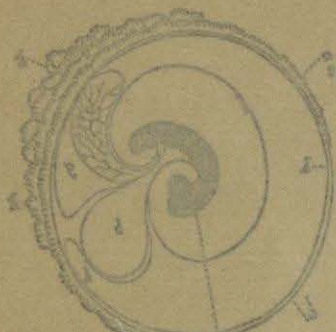


part which remains and forms the ligament called the umbilical cord by which the bladder is suspended to the navel, or umbilicus.



The amnion contains a peculiar fluid, called the liquor amnii, which in composition is similar to the serum of the blood. The embryo floats in this liquor, and probably absorbs it as nutriment. During the first two months, the space between the amnion and the inner membrane of the chorion is also filled with a peculiar gelatinous substance, which probably likewise assists in the nutrition, before the formation of the placenta and blood circulation.

PLATE XXII.

HUMAN EMBRYO AT A VERY EARLY PERIOD, FROM TEN DAYS UP TO THREE WEEKS, MAGNIFIED.

Figure 1. A very early stage. a. The area pellucida, or white of the egg. b. The primitive dot, or first sign of the embryo. c. First appearance of the heart. d. The upper margin of the vitellus, or yolk. e. First appearance of the omphalo vessels. f. Area vasculosa, or space where the future blood-vessels first appear. g. The space which separates the white from the yolk.

Figure 2. Embryo more advanced. a. The primitive dot, or *nota*, more raised. b. The tail end of the embryo. c. The omphalo vessels. d. The amnion.

Figure 3. Still further advanced embryo. a. The head. b. The caudal or tail end. c. The omphalo vessels, much increased. d. The amnion.

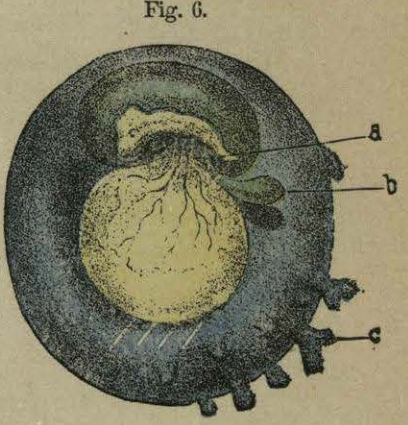
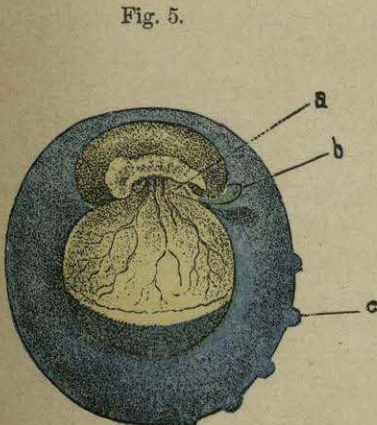
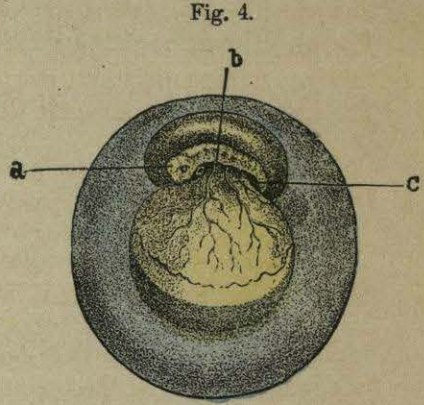
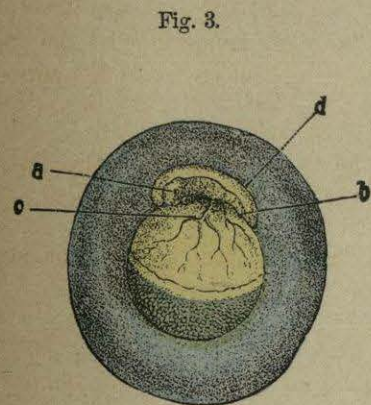
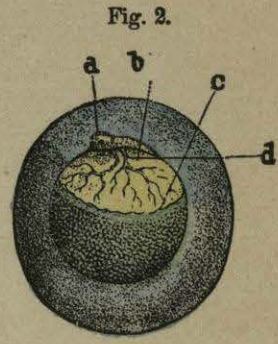
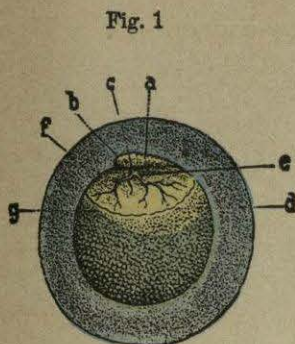
Figure 4. A still further stage. a. The head. b. The narrowing part of the yolk bag, which forms the beginning of the umbilical vesicle. c. The tail end.

