Structure of the Head of *Decticus albifrons* (Fabricius)Orthoptera,Tettigoniidae, Tettigoniinae, Decticini

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Abstract

Studies on the Structure of the Head of *Decticus albifrons* (Fabric) Orthoptera, Tettigoniidae,Tettigoniinae, ,Decticini,has been made in greater details. Descriptions of the various sutures and the sclerites these define have been given. Significance of the head sutures and sclerites has been discussed. Comparison of these as well as the appendages with corresponding structures in *Locusta migratoria* L (Orthoptera, Acridoidea, Acrididae,Acridinae) has been indicated. Important features recorded are: - Occipital sutures run up to posterior articulation of mandibles and thus form intersegmental line between mandibular and maxillary segments. Tentorium is shaped, a primitive condition found in Apterygota as well.

Key word: Head, *Decticus albifrons* (Fabrivius),Orthoptera, Tettigoniidae

Introduction

The study of the structure of the head has received considerable attention in the past by numerous workers notably the insect embryologist (13،15،9،12) and by morphologists such (5،6،7،14،2،10،11،8). Such studies were mostly directed to evaluate

the significances of embryological and morphological facts in relation to the segmental composition of the head. Although in the present work no such attempt has made yet, it would not be out of place to review briefly the contentions held by various workers. On the contrary, the studies on the structure of the head of *Decticus albifrons* (Fabr) were taken up on the assumption of known facts that the insectan head is a composite structure in which the segments of the feeding appendages have been incorporated into the primitive head which was primarily sensory in function bearing the antennae, the simple and the compound eyes.

Materials and methods

The adults as well as nymphs of *Decticus albifrons* (Fabricius),Orthoptera, Tettigoniidae were collected from Al-Rajma ,a reasonable small village beyond Benina,approximately 35 Kilometers south of Benghazi. The *Decticus albifrons* (F) were collected by insect nets. The adults were quite active and agile and their long gops and flight rendered collection difficult and taxing. However when caught ,were transferred to two separate media. Some of these were fixed alive in picrochlor-acetio fixative, left for 24 hours and were washed several times in 70%alchol.Finally preserved in woods solution (80% ethyl alcohol and glycerine in the ratio of 9:1).The head sutures and sclerites as well as the structural details of the antenna and gnathal appendages were studied by boiling the head or the parts their of in 10% KOH for 10-15 minutes. The structural details were examined under Stereoscopic binocular microscope. The diagrams were drawn approximately on the same scale but are all diagrammatic.

Results

THE HEAD

The head of *Decticus albifrons* (Fabricius) is continuously sclerotized in the cranium like manner and is therefore appropriately called a capsule. It joined to the prothorax by the cervical membrane. The capsule is somewhat oval in shape, being longer than broad and narrower ventrally than dorsally. Its median part, however, is the widest. The position of the head in relation to the axis of the body is hypognathous because the face is directed anteriorly and the mouth parts hang downwards and thus vertical in postion.The head bears a pair of compound eyes, three ocelli,a pair of antenna a pair of mandibles pair of maxillae, a single labium and a median hypopharynx.A large opening, the occipital foramen, lies on the posterior region of the head. Internally the head carries an endoskeletal structure, the tentorium.The walls of the head capsule, both anteriorly as well as posteriorly are marked off by various lines and grooves which are usually termed as sutures. These define definite areas of the head called sclerites.

SUTURES OF THE HEAD

(Figs.1, 2.3, and 4)

The anterior region of the head, commonly known as the face, presents somewhat a unique and complicated structure when compared to corresponding areas in short horned grasshoppers. The mid-dorsal region of the head is elevated thereby forming a hexagonal sclerite whose apical side has become confluent with the vertex. It appears to represent the fastigium because of a prominent angle between vertex and face.

