CHAPTER XXVIII.

FŒTAL NUTRITION.

THE manner in which the new being derives its nutriment, or the material by which it grows, is, in a great measure, unknown to us, though we certainly obtain some information about it by a study of the apparatus employed in the process.

For the first fifteen or twenty days the substance called the *vitellus*, which is analogous to the yelk of the ordinary egg, appears to supply most of the material that is required in the formation of the new being, if not all; and, indeed, this substance does not totally disappear till after the third month, though we cannot suppose it to be the sole source of nutriment then. It is also supposed, by some, that the amniotic liquor, in which the fœtus floats, may afford some nutriment, either by being swallowed, or by being absorbed through the skin. It is certain that this fluid is nutritive, and there is nothing impossible in its absorption, though it is not very likely to occur to a sufficient extent. The idea that it can be swallowed, however, is erroneous, because the mouth of the fœtus is firmly closed while in the womb; and besides, children have been born alive without *mouths*, and even without *heads*, and of course they could not have swallowed anything. It is now generally conceded by physiologists that the material required by the fœtus, for its nutrition, is obtained from the blood of the mother, through the medium of the placenta, and the vessels in the umbilical cord. It is, however, a matter of dispute whether the maternal blood is sent directly, in its ordinary state, into the body of the child, or whether it first undergoes a preparatory process, which most modern authors suppose it does.

From the earliest period of gestation, the middle membrane, called the chorion, is covered, on its outer surface, with a number of small protuberances called *villosities*, which subsequently become true blood-vessels. About the fourth month these have increased very much in size and number, and have all become conglomerated into one mass, in form like a mushroom. This is called the *placenta*. It is almost entirely formed of blood-vessels, which seem to attach themselves at one end, by open mouths, to the open mouths of other blood-vessels on the inner walls of the uterus. At the other end these vessels are drawn together and lengthened out into a long tube called the *umbilical cord*, or *navel string*, which finally enters the body of the child at the navel, and so establishes the connection between it and the mother.

The blood-vessels in the placenta, umbilicus, and fœtus, like those in the maternal body, are of two kinds, *arteries* and *veins*. The arteries, which come from the *left* side of the heart, carry the pure blood, which contains all the materials for forming and nourishing every part of the system. The veins contain the blood in its impure state, and take it to the *right* side of the heart, from whence it is forced into the lungs to be purified by the act of breathing. The blood is made impure by some of its constituents being absorbed, to form the different parts of the body, and by having thrown into it a quantity of waste and poisonous matter no longer needed.

PLATE XXX.

DEVELOPMENT OF THE GENITAL ORGANS.

Figure 1. Genital organs of an embryo, 8 weeks old, magnified. *a*. The external lips. *b*. Clitoris. *c*. Central cleft. *d*. The coccyx.

Figure 2. The same at 9 weeks. *a*. External lips. *b*. Clitoris. *c*. Central cleft. *d*. Anus. *ee*. The nymphæ. *f*. The coccyx.

Figure 3. The same at 10 weeks, magnified. *a*. The glans. *b*. The furrow, caused by the bending of the glans. *c*. External lips. *d*. The central cleft, contracted at its lower part. *e*. The anus.

Figure 4. The same at 11 weeks, magnified. This shows the perineum perfectly formed, at *a*, so that the anus and the genito-urinary passage are now separated.

Figure 5. Genital organs of a male embryo at 3 months, natural size.

Figure 6. Genital organs of a female embryo at 3 months, natural size.

Figure 7. Genital organs of male at 3 months, magnified. *aa*. The scrotum. *b*. The raphe, which divides the scrotum into two parts. *c*. The penis. *d*. The glans penis. *e*. The central cleft now nearly closed. *f*. The anus. *g*. The os coccyx. *h*. The perineum, or space between the genitals and anus.

Figure 8. Female genital organs at 3 months, magnified. *aa*. The nymphæ. *b*. The cleft, more widely open, instead of being closed, as in the male. *c*. The clitoris, corresponding to the male penis. *d*. Lower end of the nymphæ. *e*. Perineum. *f*. The anus. *g*. The os coccyx. *hh*. Large lips. *i*. The mons veneris.

