

# INDIAN OCEANOGRAPHY

## Past and present

### Early Times

THE seas around India constitute a natural frontier of our country. Since times immemorial, the inhabitants of India used the seas for transport and communication, for trade and food. Therefore, as a result of these activities quite a few interesting characteristics of our seas became known to our ancestors, and their impressions have been recorded in the days of the Vedas and the Puranas (mainly the Matsya and the Vishnu). In Kautilya's Arthashastra (ca. 300 B.C.) and on some of the Pillar Edicts of Asoka, references of fish have clearly been made. ~~Descriptions of a maritime code are found in Jataka Mala (1st century A.D.).~~ These helped the Indians to establish a sea-faring tradition which was strengthened further as the sea became more and more known.

The phenomena of ebb- and flood-tides were recorded by the Arabs who were also, probably, the first to observe the bi-annual changes in the direction of the wind and currents over the Arabian Sea. They termed this as *Mousam* (season) which is the origin of the later terminology monsoon. Moghul emperors, Babur and Jehangir, in their memoirs, and Abul Fazar of Akbar's court, in his *Ain-i-Akbari* have given an account of the fish and fisheries of Hindostan. It is believed that a moslem pilot of Gujarati origin from East Africa navigated Vasco da Gama during his voyage to India across the Arabian Sea in 1497-1498. From these examples, it can be concluded that India has had a long tradition of the study of seas surrounding its coasts.

### British Days

With the coming of the British to India, a combination of British and Indian talents occurred and this laid the foundation of the science of the sea in India. Observations on tides started in 1806 in the River Hooghly, and ever since then these are being continued. The first British record of fisheries was published in 1802 and this included the fishes of the Visakhapatnam coast. Although the different features of the oceans became the subject of interest all over the world "oceanography" became an organized science only after the successful global expedition of "H.M.S. Challenger" of the United Kingdom during 1872-1876.

The success of the "Challenger" expedition stimulated the Council of the Royal Asiatic Society of Bengal to take initiative and establish the Marine Survey of India in 1874. The naturalists of the Indian Museum, Calcutta, organized the Wood-Mason Expedition in the deep waters off the Andaman coast. This expedition and subsequent exploratory works undertaken by the medical officers of the Royal Indian Navy, marked the beginning of oceanographic study in the Indian sub-continent. These works later on led to the appointment of a Surgeon-Naturalist

to the Marine Survey of India to initiate the work and gather information on plants and animals of our seas.

Deep-sea investigation is a complicated and expensive task and it requires moderate to fairly large-sized all weather ships to work in the open sea. It also requires shipboard equipment to probe and collect information from the sea. The commissioning of "R.I.N.S. Investigator" of the Marine Survey of India and the procurement of equipment from the "Challenger", which had already completed its global work in 1876, helped to explore the marine fauna and flora of the Indian seas. In 1926, the "Investigator" finished her memorable exploration. Thus from 1884 to 1926, the fauna of the seas along the coasts of India, Burma, Ceylon and as far north as the Persian Gulf, including the Andaman and the Nicobar Islands, the Maldives and the Laccadive Archipelagoes, upto the depth of 2000 fathoms, began to be recorded with utmost care. These surveys also revealed a wealth of knowledge about the animal life, both vertebrates and invertebrates. These were described and figured in special publications brought out by the Indian Museum and the Royal Asiatic Society of Bengal.

The work started by the Surgeon-Naturalists gradually spread in the country and resulted in the establishment of marine biological studies in the Zoological Survey of India. The Fisheries Departments of the coastal states started work on marine aquaria and museums. Soon afterwards, marine biology began to be taught in some of the Indian universities. All these acti-



Fig. 1. National Institute of Oceanography, Dona Paula, Goa.

