

CONTRIBUTIONS TO THE MORPHOLOGY AND DEVELOPMENT OF THE FEMALE UROGENITAL ORGANS IN THE MARSUPIALIA.

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(Plates xxvii.-xxix.)

II. ON THE FEMALE UROGENITAL ORGANS OF *MYRMECOBIUS FASCIATUS*.

(Pl. xxvii., fig. 1; Pl. xxviii., figs. 2-4).

The following account is based on a macroscopic and microscopic examination of the genital organs of a young (about half-grown) *Myrmecobius* measuring 11.5 cms. (snout to root of tail). For the opportunity of examining the genital organs of this interesting and somewhat rare form, I have to thank Mr. Geo. Masters, Curator of the Macleay Museum.

The only reference to the genital organs of *Myrmecobius* with which I am acquainted is contained in a paper* by W. Leche, which deals, however, mainly with the muscular anatomy, the description of the female genital organs being quite short and unaccompanied by figures. No apology is, therefore, needed for the present communication.

In Pl. xxvii., fig. 1 the genital organs are shown as seen from the dorsal aspect. The ovaries (*o.v.*) in this young specimen are smooth oval bodies measuring 3 mm. in length by 2 mm. in breadth, and situated ventrally to the anterior extremities of the uteri. The

* LECHE, W. "Beiträge zur Anatomie des *Myrmecobius fasciatus*." Verhandlungen des Biologischen Vereins in Stockholm, 1891.

Fallopian tubes (*f.t.*) are thin and convoluted, not sharply marked off from the uteri, and with fimbriated openings partially investing the ovaries. The uteri are of characteristic form and disposition. Each consists as in *Perameles* of two portions—body and neck, but these two portions are here more sharply differentiated from each other than they are in that form. The body of the uterus (*ut.b.*) is somewhat fusiform in shape, twice as broad as long, and with its long axis directed almost transversely to the long axis of the animal. They are connected by the anterior free portions of the two broad ligaments which are united in front in the median line as in *Perameles*. Anteriorly the uterine bodies contract to pass over into the Fallopian tubes, while posteriorly they similarly narrow to continue on as the uterine necks (*ut.n.*). These latter pass back parallel with each other, and almost at right angles to the uterine bodies, to become imbedded dorsally in the common connective tissue mass, which also encloses the neck of the bladder ventrally and the forwardly directed portions of the vaginal canals (fig. 2). The uterine necks increase slightly in transverse breadth posteriorly, and are so closely united as to appear externally as a single structure which terminates behind in a bulbous enlargement (fig. 1, *ut.n.*). The posterior portion of this enlargement is occupied by the two median vaginae which have the form of quite short and small, completely separated cul-de-sacs (fig. 3, *m.v.c.*), into which the uterine necks directly open, distinct ora not being recognisable.

The median vaginal apparatus of this young *Myrmecobius* is thus very closely similar to that of the virgin *Perameles*,† but whereas in *Perameles* the median vaginal cul-de-sacs terminate at a very considerable distance from the upper end of the urogenital sinus, those of *Myrmecobius* end at a relatively short distance from the same (3 mm. in the present specimen). Leche apparently failed to distinguish between the uterine necks and the median vaginae, for in the paper before referred to, he says (p. 154):—"Wie bei *Phascologale calura* reichen die geraden

† For Contribution I., see Proceedings, 1899, Part i., p. 42.

Thiele der beiden Vaginæ, in der Mittellinie eng vereinigt, bis hinab zum Sinus urogenitalis ohne denselben einzumünden." From the median vaginæ there pass off anteriorly and ventrally the vaginal canals. The morphologically anterior portions of these have essentially the same relations as the corresponding parts in *Perameles*—i.e., they run directly forwards parallel with each other, in the connective tissue just ventral to the uterine necks (fig. 2, *a.vag.c.*). About the middle of the extent of the latter, the two canals leave the connective tissue mass and bend outwards at right angles to their former longitudinal course to form free tubes which, as Leche notes, are of considerable length and characteristically coiled (fig. 1, *l.vag.c.*). After forming one or two turns on each side the vaginal canals again pass inwards towards the median line and just behind the median vaginæ come to lie parallel with each other and with the urethra. The three canals are imbedded in a longitudinal strand of connective tissue (fig. 3, *l.vag.c.*, *ureth.*), representing the urogenital strand of *Perameles*, and as in that form the part of the tissue between the vaginal canals lies in the direct continuation of the median vaginæ. After a short course (about 3 mm.) in the same, the two vaginal canals and the urethra all open by separate apertures at the same level into the urogenital sinus.

