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THE EXTERNAL ANATOMY OF THE SQUASH BUG,  
*ANASA TRISTIS DE G.*\*

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INTRODUCTION

In writing this article the chief aim is to endeavor to supply a reference work on the external morphological characters of a typical Heteropterous insect. For this reason the common squash bug has been selected as it is widely distributed, well known as a pest, and is readily obtainable for study.

In order to make the paper as complete as possible the morphologists' and systematists' terms have both been used, except in referring to the wing venation (the systematists' terms being lacking in the fore-wing and the morphologists' in the hind wing).

At this point I wish to express my gratitude to Dr. H. T. Fernald and Dr. G. C. Crampton for their many helpful suggestions and assistance in preparing this paper.

ANATOMY

*Head*

The sclerites of the head capsule of the squash bug are solidly fused together making it impossible to do more than to describe the general regions of which the head is composed. Of these the occiput (occ), (Pl. LV, f. 1.) lies behind the ocelli (oc) and forms the posterior portion of the head surrounding the occipital foramen. It is marked off by a shallow transverse groove, from

\* Contribution from the Entomological Laboratory, Massachusetts Agricultural College.

the vertex. The vertex or cranium (ec) comprises the dorsal region in front of the occiput and bears the ocelli. This area is not marked off from the frons (f), which lies above and between the bases of the antennae (ant). The anterior margin of the frons is united with the base of the clypeus or tylus (c).

Below and on either side of the compound eyes (e) lie the genæ (g) while the ventral posterior portion of the head capsule forms the basal plate or gula (gu). The clypeus, as has been previously stated, is fused at its base with the frons, and at this point is narrow, but as it curves forward and downward it widens at its tip to form the base of attachment for the labrum (lbr) from which it is separated by a narrow membranous ring.

The labrum is an elongate triangular sclerite. Its anterior surface is convex, while its posterior surface is flat and contains a groove which lies above the groove on the basal half of the anterior surface of the labium (lab).

On either side of the clypeus is a narrow prolongation of the frons called the fulcrum, jugum or zygum (fr). The fulcra lie close to the lateral walls of the clypeus, hiding them, but are not united with them except at their bases, where they fuse with the head capsule. The fulcrum is shorter than the clypeus, its anterior margin lying behind the swelling of the tip of the clypeus. Its ventral margin extends to the base of the antenna where it fuses with the base of the maxillary laminae (ml).

The maxillary laminae or gena postica lie below the base of the antennae. Their bases are fused with the genæ and their ventral margins are united with the bucculæ (bu), which are chitinous plates projecting from the anterior ventral side of the head on either side of the base of the labium. The bucculæ serve to protect the posterior membranous portion of the base of the labium.

The rostrum, vagina or labium (lab) articulates with the anterior ventral region of the head between the bucculæ and is made up of four segments, the terminal segment at its tip bearing numerous sensory organs. The labium contains, as stated above, a dorsal groove in which lie the setæ (s). The edges of the groove, distal to the overlying labrum, overlap, forming a closed tube, thus giving the enclosed setæ more support (Pl. LVI, f. 8 s.). At its basal end the groove becomes very shallow; the labium becomes filled with muscles, tracheæ and nerves, and the setæ in this portion of the labium gradually come to lie

within the labrum, whose edges meet beneath and confine the setæ (Pl. LVI, f. 8 s. and Pl. LVI, fs. 21-24's). They then pass back through the articulating membrane, which lies between the labrum and clypeus, and between the lateral walls of the clypeus. The walls of the clypeus at its tip, turn under, and their edges interlock forming a narrow pair of supporting lobes above which the setæ pass. Upon emerging from these lobes the maxillary setæ (m) spread apart to receive the tip of the pharynx and the canal from the salivary pump, both of which enter the setæ at this point.

The setæ represent the mandibles (md) and the maxillæ (m). The maxillæ are fluted and interlocked so as to form two tubes, these being the upper or suction canal, and the lower or salivary canal (Pl. LV, f. 2). The mandibles are slightly shorter than the maxillæ and their tips are barbed. Their function is that of piercing the plant tissue and holding the setæ in place, while the tips of the maxillæ, which are acute and fluted, probe the plant tissues, take up the plant juices, and eject the saliva. The setæ, as stated, pass back into the head capsule and separate at their junction with the pharynx, going to either side of it. Their bases widening out form points of attachment for the controlling muscles.

