XVII.—*On the Placentation of Halicore Dugong.* By Sir WM. TURNER, M.B., LL.D., D.C.L., F.R.SS.L. and E., Professor of Anatomy in the University of Edinburgh. (Plates I., II., III.)

(Read 1st July 1889.)

Comparative anatomists have long desired detailed information on the placentation of the Sirenia. It is true that in 1878 Dr PAUL HARTING presented to the University of Utrecht a graduation thesis,* in which he described the foetal membranes and foetus of a Dugong, which had been acquired a short time before for the Zoological Museum of that University. The specimen had been preserved for many years in spirit of wine, and had apparently been collected by a surgeon to a merchant ship. The foetus was 27·8 centimetres (11 inches) long. The entire chorion, with the exception of the two poles and their immediate vicinity, was covered by densely packed, short and but little branched villi, and Dr HARTING came to the conclusion that the placenta of the Dugong was diffuse and non-deciduate.

Dr HARTING's description and drawings, though satisfactory as far as the material at his disposal would admit, were incomplete, owing to the absence of the uterus. The small size of the foetus, in relation to the magnitude of the adult animal, also made it possible that the diffused arrangement of the villi over so large a part of the surface of the chorion represented an early stage in the placental formation in this animal, and that some modification might arise in a later stage of intra-uterine development. I have, accordingly, been very desirous to acquire the gravid uterus of the Dugong, and if possible, at a more advanced stage of gestation than in the Utrecht specimen. In my endeavours to obtain such a specimen, I was fortunate to enlist the sympathy of my friend and former pupil Dr ANDERSON STUART, Professor of Anatomy and Physiology in the University of Sydney, N.S.W.; who, on hearing that C. W. DE VIS, Esq., M.A., the Curator of the Queensland Museum, Brisbane, had a gravid uterus of the Dugong in his possession, which he had received from the Moreton Bay fishers, wrote to ask if it could be sent to me. Mr DE VIS with the greatest courtesy acceded to this request, and the specimen reached me in good order in the month of May of the present year. I wish to express my indebtedness to Mr DE VIS for having so generously placed at my disposal a specimen of so much rarity and value.

The gravid uterus had been preserved in spirit sufficiently strong to have kept it in good condition, but not so concentrated as to needlessly contract the tissues. With the exception of two or three cuts of no great size, it was uninjured, though the Fallopian tubes had been divided, and the ovaries cut off in taking it out of the abdomen.

* *Het Ei en de Placenta van Halicore Dugong*, Proefschrift, 18th February 1878. Utrecht.

Uterus and Maternal Placenta.

The uterus consisted of two horns, and contained a single large foetus, which was situated in the greatly dilated left cornu (fig. 1). This the gravid horn measured along its anterior convex surface 4 feet 8 inches in its long diameter, and 3 feet 3 inches in its greatest girth. It was curved upon itself, so that the part which reached the corpus uteri, where the head of the foetus was situated, approximated to the tubal end of the cornu occupied by the tail of the foetus. It was invested in the usual way by peritoneum, which membrane passed off from it as a broad ligament. The right cornu contained no foetus, and that part which was free and surrounded by the broad ligament of peritoneum was 17 inches long: at its tubal end it was attenuated, but widened somewhat as it approached the gravid left cornu, with the wall of which, as was afterwards recognised when the uterus was opened into, its wall became closely attached for an additional length of 10 inches.

The gravid horn was opened into by an incision along its convexity, extending from its tubal end to the corpus uteri. The gravid horn communicated freely with the corpus uteri, the commencement of which was differentiated by a strong fold of mucous membrane. The mouth of the non-gravid horn was also differentiated by a sharp fold of mucous membrane from the corpus uteri, and the extended hand could readily be passed into that part of the non-gravid horn already referred to, as closely attached to the wall of the gravid cornu. The bottom of this dilated portion opened into the lumen of the more attenuated part of the non-gravid horn, which barely admitted the tip of a finger. The corpus uteri was $11\frac{1}{2}$ inches long; the hand could readily be passed along it for several inches, when it became somewhat constricted. Further back it again dilated, and the mucous lining, instead of being almost smooth, as in the part of the corpus uteri next the cornua, was elevated into distinct longitudinal folds, the best marked of which were 0.5 inch in depth. In the intervals between these folds were some transverse and oblique folds much less projecting, which gave to this part of the uterus an appearance something like that of the mucous lining of a cervix uteri. This part of the uterus contained an inspissated secretion. The posterior end of the cervix-like corpus uteri communicated by an os with the vagina; the inferior lip of the os projected more than the superior; and the os itself admitted two fingers. The vagina was 10 inches long and $5\frac{1}{2}$ inches broad. It was lined by a mucous membrane which was longitudinally folded near the os, but further back the folds were oblique and transverse. The urinary bladder and urethra were attached to the inferior wall of the vagina. The contracted bladder was only 3 inches broad by $2\frac{1}{2}$ inches high, and the pair of ureters opened into its vaginal surface.

The wall of the gravid cornu was much thinner than that of the non-gravid horn, in the latter of which the muscular coat greatly exceeded in thickness the corresponding tunic in the gravid horn. The mucous lining of the gravid horn had especial interest in

connection with the formation of the placenta, and to the characters of this I shall now direct attention.

The larger part of the mucous membrane lining the gravid horn was smooth on the surface, and with no trace of crypts or depressions visible to the naked eye. The surface was indeed, in a large part of that area which corresponds to the back and sides of the foetus, so smooth as to be almost polished, and with no appearance of succulency, which may perhaps in part be due to the hardening action of the spirit in which the uterus had been preserved. Near the mouth of the left tuba, which opened into the horn under cover of a crescentic fold of mucous membrane by an orifice large enough to admit a small surgical probe, the mucous membrane was thrown into folds, and without crypts, and some transverse folds were seen in the mucous lining placed opposite the belly of the foetus. A broad zone of mucous membrane situated towards the left end of the gravid horn presented very different characters, and constituted the maternal placenta. It was differentiated from the smooth mucous membrane on each side by a sharp, sinuous margin, the left border of which was nearly 8 inches from the opening of the left Fallopian tube, whilst the right border was between 2 and 3 feet from the corpus uteri. The zone was nearly 1 foot in breadth in the anterior convex part of the horn, and about one-half that breadth at its concavity. It was thick and succulent, more especially along the concavity of the cornu, where it was elevated into folds, and it was much more vascular than the smooth area of the mucous membrane on each side of it. It corresponded in form and relative position to a similar zonary band on the chorion. The two zones had indeed been closely adapted to each other, but in the handling and shaking to which the uterus had been subjected in its removal from the animal and its long journey before it reached me, they had become detached. When I opened into the cornu therefore the zone in the uterine wall was readily drawn away from the chorionic zone.

