of inhabitants of sea coast, and arid zones.

Time Lapse Radar for Fish Migration

Echosounder is the modern equipment in which the under water behavior of fish shoals

have been observed. Recently C. Groot and W. L. Wiley at the Fisheries Research Board of Canada, Biological Station in British Columbia have pointed out that if the display tube of an echosounder is photographed at regular intervals the movement of the fish shoals can be observed continuously (Jour. of F.R.B. Canada Vol. 22)

They photographed the echosignals of each complete horizontal scan on single frames of the cine film, when the film was projected the speed time scale made the movement obvious. One scan at a range 800 feet takes 24 seconds, so that when film taken in this way is projected at 24 frames per second, the fish movement of 24 hours can be viewed in $2\frac{1}{2}$ minutes.

Observations of time speed and direction of migration were made in this way on shoals of Sockeye Salmon in a large lakes and the reliability of this method has been proved as it tallies with the earlier observations.

(New Scientist Vol. 28, No. 468—1965)

Porpoise to participate in Naval Research.

Marine scientists at the Naval Missile Centre, Port Mugu, California have been investigating the possibility of training sea mammals to assist man in the scientific exploration of the sea. Tuffy, a porpoise from Port Mugu trained by Wallace C. Ross was selected for the experiments to determine the abilities of porpoises to act as messengers, guards and rescuer for the under water explorers of U.S. Sea Lab. II in which three successive 10 man teams of Aquanauts spent 15 days in a depth 61.5 meters during August-October, 1965.

For his role in the Sea-Lab. II, Tuffy has been trained to carry guidelines to the 'lost' divers and to carry messages and small packets between divers on the bottom and between divers and men on the surface. This male Atlantic bottle-nose porpoise is 10 years old, 7 ft. long and weighs 270 pounds (NODC Newsletter No. 8—65. August. 1965).

First Sea Fish Farm in England

The first sea fish farm of England is located in a section of the sea loch. some five acres in area near Ardamurchan in Argyllshire. Seaward entrance has been enclosed to prevent the entrace of predators, but allowing the passage of water through sluices.

The stock will consist initially of 200,000 metamorphosed plaice which are reared at the hatchery in Port Erin Isle of Man, the first plaice hatchery in the world. It is expected that in the farm, away from the natural enemies and with adequate supply of food the fish might attain marketable size more quickly than the natural stock.

Marine Geological work at the Geological Survey of India

A short resume' of work carried out by the scientists of the Geological Survey of India on the Marine Geological aspects during their participation in the scientific cruises of *INS Kistna* has been received from the Department of Mines and Metals, Ministry of Steel and Mines.

Microfaunal studies revealed the presence of 10 bryozoans and 21 foraminiferal genera in the sediments collected in addition to the separation of sponge spicules and Ostracods. Bryozoans, according to the present observation is found to flourish up to a depth of 180 m on the east coast. Some of these observations when projected on rocks containing fossil bryozoans are expected to be helpful in depicting paleogeography. Foraminifers form about 70% of the micro-organisms in the sediment. The benthonic forms are distributed throughout the continental shelf whereas the planktonic ones appear only in the lower reaches of the shelf.

Preliminary studies of heavy minerals in the clay samples from the Bay of Bengal between Visakhapatnam and Masulipatnam indicate the presence of the following minerals: Garnet, Silliminite, Zircon, Rutile, Monazite, Hornblende, Pyroxene, Apatite, Tourmaline, Opaques and Glauconite.

Seminar on Sea, Salt and Plants:

A seminar in Sea, Salt and Plants was held at the Central Salt and Marine Chemicals Research Institute Bhavnagar during 20-23 December, 1965. About 54 papers were presented by the participating scientists. Discussions were held in 7 separate sessions as follows:

1) Sea and Sea water
2) Irrigation of crops with highly saline water and sea water
3) Physiology of salt tolerance in plants
4) Marine plants and their biology I
5) Marine plants and their biology II
6) Chemistry of marine plants
7) Natural resources culture and cultivation of marine algae.

Activities of the Centre for Advanced Studies and Research in Marine Biology, Porto Novo.

Information regarding some of the activities of the Centre during Jan-June, 1965 has been received from the Director.

A seminar on Oceanography was organised at the centre during 22-24 February. Among the participants were Dr. L. H. N. Cooper, (who was visiting professor at the Centre) Dr. K. Hohendorf, Dr. T. Lenz, Dr. J. A. Birshtein, Dr. H. S. Rao, Dr. K. K. Tiwari, Dr. V. V. R. Varadachari, Mr. J. R. Naidu and Mr. N. M. Shah. Five papers on different topics were presented on the occasion besides the lectures given by Dr. Cooper and Dr. Birshtein.

Field activities of the centre is mostly limited to the inshore and estuarine areas where investigation has been carried out on the biological, chemical and hydrographical aspects. A trichodesmium bloom was observed in the inshore waters in February, 1965.