The urogenital sinus is, unlike that of *Perameles*, a long narrow canal, having in this small female an approximate length of about 15 mm.

As Leche has pointed out, a distinct cloaca is present, into which the rectum opens dorsally and the urogenital sinus ventrally. A pair of large "anal glands" are situated dorso-laterally in the circular cloacal musculature (fig. 1, *a.g.*), and open by fine ducts just within the margin of the cloacal opening. There are also present in the wall of the cloaca, as in *Perameles*, numbers of tubular glands which open partly into the ducts of the anal glands and partly directly into the cloaca.

The clitoris in my specimen is attached throughout its length, and, as Leche notes, is simple. Apically it is divided into two united halves by a septum.

From the foregoing account it will be seen that while the female genital organs of *Myrmecobius* agree in certain important respects with those of *Perameles*, as described in Contribution I., they also exhibit certain well marked differences. The two forms, *Myrmecobius* and *Perameles*, agree—(1) in the possession of a relatively small median vaginal apparatus, consisting in virginal animals of two quite separate cul-de-sacs, and completely imbedded in the tissue of the genital cord. (2) In the absence of any well marked separation between the uterine necks and the median vaginae, the former passing over directly into the latter without the intervention of distinct ora. (3) In the relations of the morphologically anterior, forwardly directed portions of the lateral vaginae which remain permanently imbedded, with the uterine necks and the median vaginae, in the tissue of the genital cord, and thus retain the position and course presented by the Müllerian ducts in the foetus. And (4) in the possession of a distinct cloaca. In these four respects the genital organs of *Myrmecobius* exhibit what I have regarded as primitive features.

As regards the points of difference in the organs of the two forms, two are worthy of remark—(1) the freedom in *Myrmecobius* of the middle portion of the lateral vaginae and their coiled character, and (2) the presence in the same of a long urogenital sinus.

In dealing with the genital organs of *Perameles*, I pointed out that the genital cord of the foetus is there retained practically unaltered as the urogenital strand of the adult, in the connective tissue constituting which the lateral vaginae remain permanently imbedded. In the adult *Myrmecobius*, on the other hand, only the anterior forwardly directed portions of the lateral vaginae and their posterior ends retain their primitive position in the tissue of the genital cord. Their middle portions have become free from that tissue and taken on a curved course. In this respect, therefore, and in the possession of a long urogenital sinus, the female genital organs of *Myrmecobius* exhibit less primitive relations than those of *Perameles*.

III. ON THE FEMALE GENITAL ORGANS OF *TARSIPES ROSTRATUS*.

(Pl. xxvii., fig. 5 ; Pl. xxviii., figs. 6-8).

The female genital organs of *Tarsipes* have not hitherto been described. I again owe the material for the present description to Mr. Masters, who kindly allowed me to remove the genital organs from two females collected by him near King George's Sound, W.A., many years ago. Considering the age of the specimens and the fact that they were simply put into spirit entire, the organs proved to be remarkably well preserved. Both sets were examined in serial sections.

One of the females had four young in the pouch, measuring g.l. 8 mm., and h.l. 4 mm.; the other slightly smaller specimen had a distinct pouch, with, however, very small teats. Both sets of organs presented essentially the same structural features. The drawings and measurements given refer mainly to the organs of the first-mentioned female.

