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THE MORPHOLOGY OF PSOCUS CONFRATERNUS BANKS (PSOCOPTERA: PSOCIDAE)

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This paper is the sixth of a series in which it is proposed to consider the morphology of representatives of various insect groups. The presentation of a paper on a member of the Order Psocoptera (= Corrodentia) is occasioned chiefly by the desire to find some aid to an understanding of certain features of the Order Mallophaga. The Mallophaga are highly specialized forms the morphology of which can not well be understood if they are considered by themselves alone. The only suggestions as to possible relationships of the Mallophaga with any other insect groups have pointed toward some connection with, or even derivation from, the Psocoptera or some psocopteroid form. For this reason an understanding of the morphology of the Psocoptera becomes highly desirable. Whether or not these suggestions have any value will not, and in fact can not, be discussed until studies which are now under way on representatives of the Mallophaga have been completed.

For the purposes of this paper there has been selected a species which, on the basis of the keys presented by Chapman (1930) seems quite definitely to be *Psocus confraternus* Banks. This is a species of very favorable size for study, its sclerotized areas are well defined, and, whether it be a generalized form or not, it seems to present no serious morphological problems. In any case it is the most favorable species that could be obtained.

The author's thanks are due to Mr. Jack Walker of Stanford University and to Dr. Carl D. Duncan of San Jose State College, for aid in obtaining the material upon which this study is based.

THE HEAD (FIGURES 38-41)

The head, as is typical of the Psocoptera, is hypognathous. The boundaries of the sclerites forming the head capsule are rather clearly defined, some of the sutures occurring as deep infoldings. A section through the clypeal region reveals such a furrow setting off the anteclypeus from the postclypeus. On the vertex, the epicranial suture is evident, extending as a coronal suture anteriorly to the ocelli, where it branches into a pair of postfrontal sutures. The extremely large posterior tentorial pits (Figure 38B) serve as the posterior terminus of the postoccipital suture, which extends forward a short distance along the lateral margin of the occipital foramen. The gular area extending from the posterior margin of the occipital foramen is entirely membranous, and may be designated only as a region.

The anterior tentorial pits (Figure 39A,C) are centered slightly lateral of the epistomal suture, just below the antennal foramina. The epistomal suture continues upward to form the lateral and posterior boundaries of an extremely large postclypeus. The tentorium itself (Figure 39A) is not of an unusual form,

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consisting of a body (MacGillivray's *corporo-tentorium*) and two highly developed anterior arms. With the assumption by the postclypeus of such a large area, the frons is confined to a rather thin strip just anterior to the postfrontal sutures.

The Antennae (Figure 39B)

The antennae are 13-segmented, each with a short scape, a short pedicel, and 11 longer flagellar segments. These flagellar segments are beset with short setae on all surfaces.

The Eyes (Figure 38)

There are three ocelli, placed in the usual triangular arrangement, two laterally on the vertex and one medially just above the frons. The compound eyes are very large, exhibiting a sexual dimorphism in respect to size. The female is provided with slightly larger eyes than the male, the shapes being essentially the same in both sexes. The ocular diaphragm (Ferris, 1940, p. 34) is represented only as a very thin ledge extending inward from the edge of the eye.

The Labrum

The anteclypeus and labrum are of ordinary character.

Behind the labrum there is a swelling which does not approach the proportions of an epipharyngeal lobe. It is regarded here only as the epipharyngeal region. Badonnel (1934, p. 26) has indicated a sclerotized median structure in this region which is so placed as to fit directly into a depression on the hypopharynx when the buccal cavity is closed. This structure is definitely not present in any of the local species dissected by the author.

The Mandibles (Figure 39D)

The mandibles offer no points of particular interest.

The Maxillae (Figure 39E)

The establishment of the homologies of Psocid maxillary structures has been attempted by several early workers, with noticeable disagreement occurring in regard to the relationships of at least one of these structures. The question as to the actual morphological significance of the structure, known variously as the "horny process," "pick," "fork," "chisel," and "furca maxillaris" and found thus far only among Corrodentian and Mallophagan species seems to have been discussed first by Burgess (1878). His conclusion was that the "fork" is in reality not a maxillary structure, but an independent organ. Reliable workers have concurred in this opinion; Ribaga (1901) termed these structures the "styliform apophyses," and Snodgrass (1905) suggested their hypopharyngeal origin. Kolbe (1880, p. 79) was apparently the first to regard the "fork" as the lacinia, and more thorough proof has been provided for this thesis by Börner (1904, 1929). Most insect morphologists have agreed with this opinion, the latest being Badonnel (1934). Working principally with *Stenopsocus stigmaticus* Imhoff and Labram, Badonnel has figured nerve and muscle arrangements in the maxilla, showing a galea, a lacinia, a four-segmented palpus, and a coxopodal area consisting only of a stipes, with no cardo. A bundle of three muscles (Badonnel, p. 75, fig. 31) is shown arising on the tentorium and inserting on the stipes. These are called tentorio-stipital muscles. This situation is not in agreement with that in *Psocus confraternus*, in which there are two muscles arising on the tentorium. These muscles, inserted on two well-separated areas, correspond directly to the ventral adductor muscles which Snodgrass figured

(1935, p. 143, fig. 79). The more posterior one of the ventral adductors is recognized as being inserted on the stipes, the more anterior one on the cardo. Since there is no well-defined suture present on the face of the sclerite on which these muscles are inserted, the view is taken here that the sclerite represents a fused condition of the cardo and stipes.

The muscle attachments of the "pick" offer proof of its identity with the lacinia. The cranial flexor apodeme of the lacinia, arising on the dorsal wall of the head capsule, is present as a prominent connection. There is an anterior dorsal muscle connecting the dorsal head capsule with the cardal area, and a stipital flexor of the lacinia joining the lacinial apodeme with the stipital area. All of this is entirely in harmony with what is found in more generalized forms and the opinion that the "pick" is definitely the lacinia is here adopted.

The Hypopharynx and Labium (Figures 40, 41)

The interpretations here placed on the structures occupying the hypopharyngeal region are at variance with those presented in the past by other authors. The large lobe lying anterior to the labium proper has generally been considered as the hypopharynx itself, and the curiously formed sclerite at the mouth of the stomadeum has been termed the "oesophageal sclerite" by most authors. Badonnel (1934, p. 98) considered the "oesophageal sclerite" to be entirely hypopharyngeal in origin. Much controversy has arisen over the identity of the large bulbous sacs lying in the body of the structure known heretofore as the hypopharynx.

In applying morphological reasoning to the problem at hand, it will first be maintained here that the paired sacs in the cavity of the hypopharyngeal region are part of the system known in other insects as the salivary gland and its ducts. The author sees no reason to regard it as otherwise, since the ducts join to become a common duct emptying into the mouth, exactly as is the case with all known salivary systems. The sacs themselves, being sclerotized, are considered here to be reservoirs, and are labeled "salivary reservoirs" in Figures 40 and 41. The ordinary relationship of the orifice of the salivary duct with the hypopharynx is such a constant one in all insect groups that it is considered here to define a landmark. The salivary duct, in all forms where the situation is clear, opens at the lower base of the hypopharynx. In *Psocus confraternus*, the orifice of the duct is above the large lobe which has been called the hypopharynx. For this reason, the lobe is regarded here not as the hypopharynx, but as a secondary lobe of the oral face of the labium. The elaborate sclerite which has been known as the "oesophageal sclerite" is here regarded as derived from the salivarium, since the orifice of the salivary duct is in its cavity. The salivarium is known to take various forms in other insects. Here it takes the shape of a hollow hemisphere with its open side forward. The two sclerotized bars which extend upward partially into the wall of the oesophagus correspond to the structures which Snodgrass calls the "basal sclerites" (1935, p. 283) and the "lateral sclerites" (1935, p. 115). The two bars, here called the basal sclerites, diverge upward and outward from the salivarium in all forms seen by the author. It should be noted that, of all the structures seen on the face of the anterior lobe of the labium, only the salivarium and the basal sclerites are actually parts of the hypopharynx. The structures lying below these are all considered to be parts of the oral surface of the labium. Just below the salivarium is a structure occurring commonly in many Corrodentia, the so-called "brush," consisting of a patch of weakly sclerotized papillary strands. Extending laterally from the brush is a bar of sclerotized form, while below the brush is another paired sclerite.

