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### دراسات على العضلات خلف الجمجمة

لثعبان ابو السيور : بساموفيس سيبيلانيس ، رتبة أوفيديا - عائلة : كولبريدي

١- دراسة على بعض العضلات المتفرقة التي يشابه أو يضاهي بعضها  
عضلات موجوده في السحالي ويقتصر وجود بعضها على الثعابين فقط

عبد الحميد خليل ، محمد وهبة ، ماجده الشابورى

يقدم في هذا البحث دراسة على مجموعة متفرقة من العضلات التي يشابه أو يضاهي بعضها عضلات موجوده في السحالي وعددها (٥) ويقتصر وجود البعض الآخر على حالة الثعابين لخدمة اسلوبها الخاص في الحركة وعددها (١).

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**STUDIES ON THE POST-CRANIAL MYOLOGY OF PSAMMOPHIS  
SIBILANS (LINNAEUS), ORDER:OPHIDIA, FAMILY:COLUBRIDAE  
IV- SOME MUSCLE ITEMS WHICH EITHER BEARS COMPARISON  
WITH ITEMS FOUND IN LIZARDS OR SPECIFIC FOR SNAKES**  
(With 13 Figs.)

By  
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**SUMMARY**

The dermo-qudrate muscle, cranio-vertebral, cranio-atlas, transverse abdominal and caudal myotomes are muscles which have great similarity and could be homologized with items found in lizards. The scalar muscles are specific for snakes. All of these muscles are described in details.

**INTRODUCTION**

The first of the present series of papers dealt with longitudinal muscles located between radial connective tissue septa (1) & (2), while the second dealt with muscles located between connective tissue septa (2) & (3). The third paper dealt with muscles moving the ribs (costal muscles). The present paper deals with a miscellaneous group of muscles which either bears some resemblance or homology with items found in lizards, or specific to snakes. In fact, muscles which are similar to items found in lizards are not fully comparable due to the special skeletal structure and mechanism of movements of snakes, for example, the loss of girdles and limbs.

**RESULTS and DISCUSSION**

**Medio-ventral and latero-ventral cranio-vertebral. (Ventral cranio-vertebral. muscle numbered 13 in lizards) (Figs. 2,4a,b & d and 8)**

This muscle is represented in Uromastix by a single pair which originates on both sides of the longitudinal mid-ventral line of the vertebral column, while in the case of the snake examined an inner and outer thick elongated pairs of muscles are found. The medio-ventral cranio-vertebral (a) (Fig. 8) collects muscle fibres that originate from the ventral edges of the hypapophyses of the cervical and first five trunk vertebrae. It extends anteriorly to be inserted by a strong and short tendon on the ventral basioccipital tubera (Fig. 2). The latero-ventral cranio-vertebral (b) (Fig. 8) collects muscle fibres that originate on the posterior corners of the lateral sides of the cervical hypapophyses. It extends forwards to be inserted by a short and strong ligament on the ventral surface of the basioccipital (Fig. 3). Those two muscles may share in the ventral flexion of the skull.

**Ventral cranio-atlas. (Most probably muscle numbered 10 in lizards) (Figs. 4a & 8).**

This muscle is small and fan-shaped, and originates by its narrow neck, by a short and

strong ligament, on the ventral surface of the centrum of atlas (Fig. 4a) and is inserted by its broad side along a transverse line located on the ventral surface of the basioccipital. An exactly similar muscle to that found in the snake examined is not found in lizards. However, (KHALIL, et al. 1977) described a muscle in Uromastix aegyptia which they named lateral cranio-vertebral (muscle numbered 10) and which is fan-shaped and originates by its broad end on the lateral sides of the anterior three cervical vertebrae and is inserted by its neck on the ventral cranial tubera. Further, KHALIL suggested a function for that lateral cranio-vertebral muscle of Uromastix aegyptia as helping in fixing the skull to the vertebral column. Most probably, the ventral cranio-atlas of the snake examined is the homologue of the lateral cranio-vertebral of Uromastix aegyptia.

