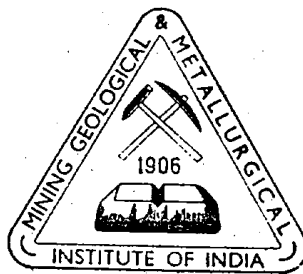


INDIA AND THE INTERNATIONAL INDIAN
OCEAN EXPEDITION

N. K. PANIKKAR



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INDIA AND THE INTERNATIONAL INDIAN OCEAN EXPEDITION

N. K. PANIKKAR

*Director, Indian Programme, International Indian Ocean Expedition,
C.S.I.R., New Delhi*

The Indian Ocean Expedition in which about twenty countries are participating with about 40 ships is a unique multi-national venture in the annals of ocean research. This project was given a concrete shape during the first International Oceanographic Congress held in 1959 in New York. The idea was discussed and developed by the Scientific Committee on Oceanic Research of the International Council of Scientific Unions and found ready support from the UNESCO and many other international agencies. Oceanographic Institutions of many countries welcomed this concerted effort to study the Indian Ocean which was the least explored of the world's oceanic regions.

Apart from the fact that no detailed study had been carried out on this ocean, there were several human aspects that called for systematic and detailed investigations in this part of the world. The land-locked nature of the northern Indian Ocean poses problems of oceanic circulation different from the Atlantic and the Pacific. Is the composition of the floor of the three oceans similar? Is there a counter equatorial current similar to the recently discovered current system of the Pacific? How are the monsoons and tropical cyclones formed? These are some of the many absorbing problems for the oceanographer which he would like to pursue. The formation and the spread of the monsoon winds and rains which play such an important part in the economy of the countries bordering the Indian Ocean still require much further elucidation. The Indian Ocean countries are peopled by nations in a lower stage of economic development and lower nutritional standards. The protein resources which might be developed as a result of location of extensive fishing areas could make an important contribution to food supplies. New mineral resources if located could likewise contribute to valuable raw-materials for industry.

Apart from all these, the very fact that oceanography as a science needed support and development in these countries and that this objective could be achieved by creating much needed interest in ocean research was in itself a sufficiently attractive inducement for many countries to come forward and support

the Indian Ocean Expedition. In spite of many shortcomings in organisation, the project has made substantial progress and what is more, it holds out promise to keep oceanography as a living science in Indian Ocean countries.

Realizing the importance of this Expedition, taken in conjunction with India's geographical position, we have taken much interest in the development of an oceanographic programme in India. In 1960 the Indian National Committee for oceanic Research was set up by the Government of India under the distinguished Chairmanship of Dr. D. N. Wadia. The Indian National Committee and its Working Groups have amongst them representatives of all organizations in the country connected with oceanography. They have developed the Indian Scientific Programmes which have been in progress since 1962.

SHIPS AND PERSONNEL.

Four ships were earmarked for the Expedition from India. These are—INS KISTNA, a 300 ft. frigate of the Indian Navy, specially refitted for oceanographic work; a 92 ft. Fisheries Research Vessel R. V. VARUNA of the Indo-Norwegian Project, built in Norway specially for fisheries oceanographic work; a 50 ft. vessel R. V. CONCH belonging to the Kerala University equipped for coastal oceanographical observations; and a 57 ft. purse-seine fishing vessel M.F.V. BANGADA of the Deep Sea Fishing Station of the Union Ministry of Food & Agriculture. The main observations will be from INS KISTNA and R.V. VARUNA. KISTNA can accommodate about 20 scientists while R. V. VARUNA can take 5 scientists. Both these vessels have been provided with all essential oceanographic equipment. We have also initiated a vigorous training programme. The personnel for participating in the Indian Programme are drawn from Indian Scientific Institutions of the Ministry of Defence (Defence Science Organization and Hydrographic Department of Navy); Ministry of Transport & Communications (India Meteorological Department); Ministry of Food & Agriculture (Central Marine Fisheries Research Institute, Mandapam and the Deep Sea Fishing Station, Bombay); Ministry of Scientific Research and Cultural Affairs (C.S.I.R., The Survey of India, the Botanical and the Zoological Survey of India); Ministry of Mines and Fuel (Geological Survey of India) and the Department of Atomic Energy. Some of the State Fisheries Departments are also joining the programmes. Apart from the Government Departments, the Universities of Kerala and Andhra, and the Tata Institute of Fundamental Research at Bombay are active participants. The responsibility for co-ordination and direction of the Indian Programme of the Expedition has been entrusted to the Council of Scientific and Industrial Research under whose aegis the National Committee for Oceanic Research functions as the policy-making body to advise the Government of India in the field of oceanology.

PROGRAMMES

The Indian Programme includes almost all branches of research in modern oceanography. The physical properties of the water masses and the process of vertical and horizontal circulation are being studied and all relevant data collected for this purpose. The main areas of observation are the Arabian Sea and the Bay of Bengal with the equatorial region as the rough southern limit. A large number of stations have been occupied in these regions, some of them deep water stations up to 3000 meters and the remainder, shallow stations up to 500 meters. Cruising plans have been so worked out that intervals between the stations do not exceed sixty miles. The hydrographic data from these stations will be used for circulation studies and for dynamical computations of ocean currents. Direct observations of ocean currents are not being made at present but this programme will be developed within the course of this year. Wave and tidal observations from existing and new tidal observation are being developed.

In the field of Chemical Oceanography observations cover salinity, phosphates, nitrates, silicates, oxygen and total phosphorus. Full coverage has not been secured in the earlier cruises. Primary production studies are carried out by the C_{14} Technique. The Atomic Energy Department at Trombay is paying special attention to radiometry. The geochemical behaviour of certain elements is studied at the Tata Institute of Fundamental Research.

