and Great Britain" which Dr. P. F. R. Venables delivered at the British Association meeting last August. Noting that the emphasis placed in the United States on general education and social studies in the curricula for courses for technological degrees is primarily on professional grounds, he suggested that this aspect of technological education deserves more attention in Great Britain than it has received. Even for part-time degrees and 'higher national certificates', he suggested that experiment is required in the provision of such post-advanced courses, especially by university extra-mural departments, and that such part-time postgraduate courses would have the advantage of being given to older students with industrial experience of potential significance.

The value of that argument is fully admitted by Mr. Raybould in discussing the question of standards; but Dr. Venables advances a further reason which, particularly at the present time, should ensure that the claims of adult education on the universities receive careful evaluation. Dr. Venables expresses the view that the courses in engineering and business administration described in the United States as 'social technology' have completely justified themselves, both as regards the students and also as regards industry, which because of its increasing complexity and its social problems needs men who are trained to handle people as well as to initiate and develop processes. He suggests that we would do well to examine the possibility of making similar provision in Great Britain, and not least in relation to productivity problems.

Any such examination must at present take account of what is being done both in the universities and in the technical colleges, and emphasizes the undesirability of dealing with technological education and university education in isolation, either from one another or from adult education in general. Mr. Raybould urges almost as strongly as Dr. Venables that not only are industrial relations an important subject of study in universities as well as elsewhere, but also that, because of the concern of such study with ends as well as means, it is particularly appropriate for association with adult education, when theory can illuminate—and itself be illuminated by—practice. Such subjects as international relations and industrial relations are, he suggests, more effectively developed as adult than as undergraduate studies, and in no other subject is there greater need for the characteristic methods and virtues of the university—thoroughness, candour and tolerance.

Persuasively though Mr. Raybould presents these important arguments for university participation in adult education, he does not disguise the test of such participation which he himself suggests. He contends that whatever the subjects studied, the attainment of a 'university standard' of work in extra-mural classes normally demands a long and systematic course of study. Given this and the conditions implied, but not otherwise, Mr. Raybould maintains that adults may, in part-time courses, undertake work and achieve results which justify universities in providing the teaching, particularly in the humanities and in those studies needed for the effective discharge of the responsibilities of citizenship. Since 1945, however, university extra mural agencies have provided a much larger number and proportion of short courses not involving "serious student effort" than at any time before that date. The expectation that the short courses would lead to longer and more systematic courses has not in general been realized. Accordingly, Mr. Raybould suggests that a radical change of policy in extra-mural work is required, with a shifting of emphasis from quantity to quality. First, he would omit most of the short courses which do not involve, in addition to attendance at lectures and discussions, directed study on the part of the students, apart from such courses, such as refresher courses designed to keep graduates engaged in teaching, industry or professional work in touch with current research in their special subjects. In most universities this policy would involve a scaling-down of programmes of work and the transfer of responsibility for elementary courses to other bodies such as the Workers' Educational Association.

Mr. Raybould recognizes clearly what is implied by such a policy, and the modifications in organization, the staffing of extra-mural work and financial arrangements which are involved. These are discussed in successive chapters in which criticisms already advanced of university participation in this work are considered in relation to particular points. All his experience does not make Mr. Raybould dogmatic; but he is confident that the difficulties can be overcome and is convinced that here is work which the universities should undertake, but with deeper insight and a fuller sense of responsibility, and with something of the spiritual impulse which inspired the whole movement thirty or forty years ago. Only then are the universities likely to avoid the danger of dissipation of their resources.

There can be no question that constructive and imaginative thinking is required, no less on the part of the universities than of the Workers' Educational Association itself. To the future policy of that Association Mr. Raybould directed attention in his booklet "The W.E.A.—the Next Phase", published two years ago. The questions there discussed are raised again in his book, and in a wider context, which makes it clear that the right answers can only be found when the functions of the universities and the broad educational situation of Great Britain are taken into account. The vital need is for fresh thought about the nature and purpose of adult education.

'OPOSSUM SHRIMPS'

The British Mysidacea

By the late Prof. W. M. Tattersall and Olive S. Tattersall. (Ray Society, Vol. 136, for the Year 1950.) Pp. viii+460. (London: Bernard Quaritch, Ltd., 1951.) 42*s*.

WHEN Prof. W. M. Tattersall died in 1943, he had been collecting materials for a monograph on the British Mysidacean Crustacea which was to be published by the Ray Society. In this work he had been assisted by Mrs. Tattersall, herself a competent zoologist, who had prepared a

considerable number of the illustrations. Most of the voluminous material, however, was in the form of notes, lists of localities and so forth, and only a few pages were actually ready for the printer. Mrs. Tattersall resolved to undertake the heavy labour of completing the monograph, incorporating her husband's notes and preparing the rest of the drawings. It may be said at once that she has accomplished admirably her self-imposed task, and that the many friends of her late husband will be grateful to her for having provided this worthy memorial to him.

