



# THE RISE OF EMBRYOLOGY

BY ARTHUR WILLIAM MEYER

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*Professor of Anatomy, Emeritus*

STANFORD UNIVERSITY



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**THE RISE  
OF EMBRYOLOGY**

**Dedicated in due humility to  
the nascent but transcendent cause of  
the history of science.**

*“For so is man without science,  
as a realme without a kyng.”*

—JOHN CAIUS, 1552

*“It is easy to sneer at our ancestors . . . .  
but it is much more profitable to try to discover  
why they, who were really not one whit less  
sensible persons than our excellent selves,  
should have been led to entertain views which  
strike us as absurd.”*

—THOMAS HENRY HUXLEY, 1881

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## PREFACE

**T**HE STUDENT who now can so easily become familiar with the elements of embryology is not likely to surmise that it required long and arduous effort, and clear thinking as well, to establish even the simplest facts—those he now takes for granted. Although chance contributed a few facts, observation and experiment were the real keys to progress. Metaphysics revealed no new facts whatsoever and often led to long-continued error.

There are many fine volumes in which the development of body form and of the various organs is delineated, but the growth of embryological ideas has been largely neglected. The chief aim of this work is to give the history of the basic ideas in embryology. The growth of some ideas is traced farther than that of others in order to reach the modern viewpoint. The story sometimes lacks chronological continuity because the pertinent records are lacking and events that were contemporary are considered together only when they concern the same idea. Some discoveries are given prominence because they were crucial and epochal in fact even if not in immediate effect.

The influence of plant embryology was not considered fully and critical comments have been restricted in order to keep the volume moderate in compass. The space allotted to an author does not necessarily correspond to his importance. Long quotations sometimes were necessary to reveal adequately a situation, an attitude, or a manner of reasoning which it was desirable to stress. The aim has been to reveal facts, not to utter dicta.

Restriction and selection of material were unavoidable in so brief a survey. A detailed and comprehensive account belongs to the historian, which the author of this study does not pretend to be. Many of the authorities and pioneers are quoted

## THE RISE OF EMBRYOLOGY

at some length, in order to avoid misinterpretation and to indicate something of the intellectual attitude and the atmosphere of the time. Their own words can best reveal our great debt to our scientific forebears, and provide a historical background which invests the subject with larger interest, and may prompt the reader to consult the sources himself. The personal views of the author have largely been excluded, for they are of the day and have little place among what is permanent in the history of this interesting subject. All quotations are given without the correction of obvious typographical errors, hiatuses are indicated wherever words are omitted, and the technical terms of authors are retained. The dates accompanying a name in the text give the actual or approximate time of activity or the life span of the person concerned, the time of occurrence of an event, or the date of a writing.

The bibliography has been placed at the end of the volume in order to avoid unnecessary repetition of titles.

Grateful acknowledgment is made to authors and publishers who have permitted the reproduction of material and to various libraries for the loan of books.

I am especially indebted to Professor George W. Bartelmez, of the University of Chicago, for the loan of a copy of the 1830 edition of Purkinje; to my colleague, Professor Emeritus Frank Mace McFarland, for the use of rare volumes from his library; and to my friend Professor Herbert M. Evans, of the University of California, whose unusually extensive collection on the history of science was generously placed at my disposal.

The task of preparing the manuscript was materially lightened by the efficient, conscientious, and obliging co-operation of our Departmental Secretary, Miss Ruth L. Miner, who took special interest in the undertaking, and by the vigilance of the Stanford University Press. I am also indebted to our technician, Mr. Frank Barrett, for great care and skill in the reproduction of illustrations from originals that often were indistinct.



## PREFACE

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SEELEY, SERVICE AND COMPANY, LTD. for illustration of "Plainsmen and Pygmies" in C. G. Rawling's *Land of the New Guinea Pygmies*, London, 1913.

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A. W. MEYER

STANFORD UNIVERSITY, CALIFORNIA  
July 1939

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## *Chapter I*

### **ABORIGINAL IDEAS OF REPRODUCTION**

**I**T WOULD be idle to speculate at length upon ideas of generation held by the earliest precursors of our civilization. It is more profitable to consider related ideas held by uncivilized peoples both in the past and at present. Unfortunately, most students of primitive man have paid little attention to this subject and the information available to us is both fragmentary and unreliable. Nevertheless it is well to consider briefly how primitive man regarded the role of the sexes in reproduction and to inquire how he may have come to think as he did and whether or not his ideas were reached by anything akin to the scientific method.

