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The Nearctic Chaoborinae (Diptera: Culicidae)

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Introduction

THE CHAOBORINAE are a small subfamily of the medically and economically significant family Culicidae. As "poor relations" of the biting mosquitoes they have been largely neglected by taxonomists.

Chaoborinae are small (1.4 to 10.00 mm.), delicate flies usually of a pale yellow, grey, or brown color. They have short mouthparts and are not known to bite; accordingly they are often termed nonbiting mosquitoes. The wing venation is typically culicid.

Only one North American species is considered to be a nuisance. This is the Clear Lake gnat, *Chaoborus (Sayomyia) astictopus* Dyar and Shannon. This insect has appeared in tremendous swarms in the summer months along the shores of Clear Lake, California, causing great annoyance and misery by its numbers alone.

As a consequence considerable work has been done on the biology of this species: Lindquist and Deonier (1942a, 1942b, and 1943); Lindquist, Deonier, and Hancey (1943); Lindquist and Roth (1950, 1951); Deonier (1943); Herms (1937).

It is known that the larvae of these nonbiting mosquitoes feed on the larvae of the biting mosquitoes and, consequently, exert considerable control on the numbers of those insects. The actual extent of the natural control thus exerted has not been investigated to any extent, but personal experience in rearing one of the species, along with recent observation by Sailer and Lienk (1954), indicates that the larvae of Chaoborinae consume large numbers of the larvae of biting mosquitoes. Since these insects are of direct value in the natural control of mosquito populations and since there is much confusion in the systematics of the group as it occurs in North America, a revisional study has long been needed.

This revisional and anatomical study lays a necessary foundation for further investigations concerning the ecological interrelationships between the nonbiting and the biting mosquitoes.

This study supplements Minnesota Technical Bulletin 126, *The Mosquitoes of Minnesota with Special Reference to Their Biologies*, treating the biting mosquitoes. Consequently, we now have a reasonably complete systematic treatment of all the Minnesota mosquitoes.

The subfamily is composed of some 75 known species which are grouped into seven genera. The genera *Promochlonyx*, *Cryophila*, and *Neochaoborus* are not present in the Nearctic. In this revision four genera only will be considered: *Corethrella*, *Chaoborus*, *Mochlonyx*, and *Eucorethra*.

Dyar and Shannon in a paper on the North American Chaoborinae (1924)

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stated that while much work had been done up to that time on the biting Culicidae, "very little attention has been paid to the American nonbiting forms, the Chaoborinae and Dixinae." This situation still prevails; since the publication of the work by Dyar and Shannon only a very few papers have been published on the North American members of this group.

There has been no adequate treatment of the morphology of either the larvae or the adults in the American literature to date. Studies of the anatomy of the larvae have been only briefly presented (Johannsen, 1903, 1934; Felt, 1904; Knab, 1909; Herms, 1937; and Deonier, 1943). The adults have been even more casually treated. The wing venation and the male genitalia of a very few species are the only structures that have been investigated (Johannsen, 1903; Felt, 1904; and Matheson, 1944).

The European fauna has fared somewhat better. The external anatomy of the adults of some European species has been described and figured by Martini (1929), while Peus (1934) has presented some aspects of the larval and pupal anatomy of several species. From a taxonomic viewpoint the most important recent papers on this subfamily are those of Martini (1929) for the Palearctic; Edwards (1932) for the world; Lane (1942, 1953) for the Neotropic; and Matheson (1944) for North America.

The first part of this paper is devoted to a detailed study of the external morphology of the adult and immature stages of *Chaoborus americanus* (Johannsen). This species has been selected as our reference species, not necessarily because it is the most typical species of the subfamily, but largely because it is quite abundant and adequate quantities of all stages are readily obtained. It is typical, however, of the genus *Chaoborus* and consequently is a good representative to which other members of the subfamily can be related and compared.

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The External Morphology of *Chaoborus americanus* (Johannsen)

A knowledge of the external morphology of the immature and adult stages is the first step necessary in the segregation and definition of species, genera, or other natural assemblages of organisms within any group under investigation. Hence, this section is intended to form the basis for the taxonomic consideration which follows. The interpretation of the external morphology here presented follows very largely that proposed by Ferris (1939 *et seq.*) and his students, Henry (1948) and Cook (1944 *et seq.*). Except where otherwise noted the anatomy of all species of *Chaoborus* is essentially identical with *C. americanus*.

THE ADULT

Chaoborus (Chaoborus) americanus (Johannsen) is a relatively small, pale yellowish-brown to dark brown, delicate appearing culicid with short mouthparts. The size is quite variable: 3.00 to 7.10 mm. body length for females and 5.50 to 8.00 mm. for males. In general appearance, the members of this species resemble typical culicids, except for the short mouthparts.

The Head

Figures 1, 2, and 3

The head capsule externally resembles that of "the mosquito" (Matheson, 1944, page 6). It consists very largely of the ocular-antennal or third segment with little evidence to indicate the inclusion of any of the posterior segments that supposedly constitute a portion of the primitive head capsule.

There is no coronal suture present, although there is a wide, pigmented, medial stripe extending from the cervical membrane forward to a termination between the antennal foramina. This coronal stripe is demarked by shallow lateral furrows.

The anterior portion of this coronal stripe expands into a median pigmented spot between the antennal foramina. This spot will be here designated as the "frontal macula" (figure 1A). The terms "coronal stripe" and "frontal macula" are topographical terms and have no morphological significance.

In the female, the antennal foramina are surrounded by a wide membranous area which begins at the inner margin of the eyes on either side and extends across the whole of the area between the foramina from below the frontal macula to the posterior margin of the clypeal sclerite. In the male, the antennal foramina are almost twice the size of those in the female and occupy most of this central membranous area.

Posteriorly there are no sutures in either sex to indicate the presence of any segment other than the ocular-antennal. Ventrally, the head capsule sclerotization has expanded to form a bridge below the foramen magnum and has obscured all evidence of primitive segmentation (figures 1C, 2B). This "postgenal bridge" (Imms, 1944) separates the posterior tentorial pits from the maxillary cardines by a solid band of sclerotization. Primitively, the posterior tentorial pits lie in the premaxillary sutures, according to Ferris (1942, 1943, 1944).

The eyes and antennae are located on the ocular-antennal segment. The eyes are large, somewhat reniform, and well separated in both sexes.

The antennae are typically culicid. These are made up of (1) a small, obscure, ringlike first segment or scape, which is bare of setae, (2) a large globular pedicel, which is bare of setae in the males but has six to eight setae in the females, and (3) a terminal flagellum of 13 segments, each of which bears a whorl of long setae in the male and a shorter, somewhat more sparse whorl in the female. The diameter of the male pedicel is approximately 1.8 times that of the female. The antennae are not illustrated.

The tentorium is well developed (figure 1B). The anterior pits are located laterally in the semi-membranous areas between the head capsule proper and the forward projecting clypeal sclerite. The tentorial arms pass through the head from the anterior pits to the posterior pits. The posterior pits are smaller than the anterior and are located at the lower margin of the foramen magnum.

