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A Further Note on the Female Urogenital System of *Hypsiprymnodon moschatus* (Marsupialia)*

By

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WITH 4 TEXT FIGURES

Three years ago a note was published in this Journal (Pearson, 1946) on the condition of the female urogenital system of *Hypsiprymnodon moschatus* Ramsay, 1875. The material then examined was in the possession of the Anatomy Department, University of Sydney, and had already been dissected and had formed the subject of an unpublished thesis by Dr. F. R. Heighway (Mrs. Abbie).

Dr. Heighway's dissection showed that the vaginal cul-de-sac ended some distance anterior to the junction of the two lateral vaginae, a primitive condition hitherto not known in the rat-kangaroos.

But it was clear that this important departure from the normal condition, based as it was upon the dissection of a single specimen, needed confirmation when other material became available, and that such a re-examination would have its greatest value if based upon the study of serial sections.

It was a fortunate circumstance, therefore, that during a recent visit to the U.S.A. I was able to examine one female specimen of *Hypsiprymnodon* in the collection of the American Museum of Natural History, New York, and still more fortunate that permission was obtained to remove the urogenital organs of this specimen for the purpose of making a complete series of transverse sections. These serial sections were made in the Tasmanian Museum, Hobart, and future investigators will be able to examine these sections in the American Museum of Natural History where they will be deposited after the present examination has been completed. An opportunity has thus been afforded of making an accurate reconstruction of the entire urogenital system of *Hypsiprymnodon* and I am indebted to Dr. Anthony, Chief of the Department of Mammals in the American Museum of Natural History, for the permission which was so readily given and to Dr. Tate of the Department of Mammals for his helpful co-operation.

In passing, it may be noted that it required a period of over sixty years to elapse after the publication of Ramsay's diagnosis of this important new genus and species (Ramsay, 1875) before the first scientific examination of the female urogenital system was made by Dr. Heighway. This in itself is a fitting commentary on the inadequate field methods which were in practice until recent times and the lesson needs to be taken to heart by many museum collectors who are still content to preserve only the skins and skeletons of even the rarest mammals.

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The specimen which forms the subject of the present note bore the A.M.N.H. number 1812 and had the following dimensions:—

Head and body, 235 mm.
Tail, 130 mm.
Pes, 57 mm.
Ear (from crown), 27 mm.
Ear (from notch), 29 mm.

The presence of two large functional nipples in the pouch justifies the assumption that the specimen was a parous female, but the measurements indicate that it had not attained full size. Though well preserved, it had not been specially fixed for histological examination. It was decided, therefore, to cut relatively thick sections (20μ), as the main purpose of the inquiry was to trace the vaginal system throughout its entire course and, in particular, to observe whether the cul-de-sac was abbreviated as in the Sydney specimen.

The disposition of the vaginal system is clearly indicated in fig. 1 (dorsal view) and fig. 2 (lateral view). A general description of the urogenital system has already been given in an earlier paper (Pearson, 1946), but it is necessary to re-examine certain features of the vaginal cul-de-sac and the lateral vaginae.

It should be said, however, that the two specimens so far examined differ materially from each other in the appearance and shape of the anterior vaginal expansion and cul-de-sac. This is made clear by comparing figs 1 and 2 in the present paper with the illustrations of the vaginal system of the Sydney specimen given in my earlier paper (Pearson, 1946, p. 17, figs 4 and 5). In the New York specimen the anterior vaginal expansion is triangular in its dorsal aspect with its apex pointing anteriorly, whereas in the Sydney specimen this expansion is in the form of a somewhat rectangular chamber about twice as broad as deep. The New York specimen has obviously been subjected to considerable dorso-ventral pressure so that the chamber has been flattened to such an extent that its width is exaggerated and its cavity almost occluded. I have thought it advisable to represent this condition in the reconstructed drawings. Fig. 3 B has been modified to show the anterior vaginal expansion as an expanded structure in one plane, though it is really folded to a considerable extent by the pressure of the surrounding organs so that in transverse section the chamber is V-shaped, the apex of the V being ventral.

The cul-de-sac in the New York specimen also suffers from this dorso-ventral flattening and its short and wide appearance seen in fig. 1 differs greatly from the long, narrow structure described in the Sydney specimen.