International Conference on Tropical Oceanography:

On the occasion of the dedication of the Virginia Key campus of the University of Miami and the new laboratory of the United States Bureau of Commercial Fisheries on the Virginia Key, an international conference on Tropical Oceanography was held. The seven day conference commenced on November 17, 1965 at Carillon Hotel. There were ten symposia covering a wide range of topics pertinent to the tropical and sub tropical oceanographic investigations as follows:—

1. Economics of Tropical Fisheries
2. High Sea Fisheries
3. Ecology of Tropical Organisms
4. Varied Approaches in Marine Zoogeography
5. Nutrient Cycles in Tropical Waters
6. Equatorial Current Systems
7. Deep Sea Biology
8. Tectonic History of the West Indies Islands Arc.
9. Carbonate Sedimentation
10. Behaviour Pattern in Tropical Waters.

The organisation of the conference was done by the Institute of Marine Science of the University of Miami.

The Sea Spider

A deep sea Oceanographic buoy called the "Sea Spider" designed to provide a near-motionless reference point and stable support for Scientific Instruments has been described. This has been successfully installed at a depth of more than 2600 feet off the coast of South Carolina by the marine Engineers and Scientists from the Woods Hole Oceanographic Institution. The buoy consists of a tripod 2,500 feet high, constructed of aluminium, glass spheres and steel cables which rise from the bottom of the Ocean to within about 100 feet of the surface. The cables are equipped with several types of Oceanographic measuring instrument. A telemetering buoy at the surface transmits the data collected from these instruments by radio to a nearby vessel.

The unique stability of the system has been achieved by distribution buoyancy over the whole structure to remove catenory from the cables which form its legs. This was done by attaching

hollow glass spheres at intervals to the steel legs of the tripod. A large aluminum float placed at the top of the structure is to avoid any motion which might be caused by wind or waves.

Acoustical studies and current measurements were conducted so far with the help of the buoy. Divers, who went below to observe and adjust the instruments, noted large schools of fish congregated near the central buoy structure (NODC Newsletter No. 9-65)

THIRD MEETING OF THE CONSULTATIVE COMMITTEE FOR IOBC

The highlights of the meeting of the Consultative Committee for IOBC which was held at Ernakulam in April, 1965 under the Chairmanship of Mr. R. S. Glover is given here briefly. A report on the IOBC was presented by Dr. N. K. Panikkar and another report on the activity of IOBC was placed before the committee by Dr. Vagn. Kr. Hansen and Mr. L. R. Kasturirangan.

Terms of References: The Committee decided to make no alteration in the five terms of references accepted in the previous meeting. It was decided to publish an extended version of Dr. Panikkar's report and also to publish in due course a general programme of the centre with regard to international collections.

Staff: Regarding the staff of the Centre the Committee reiterated its earlier recommendation to appoint Dr. Raghu Prasad as the full time scientist and also pointed out the essentiality for another Curator or a deputy Curator as counterpart of the international Curator.

The appointment of Dr. Qasim as the head of office was welcomed by the Committee as it would facilitate a close liaison between IOBC and other Centres. The Committee was informed of the appointment of five additional sorting staff which would make the total number of sorters to 18. Suggestions were also made for considering the promotion of senior sorters and to explore the possibility of getting some of them further trained outside India. Recommendations were made for awarding six additional Research Fellowships and for the appointment of a draughtsman to work at the Centre.

Building and Equipment: The proposal for acquiring 1.1 acres of land as the premises for IOBC and other centres was welcomed by the Committee in view of future developments of the Centre. The Committee recommended that Unesco should continue to provide equipment which cannot be obtained in India and that Unesco office of oceanography should allocate a minimum of $ 500 per annum for the purpose of consumable stores and small items of equipment not available in India. Necessity for dehumidifier in rooms containing sensitive equipment, dark room equipped for photocopying and a simple workshop to facilitate the maintenance of equipment and construction of suitable containers for overseas transportation of samples was observed and recommendations were made to procure these items.

Sorting Methods: It was decided to continue the standard procedure recommended earlier and any suggestion by the staff for amendment might be drafted for submission to the new international curator.

Receipt of Material for Sorting:

Observing the gaps in the spatial distribution of sampling the Committee agreed that the national coordinator should be asked to remind their colleagues of these gaps and seek ways of filling them either by providing material from existing national collections or by undertaking special sampling in future. It was also hoped that these requirements would be borne in mind after IIOE, whenever research ships pass through poorly sampled areas and that whenever possible standard samples would be taken and despatched to the centre for sorting. Committee recommended the use of visual dye to check that preservative has been added, but pointed out that picric acid damages delicate specimens.

Data processing and station list:

The Committee thought that it was essential to start the processing and distribution of basic data immediately so as to provide necessary information to donors, taxonomists as well as to the scientists at the Centre. Geographical form of representation based on Marsden Square was suggested to be most suitable and the staff of the Centre was advised to make tests of the alternative method. It was also agreed that donors of the material would be kept informed of the outstanding discoveries made from the material.

