THE EXTERNAL ANATOMY OF THE FOUR-LINED LEAF BUG, *POECILOCAPSUS LINEATUS* FAB.

by

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I. FOREWORD.

The scope of this thesis is restricted to the external anatomy of the adult of the four-lined leaf bug, Poecilocapsus lineatus Fab. (I798). The writer had a taxonomic interest in the Miridae, and selected this species for a morphological study because it is a large and well-known form, and may be considered typical of the family. Its heavy sclerotization and relative lack of pigmentation render it particularly suitable for such a study.

A search of the literature showed that no paper dealing with more than certain phases of mirid anatomy had been published. Most of these have to do with the mouthparts and the mechanism of feeding. Hoke (I926) has described the venation of the mirid hindwing; Brindley (I938) has discussed the first abdominal sternum; Singh-Pruthi (I925) has figured the male genitalia of several species and Johnson (I932) has published a paper on the ovipositor of Notostira erratica L. The remaining articles and references are brief and lacking in detail.

In describing the male genitalia of Poecilocapsus lineatus, the writer has adopted Singh-Pruthi's (I925) terminology; otherwise the terms used by Snodgrass in his Principles of Insect Morphology and as far as practical, his system of symbols, have been followed throughout. The use of several different magnifications with the various figures,

Plates I-VI, could not be avoided, but related figures have been drawn to the same scale. Ocular micrometers were employed in all cases.

Preliminary to dissection, specimens of the insect were immersed in a five per cent. solution of cold potassium hydroxide for I2 to 24 hours, washed, dehydrated in alcohol and then stained. Specimens were dissected and examined, for the most part, in euparol; this material was contained in a small glass ring which had been cemented to a slide with paraffin. Two or three drops of alcohol were added from time to time during dissection, and as the euparol thickened, a semi-permanent mount was formed. Obvious advantages resulted from the use of this method , but it necessitated heavy staining of the specimens. For this purpose Delafield's haemotoxalyn proved most effective, though gentian purple was superior with the membranous parts of the male genitalia, the tentorium and certain head structures.

II. THE HEAD AND ITS APPENDAGES.

A. Gross External Structure of the Head.

In Poecilocapsus lineatus the head sutures are suppressed or entirely obliterated; consequently, the cranial areas are obscure. Anteriorly, the head bears a prominent convex plate --- the anteclypeus (Aclp), directly below which is the slender, tapering labrum (Lm). The anteclypeus, (the

"tylus" of heteropterists), is not delineated from the postclypeus, and the latter area, in turn is continuous with the frons (Fr).

On the sides of the head, below each compound eye, are two paraclypeal lobes or plates. The anterior, and more dorsal, sclerite has a connection with the mandible; consequently, it has been termed the mandibular plate (MdPl), while the second sclerite is the maxillary plate (MxPl). The mandibular and maxillary plates are known taxonomically as the "jugum" and the "lorum".

The mandibular plate is separated from the anteclypeus by a deep cleft, and from the maxillary plate by a membranous groove. The posterior portion of the latter sclerite is continuous with the gena. On the ventral surface of the head the fused sub-genal areas form the sclerotic hypostomal bridge (Hst), or so-called "gula". The hypostomal area adjacent to the base of the labium, is differentiated into two small plates or bucculae (buc), which serve to protect the membranous base of the beak.

The beak is formed of the four-segmented labium (Lb), the short labrum and the paired mandibular and maxillary stylets (MdB and MxB). The stylets lie in a membranous groove on the anterior face of the labium; they arise from the interior of the head and emerge between the inner surfaces of the maxillary

plates. As they enter the groove of the labium, they become adherent to one another in a compact bundle; the mandibular, or anterior, stylets are slightly serrated at their apices, while the maxillary, or posterior, stylets taper to fine points. Within the labium, the inner faces of the latter bristles are closely interlocked.

The antennae (Ant) are four-segmented and almost linear. The compound eyes (E) are large and project prominently from the head. Ocelli are absent.

B. Detailed Structure of the Head.

(a). The sutures and areas of the cranium. Few of the sutures, which are distinctive features of the more generalized insect head, are to be found on the cranium of Poecilocapsus lineatus. The external groove of a submarginal ridge which reinforces the antennal socket (ASc) may be termed the antennal suture, while a subantennal suture extends from the lower corner of the antennal socket to the ventral margin of the compound eye. Ocular sutures surround the latter organs and form strong internal ridges; those which arise on the posterior margins of the eyes are produced dorsad, for some distance, to brace the laterodorsal walls of the head. The remaining sutures are peculiar to Hemiptera.

The most conspicuous of these is the deep cleft between the lateral walls of the anteclypeus, and the anterior margins of the mandibular plates. If the latter sclerites are removed, it will be seen that the cleft is coincidental with

a suture which marks the union of the anteclypeus with the lateral walls of the sucking pump (Fig. 6, Pmp). A second prominent groove separates the mandibular and maxillary plates, while a short cleft occurs at the juncture of the maxillary plates and the bucculae.

The frons in Poecilocapsus lineatus may be defined only as an indefinite area situated between the postclypeus and the vertex. As indicated, (Fig. 5, Fr), it is located far back on the head, and has been displaced and almost obliterated by the former area. The vertex (Vt) is the part of the cranium between and behind the compound eyes.

No trace of the occipital suture survives, so the boundaries of the occiput cannot be determined. The postoccipital suture also is absent, but in this case the posterior pits (Figs. 3, 5, pt) of the tentorium may be used as a land mark in locating the postoccipital area. The latter is the region above and behind the pits, which are situated relatively high on the lateral walls of the head. The postoccipital ridge (Figs. I, 3, PoR) is well developed and is almost completely divided into two strong apodemal plates.

The ventral wall of the head is formed from mesal extensions of the hypostomal areas, which have fused ventrally to form the hypostomal bridge (Figs. I, 5, Hst). Consequently, the large occipital foramen (Figs. I, 3, For) is completely posterior. The hypostomal bridge, or hypostoma, in Hemiptera

is usually, though erroneously, termed the "gula".

The remaining areas, sclerites and appendages of the head will be discussed separately in more detail.

(b). The clypeal region. The "tylus" of Heteroptera has been interpreted as the labrum, the clypeus and the anteclypeus It seems generally accepted that the clypeus is the region of the head on which the dilator muscles of the sucking pump take their origin. In Poecilocapsus lineatus these muscles arise far back on the head, between and posterior to the antennal sockets. The clypeus, (or postclypeus), in this insect, then, is dorsal, and has displaced and almost obliterated the frontal area. Obviously, the "tylus" cannot be the main body of the clypeus; it is either the anteclypeus or the labrum. If it is the latter, the small lobe hanging below it (Figs. 4, 5, Lm) is the "epipharynx", and this term usually is applied to this structure in Heteroptera. However, Snodgrass (1935) considers a small preclypeal plate in the head of the cicada to be the anteclypeus; this sclerite appears to be homologous with the "tylus" of Poecilocapsus lineatus, and the writer has adopted that interpretation. Certainly, the conical structure (Lm) in the Miridae, resembles the labrum of the more generalized forms, more closely than it does an epipharyngeal lobe.

The anteclypeus in Poecilocapsus lineatus is a prominent, hollow, convex plate. Dorsally it is continuous

with the postclypeus, and ventrally it supports the labrum. Posteriorly, its concave surface forms the anterior wall of the functional mouth (fm), while laterodorsally it bears the lateral walls of the sucking pump.

(c). The labrum. The labrum (Figs. 4, 5, 6, Lm) is a small, conical structure suspended by membrane from the tip of the anteclypeus. Its anterior surface is convex, while its posterior surface is concave; when the latter surface is opposed to the anterior surface of the first labial segment, a closed tube is formed for the protection and support of the stylets. As mentioned, in Heteroptera, the entire organ usually is termed the "epipharynx".

(d). The labium. The labium (Figs. 4,5,Lb) in Poecilocapsus lineatus is a four-segmented hollow structure, suspended from the lower extremity of the cranium by the membranous base of its first segment. On its anterior surface, the first segment is firmly hinged to the anterior face of the bucculae. The labium appearsmore or less rigid, but minute, intersegmental, hingelike structures on the interior surface of the posterior wall, suggest that the segments are capable of some movement. The tip of the fourth segment is divided into two lobes, which from their structure, would indicate that they aid in keeping the tip of the labium firmly applied to the surface on which the insect is feeding; apparently, the function of the labium is that of guiding and supporting

the stylets.

The anterior surface of the labium in Poecilocapsus lineatus has a median, membranous depression which forms a trough in which the stylets lie when at rest. This groove is lacking in the first segment, and is most pronounced in the fourth.

The morphology of the hemipterous labium is not understood, but according to Snodgrass (I935), the principal part probably consists of the prelabium alone, the postlabium being represented by the basal segment, or by the ample membranous area at the base of the organ.

(e). The mandibular plates. One of the problematical points in the morphology of the hemipterous head is the nature of the sclerites (MdPl), which in Poecilocapsus lineatus, lie on either side of the anteclypeus. They have been termed the "lora", "juga", "paraclypeal lobes" and mandibular plates. The terms "lora" and "juga" are undesirable since, not only are they without morphological significance, but "juga" is used taxonomically to indicate the maxillary plates (MxPl). Snodgrass (I935) accepts the term mandibular plates, since in Hemiptera in general, the protractor muscles of the mandible are attached on their inner surfaces, and the writer has followed this usage.

The mandibular plates have been referred to the mandibles, to the genae and to the clypeus by different authors.

Recently, two writers, Evans (I938) and Spooner (I938), have arrived at the conclusion, independently, that these sclerites are secondarily detached parts of the postclypeus. Snodgrass (I938) points out that " neither writer has given due consideration to the facts that the lower ends of the sclerites are directly continuous beneath the anteclypeus with the body of the hypopharynx, and that their lateral areas give attachment to the protractor muscles of the mandibles." Snodgrass assumes that these sclerites are morphologically, as well as anatomically, lateral expansions of the hypopharynx.

In Poecilocapsus lineatus the posterior edge of each mandibular plate is inflected, and the inflected portion is produced anteroventrad into a tapering area (Figs. 6, 7, br) which is joined to the hypopharynx (Hphy). These bridge-like, triangular areas are lightly-sclerotized, and somewhat more loosely connected with the hypopharynx than with the mandibular plates --- that is, the bases of the "triangles" are fused with the latter structures. However, their apices undoubtedly are continuous with the hypopharynx, so anatomically, the mandibular plates might well be termed "lateral expansions" of that organ.

An examination of the tentorium in Poecilocapsus lineatus discloses evidence which favours the hypopharyngeal theory of the origin of the mandibular plates. Filamentous, median extensions (Figs. 8, 9, IO, MT) of the main arms of the

tentorium are fused with the triangular, plate-like areas (br) which connect the mandibular plates and the hypopharynx, and these tentorial structures also are firmly joined to the tip of the hypopharynx. The fact that the tentorium has a common connection, both with the hypopharynx and the mandibular plates, lends support to Snodgrass's contention.

(f). The maxillary plates. The second pair of paraclypeal sclerites (Figs. 4, 5, 9, MxPl) are located below, and somewhat posterior, to the mandibular plates --- above the bucculae and continuous with the genae. In an untreated specimen of Poecilocapsus lineatus, they are convex and plate-like; in a specimen which has been soaked in caustic potash they appear merely as the flattened, anterior areas of the genae. Their posterior margins are delineated by a fold, or a line which is too faint to be termed a suture (Fig. 5, indicated by a broken line). The definite suture separating the maxillary plates from the mandibular plates, actually is a membranous groove, and the two pairs of sclerites separate readily during dissection. Ventrally, a short cleft marks their union with the bucculae.

When viewed from the anterior, the lower extremity of each maxillary plate is inflected, and the inflected area is produced into a small appendicular lobe (Figs. 9, IO, mx) In Poecilocapsus lineatus these lobes are tapering and heavily

sclerotized. Their tips almost meet, so, in conjunction with the median hypopharyngeal structure, the maxillary lobes form the lower posterior wall of the functional mouth (Figs. 6, 10, fm). In Hemiptera, these lobes and the surrounding portions of the maxillary plates, have been shown, from embryological evidence, to be the basal parts of the maxillae fused with the lateral walls of the head. The remainder of the sclerites usually is considered to be the genae.

(g). The bucculae. The lower extremity of the cranium in Hemiptera, is differentiated into two, small, plate-like structures known as bucculae (Figs. 1, 3, 5, buc), whose function apparently is to protect the membranous base of the labium. In Poecilocapsus lineatus they are not well-developed, and are only partially separated ventrally. Lateroventrally, they are continuous with the hypostomal bridge. Dorsally, a short cleft marks their union with the maxillary plates. This cleft is produced posteriorly, into a fold which has not been indicated in Fig. 5. The area above this fold may be considered the gena and the area below, the hypostomal bridge, although this division is purely artificial. Anteriorly, the lower extremities of the bucculae are produced until they meet, and the narrow bridge so formed, supports the anterior face of the first labial segment.

(h). The mandibular and maxillary setae. The structure of the mandibular and maxillary bristles was not

fully investigated by the writer --- that is, no "cross sections" were made. However this is one phase of mirid anatomy which has been dealt with in detail, by other writers. Several articles and diagrams in this connection have been published, and it seems unlikely that the feeding bristles of Poecilocapsus lineatus would differ much from the usual type.

The mandibular, anterior, or lateral stylets (MdB) are slightly serrated at their apices, while the maxillary, posterior, or median stylets (MxB) taper to fine points. The latter pair are somewhat thicker and are interlocked throughout the greater part of their length---that is, from the point where they emerge from the interior of the cranium, between the inner surfaces of the maxillary plates. The mandibular pair are free, and on emerging from the cranium, take up a position at the sides of the maxillary stylets. Both pairs of bristles are slightly expanded at their bases. The mandibular stylets arise from a sickle-shaped, plate-like structure, (mdl), which is articulated with the lateral wall of the skull, near the lower corner of the antennal socket. Snodgrass (1935) states that the mandibular bristles in Hemiptera, are articulated with the lateral margins of the mandibular plates. Such is not the case in Poecilocapsus lineatus. The point of articulation is on the border between the mandibular and maxillary plates - if anything, on the side of the latter (Fig. 10). That is, the mandibular plates may be dissected away from the cranium, leaving the mandibular bristles

firmly attached to the bases of the maxillary plates (Fig. 9). So aside from their musculature, (not investigated by the writer), the mandibular stylets in Poecilocapsus lineatus have no connection with the dorsal pair of paraclypeal sclerites.