Projecting anteriorly from the head capsule proper is the well defined clypeal sclerite (figures 1A, 1B). This sclerite is made up of the clypeus in part, but the ocular-antennal segment has also contributed to its structure. This is evident from the presence of the anterior mandibular articulation on the margins of the sclerite, about midway along its length (figures 1A, 3A, 3C).

The anterior mandibular articulation in the Neuropteroid orders is (according to Ferris, 1943 and Cook, 1943) to the paraclypeal lobe. This lobe is a part of the ocular-antennal segment often separated from the segment by the tentorial pit or a suture or sinus leading to the tentorial pit.

The clypeal sclerite forms the dorsal wall of a proboscis or rostrum. Ventrally, the rostrum is membranous. The membranous ventral portion probably contains elements of the segments posterior to the third segment.

The posterior mandibular articulation is to the margin of the cibarium at relatively the same level as the anterior articulation (figures 3A, 3C). This indicates that the cibarium has developed as a result of the inflexion of the circum-oral area, including at least the ventral remnants of the mandibular segment.

The chaetotaxy of the head is as follows: Some variation is present in the different species of the genus, and where this occurs it will be indicated in the specific descriptions. The vertex is thickly beset with long setae in both sexes. The frontal macula is bare of setae in the males, while the females have from two to seven setae. The occipital setae extend beneath the foramen magnum. The clypeus, prementum, and maxillary palpi are covered with long and short setae, and the labellae are beset with short setae.

The Mouthparts

Figures 2A, 2C, 2D, and 3

The most evident structural difference between *C. americanus* (or the Chaoborinae in general) and the Culicinae is apparent in the mouthparts. The same structures are present in each, but in the Chaoborinae the various appendages are much less elongate. According to all authors the Chaoborinae are nonbiting. As far as the literature is concerned there is apparently no information based on observation of the feeding habits of the adults, but it should be pointed out that the Chaoborinae have all of the structures necessary both for piercing and for feeding on fluids.

The labrum (figure 2D) is elongate, approximately twice as long as wide, and one-half the length of the clypeus. It is largely membranous with a slender band of sclerotization across the upper anterior margin from which another slender sclerotized strip projects anteriorly to the tip.

At the distal end of the labrum there is a pair of membranous lobes which, in their normal position, fit firmly against the medial surfaces of the labellae. The oral face of the labrum is membranous with the exception of a very slender median strip of sclerotization and two somewhat wider lateral strips which are continuous posteriorly with the sclerotized margins of the cibarial cavity.

The mandibles are short, thin, well sclerotized but transparent structures which articulate to the clypeal sclerite anteriorly and to the wall of the cibarial cavity posteriorly (figures 2C, 3A, 3C). Mandibles are present and similar in both sexes. According to Crampton (1942), mandibles in the Diptera occur in the males of only two species of Simuliidae, in one species of Ceratopogonidae, and as abnormalities in a few male Culicidae.

The maxillae (figures 1C, 2A) are directly comparable to the maxillae present in the Mecoptera and the more primitive Nematocera (for example, Anisopodidae). For a comparison see Crampton (1942), Ferris (1942), and Imms (1944). The cardines or articulatory sclerites of the maxillae articulate with the postgenal bridge of the head capsule as in *Panorpa communis* (Imms, 1944; text figure 1A) and *Phlebotomus argentipes* (*ibid.*; text figure 11).

The stipes is a long, slender, S-shaped sclerite present in the surface membrane on the posterior side of the rostrum, plus a seta-bearing, sclerotized lobe located at the distal end of and slightly detached from the S-shaped sclerite. This semidetached lobe simulates the palpifer or a basal palpal segment. Actually the lobe is neither of the latter structures since the first segment of the palpus proper articulates directly to the expanded distal portion of the S-shaped sclerite or to the main body of the stipes and not to this stipital lobe.

The maxillary palpi are four-segmented, as has already been indicated by Edwards (1932). The endite lobe of the stipes (galea of Crampton, 1942; lacinia of Imms, 1944) articulates with the distal end of the main body of the stipes (S-shaped sclerite) just mesad of the articulation of the maxillary palpus. The lacinia is slightly

longer than the mandible, blade shaped, and well sclerotized. The tip bears a group of short, stout setae.

The labium (figures 1A, 1B, 1C, 3B) is comparable to that of the more primitive Nematocera and the Mecoptera. The mentum (postmentum of Imms, 1944) is completely membranous and lies between the slender stipites of the maxillae. The distal sclerotized part of the labium is the enlarged prementum. This prementum is divided longitudinally by a median suture. The labellae (labial palpi) are two-segmented and articulate with the outer anteriormost margins of the prementum.

A small, triangular, basally sclerotized and apically membranous plate lies on the ventral side of the distal end of the prementum between the latter and the labellae. A similar structure is present in the Dixidae, the Culicinae, and several other nematoceran Diptera. Snodgrass (1944) considers this to be the ligula in mosquitoes. Imms (1944) terms the structure the "median labial process" and believes that it is not the ligula. Aside from its position, there are no criteria available which will aid in homologizing this structure with known structures in other insects.

The hypopharynx (figures 3A, 3C) is a stout, well sclerotized stylet bearing short setae distally. This structure serves as the ventral closure of the anterior portion of the oral cavity. In cross section the hypopharynx is V-shaped and is continuous posteriorly with the floor of the cibarium. The salivary duct opens into the floor of this V at the base of the hypopharynx.

The cibarium (figures 3A, 3C) has a heavily sclerotized floor. The ventral sclerotization extends around the margins of the cibarium and for a short distance over the dorsal surface. Beyond this marginal sclerotization, the dorsal surface of the cibarium is wholly membranous. Heavy muscle bundles originating on the clypeal sclerite insert on the dorsal surface of the cibarium so the whole structure is an efficient-appearing cibarial pump.

At least part of the cibarium is formed from the inflexed circum-oral region. This contention is supported by the presence of the posterior mandibular articulations on the sclerotized lateral margins of the cibarium about midway along its length.

The double articulation of the mandible seems to be unique among the Diptera. Robinson (1939) shows a single articulation (the anterior) in *Anopheles maculipennis;* Ferris (1942) found only one in Blepharoceridae; Nicholson (1945) found only one in Simuliidae; and Snodgrass (1944) apparently found but a single anterior articulation in those Diptera which he examined.

The Thorax

Figures 4, 5, 6, 7D

The head is attached to the thorax by a rather slender neck (figure 7D). The supporting elements are the paired cervical sclerites. There have been no extensive studies of this area aside from that of Crampton (1926).

Each cervical sclerite is composed of three sclerotized plates. The anterior plate of each sclerite is triangular in shape and articulates with the head on a pair of small processes at the upper outer margin of the foramen magnum.

The posterior plates are also triangular in outline. These articulate with the thorax just beneath the pronotal lobe at the inner anteriormost edge of the proepisternum. This is the same point of articulation shown in the Tipulidae (Rees and Ferris, 1939) and in the Diptera illustrated by Crampton (1942). The median plates are connected to each other by a bridge of sclerotization passing beneath the neck.

The prothorax (figures 4A, 4B, 5, 6A, 6B) is very much reduced in size. Its structure is comparable to that shown in the illustrations of the thorax of the Culicinae figured by Crampton (1942), Komp (1937), and Dyar and Shannon (1924).