In my opinion, the condition of the Sydney specimen probably gives a more faithful picture of the normal arrangement of the vaginal complex in *Hypsiprymnodon*. Nevertheless, it is important to give a description of the urogenital organs of the second female specimen of this rare genus, flattened and distorted though the organs may be through post-mortem pressure.

Cul-de-sac (*m.v.c.*)

The main purpose of the present inquiry was to ascertain whether the cul-de-sac is abbreviated, as Dr. Heighway's dissection showed. An examination of the serial sections establishes without a shadow of doubt that the cul-de-sac terminates a distance of 12 mm. in front of the junction of the two lateral vaginae

and thus bears out Dr. Heighway's findings. As stated above, the cul-de-sac of the New York specimen is expanded laterally and flattened dorso-ventrally, while in the Sydney specimen it is more or less cylindrical in transverse section. The confirmation of the primitive nature of the cul-de-sac in mature females of *Hypsiprymnodon moschatus* gives further support to the view that this species is the least specialized of the rat-kangaroos. In our view, it is the most impressive testimony on this question which has yet been produced and adds considerable strength to the evidence of teeth, simple stomach, and of the persistence of the hallux and digital pads in the pes.

The cul-de-sac can be conveniently divided into two parts; the anterior, which forms the median portion of the anterior vaginal expansion 9 mm. in length, and the posterior portion which is a median posterior prolongation of the vaginal complex 6 mm. long and 4 mm. broad.

As is the case in all marsupials, the right and left vaginae remain separate for a considerable period, but in all rat-kangaroos, including *Hypsiprymnodon*, the septum separating the two culs-de-sac breaks down before maturity is reached, though slight vestiges of the septum can still be seen in mature specimens, both dorsally and ventrally, throughout the entire length of the cul-de-sac (fig. 4).

In this way a capacious chamber, the anterior vaginal expansion *(a.v.e.)*, is produced lying anterior to the lateral vaginae. This chamber is a characteristic feature of the vaginal system of the rat-kangaroos and is composed of the anterior portion of the cul-de-sac (median) and the swollen derivatives of the anterior vaginal canals, situated laterally (see Pearson, 1950, figs 9-12). In the New York specimen the anterior vaginal expansion measures 9 mm. in length and 9 mm. in maximum width.

Lateral Vaginae *(l.v.)*

It should be noted that, whereas the cul-de-sac and anterior vaginal expansion have thin walls, the lateral vaginae and their posterior extension, the posterior vaginal sinus, have relatively thick muscular walls. The actual channel of each lateral vagina is extremely narrow with an average diameter of 400-600μ. The most significant feature in the New York specimen is the almost complete occlusion of the lateral vaginae for a distance of about 3 mm. half way along the course of each duct. In the course of the present work it has been found that all marsupials so far examined pass through an early stage in which the posterior region of each Müllerian duct is separated from the urogenital sinus by a solid rod of cells. Baxter (1935) noted this condition in the early development of the female tract of *Didelphis* and designated this rod of cells the 'sinus cord', a product of the epithelium of the sinus horn. This has been confirmed by the present writer and will be discussed in a subsequent paper. But the occlusion which is mentioned above would appear to be of an entirely different nature and has been discussed by Hill and Fraser (1925) and others. It may be said, too, that we have found occlusion of the lateral vaginae in at least one parous female specimen of *Dasyurus* as well as in the present case which, as already stated, is probably a parous female. In addition, several large but immature specimens of *Dasyurus*, *Bettongia*, and *Protemnodon* show a well-defined occlusion in each lateral vagina. These temporary occlusions may be a phase in the oestrous cycle when the vaginal epithelium is affected by the sex hormones. This is a matter on which evidence is now being collected.

Summary

A re-examination of the female urogenital system of the rare genus *Hypsiprymnodon* was made for the purpose of testing the condition of the cul-de-sac by means of serial sections. This has confirmed Dr. Heighway's claim that the cul-de-sac was abbreviated, and has strengthened the view that this genus is the most primitive of the rat-kangaroos. At the same time, it has demonstrated the close relationship of *Hypsiprymnodon* to other members of the Potoroidae by reason of its highly specialized female urogenital system.