**Dermo-quadrate. (Sternocleidomastoid, muscle numbered 8 in lizards) (Figs. 1,2,3,5 & 6).**

Before finishing the description of the axial muscles, one must refer to a muscle which is of a doubtful homology, that muscle originates on the dorso-lateral scales of the skin, just opposite to the ventral elements of the pectoral girdle when present, then it extends forwards passing outer to the second masticatory muscle (Mas. 2) then inner to the first masticatory muscle (Mas. 1) to get finally inserted on the posterior side of the quadrate bone of the skull (Figs.1,2 & 3). That muscle has some analogy to the lacertilian sternocleidomastoid (8) (KHALIL, et al. 1977), and it also has some analogy to the outer costo-cutaneous (OP.5a) of snakes. It is the opinion of the present authors that the exact homology of such muscles like the masticatory one and two (Mas. 1 & Mas. 2) as well as the dermo-quadrate (8) needs other more detailed comparative anatomical techniques such as evidence derived from innervation and embryology.

**Transverse abdominal. (Muscle numbered 23 in lizards) (Figs. 7,8,9,11 & 13).**

It should be mentioned in the present respect of describing the ventral musculature wrapping of the body that the external oblique (19), internal oblique (20), rectus abdominis (21) and the triangularis (22) of lizards (KHALIL, et al. 1977) are absent in the snake examined. Any speculations of homologizing some of the muscles described with any of the above mentioned muscles, like homologizing the supracoastal with the obliquus externus (GASC, 1967) shall not be tried in the present respect.

The transverse abdominal comprises a series of units which starts on the last cervical rib and ends on the last trunk rib. Each unit is an extremely thin ribbon-like sheet of muscle fibres which originates near the middle of the inner side of the rib and extends in a postero-lateral direction. The successive units of the transverse abdominal are fused together wrapping the body cavity, to get finally inserted on the mid-ventral line.

**Caudal myotomes. (Muscle numbered 25 in lizards) (Figs. 12 & 13).**

A hand section in the tail region (Fig. 12), similar to the hand section in the trunk region, shows that the same arrangement of the radial vertical connective tissue septa (C.S.1-C.S.4) with the positions of the different axial muscles are the same. However, in the caudal region the hypapophysis is bilaterally forked to give two ventrally pointing horns. The ventral tip of each of those horns gives a vertical connective tissue septum which in their turn fuse in the mid-ventral line thus, making with the vertebra a structure similar to a haemal arch (Fig. 12). From the ventral side of that haemal arch a vertical median connective tissue septum is given, while from each of the lateral sides of that haemal arch another vertical septum is given latero-ventrally. Those new septa can be given the numbers (C.S.5 & C.S.6) respectively. Transverse septa (myosepta) similar to those found in Uromastix aegyptia (KHALIL, et al. 1977) are not

#### IV- SOME MUSCLE ITEMS WHICH EITHER BEARS COMPARISON WITH ITEMS FOUND IN LIZARDS OR SPECIFIC FOR SNAKES .

found in the snake examined. The first segmented caudal myotome (a) is located between the fourth vertical connective tissue septum (C.S.4) and the fifth vertical connective tissue septum (C.S.5), while the second segmented caudal myotome (b) is located between the fifth vertical connective tissue septum (C.S.5) and the sixth vertical connective tissue septum (C.S.6), both just below the subcutaneous connective tissue. In other words, the caudal myotomes of Psammophis sibilans (Fig. 13) are thick segmented muscle pieces that are caudally located only in the ventral side of the snake studied, while in the case of lizards (KHALIL, et al. 1977), they occupy the ventral and dorso-lateral parts. The action of those units may help in the ventral flexion of the tail in snake studied