A pair of anterior lobes lies at either side of the anterior end of the enlarged mesothoracic scutum. These lobes are the remnants of the anterior part of the pronotum which have been forced to either side from their primitive position by the hypertrophy of the mesothoracic tergum. The anterior pronotal lobes are connected to each other dorsally by a narrow sclero-

tized collar anterior to the scutum of the mesothorax.

Caudad of the anterior pronotal lobes (according to Freeborn, 1924), the posterior pronotum has been divided into two lateral sclerites. The anepisternum is a distinct but much reduced sclerite lying ventrad of the pronotal lobes and cephalad of the posterior pronotum.

The pleural suture is quite short, extending from the coxal condyle to the margin of the posterior pronotum. The pleural apophysis extends the full length of the suture.

Another well defined suture passing just cephalad of the anterior spiracle serves to mark the posterior boundary of the posterior pronotum from the apex of the propleural suture to the mesothoracic scutum.

Immediately posterior to this suture, below and posterior to the mesothoracic spiracle, lie two sclerotized plates, one posterior to the spiracle and one ventrad of it. These sclerites are separated from each other by a well defined suture which extends from the suture posterior to (morphologically ventrad of) the posterior pronotum just below the spiracle to approximately the middle of the pleural cleft.

In the "typical culicid" illustrated by Crampton (1942, figure 6D) the posterior or upper plate is called the anterior anepisternum. Komp (1937, figure 1) calls this plate the mesanepisternum. However, both authors leave the lower part, ventrad of the postpronotum, unnamed. Freeborn (1924) calls both plates the anepisternum of the mesothorax; yet he clearly shows in his illustrations of *Dixa clavata* (1924, figure 3) that the anterior plate is located anterior to the spiracle.

By all of the available criteria this lower sclerite can only be the procepimeron (or epimeron I). In the first place, it lies immediately posterior to the pleural suture. Secondly, it lies morphologically ventrad of the posterior pronotum. Thirdly, it is separated from the area bearing the anterior or second spiracle by a well defined suture.

As far as the author can discover, the sternal regions of the Culicidae have never been investigated. At least there is no discussion of this region in any of the better known works on the Culicidae. There are, consequently, certain errors in the terminology applied to the thoracic sclerites of the Culicidae. In any case, the terminology of the Culicinae cannot be applied to the Chaoborinae.

The author has not had sufficient time to investigate the Culicinae in any detail, but a hasty examination of *Anopheles walkeri* seems to bear out this contention. It should be indicated that the author is in complete agreement with Ferris (1940) and Michener (1944) in regard to the composition of the thoracic region of insects in general and the sternal region in particular.

If the ventral surface of the thorax of *C. americanus* is examined (figure 4B), a pair of small sclerites can be seen lying mesad of the bases of the prothoracic coxae. These paired sclerites are separated from each other by a median suture, the discriminal line. These sclerites are the katepisterna since they bear the ventral coxal condyles. Hence, the structure which has been known as the episternum (or propleuron, according to some authors) is in actuality the anepisternum of the prothorax. Posterior to the paired katepisterna lies a small median sclerite, which is the secondarily developed sternum.

The mesothorax (figures 4A, 4B, 5) is the largest thoracic segment. The mesonotum or scutum forms the greater part of the dorsal region of the thorax. The lobelike, rather triangular scutellum lies immediately caudad of the scutum. On either side of the scutellum and extending down to the notal wing processes are the parascutellar sclerites (Crampton, 1942). Posterior to the scutellum is the postnotum, which is somewhat larger than the preceding sclerite and constitutes practically all of the remainder of the dorsum.

The sclerites of the pleural region can be directly homologized with those in the rest of the Culicidae, but some correction of the terminology must be first undertaken. The chief landmark is the pleural suture, which extends from the lateral condyle of the mesothoracic coxa to the pleural wing process. The suture forms a

deep phragma for the whole of its length.

The pleural apophysis arises in the lower part of the pleural suture somewhat dorsad of the coxal condyle (figure 5). This apophysis is a double invagination. The anterior invagination is merely a deepened part of the pleural suture, while the posterior is in the form of a crescent, invaginating from the body wall a short distance caudad of the first. This secondary invagination or phragma joins the primary both dorsally and ventrally, forming thereby an area within the body cavity which is closed off from the rest of the body cavity on all sides except mesally.

Just ventrad of the pleural apophysis is a small sclerotized plate which bears the lateral coxal articulation. This sclerite is separated dorsally from the main portion of the epimeron by a phragma which fuses along its inner margin with the lower margin of the pleural apophysis and extends from the pleural suture to the coxal condyle. From its position, this sclerite is the katepimeron of the mesothorax.

The area dorsad of the latter sclerite is the anepimeron rather than the mesepimeron, as culicidologists have termed it. Posterior to the coxal articulation, the meron is present as a well sclerotized but small sclerite that is largely concealed by the coxa.

Before the anterior pleural regions can be discussed, we must consider the sternal region of the mesothorax (figure 4B). There can be discerned a pair of small ventral sclerites, which are partially separated from each other by a median fold and suture. This median line is not as complete as is the median line in the prothoracic region, but it is apparent.

These small plates bear the ventral coxal articulations and are separated anteriorly from the so-called sternopleurites by distinct sutures. The median line or suture is the discriminal line. The sternal apophysis arises in its exact center. Following the concept of the insect thorax expressed by Ferris (1940) and by Michener (1944), the small sclerites just described can only be the katepisterna. The suture lying anterior to them must be the "pleural costa" of Ferris (1940) ("precoxal suture" of Michener). Then the so-called "sternopleurites" of culicidologists or "katepisterna" of more morphologically inclined workers must be the preepisterna.

Separating the preepisternum from the more dorsal elements is a complex combination of suture, membranous cleft, and phragma. This is apparently homologous with the pleural cleft in the neuropterans, *Agulla adnixa,* as described by Ferris and Pennebaker (1939), and *Plega signata,* as described by Ferris (1940). This cleft separates the preepisternum from the anepisternum above.

The anepisternum in this species and in many other Culicidae is divided into two sclerites, an anterior and a posterior, by a well marked intra-anepisternal suture. The anterior anepisternum, which is fairly well sclerotized, lies just posterior to the spiracle and dorsad of the proepimeron. The posterior anepisternum has been termed the prealar area or prealar knob by most culicidologists. Morphologically such a term is meaningless although topographically it has value.

One other landmark should be located. This is the prealar apophysis which invaginates from the apex of the intra-anepisternal suture.

The metathorax (figures 4A, 4B, 5) is quite reduced. The metanotum is a narrow sclerite which passes over the dorsum between the bases of the halteres. The postnotum of the mesothorax has pushed beneath this metanotum in its posterior expansion so that the metanotum more or less covers the posterior part of the postnotum.

A seemingly unique structure occurs in all of the members of this genus that have been examined. This is a pair of small fingerlike processes, thickly beset with small fine setae, located on the metanotum on either side of the midline. These will be referred to as the "metanotal processes."

The pleural suture in this segment is in the form of a shallow phragma which lies practically at the posterior extremity of the thorax. It extends from the pleural articulation of the coxa along the margin of the thorax about one-third of the

distance to the dorsum and there turns sharply inward and follows a rather sinuous course to the pleural wing process (haltere).

