

Development of the Genitals

from

Anatomical Studies on Human and Animal Embryos,

along with an

Appendix on the Surgical Treatment of Hypospadias.

by

Dr. JOHANNES MÜLLER,

Professor of Medicine at the Friedrich - Wilhelm - University of Bonn, Practical
Physician and Surgeon, Member of the Kaiser Wilhelm Leopold Carol Academy of
Natural Scientists, et.

with 4 copper plates

Düsseldorf, near Arnz

1830.

It is not enough to beautifully and eloquently praise the experience, but the experience itself and tireless investigations are necessary.

To my honored friend

Dr. HEINRICH RATHKE,

Court Counsellor and Professor of Physiology and Pathology at the
University of Dorpat.

By allowing myself to address a few words first to you, my dearest friend, I convey the relation in which these investigations are to the works of my predecessor. Because firstly, my investigations concern an object that was first introduced by you in science, featuring the most glorious observations. I owe my inspiration for this research to your publications. In addition, the contributions to the history of the animal world were not lost thanks to my continuous, and almost daily, observations in 1828 and 1829 of the naturally occurring development of the genitalia of amphibians, birds and mammals.

In 1828 some of my drawings and my previous observations relating to our subject resulted in discussion at the zoological section of the Assembly of Naturalists in Berlin. You and Mr. von Baer were present. This is enough to indicate how stimulating and useful this discussion was for me.

Soon and in the same winter, I was able to inform you of the discovery of the Wolffian bodies in preserved embryos and larvae of frogs. I expressed many new reservations about which I wished to make further observations. You confirmed these observations and were kind enough to tell me about any of your new observations, for which I extend my sincere thanks. You encouraged me to undertake new investigations and publications. The following year I dedicated myself completely to this job. I have come to a preliminary conclusion of my observations, that was made possible by you. Hence, one knows rightly, dearest friend, why I sincerely dedicate this publication to you.

Bonn, February 1, 1830.

With the highest respect

Yours,

Joh. Müller.

Preface.

If an experience, or discovery, or a happy thought from somebody else help me further, I am really pleased and do not care to ask to whom the author holds it and where he comes from. But it has become fashionable to say in a preface to a scientific writing, with whom one holds it, and whether one has been able to preferentially work with reason, intellect or with the senses, and in this way could have been wrong. Because the preface of a book is the only place in which the writer itself is permitted to appear, I also welcome this time the opportunity to confess what method I used, and which in particular has become necessary in these investigations. I especially wished to do this in a way more definite and more satisfactory to myself than had been done previously on other occasions. This can best be done from the point of view of the present publication.

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The development of sex in the embryo is one of the areas in which physiology has provided several theoretical and hypothetical experiments, for which, however, little actual and no sufficient empirical basis exists, which nevertheless must have every further investigation as good as its substance is. What benefits have all the speculations on the causes of sex differences, if we do not know with undisputed experience how and from which parts the genitals first arise, and how they develop from step to step if we do not make complete observations of this of several animals and of man with equal accuracy.

Opportunity, inclination, and practice in microscopic work have led me to pursue for the last few years a study of embryos from amphibians, birds, mammals, and man, which was based on mere observation and anatomical empirical knowledge. The subject may forgive if I only compile my experiences and observations without further reflection.

I am always a friend of a methodical, thoughtful, reasoned, or, what is the same thing, philosophical treatment of a subject, as for me philosophical insight is the same as rational insight. However, I do not mean by saying this is a method which can come to a conclusion without sufficient empirical justification, or the so-called natural-philosophical manner, which I have already sought to characterize earlier, by calling it false natural philosophy, which has become so seductive in the past, and which has taken us back to the times of Jonian philosophy.

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I do not criticise thereby a more poetic and enthusiastic contemplation of nature, which over the growing fragmentation retains a love for all living nature; but this, like poetry, can never become a method or a manner without getting out of hand into disgusting after-productions. This arbitrary, in some analogies fortunate, but altogether erroneous dogmatics, which one rightly quit, should not prevent me (like many others) from recognizing the truth wherever I find it.