The antennæ (ant) are composed of six segments. The third and fifth are ring joints (Pl. LVII, f. 16, r.), or reduced segments; therefore the antenna as a whole appears to be composed of only four segments. The fifth segment, or second ring joint, allows great freedom of motion to the terminal segment. The second and fourth segments are long and slender. The proximal segment is called the scape or radícula (sa). It is large and has a stalked base, which enlarges at its connection with the head to form a universal joint. The terminal segment is spindle shaped and covered with numerous sensory hairs. The other segments possess sensory hairs, but not as specialized as those of the terminal segment.

The compound eyes (e) are large and composed of many facets, and project prominently from the head. The ocelli are two in number.

The posterior portion of the head or the collum is set into the collar of the prothorax and is joined to it by a membranous neck.

*Thorax*

*Prothorax.*—The prothorax is a large chitinous segment whose sclerites are solidly fused together, with the exception of the episternum and epimeron which are separated for a short distance by the coxal cleft (b).

The notum (no) overlaps the prescutum, scutum, and a portion of the scutellum of the mesothorax dorsally; and the pleural region projects over a portion of the anterior part of the mesothorax laterally (Pl. LV, f. 1 and 4). The tergum or notum is of one piece, its sclerites being indistinguishably fused together. Its anterior portion is more or less irregular due to the attachments of the muscles of the fore leg to its inner surface. The union of the notum and pleuron forms a well defined ridge.

The Pleuron (pl) is divided, as stated above, by the coxal cleft into the epimeron (epm) and episternum (eps). The cleft extends only a short distance into the pleuron terminating in a groove. Above this the pleuron bulges out forming a larger cavity for the expanding muscles of the fore leg. This region of the pleuron is called the omium (om).

The sternum (st) is a small area lying between, and anterior to the coxal cavities, and is indistinguishably fused with the pleuron. The portion of the sternum projecting backward between the coxal cavities is called the mucro (mu). The anterior portions of the coxal cavities are formed by the inner surfaces of the epimeron, episternum, and the sternum; and are closed posteriorly by the extensions of the prothorax epimeron and sternum, together with the anterior portion of the mesosternum.

The legs show the usual five divisions into the coxa (co), trochanter or fulcrum (fr), femur (fe), tibia (t), and tarsus (ta), (Pl. LVI, f. 13). Since the fore legs are typical, although they are proportionately smaller, one description will be sufficient. At the base of the coxa hidden within the coxal cavity is a narrow plate called the trochantin (Pl. II, f. 9 ti). The coxa is a large swollen segment lying largely within the coxal cavity and is freely movable. The trochanter or fulcrum is a small segment which forms a ginglymus articulation with the coxa and is obliquely joined to the side of the femur. The femur is long and more or less spindle shaped; the tibia articulates with it by a ginglymus joint and is long and slender. The tarsus is composed of three segments. The first segment is called

the Metatarsus (meta), and the terminal segment the ungula (u). This bears divergent claws called unguicula (ua) beneath each of which lies a pulvillus (pu) modified to form a concave adhesive pad (Pl. LV, f. 3).

*Mesothorax.*—The mesothorax is attached to the prothorax by the intersegmental membrane, and the two segments are easily separated, thus uncovering the anterior area of the scutellum and the scutum and prescutum. The covered areas, or the scutum and prescutum, are also called the dorsulum.

The scutum (sc) is divided longitudinally by a wide median furrow. In the scutum, on either side of the median furrow are two irregular longitudinal impressed lines (d), which are possibly homologous with the parapsidal furrows of the Hymenoptera. If this be the case, then the area lying between the two last mentioned impressed lines would be the prescutum (psc), while the areas lateral to the lines would be the scutum (Pl. LVI, f. 10).

Lying posterior to the scutum and separated from it by a transverse ridge is the scutellum (sct), which is triangular in outline and projects posteriorly over the metathorax and the first abdominal segment. On the lateral edge of the scutellum is a ridge called the frenum (fm) (Pl. LVI, f. 10).

