A. C. Hardy. "The Open Sea — Its Natural History: The World of Plankton". The New Naturalist. A Survey of British Natural History. 335 + XV pp., 103 figs., 24 pl. Collins, London, 1956.

Both the editors' and the author's prefaces describe this book as having been written for the enlightened amateur naturalist, to encourage him to investigate the world of plankton himself, and also to serve as a guide for university students beginning studies in marine biology; the intention has not been to present a handbook in planktology. On cursory inspection of the volume, attention is immediately drawn to the beautiful illustrations, which include 142 water-colour sketches done by the author and 67 black-and-white photographs by the famous photographer of marine organisms, Dr. Douglas WILSON; these illustrations are eminently suited to arousing the interest of naturalists, young or old. The text is written in a direct, personal style, which accords well with the purpose of the book.

In most chapters the broad scope and the first-hand knowledge of the subjects treated have a stimulating effect; this is especially welcome in those cases in which the author taxes the patience of the reader rather heavily by lengthy and rather intricate discussions and detailed descriptions. The enthusiasm of the author does not leave the reader unaffected, whether he is aroused by the beauty of the objects described or by the wealth of the problems still to be solved.

The title of the book is somewhat misleading. Of the 315 pages, only 30 pages are devoted primarily to plant plankton; the remainder treat of the zooplankton and other animals. Since the chapters on "Plants of the Plankton" and "On Seasons of the Sea" are in many ways not the most satisfactory, it might have been an advantage if they had been omitted and the book given the more appropriate title, "The World of Zooplankton".

The introductory chapters include historical notes on British marine biological research, which will be read with great interest by professional planktologists. There follow chapters on little jelly-fish and lesser forms of life, siphonophores and the larger jelly-fish, more animals of the plankton (but not the crustaceans), the planktonic Crustacea, pelagic larval forms, the puzzle of vertical migration, life in the depths, phosphorescence and photophores, squids, cuttlefish and kin, and a concluding chapter on plankton and fisheries. Through these many facets, the author provides an extensive and stimulating outlook on the state of present knowledge and on the problems yet unsolved, and brings together from many sources, often not easily accessible, pieces of the puzzles encountered in every field of planktology.

It is of special interest to find here an account of the researches in many fields which the author himself started and to have his own appreciation of the new results accumulated by both his and his pupils' subsequent studies. As is the natural course of science, these have led to many revisions of the original theories. All through the book the author demonstrates his open mind and his receptivity of new ideas, and frequently refers to hypotheses which run contrary to generally adopted views.

Non-British readers of *Journal du Conseil* should note the subtitle of the series, "A survey of British natural history"; otherwise, on reading Professor

HARDY's book, they might feel that investigations of general interest have been unduly disregarded.

Although the book may not be so well suited for university teaching outside Great Britain, it undoubtedly makes stimulating reading, not only for amateurs but also for professional marine biologists, since it presents so many details which are useful in teaching and because it provokes fresh consideration of many essential problems in marine biology.

Trygve Braarud

M. H. A. Keenleyside. "Some aspects of the schooling behaviour of fish". Behaviour, **8** (2–3): 183–248, 18 figs. Leiden, 1955.

The schooling behaviour of fish is an interesting phenomenon that for long has puzzled many observers. Most have been resigned to their puzzlement; but a few bold persons have attempted to understand and explain schooling in fish — or at least some aspects of it. Such attempts, more often than not, have posed more problems than they have resolved.

KEENLEYSIDE rightly and necessarily opens his paper with a brief résumé of previous work on fish schooling, with special reference to attempts to define a school or shoal of fish. Not unexpectedly, he is dissatisfied with all the previous definitions that he has been able to find and provides a new one of his own — which is quite as unsatisfactory as all the others. According to KEENLEYSIDE, "the school will be considered an aggregation formed when one fish reacts to one or more other fish by staying near them". Fish congregated in a limited area because each animal responds similarly to a common external stimulus do not constitute a school. Thus solitary fish, such as pike, concentrated in one part of a lake because a steep temperature gradient prevents their occupying a larger area, are not to be regarded as a school but simply as an "aggregation" of fish. Such distinctions are merely academic quibbles and are largely meaningless. How, in the sea for example, is anyone to distinguish one kind of grouping from the other? In so far as the reviewer is concerned, any close concentration of one species of fish in its natural habitat is a school or shoal of those fish, no matter what may be the cause or causes of its formation. It follows, therefore, that he believes that many factors, both internal and external, can be responsible for schooling in fish whether the school be large or small, temporary or semi-permanent.

Moreover, all investigators of schooling behaviour in fish known to the reviewer, including KEENLEYSIDE, appear to think almost, if not entirely, in terms of pelagic fish. They do not tell us, for example, what name we are to give to a school of pelagic fish when, as sometimes happens, it goes to ground and spreads out compactly, but only one fish deep, on the bottom. Seldom, if ever, is it still referred to as a school or shoal. Therefore, even granting that KEENLEYSIDE's definition holds good in the pelagic phase — i. e., that one fish reacts to one or more other fish by staying near them — is it to be understood that such awareness of other fishes of its kind disappears immediately an individual fish touches the bed of the sea or of a lake? And what of wholly demersal fish? In the vicinity of Plymouth (England) there