#### Interscalar muscles. (OP.6a,b & c) (Fig. 10).

The units of those muscles are not connected with the endoskeleton by any means. In fact, those muscles are very special ophidian character which surely help in the special ophidian movement. Three muscles, each of which consists of successive thin units are found. The units of the first muscle (a) run between the successive ventral scales (Intercutali of BELLAIRS, 1969). Each unit of that muscle consists of an outer and inner pairs of elements. The outer pair of elements originates on the anterior margin of a ventral scale and is inserted on the surface of the preceding ventral scale, while the median elements originate on the posterior margin of one ventral scale and is inserted on the surface of the succeeding ventral scale. In such a case, each ventral scale is connected with both the succeeding and preceding ventral scales. Each of the units of the second interscalar muscle (b) (Squamascuali of Bellairs) connects the lateral side of a ventral scale with a median most scale of the dorsolateral side lying a short distance in front. The units of the third interscalar muscle (c) (Inter-squamali of Bellairs) run between the successive dorsolateral and dorsal scales.

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### EXPLANATION OF LETTERING

ANT. = anterior; B.O.C. = basioccipital; B.SP. = basisphenoid; CEN. = centrum; C.M. = cranial muscles; C.S.(1-6) = first to sixth connective tissue septa; C.SH. = connective tissue sheet wrapping the body; DEN. = dentary; D.R. = dorsal rib.; D.S. = dorsal scale; D.V. = dorsal vertebra; E.O.C. = exoccipital; FO.MAG. = foramen magnum; FR. = frontal; HYP. = hypapophysis; I.S. = inner side of the skin; L.16 = ligament of origin of muscle numbered sixteen; MAS.1 = masticatory one; MAS.2 = masticatory two; M.D.L. = mid-dorsal line; M.V.L. = mid-ventral line; N.A. = neural arch.; N.S. = neural spine; OD.P. = odontoid process; OC.CO. = occipital condyle; OP.1-OP.8 = first to eighth ophidian muscles; O.S. = outer side of the skin; P.O.C.P. = paroccipital

process; PR. = parietal; PR.Z. = prezygapophysis; PT. = pterygoid; PT.Z. = postzygapophysis; QU. = quadrate; S.OC. = supraoccipital; S.TM. = supratemporal; T.15 = tendon of insertion of muscle numbered fifteen; T.P. = transverse process; TU. = tubera; V.S. = ventral scale;

#### EXPLANATION OF FIGURES

- Fig. (1):** Dorsal view of the skull (after Kamal and Hammouda 1967) showing the attachments of muscles numbered (Mas. 1, 1,2,8 & 16).
- Fig. (2):** Ventral view of the skull (after Kamal and Hammouda 1967) showing the attachments of muscles numbered (8,10 & 13).
- Fig. (3):** Posterior view of the skull (after Kamal and Hammouda 1967) showing muscles attachments on that region.
- Fig. (4):**
- A.** Lateral view of the atlas showing the attachments of muscles numbered (1,9,10 & 13).
  - B.** Lateral view of the axis showing the attachments of muscles numbered (1,2,9,13 & 15).
  - C.** Dorsal view of a trunk vertebra showing the attachments of muscles numbered (2,16, OP.1, OP.2, OP.3 & OP.4).
  - D.** Lateral view of a trunk vertebra showing the attachments of muscles numbered (2,13,15,16, OP.1, OP.2, OP.3, OP.4 & OP.7).
  - E.** Dorsal view of a caudal vertebra showing the attachments of muscles numbered (2,16,17, OP.1, OP.2, OP.3 & OP.4).
  - F.** Lateral view of a caudal vertebra showing the attachments of muscles numbered (2,15,16,17, OP.2, OP.3, OP.4 & OP.7).
- Fig. (5):** Dorsal view of the head, neck and the anterior part of the trunk region showing the topology of muscles numbered (Mas.1, Mas.2, 1,8,16,17 & OP.5).
- Fig. (6):** Lateral view of the head and neck regions showing the attachments of muscles numbered (Mas.1, Mas.2, 1,8,16,17,18 & OP.5a).
- Fig. (7):** Dorso-lateral view of a right trunk rib showing the attachments of muscles numbered (17,18,23,24, OP.4, OP.5, OP.7 & OP.8).
- Fig. (8):** Ventral view of the neck and the anterior part of the trunk region showing muscles numbered (9,10,13,18,23 & 24).
- Fig. (9):** Ventral view of some trunk vertebrae showing muscles numbered (18,23,24, OP.4 & OP.8).
- Fig. (10):** Diagram of the inner side of the skin showing muscles numbered (OP.5 & OP.6) and their association with body scales.
- Fig. (11):** Ventral view of the posterior part of the trunk region showing muscles numbered (18,23 & 24).
- Fig. (12):** Transverse hand sections in the caudal region showing the vertical connective tissue septa (C.S.1-C.S.6).
- A.** In the anterior part.
  - B.** In the middle part.
  - C.** In the posterior part.

