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Morphological studies on the head and mouth parts of *Leucinodes orbonalis* Guenée, 1854

Part I — Mature larva

(Lepidoptera : Pyraustidae)

With 9 text figures

Although a large number of papers have been published on the morphology of head in insects, the work in Lepidoptera in general is scanty and there is a great diversity of opinion regarding the different scelerites of the head capsule. The principal papers dealing with the mouthparts and the head sutures of lepidopterous larvae are those of Bordas (1910), Lopez (1932), Hinton (1947) and Short (1951).

Most of the morphologists believe that the sutures and scelerites of the head have no direct relation with the metamerism of the insect head. The studies of Snodgrass (1928, 1935 and 1947) have been mostly with this point of view. Ferris (1942) challenged this view and asserted that major sutures of the head are intersegmental lines. Du Porte (1946) disagreed with both of them and emphasized that muscle attachments have no value in determining the homologies of the insect head.

Du Porte (1946) and Snodgrass (1947) suggested new terms for some of the structures which were regarded as sutures, most of which have been put by them under the term 'sulcus'. Henson (1950) indicated that the term suture should be used untill the developmental relations of these structures have been thoroughly worked out. The present author agrees with this view. Hence in this account all the lines accept the so-called 'epicranial suture' have been described as sutures.

Material and Technique

The larvae were collected from the infected brinjals and were reared in the laboratory.

The larvae were killed in hot water, their different parts were separated and treated with 5% KOH. Since boiling of insects and their parts in KOH often resulted in loss of certain delicate parts and lead to the darkening of the chitenous portions, they were usually left over-night in 5% KOH solution at a temperature of 58° to 60 °C. This method dissolved

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all muscles without dissolving the feebly chitinized or membranous portions. After thoroughly washing the material to remove all traces of KOH it was dehydrated, stained and mounted.

For musculature study fresh specimen were dissected in 90% alcohol and studied under a sterioscopic microscope.

Observations

Of the three body divisions of the caterpillar i.e., head, thorax and abdomen, the head is the smallest and most specialized division. It is heavily chitinised, non-wrinkled and dark brown. From the lateral aspect, it is oval in outline and from the cephalic view it is hemispherical.

Dorsal Aspect (Fig. 1). On the dorsal aspect of the head there is a distinct line typically in the form of a Y, with its arms directed anteriorly. This line in the past has been termed as the 'epicranial suture' the stem having been called the 'coronal suture' and the arms as the 'frontal sutures'. But this line is not marked by a groove externally, nor does it form a ridge on the inner surface; instead the head cuticle splits along it at each ecdysis. Hence it is preferable to term it as the dorsal ecdysial cleavage line of the head. In the insect under study it makes its appearance only after the second moult. Along the dorso meson of the head is a short but distinct line, the midcranial suture which runs down and meets the V-shaped epistomal suture bounding the tri-angular clypeus. The dorsal ecdysial cleavage line runs down following a course nearly parallel to the epistomal suture, both of which extend anteriorly to the epicondyles (the dorsal articulation of the mandibles). The dorsal ecdysial cleavage line with its median coronal stem and the lateral frontal arms divides the head into three clear parts. Lying on the outer side are the epicranial or the parital regions of