I then proceeded to examine the mucous membrane of the uterus in the smooth region beyond the margins of the zonary placenta. With a simple lens the free surface was seen to be very faintly wrinkled, and at distant intervals there were faint depressions such as might be made from the pressure of the head of a minute pin. The mucous membrane was easily removed from the muscular coat by tearing through the submucous areolar tissue. When flakes of this membrane were dissected off and placed on a glass slide and soaked in glycerine, they became sufficiently translucent to enable one to see, with the use of low powers of the compound microscope, the arrangement of the tubular glands of the uterus. The mouths of the glands were observed to open at intervals on the surface of the mucous membrane, and the direction of the opening was invariably oblique (fig. 5). From its mouth the gland tube could be traced obliquely through the mucous membrane into the submucous coat. As a rule, the tube was dilated close to the mouth, it then diminished in calibre and became cylindriciform, and ran for some distance as a straight unbranching tube. The tube then bifurcated, and became somewhat tortuous; the branches of bifurcation sometimes but not always branched, and each terminal branch ended with a closed rounded end. The distinctness of the gland

tubes varied according to the condition of their epithelial contents. When the cells were granular, they and the tubes were more distinct than when the cells had a clearer protoplasm. In the field included by a one-inch objective, it was quite exceptional to see more than the mouth of a single gland. The glands were relatively of considerable length, from $\frac{1}{4}$ to $\frac{1}{2}$ (7 mm. to 13 mm.) inch, and occupied an area corresponding to three or even four times the diameter of the field, covered by a one-inch objective, and as in their course they passed very obliquely from the gland mouth, the mucous membrane required to be stripped off in flakes of half an inch in diameter, in order to obtain a view of the whole length of a gland. Vertical sections made through the thickness of the mucous membrane also threw additional light upon the arrangement, and enabled one to see the form and characters of the glandular epithelium. In these sections the glands were divided sometimes longitudinally, at others obliquely, at others transversely, and the segments occupied different planes in the vertical diameter of the section; but as the glands were not numerous the segments seen in any given section were few, and were separated from each other by relatively broad areas of interglandular connective tissue (fig. 6).

As the histological characters of the mucous membrane had been well preserved, the form and arrangement of the glandular epithelium could be seen without difficulty. In the greater part of the gland-tube the cells were not sufficiently elongated to be called columnar epithelium, but were for the most part cubical in form, though some might be called polygonal (fig. 8). They were arranged in a single row, and were in part attached to the wall of the gland-tube, though in some sections they had become detached from the wall and formed clusters of cells lying loose in the lumen. The cells were nucleated, and the protoplasm as a rule was granular and opaque. The dilated part of the gland in proximity to the mouth was, however, lined by more elongated cells, which could very properly be called columnar epithelium. At the gland-mouth itself the cells were not distinct, but seemed to be broken down into a formless débris (fig. 7).

The interglandular connective tissue was also examined. The bundles of this tissue were for the most part arranged parallel to the plane of the free surface of the mucous membrane, and the membrane had consequently a tendency to split into layers running in the same direction. This tissue was loaded with corpuscles, especially in its more superficial layers, and, as I have seen in the mucous membrane of many other gravid uteri which I have examined, the corpuscles varied in appearance. A large number, and those more particularly in the superficial layers, had the spherical form, the size and the nucleated granular protoplasm of leucocytes; and it was not unusual to find them arranged in large numbers in rows situated between the bundles of connective tissue (fig. 7). From their abundance there can, I think, be no question that they have some definite functional import. Other corpuscles, more ovoid in form, had a similar kind of protoplasm. But in addition, corpuscles, such as one is familiar with in such rapidly growing connective tissue as the mucosa of gravid uteri, were seen in large numbers. They were most distinct in the deeper layers of the mucosa, where the leucocytes were

less abundant, and they had the appearance of fusiform, caudate, or stellate cells. Divided blood-vessels were also not unfrequently met with; sometimes they were empty and contracted, at other times the lumen was occupied with red blood corpuscles; the former were presumably arteries, the latter veins.

As regards the relations of the glands to the interglandular connective tissue, the gland wall was usually separated from the surrounding tissue by an interspace (fig. 7), which may, perhaps, be a lymph channel. The connective tissue bounding such an interspace externally was usually a well-defined bundle arranged in a definite manner around the gland-tube.

I then proceeded to examine the placental zone of mucous membrane from which the chorion had been detached. In the first place, I used only a simple lens, and with it went carefully over the free surface of the zone, which had a spongy character; for it was perforated by minute orifices, many thousands in number. They were circular, sub-circular, or polygonal in outline, and were closely crowded together, being separated from each other by delicate bands of mucous membrane (fig. 10). These openings communicated with crypt-like depressions in the maternal placenta in which the chorionic villi had been lodged. The form and arrangement of these crypts was determined when vertical sections through the placental zone were made and examined. Interspersed at intervals amidst these minute orifices were somewhat larger openings distinctly visible to the naked eye, and with the mouth opening obliquely on the free surface of the placental zone (fig. 10a). In many of these larger openings the end of a longer chorionic villus was inserted, and as the base of the villus had torn away from the chorion in the act of separation of the foetal placenta, these longer villi were left attached to the maternal part of the placenta. A careful survey of the whole surface of the zone showed only three patches devoid of crypts, the largest of which was $1\frac{3}{4}$ inch in length by 1 inch in breadth, whilst the smallest was 9 mm. by 5 mm., and it is possible that these may have been due to the abrasion of the crypts from the surface.

The crypt-like or spongy layer of the maternal placenta varied in thickness from one-third of a millimetre to nearly one millimetre. When vertical sections were made through it, and examined with a magnification of 60 diameters, the crypts were seen to pass from their orifices on the free surface, usually with a considerable obliquity either as far as or almost as far as the attached surface of the crypt layer. As a rule, they were elongated and tubular, and conformed to the shape of the chorionic villi which they had originally contained. Opening into them were smaller secondary crypts, which were cut across in the sections, so that the spongy character was not limited to the surface, but prevailed throughout the entire thickness of the crypt-layer (figs. 11, 12). The crypts and their subdivisions were separated from each other by slender and delicate bands of the mucous membrane. The crypts were lined by an epithelium, the cells of which were in part in apposition with their walls, and in part had become detached, and were lying loose in their cavities. Under higher powers, it was seen that the cells varied in shape; some were longer in one diameter than in the opposite, though the elongation was not so great as to

lead one to call them columnar; the majority were, however, irregular in shape, and with angular outlines, so that they may appropriately be called polygonal cells. The cells were nucleated, and as a rule the protoplasm was granular; they were stained a pinkish tint with picro-carmin. It was obvious, therefore, that the crypts possessed a distinct epithelial lining. Occasionally I obtained in a section a view of one of the larger crypts, to which I have referred in my description of the surface of the maternal placenta. It was seen to pass very obliquely and considerably deeper into the mucosa than was the case with the smaller crypts, for not only was it wider than they, but it was also three or four times longer, and extended obliquely and subjacent to the more superficial crypt-layer. In some sections the largely dilated bulbous end of one of the longer villi was seen to occupy the interior of a deeper crypt (fig. 11). These deeper crypts also possessed small secondary crypts branching off from them, and both were lined by an epithelium similar to that found in the shorter crypts already described. It is possible that these deeper crypts were the dilated mouths of the uterine glands opening on the free surface of the maternal placenta, but it was difficult to trace a gland-tube opening directly into any one of them, though in one section (fig. 12) the gland came close up to the deep crypt, and seemed as if it might have opened into it. If such were their nature, then a few of the chorionic villi, somewhat larger in size than the rest, occupied with their free ends the dilated mouths of the gland-tubes. The great bulk of the villi had been, however, lodged in the thousands of smaller crypts already referred to, which were not the mouths of glands, and indeed were quite independent of them, for they were situated in the interglandular portions of the mucous membrane, delicate bands of which formed their walls.