Figure 5. Further advanced stage. a. Pedicle of the yolk sac. b. Allantois. c. Heart-like bodies, which afterward become the villousities, or nutritive root-like vessels.

Figure 6. Most advanced stage. a. pedicle of the umbilical vesicle. b. The allantois, extending toward the chorion. c. The villousities.

The urinary organs present some very interesting features in the course of their development, representing as they do in their early stages, the permanent forms of these organs in all the lower types. In the chicken, the first sign of a urinary apparatus is describable on the third day; it is then in the form of two tubes, one extending down each side of the spinal column, from the heart downward toward the allantois. On the fourth day, these are joined in connection with these tubes, certain bodies called the corpora Wolffiana, or Wolffian bodies. These are evidently secretory bodies, and the fluid they secrete is poured into the cloaca, or end of the large intestine. These Wolffian bodies, and certain clusters of convoluted vessels which form with them, are the only urinary organs of fishes; but in the bird they develop further, and in the higher vertebrata finally become the kidneys.

PLATE XXII.



Human Embryo at a very Early Stage.

them, though they are, in fact, independently formed. After the third month the kidneys begin to increase in size, and the Wolffian bodies decrease, and this goes on during the whole foetal period, so that we finally see the kidneys fully formed and active, while the Wolffian bodies have almost disappeared.

There are several other organs which are thus formed, and apparently used, in early embryonic life, which finally disappear, and are succeeded by the permanent ones which we find at birth. These temporary ones, as before explained, are really the permanent forms in the lower types of animals, through all of which the human being passes before it becomes fully developed.

The essential generative organs in both sexes—the female ovaries and the male testes—are both developed close by the Wolffian bodies. They are not formed from them, however, but originate independently, like the kidneys. In the chicken, the first rudiments of these organs are seen about the fourth day, and there is then nothing to indicate whether they will become testicles or ovaries. Like the kidneys, they increase as the Wolffian bodies decrease.

In the human embryo, the sexual rudiments first show themselves soon after the kidneys, or about the end of the seventh week. At first they are exactly the same in both sexes, but gradually the peculiar form of each begins to show itself. In the testes, the epididymus shows itself about the tenth week, and they begin to descend to the lower part of the body about the middle of pregnancy, reaching the abdominal ring by the seventh month, and the scrotum in the ninth. Although usually found fully descended at birth, they are not always so, but occasionally one or both is delayed for some time, or even never leaves the body. In these cases the man is often thought to have no testicles, because they are not in the scrotum, but they may be just as active as if they were there, as explained elsewhere.

In some animals, as in the ram, the testicles always remain in the body.

The female ovaries undergo much less change, from their first formation, than the male testes, both in structure and position. In fact, they remain permanently very near where they were first formed. The common canal into which, in the testes, all the seminiferous tubes empty, becomes in the female the Fallopian tube. There is, of course, one of these on each side, but they gradually grow together at the upper part, and form the *uterus* by their junction. The *uterus* is thus made up of the enlarged inner ends of the Fallopian tubes, the outer ends of which are in contact with the ovaries. The part in the male corresponding to the womb in the female, is the *prostatic vesicle*, called sometimes the *sinus pocularis*. This is connected with the ends of the *vasa deferentia*, leading from the testicles, just as the womb is with the Fallopian tubes. In fact, all the parts, in either sex, are represented by corresponding parts in the other sex, simply developed in a different way. Starting the same, one grows more in one direction, and the other in another, and this makes the difference of sex. The organs are the same in both, essentially, but differently developed.

This is strictly analogous to what we see in the vegetable world, where similar buds may form thorns, leaves, flowers, or fruits. In fact, we often see common leaves changed into flower petals, stamens into pistils, and pistils into stamens. It is merely a matter of development, the fundamental germ being the same in all.

In the human being, and all other animals, it is the same. Every part originates from some of the cells into which the primary germ cell multiplies, as explained in the beginning of this chapter, and thus all parts begin the same. Not only are the

them, though they are, in fact, independently formed. After the third month the kidneys begin to increase in size, and the Wolffian bodies decrease, and this goes on during the whole fetal period, so that we finally see the kidneys fully formed and active, while the Wolffian bodies have almost disappeared.