If the anterior lobe of the labium is lifted, the oral surface of the premental area is revealed. Figure 41B shows the location and form of the small sclerites which are to be found on this surface. Their position is presumed to be premental.

The caudal aspect of the labium shows an arrangement which is not complex. The postmentum is represented by a thin sclerite extending across the expanse of membrane. There is, on the prementum, a pair of swellings laterally. These are considered to be the bases of the labial palpi. Badonnel (1934, p. 84) regards these stubs as the "prepalpifer lobe," and has carefully traced the muscle and nerve connections in this region. The muscles in his species correspond exactly with those in *Psocus confraternus*. However, the author cannot concur in his interpretation. The musculature shown by Snodgrass (1935, Figure 84), which is taken as a generalized arrangement, corresponds almost muscle for muscle with the situation in *Psocus*. The small levator of the palpus labeled "lplp" is not present. Its absence can easily be accounted for on the basis of the suppression of the palpi. Distally on the labium is found a pair of glossae and a pair of paraglossae.

THE CERVIX (FIGURES 43-46)

The neck region is rather elongated and a bit constricted, and is provided with two pairs of lateral cervical sclerites. The more anterior of these sclerites articulates with the occipital condyle of the head, and, being the larger of the two, extends caudad almost to the prothorax. The much smaller posterior sclerite articulates posteriorly with the episternum of the prothorax.

THE PROTHORAX (FIGURES 42-46)

The prothorax has departed from the usual form of the thoracic structure, most of the departures apparently having been brought about by reduction in size and the loss of structures. The size of the segment, in relation to that of the pterothoracic ones, is relatively small, being only about a third the height of the wing segments. In addition, the whole prothorax is set off from the pterothorax by an expanse of membrane. A narrow pronotum is the only tergal structure present, extending almost halfway down the pleural region. Here it is met by the episternum, which is separated from the epimeron by the pleural fold. The pleural fold is unusual in that its upper terminus is on the posterior border of the episternum.

Another peculiar feature of the pleural region is the position of the pleural apophyseal pit, which lies not in the pleural fold, as is the normal position, but definitely anterior to this fold and in the lower anterior angle of the "episternum." It is the opening, as is normal, of a well developed pleural apophysis which extends inward and downward until it meets the sternal apophysis of the corresponding side. It may of course be argued that this pleural pit is not actually the pleural apophyseal pit and that it is a quite distinct development, but the writer adopts the view that the apophyseal pit has simply migrated from its normal position.

All traces of the precoxal and ventral arcs of the subcoxa have disappeared except for two vestiges which may be assigned to these areas. In the membrane, just anterior to the coxa, is a minute sclerotization which seems to be a remnant of one of the subcoxal arcs. Badonnel (1934, p. 110) calls it the trochantin, but the view is here held that it may equally well be a remnant of the katepisternum. The other vestige is associated with the sternum.

The ventral side of the prothorax (Figure 45) bears a small, transverse plate, which surrounds the two very large sternal apophyseal pits, and which at each lateral extremity forms an articulatory point or condyle with the coxa. The area between the apophyseal pits, which are somewhat separated, may be regarded as the true sternum. But the articulations with the coxae are quite unusual developments and require explanation.

Reference to the earlier papers in this series will show that in a very large percentage of the insects a ventral articulation exists between the coxae and the ventral subcoxal arcs on the meso- and metathoracic segments. The theory has been developed by Ferris that the presence of this ventral articulation represents the generalized condition of the winged insects. It seems to have disappeared, or perhaps never to have been gained, in the prothorax, for no such articulation has been seen in any insects thus far examined except in that here under consideration and in the Mallophaga. The simplest explanation of the occurrence of such an articulation on the prothorax rests in the assumption that such an articulation originally occurred on all the segments and that in these two Orders it has been retained in the prothorax.

THE PTEROTHORAX (FIGURES 42-49)

The comparatively large pterothorax is formed of two rather similar, closely approximated segments which at once suggest the form of the Neuropteroid thorax. The increase in size of the mesothorax over the metathorax, as seen in so many specialized insects in the Neuropteroid line of development, is noticeable to a slight extent in this.

The Notum (Figure 42)

The main expanse of the notal areas is represented in each segment by the scutum. The scutum of the mesothorax is large, three-lobed, and indented by a pair of notaulices. The metathoracic scutum is smaller, containing only a suggestion of the three-lobed condition, and it is without notaulices. A clearly defined scutellum, as well as a postnotum, is present on each segment. The postnotum of the metathorax is divided by a median suture, while that of the mesothorax has no such division. A very prominent phragma is present between the two segments of the pterothorax, being deeply infolded not only from above downward, but also laterally along the posterior boundary of the postnotum of the mesothorax. This has drawn certain pleural structures of the metathorax inward.

The Pleural Areas (Figure 43)

The two winged segments differ from each other quite radically in the pleural structures. Each has a subalare, and each has one basalare. The subalare of the metathorax has three thin sclerotized bars radiating outward into the membranous area surrounding it, while the basalare (Figure 44) of that segment has been drawn inward with the phragma, so that it is not visible on the surface. The anapleural area of the mesothorax shows a curious development in the form of a vertical split in the anepisternum, forming a divided condition of this sclerite such as is seen elsewhere in the higher Diptera. A question arises as to the identity of the more anterior lobe of the anepisternum. At first glance, it would appear to be the prescutum, but, because of the wide connection with the obvious anepisternum, it is taken to be actually a part of the latter. Investigation of more Psocids may show that this sclerite really is prescutal in character. The epimeron of this segment is present as a single sclerite, with no division into two parts. The anepisternum and anepimeron of the metathorax are clearly defined.

The katapleural area of the mesothorax consists of a large katepisternum and a trochantin which articulates with the coxa. The ventral view (Figure 45) indicates that this articulation might be either trochantinal or katepisternal. The latter possibility could arise from the formation of a split just behind the ventral condyle. In other Psocids seen by the author, the split extends farther dorsally, indicating a trochantin fused at its base with the katepisternum. This is taken to be the case in *Psocus confraternus*, and consequently such an interpretation is here adopted. A slight internal ridge is present at

the anterior border of the katepisternum. This may be interpreted as the pleural costa, establishing the identity of the katepisternum. There is no postcoxal arc on the mesothorax. The metathorax bears a greatly elongated, narrow trochantin, whose antecoxal extension articulates with the third coxa. No katepisternum or preepisternum are present. The postcoxal arc of the katepimeron is complete, extending down to the sternal apophyseal pits.

The Ventral Areas (Figure 45)

A weak discriminal line (see Ferris, 1940, p. 36) is present on the mesothorax, but cannot be seen on the metathorax. No ventral articulations occur on the pterothorax. Badonnel (1934, p. 118) figures a spinasternum between the prothorax and the mesothorax of *Stenopsocus*. Such a structure is plainly not present on *Psocus confraternus*, nor on any other Psocids seen by the author.

The midventral region is occupied by a continuous sclerotized strip extending from the katepisternum of the mesothorax to the katepimeron of the metathorax. This strip is broken only by the sternal apophyseal pits of the two pterothoracic segments. The only truly sternal elements of these segments are the thin areas between each pair of pits. The remainder of the ventral strip is considered here to be the result of the fusion of the subcoxal arcs.