Subjacent to the crypt-layer of the mucous membrane of the placental area was the glandular-layer, and in it short segments of the gland-tubes could be seen at irregular intervals and at different depths (fig. 11). As in the corresponding sections through the non-placental area of the mucous membrane, the tubes were divided either longitudinally, obliquely, or transversely. The glands were lined by a cubical epithelium, which was either attached to the wall or was lying loose in the lumen. In some sections the gland-tubes were seen approaching and indeed lying immediately subjacent to the crypt-layer, and in the section above referred to a gland appeared as if it might have opened into one of the deeper crypts (fig. 12).

The connective tissue in the gland-layer contained a large number of corpuscles, partly leucocytes and partly those belonging to the connective tissue itself, similar to those I have already described in the non-placental part of the mucous membrane.

An attempt was made to inject the finer vessels of the uterine mucous membrane through the uterine veins and arteries, but without success. Although the injection passed into the larger trunks, it did not penetrate the smaller arteries and veins, or the capillaries, which was doubtless due to the constricting action of the spirit in which the uterus had so long been immersed. There can, however, be no question that capillaries had ramified freely in the walls of the crypts, and had formed networks similar to those

which I have injected, and figured in so many of the other specimens of placentæ which I have described.*

Attention was then paid to the appearance of the mucous membrane lining the non-fecundated cornu. The dilated commencement of this cornu was lined by a mucous membrane similar in appearance to the non-placental mucosa in the gravid horn. In the non-dilated part of the non-fecundated cornu, the mucous lining was partly smooth, and partly elevated into slender, low, longitudinal folds. Vertical sections were then made through the mucous lining of the non-expanded horn, and examined microscopically. It was at once seen that the mucosa was much thinner than in both the placental and non-placental areas of the gravid horn. The glands were cut across in the sections, but the portions of gland-tube thus divided were much more closely set together than in the fecundated cornu, and the interglandular connective tissue was much smaller in quantity. These differences will at once be recognised by comparing fig. 6, from the fecundated cornu, with fig. 9, from the non-fecundated cornu, which are drawn to the same scale. The glands in the fecundated cornu were a little larger than those in the non-gravid horn, but they resembled each other in the characters of their epithelial contents. Whilst in both regions leucocytes, and connective tissue corpuscles were present in the interglandular tissue, it seemed as if in the non-fecundated cornu the leucocytes were relatively much less numerous. From a comparison of the membranes in the two cornua it is obvious that the great expansion of the mucosa in the gravid horn is very little due to dilatation of the glands, but is almost entirely the result of an extraordinary growth of the interglandular connective tissue, which has added both to its thickness and superficial area; so as to accommodate it to the enormous expansion of the horn as a chamber for the lodgment of the foetus, of its membranes and the fluids of the amnion and allantois. The great growth of the interglandular connective tissue in the mucous lining of the gravid horn in the Dugong, is in accordance with the observations which I have previously made and recorded on the placenta in many other mammals.

Fœtal Membranes and Fœtus.

The chorion was an elongated sac, bent upon itself, and corresponding in form to the gravid horn in which it was contained. Its left pole was in proximity to the left tuba, its right pole occupied the horn where it communicated with the corpus uteri. Owing to the head of the foetus being directed to the right, this pole of the chorion was more capacious than the left pole near which the tail of the foetus was situated. The chorion was carefully examined to see if it possessed a diverticular prolongation which had occupied the dilated part of the right non-gravid horn, but none was seen.

The outer surface of the chorion was smooth and non-villous in much the larger part of its area. The villous part was limited to a zonary band, which passed around the

* See amongst others the Placenta of the Lemurs, in *Trans. Roy. Soc. Lond.*, vol. 166, 1876: that of *Orca gladiator*, in *Trans. Roy. Soc. Edin.*, vol. xxvi., 1871, and of the Grey Seal, Fox, and Cat in the same, vol. xxvii., 1875.

chorion, considerably nearer to the left than the right pole, so that it was excentric in position (fig. 2). The greatest breadth of the zone was on the anterior convexity of the chorion, where it measured $11\frac{1}{2}$ inches (292 mm.); in the concavity it was only about half that breadth, whilst at a line about midway between it was $9\frac{1}{2}$ inches (241 mm.). In the concavity of the chorion, the zone was thicker and folded, whilst on the convexity it was thinner and smoother, but the whole surface was flocculent from the presence of multitudes of closely compacted villi. The margins of the zone were differentiated from the non-villous chorion by a sharp sinuous line. The left border was about one foot from the left pole of the chorion, whilst the right border was about $2\frac{1}{2}$ feet from the right pole,* so that if the chorion be supposed to be equally divided into a right and a left half, the whole of the zone was situated in the left half. The chorionic zone formed the foetal part of the placenta, and it was found to be detached from the maternal placenta, when the uterus was opened, as has already been stated.

I then lifted out of the gravid horn the chorion with its contents, and made a cut through that membrane opposite to the spinal column of the foetus from the cephalic pole to the right border of the placental zone. A large sac was opened into, which proved to be the allantois. This sac was very capacious, and completely surrounded the amnion from its cephalic pole to the right placental border of the chorion. The outer wall of the sac, smooth, and free on its inner surface, was formed by that part of the allantois which constituted the endochorion, and which extended from the cephalic pole of the chorion to the right border of the placenta. The inner wall of the sac consisted of the allantois which enveloped the bag of the amnion. Immediately subjacent to the right margin of the placenta, where it was opposite the back and in part the sides of the foetus, the endochorion was reflected on to the outer surface of the amnion, and became continuous with the allantois covering that membrane. The sac of the allantois was consequently not continued over the inner surface of the placenta in its whole extent, for throughout an ovoid area 8 inches in diameter in one direction, and 5 inches in another, which lay opposite the back and sides of the foetus, the amnion was in direct contact with the inner surface of the placenta. The arrangement of the allantois in relation to the part of the placenta which was opposite the belly of the foetus differed materially from that above described, for it was prolonged across the inner surface of that portion of the placenta from the right to the left border, and its sac was continued into the caudal part of the chorion up to the caudal pole. Immediately to the left of the ovoid area, where the amnion was in direct contact with the placenta, the allantoic sac was again interposed between the placental area of the chorion and the amnion, and was continued into the caudal pole of the chorion so as to surround the caudal end of the amnion, as completely as its cephalic end. Hence the whole extent of the amnion from the caudal to the cephalic end of the foetus, with the exception of the ovoid area in relation to a limited part of the inner surface of the placenta, was surrounded by and in contact

* Owing to the poles of the chorion being rounded and bent each on itself, it is difficult to fix with precision the central point of the pole. The above measurements are therefore to be regarded as approximative.

with the inner wall of the sac of the allantois, which together with the fluid in that sac separated the amnion from the endochorion (see woodcut, p. 660).