There are several other organs which are thus formed, and apparently need, in early embryonic life, which finally disappear, and are succeeded by the permanent ones which we find at birth. These temporary ones, as before explained, are really the permanent forms in the lower types of animals, through all of which the human being passes before it becomes fully developed.

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In the human embryo, the sexual rudiments first show themselves soon after the kidneys, or about the end of the first month; first they are exactly the same in both sexes, but gradually the peculiar form of each begins to show itself. In the male sex, the rudiments of the testes are seen about the middle of pregnancy, reaching the abdominal cavity about the fourth month, and there is then nothing to indicate whether they will become testicles or ovaries. Like the kidneys, they increase as the Wolffian bodies decrease.

PLATE XXIII.

STILL MORE ADVANCED STAGES, PRECEDING THE THIRD WEEK, MAGNIFIED.
Figure 1. a. The chorion. b. The villousities. c. Amnion. d. Embryo. e. The heart. f. Pedicle of the umbilical vesicle. g. The umbilical vesicle. h. Vessels of the allantois.

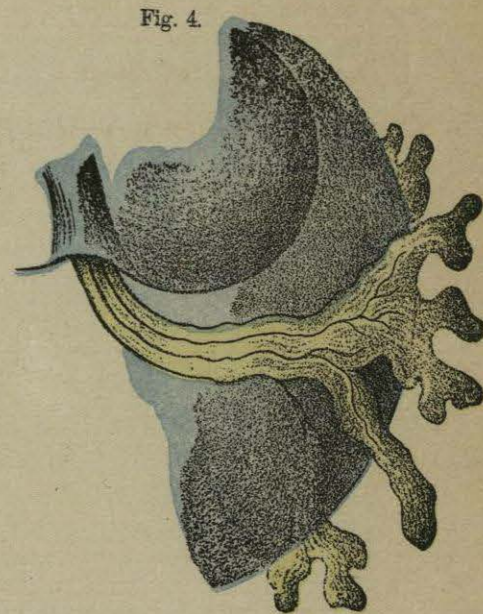
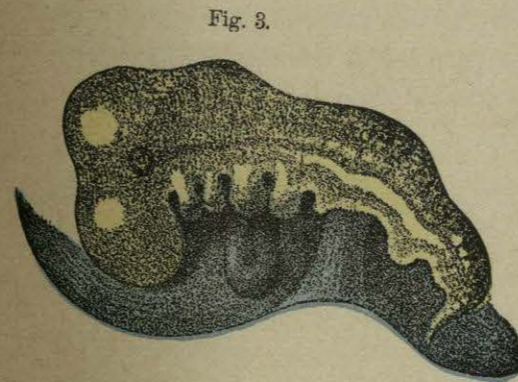
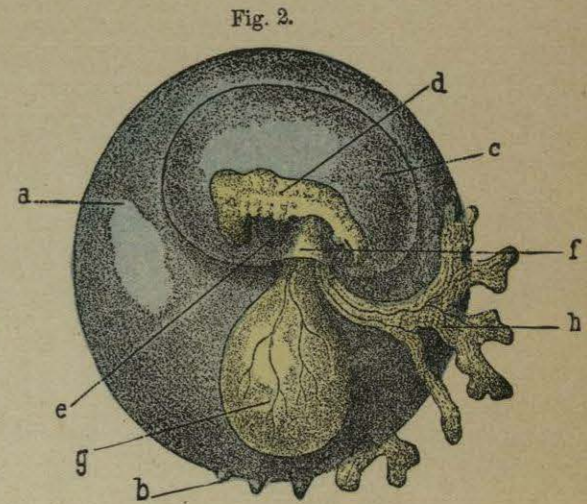
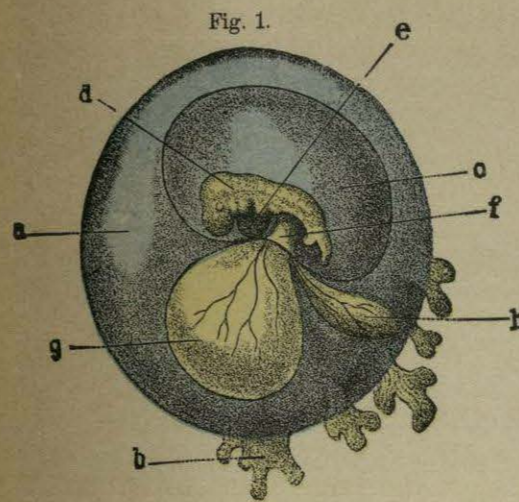
Figure 2. Still more highly developed. a. The chorion. b. The villousities. c. The amnion. d. The embryo. e. The heart. f. Pedicle of the umbilical vesicle. g. The umbilical vesicle, much diminished in size. h. Vessels of the allantois, now connected with the villousities.