Also considered essential that a standard chart should be used for biological, physical and chemical data from the IIOE and requested the assistance of UNESCO and IOC in reaching an early agreement and that supplies of charts may be made available preferably free of charge to participants in the expedition.

Preparation of a basic station list and its publication as a UNESCO technical report was recommended. Committee suggested to make an appraisal of the items required for the storage of data and for the duplication of records as a precaution against accident loss or damage.

Library: Committee expressed its satisfaction in the inprovement of library at the Centre and recorded its gratitude to the donors and the University of Kerala for the Cooperation. The role of UNESCO office of oceanography in securing materials to enrich the library was also pointed out.

Collaboration with ZSI: The Committee hoped that there would be mutual exchange of information and collaboration between IOBC and Zoological Survey of India in matters relating to analysis and references and Dr. Tiwari was asked to explore the possibilities of initiating it.

Future development of the Centre and International Collections:

The Committee recognised the prime importance of assessing the potential natural resources of Indian Ocean on a sound basis of fundamental knowledge of biogeography and taxonomy. The second stage of development would be the analysis of seasonal annual and spatial variation in the abundance and composition of plankton. Since this requires samples collected throughout the year, consideration should be given to the possibility of developing a long term sampling programme, which should be developed in collaboration with other institutions inside and outside India. It was suggested that an extensive feasibility trial should be started with continuous Plankton Recorder as the same has been shown to be of potential value during the recent German expedition. Since the biogeographical studies would raise many questions demanding special ecological research, both in the field and laboratory, the Committee desired that the Centre should collaborate closely with other institutions engaged in research on related problems including the proposed National Institute of Oceanography. Members noted the excellent opportunity existing in Cochin to cover the whole spectrum of biological oceanography by an integration of research.

The Committee emphasised the potential value of IOBC (1) in providing service for workers engaged in tropical studies, (2) as a centre engaged in research on the plankton of Indian Ocean (3) as a training centre, both for Indian recruits to marine biology and to workers from other countries who wish to specialise on tropical problems.

Moreover the Committee strongly felt the necessity for laboratories of high standing to train the scientists from the temperate as well as tropical zones and expressed hope that other national and international organizations would follow the lead provided by Unesco. The Committee took note of the recent recommendation of the 3rd Regional Meeting of Marine Science Experts in East and South East Asia in which IOBC has been considered as a model which could be adopted in future for organisation of similar centres in other countries. The Committee suggested in concurrence to one of the terms of the above recommendation that Unesco should publish a booklet describing the

international collections and their analysis at IOBC.

Taxonomic and biogeographical stuides of the International collections: The Committee asked the Curator to make a forecast, based on the sample sorted so far on the expected order of magnitude of the total number of specimen in each of the 80 categories of the sorted material. After these predictions are over, the Committee would approach individual experts and National Co-ordinators inviting their cooperation in the analysis of the data and national specialists would be requested to provide certain minimum information which will enable a quantitative biogeographical treatment. of the results. With a view to coordinating the biogeographical objective, the Committee believed that whenever possible the work should be done in the centre itself. Senior and Junior scientists would work together with the twin objective of training and research and young workers in other laboratories should have opportunity to study international collection under proper guidance and supervision.

Priority should be given to the study of larval fish and the Committee requests the assistance of Unesco office and Oceanography in seeking the advice of the prominent biologists in order to set up an international team to work at the centre on larval fish. especially that of clupeidae and Scombridae.

Other Research Activities :

The Committee urged strongly that the sorting staff should undertake research activities under the guidance of senior officers, visiting workers and the curators and an immediate start should be made to plot distributions. Among other research topics it is suggested that it might be possible to investigate the differences between sampling by night and day and the centre might also undertake a general examination of subsampling methods in plankton studies. The Committee recommended that the attention of the SCOR working group on Intercalibration of zooplankton methods should be drawn to the need for a well designed and thorough programme of research on the sampling characteristics of the IOSN and alternative nets and also suggested that IOSN should be retained as the preferred sampler for augmenting the international collections.

FOURTH SESSION OF THE INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION

The fourth session of the Intergovernmental Oceanographic Commission was held at the UNESCO Headquarters, Paris from 3 to 12 November 1965 under the Chairmanship of Dr. N. K. Panikkar. Delegates from 35 member-countries and representatives and observers from 23 intergovernmental and non-governmental organizations attended the session of the Commission. Among the subjects discussed, the most important were: International aspects of Tsunami Warning Systems in the Pacific, Development of National Programmes, Problems of variability in the oceans, Marine Pollution, Ocean-atmosphere interchange problems, oceanographic data exchange, storage and retrieval of scientific information, Elimination of doubtful hydrographic data, ocean data service and communication requirements, Indian Ocean Atlases and reports, Deep-Sea tide gauges, follow up of ICITA and GTS programmes, meetings of the international coordination group for Kuroshio investigations. Also included is a brief discussion on the establishment of an international submarine laboratory. The Commission adopted 16 resolutions on all these subjects and the details of these resolutions are given below.