When the metathorax is viewed from the ventral side, we again find the small paired katepisterna separated by the discriminal line bearing the ventral coxal articulations. The katepisterna are continuous as thin sclerotized strips around the front of the coxae, with the small plates lying just dorsad of the metathoracic coxae.

Since there is no evident suture (pleural costa) between the ventral element and the dorsal element above the coxa, it is probable that the dorsal element is merely a part of the katepisternum. This dorsal part has been termed the "metaeusternum" by Komp (1937) and the "metameron" by Carpenter *et al.* (1946). The anepisternum is separated from the katepisternum by the pleural cleft. The epimeron is exceedingly narrow ventrally but becomes wider above the sharp inturning of the pleural suture. Dorsally it is bounded by the metanotum.

To return to the ventral area once more, there arises from the posterior part of the discriminal line a pair of distinct sternal apophyses, which are not united with the pleural apophyses. These metathoracic sternal apophyses differ from the mesothoracic apophyses in this detail and also in the fact that they are separate all the way to their common base.

As far as ornamentation of the thorax is concerned, the mesoscutum is marked with two pairs of dark brown to black vittae (figure 6C), which indicate the origins of the thoracic muscles. These vittae are present in all species of the subfamily and are characterized by the complete absence of micro- and macrosetae. The remainder of the mesoscutum bears long setae in the pattern indicated in figure 6C. The scutellum bears two or three irregular transverse rows of long setae, and the postnotum is bare.

There are present, in addition, long setae on the pronotal lobes, the postpronotum, the proepisternum, preepisternum, anepisternum, the upper part of the mesepimeron, and the parascutellum. Except for the parascutellars, which are absent in *Sayomyia* and *Schadonophasma,* these setae are present in varying numbers in all species. All species of *Chaoborus* have the whole of the thorax covered with microsetae with the exception of the vittae noted above.

The Thoracic Appendages

Figures 7, 8, 9A, 9C

The wings (figure 9C) are well developed and possess a typically culicid venation. The wing veins bear what appear under examination with a light microscope to be but slightly modified setae. However, electron micrographs[2] of these "setae" reveal that they have the structure of scales. Around the posterior border of the wing there is also a fringe of long lanceolate scales, which electron micrographs reveal to have typical scale structure. These lanceolate scales occur in two sizes, the shorter approximately one-half the length of the longer. The wing membrane is, in addition, covered with typical culicid microtrichia. There is no profound difference between the basal articulatory sclerites (figures 8A, 8B) of this species and that of the more generalized pattern of articulations illustrated by Snodgrass (1935).

The halteres can be understood by reference to figure 9A. The homology of the halteres with an unmodified wing is readily apparent if one examines the basal portion or scabellum. The axillary sclerites can be seen to correspond quite closely with those present in unmodified wings. The capitulum is large and somewhat spherical, and it bears on the mesal surface three or four setae. The entire surface of the midhaltere and capitulum is covered with microsetae.

The legs present no unusual features, as can be ascertained by reference to figure 7. The coxae are stout and short. The coxae of all three thoracic legs bear some setae arranged in a fairly definite pattern, as shown in the illustration. The

[2] The author is indebted to Dr. A. Glenn Richards for the electron micrographs of these wings and the interpretation thereof.

prothoracic and metathoracic coxae also bear patches of very minute setae on their caudal margins. The prothoracic coxae possess a lateral and a mesal patch, and the metathoracic coxae a lateral patch.

The remaining segments have no features of note. The first tarsal segment is slightly less than one-half the length of the tibia. All the segments are covered rather densely with both long and short, slender setae. The third tarsal segment of the mesothoracic leg of the female has on the caudal surface a series of short setae, slightly stouter than the rest, arranged in the form of a comb.

The last tarsal segment bears a pair of small claws, on which a number of small setae are located basally, and a pair of setaceous pulvilli approximately one-half the length of the claws. There is no empodium. The metathoracic leg is the longest, with the prothoracic leg two-thirds as long and the mesothoracic leg two-fifths as long.

The Abdomen and Its Appendages

The pregenital segments of the abdomen (figure 10D) are quite simple in structure. They are composed simply of a tergite and a slightly smaller sternite. In this species the tergite of the first segment is smaller than the succeeding tergites, and the first sternum is completely membranous.

There are eight pregenital segments in both males and females. The chief difference evident between the structure of this area in the two sexes is one of proportion. In the male the tergites are almost equal in length and breadth, while in the female the tergites are almost twice as wide as long, thus correlating with the greater width of the female abdomen.

In both sexes the abdominal segments and the intersegmental membranes are covered with minute microsetae with the exception of small, paired, bare spots on the tergites of segments 3 through 6. These spots appear as pale, roughly circular patches on the tergites when viewed under low magnification. The tergites and sternites of both sexes bear numerous long setae in well defined rows occurring at the posterior and lateral margins of each sclerite. The exception is tergite 1 in which the posterior row is medial.

The abdominal spiracles are quite minute, but they can be discerned in the membrane between the tergites and sternites in the anterior half of each segment.

The Terminalia of the Male

Figures 9B, 9D

The eighth segment is unmodified in the male but is only one-fourth as long as segment 7. The ninth is the first segment actually involved in the genitalic structures. The ninth tergite is well developed and somewhat triangular in outline, and it bears two dorso-lateral lobes on each of which are from 9 to 11 setae.

The sternite is less well developed, forming simply a narrow collar of sclerotization around the morphologically ventral but topographically dorsal side of the apex of the abdomen. This collar is deeply emarginate posteriorly.

Following the interpretation of Michener (1944a) (see also Gustafson, 1950), the gonocoxites arise from the posterior lateral margins of the ninth segment. The gonostyles articulate with the apical portion of the gonocoxites. In this species the gonostyle is heavily sclerotized and bears a few scattered, minute setae but no terminal spine.

A pair of small appendagelike sclerites lies between the gonocoxites on either side of the genital orifice. Dyar and Shannon (1924) termed these the "tenth sternites" and Edwards (1932) indicates that they are probably the parameres. These structures articulate to the bases of the coxites and are moved by muscles which originate within the coxites; therefore they cannot be "tenth sternites." The term "paramere" means so many things to different authors that this name is impractical to use. Following Michener (1944a) still, the musculature and the point of attachment indicate that they are the penis valves.

The penis valves articulate to the morphologically mesoventral edge of the anterior margin of the gonocoxites. Apically they lie free of the surface membrane on

either side of the genital orifice. There is no obvious penis, merely a membranous lobe. The penis valves have a very characteristic form in different species and are, therefore, of considerable taxonomic importance.

The postgenital segments are not developed in the male. The anus simply opens through the apical, membranous lobe which bears the genital orifice. Morphologically the anus is dorsal to the genital orifice, but topographically, owing to rotation of the terminal segments, the anus is ventral. Edwards (1932) in his diagnosis of this subfamily indicates "hypopygium not inverted." As far as this species is concerned, this is not true, nor is it true of any other member of the genus *Chaoborus* that the author has seen.