Explanation of Figures

a.v.e.—anterior vaginal expansion
bl.—bladder
cl.—clitoris
l.v.—lateral vagina
m.v.c.—median vaginal cul-de-sac
oc.l.v.—occluded part of lateral vagina
os.u.—os uteri
p.v.s.—posterior vaginal sinus
r.ur.—right ureter
r.ut.—right uterus
u.g.s.—urogenital sinus
u.o.—opening of urethra into urogenital sinus
ureth.—urethra
ut.n.—uterine neck

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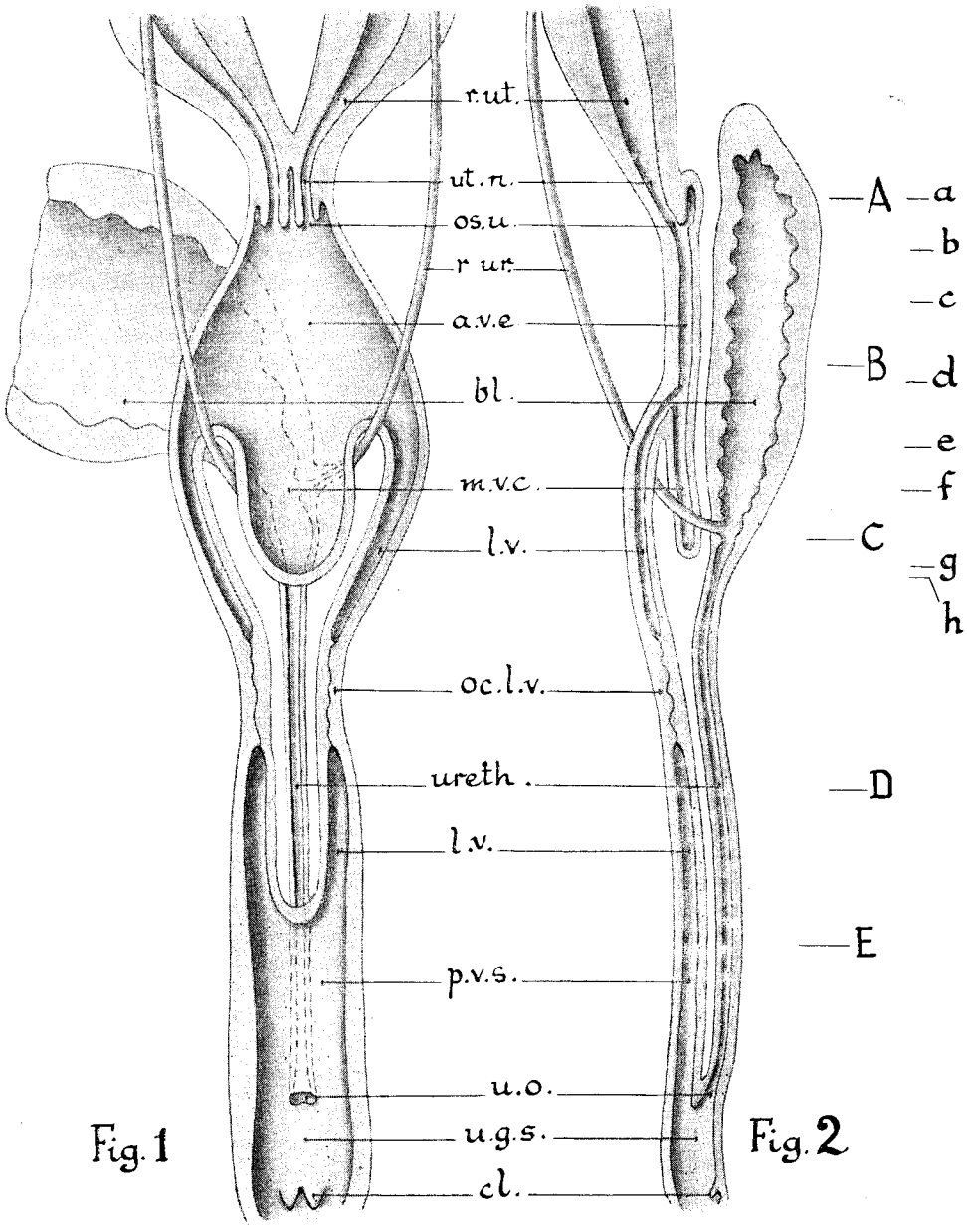

FIG. 1.—Reconstruction of the female urogenital system of *Hypsiprymnodon moschatus* (view from the dorsal surface showing a horizontal section of the various parts). x 4.

FIG. 2.—The same in sagittal section. x 4.