Figures 3 and 4 are parts of figure 2, more highly magnified.

The male testes, both in structure and position, in fact, are exactly the same in both sexes, but gradually the peculiar form of each begins to show itself. In the male sex, the rudiments of the testes are seen about the middle of pregnancy, reaching the abdominal cavity about the fourth month, and there is then nothing to indicate whether they will become testicles or ovaries. Like the kidneys, they increase as the Wolffian bodies decrease.

This is strictly analogous to what we see in the vegetable world, where similar parts may form thorns, leaves, flowers, or fruits. In fact, we often see common parts changed into lower petals, stamens into pistils, and pistils into stamens. It is merely a matter of development, the fundamental germ being the same in all. In the human being, and all other animals, it is the same. Every part originates from some of the cells into which the primary germ cell multiplies, as explained in the beginning of this chapter, and thus all parts begin the same. Not only are the

PLATE XXIII.



Further Developed Embryo.

two sexes alike at first, but every part of each one is the same in the beginning, and becomes differentiated by a process of evolutionary development.

The skin, which is to surround and inclose all the organs, begins to form at a very early period, from a number of minute granules, which are developed in the original germinal membrane. These granules are, at first, seen to be always in rapid motion, like the seminal animalcules, and this continues till they are fully consolidated into the membrane called the skin. This motion is apparently essential to the proper development of the skin, which would probably be imperfect if it did not take place, and from some stoppage of it, possibly, many diseases and imperfections of the skin may be owing.

It is worthy of notice, that the same causes which arrest the motion of the seminal animalcules, have the same effect upon the skin granules. Opium, for instance, arrests them immediately, and so does alcohol! It is quite conceivable, therefore, that the use of opium, or alcohol, in excess, by the mother, at a certain stage of pregnancy, may originate skin disease in the child, even before it has well begun to be formed. And the same may be true of many other agents.

We see, therefore, that it is important to consider the welfare of the future new being, and what may be to its benefit or injury, long before it is born.

It is a very short-sighted view to suppose that our care in regard to it should begin only at birth, for its future constitution, bodily and mental, may be irrevocably influenced from the very moment of conception.

The cells, or granules, which form other parts, as well as those which form the skin, are also seen to exhibit this rapid motion, and it probably occurs in them all. It is the incipient development of *life*. The embryo itself, in its earliest stages, is usually seen to be in rapid motion, like the germ in many of the lower organisms, as described in the chapter on spontaneous generation.

In the development of the external organs of generation, there is much that is very interesting and instructive to observe. In the early stages, there is no distinction whatever between the two sexes, and the conformation of the organs, both in man and all the higher animals, is precisely the same as it is permanently in the oviparous vertebrates. Up to the fifth or sixth week there may be seen in the embryo, externally, the opening of a *cloaca*, as in birds, in which the ureters, the intestines and the sexual ducts all terminate. About the tenth week, the intestinal opening, or anus, and also the urinary and sexual canals, begin to be divided from each other by partitions forming between them, and the bladder is developed. At this stage the parts have much the same conformation as in certain birds, and in the non-placental mammals.

The external opening of the genito-urinary canal is now seen to be surrounded by two thick folds of skin, which may become either the large lips of the female vulva, or the two halves of the male scrotum. Between these two folds of skin there is also formed a kind of longish bud, of rather firm consistence, which has a gland on the end, and a furrow, or cleft, on its under surface. In the female this organ is drawn back considerably into the canal, and forms the *clitoris*, while the two sides of the furrow, or cleft, form the small lips, or *nymphae*. In the male, however, it develops further, and becomes the *penis*, the two walls of the cleft closing over and forming the tube called the *urethra*, or common passage for the urine and semen.

The penis, therefore, is the same as the clitoris, only more fully developed,—the scrotum corresponds to the two large lips, and the walls of the urethra to the *nymphae*.

two sexes alike at first, but every part of each one is the same in the beginning and becomes differentiated by a process of evolutionary development.
 The skin, which is to surround and inclose all the organs, begins to form at a very early period from a number of minute granules which are developed in the external germinal membrane. These granules are at first seen to be always in rapid motion, like the seminal asterozoites, and this continues till they are fully consolidated into the membrane called the skin. This motion is apparently essential to the proper development of the skin, which would probably be imperfect if it did not take place, and from some stoppage of it possibly many diseases and imperfections of the skin may be owing.

