

methods. A. H. Laurie finds that Blue whales reach physical maturity at ten or eleven years of age and that they breed only once in two years at most and often only every third year. The length of female Blue whales has decreased so much that on an average they are caught before they have had time to reproduce at all. Continued fishing on the present scale must have a disastrous effect on the stock. As Laurie points out, when killing has reached the point at which recruitment shall virtually have ceased, the future of Blue whales and whaling will

be limited to the lifetime of those whales now living. Shall it be said of whaling as may now be said of other branches of the fishing industry: *inopem me copia fecit*?

¹ Discovery Reports, vol. 15. Title page and Contents. Pp. vi. 9d. net. The Hydrology of the Southern Ocean. By G. E. R. Deacon. Pp. 124+44 plates. 30s. net. Notes on the Dynamics of the Southern Ocean. By G. E. R. Deacon. Pp. 125-152. 4s. net. New Species of Marine Mollusca from New Zealand. By A. W. B. Powell. Pp. 153-222+plates 45-56. 15s. net. The Age of Female Blue Whales and the Effect of Whaling on the Stock. By A. H. Laurie. Pp. 223-284. 9s. net. (Cambridge: University Press, 1937.)

Progress in Building Research

A MATTER of considerable importance dealt with in the report for the year 1937 of the Building Research Board, by Dr. R. E. Stradling, director, is the account of the work done in connexion with "Soil Mechanics". This is a new and rapidly developing branch of engineering science which, it is felt, has not received from practising engineers in Great Britain the measure of recognition accorded to it elsewhere. The report therefore lays especial stress on the importance of recent developments in this direction. In the past, it is pointed out, such civil engineering problems as those associated with foundations and the stability of cuttings and embankments, have had to be dealt with on an empirical basis. As the necessary scientific knowledge did not exist this was inevitable; but a new school of thought has arisen and, following the lines explored by Terzaghi and others, the Station has been engaged in a programme of research. In this it has been actively assisted by the Earth Pressures Committee of the British Association, and by an Earth Pressures Sub-Committee set up by the Institution of Civil Engineers. Abroad, the results of research have had a large measure of application and there are reported to be signs of increasing attention here, the inquiries received at the Building Research Station being taken to show that engineers are becoming more fully aware of the assistance which this new science can give in promoting accurate and economical design. This increased interest has had the result that the soil mechanics section at the Station has been strengthened and it is hoped, with the support of outside bodies interested in its aims, to extend its operations and so to hasten the work of fundamental research and the solution of problems of immediate practical interest.

The two avenues of soil research which have been mainly followed at the Station are in connexion with the settlement of structures and the stability of earth slopes. In its method of dealing with the former the development of this science has led to a complete change in the mode of approach to this type of problem. In the past, it was held that the type of soil alone governed the pressure which could be imposed upon it. From the accumulation of practical experience, certain broad rules were evolved and, as a result, the so-called 'bearing values' of different soil types were embodied in tables which formed the basis of design. In difficult or doubtful cases loading tests might be carried out, usually on comparatively small areas, in an endeavour to assess the bearing value in these cases.

The new mode of approach is through an under-

standing of the mechanism by which settlements take place and, considering the structure itself, the relative amount of settlement permissible as between one part of the structure and another is regarded as the determining factor in the design of the foundations. It is to the work of Terzaghi and his followers that an appreciation of the broad aspects of the problem is due. Although, as the report states, the mechanism by which settlements occur has not as yet been fully explained, it is understood that settlement depends not only on the type of soil immediately below the footings but also on the nature of the soil strata to a considerable depth. A deep-seated stratum of soft clay may be, and indeed has often been, the cause of serious settlement. Apart from the influence of the pressure on a footing, settlement depends on the size of the footing, the depth at which it is placed and the presence of other footings in the immediate proximity. In the case of clay soils, time is also an important element, for settlement continues at a diminishing rate for a period determined by the conditions, and failure may occur some time after the completion of the structure. With so many factors entering into the problem, the difficulty in interpreting the results of loading tests and in appraising the limitations associated with them becomes obvious.

In the second part of the report, which contains the more detailed account of the Station's activities during the year, an outline is given of the methods employed in estimating and analysing the settlement of a structure. It is based on the laboratory examination of soil samples taken in an 'undisturbed' condition from several strata beneath the structure. From the results of tests made with the Terzaghi oedometer together with calculation of the distribution of pressure from the building, it is possible to estimate the amount of settlement to be expected. It may be objected that the conditions of the test do not actually reproduce those existing in practice, and this is acknowledged, but if, from actual measurements, agreement can be shown between the actual and the estimated movements, then a very great step forward can be recorded. This represents the present stage of development of the subject; every effort is being made to get information about such comparisons and, the more the work progresses, the more impressive does the closeness of the correlation appear. The results of work done in connexion with a new building for the Fire Testing Station, Elstree, will shortly be published and it is claimed that the agreement in this case is as near as one can hope to get. Further cases are under observation and, as the data from these become available, this method of testing and

analysis will be more firmly established. It certainly provides a much more accurate design technique than any other known method.

