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THE EXTERNAL MORPHOLOGY OF LUCIDOTA CORRUSCA LINN (COLEOPTERA : LAMPYRIDAE)

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C O N T E N T S

INTRODUCTION

No thorough study of Lamprid beetles has ever been made, and the phylogenetic position of the Lampyridae in the order Coleoptera is still a matter of dispute, due largely to the fact that very little is known concerning the comparative morphology of these primitive beetles. The purpose of this investigation has been to furnish a detailed morphological study of a typical Lampyrid beetle as the basis of our knowledge of the comparative morphology of the Lampyridae. Especial attention has been given to the characters of phylogenetic importance for determining the position of these beetles in the general scheme of classification, as well as to the characters of value in grouping the genera and identifying the species of Lampyridae. The knowledge gained from this investigation will serve as the basis for a better founded study of the phylogeny and taxonomy of the Lampyridae and their relatives in the order Coleoptera.

Lucidota corrusca Linn, was considered the most prevalent and representative Lampyrid beetle by the writer; and this paper is an investigation of its external morphology.

SPECIES STUDIED

This insect was first described as Lampyris corrusca by Linnaeus in 1767 (Systema Naturae, Edition II, page 644). The generic name Lampyris was used by many, including Fabricius, but was changed to Ellychnia by Leconte in 1851. Leng (1920) incorporated Ellychnia into Laporte's genus Lucidota (1833). Since the specific name has not been changed, Lucidota corrusca Linn. is the valid name.

DESCRIPTION

Blatchley gives the following description: "This genus and the next four (Ellychnia, Pyropyga, Pyractomena, and Photinus) are grouped by Leconte under the name of Photini. All five genera have the head covered by the hood-like thorax. The elytra vary in color, but in all our species without well developed light organs they are black. Of the group he (Leconte) says, 'There are in many families of Coleoptera strong resemblances between species of different genera, but I know of none more deceptive than those presented by this group of Photini. The inexperienced student should, therefore, always ascertain the genus to which his specimen belongs before attempting its specific determination.' The genus Lucidota is easily known by the very broadly

compressed antennae which are not serrate but gradually narrowed externally, with the second joint very short and transverse. The light organs are feebly developed and indicated by yellow spots on the last ventral of the female or on the last two ventrals of the male. The species belonging to it are diurnal and frequent shady places."

Lucidota corrusca Linn. is characterized by the following description: Oblong-oval. Black or rusty black; thorax with disk and side margins black; between these a reddish and yellow space or line. Third joint of antennae longer than wide. Thorax semi-oval, its apex regularly rounded. Elytra finely granulate and thinly covered with a fine, prostrate yellowish pubescence; each with three or four rather indistinct costae. Length 10-14 mm.

Bethune, taking a description from Kirby's Fauna Boreali--America; Insecta, includes other features as follows: Body--pubescent, brown-black; Prothorax--nearly semi-circular, disk elevated, rose colored streak dilated and yellow as well as anteriorly adjoining elevated part on each side. Most numerously and minutely punctured.

MORPHOLOGY

Head Capsule (Figs. 1,2,3)

The head capsule of Lucidota corrusca, when viewed from above, is roughly circular; but, when viewed frontally, it is somewhat elliptical and broader from side to side than from top to bottom. Most of the sutures demarking the head regions in lower insects have nearly or entirely disappeared, but in the head capsule several regions may be distinguished. In the dorsal region are two parietals (pa), an occiput (occ) which circles downward and is also on the ventral wall, a postclypeus, a frons(fr) and a labrum (lr). In the ventral region are two genae (ga), two postgenae (pge), a continuation of the occiput (occ), gula (gu), submentum (sm) and the mentum (mn). These regions are for the greater part undifferentiated by sutures or other limits, and consequently gradation one into the other frequently occurs.

A frontal-dorsal view of the head capsule is shown in Fig. 2. The coronal suture, which nominally separates the parietals is lacking except for a small fragment. This fragment together with the two frontal sutures (fs) comprise the epicranial suture and form an inverted Y between and slightly posterior to the antennal openings. The coronal suture fades out posteriorly, and the parietals merge to form the greater part of the vertex of the head.

The parietals are bounded posteriorly by a slightly developed occipital suture (occ) and laterally by the genae (ga). The occipital suture demarks the anterior limit of the occiput (occ). The occiput bends downward around the latero-posterior region of the head and terminates at the base of the gula. The frontal sutures (fs) demark the frons (fr), which lies forward of these sutures. The frons is fused indistinguishably with the postclypeus to include all of the region anterior and ventrad of the frontal sutures, with the genae and anteclypeus as boundaries. The labrum (lr) is attached to the head capsule by a semi-membranous area which is the anteclypeus. The labrum itself lies forward of this and is articulated with the head capsule, as in a typical insect. The minute anterior tentorial pits (at), sometimes called frontal pits, are situated in the genal region between the antennal and eye openings. The large round eyes are located dorso-laterally nearly two-thirds of the head length forward. The antennal sockets are situated forward and ventrad of the eyes, and are closer together than are the eyes. The antennal sockets are oval and bear a small process or antennifer (anf) on the meso-ventral rim. The antennifer serves as a pivotal point for the antenna.

A ventral aspect of the head capsule is shown in Fig. 3. The genae (ga) are confluent with the parietals anteriorly and with the postgenae (pge) posteriorly. The

occiput is separated from the postgenae by the occipital suture (ocs). The gula extends caudally around the "occipital foramen" (ocf) to the posterior limits of the head. On the convex surface of the gula, as viewed from below, are two extensions of the gula, one on either side of the median line. These extensions bear the posterior tentorial pits (pt); and it is from these extensions that the cardines (cd) are articulated. Mesally the gula is contiguous with the submentum (sm) and mentum (mn), and the entire structure is an undemarked one.

Tentorium (Fig.7.)