Internal Skeleton (Figures 44, 46)

The notaulices on the mesothoracic scutum are deeply invaginated, forming an internal ridge. The phragma of the mesothorax is very deeply infolded and extends ventrad to the metathoracic spiracle. The pleural apophyses occur as infoldings along the lines of the pleural folds, and bear no elaborate structure. The sternal apophyses are rod-like formations reaching upward and outward into the body cavity. A small pocket has been formed by a twisted condition at the base of the anterior lobe of the anepisternum.

The discriminal line shows internally as a low median ridge which fades out posteriorly.

The Legs (Figure 47)

The legs of all thoracic segments are essentially alike, differing among themselves only in size. The coxa bears on its lower anterior surface a patch of spines. This does not correspond to the trochantinal signum of Ferris (1939, p. 126), which ordinarily occurs near the trochantinal condyle. The trochantin bears a very large cone-shaped trochanteral apodeme, which fills the bulk of the coxal cavity and reaches into the body cavity. On the upper surface of the trochantin is found a deep cavity, at whose base lie two large setae. The femur, tibia, and two-segmented tarsus bear, in addition to setae and hairs, peculiar spines which have the appearance of a thick spine growing out of the base of a lobed crown. At the base of each crown there appears to be an internal bulbous structure. The claws are simple and there are no arolia of pulvilli on the terminal segment.

The Wing Bases (Figure 49)

No tegula is present on the wing bases. Otherwise, the arrangement of sclerites corresponds to Snodgrass' description of the general pattern. No fourth axillary sclerite is found on either wing. The first axillary sclerite is drawn out into a long, curved plate on both wings.

The Wings (Figure 48)

The hindwing is smaller than the forewing and presents a more simplified

pattern of wing veins. In addition, the forewing bears a pterostigma which is not found on the hindwing.

With the Comstock-Needham system as a basis, the interpretation of the venation presents no difficulties. The long radial-medial crossvein in the forewing is characteristic of *Psocus confraternus*. Fusion occurs in some cases between a few of the more important veins. The median and cubital bases in the forewing, and the radial, median, and first cubital in the hindwing are confluent.

THE ABDOMEN (FIGURES 50-52)

The abdomen shows eleven segments. These are not clearly defined, in the main, because of the fact that the greatest expanse in both tergal and sternal areas is entirely membranous. The first abdominal tergite and sternite in both sexes are each represented by sclerites which have become secondarily split (Figures 42, 45). Their identity is indicated by the presence of the first abdominal spiracle. No other sclerotized areas are to be seen in either sex, with the exception of the respective genital segments, which appear on the terminal end of the abdomens as pigmented caps. In fresh specimens, the segmentation of the intervening delicate membrane is made obvious by intersegmental furrows, but these are lost in preserved specimens.

Terminalia of the Female (Figure 50)

The identity of the eighth abdominal segment is established by the eighth spiracle, which is set in the membrane of the pleural area. No tergite occurs on this segment. The sternite takes the form of a Y-shaped sclerite involving the subgenital plate, from which extends caudally the median egg guide. There are no gonapophyses on this segment. Between the eighth and ninth segments, and covered by the egg guide, is the genital opening. This is a wide opening, with a kidney-shaped sclerotized plate attached to the anterior lip. A rigid annular ring can be seen on the vagina, set in a bit from the vulva.

The ninth abdominal segment bears an extremely large tergite which extends down around to the ventral side. The venter is occupied by membrane. A large coxopodite occurs adjacent to the lower boundary of the tergite. Borne on this coxopodite are two pairs of gonapophyses, the second and third valvulae. Thus, there is present a fairly generalized ovipositor, with the exception of the absence of the first valvulae.

The tenth segment presents certain peculiarities in its dorsal structures. There is present a median tergal plate (Figure 50B) with a membranous apical portion which constitutes what would ordinarily be called the epiproct. On each side of this median plate is a large sclerotized lobe which bears a raised patch of little nodules and hairs that have been considered by some authors to have a sensory function. Chapman (1930) has referred to this area as the "sense tubercle of the paraproct," and Badonnel (1934) called it the "trichobothrial disc." These lobes have been considered by Chapman to be the paraprocts.

An investigation of the musculature shows bundles of normal intersegmental muscles extending from the ninth tergite to the median plate and also to the two sclerotized lobes. This being the case these lobes can scarcely be the paraprocts, for the paraprocts belong to the eleventh segment and are not known to have any muscles arising from the tergite of the ninth segment. The view is here adopted that these lobes are lateral fragments of the tenth tergite, being much of the nature of the "hemitergites" seen in the Plecoptera. The base of the median plate is also regarded as a portion of the tenth tergite while the apical lobe is here considered to be the eleventh tergite.

Terminalia of the Male (Figures 51, 52)

The eighth abdominal segment is identifiable by the eighth spiracle which has become involved with the eighth sternite. There is no tergite present on the eighth segment.

The ninth segment bears a large tergite, which is indented by a suggestion of a furrow that divides it into an anterior and a posterior portion. The possibility that the anterior of these sections is actually the eighth tergite may be suggested, but an examination of the musculature precludes this possibility, as does the attachment of the coxopodites to this anterior portion. The furrow must be regarded as a secondary and morphologically non-significant development.

To the lower, posterior angle of the tergite there is attached on each side a movable lobe that in its musculature and otherwise corresponds to the coxopodite of the ninth segmental appendage. These coxopodites do not bear styles, but their apices turn mesally to form terminal hooks.

The tergite is united by a narrow sclerotized bridge to the sternite and the sternite is also fused mesally with the sternite of the eighth segment. Posteriorly it is produced into a median lobe that is curved dorsally in the form of a hook. This sternite, with its terminal lobe, is the hypandrium or subgenital plate of the non-morphological terminology.

The tenth segment seems to lack the median tergal plate which is seen in the female, but possesses two lateral lobes, which for the same reasons as were adduced in the case of the female are here regarded as fragmenta of the tenth tergite. These lobes each terminate posteriorly in a curved hook.

The eleventh tergite is a median dorsal plate which protrudes upward from between the apices of the lobes of the tenth tergite. Just ventrad of it is the anal opening. No sternite belonging to the eleventh segment is present.

The actual copulatory organs are very poorly developed, being merely a pair of small, surface sclerotizations lying just above the apex of the ninth sternite. A stout apodeme extends inward from each paramere, serving as the point of insertion for muscle bundles which originate on the ninth sternite. The remainder of the phallus and phallobase is entirely membranous and there is apparently no sclerotized penis.

THE SPIRACLES (FIGURE 53)

The only features of note concerning the spiracles are their positions and the unusual development of the peritreme of the mesothoracic spiracle.

The mesothoracic spiracle is located just ahead of the anepisternum and carries on its anterior border an enlarged peritreme which might be mistaken for an anapleural sclerite. The posterior portion of the peritreme has the normal proportions.

The metathoracic spiracle has a peritreme with no special developments. The actual orifice, as in the mesothorax, is essentially in the form of a slit, bearing no filtering apparatus.

The first seven abdominal spiracles are set in the membrane of the pleural region and consist each of a sclerotized ring bearing a bar-like projection on one side. This opens into a bulbous membranous sac below the surface. The actual trachea is attached to the inner side of the sac.

The spiracle of the eighth abdominal segment in the male has abandoned its morphological dorsal position to become involved in the eighth sternite. Its form is essentially the same as in the other abdominal spiracles.

GENERAL OBSERVATIONS

It will be evident from the foregoing discussion that there are only a few structures in which the Psocoptera, as represented at least by the species here considered, present any special morphological problems.

The "maxillary pick," about which there has been much argument and which is one of the most peculiar features of the Order, is very evidently merely a development from the lacinia and from the enlarged and heavily sclerotized apodeme of the cranial flexor muscle of the lacinia.