The plate-like structure (mdl) from which each mandibular bristle arises, consists of a sickle-shaped, sclerotized rod, and a median area which is membranous or lightly sclerotized. There is nothing to indicate whether this, and the corresponding structure in the case of the maxillary bristle, are parts of the bristles themselves; the writer presumes they are not, since they are lightly attached to the bases of the bristles, and firmly attached to the wall of the cranium.

Each maxillary bristle arises from a sclerotized rod (Figs. 8, 9, mxl) somewhat posterior to the point of origin of the former bristles. The sclerotized rod tapers slightly, and is firmly secured to the surface of the main arm of the tentorium --- at a point opposite the dorsal arm, and at right angles with the main structure.

(i). The hypopharynx and the functional mouth. The hypopharynx (Figs. 6, 7, Hphy) in Poecilocapsus lineatus, is a heavily sclerotized, plate-like structure, the basal portion of which is continuous with the ventral wall of the sucking pump. Its extreme tip is bi-lobed, and situated between the two lobes is a minute, tongue-like organ (Fig. 7, hyph) whose function

probably is sensory. The tip of the hypopharynx is fused with the bridge-like extensions (br) of the mandibular plates. When viewed from the anterior, the free tip of the hypopharynx projects downwards between the edges of the maxillary plates; the triangular extensions of the mandibular plates take up their position at its sides, and the median area between the former sclerites is closed by the three structures. Below this again, are the maxillary lobes. Thus, the posterior wall of the functional mouth (Figs. 6, 7, 10, fm) is formed dorsally by the tip of the hypopharynx combined with the lateroventral extensions of the mandibular plates, and ventrally, by the paired maxillary lobes. The anterior wall of the functional mouth is the concave, posterior wall of the anteclypeus, and the latter is continued dorsad to form the roof of the sucking pump.

The functional mouth, then, is simply a cavity, formed by the apposing surfaces of these structures, which is continuous with the lumen of the sucking pump. According to Snodgrass (1935) the chamber of the sucking pump in Hemiptera represents the preoral cibarium of orthopteroid insects; the true mouth is the posterior opening of the pump into the stomodaeum.

(j). The tentorium. The tentorium (Figs. 6, 7, 8, 9, 10) in Poecilocapsus lineatus consists of large, ribbon-like, paired lateral structures, two dorsal arms and a pair of thread-like, median arms. The three pairs of tentorial structures

will be termed the lateral arms (LT), the dorsal arms (DT) and the median arms (MT). It is probable that the lateral arms consist of the fused, definitive anterior and posterior arms, and that the dorsal and median arms are secondary outgrowths of the definitive anterior arms. The lateral arms are conspicuous, fairly heavily sclerotized, and extend from the anterior tentorial pits (Fig. 9, at) to the posterior tentorial pits (Figs. 3, 5, 10, pt). The former pits are located at the sides of the maxillary lobes; the latter are situated in the postoccipital region of the laterodorsal wall of the cranium. The lateral arms are flattened throughout the greater part of their length, but in the vicinity of the dorsal arms, are somewhat trough-like. A permanent fold occurs along the median margin of the anterior half of each lateral arm, and this fold has given rise to a flap-like, less heavily sclerotized area which rests upon, or is lightly attached, to the dorsal wall of the salivary syringe (Fig. 9, Syr). The more heavy sclerotized area at the side of the flap, is attached to the anterior tentorial pits.

The dorsal arms arise from the lateral arms midway between the anterior and posterior tentorial pits. They are slender and taper to fine filaments, which, in a specimen which has been treated with caustic potash, float free in the lumen of the head--that is, there is no direct union with the body wall. Apparently, the filaments are attached to muscle

fiber or connective tissue lining the dorsal wall of the cranium, near or within the margin of the compound eye. Judging from their positions, the dorsal arms may have some relation with the maxillary rods.

The median arms are thread-like, and invisible unless stained. They arise from the lateral arms slightly posterior to the maxillary rods, and extending forwards, expand into paired sheets of membrane, which mesad, are securely fastened to the ventral edge of the hypopharynx, and laterad, are continuous with the inflected edges of the mandibular plates. The two plates (Fig. 7, mt) at the posterior ends of the median arms, are merely their expanded ends which are inserted into the lateral arms.

The tentorium of Poecilocapsus lineatus departs considerably from the usual hemipterous type, but obviously there is much variation throughout the order. Muir (1929) points out that the "large" arms do not arise from the "anterior portion of the head capsule", but from the hypopharynx. Possibly Muir uses the term "hypopharynx" in a broad sense--to denote an area corresponding to the ventral margins of the maxillary plates, beside the maxillary lobes, in Poecilocapsus lineatus. Muir notes further that "the lateral portions of their walls may be formed from the maxillary plates, as their openings are beside the maxillary plates and the maxillary setae are in intimate relation to them". This statement supports the writer's observation

that in Poecilocapsus lineatus, the anterior tentorial pits are located not on the hypopharynx, but on the maxillary plates themselves.

(k). The sucking pump. The chamber of the sucking pump (Figs. 6, 7, 8, Pmp) is a heavily-sclerotized, trough-like structure which extends almost the full length of the head. Anteriorly, its lateral walls are separated from the anteclypeus by a conspicuous suture--coincidental with the suture which delineates the anterior margins of the overlying, mandibular plates. Ventrally, it is fused with the base of the hypopharynx, and posteriorly, it is continuous with the stomodaeum.

The dorsal wall of the sucking pump is flexible, and is deeply invaginated into the lumen of the chamber. In a specimen which has been treated with caustic potash, the midline of the dorsal wall exhibits a prominent row of bristle-like structures; the latter obviously are apodemes for the attachment of the dilator muscles of the pump. These apodemes are semi-rigid, and the direction in which they are pointed is constant; thus, it was possible for the writer to interpret the clypeal region of the cranium without investigating the musculature.

(l). The salivary syringe. The salivary syringe, or salivary pump (Figs. 9, 10, Syr) in Poecilocapsus lineatus, is a small, hollow, cup-shaped organ situated between the lower extremities of the maxillary plates. Its kidney-shaped outlet opens directly behind the maxillary lobes, so that the latter

appear like flaps, or gates to regulate the flow of the salivary secretions. The walls of the organ are heavily sclerotized, and its wider end is deeply invaginated. Within its lumen is a piston (ptn) which terminates in an apodeme for the attachment of muscles, while on its ventral surface, a small hummock receives the duct of the salivary glands.

In general, the salivary syringe in Poecilocapsus lineatus resembles that of the cicada, as described by Snodgrass (1935); but there are these differences. The syringe in the latter insect, discharges to the exterior through an outlet tube opening on the tip of the hypopharynx; further, the entire organ is well above the maxillary lobes. In Poecilocapsus lineatus there is no outlet tube; the syringe has no connection with the hypopharynx and it is situated somewhat lower in the head. As has been mentioned, flap-like areas of the "lateral" tentorial arms rest upon, or are lightly attached, to its dorsal surface.

Snodgrass (1935) states. "Morphologically, there can be little doubt that the syringe, (in Hemiptera), is a highly specialized development of the salivary pocket, or salivarium of Orthopteroid insects."

(m). The compound eyes and the antennae. The compound eyes (Figs. 1-5, E) in Poecilocapsus lineatus are large, oval and many-faceted. One third of the surface is devoid of ommatidia; this non-faceted area (Figs. 1, 3, nfa) occurs on the inner, posterior face of the eye, and extends ventrad for some

distance. Internally, a heavy skeletal ridge surrounds the edges of the eye, and, on the posterior margin, this ridge is produced dorsad to brace the wall of the cranium.

The antennae (Fig. 37, Ant) are four-segmented and almost linear. The basal segment is almost bare, but the remaining three are thickly clothed with hairs. Segments three and four, particularly the latter, have a tendency to break up into innumerable rings when soaked in caustic potash.

III. THE NECK.

The neck or cervix in Poecilocapsus lineatus is membranous, devoid of sclerites and entirely concealed within overlapping parts of the head and prothorax.

IV. THE THORAX AND ITS APPENDAGES.

The thorax in Poecilocapsus lineatus is distinctly divided into a prothoracic part and a meso-metathoracic part or pterothorax. The writer has found it convenient to follow this natural arrangement, and in the description which follows, as well as in Figs. 11-20, Plates II, III, the prothorax and pterothorax have been dealt with as separate entities.

A. The Prothorax.

The episternum and epimeron of the prothorax are separated by the pleural suture, and the sternum is differentiated into basisternal and sternellar areas; otherwise the sclerites of this segment are solidly and indistinguishably fused. Sternum

and episternum are much reduced in size, so notum and epimeron, together, constitute by far the greater part of the prothoracic exoskeleton.

(a) The notum. The notum (Figs. 11-14, T) is much expanded, and of one piece. Elevations or "callosities" of taxonomic import, occur on its surface, and its anterior margin forms the roof of the prothoracic "collar", but neither externally nor internally does it bear any sutures or ridges. Posteriorly, it overlaps and almost covers the scutum (Sct_2) of the following segment, while laterally, a very definite ridge (Fig. 11 indicated by a broken line) is formed by its union with the pleuron. Anteriorly, the notum is continuous with the episternum (Figs. 11, 12, 13, Eps).

(b) The pleuron. The pleuron is penetrated by the coxal cleft for only a short distance, but there is a well-defined pleural suture (Figs. 11, 13, PlS) and its internal inflection, the pleural ridge (Fig. 14, PlR). The ridge itself is half-moon-shaped, but the medium area of its face is extended into an apodemal process, the pleural apophysis (Figs. 12, 14, PLA), which projects inwards and downwards until it almost meets the corresponding, sternal apophysis, (SA). The episternum is small, and is fused with the basisternum (Bs) to form a single, triangular plate (Fig. 13). Consequently, the enlarged epimeron (Epm) constitutes the greater part of the pleuron, and since it is inflected ventrad and mesad, much of the venter is formed by this sclerite. Its

lower extremity is produced into a very narrow postcoxal bridge, or postcoxale (Figs. 12, 13, 14, Pcx) which is united with the sternum. Laterally and ventrally, the epimeron partially overlaps the episternum of the mesothorax.

(c). The sternum. The sternum (Fig. 12) is a small area lying between the coxal cavities. A less heavily sclerotized part, adjacent and caudad to the pits (sa) of the sternal apophyses, may be considered the sternellum (sl), while anterior to, and separated from the latter by a suture, is the basisternum. The basisternal area is triangular, and is produced posteriorly into a cone-like swelling known taxonomically as the "xyphus"; the ridge of the "xyphus" has been indicated by a broken line in Fig. 12, and behind this ridge, the basisternum is inflected dorsad to meet the sternellar area. On its lateral margins, the sternellum bears a pair of short but heavy, sternal apophyses, (Figs. 12, 14, SA), the pits (Fig. 12, sa) of which are oval and relatively large. Behind the pits, the sternellum is produced laterad to fuse with the narrow, postcoxal bridge (Pcx).

It is difficult to determine the posterior limits of the sternellar area in an unstained specimen, but a suitable stain shows that the boundary between that sclerite and the intersegmental membrane (Fig. 12, Mb) is sharply defined. Caudad to the sternellum, the intersegmental membrane has a small, conical, membranous inflection, and a corresponding but less-pronounced, median process occurs at the point of its attachment

with the notum. The ventral inflection possibly represents a spina, and the membranous area surrounding it, a degenerating spinasternum. The membrane is secured to the epimeron slightly posterior to the pleural ridge, and bears the first thoracic spiracles (Sp) on its lateroventral areas; the spiracles are circular and large, and since the epimeron overlaps the mesoepisternum, they are protected by the former sclerite.

The coxal cavities (CxC) are smaller and more circular than those of the pterothorax, and their edges are stronger and more deeply inflected. The fused episterna and basisternum, or precoxal bridges, are thrown up into prominent strengthening folds along their anterior margins. A rudimentary trochantin (Fig. 12, Tn) is present, but it is so reduced that it might easily be overlooked; it is loosely joined to the pleuron, and so firmly connected with the coxa, that it is almost an impossibility to detach the one without the other.

B. The Pterothorax.

(a). The mesonotum. In Poecilocapsus lineatus the mesothorax has developed at the expense of the metathorax--dorsally, in particular. The mesonotum (Fig. 17) consists of prescutum ($Prsc_2$), scutum (Sct_2), scutellum (Scl_2) and post scutellum ($Pscl_2$), and these four sclerites constitute the greater part of the pterothoracic dorsum. The scutum and the median prescutum form a quadrate plate, separated from

the triangular scutellum by the scutoscutellar suture (vs). From the anterior margin of the quadrate plate, a pair of notaulices (no) converge towards a median suture (ms), and terminate midway in the scutal area. The nature of these notaulices is controversial. Some entomologists have regarded them as homologous with the parapsidal furrows of Hymenoptera, while others consider them to be discontinuous, median parts of the transverse prescutal suture, turned posteriorly. If the latter is correct, the prescutum is the area between.

The flaw in this interpretation, according to Snodgrass (1935), is that "in some insects as in the Tenthredinidae, both the transverse prescutal suture, and the convergent sutures (notaulices) are present, showing that the area between the latter belongs to the scutum". However, it is the usual custom to regard this median area as the prescutum, and the writer has followed suit. Actually, there is some evidence in Poecilocapsus lineatus, that these notaulices are parts of the prescutal suture; in a cleared specimen, the internal ridges (Fig. 16, indicated by a dotted line) which form the notaulices may be traced ventrad through the phragma (IPh), and laterad to the borders of the prealar ridges (Pra_2), and it is from these sclerites that one would expect the prescutal suture to arise normally.

The broad plate formed by the prescutal and scutal areas is strengthened, internally, by three longitudinal ridges, (formed by the notaulices and median suture), and is protected

externally, by the overlapping pronotum. Only the deflected, posterior section of the plate is visible when the prothorax is undetached, and as might be expected, this region is more heavily sclerotized than the anterior section. Each anterior, lateral angle of the scutum is produced into a prealar bridge, or prealare (Figs. 15, 16, 18, Pra$_2$), that extends ventrad to the episternum (Eps$_2$) and thus supports the notum. Behind the prealares occur a pair of triangular plates (pra$_2$), which are lightly sclerotized and have somewhat indefinite boundaries; apparently their function is that of strengthening the membranous areas anterior to the forewings. On its alar margins the scutum bears the anterior notal wing process (Figs. 15, 17, ANP) and the posterior notal wing process (PNP), and a cleft occurs between the two. This cleft is produced into a reversed notal suture (Fig. 17, rvs) which has no internal ridge; evidently, the sclerotization of the cuticula has become secondarily discontinuous along this line, in order to give flexibility.

Anterior to the prescutum, and separated from it by the antecostal suture (Fig. 16, acs), is a very narrow acrotergite (atg). The latter bears a phragma (Figs. 16, 18, IPh), which is divided into halves by the median suture (ms) and its internal ridge.