The epicranial suture , redesignated as ecdysial line by Deport (1946) and Snodgrass(14) is also distorted. The ecdysial cleavage line(fig.2,cl) in nymphs runs from the vertex into the frons and is, in fact, continuous with the corresponding line on the prothorax (fig.2,pro).But in adults the

ecdysial line is replaced by the midcranial sulcus (fig.1,mcsc)which is submarginal in origin. The basal parts of the temporal sulci(fig.1,ts) and antefrontal sulci(fig.1, afs) are confluent, having the same course but the former converge to meet ventral to midcranial sulcus. The frontal sulci are deeply notched dorsally to accommodate the lateral ocelli (fig.1and 3, l.o).These then converge between the bases of the antennae are joined by which forms a strong inflection internally.

The transfrontal sulcus(fig.1,t fs): divides the frons into a narrow, smaller dorsal sclerite ,the antefrons (figs.1 and 3 afr) and a wider and larger ventral sclerite,the postfrons(figs.1 and 3,pfr).The postfrontal sulci(fig.1,pfs) run ventrally but fall short of the epistomal sulcus(fig.1,.3,es).The frontal sutures(figs.1 and 3,fs1) which cut across the face laterally are weak lines and do not appear to be of any significance unless otherwise these are considered as parietal suture which demarcate antennae, compound eyes and lateral ocelli from the median postfrontal sclerite. The epistomal or frontoclypeal sulcus(figs.1 and 3,es) is a transverse suture which runs between the anterior tentorial pits(fig.1,atp). It is slightly down curved in the middle. It demarcates the dorsal postfrons(fig.1 and 3,pfr) from the ventral anteclypeus(figs.1 and 3,aclp).The anterior (secondarly articulations of the mandibles (fig.3,md2)are located at the extremites of the epistomal suture. A clypeal suture (figs.1 and 3clp) divides the clypeus into a ventral,narrower anteclypeus (aclp) and a dorsal, wider postclypeus (pclp).The labrum(lm)firmly hangs down from the postclypeus and union is marked off by a narrow, crescent-shaped clypeolabral sulcus(fig.1 and 3,cls).

The subocular or frontogenal sulcus(fig.1 and 3,sos) is incomplete in as much as that it does not extend up to the anterior tentorial pit. It runs downwards from the lower limits of the compound eye and meets the frontal suture(fig.1 and 3,fs1).It demarcates the postfrons the lateral

sclerite, the gena(fig.1 and 3,ge).Ventral to the gena, lateral to anterior tentorial pit and between the anterior and posterior articulations of the mandibles is located,the dorsal extension of subgenal suture, the pleurostomal sulcus(fig.1 and 3,pls) which marks off a narrow pleurostomal sclerite (fig.1 and 3,plst)above the mandible. The compound eyes (fig.1 and 3,e) as wellas the antennae(fig.3,ant) are demarcated from the major sclerite of the head by submarginal circumocular sulcus(fig.1,cos) and circumantennal sulcus (fig.1,cas) respectively. These demarcate marginal ocular sclerite (fig.1,osc) around the compound eye, and the antennal sclerite(fig.1,asc) around the antennal socket(fig.1,aso).

The posterior region of the head capsule carries a large opening, the foramen magnum, more appropriately called as occipital foramen(fig.4,for).The sclerotized part of the head is wider than long. It is marked off laterally by the occipital sulcus (fig.3 and 4,ocs) which is not continuous with that of the corresponding side since it falls short of reaching the vertex. It, however, extends ventrally up to posterior (primary articulation of the mandible(fig.3,md1).These separate the dorsal occiput(fig.4,oc) and ventral postgena (fig.3.4,pge) from the parietals and gena respectively.

A horse-shoe shaped submarginal suture,the postoccipital sulcus(fig.4,pos) flanks the occipital foramen. It terminates ventrally at the posterior tentorial pit (fig.4, ptp). The postoccipital sulcus separate the narrow postocciput (fig.4,poc) from the occiput (fig.4,occ) and postgena (fig.4,pge).