PLATE XXIV.

Figure 1. Human embryo of 3 weeks pregnancy; natural size. A. The embryo. B. Umbilical vesicle. C. Amnion. D. Chorion. E. The villosities, or root-like vessels which absorb nutriment. F. Exterior of the decidua vera, or lining membrane of the womb. G. Interior of the same.

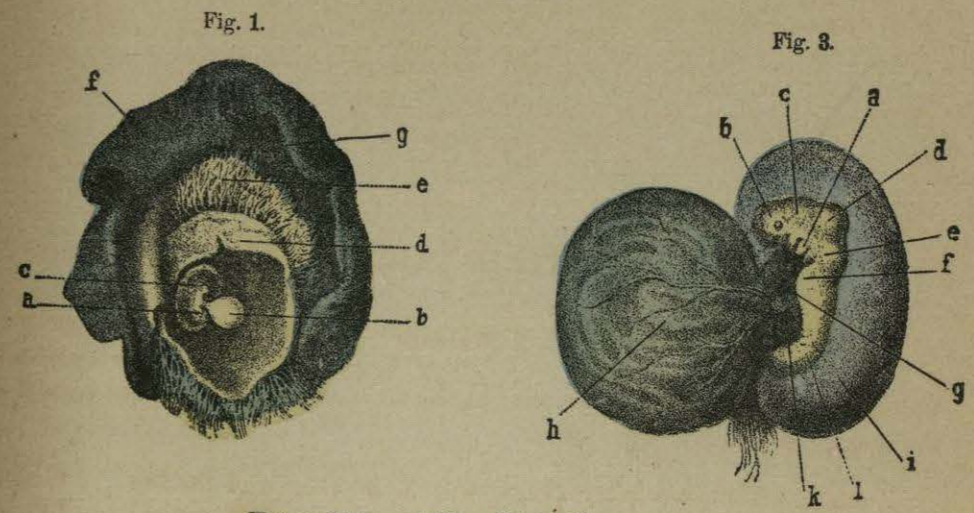
Figure 2. The same embryo magnified. A. Rudiments of the face. B. Vesicle which becomes the front part of the brain, or cerebrum, at the lower part of which may be seen a small point, which is the beginning of the eye. C. Vesicle of the third ventricle. D. Vesicle of the corpora quadrigemina. (C., D. and E. are parts of the brain.) E. Vesicle of the medulla oblongata. F. Beginning of the walls of the abdomen. G. The heart. H. Umbilical vesicle. I. Amnion. K. The pedicle of the umbilical vesicle. L. Rudiments of the lower limbs.

Figure 3. Human embryo at the fourth week; natural size. A. The embryo. B. Umbilical cord. C. Amnion. D. Umbilical vesicle. E. Internal surface of the chorion. F. The villosities. G. The external surface of the decidua vera. H. Internal surface of the same.

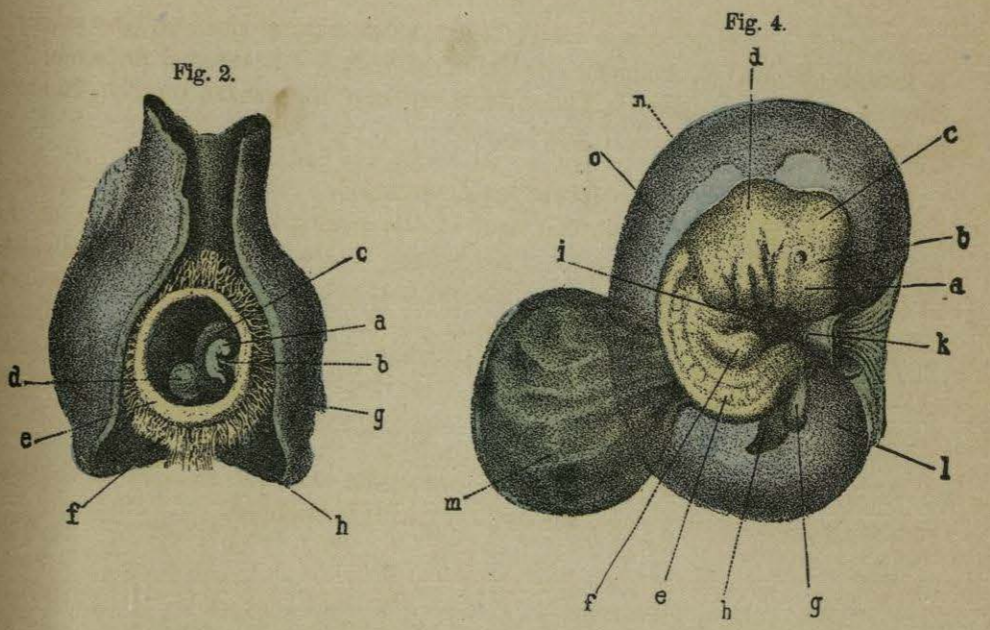
Figure 4. Embryo in the fourth week, magnified. A. Vesicle of the cerebrum. B. Vesicle of third ventricle. C. Vesicle of the quadrigemina. D. Vesicle of the cerebellum (all the above are parts of the brain). E. Dorsal laminae. F. Rudiments of the upper limbs. G. Rudiments of the lower extremities. H. The tail, or end of the spine, curved backward. I. The heart. K. Sheath of the umbilical cord. L. The amnion. M. The umbilical vesicle withering away. N. Vesicle of the medulla oblongata, or top of the spinal marrow. O. The indentation, which afterward becomes the neck, and separates the head from the trunk.

