

**THE DEVELOPMENT OF THE
FROG'S EGG: AN
INTRODUCTION TO
EXPERIMENTAL EMBRYOLOGY**

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The Development of the Frog's Egg: An Introduction to Experimental Embryology by Thomas Hunt Morgan

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THOMAS HUNT MORGAN

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C. C. THOMAS
Chicago

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EXPERIMENTAL EMBRYOLOGY

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PREFACE

THE development of the frog's egg was first made known through the studies of Swammerdam, Spallanzani, Rusconi, and von Baer. Their work laid the basis for all later research. More recently the experiments of Pflüger and of Roux on this egg have turned the attention of embryologists to the study of development from an experimental standpoint. Owing to the ease with which the frog's egg can be obtained, and its tenacity of life in a confined space, as well as its suitability for experimental work, it is an admirable subject with which to begin the study of vertebrate development.

In the following pages an attempt is made to bring together the most important results of studies of the development of the frog's egg. I have attempted to give a continuous account of the development, as far as that is possible, from the time when the egg is forming to the moment when the young tadpole issues from the jelly-membranes. Especial weight has been laid on the results of experimental work, in the belief that the evidence from this source is the most instructive for an interpretation of the development. The evidence from the study of the normal development has, however, not been neglected, and wherever it has been possible I have attempted to combine the results of experiment and of observation, with the hope of more fully elucidating the changes that take place. Occasionally departures have been made from the immediate subject in hand in order to consider the results of other work having a close bearing on the problem under discussion. I have done this in the hope of pointing out more definite conclusions than could be drawn from the evidence of the frog's egg alone.

In treating the general problems of development, I have tried to keep as near to the evidence as possible. I have intention-

ally avoided at times the discussion of the more theoretical problems arising from the experiment, for it seems to me that such discussions are out of place in a volume of this sort. Only the early stages of the development have been considered, because almost all of the experimental work on the frog's egg has been done on the early stages, and also because I am more familiar with the development and with the experiments of this period. Moreover, the later stages have been recently most admirably described by Marshall in his *Vertebrate Embryology*.

A few words of personal explanation may be added. For several years I have been collecting the material for the present volume, but as the literature is so extensive and as I have had other work to do first, I made but slow progress. In the summer of 1893 I set seriously to work, and owe much to the admirable facilities offered by the University of Berlin. I take pleasure in acknowledging my indebtedness to Geheimrath Professor Fr. E. Schulze for many privileges and kindnesses extended to me in Berlin. The work was continued irregularly during the winter of 1893-1894 while enjoying the opportunities of the Stazione Zoologica in Naples. During the winter of 1894-1895 the material was brought together and in the summer of 1896 at Zürich the manuscript was almost completed. I gladly take this opportunity to thank Professor Arnold Lang for many courtesies extended to me during two visits to Zürich. Dr. Driesch has most kindly looked over some of the chapters, and has made many valuable suggestions. Dr. H. H. Field has also examined a part of the manuscript and helped me in several directions. To Professor E. B. Wilson I am under heavy obligations, and owe much to his valuable suggestions and corrections. To Dr. H. Randolph I owe a debt of gratitude for kindly advice and criticism. I am also greatly indebted to Professor Joseph W. Warren and to Professor E. A. Andrews for advice in connection with the revision of the proof.

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