The tentorium consists of two paired structures. The posterior arms (pta) arise as invaginations of the ventral region of the head; the anterior arms (ata) arise as invaginations of the frontal region of the head. Outwardly, the posterior and anterior arms are indicated by the posterior tentorial pits (pt) and anterior tentorial pits (at) respectively. The two invaginations meet and fuse within the head. The thread-like appearance of the anterior arms distinguishes them from the posterior arms. Contiguous mesally with each posterior arm is a flattened area. These areas project towards each other posteriorly and then curve gently away until they unite with the small processes (a) at the apices of the anterior arms. The flattened areas are homologous with the corporotentorium present in certain Orthoptera.

Directly opposite the median process (a) at the apex of the anterior arm lies a small process which is the remains of the dorsal arm. Besides bracing the cranial walls, the tentorium furnishes a point of attachment for the various muscles of the head, chiefly those of the mouthparts.

The structure of the tentorium, with plates strikingly like those forming a so-called corporotentorium, with small median processes at the apices of the anterior arms and with dorsal arms (although non-functional), is very similar to the Orthopteran type of tentorium.

Antenna (Fig.5.)

The eleven segmented, slightly compressed filiform antenna articulates with the head by means of a pivotal plate or antennifer (anf) located on the ventral margin of the membranous antennal socket (as). A groove on the scape of the antenna fits around the antennifer which acts as a fulcrum.

The scape (sc) is a long, thick segment, compressed and tapered somewhat towards the bulbous base. The bulbous base contains the groove which fits over the antennifer. The distal end of the scape contains a socket for the reception of the proximal end of the second segment. The second segment or pedicel is short, being but little more than a third the length of the scape. It is also narrower, being the approximate width of the next few

segments. The pedicel is movably articulated with the scape, but is only slightly movable in its articulation with the third segment. The third, fourth, and fifth segments are each almost twice the length of the pedicel, while the sixth, seventh, eighth, ninth, and tenth segments are each approximately one and one-half times the length of the pedicel. Each segment is slightly compressed and slightly larger distally, though the antennae are not serrate. Each segment gradually decreases in width until the final segment is but two-thirds the diameter of the third. The distal segment is longer than any segment but the scape, and is bluntly pointed. Each segment is movably articulated with the next. Each bears small hairs over its surface and each is punctate.

Mandible (Fig.4.)

The mandibles (md) when in apposition usually lie tip to tip. Since the Lampyridae are a predacious group, the mandibles are used chiefly for grasping their prey. Lucidota corrusca exhibits this characteristic with simple biting organs and strong incisor points. The mandibles are smooth and heavily sclerotized. They are oval in cross-section. The distal portion is long and sharp, while the basal portion is rounded and much wider. The mesal surface of the basal portion bears a very dense plate of hairs. The outer edge of the mandible bears numerous

long hairs. The inner basal region is extended posteriorly. Curving posteriorly and ventrad of the outer side of the mandible is an arm which connects the outer side of the mandible with the posterior extension of the inner basal region. On this arm is a condyle (co) which articulates with a ginglymus (gly) on the gena. A membranous area connects the mandible with the labrum.

The mandibles are moved by tension of the flexor muscle, which is attached to the posterior mesal process. The mandibles are opened by the extensor muscle which joins with the mandible laterally.

Labrum

The labrum (lr), a small chitinized area bearing a few setae, projects ventrally from the fronto-clypeal region of the head. Posterior to the labrum is a membrane which extends beyond the labrum ventrally and dorsally. Dorsally it extends within the head capsule and forms the roof of the mouth.

Maxilla (Fig.13.)

The maxilla contains the following sclerites: stipes (st), cardo (cd), palpifer (pfr), maxillary palpus (mp), galea (g), and lacinia (l). The flattened and reversely curved cardo is roughly rectangular in shape and is only slightly movable at its basal articulation to the

gula. The stipes is somewhat compressed and about twice as long as it is broad. Both the cardo and stipes are devoid of pubescence. The stipes bears the mala, which is a flexible structure, composed of two conical lobes which have fused together. The mesal lobe is the lacinia, while the outer lobe is the galea. The lacinia is longer than the galea, which, however, is somewhat stouter. Though the lateral surface of the galea bears many long setae, the entire surface of both the galea and lacinia is covered with a fine curly pubescence.

The palpifer is long and pyramidal in shape, and has broken away from the stipes distally. A membraneous area connects the palpifer with the first segment of the maxillary palpus, which is cylindrical in shape. The second segment is slightly longer and increases in diameter distally. A semi-membranous area around the distal end cuts deeply into the chitinized surface of the segment mesally. The third segment is nearly globose, and, like the second segment, it has a large semi-membranous area. The first three segments and the palpifer are sparsely set with short hairs. The distal segment of the maxillary palpus is conical in shape but somewhat compressed. The base is rounded to articulate with the third segment. The distal segment is grooved mesally and probably is used as a scraper. Each segment is movable with the next to give the palpus flexibility.

Labium (Figs. 3, 6)

The labium consists of a basal submentum (sm) mentum (mn) mental membrane, two palpigers (pgr), ligula (lg), and the three-segmented labial palpi (lp).

The submentum is contiguous with the mentum anteriorly. Posteriorly, the submentum is confluent with the gula. Thus, the entire structure of gula, submentum, and mentum is an area undifferentiated by sutures. The mentum is bilobed. Within the groove and connecting the lobed mentum with the palpigers is the mental membrane. The palpigers have possibly fused with the labiostipites. This fusion product is the prementum of some writers. At any rate, the palpigers remain separated from each other by a suture their entire length. Anteriorly, the palpigers support the three-segmented labial palpi. The first segment is movably articulated with the palpiger-labiostipites. The second segment is but two-thirds the length of the first, and the basal portion of this second segment forms a bulbous area. Both the first and second segments bear a few setae. The third segment of the labial palpus is flattened, except at the base, and roughly triangular in shape. It is immovably united with the second segment and it is so borne as to give a hatchet-like appearance to the palpus.