The postcutellum (psct) of the mesothorax forms the anterior wall of the phragma (phr) situated between the meso and the metathorax, while the prescutum (psc) of the metathorax forms its posterior wall. Both of these sclerites are only slightly visible externally (Pl. LVI, f. 10).

The fore wings are characteristic of the suborder Heteroptera being partly membranous and partly coriaceous. Their bases articulate with the mesonotum by means of small chitinous plates called ossicula or axillaries.

The membranous and coriaceous portions of the fore wings are separated by a more or less broken oblique suture called the sutura membranæ (s-m). The coriaceous portion is marked off into three areas by two longitudinal sutures (Pl. LVIII, f. 19). These areas are as follows: the clavus (cl), which lies next to the mesoscutellum when the wings are in repose; the corium (cr) which lies between the two sutures; and the embolium or costal area (em), which lies beyond the second suture. The first suture or the one which marks off the clavus is called the sutura clavi or anal furrow (s-c). The suture separating the corium from

the embolium is called the median furrow (m-f). The margin of the clavus, which when the wing is at rest lies along the lateral edge of the mesoscutellum, is called the margo scutellaris (m-s), while the margin of the clavus beyond the tip of the mesoscutellum, is called the commissura (cm).

There are three angles in the coriaceous portion, used in classification. These are as follows: the internal angle, *angulus internus* (a-i) formed by the meeting of the *sutura membranæ* and the *sutura clavi*; the *angulus clavi* (a-c), which lies between the *sutura clavi* and the commissura; and the *angulus scutellaris* (a-s), which is formed by the meeting of the commissura and the *margo scutellaris*.

The coriaceous portion of the wing has an inconspicuous venation to which the following names have been given. The *costa* (ca) is the longest vein, lying nearly parallel to the costal margin of the wing. The *subcosta* (sca) and *radius* (ra) lie posterior to the *costa*, their basal halves being coalesced. Behind or posterior to the coalesced *subcosta* and *radius*, lies the median vein (me) connected by a short cross vein (r-m) near its tip with the radial sector. The *cubitus* (cu) lies within the clavus; and the first anal vein (a) lies along the *margo scutellaris* except at its base where it extends into the clavus.

The anterior part of the mesopleuron is hidden under the prothorax. It is partially divided into two sclerites, the *epimeron* and the *episternum*, by the coxal cleft over the insertion of the *mesocoxa*. A third plate which is a marked off portion of the *epimeron* lies at the base of the fore wing and is wholly hidden by the prothorax. It is called the *basalar plate* (ba). A chitinous plate called the *prealar bridge* (o) connects the pleuron and the scutum near the juncture of the mesothorax with the prothorax. Below this plate lies the mesothoracic spiracle (sp) in the intersegmental membrane between the meso and prothorax. Posterior to the *basalar plate* is an invaginated triangular apodeme (ap) whose position is indicated externally by a cavity. A continuation of one of the angles of this cavity marks off part of the dorsal border of the pleuron causing it to appear as a sclerite. A membranous area extends from the base of the fore wing to the *prealar bridge*, and separates the scutum from the pleuron and its plates.

The sternum is of one piece solidly fused with the *episternum*. The coxal cavities are formed by the inner surfaces of the

epimeron, episternum and sternum anteriorly, and posteriorly by the anterior margin of the metasternum and metæpisternum.

*Metathorax.*—The notum of the metathorax is well developed and is composed of three sclerites. The prescutum (psc), which has already been described, forms the posterior wall of the phragma between the meso and metathorax, and in its normal position is only slightly visible from the exterior. The scutum (sc) and scutellum (sct) are fused and the visible portions appear as an elongate triangular sclerite on either side of the mesoscutellum which hides the middle portion. The postscutellum (psct) lies behind this sclerite and is fused with it, its central portion being hidden beneath the projecting mesoscutellum.