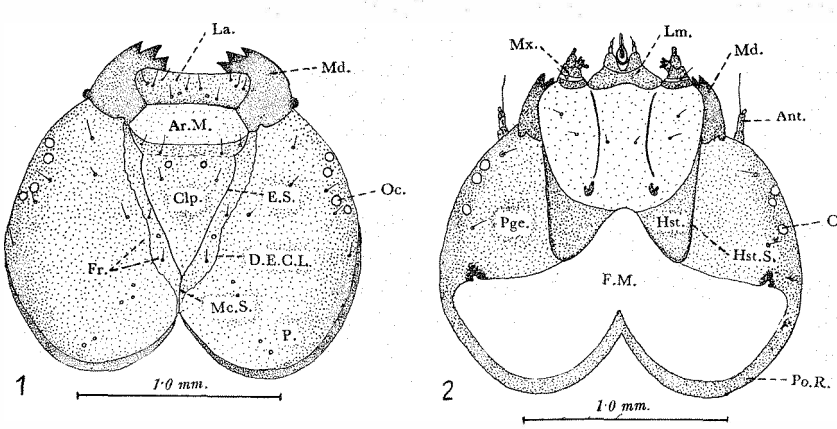

Fig. 1. Dorsal aspect of the head of larva. — Fig. 2. Ventral aspect of the head of larva. *Ant.*, Antennae; *Ar. M.*, Articular membrane; *Clp.*, Clypeus; *D.E.C.L.*, Dorsal ecdysal cleavage line; *E.S.*, Epistomal suture; *F.M.*, Foramen magnum; *Fr.*, Frons; *Hst.*, Hypostome; *Fr.*, Frons; *Hst.*, Hypostome; *Hst. S.*, Hypostomal suture; *La.*, Labrum; *Lm.*, Labium; *Md.*, Mandible; *Mc.S.*, Mideranial suture; *Mx.*, Maxilla; *Oc.*, Ocelli; *P.*, Parietal region; *Pge.*, Postgena; *Po. R.*, Postoccipital ridge

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the head and on the inner side the frons bounded internally by the epistomal suture which bounds the clypeus. There are six ocelli and a antenna on the latero-ventral side of each epicrania.

Clypeus (Fig. 1). It is the prominent triangular area bounded dorsally by the epistomal suture and ventrally by the articular line (formerly called the 'clypeo-labral suture') between the clypeus and the labrum. The basal angles of the clypeus carry the anterior mandibular articulations. The epistomal suture is recognised because of having a V-shaped epistomal ridge. From the arms of the epistomal ridge arise the anterior tentorial apophyses, which identify it as the epistomal suture and thus indirectly the clypeus. The muscles that take their origin on the clypeus are the cibarial muscles and the dorsal muscles of the buccal cavity. The clypeal muscles are inserted anteriorly to the frontal ganglion. The region of the clypeus bears six setae of varying length.

Frons (Fig. 1). The frontal area is very much reduced and can be identified by the origin of the labral, precerebral, pharyngeal and hypopharyngeal muscles on this region. Its ventral limit is formed by the epistomal suture and hence it can be easily recognised. But there is no exact anatomical boundary between the frons and the parietals. It starts on either side of the midcranial suture and extends ventrally to the bases of the mandibles as two narrow triangular plates on either side of the clypeus. It bears four setae, two on each side, and two punctures one on each side. The punctures on the region of frons have not been recorded by any author so far in any other lepidopterous larvae.

Labrum (Figs. 1, 6 and 7). The labrum, which is separated from the ventral margin of the clypeus by a flexible articular membrane, is a simple bilobed structure and overlies the mandibles. Each lobe of the labrum bears five setae. Ventrally the labrum has six sensillae basiconium three on each lobe and lying in a semicircle. Several pit-like punctures are also seen on the labral lobes and possibly function as the sensillae.

Mandibles (Fig. 9). The mandibles are of the typical chewing type. They are suspended from the lower margins of the cranium, and have well developed anterior and posterior articulations termed as hypocondyle and epicondyle respectively. In the former the condyle is on the cranial margin, placed just lateral to the clypeus which is received into a socket at the base of the jaw. But in the latter the case is just the reverse and the socket is borne on the cranial margin which receives the condyle of the mandible. On the ventral side of the mandibles there is a third condyle which fits into the socket of the cranium. The mandibles are highly chitinised denticulate structures and each of them has five dark, tooth-like projections or denticulations. The mandibles are darker in the regions of denticulation and articulations. There are two prominent setae on the dorsal surface of each mandible.