The presence of a ventral articulation of the prothoracic coxae is a definite peculiarity.

The enlargement and position of the trochantin of the mesothorax is peculiar, as is the retention of the trochantin and suppression of the precoxal arc of the subcoxa on the metathorax.

The ventral coxal articulations of the coxa on the pterothoracic segments have been lost, but otherwise the pterothorax conforms to the pattern seen in the Neuropteroid series.

In the female the suppression of the gonapophyses of the eighth segment may be noted, together with the retention of the normal complement of valvulae on the ninth segment.

The peculiar lateral lobes, here regarded as fragmenta of the tenth tergite, in both male and female, are quite distinctive features.

In the male the coxopodites of the ninth segment are retained but the styles have been lost.

Structures which may be interpreted as parameres are present but otherwise the phallic structures of the male are membranous.

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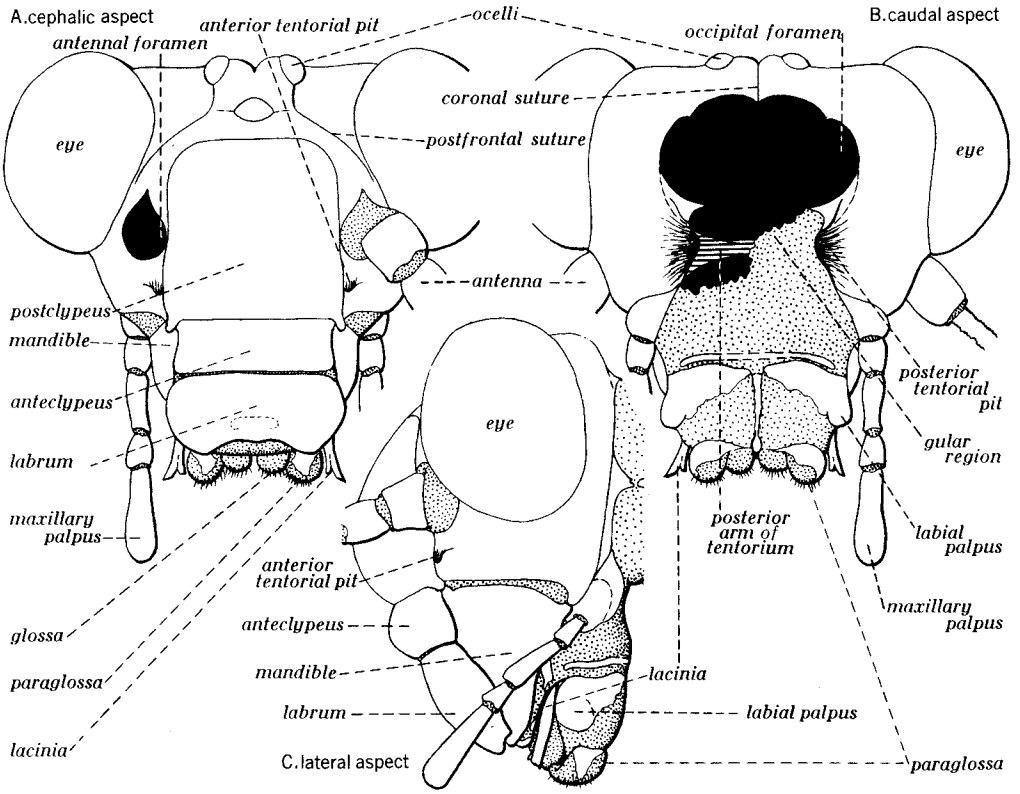
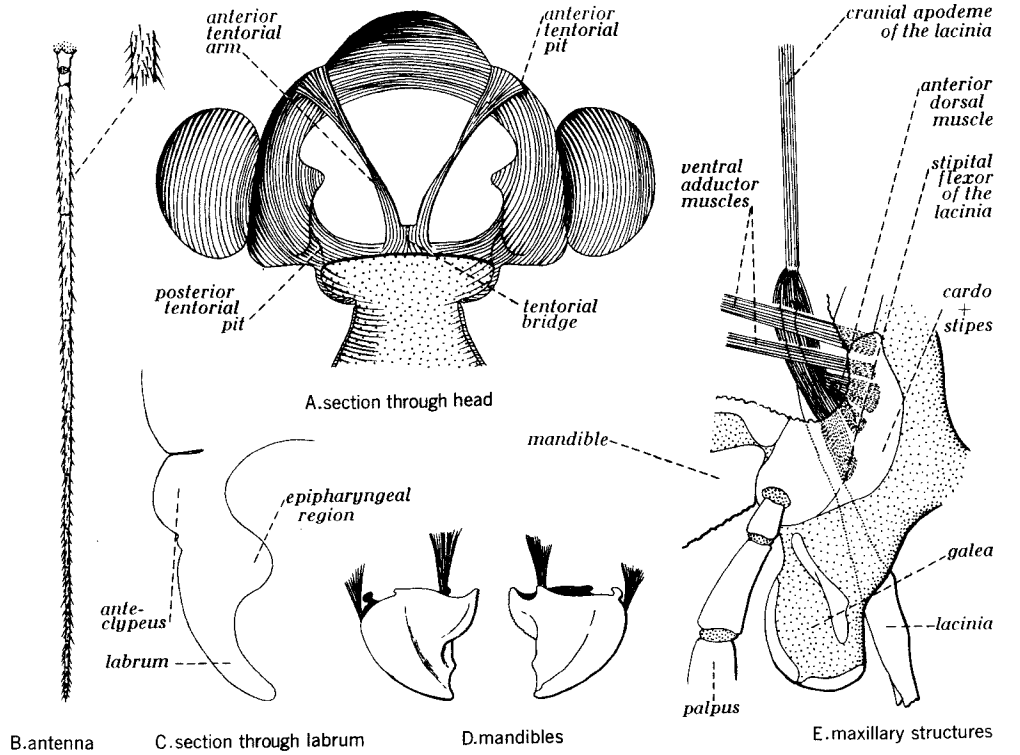


