THE NATIONAL INSTITUTE OF OCEANOGRAPHY

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AN outline of the history and aims of the National Institute of Oceanography was given in *Nature* of March 17, 1951. The Institute has now been housed in its own premises for more than a year, and is fairly well established. The new laboratory is on Wormley Hill, near Witley Station, half-way to the coast on the main line from London to Portsmouth. The building was erected as part of an Admiralty research establishment in 1943 on a corner of the estate of King Edward's School, Witley; it is now rented from the Admiralty with the goodwill of the Bridewell Trust, which agreed to lease the site for the Institute's work. The building measures 180 ft. by 40 ft. and has four stories. Inside there are large well-lit working spaces for marine physics, biology, chemistry and other aspects of oceanography, a fairly spacious library, dark-rooms, drawing office, laboratory workshop, machine shop, carpenter's shop, storage space, kitchen and dining room. There are additional spaces in outbuildings for storage, battery-charging, sand-blasting and paint-spraying.

The advantages of such a building lying in a very pleasant and accessible position might be lessened by the fact that it is sited 350 ft. above the sea and 35 miles inland; but since the Institute's work needs mainly deep water and recording apparatus installed on widely separated parts of the coast, the objection is not serious. On the contrary, with such a wide range of subjects to be covered, there are advantages in being near London. The transport of equipment by road to the ship is not difficult, and often cheaper than bringing the ship back to the home port, and it is not a bad idea to treat each cruise as a small

expedition: the staff whose turn it is to go to sea take good care that the apparatus works, and they probably find it easier to get on with the work when they are detached from their homes and headquarters.

The annual report of the National Oceanographic Council for 1952-53 shows that some £22,000 had been spent on adapting and equipping the new building, and about half as much again has been used for completing the work in 1953-54; but the impression now given to visitors is one of a laboratory well suited for the immediate objects and for expansion.

The main emphasis of the Institute is on long-term research, but plenty of scope is allowed for work on immediate practical problems which have a useful bearing on oceanography and keep the staff in touch with other laboratories and potential applications of their work. Assistance is given to authorities concerned with marine aspects of defence research, and to those responsible for regulation of the whaling industry, and help and advice are given to many others. One of the most frequent ways in which help is given is in the analysis of complex records, for which the equipment developed for analysis of wave records is particularly suitable. Facilities for making observations in deep water are afforded to research workers from universities and other laboratories. The Institute has already an extensive and up-to-date library covering most aspects of oceanography, and deals regularly with a wide variety of requests for information.

The principal items on the Institute's own research programme are all aimed at increasing our under-

Fig. 1. National Institute of Oceanography, Wormley

Fig. 2. R.R.S. *Discovery II*

standing of the basic physical, biological and chemical processes in the oceans, so that present and future problems can be approached more intelligently than at present.

Research Programmes

Interchange of energy between atmosphere and oceans. Statistical estimates of the transport of heat from one part of the ocean to another are being based on the data collected by the Marine Division of the Meteorological Office from selected ships. The transfer of momentum from the wind to the sea is being studied from measurements of changes in direction and velocity of the wind near the sea surface, and measurements of the transfer of energy and momentum across a water surface are being made on the King George VI Reservoir and at sea.

Response of the sea surface. Wave recorders have been developed for most purposes, together with the apparatus for analysing the records, so that the development of the wave pattern can be treated realistically as the growth of a wave spectrum. By using shore-based wave recorders and selecting well-defined storms at varying distances, methods have been devised for predicting the wave spectrum in the storm area and at the coast. The work is now being extended to deep water (well away from the coast, tidal streams and other disturbing factors) with the help of routine wave recordings by ship-borne wave recorders installed in the Ocean Weather Ship *Weather Explorer* and R.R.S. *Discovery II*. Theoretical and experimental studies are also being made. A theoretical and practical study has been made of the relation between microseismic oscillations and waves, and a start has been made on an investigation of the sources of energy responsible for exciting the natural oscillations in coastal waters and 'range action' in harbours.

Wind drift is being studied with the help of continuous records of the varying e.m.f. between the English and French coasts due to varying flow of

water through the Strait of Dover, and with continuous records of the daily magnitude and direction of the flow of water past light-ships around the British coast. Figures are also being obtained from the recovery of drift-cards put out in the ocean west of the British Isles.

Wind-driven and thermodynamic circulation in the oceans. In view of the importance of a detailed understanding of the principal surface currents and deep-water movements to all aspects of oceanographic and fishery research, the study of oceanic water movements is intended to have first place in the Institute's programme of research in marine physics; but progress is slow because of theoretical and practical difficulties, and because the subject depends on

most of the other research items. While progress is being made with the preliminary studies, apparatus has been designed to measure the deep-water movements. One of the methods will use a pattern of sono-radio buoys to follow the path of a slowly-sinking acoustic transmitter; another will use a current meter towed in the deep layers by a very long cable to measure the relative speed of surface and deep movements. Arrangements have also been made for three-dimensional measurements of velocity close to the sea bottom to study the effect of friction for different water speeds and density profiles; this must be done in fairly shallow water.

Free and forced oscillations in the oceans. The velocities due to tides and internal waves must be taken into account in studies of deep-water movements, and a start has been made with the development of apparatus for measuring small pressure changes in deep water. Attempts are also being made to find a practical method of making continuous records of the oscillations of 'density layers' in the ocean.

