

INTRODUCTION

This manual represents a compilation of the methods for handling embryological materials available at Woods Hole, Massachusetts. The material outlined was assembled from personal communications, from the laboratory guides prepared by members of the Embryology Course staff of the Marine Biological Laboratory at Woods Hole, from the observations made by Marjorie Hopkins Fox, Annette Eggers and Margaret E. Davidson as Embryology Course research assistants, and from the work on marine forms done by the senior author and Catherine Henley.

In the past, much valuable time-saving information has been lost because it passed from investigator to investigator merely by word of mouth. E. E. Just's articles in the *Collecting Net* (1928) and his book, "Basic Methods for Experiments on Eggs of Marine Animals" (1939), were the first attempts to preserve this type of knowledge for the younger generations of investigators. This manual was started as an extension of Just's book, giving more details about the forms he described, and including data on additional species. Wherever possible, we have avoided descriptions of standard technical laboratory procedures which are available in other books.

Although our account is based upon those animals available at Woods Hole, it is apparent that the methods may be used to advantage elsewhere. Many of the forms described here are available along the entire Atlantic coast, and closely related forms (with similar breeding-habits and similar embryonic development) are to be found on the European, Pacific and southern Atlantic coasts. The breeding seasons listed in this account apply in most cases only to the Woods Hole region.

Many workers at Woods Hole have been limited in the scope of their work by lack of information concerning the local fauna. Given a concise source of information, an investigator should be able to select the egg best suited for any purpose: large or small; transparent and colorless, or opaque and pigmented; with a tough membrane, or with a delicate one; with external jelly, or free of it. It is possible to utilize eggs at each of the four recognized stages of attainment of the fertilizable condition; eggs with a pronounced cortical change at activation, or with little or no change; eggs with or without micropyles; eggs with slow or rapid sperm penetration, and with slow or rapid development; eggs with any of the various types of cleavage; etc.

The present volume is admittedly incomplete, and better methods for handling certain of the materials may be forthcoming, or even already in use. We hope that workers will report errors, and make suggestions concerning improvements; gaps in the data should be filled in, and information for additional forms added. Each genus of animal at Woods Hole probably provides embryological materials worthy of investigation, and it is hoped that eventually all the most useful forms will be included in a later revision of this work.

The listing of the names of the co-authors is on an alphabetical basis. Mrs. Fox served as research assistant in the Embryology Course at the M. B. L. during the summers of 1945, 1946, and 1947, obtaining information for this manual. She was succeeded by Miss Eggers for the summer of 1948, and by Miss Davidson for the summers of 1949 and 1950. After a lapse of several years, the work was resumed

in 1956 under a National Science Foundation grant (NSF-G2477) with the aid of Miss Henley, who edited the sections previously prepared and added several new ones.

In general, the nomenclature which we have adopted for the forms considered is that used in the classic earlier papers in the field of embryology, since we feel that these are the names by which the animals are best known to workers at Woods Hole. Thus, we have retained the generic names "Nereis" and "Mactra," for example, even though recent taxonomic revisions have assigned other names to both these forms. All the common synonyms known to us for the names of animals considered are included in the index to this volume, and in the heading of each description.

The arrangement of sections is based on a phylogenetic sequence from "lowest" to "highest," and within each sub-division, the genera are described in alphabetical sequence.

A bibliography has been compiled for each section, listing (1) those papers and books on which our description is based, and (2) some of the reports in the literature which have utilized the form under consideration. We have made no effort to include all the papers describing work done on a given animal, but only those which were most useful to us in our compilation.

There were many early investigators at Woods Hole who worked out the details of obtaining and handling one or more types of embryological materials, as well as the fundamental aspects of the embryology of such forms. Sometimes they incorporated this information into their papers, but more often it was omitted. About 1940, when the older generation of embryologists at Woods Hole (including E. B. Wilson, E. G. Conklin, F. R. Lillie, A. D. Mead, A. L. Treadwell, C. M. Child, H. E. Crampton and others) was beginning to dwindle in numbers, Dr. Viktor Hamburger suggested that plans be made for a manual which would put on record some of the methods utilized by those studying the development of marine animals; he obtained funds from the Marine Biological Laboratory for a summer research assistant to help with the project, beginning in 1945.

Another factor contributing to the initiation of the work was the almost total disappearance of the sea urchin, *Arbacia*, from the usual collecting grounds near the Laboratory; this occurred about 1945. Earlier, when sea urchins were abundant at Woods Hole and thousands were often collected at a time, the *Arbacia* egg was the "standard living cell" upon which much of the physiological, biochemical and cytological work was done. With the marked decrease in numbers of *Arbacia*, however, it became impossible for many investigators to utilize this form, and there were frequent inquiries as to the availability of other egg-species.

A collector-curator, George M. Gray (head of the Supply Department for many years), had very extensive and readily available knowledge of the Cape Cod marine organisms. He was succeeded in 1933 by James McInnis, and the staff of the Supply Department was trained under the able direction of Mr. Gray, Mr. McInnis and the older, experienced men. It would have been impossible to produce this guide without the willing help given by members of the Department.

Although it is impossible for us to mention the names of all those who directly or indirectly contributed to the M. B. L. Embryology Course outlines (which served as a basis for some of the sections in this book), we should like to acknowl-

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