Both the endochorion and the allantois enveloping the amnion were vascular, and the vessels were derived from the umbilical cord. The cord was undivided for from 3 to 4 inches beyond the belly of the foetus, and in its undivided part it was invested by the amnion. A transverse section made through it immediately before its division showed eight vessels, four arteries and four veins, each of which was surrounded by delicate gelatinous tissue. As soon as the cord reached the allantois it divided into four branches, each of which contained an artery and a vein. Each branch immediately became invested by a fold of the allantois, by means of which it was conveyed to the inner surface of the placenta opposite the belly of the foetus. These folds were of considerable length and breadth, and were continuous with that layer of the allantois which enveloped the amnion. They and the branches of the cord situated along their free borders had floated in the fluid of the allantoic sac. The cord was spirally twisted before its division, each of its branches also was tortuous, and a similar character also was seen in the vessels as they ramified on the inner surface of the placenta. An attempt was made to inject the umbilical vessels with gelatine and carmine, which was successful as far as the large trunks were concerned. Many of the vessels ramifying on the inner surface of the placenta were also filled. The injection had not penetrated into the capillaries within the villi, though it was not unusual to see villi stained with carmine from the injecting material.

The vascularity of the chorion was not limited to the placental zone, for a number of vessels, both arteries and veins, passed beyond each margin of the placenta as far as the corresponding pole of the chorion. To some extent the injection had penetrated into these vessels, but even when not injected they could be readily seen to ramify in the endochorion lining the non-zonary parts of the chorion.

The villi in the placental zone varied in length. Comparatively a few were on the average $\frac{7}{10}$ ths inch (18 mm.) long, but the great majority, many thousands in number, were from $\frac{3}{10}$ ths to $\frac{4}{10}$ ths inch (8 to 10 mm.). The stems of the villi were cylindriciform and filamentous, but those of the longer villi were thicker and tougher than the stems of the shorter villi. The shorter villi branched about $\frac{1}{10}$ th inch (2.5 mm.) or a little more from their origin from the chorion, and gave rise to two, three, four, or more rarely five branches, which arose in proximity to each other (fig. 3). They were much smaller than the stems from which they sprang, and after a course of about $\frac{2}{10}$ ths inch they not unfrequently bifurcated, and the branches of bifurcation ended in short terminal buds. These shorter villi had been lodged in the shorter crypts which formed the spongy surface of the uterine mucosa, and had been drawn out of the crypts before I opened the uterus.

The longer villi were more firmly attached to the maternal zone, so much so indeed that they had been torn away from the chorion, and their free ends were implanted in the wider and deeper crypts described in my account of the maternal placenta. The free

end was dilated into so bulbous an expansion as obviously to interfere with the ready extraction of the villus from the crypt (fig. 11).

The substance of each villus consisted of a delicate connective tissue such as one is accustomed to see in these structures. Many had a definite epithelial investment, the cells of which were irregularly polygonal, but others had lost their epithelial coat. What, however, was especially noticeable was the large amount of cells, either singly or in groups, which were seen floating in the fluid in which the villi were examined after they had been teased asunder with needles. These cells consisted in part without doubt of the epithelial investment of those villi which had lost their covering probably in the process of teasing; but from the numbers seen I think that many were derived from the lining epithelium of the maternal crypts, which having been detached and intermingled with the villi, had come away with them when the foetal placenta separated from the maternal.

Projecting from the inner surface of the endochorion into the allantoic sac were numbers of flattened leaf-like bodies, which I shall name the allantoic bodies. They were arranged either singly, or in pairs, or sometimes in rows of several situated close together. They were confined in their position to the allantois close to the placental borders, or to that part of the placenta which was covered by the allantois. They grew, therefore, from the most vascular part of the membrane, and were continuous with the coats of the blood-vessels, more especially the veins. These allantoic bodies varied in shape and size. Some were elongated and attached by narrow pedicles to the endochorion; others were broader than long, and with broad bases of attachment, and when a row of them occurred close together along the course of a particular vessel they sometimes were continuous with each other at the base of attachment. The longest of these bodies was $\frac{3}{4}$ of an inch, but $\frac{1}{2}$ an inch (13 mm.) was a more usual size. The base of attachment was in many cases $\frac{3}{4}$ of an inch, but when two or more had fused together the base was much more elongated. The smallest allantoic body which I measured was 3 to 4 mm. in diameter. In colour they were light brown, like that of the allantoic membrane, but this was probably not the natural tint, as the membranes were all stained and discoloured. All these bodies were flattened, but this may possibly have been due in part to *post-mortem* compression, after the allantoic and amniotic fluids had been evacuated, and the weight of the foetus had pressed against them.

Some of the allantoic bodies were then removed along with the part of the vessel to which each was attached and prepared for microscopic examination, and sections were made through them and their blood-vessel from the attached to the free border. They were seen to be continuous with the fibrous connective tissue coat of the vein, to which they were attached by the base, and in tracing them from the base to the free border they became more and more attenuated. They consisted for a part of their thickness of wavy bundles of white fibrous connective tissue; but in the axis of the body the tissue was modified in appearance. When teased out with needles elongated fibro-cells could be isolated, the characters of which were scarcely sufficiently differentiated to

permit one to say whether they were more like embryonic connective tissue, or involuntary muscular fibres, though I am inclined to think the former, for the nuclei in association with them were more fusiform than rod-like. Small blood-vessels were also seen to be cut across in the sections.

I did not obtain any evidence of the presence of an umbilical vesicle.

The amnion was a capacious sac for the lodgment of the foetus with its amniotic fluid. It extended from the cephalic to the caudal pole of the chorion, and throughout its entire extent, except at the ovoid area on the placenta already described, it was separated from the chorion and placenta by the inner layer of the allantois and the allantoic sac. Its poles, therefore, were free, and could be readily moved to and fro in the allantoic cavity. Its outer surface was united to the inner layer of the allantois by delicate areolar tissue, which, on being torn through, enabled the two membranes to be separated from each other. Its inner surface was smooth and polished, though in places blood-stained and with adherent blood-clots, due to two punctured wounds in the uterus and foetus. It was particularly noticed that the amniotic covering of the cord, as well as the inner surface of the sac, was free from such granular projections as have been seen by various observers in considerable numbers studding the free amniotic surface in the Cetacea,* and which I have named the amniotic corpuscles.

The foetus was a male. It occupied the bag of the amnion, being curved on itself, so that the tail was bent forward under the hinder part of the body, and the head was bent back towards the chest. In consequence of this curvature the tail concealed the penis and anus, and the abdomen was marked with deep transverse folds. The pectoral limbs were directed backwards and somewhat ventrally on the sides of the trunk. There was no dorsal fin. The skin was smooth, and of a dull yellowish-grey tint, lighter on the belly than on the sides and back. Scattered, delicate, silky hairs from $\frac{3}{10}$ ths to $\frac{4}{10}$ ths of an inch long, projected through the skin, more numerous on the head and body than on the limbs and tail. The mouths of the hair follicles were very distinct, their position being made more clear by the integument immediately surrounding each follicle being of a paler hue. The hairs and follicles were arranged on the back of the foetus in rows having an antero-posterior direction. In the intervals between these follicles a number of much finer spots were interspersed. These were apparently the mouths of follicles for smaller and more delicate hairs, but the hairs were not projecting from them. From the front of the muzzle a moustache, consisting of short, stiff, white hairs, projected, and more delicate hairs grew out of the skin of the lower lip.