NOTE.—Fig. 3 shows five sections cut at the levels A, B, C, D, and E indicated above. Fig. 4 shows eight sections cut at the levels *a*, *b*, *c*, *d*, *e*, *f*, *g*, and *h* indicated above.

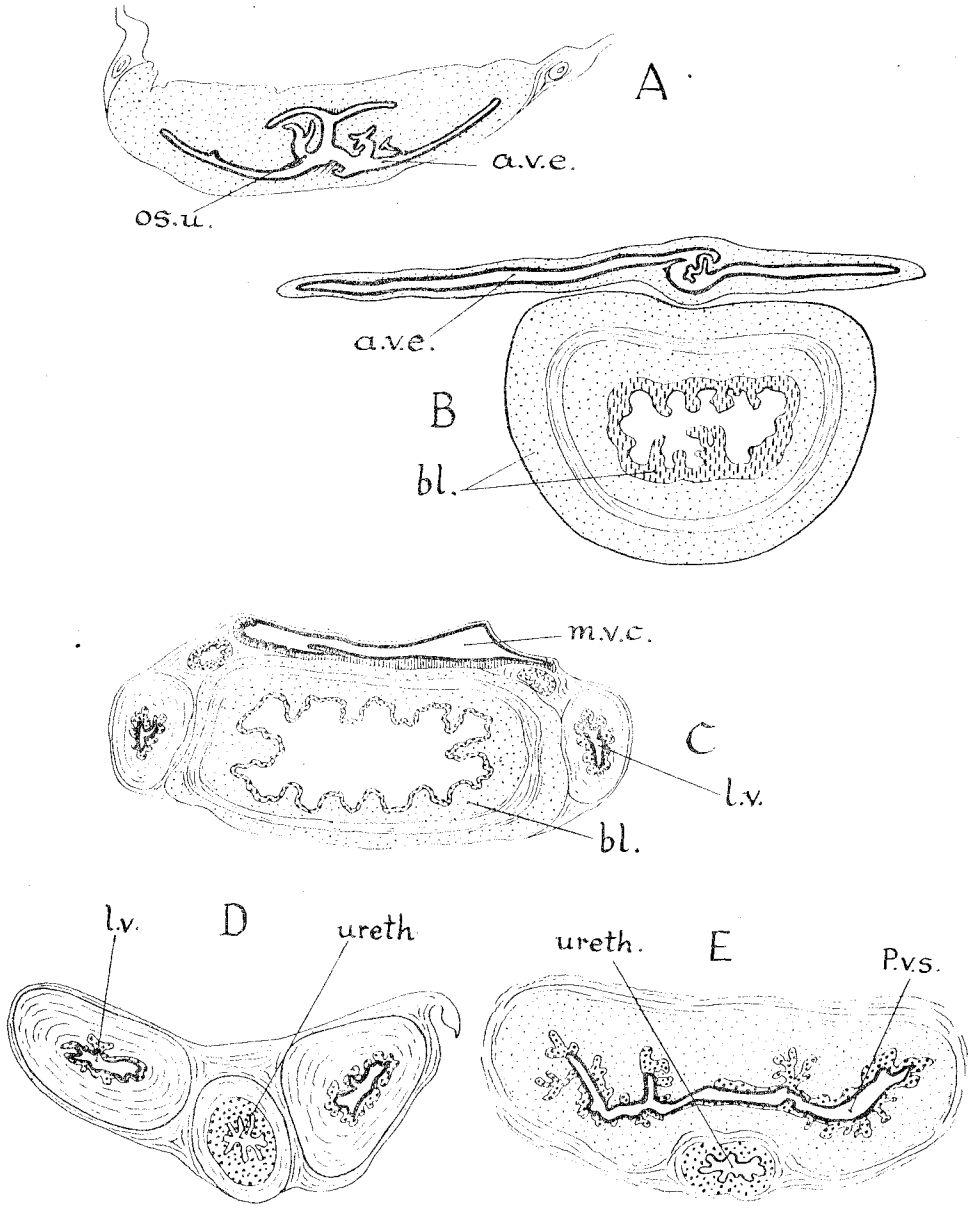

FIG. 3.—Diagrammatic drawings of transverse sections at the levels of A, B, C, D, and E respectively in figs 1 and 2.