But what I call philosophical method has nothing in common with those dogmatics. First of all, I demand that one be tireless in observing and experiencing, and this is the first requirement I set for myself and strive to fulfill ceaselessly. Perhaps one will believe from my previous aspirations that I am honestly serious about this affirmation; and I shall be very glad to consider this publication as a good testimony of it.

Then I demand that research, once it has been obtained with sufficient breadth and greatest accuracy, is not merely thrown together, but instead, like nature deals with the development and preservation of the organic beings, pursuit to understand the pieces that make up the whole, provided that one recognized the individual parts and therefore has come to the concept of the whole.

With every isolated insight into the structure of the organism, we recognize that these organs cannot be formed differently, as integrating parts of the whole, we

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admire the highest reason in the construction of the eye, as in every part of the skeleton; in the muscular structure of every limb. We see the development of the embryo from the germ, as a progression of the general and the whole into its integrating parts. This is not the case for the physical laws. In the physiology of plants and animals, a larger field is opened to comprehension; it is necessary to become aware of the rational laws of development and to strive to understand the whole as well as the parts when one has arrived at the concept of the whole just as nature proceeds with organisms. However, facts and observations must pass by our senses and our spirits, and only then, according to the laws of our mind, to distinguish the essential from the accidental in every change, the essential from which to understand the individual.

For this Caspar Friedrich Wolff, Goethe's predecessor provided the correct and unequivocal example. What resembles the philosophical method, as it is in Wolff's theory of generations, coupled with so much rigorous research, dignified, and ever more thorough observation? The critique of the hypotheses about the procreation with which the German edition of his famous work begins remains an eternal pattern of philosophical acuteness; it is just as remarkable because of the very rare and only perfection of representation and style in the half of the last century. In recent times, Andreas Sniadetzki has in the, unfortunately little known, magnificent publication: *Theory of Organic Beings*. Translated from Polish, Nuremberg 1821. followed a similar approach.

This study, conducted with philosophical depth and mathematical method, shows how the elements of medicine must be laid; in my opinion, it is the first physiological basis of a scientific system of medicine. Finally, I am also allowed to name a work that spreads with philosophical sharpness and clarity, as well as empirical solidity and love of truth over the whole of organic physics. You probably have guessed that I am talking about G. R. Treviranus' *Biology* which has the most thorough descriptions. But the spirit of these men is infinitely different from the arbitrary natural-philosophical dogmatics of the past decades, which, through exaggeration, arbitrariness, and laziness, has caused for many disdain for all philosophical endeavor. After all, a late famous doctor and professor called every error of his students a philosophy. For no other reason did I mention those great examples than to protect myself from any misunderstanding to distinguish what I call a philosophical method from all ambiguous ones. Otherwise, I know well that the celebration and admiration of a large sample still bring me no progress.

But that the experience of such a well thought-through discussion and compilation is appropriate, it is necessary that they are really good and correctly researched. Nowadays much more than ever is experienced and experimented, but how often is this research confusing, how often not rigorous enough for every precise observer, that in fact in some physiological experiments hands and eyes, but not criticism and logic, were used.

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By careless research and experiments, one cannot become the Galileo of medicine and physiology. Fortunately, however, the way of the sublime Galileo among us has long been designated; Harvey, Malpighi, Wolff, Haller have walked it, and the method is so well described that any, even the more limited talent, and the most modest ability for the progress of the whole, can gain the greatest merit, after all, which are the benefits of a good method and a student.

What now makes good research, a good experiment? Above all, it has to be confirmed. For if the experiments no longer need to be confirmed, I would suggest to preferably do experiments such as a famous physician once did, who replaced the spinal cord of an animal with an amalgam of metals and had the audacity to tell that the animal continued his movements for a few moments. I desire research that can be repeated in all cases, which always give the same results as one would expect from any good physical experiment. Every impartial and unprejudiced person will agree with me that one can not say that of many, indeed most of the popular physiological experiments.

