XII. Reproductive System
Fig. 1 A - Female genital system of *Xenentodon* in ventral view.

Fig. 1 B - Male genital system of *Xenentodon* in ventral view.

Fig. 1 C - Schematic diagram showing the arrangement of genital ducts and their opening in relation to the anal and urinary apertures.

Abbreviations:

A.F. - Anal fin
A.BL. - Air Bladder
A.OP. - Anal opening
F.G.OP. - Female genital opening
GON. - Gonads (testes or ovaries)
G.OP. - Genital opening
INT. - Intestine
L.OVR. - Left ovary
L.TES. - Left testis
M.G.OP. - Male genital opening
OVD. - Oviduct
R.OVR. - Right ovary
R.TES. - Right testis
URE. - Ureter
URI.BL. - Urinary bladder
UR.OP. - Urinary opening
VAS.D. - Vas deferens
Fig. 2 - T.S. of the testis of *Xenentodon*. x 60

Fig. 3 - T.S. of the ovary of *Xenentodon* showing various stages in the growth of the ovum. x 36

Fig. 4 - T.S. of the ovary of *Xenentodon* showing secondary oocyte. x 36

Abbreviations:

CEN.C. - Central cavity
CHR.G. - Chromatin granules
CON.T. - Connective tissue
FOL.EP. - Follicular epithelium
MO. - Mature oocyte
N. - Nucleus
NUC. - Nucleolus
OG. - Oogonium
OV.LAM. - Ovigerous lamella
PS. - Primary oocyte
S. - Spermatocytes
SE. - Serosa
SEP. - Septa
SO. - Secondary oocyte
SG. - Spermatogonia
SP. - Spermatids
TH.FOL. - Theca folliculæ
TS. - Third oocyte
TUN.ALB. - Tunica albuginea
VAC. - Vacuoles
VIT.M. - Vitelline membrane
Y. - Yolk
Fig. 5 - T.S. of ovary of *Xenentodon* passing through the oocyte (III) showing nucleus, vitelline membrane and the follicular epithelium. x 150

Fig. 6 - T.S. of the ovary of *Xenentodon* showing atretic follicle. x 150

Fig. 7 - T.S. of the ovary of *Xenentodon* passing through the oocyte (III) showing zona radiata, vitelline membrane and theca folliculæ. x 400

Fig. 8 - T.S. of ovary of *Xenentodon* passing through the mature oocyte showing yolk, vacuolated cortical cytoplasm, vitelline membrane, follicular epithelium and theca folliculæ. x 450

Abbreviations:

- ATR. - Atretic follicle
- COR.CY. - Cortical cytoplasm
- D.FIL. - Disintegrating filaments
- EXT.VIT.M. - External vitelline membrane
- F. - Filament
- FOL. EP. - Follicular epithelium
- N. - Nucleus
- TH.FOL. - Theca folliculæ
- VAC. - Vacuoles
- V.CY. - Vacuolated cytoplasm
- VIT.M. - Vitelline membrane
- Y. - Yolk
- Z.RAD. - Zona radiata
The Male Reproductive Organs


The testes (TES, Fig. 1 B) are two in number. They are elongated structures with small constrictions dividing them into 5 to 7 lobes. The right testis (R.TES, Fig. 1 B) is longer than the left one. Each testis is supported by a peritoneal covering, the mesorchium, which attaches the testis to the air bladder. Each testis is continued into a small vas deferens (VAS.D. Fig. 1 B) which combines with its fellow of the opposite side to form a common spermduct (M.G.OP. Fig. 1 B). The common sperm duct opens to the outside by a separate
opening, in between the anal and the urinary apertures (G.O.P. Fig. 1 C). The seminal vesicles as reported in many marine teleosts (Wiesel, 1943, '49) are absent in Xenantodon.

Each testis when viewed against light in fresh condition shows a lighter cortical portion and a denser medullary portion. It is covered by a connective tissue layer and the serosa. The layers are similar to the ovary but they are thinner in the case of testes. The connective tissue forms many septa (SEP. Fig. 2) thus enclosing cavities of various sizes. The spermatogonia (SG. Fig. 2) are found mostly in the peripheral interseptal spaces. The spermatogonium is a comparatively large sized cell with a round nucleus and a small nucleolus. The spermatocytes (S. Fig. 2) are seen as small round patches with little cytoplasm. The nucleolus is not visible in them. The central part of the testis generally contains a single large-sized cavity filled with a dense mass of spermatids (SP. Fig. 2) cells. The spermatids are mainly nuclear structures surrounded by a very thin layer of cytoplasm. The cytoplasm appears to be drawn out into a sort of tail in some of them. The spermatozoa as such were not visible in most of the testes examined.
The Female Reproductive Organs

The female reproductive system consists of a pair of ovaries. The two ovaries lie in the posterior part of the body. They are joined together and their internal cavities are continued into the common oviduct (OVD, Fig. 1 A) which opens to the outside between the anal and urinary apertures. Parker (1943 in brown Trout, Kamlaveni (1961) in some fishes and Sinha (1961) in Wallago have also reported a separate female genital opening.