The subgenal sulci extending from the posterior tentorial pits are called hypostomal sutures(fig.3,hs) which set off marginal sclerites,the hypostoma(fig.3.4, hst). The mid-ventral region of the head capsule, below the foramen magnum, is in fact open though it appear as closed due to transverse basal position of the body of the tentorium.

SCLERITES OF THE HEAD

(Figs.1, 2.3, and 4)

The various sutures of the head described above demarcate definite intersutural areas usually referred to as sclerites.The principal areas comprise the median fronto- clypeal,the lateral parietals, the posterior occipital arch, the postocciput, and the ventral subgenal areas. Snodgrass (12) defined frontoclypeal region as an area between the compound eyes and the antennae which extends ventrally to the labrum.

The vertex (figs.1 and 3, vx) represents the apex of the head, between and behind the compound eyes. A distinct angle, the fastigium if formed between the vertex and frons.The fastigium terminates at the transfrontal sulcus. The sclerite dorsal to it is designated here as antefrons (figs.1.3,afr) and the one ventral to the transfrontal sulcus is the postfrons (figs.1.3,pfr).

The frons is roughly a hexagonal sclerite though the top side is confluent with the vertex.It bears the midcrainal (coronal) sulcus and is cut across by the temporal sulci. The postfrons is longer than wide and is limited ventrally by the epistomal suture. It carries median ocellus (mo) quite near to its basal region.

The **clypeus** (fig.1 and 3,clp) is somewhat triangular sclerite, being wider at base and narrow distally. It is divided into proximal, narrower postclypeus (fig.1,pclp) and the distal wider anteclypeus (fig.1.3,aclp).The lateral as well as the latero-ventral margins of anteclypeus from shallow emarginations. Besides its mid-ventral area bears a conical groove which carries a deep circular pit.

The parietals(fig.1,prtl) form the lateral areas of the head capsule and these are demarcated both anteriorly as well as posteriorly by the frontal and occipital and occipital sutures respectively. The parietals, however are confluent at vertex because of imperfect of the midcranial sulcus.

The parietal of either side bear the lateral ocellus (fig.1.3,Lo),a compound eye(fig.1.3.4,E) and an antenna(fig.3,ant).Each compound eye is encircled by a narrow ocular sclerite (fig.1,osc) being separated by the circum-ocular sulcus. Likewise the antenna is surrounded by a antennal sclerite (fig.1, asc) which is demarcated by the circumantennal sulcus.

The lateroventral parts of the parietal lying below the compound eyes, are the gena (fig.1 and 3,ge).These are demarcated from the median postfrons by an incomplete subocular (frontogenal) sulcus. The genae are continued postteriorly as postgenae (fig.3 and 4,pge) up to the postocciput. Due to articulation of mandibles and the maxillae to the lower limits of the genae,its walls are strengthened by submarginal ridge, the subgenal sulci.As mentioned earlier, its anterior part, lying over the mandib-ble,forms the pleurostoma sulcus which sets off a marginal sclerite,pleurostoma(fig.1. and 3,plst).Likewise its posterior part,the hypostomal sulcus, situated posterior to man-dibles,separates a narrow sclerite, the hypostoma(fig.3 and 4,hst).

The posterior region of the head capsule is represented by the sclerites of the gnathal segments. These comprise the occipital, postgenal, postoccipital and subgenal areas.

The posterior surface of the cranium is occupied by an opening, the foram-en magnum, more appropriately known as the occipital foramen as it is surrounded on its dorsolateral boundary by the occipital arch and ventrally by the base of the labium. Its lateral limits are defined by the occipital sulci(figs.3 and 4,ocs).The sulci of the opposite sides do not meet dorsally and thus exhibit a marked deviation from the generalized horse-shoe shaped condition. However, these extend ventrally up to the primary(posterior) articulation of the mandibles. The occipital sulci demarcate the dorsal, narrow part of the cranium as occiput(figs.3 and

4,oc) and the lateroventral wider area, lying posterior to the genae, is referred to as postgena(figs.3 and 4,pge).

