phy) admittedly is restricted to physical oceanography. Even that limitation, however, proved to be difficult, and the author frequently finds it necessary to discuss developments in marine biology, especially in the later epochs. Originally the idea was to limit the book not only to physical oceanography but to the work of British researchers, but the author soon realized that oceanography recognizes no political boundaries. In another respect the title may be misleading, for while many names are mentioned there is almost nothing about the personalities of the individuals. One can occasionally infer personal attributes from the context, especially in the last chapters, but on the whole the book concerns work done, things seen, and theories developed.

Nevertheless this is a very valuable work, a solid treatment which at first glance seems to have cited every significant paper in physical oceanography from Pliny to 1900, with a brief statement of the major points of each. Every substantial statement is carefully documented in the notes at the end of each chapter. From this careful survey of the literature the author has reconstructed the scientific or rational viewpoint of the past with respect to the oceans. Thus we can get a good idea of how the medieval Arabs and Giraldus Cambriensis understood the tides and how in the Renaissance man turned to attempts to measure the phenomena of nature and thus began the flowering of science in the sea in the 17th century. And so on, through the early-19th-century preoccupation with tidal problems and finally to the beginnings of professional oceanography in the *Challenger* era. Now and then a fable falls by the wayside—Magellan did not, it seems, try to sound the deep ocean but was simply trying to find anchorage off a steep coast. Coriolis is hardly mentioned at all, and it is obvious that the author is of the opinion that he was erroneously credited for generalizations made by Halley and others. Perhaps Coriolis should have been given a few more words for the benefit of those who have been using his name in vain all these years.

It is true, of course, that oceanography did not have its own identity and that people did not choose the study of the oceans as a professional career until the last part of the 19th century. Nevertheless, according to the author, there were three periods of activity in the marine sciences in Europe between the middle of the 17th century and the end of the 19th. The first of these was in the 1660's, with men like Boyle and Hooke, the second was in the late 18th century, the time of the great natural philosophers and navigators, and the third of course was the era of formal deep-sea exploration, the pursuit of knowledge of the sea for its own sake inaugurated by the men of the *Challenger* and their colleagues in other lands. The chapter on the *Challenger* epoch is one of the best in the book; it is good to see such antiestablishment critics as James Croll and W. L. Jordan given their due along with all the better-remembered people. The *Challenger* era did not end, of course, precisely at 1900. The *Reports* were finished in 1895, but the influence of the men who saw the work of the Challenger Office to completion, and of Edinburgh as an oceanographic center, persisted into the 20th century. The true ending of the 19th century was not 1900 but 1914 (which was, symbolically enough, the year of Sir John Murray's death in an automobile accident), and in her final chapter the author mentions many events and people of the first decades of the 20th century. In this context I find it odd that while the establishment of a chair of oceanography at Liverpool is mentioned (as one of several isolated incidents), the name of James Johnstone, who first held that chair, is not. Although the career of this remarkable individual was for the most part after 1900, he was a true product of the late-19th-century ideal of education for the working classes (he came up from a furniture factory and qualified for the university by attending night school), and he certainly deserved mention. His writings, especially his book *Conditions of Life in the Sea* (1908), forecast much of our modern concern with productivity of the seas, quantitative assessment of the bottom fauna, and the rest of the numbers game. Of course this has to end somewhere, but again it might have been mentioned that the drilling at Funafuti simply did not go deep enough; since then we have been able to drill to the bottom of that subject.

From the viewpoint of modern historical concern about science, the consideration of the application of technology to oceanography is inadequate; much of what happened in the 19th century was related to the development of transoceanic cables and the applications of steam power. This is obvious to specialists and implicit in many statements in the book, but might have been pointed up for the benefit of students. One of the oddities of this scholarly work is the selection of illustrations. The only portrait is of the Bishop of Llandaf, whose contributions to oceanography were considerably less than those of Benjamin Franklin, who is discussed in the text facing the bishop's handsome picture. Well, we all know what Franklin looked like—but what about Luigi Conte Marsigli, the Scoresbys, and all the others?

Enough; few reviewers can resist the opportunity to ride their own hobby horses roughshod over an author. This book is a definitive contribution, and it will stand as a mainstay for those concerned with the subject and should change many an introductory lecture, formerly based on John Murray's historical summary in the *Challenger Reports* (1895) and W. A. Herdman's *Founders of Oceanography and Their Work* (1923). In the meanwhile, the door is wide open for an equally solid treatment of marine biology or biological oceanography.

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Useful Embryos

Experimental Embryology of Marine and Fresh-Water Invertebrates. G. REVERBERI, Ed. North-Holland, Amsterdam, and Elsevier, New York, 1971. xxiv, 588 pp., illus. $32.

Ilynassa? *Nereis*? *Tubifex*? *Dentalium*? *Arbacia*? *Styela*? *Beroe*? Aside from *Ilynassa* and *Arbacia*, these names today mean little to most developmental biologists, indeed to most biological scientists. Yet, for the years from 1890 to 1940 the names of these invertebrates dominated the literature of experimental embryology. Studies on their embryos, along with equally important ones on the frog and chick embryo, laid the foundations of both descriptive and experimental embryology and suggested the current dogma of cytoplasmic determinants in the egg which become segmented unequally during cleavage and later interact with equal nuclei to yield unequivalent gene expression.