The genital organs are shown from the ventral aspect in Pl. xxvii., fig. 5. The ovaries (*ov.*) are smooth ovalish bodies, measuring 1.25 mm. in length by .75 mm. in breadth, lying in contact with the dorso-mesial borders of the uteri. The Fallopian tubes are sharply marked off from the uteri; they are slightly convoluted and of no great length. The bodies of the uteri are somewhat ovalish, dorso-ventrally compressed structures, with their long axes directed transversely and measuring in the first female 4 mm. in length by 3 mm. in breadth, and in the second 3.5 mm. by 1.5 mm. Posteriorly the body of each uterus contracts to form the uterine neck which, as in *Myrmecobius*, passes back almost at right angles to the long axis of the body. Histologically the necks are distinguished as in *Myrmecobius* by the absence of uterine glands.

The two uterine necks continue back side by side, surrounded by a common muscular layer and quite free from any adjacent structure, to open into the median vagina. They form at their posterior ends a prominent papilla which projects for some

distance into the cavity of the vagina and at whose apex the two ora are situated.

The median vaginal apparatus in *Tarsipes* consists of a single short canal, without any trace of division into two. In front the median vagina (fig. 6, *m.v.c.*) possesses a fairly large lumen, but it rapidly narrows behind and passes back as a dorso-ventrally compressed canal, which directly opens at its hinder end into the anterior extremity of the urogenital sinus (fig. 8, *m.v.c.*). It lies in the hinder part of its extent in the connective tissue of the urogenital strand, between the two lateral vaginal canals above and the urethra below (figs. 7 and 8, *m.v.c.*). *Tarsipes* thus agrees, as I pointed out in Contribution I., with certain species of the family *Macropodidae* in the possession of a direct and, after the first parturition, permanently open median passage for the birth of the young. In the second set of organs at my disposal, the direct communication is also present, from which fact I conclude from analogy with Macropods that this female had also bred at some previous time. From the anterior end of the median vagina there arise the lateral vaginal canals. These have a quite short free course and are only very slightly curved outwards around the inpassing ureters. Immediately below the level of the latter, the vaginal canals approximate and eventually run back parallel with each other and side by side dorsally to the median vagina (figs. 7 and 8, *l.vag.c.*). The bladder unites with the ventral aspect of the median vagina shortly behind the anterior end of the latter, and after receiving the ureters rapidly contracts to form the urethra, which passes back in the common mass of connective tissue, ventrally to the median vagina (fig. 7, *ureth.*). The median vagina opens by a narrow, longitudinal slit-like opening into the anterior end of the urogenital sinus, while shortly behind this the two lateral vaginae open into each other and at the same time also communicate with the sinus. The latter is of considerable length, with a longitudinally ridged lining. At its posterior end, ventrally, is the clitoris, attached throughout its length and deeply grooved dorsally, but devoid of

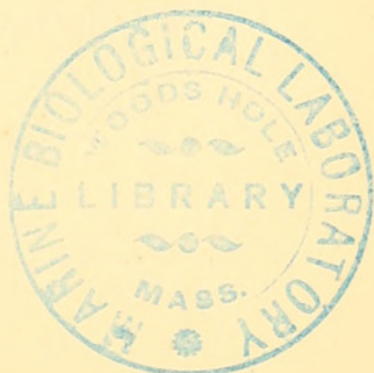
an internal septum. A distinct cloaca is present. The cloacal opening is of characteristic form, being long, narrow and spout-like (fig. 5). A cloacal sphincter muscle is not present. A pair of large anal glands open far back into the cloaca.

IV. NOTES ON THE FEMALE UROGENITAL ORGANS OF *ACROBATES PYGMÆUS* AND *PETAURUS BREVICEPS*.

The female organs of *Acrobates* have already been shortly described by Owen,* whose observations I in the main confirm, and extend. The following notes are derived from an examination of a series of serial sections through the organs of a pregnant female, with shrivelled blastodermic vesicles in the uteri and with three 2 cm. young in the pouch.

