XXII. *On the Placentation of the Lemurs.* *By* William Turner, *M.B.* (*Lond.*), *Professor of Anatomy in the University of Edinburgh.* *Communicated by Professor* Huxley, *Sec.R.S.*

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Contents.

Prior to the year 1871 naturalists were unacquainted with the form and structure of the placenta in the Lemurs. On the 14th August of that year M. Alphonse Milne-Edwards communicated to the Academy of Sciences of Paris a short memoir, entitled "Observations sur quelques points de l'Embryologie des Lémuriens, et sur les affinités zoologiques de ces animaux"*. In this memoir M. Milne-Edwards stated that he had examined gravid uteri of Lemurs belonging to the genera *Propithecus*, *Lepilemur*, *Hapalemur*, and *Chirogaleus* with the following results. The chorion was almost entirely covered by villi, compactly arranged, constituting a kind of vascular cushion, and forming a placenta which enveloped, as with a hood, almost completely the amnion. He named the placenta "*placenta en cloche*," or bell-shaped placenta. The villi were very bushy in the upper and mid portions of the ovum, and diminished gradually as they approached what he terms the cephalic pole, where they disappeared over a surface of some extent. The caduca uterina was very developed, and presented a corresponding disposition. He found a large sac between the chorion and amnion, which he regarded as the umbilical vesicle. He concluded that the placenta was constructed on a distinct type from that of all other mammals, but was further removed from that of Man, Apes, Bats, Insectivores, and Rodents than from that of the Carnivora,—"car si l'on suppose un instant le pôle caudal de l'œuf du chien envahi par les villosités du placenta, on a presque la réalisation des caractères spéciaux à l'œuf des Lémuriens."

In October of the same year M. Milne-Edwards reproduced this memoir†, but with some important additions and modifications. In *Propithecus*, he said, the vascular cushion formed by the villi resulted from the confluence of a multitude of irregular cotyledons. The middle and upper portions of the mucous membrane exhibited numerous

* Comptes Rendus, 14 Août, 1871, p. 422.

† Annales des Sciences Naturelles, October 1871.

irregular anfractuosities, and the surface of the mucosa was hypertrophied, so as to form a caducous layer very analogous to that which, to a very feeble extent, adheres to the discoid placenta of the Apes, the Insectivora, and the Rodents. In the vicinity of the cervix uteri this hypertrophy gradually ceased, and the mucosa became quite smooth. The sac which in his first communication he described as the umbilical vesicle he now recognized to be the "allantois." In the genera *Lepilemur* and *Hapalemur* the placenta was similarly constructed, but the villi were less compact. In *Cheirogaleus* the placenta was also bell-shaped, but extended over almost the entire surface of the ovum.

In these memoirs M. MILNE-EDWARDS, whilst regarding the form of the placenta as peculiar, though approximating to that of the Carnivora, is obviously of opinion that, like the placenta in the higher mammals, it possessed a decidua.

Since their publication, however, M. MILNE-EDWARDS appears to have modified, in a very material manner, his views regarding the placentation of the Lemurs. In a private communication made to Mr. ST. GEORGE MIVART, and referred to by that anatomist in an essay on the zoological rank of the Lemuroidea*, these animals are said to have no decidua, and to possess a diffused placenta. No additional observations are detailed, and no explanation is given of the reason why so decided a change of opinion has been arrived at.

In none of his communications does M. MILNE-EDWARDS enter into the minute structure of the placenta, or refer to the relations of the utricular glands to the maternal part of the organ, or describe the condition of the maternal vascular system. The indefinite position in which, not only the form of the placenta, but its minute structure have been left by the only anatomist who has had the opportunity of examining the gravid uteri of the Lemurs has rendered necessary a reexamination of the organ.

Being desirous of contributing to the solution of this question, I wrote to my friend Dr. ANDREW DAVIDSON, of Antananarivo, Physician to the Court of Madagascar, to whom I had been indebted on a former occasion for valuable specimens in illustration of the zoology of Madagascar, and requested him to procure for me, if possible, some Lemurs in the gravid condition. Dr. DAVIDSON at once most cordially acceded to my request, and engaged a man to go into the forest to obtain the specimens, as these animals do not breed in confinement. As the ordinary mode of preserving the carcasses of small animals by immersion in spirit hardens the tissue and organs so as to interfere with their subsequent microscopic examination and minute injection, I suggested to Dr. DAVIDSON that the abdominal cavity should be opened and filled with dry salt, and the carcasses packed in the same preservative, as I had found from experience that the most minute injections could be made of organs treated in this manner.

On the 4th November, 1875, a box containing six carcasses of gravid Lemurs, preserved according to my directions, reached me. The skins were enclosed along with the carcasses, so that I was able to identify the animals. The animals sent were a specimen of *Indris brevicaudatus*, one of *Propithecus diadema*, and four of *Lemur rufipes*. For the

* Proceedings of the Zoological Society of London, 1873, p. 504.

determination of the specific name of the last I am indebted to Dr. GÜNTHER, to whom I sent a skin for identification, as I had not in Edinburgh sufficient materials for comparison. Two of my pupils from Madagascar, ANDRIANALY and RAJAONAH, to whom I have shown the skins, have very kindly given me the native names with their English equivalents. *Indris* is called "Simpona," or the short-tailed; *Propithecus* is "Varika," or the spotted; and *Lemur rufipes* is named "Amboan'ala," or dog of the forest.

As *Propithecus* is the genus which is more especially described by M. MILNE-EDWARDS, I shall in the first instance relate what I have seen in that animal.

Gravid Uterus of Propithecus diadema.

The uterus of the gravid *Propithecus* was pear-shaped, with the fundus directed forwards in the abdominal cavity. Its length was 4 inches, its greatest breadth $2\frac{1}{4}$ inches. A pair of slender Fallopian tubes extended outwards from the side of the uterus; but whilst the left tube was $1\frac{1}{2}$ inch from the free rounded border of the fundus, the right was 2 inches, so that the uterus was not symmetrical. Close to the mouth of each tube was a pavilion for the lodgment of the ovary, and this gland was attached to the uterus by a distinct ligament. The right ovary was about the size of a common pea; the left was double the size, and contained a corpus luteum. A well-marked round ligament sprang from the uterus close to the origin of each Fallopian tube, and two broad ligaments, enclosing blood-vessels between their folds, were attached to the sides of the uterus. The vagina, $1\frac{1}{2}$ inch long, was continuous with the wall of the uterus.

When examined externally, the uterus, though not quite symmetrical, yet seemed as if single; but when the cavity was opened into by a longitudinal incision along the posterior wall, it was seen to consist of a corpus uteri and two cornua. The uterus contained a single fœtus, which occupied the corpus uteri and left cornu, which together formed the great bulk of the uterus. The right cornu was no bigger than could contain a hazel-nut, and was so blended with the wall of the enlarged left horn that the demarcation between them was not visible externally. The two cornua freely communicated with the corpus uteri, and a septal fold, half an inch deep, covered on each surface with mucous membrane, marked the plane of demarcation between the two horns.

The free surface of the mucous membrane lining the anterior and middle thirds of the cavity of the corpus uteri and left cornu was thrown, over the greater part of its extent, into numerous shallow convoluted folds, separated by intermediate sulci, constituting "une multitude d'anfractuosités irregulières," as described by M. A. MILNE-EDWARDS*. These folds gave to the mucosa a spongy succulent character. Multitudes of crypt-like recesses were situated on the summits and sides of the folds, as well as at the bottom of the intermediate sulci. Scattered amidst these folds were upwards of twenty irregularly elongated areas of the mucosa, in which the folds and crypts were either absent altogether or much diminished in size and relative numbers. The largest of these areas was

* Ann. des Sciences Naturelles, p. 3, Oct. 1871.

about $\frac{4}{10}$ inch in its long diameter, though many were much smaller; they were depressed below the general plane of the mucosa and surrounded by crypts. The mucous membrane covering these areas was not succulent, but smooth; it had not the brownish-yellow colour of the surrounding membrane, but glistened with a bluish tint; it had a tense and, in places, a puckered appearance, not unlike a cicatrix on the surface of the skin. In the posterior third of the uterine cavity the folds on the surface of the mucosa had almost entirely disappeared, and in proximity to the os uteri the membrane was quite smooth and destitute both of folds and crypts.

The mucous lining of the right uterine cornu was for the most part smooth and free from crypts; but on and near the septum between the two cornua it was folded and subdivided into crypts. It was particularly noticed that the mucosa surrounding the opening of the Fallopian tube into the right cornu was perfectly smooth, whilst that surrounding the opening of the left tube was folded and covered with crypts. The uterus was separated from the vagina by a circular fold, which marked the os uteri, but no special cervix was separated from the general cavity of the corpus uteri.

The crypts were shallow cup-like depressions on the free surface of the mucosa. When examined under magnifying-powers of from 20 to 40 diameters, they were seen to be arranged in groups, which were separated from each other by folds of the mucosa. The crypts in each group were bounded by slender shallow folds of the mucosa, which formed the septa between the individual crypts, and usually had a sinuous direction. When examined with higher powers of the microscope, the walls of the crypts were seen to be formed of an abundantly corpusculated and delicate connective tissue.

As, before opening the uterus, I had injected, with the aid of my museum-assistant, Mr. A. B. Stirling, the uterine arteries with gelatine and carmine, I was enabled to study the disposition of the vessels in the walls of the crypts. Ascending from the deeper part of the mucosa to the crypt-layer were numerous small arteries filled with a red injection, which divided into branches that ended in a compact capillary plexus. This plexus was situated in the connective-tissue walls of the crypts; its vessels had a sinuous course following the curvatures of the crypt-walls. Not only did the capillaries belonging to the crypts of the same group form a freely anastomosing plexus, but the capillaries of adjacent groups also freely anastomosed with each other, so that a continuous plexus was distributed throughout the crypt-layer of the mucosa, which gave to the surface of the injected mucous membrane a bright red colour.

The epithelium had been to a great extent lost from the surface of the mucosa, but at the sides and bottom of the crypts, where it was more protected from injury, it could be seen. The cells were columnar in shape, and set with their attenuated ends on the subepithelial connective tissue, whilst their broad free ends formed a mosaic pattern.

Beneath the crypt-layer of the mucosa the utricular glands were situated. In vertical sections through the membrane the glands were repeatedly divided, so that only short segments of each gland could be seen. Although the stems of the gland-tubes

were directed towards the surface of the mucosa, none was seen to open into a crypt. When the free surface of the membrane was examined with a magnifying-power of 45 diameters, the glands were observed to lie for the most part obliquely beneath the crypts, but, instead of opening into them, they converged in considerable numbers towards the depressed smooth areas already described on the surface of the mucosa. Each area that was examined had several annular openings in it, which were the mouths of the glands, and through some of them a plug of epithelium could be seen to project. As the membrane in the smooth depressed areas of the mucosa of *Lemur rufipes* was more translucent than in *Propithecus*, and the relation of the glands to their openings was more distinctly seen in that genus, I shall give in the description of that animal a more detailed account of the arrangement. The vascularity of the gland-layer of the mucosa and of the smooth depressed areas was less than that of the crypts.