At the end of the session, the Commission elected Prof. H. Lacombe (France), as Chairman, Commodore W. Langeraar (Netherlands) and Prof. F. Pautch (Poland) as Vice-Chairmen. While concluding the session, the retiring Chairman, Dr. Panikkar emphasized the need for strengthening and furthering the activities of the Commission.

RESOLUTIONS

I International aspects of the Tsunami warning system in the Pacific

The Intergovernmental Oceanographic Commission,

Recognizing the importance of providing timely warning of the approach of Tsunamis in the Pacific Ocean,

Noting the report of the Working Group Meeting on the International Aspects of the Tsunami Warning System in the Pacific,

Commends the Working Group for its efforts and the comprehensive report of the Honolulu meeting submitted to this Commission,

Notes with appreciation the offer of the United States to undertake the expansion of its existing facilities in Honolulu to become the International Tsunami Information Centre,

Accepts the offer of the United States and recognizes the existing Tsunami Center at Honolulu as the International Tsunami Information Centre of the Intergovernmental Oceanographic Commission,

Establishes an International Coordinating Group composed of interested member States in the Pacific to effect liaison among the participating Members, to promote exchange of information on developments of observing methods and of techniques of tsunami forecasting, to effect liaison with other interested organizations, and to provide advice on ihe operation of the International Tsunami Information Centre,

Encourages the member states to exchange scientific and technical personnel among the various national Tsunami warining and research centres, and,

Commends to the governments of member states the implementation of the various technical recommendations included in the Working Group Report, and

Considering that the International Coordinating Committee on the Tsunami Warning System should be a function of this Commission rather than of Unesco,

Requests the IOC Bureau and Consultative Council at its next meeting to constitute the IOC International Coordinating Group on the Tsunami Warning System, meetings of which will be financed in a manner similar to other IOC subsidiary bodies, and further

Requests the Director-General of Unesco to consider furnishing the financial support to individual scientists who might travel from other countries to the International Tsunami Information Centre for purposes of cooperative tsunami research and training in the operation of the International Tsunami Warning System; the possibility of using the International Seismological Fund if established should also be considered.

II On Elimination of Doubtful Hydrographic (Bathymetric) etc Data

(*proposed by the ad hoc group on the basis of the draft prepared by the Netherlands delegation*)

The Intergovernmental Oceanographic Commission,

Recongnizing the prime responsibility of the International Hydrographic Bureau as the Data Centre for bathymetric data and believing that accurate and trustworthy bathymetric data is vital to both oceanogrphic and hydrographic work;

Having studied a request of the IHB that oceanographic vessels use all opportunities to carry out investigations, as far as other commitments allow, aimed at eliminating doubtful hydrographic data from nautical charts;

Considering that such a task constitutes an integral part of World Ocean Study and as such has a place in the "General Scientific Framework of World Ocean Study" Prepared for the Commission;

Being convinced that the growing density and extending limits of world shipping will continue to provide national hydrographic services with an increasing amount of bathymetric information of a doubtful nature from a hydrographic point of view;

Being aware that the responsibility for the publication of hydrographic information lies

with the national hydrographic services exclusively and that the important role of the IHB in this matter is of a coordinating nature;

Requests Members of the Commission to include in their oceanographic programmes an increased emphasis on hydrographic observations of a standard which would contribute to a reduction of doubtful hydrographic data;

Proposes that for this purpose Members of the Commission forward to the IHB (through the IOC Secretariat or directly) a statement prepared by the national hydrographic services listing the kinds of information they consider to be essential for the adeqate elimination of doubtful hydrographic data;

Proposes further that the IHB prepare a comprehensive and coordinated list of such requirements from the lists so received and communicate this new list to the IOC Secretariat which will forward it to the Members of the Commission;

Recommends that Members of the Commission arrange for close liaison and cooperation to be maintained between their national hydrographic services and agencies responsible for the carrying out of oceanographic programme;

Requests that the IHB expedite as far as possible publishing general information on doubtful hydrographic data; and

Recommends that Members of the Commission publish in their Notices to Mariners and send to the IHB (either directly or through the IOC Secretariat) operational information on new doubtful hydrographic data for inclusion of this information in more permanent publications of the IHB.

III

Concerning the Storage and Retrieval of Scientific Information

The Intergovernmental Oceanographic Commission,

Recognizing the rapidly expanding volume of information concerning the results of marine research and the urgent need to ensure that the information be readily retrieveable by scientists concerned with every aspect of marine research in all parts of the world, and by all those concerned with these matters in both government and industry;

Noting the need for all such information not only to be retrievable but for this retrieval to be as speedy as possible, together with the acknowledged inability of even the largest national organizations, or the World Data Centres, to accept these tasks at the present time;

