On the External Morphology
of Idiocerus clypealis Leth

(*Homoptera*: *Jassidae*)

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(With 5 figures)

Contents

Introduction

The mango leafhopper, *Idiocerus clypealis Leth.*, is a serious pest of mango blossoms and is found throughout the tropics and into the milder subtropical regions of the world. Its pestiferous activity has been recorded from India, Burma and Ceylon (Distant, 1907), Formosa (Schumacher, 1915), Philippine Islands (Mackie, 1916), Labuan Islands (Gater, 1924) and Cochin (Caresche, 1935). Considerable attention has been given to the study of biology and control measures of this insect pest. It is unfortunate that no detailed work on its external anatomy has been attempted so far. Distant (1907) presented an illustration of the adult which has been

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standard in the literature. QADRI (1949) described the skeletomuscular structures of the head capsule.

It is the purpose of this paper to present illustrations of the exoskeleton of the adult to serve as an aid in its identification as well as to present a detailed morphological study of this insect.

Material and Technique

The insects used in this investigation were brought fresh from the mango orchards. The insects were boiled for five minutes in 5% solution of caustic soda until the parts were soft. Then the treated specimens were washed in distilled water. The washing was again completed by placing the boiled specimens under running tap water for ten minutes. These specimens were, then preserved in 70% alcohol for examination.

The exoskeleton was dissected with fine scissor and needles. This was then dehydrated with upgrade alcohols and transferred to clove oil. When the clove oil had displaced the alcohol the specimen was mounted in canada balsam.

I. The Head

A. General Structure

In anterior view the head (fig. 1 A) is triangular with apex below. The side angles are round and capped by the compound eyes (E). The compound eyes are more angular than round in their outline. The head is flattened, face being convex while the rear surface is hollowed to fit in the anterior end of the prothorax. The antennae (Ant) arise close together from the face between the lower halves of the compound eyes, where each is inserted into a circular socket of the head wall. The mouth parts are attached to the lower part of the head which is typically opisthognathus. In its natural position three jointed labium extends upto the anterior end of the third coxae.

The head does not present sutures to the extent that they are in some of the lower insects. The following regions and sutures can be conveniently distinguished.

Anteriorly the prominent convex plate belongs to the clypeal region of the head (Clp). The plate is differentiated by the epistomal suture (es) laterally but dorsally it has no demarked suture and the plate is fused with the frons (Fr.) The lateral demarkation of this suture extends between the bases of the antennae. The vertex (Vx) is the prominent top of the head and possess two black areas (ba) each situated near the eyes. These two black areas are, however, absent in females. The upper part of the face is the frons immediately above the large clypeal plate. This region bears two ocelli (o) a little above the origin of the antennae. Between the large clypeal plate and the base of the labrum (Lm) there is a very distinct small region: anteclypeal plate (Aclp), in most homopterous insect this is indistinct or absent. The labrum is a small triangular lobe closely applied to the anterior

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side of the base of the labium (Lb). It hangs from the anteclypeal plate with its apex angle downwards. Below the compound eyes on each side of the head there are two lateral plates (A, B). The plates are separated by a membranous groove (h). The anterior plate (A) is commonly called the mandibular plate since the mandibular bristle is articulated by a lever like arm with the posterior border of its upper part. The second lateral plate (B) is continuous dorsally with the cranial wall and is termed as maxillary plate.

