THE OVARIAN OCCLUSION APPARATUS IN THE VIVIPAROUS CYPRINODONTS LEBISTES RETICULATUS PETERS AND XIPHOPHORUS HELLERI HECKEL

BY

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In order to retain the developing embryos in the uterus a mechanical occlusion apparatus, the cervix uteri, is present in all, except the lower mammals. A detailed description of this caudal part of the uterus has been given e.g. in 1927 by STIEVE for the human female and in 1932 by VAN DEN BROEK for several mammals.

As to the mechanical function of the cervix there exists no common agreement. STIEVE (1927) supposed that its solidity is due partly to the large quantity of tough mucus, produced by the cervical glands and partly to the cavernous tissue, which forms the principal part of it. During parturition the blood is driven out of the cavernous spaces by the pressure of the fluid, enclosed by the foetal membranes, with the result that the cervix channel is dilated.

According to GOERTTLER (1929) the dilation of the cervix uteri is caused by contraction of a complicated system of muscle fibres in the cervix wall.

The observation of STIEVE (1927) that the tissue of the human cervix uteri closely resembles that of a corpus cavernosum, has been confirmed by DE SNOO (1939, 1946). Moreover, this author was of opinion that the pressure of the fluid bladder, formed by the foetal membranes, is not able to open the cervix lumen, as he observed that during labour the cervix uteri is neither elongated nor strained. Therefore he considers the cervix to be a passive occlusion apparatus, which is capable of holding the foetus within the uterus during pregnancy and which towards the end of the gestation period becomes softer by a reversible colloidal chemical process. By means of stretching experiments with strips of cervix tissue DE SNOO tried to obtain confirmatory evidence. This special cervix tissue, which consists of cells intermediate between connective tissue cells and muscle fibres, was found by him in the human female and in a number of mammals, viz. the monkeys *Macacus cynomolgus* and *Chrysothrix sciureus*, and in the bitch, cat, mare, cow, ewe, hedgehog

and Guinea pig. In Marsupials it was absent, a fact ascribed to the short duration of the gestation period in this mammalian group.

According to DE SNOO the cervix tissue is therefore a specific structure of the higher mammals. He was unable to find it in some ovo-viviparous lizards and snakes. As he did not investigate viviparous fishes, it was decided to examine the viviparous Cyprinodonts *Lebistes reticulatus* and *Xiphophorus helleri* in this respect.

The ovary of *Lebistes* lies in the body cavity, surrounded by the liver, a double loop of the intestine, the muscular body wall and the air bladder. Originally there are two ovaries, but these fuse early in development, and from this moment possess a common oviduct.

As in other Teleosts the wall of the ovary passes over into the wall of the oviduct. Here a number of lobes was found (fig. 1). They are