Fig. A—t.s. through the region of the os uteri. x 15.
Fig. B—t.s. through anterior vaginal expansion. x 8.
Fig. C—t.s. at level of the cul-de-sac. x 10.
Fig. D—t.s. showing lateral vaginae and urethra. x 15.
Fig. E—t.s. through posterior vaginal sinus and urethra. x 15.

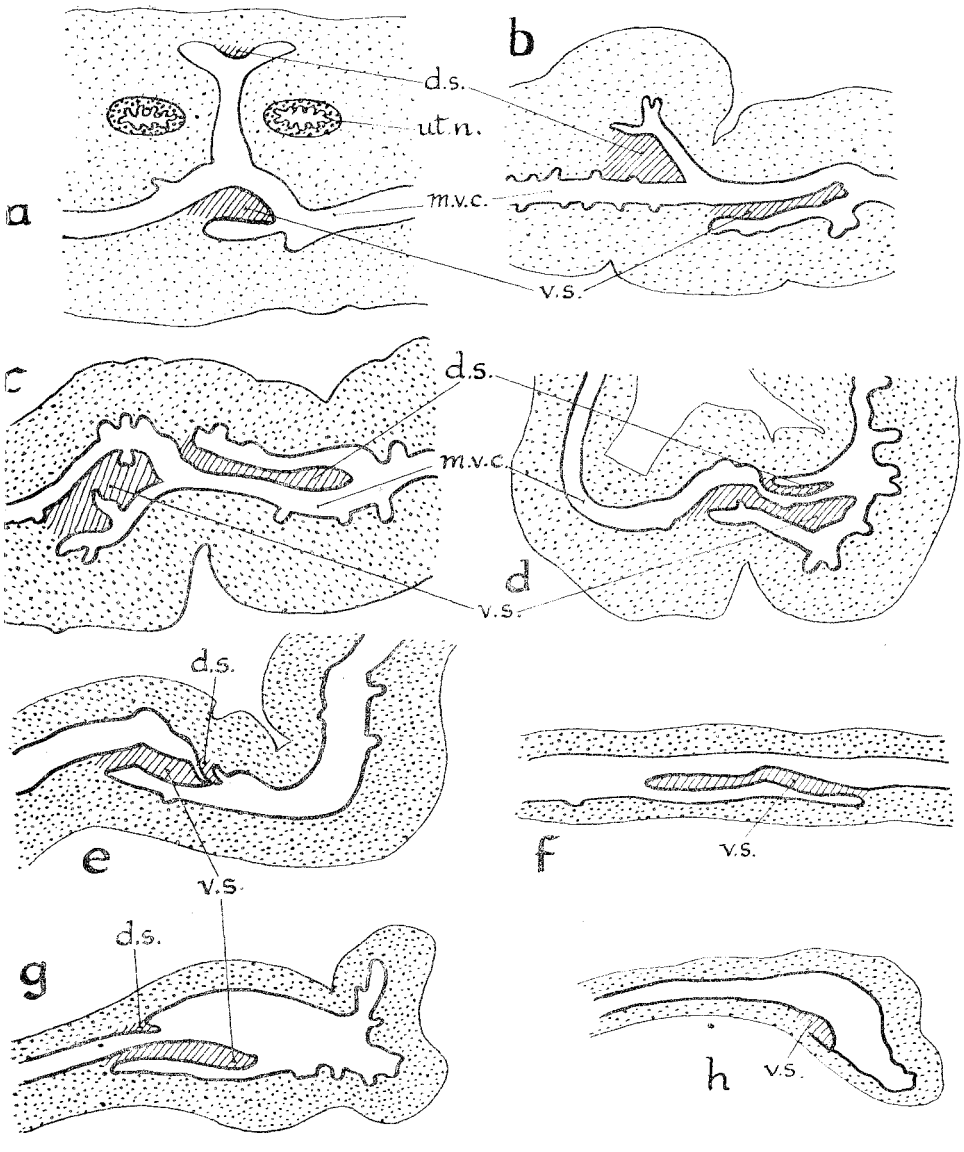

FIG. 4.—Diagrammatic drawings of transverse sections at the levels *a*, *b*, *c*, *d*, *e*, *f*, *g*, and *h* respectively in figs 1 and 2. These figures show the dorsal and ventral remnants of the septum which originally separated the right and left culs-de-sac. x 25.

NOTE.—The levels of *g* and *h* in figs 1 and 2 should be shown ½-inch more anterior than shown at present.