

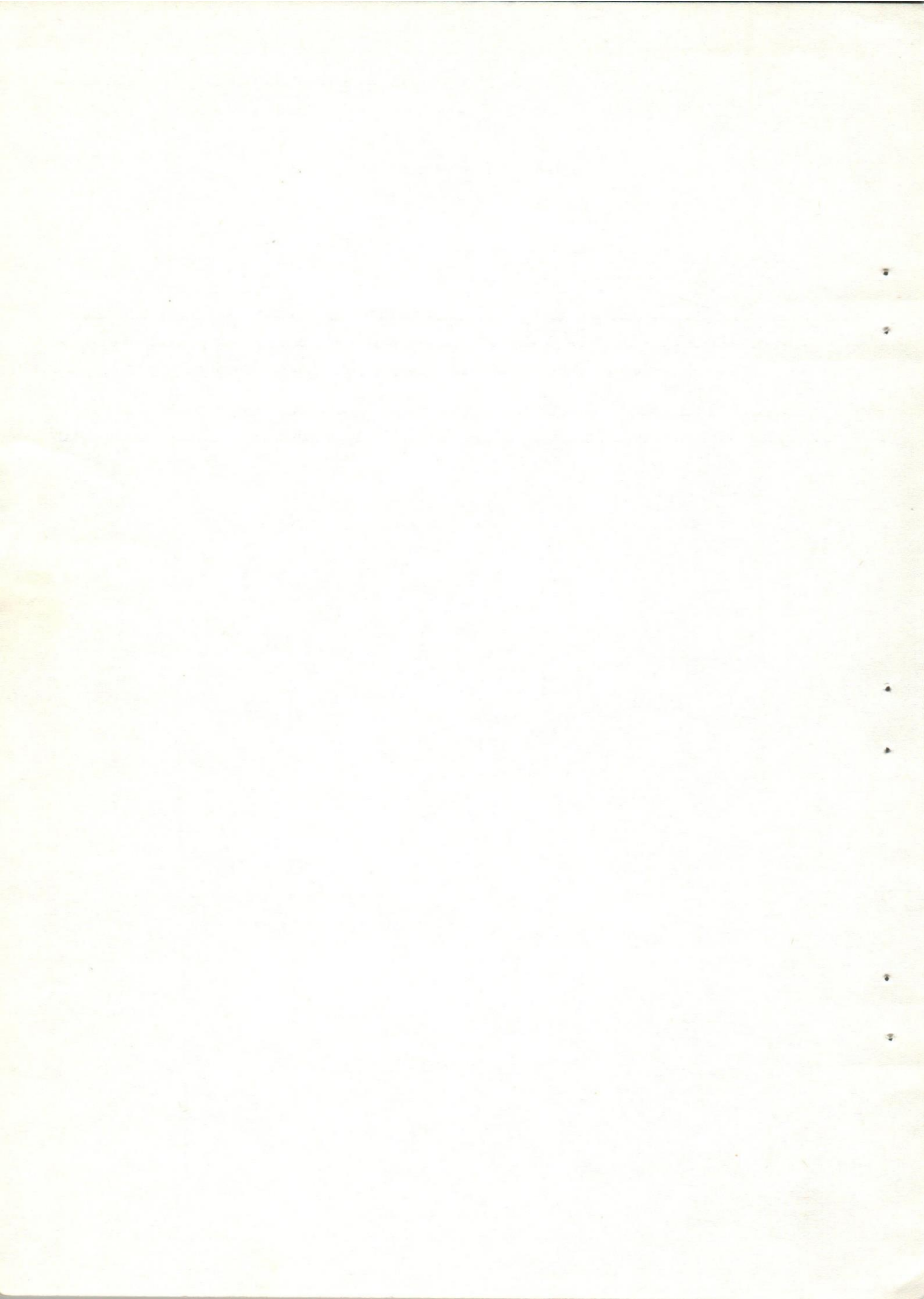
قسم : علم الحيوان - كلية العلوم - جامعة أسيوط .  
رئيس القسم : أ.د / محمد خليل النصار .

دراسات تشريحية وهستولوجية على الجهاز الهضمي  
للقوقع " فيفيارس يونيكلر "

عبد الونيس بديني ، منى حمادة

يعتبر هذا البحث الجزء الأول من دراسة متكاملة على الجهاز الهضمي لأحد قواقع المياه العذبة في بيئتنا المصرية ، وهو القوقع المعروف باسم " فيفيارس يونيكلر " الذي لم يلق اهتماما سابقا ويتعلق هذا الجزء بدراسة العضلات التي تربط بين جدار الرأس والكتلة الفموية وكذلك الغلاف العضلي لهذه الكتلة دراسة تركيبية ووظيفية .