The ligula when viewed from a ventral aspect appears as a hairy crescent-shaped extension projecting between

the labial palpi dorsally. From a dorsal aspect the ligula appears as two hairy areas with the curved mesal surfaces touching at about two-thirds the distance forward, and then separating again at both ends. The ligula overlaps the greater part of the first segment of the labial palpi.

Cervix (Figs. 2,3)

The cervix or neck region of Lucidota corrusca is long and gives the head great elasticity of movement. Imbedded in the cervix are two pairs of cervical sclerites. The anterio cervical sclerites (acs) articulate anteriorly with the head capsule. This sclerite is large, narrow at the base, curving and widening laterally, and bending downward at about two-thirds its length. The posterior third of the sclerite is only weakly sclerotized. The posterior cervical sclerites are small and rectangular with rounded corners. They are located immediately cephalad of the pronotum. The cervical sclerites serve to strengthen the cervix and support the head.

THORAX

Prothorax (Figs. 8,12)

The pronotum (pn) consists of a single sclerite which is nearly semi-circular in outline. The anterior and

lateral edges of the pronotum are flat and thin, while the mesal-dorsal region covering the head is convex. Around the edge of the pronotum is a single row of large punctures, while the remaining surface of the pronotum is punctate. Ventrally the pronotum is inflexed to form two nearly parallel walls which serve to connect the pronotum with the prosternum. The ventral surface as well as the inflexed surface of the pronotum is punctate, while the punctures described on the dorsal surface appear contiguous with similarly located punctures on the ventral margin.

The sternum of the prothorax includes a basisternum (bs), furcasternum (fs), and two precoxal bridges (pc). The sternum is a narrow band which connects with the pronotum. Mesally the basisternum is produced caudally a short distance to form the prosternal lobe (psl) which appears as an elevated portion of the posteriorly projecting arm of the basisternum. The precoxal bridges (pc) extend to the pronotal wall and include the greater part of the area cephalad of the coxal cavities. The furcasternum (fs) appears as a flat area at the base of the prosternal lobe and bears the internal furcal arms which project caudad and dorsad at an angle of 45 degrees to the basisternum. These projections serve as a muscle attachment and help in the formation of the coxal cavities.

The precoxal bridges abut against the pronotum. The posterior edge of the abutting precoxal bridge forms a slender arm with which a small process is articulated. This process unites with the pleural region of the prothorax.

The pleural region of Lucidota corrusca is situated within the prothoracic cavity and is hidden from view. Thus, it is called a hidden pleural region. In the case of this species, the epimeron (em) has folded over ventrally and is partially fused with the episternum (eps) upon which it lies. The epimeron is smaller than the episternum and the episternum therefore extends beyond the epimeron. Ventrally the combined structure is convex, while dorsally it is concave. Hairs are borne on the inner surfaces (which correspond to the outer surfaces of insects with unhidden pleural regions) where two sclerites do not overlap. Contiguous with the anterior and mesal portion of the episternum is a long pointed extension called the trochantin (tr).

Prothoracic Leg (Fig. 16,18)

The leg is composed of five divisions: the coxa (c), trochanter (tch), femur (fe), tibia (ti), and tarsus (ta). The stout coxa is cylindrical in shape and is cut off diagonally at the base. The base of the coxa articulates anteriorly with the apex of the trochantin (tr)

and laterally with the extended tip of the episternum. The coxa occupies most of the coxal cavity and projects backward and mesally to some extent. A groove at the distal end of the coxa receives the process at the base of the trochanter. The trochanter is but half as wide as the coxa but enlarges somewhat distally. It also curves slightly outward, so that the outer surface is much shorter than the inner surface. The distal end of the trochanter is united immovably with the femur.

The femur is moderately stout and slightly compressed. It is grooved distally on the inner surface for the reception of the tibia which can be drawn into it. The distal end of the femur receives the narrowed end of the tibia.

The tibia is narrow basally. The rest of the tibia is about twice the breadth of the articulatory base, and is slightly longer and narrower than the femur. The distal end of the tibia bears two mesal lobes, while on its inner distal surface are borne two spurs. The basitarsus articulates with the tibia between its distal lobes and is so articulated as to allow the tarsus to be flexed between the tibial spurs.

The first tarsal segment or basitarsus is somewhat triangular in shape when viewed from a lateral aspect, while from a dorsal aspect it is nearly parallel-sided. There is a small rounded basal process which forms

a condylar structure for articulation with the tibia. The basitarsus is provided with a socket for the reception of the second tarsal segment. The second tarsal segment is parallel-sided with its basal portion sloped diagonally inward and the distal end rounded. The third tarsal segment articulates with the second segment by means of a typical groove. The third segment is wider than long. From a lateral aspect the dorsal and ventral walls curve ventrally. From a ventral or dorsal aspect the segment is straight-sided, though it is larger at the distal end. Each of the three segments bears hairs along its distal end. The fourth tarsal segment is short, broad, and tapering distally. From each side extends a structure called a tarsal pulvillus (pv). These structures are densely covered with hair ventrally. This hair gives off an exudate which enables the insect to cling to smooth objects while in an inverted position. The tarsal pulvilli have a lateral movement. Attached to the distal end of the fourth segment is the elongate fifth segment or distitarsus (dt). The distitarsus (dt). is long and nearly cylindrical, although it widens slightly distally and curves ventrally. The ventral distal portion of the distitarsus is widely grooved. Within this groove lies the unguitractor (ugt) and the empodium (emp), which are parts of the pretarsus. The unguitractor is a small oval plate contiguous distally with the empodium. The empodium

occupies the small area at the tip of the unguitractor. The ungues or claws (ung) are long, sharp, and hollow. They are flexed by the tension of the flexor membrane which, in turn, is connected to the unguitractor tendon (ut), a tendon that passes through the distitarsus to the tibia. Tension on this tendon causes the claws to close. Dorsally the ungues articulate with the dorsal tip of the distitarsus by means of the unguifer.