The occipital arch is delimited by a horse-shoe shaped post occipital sulcus (figs.3 and 4,pos) which terminates ventrally at the posterior tentorial pits (figs.3 and 4,pt).It sets off a marginal sclerite ,the postoccput (figs.3 and 4,poc). The latter is produced, almost in the middle, into a small process, the occipital condyle (figs.3and 4,occ).The anterior cervical sclerite (figs.3,cv1) is articulated to the lower limits of the occipital condyle.

Labrum (Fig.3.5,lm) is a broad, flat symmetrical lobe which projects ventrally over the mandibles and forms the anterior wall of preoral cavity between the gnathal appendages. it is attached at base to the anteclypeus by the clypeolabral suture. It thus provides free movement to the labrum.

The labrum is a double-walled structure since its anterior wall is reflexed inwards. It mediodistal forms the epipharynx while the proximal area is continuous with the membranous surface of the clypeus. Its distal(ventral) margin is neither incised nor its upper surface is divided into antelabrum and postlabrum. The proximal lateral areas of the labrum carry a pair of sclerites, the torma(tor) which extend into the epipharyngeal surface of the clypeus. Albrech (1) observed that is *Locusta migratoria* the labrum is asymmetrical, bears a ventral notch, carries an elevation between the tormae as well as a Y-shaped depression carrying four oval sclerites. In *Decticus albifrons* (Fabricius) the labrum symmetrical, without apical notch, elevation between tormae is absent and the depression is median with a pair of oval to rectangular sclerites between the tormae.

Hypopharynx(Fig.6 and 7) is a somewhat regular shaped tongue like organ which lies in the preoral cavity .It is attached to the head on an oblique line running from the mouth to the labium. The aboral surface of

the hypo pharynx is differentiated into a fixed basal basilingua (fig.6 and 7,bl) and a free distal lobe, the distilingua (fig.6 and 7,dl).These two areas are separated by a constriction which is located approximately at level with the external clypeolabral sutures. The hypopharynx divides the intergnathal (preoral) cavity into an anterior food pocket termed as cibarium by Snodgrass(1935),and a posterior salivarium into which the salivary ducts opens. The anterior surface of basilingua bears a median depression, called the sitophore (fig.6 and 7,sit),which is continuous with the mouth. The dorsal surface of the hypopharynx bears numerous setae. A pair of slender sclerotic bars, the lingual sclerites (fig.7,w) run postero-ventrally from the proximal end of the distlingua and project beyond the actual opening of the salivary duct in the salivarium(fig.6,sal).The posterolateral area of the basilingua carries a pair of short but wider hypopharyngeal sclerites(fig.6 and 7,hs) which articulates with anterior end of the lingual sclerites as well as with the transverse bar (fig.6 and 7,tb) at adorsal surface. It proximally divides into two arms, The anterior or oral arm(fig.6 and 7,y)continues into pharynx where it serves for the insertion of the rectractor muscles of the mouth angles, The posterior or the loral arm (fig.6 and 7,x) extend laterally to the base of the adductor apodeme of the mandible. These sclerites constitute the suspensorium of the hypopharynx.

Tentorium of *Decticus albifrons* (Fabricius) (fig.7)is formed by the invagination of the body wall of the head. It is strongly developed and braces the lower edges of the cranial walls. It lies below the stomodaeum and lends support to it. Besides,it provides attachment to various of the gnathal appendages. It consists of two pairs of arms. The anterior tentorial arms (atr) arise from the anterior tentorial pits (atp)which are located at either end of the epistomal sulcus (es).The anterior tentorial arms form median processes(mp) at the lower limits. These are continued posteriorly to join the body of the tentorium,the