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EXPERIMENTAL RESULTS

Fig. 1. ... ..

Fig. 2. ... ..

Fig. 3. ... ..

Fig. 4. ... ..

Fig. 5. ... ..

Fig. 6. ... ..

Fig. 7. ... ..

Fig. 8. ... ..

Fig. 9. ... ..

Fig. 10. ... ..

Fig. 11. ... ..

Fig. 12. ... ..

Fig. 13. ... ..

Fig. 14. ... ..

Fig. 15. ... ..

Fig. 16. ... ..

Fig. 17. ... ..

IV- SOME MUSCLE ITEMS WHICH EITHER BEARS COMPARISON WITH ITEMS FOUND IN LIZARDS OR SPECIFIC FOR SNAKES

Fig. (13): Ventral view of the posterior part of the trunk region and the anterior part of the caudal region showing muscles numbered (17,18,23 & 25).

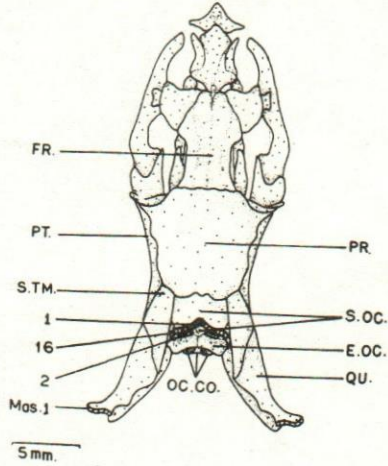


Fig. 1

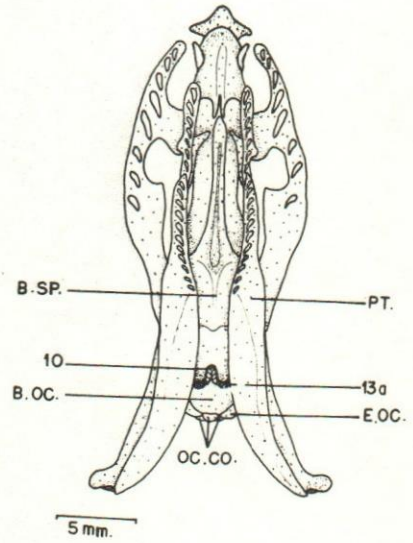


Fig. 2

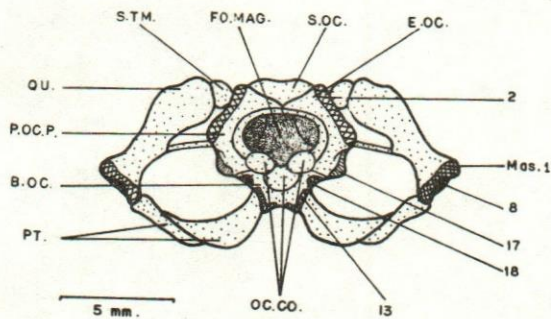


Fig. 3

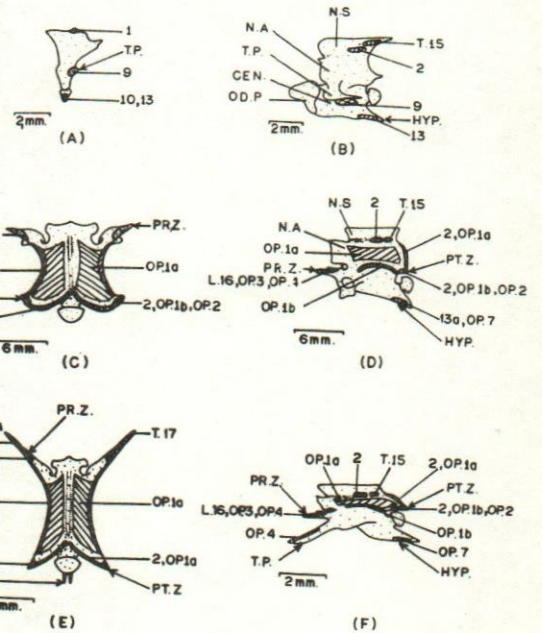


Fig. 4

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DEPARTMENT OF CHEMISTRY

THE STRUCTURE OF THE CARBON DIOXIDE MOLECULE  