وقد اتضح من هذه الدراسة أن هذه العضلات لها خصائص من حيث الشكل والعدد والمكان تميز هذا النوع من القواقع وتناسب مع طريقة قيام الكتلة الفموية بوظيفة جمع الغذاء وتمزيقه وهضمه جزئيا بفعل اللعاب ثم دفعه الى المريء .





ANATOMICAL AND FUNCTIONAL STUDIES ON THE DIGESTIVE SYSTEM OF VIVIPARUS UNICOLOR  
(OLIVIER, 1801)

1- THE OUTER MUSCULATURE OF THE BUCCAL MASS.

(With 5 Figures)

By

E.A.M. BEDDINY and M.I. HAMADA

(Received at 23/2/1981)

SUMMARY

The extrinsic muscles and muscular coat of the buccal mass of the Egyptian viviparid snail Viviparus unicolor has been macro- and micronanatomically studied for the first time. Their structure has been correlated with their function and with the mechanism of feeding of the snail. Also, it has been compared with the corresponding constituents of other gastropods.

INTRODUCTION

A perusal of the literature reveals that Viviparus unicolor has not yet received considerable attention by Egyptian zoologists. Also, as far as can be ascertained, the present species as well as other Viviparus species, have not yet been fully investigated to explore their internal macro and microanatomy for the sake of recognizing their generic and specific characters. Furthermore, no complete anatomical studies on the buccal mass of a member of the family, Viviparidae have been met with in the literature. YET, COOK (1949) has referred briefly to the reduced radula and jaws of Viviparus viviparus (L.). On the other hand, the buccal mass of other mesogastropods has been studied by a number of authors. Among those one can mention PRASHAD (1925) working on Pila globosa, DEMIAN (1964) and LUTFY and DEMAIN (1967) on Marisa cornuarietis.

Accordingly, the present paper deals with the functional morphology of the extrinsic muscles and muscular coat of buccal mass of the Egyptian viviparid snail Viviparus unicolor, as a part of an investigation on its digestive system. Such study however, is an attempt to elucidate the adaptation of these muscles to their function, and to provide additional evidence for the problem of the phylogeny of viviparids and mesogastropods.

MATERIAL AND METHODS

The specimens of Viviparus unicolor used in the present investigation were collected from the region of connection between the River Nile and Ibrahimia canal at Assiut City. The methods of collection of the specimens, separation and preservation of the soft parts have been recorded in a previous paper on the same species (BEDDINY and HAMADA, (1981).

For histological studies, the buccal mass was fixed in Bouin's fluid, and paraffin sections, 5-6  $\mu$  thick, were stained with Harris haematoxylin-eosin combination or Mallory's triple stain. This general technique gave satisfactory results. For the differentiation of mucus-secreting tissues, VASSOR & CULLING'S (1959) method was adopted; using toluidene blue - veronal acetate solution.

THE BUCCAL MASS

In V. unicolor, the buccal mass, which forms the anterior part of the digestive system, is a conspicuous globular nearly pyriform muscular reddish mass. In the adult snail, it measures about 2.75 mm. in length, 1.5 mm. in its greatest posterior width and 1.2 mm. in its maximum height.

In the snail under investigation, the mouth opening is the true entrance to the alimentary tract due to the absence of a proboscis. It appears, at rest, as an inverted T-shaped slit extending vertically on the most anterior surface of the snout. The margins of this slit take the form of thick plicate pale yellowish continuous lip or peristome. Their colour can be easily differentiated due to the darkly pigmented nature of the cephalic region



surrounding them. It seems reasonable to believe that the foldings of the borders of the mouth permit, during feeding, the widening of the opening to a considerable extent.

When the dorsal cephalic wall is cut opened medially by a longitudinal incision (PL. 1, Fig. 1), the buccal mass becomes exposed and appears under the dissecting binocular microscope, occupying a median, relatively large part of the cephalic haemocoel. It is attached to the cephalic wall by a number of thin extrinsic muscle strands inserted into all the sides of the mass. The cerebral ganglia can be easily seen in the cephalic cavity, one on either side of the posterodorsal edge of the mass. The cerebral commissure, extending between these two ganglia, passes transversely over the posterior most edge of the buccal mass, at the point of its connection with the oesophagus. The two buccal ganglia can not be easily differentiated by macroanatomy. In sections, they can be seen attached to the muscles of the buccal mass, on the ventrolateral sides of the posterior region of the two lateral odontophoral cartilages. The buccal commissure extends below the two lateral odontophoral cartilages and the radular sac. The cerebrobuccal connectives extend, nearly vertically, on both sides of the buccal mass near its posterior end.