When the uterus was opened into, the bag of the chorion, with its enclosures, was found free and quite unattached to the uterine surface; the caudal end of the fœtus was projecting through the os uteri, and the cephalic end was in the uterine fundus formed by the dilated left uterine cornu. The chorion and other membranes enveloping the caudal end of the fœtus were torn away, so that the tail and hind limbs were exposed, but the chorion enclosing the head and thorax was entire. The free surface of the uninjured chorion was traversed by numbers of ridgelets, some of which were in parallel rows, whilst others had more of a reticulated arrangement. Sometimes the ridgelets were closely crowded together; at other times they were separated by well-defined intervals. Although the separation of the chorion from the mucosa did not permit one to see the fœtal placenta in position, yet there could be no doubt that the ridgelets had fitted into the sulci between the folds of the mucosa. When examined microscopically the ridgelets were seen to be divided into villi, the greater number of which were broad leaflets, though many were more filamentous and elongated in form. To some extent also smaller leaf-like and filamentous villi arose from the surface of the chorion between the ridgelets. An occasional irregular patch on the chorion free from villi and ridgelets was seen, which had undoubtedly been in apposition with the smoother depressed parts of the mucosa, and the villi on the rest of the chorion had fitted into the crypts in the mucous membrane. The chorion with its villi possessed the usual structure of this membrane. It consisted of connective tissue, with a layer of cells on the free surface. The torn state of the membrane prevented an injection from being passed into the umbilical vessels; but there can be no doubt that the villi were highly vascular. In M. Milne-Edwards's specimens of *Propithecus* the head of the fœtus presented to the os uteri and the cephalic end of the chorion was smooth in correspondence with the smooth surface of the mucosa surrounding the os; whilst the opposite or caudal end was villous. In my specimen the caudal end of the fœtus was the presenting part; and though the chorion enveloping it was torn away, there can be no doubt that it had been free from villi, for the surface of the mucosa with which it had been in apposition was smooth and without crypts. The opposite or cephalic pole, again, was strongly

villous, and the surface of the mucosa in the region of the left Fallopian tube, with which it was in apposition, was not only folded, but subdivided into multitudes of crypts. That the chorion had also been prolonged into the non-gravid horn is evident from the presence of crypts on the surface of a part of its mucosa.

The amnion and allantois were so much injured that it was not possible to ascertain their relations to the chorion. The umbilical cord was 2 inches long, and contained two umbilical arteries and one vein, the latter of which bifurcated as it approached the placenta. The fœtus was well developed, and measured 5 inches from the tip of the nose to the root of the tail. The tail was $3\frac{1}{2}$ inches long. The surface of the body was covered with hair, and the nails were distinct. The incisor, canine, and premolar teeth were erupted, but the molars were concealed by the gum. The fœtus was a male.

Gravid Uterus of Lemur rufipes.

The gravid uteri of the four specimens of this Lemur varied somewhat in size and in the development of the embryos. In the smallest specimen, which I shall name A, the uterus was distinctly two-horned. A single fœtus occupied the left uterine cornu. The length of this horn with the body of the uterus was $3\frac{1}{2}$ inches, and the fundus uteri, which was formed entirely by the left cornu, reached $1\frac{3}{10}$ inch beyond the place of attachment of the left Fallopian tube; the breadth of this horn was $1\frac{1}{2}$ inch. The right cornu was only $\frac{8}{10}$ inch long and $\frac{1}{2}$ inch broad. The other three specimens, which I shall name B, C, D, each contained a single fœtus; in B and C it was on the left side, and in D on the right. In all the uterus was very unsymmetrical in form, owing to the much greater development of the cornu of the side containing the fœtus over the opposite horn. The fundus of the uterus was formed by the gravid horn, which in B projected $1\frac{1}{4}$ inch beyond the place of attachment of the corresponding Fallopian tube, in C $1\frac{1}{2}$ inch, and in D only $\frac{2}{3}$ inch. In B the left cornu and corpus uteri together measured 4 inches in length, and in C $4\frac{1}{2}$ inches; in D the right cornu and corpus uteri were together $3\frac{3}{4}$ inches long. In all three the non-gravid cornu appeared as a short diverticulum from the side of the corpus uteri, with which it freely communicated, a short septal fold, as in *Propithecus*, marking the plane of separation between the two horns. In the four specimens the ovaries were about as large as peas. In A, C, and D the corpus luteum was in the ovary corresponding to the gravid cornu; in B it was in the ovary of the opposite horn. As A was evidently at an earlier stage of development, I shall reserve its description until after I have pointed out the characters of B, C, and D.

In B and D the fœtus lay longitudinally in the uterus, with the head presenting to the os uteri; in C the direction of the fœtus was more oblique, the head, though lying towards the os, being situated near the uterine orifice of the right Fallopian tube. In all three the caudal end of the fœtus was in the fundus uteri formed by the gravid horn. In these specimens the chorion was uninjured. When each uterus was opened into by a longitudinal incision through the posterior wall, the chorion was seen *in situ*

in close apposition with the uterine mucous membrane. On gentle traction the chorion could be raised from the mucosa, the ridges on the chorion being drawn out of the sulci and the villi out of the crypts, so that the fœtal and maternal parts of the placenta could be separated from each other without any structure having to be torn through.

In all three specimens the free surface of the uterine mucosa was elevated into folds in a considerable part of its extent, though they were not quite so prominent as in *Propithecus*. Both the folds and intermediate sulci were pitted with multitudes of crypts. The mucosa in the posterior third or fourth of the uterus, extending back to the os, was for the most part smooth and free from crypts. In C a smooth band also extended from the os as far as the non-gravid horn, the mucous membrane of which was also for the most part smooth and free from crypts. A similar smooth patch of some size was seen on the mucosa lining the gravid horn, extending into that cornu from the orifice of the Fallopian tube; in C this smooth surface was ovoid in form, and measured 1 inch by $\frac{6}{10}$ inch; in B and D it was almost circular, and about 1 inch in diameter. But, further, irregularly elongated, depressed, smooth areas, about equal in number and size to those described in *Propithecus*, were scattered within the folded crypt-covered part of the mucosa. These areas were quite free from crypts, and did not have so tense and puckered an appearance as in *Propithecus*. The arrangement and structure of the crypts themselves so closely resembled what I have described in *Propithecus*, that it is unnecessary to repeat the description.

The mucosa of *Lemur rufipes*, from being thinner and more translucent than that of *Propithecus*, was peculiarly well fitted for the examination of the arrangement of the utricular glands. When the free surface of the membrane was examined under low powers of the microscope, the tubular glands were readily seen lying beneath the crypts, but very much fewer in number than the crypts. A few of the glands were very tortuously arranged, but more usually they were almost straight; they occasionally bifurcated in their course, and at times gave origin to short diverticula. None of the glands was seen to open into a crypt. The glands situated beneath the crypts converged in a very remarkable manner to the smooth areas of the mucosa already described, and as a rule the tubes became quite straight, though occasionally a tortuous gland was seen beneath the smooth part of the membrane. The straight tubes ran obliquely for a greater or less distance beneath the smooth area, gradually approaching the surface, on which they opened by annular mouths. Ten, twenty, or even a greater number of glands, varying with the extent of the surface, were seen to open on a single smooth area. Usually the glands opened by independent orifices; occasionally two glands joined together immediately before reaching the free surface, and still more rarely three glands joined and opened by a single large mouth; as a rule, the orifices were directed obliquely to the surface, and bounded by a slender fold of the membrane. The mouths of the glands were often arranged in groups of five or six, and between adjacent groups were patches of smooth membrane in which no openings were visible.

Straight and tortuous glands were seen in considerable numbers beneath the smooth

surface of the mucosa surrounding the os uteri, beneath the smooth patch of membrane situated in the fundus of the gravid horn and beneath the smooth mucosa lining the non-gravid horn: in each of these localities the glands opened on the smooth free surface. Quantities of epithelium-cells were contained in the gland-tubes. The cells did not, as a rule, form a continuous lining, but were broken up into separate masses. As a rule, also, the epithelium lining the gland-tube near its mouth was not *in situ*, and that which had formed the covering of the smooth areas was shed. The long interval between the death of the animals and the time of examination, together perhaps with the action of the salt, will, I think, sufficiently account for the loosening of the epithelium-cells in these localities. The number of gland-tubes in the deeper layer of the mucosa was greater than near the surface, so that each gland stem or duct, as it approached the surface, must have received the secretion of several of the deeper tubes.

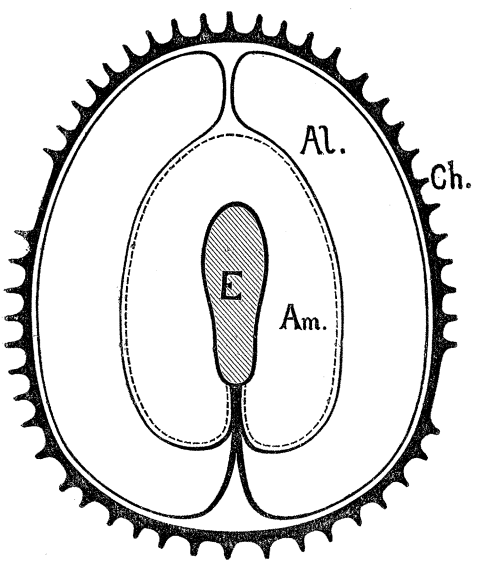
The chorion occupied the cavity of the corpus uteri and gravid horn, and gave off from the depending part next the os uteri (the so-called cephalic pole of M. A. MILNE-EDWARDS) a short prolongation, having the appearance of a diverticulum, which passed into and occupied the cavity of the non-gravid horn. This diverticulum was best marked in B, in which it measured $\frac{8}{10}$ inch in length; so that the chorion might be described as extending from the tip of one cornu, through the corpus uteri to the tip of the opposite horn. The extension of the chorion into the non-gravid horn had not been recognized by M. A. MILNE-EDWARDS in his specimens; so that whilst he quite correctly regarded that enveloping the caudal end of the fœtus as one pole, he supposed the portion of this membrane which was next the os uteri to be the opposite pole. But the true poles of the chorion are the ends situated in the horns of the uterus, whilst the part covering the head of the fœtus is not a true pole, but the most depending part of the membrane next the os uteri.

The surface of the larger proportion of the chorion was covered by villous ridges, similar to those described in *Propithecus*, and the parts of the chorion in apposition with the smooth surfaces of the mucosa were bare of villi. Thus a bare surface of some size was at the caudal pole of the chorion in the fundus uteri; another bare surface was on the opposite pole in the non-gravid horn, and a still larger bare surface was on that part of the chorion which, enveloping the head of the fœtus, lay opposite the os uteri. The parts of the chorion which were in apposition with the irregularly elongated smooth areas of the mucosa lying amidst the crypt-covered surface were also non-villous. The chorion had the usual structure of that membrane, and its epithelial covering was distinct. I did not succeed in obtaining an injection of the umbilical vessels; but there can be no doubt that the villi were highly vascular; and from what I have seen in other animals possessing a diffused arrangement of the villi over the chorion (*e. g.* Pig, Mare, *Orca*, Narwhal, Dromedary), it is also very probable that a network of capillaries was distributed beneath the intervillous parts of the membrane.