The muzzle was very characteristic. It was flattened at the front, and consisted of two lateral halves, with a median portion. The lateral halves sloped downwards and outwards so as to conceal laterally the lower lips and mouth slit; but in front the mouth slit was seen below the median portion of the muzzle, which was a tongue-like lobe projecting from the anterior end of the roof of the mouth. A mesial groove, commencing

* I may refer to a detailed description of the amniotic corpuscles in my account of the Placentation of *Orca gladiator*, in *Trans. Roy. Soc. Edin.*, 1871, vol. xxvi.

just above the tongue-like lobe, ran upwards for $1\frac{3}{4}$ inch, when it ended in a shallow transverse groove not quite $\frac{1}{2}$ inch long. On each side of the mesial groove was a lateral groove of about the same length, which passed obliquely downwards and outwards to the most projecting part of the lip on its own side. The palpebral fissure was small, so that only a limited surface of eye-ball was exposed. The auditory meatus was about the size of the head of a small pin. The two anterior nares were situated above the muzzle; they were crescentic in shape with the concavity downwards, and were about $\frac{3}{10}$ ths of an inch asunder; each nostril was $\frac{2}{10}$ ths of an inch wide and $\frac{4}{10}$ ths of an inch in vertical diameter, and had a flap-like piece of skin at the orifice. The pectoral limb was paddle-shaped, and with a slight indentation in its posterior end near the ulnar border. The lobes of the horizontal tail projected behind the mid point, so that the hinder border was concave, but there was no mesial notch. The anal orifice was relatively large. The penis projected through a circular hole surrounded by a fold of skin which was 5 inches in front of the anus. The umbilical cord projected from the wall of the abdomen 2 inches in front of the orifice for the penis. It is difficult to get exact information of the length of the adult Dugong, as the statements in the books vary from 8 or 10 feet to 20 feet. On the supposition that the adult is only 10 feet long, then this foetus had attained quite one-half of the adult length.

Dimensions of Foetus.

	Feet.	Inches.
Length along curve of back,	5	4
From middle of tail to anus,	1	1
From anus to orifice for penis,	—	5
From orifice of penis to umbilicus,	—	2
From axilla to tip of pectoral limb,	—	7
Greatest breadth of pectoral limb,	—	$3\frac{3}{4}$
From angle of mouth to eye,	—	$3\frac{1}{4}$
Width of mouth slit,	—	4
From mouth to nostril,	—	$3\frac{3}{4}$
From eye to external meatus,	—	$3\frac{1}{4}$

I am also indebted to Mr DE VIS for a much smaller foetus from another uterus, which was, however, unaccompanied by any of the membranes. It was a male, and was curved on itself like the larger specimen. The surface of the skin was a pale drab colour, and was marked with spots which obviously showed the position of the hair follicles, though no hairs were to be seen, neither was any moustache visible. The muzzle showed the mesial tongue-like process, which was relatively larger than in the older specimen. The muzzle was flattened in front. The eye-balls were relatively large, but the palpebral fissure was very small. The anterior nares were small, and the auditory meatus was so minute as to be scarcely visible. The tail was bilobed, but the mid point projected a trifle further back than the lateral lobes. The pectoral fin was paddle-shaped, and with a similar indentation in its border to that described in the older foetus. There was no dorsal fin. This foetus was only 14 centimetres long ($5\frac{1}{2}$ inches).

General Observations on the Placentation of the Dugong.

I have already stated that a description of the foetal membranes of the Dugong was given a few years ago by Dr HARTING of Utrecht. His specimen was at a much earlier stage of development than mine, for his foetus was only 27·8 cm. long, whereas mine measured 163 cm., i.e., 5 feet 4 inches. The chorion presented a very different appearance in the two specimens. HARTING describes it in his example as being, with the exception of its poles, covered on its entire surface with villi; the length of which varied from 0·7 to 1·5 mm. They were most dense at the middle of the chorion, where the branches of the umbilical vessels reached the chorion. The villi extended to about 3 cm. from the posterior pole, but had amidst them spaces bare of villi, so that the border of the chorion adjoining the naked pole was very sinuous. The villi approached the anterior pole to from 4 to 5 cm. The villi were formed of connective tissue covered by a layer of round or oval cells, and contained capillary blood-vessels. The posterior non-villous pole had probably been in relation to the tubal end of the uterine cornu and the anterior non-villous pole to the ostium uteri, but in the absence of the uterus their relations could only be surmised. Close to the anterior pole of the chorion was an appendage covered by villi, which HARTING thought might have been lodged in the non-fecundated horn of the uterus. Owing to the distribution of the villi over so large a proportion of the surface of the chorion, HARTING came to the conclusion that in the Dugong the placenta was diffused as in the Cetacea, the Pig, and the Mare.

My dissection of the gravid uterus in a much more advanced stage of development puts the placentation of this animal in quite a new and different light. As has been stated in the description, the placenta is zonary, the zone not being situated around the equator of the chorion, but somewhat nearer to the caudal end of the embryo; and the zone is as perfect in form as in the Cat or other carnivorous animal.

It will be necessary, therefore, to consider how the change from the more diffused arrangement seen by HARTING to the zonary form observed by me was brought about. For this purpose I may refer to observations which I made some years ago on the placenta of the common Cat at different stages of development.* In an early stage the whole chorion, except an area $\frac{1}{10}$ th inch in diameter at each pole, was covered with villi. In a more advanced stage, the non-villous area was somewhat larger at each of the poles, though much the greater part of the chorion was still villous, and the placenta had assumed the form of a broad zone (fig. 4). In the latter half of gestation the villi were limited to a comparatively narrow zone surrounding the equator of the chorion, and a much larger area was smooth and free from villi than that which was occupied by the placenta.

Corresponding changes in the proportion of the villous to the non-villous chorion take place also, I believe, in the development of the placenta in the Dugong. At first the chorion is in all probability entirely covered with villi as is the case indeed at an

* See for further details my *Lectures on the Comparative Anatomy of the Placenta*, p. 72, Edinburgh, 1876.

early stage of development of the human ovum. Then as it becomes elongated the villi disappear from the poles, so that a definite non-villous area appears at each pole, and with the continued growth of the ovum the proportion of the bare spaces to the villous chorion increases. This is apparently the stage of development at which HARTING's specimen had arrived, and it will be observed that he saw not only the naked poles, but the presence of bare patches amidst the villi, which obviously marked the beginning of a further disappearance of these structures. In my specimen the placenta had undoubtedly reached its completed stage of development as a definite zonary band.

Another point of difference in the chorion at these two stages of development must also be referred to. In Dr HARTING's example there was an appendage covered with villi apparently extending into the non-fecundated cornu. In my specimen no such prolongation was present, and one can see why in the more advanced stage of development such an appendage was unnecessary. So long as the villi were diffused over a large area of the chorion, there must have been a corresponding diffusion of the crypts in the uterine mucous membrane for their reception. Consequently at this early stage of development, as much of the mucous lining of the non-fecundated cornu as corresponded with the villous surface of the appendage of the chorion would contribute to the formation of the placenta. But with the gradual atrophy of the villi from the poles and from a large part of the surface of the chorion, the corresponding crypts in the mucous membrane would also disappear; the appendage would become functionally inactive, and would either atrophy, or become, by the great dilatation of the chorion in the gravid horn, incorporated with or expanded into it.