PLATE XXX.

Fig. 1.

Fig. 2.

Fig. 3.

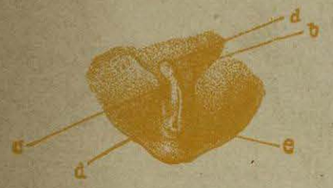


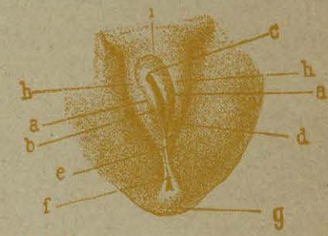
Fig. 4.

Fig. 5.

Fig. 6.

Fig. 7.

Fig. 8.



Development of the Genital Organs

The course of the blood, therefore, is from the left side of the mother's heart along her arteries till it reaches the arteries of the uterus, from thence it passes into those of the placenta, and thence into those of the umbilicus which convey it into the body of the child. When there it circulates in its arteries, supplies the material for its further increase and development, becomes in consequence impure, and passes into its veins, the same as in the maternal body. From these veins it passes into those of the umbilicus and placenta, and, apparently, into those of the mother, by which it is conveyed to the right side of her heart, and by its action to her lungs, to be again purified when she breathes. This explains what was previously stated, that the child uses the mother's heart, lungs, and stomach while in the womb, and has, therefore, no occasion to use its own.

The diameter of the placenta is about six inches, and its thickness about one inch and a half. The length of the umbilical cord is from eighteen to twenty-four inches, its diameter about half an inch. These dimensions are, however, subject to great variation. Instances are mentioned of the cord being five feet long, and as thick as the child's arm. I have seen one myself four feet long. Sometimes it will be very short, not more than eight or ten inches. It is composed of one artery and two veins, twisted together like the strands of a cable, and a sheath surrounding them composed of the chorion and amnion. Between the sheath and the vessels is a thick gelatinous fluid called the gelatine of Wharton.

This explanation, it must be remembered, is in fact merely hypothetical. The direct passage of the blood through the placenta, from the mother's vessels into those of the cord, is denied by many physiologists, who contend that there is an intermediate set of vessels in the placenta, in which it first undergoes important changes. They also contend that the impure blood does not pass through into the mother's veins at all, but is purified in the placenta, and immediately returned. Some have even averred that the placenta is not required at all, to supply nourishment, but is merely a purifying organ. It is now known, however, that it is not absolutely essential to either process, for children have been born alive, and perfectly formed, which merely floated loosely in the amniotic liquor, having neither placenta nor cord, nor any other connection with the mother. How they were nourished we cannot tell. These, however, must be regarded merely as curious exceptions, there being little doubt but that fœtal nutrition is ordinarily effected through the placenta and cord, by means of the mother's blood, somewhat in the manner we have described.

PECULIARITIES OF THE FŒTAL CIRCULATION.

From the circumstance of the fœtus not using its heart and lungs, like the adult, its circulation has several modifications.

The engine by which the blood is forced along its vessels is the *heart!* This is divided into two distinct parts, each of which has two cavities, the upper one called the *auricle*, and the lower one the *ventricle*, which communicate with each other by curious valves. In the adult, the whole of the impure blood is poured into the right auricle, that from the lower part of the body by the *inferior vena cava*, and that from the upper part by the *superior vena cava*. From the right auricle it passes into the right ventricle, which pumps it into the lungs, by way of the pulmonary artery; here it is purified by the act of respiration, and then brought, when pure, by the pulmonary veins, into the left auricle, and passes from thence into the left ventricle, which

PLATE XXXI.