The chorion of C was then cut through by a longitudinal incision, and the sac of the allantois was opened into. It was 4 inches long, and extended from the caudal pole

as far as the head of the fœtus, but did not pass into the short diverticulum of the chorion which occupied the non-gravid horn. Opposite the abdominal aspect of the fœtus, where the umbilical vessels passed to the chorion, the outer wall of the sac of the allantois was reflected on to the inner surface of the chorion; and along a line opposite the back and head of the fœtus the allantoic membrane was again reflected on to the outer surface of the amnion, so as to form the inner wall of the sac of the allantois. The sac of the allantois was thus divided into two almost equal parts, one corresponding to each lateral aspect of the embryo; but as the line of reflection opposite the abdominal aspect was not equal to the length of the sac, the two halves on opposite sides freely communicated with each other. The amnion formed a well-defined bag enclosing the fœtus, coequal in length with the sac of the allantois, and, like it, not extending into the short diverticulum of the non-gravid cornu.

Diagram of the arrangement of the fœtal membranes of *Lemur rufipes*, as seen in transverse section through the embryo.



E. Embryo.
Al. Sac of allantois.
Ch. Chorion, with villi and non-villous patches.
Am. Sac of amnion. The dotted line represents the amnion.

The fœtus was well developed, and measured between 5 and 6 inches from the tip of the nose to the root of the tail. The head, instead of being bent forward under the thorax, was twisted round, so that the lower jaw rested on the back. The tail, 4 inches long, was curved under the belly. The hind limbs were flexed at the hip, knee, and ankle-joints; the joints of the fore limbs were also bent. The skin was well haired, and the nails were developed on the digits.

When the uterus of A, the least developed specimen, was opened into by an incision along the posterior wall, the non-gravid cornu was seen to communicate with the corpus uteri $1\frac{2}{12}$ inch from the os uteri. The corpus uteri, for $\frac{1}{2}$ an inch beyond the os, was a narrow tube, in which the mucous membrane was longitudinally folded as in the non-

gravid uterus; it then became more dilated, so that the mucous membrane was more expanded, but free from crypts. The mucosa of the non-gravid cornu was quite smooth and without crypts. The gravid left cornu, which measured $2\frac{3}{10}$ inches from the summit of the fundus to the corpus uteri, was dilated and contained the ovum. The mucous lining in close proximity to the corpus uteri was smooth and free from crypts, but for the most part it was folded and subdivided into crypts, as in the other specimens of *L. rufipes*. Extending, however, from the orifice of the Fallopian tube into the fundus was a smooth ovoid surface free from crypts, about 1 inch in its long diameter; and several elongated, depressed, smooth areas, in which the mouths of the glands were seen to open, were situated amidst and surrounded by the crypt-covered folds.

The chorion was ovoid in form, $1\frac{8}{10}$ inch long, and did not pass either into the corpus uteri or the cavity of the non-gravid horn. The broader end of the ovum was situated in the fundus uteri; the narrower end came almost up to the corpus uteri. The surface of the chorion was almost uniformly villous, a small bare patch being situated at the pole directed towards the corpus uteri, whilst a larger non-villous patch was on the pole of the chorion, in apposition with the smooth surface of the mucosa in the uterine fundus. An occasional narrow bare patch also corresponded to the depressed smooth areas on the mucosa already referred to. It is clear, therefore, that the corpus uteri and non-gravid cornu do not become dilated in the earlier stages of development, and that the chorion only grows into them as the development of the fœtus progresses. The proportion of villous chorion to non-villous in this specimen was considerably greater than in B, C, and D.

Gravid Uterus of Indris brevicaudatus.

This uterus, from its small size, was obviously the least developed of the specimens which had reached me. It was distinctly two-horned, and the right cornu was somewhat bigger than the left. The distance from the os uteri to the fundus of the right cornu was $1\frac{3}{10}$ inch, to the fundus of the left cornu 1 inch. Each cornu had attached to it a Fallopian tube, a round ligament, a broad ligament, and an ovarian ligament with its ovary. A corpus luteum was in the right ovary, and in close relation to each ovary was a pouch-like fold of the peritoneum.

The cavity of the uterus was opened into by an incision through the posterior wall. The entrance to the smaller cornu was $\frac{4}{10}$ inch from the os, and the uterine mucosa up to that entrance, which formed the lining of the corpus uteri, was raised into longitudinal folds. The entrance into the more distended cornu was marked by a comparatively broad fold of the mucosa, which ran transversely around the greater part of the mouth of the cornu. The mucous lining of the distended horn was thrown into strong convoluted folds, with deep intermediate sulci: the main direction of these folds was longitudinal; but they were much more tortuous, subdivided, and prominent than those in the corpus uteri.

Unfortunately I did not succeed in seeing the ovum in this specimen. Under the

action of the salt in which the carcass had been for so many months preserved after the animal had been shot, the uterus had become so much contracted that it required some hours steeping in water before it was fit for drawing and dissecting. As the ovum could have been in only a very early stage of development, its delicate tissues had probably so shrivelled up that it entirely escaped notice when the uterus was opened. There could, I am sure, be no question that the uterus was gravid, for not only was the one horn more distended than the other, but the folds of its mucous membrane were bigger, much more convoluted and subdivided than is the case with the folds of the mucosa in the non-gravid uterus.

General Observations on the Placentation of the Lemurs.

Several eminent zoologists, in classifying the Mammalia according to their placental characters, have placed the Lemurs, along with the Insectivora, Rodentia, Chiroptera, Apes, and Man, in the Discoplacentalia. So far as I have been able to examine the literature of the subject, no description of the dissection of a gravid uterus of a Lemur containing a disk-shaped placenta has been put on record. Indeed, until M. Alphonse Milne-Edwards published his brief Memoirs on their placentation, no gravid uterus of a Lemur appears to have been examined. Because the Lemurs corresponded to the Apes in the opposability of the thumb and great toe, in the presence of incisor, canine, premolar, and molar teeth, and in the pectoral position of at least two of the mammæ, and to the Insectivora in the pointed tubercles on the crowns of the molar teeth, it has apparently been assumed that they must also correspond with the Apes and Insectivora in the possession of a disk-shaped placenta. The observations of M. Alphonse Milne-Edwards have, however, clearly proved that the placenta in the Lemurs is not disk-shaped; and though he applied to it the name bell-shaped, he yet concluded that it had affinities to the zonary placenta of the Carnivora.

From the description which I have given in this Memoir of the arrangement and structure of the maternal and fœtal parts of the placenta in the several genera examined, it will I think be at once admitted that not only is the placenta in the Lemurs not discoidal, but that it cannot be regarded as a modification of the zonary form of placenta.

Both in form and structure the placenta in the Lemurs is without doubt a diffused placenta. To make this important conclusion clearer, I shall summarize the facts which prove this to be the character of the placentation.

a. By gentle traction the ridges and villi of the chorion can be drawn out of the sulci and crypts of the uterine mucosa so that the fœtal and maternal parts of the placenta can be readily and completely separated from each other, as can be done in the diffused placenta of the Pig, Mare, or Cetacean, but as cannot be done either in the discoid placenta or in the zonary placenta of the Carnivora.

b. The chorion is prolonged from the tip of one cornu, through the corpus uteri, to the tip of the opposite horn, as in the uniparous Mare and Cetacean, and is not, as in the uniparous Seal, limited to the side of the uterus in which the fœtus is developed.

c. That the villi are not uniformly distributed over the entire surface of the chorion in the Lemurs is no argument against the diffused character of the placenta; for in none of the other specimens of the diffused placenta which I have examined (viz. the Pig, Mare, *Orca*, Narwhal, *Balænoptera*, *Manis*, and Dromedary) have I seen the whole surface of the chorion covered by villi. In the genera of Lemurs which I have here described, and in the additional genera *Lepilemur*, *Hapalemur*, and *Cheirogaleus* described by M. A. MILNE-EDWARDS, a considerable surface free from villi, corresponding to the presenting part of the fœtus, lay opposite the os uteri. In the Mare, *Orca*, and the Narwhal I have also seen a smooth surface of chorion bare of villi in this locality, which in the Narwhal measured 6 inches in one direction by 4 in another; in *Orca* and in the Mare the bare patch was smaller in size. In my specimens of *Lemur rufipes* a bare surface was also found on the poles of the chorion situated in the uterine cornua; but this is also a not unfrequent character in the diffused placenta, for I have seen it in *Orca**, the Mare, and the Narwhal†. In the Narwhal the chorion occupying the non-gravid horn was bare of villi for about 5 inches from the pole, and even for a greater distance the villi were irregularly scattered, so that well-defined smooth patches could be traced as far as 10 or 12 inches from the pole; whilst the end of the chorion in the gravid horn had smooth bands radiating for about 1 inch from the pole. In the pluriparous Pig, as was known to VON BAER, the poles of the chorion are free from villi; and in one animal which I examined I found a smooth non-villous surface extending for nearly 3 inches from each pole. The smaller bare patches in the Lemurs situated amidst the villous surface are also not without their homologues in other forms of the diffused placenta. In the Narwhal smooth spots, varying in diameter from $\frac{1}{10}$ to $\frac{2}{10}$ inch, and surrounded by villous tufts, were occasionally situated on the villous surface of the chorion, and these spots were in apposition with smooth surfaces of the mucosa free from crypts. In the Pig numerous star-like spots, varying from $\frac{1}{5}$ to $\frac{1}{20}$ inch in diameter, were scattered over the surface of the chorion, and these spots were in apposition with smooth surfaces of the mucosa free from crypts. In the Mare narrow smooth bands of chorion were in apposition with smooth ridges on the uterine mucosa. In *Balænoptera* and the Dromedary I have also seen non-villous surfaces on the chorion, but the want of the uterus prevented me from localizing them in their relations to the mucosa. In *Manis*, as Dr. SHARPEY pointed out, a band free from villi ran longitudinally along the concavity of the chorion, and there was a corresponding bald space on the surface of the uterine mucosa.

d. The shortness of the villi and the shallowness of the crypts situated in the mucosa for their reception are characters common to all the examples of diffused placenta which I have examined. It is owing to this arrangement that the ready separation of the fœtal placenta from the maternal can be effected, as the hand and fingers can be drawn out of a glove.

* I have given a detailed description of the placentation of *Orca gladiator* in Trans. Roy. Soc. Edinb. 1871.