Other than the deflected, posterior region of the scutum, the triangular, dorsal surface of the scutellum is the only area of the alinotum visible when the wings are folded over the back of the insect. The scutellum is arched and very

heavily sclerotized. A narrow, marginal fold (Figs.15, 17, scl$_2$) extends almost the full length of the main sclerite, and then is produced laterad to become joined to the inner surface of the episternum (eps$_2$). This extension of the mesoscutellum, in the squash bug, Tower (1914) terms the "frenum". Where it crosses the postalare (Pa$_2$) it is secured to the anterior margin of that sclerite, and somewhat beyond this point, it is expanded into a small plate which gives attachment to the final sclerite of the axillary cord (Fig. 35, AxC).

The postscutellum (Figs. 15, 17, 19, 20, Pscl$_2$) is a broad, horseshoe-shaped sclerite, deeply concave on its inner face, but only partly visible externally. It bears the second phragma (Figs. 19, 20, 2Ph) on its ventral margin, and from its lateroventral angles are produced a pair of heavy, tergal apophyses (TA$_2$). The postscutellum is separated from a strong postalar bridge, or postalare (Figs. 15, 17, 20, Pa$_2$), by a suture. Externally, the latter sclerite is joined to the metabasalare (Figs. 15, 17, Ba$_3$), but internally, it is produced lateroventrad underneath this sclerite, so that the two form a cylindrical bridge (that is, there is a space between the basalare, and the internal extension of the postalare). Anteriorly, the inner face of the postalare is extended forwards to form a bridge (Fig. 20, br) which is fused with an internal ridge of the mesoepimeron; posteriorly, it is produced ventromesad into an arch which extends to the tergal apophysis, and here it unites

with that structure and the second phragma.

(b). The mesopleuron. The mesopleuron is simple in its structure. A well developed pleural suture (Fig.15, PlS_2) separates it into a large episternum (Eps_2) and a relatively narrow epimeron (Epm_2). The pleural suture forks dorsad and cuts off an episternal subdivision (eps_2), while on the latero-dorsal margin of the epimeron, a lobe-like division (epm_2) of that sclerite is connected with the basalare (Ba_3) of the following segment. Dorsad, the episternum in conjunction with the narrow dorsal edge of the epimeron, supports the pleural wing process (WP_2), while ventrad, it is continuous with the basisternum (Bs_2).

The inflected pleural ridge of the pleural suture expands into a large plate-like apodeme (Fig. 15, indicated by a dotted line) which bears a small, inward-projecting, pleural apophysis; It is the ventral margin of this apodeme which forms externally the anterior fork of the pleural suture. Dorsad, the apodeme narrows and is produced into the heavily sclerotized, pleural wing process. The dorsal, or anterior edge of the episternal subdivision (eps_2), is inflected into an internal ridge; the latter is narrowed posteriorly, but flattened and expanded anteriorly into an apodeme which is fused with the anterior edge of the episternum. Internally, the epimeral subdivision (epm_2), along the suture which delineates it externally, projects slightly forwards and inwards to form a horizontal ridge, and the dorsal part of this ridge

is fused with the bridge (Fig. 20, br) which is an internal extension of the mesopostalare.

Besides this internal, bridge-like device which interlocks mesoepimeron and mesopostalare, a small lobe (Fig. 17, e) on the anterior margin of the metabasalare (Ba_3) is continuous with the dorsal edge of the epimeral subdivision (epm_2), and, as will be shown later, an extension of the metabasisternum (Bs_3) projects dorsad under the inflected edge of the mesoepimeron, and is joined to that sclerite internally. Thus, the two segments of the pterothorax are securely fused, and not merely connected by membrane as in the case of the prothorax and mesothorax.

(c). The mesosternum. The mesosternum is composed of a very large basisternal area (Figs. 16, 18, Bs_2) which is continuous with the episternum, and a small inflected sternellum (Sl_2). Much of the basisternum is anteroventral in position (Figs. 15, 16), and the region which is purely ventral forms a prominent swelling between the anterior margins of the coxal cavities. Posteriorly, the swelling terminates in a pair of transverse convergent sutures (Fig. 18, cs), the tips of which do not quite meet, and the entire mesosternal area behind these sutures, the writer has considered the sternellum.

Both basisternum and sternellum are divided by a longitudinal median suture (ms) which forms a narrow but deep internal ridge. This ridge is a forward extension of a rather

complex endoskeletal structure which Snodgrass (1935) has termed the sternacosta. In its typical form, the sternacosta is merely a transverse ridge through the pits of the sternal apophyses. However, in Poecilocapsus lineatus it has become variously branched; a short ridge is produced forwards from each end of the transverse ridge, and bifurcates; one branch diverges laterad around the anterior edge of the coxal cavity, while the other converges mesad. The latter ridges form externally the convergent sutures (Fig. 18, cs) which mark the boundary between basisternum and sternellum. Posteriorly, a pair of ridges from which are produced the bases of the sternal apophyses (SA_2), diverge along the median edges of the coxal cavities, and form externally the divergent sutures (ds). Within the latter are located the elongate pits (sa) of the sternal apophyses. The median ridge extends the full length of the mesosternum, and then splits into two branches ---- each of which is produced dorsolaterad on the basisternal margin, and terminates midway between the median suture (ms) and the prealar bridges (Pra_2).

The sternal apophyses (Fig. 18, SA_2) are very conspicuous. Each consists of a broad base, and a long, stalk-like filament which ends in a small, circular apodeme. The posterior and median areas of the base are associated with the mesotergal apophysis (Fig. 20, TA_2), while the filament and its circular apodeme, are associated with the mesopleural apophysis. The coxal cavities (CxC_2) are large and almost

quadrate; anteriorly, they are bounded by the fused basisternum ($\underline{Bs}_2$) and episternum ($\underline{Eps}_2$), laterally, by the epimeron ($\underline{Epm}_2$), posteriorly, by lateral extensions of the metabasisternum ($\underline{Bs}_3$), and medially, by the posterior, divergent extensions of the sternellum ($\underline{Sl}_2$).

The trochantin (Fig. 18, $\underline{Tn}_2$) of the mesothorax resembles that of the prothorax, but it is larger and relatively longer. It differs from the latter in being equally firmly attached to both coxa and episternal edge.

(d). The metanotum. The metanotum consists of two tergal plates-- the fused scutum and scutellum (Figs. 15, 17, $\underline{Sct}_3 + \underline{Scl}_3$), and the postscutellum ($\underline{Scl}_3$). The scutoscutellar plate is made up of a narrow, strap-like median portion bearing an expanded, flat, triangular area at either end. Probably the triangular areas represent the scutum, and the median portion, the scutellum, but there is little to indicate the limits of the two divisions. The entire plate is flexible and lightly sclerotized; its distal extremities form the anterior notal wing processes ($\underline{ANP}_3$), and the main function of the sclerite appears to be that of providing attachment for the hind wings.

Laterad to the scutoscutellum, and situated in the membrane between that sclerite and the metaepisternum, is a small oblong plate, the anterior extremity of which approaches the pleural wall and probably articulates with it. It acts as a point of attachment for the final axillary sclerite

of the hindwing, and appears to be a portion of the scutoscutellum which has migrated laterad.

The postscutellum is heavily sclerotized, and forms an arch which braces the metaepimera and supports the scutoscutellar plate. Medially, its ventral margin bears the third phragma (Fig. 15, 19, 3Ph), and below the latter, at the juncture of postscutellum and epimera, are a pair of triangular, tergal apophyses (TA_3). Phragma and apophyses are parts of the same structure, but the narrow ridge which links them together is situated just under the postscutellar margin, and is not visible externally. The lateral areas of the postscutellum form the postalar bridges, which are differentiated from the remainder of the sclerite by conspicuous strengthening folds (Figs. 15, 19, indicated by broken lines).

(e). The metapleuron. The metapleuron differs from the mesopleuron in that its component sclerites have no subdivisions, and the pleural suture (Fig. 15, PlS_3) which separates it into episternum (Eps_3) and epimeron (Epm_3) bears no corresponding internal, pleural ridge. A short suture arises on the anteroventral margin of the episternum, and is produced into a fold which extends posteriorly to the mid-region of the sclerite. This suture and fold the writer would take to be a line of demarcation between pleuron and sternum, and if so, the ostiolar peritreme (Figs. 15, 18, OsP) is largely, and probably entirely, a sternal structure.

The epimeron is relatively small. Its dorso-lateral margin is separated from the metapostscutellum by a conspicuous suture, and its posteroventral extremity is produced into a very narrow and semi-membranous postcoxal bridge (Figs. 18, 19, $\underline{Pcx}_3$).

The second, or metathoracic spiracle (Fig. 15, Sp) is situated on the membrane between mesoepimeron and metaepisternum, and is closely associated with the inflected edge of the latter sclerite. It is longer than the first spiracle but is much more slender. In Fig. 15, the pleura of the pterothoracic segments have been separated slightly to illustrate this point; normally, the spiracle is protected by the posterior margin of the mesoepimeron.

(f). The metasternum. The metasternum is differentiated into basisternal and sternellar areas, though at first glance the latter appears to be lacking. Medially, the basisternum (Fig. 18, $\underline{Bs}_3$) forms a protuberant, quadrate plate between and posterior to the mesocoxal cavities. It is somewhat diamond-shaped, and its apex projects backwards over the sternellar region, while laterad, it is extended to form a part, and possibly the whole, of the areas which bear the ostioles of the stink glands.

The sternellum ($\underline{Sl}_3$) is the narrow, transverse area of sclerotization posterior to the u-shaped, sternacostal suture (ss.) It is lightly sclerotized, and might easily be taken for a portion of the membranous, first abdominal sternum (IA), which

as will be explained later, has invaded the thoracic region and become fused with it; however, staining discloses that the boundary (Fig. 18, indicated by a broken line) between thoracic and abdominal sterna is fairly sharply defined. Posteriorly, the lateral areas of the sternellum diverge and join with the edges of the metacoxal cavities.

The metasternal apophyses (Figs. 18, 19, 20, SA_3) are borne on a transverse, sternacostal ridge, which is shallow and inconspicuous, but appears to be homologous with similar structures in the first and second thoracic segments. The ridge is bifurcate. One branch diverges posteriorly and bears the club-like, sternal apophysis, while the other continues anterolaterad and is produced into the internal inflections of the ostiolar ridges. Beyond the apophysis, the posterior branch forms the median edge of the coxal cavity, and fuses with the narrow postcoxale.

A pair of shallow, internal ridges (Fig. 18, indicated by a dotted line), of which there is no external indication, arise near the anterior margin of the basisternum and extend posterolaterad. At the posterior, median corners of the mesocoxal cavities they expand into flattened apodemes (Fig. 20, ap) which possibly function in lieu of the non-existant pleural ridges. Dorsad, they are continuous with the edges of the mesoepisternum.

The lateroventral walls of the metathorax bear the ostioles of the stink-glands, and around each opening the peritreme (Figs. 15, 18, 20, OsP) is thrown up into a series of prominent ridges and furrows. From an examination of a single

species, it is difficult to tell whether this area is entirely sternal, or whether it is partly pleural, and while there is little doubt that the anterior part is a lateral expansion of the basisternum, it is possible that posteriorly, the episternum has become fused with the sternum. Anatomically, it appears to the writer that the area posterior to the anterior branch of the sternacostal ridge, belong to the sternellum, and in Fig. 15, the entire peritreme has been designated as sternum ($\underline{S}_3$).

The median area of the basisternum, anterior to the sternacostal suture, is narrowed and drawn out into a tapering arm which forms the posterior boundary of the mesocoxal cavity. The extremity of the arm projects dorsad under the inflected edge of the mesoepimeron, and is joined to that sclerite internally.

The pits (Fig. 18, $\underline{sa}_3$) of the sternal apophyses are situated on the sternellum just before the anteroventral angles of the metacoxal cavities, and are partly hidden by the ostiolar ridges. They are circular and inconspicuous. The coxal cavities ($\underline{CxC}_3$) are oval and are bounded dorsally by the mesoepimeron, anteroventrally by the metasternum, medially by the sternellum, and posteriorly by the membranous first abdominal sternum. The trochantin (Fig. 18, 19, $\underline{Tn}_3$) resembles that of the mesothorax, but is slightly longer; it is firmly attached to the edge of the episternum.

C. The Wings and the Wing Sclerites.

Forewings--The forewings are partly membranous and partly coriaceous and are typical of Heteroptera. An oblique suture separates the distal,membranous, and the basal, leather-like areas of the wing, and the latter section is divided into two regions by the longitudinal claval suture (Fig. 33, cls); these are the clavus and corium-embolium. The clavus lies next to the mesoscutellum when the wings are in repose; the corium lies beyond the claval suture, and the embolium is the costal region. A small triangular area, or cuneus, is marked off by a short fracture near the embolar tip.

The coriaceous part of the wing has an inconspicuous venation. Costa (C) lies nearly parallel to the costal margin while radius (R) and cubitus (Cu) are situated in the embolium. One conspicuous claval vein (Cl) is present. The membrane has two basal cells or areoles and the posterior margin of the larger cell is formed by cubitus. Beyond the latter is the vannal vein (V), but otherwise no venation is present in this part of the hemelytron.

Hind Wings-- The hind wings are wholly membranous and distinctly veined. Costa lies along the costal margin. Subcosta fuses with radius and they continue as one vein the rest of their length. Radius unites with the first and second media (M 1 + 2), while the third and fourth media (M 3 + 4) appear to have joined, and lie about the center of the median area.

Cubitus is broken but has not lost its basal attachment. Two strong anal veins are present, following the Comstock-Needham system, or post cubitus (Pcu) and one vannal.

On either side of M 3 + 4 lies a colourless track (indicated by a broken line) which represents the path of a trachea, and directly posterior to postcubitus is the vannal fold (vf).

The wing sclerites -- The pteralia of the forewing consist of an anterior humeral plate (not illustrated in Fig. 35) at the base of the costal vein, a group of axillaries (IAx-4Ax) and two median plates (m, m^1). Posteriorly, the margin of the articular membrane, or axillary cord (AxC), contains three minute sclerites.

In the hind wings, (Fig. 36), a small lobe anterior to the humeral plate (Hp), the writer has taken to be the tegula (Tg). Three axillaries and one median plate are present. The axillary cord is non-ligamentous, and contains no traces of sclerotization.

D. The Legs.

The legs exhibit the usual six divisions of coxa, trochanter, femur, tibia, tarsus and pretarsus. Since the hind legs are typical, though proportionately larger, one description will be sufficient.