The anterior parts of the salivary glands and their two ducts can be seen, by macroanatomy, extending longitudinally on both dorsal sides of the posterior half of the buccal mass. The anterior parts of the two salivary gland ducts become embedded in the musculature of the dorsolateral parts of the mass nearly at the end of its anterior half (PL. 1, Fig. 1).

The outer musculature of the buccal mass of Viviparus unicolor will be described in the following manner:

- 1- The extrinsic muscles.
- 2- Muscular coat of the buccal mass.

1- The extrinsic muscles:

There are some extrinsic muscles arising from the body wall and inserted into the buccal mass. These muscles can be discriminated according to their points of insertions into:

a) Med-dorsal extrinsic muscles (ml. do. ex. m.) (PL. 1, Fig. 1).

These are in the form of several pairs of narrow and weak muscle strands originating from the inner surface of the dorsal cephalic at its median longitudinal line and extending to the external dorsal surface of the buccal mass, to become inserted into its musculature, on either sides of the middorsal line. The muscular strands of both sides are not always symmetrical because some pairs differ in length.

According to the position of these muscles, it is probable to assume that they may aid in fixing the buccal mass to the cephalic wall and in the increase and decrease of the size of the buccal cavity during contraction and relaxation respectively. These successive changes in the size of the buccal cavity are probably necessary for the process of cutting and ingestion of the food material.

The mid-dorsal extrinsic muscles of V. unicolor appear to correspond to the 6-8 pairs of mid dorsal protractors of the buccal mass of the ampullarid snail Marisa cornuarietis (DEMIAN, 1964) and to the one pair of such series of muscles designated by SCOTT (1957) as "Protractor dorsal posterior medial" in Argentinian ampullarids.

b) Ventro-lateral muscles (ven. la. m.) (PL. 1, Fig. 5).

These muscles are in the form of two short broad, somewhat, pigmented bands. Each band originates from the ventro-lateral part of the inner surface of the cephalic wall and extends towards the opposite ventrolateral part of the anterior edge of the buccal mass where it becomes inserted. At its point of origin, each band is expanded to form three interconnected muscular branches. These muscles attach the buccal mass to the cephalic wall. Their contraction and relaxation apparently cause the successive projection and retraction of the mouth opening during feeding.

c) Circumoral dilators (cir.or.dil.) (PL. 1, Fig. 1).

These muscles consist of a large number of small, short, slender muscle bands, originating from the inner surface of the anterior-most part of the cephalic wall and extending towards the extreme anterior part of the buccal mass, in a radial manner, and finally become embedded into its musculature. In microanatomy they appear in the form of short, fine, spindle shaped muscle fibres arranged in a semicircular form around the mouth opening. The arrangement of these muscles show that they apparently cause the widening of the oral aperture during contraction and its narrowing during relaxation. Such mechanism may admit the protrusion of radular ribbon from the



### DIGESTIVE SYSTEM OF *VIVIPARUS UNICOLOR*

relatively wide mouth opening, during the contraction of the muscles, for feeding.

The position and possible function of the circumoral dilators of *V.unicolor* show that they correspond to those of the mesogastropod *Marisa cornuarietis* (DEMIAN, 1964), and to the dorsal mandibular dilators of the basommatophore *Planorbis corneus* (HEMBROW, 1973). Also they correspond to some of the muscles of *Pila globosa*, referred to by PRASHAD (1925) as the "ventral protractors" of the buccal mass.

d) Lateral Extrinsic Muscles (La. ex.m.) (PL. 1, Fig. 4).

These muscles take the form of two lateral biforked bundles. Each one originates as a single band from the inner surface of the posterolateral part of the cephalic wall, at a point opposite the pro-oesophagus. It extends within the cephalic haemocoel in an anterior direction towards the posterolateral part of the buccal mass and become divided into two branches, before the point of insertion. One of the branches extends anteroventrally to become embedded in the lateral musculature of the odontophoral cartilage, while the other passes dorsally for a relatively short distance and becomes inserted into the muscle coat of the buccal mass at its junction with pro-oesophagus. Sections show that each bundle includes, circular, longitudinal and oblique smooth muscle fibres. No corresponding muscles have been reported in *Marisa cornuarietis* (DEMIAN, 1964) or in *Planorbis corneus* (HEMBROW, 1973).