† An account of the placentation of the Narwhal is given in Proc. Roy. Soc. Edinb. Feb. 1876.

e. The form and arrangement of the crypts and the distribution of the blood-vessels in their walls are so like what I have seen in *Orca* and in the Narwhal, that it was difficult, when the preparations were placed side by side, to distinguish the one from the other.

f. In the Lemurs the glands did not open into the crypts, but on the surface of the depressed smooth areas of the mucosa surrounded by the crypts; in the Pig, the Mare, and occasionally in the Narwhal the glands also did not open into the crypts, but on intermediate smooth surfaces of the mucosa,—the peculiarity in the Lemurs being that the mouths of so many glands were concentrated in one area; whilst in the Pig and Narwhal, so far as I have seen, only a single gland opened in each smooth area, and in the Mare the mouths of the glands opened at intervals on the ridges which separated the crypt areas from each other. The placenta in the Lemurs, therefore, corroborates the conclusions which have been drawn by Professor ERCOLANI, of Bologna, and myself, from the study of various forms of placenta, that the crypts which receive the villi are not produced by a dilatation of the glands, but are new structures arising during pregnancy from a hypertrophy and folding of the interglandular part of the mucous membrane*.

In further illustration of the arrangement of the utricular glands in the Lemurs, I may relate some observations which I made some months ago on the non-gravid uterine mucosa in the Slow Lemur (*Nycticebus tardigradus*). The mucosa in each cornu was elevated into six distinct longitudinal folds. It was as thick as the muscular coat, and covered by a well-defined layer of columnar epithelium. In the deeper part of the mucosa the glands were seen to branch repeatedly, and the number of tubes was considerable. In vertical sections through the membrane these tubes were cut across, some transversely, others obliquely or longitudinally. From these branched tubes comparatively few gland-ducts proceeded, which ran very obliquely to open on the free surface of the mucosa; so that the paucity of the tubular glands near the free surface of the mucosa, as compared with the deeper part of that membrane, was in conformity with what I saw in the gravid uterus of *Lemur rufipes*. In the uteri of the Pig, Mare, *Orca*, and the Narwhal a gland stem or duct is also formed by the junction of several branches.

In the Lemurs, as in other placental mammals, the crypts are without doubt secreting organs. The columnar epithelium which lines them has the characters of a secreting epithelium, and the compact subepithelial capillary plexus supplies an abundance of blood from which the secretion may be formed†. The concentration of the mouths of

* The evidence on which this conclusion is based is supplied by Prof. ERCOLANI in a series of Memoirs which have appeared in the 'Mem. dell' Accad. delle Scienze di Bologna' from 1868 to 1873, and by myself in my Lectures on the Comparative Anatomy of the Placenta, before the Royal College of Surgeons of England, June 1875, 1st series, published at Edinburgh, 1876.

† The argument in support of the secreting function of the uterine crypts formed during the development of the placenta is stated in my lectures before the Royal College of Surgeons of England, above referred to.

the utricular glands in special areas dissociates their secretion from that of the crypts. The villi which fit into the crypts are the parts of the chorion which absorb their secretion; whilst the smooth, non-villous surfaces of the chorion opposite the smooth areas on the mucosa are engaged in the absorption of the secretion of the glands.

As the placenta in the Lemurs has the arrangement and structure of a diffused placenta, it is presumably as non-deciduate as that of the other animals which possess the same form of placenta; for in it, as in them, the fœtal placenta can be separated from the maternal without carrying away a portion of the uterine mucous membrane. The demonstration, therefore, of the diffused and non-deciduate nature of the placenta in the Lemurs has an important bearing on the classification of these mammals. As it may be desirable to say a few words on this matter, I shall commence by a brief review of the opinions expressed by various zoologists of the position of the Lemurs in the class Mammalia.

As is well known, LINNÆUS constructed the order *Primates* to include Man, Apes, Lemurs, and Bats. BODDAERT, in 1785, proposed the term *Quadrimana* for the Apes and Lemurs, as expressing the four-handed function of their limbs. BLUMENBACH, in 1795, and CUVIER, shortly afterwards, separated the Apes and Lemurs from Man and the Bats, and made for them the distinct order *Quadrumana*; and this arrangement, with some variations in the mode of subdivision of the order, has been adopted by Messrs. ST.-HILAIRE, WATERHOUSE, H. MILNE-EDWARDS, OWEN, VROLIK, VAN DER HOEVEN, and GIEBEL. DE BLAINVILLE preferred to retain the order *Primates*, in which he included the Apes and Lemurs; and this arrangement, with some variations in the mode of subdivision of the order, has also been adopted by Messrs. J. E. GRAY, ST. GEORGE MIVART, and HUXLEY.

Several zoologists have, however, regarded the structural differences between the Apes and Lemurs as so important that they could not be included in the same order. In 1830, WAGLER proposed that the Apes should form the order *Simiæ*, and the Lemurs the order *Lemures*. GRATIOLET also separated the Lemurs from the Apes, and placed them at the head of the Bats and *Insectivora*; PAUL GERVAIS is also of opinion that they should form a distinct order. M. ALPHONSE MILNE-EDWARDS, in his memoirs already quoted, adduces various reasons against including the Apes and Lemurs in the same order, and proposes the order *Lemuria*, which he considers to have closer affinities with the *Carnivora* than with the Apes, Bats, and Insectivores. HAECKEL, VICTOR CARUS, and CLAUS have also regarded the structural characters of the Lemurs as possessing an ordinal value, and adopting a term applied to these animals by BRISSON, so far back as 1756, have constructed for them the order *Prosimii* or Half-Apes. HAECKEL and CARUS regard the Lemurs as the oldest group of disco-placental mammals. By all these naturalists, with the exception of M. ALPHONSE MILNE-EDWARDS, whether they place these animals in a distinct order or not, the Lemurs are regarded as having closer affinities to the Apes, *Insectivora*, and Bats than to any other mammals.

The demonstration of a diffused, non-deciduate placenta in the Lemurs introduces a

new structural element into the consideration of the position they ought to occupy in the class Mammalia. If, as has been done by several eminent zoologists, the form and structure of the placenta are to be taken as the chief guides in the classification of the Mammalia, then the Lemurs can no longer be associated with those orders in which a discoid, deciduate placenta occurs. Not only in the form and structure of the placenta, but in the large size of the sac of the allantois, the Lemurs approach more closely to the *Perissodactyla*, *Suina*, and *Cetacea* than to any of the other orders of mammals, and ought, therefore, to be grouped along with them, if the placenta is to be taken as the dominant character for purposes of classification. The question, therefore, naturally arises whether the placental characters are of such primary importance as to outweigh, in framing a system of classification, those furnished by the other organic systems. The same question also arose in the course of an investigation into the placentation of the Sloths*, when I demonstrated that in *Cholopus* the placenta was multilobate, discoid, and deciduate, whilst Dr. SHARPEY had previously shown that in *Manis* the placenta was diffused and non-deciduate; so that if the placenta be taken as the basis of classification *Manis* and *Cholopus* could no longer be regarded as members of the same order *Edentata*. In the case of the Lemurs it will, I think, be considered by most zoologists that the characters of the teeth, the general configuration of the skeleton, the unguiculate digits, the hand-like form of the distal part of the extremities, the presence of a calcarine fissure in the cerebrum, and the pectoral position of at least two of the mammæ are characters which indicate that the Lemurs have much closer affinities with those mammalian orders with which it has been customary to associate them, than with the *Perissodactyla*, *Suina*, and *Cetacea*. Collectively these characters ought, I think, to be regarded as more valuable indications of structural affinity, than should the presence in the Lemurs of a non-deciduate, diffused placenta with a large allantois be regarded as indicative of structural dissimilarity from the Apes and *Insectivora*, though the placenta in the latter is deciduate and discoid and the allantois aborted.

But though I am of opinion that the general affinities of the Lemurs are such as to lead one to retain them in association with the Apes and *Insectivora*, there can, I think, be no question that the diffused and non-deciduate nature of their placenta, with the large allantoic sac, are distinctive characters of so much importance that they cannot be classed in either of those orders, but have themselves an ordinal value. Hence I agree with those zoologists who separate the Lemurs from the Apes; and to the distinctive characters derived from the teeth, skeleton, &c., advanced by previous writers, I would add those to be drawn from the placenta and the fœtal membranes.

In conclusion, it may not be without interest to consider how far the determination of the non-deciduate, diffused character of the placentation in the Lemurs affects the theory advanced by Professor HAECKEL†, that the Half-Apes (*Prosimiæ*) were the primary form out of which the several orders of deciduous placental mammals had originated.

* Transactions of the Royal Society of Edinburgh, 1873.

† 'Natürliche Schöpfungsgeschichte.'

In constructing his pedigree of the Mammalia, HAECKEL, though admitting the difficulty of solving the question, is inclined to think that the placental mammals had at once diverged into two completely distinct groups, a Non-deciduate and a Deciduate. Out of the Non-deciduata, he says, had proceeded the *Ungulata* and *Cetacea*, with their diffused or cotyledonary forms of placenta; out of the Deciduata had arisen the *Insectivora*, *Carnivora*, *Chiroptera*, *Rodentia*, *Hyracoidea*, *Proboscidea*, Lemurs, Apes, and Man, with a zonary or discoid form of placenta; whilst the primæval form common to all the Deciduata was the group of Half-Apes, or *Prosimiæ*, of which the Lemurs of the present day are the descendants and representatives.

The principle which guided HAECKEL in framing his pedigree of the Mammalia rendered it necessary for him to assume that the Lemurs possessed a deciduate placenta, so that they might serve as the primary group of origin of the deciduate mammals. But I have just shown that in these animals the placenta is diffused and non-deciduate, so that the Lemurs must be transferred to the Non-deciduata, and, on the hypothesis advocated by HAECKEL of an independent origin of the Deciduata and Non-deciduata, they can no longer be regarded as the root form of the deciduate mammals.

It appears to me, however, that the conditions of the theory of descent may, so far as it is based on a consideration of placental characters, be more satisfactorily provided for by assuming that the deciduate placenta had been evolved from the non-deciduate, rather than that an abrupt divergence into two distinct placental groups had occurred*. No one, I suppose, would doubt that the diffused placenta has the most simple mode of structure, and that the distribution of the villi over the surface of the chorion presents a close approximation to the primary embryonic arrangement; whilst the discoid placenta exhibits the greatest departure from the diffused villous chorion of the early embryo. Not only is the placenta in the discoid form concentrated in a limited area, but its internal structure is much more complicated; for the diminution in the relative proportion of the surface of the chorion, subserving the function of a placenta, has rendered necessary a greater degree of complexity in the form of the villi and in the foldings of the uterine mucosa throughout the placental area. It seems to me, therefore, to be more in accordance with a theory of descent that the complex form of placenta should be regarded as having been evolved out of the simple, than that each should have arisen independently, as is assumed by HAECKEL, out of a non-placental subclass of Mammalia.