At the base of the coxa, hidden within the coxal cavity, is a slender trochantin (Figs. 18, 19, Tn_3). Regardless of its origin, the writer has found it convenient to describe

and illustrate this sclerite in connection with the coxal cavity. The coxa (Fig. 38, Cx) is large, swollen and cylindrical; it protrudes some distance beyond its cavity and moves freely on a monocondylic joint. The trochanter (Tr) is a small, truncate cone, joined obliquely to the base of the femur and forming a close, dicondylic articulation with the coxa. An oblique cleft partially separates this segment into halves. The femur (Fm) is more or less spindle-shaped and articulates with the slender, and heavily-spined tibia (Tb) by means of a typical, dicondylic joint. Beyond are the three subsegments, or tarsomeres (Tar) of the tarsus--possessed of limited movement by connecting membranes. The pretarsus (Ptar) is the terminal segment of the leg. It consists of a membranous base, a pair of small, median appendages, the arolia, and two well developed lateral claws. The membranous base arises from the end of the tarsus, and the arolia are a continuation of this structure, although their walls appear partly sclerotized.

V. THE ABDOMEN AND THE MALE AND FEMALE GENITALIA.

A. The Abdomen.

In the abdomen of Poecilocapsus lineatus there are ten distinct segments and what appear to be vestiges of an eleventh. The first seven segments are composed of a series of four sclerites. Three of these are situated in the dorsum of each segment, and the fourth forms the lateral and ventral abdominal areas. The dorsal sclerotization consists of a

principle median tergite (Fig. 21, mtg) and two small laterotergites (ltg). The laterotergites, situated one on each side of the median tergite, extend to the prominent lateral edges of the dorsum and form the troughs in which the wings lie when at rest. The lateroventral plates (Fig. 21, lst) contain the spiracles (Sp) near their dorsal edges, and apparently are of a composite nature--that is, they are formed from the sclerotizations of the primary, sternal and pleural areas.

In the female, the laterotergites are distinct from the second to the seventh segments; in the seventh segment of the male, however, there is only a suggestion (Fig. 30, indicated by a broken line) of a laterotergite. The mesal boundaries of these sclerites are indefinite, as are the lateral margins of the median tergites. The anterior margin of the first median tergite is joined by membrane to the ventral edge of the metapostscutellum, while its posterior margin bears a shallow phragma which projects backwards under the anterior edge of the second median tergite. The latter tergite is fused with, or securely joined to the first median tergite, but the remainder are connected only by membrane.

The first sternum is membranous save for two, small, oblong plates (Figs. 18, 19, 23) which articulate with the posterior edges of the metacoxal cavities, at their sternal angle. Anteriorly, the sternum has invaded the thoracic region and become fused with the metasternellum; consequently, the

primitive epimero-metasternal connection is reduced to a semi-membranous ring around the posterior margin of the coxal cavity. Brindley (1938) has pointed out. "The development of the mesothorax (in Heteroptera) at the expense of the structure behind it, coupled with the need for bracing forward the heavy abdomen, has resulted not so much in the telescoping of the first abdominal sternum, as in its superimposition and fusion with that region of the metathorax which lies immediately in front of it".

Laterotergites are absent in the eight segment of both the male and female abdomens. However, a prominent groove extends along the lateral edges of the eighth dorsum and, in a cleared specimen, there is a suggestion of this groove (Figs. 21, 25, indicated by a broken line) in the ninth segment of the female abdomen. The region below the broken line in the ninth segment, definitely is tergal (shown by the connection of the first and second valvifers). Consequently, if this suggestion of a groove in the ninth segment is homologous with the actual grooves which occur along the dorsal edges of the preceding segments, then the lateroventral plates (lst) are formed, not only from the sclerotizations of the primary sternal and pleural areas, but actually contain part of the tergal sclerotization. This would be in keeping with the contention of Snodgrass (1935) that, "with some insects, again, the spiracles occur in lateral parts of the ventral plates, and

in such cases it is evident that the definitive sterna are continuous sclerotizations of the primary sternal, pleural and laterotergal areas."

There are eight spiracles in the abdomen of Poesilocapsus lineatus - one in each of the first eight segments. The first spiracle (Fig. 21, ISp) is situated on the dorsum--in the membrane adjacent to the anterolateral angle of the first median tergite, and is so minute that it is extremely difficult to find. The remaining spiracles, located near the dorsal margins of the lateroventral plates, are relatively conspicuous.

The eleventh segment, if such it is, is present in both male and female abdomens. Surrounding the anus is a narrow, sclerotic ring (Fig. 32, XIT). Actually this ring is not continuous, but is separated by a pair of fractures into dorsal and ventral halves. Whether this ring represents an actual segment, or whether it is merely a secondary development, the writer is unable to say, but it is of interest to note that Silvestri (1932) designates what is apparently the same structure, in the male abdomen of Lopus lineolatus Brulle, as an eleventh segment.

B. The Female Genitalia.

In the female abdomen the seventh sternum is the subgenital plate, and the eight has been obliterated. The

venter of the ninth segment is reduced to a narrow, membranous space between the valvulae of the ovipositor, and the tenth sternum has disappeared completely.

The base of the ovipositor issues caudad to the seventh sternum, between the eighth and the ninth segments. Two pairs of functional valvulae are present. The first, or ventral valvulae (Figs. 22, 25, IVl) are flattened, sword-shaped and serrated at their tips, while the second, or dorsal valvulae (2Vl) are flattened, spear-shaped and more heavily sclerotized than the former. Both pairs of valvulae are ensheathed by the second valvifers (2Vlf), which form a pair of parallel plates running from the base of the ovipositor to the end of the ninth segment. On the posterior ends of the second valvifers are borne the accessory lobes or third valvulae (3Vl), which are very much reduced in size and non-functional; their tips are joined by membrane (Fig. 24), and they serve to ensheath the distal part of the shaft.

The first valvulae are free at their bases, and their shafts are connected with the first valvifers (Figs. 22, 25, lVlf) by a pair of heavily sclerotized rami (Ira). The first valvifers are fused mesally and have migrated to the seventh segment. Beyond the valvifers, the rami are thickened, and are continued posterodorsad to join with a pair of sclerotized struts (Ist), which extend vertically along the

anterior edges of the ninth tergum. Ventrally, each of these struts articulates with a condyle located mid-way between the two ends of a horizontal strut (2st), which runs along the dorsal margin of the second valvifer.

The second valvulae are joined dorsally at their base, and their ventral edges are produced into a pair of rami (2ra) which fuse with the sclerotized strut (2st) of the second valvifer. The strut runs almost the full length of the valvifer, and bears two vertical branches which further strengthen the latter structure. Internally, the dorsal edge of the second valvifer is joined to the inner, ventral margin of the ninth tergum.

C. The Male Genitalia.

The principal segment involved in the genital modification of the male abdomen is the ninth. Externally, at least, the eighth segment is no different from those preceding it. The ninth, however, has become a continuously sclerotized annulus, and is decidedly asymmetrical. Posteriorly, at its lateroventral angles, are two cavities (Fig. 32, ForHrp) in which are articulated a pair of movable claspers or harpagones, and above each clasper is a small, blunt process of the body wall, which has no apparent function. The ninth venter (Fig. 27, IXS), or male subgenital plate projects posteriorly, and the entire segment is heavily sclerotized.

The tenth, or first postgenital segment, likewise has undergone modification. Dorsally, it is narrow and inconspicuous but laterally it expands into a pair of convex plates (Fig. 32, XT) which are capable of slight movement - particularly the larger plate; it is unlikely that the latter is independently musculated, but probably it can be moved aside by the extrusion of the intromittent, phallic organ. These lateral plates have a double function - they partially close the foramen between the ninth and tenth segments, thus protecting the terminal membranous parts of the abdomen, and at the same time, the larger plate appears to act as a sheath for the tip of the phallosoma (Fig. 32, Aed). Ventrad, the lateral plates merge with an asymmetrical, membranous or very lightly sclerotized area, which connects the two, and hangs like a curtain over the harpagonal cavities. This membranous area, the writer would take to be the tenth sternum. The anus is enclosed by the eleventh segment, and surrounding the latter are folds of membrane - apparently the conjunctiva between the tenth and eleventh segments.

In describing the phallic organs of Poecilocapsus lineatus the writer has followed Singh-Pruthi's (1925) terminology, and has resisted the temptation to add or substitute certain terms of later authors. Singh-Pruthi's paper has been selected for purposes of comparison, since he is the one author who has dealt with the male genitalia of the Miridae. The term harpagones, however, has been used in place of parameres, since

these movable claspers are peripheral accessory structures. Each harpago consists of an external, basal region which bears a distal hook, and of an internal, proximal region which is flattened into an apodeme (Fig. 28, Ap) for the attachment of muscles. Snodgrass (1935) presumes that the harpagones, in Hemiptera, represent the styli of the more generalized insects.

The phallic organ, or aedeagus, is a median, tubular structure which is produced from a backward continuation of the conjunctival membrane between the ninth and tenth sterna. It consists of a proximal, thecal part or phallosoma, (phallotheca--Snodgrass) which is heavily, though unequally sclerotized, and a distal, membranous part or endosoma, (aedeagus---Snodgrass). The latter, in the condition of repose, is ensheathed by the phallosoma; when it is everted, the intromittent part is the vesica, and that part of the endosoma which remains to line the phallosoma is the conjunctiva. The distal tip of the phallosoma has a bell-shaped aperture---the phallosoma mouth (Fig. 31, PhsM). The vesica is separated into four lobes or diverticula (Figs. 29, 31, VsDv) between which is situated the opening, or male gonopore (Gpr), of the ejaculatory duct. The vesicular lobes are clothed with spines which are very minute, but on the more dorsal lobe which is somewhat attenuated and more heavily-walled than the others, the spines are relatively large. From the conjunctival region of the endosoma arises a long, hooked process (Spn), and on the wall of one of the vesicular lobes is a flap-like area (Fig. 29, VsApp) which is

partially sclerotized; otherwise, the endosoma is entirely membranous.

The basal part of the thecal phallosoma is known as the basal plate (BP). Typically, in Heteroptera, the basal plate is a paired, horseshoe-shaped structure, but in Poecilocapsus lineatus, the area between the two halves has become closed dorsally. A small opening, the basal foramen (BFor) remains, however, and through this opening the aedeagus is in communication with the body cavity. What is apparently a very lightly sclerotized section of the ejaculatory duct enters the opening, and is produced into the heavily sclerotized part (EjD) which runs the length of the phallosoma, and opens on the vesica. Posterior to the basal foramen, the basal plate forms a hinge-like device, and ventrad to the hinge, the phallosoma is membranous to permit flexion.

On either side of the hinge, the basal plate is produced posteriorly into a lateral wing-like area, and from each wing arises a stalk-like filament which bears an apodemal plate (BAp). The apodemal plates appear to be associated with the apodemes of the harpagones, which take up a position at their sides.

VI. SUMMARY.

1. A detailed study, illustrated with thirty-eight figures, describes the external structural characteristics of the adult of Poecilocapsus lineatus Fab.

2. The head and its appendages are typical of Heteroptera, but the head sutures are suppressed or entirely obliterated, and consequently the cranial areas are obscure.

3. The hypopharyngeal theory of the origin of the mandibular plates, is supported by the presence of a sclerotized bridge, which connects the ventral edge of each mandibular plate with the distal tip of the hypopharynx.

4. The tentorium is composed of a pair of lateral arms, (the fused definitive anterior and posterior arms), a pair of dorsal arms and a pair of thread-like, median arms. The median arms have a common connection both with the hypopharynx and the mandibular plates, which lends further support to the hypopharyngeal theory of the origin of the latter structures. The anterior tentorial pits are located on the maxillary plates, at the sides of the maxillary lobes.

5. The neck, or cervix, is membranous, devoid of sclerites and entirely concealed within overlapping parts of the head and prothorax.

6. The thorax is typical of Heteroptera. The sterna of the three segments are subdivided into basisternal and sternellar areas, and evidences of a degenerating spinasternum are to be

found in the prothoracic segment. Anteriorly, the first abdominal sternum has invaded the thoracic region and become fused with the metasternellum; consequently, the primitive epimero-metasternal connection is reduced to a semi-membranous ring around the posterior margin of the metacoxal cavity.

7. In the abdomen, there are ten distinct segments and what appear to be vestiges of an eleventh. The first seven segments are composed of a series of four sclerites. Three of these are situated in the dorsum of each segment, and the fourth forms the lateral and ventral abdominal areas. The first sternum is membranous save for two, small, oblong plates which articulate with the posterior edges of the metacoxal cavities, at their sternal angle.

8. In the female abdomen, the seventh sternum is the subgenital plate, and the first valvifers have migrated to the seventh segment. The ovipositor, and its associated parts of the eighth and ninth segments, are typical of Heteroptera.

9. The ninth segment, in the male abdomen, has become a continuously sclerotized annulus, and is decidedly asymmetrical. Posteriorly, it bears a pair of movable claspers, or harpagones. The tenth segment, likewise, has undergone modification. Dorsally, it is narrow and inconspicuous, but laterally, it expands into a pair of convex plates; the latter probably are not independently musculated, but apparently can be moved aside by the extrusion of the intromittent phallic organ.

10. The phallic organ or aedeagus is a median, tubular structure which is produced from a backward continuation of the conjunctival membrane between the ninth and tenth sterna. It consists of a proximal, thecal part or phallosoma, which is heavily though unequally sclerotized, and a distal, membranous part or endosoma. The endosoma is separated into four lobes, or diverticula, between which is situated the opening, or male gonopore, of the ejaculatory duct.

ACKNOWLEDGMENTS.

The writer wishes to acknowledge the assistance and advice received from Dr. E. M. DuPorte, Professor of Entomology, Macdonald College, under whose direction this thesis has been prepared. Grateful acknowledgment also is made to Mr. G. S. Walley of the Entomological Division, Science Service, Dominion Department of Agriculture, for his helpful advice, and to the Entomological Division for supplying the materials with which the investigation was carried on.

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Lettering of Figures.