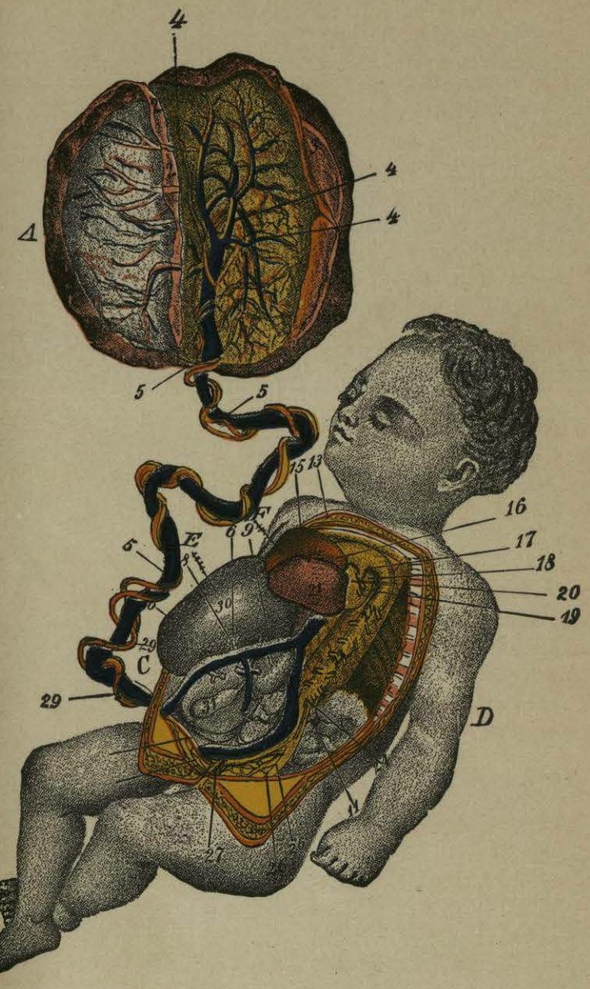
THE PLACENTA AND UMBILICAL CORD, SHOWING THEIR CONNECTION WITH THE FŒTUS.

A. The placenta. D. The fœtus. B. The umbilical cord. On the under surface of the placenta, A, the ramifications of the blue veins and the red arteries are plainly shown, and their continuation into the twisted vessels of the umbilical cord, B, which at the navel, C, enter the body of the child. From the navel they are continued up the interior of the body to the heart, F. E. The liver.

Length of the umbilical cord, or navel string, from one foot and a half to two feet. It apparently has no nerves, for the child shows no sign of pain when it is cut.

The placenta usually weighs about a pound, but sometimes considerably more. When there are two or more children, each one has its own placenta, though they occasionally coalesce together.

The placenta, cord, and membranes, form what is called the *after-birth*, because they come away after the child. (*See Frontispiece.*)



The Fœtus with its Appendages.

pumps it into the great aorta, and from thence into the smaller arteries all over the body.

The two sides of the heart, therefore, do not communicate directly with each other, but there is a strong partition between them. In the fœtus, the arterial blood from the mother, when it leaves the umbilical artery, enters first the liver, runs through its vessels, gives off the bile found in it, and then joins the vena cava inferior. By this passage it is taken into the right auricle, along with the impure blood of the vena cava. From the right auricle it passes through a hole in the partition directly into the left auricle, instead of taking the indirect route by the lungs as in the adult. From the left auricle it passes into the left ventricle, and is from thence distributed by the arteries all over the body. This opening in the partition is called the *foramen ovale!*

After birth, when the blood begins to pass through the lungs, this passage closes up. By the eighth day it is generally obliterated, often much sooner, though occasionally it has remained open longer without inconvenience. In some cases the foramen ovale does not close at all. The child has then what is called the *blue disease!* The whole body is of a uniform leaden, or blue color, and the whole system is generally languid and sluggish. The blue color is caused by the dark blood of the veins mixing with that of the arteries. These children mostly die early, but some live to be five or six years old, and one I saw twelve, but this is rare. No remedy can be had for this affliction, and I have never known it to cure spontaneously. Some children are so very dark for a few days after birth as to cause great alarm. This is owing to the foramen ovale being very open and closing slowly. No apprehension need be experienced in such cases, as they soon come right.