The book opens with a historical summary of the literature on the group, followed by chapters on the general morphology and bionomics. These chapters are quite competently done, although Prof. Tattersall's great experience would, no doubt, have enabled him to supplement them on many points. It would have been interesting, for example, to have had a fuller discussion of the so-called 'luminous organ', from which the genus *Gnathophausia* derives its name. In the systematic part which follows, the keys to families, genera and species seem to be well constructed, although their adequacy could only be tested by using them in the actual determination of specimens. The generic and specific diagnoses are clearly phrased and so arranged that comparison is easy. The figures are admirably clear and, from an artistic point of view, are not unworthy to be placed alongside the work of such masters of crustacean iconography as G. O. Sars and H. J. Hansen.

A valuable feature of the book is the list of localities in British seas given for each species. These lists are taken from Prof. Tattersall's notes, and, in very many cases, were authenticated by his own examination of specimens. Where this could not be done, the names of the authors responsible for the records are given. As in the case of many other groups of marine invertebrates, these lists show how patchy is our knowledge of the distribution of the littoral fauna around British shores. Very few marine laboratories have published lists of the local fauna like that available for Plymouth, and over great stretches of coastline where there are no laboratories the composition of the littoral fauna is a subject for guesswork. For example, there is some reason for believing that the fauna of the shores of the Moray Firth differs considerably from that of the rest of East Scotland; but there are very few Mysidacea recorded from it in this work.

A good deal of importance is attached to Geoffrey Smith's supposed discovery of a vestigial exopod on the mandible of *Paranaspides* (which is not, of course, a Mysidacean, as the unwary reader of p. 10 might be led to suppose). It is necessary, therefore, to say that no one has been able to confirm Smith's statements on this point and that the 'exopod' was certainly absent in the single specimen dissected by the present writer in order to search for it.

Misprints and similar errors, although not numerous, are sufficiently conspicuous to suggest inadequate proof-reading, for which, of course, the author may not be to blame: "neutral" for "neural" makes nonsense on p. 360; Davis Straits is not in Scotland (p. 119), nor St. Andrews in the "north" of that country (p. 372); the maxilla is not a "thoracic" appendage (p. 300); and a very distinguished British zoologist of the last generation (or the one before that, perhaps) did not spell his name "Lancaster" (p. 433). Finally, several references in the text are not explained in the bibliography at the end of the volume.

W. T. CALMAN

NATURAL HISTORY OF GUANOS

Survey of Existing Knowledge of Biogeochemistry, 3

The Biogeochemistry of Vertebrate Excretion. By George Evelyn Hutchinson. (Bulletin of the American Museum of Natural History, Vol. 96.) Pp. xviii+554+16 plates. (New York: American Museum of Natural History, 1950.) 10 dollars.

GUANO has played a considerable part in agricultural history. The original Peruvian material began to be imported into Great Britain, in substantial amount, during the 'hungry forties' of the nineteenth century, and for more than a generation it constituted a substantial part of the total fertilizer supply. In the southern part of the United States, also, it restored the productivity of the worn-out soils of the old tobacco and cotton plantations. We now know that its effects are to be explained simply enough—it provided both phosphate and nitrogen in concentrated and readily available forms. But farmers often thought of it as something with quite miraculous properties.

Mr. G. E. Hutchinson's monograph is by far the most complete treatise on the subject, and the standard of his scientific scholarship is of the highest. He enumerates and describes the known deposits, analyses the climatological and biological conditions under which they have been formed, critically examines the great mass of literature and points to the lack of proof for some of the earlier theories and to the remaining gaps in our knowledge.

Many of the broad generalizations about guano formation are easily to be understood. Large volumes of excrement and egesta will be deposited wherever large numbers of sizable animals congregate to rest or to rear their young. Marine birds and seals yield the largest quantities of possible raw material; and in both cases a fish diet results in material with high initial contents of phosphates and of nitrogen compounds. But, other things being equal, the product from birds will have the higher value, because the excreted nitrogen is mostly in the relatively stable form of uric acid and, moreover, is in a semi-solid form that is rapidly desiccated. Preservation is tolerably complete only on rainless sites, because even moderate and occasional moistening leads to a breakdown of nitrogen compounds into volatile products. Again, the eggs and young of sea-birds are liable to wholesale destruction by land predators, so that island sites are the only ones that can support large permanent bird-colonies; certain rainless islands, however, are uncolonized because soil or rock surfaces reach day temperatures that are lethal to developing embryos.

In many cases the population of guano birds shows marked cyclical changes—usually a gradual build-up followed by holocaust. The latter does not seem to result from a build-up either of birds of prey or of parasites, and famine rather than epidemic disease seems to be the common cause. The catastrophic falls are more marked among surface-feeders than among deep-diving species, and may thus probably be related to changes in the size and frequency of shoals of shallow-swimming fish. Where the chief food of a particular surface-feeding bird is a species of fish that swims at depths which vary according to the relative temperatures of the upper and lower waters, the immediate cause of catastrophe might be, for example, a persistent high temperature of the uppermost layer of the sea. It is thus tempting to