A - abdomen

Aclp - anteclypeus

acs - antecostal suture

Aed - aedeagus

ANP - anterior notal wing process

Ap - apodeme

ap - apodeme

ASc - antennal socket

at - anterior tentorial pit

atg - acrotergite

Ax - wing axillary

AxC - axillary cord

Ba - basalare

BAp - basal apodeme

BFor - basal plate foramen

BP - basal plate

br - bridge

Bs - basisternum

buc - bucculae

C - costa

Cl - claval vein

cls - claval suture

cs - convergent suture

Cu - cubitus

Cx - coxa

CxC - coxal cavity

DT - dorsal tentorial arm

ds - divergent suture

E - compound eye

EjD - ejaculatory duct

Epm - epimeron

epm - epimeral subdivision

Eps - episternum

eps - episternal subdivision

Fm - femur

fm - functional mouth

For - foramen

ForHrp - harpagonal foramen

Fr - frons

Ge - gena

Gpr - gonopore

HP - humeral plate

Hrp - harpagones

Hst - hypostoma

Hyph - hypopharynx

hyph - tongue-like lobe of hypopharynx

Lb - labium

Lm - labrum

lst - lateroventral sclerites

LT - lateral tentorial arm

ltg - laterotergite

M - media

m - median plate

Mb - intersegmental membrane

MdB - mandibular bristle

MdPl - mandibular plate

mdl - mandibular lever

ms - median suture

MT - median tentorial arm

mt - expanded end of tentorial arm

mtg - median tergite

mx - maxillary lobe

MxB - maxillary bristle

mxl - maxillary lever

MxPl - maxillary plate

nfa - non-faceted area

no - notaulices

OsP - ostiolar peritreme

Pa - postalare

Pclp - postclypeus

Pcu - postcubitus

Pcx - postcoxale

Ph - phragma

Phs - phallosoma

PhsM - phallosoma mouth

PlA - pleural apophysis

PlR - pleural ridge

PlS - pleural suture

Pmp - sucking pump

PNP - posterior notal wing process

PoR - postoccipital ridge

Pra - prealare

pra - triangular extension of prealare

Prsc - prescutum

Pscl - postscutellum

pt - posterior tentorial pit

Ptar - pretarsus

ptn - piston, of salivary syringe

R - radius

ra - ramus

rvs - reversed notal suture

S - sternum

SA - sternal apophysis

sa - pits of sternal apophyses

Sc - subcosta

Scl - scutellum

scl - marginal scutellar fold

Sct - scutum

Sl - sternellum

Sp - spiracle

Spn - spine

ss - sternacostal suture

st - strut

Syr - salivary syringe

T - notum

TA - tergal apophysis

Tar - tarsus

Tb - tibia

Tg - tegula

Tn - trochantin

Tr - trochanter

V - vannal vein

Vl - valvula

Vlf - valvifer

vf - vannal fold

vs - scutoscutellar suture

VsApp - vesicular appendage

VsDv - vesicular diverticula

Vt - vertex

P L A T E I.

fig. 1. - Head, ventral view.

2. - Head, dorsal view.

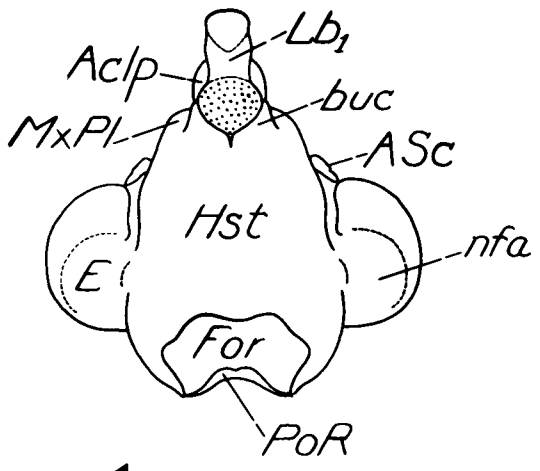
3. - Head, posterior view.

4. - Head, anterior view.

5. - Head, lateral view.

6. - Anteclypeus, mandibular plates and sucking pump, lateral view.

7. - The same, showing anterior attachment of median tentorial arms, ventral view.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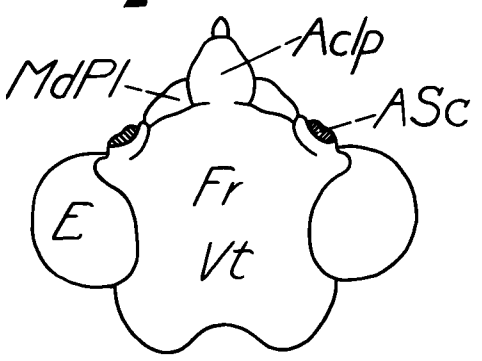
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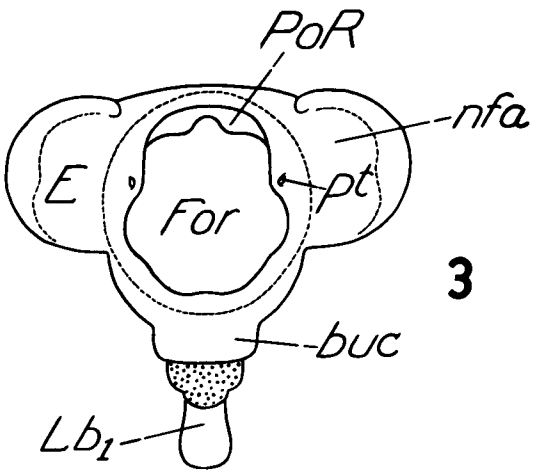
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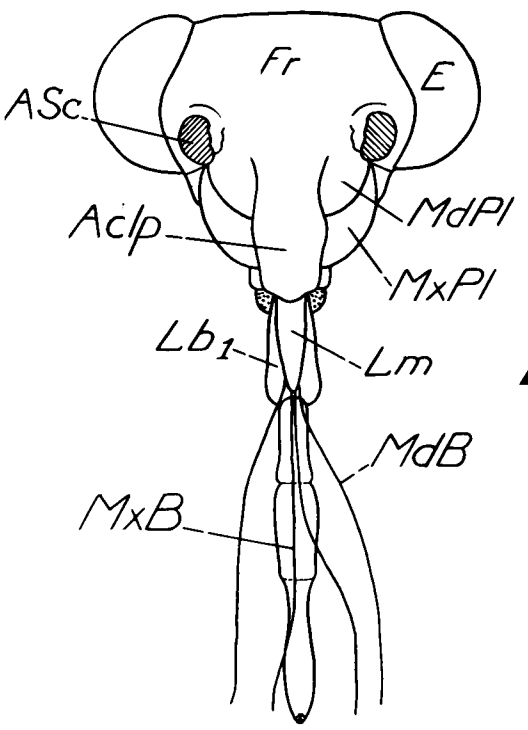
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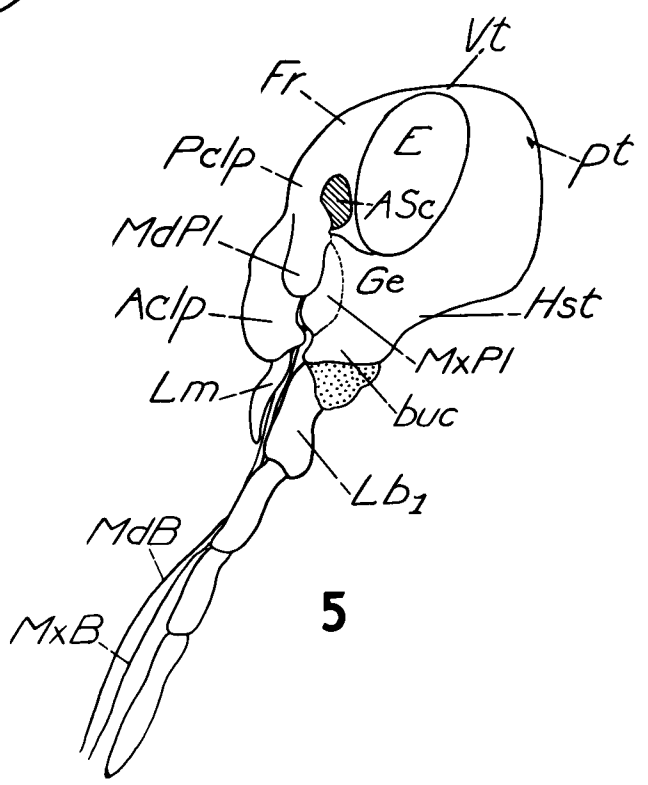
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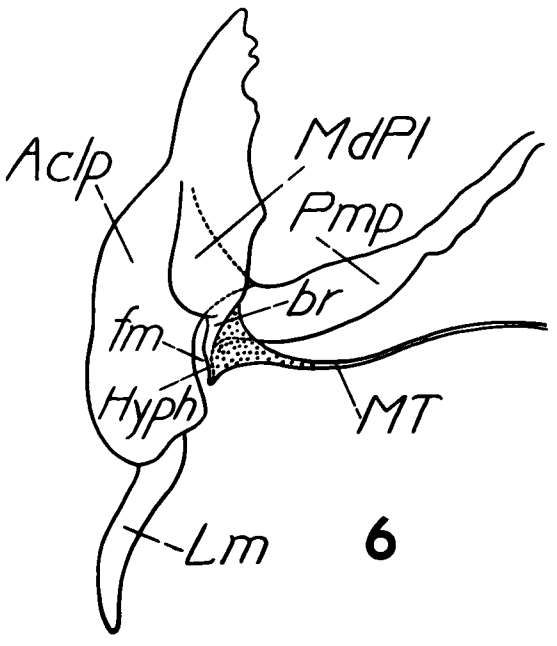
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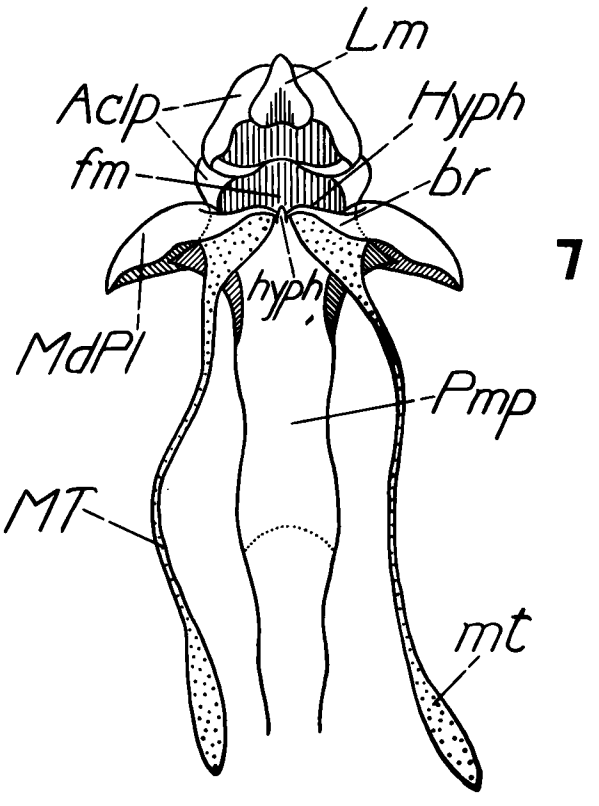
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7

P L A T E II.

fig. 8.-- Interior of head, dorsal view. Semi-diagramatic.

9. - The same, anteclypeus, sucking pump and anterodorsal region of cranium cut away to show anterior attachment of lateral tentorial arms.

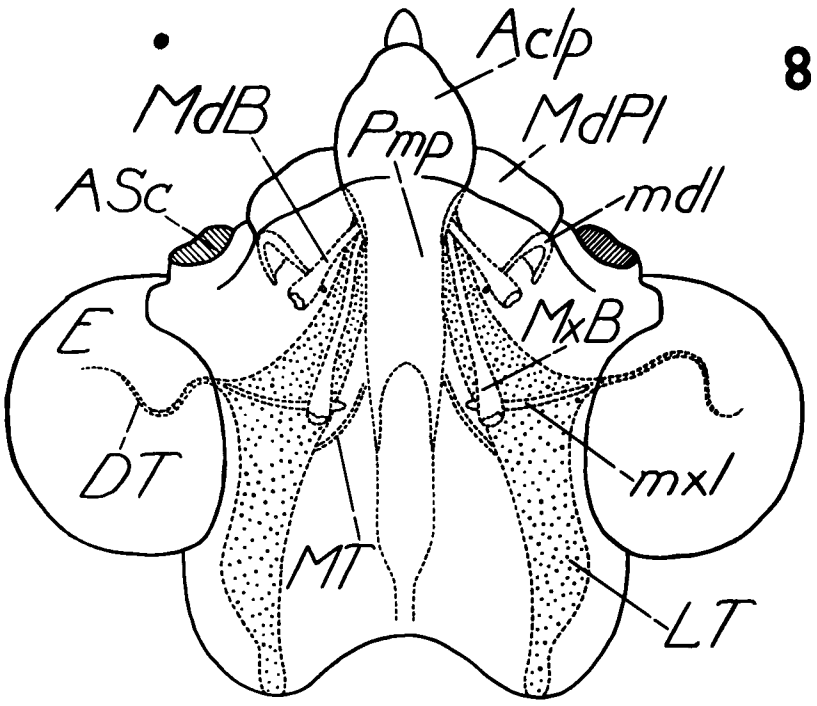
IO. - Interior of head, lateral view. Semi-diagramatic.

II. - Prothorax, lateral view.

I2. - Prothorax, ventral view.

I3. - Prothorax, anterior view.

I4. - Interior of prothorax, posterior view.