The Terminalia of the Female

Figures 10A, 10B, 10C

In the female genitalic complex, segment 8 is likewise unmodified. In segment 9 the tergite is somewhat bilobed posteriorly, each lobe bearing approximately nine rather long setae. Ventral and posterior to sternite 8 (in the area called the atrium by culicidologists), there are three openings. The most posterior of these is, at least in part, the spermathecal duct opening. The next anterior opening could not be traced but may represent an accessory gland pore. The gonopore is the largest and most anterior opening.

Posterior to the pore of the spermathecal duct there is a small, transverse, slender sclerite (probably homologous to the "cowl" of the Culicinae), which is closely joined laterally to a pair of small triangular sclerites. According to Gerry (1932) and Gjullin (1937) this cowl is the ninth sternite. Edwards (1941) indicates that this cowl is not sternite 9 in the Culicidae but that the true ninth sternite is represented by a small plate (the insula) anterior to the atrium in some Culicidae. He bases this on the assumption that the gonopore of the females in this family lies between segments 9 and 10 and not between 8 and 9.

This view is apparently not held by Gerry or Gjullin and certainly not by Crampton (1942). In the Tipulidae figured by Rees and Ferris (1939) the gonopore obviously lies between 8 and 9. Therefore, there is no reason why the so-called cowl should not be the reduced ninth sternite rather than some secondarily developed structure.

The postgenital segment (segment 10) is large and bilobed and bears the paired cerci. The cerci in all *Chaoborus* species are beset with short setae. The anus opens through a cleft between the two lobes of the tenth segment.

The spermathecae are three in number, spherical, and well pigmented. The spermathecal ducts are sclerotized and pigmented for a short distance from the point of union with the spermathecae. In this species these ducts are always curved and lie parallel to the surface of the spermathecae for the full length of the pigmentation.

THE FOURTH INSTAR LARVA

Figures 11, 12

The curious form and structures of the larvae of the Chaoborinae in general and *Chaoborus* in particular have been dealt with by various authors: Weismann (1866), Meinert (1886), Johannsen (1903), Felt (1904), Knab (1908), Peus (1934), Eckstein (1936), Hermes (1937), and Deonier (1943). There is no need, therefore, to stress the wide divergence of the larvae of Chaoborinae from the remainder of the Culicidae.

C. americanus is long (10.00 to 13.00 mm.), slender, and practically transparent. It lies horizontally in the water when at rest (figure 12A). The tracheal system is represented by one pair of air sacs in the thorax and another slightly smaller pair in the seventh abdominal segment. No spiracles are present. References to papers concerned with these air sacs and their probable function as hydrostatic organs in the Chaoborinae can be found in the bibliography of Wesenberg-Lund (1943). There is no siphon present, although ac-

cording to Peus (1934) a "siphon vestige" is supposedly present.

Phylogenetically to select this species as representative is to start at the wrong end of the evolutionary series; the structures of the larvae of this species—or of the genus *Chaoborus*—cannot be fully explained without reference to some of the more generalized species of the subfamily as, for example, *Mochlonyx velutinus*.

The Head

The head (figure 11) is elongate and compressed laterally. Posteriorly there is faint indication of the coronal and clypeofrontal sutures (figure 11A), but beyond this there are no intersegmental sutures on the head capsule. Anteriorly the head capsule is drawn out into a long, deep, proboscislike structure, which bears at its apex the closely approximated antennae (figures 11B, 11C).

A short, longitudinal, median suture between the antennal foramina extends two-thirds of the distance to the eyes. This may indicate the infolded remnant of the clypeus which has been reduced concomitant with the mesal approximation of the antennae.

Ventrally and topographically caudad but morphologically anterior to the antennae is a cluster of five pairs of long setae which have been termed the "postantennal filaments" by Johannsen (1934) (figure 11B). Immediately posterior to these setae are two flat, bladelike, anteriorly serrate setae which have been termed the "prelabral leaf-like appendages" by Felt (1904) (figures 11B, 12D).

Topographically posterior to this is the reduced and simplified labrum. This bears three small setae on its aboral surface and is covered at the apex by a dense imbrication of short, stout, flattened, apically bifurcate setae. On either side of the apex of the labrum there are two pairs of setal fans (figure 11B). These correspond in position to the messorial fans of the Culicinae, but there are no other criteria by which these can be identified in this species since the musculature of the labrum is much reduced.

Schremmer (1950) has made an interesting case for the theory that this is not the labrum in *Chaoborus* but is actually the epipharynx or a structure of the palatum or roof of the cibarium. However, he does not take into account the nature of the homologous structure in the larvae of *Mochlonyx* and *Eucorethra*. In the latter two genera (figures 22, 27) the fact is evident that the appendage attached to the anterior margin of the clypeus is the labrum. In the latter two genera the antennal foramina have not become approximated so as to obscure the homology.

Between the clypeus and labrum in *Mochlonyx* are setae which are probably homologs of those setae in *Chaoborus* which are termed postantennal filaments. The tip of the labrum of *Mochlonyx* possesses both bifurcate and three-tined setae as in *Chaoborus*. The palatal surface of the labrum of *Mochlonyx* bears a pair of setal fans which have the form and structure of those present at the apex of the labrum of *Chaoborus*. For these reasons it is believed that this structure is the labrum and not the epipharynx.

The tentorium (figure 11B) consists of a pair of very slender rods which pass from a point just anterior to the anterior mandibular articulations through the head to the lateral margins of the foramen magnum at a level slightly above the simple or larval eyes.

There are two pairs of eyes (figure 11B) in the last instar larva, a pair of large, incompletely developed adult eyes located anteriorly and a pair of small, simple larval eyes located close behind.

The mouthparts are much reduced, and only the mandibles of the true oral appendages appear large enough to serve as feeding organs. In these larvae the antennae (figure 11B) have become modified in structure and function to serve also as feeding organs or at least as organs of prehension. Each antenna consists of a single, long, stout segment. At the apex this bears five stout, curved, bladelike setae, four long and one somewhat shorter. The longer setae are approximately equal in length to the antenna itself.

The mandibles (figure 12E) are well developed. They have at their outer anterior corner a fan of 22 to 29 stout, curved, bladelike setae about one-half as long as those of the antennae. On the outer posterior angle of each mandible there are three stout, heavily sclerotized teeth. These teeth are preceded by one short and two long, slender, unmodified setae and two small spines. Each mandible articulates to the head capsule anteriorly just beneath the anterior tentorial pit and posteriorly to the lateral wall of the head immediately anterior to the maxilla (figure 11B).

The maxillae (figure 12C) are considerably reduced. Each consists of a flat, somewhat curved, lobelike stipes and a small, fingerlike, laterally placed process which is the maxillary palpus. This palpus bears a single apical seta, and the stipes bears two widely spaced small setae.

The labium (figure 12B) is even further reduced. It consists of a small, median, somewhat sagittate plate—the submentum (Cook, 1949)—which has a pair of small setae at its apex and a very small, posteriorly rounded prementum. At the apex of the prementum is a minute pair of two-segmented labial palpi. The salivary duct opens into the cibarial cavity immediately anterior to the prementum.