Another and very important conclusion to which Dr HARTING arrived was that the placenta in the Dugong was indeciduate. This indeed was almost a necessary corollary from its diffused structure, for so far as we at present know every diffused placenta is non-deciduate. But the recognition of the zonary form in the more advanced stage of placental development of the Dugong has introduced another element into the discussion of this subject. Our knowledge of the zonary placenta has hitherto been confined to its presence in the Carnivora proper, the Pinnipedia, Hyrax, and the Elephant. In all of these animals the placenta is deciduate, *i.e.*, when shed in the course of parturition the chorion carries away with it distinctly recognisable portions of the vascular mucous coat of the uterus. On *a priori* grounds we should expect to find that the Dugong, with its zonary placenta, was also deciduate. I examined the placenta, therefore, with great interest with the view to determine this question.

The relative shortness of the great majority of the chorionic villi, and the corresponding shallowness of the uterine crypts in which these villi had been lodged, together with the cylindric shape both of villi and crypts and the paucity of their branches, had permitted the separation of the foetal and maternal divisions of the placenta from each other before the uterus was opened into. The separation had apparently taken place as readily as in the Mare or Cetacean, in which animals, though the villi and crypts are short, yet the villi have numerous tuft-like branches, and the crypts are subdivided

into corresponding recesses. As the Mare and Cetacean are typical examples of mammals with a non-deciduate placenta, the Dugong also in the general scheme of its placenta without doubt resembles them. But my description has shown that, in addition to the multitudes of short villi and shallow crypts, the Dugong also possessed a small proportion of longer villi, which were implanted in longer, wider, and more deeply seated crypts, passing for some distance in an oblique direction subjacent to the layer of short crypts. From the fact that in the separation of the maternal from the foetal part of the placenta which had occurred before I opened the uterus, these longer villi had torn away from the chorion, and had remained implanted in the more deeply seated crypts, it is evident that the villi were more difficult to draw out of the crypts, and it is possible, therefore, that in the normal act of parturition, when these villi separate along with the rest of the foetal placenta, they may drag away the vascular walls of the maternal crypts in which their bulbous ends are implanted. Should this be the case, then the placenta of the Dugong would in a limited sense be deciduous, though in far the greater part of its area it would, as already stated, be non-deciduate. If I am right in this supposition of the shedding of the vascular walls of those maternal crypts in which the longer villi are inserted, whilst the shorter crypts retain their attachment to the uterus, then the placenta, whilst in the main non-deciduate, would furnish an example of the commencement of the deciduate type, and would illustrate the transition from a non-deciduate placenta to the more perfect deciduate type seen in the Carnivora and other zono-placental mammals. Should, however, these larger villi separate from the maternal placenta without taking with them the vascular walls of their crypts, which I think is the more likely, the placenta would be throughout non-deciduate. The placenta of the Dugong would then furnish us with a new type of placenta, one which is both zonary and non-deciduate. The presence of these two characters, hitherto unknown as existing in combination in any placenta previously examined, teaches us that the similarity in form which the Dugong's placenta bears to that of the Carnivora and Seals does not necessarily imply a correspondence in the intimate relations of the structural elements. We cannot therefore predicate whether a placenta is deciduate or non-deciduate from the study merely of its external form.

In the discussion of this question I have used the term deciduate in the sense in which it is usually employed to express the shedding of the vascular part of the maternal placenta during parturition. In a communication made to this Society a number of years ago,* I showed that both in the Sheep and Cow the epithelial lining of the uterine crypts was to some extent shed along with the tufts of the foetal villi. It is not unlikely that a partial shedding of this epithelium may also take place in the Dugong, for, as I have already explained (pp. 645, 650), not only were the epithelial cells in many cases loose in the crypts, but others had become so far detached as to be intermingled with the villi of the chorion.

* *Proc. Roy. Soc. Edin.*, May 1875; and *Lectures on the Comparative Anatomy of the Placenta*, p. 108, Edinburgh, 1876.

A point of much interest in the study of the placenta in any mammal is the relation between the crypts in which the villi are lodged and the glands of the uterine mucous membrane. On the supposition which was at one time entertained that the crypts were the dilated mouths of the uterine glands, there would require to be as many glands as there are villi in order that they may be mutually accommodated. The inadequacy of this hypothesis was, however, pointed out some years ago both by Signor ERCOLANI and myself, from the study of the gravid uterus in the Pig and Mare, in which animals we showed that the glands opened on definite areas of the mucous membrane opposite portions of the chorion where there were no villi, and that the uterine crypts were interglandular in position.* Subsequently, in an account of the placentation of the Lemurs, I described a yet more striking example of the interglandular position of the crypts.† In the Cetacea again, as illustrated by *Orca gladiator*,‡ I found that though a small proportion of the crypts was associated with glands, the great majority had no such relation, and were interglandular in position. The Dugong also exemplifies the accuracy of this view. If in it all the villi had been lodged in the mouths of glands, then thousands of glands would have been needed for their reception; whereas, as we have already seen, the glands were sparing in number in the placental area. The only crypts which seemed indeed in the Dugong as if they might be associated with glands were those wider and more deeply situated ones in which the longer villi were lodged. But the shorter crypts, which formed the great majority of the recesses for the villi, were interglandular in the Dugong, and were produced without doubt by an uprising and active growth of the interglandular tissue of the mucous membrane around the villi. The villus and the wall of its crypt were contemporaneous in their growth, and the depth of the crypt corresponded to the length of the villus. The epithelial lining of the crypts is also an important factor in their construction, and its discovery in the Dugong brings its placenta in this particular into harmony with those of the other mammals that I have described.§

One or two other points of comparison with the specimen described by Dr HARTING may now briefly be referred to. In both the allantois was a capacious sac, and extended to opposite poles of the chorion, and conveyed blood-vessels in its endo-chorionic layer; and the arrangement of the larger trunks of the umbilical vessels was also similar in the two specimens. Both also possessed allantoic bodies, which differed somewhat in colour, form, and structure in the younger and more advanced specimens. In HARTING's young example they were yellowish-white, round or ovoid, and made up of areolar tissue arranged so as to bound a large number of small cavities, the walls of which were constituted of interlacing elastic fibres united into bundles, and between

* *Lectures on the Comparative Anatomy of the Placenta*, Edinburgh, 1876.

† *Trans. Roy. Soc. Lond.*, vol. 166, 1876.

‡ *Trans. Roy. Soc. Edin.*, vol. xxvi., 1871.

§ For a discussion on the physiological relations of the epithelial lining of the crypts, I may refer to the section headed "Physiological Remarks," in my *Lectures on the Comparative Anatomy of the Placenta*, p. 114, Edinburgh, 1876.

which small fusiform cells were seen. Within the areolæ some cells resembling leucocytes were found. These bodies were invariably attached to the coats of the blood-vessels, almost always to the veins, and HARTING regards them as diverticula from the vascular wall. In my older example they were also closely attached to the coats of the umbilical vessels of the endochorion. They were light brown in colour, flattened or plate-like in form, and not subdivided internally into areolæ. They were, however, obviously similar structures in the two specimens, and the differences at the two ages were doubtless due to the one being structurally more advanced than the other.