The pleuron (pl) is partially divided by the coxal cleft into a large epimeron or pleurum and a very small episternum, the latter being indistinguishably fused with the sternum. At the upper end of the cleft lie the two light yellow scent glands (sg) separated by a pit which extends into the body cavity and into which flows the fluid secreted by the glands. Lying above the scent glands and hidden in the folds between the meta and mesothorax is the metathoracic spiracle. On either side of the dorsal margin of the metapleuron is a longitudinal grooved area called the cenchrus (Pl. LV, f. 4, cc and Pl. LVI, f. 10, cc), in which there lies a ridge, located on the ventral side of the costal margin of the fore wing.

The hind wings or alæ (hw) are joined to the metathorax although their bases appear to lie mostly above the mesopleuron when viewed laterally. Their bases articulate with the fused scutum and scutellum, whose posterior margin is continuous with the posterior margin of the wing. The alæ articulate with the metanotum by means of numerous small chitinous plates called ossicula or axillaries.

The wing is wholly membranous and distinctly veined. The venation given is the purely systematic one. The costa primaria (ca-p) is the large vein lying just posterior to and parallel with the costal margin in the basal half of the wing (Pl. LVIII, f. 20). The costa subtensa (ca-s) lies below the costa primaria and is more or less parallel with it. Near the distal end of the costa subtensa is a short incomplete transverse vein which nearly reaches the costa primaria. This is called the Hamus (ha). The distal ends of the costa primaria and subtensa are connected

by a short vein, the costa connectens (ca-c). From the union of the costa primaria and costa connectens the costa apicalis (ca-a) extends outward toward the apex of the wing. Behind the costa apicalis and nearly parallel with it lies an unnamed vein which is usually unbranched although in an abnormal specimen a short branch vein has been noticed arising from it and extending outward between it and the costa apicalis. From the union of the costa subtensa and the costa connectens extends the costa decurrens (ca-d), a strongly curved vein. Behind the costa decurrens lie two nearly straight, short veins called the costa lineatæ (ca-l). Behind the costa lineatæ lie three veins in the anal area, the costa radiantes (ca-r). The first is not attached to the base of the wing while the second and third are so attached.

### *Abdomen*

The abdomen is broadly joined to the thorax and its anterior portion is overlapped by the metathorax to such an extent that the spiracle situated in the pleural region of the first abdominal segment is completely hidden beneath the metapleuron. The first six segments of both male and female bear a pair of spiracles.

The first four and part of the fifth segments of the abdomen show clearly the marking off into four typical regions. The notum (no) is the flat, black, dorsal portion on which the wings rest. The pleural areas or connexivum which form the sides of the trough in which the wings lie when at rest are situated one on either side of the dorsal region, and extend to the prominent lateral edges of the abdomen. The sternal area is that forming the ventral and lateral portions of the abdomen. The spiracles (sp) are located near the dorsal edges of the sternum. The sclerites of the posterior portion of the fifth segment, and of the segments following, are more or less closely fused together and are specialized for reproduction in both males and females.

There are nine segments in the abdomen of the male. The seventh is not visible under normal conditions, but together with a large part of the eighth segment, is retracted within the sixth segment. The seventh segment is highly specialized for this purpose, being merely a collar of chitin which telescopes over the base of the eighth segment. The eighth or genital segment is also highly specialized, its sclerites being solidly



fused together, except dorsally where the chitin is almost membranous just anterior to the rectal cauda (rc). Its shape is also greatly modified. The dorsal aspect presents a large pit or cavity, above which lies the rectal cauda and the genitalia. The chitinized tip of the rectal cauda is the much modified ninth segment. The rectal cauda projects posteriorly from the dorsal wall of the eighth segment, which is called the pygidium (pg). The basal half of the rectal cauda is membranous above and below, but slightly chitinous laterally. Its posterior half, which lies folded and hidden within the basal portion, is membranous except the tips which are chitinized, and open and close as do the edges of a purse. Beneath the basal portion of the rectal cauda lies the œdeagus, those chitinized portions of the male genital organs through which pass the membranous structures connected with the ejaculatory duct. Posterior to the œdeagus lie two movable appendages or styli (la). The ventral portion of the eighth segment which bears internally the lateral appendages and contains the œdeagus is called the hypopygium (pp).