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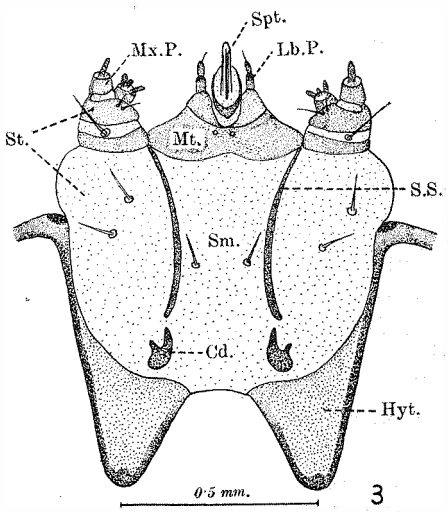

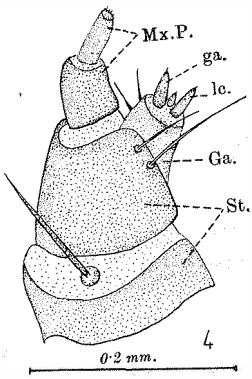

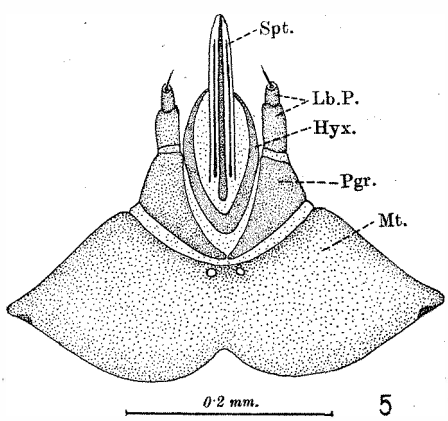

Fig. 3. Maxillae and the labium of the larva with hypostomal plates. — Fig. 4. Right maxilla of the larval head. — Fig. 5. Labium of the larval head with spinneret. *Cd.*, Cardo; *Ga.*, Galea; *ga.*, Distal segment of the galea; *Hyt.*, Hypostome; *Hyx.*, Hypopharynx; *Lb.P.*, Labial palp; *Lc.*, Distal segment of lacinia; *Mt.*, Mentum; *Mx.P.*, Maxillary palp; *Pgr.*, Palpiger; *Sm.*, Submentum; *Spt.*, Spinneret; *S.S.*, Stipital suture; *St.*, Stipes

Antennae (Fig. 8). The antennae are very much reduced in size and are situated in pits on the membranous areas just lateral to the bases of mandibles. These antennal pits are known as antocoria and permit the antennae to be protruded through full length or retracted when only distal portion of the antennae remains visible. Each antennae of the caterpillar consists of three segments of which the middle one is the largest, the proximal or the first one is reduced to a mere basal ring and the third or the terminal one is very small and appears like a minute apical papilla of the second one. The segments are separated by well developed coriae which ensure free movement of the segments. The first segment is devoid of any setae. The second segment has five setae of which one is very long, even longer than the whole of the antenna itself. The third segment bears three setae distally.

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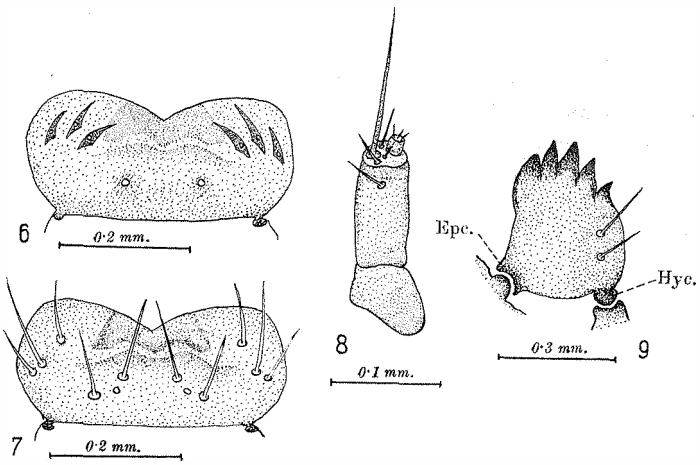

Fig. 6. Labrum of the larva (dorsal aspect). — Fig. 7. Labrum of the larva (ventral aspect). — Fig. 8. An antenna of the larva. — Fig. 9. A mandible of the larva showing condyles. *Epc.*, Epicondyle; *Hyc.*, Hypocondyle

Eyes. The eyes are simple and are situated ventro-laterally on both the sides of the head. The number in each group of ocelli is six. Five of the six ocelli are arranged in a semi-circle and the sixth one lies on the median part of its diameter.