Noting also the efforts already being made by the Fisheries Division of FAO, with the assistance of various international and national institutions, to provide an intelligence and information re-retrieval service, especially through their Current Bibliography on Aquatic Sciences and Fisheries, both as concerns marine (and fresh water) research in general and fisheries research in particular (Report of the 3rd Session of ACMRR and IOC/IV-18), and the views expressed by SCOR Working Group 12 on Marine Science Abstracts and Bibliographies, concerning the need to ensure the maintenance and further improvement of these services as a minimum requirement, with the consequent need for maximum support by all countries concerned;

Recognizing further that these objects cannot be achieved by irregular support (already one collaborating body having been forced to conclude its operations for lack of funds), so that continuing and expanding support is required;

Recommends that Member States, together with SCOR and ACMRR, urgently consider what steps might be taken, in collaboration with other interested bodies, to ensure, for the promotion of oceanography in general, the sufficient funds, facilities and staff are made available for the provision of a retrieval service adequate to the needs of the international marine research community, and

Requests Unesco meanwhile to consider ways and means of developing increased collaboration with FAO with a view to enlarging coverage of various disciplines by the CBASF.

IV On Ocean-Atmosphere Interchange

(presented by the drafting committee appointed by the Commission)

The Intergovernmental Oceanographic Commission,

Considering the importance of the exchange of energy and matter between ocean and atmosphere on the oceanic circulation and its variations, the generation and propagation of ocean waves, the changes of sea level in coastal areas, ocean temperature patterns and their variations in the composition of surface waters and lower atmosphere, the circulation of the atmosphere and its variations, and the modification of air masses,

Recognising that an understanding of air-sea interaction is a fundamental basis for long range prediction of weather and of ocean surface conditions and circulation, as well as for the effective exploitation of marine food resources for use by man,

Noting the action of IUGG in establishing a Committee on Atmospheric Sciences, and a joint committee under IAMAP and IAPO to examine the scientific aspects of air-sea interaciton, and

Further noting with appreciation the recommendation of the WMO Commission for Maritime Meteorology that arrangements be worked out between WMO and IOC permitting the closest possible cooperation between the CMM Working Group on Ocean-Atmosphere Interaction and the appropriate IOC body,

Urges IAMAP, IAPO and SCOR to act vigorously in stimulating the scientific study of the physical and chemical processes governing the exchange of energy and matter between ocean and atmosphere and the development of satisfactory methods for estimating the flux of energy and matter between ocean and atmosphere,

Decides to establish an IOC Working Group on Ocean-Atmosphere Interaction to consider the operational aspects and opportunities for intergovernmental action in this field. In order to ensure the closest possible cooperation with WMO, it is recommended that Members should include on their national delegations to this working group appropriate members of the analogous CMM Working Group,

Establishes the following terms of reference for the Working Group :

(1) To evaluate the results of scientific investigations of air-sea interaction in order to ascertain their applicability to intergovernmental programmes of joint action.

(2) To consider the instrumental and operational problems involved in the development of such programmes.

(3) To consider the ways in which intergovernmental action could strengthen the forecasting of sea surface conditions, and facilitate the exploitation of marine food resources.

(4) To recommend appropriate programmes of intergrovernmental action to the Commission, to WMO, and to other international bodies concerned.

Requests the Bureau and Consultative Council to determine at its next meeting the membership and the appropriate time and place for the first meeting of this Working Group.

V On Marine Pollution

The Intergovernmental Oceanographic Commission,

Recognising the great and growing concern about marine pollution and also the great urgency of understanding better the processes governing marine pollution with a view to facilitating their ultimate control,

Recalling Article 25 of the 1958 Geneva Convention on the High Seas,

Recognising also the parallel interest of various other international bodies in this important problems and desiring to cooperate with them;

Recognising further the action already being taken by the ACC Sub-Committee on Oceanography of ECOSOC, in transmitting to member governments a questionnaire concerning pollu-

tion problems, under the authority of the Secretary-General of the United Nations Organisation, with a view to coordinating the activities of the various UN agencies concerned in this field".

Decides to establish a Working Group on marine pollution to report to the Fifth Session how the Commission can further the national and international studies of relevant oceanographic processes.

Refers for further consideration by the Working Group, to the documents on marine pollution submitted at the Fourth Session.

Requests SCOR and ACMRR to assist the Working Group.

Invites other international organisations concerned with marine pollution to collaborate with the Working Group.

Urges that, meanwhile, member countries intensify their investigations of marine pollution in all its aspects, and report through the appropriate channels".

Requests the Bureau and Consultative Council to determine at its next meeting the membership and the appropriate time and place for the first meeting of this Working Group.

VI On Data Exchange

The Intergovernmental Oceanographic Commission,

Noting with concern that the submission of data on Declared National Oceanographic Programme is progressing slowly;

Noting further that less than half of the Member States have declared any national programmes as defined in the Manual on International Oceanographic Data Exchange;

Desiring to remedy this situation in order to promote the full and expeditious transmission of oceanographic data to the data centres and through them to the oceanographic community;

Requests all Member States to review their own oceanographic programmes since 1960 and by 1st February 1966 to inform the Secretary of the Commission on which programmes they are prepared to exchange data in accordance with the procedures provided in the Manual on International Oceanographic Data Exchange.