Factors governing the distribution of marine organisms. The biological activities of the Institute have been founded on the work of the Discovery Committee, which regarded oceanographic work as an essential part of research on whales and built up an exceptionally rich and well-documented collection of oceanic plankton and other marine life. It is excellent material for studies of the distribution of marine plants and animals in relation to their environment, and adequate for the initial testing of any general conclusion about the effect of environmental factors on the movements and distribution of oceanic species. The key to the distribution of a number of pelagic organisms has already been found in the division of different stages in the life-history between surface and deeper-water masses and currents, and further investigations into such processes are being pursued.

Taxonomic and faunistic work. The collections can be roughly divided into the plankton samples obtained from standard nets which are used in the special studies of distribution already referred to, and the more general collections obtained from a variety of tow-nets, trawls, dredges and miscellaneous sources. The Discovery Committee's system of sorting these general collections into groups for examination by specialists is being actively pursued, and the Institute is indebted to many workers who are preparing, or who have already contributed, papers for the Discovery Reports. Contributions from such specialists, who work either in museums or other institutions or privately, are mostly taxonomic reports. Many of them are based on very extensive material, and it is fair to say that they make substantial contributions to what is known of life in the sea.

Productivity of ocean waters. Of comparable importance to the variety of life in the sea is the quantity of life and the rate of organic production. Much work in the field has aimed at a comparison of the wealth of the fauna and flora in different regions, and at relating the distribution of whales and plankton to the physical and chemical patterns. Observations were made over wide oceanic areas, in all latitudes from the Antarctic to the tropics, characterized by marked features or contrasts in fertility, and they provide data not only on variations from place to place but also at different times of year. In the analysis of such material good progress is being made towards the definition and explanation of normal distribution of, and regular variations in, the quantities of organisms; and work is being pursued into principles which should help to explain the less regular and long-period fluctuation, and to confirm other tentative conclusions.

Whale research. The main purpose is to study the bionomics of whales, and one of the principal objects is to acquire knowledge for the sustained and efficient exploitation of whales. Just as fisheries research is dependent on the oceanography of the fishing grounds, whale research is dependent on studies of the oceanic plankton, of the variations in oceanic productivity, and of the distribution of physical and chemical variables in the water, especially because the work is largely concerned with distribution, migrations and movements of the population of whales. Much effort is devoted also to anatomical and physiological studies of reproduction, growth and age, which in turn must be examined in relation to distributions and migrations, and the statistics of catches. The ultimate aim is prediction: to be able to make reasonably accurate estimates of where, when and in what quantities whales will be found, what will be the effect of hunting them at one time and place or another, and in what degree the populations will be able to replace their losses or recover from depletion.

New methods. The staff of the Institute includes workers with experience in most aspects of oceanography, and enthusiasm to apply them to practical problems. The methods and techniques developed cover a wide range of interests: for example, a fisherman wanting to know something about sub-surface currents would not use apparatus unless it was simple, cheap and required no maintenance; but a research worker does not mind how elaborate the mechanism or electronic circuit is, provided he can obtain a continuous record down to very low velocities. Both types of instrument have been

developed in the Institute; they include a fairly wide range of apparatus for recording waves, currents, water-level and beach profiles, and techniques for analysing and correlating records. Most of them have already been proved useful, and suitable for a wide range of applications.

Considerable attention is being paid to methods of sampling deep-sea animals which may be too active to be caught in towed nets. Detailed experiments have been made to find the most practical voltages, length and repetition frequency of electric pulses which might be used to prevent active animals from escaping a net. Underwater television has been tried for examining the water and sea bottom down to 1,000 ft. Experiments are being made with an echo sounder using a balanced transmitter and receiver which remain in the vertical as the ship rolls. Various adaptations of long lines, traps and other fishing methods for securing oceanic animals are also being tested.

Movements of sand and beach material. The Institute has inherited an interest in the factors which influence the growth and changes in offshore bars and harbour approaches, and affect landing operations on a beach. Much of the apparatus for recording wave height, oscillatory water velocities, wave reflexion, and small changes in ground profiles in shallow water and on the beaches has been developed; but the systematic approach to the problem has been delayed by the theoretical difficulties and prior claims of work involved in setting up the new laboratories and other projects. There are many demands for more precise information about the processes which influence coastal erosion and, although the problems belong to the field of hydraulic engineering rather than marine physics, the scientist whose work lies offshore can help to solve them.

Further details of the Institute's work are described in the annual reports of the National Oceanographic Council issued each year since 1949-50, and in its first volume of Collected Reprints issued in March 1954 and Discovery Reports which have been published from time to time as completed.

Many authorities have helped the Institute on to its feet and now, as in the past, the work owes much to the interest and support of the Superintendent of the Admiralty Research Laboratory and the Director and Trustees of the British Museum (Natural History), where the bulk of the Discovery Collections is still housed. Many zoologists, some of them on the staff of the Museum, have devoted much time to groups from these collections, and contributed to the Discovery Reports. The Chief Engineer, Post Office Engineering Section, has afforded much help in the study of the effect of wind on tidal streams, and the Elder Brethren of Trinity House have been very co-operative in allowing measurements to be made from light-ships. The Marine Division of the Meteorological Office has been most helpful in providing marine meteorological data and wave records taken every three hours while the *Weather Explorer* is at sea. The R.A.F. has given invaluable help in the study of drift currents in the eastern North Atlantic Ocean. Finally, the Institute is indebted to a number of whaling companies of several nationalities which have given indispensable help in the collection of material and generous facilities for the marking of whales, and to ships which have forwarded reports of the sighting of whales.