Dorsally, the abdomen of the female presents ten segments. The tenth, which forms the chitinous lips of the rectal cauda, is hidden within the ninth, except when extruded, and is widely separated from the ninth by the membranous rectal cauda. The dorsal portion of the ninth segment is called the pygidium. Ventrally, the ten segments are not so easily recognizable, especially when the abdomen is extended, as the segments are variously modified for protective and reproductive purposes. Attached to the insides of the dorsal and ventral portions of the eighth abdominal segment are two pairs of chitinous appendages, the lateral appendages or styli, armed with stiff spines or hairs. These lie above and protect the soft portions of the genitalia when in repose. These appendages may function as claspers in copulation, but actual observation of this function will be necessary to determine this point. The ventral portion of the eighth abdominal segment is called the hypopygium.

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## LETTERING OF FIGURES.

Numbers 1-10 denote number of the segment. Subscripts 1, 2, 3, pro-, meso-, metathorax, respectively.

a anal vein.  
 a-c angulus clavi.  
 a-i angulus internus.  
 a-s angulus scutellaris.  
 ab abdomen.  
 ant antenna.  
 ap apodeme.  
 b coxal cleft.  
 ba basalar plate.  
 bc bulb of antenna.  
 bu bucculæ.  
 c clypeus or tylus.  
 ca costa.  
 ca-a costa apicalis.  
 ca-c costa connectens.  
 ca-d costa decurrens.  
 ca-l costa lineatæ.  
 ca-p costa primaria.  
 ca-r costa radiantens.  
 ca-s costa subtensa.  
 cc cenchri.  
 cl clavus.  
 cm commissura.  
 co coxa.  
 cr corium.  
 cu cubitus.  
 d parapsidal furrows.

e eyes.  
 em embolium.  
 epm epimeron; mesothoracic epm = scapula; metathoracic epm = pleurum.  
 eps episternum.  
 f frons.  
 fe femur.  
 fm frenum.  
 fr fulcrum, jugum or zygum.  
 fw fore wing.  
 gula.  
 hw hind wing, ala.  
 la lateral appendages, styli.  
 lab labium, rostrum, vagina.  
 lbr labrum.  
 m maxillary setæ.  
 m-f median furrow.  
 m-s margo scutellaris.  
 md mandibular setæ.  
 me median vein.  
 ml maxillary laminæ, gena postica.  
 mta metatarsus.  
 mu mucro.  
 n salivary canal.  
 no notum.  
 o prealar bridge.  
 oc ocelli.  
 occ occiput.  
 om omium.

p	suction canal.	s-m	sutura membranæ.
pg	pygidium.	sa	scape.
phr	phragma.	sc	scutum.
pl	pleuron; abdominal pleuron = connexivum.	sca	subcosta.
pp	Hypopygium.	sc	scutellum.
psc	prescutum.	sg	scent glands.
psct	postscutellum.	sp	spiracles, stigmata.
pu	pulvillus.	st	sternum.
r	ring joints.	t	tibia.
r-m	connecting vein between ra and me.	ta	tarsus.
ra	radius.	ti	trochantin.
rc	rectal caudæ.	tr	trochanter, fulcrum.
s	setæ.	u	ungula.
s-c	sutura clavi, anal furrow.	ua	unguicula.
		v	vertex, cranium.

## EXPLANATION OF PLATES.

## PLATE LV.

- Fig. 1. Lateral view of head, thorax and first segments of the abdomen.  
 Fig. 2. Cross section of the mandibular and maxillary setæ.  
 Fig. 3. Lateral view of a tarsal claw and the adhesive pad or modified pulvillus lying beneath it.  
 Fig. 4. Lateral view of the meso- and metathorax, as seen looking obliquely backward, the prothorax being removed and the wings raised and the abdomen abnormally extended to show the spiracle on the first segment.  
 Fig. 5. Dorsal view of the abdomen. The female genitalia are not extended.