N. B.—If these plates are studied in connection with the detailed description, previously given, of each stage, both will be readily understood.

PLATE XXIV.



Human Embryo at Three Weeks, Natural Size.



Human Embryo at Third and Fourth Weeks, Magnified and Natural Size.

The male, in short, is merely the female in a more advanced stage of evolution, not only externally, as here shown, but also internally, as explained before.

The urethral canal, in the male, is usually completely inclosed about the fourteenth week, but sometimes it does not inclose completely at all, and then we have the malformation that will be explained further on, in which there is an opening by which the urine escapes at some other place than the end. Most cases of what are called *hermaphrodites*, in human beings, arise from imperfect, or abnormal development at this stage. Sometimes, in the male, the parts will remain, more or less, in the female stage, while in the female, on the contrary, some of them will advance to the male stage. Instances of both kinds, with full explanations, will be given in a subsequent article, but the following illustrations will make the matter readily understood.

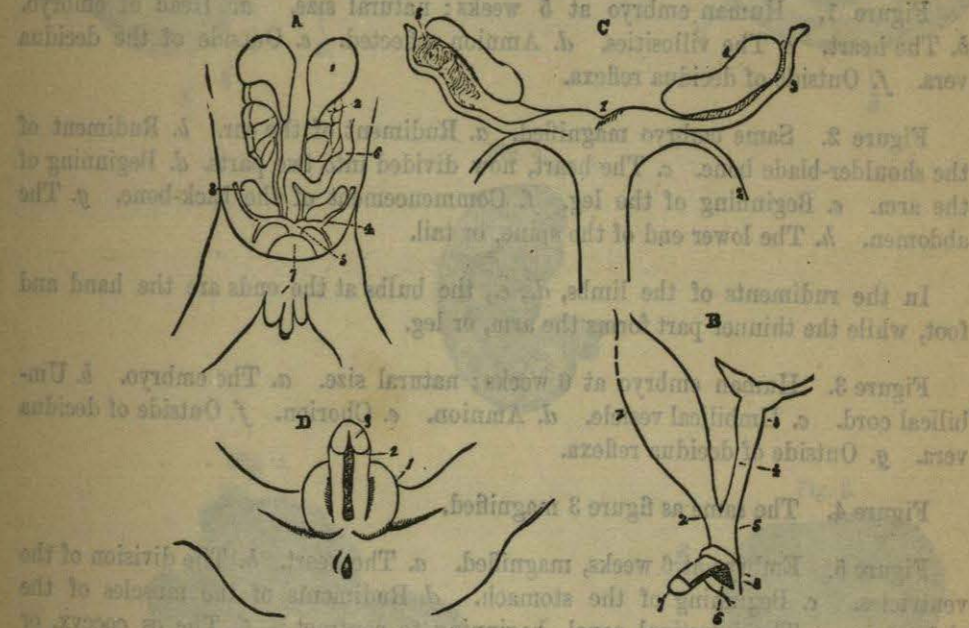


FIGURE 108.—Urinary and Generative Organs of the Human Embryo, when about three and a half inches long.

A. General view of all the parts.—1. The capsules on the tops of the kidneys; very large at this stage.—2. The kidneys, yet quite small.—3. The ovary.—4. The Fallopian tube.—5. The uterus.—6. The intestine.—7. The bladder.