Imbedded in the membrane caudad of the coxal cavities and immediately cephalad of the katepisternum of the mesothorax lies the mesothoracic spiracles (sp). These are oval in shape. The spiracular opening is located on the lateral end of the plate.

Mesothorax (Figs. 9,10,11,19)

The mesothorax consists of a dorsal collar or mesonotum, a sternal area, and a lateral area. The mesothorax is smooth and bears several small setae. The mesothorax bears two pairs of appendages, the elytra and the mesothoracic legs.

The mesonotum is a loosely fitting collar which forms the dorsal covering of the mesothorax. In the forward angle formed by the scutum is a small semi-membranous area called the prescutum (prs). Posterior to the prescutum is a large area which is short mesally but is enlarged laterally

so as to include most of the lateral edge of the notum. This area is the scutum (sct). Posterior to the scutum and separated from it by a suture is the diamond-shaped scutellum (scl). Laterally the edges of the scutum and scutellum flex ventrally a short distance. At the anterior and posterior margins of the ventrally flexed area there are prolonged processes which join with the pleural region. The mesonotum is covered with a fine pubescence.

The mesopleuron is divided into two main divisions: the episternum and the epimeron. The episternum (eps) forms a long straight arched sclerite, which is separated posteriorly from the epimeron (em) by a strong pleural suture (ps). The epimeron, like the episternum, is arched in cross section and is of the same general shape. The anteriormost tip of the episternum forms the region with which the elytra is articulated. Ventrally, the episternum is contiguous with the precoxales (pc) of the sternum. The basisternum (bs) is produced caudally into a blunt point between the coxal cavities. The coxal cavity (cc) is surrounded by the pleuron and the sterna of the mesothorax and metathorax. The pleural suture projects deeply into the coxal cavity laterally, while directly opposite is another invagination or process within the coxal cavity. This is the furca.

The furcasternum protrudes laterally and slightly cephalad within the body cavity. The furcasternum serves as a floor to the coxal cavity, and, although not well developed, serves as an attachment for many muscles of the mesothorax.

Mesothoracic Leg

Articulated with the episternum above the pleural suture is a trochantin (tr), a slender arched sclerite. This sclerite articulates with the anterior basal surface of the coxa. A second connection is afforded the coxa by its attachment to a groove on the lateral basal region of the coxa with the pointed tip of the projecting pleural suture. The coxa is of the same general shape but slightly longer and thinner than that of the prothoracic leg. It is also grooved for the reception of the femur. From a caudal aspect, the distal end has a large grooved area with which the trochanter articulates. The femur and tibia are slightly longer and thinner than are the corresponding segments of the prothoracic leg. The remaining segments of the leg are fundamentally the same as those of the prothoracic leg already described.

Elytra (Fig. 15)

The elytra are coriaceous and sharply flexed ven-

trally along the anterior proximal edge. Thus, when in apposition, greater protection is given by the inflexed portion. The rim of the elytra is striated with a single row of deep punctures, while the rest of the surface is punctate. There are a few weak veins perceivable in the elytra.

Metathorax (Figs. 9,10,14,19)

Metanotum

The prephragma (pph) is crescent shaped and divided dorsally. Posterior to and dorsad of the prephragma lies the prescutum (psc). The lateral edges of the prescutum extend ventrally and anteriorly so as to connect with the mesopleuron. Posterior to the prescutum is a large V-shaped sunken area, which extends nearly to the posterior limits of the metathorax. This area is the median groove (mg). The anterior mesal two-thirds of the groove is produced into a spindle-shaped chitinous area which lies slightly above the floor of the groove. The forward part of this spindle, divides the prescutum. On either side of the spindle, and bounded anteriorly by the prescutum, is a semi-membranous area. Posterior to the semi-membranous area of the groove is a chitinized area which extends to the posterior limit of the groove. On either margin of the groove is a

long club-shaped raised portion, which serves to differentiate the groove from the scutum. The scutum (sct) is divided by the median groove and lies laterad of the groove. The scutum is the largest area of the metanotum. The anterior lateral portions of the scutum are produced into triangular areas which form the anterior notal wing processes (anp). From the posterior lateral margin of the scutum there extends an arm which is known as the posterior notal wing process (pnp). Extending on each side of the scutum are the alar membranes.

The scutellum (scl) lies posterior to the scutum and is divided into two halves by the median groove. The anterior margin of the scutellum is rounded, while the posterior margin is straight. Thus, the scutellum is roughly semi-ovoid with a V-shaped constriction anteriorly.

Posterior to the scutellum and separated from it by a membrane lies the postscutellum (prsc) which projects posteriorly to form a lobe on each side of the median line. The membrane connecting the thorax with the abdomen is attached over these lobes, which form the post fragma. The lateral margin of the postscutellum is produced anteriorly and posteriorly to join the pleural region.

The Metapleuron

The metapleuron consists of the dorsal epimeron

and the ventral episternum, which are shifted from the vertical position. The epimeron is divided into a rectangular basal portion, the katepimeron (kem), and a long anterior arm called the anepimeron (aem). The posterior end of the katepimeron extends posteriorly into a small folded area. The distal end of the anepimeron forms the triangular alifer. Dorsally, the epimeron is connected with the postscutellum by a membrane. Dorsad of the katepimeron and lying between the katepimeron and third axillary sclerite is the subalar sclerite (sa). Ventrally, the epimeron is separated from the episternum by the pleural suture (ps). The episternum is divided by a suture into a basal posterior area, the katepisternum (kes), and an anterior arm, the anepisternum (aes). The katepisternum is hooked and pointed posteriorly. It increases in size anteriorly until the ventral margin curves dorsally towards the anepisternum. The anepisternum is enlarged posteriorly and forms an arm which is closely attached to the anepimeron. The distal end of the anepisternum is rounded and notched to receive the wing base. This is the basalar region (br). From a ventral aspect, the anepimeron and anepisternum are separated basally but are united distally by a semi-membrane. Cephalad of the katepisternum and dorsad of the mesepimeron lies the

metathoracic spiracle.

