On the Arrangement of the Embryonic Membranes in Marsupial Animals.

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With Plate XLIII..

The facts to be mentioned in the following short notice have hitherto been not only imperfectly but erroneously described.

Since my arrival in Australia I have obtained considerable numbers of early embryos of various marsupial animals.

Of Phascolarctos cinereus ("Native Bear") I have a very complete series of nearly 100 embryos in all stages from the unsegmented ovum onwards, while of the various kangaroo and wallaby types I have embryos in most of the stages. I shall not deal with the history of the germinal layers or of the general development in the present paper. The descriptions which follow holds especially for Phascolarctos cinereus and Halmaturus ruficollis.

These species represent two of the main divisions of the Marsupials, viz. (i) the short-faced opossum-like, and (ii) the long-faced kangaroo-like forms. I think it fair to regard the condition found in these as the typical marsupial one.

Both Phascolarctos and Halmaturos breed twice in each year, producing a single young one on each occasion. Exceptions to this are by no means uncommon, and in one "native bear" I found three blastodermic vesicles in one uterus.

Ovum.—The ovum arrives in the uterus from the Fallopian tube at a very early stage. In one instance I found an unsegmented ovum in the uterus.

Uterus.—Both uteri are very much enlarged in the early stages, and up to the time when the blastodermic vesicle measures about 8 mm. in diameter, the unoccupied is equal in size to the occupied uterus. The size of the uterus during gestation is due to the enormous development of its inner lining. The muscular coat also becomes slightly thicker. This inner lining is composed of a number of coiled tubular glands. Each gland is a hollow tube with large secreting cells forming the wall. Each gland opens separately by a small pore into the cavity of the uterus. I believe that the function of these glands is to supply a nutritive fluid for the growth of the young embryo. There is no vascular connection developed in any stages of the development between the embryo and the uterine wall.

The blastodermic vesicle lies quite unattached in the uterus. The zona radiata persists until the vesicle attains a diameter of 15 mm.

Subzonal membrane.—Meanwhile the amnion forms in the ordinary way. The false amnion continuous with the ectoderm covering the blastodermic vesicle I shall speak of as subzonal membrane.

While the embryo is being folded off from the yolk-sac another process is going on at the same time.

Yolk-sac.—The yolk-sac grows round the embryo in the sam emanner that the amniotic folds did in an earlier stage. This may be also described by saying that the embryo sinks into an indentation in the side of the yolk-sac, which finally forms an almost complete investment similiar to the amnion and closely overlying that membrane. The walls of these yolk-sac folds, however, do not meet. They leave a circular area where the amnion is only separated by fluid from the subzonal membrane.

Allantois.—Into this circular area the allantois grows, and in the last period of intra-uterine life completely fills up the

space. In this way the embryo comes to hang in the interior of a vesicle whose outer wall is the subzonal membrane. The vesicle is oval and attains a size of 35 mm. in its longest, and 25 mm. in its shortest diameter. The yolk-sac occupies the greater part of the inner surface of the subzonal membrane.

Vascular area of yolk-sac.—The allantois in its greatest development occupies an area of about 12 mm. diameter, and in the later stages becomes vascular, but never develops villi. Professor Owen long ago describes the main features of the vascular supply of both yolk-sac and allantois. The whole vascular area is covered by flat cells of the subzonal membrane There is no attachment to the uterus in this region.

Attachment of embryo to uterus.—The large oval vesicle, with the embryo suspended in its centre after attaining a diameter of 12·5 mm., begins to attach itself to the wall of the uterus. This attachment is caused by the growth of the cells of the subzonal membrane immediately outside the sinus terminalis; the cells of the subzonal membrane begin to enlarge and become amœboid. They throw out pseudopodia-like process, which fit in between the cells of the uterine epithelium and serve to attach the blastodermic vesicle to the uterus. This attachment is entirely non-vascular, and is the sole means by which the vesicle is attached to the uterus.

Just before birth the vesicle is sharply marked out into two areas, one of which has a smooth glistening surface and corresponds to an area of flat epithelium covering the vascular area of the yolk-sac and the vascular allantois; the other has a white opaque appearance and corresponds to the area of large amœboid attaching-cells. In Phascolarctos cinereus the attached area is next the opening of the uterus into the vaginal passages. In the kangaroo-like forms the attached area occupies that part of the uterine wall next the opening of the Fallopian tubes into the uterus.

Last year I was too late to obtain the early stages of either Ornithorhynchus or Echidna, still I think it probable from the structure of the uterine wall and from the appearance of a

membrane which I found in the uterus of an Ornithorhynchus whose young had just been born, that the Monotremes possess a somewhat similar arrangement to the condition described above in Didelphia.

Before this is published I shall have obtained the early stages of Ornithorhynchus, but I have decided to send home this communication without waiting, because of the interest which attaches to the discovery of the exact relations of the embryo to the maternal parts in these Mammalia.

The facts above described, so far as I see at present, throw little light on the evolution of the placenta in Monodelphia. The arrangement in the Didelphia is a unique one. I shall defer the discussion of it until my future papers on the development of the embryo itself.

DESCRIPTION OF PLATE XLIII,

Illustrating Mr. H. Caldwell's Paper "On the Arrangement of the Embryonic Membranes in Marsupial Animals."

FIG. 1.—Advanced embryo of Phascolarctos cinereus, removed from the uterus by slight maceration to show the relation of the embryo to its membranes. Natural size. *s. z.* Subzonal membrane. *am.* Amnion. *al.* Allantois. *y. s.* Yolk-sac (umbilical vesicle). *s. t.* Sinus terminalis. The mesoblast forming the vascular area of the yolk-sac and allantois is indicated by the red line.

FIG. 2.—Section through a portion of the wall of an advanced vesicle of Halmaturus ruficollis in the region of the sinus terminalis, showing the transition from the flat cells of the subzonal membrane covering the vascular area to the amœboid attaching cells covering the non-vascular area of the yolk-sac. *a.* Subzonal membrane. *b.* Hypoblast of yolk-sac. *s. t.* Sinus terminalis. *c.* Blood-vessels. *p.* Blood-corpuscles. *amb.* Amœboid cells, with processes torn out of uterine epithelium. *fl.* Flat cells. Zeiss, oc. 2, Obj. D.