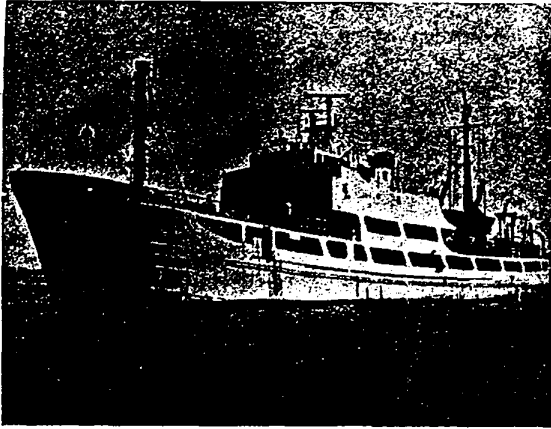


Fig. 2. R. V. GAVESHANI anchored at her homeport, Marmugoa.

vities, however, came to a standstill with the outbreak of Second World War.

### Post-Independence Work

From 1947 onwards considerable resources began to be diverted towards the study of the oceans with the primary object to obtain more food from the sea. Thus the investigations in ocean science started to be concentrated mostly in the fields of marine biology and fisheries. A few universities initiated courses in Marine Biology and Oceanography at the post-graduate level. With the setting up of Central Marine Fisheries Research Institute in 1947, the need for oceanographic investigations as an integral part of marine fisheries research was finally recognized.

The post-war developments in oceanography in other countries were in the form of long round-the-world expeditions. Ships which cruised in the Indian Ocean either took Indian scientists on board for short periods or provided material for research. Notable among these ships were "John Murray" from the United Kingdom; "Albatross" from Sweden; "Galathea" from Denmark; and "Vityaz" from the Soviet Union. Indian marine biologists utilized these opportunities, and in their investigations in near-shore and coastal waters, developed a substantial amount of knowledge on marine life. On the works done by Indian scientists, several well known marine biologists from abroad remarked that they were amazed to find works of such high quality coming out of laboratories which were equipped either poorly or with very modest facilities.

Gradually, joint international projects on fisheries began to be established. Notable among these is the Indo-Norwegian Project with its base first at Quilon and then at Cochin. Institutes such as the Deep-Sea Fishing Station, the Central Institute of Fisheries Technology and others were also established to explore the fishery resources around India and to improve upon the fishing methods.

Of all the seas, the Indian Ocean is the only ocean which is subjected to the bi-annual reversal in the direction of wind-systems. This phenomenon is called the "monsoon" and it has a tremendous influence on the livelihood and economy of the countries bordering the Indian Ocean. Realizing this little-understood phenomenon and many other features of the Indian Ocean which are totally unknown, the world community of oceanographers launched a cooperative investigation called the International Indian Ocean Expedition (IIOE). This was the first major cooperative investigation of the Intergovernmental Oceanographic Commission (IOC) of UNESCO. The IOC was established in 1961 following the successful completion of the International Geophysical Year, 1957-58. The International Indian Ocean Expedition began in 1961 and ended in 1965. In this

programme, about 40 ships and 50 countries participated. Notable among the ships which took part were "R.V. Anton Bruun", "R.V. Argo", and "R.V. Atlantis II" all of the U.S.A.; "R.R.S. Discovery" of the United Kingdom; "R.V. Vityaz" and "R.V. Akademik Knipovitch" of the U.S.S.R.; "F.S. Meteor" of the Federal Republic of Germany; and "R.V. Varuna" and "I.N.S. Kistna" from India. The Indian National Committee on Oceanic Research (INCOR) was established in 1962 by the Council of Scientific and Industrial Research (CSIR) to organize the Indian participation in the IIOE.

The Indian oceanographers made full use of the opportunities provided during the IIOE. Several young scientists obtained their training on board some of the foreign ships. A team of young scientists went regularly on board "Kistna" to collect all types of information from the Indian Ocean in all weather conditions. India played host to different participating vessels in the programme and to the scientists from abroad. Thus, it can be said, that the IIOE helped in establishing a nucleus of well-trained oceanographers in India.

