A STUDY OF THE HUMAN PLACENTA, PHYSIOLOGICAL AND PATHOLOGICAL.

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(Plates XIX. to XXII.)

Part I.—Development and Normal Structure.

The object of this paper is to give some account of the minute structure of the human placenta, with especial reference to its development. For the sake of brevity, a description of the macroscopic characters of the placenta is omitted, and some of the better known points of histology are only briefly alluded to.

For reasons which will afterwards appear, the normal structure of the placenta must be studied in specimens obtained not later than the mid-term of gestation. This paper is therefore not concerned with the placenta at the full term. Frequent references are made to the very voluminous literature of the subject, and a list of all such references will be found at the end of the paper.

The placenta consists of two distinct series of structures; one developed from the ovum, *the fœtal placenta*; the other developed from the uterus, the *maternal placenta*. The two parts, of which the placenta is composed, are best studied separately.

A. *The Fœtal Placenta.*

The fœtal placenta is an elaboration of the outer fœtal envelope or chorion; it is therefore necessary, in the first place, to trace briefly the development of this membrane.

Very few facts are known concerning the development of the human ovum, during the first 14 days of its existence. Reichert (36)[1] and His (13) have described human ova of about 12–13 days; in them the decidua reflexa was fully formed, and chorionic villi

[1] The numbers in brackets refer to the Bibliography at the end of the paper.

were present over the greater part of the surface of the ovum. By what precise steps this stage is reached, in man, is not known. We can only assume that it is by a process which does not materially differ from that of mammals lower in the scale than man. We therefore conclude that two structures are chiefly concerned in the formation of the human chorion—(1) the *zona pellucida* or primitive envelope of the ovum, and (2) the *subzonal membrane*, or *false amnion*, which is applied to the inner surface of the *zona pellucida*, forming a complete sphere within it. The latter envelope is formed, together with the true amnion, from the extra-embryonic portion of the somatopleure. It is composed of an outer epiblastic and an inner mesoblastic layer. Kölliker ([21]).

There has been great conflict of opinion upon the relations of the allantois to the chorion. The old view was that the allantois grew out from the posterior end of the primitive alimentary canal to the wall of the ovum, in the form of a hollow process, surrounded by mesoblastic tissue; that a direct connection was thus established between the embryo and the envelope, and that along this bridge vessels developed from the terminal bifurcations of the aorta, which vascularised the chorion. This view has recently been opposed by His, and in point of fact their are no direct observations to support it. His ([13]) points out, among other objections to the theory, that allantoic or umbilical vessels have been found reaching the chorion by a mesoblastic stalk at a period when the allantois itself is only beginning to appear. Without entering into the discussion further, the view of His may be briefly stated, and adopted as most in accord with the facts as they stand at present.

The old view assumed that, after the closure of the amnion, a connection was established between the embryo and the wall of the ovum by the outgrowth of the allantois. His believes that by the closure of the amnion the fœtus is not entirely separated from its envelopes, but remains in connection with them through a bridge of mesoblastic tissue, which is continuous with its posterior extremity. This bridge he terms the *ventral stalk*. Along it the umbilical vessels grow to reach the chorion. At a later period the allantois grows out towards the chorion, in contact with the ventral stalk; but it never quite reaches the wall of the ovum. It participates with the ventral stalk and the umbilical vessels in the formation of the umbilical cord.

The chorion is thus derived from the embryonic epiblast and mesoblast layers; the epiblast forms the epithelial layer covering the entire membrane and its villi; the mesoblast forms the connective tissue stroma supporting the vessels. The zona pellucida probably disappears early.

In the earliest specimens of the human ovum which have been carefully examined (about the end of the second week), villi were found over nearly the entire surface of the chorion; they, therefore, probably appear at a very early period. They are formed, in the first place,

underlying decidua. As the discoidal placenta develops, the villi covering the general chorionic surface atrophy and become devascularised, and by the end of the second month this process is already complete. A diminution of the total area of the placenta is thus compensated for by the specialisation of a part of it.

