ZOOLOGY

THE EFFECT OF INSEMINATION ON THE UTERINE EPITHELIUM OF ELEPHANTULUS

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When studying the post-partum involution of the uterus of Elephantulus, during which process the reformation of the uterine epithelium is a salient feature, I remembered having noticed a similar behaviour of the epithelium after insemination. This, of course, motivated me to study again those series of sections of the ovary and uterus in which spermatozoa had been found. It then appeared that, although superficially similar, the reaction of the uterine epithelium after insemination is totally different from that during involution. As Elephantulus ovulates and copulates shortly after parturition, when the involution of the uterus is not yet completed and thus the one phenomenon may obscure the other, for the present study only uteri of animals coming out of anoestrus or of young animals that had just become sexually mature were selected, and of these there were 18 in the collection.

During the post-partum involution, the uterine epithelium, that even in late pregnancy forms a continuous lining of the lumen, is enormously reduced in area and as it had already a certain height during pregnancy, being then cuboidal or even cylindrical, there would be far too much epithelium for lining the small lumen finally reached, if no special measures were taken. A detailed account of this involution will be given elsewhere (to appear in Acta Zoologica). It may be sufficient to say here that the uterine epithelium during the contraction is thrown into numerous high folds. The bases of these folds fuse to form the new lining and all the rest is thrown off as a necrotic mass into the lumen and removed from there to the exterior.

At the approach of oestrus many mitotic divisions in the uterine epithelium can be observed (VAN DER HORST and GILLMAN, 1941). The result of this activity is that at the time of oestrus and before copulation has taken place, the epithelium is very high and crowded with nuclei that are arranged at different levels (fig. 2*a*). Immediately after insemination this epithelium forms numerous outgrowths of an irregular form (fig. 1). They break up into individual cells and these loose cells, now spherical in form,

float into the uterine lumen where they become entangled in a network of fibres. Also a number of spermatozoa can be discerned between these fibres which apparently are the result of a coagulation of the spermatic fluid. Here and there the peripheral part of the epithelium is desquamated

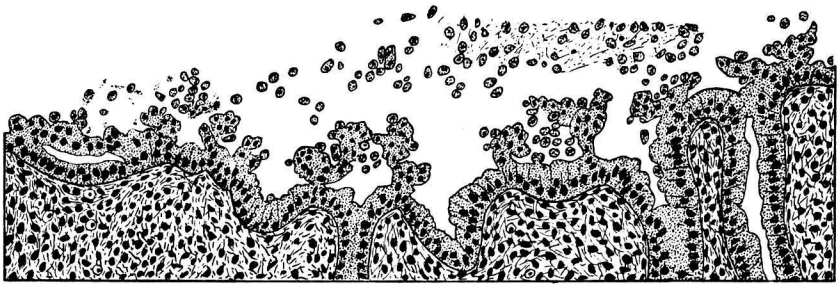
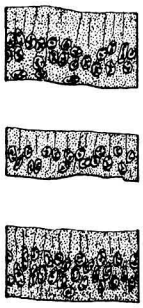


Fig. 1. The uterine epithelium of Elephantulus shortly after insemination. × 150.

as a whole, also this will break up into individual cells. This process is not localised, but occurs over the whole length of the uterine horn and is obviously a result of irritation exerted by the spermatic fluid on the epithelium.

The uterine epithelium in this way loses a considerable number of its constituent cells and the result is striking. During early pregnancy, and before the uterus begins to swell, the epithelium instead of being high columnar as before, has become much thinner, being formed of low columnar cells with the nuclei arranged neatly in a single layer (fig. 2*b*).



a. The uterine epithelium just before copulation,

b. the epithelium after fertilisation,

c. the epithelium after a sterile ovulation. × 250.

Fig. 2.

This result is very obvious when one compares this epithelium with that after a sterile ovulation. In the latter case the epithelium remains very high (fig. 2*c*).