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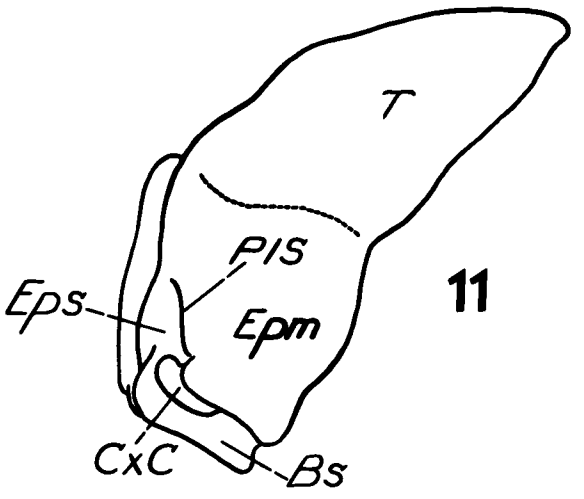

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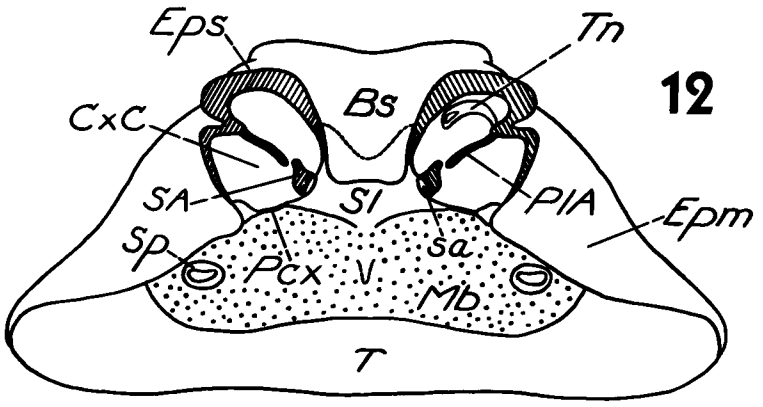

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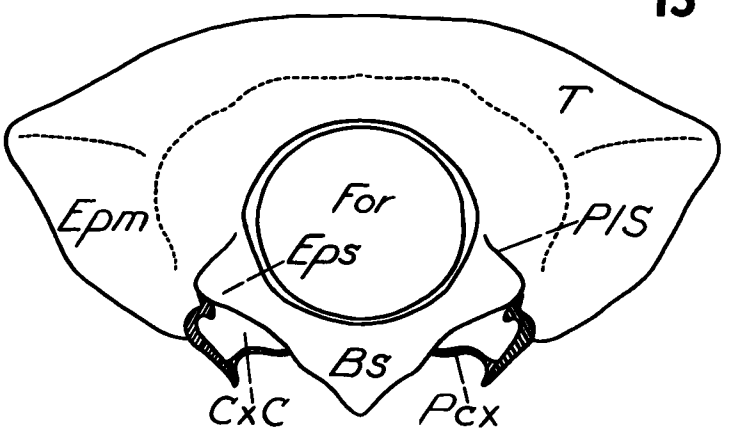

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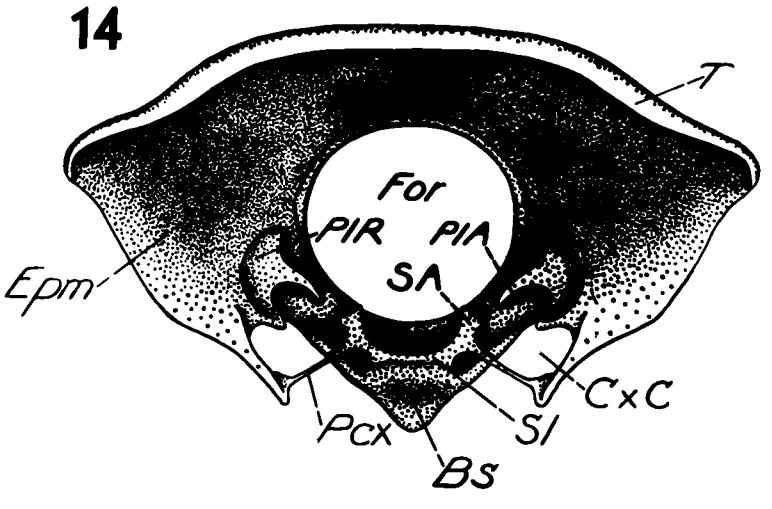

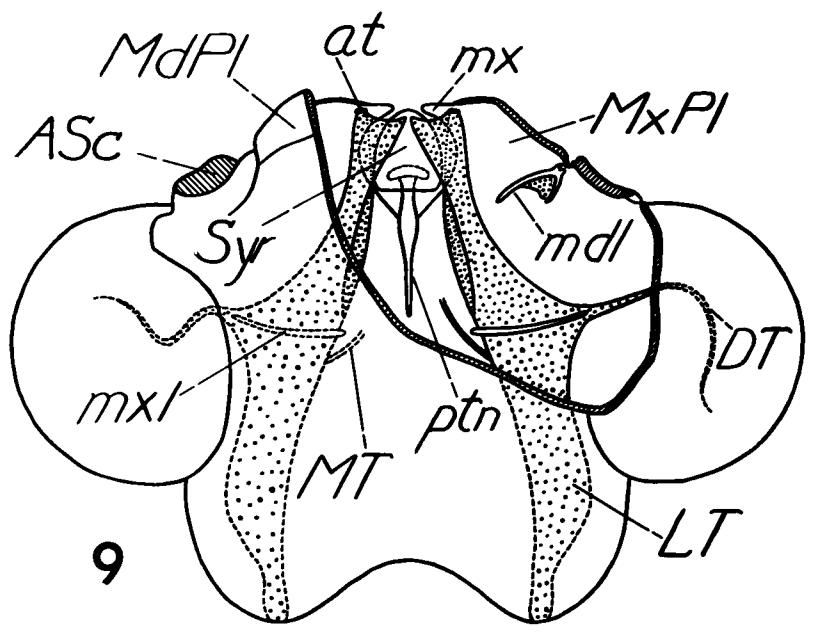

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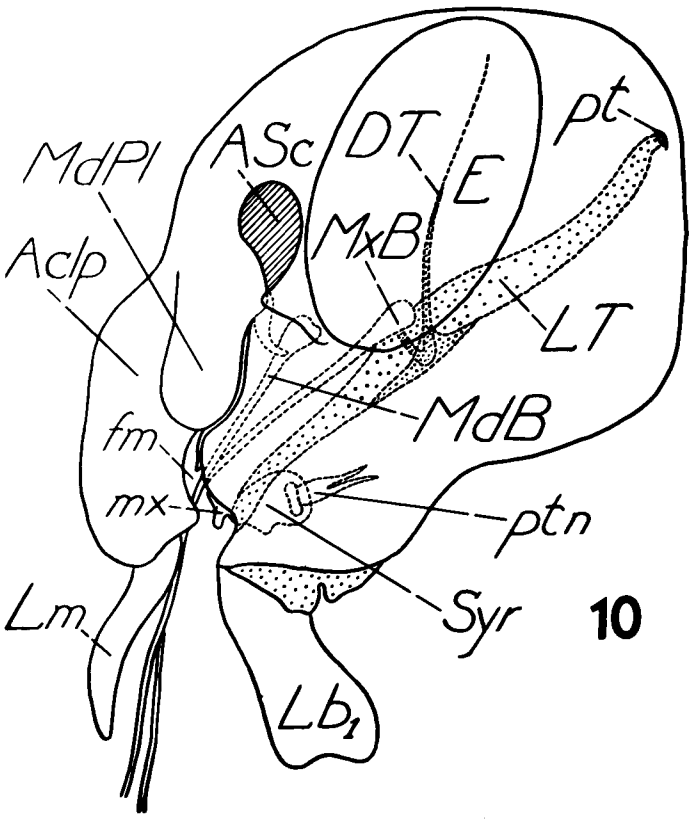


10

P L A T E III.

fig. I5. - Pterothorax, lateral view. (Wing sclerites removed and pleura of segments slightly separated to show position metathoracic spiracle).

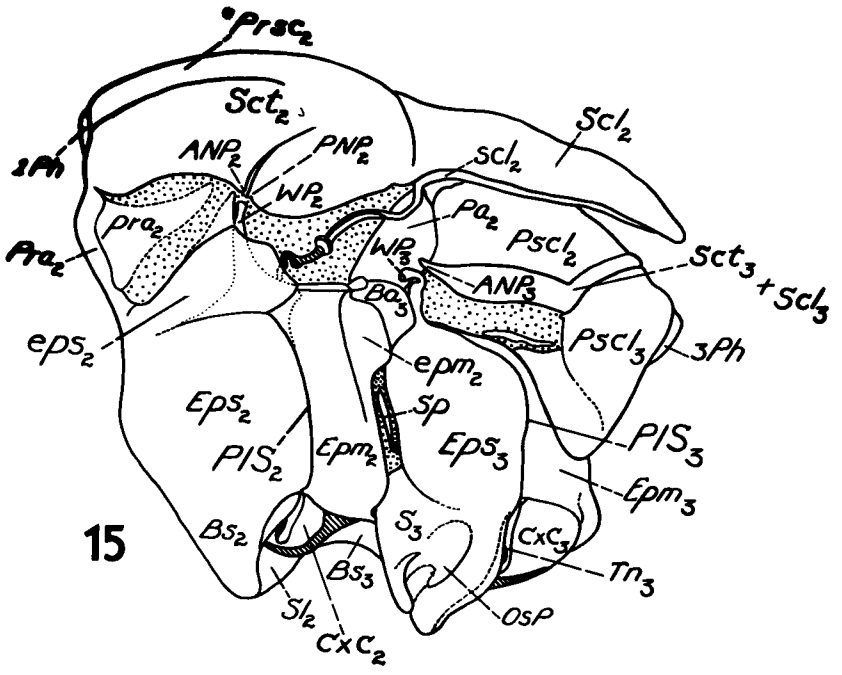
I6. - Mesothorax, lateral view.

I7. - Pterothorax, dorsal view.

I8. - Pterothorax, ventral view.

I9. - Metathorax, posterior view.

20. - Interior of metathorax, anterior view. (Mesoscutellum removed).



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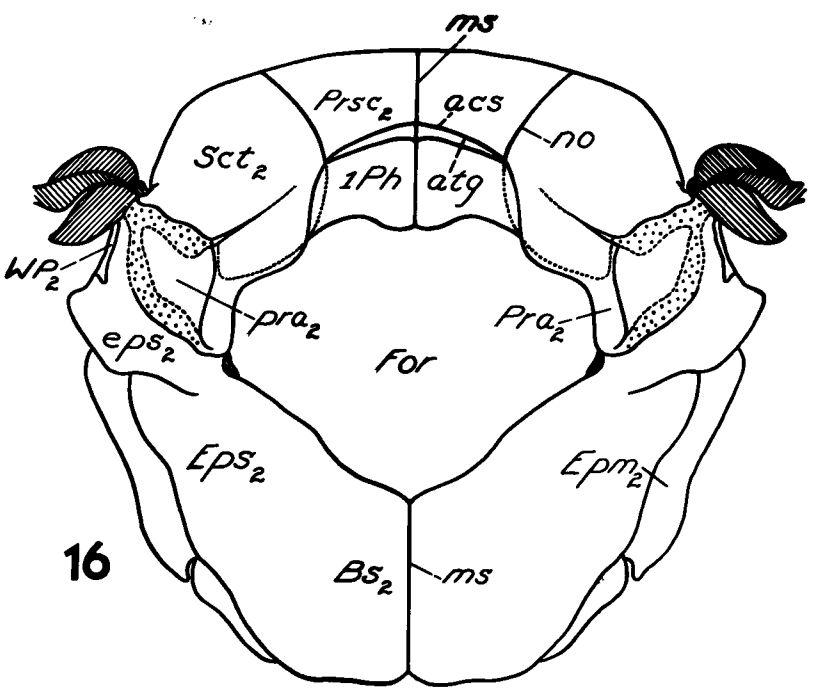

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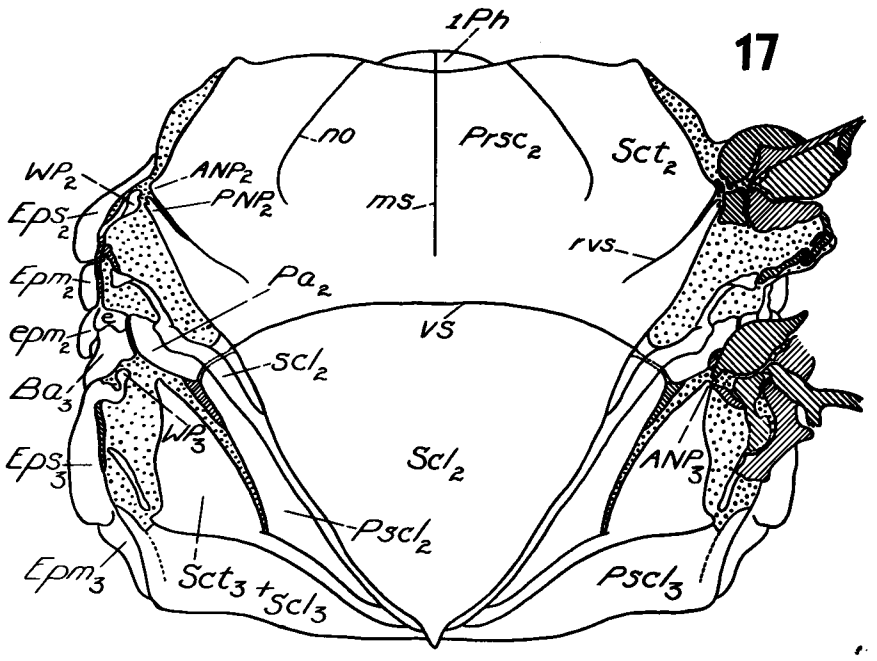

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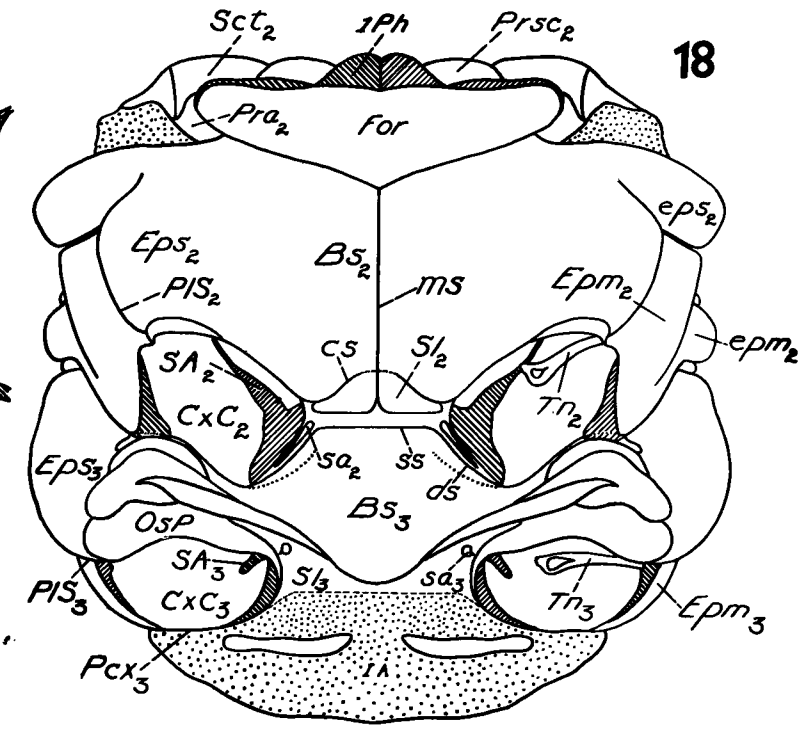