It probably may be assumed that the remote ancestors of civilized peoples entertained opinions as to generation akin to those current among primitive peoples of today, or among those which recently became extinct or are now in the course of extinction. For it seems unwarranted to hold that the mind of primitive man reached conclusions in a manner different from that of modern man. To maintain this would imply that every organ of the human body functioned differently in the past. Normal children in the same state of development and with similar experiences and aptitudes react in essentially the same way to the same stimuli under identical conditions. That primitive peoples likewise did so is indicated by the fact that folk stories and religious ideas of much the same pattern are known to have prevailed in widely separated regions of the globe.

Primitive man faced the unknown to a far greater degree than we. Like the child who turns to his mother with the unexpected question, "Mother, how does one begin to live?" so they, too, must have raised this and many other similar queries.

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Yet, as Hartland (1909-10)\* well said, we are likely to forget that

for generations and aeons the truth that a child is only born in consequence of an act of sexual union, that the birth of a child is the natural consequence of such an act . . . . and that every child must be the result of such an act and of no other cause, was not realised by mankind . . . . down to the present day it is imperfectly realised by some peoples, and . . . . there are still others among whom it is unknown. [II, 250.]

To hold that coitus is not related to conception seems very singular to us. Yet, according to Keysser (1911), some native women of German New Guinea hold firmly to this belief even today. While it may startle us to learn that primitive peoples as a rule hold entirely incorrect ideas of generation, it is well to remember that there still are those among our own people who are grossly misinformed regarding this and similar matters. As Frazer said:

In some islands of Southern Melanesia the natives appear . . . . to believe that sexual intercourse is not necessary to impregnation, and that a woman can conceive through the simple passage into her womb of a spirit-animal or a spirit-fruit without the help of a man. . . . "It seemed quite clear that [on the island of Mota] there was no belief in physical impregnation on the part of the animal, nor of the entry of a material object in the form of the animal into her womb. . . . " [V, 97.]

Yet Frazer also stated that "the Maoris 'are acquainted with the sex of trees, etc., and have distinct names for the male and female of some trees.'" (II, 24.)

According to Malinowski (1927), the Trobriand Islanders believe that their domesticated pigs bear young without union with males, and the natives are much offended if told when eating pork that it is in fact the flesh of the offspring of wild boars. They castrate all their domesticated male pigs when young, in order to improve the quality of their flesh for food, and remain

\* For this and similar references, consult the Bibliography at the end of this book.



## ABORIGINAL IDEAS OF REPRODUCTION

strangely unaware that their domesticated females cohabit with wild boars on the outskirts of the settlements.

Spencer and Gillen (1927) likewise reported that in the Arunta and all other Central, Northern and many Western Australian tribes, the idea is firmly held that the child is not the direct result of intercourse, that it may come without this, which merely, as it were, prepares the mother for the reception and subsequent birth of a child who, in spirit form, inhabits one of the local totem centres. The practice of sub-incision\* cannot be attributed to the desire to check procreation by this means. [I, 222.]

And Hartland said:

Even at the present day the Arunta invariably ascribe birth to a totally different cause; and it is important in this connection as showing their ignorance on the subject that they date conception from the time when the woman becomes conscious of pregnancy—that is to say, from quickening. In this respect they resemble the Bahau of Central Borneo, who, according to Nieuwenhuis, have no notion of the real duration of pregnancy, dating its commencement only from the time it first becomes visible. [II, 274–75.]

Although, as Frazer states, some of the tribes to the north in Guinea ascribe the conception of the child to a particular man, this always is someone other than the actual father—an individual who is thought to have given the particular woman certain food or to have ordered the ghost of a dying kangaroo or an emeu to go to her. According to Hartland, “not merely animal and vegetable substances, even stones have been described as fructifying women” (I, 11), and among the practices mentioned by him which are believed to induce fertility or to cause impregnation are

bathing or washing or at least sprinkling with water or some other liquid as an integral part of the [marriage] rite. Where this is not the case the water-god is invoked. The fertilising power of liquids, especially water, is thus recognised in them all. This would seem to be the chief idea underlying the rites in connection with water performed by a bride on being brought to her new home. [I, 87.]

\* In subincision, a puberty rite, the penile urethra is slit open from below, in part or throughout its extent.