Ventral Aspect (Fig. 2). So far as the fundamental structures are concerned the ventral aspect of the head of a caterpillar is only little different from the orthopteroid head.

The foremen magnum is very large and is almost as wide as the cranium and extends forward dorsally in the median notch of the vertex. The postgenal regions are elongated between the foremen magnum and the posterior articulation of the mandibles. The labium occupies the central portion having well developed post-genal region extending from the neck membrane to the posterior articulation of the mandibles and with antennae developed from the pits at the anterior borders of the postgenae. On each side a posterior medium part of postgena is separated from the more lateral region by the hypostomal suture forming a ridge inside. The median part of the postgena, thus separated by the hypostomal suture is known as hypostoma or hypostomal region. The inner angles of the two hypostomal regions are approximated but not united on the median line behind the base of the labium and are separated by the neck membrane. The maxillae are suspended by the articulations of the cardines against the margins of the hypostomal sclerites of the post-genae. The lateral wall of the cranium around the foramen magnum forming the postoccipital ridge is inflected inwards.

Maxillae (Figs. 3 and 4). The basal parts of the maxillae and the labium are united and their chitinous areas are broken up into small plates. Each

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maxilla includes a cardinal area and a stipital area both of which are united with the basal parts of the labium.

The cardo (Fig. 3) is represented by one principal sclerite situated on each side of the basal region of the submentum in between the caudal end of the stipital ridge and the dorsal margin of the hypostomal region. Unlike other lepidopterous larvae which have been described the cardinal areas are not articulated to the hypostomal margin. They lie free in the basal membranous areas of the maxillae and the labium and each cardinal sclerite forms the basal margin of maxilla of its side. The cardinal regions are devoid of any setae.

The stipital area (Fig. 4) of each maxilla contains both chitinised and unchitinised areas. Its basal part is largely membranous and bears a pair of setae. The inner margin of each maxilla is separated from the membranous submentum by a highly chitinised stipital suture bearing a strong ridge inside which extends upto the anterior point of the cardo. Besides the large membranous area each stipital region includes two principal sclerites towards its anterior end. A large sensillum trichodium is present on the membranous area in between the two strap like chitinised sclerites of the stipital area. Towards the extreme anterior end each stipital area bears a two segmented maxillary palp and the terminal lobe representing the galea and bearing the distal segments of galea and lacinia. The terminal lobe is separated from the stipes by a suture which RIPLEY(1923) termed as secondary suture. Near the lateral margin of this suture are found a pair of setae situated one behind the other. The anterior one of these is smaller while the posterior one is fairly large.

Maxillary palp (Fig. 4). The maxillary palp is a two segmented structure and not three segmented as noted by LOPEZ (1932) in *Carpocapsa*. The first segment is nearly twice as broad as the second or terminal one. On the distal end of the second segment numerous microscopic hairs are visible which may be functioning as the sensillae.

Galea and lacinia (Fig. 4). Galea is in the form of a large segment lying mesad to the basal segment of the maxillary palp. At the tip of the segment of the galea, two maxillary lobes are visible which seem to be distal segments of galea and lacinia. In between the two maxillary lobes is a small papilla which is probably sensory in function.

Labium (Figs. 3 and 5). It lies between the two maxillae and occupies the central portion of the ventral aspect of the head. The basal parts of the labium and maxillae are united. The broad membranous surface of the basal region of the labium is united on each side with the marginal ridges or stipital suture, and its basal part is continuous laterally with the membrane of the cardinal areas. Proximally, the labium is continuous with the neck membrane between the proximated ends of the hypostomal plates.