It is, therefore, possible to account in a fairly satisfactory manner for the nutrition of the ovum from the end of the second week onwards. One point in this connection must be left over for future consideration, namely, the relative part which is played in the nutrition of the ovum by the glands and by the blood vessels of the maternal tissues. But there remains the important question: How is the ovum nourished during the first two weeks of its existence before the formation of the allantoic circulation? During these two weeks the ovum increases to twenty-five times its original diameter. The suggestion that, as in the case of the Aves, there is stored up in the minute human ovum an amount of nutrient material, sufficient to accomplish these results, seems incredible. The true solution is probably to be found upon quite other lines. A Dutch observer, Hubrecht, has in a recent research ([16]) upon the placentation of the hedgehog, thrown a good deal of light upon the question of the early nutrition of the ovum. In the earliest stages of the development of the hedgehog, Hubrecht describes a layer of very vascular spongy tissue surrounding the ovum, which he terms the trophosphere. This trophosphere is formed in part from the ectoderm of the blastocyst, and in part from the adjacent cellular tissue of the decidua. It contains large sinuses full of maternal blood; the outer layer of the fœtal ectoderm, as well as the decidual portion, is thus richly supplied with maternal blood. When the vitelline circulation is established, primitive mesoblastic villi are formed, containing branches of the vitelline vessels, which push their way into the tissues of the trophosphere, and thus bring the fœtal and maternal blood vessels into close contact. There is in fact, in the hedgehog, a vitelline placenta formed, consisting of a fœtal portion with villi, and a maternal portion with large blood sinuses. Later on, as the allantoic circulation develops, the vitelline placenta disappears. It may be, of course, that the vitelline placenta of the hedgehog has no homologue in the human ovum, but Hubrecht's observations are, at least, highly suggestive.

To return now to the formation of the discoidal placenta. During the second month its formation is begun; after the mid-term it undergoes numerous retrograde changes, which will be described in a subsequent paper. The normal structure of the placenta must therefore be studied in specimens taken from the third and fourth months.

At the third or fourth month the fœtal placenta consists of a dense forest of tree-like structures, having many complicated branches. Their base of attachment is the wall of the ovum. The villi are the free terminal and lateral buds, and the divisions upon which they grow represent the twigs and branches. In their growth adjacent branches often become

has made out that a definite increase in size and number of the vessels occurs in the superficial layers of the mucosa, and that the dilated vessels, probably capillaries, rupture and form small hæmorrhages beneath the epithelium. Later, the extravasated blood collects in lacunæ, formed by destruction of the connective tissue, which in time burst through the epithelium, and allow the blood to escape into the uterine cavity. The rupture of the vessels is probably due to (1) thinning of their walls (2) diminished support of surrounding tissues, (3) some undetermined form of degeneration affecting their walls.

If a fertilised ovum does not reach the altered mucous membrane, the stage of activity subsides, and the damage done is probably soon repaired, the epithelial layer being regenerated from the glandular epithelium which remains. Under the stimulus of the presence of a fertilised ovum, however, the mucous membrane enters upon a new career, and becomes the decidua of pregnancy.

The changes which occur in the formation of the decidua may, for convenience, be divided into three stages:—

The first stage is characterised by the development of decidual cells, and the occurrence of extensive hæmorrhages in the mucosa. The decidua vera, reflexa, and serotina show the changes characteristic of this stage.

The second stage affects the serotina only. It consists in the invasion of the serotina by the chorionic villi, and the opening up of the maternal vessels, by which the circulation through the intervillous spaces becomes established.

The third stage represents the adult phase, in which the serotina consists of two distinct layers—a superficial compact, and a deep cavernous layer.

After the completion of the first stage the vera and reflexa undergo retrograde changes.

First stage.—In the first stage the decidua differs from the mucous membrane of menstruation in two essential particulars—first, in the presence of large numbers of large, round, nucleated cells, known as the decidual cells; and, secondly, in the widespread occurrence of dilatation and rupture of the vessels.

The decidual cells may be considered to be characteristic of pregnancy. It is certain that they do not occur during menstruation. Similar cells have, however, been observed by Overlach ([49]) in acute phosphorus poisoning, and by Calderini ([50]) as the result of experimental irritation of the uterus in animals. Pregnancy is, however, the only instance in which they occur under normal conditions. The characters of decidual cells are too well known to need recapitulation. Their development from connective tissue corpuscles has been repeatedly observed—Hart and Gulland ([15]), Minot ([22]), Bumm ([5])—and may be readily traced in a young ovum. The stages by which the spindle cell becomes the large round decidual cell are presented *ad naturam* in

Plate XIX. Fig. 1. Transition forms of every shape and variety may readily be found. They generally show a single, large oval, deeply-staining nucleus; at times there are two nuclei, very rarely three. In almost all parts red blood corpuscles are found lying singly or in heaps among the decidual cells.