corporotentorium(ct).The posterior tentorial arms (ptr) arise from the posterior tentorial pits(ptp)at the lower limits of the postoccipital sulcus.These extend anteriorly to join with the corporotentorium.The posterior tentorial arms are almost continuous with the bridge of the tentorium. The Tentorium of *Decticus albifrons* (Fabricius)on the whole appears as an inverted¶–shaped structure when viewed from behind.It is definitely not X–shaped as is the case in acridid grasshopper.The condition presented here is somewhat similar to that of apterygotes and thus indicates that tettigoniids are more primitive than acridids. The dorsal arms of the tentorium(dtr) arise from the base of the anterior arms. These are feebly sclerotized, apodeme–like structures which are broad at base but taper out distally to a point through which these attach to the hypodermis in the viscinity of anternal sockets.

DISCUSSION

In the following pages are discussed the morphological features of *Decticus albifrons* (Fabricius) in which the head capsule present variations from the conditions exhibited in *Locusta migratorya* L described by Albrecht(1).

Besides, certain structural features which are otherwise either absent in *Locusta migratoria* L or are considered of some morphological significance from the standpoint of phylogeny are also commented upon. The inverted Y–shaped epicranial suture so clearly exhibited in *Locusta* is incomplete in *Decticus albifrons* (Fabricius) as the coronal suture is absent but the submarginal sulcus bearing a strong,flat,vertical apodeme is clearly marked off. It, however,has no morphological relationship with the so–called epicranial suture(designated in present work as ecdysial suture). The frontal sutures initially run along with the temporal sulci in *Decticus albifrons* (Fabricius)which is not the case in *Locusta migratoria* L .Distally, beyond the transfrontal suture, the frontal and parietal sutures are confluent but these become distinctly beyond the median

ocellus. The parietal sutures are absent in *Locusta migratoria* L.Similarly the transfrontal suture divides frons into antefron and postfron, but no corresponding suture has been described in *Locusta migratoria* L .Likewise the angle formed between the vertex and the face,that is the fastigium is also absent in *Locusta migratoria* L. The various frontal ridges of *Locusta migratoria* L are absent here. The location of compound eyes, antennae and the median ocellus is similar in both. The lateral ocelli, however, lie close to antennal socket in *Locusta migratoria* L but these are far removed dorsally in *Decticus albifrons* (Fabricius).

The frontoclypeal (epistomal suture is similar in form and location,being situated between the anterior tentorial pits. The clypeus is distinguishable into post- and anteclypeus-a condition not described in *Locusta migratoria* L.

The labrum is symmetrical and its ventral margin does not possess any emargination(notch).The epipharyngeal region exhibits wide variation from that of *Locusta migratoria* L.There is neither any elevation between the tormae nor the depression is Y-shaped, being median here. Besides, the four oval sclerites described in *Locusta* are also absent and the location of the paired oval sclerites between tormae is median rather than lateral. The frontogenal (subocular) sutures are clearly marked off but these do not extend ventrally upto anterior tentorial pits as in *Locusta migratoria* L.

The occipital sutures are not horse-shoe shaped in *Decticus albifrons* (Fabricius) as they are incomplete at the vertex. However, these extend ventrally right unto posterior (primary) articulation of the mandibles. A similar condition is met with *Machilis* (Apterygota, Thysanura).I am therefore, inclined to consider this as an intersegmental line between the mandibular and maxillary segments. I consider that *Decticus albifrons* (Fabricius) is an ideal insect to study the embryology of the head. Such

studies are more likely to confirm the existence of an intersegmental line between the mandibular and maxillary segments in the embryo as well. This feature becomes all the more significant as it indicates that tettigoniids probably are more primitive than the acridids by preserving the primitive condition shown by *Machilis*.

The post occipital suture is similarly placed in both the species and definitely represents an intersegmental line between the maxillary and labial segments – a view held by almost all the earlier workers. Similarly the subgenal (hypostomal and pleurostomal) sutures are also similar in form and location in both the insect under discussion.