I have elsewhere recorded† observations on the structure of the placenta which show that the line of demarcation between the Non-deciduata and Deciduata is not so abrupt as has usually been supposed, but is graded over by an intermediate arrangement—the passage from the diffused placenta, in which no maternal tissue deciduates during parturition, to those deciduate placentæ in which both the epithelial and subepithelial

* In the last of my Lectures on the Comparative Anatomy of the Placenta, delivered at the Royal College of Surgeons, June 1876, and printed in the Journal of Anatomy and Physiology, Oct. 1876, I have discussed at much greater length the structure of the placenta in relation to the theory of evolution.

† Proceedings of the Royal Society of Edinburgh, 1875.

vascular tissue of the uterine mucosa are shed being effected through the cotyledonary placenta, in which the epithelial lining of the maternal cotyledons separates along with the fœtal villi. I have also shown * that amongst the deciduate placentæ, in the different genera and orders, considerable variations occur in the relative proportion both of the epithelial and subepithelial vascular tissue of the placental area shed during parturition.

On the hypothesis which I have just advanced, that the more complex forms of placenta may have been evolved out of the more simple, the possibility that the Lemurs, notwithstanding the non-deciduate and diffused character of their placentation, may have been the stock from which the deciduate mammals had been derived does not present so many difficulties as are involved in the hypothesis put forward by Professor HAECKEL.

EXPLANATION OF PLATES 49, 50, 51.

For the series of coloured drawings in illustration of this memoir, which have been drawn with great care under my superintendence, I am much indebted to my former assistant, Mr. ALFRED H. YOUNG, M.B.

Fig. 1. Posterior surface of the gravid uterus of *Propithecus diadema*. Natural size.

Fig. 2. Posterior surface of the gravid uterus of *Lemur rufipes*. Specimen A. Natural size. *f*, fecundated, and *nf* non-fecundated cornu; *o o*, ovaries.

Fig. 3. Outer surface of chorion from the gravid uterus of *Lemur rufipes*. Specimen A. Natural size.

Fig. 4. Outer surface of chorion of *Lemur rufipes*. Specimen B. Natural size. *f*, the pole in the fecundated cornu of the uterus; *nf*, the pole in the non-fecundated cornu; *b*, the bare surface opposite the os uteri.

Fig. 5. Ovum of *Lemur rufipes*. Specimen C. Natural size. The chorion in the fecundated cornu has been cut through by a longitudinal incision, and the sac of the allantois opened into. V, the villous surface of the chorion at one pole; *am*, the amnion, containing the fœtus, seen through the layer of allantois which covers it; *al*, the line of reflection of the allantois from the outer surface of the amnion to the inner surface of the chorion; *uv*, vessels of the umbilical cord passing to the chorion; *nf*, the pole in the non-fecundated cornu.

Fig. 6. The inner surface of the gravid uterus of *Propithecus diadema* after the removal of the fœtus and its membranes. *f*, the fecundated cornu, the mucosa of which displays the sinuous folds and the depressed smooth areas described in the text; *nf*, the non-fecundated cornu; *os*, the fold of mucosa which marks the os uteri; V, the vagina. Natural size.

* Memoir on the Placentation of the Seals, in Transactions of the Royal Society of Edinburgh, 1875.

Fig. 7. Free surface of a small portion of the uterine mucosa of *Propithecus diadema*. × 2 diameters. The convoluted folds of the mucous membrane with their crypts are represented, and amidst these folds five smooth depressed areas, in which the mouths of the utricular glands open, may be seen.

Fig. 8. Anterior surface of the gravid uterus of *Indris brevicaudatus* in an early stage of pregnancy. Natural size. *f*, fecundated, *nf* non-fecundated cornu. *o o*, ovaries; *l*, round ligament; V, vagina.

Fig. 9. Surface view of one of the smooth depressed areas on the uterine mucosa of *Lemur rufipes*. × 50 diameters. In the smooth area may be seen the open mouths of a number of glands which converge to the area from beneath the surrounding crypts. The great vascularity of the walls of the crypts is shown, but at the right side of the figure the injection has not penetrated into the capillary plexus. If this drawing be compared with the free surface of the uterine mucosa of the gravid Pig, as figured in my paper in the 'Journal of Anatomy and Physiology,' October 1875, a close correspondence will be seen in the arrangement and vascularity of the crypts; but whilst the smooth depressed spot in the Pig has only one gland opening in it, that in the Lemur has between twenty and thirty. The specimen satisfactorily shows the independence of the glands and the crypts; for although the glands are subjacent to the crypts, they do not open into them.

Fig. 10. Vertical section through two convoluted folds and an intermediate sulcus of the uterine mucous membrane of *Propithecus diadema*. *a*, the vascular crypt layer of the mucosa; *b*, the subjacent glandular layer; *c*, the muscular coat. If this drawing be compared with a similar vertical section through the uterine mucosa of *Orca gladiator*, which I have figured in the Transactions of the Royal Society of Edinburgh, vol. xxvi. plate xviii. fig. 12, a remarkable resemblance in the form and vascularity of the crypts will be seen; in *Orca*, however, the glandular layer is thicker than in *Propithecus*. *ff*, two folds vertically divided; *s*, intervening sulcus. Both the sulcus and the folds are thickly pitted with crypts. × 50 diameters.

Fig. 11. A more highly magnified view of portions of the walls of two crypts, to show the relation of the columnar epithelial lining of the crypts to the capillary plexus in the wall. A, a crypt vertically divided; B, a crypt cut across obliquely.

Fig. 12. A portion of the chorion of *Propithecus diadema*, magnified, to show the subdivision into villi of the ridges which traverse its free surface.

ADDENDUM.—July 15th, 1876.

A few days ago the Library of the University of Edinburgh received the recently published parts of the great work 'Histoire physique, naturelle et politique de Madagascar,' publiée par ALFRED GRANDIDIER, Paris, Imprimerie Nationale, 1875. The parts published are vol. ix. tome iv. atlas 1, and vol. vi. tome i. texte 1, première partie, in which the description and illustration of the Natural History of the Mammals of Madagascar is commenced by MM. ALPHONSE MILNE-EDWARDS and ALFRED GRANDIDIER. From a note in the 'Comptes Rendus' of 20th December, 1875, p. 1280, which I did not see until after this Memoir had been communicated to the Royal Society, it would appear that these volumes were published at the close of last year.

The volume of text contains a description of the osteology and myology of the family *Indrisinæ* of the order of Lemurs. The volume of the atlas contains 122 beautiful lithographic and photographic plates in illustration of the external form and colour and the internal anatomy of this family of Lemurs. Plates 113 to 121 inclusive are devoted to figures of the gravid uterus and its contents in *Propithecus diadema*, *Edwardsii*, and *Verreauxii*, *Avahis laniger*, and *Indris brevicaudatus*; but no description of these figures has been published either with the atlas or in the volume of text. The generally villous surface of the chorion is shown in these figures, and in *Propithecus diadema* smooth spots are scattered amidst the villi; but no similar spots are represented on the chorion of the other species, though *P. Edwardsii*, *P. Verreauxii*, and apparently *Indris brevicaudatus* have a smooth chorion opposite the os uteri. In none of the figures is the presence of a rudimentary horn to the chorion extending into the non-fecundated uterine cornu represented. In *P. diadema* and *I. brevicaudatus* the uterine mucosa is seen to be raised into minute folds, and in *P. diadema* the presence of depressed smooth areas on the mucosa is shown. Beyond figuring a capillary plexus in the fœtal villi and uterine mucous membrane, no representation of the minute structure of the placenta has been given, and no notice is taken of the uterine glands and of their relations to the depressed areas in the mucosa. The illustrations, therefore, are incomplete in some interesting and important particulars. The amnion, allantois, and a small pedunculated sac, which looks like the umbilical vesicle, are, however, beautifully figured.

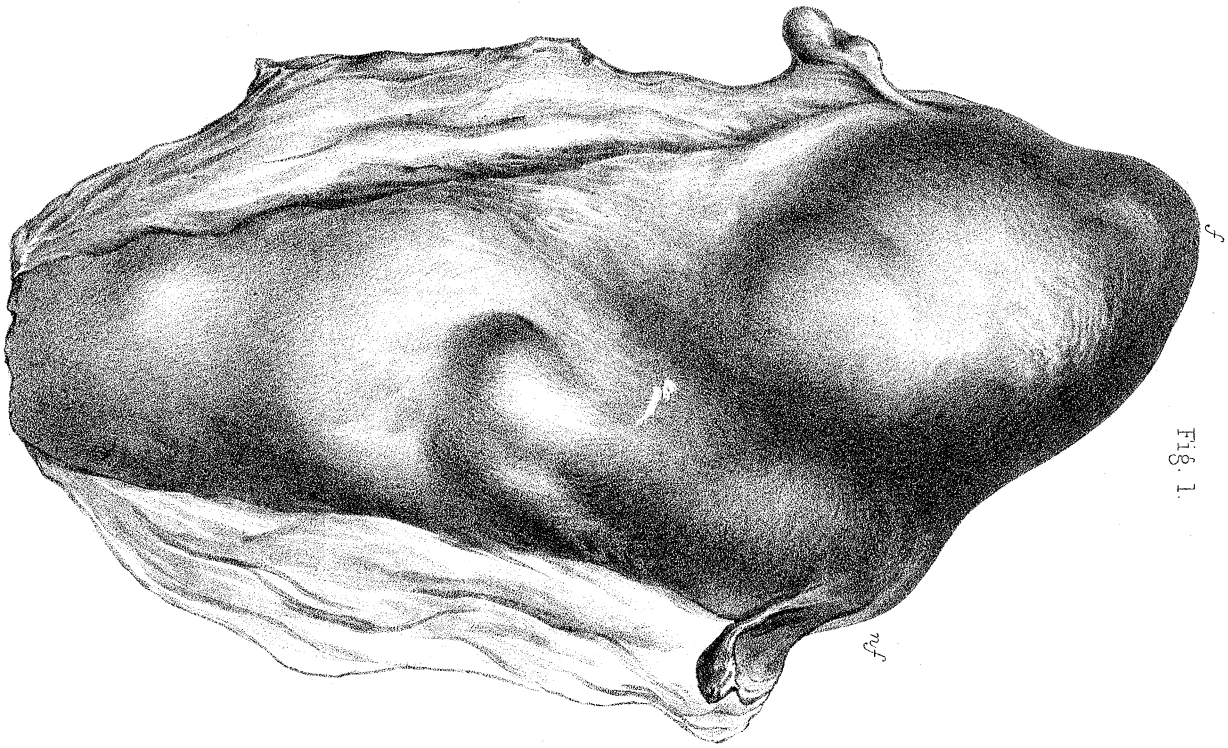


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Fig. 4.