## PLATE LVI.

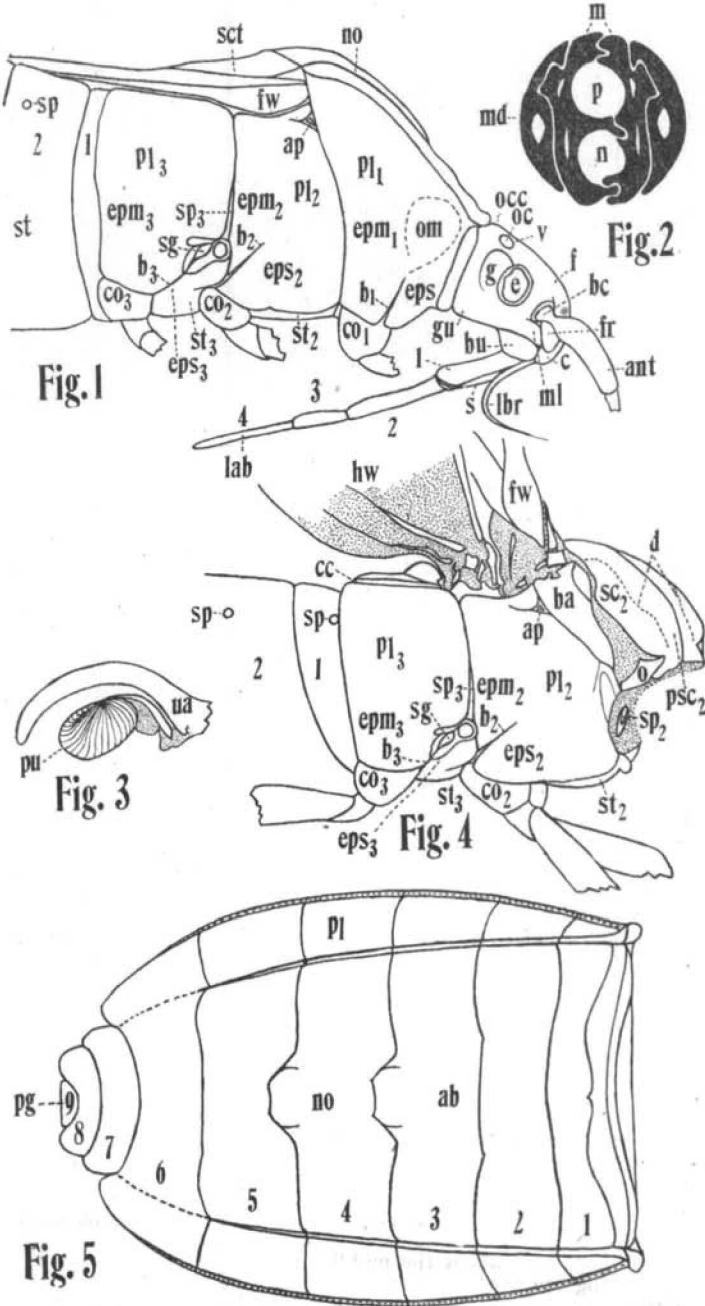
- Fig. 6. Maxillary setæ showing fluted and piercing tips; (see fig. 2 cross section of maxillary setæ).  
 Fig. 7. Mandibular setæ showing barbed and piercing tips.  
 Fig. 8. Cross section of labium at the tip showing how the setæ are supported.  
 Fig. 9. Coxa and trochantin.  
 Fig. 10. Dorsal view of the meso- and metathorax with the wings extended.  
 Fig. 11. Lateral view of the male genitalia extended.  
 Fig. 12. Ventral view of the male genitalia normally retracted.  
 Fig. 13. Typical leg.  
 Fig. 14. Lateral view of female genitalia normally retracted.

## PLATE LVII.

- Fig. 15. Dorsal view of male genitalia extended.  
 Fig. 16. Antenna.  
 Fig. 17. Ventral view of the insect showing female genitalia.  
 Fig. 18. Lateral view of female genitalia extended.

## PLATE LVIII.

- Fig. 19. Fore wing.  
 Fig. 20. Hind wing.  
 Figs. 21-24. More or less diagrammatic.  
 Fig. 21. Cross section of second segment of the labium, showing the position of the setæ.  
 Fig. 22. Cross section at the tip of the first segment of the labium, showing the position of the setæ.  
 Fig. 23. Cross section at about the middle of the first segment of the labium, showing the position of the setæ.  
 Fig. 24. Cross section at the base of the labrum, showing how the setæ are supported.