The Thorax and Abdomen

The thorax offers little for discussion. It is composed of the three thoracic segments intimately fused into a single enlarged unit located immediately posterior to the short, slender cervical region. It bears numerous, more or less segmentally arranged, multiple setae, much as in other Culicidae. These setae are so transparent as to be very difficult to detect.

The eight succeeding abdominal segments offer no more by way of structural features than does the thorax. Each segment is beset with several plumose setae. Near the posterior end of segment 8 there is a slight constriction that sets off a small annulation from the anterior part of the segment (figures 12A, 12F). A slight conical protuberance is present on the dorsal side of this small posterior annulation. According to Peus (1934) this is the vestige of the siphon of other Culicidae. It should be pointed out, however, that the annulation on which this "siphon vestige" occurs has a musculature which indicates that it is a segment. This then is segment 9, and the siphon occurs on segment 8. Thus, the term "siphon vestige" seems to be inaccurate.

The anal segment (figure 12F), posterior to segment 9, is a composite structure formed by the fusion of the remaining body segments. Ventrally the anal segment bears a row of 23 to 26 long, pectinate setae. This row is homologous to the ventral brush of other Culicidae.

At the posterior end of the anal segment are four short, acutely pointed papillae, above which is a cluster of four pectinate setae. In these structures the correspondence to the Culicinae is very close. Ventrad of the anal papillae is a structure not present in the Culicinae, the "anal apparatus" (Peus, 1934). The area around the anal opening is expanded to form a terminal lobe which passes around the ventral side of the anus. This bears ventrally and medially two flat, anteriorly directed, hooklike processes (figure 12G). Extending laterally and dorsally from the ventral hooks around the outer margins of the anal lobe is a series of flattened processes (figure 12H). The processes are of two sizes which alternate with each other. The whole apparatus can be retracted and drawn within the anal opening. This complex structure has probably been modified from originally paired anal prolegs such as are present in the Chironomidae.

THE PUPA

Figures 18A, 18B, 18C

The morphology of the pupa of this species will not be discussed to any considerable extent since there are few external features that warrant such discussion and since there has been but little morphological investigation of the pupae of insects in general.

The pupa of this species resembles the pupae of the Culicinae. The cephalothorax

is smaller relative to the total size of the body, constituting something less than one-third of the total length. The thoracic respiratory horns (figure 18C) differ from those in the Culicinae in that they are spindleshaped, and each possesses a narrow, slitlike opening which is located on a small papilla at the distal end of the horn. The surface of the respiratory horn is closely reticulated.

The abdomen is relatively longer than in the Culicinae and hangs straight down rather than curving forward beneath the cephalothorax. The seventh segment of the abdomen (figure 18B) is longer than the preceding segments, while the eighth is quite short. There are setae on the abdominal segments which are useful in the separation of some of the species examined. These will be referred to under the specific descriptions.

The caudal end of the pupa bears a pair of paddleshaped appendages (figure 18A). These paddles are strengthened laterally by a pair of marginal ribs, the inner conspicuously serrate for the distal three-fourths of its length, and the outer very inconspicuously serrate on the distal fourth. There is in addition a median rib which has a branched seta at the middle. The membrane between these ribs is quite thin and transparent.

Taxonomy of the Chaoborinae

CONSIDERATION OF THE TECHNIQUES USED

The following measurements have been found to be of value in this study and will be included for each species: head width (H.W.), width between eyes at the narrowest point on the facial aspect (W.B.E.), clypeus length (C.L.), prementum length (P.L.), wing length from the tip to the incision distal to the alula (W.L.), and wing width at the distal end of Cu_2 (W.W.).

The following ratios have also been found useful:

$$\frac{\text{head width}}{\text{width between eyes}} \text{ (H.W./W.B.E.)}$$

$$\frac{\text{head width}}{\text{prementum length}} \text{ (H.W./P.L.)}$$

$$\frac{\text{head width}}{\text{clypeus length}} \text{ (H.W./C.L.)}$$

$$\frac{\text{wing length}}{\text{head width}} \text{ (W.L./H.W.)}$$

$$\frac{\text{wing length}}{\text{wing width}} \text{ (W.L./W.W.)}$$

$$\frac{\text{wing length}}{\text{length of profemur}} \text{ (W.L./Pf.L.)}$$

In addition, in the males the following are used:

$$\frac{\text{length of gonocoxite}}{\text{length of gonostyle}} \text{ (Co.L./St.L.)}$$

$$\frac{\text{length of penultimate antennal segment}}{\text{length of ultimate antennal segment}} \text{ (Pu.L./U.L.)}$$

For the sake of brevity, the symbols in parentheses following these expressed ratios and measurements will be used henceforth.

These measurements and ratios were variable, but differences in the means and lack of overlap of range or small overlap of range were the criteria used in their selection.

The specimens used for these measurements were slide mounted after having been cleared in 10 per cent KOH, stained with basic fuchsin when necessary, and mounted in balsam. The wings were not treated with KOH.

Keys

KEYS TO THE GENERA OF THE CHAOBORINAE

Adults

1. First tarsal segment longer than second (figure 7A) 2

1a. First tarsal segment shorter than second (figure 20B) *Mochlonyx* (p. 41)

2. Anal vein terminates at or before fork of Cu (figure 25C); pedicel and capitulum heavily setaceous (figure 25B); claws with basal tooth (only one species) ..... *Eucorethra* (p. 50)

2a. Anal vein terminates distad of fork of Cu (figure 9C); pedicel and capitulum with few setae (figure 9A) or with numerous short setae (figure 30B); claws simple 3

3. R_1 terminates closer to R_2 than to Sc (figure 9C); pedicel and capitulum with no more than 15 setae (figure 9A); claws all equal ..... *Chaoborus* (p. 20)

3a. R_1 terminates closer to Sc than to R_2 (figure 30C); capitulum with numerous short setae (figure 30B); claws on prothoracic legs of ♂♂ unequal ..... *Corethrella* (p. 55)

Larvae

1. Eighth abdominal segment with no siphon or external trace of respiratory apparatus (figure 12A); head narrow; antennae approximate ..... *Chaoborus*

1a. Eighth abdominal segment with siphon (figures 23A, 33A) or at least a prominent spiracular apparatus (figures 28A, 28C); head broad; antennae may or may not be approximate 2

2. Antennae approximate; each ocular lobe with a transverse row of stout setae (figure 32A) ..... *Corethrella*

2a. Antennae widely separated; no row of stout setae on ocular lobes (figures 22A, 27A) 3

3. Eighth abdominal segment with an elongate siphon; thorax and abdominal segment 7 with a pair of enlarged air sacs; terminal antennal setae as long as or longer than antennal segment (figure 23A) ..... *Mochlonyx*

3a. Eighth abdominal segment with a short spiracular apparatus as in *Anopheles;* no enlarged air sacs in thorax or abdominal segment 7; terminal antennal setae shorter than antennal segment (figure 28A) ..... *Eucorethra*

Pupae

1. Terminal abdominal segment with movable, paddlelike appendages (figures 18A, 18D, 18F, 18H, 18K, 28D) 2

1a. Terminal abdominal segment without movable, paddlelike appendages (figures 34A, 34B) ..... *Corethrella*