Metasternum

The metasternum is large, smooth, and nearly flat. The basisternum (bs) is bounded anteriorly by the mesosternum and coxal cavities, laterally by the katepisternum, and posteriorly by the coxae and furcasternum. A slight median carina extends from the anterior end one-third the distance backwards, while from the posterior margin a similar carina extends one-third the distance forward. Immediately caudad of the mesothoracic coxal cavities the basisternum is grooved for the reception of the coxae. The remaining part of the basisternum is nearly flat and bears small setae.

Furcasternum

The furcasternum (fs), from a ventral aspect, appears as two small triangular processes near the median of the posterior margin of the metasternum. From an internal aspect the furcasternum is larger, arising from the small triangular processes and curving first mesally and then ectally. Thus the general shape is that of a shield with a furcated, enlarged base. This structure is directed forward and dorsad at an angle of nearly 45 degrees to the metasternum. The furcasternum is flatly

V-shaped in cross-section, the apex of the V being directed dorsally.

Metathoracic Leg (Fig. 17)

The metathoracic legs are similar in appearance to those of the first and second thoracic segments, although they are situated closer together. The coxa (c) is longer than are those of the forward segments and reaches to the epimeron. Its anterior margin is formed into a hook which connects with a similar hook on the posterior margin of the katepisternum. Anteriorly the coxa is open and serves as a part of the body wall. Posteriorly the coxa bends caudally to form a cylinder with which the trochanter is articulated. The coxa is faintly grooved to divide it into an anterior eucoxa (eu) and a posterior meron (mr). The trochanter articulates with the coxa in the same way as described for the prothoracic leg. The femur and tibia are longer and proportionately narrower than the corresponding parts of the mesothoracic leg. With the exception of the basitarsus (bt) the remaining leg segments are nearly identical with the corresponding parts already discussed. In this case, the basitarsus is slightly broader and more rounded than the basitarsus of the prothoracic leg.

Wings and Wing Axillaries

The metathoracic wings articulate with the metanotum by means of several sclerites, including four axillary sclerites. The pivotal points of wing movement, the basalar regions, have already been described.

Axillary Sclerites (Fig. 14)

The first axillary sclerite (1 ax) lies laterad of the scutum and is closely associated with the lateral margin of the anterior notal wing process (anp). The first axillary is wide posteriorly, narrowing anteriorly and curving distally to form a cleft. The distal end is somewhat horn-shaped. The first axillary is associated with the subcostal wing vein (Sc).

The second axillary (2 ax) lies within and slightly posterior to the cleft of the first axillary. It is bilobed posteriorly and narrowed and twisted nearly 180 degrees anteriorly. The proximal edge of the axillary is articulated with the distal edge of the first axillary.

The third axillary (3 ax) is the largest of the axillary sclerites. The anterior of the sclerite is plowshare in shape with the point directed proximally. A large triangular area which reaches to the posterior notal wing process (pnp) forms the posterior area of the

sclerite. The third axillary is connected to the second axillary by a membrane. Ventrad of the third axillary lies the subalar sclerite (sa).

The fourth axillary (4 ax) is a small oval sclerite imbedded in the membrane between the scutum and the proximal tip of the third axillary.

Located in the alar membrane cephalad of the scutum and anterior notal wing process lies a flat oval humeral plate (hp).

The Wing (Fig. 20)

The interpretation of Coleopteran wing venation is still a matter of controversy. Some veins have been atrophied completely, while others are well developed. In this paper an interpretation based on the work of Forbes (1922) has been adopted.

The costa (C) is slightly swollen proximally and has a hook for articulatory purposes near its base. The vein extends distally, although it is fused the greater part of its length with the subcosta.

The subcosta (Sc) arises as a large flat sclerite associated with the first axillary sclerite (1 ax). From the large flat plate the subcosta extends distally, bending anteriorly and joining the costa, with which it is fused the remaining three-quarters of the length of

the wing.

The radius (R) together with the first and second axillaries (1 ax & 2 ax) forms the principle articulation with the thorax. The radius is distinct from the subcosta and parallels the anterior margin of the wing nearly to the apex. The radial field consists of a radial sector (Rs) from which the fused R_2 & R_3 arise. R_2 & R_3 unite with R_1 just before the latter reaches the margin of the wing. A radio-medial cross-vein (r-m) connects the radial sector with the median.

Median (M) fades out basally. Distally it extends to the radio-medial cross-vein (r-m). At the cross-vein it bends posteriorly to the margin of the wing as M_4.

Cubitus (Cu) is a nearly straight vein which is associated basally with the second axillary (2 ax). Distally cubitus meets and unites with M_4.

The first anal vein (1st A) apparently branches proximally from cubitus. It is not known whether the cross-vein (cu-a) or the base of the main vein has disappeared. At any rate the vein curves posteriorly and then anteriorly before terminating near the margin of the wing.

The second anal vein (2nd A) arises slightly anterior to the third axillary (3rd ax). This vein

branches to form 2nd A_1 and 2nd A_2. The second anal vein branches forward at a right angle, meets the first anal vein with which it unites a short distance as 1st A & 2nd A_1, and then separates and extends nearly to the margin. 2nd A_2 which is lacking in Lucidota branches from 2nd A_1 in related genera. 2nd A_3 continues as a straight vein from 2nd A.

Two cross-veins (2a-3a) demark the "wedge cell" (W) and connect the second anal vein with the third anal vein.

The third anal vein (3rd A) originates basally with the second anal vein. Midway of its length it branches into 3rd A_1 and 3rd A_2.

The fourth anal vein (4A) is a single nearly straight vein which is not directly associated with the other anal veins.

The wing appears to be thinner in parts where the folds occur, and this lighter color gives the wings a somewhat striped appearance. The apex of the wing has a double chevron fold. Forbes states, "that if wing venation means anything, then this group of insects seems a degenerate one."