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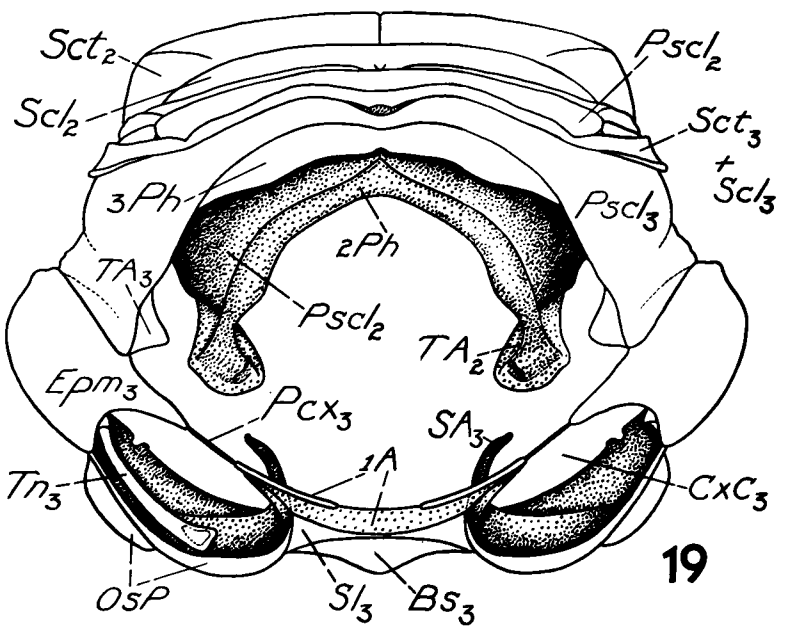

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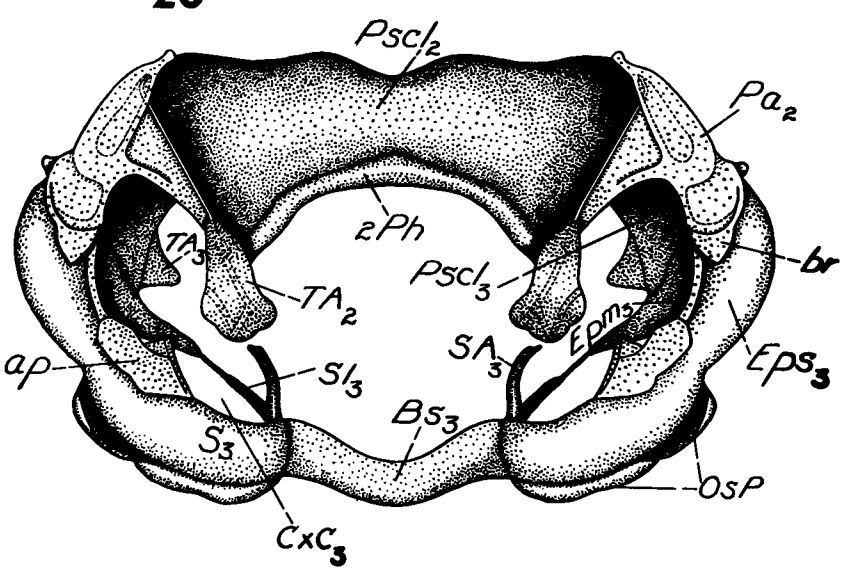

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P L A T E IV.

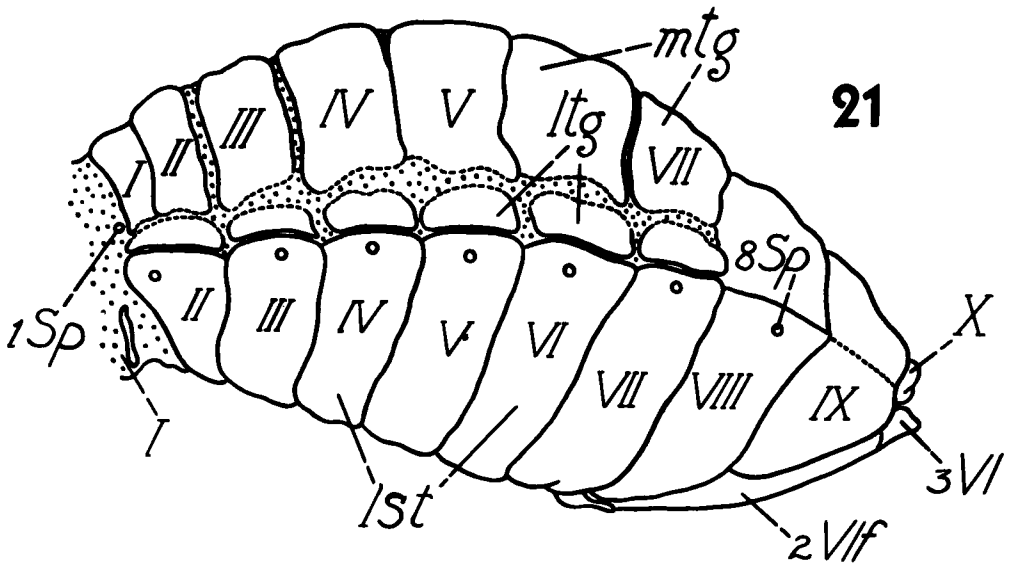
fig. 21. - Abdomen of female, lateral view. (Tergum expanded dorsad to show relationship of tergites and lateroventral sclerites).

22. - First valvulae and first valvifers ventral view.

23. - Abdomen of female, ventral view.

24. - Second valvulae and second valvifers, ventral view. (Left valvula and right valvifer cut away).

25. - Ovipositor, lateral view. (Seventh, eighth and postgenital segments removed).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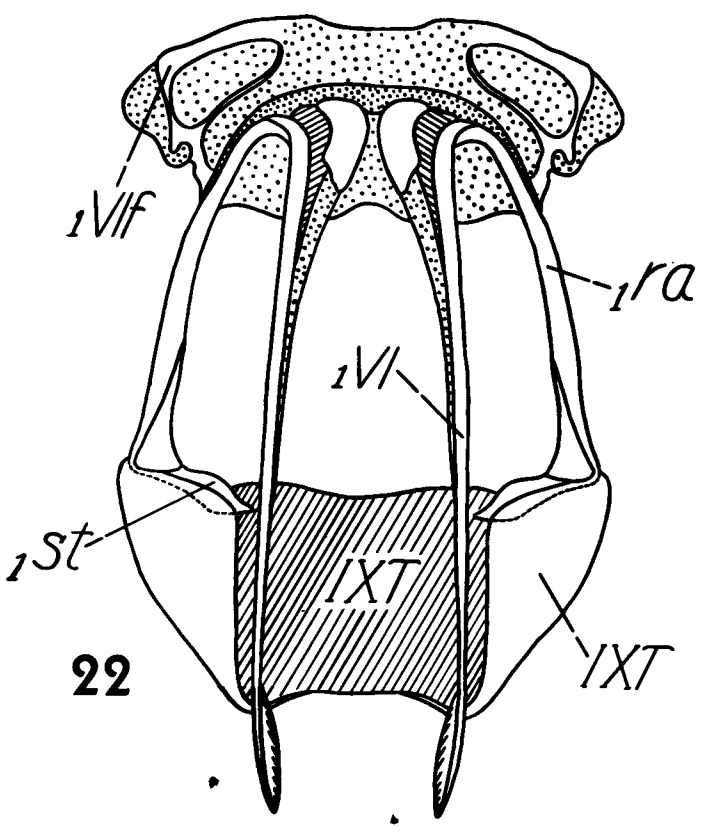
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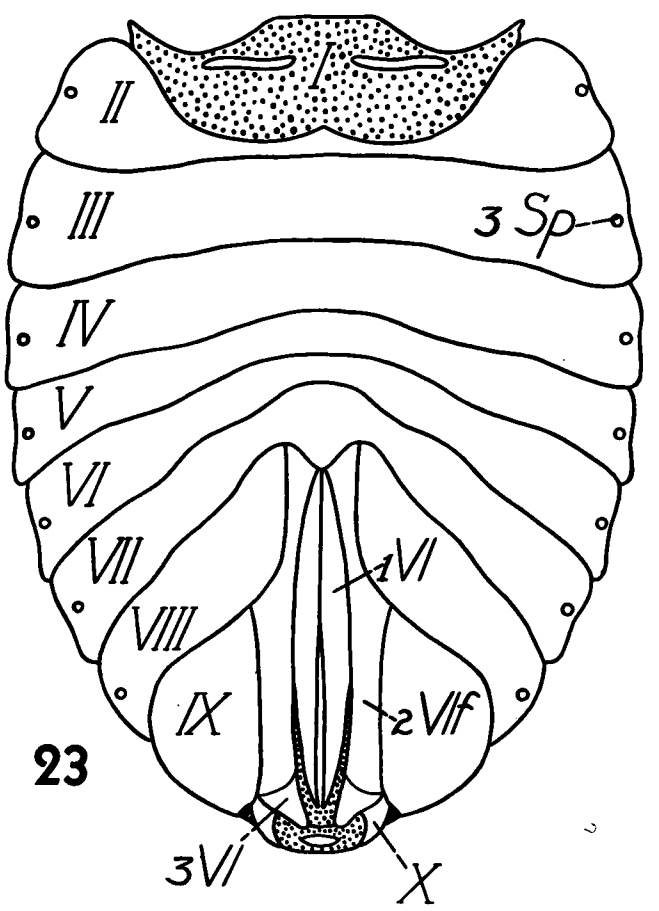
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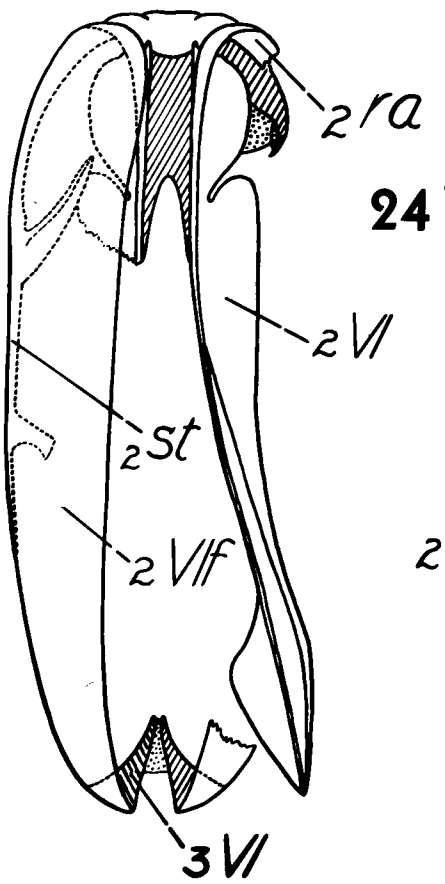
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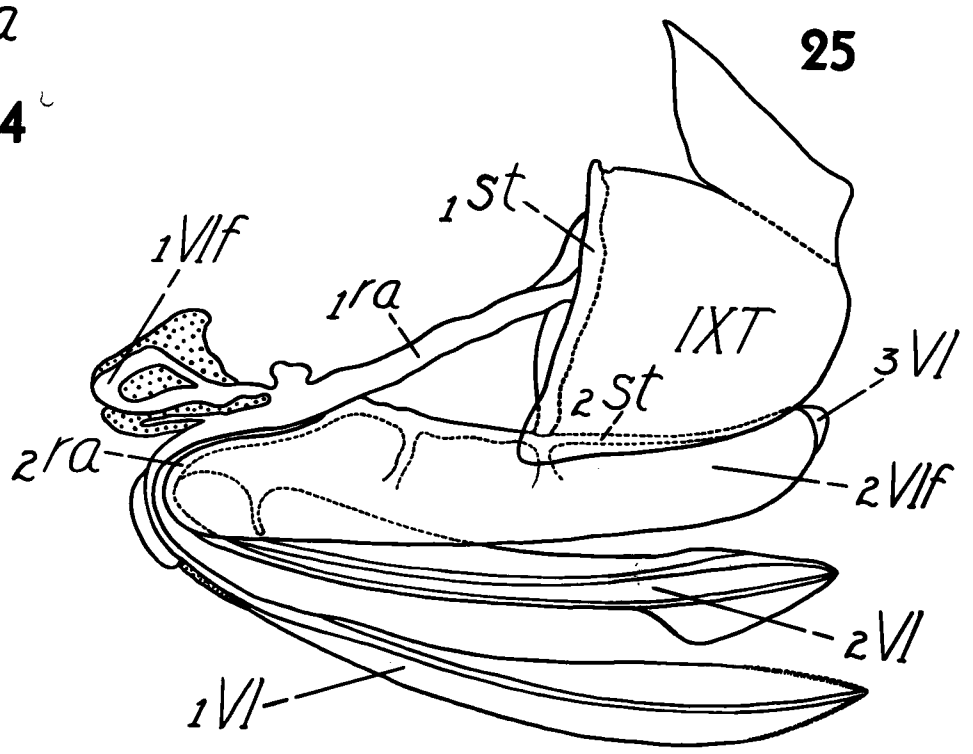
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1VI

25

P L A T E V.

fig. 26. - Terminal abdominal segments of male, dorsal view.

27. - The same, ventral view.

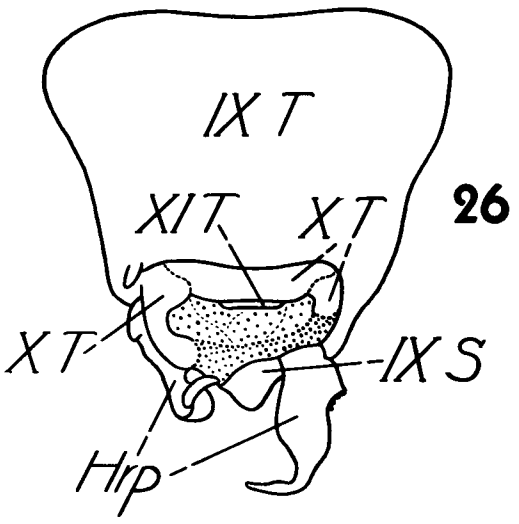
28. - Harpagones, ventral view.

29. - Aedeagus, dorsal view.

30. - Terminal abdominal segments of male, lateral view.

31. - Aedeagus, lateral view.

32. - Terminal abdominal segments of male, posterior view.