The impure blood from the upper part of the fœtal body, which is brought down by the superior vena cava, also enters the right auricle, but does not pass from thence through the foramen, like that from the inferior vena cava. By a peculiar arrangement this blood is made to pass down into the right ventricle, and from thence along the pulmonary artery, the same as in the adult state. Only a very small portion, however, passes into the lungs, the great part being taken along a tube called the *ductus arteriosus* into the great artery called the aorta, where it begins to turn down to the lower part of the body. In consequence of this, the arterial blood going down to the lower part of the body is mixed with this portion of impure, venous blood, brought by the ductus arteriosus from the superior vena cava; while that going to the head, and upper part of the body remains pure. And this is the reason why the lower part is always so much smaller than the upper part, previous to birth; it receives less pure nourishment. The head and chest appear, at an early period, almost as large as the rest of the body.

This circumstance also explains why, in the great majority of cases, the *right* arm is preferred to the *left*, and has more real power. The place where the ductus arteriosus pours the impure blood into the aorta, is almost immediately opposite to where the artery is given off which feeds the left arm. In consequence of which, in most cases, a small portion of this impure blood becomes mixed with the arterial blood, and the left arm is, therefore, in the same situation as the lower limbs, and like them is comparatively imperfectly developed. The right arm is not liable to any such deprivation. In some cases the insertion of the ductus arteriosus is lower down, so that no such mixture occurs. Both arms are then equal, and this accounts for the fact that in some persons there is no difference. In some cases, no doubt,

early habit may overcome this natural inferiority, and even give the preference to the left arm; but such instances are rare.

The ductus arteriosus closes up about the same time as the foramen ovale.

The two veins which convey the impure blood back to the mother, to be purified, originate from the iliac artery, pass up the sides of the bladder toward the navel, enter the sheath of the cord, and so reach the placenta. They are obliterated about the third or fourth day after birth, and assume the form of a cord.

The real source of *all* the blood in the body of the child is a mystery; it would certainly appear most likely for the whole of it to be derived from the mother, but there are many circumstances which make it probable that the child may form some itself, by digesting the fluid it is supposed to absorb. This view is supported by the fact that there is found in its bowels at birth, and even before, a greenish substance like excrement, called *meconium*. This has every appearance of being the product of digestion, though some suppose it to be derived from the liver. It occasionally contains hair, and other anomalous substances.

The most recent investigations in regard to fœtal nutrition show that the connection between mother and child is established in the following manner: In the walls of the womb there are formed, during gestation, certain cavities, called *sinuses*, into which the curling arteries of the womb pour blood. The tufts of fœtal vessels in the placenta dip into these cavities, like roots dipping into water, and absorb the blood as needed. The mother, therefore, supplies the blood to the fœtus, but its blood-vessels and hers are not continuous one with another. This is shown in the following cut:

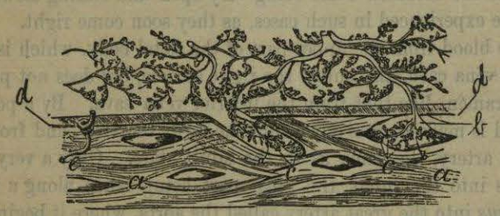


FIGURE 109.—*Connection between the Womb and Placenta.*

b. One of the cavities, or sinuses, into which the fœtal blood-vessels are seen to dip. Another is shown further along. *cc*. Are the fœtal vessels, dipping into the sinuses. *dd*. The decidua, lining the inside of the womb. *e*. One of the uterine curling arteries which pour the blood into the sinuses.

CHAPTER XXIX.

EXTRA-UTERINE CONCEPTION, AND UNNATURAL OR MONSTROUS GROWTHS.

IT sometimes happens that a fœtus is formed *outside* of the womb, either on the ovary, in the tube, or in some part of the abdomen, as among the intestines, for instance. These are called *extra-uterine conceptions*, and their origin has always been a mystery. It was long thought that such cases proved the old doctrine of conception, which supposed that the semen was conveyed to the ovary, and impregnated the egg there, otherwise, said its advocates, how could the fœtus ever be found outside the womb, if conception takes place inside?