The lateral extrinsic muscles of the buccal mass of *V.unicolor* probably aid in its attachment to the cephalic wall and in its anterior extension and posterior retraction during the feeding mechanism.

2- Muscular coat of the buccal mass (PL. 1, Fig. 2).

The buccal mass of the species under investigation is characterised by an outer thin muscular sheath. Its thickness decreases backward and ranges from 50 to 165  $\mu$ . It is composed of smooth muscle fibres extending mainly in a circular direction, with few dispersed oblique ones. These muscular strands are richly supplied with blood vessels, causing their deeply red colour. The muscular coat is connected with extrinsic muscles and the intrinsic muscular coat of the odontophoral mass. The arrangement of the muscle fibres in the coat shows that they probably connect the muscular bands of the different constituents of the buccal mass together and thus may coordinate their actions during feeding.

### DISCUSSION

In spite of the fact that the basic pattern of the outer musculature of the buccal mass of *V.unicolor* is nearly similar to that of other gastropod herbivores, yet, it shows certain specific characters. Such characters, however, are in coordination with the required muscular actions during feeding. One of these characters is the presence of the lateral biforked extrinsic muscles in the buccal mass of the present species, while they are absent in *Marisa cornuarietis* (DEMIAN, 1964), and *Planorbis corneus* (HEMBROW, 1973).

### REFERENCES

- Beddiny, E.A.M., and M.I. Hamada, (1981): Notes on the Egyptian snail *Viviparus unicolor*, with reference to its taxonomic status. Assiut Vet. Med. J. (in press).
- Cook, P.M. (1949): A ciliary feeding mechanism in *Viviparus viviparus* (L) Proc. Malac. Soc. 27: 265-271.
- Demian, E.S. (1964): The anatomy of the alimentary system of *Marisa cornuarietis* (L). K. Vet. O. Virrerh. Samh. Handl. F. 6. Sep. B. ED. 9. No. 7.
- Hembrow, D. (1973): Observations of the structure and function of the buccal mass of *Planorbis corneus* (L). Proc. Malac. Soc. Lond. 40, 505.
- Lutfy, R.G. and Demian, E.S. (1967): The histology of the alimentary system of *Marisa cornuarietis*. Malac., 5(3): 375-422.
- Prashad, B. (1925): Anatomy of the common Indian apple snail *Pila globosa*. Mem. Ind. Mus. VIII, 3, pp. 91-152.
- Scott, M.I.H. (1957): Estudio morfológico y taxonómico de las Ampullarídes de la República Argentina. Rev. Mus. Argentino Cien. Nat. "Bernardino Rivadavia" Cien. Zool., 3 (5): 231-333, Pls. I- XXIII.
- Vassor, P.S. and Culling, C.F.A. (1959): Carleton's histological technique 4th ed. pp: 214-215, Oxford University Press, New York.



## EXPLANATION OF PLATE 1

- Fig. 1: Dorsal view of the buccal mass as seen in situ, after the removal of the dorsal wall of the head.  
 Fig. 2: Photomicrograph of a T.S. of the buccal mass showing its muscular coat.  
 Fig. 3: Dorsal view of the odontophoral cartilages and the radular sac to show the attachment of the muscles.  
 Fig. 4: Drawing of the lateral aspect of the buccal mass with the radular sac extended to one side.  
 Fig. 5: Drawing of the ventro-lateral aspect of the buccal mass.

## KEY TO LETTERING OF FIGURES

ant. end of b.m.	= anterior end of buccal mass.
b.v.	= blood vessel.
c.cm.	= cerebral commissure.
c. gn.	= cerebral ganglion.
ceph. wall.	= cephalic wall.
cir. or. dil. m.	= circumoral dilatoral muscles.
l. ct.	= lateral cartilage.
la. ext. m.	= lateral extrinsic muscles.
mi. do. ex. m.	= middorsal extrinsic muscles.
m. co.	= muscle coat.
pig. l.	= pigmented layer.
po. Vent. rat.t.	= posteroventral radular tensor.
pro. oes.	= prooesophagus.
rd. s.	= radular sac.
s. gl.	= salivary gland.
s. gl. d.	= salivary gland duct.
sup. rd. fl.	= supraradular flexor.
sus. rd. s.	= suspensors of radular sac.
vent. la. m.	= ventrolateral muscles.
v.l.r.t.	= ventrolateral radular tensors.