The presence of giant cells in the decidua has been known for many years; they are generally supposed to be developed from decidual cells by a process of nuclear division. I am convinced that this is incorrect, and that the so-called giant cells are in reality sections of epithelial buds from the chorionic villi, which have become embedded in the decidua. This point will, however, be referred to more fully later on.

The small vessels are all markedly dilated, and their walls thinned. These changes are most marked towards the surface, where many vessels have ruptured, with extravasation of blood into the decidual tissue. The blood poured out breaks up the surrounding tissues, and finally makes its way out into the free space between the chorion and the decidua. Some of the hæmorrhages in the decidua are of large size, and often considerable extravasations into the intervillous spaces are found at the end of the first month. These changes, representing the first stage, are mainly preparatory, and are probably completed towards the end of the first month. They occur alike in the decidua vera, reflexa, and serotina; the second and third stages, however, are limited to the serotina.

Second stage.—The period during which the changes, characteristic of the second stage, occur cannot be exactly defined. They probably commence about the end of the first month; round the growing margin of the placenta they may continue until the last weeks of gestation, although in the more central parts they are completed earlier. They are in fact progressive and contemporaneous with the period of growth of the placenta itself.

There has been great difference of opinion expressed about the development of the serotina, and it is impossible, within the limits of this paper, to review the many theories that have been advanced. I shall, therefore, only refer to results which have been satisfactorily confirmed.

The changes which occur in the serotina are due to the remarkable activity of the chorionic villi. Wherever the placenta is growing the process of proliferation by budding, already described, goes on actively in the villi. These also invade the serotina, break up its tissues, and bore through the walls of its vessels. In this manner the maternal circulation through the intervillous spaces becomes established.

A section of the serotina at the beginning of the second month is shown in Plate XX. Fig. 5. The dilated and turgescent state of the vessels is very striking. Hæmorrhages into the tissue are seen at Hæm. At Gld. is shown a section of a dilated gland, well preserved, although detached, cubical epithelium; in many sections of glands the epithelium is markedly proliferating. The decidual cells are loosely arranged, and in places there are masses of small round cells among them. The tissue is in parts extensively broken up by hæmorrhage; many of the glands contain blood (Plate XX. Fig. 6, Plate XXI. Fig. 11), and some of them are seen to communicate by a rupture with a neighbouring hæmorrhage (Plate XX. Fig. 6). In this manner irregular cavities full of blood are formed by rupture of vessels, and opening up of the surrounding decidual tissue.

In the neighbourhood of the hæmorrhages the decidual cells are seen to be actively engaged in absorbing blood (Plate XX. Fig. 6). Some of them contain only a small quantity of blood in the perinuclear protoplasm. Others are full of blood, and in these the nuclei are more deeply bloodstained than the protoplasm. The glandular epithelium may also, in the same way, be found absorbing the blood effused into the gland channel (Plate XX. Fig. 6). This process is probably an attempt at repair, on the part of these active cells. I am not aware that it has been described in the human serotina before.

It has been already stated that maternal blood becomes effused into the intervillous spaces as early as the end of the first month. This blood is to some extent reabsorbed by the chorionic epithelium (Plate XX. Fig. 6). The proliferating epithelium covering the villi, and the epithelial buds, are equally active in this respect. This process has been described by Strahl ([44]) as occurring in the placenta of the bitch. It has no nutritive significance, but is merely a method of disposing of what is practically a foreign body. There is no effective circulation through the intervillous spaces at this period, and blood effused into them represents practically an interstitial hæmorrhage.

Masses of small round cells are often found in the neighbourhood of the serotinal hæmorrhages (Plate XX. Fig. 5). Some of them are, no doubt, leucocytes, but very many arise from the decidual cells by a process of division. The transition stages of this process are represented *ad naturam* in Plate XIX. Fig. 2. These cells are probably concerned in the absorption of blood, and in the process of repair.

This is the condition in which the serotina is found at the period in which the villi begin to invade it. For many years the view first advanced by Turner (*loc cit.*) was maintained, that the villi penetrate the serotina by entering the open mouths of the dilated glands. It is now agreed that this is an error. Early in the second stage the mouths of the glands become closed, although the deeper dilated portions remain until the end of gestation. The villi bore their way directly into the serotinal tissues.