These allantoic bodies in the Dugong are probably homologous with the well-known "hippomanes" of the Mare, which, though usually found floating in the fluid contents of the allantois, yet arise, as I pointed out some years ago,* in the gelatinous tissue which connects the chorion with the endochorion. They also correspond with the shot-like white spherical bodies which Professor ROLLESTON† and I have described in the corresponding gelatinous tissue in the Pig;‡ which bodies are also attached to the walls of the blood-vessels. Sir RICHARD OWEN has shown the presence of similarly situated bodies in the foetal membranes of the Elephant§ at about the middle of gestation, most numerous near the placenta, and developed in connection with the coats of the umbilical vessels. From a microscopic examination, to which I subjected a specimen some years ago, I found|| that it consisted of a tough fibrous tissue in which nuclear-looking particles were imbedded. Dr CHAPMAN of Philadelphia has since described¶ the membranes of an Elephant delivered at the full term, and has figured these bodies attached to the umbilical vessels, both veins and arteries, on and near the placenta. He considers them to project towards the amnion, as the allantoic sac had disappeared in the placenta at the full term. He states that they are fibrous in structure, with some interfibrous granular matters. It is difficult to give a satisfactory explanation of the function of the allantoic bodies.

Neither in Dr HARTING's specimen nor in mine were any amniotic corpuscles to be seen, nor was there any evidence of the presence of an umbilical vesicle.

It will now be of interest to compare the placentation of the Dugong, which may be taken as a type of the Sirenia, with that of those orders of mammals with which the Sirenia have from time to time been regarded as most closely allied.

By the Messrs CUVIER the Sirenia were grouped with the Cetacea as a suborder, Cetacea Herbivora. Although the Sirenia have without doubt some points of correspondence with the Cetacea in their placental relations, they possess many more features of difference. Both orders of mammals have a bicornuate uterus and are uniparous.

* *Lectures on Comp. Anat. of Placenta*, p. 26.

† *Trans. Zoolog. Soc.*, vol. v., 1863.

‡ *Lect. Comp. Anat. Placenta*. C. HENNIG has subsequently published a description of these bodies in the Pig (*Sitz. der Naturf. Ges. zu Leipzig*, 1877).

§ *Trans. Roy. Soc. Lond.*, 1857; *Anat. Vertebrates*, vol. iii.

|| *Lect. Comp. Anat. Placenta*, p. 27.

¶ *Jour. Acad. Nat. Sci. Philad.*, vol. viii., 1880.

In the Cetacea the chorion occupies both uterine horns; in the Dugong it is situated in only one horn, at least in the later stage of gestation. In the Cetacea the villi are diffused over both horns of the chorion, except at the poles and opposite the os uteri and the uterine crypts are also diffused; in the Dugong in the fully-developed placenta, the villi are aggregated into a zone on one side of the equator of the chorion, and there is a corresponding limitation of the uterine crypts. In the Cetacea the allantois though extensive, and lying in both horns, does not reach the poles of the chorion, as it does in the Dugong; and whilst the latter possesses allantoic bodies, there are none in the former. In the Cetacea the amnion extends into both horns, reaches beyond the allantois, and possesses numerous amniotic corpuscles. In the Dugong the allantois extends beyond the amnion, and the latter has no corpuscles. Neither in the Cetacea nor the Dugong has an umbilical vesicle been recognised. The Cetacea are undoubtedly non-deciduate. The Dugong is also without doubt in the main non-deciduate, though there is the possibility of an exception in the case of the longer villi and the walls of the deeper crypts. But in this matter I would again point out that in the separation of the foetal from the maternal placenta, which had taken place in my specimen before I opened the uterus, the longer villi had detached themselves from the chorion and remained imbedded in the uterine wall; whilst on the hypothesis of this part of the placenta being deciduate, one would have expected rather that the longer villi would have continued to be attached to the chorion, and the walls of the deeper crypts to have torn away from the uterus and have enclosed them. There is nothing in the structure of their respective placentæ to justify the retention of the Cetacea and Sirenia in the same order.

By some zoologists the Sirenia have been regarded as allied to the Ungulata. Amongst ungulate mammals the placenta is not uniform in its arrangement. The Pigs, the Equidæ, the Camelidæ, Tragulidæ, the Tapir, Hippopotamus, and probably the Rhinoceros, furnish typical illustrations of the diffused variety of placenta; the Ruminants generally exemplify the cotyledonary form; whilst the Giraffe* and *Cervus mexicanus*,† in addition to a number of large and small cotyledons, had patches of villi diffused over portions of the chorion intermediate to the cotyledons, so that they combined the characters of both types. All these animals agree in possessing a large and persistent allantoic sac. The umbilical vesicle, however, either disappears at an early period of utero-gestation, or is so small as to be recognised with difficulty. All ungulate mammals, which possess a diffused or cotyledonary placenta, are non-deciduate in the sense in which that term is usually employed.

Hyrax, which has certain ungulate affinities, also possesses a zonary placenta, which, as I showed some years ago,‡ corresponds in structure with that of the domestic Cat. The sac of the allantois is so large as to reach the opposite poles of the chorion, but the umbilical vesicle apparently atrophies at a comparatively early period of utero-gestation.

* See my *Lectures on the Placenta*, p. 67.

† See my description of the Placenta of the Mexican Deer, in *Journal of Anatomy and Physiology*, vol. xiii. p. 195, 1879.

‡ *Proc. Roy. Soc. Lond.*, Dec. 16, 1875.

The ungulate affinities of the Elephant have been dwelt upon by various naturalists. This animal has a well-marked zonary placenta, which Sir RICHARD OWEN stated to be in the middle of the chorion, though Dr CHAPMAN in his more advanced specimen found it to be on one side of the middle. In addition, the chorion possessed a small vascular patch of villi diffused at each pole of the chorion. The deciduate character of this placental zone was recognised both by OWEN and myself; and CHAPMAN estimates, from the injection of the blood-vessels in his specimen, that at least one-fourth of the shed girdle-like placenta consisted of the hypertrophied mucous membrane of the uterus. In OWEN's specimen the allantois was persistent; in CHAPMAN's it is said to have disappeared as a distinct sac. OWEN makes no mention of an umbilical vesicle, and CHAPMAN states distinctly that he did not find a trace of it. DE BLAINVILLE regarded the Sirenia as a group of aberrant Elephants, and more recently Dr MURIE* has referred to the probable affinities between the Sirenia and the Elephant.

Many years ago Sir RICHARD OWEN† pointed out that the placenta is not an organ which guides to the true grouping of the Ungulata, and that the modifications of the placenta do not form a true guide to the affinities or classification of the Mammalia generally. In more than one memoir‡ I have also shown that the placenta cannot be taken as a dominant organ for purposes of classification; yet, in the study of the affinities of animals, its characters require to be considered in conjunction with those of the other organs in the body. In this connection, therefore, it is interesting to observe that, as regards its form, the placenta both in the Elephant and the Dugong is zonary; though they differ in this very important particular, that in the Elephant the zonary placenta is deciduate, in the Dugong it is almost entirely, if not entirely, non-deciduate.