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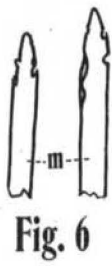


Fig. 6

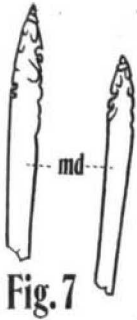


Fig. 7



Fig. 8

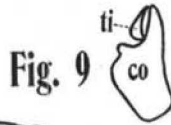


Fig. 9

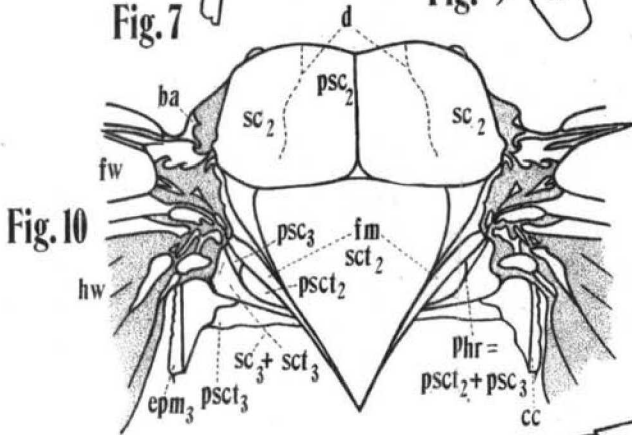


Fig. 10

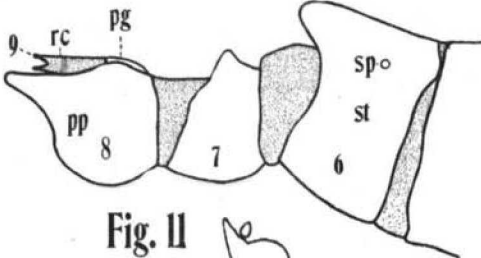


Fig. 11

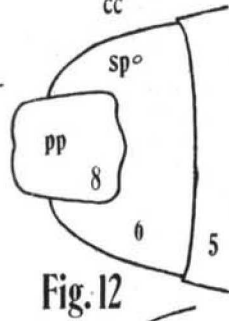


Fig. 12

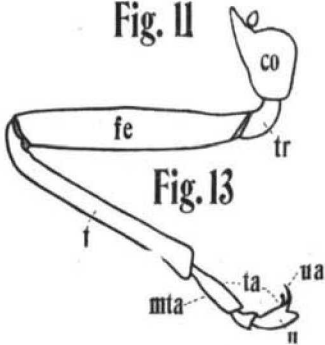