B. The bladder and generative organs of the same, seen sideways.—1. The bladder.—2. The urethra.—3. Uterus, with two horns.—4. The vagina.—5. Part common as yet to both urethra and vagina.—6. The common orifice for both urinary and generative organs.—7. The clitoris.

C. Internal organs of the same.—1. Uterus.—2. Round ligaments.—3. Fallopian tubes.—4. Ovaries.—5. The remains of the Wolffian bodies.

D. External generative organs of the same embryo.—1. The large lips.—2. The nymphæ.—3. The clitoris, with the open cleft underneath. This may either remain what it is at this period,—a female clitoris,—or it may develop further into a male penis.

This would almost certainly be taken for a male embryo, on a cursory inspection, and indeed, the correspondence of the several parts with those of a male is very striking. The clitoris (D 3) is a true penis, except that it has an open furrow underneath, instead of a closed tube; but it is readily seen how this furrow becomes a tube, by the two sides closing over, and then it is a true male organ. The large lips (D 1) only need to grow together to form a scrotum, into which the ovaries may descend and become testicles.

The male in short is merely the female in a more advanced stage of evolution, not only externally, as here shown, but also internally, as explained before. The internal canal, in the male, is usually completely closed about the fourth week, but sometimes it does not become completely at all, and then we have the malformation that will be explained further on, in which there is an opening by which the urine escapes at some other place than the end. Most cases of what are called hermaphrodites, in human beings, arise from imperfect or abnormal development at this stage. Sometimes, in the male, the parts will remain more or less in the female stage, while in the female, some of them will advance to the male stage. Instances of both kinds of malformations will be given in a separate article, but the following illustrations will make the matter readily understood.

PLATE XXV.

Figure 1. Human embryo at 5 weeks; natural size. *a.* Head of embryo. *b.* The heart. *c.* The villosities. *d.* Amnion reflected. *e.* Outside of the decidua vera. *f.* Outside of decidua reflexa.

Figure 2. Same embryo magnified. *a.* Rudiment of the ear. *b.* Rudiment of the shoulder-blade bone. *c.* The heart, now divided into two parts. *d.* Beginning of the arm. *e.* Beginning of the leg. *f.* Commencement of the back-bone. *g.* The abdomen. *h.* The lower end of the spine, or tail.

In the rudiments of the limbs, *d.*, *e.*, the bulbs at the ends are the hand and foot, while the thinner part forms the arm, or leg.

Figure 3. Human embryo at 6 weeks; natural size. *a.* The embryo. *b.* Umbilical cord. *c.* Umbilical vesicle. *d.* Amnion. *e.* Chorion. *f.* Outside of decidua vera. *g.* Outside of decidua reflexa.

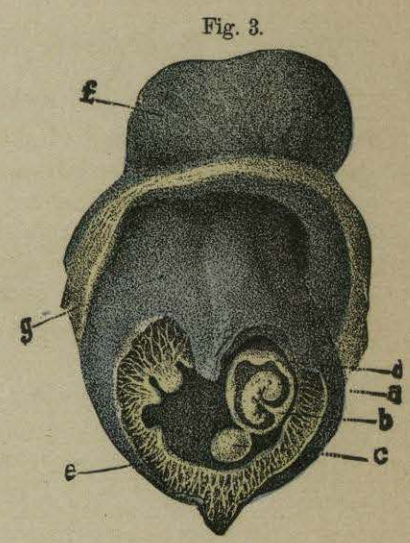
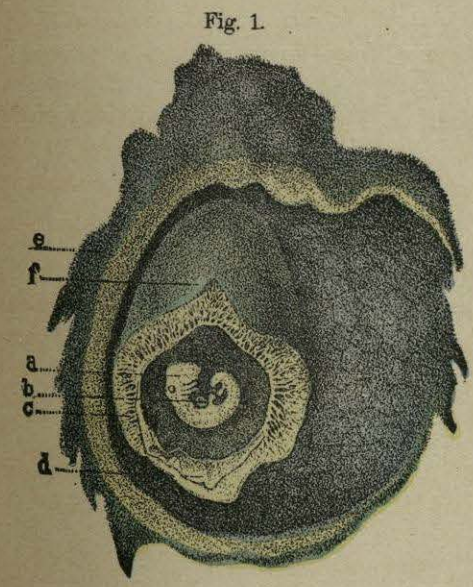
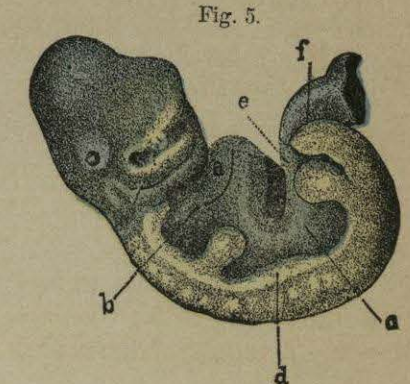
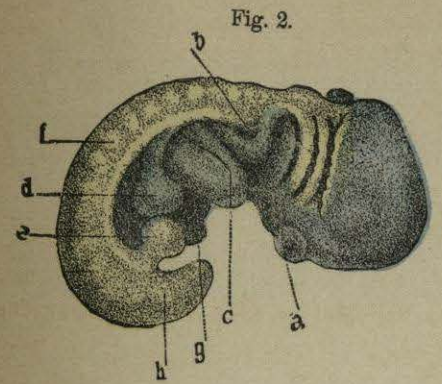
Figure 4. The same as figure 3 magnified.