The hypopharynx is almost similar to that of *Locusta migratoria* L except that the hypopharyngeal sclerites of corresponding sides are joined to a transverse bar lying between the basilingual and distilingual regions.

CONCLUSIONS

The structure of the Head of *Decticus albifrons* (Fabricius), Orthoptera Tettigoniidae, Tettigoninae, Decticini, has been studied in detail. The sutures and the sclerites both of the anterior(facial) and posterior(occipital) region have been described. Significance of the head sutures and sclerites has been discussed. Comparison of these as well as the corresponding structure in *Locusta migratoria* L (Orthoptera, Acridoidea,Acrididae,Acridinae) has been indicated. Important features recoded are that the occipital sutures run up to posterior articulation of mandibles and thus form interseg-emental line between mandibular and maxillary segments.

ACKNOWLEDGMENTS

I wish to thank Professor.Dr.S.S.Akbar, who gave assistances with many parts of this investigation and shared with me several of the results of his own studies. Thanks are also due to Professor. Dr. D. K. MCE .Kevan, Director, Lyman Entomological Museum, McGill University, Canada for the identification of the species.

دراسة تفصليه للتركيب التشريحي لرأس حشرة *Decticus albifrons* (Fabricius1775) Orthoptera ,Tettigoniidae, Tettigoninae, Decticini

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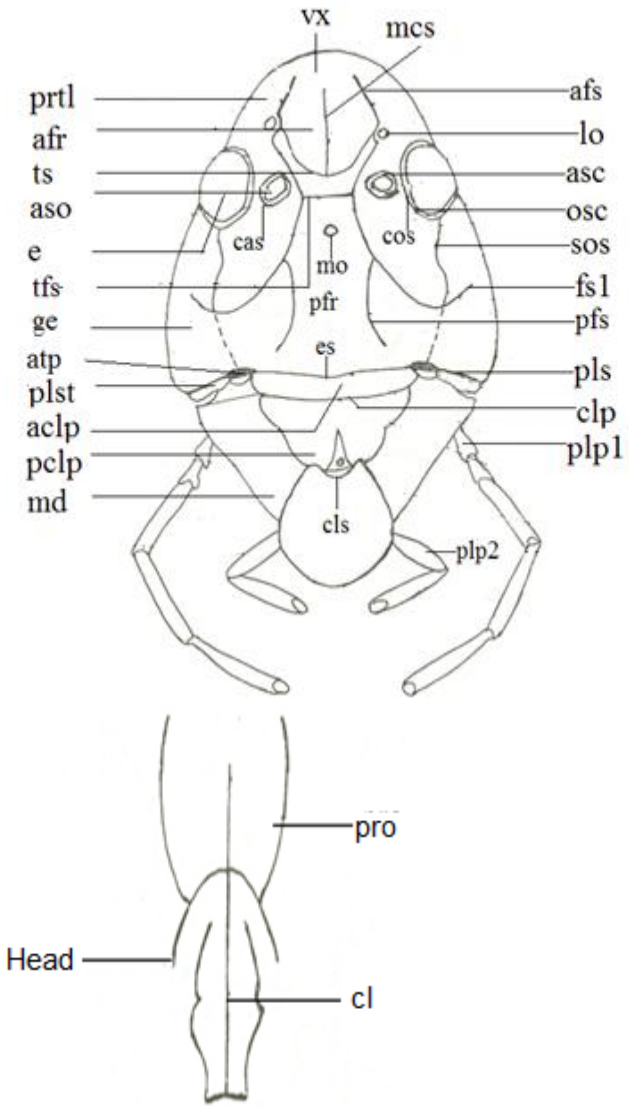
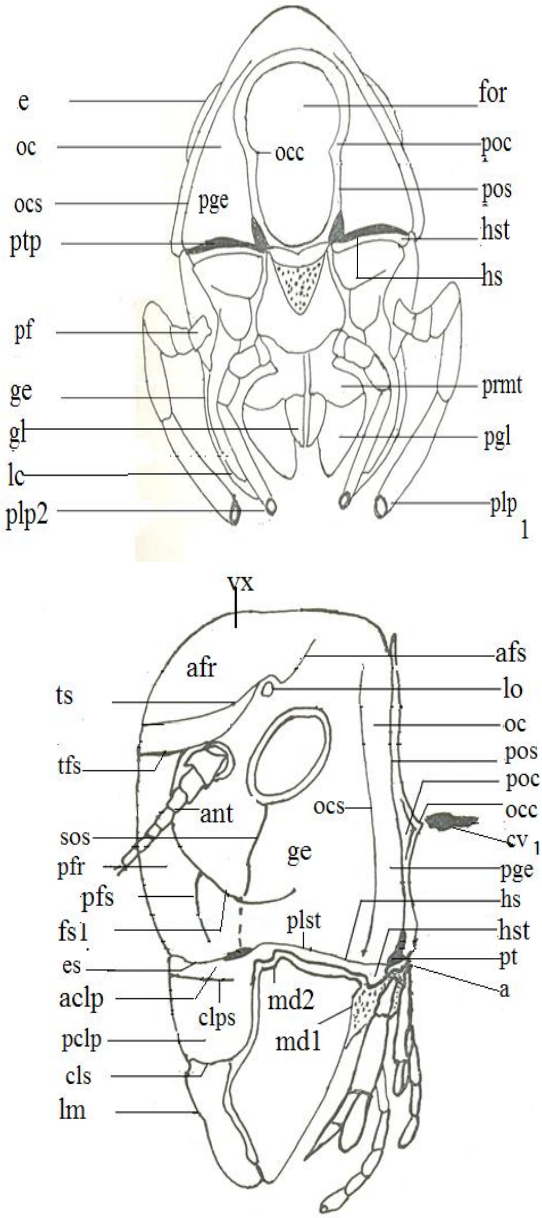
الملخص