The importance of locating new fisheries resources being one of the major objectives of the Expedition, the marine biology and Fisheries Programme is oriented to understand the productivity of the seas, the location of spawning grounds of commercial fishes and the location of areas capable of intensive fishing. Critical studies of plankton production and distribution of the major components of marine plankton will be taken up from selected areas. Plankton sampling for the Expedition as a whole is being made through the Indian Ocean Standard Net which has been developed by the SCOR working group in biology as a basis for the comparison of results obtained in different areas by different ships. The large amount of plankton material collected by this standard method by all the ships are brought to the Indian Ocean Biological Centre established in Ernakulam near Cochin, where this material is sorted and will be placed in the hands of specialists for further studies. This centre is being developed by the Council of Scientific and Industrial Research with technical assistance from the UNESCO.

The marine geology and geophysics programme includes bathymetric, magnetic, seismic and gravity studies but here we have been slow owing to inadequate instrumentation. The position has now been rectified. Regular Echo-Sounding with the precision depth recorder is being made for getting profiles of the ocean bottom all along the routes taken by the ships, so that the data

collected could be used to develop accurate bathymetric charts by our Hydrographic office at Dehra Dun. Some results of interest already been obtained from INS KISTNA which during her recent cruises came across several submarine canyons on the continental slope of the Coromandel Coast.

By far the most ambitious programme from the Indian side is in the field of Meteorology. The studies include the sequence of events and the spatial relations between those events which make up the large-scale monsoon circulation in the Indian ocean, which although known from ancient days to the mariners, is still a very imperfectly understood atmospheric phenomenon. The complete reversal of ocean currents and air circulation when the South-West Monsoon changes to the North-East is a factor which has far-reaching consequences in the sea and the air. To study these processes in a systematic manner and to handle the large volume of atmospheric and ocean weather data that would be accumulated as a result of the Expedition, an International Meteorological Centre has been established in Bombay by the Government of India with the assistance of the U.N. Special Fund. Advanced computer techniques are being employed here for the quantitative treatment of data. The U.S. Weather Bureau is collaborating with this Centre in a bilateral programme of weather studies aided by special aircraft. It is hoped that by the time the Expedition is over the whole range of weather phenomena in the Indian Ocean would have been subjected to the closest study. Not since the Valdivian Expedition of 1898-99 has any such attempt been made to study Indian Ocean Meteorology. The Indian Meteorological Department has done much work towards the understanding of these complex factors and as part of the expedition effort, systematic radiosonde observations were initiated for oceanic regions from INS KISTNA in the Arabian Sea.

The problem of oceanic circulation of the Arabian Sea is a matter of special importance to India. The fact that over two-thirds of the total annual production of sea fish in the country is obtained from the west coast obviously points to a higher productivity of the Arabian Sea waters as compared with that of the Bay of Bengal. But the exact reasons for this increased productivity in terms of oceanographic conditions still remain to be elucidated. Many former observers have conjectured the possibility of nutrient laden deep waters coming to the surface through the influence of (a) bottom drifts striking against submarine ridges; (b) upwelling of water associated with the prevailing current systems; (c) large-scale turbulence caused by strong monsoon winds which pile the water against the west coast of India; and (d) coastal eddies resulting from the local wind effects.

Recent studies made by researchers of the Central Marine Fisheries Institute and of the Indo-Norwegian Project have clearly shown that deep water of low temperature and low oxygen content occurs considerably higher up near the surface on the west coast of India. Indications of low temperature water in

coastal regions are also available from surface temperature and salinity charts for the Arabian Sea published by the Dutch Meteorological Institute. A number of observations showing high values of phosphates for the Arabian Sea coastal waters of the west coast have been reported as against the Bay of Bengal coastal waters. Intensive studies on the standing crop of plankton have also shown substantially high organic production off the Malabar coast. The correct understanding of the forces responsible for this upwelling and indeed whether it is upwelling in the classical sense or a combined effect of several factors will be one of the problems whose solution will be sought by Indian workers because of the very close relation which these phenomena have on the movements and shoaling of the sardines and the mackerel which form the backbone of Indian Marine Fisheries. Valuable data in this direction have already been obtained by the work of R.V. VARUNA. Oceanography team working at the Andhra University has shown upwelling in the Waltair coast but its relation to fisheries of the Bay of Bengal remains to be investigated. Indian ships and the U.S. Research Vessel ANTON BRUUN are devoting some time to this problem.

Oceanography is a very young science in India. In recent years the notable advances have been the growth of two schools of oceanography since 1950, one associated with the Central Marine Fisheries Institute at Mandapam and its Sub-Stations and the other associated with the Andhra University. The Naval Physical Laboratory at Cochin has come to the fore recently in certain aspects of physical oceanography and many other institutions are newly entering this field. Inadequacy of research vessels for work which cramped earlier efforts has now been overcome. It is hoped that Indian participation in this expedition will result in substantial advancement to oceanological studies in the country and the development of applied marine sciences based on a solid foundation of fundamental work. A country with over three thousand miles coastline and a pre-eminent geographical situation in the Indian Ocean will require a number of trained oceanographers and a vigorous marine sciences programme towards which Indian participation in this Expedition can only be just a beginning. Indian experience during the International Indian Ocean Expedition will be consolidated and developed into a National Institute of Oceanography, which will organize work in the physical, geological, biological and chemical aspects of ocean research. The Council of Scientific and Industrial Research propose to establish this Institute during the Fourth Plan period at some suitable coastal place with units of research in both East and West Coasts of India.