Figure 5. Embryo at 6 weeks, magnified. *a.* The heart. *b.* The division of the ventricles. *c.* Beginning of the stomach. *d.* Rudiments of the muscles of the abdomen. *e.* The intestinal canal, beginning to contract. *f.* The os coccyx, or tail-like end of the backbone.

The gradual evolution of one part after another can now be very readily seen; and it is easy to understand how slight a thing may interfere with the development of any part, in these early stages, and so lead to deficiency, or deformity of that part.

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PLATE XXV.



Human Embryo in the Fifth Week.

At this stage it is really of neither one sex nor the other, but may become either male or female.

In short there is no part, in either sex, that a part corresponding to cannot be found in the other sex, but differently developed. It is not at all surprising, therefore, that irregularity of development should often occur, making an individual of doubtful, or double sex, like the so-called hermaphrodites.

It has already been remarked that the part first distinctly developed is the spinal column. At first, however, this is merely a jelly-like chain of connected cells, tapering at both ends, and inclosed in a sheath, or investing membrane, which eventually becomes fibrous. This is called the *chorda dorsalis*, and in man is only temporary, being succeeded by the true backbone, and spinal marrow, which are formed gradually. In the lowest vertebrates, however, such as the *amphioxus*, and some fishes, the spinal column never advances beyond this stage, but remains always the *chorda dorsalis*, as we find it in the human embryo at an early stage.

In vertebrates a little higher, a true bony spine is formed from the fibrous sheath, which gradually ossifies; but in man, and all the higher types, the bony plates are formed independently, and more perfectly. In short, the development of the spinal column becomes more perfect in each type, as we ascend in the scale, just as we see the other organs do, till in man it becomes the most perfect. It has, however, in him to go through all the stages, from the simple *chorda dorsalis* upward to the true spinal column.

The limbs, upper and lower, in all vertebrates, develop from leaf-like buds, which grow from the sides of the trunk, and they also go through several modifications of development. Thus, in the human embryo, the toes and fingers are at first united by a membrane, or webbed, as in the swimming animals; but the web gradually disappears as growth progresses.

In the brain, also, the gradual progress, from the lowest type to the highest, is distinctly traceable. At an early period, the human brain is almost exactly like that of a fish, so that the two are scarcely distinguishable. At a later period, it equally resembles the bird brain, and still later, that of the marsupials. It becomes truly human only after having been fish, reptile, bird, and marsupial.

The same law of development prevails with the eye, and all the other organs of sense, which in their earlier stages are not human, but like those of the lower vertebrate types.

This important fact is very suggestive, as it shows us to what a great degree, and in what way, a human being may be affected, for good or ill, *before birth*.

The quality of the mother's blood, and her nervous condition, at any stage of foetal development, must exert a vast influence over the bodily development of the new being; and whatever influences it bodily, does so mentally and morally, through all its future existence. But how few human beings ever give this a thought, or rather, how few are acquainted with the fact. Dr. Combe says, "We have demonstrative evidence that a fit of passion, in a nurse, vitiates the quality of the milk to such a degree as to cause colic and indigestion, or even death, in the suckling infant. If, in the child already born, and in so far independent of the parent, the relation between the two is thus strong, is it unreasonable to suppose that it should be yet stronger, when the infant lies in its mother's womb, is nourished indirectly by its mother's blood, and is, to all intents and purposes, a part of her own body? If a sudden and powerful emotion of her own mind exerts such an influence upon her