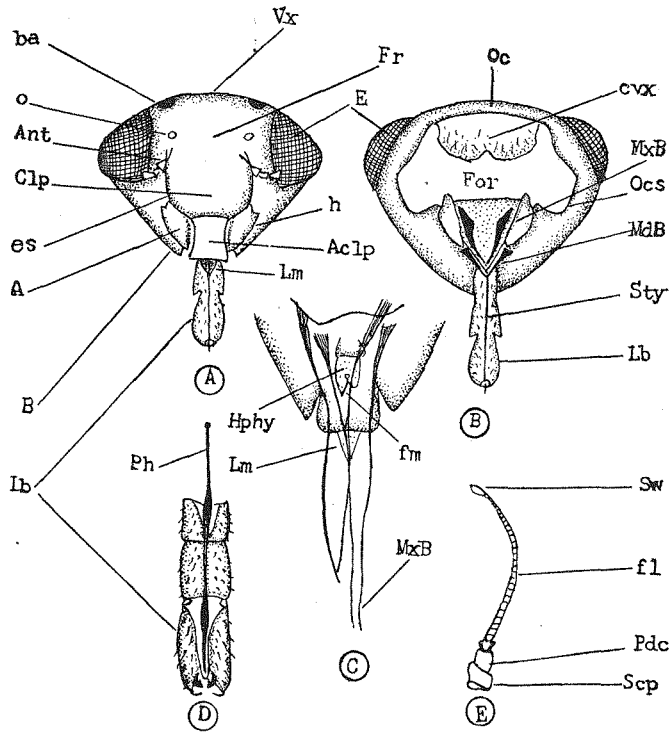

Fig. 1. Head and its appendages. A Anterior view of the head (× 22.5). B Posterior view of the head (× 22.5). C Mouth parts (× 30). D Labium (× 30). E Male antenna (× 30)

Its upper part is the gena but the gula is not demarked because it is fused with the lateral wall of the head.

The posterior wall of the head (fig. 1B) is perforated by a large hole, the foramen magnum (For) by means of which the head cavity is connected through the membranous neck (cvx) with the cavity of the thorax. This part of the cranium has only few of the sutures and areas. The occiput (Oc) is a very narrow region and the occipital suture (Ocs) is present ending centrally to the posterior articulations of the mandibular bristles (MdB). The labium (Lb) is suspended from a large membraous ventral area which is continuous with the neck and fits on the posterior end of a highly chitinised plate so as to carry within its groove the four piercing stylets (Sty).

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B. Antennae

The antennae (fig. 1 E) are two slender, jointed and movable appendages of the head each attached near the eyes. The base of the antenna is set into a small membranous area of the head called antennal socket. The rim of the socket is prominent by an internal ridge formed by an external inflection, the antennal suture. Each antenna consists of three parts which form a prominent elbow with each other. The first part is the scape (Scp) which is a single joint inserted into the antennal socket of the head by a prominent base. The second part of the antenna, distinguished as the pedicel (Pdc) is a single, short and cylindrical joint. It is almost equal in length with the first joint. The part of the antenna beyond the pedicel is the flagellum (fl.) It is setaceous, long and composed of 54 to 58 segments. The first segment is somewhat thicker and fusiform in shape than the others. The base is articulated freely to the distal end of the pedicel which permits a free motion to the flagellum. The female antenna is stouter than that of the male which is thread like, small and inconspicuous. Moreover, the male antenna bears a disc like swelling (Sw) on the tip of the flagellum.

C. Mouth Parts

The suctorial mouth parts as found in *Homoptera* are all represented in this insect and are described below:

Labrum — It is only about half as long as the anteclypeus and differs in shape from the labrum of other *Homoptera* in that instead of being a narrow pointed process, it is a triangular and flat in general shape with its base attached to the anteclypeus.

Hypopharynx — It is conical and lies in the ventral wall of the head between the lower ends of the mandibular plates. The surface of the hypopharynx is covered by the epipharynx which contains a median groove, and this groove, converted into a tube (fm) by the overlying epipharyngeal wall (fig. 1 C).

Labium — (fig. 1 D) It is a rigid organ and is divided intothree segments. Its anterior surface is deeply concave to form the channel of the beak containing the mandibular and maxillary bristles. It is attached below the hypopharynx on the lower side of the head. The attachment is by means of a delicate membrane attached to the edge of the foramen. The first or the basal segment of the labium is membranous and is well protected between the procoxae in a membranous fold. The attachment of the labium to the prothorax is between prothorax and mesothorax typical of the *Homoptera* and it is very rigid. In fact in most cases when the head was removed from the rest of the body the labium remained fastened to the thorax but tore loose at its base from the head. The labium is slitted throughout its entire length. At its base, where it is almost flate, it has only short, low, lateral edges and the upper parts of the mouth fit into this. The labium

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dharynx (Ph) lies on the floor of the labium and is highly chitinised. It is tube shaped and extended at its cephalic end to fuse with the hypopharynx. The sensory hairs are present all over the labium. At the distal end, the third segment is highly chitinised, with a circular tip ending in two lateral tongue like processes.