The zonary placenta possesses its best known form and structure in the Carnivora proper and in the Pinnipedia, in which animals it is usually equatorial in position. In both these suborders it is highly deciduate, although the relative amount of mucous membrane which separates along with the chorion would seem to vary in different species.§ All these animals possess a persistent and well-developed allantoic sac, and as far as we at present know they have also a persistent umbilical vesicle. Except in the mere form of the placenta, the Dugong does not seem to have any special affinity with the Carnivora proper, or with the Pinnipedia.

J. F. BRANDT in his great memoir, "Symbolæ Sirenologicæ,"|| compares the Sirenia in their structure and habits with the Cetacea, Pachydermata, Phocaceæ, and Zeuglodon. Although he considers that in some respects they are more closely allied with the phytophagous Pachyderms than with any other order of mammals, yet from the evidence

* "Form and Structure of the Manatee," *Trans. Zool. Soc. Lond.*, vol. viii., 1870.

† Memoir on the "Placenta of the Elephant" (*Trans. Roy. Soc. Lond.*, 1857).

‡ Memoir on the "Placentation of the Sloths" (*Trans. Roy. Soc. Edin.*, 1873, vol. xxvii.); and on the "Placentation of the Lemurs," in *Trans. Roy. Soc. Lond.*, 1876, vol. clxvi.

§ See my *Lectures on the Comp. Anat. of the Placenta*, p. 111.

|| *Mém. de l'Acad. Imp. des Sciences de St Petersb.*, 7th series, fasc. ii. and iii., cxii., 1869.

at his disposal he regards them as forming a distinct order. He had no knowledge of the form and structure of their placenta, but from the description which I have given of that organ in the Dugong, it is clear that its type of structure is so peculiar as to strengthen the view that the Sirenia have an ordinal value.

From the study of the placenta of the Dugong it is obvious that in future it will be necessary to arrange the mammals which possess a zonary placenta into two groups :

ZONO-PLACENTALIA.

a. Non-deciduata.—Dugong either whole or in great part; probably also the Manatee.

b. Deciduata.—Carnivora, Pinnipedia, Elephant, Hyrax.

WOODCUT.

The subjoined woodcut is a diagrammatic representation of the arrangement of the foetal membranes, and their relation to the embryo Dugong; p. 648. The embryo has been drawn in the amniotic sac by Mr GUSTAV MANN.

Ch, the chorion, with *Pl* the zonary placenta. *Al*, the sac of the allantois; *Al'*, the outer wall of the sac or endochorion; *Al''*, the inner wall of the sac. *Am*, the sac of the amnion, the membranous wall of which is represented by the dotted line.

EXPLANATION OF PLATES I., II., III.

PLATE I.

- Fig. 1. A view of the gravid uterus of *Halicore Dugong*, greatly reduced: *f*, the fecundated left uterine cornu; *nf*, the non-fecundated right cornu; *v*, the vagina; *uu*, the two ureters opening into the bladder; p. 642. From nature, by my pupil, Mr HARRY G. MELVILLE.
- Fig. 2. The chorion extracted from the uterus of the same animal, showing the zonary placenta and the umbilical vessels ramifying in the smooth parts of the chorion: *h*, opposite the head of the fœtus; *a*, opposite the anterior extremity; *t*, opposite the tail; *u*, opposite the umbilical cord, greatly reduced; p. 648. Figs. 2 and 4 were drawn from nature by Mr MICHAEL SCOTT.
- Fig. 3. One of the shorter villi of the chorion detached from its neighbours, and with its branches drawn asunder; $\times 13$; p. 649. From a drawing by the senior demonstrator of anatomy, DAVID HEPBURN, M.B.
- Fig. 4. Chorion of a Cat in an early stage of gestation, to show how extensively the villi are diffused over the surface, also the non-villous character of the poles; natural size; p. 653. From a specimen which I have placed in the series of placentæ in the Anatomical Museum of the University of Edinburgh.

PLATE II.

- Fig. 5. Surface view of the mucous membrane of the left fecundated cornu of the Dugong in the non-zonary area. The uterine glands may be seen ramifying in the mucous membrane, and the dilated mouths open obliquely on the surface; $\times 30$; p. 643. The figures in this Plate, and fig. 10 in Plate III., were drawn from nature, by my pupil, Mr GUSTAV MANN.
- Fig. 6. Vertical section through the mucous membrane of the same cornu in the non-zonary area. Sections through the gland-tubes occur at different depths, and separated by relatively wide intervals occupied by interglandular connective tissue: *m*, the mouth of a gland opening on the surface; *v*, a transversely divided blood-vessel; *mc*, muscular coat; $\times 80$; p. 644.
- Fig. 7. Vertical section through the mouth of the gland, *m*, shown in fig. 6 and the adjoining part of the mucous membrane; $\times 400$. The oblique direction of the gland-mouth and the appearance of the columnar epithelium cells which occupy the parts of the gland-tubes that lie near the surface of the mucous membrane are shown. The interglandular connective tissue contains numerous leucocytes, *l*, as well as connective tissue corpuscles; *v*, a transversely divided blood-vessel; p. 644.
- Fig. 8. Vertical section through the closed end of a gland in the deeper part of the mucous membrane; $\times 450$. The epithelial lining of the gland consists of cubical cells; p. 644.
- Fig. 9. Vertical section through the mucous membrane of the non-fecundated right cornu of the same uterus; $\times 80$. The gland-tubes are smaller than in the fecundated horn, and as the interglandular connective tissue is much less abundant, the tubes are much closer together. Compare this figure with fig. 6. *v*, blood-vessels divided; *mc*, the muscular coat; p. 647.

PLATE III.

- Fig. 10. Surface view of the mucous membrane of the fecundated cornu in the placental zone. The orifices of a number of the smaller crypts are represented, and at *a* the mouth of one of the large crypts; $\times 30$; p. 645.
- Fig. 11. Vertical section through the mucous membrane of the placental zone; $\times 60$. The figure shows the crypt layer, *cr*, and the glandular layer, *gl*, in the latter of which divided glands are represented. The crypt layer consists for the most part of the shallower crypts for the lodgment of the shorter villi; but in the section one of the deeper and more obliquely directed crypts can be seen. In this deep crypt the bulbous end of one of the longer villi, *v*, is lodged; p. 645. This and the following figure are from drawings by DAVID HEPBURN, M.B.
- Fig. 12. Vertical section through the crypt layer, *cr*, and the more superficial part of the glandular layer, *gl*, of the placental zone; $\times 240$. The epithelial lining of the shallower crypts is seen, and in some of these loose epithelial cells occupy the recesses out of which the shorter villi have been drawn. The section has also passed through one of the deeper and more obliquely directed crypts, and the villus, *v*, which it contains has been divided. The epithelial covering of the villus and the epithelial lining of the crypt are in part in place, but for the most part have been detached from the surfaces which they had covered. Closely subjacent to the deeper crypt is a gland, *gl*, with its epithelial lining, which seems as if it might have opened into the crypt; p. 646.

W. TURNER ON PLACENTA OF DUGONG. — PLATE I.

W. TURNER ON PLACENTA OF DUGONG. — PLATE II.

Fig. 7.

Fig. 8.

Fig. 9.

Fig. 5.

Fig. 6.

W. TURNER ON PLACENTA OF DUGONG. — PLATE III.

Fig. 12.

Fig. 10.

Fig. 11.