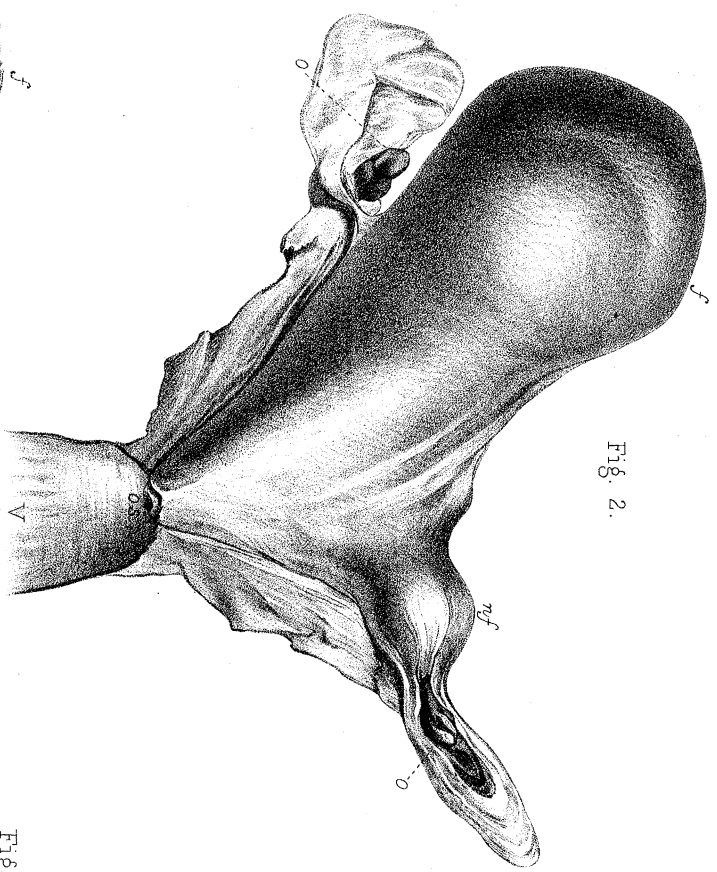

Fig. 2.

Fig. 3.

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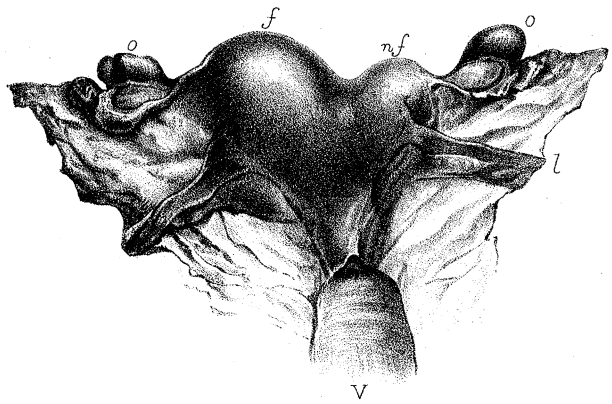

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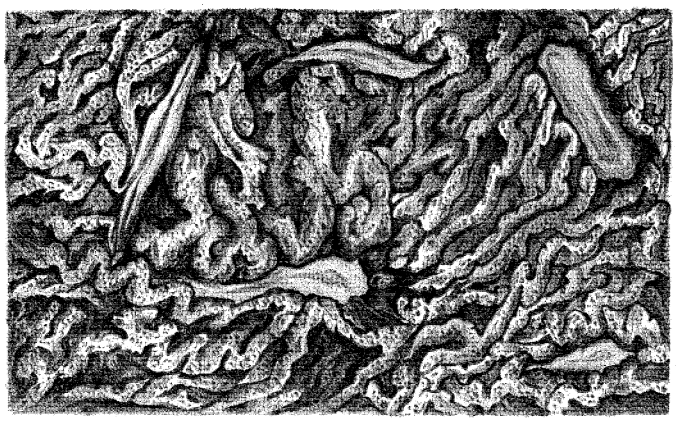

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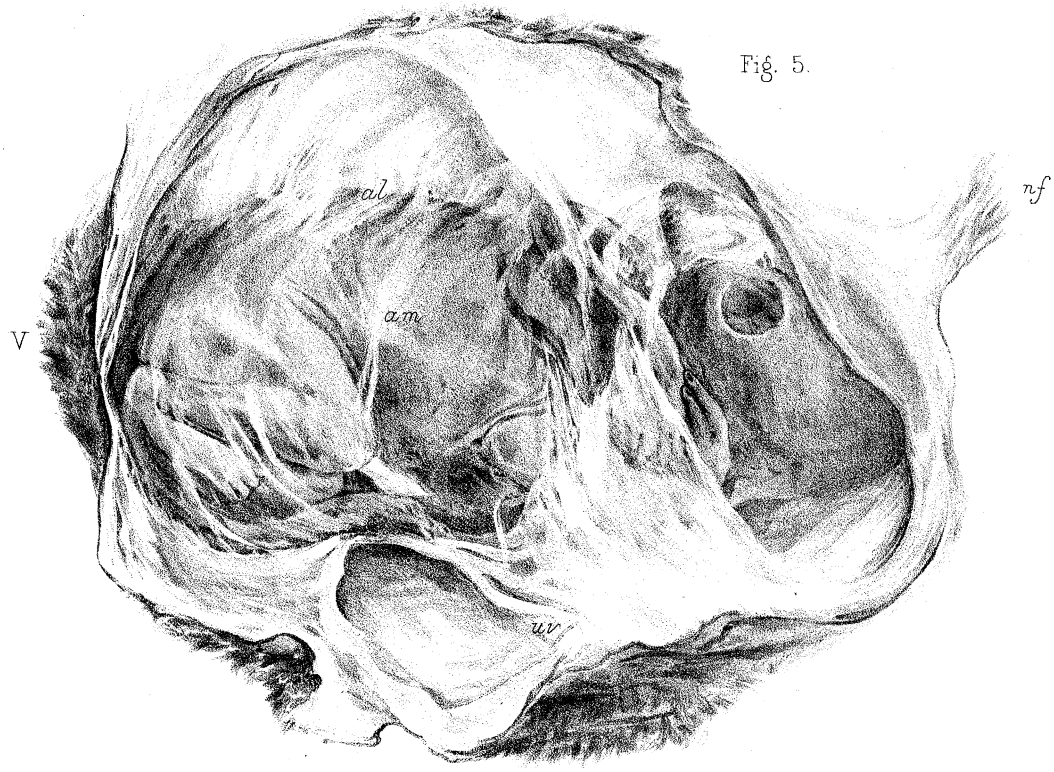

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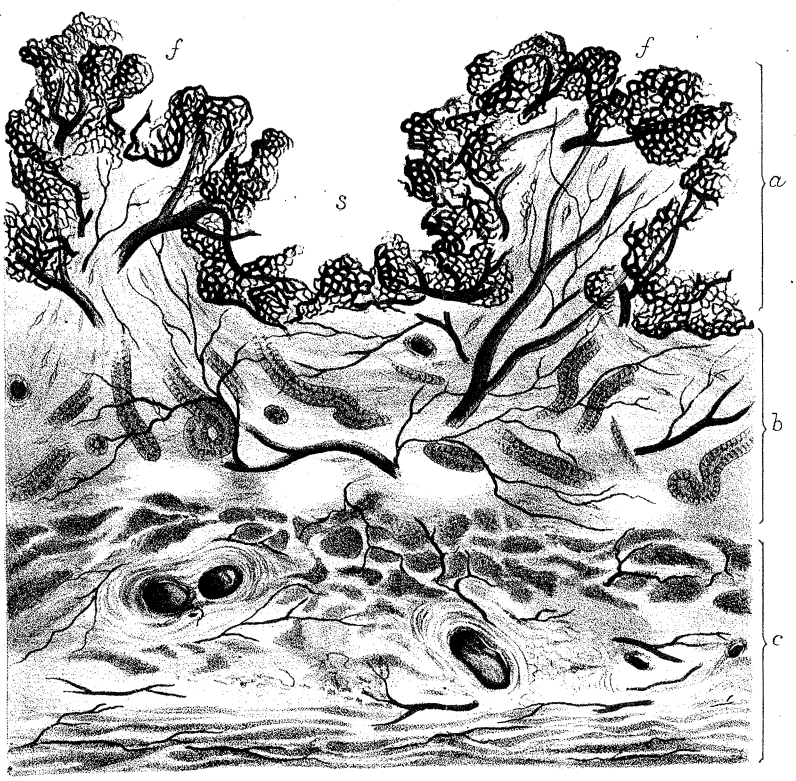

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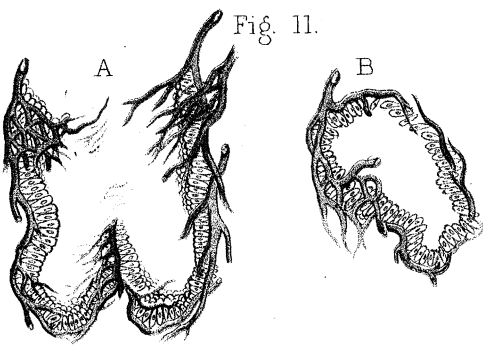