The process of penetration appears to depend upon the activity of the epithelial buds. In Plate XX. Fig. 6 are seen a number of sections of buds which have buried themselves in the serotina; the specimen is from the middle of the second month. By the steps which have been previously described, the bud becomes a villus, from which in turn fresh buds arise. There is no evidence that fully formed villi push their way into the serotina by growth from behind. In this manner, first the superficial layers, and then the deeper ones, are invaded by the villi. Plate XX. Fig. 6 shows a deeply situated hæmorrhage in which a villus is embedded, and around it are numerous sections of epithelial buds, arising from other villi which do not appear in the section. Those parts of the serotina, which are thus invaded by the villi, become excavated; already disintegrated by hæmorrhage they now become entirely broken down, and thus pits or depressions are formed upon the serotinal surface.

This process of excavation results in the formation of an irregular series of elevations and depressions upon the surface of the serotina. It is found that the arteries open upon the elevations, while the veins open upon the intermediate depressions, Bumm (4), Ahlfeld (1). No one seems yet to have definitely proved that the arteries are opened up by the villi penetrating their walls. There remains, therefore, the possibility that the arterial capillaries rupture from the force of the blood current, assisted by thinning of their walls, and loss of support from surrounding tissues. An opening once made tends continually to enlarge by the action of the outflowing blood upon the loose decidual tissue. Villi cannot enter the channel against the blood current; the openings of the arteries are, therefore, always clear of villi, which are washed away from its immediate neighbourhood. The walls of the veins, on the other hand, are probably broken through by the villi. The direction of the blood stream favours their penetration, and venous channels can generally be distinguished by the fact that they contain sections of villi or epithelial buds. By the end of the second month there is probably a definite circulation through the intervillous spaces.

It is at this period that the so-called giant cells have been described as appearing in the placenta. I believe that these cells are, in reality, sections of epithelial buds. They have been described as present in all parts of the serotina; but especially in the deeper parts, and in the venous channels. It is in precisely these parts that the epithelial buds are most numerous. Structurally, the buds are merely multinucleated plasmodia, and so are giant cells. The only question is, therefore, as to their origin. After a very careful search I could find no evidence of the formation of giant cells from decidual cells, while their origin from the chorionic epithelium has been already demonstrated in Plate XIX. Fig. 4 and Plate XXI. Fig. 8. I am, therefore, inclined to believe that they are, in reality, fœtal structures.

As a result of the excavation of the serotina, which occurs at this period, small portions of decidual tissue appear at times to become detached, and carried into the intervillous spaces by the blood current. They may even be found immediately beneath the chorionic membrane. They become moored to one or more of the villi, and later on undergo retrograde changes, which are of considerable importance in connection with the formation of the white placental infarct. This matter does not, however, come within the scope of the present paper.

When the intervillous circulation has been established, no further active changes occur in the serotina at that part. Round the growing placental margin, however, changes characteristic of the second stage may be found up to the last weeks of gestation.

The process by which the placenta increases in size deserves a moment's consideration, and this is perhaps the most convenient place at which to refer to it. The growth of the placenta is intimately associated with the development of the decidua reflexa. It is now agreed that the reflexa is formed by a splitting of the vera around the base of attachment of the ovum. The superficial layer, containing numerous vessels and glands, grows up around the ovum and encloses it. The reflexa is, therefore, the superficial layer of the vera reflected over the ovum. It is nourished by vessels which enter its base from the vera. It is thickest in the parts nearest its junction with the vera, and towards the free pole of the ovum it thins gradually away; this thinning being probably brought about by the pressure of the growing ovum, and the distance of the part from the source of blood supply. As the ovum grows the reflexa is carried with it and thus becomes raised from the vera over a continually increasing area. In this manner room is provided for the peripheral growth of the placenta. This growth is at first very rapid. At the end of the second week the base of attachment of the ovum is equal in area to about one-fifteenth of the total uterine surface. By the end of the third month the placenta occupies one-fourth of the total uterine surface, and this proportion is maintained up to the end of pregnancy. That is to say, after the third month, the growth of the placenta is only proportional to that of the entire uterus. After the third month, too, the functions of the reflexa cease to be of importance; the growth of the ovum has overtaken that of the uterus and fills it entirely, and the reflexa atrophies from constant pressure.