Stylets — These are the typical mandibular and maxillary bristles of the most *Homoptera.* They arise from the walls of the bristle pouches between the inner surfaces of the maxillary plate. When they are detached from the labial groove, they are held together by the labrum above, the maxillary sclerites on the sides and by the hypopharynx below. From this point the bases of the mandibles and maxillae diverge in the form of the letter 'Y' (fig. 1B). The bases of these stylets are hollow funnel shaped and heavily chitinised. The maxillary bristles arise at a higher level than do the mandibular bristles. The mandibular bristles are thicker than the maxillary bristles, but not so wide. The tip of the mandible is very slender and sharp bearing 9 to 12 blunt serrations. The tip of the maxilla is of similar shape but with a sharp projection instead of serrations.

II. The Thorax

A. General Structure

The usual three segments of the thorax of this insect are not very clear. The thorax is distinctly divided between its first two segments into a prothoracic part and a meso-meta part. The second part is composed of the wing bearing segments which are closely united with each other, commonly termed as pterothorax in *Homoptera.*

Prothorax — (fig. 2) The whole prothorax comes out from the thoracic region as a single piece. The tergum, sternum and pleuron are clearly demarked. The pronotum (ptm) is closely attached to the anterior of the mesothorax and lies in a semi circular convex form like a collar upon the head. It is devoid of sutures and sclerites. The pleuron of the prothorax (ppa) is smaller than the pronotum and consists of a simple plate which supports the front coxa by its lower posterior angle (a). The prosternum (pst) is a small triangular plate lying before the bases of the front coxa. Internally the prothorax bears some chitinised ridges which serve for the muscle attachments but no distinct furca is developed in this thoracic region.

Pterothorax — It supports the organs of locomotion and flight and are themselves important in the mechanism for moving the wings. The terga, sterna and pleura have been modified accordingly. In the present study the meso- and metathoracic regions have been marked out and are discussed below:

Mesothorax (fig. 2). It occupies almost the whole of the thorax. It is well developed and presents some of the impotant sclerites of a typical thoracic

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region. Dorsally it consists of a large tergal plate which forms the round roof of the thorax and can be differentiated into prescutum, scutum and scutellum. The scutum (Sct) is not clearly demarked from the prescutum (Prsc) but it can be recognised by the dorsally pressed plate. The scutellum (Scl) is separated by a transverse suture (f) which has become indistinct in the middle. The posterior part is demarked by a secondary ridge (sr) having

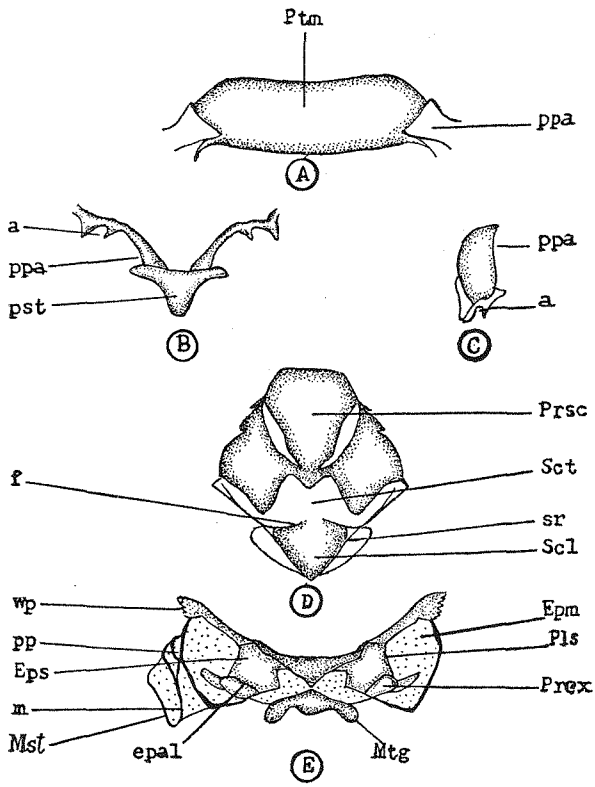

Fig. 2. Exoskeleton of the thoracic region (× 30). A Pronotum. B Propleuron. C Prosternum with propleuron in side view. D Mesothorax. E Ventral portion of the mesometa part of the pterothorax

apex directed posteriorly. The true scutellar region is thus divided into, a median elevated triangular area and the two lateral depressed areas.

The mesopleuron is highly modified and presents developed sutures. The pleural suture (Pls) extends from the base of the coxa to the wing process. It divides the two principal sclerites of the mesothorax, the anterior episternum (Eps) and the posterior epimeron (Epm). There is also present the episternoprecoxal suture (epal) which separates the episternum from the precoxale (Prcx).