The true cause of an extra-uterine conception is this: Any sudden and violent emotion, as a *fright*, for instance, will sometimes reverse the action of the Fallopian tubes, so that they will convey anything *from* the womb toward the ovaries, or contrary to their usual course, so that if an egg should have passed down near the womb, but not have quite left the tube, it might be taken back again during this reverse action. Now, according to our previous explanation, it will be seen that the egg may be impregnated, in some cases, while in the uterine end of the tube, because the semen occasionally penetrates so far; and it is therefore possible that an egg so impregnated may be conveyed to the other end of the tube, or even out of it completely, by this reverse action. It is not necessary for the development of the egg that it should be in the womb, but, on the contrary, it will develop in any part, if it can attach itself to some blood-vessel, though it will never form into a perfect human being except inside the womb. In these cases, therefore, when the egg after impregnation is taken to the other end of the tube, or to the outside, it is possible for it to grow in this way, though imperfectly, and thus form an extra-uterine conception. I have two beautiful models representing actual cases of this kind. It may even be taken, by the motion of the body, after it becomes loose, to various parts of the pelvic or abdominal cavities, where it will attach itself and develop in the same manner. In other cases it has been known to imbed itself in the walls of the womb, and develop there.

Several instances of extra-uterine conception have come under my notice, and I have bestowed considerable attention upon them. Sometimes the development will be indefinite, having no resemblance to a human being; while at others it will be tolerably perfect, and attain a large size, as large in some instances as a fœtus of five months. It is usually, however, a monstrosity, imperfect in some particular. The placenta and cord are found, as in the inter-uterine conception, as also the amnion and chorion, but only occasionally a membrane analogous to the decidua, this being properly a product of the uterus alone. The expulsion of these products cannot, of course, be effected in the ordinary way; they have either to be removed by an operation, which is rarely resorted to, or else left to nature, in which case they may terminate in various ways. Some authors say they will occasionally

be absorbed, and so disappear. More generally, however, labor pains come on at the ordinary time, decay commences, an abscess is formed, and the remains of the fœtus work through the opening. If she does not immediately succumb, the wound may then heal, and the woman perfectly recover her health. Cases of this kind have often been met with. I remember one in which all the parts did not come away under six months; the head was nearly perfect. Sometimes the pains will return every nine months, for a long time, before decay commences. In other cases, instead of decaying, the fœtus, with its appendages, will become callous, and form into a hard tumor, which may remain during the individual's life, without causing serious results. I saw a lady very recently who had carried one of these tumors for nine years! And I assisted at the dissection of another in whom it had existed for thirteen years. It was as large as the head, and fixed on the right side of the abdomen, apparently just underneath the skin. These accidents, though serious, are not necessarily always fatal. Females have been known to suffer from them several times in succession, though sometimes the next conception will be perfectly natural. Very generally, however, the first case is followed by barrenness.

FORMATION OF ONE CHILD WITHIN ANOTHER.

Fœtal development will sometimes occur under more extraordinary circumstances even than those already mentioned. One fœtus may be contained within another. A case of this kind occurred at Verneuil, in France, in the year 1804, in a child named Bissien, who differed in no external particular from other children, but always complained of something being the matter in his left side. A small tumor appeared there early, but the development of his body and mind went on as usual, and nothing particular was noticed till he was thirteen years of age. The tumor then suddenly increased in size, he began to pass from his body a quantity of putrid matter mixed with long hair; fever set in, and he died when about fourteen. Upon making a post-mortem examination, there was found between the intestines and spine the remains of a fœtus. The teeth, nails, hair and bones, were not like those of a mere infant, but evidently indicated that the inclosed fœtus was as old as the one in whom it was formed! Such cases are extremely rare, and I believe this was the first that was properly observed or explained. Singular as it may appear, it can be readily explained, if the description we have given of the process and organs of generation be borne in mind.