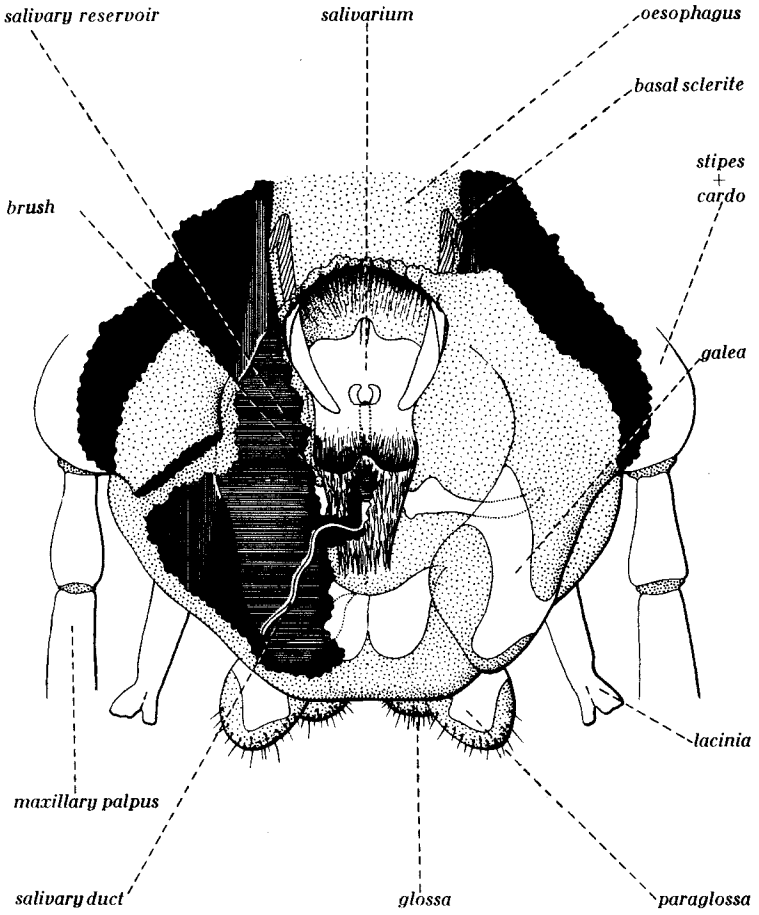
Psocus confraternus,head

Figure 38



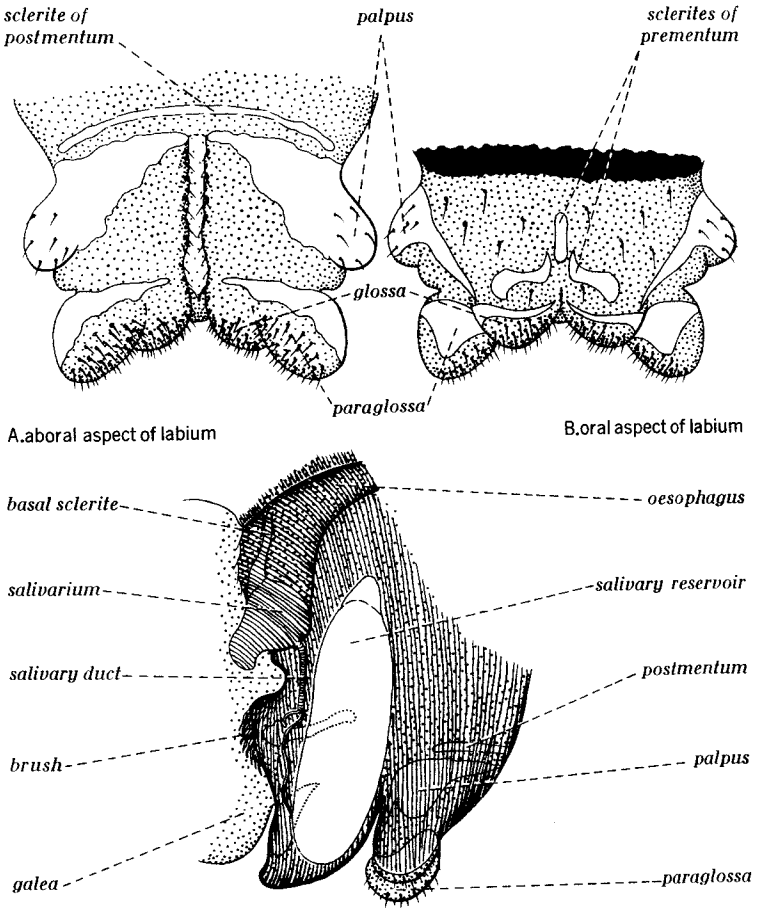
Psocus confraternus,details of head structure

Figure 39



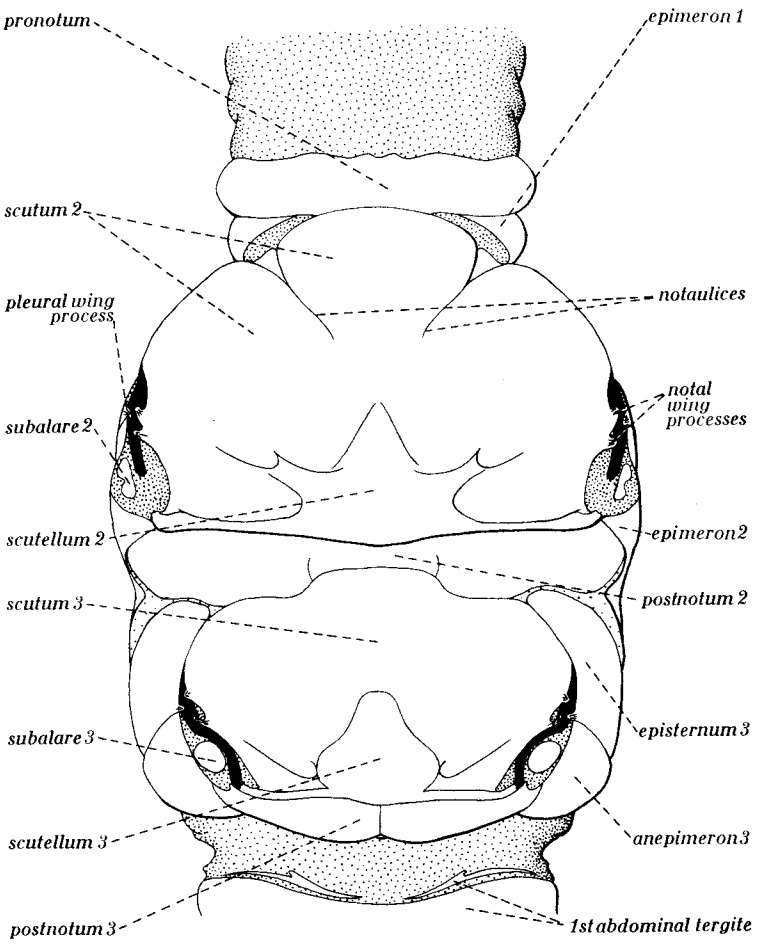
Psocus confraternus, cephalic aspect of mouthparts, labrum and mandibles removed

Figure 40



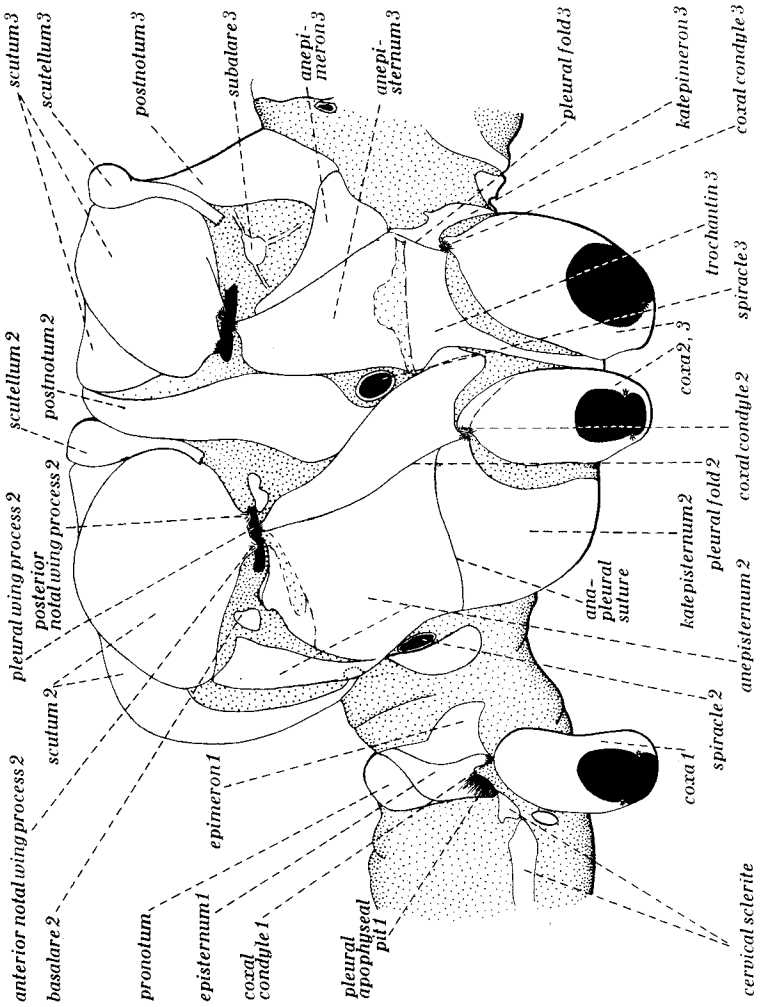
Psocus confraternus, details of labium and hypopharynx