I further demand that in every research the essential will be distinguished from the accidental. The physicist, who wants to introduce us into an area of physics, into the theory of statics, of electricity, is not right about any attempt to do so, it is an experiment, a phenomenon from which all others can be deduced. Goethe says, "What would we say of the architect who had come through a side door of a palace, and now wanted to describe and present this building based on the first, inferior side of it?"

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That kind of research which distinguishes the essential from the random is the true observation of which physicians have always rightly said that it is so rare because reason and sense are equally active in experiencing. To distinguish and to observe what is or is not concluded from experiments, what is essential and what is accidental. If all medical research was true observations, the practical physicians, who believe that the way of pure research and research alone, are not at the same time full of peculiar theories, but true observers, then practical medicine would be better off. If all our experiences consisted of such observations, then all further theorizing would be unnecessary, and the theory would be a simple narrative of the facts, of which one is the consequence of the other. But since there are few experiences of this kind, constant introspection in addition to all sharpness of criticism is necessary, and the sharpness of the thoughts becomes just as necessary as the sharpness of the senses.

It is hardly necessary to note that it is the duty of the scholars to seize everything that happens among all nations for his science. This is now possible and it is essential for the European advancement of science. A German, French, English

school of medical science is barbarism. In Germany, however, this evil is hardly worth mentioning, and for us, the idea of an isolated English or French natural history, physiology, medicine seems as barbarous as the idea of a Prussian, Bavarian, Austrian physiology and medicine.

Before I leave this subject altogether, I still have to commemorate a not infrequent dishonesty in the use of literature. The popular style of quoting writers has often been criticized for accumulating quotations without reading them; but it seems even worse to me if one described a great deal of literature before an object with seemingly great erudition, but has not used it in the least; indeed, only talks about the trivial refuted in those publications. It would be much better to demonstrate one's knowledge of the literature by emphasizing only those few from a multitude of publications which are proven and worthy of memory. It also does not depend on the series of titles found in the libraries, because too often what is worth reading regarding a topic is hidden in publications with a completely different title.

But for too long now, I have withdrawn the reader's attention from the subject of present publication. If one applies what I have mentioned regarding observation and method, to our knowledge of the development of the sexual difference in embryos, then one has to confess that for such an investigation it is not sufficient to collect a large number of correct observations, but also needs experience. Above all the most precise knowledge of the development of the sexual organs is necessary.

The aim of the present script is to present this knowledge for several animal classes more completely and more accurately than we were able to do until now. The author abstains from any reflection in such a difficult matter; he merely tells what he has seen, subjecting every observation to its own criticism in order to recognize what can be concluded or not. These experiences must be present with all sharpness, precision, and detail before any further combination, induction, etc. can be contemplated.

Therefore, I sincerely hope that this research will not only be repeated but that it will be extended to an even greater number of animals.

The spring and summer time is precious to the observer, but you can not focus on everything at the same time. To observe the development of the Batrachians, namely frogs, toads, and salamanders, our stagnant waters offer the most beautiful opportunity in springtime, with no day to miss. Then in the spring and summer time, one can collect a large number of bird embryos for examination, partly through breeding experiments, partly collected from forests and fields, if one gives orders for this. It is also possible to continuously obtain sheep embryos in every city during autumn and winter. On the other hand, I completely lacked fish embryos; and I have to moderate myself regarding the development of

human genitalia to not be able to produce the details I achieved in the other animals, one should recognize my best intentions, and consider fairly that even heads of public collections regret the shortage of embryos. I am not the head of a public collection, and that in this respect I was supported only by the embryos which I stored in my private collection, and which I, like many other things, did not acquire without the greatest expense. In contrast, my observations from the class of mammals are so much more complete. The inclined reader should therefore not omit, while reading the section on man, to take into consideration the description of mammals. And so the naturalists, who have been given a more ample opportunity, are invited to expand and rigorously examine the observations in the same way as other research. At last, I request that the inclined reader does not overlook the introduction, because it is necessary for the understanding of the remaining descriptions. Generally, I ask everyone to respect the whole publication, because the arrangement is in a way that there is a constant relation to the preceding descriptions.

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