The submental region is very large but it is largely membranous. The membranous submental region bears a pair of setae in the central region. Strongly chitinised submental plate which SNODGRASS (1928) observed in *E. acraea* is not present in the head of *Leucinodes* larvae.

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The distal, free lobe (Fig. 5) of the labium bearing the spinneret is the mentum. The hypopharynx is also attached on the anterior surface of the mentum as is seen by the opening of the silk or salivary ducts, which normally always lie between the labium and the hypopharynx. The spinneret which contains the opening of the silk duct is situated in between the two labial palps.

Labial palps (Fig. 5) These are two segmented structures, the basal segment being much bigger than the distal one. The base of the palp is set on a membranous fold and next to it is a semicircular chitinous band which RIPLEY (1923) termed as palpiger. The distal segment of each labial palp bears a terminal seta.

Discussion

SNODGRASS (1928) states that "Caterpillars are remarkable for their standardization of structure. In none of the other large groups of insects is there such uniformity in fundamental organisation as in the larvae of Lepidoptera". His remark appears to be true so far as the fundamentals of anatomy are concerned but a closer study reveals many differences. However, there is a great confusion and difference of opinion regarding the morphology of various structures particularly the external morphology of the larval head.

Ecdysial cleavage line: Controversy exists round one of the most important features of the insect head, particularly in Lepidoptera, viz., the inverted Y-shaped line, which has hitherto been designated as the 'epicranial suture'.

DU PORTE (1946) asserted that this line has no structural significance at all, as it is merely a line of weakness in the head wall along which the cuticle splits at ecdysis. He termed it as "ecdysial suture or line". The presence of such a line has been noted in almost all immature insects and it was known to early workers that at ecdysis the cuticle splits along this line. SNODGRASS (1947) preferred to term it as the 'ecdysial cleavage line', the median part of which, that is the stem of Y, having been termed as the 'coronal stem' and the arms of Y as the 'frontal arms'. This term appears to be more appropriate, because the word cleavage line explains its function clearly. Moreover it is in no sense a suture because along such a line the exocuticle is wanting and the endocuticle extends upto the epicuticle (WIGGLESWORTH 1948). HINTON (1947) noted the occurrence of the cleavage lines on the ventral surface of heads also of some larvae of Megaloptera, Coleoptera, Trichoptera and a few Lepidoptera (some Hesperiidae) und therefore differentiated the ecdysial cleavage lines as dorsal and ventral. In the insect under study there appears to be no sign of the ventral ecdysial line but in view of the fact that it has been observed in some other insects it seems logical to term the so called 'epicranial suture' as the 'dorsal ecdysial cleavage line'.

RILEY (1904) in his account of the embryonic development of the head of *Blatta* put forward the thesis that the 'Y-shaped' "epicranial suture" on the insect head is embryonic in origin. The Y-shaped "epicranial suture" of the head, RILEY claims, results from the dorsal closure between the protocephalon

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(preoral lobe) and the cephalic lobes. Later workers have largely agreed with RILEY's findings regarding the origin of the dorsal ecdysial cleavage line. Now, if RILEY's finding that the Y-line is embryonic in origin is taken as valid, then it has to be regarded as a true suture. DU PORTE (1946) and SNODGRASS (1947) ruled out RILEY and asserted that the line is post-embryonic in origin. Their main argument is that it is too variable in position in different groups of insects than might be expected of a structure of such a fundamental significance.

While this argument of DU PORTE (1946) and SNODGRASS (1947) does not appear very convincing particularly because of the fact that there are other structures in the insect body which though embryonic in origin are very variable in form and position in different groups, it remains, nevertheless a fact that the Y-shaped line of the head is a feature peculiar to insects being absent in other arthropods. If it represents such an important thing as the dorsal closure and the union of the head components, it should be present in other arthropods also, which is not the case. Other arthropods have different ways of ecdysis and the absence of this line in their head goes a long way to substantiate the view that it is not embryonic in origin.