In 1962, an international centre, called the Indian Ocean Biological Centre (IOBC), was developed at Cochin with the help of UNESCO. Its function was to provide shorebased facilities for sorting and identification of zooplankton collected during the expedition by different ships. This effort gave rise to the publication of several well-illustrated atlases on zooplankton of the Indian Ocean.

The termination of the IIOE saw the birth of a new institution called the National Institute of Oceanography (NIO) in 1966 under the CSIR. This led to the long-awaited recognition of the science of oceanography in the country. The NIO with its headquarters in Goa and three regional centres at Cochin, Bombay and Waltair is the only institution in India devoted exclusively to the study of the oceans.

Parallel developments also occurred in the universities, and today almost all branches of oceanography is being included in the curriculum of studies at the post-graduate level of several Indian universities.

### The Seventies

India has a 6000 kilometre long coastline from which about 1.4 million tonnes of fish is being harvested every year. Intensive efforts are being made to increase the fish production substantially. The potential fishery resources of the Indian Ocean are estimated to be about 10 million tonnes.

India's coastal population is of the order of about 150 millions. Of these, about 1.6 million people are engaged in fishery activities using about 12,000 mechanized and 100,000 country crafts. India has recently declared 200 nautical mile economic zone. With this declaration, nearly 587,600 square nautical miles have been added to our maritime zone. This large area has given a far greater responsibility to the scientists for the exploration and exploitation of living and non-living resources from the economic zone.

The NIO being fully aware of its responsibilities has made rapid strides in enhancing its capabilities. Today NIO has seven divisions which cover Physical Oceanography, Chemical Oceanography, Biological Oceanography, Geological and Geophysical Oceanography, Ocean Engineering and Data and Planning. It has a very young team of scientists, and some of its scientists have been internationally recognized in their fields of specialization.

The research vessel "Gaveshani" of NIO was commissioned in 1976. The ship has a displacement of 1900 tonnes (DWT) and is equipped with several modern oceanographic equipment. With the commissioning of "Gaveshani", oceanography has taken a big leap forward in the country. One of the significant achievements of NIO has been the survey of the sea bed from the Bombay High oil fields to Bombay coast, for the transport of crude in pipelines. This survey alone has saved the country several

million dollars in foreign exchange. "Gaveshani" is at present fully engaged in the survey of minerals and fishery resources of the Indian waters. Notable achievements of "Gaveshani" in such a short time include the site selection for "Sagar Samrat" for test drilling in the Angria Bank off Ratnagiri and the location of several potential fishing grounds in the open waters of the Bay of Bengal and Arabian Sea.

Another important field of activity at the institute is aquaculture or sea farming. Certain varieties of mussels and oysters have been successfully cultured in our coastal waters. It is now proposed to develop the technology of aquaculture using treated domestic sewage.

NIO scientists have also made significant contributions towards the development of Indian harbours, protection of beaches from erosion, study of currents, diffusion and turbulence in coastal and nearshore regions for the disposal of sewage and industrial effluents.

Of late, the protection of marine environment from pollution has added new dimensions to the science of oceanography. In our coastal waters nearly 150 km<sup>3</sup> of domestic sewage and industrial wastes are being discharged annually. We are also using about 34,000 tonnes of pesticides for agriculture and 110,000 tonnes of synthetic detergents per year for washing and cleaning purposes. About 25% of these chemicals find their way into the marine environment. The world transport of crude oil across the seas is around 1400 million tonnes per year. Of the total volume transported from the Gulf countries across the Arabian Sea, a significant amount gets into the sea by accidental spills and deliberate dumping of bilge from the tankers.

The Indian scientists are doing their best to protect the marine environment from the adverse effects of pollution. Thus, from a modest beginning, the NIO has emerged as a fairly sizeable and prominent organization in the field of oceanography in the Indian Ocean region.