Abdomen (Figs. 21, 22, 23)

The abdomen is composed of eight visible seg-

ments. The remaining segments have been greatly modified and are hidden from view. The oval-shaped abdomen is bluntly rounded, and the anterior portion is broadly united with the thorax. The pleural region of the abdomen has fused with the sternum, as is indicated by the position of the spiracles, the landmarks of the pleural region. Great elasticity is given the abdomen by the membrane which connects the sclerites of the abdomen.

There are eight visible tergites (t). The first tergite is but weakly sclerotized and is joined to the postscutellum (prsc) by a narrow membrane. The anterior portion of the second tergite is weakly sclerotized, while the remaining portion of this tergite (2 t) and the remaining tergites are more strongly sclerotized. Each of the tergites, excepting the fourth and eighth, are of approximately equal length. The fourth and eighth tergites are longer than the others. The first six tergites are of nearly the same width, while the seventh tergite is much narrower. The eighth tergite is greatly reduced in width. The eighth tergite of the female is more angular than that of the male, the posterior margin being bluntly rounded in the former while it is produced into four small, rounded posterior lobes in the latter.

There appear to be but seven visible sternites

(s). This is due to the fusion of the first and second sternites, the first sternite being extremely short and scarcely visible. The first sternite joins the abdomen to the metathorax just dorsad of the coxae. All of the sternites are of approximately equal length with the exception of the first, which is reduced, and the fourth, which is longer. They vary so greatly in width as to give the abdomen an oval-shaped outline, the greatest reduction in width being shown by the seventh and eighth sternites. The lateral edges of the sternites, excepting the first and eighth, curve dorsally. This curved area represents the fusion of the pleural region with the sternites. In each of the upturned areas of the sternites is located a spiracle (sp). The spiracle of the first abdominal segment has shifted ventrally and lies posterior to the metasternum. The eighth sternite of the male is bilobed posteriorly, forming two large rounded lobes. The male genitalia projects slightly from between the lobes. The eighth sternite of the female is triangular in shape with a deep notch in the posterior margin. Normally, the styli project beyond the two lobes formed by the notch.

Female Genitalia (Figs. 22, 24)

From a lateral aspect the extended female

genitalia are elongate and narrow, with a second elongate arm projecting dorsally from near the eighth tergite. From a dorsal or ventral aspect the genitalia are bilobed, each lobe bearing a stylus.

The ninth tergite (9 t) forms the proximal dorsal half of the genitalia. From the ninth tergite extends the proctiger (p) which apparently represents the tenth tergite (10)t). A sclerite, the paraproct (pp), forms a V-shaped structure whose arms extend laterally. The tip of the proctiger bears the anus (an). The valvifers (vf) are narrow sclerites extending from beneath the eighth sternite (8 s). Posterior to the valvifers lie the coxites which bear several setae. Each lobe of the coxite bears a strongly sclerotized area. Each of the lobes bears a stylus (sty) at its tip. Between the lobes is the vulva (v).

Male Genitalia (Fig. 25)

The male genitalia are covered with a chitinized sheath. The rounded basal piece (bp) bears the pincer-like arms called the parameres (pm). Between the parameres is the aedeagus (the median lobe of some authors) through which the ejaculatory duct passes. The ejaculatory duct (ej) arises at the testes, enters the basal piece and terminates at the posterior end of the aedeagus.

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Abbreviations

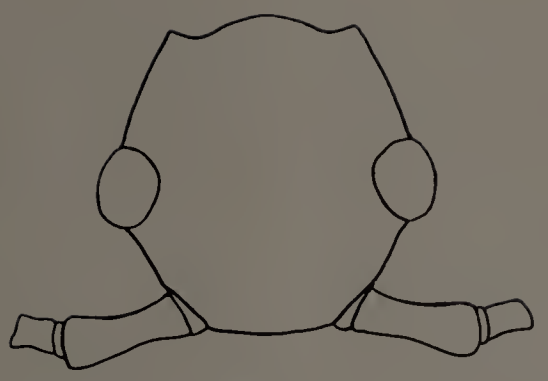
A	anal vein
a	process at apex of anterior tentorial arm
acs	anterior cervical sclerite
aed	aedeagus
aem	anepimeron
aes	anepisternum
an	anus
anf	antennifer
anp	anterior notal wing process
ant	antenna
at	anterior tentorial pit
ata	anterior tentorial arm
ax	axillary sclerite
2a-3a	crossvein
bp	basal piece
bs	basisternum
br	basalar region
C	costa
c	coxa
cc	coxal cavity
cd	cardo
co	condyle
Cu	Cubitus
cv	cervix
cx	coxite
dt	distitarsus
e	compound eye
ej	ejaculatory duct
em	epimeron
emp	empodium
eps	episternum
eu	eucoxa
fe	femur
fm	flexor membrane
fr	frons
fs	furcasternum
fs	frontal suture

g	galea
ga	gena
gly	ginglymus
gu	gula
hp	humeral plate
kem	katepimeron
kes	katepisternum
l	lacinia
lg	ligula
lp	labial palpi
lr	labrum
M	media
md	mandible
mg	median groove
mn	mentum
mp	maxillary palpus
mr	meron
occ	occiput
ocf	occipital foramen
ocs	occipital suture
p	proctiger
pa	parietal
pc	precoxal bridge, precoxales
pd	pedicel
pfr	palpifer
pgr	palpiger
pm	paramere
pn	pronotum
pnp	posterior notal wing process
pp	paraproct
pph	prephragma
prs	prescutum of mesothorax
prsc	postscutellum
ps	pleural suture
psc	prescutum of metathorax
psl	prosternal lobe
pt	posterior tentorial pit
pta	posterior tentorial arm
pv	pulvillus

R	radius
Rs	radial sector
r-m	radio-medial crossvein
s	sternite
sa	subalar sclerite
Sc	subcosta
sc	scape
scl	scutellum
sct	scutum
sm	submentum
sp	spiracle
st	stipes
sty	stylus
t	tergite
ta	tarsus
tch	trochanter
ti	tibia
tr	trochantin
ugt	unguitractor
ung	ungues or claws
ut	unguitractor tendon
v	vulva
vf	valvifer
W	wedge cell