The belief that the ecdysial cleavage line is of secondary origin is proved from the study of this insect particularly. In the larvae of *Leucinodes orbonalis* the ecdysial cleavage line makes its appearance only after the second moult, being absent in the 1st and 2nd instar of the larvae. Upto the second moult, the head capsule is shed entire. That no rupture of the head capsule takes place is evidenced by the examination of the exuviae or the ecdysed skin. The ecdysial rupture takes place in the thoracic region and the head of the larva is drawn back out of the old head capsule leaving the latter intact. The late appearance of the line is significant of its post-embryonic origin. What is the need for the cleavage line of the head capsule in later moults may well be questioned ? Our possible explanation to this peculiar feature is that in the *Leucinodes orbonalis* larvae, as well as in most other Lepidopterous larvae, the width of the head capsule increases in geometrical progression (DYAR 1890). The head width of the larvae under study is 0.204 mm. in the first instar, 0.408 mm. in the second instar, 0.720 mm. in the third instar and 1.360 mm. in the fourth and the final instar. When the difference in the head width of the first two instars is not much, it may be possible for the head capsule to pass back through the neck opening of the old head cuticle; but in later instars, owing to the great increase in the head width, the head cannot pass back through the neck-opening and consequently it has to emerge by the direct rupture of the head cuticle along the dorsal ecdysial cleavage line.

Therefore, on the basis of the extreme variations in its position, its absence in arthropods other than insects and its late appearance in the larva under study, it appears logical to believe that this inverted Y-shaped line on the dorsal aspect of the head is not a suture of embryonic origin but is the line of weakness along which the head cuticle splits during ecdysis.

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Epistomal suture, Clypeus and frons: There is a great controversy regarding the position of the clypeus, frons and labrum; the main question being as to whether triangular area bounded dorsally by the epistomal suture and the narrow triangular strips on either side of it are to be accepted as the clypeus and the frons respectively or not. FORBES (1910) and PETERSON (1912) termed the triangular area as 'front', CRAMPTON (1921) and RIPLEY (1923) termed it as 'frons'. Besides, CRAMPTON (1921) and IMMS (1948) applied the term 'adfrontal' or 'adfrons' to the area bounded ventrally by the epistomal suture and dorsally by the arms of the so called 'epicranial suture' or the dorsal ecdysial cleavage line. SNODGRASS (1928) on the basis of the study of musculature, designated this characteristic area as the clypeus. He largely based the recognition of the clypeal area on the attachment of the prepharyngeal or cibarial muscles and held that its dorsal boundary is formed by the epistomal suture which carries a strong ridge inside and from the arms of which arise the anterior tentorial apophyses. He also showed that the frontal area of the head can be identified by the origin of the labral retractor muscles upon its inner surface and stated that in the caterpillar head, the labral muscles arise either upon the median internal ridge of the cranium or upon the dorsal bifurcations of this ridge. Thus be concluded that the ventral limit of the frons is the epistomal suture and there are no dorso-lateral limits. He applied this term in an indefinite sense for the facial area of the head above the clypeus, or the clypeal area. The area designated as frons, therefore, he regarded to be topographical and not anatomical. LOPEZ (1932) in describing the external morphology of the head of *Carpocapsa* agreed with the criteria suggested by SNODGRASS for distinguishing the areas of the frons and the clypeus.

DU PORTE (1946) challenged SNODGRASS' criteria of muscle attachments. Thus ignoring the value of muscular attachments in determining the homologies of the parts of exoskeleton, DU PORTE in his study on the face of insects in all the major orders termed the triangular area (clypeus) as 'antefrons' and restricted the term clypeus to the membranous area between the clypeus and the labrum of SNODGRASS. He believed that in Lepidopterous larvae, the so-called epistomal suture is a combination of transfrontal and frontogenal 'sulci'. The frontoclypeal suture may or may not be present in Lepidopterous larvae, according to him.