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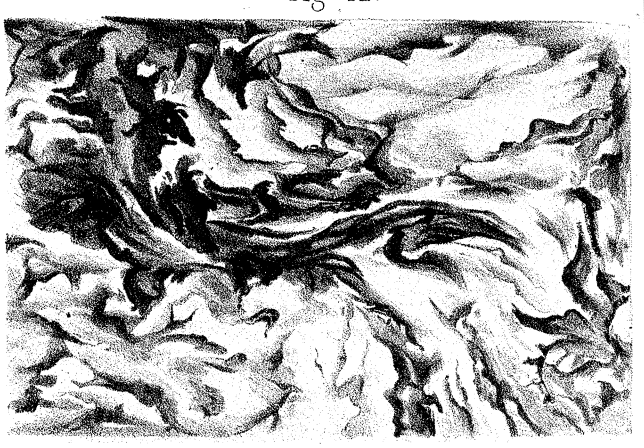
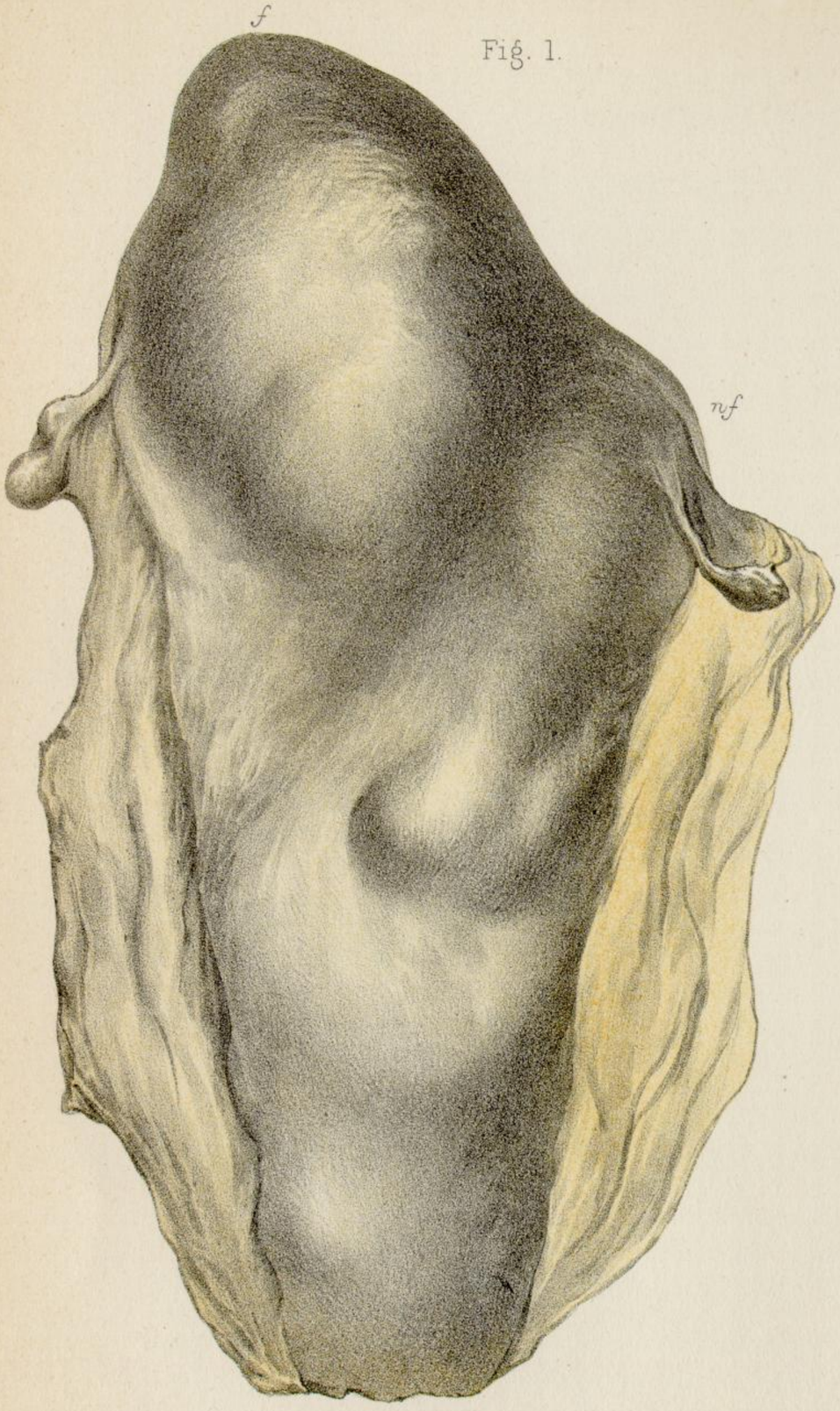


Fig. 1.



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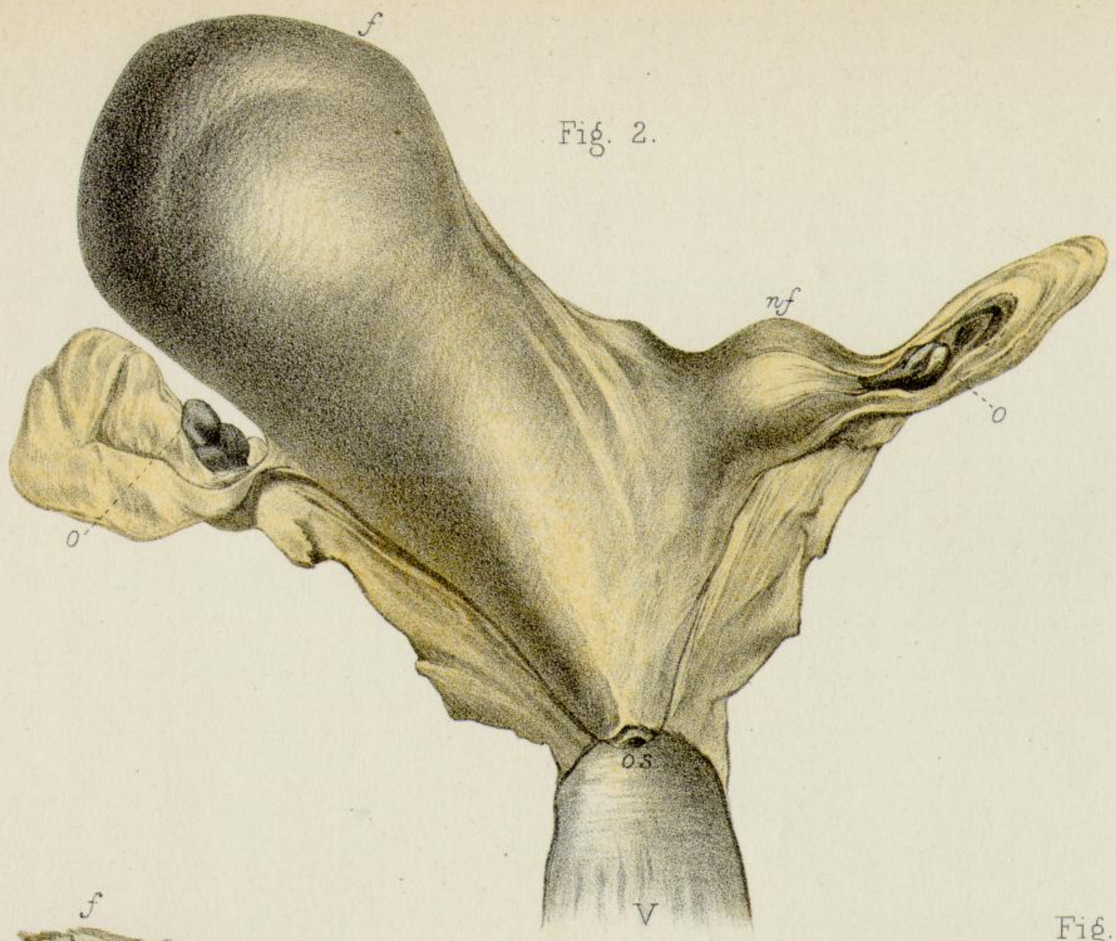

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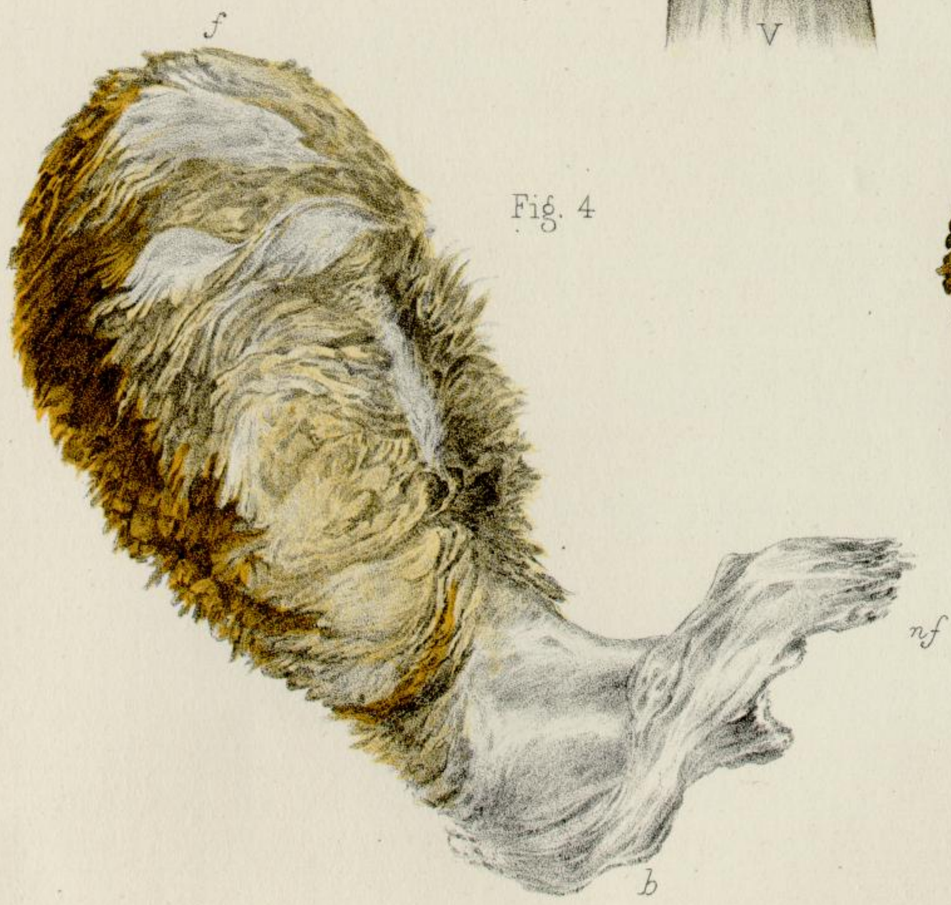

Fig. 1. Posterior surface of the gravid uterus of *Propithecus diadema*. Natural size.

Fig. 2. Posterior surface of the gravid uterus of *Lemur rufipes*. Specimen A. Natural size. *f*, fecundated, and *nf* non-fecundated cornu; *o o*, ovaries.

Fig. 3. Outer surface of chorion from the gravid uterus of *Lemur rufipes*. Specimen A. Natural size.

Fig. 4. Outer surface of chorion of *Lemur rufipes*. Specimen B. Natural size. *f*, the pole in the fecundated cornu of the uterus; *nf*, the pole in the non-fecundated cornu; *b*, the bare surface opposite the os uteri.

Fig 6.

Fig. 7.

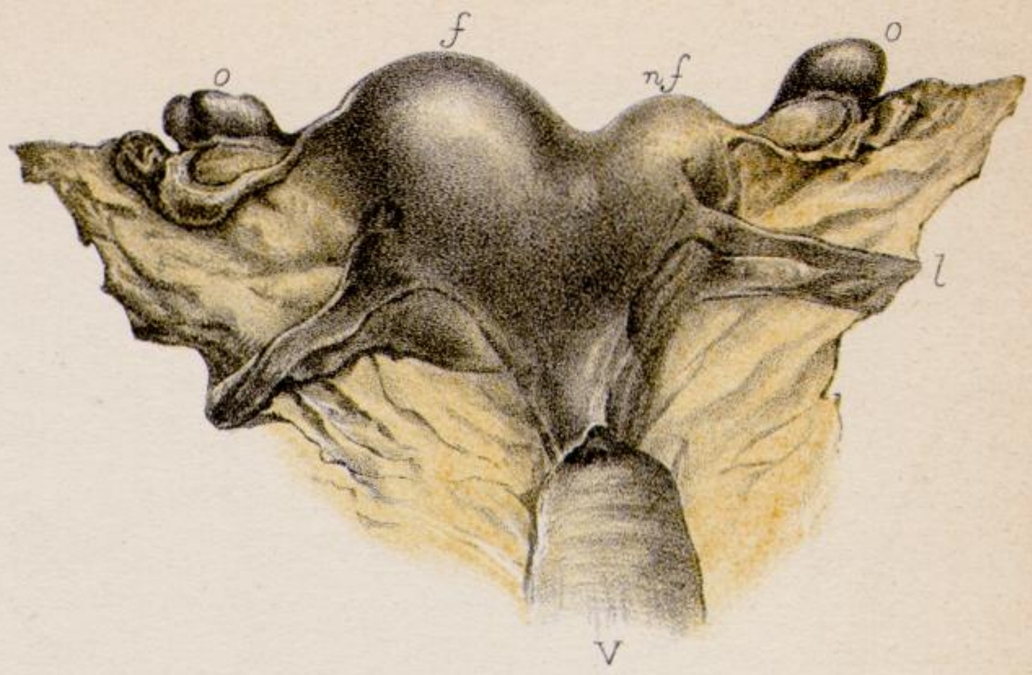

Fig. 8.