Glycogen has been found by Merttens ([31]) and others in the glandular epithelium and in the decidual cells of the serotina. It is contained in fairly definite areas of the periphery of these cells. The presence of glycogen in the placenta was discovered by Claude Bernard ([51]), but I am not aware that it has been precisely localised before. I have not been able to find glycogen in any of my specimens, and I am, therefore, inclined to believe that its presence is not constant.

Third stage.—By the time that the intervillous circulation is established the placenta has assumed its adult form. The serotina now undergoes some measure of consolidation and repair. The hæmorrhages become to a great extent cleared up, although blood corpuscles may in parts be found among the decidual cells at the mid-term of gestation. The decidual cells become more closely packed, forming an altogether denser type of tissue than that of the earlier stages. Villi are unable to penetrate it for any considerable distance, but they become attached in large numbers to its surface.

Even at the beginning of pregnancy the decidua is roughly divisible into two layers: a superficial layer, in which the hæmorrhages are most numerous, and a deep layer containing the dilated glands. In the third stage, however, the serotina consists of two perfectly distinct layers: a superficial compact layer, and a deep cavernous layer (Plate XXI. Fig. 12). *The superficial layer* is composed of closely-packed decidual cells, and is traversed by the placental arteries and veins, which open upon its surface into the intervillous spaces. There are no glands in this layer. The surface is covered by a stratum of fibrin. The *deep or cavernous layer* contains a network of irregular, dilated, glandular channels. In the third and fourth months, many of the glands retain a well-preserved lining of cubical epithelium. Towards the end of pregnancy, only occasional small groups of these cells remain; so that the channels are often mistaken for veins. The arteries and veins, of course, also pass through it. The decidual stroma consists of cells smaller and more closely packed than those of the superficial layer. It is through the deep layer that separation of the placenta occurs when it is normally shed.

The course of the maternal vessels deserves more detailed notice. The fact that these vessels opened into the intervillous spaces was proved long before the details of the process by which this communication becomes established were worked out. Waldeyer ([43]) first succeeded in making satisfactory observations upon this point, and his research is one of the landmarks of the study of the placenta. Very little has since been added to his description of the course of the maternal vessels in the adult placenta.

There are very few capillaries in the serotina at this period; the arteries and veins open directly into the intervillous spaces, but before doing so they give off a few nutritive branches to the serotina. The arteries run a spiral course right through the uterine wall. In many naturally shed placentæ, the torn ends of these arteries may be detected upon the maternal surface. In the muscular wall of the uterus, they show the usual three coats, and round many of them is found a semi-circular, peri-lymphatic space. When the artery leaves the muscular wall the middle coat disappears, and in the serotina there is only an endothelial layer surrounded by a loose fibrous sheath. The artery enters the serotina vertically, but alters its course so as to open obliquely into the intervillous spaces. The fibrous sheath ceases abruptly just before the artery opens. Waldeyer asserts that the endothelial layer may be traced not only up to the opening, but for some distance over the surface of the adjacent serotina. Others believe that it disappears with the fibrous sheath, so that the actual aperture is formed only by the rounded edges of the decidual tissue (Plate XXII. Figs. 15 and 16).

The veins form large sinuses in the muscular wall of the uterus.

On reaching the serotina their course is nearly parallel to its surface, they then rise gradually and so open very obliquely into the intervillous spaces.

We are now in a position to refer to the vexed question of the origin of the intervillous spaces. In the first place, the boundaries of the general intervillous space should be pointed out. Towards the uterus it is limited by the serotina; towards the fœtus by the chorionic membrane, from which the villi arise; at the placental margins by a reflection of the serotina beneath the chorionic membrane. The placental margin represents the line of union of the three parts of the decidua; the decidual tissue is here especially thick, it supports the circular sinus and contains numbers of embedded villi. It is prolonged into the placenta beneath the chorionic membrane for 1 to 2 inches, thinning out gradually as it passes inwards.