The two uteri pass back side by side and posteriorly gradually contract to form the uterine necks, which after a quite short free course enter the connective tissue between the forwardly projecting portions of the lateral vaginal canals, to open each by a medianly situated aperture on a slight papilla, into the corresponding median vagina. As Owen described, two median vaginae are present. They are separated by a common partition wall over by far the greater portion of their extent, but in my specimen, unlike Owen's, the septum disappears posteriorly, so that there is here a quite short common median vagina recalling the condition in the multiparous *Perameles*. This ends blindly in the connective tissue between the lateral vaginae about .6 mm. above the anterior end of the urogenital sinus. Although remains of a pseudo-vaginal passage are not certainly recognisable, I am inclined to believe that such will be found to occur at parturition. The lateral vaginal canals, as Owen describes, pass forwards alongside, and external to, the uterine necks and then bend outwards, "forming a curve like the handles of a vase." They then converge and pass back with the urethra and median vaginae in

* OWEN, R. "On the Generation of the Marsupial Animals, &c." Phil. Trans. 1834.



the common mass of connective tissue, to open by a single aperture into the urogenital sinus. The sinus has a length of about 5 mm. It opens with the rectum into a distinct cloaca. The clitoris, situated ventrally at the junction of sinus and cloaca, is attached throughout its length; it is deeply grooved dorsally and markedly bifid at its apex. Two pairs of anal glands are present. The cloacal opening is narrow, somewhat spout-like, and ventrally directed.

In *Petaurus breviceps* the uteri and lateral vaginae are related very much as in *Acrobates*. The median vaginal apparatus, however, consists of a single and quite short undivided canal, which ends blindly in the connective tissue, at a considerable distance from the anterior end of the urogenital sinus. According to Forbes* in *P. sciureus* "there are apparently two small cul-de-sacs; but the specimen examined does not allow me to say whether or no they unite."

V. ON THE EXISTENCE AT PARTURITION OF A PSEUDO-VAGINAL PASSAGE IN *TRICHOSURUS VULPECULA*.

(Pl. xxix, fig. 9).

In Contribution I.,† while discussing the general significance of the occurrence of a direct median passage for the birth of the young in Marsupials, the following remark occurs: "As regards other forms, there are some, e.g., *Trichosurus vulpecula*, in which the young are almost certainly born through the lateral vaginal canals, here comparatively short and simple in their course" (p. 74). Since the date of writing the above I discovered that in *Dasyurus viverrinus* a pseudo-vaginal passage essentially similar to that described for *Perameles* exists at parturition and serves for the outward passage of the young.‡ The wholly

* FORBES, W. A. "On some Points in the Anatomy of the Koala (*Phascogale cinereus*)."
P.Z.S. 1881, p. 190. Footnote.

† Proceedings, 1899, Part i.

‡ HILL, J. P. "On the Foetal Membranes, Placentation and Parturition of the Native Cat (*Dasyurus viverrinus*)."
Proc. Roy. Soc. 1900.

unexpected occurrence of the direct median passage in *Dasyurus* impressed on me the necessity of testing the above assumption by the examination of serial sections of the median vaginal apparatus in *Trichosurus*, with the result that a pseudo-vaginal passage was also found to occur in this form.

The female genital organs of *Trichosurus* were described and figured by Brass* in 1880, and in the following year W. A. Forbes,† in a paper on the Koala, very shortly, in a footnote, refers to the uteri and median vaginal apparatus without alluding to Brass's account.

According to the latter author, the uteri open "in die, von Vaginæ gebildeten, colossalen Blindsäcke. *Dieselben sind in der Mittellinie vollständig durch ein Septum von einander geschieden und bis hinab zum Sinus urogenitalis verlängert ohne jedoch in denselben einzumünden*" (p. 13. *Italics mine*). His fig. 1 of Taf. ii., representing the organs from the dorsal side, shows the median vaginal apparatus ending abruptly in contact with the approximated posterior portions of the lateral vaginal canals, while his fig. 2, representing a horizontal section, shows the same part terminating freely behind and unconnected in any way with the lateral canals. I would again point out that such representations of the relations of these parts are wholly inaccurate. The posterior section of the median vaginal apparatus of *Trichosurus* passes down to enter, and lies imbedded in, the connective tissue, which also encloses the posterior portions of the lateral vaginae and the urethra.

According to Forbes, "each os tincae projects as a prominent and quite free papilla into *the common vaginal chamber*, formed by the coalescence and fusion of the two diverticula present in *Phascolomys* and *Phascolarctos*. This chamber is capacious and has only a very slight indication of a median partition left" (p. 190. *Italics mine*).