Explanation of Figures

Fig. 1 Dorsal view of head
Fig. 2 Dorso-frontal view of head
Fig. 3 Ventral view of head
Fig. 4 Dorsal view of left mandible
Fig. 5 Antenna
Fig. 6 Dorsal view of labium and ligula
Fig. 7 Tentorium
Fig. 8 Ventral view of prothorax
Fig. 9 Internal ventral view of pterothorax
Fig. 10 External ventral view of pterothorax
Fig. 11 Mesonotum
Fig. 12 Pleural region of prothorax
Fig. 13 Maxilla
Fig. 14 Metanotum
Fig. 15 Ventral view of left elytra
Fig. 16 Pretarsus
Fig. 17 Metathoracic leg
Fig. 18 Prothoracic leg
Fig. 19 Lateral view of pterothorax
Fig. 20 Metathoracic wing showing venation
Fig. 21 Ventral view of abdomen (male)
Fig. 22 Terminal ventral segments of female
Fig. 23 Dorsal view of abdomen (male)
Fig. 24 Lateral view of female genitalia
Fig. 25 Ventral view of male genitalia



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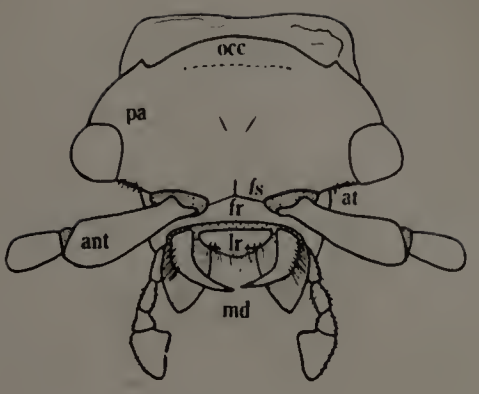


Fig. 2

Fig. 4

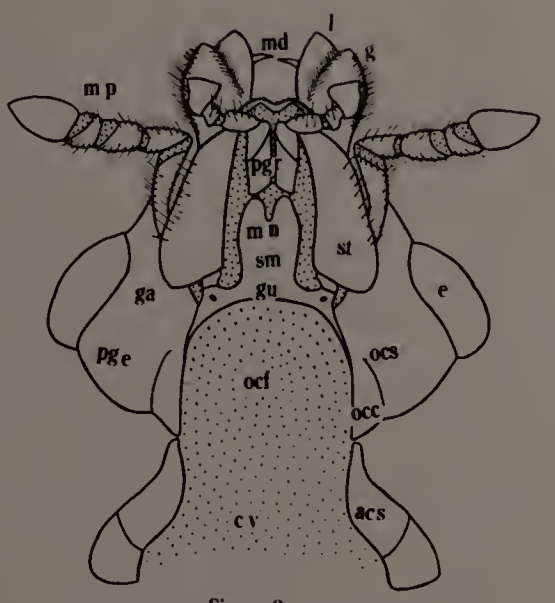
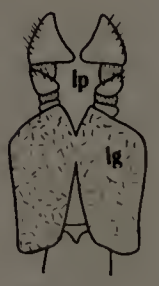


Fig. 3

Fig. 5



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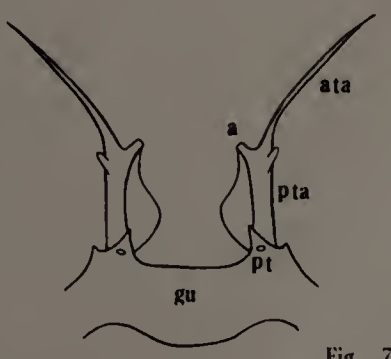

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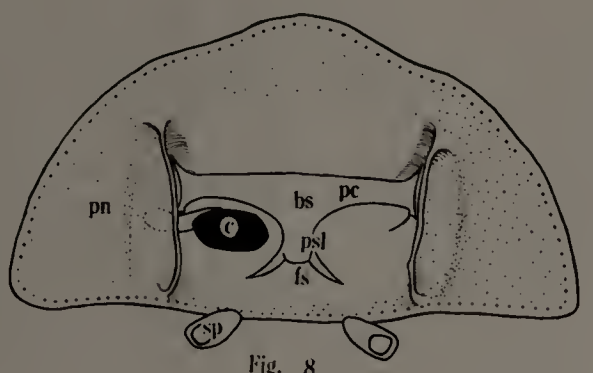

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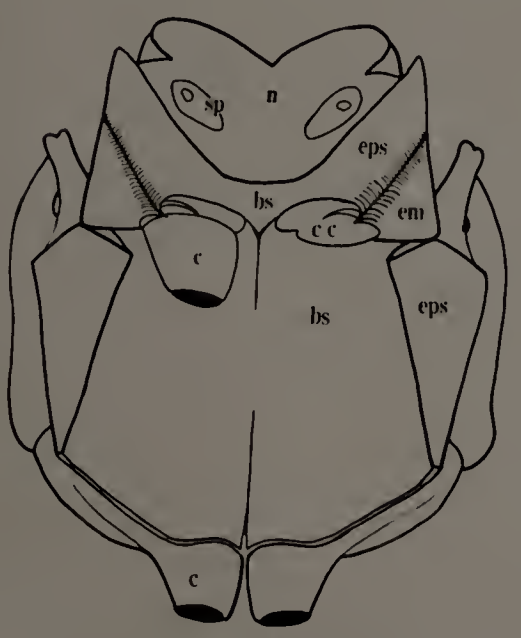

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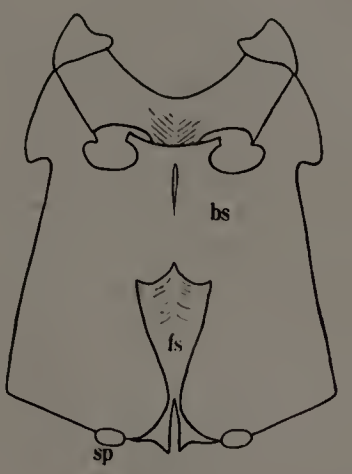