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The mesosternum (Mst) is a simple ventral region of the pterothorax. In the middle it is marked by a long median ridge (m) which ends posteriorly into a pit (pp). This ridge makes the internal base of the furca. In this case there is no evident distinction between basiosternum and furcosternum.

Metathorax. It is reduced to a narrow sclerite corwded in a circular form. The metatergum (mtg) is comparatively developed but is devoid of usual structures. It has not been possible to separate the metapleuron and metasternum as they are completely fused having wing processes (wp) at their anterior dorsum and the coxal cavity on the two sides ventrally. The furca is well developed which serves for the attachment of muscles to give enough support to the metathoracic leg which is well developed.

B. Legs

The three pair of legs (fig. 3) differ chiefly in size and in the form of coxa and few other joints. The posterior leg is the largest and the two anterior pair of legs are almost similar in size and shape. Each leg consists of five segments which are united by membranous joints. The comparative shape of each joint in different legs is discussed below:

Coxa — (Cx) The coxae of the prothoracic and metathoracic legs are tubular and prismatic. The coxa of the mesothoracic leg is smaller than that of the prothoracic leg and that of metathoracic leg is stout, large and boat shaped. The movement of the prothoracic sterno-coxal articulation are very free, the anterior legs are not only used as limbs, but almost as arms, serving to clean the face and stylets and in climbing. The wide open proximal margin of the metathoracic coxa is connected with the edges of the sterna by a loose syndesmosis, which forms a kind of seat, in which the coxa moves. The movement of the metathoracic coxa is more than those of other coxae, as it is capable of rotation. The freedom of movement in the metathoracic coxo-sternal articulation permits the anterior legs to be used in cleaning the wings and the abdomen.

Trochanter — (Tr) The second segment is the wedge shaped piece in between the coxa and femur (fmr). It is a small segment in this insect and differs in its form. The prothoracic and mesothoracic trochanter is triangular and that of metathorax slipper shaped. The metathoracic trochanter is bigger in size.

Femur — (fmr) The third segment is tubular, jointed and slightly narrowed towards the end but that of the metathoracic leg is rigid and compressed with a broader extremity.

Tibia — (tb) It is the longest segment of the leg in this insect. It is cylindrical, and bears numerous short spines. The tarsus of the metathoracic leg is longest and contains a double row of spines. All the tibiae are thickest at the distal extremity and are hollowed out below for flexion.

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Tarsus — (Tar) The fifth segment is divided into three segments, the fist being the longest in metathoracic leg and in other tarsi it is smaller. The third segment is larger in pro- and metathoracic tarsi.

The terminal dorsal joint supports a complicated apparatus, the pretarsus (fig. 3B). It bears a pair of movable lateral claws (Un) rested on its base articulated dorsally to the end of the tarsus, and the body of the

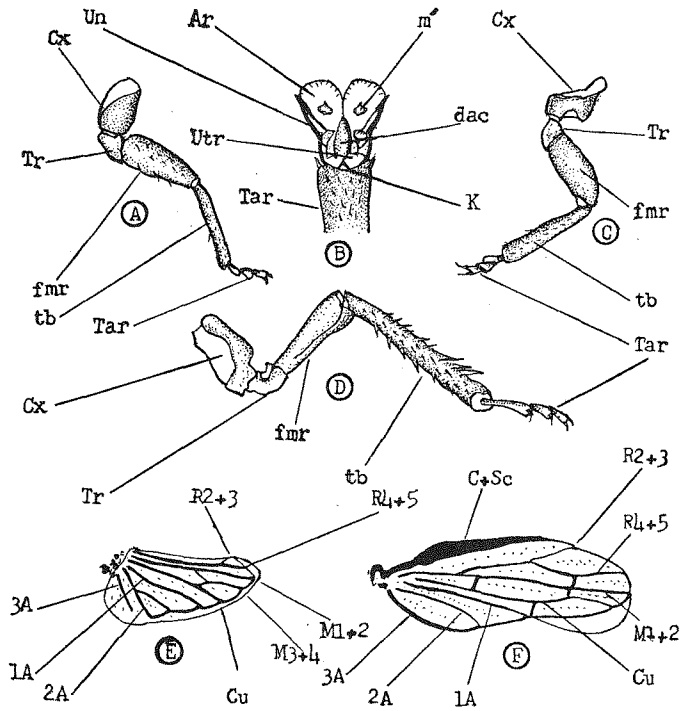

Fig. 3. Thoracic legs and wings. A Prothoracic leg (× 22.5). B Pretarsus (× 48.75). C Mesothoracic leg (× 22.5). D Metathoracic leg (× 22.5). E Hind wing (× 45). F Fore wing (× 45)