Recently these concepts have been more elegantly defined and extended in the amphibian embryo. There are, however, embryos of marine and freshwater invertebrates which are especially suit-

able for specific developmental studies. These have been notably underutilized in recent years, and it is to the fostering of a better appreciation of these organisms that this book is addressed. Covered in this volume are the descriptive and experimental embryology and biochemical embryology (where known) of 15 organisms, including coelenterates, ctenophores, flatworms, annelids, several mollusks, nemerteans, echinoderms, ascidians, and amphioxus.

The book is addressed to molecularly oriented biologists, with the ostensive purpose of pointing out the unique and important problems in development which can be solved with the appropriate organism. Some of these organisms are certainly described in this book, but most readers unversed in classical embryology will find the reading difficult. There is no introductory or integrating chapter that reviews the general patterns of development, and the nomenclature used in describing development is not defined. Fortunately, several of the authors do present sufficient introductory material and comprehensive overviews to aid the uninitiated. For the nonembryologist, therefore, I would recommend consulting these chapters first and then moving on to the other chapters. The chapters by Clement (*Ilynassa*) and Hess (*Limnea*) provide particularly good introductions to spirally cleaving eggs and the loose distinctions between "mosaic" and "regulative" embryos. These chapters could be followed by that on sea urchins by Czihak. His treatment of this important group is encyclopedic and he presents many original illustrations.

Armed with this background, the reader could now tackle other chapters. However, if the former molecular biologist (now of course an aspiring developmental biologist) wants to use these embryos, he had better have access to other literature, for information on the techniques of obtaining and handling marine embryos is sadly lacking in this volume. Again, the chapters on *Ilynassa* and *Limnea* and also Arnold's description of cephalopod development are pleasant exceptions. This last article is especially important, for recent discoveries and techniques make cephalopods attractive for studies on the role of the egg cortex as a depository of cytoplasmic information.

Some readers may be disappointed at the dearth of biochemical information about the various embryos described in this book. This is not due to neglect on the part of the authors, however, but rather reflects the small number of workers who have studied these embryos from a biochemical viewpoint. The information available in this volume might well stimulate renewed interest in these important groups. New factors that should facilitate such studies are the availability of well-equipped marine research centers and jet plane transportation of aquatic organisms from almost anywhere in the world.

The book suffers in being already out of date (most of the citations are earlier than 1968), but no comparable treatise has been published in several decades. Also lacking are the stimulating perspectives and questions that characterized such prominent early texts as Waddington's *Principles of Embryology* or Weiss's *Principles of Development*. Nevertheless, Reverberi's treatise is the only current review of these potentially important embryos.

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Atmospheric Microphysics

The Physics of Clouds. B. J. MASON. Second edition. Clarendon (Oxford University Press), New York, 1971. xvi, 672 pp. + plates. $38.50. Oxford Monographs on Meteorology.

Students of the atmospheric sciences will welcome this second edition of B. J. Mason's authoritative review of cloud physics with particular emphasis on microphysics. The first, widely used edition, which was published in 1957, has been out of print for a number of years, and the revision has been awaited with interest. This new book will not disappoint scientists familiar with Mason and his work. It represents a thorough distillation of the literature, is written in an excellent style, and is well illustrated with drawings and photographs.

The structure of the book is identical to that of the first edition. The chapters deal, in order, with water vapor condensation, condensation nuclei in the atmosphere, the growth of droplets in clouds and fog, initiation of the ice phase in clouds, the formation of snow crystals, natural precipitation processes, the artificial modification of clouds and precipitation, radar studies of clouds and precipitation, and the electrification of clouds. Two appendices cover the collision and coalescence of water droplets and the fall of raindrops. There is a very lengthy bibliography.

For the most part, Mason has succeeded admirably in achieving the purpose of this extensive revision, that is, "to provide a fairly complete and critical account of all important developments up to the end of 1969." Every chapter of the book with two exceptions has been expanded substantially, and new material, some published as late as 1970, has been incorporated. The more extended text reflects new research carried out particularly in such subjects as the growth of droplets, ice-crystal nucleation, precipitation growth, the development of radar observational techniques, and cloud electrification.

One distinct shortcoming in this book is the relatively inadequate treatment given the artificial modification of clouds and precipitation. Although this edition is about 40 percent longer than the first one, the chapter on cloud modification is about 25 percent shorter. The tone of the material reflects the somewhat pessimistic view Mason has expressed in his public statements on the subject. It does not appear that he examined the existing literature with the same open-mindedness that is reflected in the other parts of the book.

Notwithstanding the weaknesses in this chapter, the book is an outstanding one which should be at the disposal of everyone seriously interested in the physics of clouds and precipitation. It is unfortunate that the publisher is asking such a high price.

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