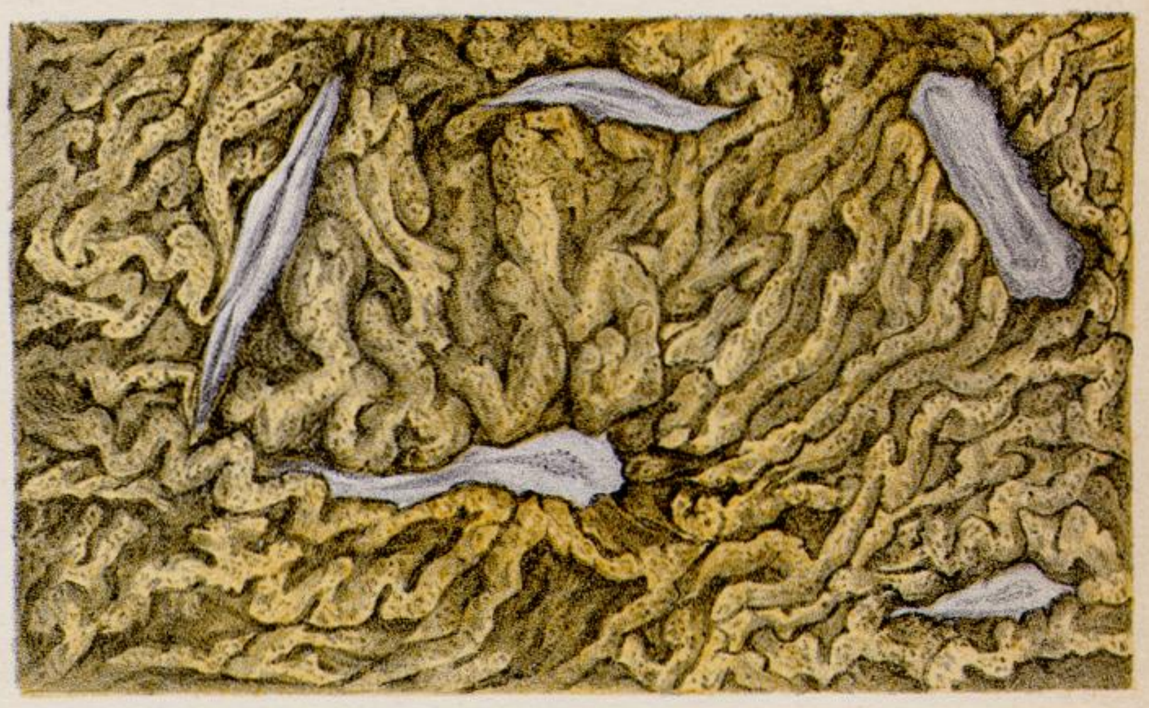

Fig. 5.

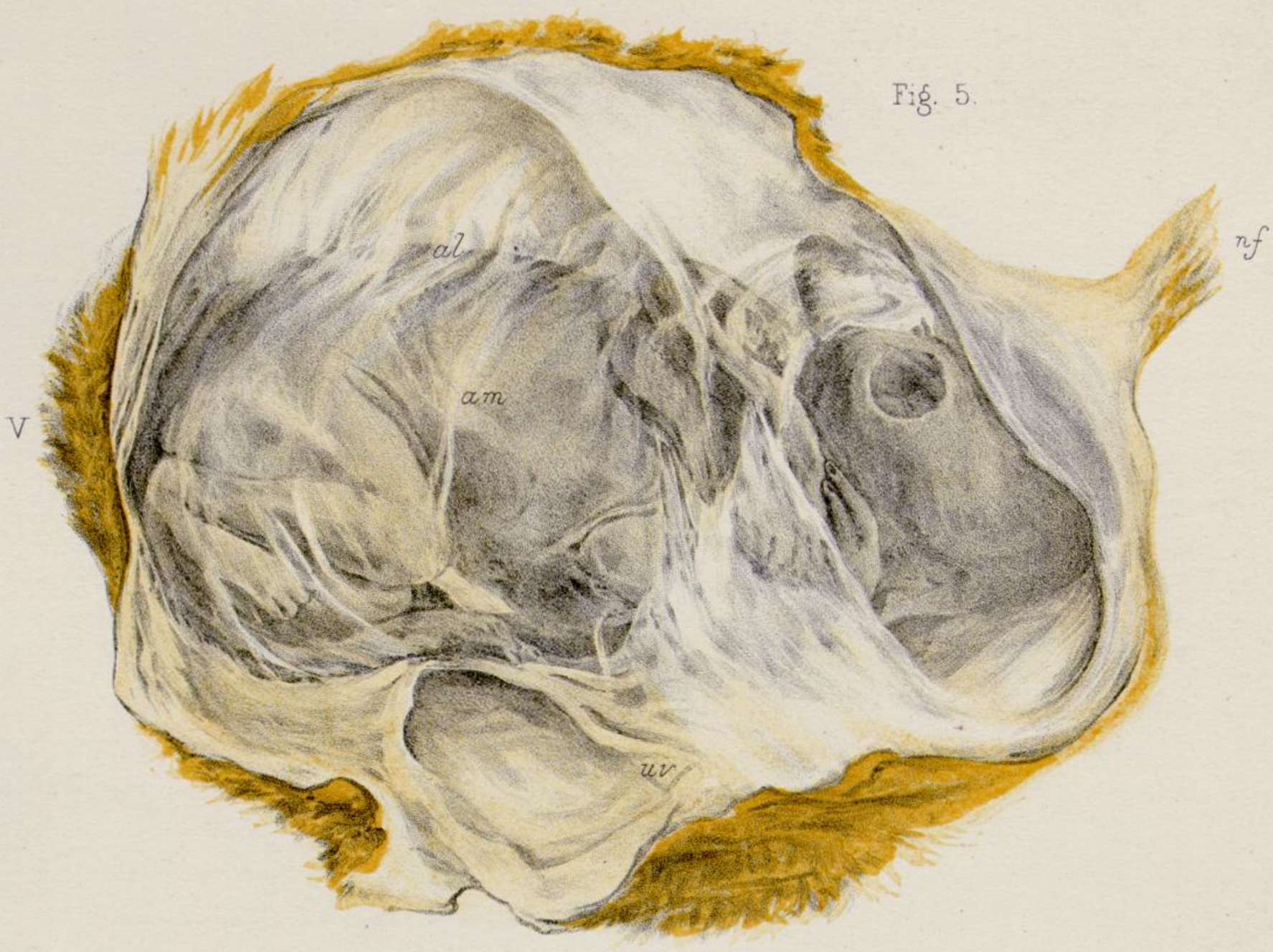

Fig. 5. Ovum of *Lemur rufipes*. Specimen C. Natural size. The chorion in the fecundated cornu has been cut through by a longitudinal incision, and the sac of the allantois opened into. V, the villous surface of the chorion at one pole; *am*, the amnion, containing the fœtus, seen through the layer of allantois which covers it; *al*, the line of reflection of the allantois from the outer surface of the amnion to the inner surface of the chorion; *uv*, vessels of the umbilical cord passing to the chorion; *nf*, the pole in the non-fecundated cornu.

Fig. 6. The inner surface of the gravid uterus of *Propithecus diadema* after the removal of the fœtus and its membranes. *f*, the fecundated cornu, the mucosa of which displays the sinuous folds and the depressed smooth areas described in the text; *nf*, the non-fecundated cornu; *os*, the fold of mucosa which marks the os uteri; V, the vagina. Natural size.

Fig. 7. Free surface of a small portion of the uterine mucosa of *Propithecus diadema*. × 2 diameters. The convoluted folds of the mucous membrane with their crypts are represented, and amidst these folds five smooth depressed areas, in which the mouths of the utricular glands open, may be seen.

Fig. 8. Anterior surface of the gravid uterus of *Indris brevicaudatus* in an early stage of pregnancy. Natural size. *f*, fecundated, *nf* non-fecundated cornu. *o o*, ovaries; *l*, round ligament; V, vagina.

Fig 9.

Fig. 10.

Fig. 11.

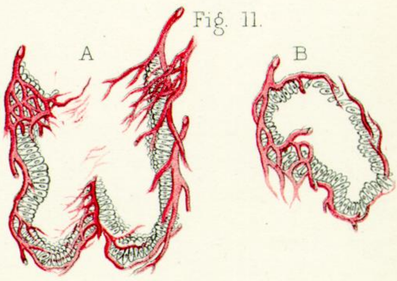

Fig. 12.

Fig. 9. Surface view of one of the smooth depressed areas on the uterine mucosa of *Lemur rufipes*. × 50 diameters. In the smooth area may be seen the open mouths of a number of glands which converge to the area from beneath the surrounding crypts. The great vascularity of the walls of the crypts is shown, but at the right side of the figure the injection has not penetrated into the capillary plexus. If this drawing be compared with the free surface of the uterine mucosa of the gravid Pig, as figured in my paper in the 'Journal of Anatomy and Physiology,' October 1875, a close correspondence will be seen in the arrangement and vascularity of the crypts; but whilst the smooth depressed spot in the Pig has only one gland opening in it, that in the Lemur has between twenty and thirty. The specimen satisfactorily shows the independence of the glands and the crypts; for although the glands are subjacent to the crypts, they do not open into them.

Fig. 10. Vertical section through two convoluted folds and an intermediate sulcus of the uterine mucous membrane of *Propithecus diadema*. *a*, the vascular crypt layer of the mucosa; *b*, the subjacent glandular layer; *c*, the muscular coat. If this drawing be compared with a similar vertical section through the uterine mucosa of *Orca gladiator*, which I have figured in the Transactions of the Royal Society of Edinburgh, vol. xxvi. plate xviii. fig. 12, a remarkable resemblance in the form and vascularity of the crypts will be seen; in *Orca*, however, the glandular layer is thicker than in *Propithecus*. *ff*, two folds vertically divided; *s*, intervening sulcus. Both the sulcus and the folds are thickly pitted with crypts. × 50 diameters.

Fig. 11. A more highly magnified view of portions of the walls of two crypts, to show the relation of the columnar epithelial lining of the crypts to the capillary plexus in the wall. A, a crypt vertically divided; B, a crypt cut across obliquely.

Fig. 12. A portion of the chorion of *Propithecus diadema*, magnified, to show the subdivision into villi of the ridges which traverse its free surface.