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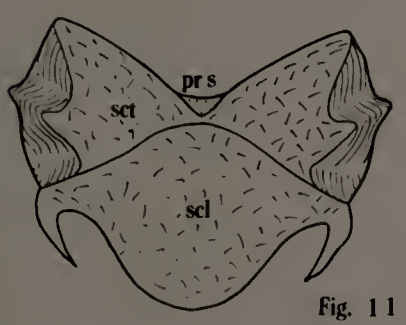


Fig. 11

Fig. 12

Fig. 13

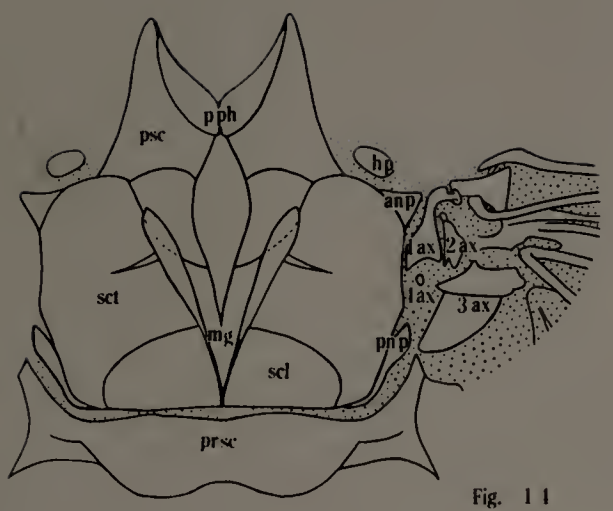


Fig. 11

Fig. 15

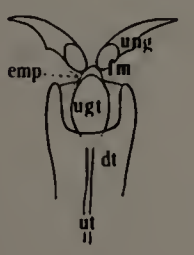
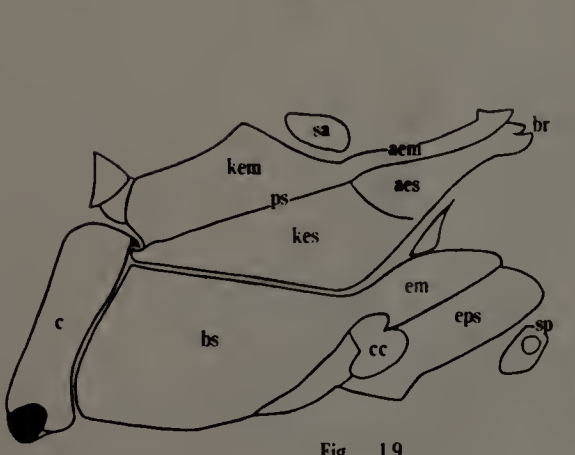


Fig. 16

Fig. 17

Fig. 18



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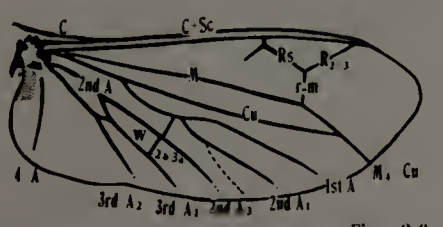

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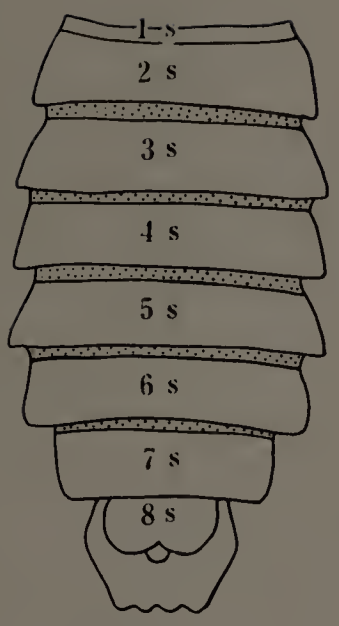

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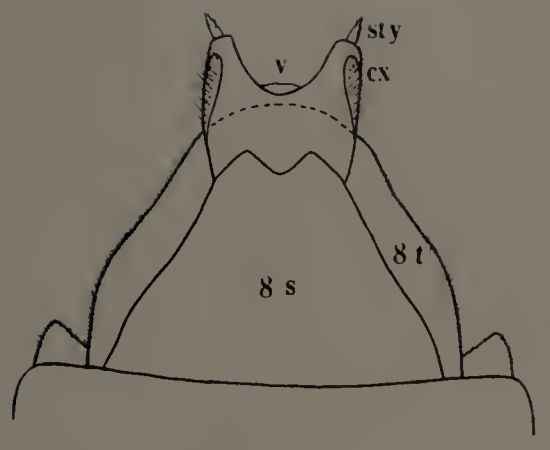

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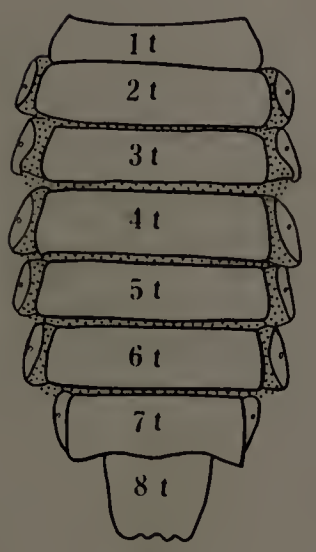

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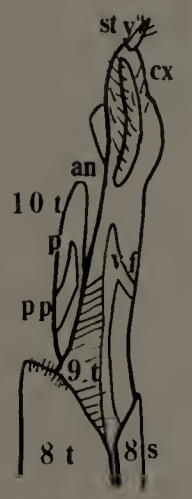

Fig. 24

Fig. 25

Approved by

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