وهو نوع من الجراد المحلي تم تجميعه من منطقة الرجمة التي تبعد عن مدينة بنغازي حوالي 35كم، حشرات هذه الفصيلة تتغذى على حبوب النباتات النجيلية والحشائش والذرة والأرز وهى تسبب ضرر كبير، ويغلب على أنواعها اللون الأخضر، وتتميز الحشرة البالغة بان قرون استشعارها طويلة جدا، معظمها حشرات مجنحة ولكن توجد أنواع غير مجنحة، آلة وضع البيض طويلة تشبه السيف، الذكور تصدر صوتا بحك الجناحين الإمامين بعضهما ببعض، الأرجل الخلفية محورة للقفز والرسغ مكون من 4 عقل، البيات الشتوي فى طور البيضة. لقد تم دراسة خطوط الالتحام(خطوط التقسيم) والصفائح الصلبة(أجزاء الرأس) لمناطق الرأس لكل من المنطقة الأمامية(الوجيهة) والمنطقة(الخلفية(القذالية) بالتفصيل وبدقة متناهية. دراسة أهمية خطوط التقسيم والصفائح الصلبة لمنطقة الرأس ،مقارنتها بلأجزاء المرادفة لها في الجراد الصحراوي *Locusta migratoria* L (Orthoptera, Acridoidea, Acrididae,Acridinae)