The ovaries are yellow in colour and when they are mature, they give mulberry-like appearance due to the bulging ova. They are attached to the air bladder by a peritoneal membrane forming the mesovarium. The right ovary (Rt.OVR. Fig. 1 A) is slightly longer than the left. Each ovary is covered by a fold of the serosa. The outermost layer is made up of thin peritoneal flattened cells followed by a tougher covering of the fibrous tunia albuginea. From the tunica albuginea (TUN.ALB. Fig. 3) connective tissue lamellae extend into the central cavity of the ovary. Inside these connective tissue lamellae (Ovigerous lamellae, James, 1946) (OV.LAM. Fig. 3) are seen developing ova in various stages of development. The central cavity (CEN.C. Fig. 4) is very small as it is practically filled up with the ovigerous lamellae. Internally the ovaries are lined by a germinal epithelium. The germinal epithelium is not continuous. The ovigerous lamellae which
are separated by the connective tissue septa (CON.T. Fig. 3) practically fill the most of the internal space so that the central cavity is very small in the mature ovary. The central cavity is continued directly into the common oviduct (OVD. Fig. 1 A). The various stages of the developing ova as observed in the sections of the ovary during the month of June and July are detailed below.

During these months the ovaries are in the active phase. The eggs of Xenentodon are remarkable due to the presence of external filaments which help in attaching the eggs to the aquatic vegetation. The formation of these filaments is quite interesting.

Stage 1
(OG. Fig. 3)

Decoiiium

The oocyte (one) is an enlarged cell of the germinal epithelium in which the nucleus is deeply stained and is seen to contain many darkly staining chromatin granules.

Stage 2
(PS. Fig. 3)

Primary Oocyte

The cytoplasm is uniformly stained and the nucleus is oval in shape. The nucleolus (1 to 3) are visible and the
chromatin granules (CHR.G. Fig. 3) are seen towards the periphery of the nucleus. The blood vessels are seen surrounding the developing oocyte which now has a thin covering of the follicular cells. These cells form the theca folliculi (thecal membrane).

Stage 3
(SO. Fig. 4)

Secondary Oocyte

The nucleoli disappear but they are still visible in some of the oocytes at this stage. Minute chromatin granules (CHR.G. Fig. 4) are seen towards the periphery of the nucleus. The cytoplasm shows minute vacuoles (VAC. Fig. 4). The follicular wall is now made up of two parts.

i) Theca folliculi (Thecal membrane): This is a thin layer (TH.FOL. Fig. 4) of flattened connective tissue cells forming a covering.

ii) The epithelium proper of the follicle. The follicular epithelium is of the columnar type. It just makes its appearance at this stage and becomes prominent in the later stages.

The follicular cells are setting themselves in a columnar fashion. The nuclei of the follicle cells are elongated and lie more towards the base of the cells. The vitelline membrane is slightly thicker.
Stage 4  
(Figs. 5 and 7)

Oocyte Three

The cytoplasm of the cell is intensely vacuolated. The vitelline membrane (VIT.M. Fig. 5) is now seen in two parts. Internally it is a zona radiata (Z.RAD. Fig. 7) while externally it is an uniform layer taking intense pink colour with Haematoxylin and eosin and Allochrome stains. At places it appears as though it is made up of cylindrical cells but actually it is an uniform layer and a sort of condensation of secretion. It sends outgrowths into the follicular epithelium (FOL.EP. Fig. 8). In transverse sections, these extensions of the vitelline membrane (EXT.VIT.M. Fig. 7) also look like cylindrical cells. They ultimately form the filaments by means of which the egg becomes attached to the aquatic weeds. These outgrowths into the follicular epithelium, which form the filaments of the mature ovum look like oval, oblong or ovoid droplets among the follicular cells. The follicular epithelium and the theca folliculae (TH.FOL. Fig. 8) are well developed.

Stage 5  
(Fig. 3)

Oocyte Four

Vacuoles disappear. The yolk deposition becomes more intense in the ovum. The vitelline membrane is uniform and is without the zona radiata.
Stage 6
(M.OV. Fig. 3)

Mature Ovum

It is covered by a thin layer of connective tissue cells in which the blood capillaries are seen forming the theca folliculæ followed by the follicular epithelium (FOL.EP. Fig. 3) whose arrangement is disturbed by the filaments. Then comes the vitelline membrane (VIT.M. Fig. 3) proper which is in contact with the filaments here and there. Internal to vitelline membrane is the cortical area in which the cytoplasm looks frothy due to the presence of vacuoles. Except this cortical area the egg is full of yolk (Y. Fig. 3) which is stained uniformly.

Disintegrating or atretic follicles (ATR.FOL. Fig. 6) are also seen in the ovary.

Remarkable feature regarding the development of the ovum of Xenentodon is regarding the formation of the outer filaments. The filaments are liable to be mistaken as follicular structures; but actually they are outgrowths from the vitelline membrane. They are formed as a sort of secretion from the vitelline membrane.

Among the various classical workers on the ovary and the ova of the fishes like Mark (1890), Eigenmann (1890), Wallace (1904) and Retzius (1912), Mark (1890) was the first who
insisted that it is the vitelline membrane proper in *Lepisosteus* which gives rise to the filaments and other outgrowths. The same is true in the case of *Xenentodon*. Presence of interstitial cells, which are endocrine in function, has recently been demonstrated by Gaur (1968) in the ovaries of *Labeo gonius* and *Cirrhinus mrigala*. 