segment is reduced to a median claw (dac) which gives rise to a membranous median lobe, the arolium (Ar). The arolium is bilobed and has two aroliar pads (m′) in each lobe. Dorsally each claw is articulated to the unguifer (K), a median process of the distal end of the last tarsomere. On the ventral surface of the pretarsus is a median basal plate, the unguitractor (Utr) which is partly invaginated into the end of the tarsus.

C. Wing Venation

As in other *Jassidae* (METCALF, 1913) the wings of this insect also show a marked specialization by reduction which is usually accompanied by the atrophy of one of the branches of the main trachea.

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Fore wing — (fig. 3F) Costa (C) is absent being completely fused with the subcosta (Sc), forming a well developed vein which occupies the costal margin of the forewing. Radius (R) is two branched although in other genera of *Jassidae* it is three or even four branched. The two branches of the typical radius represent R_{2+3} and R_{4+5}. R_1 is completely lost. Media (M) is typically two branched in most *Jassidae* but in this insect it is reduced to an unbranched condition. Cibutus (Cu) is reduced to a single vein and does not coalesce for some little distance from the base of the wing as in other

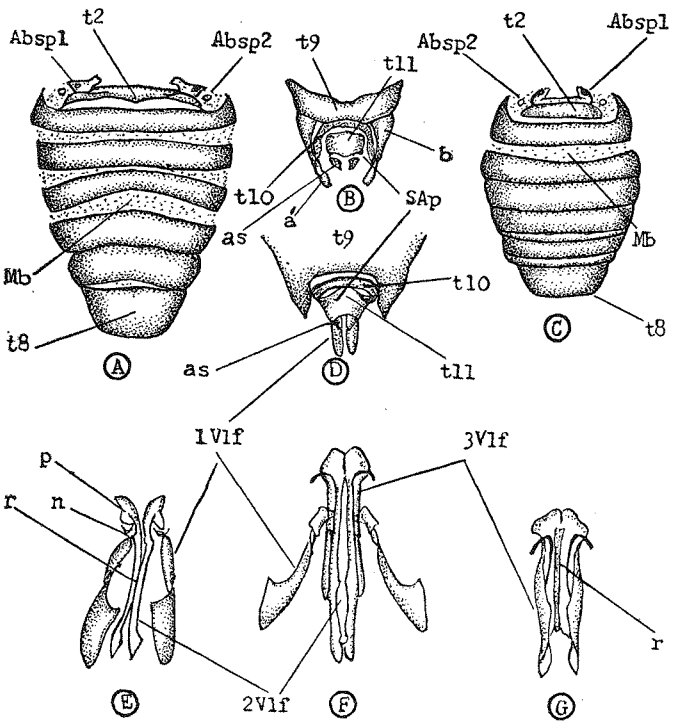

Fig. 4. Dorsal view of the male and female adbomen, and the female genital structures. A The female abdomen (× 22.5). B The male genitalia (× 33.75). C The male abdomen (× 22.5). D The female genitalia (× 33.75). E, F, and G Female genital valvifers dissected out (× 22.5)

genera of the *Jassidae*. The first and second anal veins (1A, 2A) are well developed but the third anal (3A) is inconspicuous and forms the lower margin of the wing.

Hind wing — (fig. 3E) The costa and subcosta are absent. Radius (R) is two branched and is represented as R_{2+3} and R_{4+5} but no indication or R_1 is seen. The medial trachea (M) is two branched and is represented as M_{1+2} and M_{3+4}. Cubitus (Cu) is unbranched. All the three anal veins are well developed. The first anal (A) is unbranched, the second anal (2A) two branched and the third anal (3A) is reduced to an independent single vein.