Requests further that Member States take the necessary steps to submit their data from such Declared National Programmes to the appropriate World Data Centre as quickly as possible; and

Requests the Secretariat to convene the IOC Working Group on Data Exchange in March 1966 at Copenhagen with observers to be invited from the ICES. This Working Group is to discuss various aspects of international data exchange following the guidelines provided in the Report of the Fifth Meeting of the IOC Bureau and Consultative Council (IOC/B-22) and paying particular attention to methods whereby flow of data to the World data Centres can be increased and speeded up. In this connection, consideration should be given to simplifying the techniques of actual data exchange including among other things, consideration of standard formats for such exchanges and to the continued close cooperation among World Data Centres and regional data centres such as the ICES Service Hydrographique. The Working Group should also consider the recommendations of the Joint ACMRR-SCOR Working Group on Biological Data (UNESCO-IOC/INF-80) and also consider the publication by the World Data Centres of a comprehensive catalogue listing the types and amounts of data from the International Indian Ocean Expedition which are available for use by oceanographers.

VII On development of National Programmes

The Intergovernmental Oceanographic Commission,

Recognizes again the urgent necessity for mutual assistance between its Member states in developing their national programmes in order to study the oceans as a whole more thorougly;

Reaffirms with vigour the relevance of Resolution III-14;

Decides that the Working Group on Mutual Assistance, as established under Res. III-14, helps the Commission to carry out, in cooperation with the advisory bodies to the Commission and other interested international organizations, the following tasks;

1. Encourage sister-relationships between universities and government agencies in advanced countries on the one hand and developing countries on the other.
2. Obtain and arrange for dissemination of information on the availability of reliable, easily-operated and relatively inexpensive oceanographic instruments and on standard methods and procedures.
3. Study and advise on curricula and methods for educating marine scientists and technicians.
4. Help Member States to obtain needed financial and technical assistance for development of marine sciences.
5. Arrange for places on research vessels for the training of marine scientists and technicians of developing countries.
6. Encourage regional collaboration between institutions working in neighbouring areas.
7. Work out details relating to selection, operation and responsibilities of visiting experts and Committees.
8. Consider the desirability of stimulating the holding of regional symposia to discuss problems and exchange ideas relative to the development of national oceanographic programmes.
9. Consider means of assisting in the procurement of essential equipment requiring foreign currency.
10. Consider what actions should be taken to encourage governments to recognize the importance of oceanography for their own countries.
11. Consider the most appropriate means by which the Technical Assistance and Special Fund financing within the U. N. System may be utilized for mutual assistance.

Instructs the Secretary to convene the Working Group on Mutual Assistance in June 1966 in Unesco, Paris, after the 2nd International Oceanographic Congress.

VIII On Communication Requirements

The Intergovernmental Oceanographic Commission,

Noting the reports of the ad hoc Working Group on Communication Requirements,

Reaffirms the importance of the Ocean Data Service and the urgent need for suitable radio frequency allocations,

Adopts the Report of the Extraordinary Meeting of the Working Group of Communications (Doc. IV-19), and

Requests the Secretariat to circulate the annexed proposal of the Federal Republic of Germany, as suggested in the ad hoc report, and further,

Requests the Secretariat, in collaboration with the Chairman of the Working Group, to revise and circulate the draft on Radio Communication requirements for Oceanography, as suggested in the ad hoc report, and

Invites Mr. Snodgrass, Chairman of the Working Group to represent IOC at the forthcoming meeting of CIRM in London, November 1965.

IX On Variability on the Ocean

The Intergovernmental Oceanographic Commission,

Noting with appreciation the report of the first meeting of the Working Group on the Variability in the Ocean;

Invites SCOR to consider the establishment of a Working Group of scientists to evaluate suitable instrumentation for time series measurements;

Welcomes SCOR's proposal to hold a symposium on physical and biological variability at its General Meeting in May 1966;

Decides to convene the second meeting of the IOC Working Group on Variability in the Ocean in September 1966, to be held in conjunction with the Statutory Meeting of the International Council for the Exploration of the Sea.

Accepts the proposal of the Working Group that informal committees be found in the USSR, North America and Western Europe to prepare proposals for possible experiments for discussion by the Working Group at this meeting.

X

On the follow-up of ICITA and GTS

The Intergovernmental Oceanographic Commission,

Noting the successful completion of the first International Cooperative Programme formulated by the Commission, the International Cooperative Investigations of the Tropical Atlantic (ICITA),

Noting also the successful completion of the Guinean Trawling Survey (GTS) sponsored by the Scientific Technical and Research Commission of the Organization of African Unity,

Recognizing the increased research and fishery development which is being undertaken in the West African Areas as a result of these programmes, including the existing and proposed projects of the Expanded Programme of Technical Assistance of the United Nations and the United Nations Special Fund,

Desiring to ensure the most complete application

Desiring further to develop cooperative research programmes to investigate any gaps in knowledge as a result of ICITA and GTS,

Decides to establish a Working Group for this purpose to be open to all interested members of the Commission,

Invites the Food and Agriculture Organization of the United Nations and the Organization for African Unity to co-sponsor this Working Group, with membership of the Working Group to be open further to those States with an interest in the subject which are members of a co-sponsoring organisation but no members of the Commission and

Requests the Secretary to seek the convening of the Working Group in conjunction with the Symposium on the Results of ICITA and GTS to be held in West Africa in 1966.