2. Thoracic respiratory horns trumpet-shaped, wide open at apex (figure 28F) ..... *Eucorethra*

2a. Thoracic respiratory horns spindleshaped, tracheal opening small and slitlike (figure 18C) 3

3. Anal paddles with thin delicate membrane, reinforced by obvious ribs on each side and in middle (figure 18A) ..... *Chaoborus*

3a. Anal paddles with membrane rigid, no obvious marginal ribs (figure 23C) ..... *Mochlonyx*

KEY TO THE SUBGENERA OF *Chaoborus*

Adults

1. Wings spotted; legs with spots or rings; with or without well developed pulvilli; no parascutellar setae 2

1a. Wings clear; legs unmarked; pulvilli at least half as long as claws; parascutellar setae present ..... *Chaoborus s. str.* (p. 20)

2. Pulvilli at least half as long as claws; males without a lobe or paired, stout setae on gonocoxites; penis valve with large clawlike head (figure 16J) (only one species) ..... *Schadonophasma* (p. 28)

2a. Pulvilli minute, less than one-fourth as long as claws; males with a lobe or paired stout setae on inner face of apical half of gonocoxites (figures 16A, 16C, 16E); penis valve with small head (figures 16B, 16D, 16F) ..... *Sayomyia* (p. 31)

KEY TO THE SPECIES OF *Chaoborus s. str.*

Adults

1. Frontal macula of females with 1 to 6 setae (usually); prementum short, head width approximately 2.75 times prementum length or more; preapical spine of penis valve shorter than head of penis valve (figure 16G) 2

1a. Frontal macula of females without setae; prementum longer, head width less than 2.6 times prementum length; preapical spine of penis valve as long as or longer than head of penis valve (figure 16H) *C. flavicans* (p. 23)

2. Postpronotum darkest at extreme upper margin and posterior angle; medial pronotal setae lacking in females; pleural apophyseal area without pigmentation; capitulum ovoid; preapical spine of penis valve shorter than head, penis valve head large, spatulate (figure 16I) ..... *C. borealis* n. sp. (p. 25)

2a. Postpronotum lighter at upper margin and around postpronotal setae, darker immediately below setae; medial pronotal setae numerous in females; capitulum spherical; pleural apophyseal area darkly pigmented; preapical spine of penis valve minute (figure 16G) ..... *C. americanus* (p. 20)

KEY TO THE SPECIES OF SUBGENUS *Sayomyia*

Adults

1. Adults with two large, indistinct brown patches on wings (figure 13H); femora and tibiae with a series of reddish-brown rings for their full length ..... *C. annulatus* n. sp. (p. 39)

1a. Adults with small discrete reddish-brown spots on wings at bifurcations and apices of veins and along veins; femora and tibiae may be spotted but never completely ringed with brown 2

2. Legs without distinct spots; wings only faintly spotted; gonocoxite of male without lobe; pale species ..... *C. albatus* (p. 38)

2a. Legs with distinct spots of reddish-brown 3

3. Setae of scutum and abdomen arising in reddish-brown spots or pinnaculae. East of the Rocky Mountains ..... *C. punctipennis* (p. 32)

3a. Setae of scutum and abdomen not located in reddish-brown pinnaculae. Pacific Coast states ..... *C. astictopus* (p. 35)

KEY TO THE KNOWN LARVAE OF *Chaoborus*

1. Dorsal process of segment 9 apparently two-segmented (figure 18J); mandibular tooth 2 without an attached tooth (figure 17F); antenna with a spine on anterior face one-fourth distance from base (figures 17M, 17N, 17O); labrum with a pair of long setae on anterior face near middle (figure 17P) ..... Subgenus *Sayomyia* 5

1a. Dorsal process of segment 9 not two-segmented (figure 12F); antenna without a spine on anterior face or, if present, near distal end (figures 17J, 17K, 17L); labrum with short setae on anterior face near middle (figure 11B) 2

2. Prelabral leaflike appendages less than 2.5 times longer than wide (figure 12D) ..... *C. americanus*

2a. Prelabral appendages at least four times longer than wide (figures 17A to 17E) 3

3. Antenna with seta on anterior face one-fourth to one-third distance from distal end (figure 17L); mandibular fan with 10 to 12 setae ..... *C. flavicans*

3a. Antenna without seta on anterior face (figure 17J) 4

4. Mandibular fan with 13 to 20 setae; size large (15.00 to 19.00 mm.) ..... *C. nyblaei* (p. 28)

4a. Mandibular fan with 11 to 12 setae; size small (10.00 to 11.00 mm.) ..... *C. borealis*

5. Prelabral appendages seven times, or less, longer than wide (figure 17E) ..... *C. albatus*

5a. Prelabral appendages 15 times, or more, longer than wide (figures 17C, 17D) 6

6. Seta on anterior face of antenna .021 to .026 mm. long (figure 17M); east of Rocky Mountains ..... *C. punctipennis*

6a. Seta on anterior face of antenna .034 mm. long (figure 17N); Pacific Coast ..... *C. astictopus*

The larva of *Chaoborus (Sayomyia) annulatus* is as yet unknown.

KEY TO THE KNOWN PUPAE OF *Chaoborus*

1. Lateral rib of paddle with a few serrations or teeth at apex 2

1a. Lateral rib of paddle without any trace of teeth or serrations 3

2. Median rib of paddle indistinct, bearing a plumose and a simple seta medially; lateral rib with at most two or three minute teeth at apex (figures 18H, 18K) 4

2a. Median rib of paddle distinct, a single plumose seta medially; lateral rib with seven to nine serrations (figure 18A) ..... *C. americanus*

3. Median rib of paddle with a minute seta at apex (figure 18D); dorsum of seventh abdominal segment with four pairs of posterior setae (figure 18E) ..... *C. flavicans*

3a. Dorsum of seventh abdominal segment with three pairs of posterior setae and with one pair of lateral setae (figure 18G) ..... *C. nyblaei*

4. Inner or mesal rib with numerous serrations on apical three-fourths of surface (figure 18H); median rib incomplete apically ..... *C. punctipennis*

4a. Mesal rib with very sparse serrations, only two or three on apical one-third of surface (figure 18K); median rib indistinct but complete ..... *C. astictopus*

The pupae of *C. borealis*, *C. albatus*, and *C. annulatus* are unknown.

KEY TO THE SPECIES OF *Mochlonyx*

Adults

1. Wings pale to somewhat infuscated, wing scales unicolorous (figure 20F) 2

1a. Wings mottled with patches of light and dark scales (figure 20E) ..... *M. cinctipes* (p. 46)

2. Proepisternal setae 6 to 13, posterior pronotal setae 3 to 15, upper mesepimeral setae 19 to 29, katepisternum 3 with a few setae; metathoracic claws of male identical with those of prothoracic and mesothoracic ..... *M. velutinus* (p. 44)

2a. Proepisternal setae 2, postpronotal setae 1, upper mesepimeral setae 3 to 5, no setae on katepisternum 3; pro- and mesothoracic claws of male with median and basal teeth, metathoracic claws simple ..... *M. fuliginosus* (p. 48)

Larvae and pupae of *M. velutinus* and *M. cinctipes* indistinguishable; larva and pupa of *M. fuliginosus* unknown.

