

be true, but needs to be argued. Growth, water flow and geographical distribution in blastoids are discussed by Macurda. Fay and Wanner wrote the systematic part.

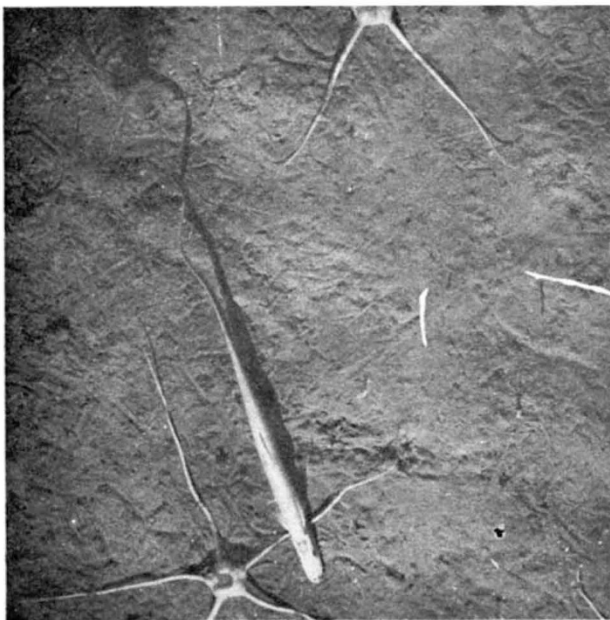
The chapter on Eocrinoidea by Ubaghs is a major advance. It is the first attempt to describe this important group comprehensively and in detail, and is virtually faultless. Ubaghs also wrote the chapter on Stylophora. I have recently transferred these animals to the Chordata (*Bull. Brit. Mus. (Nat. Hist.) (Geol.)*, 16 (6); 1968), because they possess gill slits and other chordate features, and their stems can be taken as equivalent to tails. For Ubaghs, however, the stems are arms. In my opinion his view disagrees with the observed structure of the stems and of the thecae. I find it impossible to understand Ubaghs's work without "translating" it and turning most of the pictures upside down. No doubt he has equal but opposite difficulty with my work. It is fitting to add that the writing is clear, the observations objective and the systematics largely acceptable.

The chapter on Cineta, also by Ubaghs, is the first real contribution to knowledge of this group for forty years. Ubaghs may have transposed mouth and anus. The plating of the presumed food groove does not look right for its suggested function. The Soluta are dealt with by Caster. This appears to be a contribution of high standard.

A summary of knowledge, such as this one, also reveals our ignorance. Two things are obvious: first, there must be innumerable forms to be described especially from the Cambrian; second, the internal anatomy is unknown in the great majority of cases. Future work must fill these gaps, and allow us to write a connected history of our earliest ancestors and their relatives.

R. P. S. JEFFERIES

## DEEP-SEA STUDIES



A holosaur of the genus *Aldrovandia*, one of several fish that live at the bottom of the sea. It is seen in this picture with a brittle star. As shown, holosaurs swim by undulating the rear half of the tail, though exceptionally the whole body may be thrown into eel-like waves. This picture from a chapter entitled "Deep-Sea Photography in the Study of Fishes", by N. B. Marshall and D. W. Bourne, is one of many in the latest number, *Deep-Sea Photography*, edited by J. B. Hersey, in the series, *The Johns Hopkins Oceanographic Studies* (Johns Hopkins Press: Baltimore; Oxford University Press: London, 1965 6d).

## FISH MIGRATION

### Fish Migration

By F. R. Harden Jones. Illustrated by H. E. Jenner. Pp. viii + 325. (Arnold: London, April 1968.) 120s.

DESPITE its importance to the pure and applied fish biologist and the large research effort devoted to its investigation during the present century, no general account of the subject of fish migration has appeared in the English language since Dr Alexander Meek's classical work was published in 1916. Since that time, with the development of new techniques of investigating fish movements in the field and laboratory, important advances have been made in our understanding of their general migration patterns in the sea and in freshwater, and of the sensory and behavioural mechanisms governing them. This work has been conducted on many different species of fish in different parts of the world; in consequence, a very large and scattered literature has accumulated, presenting the student of this subject and even the advanced research worker with a major literature search problem in becoming fully informed of the results of past work and in keeping up to date with current progress in this field. An authoritative, critical and up to date account of the present state of knowledge on this subject was therefore urgently needed.

Dr Harden Jones's book fulfils this need most impressively; in my view it is one of the most important post-war additions to the literature on fish biology and will probably remain the most complete work on the subject of fish migration for many years to come. It should be read not only by all students and research workers in the fish biology field but also by workers engaged in studies of the migrations and movements of other animal groups.

The book contains thirteen chapters, which fall conveniently into three main groups, namely, chapters 1-3, 4-9 and 10-13, each dealing with a major division of the total subject matter. The first three chapters provide a general introduction to the subject, starting with the meaning and definition of migration and other relevant concepts and terms, followed by a general description of features of the general biology, physiology and behaviour of fish, and of the environment in which they live, of relevance to migration processes, and a brief review of the methods used in the study of fish migration. This is followed in chapters 4-9, which make up just over half the text, by a critical review of the available information on the migration patterns and processes for each of five, widely differing groups of fish, which have been subject to intensive investigation for many years and on the explanation of the migration processes of which various hypotheses have been erected. These chapters, I think, form the main meat of the book. Then, in the remaining chapters, the author examines the basic mechanisms involved in fish migration, including the concept of and evidence for homing; the parts played by directed and undirected movements in migration; the types of sensory stimuli governing fish movements and the behavioural responses to them. Finally, in chapter 13, the author draws attention to the absence of critical scientific data relating to many of the mechanisms involved in the migration processes in the sea and hence of the difficulty of assessing objectively the validity of the various, often conflicting hypotheses erected by different workers describing them. As he also points out, however, the recent development of new techniques, especially sector scanning sonar, for tracking the detailed movements of fish in the sea has provided the wherewithal for more precise studies of these basic mechanisms in the future.

The author has collected together in chapters 4-9 a vast amount of detailed descriptive information, some of it previously unpublished, in presenting an objective picture of current knowledge of the migrations of his