Another organization which has made very significant contributions to the offshore exploration is the Oil and Natural Gas Commission (ONGC). In 1973 the ONGC obtained the first jack-up platform, "Sagar Samrat", for offshore drilling, and by early 1974, it struck oil in commercial quantities in the Bombay High region. Of late, oil has been discovered in several other areas as well. ONGC has now five drilling platforms exploring and exploiting the "black gold" from the sea bed. In 1975, ONGC acquired its own research vessel "Anveshak", which is equipped with modern seismic, magnetic and other geological and geophysical equipment.

### International Cooperation

Oceans are known as the common heritage of mankind and scientists are supposed to be the seekers of truth and knowledge to be used by everyone. No single nation in the world has the capability to carry out all aspects of oceanographic research and exploit all types of resources from the vast oceans. Therefore, international cooperation becomes an essential prerequisite for oceanographic research.

Besides the multi-national programme, International Indian Ocean Expedition which ended in 1965, India participated in the Indo-Soviet Monsoon Experiment in 1973. The preliminary findings of this monsoon experiment led to the development of a big international project called MONEX (Monsoon Experiments), for the year 1979.

Other international projects in which India is involved are: (i) Marine Pollution (Petroleum) Monitoring Pilot Project (MAPMOPP) under the framework of Integrated Global Ocean Station System (IGOSS) of IOC, (ii) Marine Environmental Monitoring and Marine Living Resources Assessment for the Indian

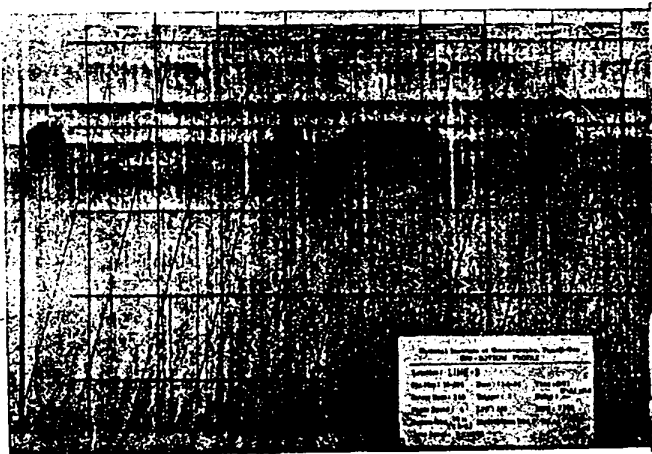


Fig. 3. Wave-like formations below the sediment surface indicating possible existence of natural gases. The total distance represented by the picture is 2 kilometres. Distance between the sediment surface and the peaks of the wave-like formations are approximately 15 metres. (From records of seismic survey carried out by GAVESHANI).

Ocean Region under United Nations Environment Programme (UNEP). Under these projects, several scientists were trained abroad in the use of advanced techniques. All the training components of these international projects are looked after by the Working Committee for Training, Education and Mutual Assistance (TEMA) in Marine Sciences — a subsidiary body of IOC. The present elected Chairman of TEMA is from India.

### The Future

Oceanography is an expensive science because this science is done at sea and hence the use of a ship and many sophisticated instruments become indispensable. Most of these instruments are yet beyond the capabilities of developing countries. In India also, we are yet to manufacture some of the highly advanced instruments needed for oceanographic research. In the field of shipboard equipment, it will be necessary to enter into collaboration with some of the industrialized countries. However, it is certain that with the progress that our country has made, we would be able to produce sophisticated instruments like precision-depth recorder, side-scan sonar, magnetometer, boomer, gravimeter, self-recording and telemetering current meters, spectrophotometers, satellite navigation system etc. needed for our work at sea, in not too distant future.

India has at present nearly one thousand marine scientists. Many of them are internationally acknowledged specialists in different fields of oceanography. During the past decade, there has been a sharp increase in the number of marine scientists trained in Indian universities. A steep upward rise has also been recorded in the quality and quantity of publications in marine sciences.

India is rapidly increasing her capabilities in developing indigenous technology in marine science. If our rate of progress remains the same as it is now, our country will soon become self-reliant in the field of oceanography.

Marine Scientist — May His Tribe Increase!

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