* BRASS, A. "Beiträge zur Kenntniss des weiblichen Urogenitalsystems der Marsupialen." Inaug. Diss. Leipzig, 1880.

† *Loc. cit. (ante)*, p. 190. Footnote.

From these two quotations it will be seen that, according to Brass, the median vaginal apparatus consists of two completely separated halves; according to Forbes, of a single chamber with only slight traces of a median partition. My own observations show that both conditions occur. In the organs of undoubted virgin animals, the apparatus consists, as Brass describes, of two cul-de-sacs completely separated by a thin, often semi-transparent partition. The two cul-de-sacs terminate in the connective tissue ventral to the converging posterior portions of the lateral vaginae, between the latter and the neck of the bladder and some distance in front of the anterior end of the long urogenital sinus. In the organs of females which have given birth to young, on the other hand, I find that the median partition has over by far the greater portion of its extent disappeared, thus placing the two cul-de-sacs in wide and open communication. In such females, remnants of the septum are present, usually in the form of dorsal and ventral median folds of slight though varying width. Occasionally the two folds may meet in front and behind, and exceptionally I have found the two cul-de-sacs in communication through a large aperture in the posterior portion of the septum, here largely persistent.

The question now arises, at what period does the vaginal septum break down? What little definite evidence I possess points to the conclusion that the rupture and consequent disappearance of the greater portion of the septum is contemporaneous with the first act of parturition and probably is brought about by the passage of the young one into one or other of the cul-de-sacs. In the organs of a female which had quite recently had young (*a*, below), I find the two vaginal cul-de-sacs in open communication, but very considerable remnants of the septum are present in the form of wide dorsal and ventral folds. Not only so, their free margins present a torn and quite irregular appearance, forcibly suggesting that the septum had only recently been ruptured.

In view of the above and the fact that while in late pregnant females the septum may be found complete, such is never the case so far as I have observed in multipara, and further from

analogy with *Perameles* where I have shown that the common median vagina is actually formed as the result of parturition, we may reasonably conclude that in *Trichosurus* the same also holds good.

Pseudo-vaginal passage.—The genital organs (*a*, *b*, and *c*) of three females have been examined in serial sections, commencing at the level of the hinder portion of the median vagina and extending backwards. The first two sets of organs (*a* and *b*) were unaccompanied by young, but, as will be pointed out, had obviously been taken from females in which the young had recently been born. In the third set a young one was sent by my collector along with the organs.

In (*a*) both uteri were enlarged, the left having been the pregnant one. Its body measured 27 mm. in length by 16 mm. in breadth. In a female with a young one just ready to be born, the body of the pregnant right uterus measures 26 by 18 mm. As before mentioned, the vaginal septum presented the appearance of having been recently ruptured. From these facts, and from the condition of the pseudo-vaginal passage, I conclude that parturition had been completed only a few hours previously. In section the posterior portion of the median vagina is seen to lie in the connective tissue, between the lateral vaginae, now running parallel with each other and the neck of the bladder. Posteriorly as the sections are traced back, the lumen of the epithelially lined vagina is found to be directly continued back, after the disappearance of the lining as a large quite irregular cleft—the pseudo-vaginal passage—in the connective tissue ventral to the lateral vaginae. As in *Perameles* and *Dasyurus*, the passage is bounded solely by connective tissue, in which indeed it appears as a mere tear, presenting as it does every appearance of having been caused by mere mechanical rupture. In outline it is quite irregular owing to the presence of inwardly projecting shreds of connective tissue, while fragments of the same occur free in the lumen. The formation of the passage has been accompanied by a considerable extravasation of blood, large and small clots occurring in the tissue both in and around the

passage (Pl. xxix.). Such clots, however, are limited mainly to the more anteriorly situated portion of the passage. In the connective tissue leucocytes are also present in considerable numbers. Posteriorly the passage becomes much reduced in size, appearing in section as a transversely extended narrow cleft. Through an unfortunate accident I was unable to see the hinder opening of the passage in this set of organs.

In (b) the body of the left uterus measured 23 by 15 mm. I consider the female from which this set of organs was taken had given birth to the young one within the previous twenty-four hours. Both in this set of organs and in the next (c) the vaginal septum is represented by low dorsal and ventral folds with uniform free margins.