XI

On the Cooperative Study of the Kuroshio and Adjacent Regions

The Intergovernmental Oceanographic Commission,

Having considered the reports of the First and Second Meetings of the International Coordination Group for the CSK,

Notes with appreciation that the work of the CSK successfully started in the summer of 1965, and

Invites participating Member States to continue the support of the CSK with a hope of further development in implementing the programmes,

Approves the election of the International Coordinator and the Assistant International Coordinator for Fisheries and their terms of reference,

Requests the Assistant International Coordinator approach the FAO (IPFC) to convene jointly a meeting of the Coordination Group for Fisheries Studies of the CSK towards the end of developing and carrying out of programme of fisheries studies in close conjunction with the oceanographic studies of the CSK,

Notes with interest the plans for work in the South China Sea advanced by Thailand, Vietnam and Malaysia, and

Welcomes and encourages the valuable addition of this segment of the CSK study as originally planned, and

Noting the great importance of studies in the southern part of the South China Sea,

Recommends that countries participating in the CSK plan work in the area as possible,

Recommends that the CSK Coordination Group take every opportunity when planning their further work to increase emphasis on investigation of variability problems,

Appreciating the action already taken by many Member States in extending port and customs facilities to the vessels paticipating in the CSK,

Invites Member States concerned which have not yet extended such facilities, to do so,

Notes with appreciation the establishment by Japan of the Kuroshio Data Centre, and,

Looks forward to the continued successful operation of the Data Centre.

Notes with appreciation the cooperation of FAO in facilitating the work of the CSK Assistant International Coordinator for Fisheries, in establishment of sea-going fellowships under the 1967-68 EPTA Programme and in other ways, and

Commends the Fisheries Division of FAO for this cooperation in problems of mutual interest,

Draws the attention of the U.N. Technical Assistance Board to the importance of this EPTA fellowships plan in the advancement of marine sciences, and

Urges countries having suitable facilities to consider sympathetically the possibility of their acting as hosts to the sea-going fellows,

Being aware of the fact that the Eleventh Pacific Science Congress will be held in Tokyo in August 1966.

Approves the plans to hold the third meeting of the CSK Coordination Group concurrently with the Eleventh Pacific Science Congress.

XII

On an International Submarine Laboratory

The Intergovernmental Oceanographic Commission,

Recognizing that the establishment of an International Submarine Laboratory, for use as an applied science centre involving prolonged periods under water and open to all research workers, is of interest of the Intergovernmental Oceanographic Commission,

Hoping that member countries appreciating the importance of the results to be expected from such a laboratory, will cooperate in making it a reality,

Decides to communicate to member countries all such information as may be supplied to it on this subject by the responsible authorities.

XIII

On a Cooperative study of the Dynamics and Properties of the North Atlantic Ocean

The Intergovernmental Oceanographic Commission,

Considering the successful conclusion of the International Cooperative Investigations of the Tropical Atlantic Ocean and the importance of its results to an understanding of the dynamics and properties of the North Atlantic Ocean;

Having in mind the important influence of variations in the oceanic circulation on the climate, weather, commerce, and fisheries of the North Atlantic Region;

Realizing the desirability of extending the research developed in the programmes of the International Cooperative Investigations of the Tropical Atlantic to the Guinean, Antilles, Gulf Stream and North Atlantic current systems for these reasons;

Requests SCOR and ACMRR in cooperation with ICES and ICNAF and taking into account all the work in progress to study the possibility of developing cooperative investigations of this region reporting their recommendation to the next Session of the Commission including if feasible suggested plans for its conduct.

XIV

On General Scientific Framework

The Intergovernmental Oceanographic Commission,

Recognizing the substantial impact on the world oceanographic community of the first draft of the document presently entitled "General Scientific Framework for World Ocean Study",

Commends the work of SCOR and ACMRR on its preparation,

Appreciates the efforts of the Joint Working Group to revise the present text,

Suggests that the editor appointed by that Group decide a more appropriate title to the document,

Requests the Director-General of Unesco provide for printing the English version of the new document in the IOC Technical Series by the time of the Second International Oceanographic Congress,

Proposes that those Member States which translated the original Draft undertake to tranlate the revised version and make these translations available for printing by Unesco in 1967.

Invites SCOR and ACMRR to keep under review the desirability of developing another revision at a future date.