On the cognate subject of the stability of earth slopes, the report states that special opportunities have arisen during the year for the study of earth bank failures on a practical scale, and the various engineers concerned have given facilities for samples and measurements to be taken on the sites. It is now held that the stability of an earth slope depends upon the shear characteristics of the soil in the slope and in the foundation layers. The shear resistance of clay has been shown to depend on its cohesion, with the result that the maximum angle at which a clay slope can stand without support decreases rapidly

with increasing height. This puts a new complexion on the problem, and the report shows how progress is being made to determine the properties of soils and how these and other aspects of it are being investigated.

These notes treat of but one of the many interests being dealt with by the Station, ranging from the homely problem of the smoky chimney through the whole gamut of building problems to research on the constitution and properties of materials. Both in its routine work and in special investigations the fact is clearly recognizable that the services of the Station are of great value to the building trade and to the nation, as well as to the promotion and development of applied science in a wide field.

Australian Echinoderms

DR. H. L. CLARK'S first papers on Australian echinoderms appeared in 1909 when he described the Australian forms in the Museum of Comparative Zoology, and the *Thetis* collection made off New South Wales and at Lord Howe Island. They proved to be the forerunners of a series, continued to the present day*, in which he has made known far more about Australian echinoderms than any other man. He has described the collection of the Western Australian Museum (1914); the many echinoderms, excepting the holothurians, taken by the *Endeavour* off the coasts of Queensland, New South Wales, Tasmania, Victoria, South and Western Australia (1916); a small collection from Western Australia (1923) and another from the Barrier Reef (1926); the very large collection, other than the holothurians, of the South Australian Museum (1928), mostly southern forms; and the echinoderms, other than asteroids, of the Barrier Reef Expedition (1932).

All but the first of these papers were on collections submitted to Dr. Clark, as an expert in another country, by Australian and other authorities. The collections comprised nearly 6,000 specimens among which were representatives of 113 new species. In the meantime, in 1913, Dr. Clark had been to Australia himself and had made a large collection in the Torres Strait. It was described in two papers in 1915 and 1921.

These notes on earlier papers are given as a background against which to see Dr. Clark's most recent work. They show that he had described a great deal of material from all coasts of Australia except the north-western, which remained a *terra incognita* in marine zoology. His most recent paper describes the very rich echinoderm fauna he found in the north-west and much additional material from all other coasts as well.

It is based on specimens which for the most part he himself collected, alongshore and by dredging, on his visits to Australia in 1929 and 1932. Treating the two visits as one, he spent six weeks at Darwin, visited two points on the coast between Darwin and Broome and spent three months at Broome; small collections were made, where echinoderms occurred, at five points between Broome and Perth, and three weeks collecting was done from Fremantle. There followed short visits to study the material at the

Museums of Adelaide, Melbourne, Hobart, Sydney and Brisbane and collecting excursions from some of them. Finally, three weeks were spent at Lord Howe Island in the Tasman Sea.

Dr. Clark returned to America with more than 11,000 specimens of echinoderms of which he and his immediate helpers, including Mrs. Clark, collected nearly 10,000, the remainder being loans and gifts from museums and other sources in Australia. They represented 422 species of which 128 were new. The descriptions of the species are, as in Dr. Clark's papers on the Torres Straits collections, richer because the author saw them alive and observed their abundance and habits and colours. His descriptions of these things will be invaluable to those who may seek the animals in life. They are of great interest to students who cannot; for them Dr. Clark has described too the colours the species have when dried or kept in spirit—though it is often the dingy brown called 'museum colour'. There are eighteen beautiful coloured plates based on sketches made from life by Mrs. Clark; they and the coloured plates of the Torres Straits report must make the Australian echinoderm fauna one of the best illustrated in colour in the world.

The report falls into five sections corresponding to the five echinoderm classes. Before each, Dr. Clark tells us, among other things, where the members of this class are most abundant in Australian waters, in what sites they should be sought, and how they may best be fixed and preserved. Because the species of the starfish genus *Anthenea* are mostly Australian and Dr. Clark had a large series before him, he has discussed or described all the known species and given a key to them. In the ophiuroid section he has made a beginning with—what has long been overdue—a sub-division of the large genus *Ophiothrix*, starting with the long-armed species of the Indo-Pacific region. At the end of the volume are local lists of echinoderms for ten localities.

Dr. Clark has in earlier papers discussed the geographical distribution of the Australian echinoderm fauna and its relationships to that of other regions. Now that he has collected and described so much new material, a great deal of it from the hitherto unknown north-west, it is good to know that in a subsequent report he hopes to give a full account of the fauna as at present known, and to discuss its apparent history and relationships. D. D. J.

*"Echinoderms from Australia, an account of Collections made in 1929 and 1932" by Dr. Hubert Lyman Clark. *Mem. Mus. of Comparative Zool.*, 55. Pp. 596 + 23 pls.