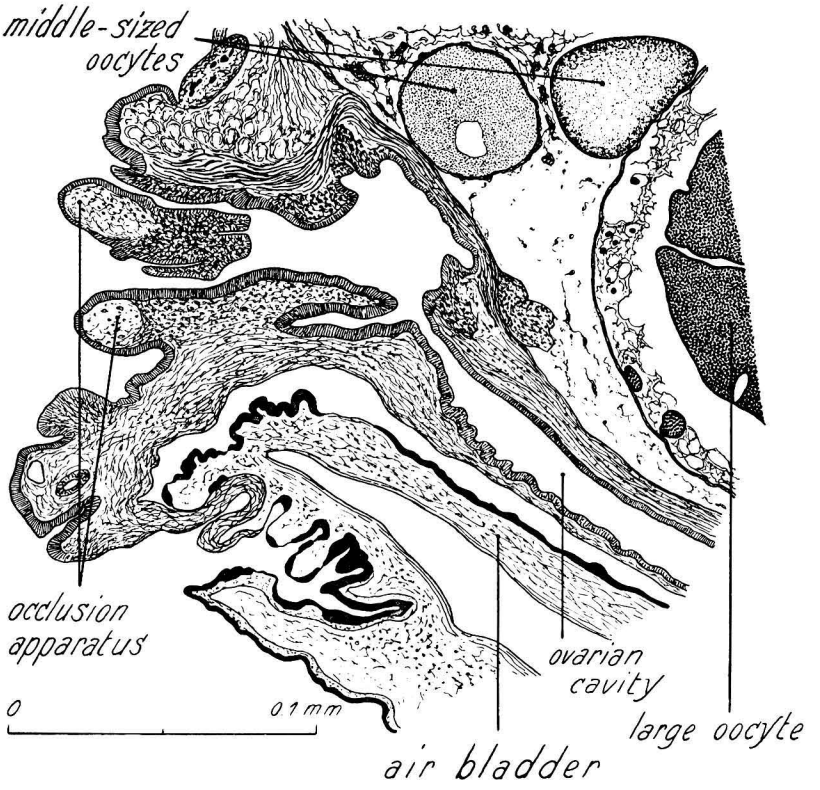

Fig. 1. Occlusion apparatus of an adult female of *Lebistes reticulatus*. The longitudinal walls, consisting of occlusion tissue, are covered by ovarian epithelium. In the ovary a number of oocytes.

covered with epithelium cells similar to those lining the ovarian cavity; under the epithelium a stroma with connective tissue cells and a longitudinal layer of peculiar tissue occur (fig. 2). Perpendicular to the latter

a radial layer of similar tissue is found. Both layers consist of cells strongly resembling those of the occlusion tissue of the cervix of the mammalian uterus [cf. figs. 125, 126, 128 and 136 of DE SNOO (1939)].

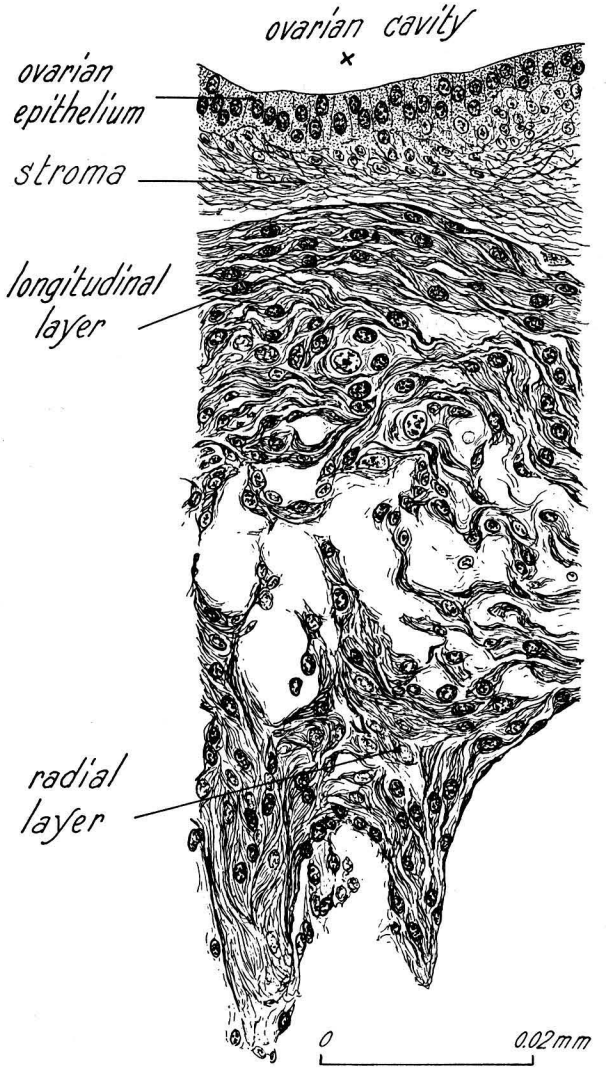

Fig. 2. Part of the occlusion apparatus of *Lebistes reticulatus*, highly magnified. The following details are visible: ovarian epithelium, stroma, longitudinal and radial layers of occlusion tissue.

These lobes are already present in the ovary of the juvenile female of *Xiphophorus* (fig. 3). They develop by an invagination of the ovarian epithelium, a process which proceeds backwards as well as forwards.

In the adult female *Xiphophorus* the occlusion apparatus is much more clearly differentiated. The lobes are more numerous and the spaces

between them larger. Secondary lobes may also develop, while the subepithelial connective tissue layer has increased in volume.