AS DETERMINED BY X-RAY CRYSTALLOGRAPHY



Fig. 1



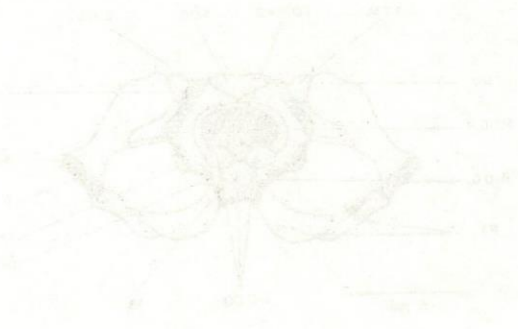
Fig. 2



Fig. 3



Fig. 4





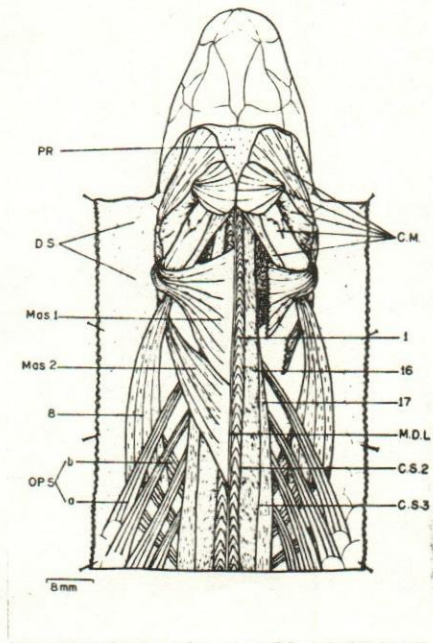


Fig. 5

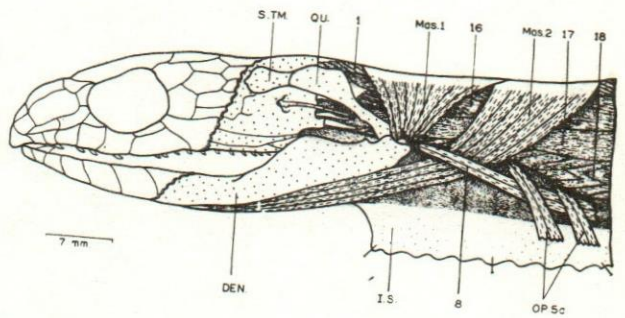


Fig. 6

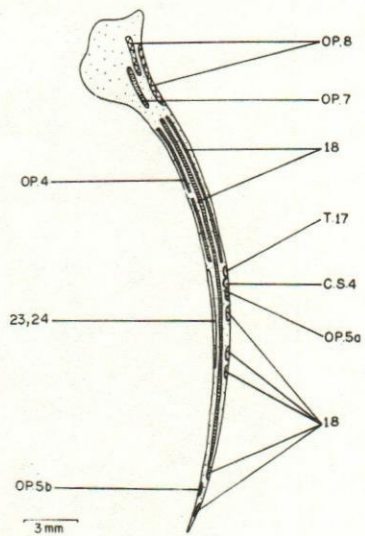


Fig. 7

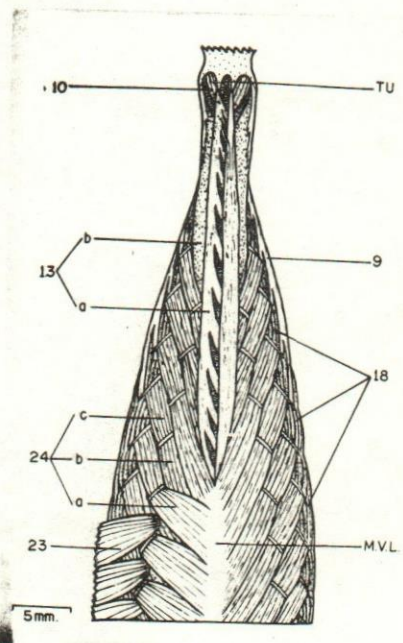


Fig. 8



Fig 1



Fig 2

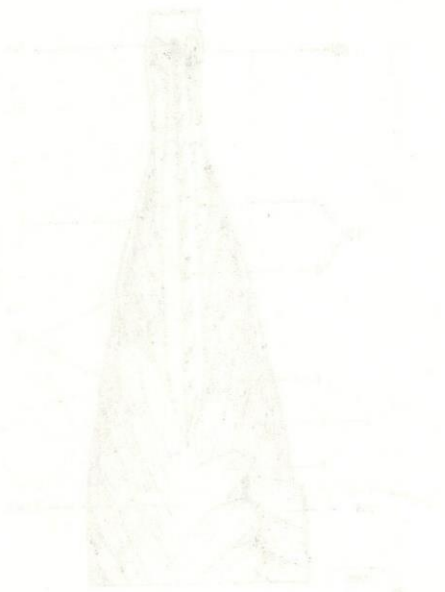


Fig 3

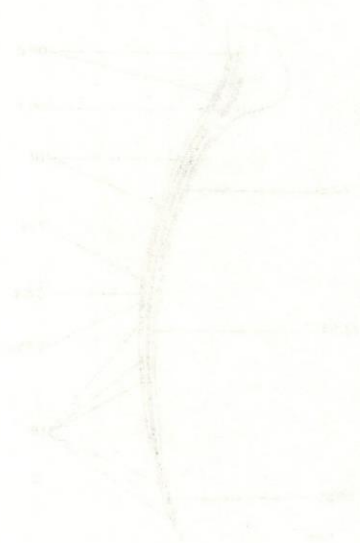


Fig 4