The sectional appearances presented are essentially the same as in the preceding set of organs. The pseudo-vaginal passage continues back from the median vagina as a quite irregular space in the connective tissue. It lies at first ventrally to the two lateral vaginae, but posteriorly it is situated between the ventral halves of the same. In front the passage has the same irregular outline as in (a). The connective tissue projects in the same irregular fashion into its lumen, and presents the same torn and ragged appearance. Extravasated blood is present in the connective tissue around the anterior portion of the passage, but in much less quantity than in (a). In the hinder part of its extent the passage has, as in (a), the form of a narrow cleft, which finally opens into one of the lateral canals immediately in front of the anterior end of the urogenital sinus. As in *Dasyurus* the aperture of communication is a long slit-like break in the epithelium lining the canal.

The third set of organs (c) was taken from a female with an 18.5 mm. young one in the pouch. The body of the left uterus measured 18 by 12 mm. A recently born young one in my collection measures in greatest length 15 mm. According to Broom* "the average size is a little over 14 mm" (p. 720). The 18.5 mm. young one is probably not more than ten days old.

* BROOM, R. "A Contribution to the Development of the Common Phalanger." Proc. Linn. Soc. N.S. Wales, 1898, Part 4.

In the sections practically the only trace of the pseudo-vaginal passage now present is a slight condensation in the connective tissue in the direct line of continuation of the median vagina, and distinguishable by its more deeply staining qualities. From the condition in this set of organs it would be quite impossible to foretell the existence of a pseudo-vaginal passage in *Trichosurus*. In this connection it may be noted that in *Dasyurus*, as I have elsewhere described, on the third day after parturition, the pseudo-vaginal passage has completely healed up, and practically all trace of it has disappeared. In these two forms then, as in *Perameles*, the pseudo-vaginal passage must be reformed anew at each succeeding act of parturition.

Trichosurus is the first Diprotodont genus in which a pseudo-vaginal passage has certainly been found to exist, and its occurrence in a member of this suborder supports, it seems to me, the view put forward in Contribution I, of the origin of the direct post-partum communication between the median vagina and the urogenital sinus as it exists in the majority of the *Macropodidæ*, and it further renders the suggested occurrence of a pseudo-vaginal passage in *M. major* all the more probable.

ERRATUM.

In Contribution I (Proceedings, 1899, Part i.), on page 49, third line from bottom, and on page 51, third line from top—*for fundus read neck*.

EXPLANATION OF PLATES.

Reference letters.

a.g. Anal gland. *a.vag.c.* Anterior forwardly directed portion of lateral vaginal canal. *bl.* Bladder. *cl.o.* Cloacal opening. *fim.* Fimbriated opening of Fallopian tube. *f.t.* Fallopian tube. *l.vag.c.* Lateral vaginal canal. *m.v.c.* Median vaginal canal. *ov.* Ovary. *rect.* Rectum. *ur.* Ureter. *ureth.* Urethra. *ut.* Body of uterus. *ut.n.* Uterine neck.

(Plate xxvii.)

Fig. 1.—Urogenital organs of *Myrmecobius fasciatus*, from the dorsal aspect ($\times 4$).

Fig. 5.—Urogenital organs of *Tarsipes rostratus*, from the ventral aspect ($\times 2$).

(Plate xxviii.)

Figs. 2, 3 and 4.—Trans. sections through the genital organs of *Myrmecobius fasciatus*. See text. ($\times 18\frac{2}{3}$).

Figs. 6, 7 and 8.—Trans. sections through the preceding genital organs of *Tarsipes rostratus*. See text. ($\times 24$).

(Plate xxix.)

Fig. 9.—Reproduction from photo-micrograph of trans. section, urogenital organs, *T. vulpecula*, showing the pseudo-vaginal passage. The dark mass to one side of the passage is formed by extravasated blood (\times about 55).



Hill, James Peter. 1900. "Contribution to the morphology and development of the female urogenital organs in the Marsupialia." *Proceedings of the Linnean Society of New South Wales* 25, 519–532. <https://doi.org/10.5962/bhl.part.12170>

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