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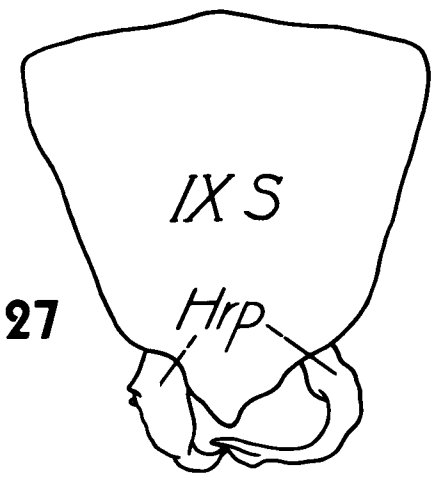

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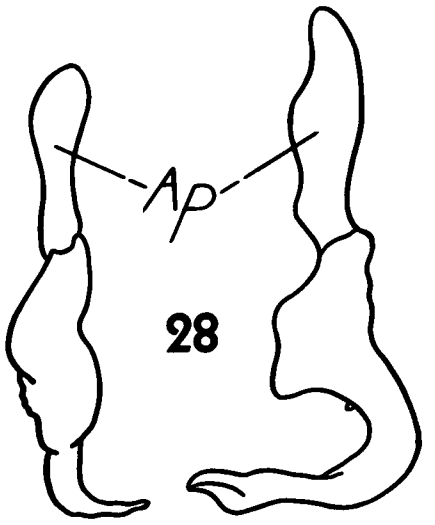

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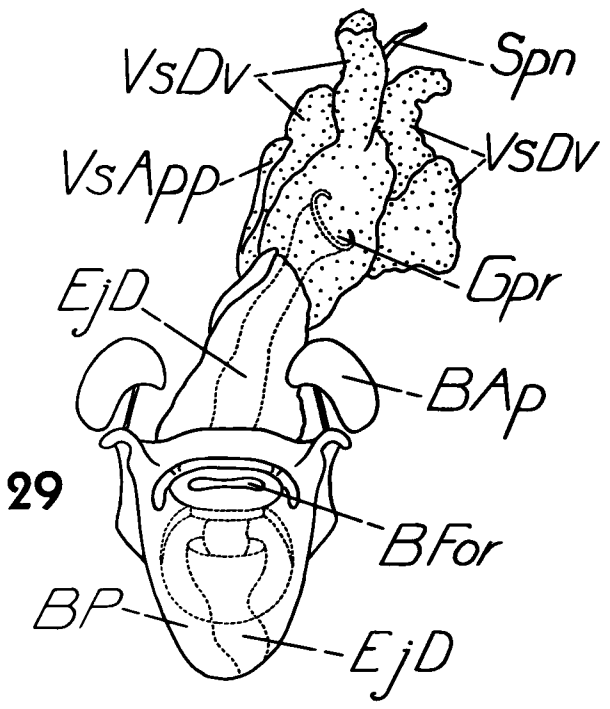

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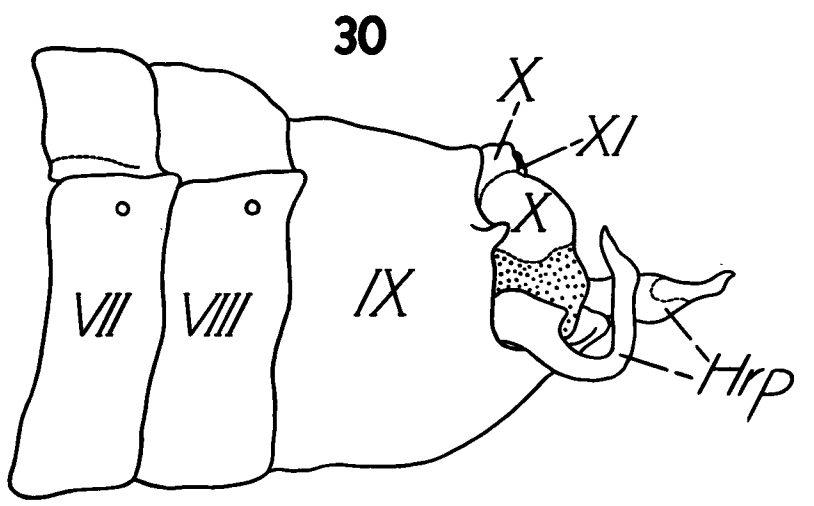

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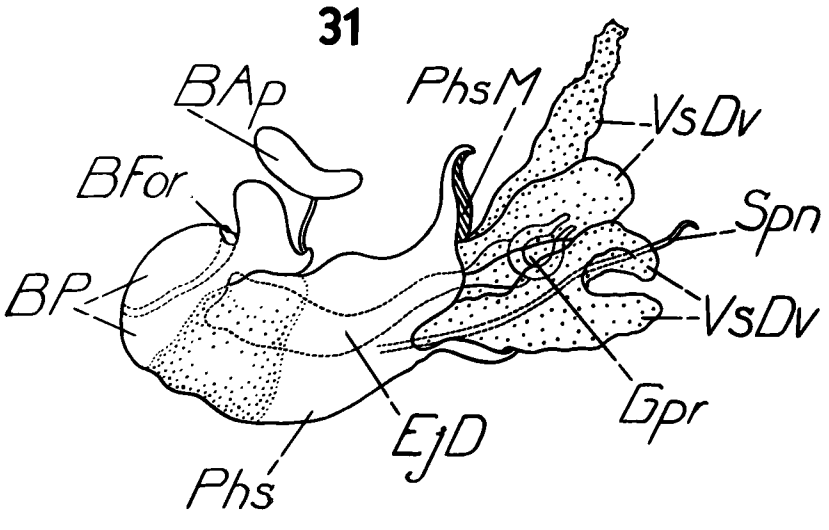

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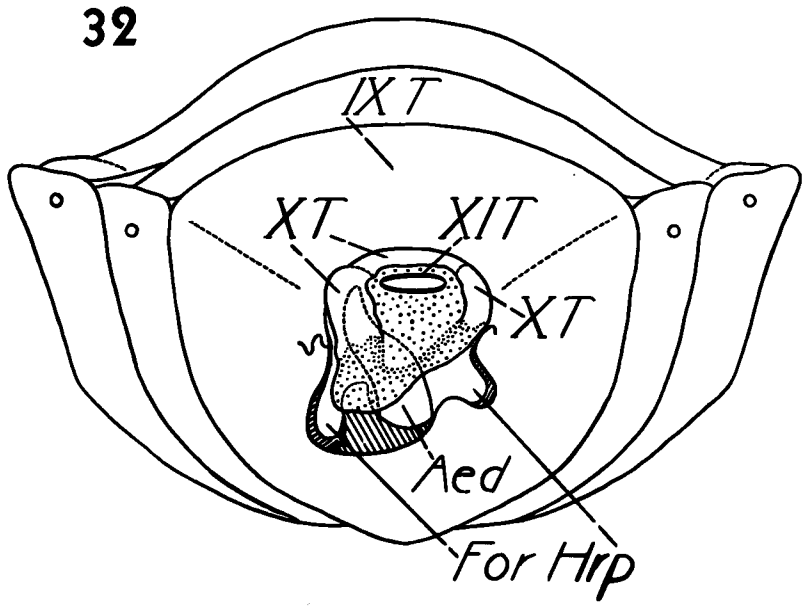


32

P L A T E VI.

fig. 33. - Forewing.

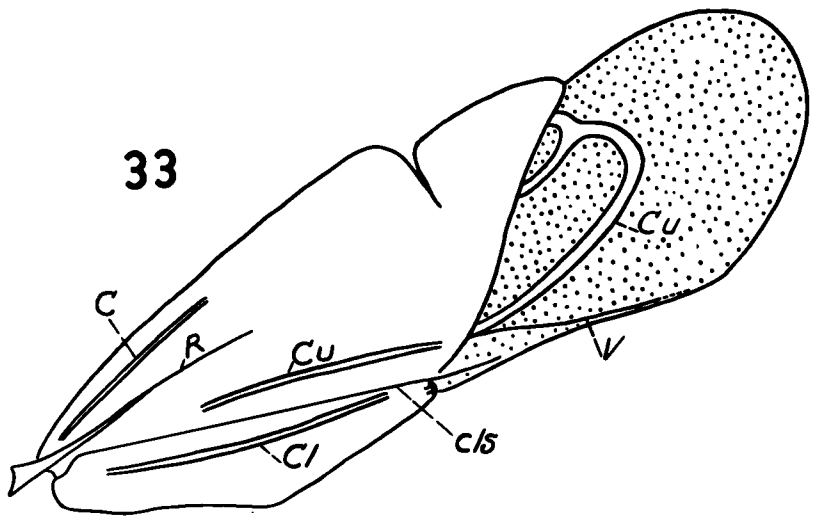
34. - Hind wing.

35. - Base of forewing, showing axillary sclerites.

36. - Base of hindwing, showing axillary sclerites.

37. - Antenna.

38. - Hind leg.



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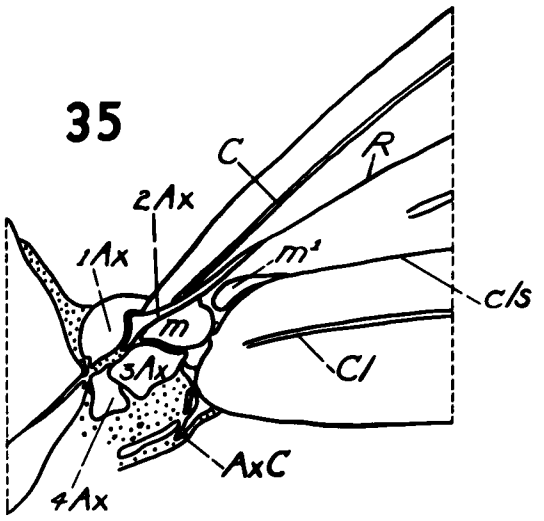

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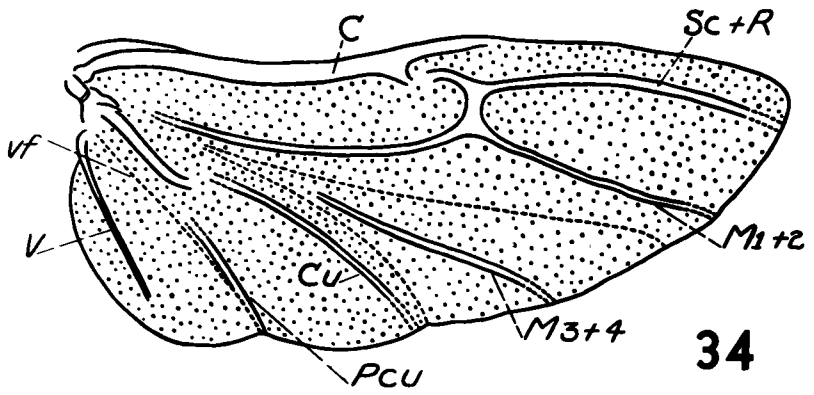

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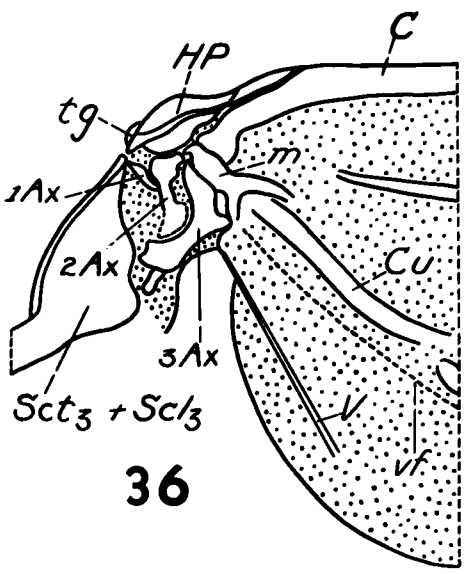

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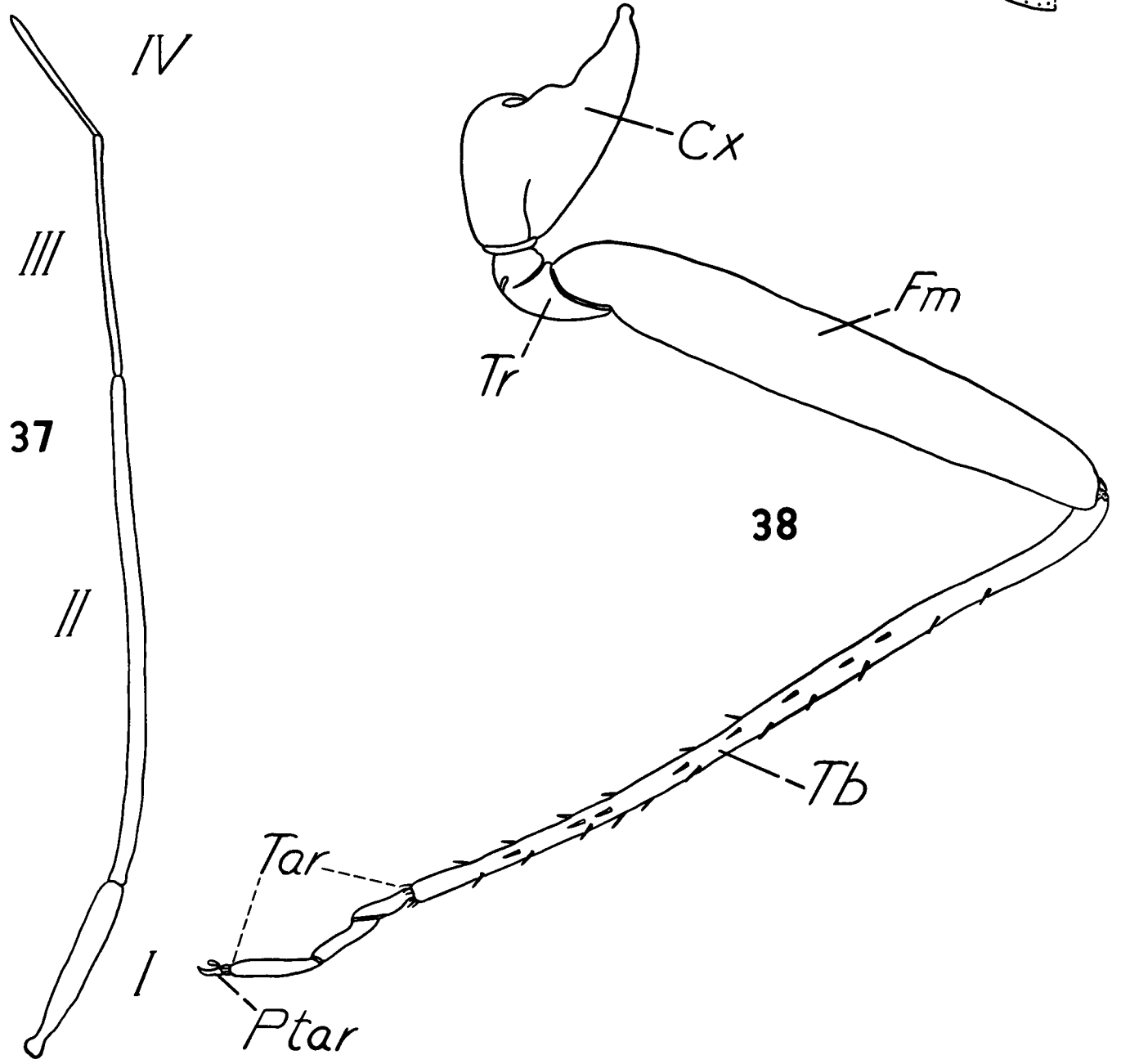

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