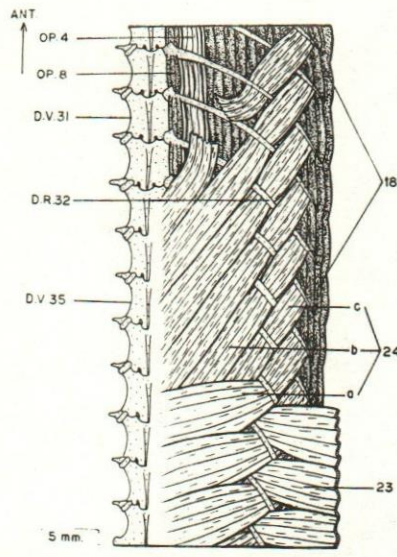


Fig. 9

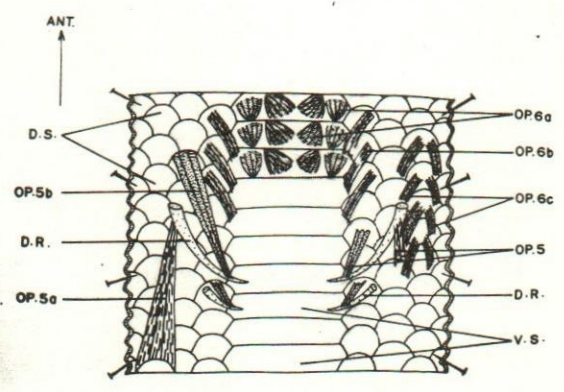


Fig. 10

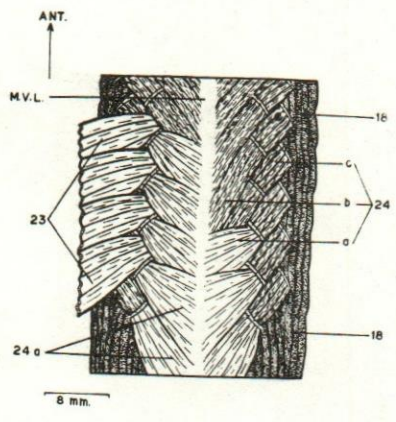


Fig. 11

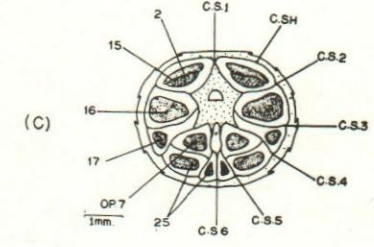
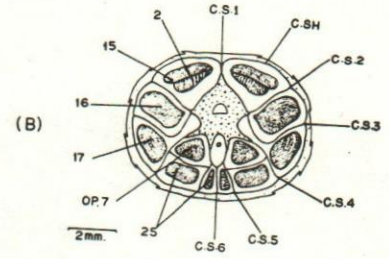
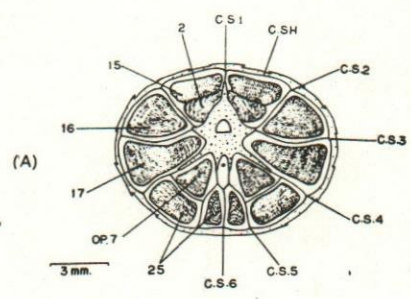


Fig. 12

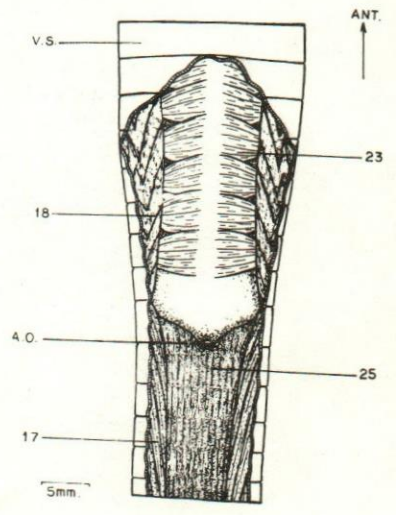


Fig. 13

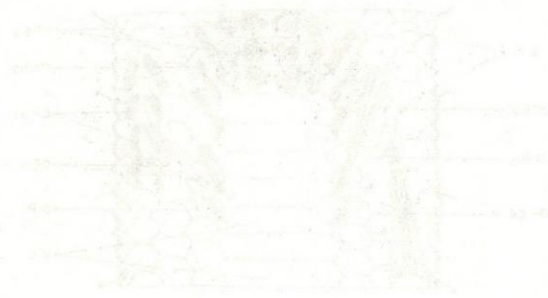


Fig. 10



Fig. 9



Fig. 13



Fig. 12

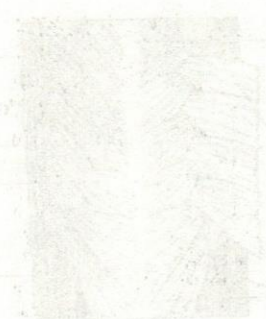


Fig. 11