Figure 41



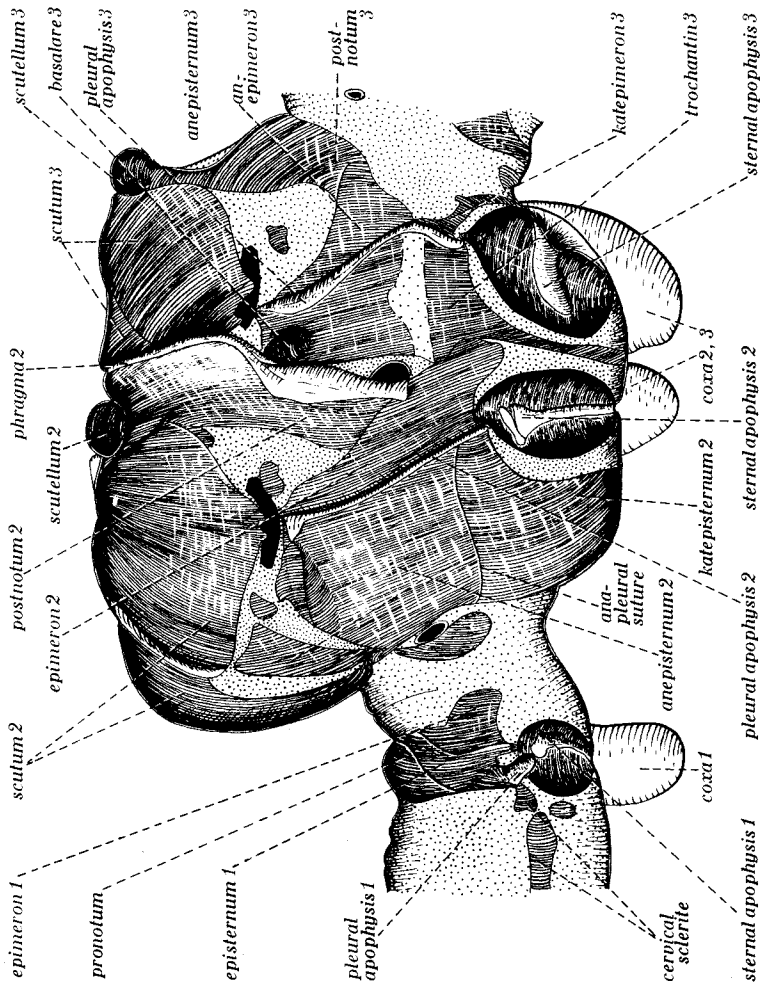
Psocus confraternus, dorsal aspect of thorax

Figure 42



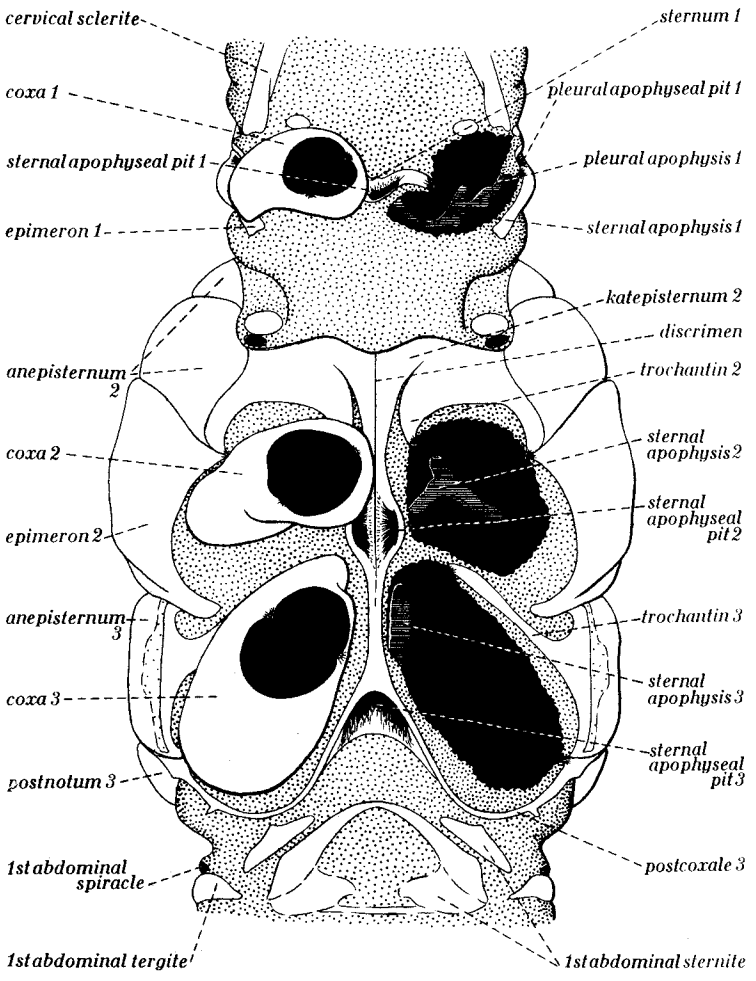
Psocus confraternus, lateral aspect of thorax

Figure 43



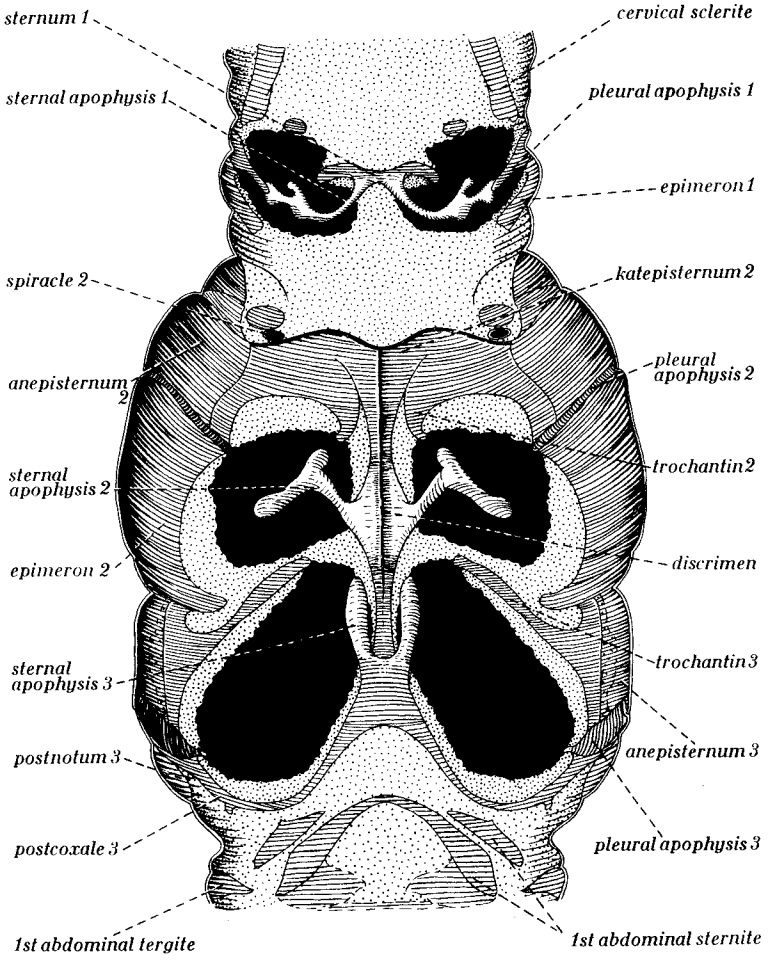
Psocus confraternus, median longitudinal section of thorax