In all such cases there have been two eggs impregnated, as in a case of twins, but only one has developed into a child while in the womb, and the other has become inclosed within its body. The egg thus inclosed may retain its vitality, but not develop for an indefinite period, perhaps not till many years after that child is born, and very likely there are many cases in which it never does. There is nothing more extraordinary in its development, however, when it does take place under such circumstances, than there is in extra-uterine conception in the mother's body, because the conditions are the same. The most wonderful circumstance is that the egg should remain so long dormant, and still be able to grow after such a lapse of time.

I have met with several cases of included fœtuses in dissecting animals, and a physiological friend informed me that he once found one in a man of thirty, which was so perfect that he could perceive it to be of the male sex. This man was, therefore, really pregnant with *his own twin brother*.

As a proof of our explanation of the causes of extra-uterine fœtuses, it may be stated that, in every such case when its history could be traced, a fright or other accident had been experienced about the period of conception. It is a singular fact, also, that the most of such cases have been *from illicit intercourse*, in which females, of course, are often liable to the fear of discovery and exposure, and to be disturbed.

The most convincing proof, however, that extra-uterine conception is owing to fright, or disturbing violence, has been obtained by experiment upon animals. It has been found that a blow upon the head, if it be given about the time of conception, will nearly always cause an extra-uterine development. It is dangerous, therefore, for association ever to be practiced when any disturbance may be experienced immediately after. If conception has already taken place, such violence or fright may materially affect the development of the new being, by suspending the vital power for a time. Thus a celebrated physiologist gave a female dog a violent blow on the head, at the time of conception, so that she was partially paralyzed for some days, and when she brought forth her young, all of them, except one, either had *no hind legs*, or were deformed, or puny and weak. In another similar experiment, four deformed young ones were born and three others were formed extra-uterine. The four eggs had therefore evidently reached the womb at the time of impregnation, while the other three were at the uterine end of the tube, which, having its action reversed, took them to the outside.

All our ideas connected with the development and birth of man, are so associated with the maternal *womb* that it sounds strangely unnatural to speak of children being formed in any other part of the body. Still, it is a fact that they sometimes are, as already shown; nor will this seem so mysterious and wonderful when the true nature of fœtal development is borne in mind.

The female germ cell, or ovum, receives such an electrifying influence from the accession of the male sperm cell, in fecundation, that it will develop anywhere if it have the requisite conditions of warmth, moisture and nutriment in an available form.

It is true all these conditions are found best in the womb, and the new being can also find its way, from there, into the world with safety to itself and the mother. An impregnated egg, however, will form a child in the ovary, the Fallopian tube, in the walls of the womb, or in the abdomen itself, among the intestines—in fact, almost anywhere in the body where accident may convey it.

In very ancient works such cases are recorded, but their nature not being known, all kinds of theories were adopted in regard to them. It was only when the human female anatomy and physiology were practically studied by competent observers that they could be understood.

It is somewhat remarkable that the womb, even when the child has no connection with it, is still affected by the impregnation. It enlarges, becomes engorged with blood, the neck clogs up with mucus, and a deciduous membrane forms to line its interior. It is, therefore, evidently in sympathy with what is going on, though not directly concerned in it.

Sometimes the ovum, in these extra-uterine cases, arrives at full maturity, dies, putrefies, and by causing inflammation, makes a passage for itself, by which the remains escape. Sometimes it passes away in fragments by the bowels; at other times by an abscess, on the outside of the abdomen. Occasionally, it works its way into the vagina, and still more rarely into the bladder.

PLATE XXXII.

EXTRA-UTERINE CONCEPTION—OVARIAN.

This represents a remarkable case of extra-uterine conception, in which the child was formed in the ovary itself. There was, of course, no connection with the womb, nor were there the usual membranes, but a confused placental mass connects the child with the cavity in the ovary in which it was formed.

A. The amnion. B. The chorion. CCC. The placenta. DDD. Fragments of the corpus luteum. EEE. Covering of the ovarium. F. The Fallopian tube. G. The omentum or membrane covering the intestines.

A Remarkable Case of Ovarian Fecundation.