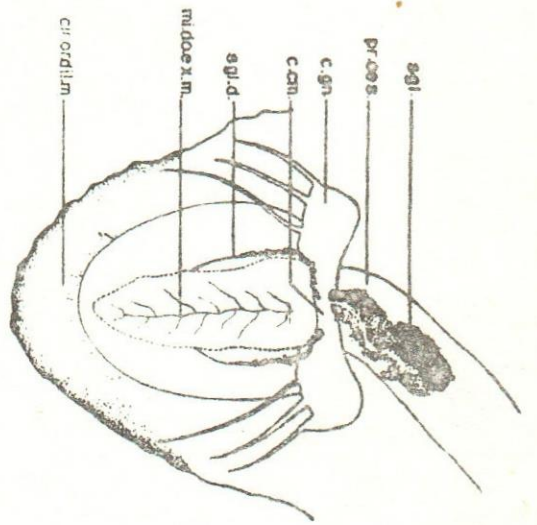


Fig (1)

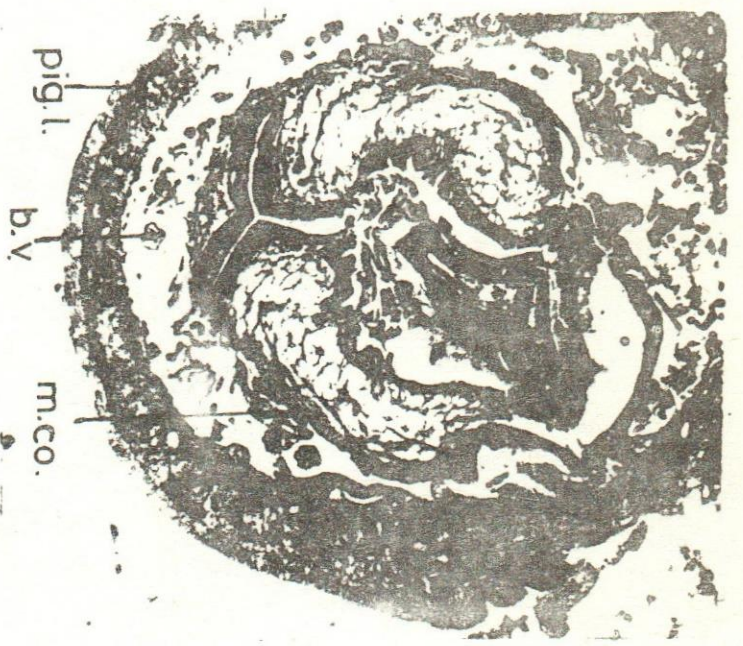


Fig. (12)

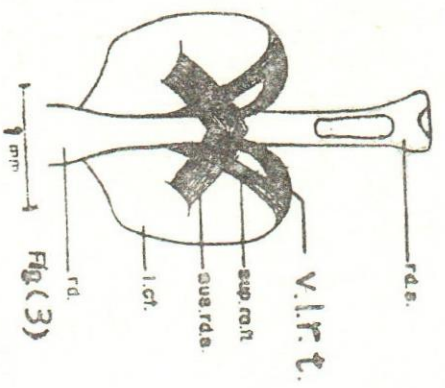


Fig (3)

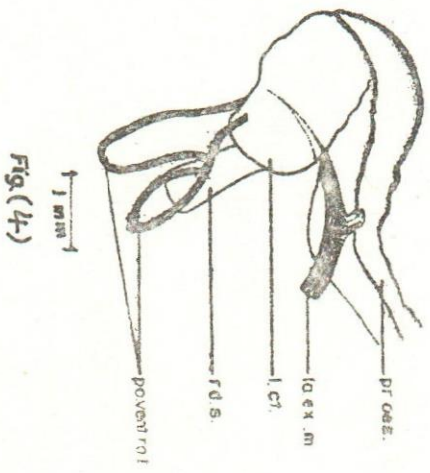


Fig (4)

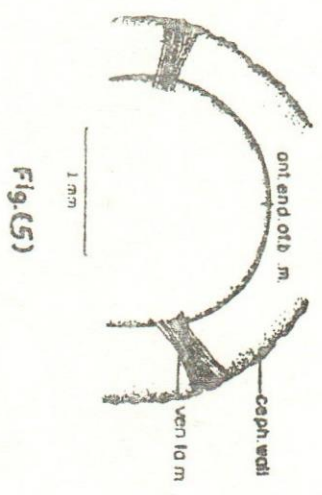


Fig (5)

Pl. II