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III. Abdomen

A. General Structure

The base of the abdomen is wide and broadly joined to the thorax. It is abruptly tapered to a point at the posterior end (fig. 4 and 5). The abdomen of the female is much larger than that of the male. The abdomen in both the sexes has eleven visible segments. The first abdominal segment is added to the metathorax. The second abdominal somite forms a short stalk for the abdomen. Two pairs of spiracles (Absp 1 and 2) are situated in the membranous region of these two somites dorsally. The first pair belongs to the first

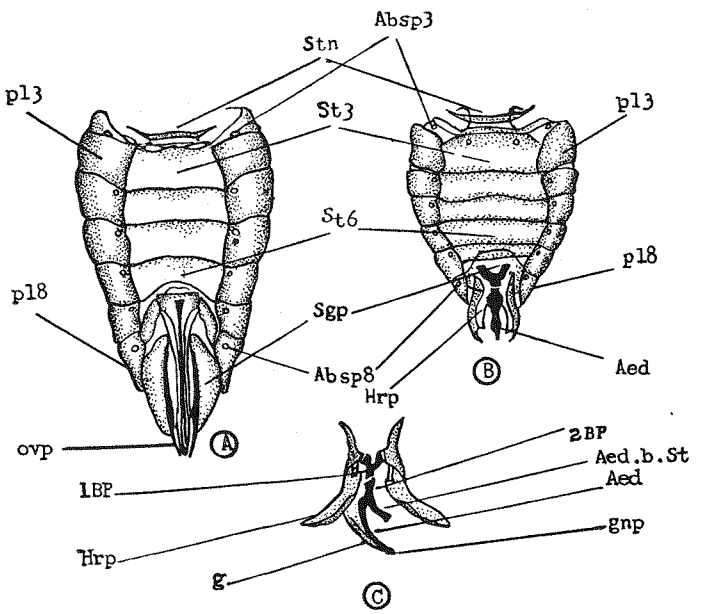

Fig. 5. Ventral view of the male and female abdomen, and the male genital structures dissected out. A The female abdomen (× 22.5). B The male abdomen (× 22.5). C Male genital structures (× 30)

abdominal segment which is attached to the metathorax. The abdomen of the female differs from that of the male in having the ninth segment as a stout continuous plate representing the pleurite and tergite of the same somite, in male this is displaced posteriorly as free lobes bearing the claspers. The tenth segment is present in the abdomen as a collar of the conical end piece of the body and the eleventh segment bears anus at its apex and anal styles (as) dorsolaterally. The anterior margin of the female tergites is slightly notched in the middle but in male, only seventh and eighth are notched.

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The tergal plates (fig. 4) cover the abdomen dorsally. Each overlaps one behind another by a wide margin. They are highly chitinised. Internally all the tergites protrude anterio-laterally inside the body cavity. The overlapping edges are connected by large flexible intersegmental membrane (Mb), each of which forms a wide fold between the terga. The usual primary intersegmental folds of the insects the antecosta and acrotergite are lost and the muscles are attached simply on the anterior edge of the tergum. The first terga in both the sexes is deeply clefted enclosing first and second tergites.

The pleural region (fig. 5) is membranous and is a short piece between the tergum and the sternum of the abdominal segments. There are six distinct pleurites corresponding to each of the tergites three to eight (pl 3 to pl 8). The pleuron of the first and second segment is fused and is represented by a membranous area above which bears a pair of spiracles (Absp 3) near the junction of the third pleuron. In male the third pleuron is devoid of the spiracle otherwise each pleuron bears one pair in both the sexes. Thus in the pleural region there are six pairs of spiracles in female and five pairs in male. There are four distinct sternites in female and five in male. The sternites of the first and the second segments (Stn) are broken into pieces and are not clearly represented as the succeeding ones. They are reduced in both the sexes as hinge piece being attached with the metasternum. The sternites are not chitinised and are much smaller in size than the tergites of the same segments. The rest of the pleurites and sternites are reduced and differ widely in the sexes on account of their modification in each as parts accessory to organs of copulation and egg laying.

B. Male genitalia

The phallic organs are well developed and the periphallic structures are present in the form of lobes or processes arising from the eighth, ninth and tenth abdominal segments. The genital segment consists of the supra anal plate, sub genital plate, harpagones and aedeagus.