The whole process is of short duration. Already when all the eggs are assembled in the tubal egg chamber, where they are fertilised, the epithelium has nearly resumed its regular appearance, only a few small excrescences are still present, but these will also soon disappear (fig. 3). By this time only a few loose cells have remained in the lumen of the uterine

horns. On the other hand a dense mass of fibres and decaying cells has accumulated in the median uterus, where it forms a real plug. This might be called a vaginal plug, if Elephantulus had a vagina at all which is not the case (VAN DER HORST, 1942). A vaginal plug is known to occur in some

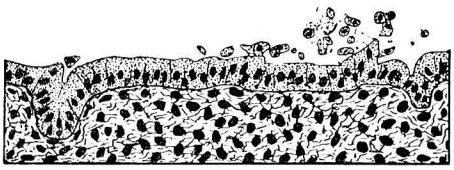


Fig. 3. The uterine epithelium some time after insemination. × 150.

other mammals, particularly in rodents and bats (MEISENHEIMER, 1921). In rodents it is formed by the coagulation of the secretion of the vesicula seminalis that is ejaculated after the seminal fluid proper. This cheese-like substance fills the vagina after copulation, and thus the seminal fluid is retained in the uterus. Whereas in rodents only the male provides the products forming the vaginal plug, in bats the female genital tract is responsible for its occlusion. In Vespertilio and Plecotus this is effected by a secretion to which leucocytes and loose epithelial cells are added, in Vesperugo a proliferation of cells closes the duct. As fertilisation takes place a long time after copulation in bats, this vaginal plug also serves to keep the seminal fluid in the uterus for several months. In Elephantulus both sexes partake in the formation of the "vaginal" plug. Part of the seminal fluid coagulates in the lower uterus as is shown by the presence of sperms in the fibrous mass. To this are added a great many loose cells, desquamated from the uterine epithelium.

The function of the "vaginal" plug of Elephantulus seems to be different from that of rodents or bats. In the former animal the plug is formed only after the spermatozoa have performed their function in fertilising the eggs. Therefore this plug is not formed for the retention of the seminal fluid in the uterus. It is more likely that it inhibits in some way the peristaltic contractions of the uterine wall and thus prevents the early embryos, when they descend, from being ejected from the uterus.

PINCUS and others have demonstrated that the cells of the corona radiata of the rabbit are rapidly dispersed under the influence of the spermatic fluid (PINCUS and ENZMANN, 1936). The active factor was identified as being hyaluronidase, an enzyme that affects the intercellular ground substance (see DURAN-REYNALS, 1950). In Elephantulus the egg is liberated not only from the corona radiata but even from the zona pellucida directly at the moment of ovulation. Even so, whatever there is left of the corona radiata breaks up into isolated cells in the Fallopian tube. It is, however, possible or even likely that this same substance, hyaluronidase, which has been found in the spermatic fluid of

several mammals, is responsible for the partial breaking up of the uterine epithelium into loose cells, and thus for the formation of the "vaginal" plug in Elephantulus. May be this can contribute something to the much debated subject of the influence of hyaluronidase on the fertility of mammals.

REFERENCES

DURAN-REYNALS, F. e.a., The ground substance of the mesenchyme and hyaluronidase. Ann. New York Acad. Sc. **52**, 943—1195 (1950).

HORST, C. J. VAN DER, The post-partum involution of the uterus of Elephantulus. To appear in Acta Zoologica.

——— and GILLMAN, J., The menstrual cycle in Elephantulus. S. Afr. J. Med. Sci., **6**, 27—46 (1941).

———, Some observations on the structure of the genital tract of Elephantulus. J. Morph. **70**, 403—429 (1942).

MEISENHEIMER, J., Geschlecht und Geschlechter im Tierreiche. Gustav Fischer, Jena (1921).

PINCUS, G. and ENZMANN, E. V. ,The comparative behavior of mammalian eggs in vivo and vitro. Jour. Exp. Zool., **73**, 195—208 (1936).