The editor next discusses the position and classification of the Protozoa and directs attention to the difficulties they present. He has gone back to the old name Protista, given by Haeckel in 1866, and recognizes a Phylum Protista which includes both the branches (*embranchements*), Protozoa and Proto-phyta, which cannot be clearly separated from one another. He employs the term phylum in a higher ordinal sense than is general in Britain, for he recognizes only two phyla of animals—the Protozoa and the Metazoa—and so his term *embranchement* corresponds more closely with our phylum. Transposing the terms in this way, he divides the Protozoa into five sub-phyla as follows: the Rhizoflagellata containing the more general Rhizopoda and Flagellata, again combining them because of the overlap; the Actinopoda (Acantharia, Radiolaria and Heliozoa), the 'pseudopodia' of which are of a fundamentally different type from those of the rhizopods; the Sporozoa; the Cnidosporidia; and the Ciliata. While perhaps this classification may not meet with general acceptance since it differs so noticeably from what may be called the orthodox, it is logical and deserving of careful consideration in view of the arguments put forward in support of it. What may surprise most general zoologists is the transference of the opalinids from the ciliates to the flagellates.

The present volume deals only with the general introductory matters and the sub-phylum Flagellata. The introductory accounts of the structure, physiology, nuclear behaviour, life-cycle and biology of the various categories form a valuable part of the work. Under the systematics of each class there is, wherever possible, a section dealing with its fossil members, a reminder of the present interest in microfossils. It is regrettable that the exigencies of the times are reflected in the price, for this highly commendable book should be readily accessible to every zoologist.

C. H. O'DONOGHUE

HYDROGRAPHY IN FISHERIES RESEARCH

Hydrography in relation to Fisheries

Being the Buckland Lectures for 1938. By Dr. John B. Tait. Pp. xii+106. (London: Edward Arnold and Co., 1952.) 7s. 6d. net.

THE Buckland Lectures are given each year to varied audiences by a scientific worker engaged in fisheries research. Before the 1938 series, the Lectures had been given by biologists or zoologists; the series just published differs in that Dr. J. B. Tait makes his contribution as a physicist interested in the sea itself rather than in its animals. An introduction explains the subject of hydrography (or physical oceanography) and, with examples, justifies the existence of a hydrographer in a fisheries laboratory.

In Chapter 1 Dr. Tait discusses the effects of physical conditions in the sea upon fishes. He deals at length with the part played by temperature in determining the geographical distribution of the various species and collates the results of many workers in this field during the past fifty years. Evidence that spawning is stopped by abnormally high or low temperatures is given, and this is followed by a table listing the ranges of temperature, salinity and depth in which the various species of fish are found. Once the fish have spawned, the rate of

development of eggs is largely influenced by the water temperature; for example, herring eggs hatch in under a week at 14° C., but would take about seven weeks at 0–1° C. Growth of the larvæ similarly is more rapid at the higher temperatures; off the east coast of Scotland spring-born herring grow in length and weight more quickly than those born in August and September. Before leaving the influence of temperature on adult fishes, Dr. Tait mentions the exceptionally cold winter of 1928–29 during which large numbers of fish were killed by the extreme conditions. These facts were corroborated during the early months of 1947 in similar conditions. The effects of salinity, light intensity, viscosity of the sea water, and osmosis are briefly discussed.

One of the most interesting aspects of hydrography is the study of currents in the sea. Dr. Tait mentions several approaches and then gives a fairly comprehensive account of his own work with drift-bottles in the northern North Sea and adjacent regions. The manner in which the information accruing from the recapture of bottles is used by the scientific worker in constructing a picture of the current systems over wide areas is described. The importance of a knowledge of these systems is stressed and illustrated with many examples, one of which is the controversial question of fish migrations. The most widely accepted theory suggests that migrating fish swim against the current, and is apparently supported by the movement of eels in the Atlantic Ocean, of cod near Iceland, and of plaice in the Shetland Islands area, to quote the text. Dr. Tait adds that 'as the knowledge of currents grows in detail, so will this theory receive the greater confirmation'.

In Chapter 2 the reader is taken into the chemical department of the hydrographer's laboratory. He is introduced to the difficulties in analysing sea water and to the importance of such characteristics as hydrogen-ion concentration. In the sea where the concentration of the nutrient salts approaches, and often falls below, the limit required by marine organisms, it is obviously desirable to measure these concentrations; chemical oceanographers have worked out methods to estimate the number of parts of these elements per thousand-million parts of sea water, and the effects of their variation on fisheries can now be studied.

In his last chapter, Dr. Tait relates fluctuations in the abundance of fishes to hydrographical conditions in their environment. A diagram showing sea temperature and monthly catches of haddock would appear to indicate a complete explanation of the varying catch; but, as stated, the solution is not so simple. Dr. Tait presents the outline of his argument for the relation between fishery fluctuations and the incursions of Atlantic oceanic water into the North Sea. Although obviously aware of the scarcity of suitable hydrographical data, he finds support in a similar environment in the English Channel. It is interesting to read a note appearing in *World Fishing* of January 1953: "Reports from the Baltic indicate that the salinity there has increased considerably in recent years. As a consequence, the inflow of cod has been better and, although previously cod did not appear in Finnish waters, Finnish fishermen are now obtaining reasonable catches".

In closing, Dr. Tait would welcome more systematic and intensive measurement of hydrographical factors; but it will be apparent to all readers of his book that important steps have been made in spite of the difficulties in observing at sea. DAVID VAUX