The supra anal plate (fig. 4B, SAp) is a small plate attached to the anterior edge of the subgenital plate. It consists of a chitinised ring which expands into a broad, two lobed plate on each side. The subgenital plate is a large plate (fig. 5B, Sgp) carrying the basal structures of the external genital organs. This is the real ninth sternum of this insect. Among these structures there is one pair movably articulated harpagones (Hrp). They arise from the floor of the subgenital plate, where their bases are associated with the sclerites of the phallobase (fig. 5C). The phallobase consists of two basal plates (1BP and 2BP). The first basal plate is 'U' shaped and the second plate is flattened being fused to form a short prolongation which is twisted. This ninth segment (fig. 4B) bears in addition to harpagones, accessory periphallic structures having the form of long arms (á) and broad lo-

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bes (b). They are not provided with muscles and hence in this respect they differ from the harpagones. The aedeagus (fig. 5C) is much elongated, curved and narrow. It is more strongly chitinised at its distal end than it is in the curved position. When viewed ventrally it is much wider in the proximal region, narrow in distal and pointed at the apex. A groove appears at the base which is known as basal foramen. This groove is formed due to a prolongation of aedeagus basal support (Aed. b. St). This process is clearly seen when viewed laterally after dissecting out the male genitalia (fig. 5C). At the apex the external opening of the aedeagus (Aed) lies the gonopore (gnp). This portion is swollen and gives rise to two pairs of setaceous structures (g), one pair being longer than the other. These are the abdominal processes of the aedeagus and are meant for muscle attachment.

C. Female genitalia

The supra anal plate (fig. 4D, SAp) is cup shaped, with its apex blunt. The subgenital plate (fig. 5A, Sgp) is much broader and more longer than the supraanal plate. It is almost as heavily chitinised as the supraanal plate and is wedge shaped. Its lateral margins are almost straight, forming an acute angle at the apex. The outgrowths which forms the ovipositor (ovp) is formed from the three pairs of valvifers (fig. 4E, F, and G). The ovipositor arises from the base of the ninth segment between the eighth tergum and the seventh sternum. The ovipositor is seen to be an elongate organ with dorsal and ventral outlines almost parallel. The caudal extremity is actually pointed and the tip extends beyond the subgenital plate.

The first valvifer (1 Vlf) arises from the membranous part of the eighth segment. There is a highly chitinised plate (p), implanted in it are triangular plates (n) carrying the first valvulae. The shafts of the first pair of valvifers are highly chitinised, internally concave and convex externally. The caudal extremity of this valvifer is expanded to form cover for the extending end of the ovipositor. All the other shafts of the ovipositor are normally concealed by this valvifer. At the anterior end the second pair of valvifers (2 Vlf) are directly continuous with the plate (n) and is less chitinised. Both the shafts of this valvifer form a median rod and are united with each other in such a way that it is not possible to separate them. The third pair of valvifer (3 Vlf) issues from the seventh sternal plate which is the supraanal proper. The shafts of this valvifer are broader and scarcely chitinised and have the form of flattended blades. When the ovipositor is not in use it is ensheathed between the convace inner surfaces of the third valvulae. Thus the third valvifer forms the case of the ovipositor while the first valvulae cover it externally. The second and third pairs of valvifers possess longitudinal highly chitinised rideges (r). These ridges form groove in which the valvifers fit closely.

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Summary

A detailed morphological study of the adult *Idiocerus clypealis Leth*, is presented for investigators interested in the structure of *Jassidae*. The illustrations include external anatomical features of both dorsal and ventral aspects of the head capsule, thorax and abdomen. The more important features are as follows:

1. The head has got a prominent and convex clypeal region. The vertex possesses two distinct black areas which are absent in females. Anteclypeal plate is developed. The antennae are setaceous consisting of 54 to 58 segments. The female antennae bear a disc like swelling on the tip.

2. The pronotum is devoid of sutures and forms a semi circular convex collar of the head. The mesothorax is well developed and occupies almost whole of the thoracic region. Metatergum is small and completely fused with the metapleuron and metasternum. In the fore wing costa and subcosta are fused, radius is two branched and media is unbranched.

3. Eleven abdominal segments are distinguished, the first being added to the metathorax and the second forms a short stalk for the abdomen. The antecosta and acrotergite are lost. In male the third pleuron is devoid of spiracle. A detailed account of the male and female genitalia is given.

Zusammenfassung

Die Morphologie der Imago von *Idiocerus clypealis Leth* wird eingehend beschrieben. Abgebildet wird die morphologische Struktur von Kopf, Thorax und Abdomen nebst Anhängen.

Резюме

Подробно описывается морфология имаго *Idiocerus clypealis Leth.* Морфологическая структура головы, грудной клетки и брюшка с добавочными частями изобаржены в рисунках.

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