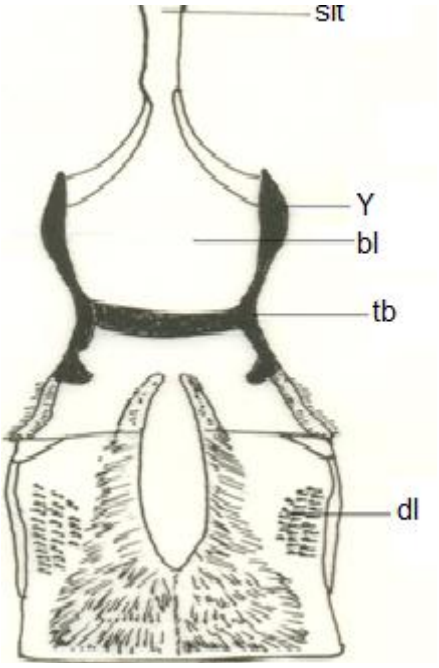
من الخواص المهمة التي تم تسجيلها هي أن خط الالتحام القذالي في المنطقة الخلفية للرأس بالرغم من انه غير كامل ظهريا إلا انه بطنيا يمر بخلف تمفصل الفكوك العليا ولهذا يكون خط مابين عقل الفك العلوي والسفلي.التركيب الداخلي للرأس علي شكل-¶، ويلاحظ وجود أذرع ظهرية ضعيفة، وهذه من صفات بدائية موجودة في الحشرات عديمة الأجنحة ،مما يشير بأن حشرة**Tettigoniidae** (Fabricius) ***Decticus albifrons*** من الحشرات البدائية.



Fig(2): Dorsal part of Prothorax of nymph Fig (1): Front view of the head of adult



Fig(3): Lateral view of the head Fig (4): Posterior view of the head



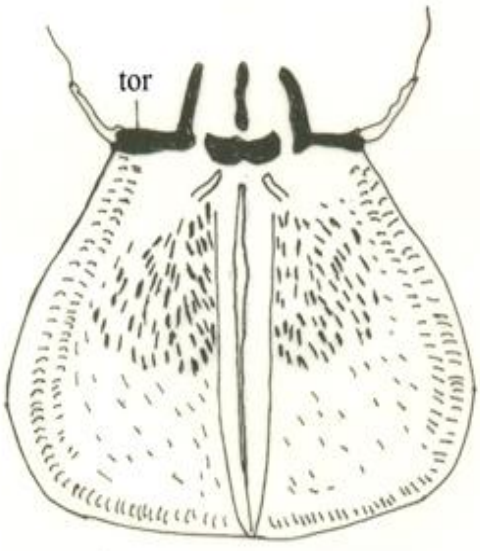
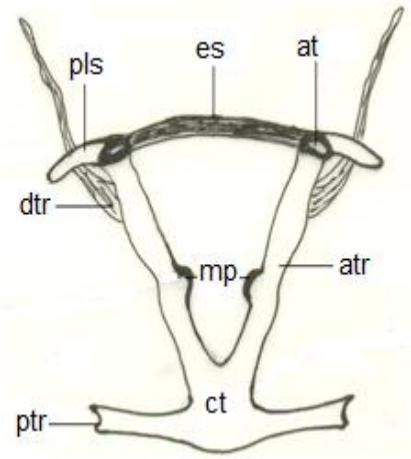


Fig (5): Inner view of the Labrum Fig (6): Dorsal view of the Hypopharynx



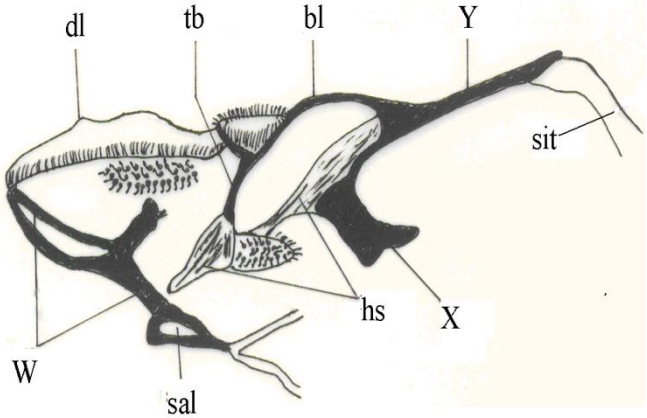


Fig (7) Lateral view of the Hypophyrnx Fig(8) Posterior view of the Tentorium

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