The question at issue has been, Are the intervillous spaces altered maternal vessels or not? The solution has been sought in the direction of determining whether the spaces are entirely enclosed in tissue of maternal origin, that is, whether or not the villi receive an investment of maternal tissue. Among the earliest advocates of the view that the intervillous spaces are maternal were Turner and Ercolani. They based their theory upon the opinion they had formed that the villi of the adult placenta possessed a complete investment of maternal tissue; the intervillous spaces could then quite properly be regarded as altered maternal blood vessels. They did not attempt, however, to establish their views by tracing the development of these spaces. Somewhat the same theory has been revived in a different form by Waldeyer, and also by Keibel. These observers believe that they have found a delicate layer of endothelium covering the villi, which they hold to be the representative of the walls of dilated maternal capillaries. Keibel's observations ([18]) are so incomplete that little importance can be attached to them. Waldeyer's observation, therefore, stands alone, and it is important to remember that it derives no support whatever from the facts which have been established in regard to the beginnings of the placenta. More recently still, Kossmann and Merttens (*loc. cit.*) have attempted to return to the theory of Turner and Ercolani by applying the facts of comparative anatomy to the human placenta. Reasons have, however, already been given for suspending judgment upon this point for the present.

The methods by which these theories have been arrived at are open to objection. The question cannot be solved by observations upon the adult placenta (that is, upon the placenta in the second stage), supplemented by theories accounting for what is then found. The facts can only be arrived at by tracing in detail the steps by which the intervillous spaces are formed; when this is satisfactorily accomplished their origin is no longer a matter of theory but of fact. An attempt is made in this paper to describe the changes in the placenta which result in the formation of these spaces. These changes occur, however, at a very

tions essential to their nutrition which are present in the earlier stages.

I have endeavoured in this paper to deal only with those changes and processes by which the human placenta is carried to its highest point of development and functional activity. The placenta at term is an overripe and decadent structure. Many changes are found in it which can only be regarded as degenerative, and these are left over for consideration in a subsequent paper. Among the matters thus left over, it is perhaps necessary to mention the subject of the origin of the substance known as canalised fibrin, which plays such an important part in the structure of the placenta at term. I believe the appearance of this substance to be the direct result of degenerative changes, and it has therefore not entered into the scope of the present paper. It is referred to now merely to avoid misconception.

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DESCRIPTION OF PLATES XIX. to XXII.

Plate XIX.

Fig. 1.—Represents the development of decidual cells from connective tissue corpuscles. The different forms are all drawn from the section represented in Figs 6 and 7. (Leitz, Oc. 3, Obj. 7.)

a. Connective tissue corpuscles.
b. Intermediate forms.
c. Decidual cells.

Fig. 2.—Represents the formation of small round cells from decidual cells by fission. (Leitz, Oc. 3, Obj. 7.)

a. Decidual cells.
b. Cells in various stages of division.
c. The resulting small round cells, many of them closely resembling leucocytes.
d. Further division of the small round cells.
e. Free nuclei.

Fig. 3.—Illustrates the process of budding and formation of new villi. The sections are from a complete ovum at the sixth week. (Leitz, Oc. 3, Obj. 7.)

A. Section of villus.

S.l. Superficial layer of the chorionic epithelium; the deep layer is not seen, it is often absent in young villi.
Ep. bud. Epithelial bud, springing from the superficial layer.
St. Stroma of villus.

B. Section of a rather larger villus than *A*. Two epithelial buds are here shown; into the lower one the connective tissue stroma is prolonged.
C. Horizontal section of an epithelial bud. There are two vacuoles present, and the nuclei are arranged roughly round the periphery.
D. Horizontal section of a bud further developed than *C*. There is a section of a vessel near one end, with a distinct wall, and containing blood in its lumen.

Fig. 4.—From a placenta of the seventh month, injected with carmine-gelatine, by means of a tube and funnel. The section is stained with logwood. (Leitz, Oc. 3, Obj. 7.)

Cap. Capillaries filled with injection; they run for the most part immediately beneath the epithelium of the villus.

St. Stroma of the villus saturated with the injection; the nuclei and the protoplasmic network are uninjured, the injection being contained in the meshes.

T. Small twig springing from a capillary, and opening into the meshes of the network.

End. Endothelial cells representing the capillary wall.

Plate XX.

Fig. 5.—Vertical section through the decidua serotina at the sixth week. From the same specimen as Fig. 3. (Leitz, Oc. 3, Obj. 3.)

D.C. Decidual cells.
R.C. Clusters of small round cells.
Cap. Distended capillaries, some of which have ruptured.
Hæm. Hæmorrhage into the decidual tissue.
Gld. Section of a gland, with cubical epithelium.
Art. Arterioles.

Fig. 6.—Shows the penetration of the villi into the decidual tissues. From the same specimen. (Leitz, Oc. 3, Obj. 3.)