Following soon after, however, SNODGRASS (1947) reaffirmed his faith on the muscle attachments and stressed that "facial muscles of insect head are reliable criteria for determining the homologies of the surface parts of the cranium". HINTON (1947) differed with SNODGRASS' criteria listed above and directed the attention to the fact that two pairs of the precerebral pharyngeal muscles of caterpillars do not arise on the frons and demonstrated it in several species of caterpillars. He discarded SNODGRASS' interpretation of the caterpillar head and forwarded his own interpretation in which the external grooves of the Y-shaped ridge are called the "adfrontal sutures", the stem of the Y-shaped ridge as the "midcranial sulcus" marked externally by the "median adfrontal sutures", the anterior arms of the latter as the "lateral adfrontal sutures".

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Cranial areas are not differentiated according to him and he does not identify the triangular plate as the clypeus but believes it to be merely a part of the frontoclypeal apotome. SHORT (1951) on the basis of his work on the larvae of several families came to the conclusion that the positions of cranial muscles of the caterpillars agree completely with HINTON's findings and do not comply with the findings of SNODGRASS (1947). But he preferred to use the terminology of SNODGRASS (1947) because of its universal application to all insect orders. Later, in his study of the head muscles of larval Hymenoptera he found the position of the head muscles exactly the same as indicated by SNODGRASS.

In the insect under study the positions of the cranial muscles is in agreement with the findings of HINTON (1947) and SHORT (1951). From the description of the position of facial muscles in *Leucinodes orbonalis*, which have been given in the text, it is clear that the authors observations are in agreement with those of SNODGRASS (1947) so far as the attachment of cibarial muscles is concerned. Hence there is no difficulty in recognising the area of clypeus. However, the observations regarding the attachment of muscles in the region of frons are in agreement with those of HINTON (1947) and SHORT (1951) and differ from those of SNODGRASS (1947). Hence the question arises whether these discrepancies about the muscles of the caterpillar head vitiate SNODGRASS' method of recognising the frons and clypeus of insects. It should also be noted in this connection that DORSEY (1933) in Coleoptera, COOK (1944) in Diptera and SHORT (1953) in larval Hymenoptera have proved that the observations of SNODGRASS on the attachment and arrangement of facial muscles are substantially correct. Moreover, SNODGRASS (1947) has clearly indicated that the ventral limit of the frons is the epistomal suture but there are no dorso-lateral limits. Hence, the presence of this muscle laterad to the cleavage line leads us to regard the possibility of this area being included in the frontal area. All the workers are in agreement to call the adjacent areas of the epistomal suture either as frons or post-frons or adfrons, so there appears no difficulty in accepting this area atleast as a part of frons. The authors are, therefore, inclined to believe that the presence of one of the precerebral pharyngeal muscles laterad to the frontal arms of the dorsal ecdysial cleavage line does not discredit the criteria of SNODGRASS (1947) of recognising the cranial areas on the basis of muscle attachments. Moreover, the evidence of the remainder of the muscles, the epistomal suture and the anterior tentorial arms outweight the discrepancies. Besides this, HINTON's terminology is applicable only within the narrow limits of an order while that of SNODGRASS is applicable throughout all insect orders. Hence it appears more logical to retain the terminology suggested by SNODGRASS.

However, at this stage nothing can be definitely said as to whether SNODGRASS' or DU PORTE's criterion is correct. Evidently, a large number of detailed observations and a thorough study of the development of insect head in different orders is needed before we accept or reject any one of them. DU PORTE's contention appears to express an extreme view and it seems more reasonable to retain the terminology of SNODGRASS until it can be shown that, as a whole,

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numerous and widespread aberrations make invalid his method of establishing homologies.

Labrum: The bilobed labrum is separated from the ventral end of the clypeus by a wide flexible membranous area described as the articular membrane in this account. SNODGRASS (1947) pointed out that in the insect body there are areas where "the sclerotization of the cuticle has become secondarily discontinous in order to give flexibility". He does not give any example. In the insect under study the line between the clypeus and the labrum and the lines between the podomeres of the appendages are of this nature and they permit the movement of sclerotized parts, hence these structures have been called 'articular lines' and the membrane which allows movement of a sclerotized area or areas has been termed as an 'articular membrane'. However, DU PORTE (1946) ignoring the importance of muscle attachment in determining the homology of various cranial regions termed the true clypeal area as the 'adfrontal area' and the membranous area as the 'clypeus'. HINTON (1947) preferred to term it as 'anteclypeus'. But the fact that none of the stomodaeal muscles arise upon this membranous area while the clypeal dilator muscles have their origin above on the triangular plate proves the error of his interpretation. On the basis of muscle attachments it has been preferred to follow the terminology proposed by SNODGRASS, hence this membranous area has been termed as the articular membrane and the bilobed area as the labrum.