Fig. 13

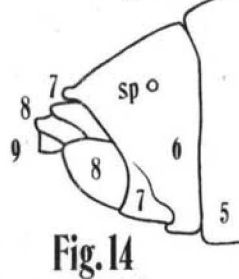
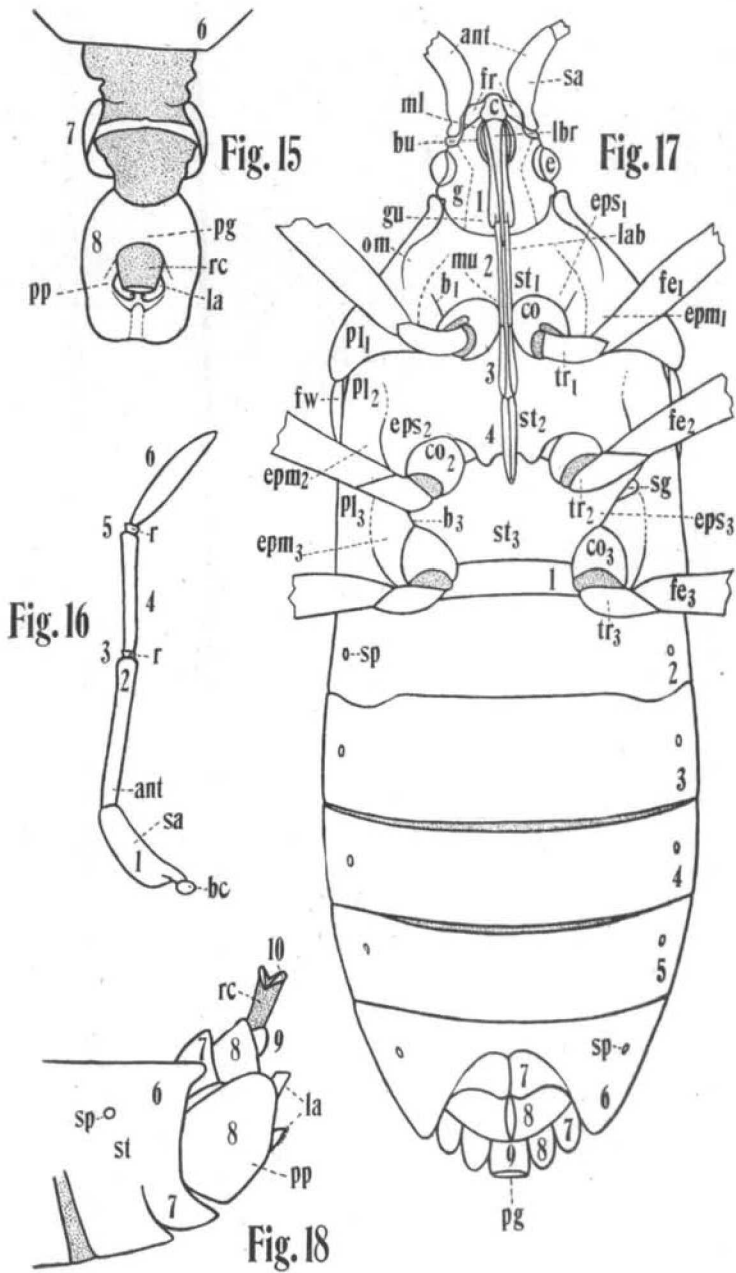


Fig. 14



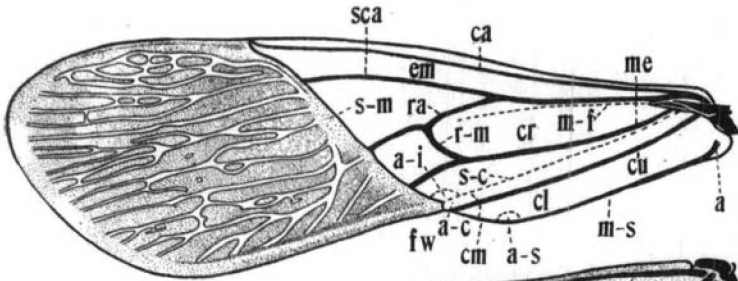


Fig. 19

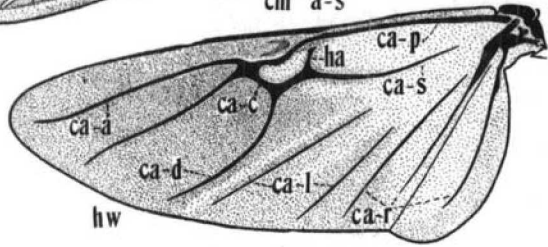


Fig. 20

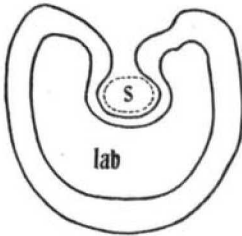


Fig. 21

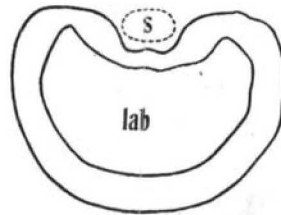


Fig. 23

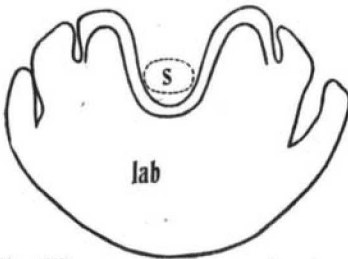


Fig. 22

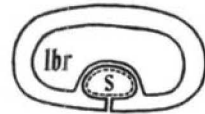


Fig. 24