Figure 44

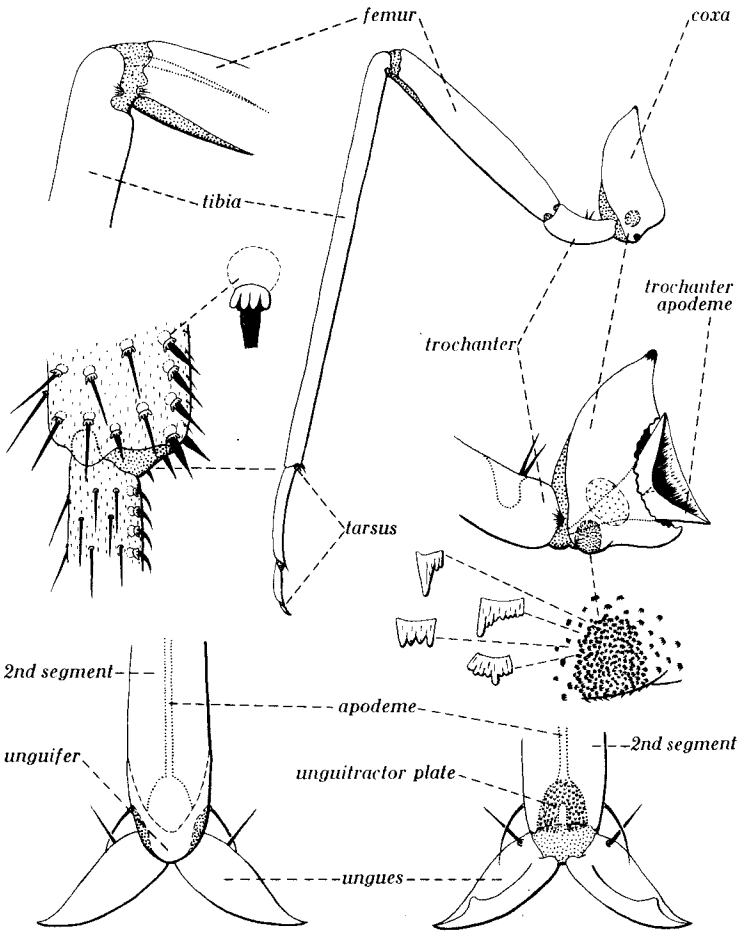


Psocus confraternus, ventral aspect of thorax

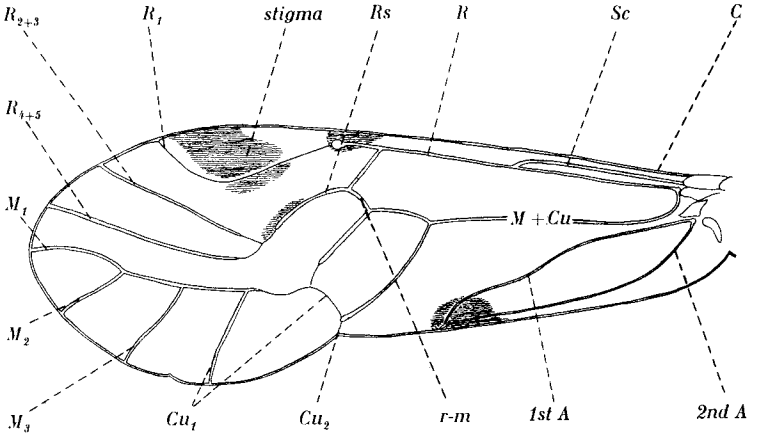
Figure 45



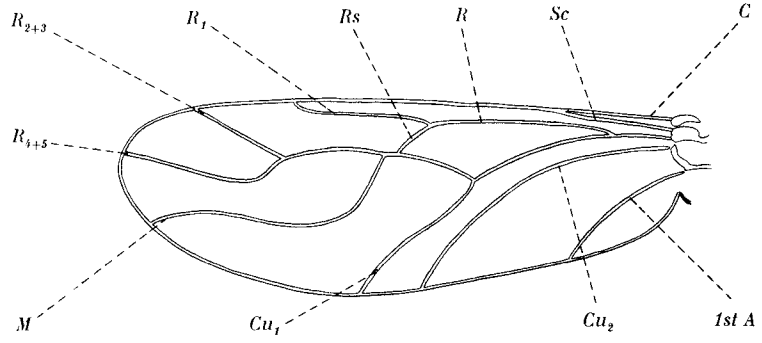
Psocus confraternus, internal skeleton of thorax, dorsum removed — Figure 46