Maxillae: There is some difference of opinion regarding the various parts of the maxillae. SNODGRASS (1928) considers that there is no maxillary palp in the maxilla of caterpillars and the structure generally interpreted as such is lacinia. He also states that there is no evidence to indicate the presence of galea, and the entire lobe consists of lacinia alone which has become complicated in form by the development of large sensory papillae. Again SNODGRASS (1935) states that "each stipital area ends in a membranous lobe homology of which is difficult to determine". TILLYARD (1922) has shown in *Sabatinca* the maxillary palp along with lacinia and galea. FORBES (1910), CRAMPTON (1921) and LOPEZ (1932) all agree that both galea and the maxillary palp are present in the maxilla of the lepidopterous larvae. It appears difficult to understand the view point of SNODGRASS particularly because the galea which forms such an important and well developed structure as the proboscis in the adult Lepidoptera should be absent in the larva while the lacinia which is represented in the adult by a very small inconspicuous and nonfunctional sclerite should be so well developed in the larva. The author thus considers that the larval maxilla bears a prominent galea, besides the palp.

Summary

In the head various areas and sutures are determined and an attempt is made to clarify the controversy regarding the nature of certain head sclerites. SNODGRASS's criterion for the determination of the various sclerites on the basis of muscle attachments has been found to be reliable. The so-called "epicranial suture", being of postembryonic origin in the insect, is shown to be the dorsal ecdysial cleavage line. Thus the central triangular area of the

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head bounded dorsally by the epistomal suture is regarded as the clypeus, while the area dorsal to the epistomal suture is shown to be the frons which has no dorsolateral limits. The structure and morphology of the mouth parts and other head sclerites is described in detail. It is shown that contrary to the general belief the larval maxilla bears a prominent galea, besides the palps.

Zusammenfassung

Verschiedene Felder und Nähte am Kopf werden bestimmt, und es wird versucht, die Kontroverse über die Art gewisser Kopfsklerite zu klären. Snodgrass' Kriterium zur Bestimmung der verschiedenen Sklerite auf der Basis der Muskelbänder erwies sich als zuverlässig. Die sogenannte „Epicraniumnaht", die postembryonisch im Insekt entsteht, wird als die dorsale Häutungstrennlinie dargestellt. Daher wird das zentrale dreieckige Feld des Kopfes, das dorsal von der Epistomanaht begrenzt wird, als Kopfschild betrachtet, während das Gebiet dorsal zur Epistomanaht als Stirn dargestellt wird, die dorsolateral nicht begrenzt ist. Struktur und Morphologie der Mundteile und der anderen Kopfsklerite werden im einzelnen beschrieben. Es wird gezeigt, daß entgegen der allgemeinen Ansicht die Maxillen der Larve außer den Palpen eine hervorragende Galea besitzen.

Резюме

Определяются различные области и шви головы и делается попытка, выяснить спор о некоторых склеритов головы. Критерии Snodgrassa для определения разных склеритов на основе мускулярных лент оказались ненадёжними. Так называемый „эпикраниальный шов", который образуется постэмбрионально в насекомом, толкуется как дорсальная граничная линия линяния. Поэтому рассматрнвается центральная трёхугольная область головы, которая дорсально обграничивается эпнстомным швом как головной щит, в то время как область дорсально от этого шва рассматривается как лоб, который не обграничен дорсолатерально, Описываются детально структура и морфология частей рта и других головных склеритов. Показывается, что напротив обычному мнению, максиллы личинок имеют кроме палп и галею.

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