

remain unduly orientated to undergraduate needs. Yet the proportion of graduates will rise everywhere during the coming ten, twenty, thirty years; at some universities indeed (at the Imperial College of Science and Technology, London, for example) this policy is already fast being implemented.

In a period when it is the done thing to marry and have children early, especially in the professional classes, and when a parental means test for the graduate student must before long become a thing of the past, is enough thought being given even in the modern universities to the problems involved? The idea of raising the percentage of graduates accommodated in halls of residence by a variety of means, including the addition of specially planned halls for graduates, must be considered. At some universities already a few houses have been admirably adapted to yield numbers of flats for graduate students (though sometimes at the risk of isolating the graduate further from the life of the university);

and there are several active graduate students' councils. But the special needs and aptitudes of the graduate for a liberal education as well as for research training have been little regarded.

No doubt, Oxford and Cambridge are likely for some years to come to be magnets to graduates from elsewhere. But other universities, too, are attracting increasing numbers of students from outside themselves (including some from Oxford and Cambridge) and it is surely good that this should be so. Experience of two universities of differing temper and situation is often likely to be more enriching than of one only.

This pioneer report from Oxford is much to be welcomed—for its encouraging facing of local facts; for its wealth of practical ideas; but also for the example it gives other universities to set in motion corresponding investigations and to think thoughts of their own on their provision for the graduate within them.

W. R. NIBLETT

## THE INDIAN OCEAN EXPEDITION

THE Special Committee on Oceanic Research, meeting in Copenhagen and Helsinki in July, was set up by the International Council of Scientific Unions in 1957, on the grounds that a new international scientific organization was needed to strengthen and promote research in marine science. It was to initiate joint programmes in consultation with the scientific unions and other organizations. The Committee met for the first time in the Woods Hole Oceanographic Institution in August 1958, and among other measures proposed a joint expedition to the Indian Ocean. It tried to choose the area most likely to attract the attention of scientists, where the work would appeal to world organizations which promote science and human welfare, and where better understanding is likely to prove most immediately useful to the surrounding countries. The Indian Ocean was an obvious choice<sup>1</sup>.

The complete change-round of some of its currents in response to changes in wind direction will give physicists a fairly unique opportunity to study factors that influence water movements. Better knowledge of accompanying biological changes will improve our quantitative understanding of factors that control oceanic productivity. More detailed information about the distribution of fish—especially those that live in mid-ocean—in relation to the boundaries between currents and water layers should advance fisheries science and be readily usable. The Indian Ocean is an ocean with exceptional and prominent features. The exchange of energy between sea and air has much to do with the powerful monsoon winds, and any improvement in long-term forecasting of their onset and intensity will be very useful. We know there are large fish populations in mid-ocean, and records of tremendous mass mortalities occurring from time to time show that they live in critical marginal conditions. In geophysics, as in other aspects, the Indian Ocean offers attractive sites for research.

The justice of trying to boost science by pledging the anticipated success of a new scheme has rightly been questioned, and there is no doubt of the sincerity and good intentions of the editor of the

privately circulated "Indian Ocean Bubble", which has voiced very reasonable opposition. He does not quite say that skilled young scientists who form the real backbone of our research laboratories will be swindled by the promoters, but he criticizes the prospectus which probably has promised too much, and sounds a clear warning about the ill effects of hindering new approaches and critical experiments by too much regimented and routine work. He makes chilling reference to recent books, "The Tragic History of the Sea", by C. R. Boxer—three accounts of disastrous early Indian Ocean expeditions—and "The South Sea Bubble", by John Carswell—a general popular account of the venture that he frightens us with.

The effort devoted to marine science is, however, in no way commensurate with the magnitude, variety and difficulty of the problems it has to solve, and after a hundred years work, much of it devoted to fishery problems, we have little idea about the distribution of current with depth in any ocean. We can quote another editor who hailed the departure of one of our greatest expeditions to the Southern Seas with the words, "We may wait, it is true, and consign to centuries to come, the toils, the glories and the hopes of science, or we may rely on an easy effort distributed over length of years for the accomplishment of much that vigorous exertion might now effect". He continues, "There are secrets of Nature we would fain see revealed while we yet live in the flesh—resources hidden in her fertile bosom for the well-being of man upon Earth we would fain see opened up for the use of the generation to which we belong. But if we would be enlightened by the one or benefited by the other, we must lay on power both moral and physical without grudging and without stint". He makes a more encouraging reference to the poet who wrote:

"Nimm die Zögernde zum Rath  
Nicht zum Werkzeug deiner That"

These admonitions appeared in the *Quarterly Review* 120 years ago, and they are as timely and well-intentioned as the new cautions.

Extensive investigation of the South Atlantic Ocean by the German *Meteor* Expedition in 1925-27 did much to advance marine science, and there is little doubt that concerted effort with our new techniques in the Indian Ocean will meet with similar success provided we give ourselves as much time to learn from it, and avoid too much organization as a pattern of things to come. Perhaps the new venture follows too soon on the International Geophysical Year surveys, but the organization and the problems are being approached very carefully, by the research-minded scientists as well as those who see the need for some campaigning.