Psocus confraternus, details of mesothoracic leg — Figure 47



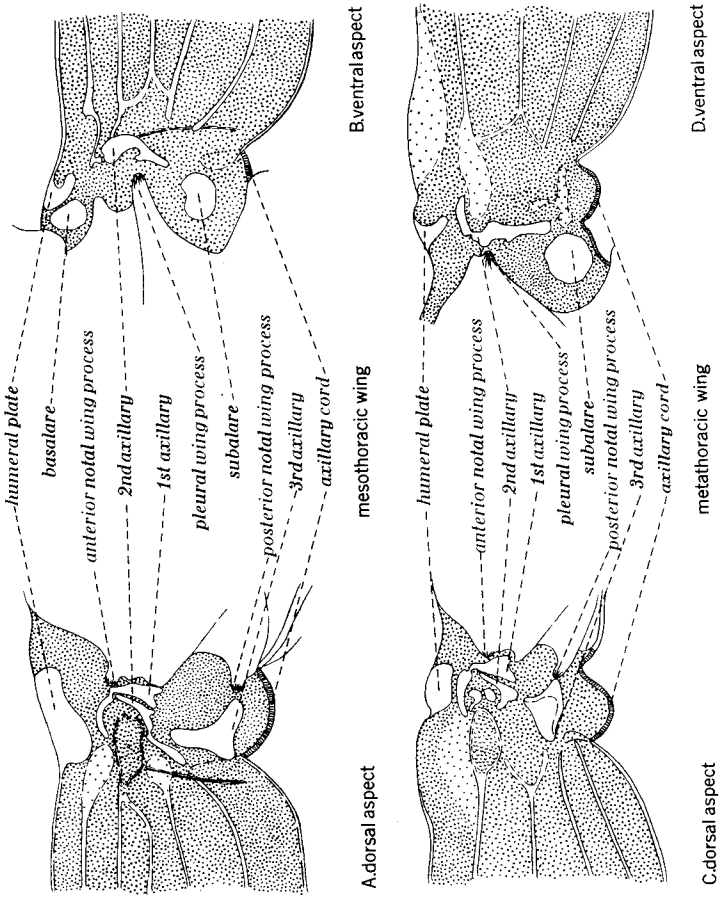
A.mesothoracic wing



B.metathoracic wing

Psocus confraternus, wing venation

Figure 48



Psocus confraternus, wing bases

Figure 49

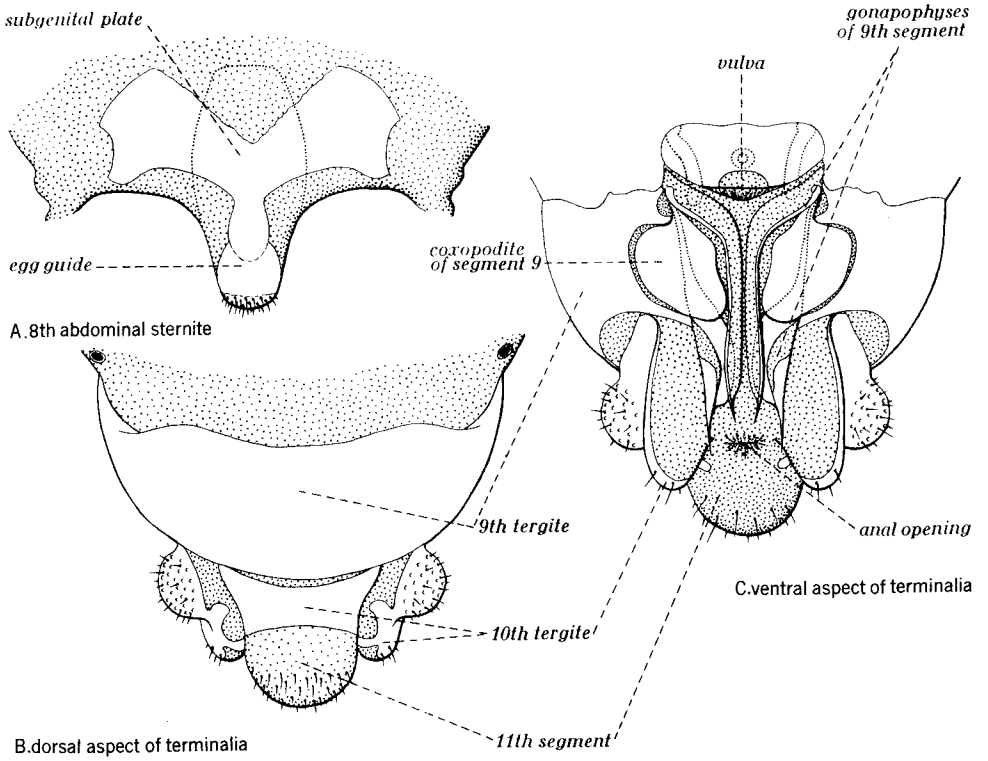


Figure 50 Psocus confraternus, female genitalia

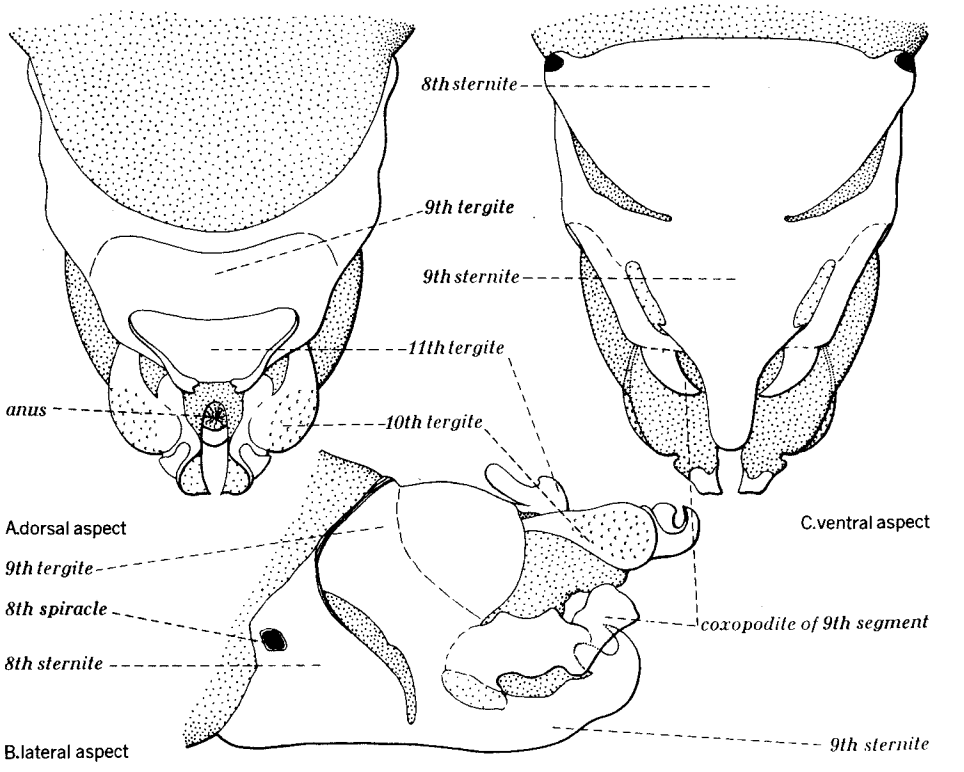
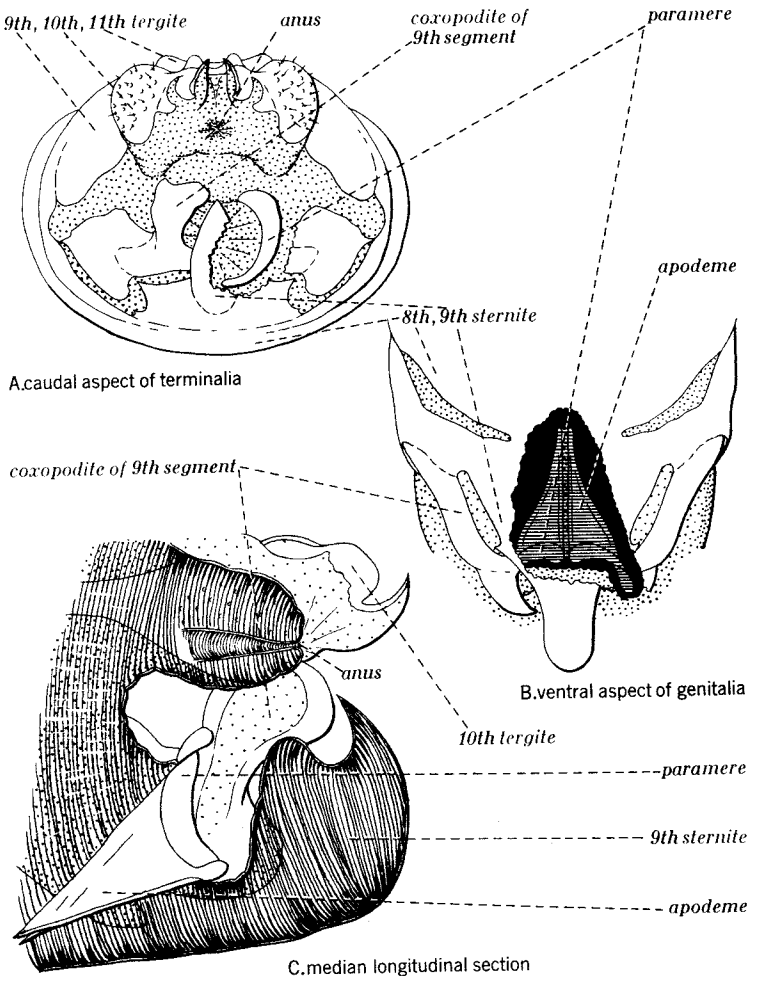


Figure 51 Psocus confraternus, male genitalia



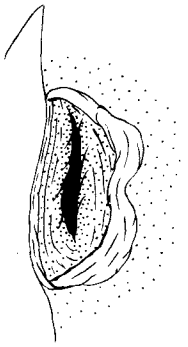
A.caudal aspect of terminalia

B.ventral aspect of genitalia

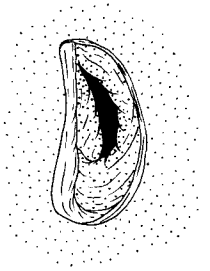
C.median longitudinal section

Psocus confraternus, male genitalia

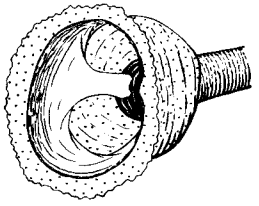
Figure 52



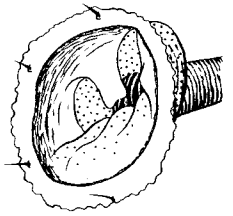
A.mesothoracic spiracle



B.metathoracic spiracle



C.abdominal spiracle vi



D.abdominal spiracle viii

Psocus confraternus, details of spiracles

Figure 53