XV

On Indian Ocean Atlases and Data Reports

The Intergovernmental Oceanographic Commission,

Accepts and commends for further implementation the reports of the IIOE Coordination Group (UNESCO/IOC/IV-10) and of the Ad Hoc IIOE Coordination Group (UNESCO/IOC/IV-INF.98), and, taking into account additional recommendations by the Commission,

Resolves to accept the proposals of Professor Krey (University of Kiel), Professor Ramage (University of Hawaii), Dr. Udintsev (Institute of Oceanology, Moscow) and Professor Wyrtki (University of Hawaii) to prepare atlases for Chemical Biology, Meteorology, Geology-Geophysics, and Physical Oceanography respetively, and further

Resolves to appoint under their respective chairmanships Editorial Boards consisting of scientists nominated by Australia, Japan, South Africa, USA and USSR for the atlas on Chemical Biology; by India, UK and USSR for the atlas on Meteorology; by the Federal Republic of Germany, India, UK and USA for the atlas on Geology-Geophysics; and by Australia, the Federal Republic of Germany, France, Japan and USSR for the atlas on Physical Oceanography, and

Recommends to Unesco that it provide funds for the appropriate travel of the editors and the members of the boards, and

Authorises the Bureau, in consultation with the IIOE Coordination Group, preferably by correspondence, to accept proposals for additional atlases, and further

Recommends that its members participating in the IIOE publish their own cruise and data reports and supply national coordinators of other participating countries with at least three copies of each series free of charge.

XVI

On Deep-Sea Tide Gauges

The Intergovernmental Oceanographic Commission,

Realising that actual measurements of deep-sea tides are important inter alia for,

(1) developing the first reliable theoretical determinations of global tides,
(2) arriving at the first reliable estimates of oceanic tidal friction,
(3) applying tidal corrections to other geophysical measurements such as gravity tides and electric potential,
(4) obtaining a better understanding of the linkage between deep-sea tides and those on the continental shelf,
(5) providing data to be utilised in dynamic numerical or analogue prediction models,
(6) understanding the origin of internal waves of tidal period, and
(7) possible use in tsunami research and detection;

Notes with great interest that IAPO is forming a Working Group on Deep-Sea Tides which has begun the formulation of a cooperative international programme for the systematic investigation of tides in the deep sea; and

Urges IOC Member States to follow closely the work of this IAPO Working Group and where possible to plan to participate in this investigation by obtaining deep-sea gauges as they become available and by encouraging research work in this area of oceanography.

VISITORS

At Ernakulam, the following persons visited Indian Ocean Biological Centre and other centres under the directorate of Indian Ocean Expedition.

1. Shri K. P. Krishna Pillai,
   Editor, USIS. Madras.
2. Dr. A. G. K. Menon,
   Z.S.I. Calcutta.
3. Shri B. K. Nair,
   Department of Zoology, Kerala University, (with a party of eight students)
4. Dr. J. M. Bassot,
   Institute Oceanographique Paris (gave a lecture on Bioluminiscence)
5. Shri A. P. Srinivasa Dikshitulu,
   Govt. College, Chittur (with a group of students)
6. Shri Romesh Chandra,
   Director, Patna Station of A.I.R. (Recordings are being made for a programme—reviewing Indian Ocean Expedition)
7. Shri A. K. Naik,
   Research Officer, Directorate of Fisheries, Maharashtra.
8. Dr. and Mrs. M. B. Vajifdar.
   T.I.F.R. Bombay
9. Shri S. Balaram
   (with a group of students from S.N. College, Quilon)

PUBLICATIONS RECEIVED:

1. Annual Report of Oceanographic Observations Vol. 12—1963.
   (Fisheries Research & Development Agency, Pusan, Korea).
2. Intergovernmental Oceanographic Commission—Information Paper No. 14—August, 1965.
3. CSIR News—Vol. 15 No. 21, Nov. 15, 1965.
   Vol. 15 No. 22, Nov. 30, 1965.
   Vol. 15 No. 23, Dec. 15, 1965.
4. Science Reporter—Vol. 2 No. 11 Nov. 1965 C.S.I.R.
5. Vigyan Pragati (CSIR) Vol. 14, No. 10 October, 1965.
6. Current Affairs Bulletin (FAO) No. 43 August 1965.
7. The Sea Horse Vol. 1 No. 6 August 1965.
8. Indian Journal of Biochemistry (CSIR) Vol. 2 No. 3 September 1965.
9. Report B.I.O. (Dartmouth) 65-6, March 1965.
10. International Marine Science (UNESCO) Vol. III No. 3 Oct. 1965.
11. F.R.B., Canada Manuscript No. 198
12. Information Bulletin on Planktology in Japan No. 12 Sept. 1965.
13. IUGG Chronicle No. 61 October 1965.
14. Oceans Vol. XII No. 1 Oct. 1965.
15. NML Technical Journal, Jamshedpur (CSIR) Vol. VII No. 3 August 1965.
16. Report B.I.O. 65-9, June 1965.
17. Research & Industry (CSIR) Vol. 10 No. 10 October 1965.
18. F.A.O. Information Bulletin No. 27 August. 1965.