The planning and operating of programmes is being done by national committees for oceanic research. Growing interest in them has already sent research ships from the United States and the U.S.S.R. to the Indian Ocean, and useful observations are also being made by H.M. survey ships and Royal Australian Navy frigates. At the peak of activity, covering the north-easterly and south-westerly monsoons of 1962-

63, there may be as many as twelve ships working in fairly close co-operation. It is expected that a ship from the United Kingdom will be there, and that she will play an effective part in the programme as well as serving as a base for scientists whose work is likely to be advanced by special observations in Indian Ocean conditions.

The Special Committee on Oceanic Research chose Copenhagen and Helsinki for its meetings because many marine scientists were already at Copenhagen to take part in intergovernmental discussions arranged by Unesco, and at Helsinki to participate in the scientific meetings of the International Union of Geodesy and Geophysics. There is much careful and detailed work to do. Those taking part will be heartened by the recent announcement from the White House of active support to the U.S. contribution for which the National Academy of Sciences-National Research Council is scientifically responsible.

G. E. R. DEACON

<sup>1</sup> See *Nature*, **180**, 894 (1957).

## WATER RESOURCES IN THE UNITED STATES

THE pressure of growing populations with rising standards of living increasingly brings water into focus as a basic raw material in need of both study and conservation. Nowhere is this realized more fully than in the United States, where development in a wide range of activities is at present limited by water supplies. As a result of Senate Resolution No. 48 of the eighty-sixth Congress of the United States a Select Committee on National Water Resources was set up in 1959 to study the extent and character of water resources activities required to provide the future quantity and quality of water needed for all segments of the economy in the United States.

Headed by Senator Robert S. Kerr from Oklahoma, this Committee has now been at work during the past year and has within a short space of time produced an impressive array of reports on a wide variety of hydrological topics\*. Although confined to the United States, many of these reports have relevance to water problems that the United Kingdom and the Commonwealth face, and it is the aim of this review to indicate the coverage of the reports so far available together with their main conclusions. The speed with which the Select Committee has produced a great body of useful basic material is notable, and this has been achieved by the Committee calling upon existing authorities and organizations to provide the appropriate hydrological information.

\* Reports available in June 1960 and printed for the use of the Select Committee on National Water Resources of the United States Senate pursuant to Senate Resolution No. 48 of the Eighty-Sixth Congress. Government Printing Office, Washington:

No. 2, Reviews of National Water Resources during the Past Fifty Years, October 1959; No. 3, National Water Resources and Problems January 1960; No. 4, Surface Water Resources of the United States, January 1960; No. 7, Future Water Requirements for Municipal Use, January 1960; No. 9, Pollution Abatement, January 1960; No. 12, Land and Water Potentials and Future Requirements for Water, December 1959; No. 13, Estimated Water Requirements for Agricultural Purposes and their Effects on Water Supplies, December 1959; No. 16, Flood Problems and Management in the Tennessee River Basin, December 1959; No. 19, Water Resources of Alaska, January 1960; No. 20, Water Resources of Hawaii, January 1960; No. 21, Evapo-Transpiration Reduction, February 1960; No. 22, Weather Modification, January 1960; No. 23, Evaporation Reduction and Seepage Control, December 1959; No. 24, Water Quality Management, February 1960; No. 25, River Forecasting and Hydrometeorological Analysis, November 1959; No. 26, Saline Water Conversion, November 1959; No. 27, Application and Effects of Nuclear Energy, December 1959; No. 28, Water Resources Research Needs, February 1960.

As a result the reports fall into a number of natural groups largely related to the reporting department, the stage being set by No. 2, where the Legislative Reference Service of the Library of Congress reviews and summarizes the work of more than 20 commissions or committees which have investigated national water policies and problems in the United States during the past fifty years. With few exceptions previous study groups have paid little attention to the questions which the Senate has placed before the present Select Committee; notably, "How much water development is needed? When is it needed? Where is it needed? What should be the pattern of water development? What amounts of water will be required in relation to various levels of population and economic activity? What are the economic limits of water development?"

One of the first authorities that the Committee turned to for basic information was the Geological Survey; this department has prepared reports Nos. 3 and 4 dealing with the national water resources, both surface and underground, and related problems. In addition to furnishing quantitative information showing the use of water, the availability of water, and the amount of storage required to maintain certain rates of river-flow, report No. 3 identifies and discusses water problems in the fields of supply, variability, distribution, natural quality, pollution and floods. The report indicates that almost every part of the United States faces current or potential water problems. An estimated water use in 1960 of 250 thousand million gallons of fresh water a day is projected to rise to 600 thousand million gallons a day by 1980. This fortunately still falls considerably short of the estimated manageable supply of 1,160 thousand million gallons a day, but it does mean that in many areas much water will have to be used over and over again and that pollution abatement becomes critical. Report No. 4 presents in tabular and map form the surface water resources of each State. Data on average, maximum, and minimum discharges in cubic feet per second, and average annual run-off in acre-feet at key-points within each State are given, together with a very interesting set of maps showing