In some respect the morphology of the occlusion apparatus resembles that of the muscular wall of certain hollow organs which are capable of maintaining a distinct tonus without much loss of energy.

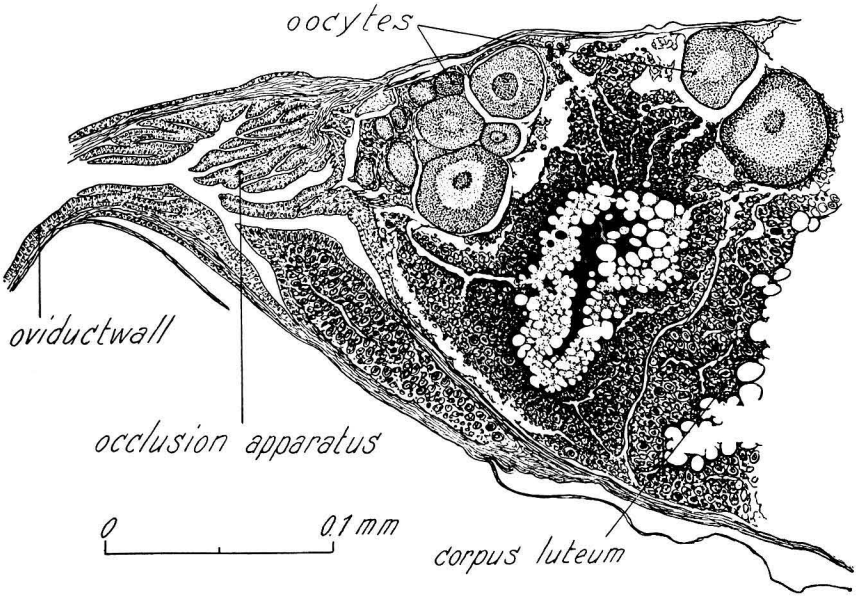

Fig. 3. Occlusion apparatus of a juvenile *Xiphophorus helleri*. Simple system of lobes, developed by an invagination process from the ovary wall. Several oocytes of different sizes are visible as well as corpora lutea.

As an ovarian occlusion apparatus occurs in *Lebistes* as well as in *Xiphophorus*, it is likely that this apparatus is generally found in the viviparous Cyprinodonts. In these fishes in which the number of young may even be very large [up to 97 in *Lebistes* (SCHMIDT, 1920), or more than 200 in *Xiphophorus*] the presence of an occlusion apparatus, which can resist a high internal pressure, is very appropriate.

As to the expulsion of the young, DE SNOO (1939) distinguished an expulsion without and with peristalsis. The first mechanism is present in the primates, whereas the second is to be found e.g. in Ungulates.

According to STOLK (1950) in the Cyprinodonts the expulsion of the young must take place with the help of peristalsis of the oviduct wall. This opinion is based on the fact that in *Lebistes* the oviduct wall possesses a well developed musculature, whereas the wall of the ovary is devoid of a muscle layer. Moreover, the young are born without any detectable pressure of the ventral body wall: during parturition the ventral muscles remain quiet. Consequently an intra-abdominal pressure cannot play any significant role during parturition. Finally the fact that parturition

generally takes place in transverse position is in favour of a peristaltic mechanism.

It therefore appears that in the Cyprinodonts the embryos are kept within the ovary with the help of the occlusion apparatus, present at the transition of the ovary into the oviduct. It is probable that at the end of the gestation period the tissue constituting this apparatus relaxes. This is possible due, first to a reversible colloidal chemical process, and second to the high pressure of the ovarian fluid in which a great number of fully grown embryos is present. After the occlusion apparatus has been opened, the embryos are transported through the oviduct with the help of the peristalsis of its wall.

It is likely that further research will also reveal an occlusion apparatus in other groups of fishes as well as in those of ovo-viviparous snakes and lizards, in which a gestation period is found.

Summary.

In the viviparous Cyprinodonts *Lebistes reticulatus* and *Xiphophorus helleri* an occlusion apparatus is present, where the ovary passes into the oviduct. The tissue composing it resembles that of the cervix uteri in the human female, described by DE SNOO (1939, 1946). After the occlusion apparatus has been opened the young pass through the oviduct, presumably with the help of the peristalsis of its wall.

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