D. Decidua.
V. Section of a villus embedded in a hæmorrhage.
Hæm. Hæmorrhages.
Ep. buds. Sections of epithelial buds from other embedded villi, not shown in the section.
(*a*) (*a*). Buds showing sections of vessels in their interior.

Plate XXI.

Fig. 7.—From a three months' placenta, showing the two layers of the chorionic epithelium, and the protoplasmic network of the villus stroma.

Fig. 8.—From a six weeks' ovum. Villus showing the proliferation of the chorionic epithelium and an elongated epithelial bud.

Fig. 9.—From a six weeks' ovum. Shows the epithelial covering of the chorionic membrane, which is budding in places, and the proliferation of its nuclei. Two large epithelial buds appear in section, one of which contains two vessels, the other, one.

Fig. 10.—From a nine months' placenta, in which the fœtal blood had been retained (natural injection). The villus in section shows several large capillaries packed with blood, and many sections of smaller ones scattered through the stroma.

Fig. 11.—From a six weeks' ovum. The section is through the deeper part of the decidua serotina. Several glands are shown, containing blood, in the lower part of the figure; a large hæmorrhage occupies the upper part. At the margin of the hæmorrhage is a large epithelial bud with two vessels in section.

Fig. 12.—From a seven months' placenta. The figure shows the two layers of the serotina at this period; the dark band along the surface is composed of canalised fibrin.

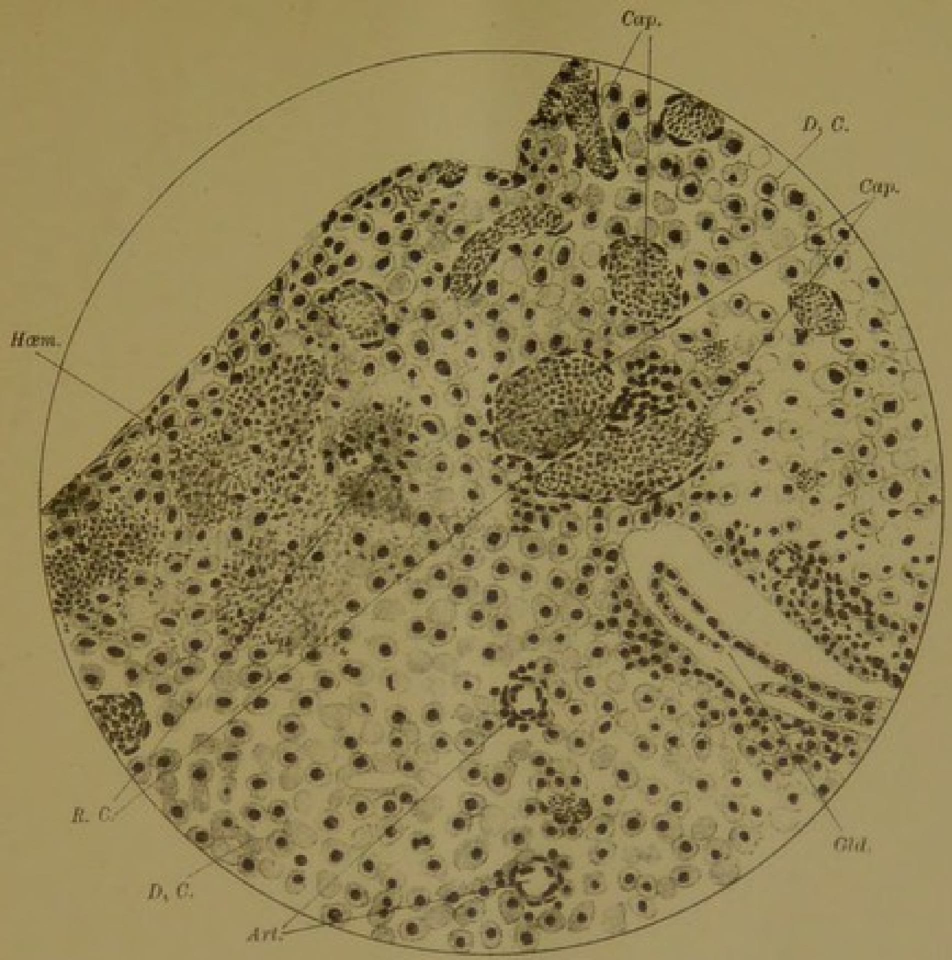

Fig. 5.

Fig. 6.

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