KEY TO THE SPECIES OF *Corethrella*

Adults

1. Clypeus of both ♂♂ and ♀♀ with numerous (20-30) setae; gonostyle with an apical seta (figure 31E) ..... *C. laneana* (p. 62)

1a. Clypeus with less than 10 setae; no apical seta on gonostyle 2

2. Head of both ♂♂ and ♀♀ with a multiple row of setae mesad of eye margin posteriorly (figure 31D); gonostyle with a stout mesoproximal seta (figure 31C) ..... *C. appendiculata* (p. 60)

2a. Heads of ♂♂ and ♀♀ with a single row of setae mesad of eye margin posteriorly (figure 29B); gonostyle with no mesoproximal seta (or a minute one) (figure 31A) ..... *C. brakeleyi* (p. 58)

Larvae

1. Sutures bounding submentum parallel (figure 33C); abdomen without dorsal brown pigment patches ..... *C. appendiculata*

1a. Sutures bounding submentum divergent posteriorly (figure 32B); each abdominal segment with a median dorsal brown pigment patch (figure 33A) 2

2. Setae of anal and dorsal brushes single ..... *C. brakeleyi*

2a. Setae of anal and dorsal brushes bifid ..... *C. laneana*

Pupae

1. Respiratory horn constricted medially (figure 34C); abdominal tergite 7 without postero-lateral setae (figure 34A) ..... *C. brakeleyi*

1a. Respiratory horn not medially constricted (figures 34D, 34E); abdominal tergite 7 with a minute or long seta at each postero-lateral corner 2

2. Tergite 7 with a long, conspicuous seta at each postero-lateral corner (figure 34B); respiratory horn short (.19-.21 mm.), broad near base (figure 34D) ..... *C. appendiculata*

2a. Tergite 7 with a minute seta near each postero-lateral corner; respiratory horn longer (.34 mm.), narrow at base (figure 34E) ..... *C. laneana*

Chaoborus Lichtenstein, 1800, Wiedemann's Archiv. Zool. *1*:174. Type: *C. antisepticus* Licht. = *C. crystallinus* DeGeer 1776.

Corethra Meigen, 1803, Illigers Mag. II, 260. Type: *C. lateralis* Mg. = *C. crystallinus* DeGeer. Not *T. culiciformis* DeGeer [*fide* Edwards, 1920, 1930].

The genus *Chaoborus* Lichtenstein was divided into three subgenera, *Chaoborus s. str., Schadonophasma* Dyar and Shannon, and *Sayomyia* Coquillett, by Dyar and Shannon (1924).

THE SUBGENUS CHAOBORUS

The subgenus *Chaoborus* in the Nearctic is composed of species from 3.00 mm.-8.00 mm. long. The wings are unmarked; vein RS is long and may have a short spur (basally directed) at its base; vein Cu runs to the hind margin of the wing or almost there and is not spurred; vein An rarely attains the level of m-cu. The legs are unmarked; pulvilli are distinct and approximately half as long as claws. One to three parascutellar setae are always present. The gonocoxites of the male are without a preapical lobe. The penis valves bear a minute to large preapical spine.

CHAOBORUS (CHAOBORUS) AMERICANUS (JOHANNSEN)

Corethra plumicornis, var. *americana* Johannsen, 1903, N. Y. State Mus. Bul. 68, pp. 395-397, pl. 39.

Sayomyia americana (Johannsen), Felt, 1904, N. Y. State Mus. Bul. 79, pp. 368-370, figs. 107-111.

Sayomyia hudsoni Felt, 1904, *ibid.*, pp. 371-374, figs. 112-113, pls. 13, 28, 40, 47. Johannsen, 1934, Cornell Agr. Expt. Sta. Mem. 164, p. 44 *(Chaoborus).*

Chaoborus crystallina, Dyar and Shannon (not DeGeer), in part, 1924, Insecutor Inscitiae Menstruus *12*:210.

Chaoborus americanus (Johannsen), Matheson, 1925, Canad. Ent. *57*:159. Edwards, 1932, Genera Insectorum, Fasc. 194, p. 25. Johannsen, 1934, *ibid.*, pp. 43-44, pl. 15, fig. 148, pl. 18, figs. 168, 169, 170, 172. Matheson, 1944, A Handbook of the Mosquitoes of North America, Comstock Pub. Co., Ithaca, N. Y., p. 95, pl. 10, fig. 3.

Comments

A considerable variation in absolute size, color, and setaceousness is evident in this species, and this variation is in part correlated with geographical distribution. The larger, blacker, more setaceous specimens are usually found in the northern part of the range.

C. americanus is readily distinguished from other species of *Chaoborus* by the characters given in the keys. In addition, the females have from 10-30 setae on the median pronotal sclerite, whereas in *C. flavicans* these setae are usually absent (75 per cent of those examined) or no more than six in number. In *C. borealis* these are entirely absent.

This is a widespread species ranging across North America from the Atlantic Coast to the Uintah Mountains in Utah and north into Alaska. The southern limits of its distribution are New Jersey and southern Illinois.

Larvae are found in small ponds of a semipermanent to permanent nature throughout the year.

Description

MALE

Total length 5.50-8.00 mm. All setae relatively uniform in color on any one specimen but vary from light yellowish-brown to black in different specimens; general body coloration light yellowish-brown to black.

Head (figure 2B)

Head capsule light in color, darkened over vertex; pedicel dark brown to black, flagellar segments with dark basal ring, dark at whorl, lighter apically; antennal setae yellow to dark brown; lateral margins of clypeus somewhat infuscated; maxillary stipites, palpi, sclerotized portions of label-

lae all infuscated. Irregular double row of setae extending forward on either side of postfrontal stripe; frontal macula bare.

Head width .89-1.05 mm.; width between eyes .44-.64 mm.; length of prementum .28-.37 mm.; length of clypeus .26-.33 mm.; penultimate antennal segment length .23-.33 mm.; ultimate antennal segment length .12-.23 mm.; H.W./W.B.E. = 1.64-2.08; H.W./P.L. = 2.95-3.38; H.W./C.L. = 3.05-3.71; Pu.L./U.L. = 1.29-1.89.

Thorax (figures 4A, 6A, 6B, 6C)

Thorax light yellowish to grey in ground color with conspicuous darker areas (figure 6A). Anterior pronotal lobes uniformly darkened; posterior pronotum darker on upper half, except around setae; vittae dark brown to black; medial area of scutum darker in ground color than lateral areas; scutellum, postnotum, anterior margin of anterior anepisternum, lower two-thirds of preepisternum and area of pleural apophysis all darkened.

Medial seta row of mesoscutum terminating in a dense cluster of scales. Pronotal setae approximately 30-60; proepisternal setae 5-19; posterior pronotals 6-12; prepisternal setae 3-10; anepisternals 12-27; upper mesepimerals 10-22; parascutellars 1-3.

Thoracic appendages

Wings (figure 9C) clear to slightly infuscated; length 3.14-4.11 mm.; width .70-1.00 mm.; W.L./W.W. = 4.00-4.47; W.L./H.W. = 3.33-3.93. Lanceolate scales of wing margin of two alternating lengths: .15-.17 mm. and .057-.071 mm. (measured at apex of anal vein); scales longer at wing base; vein An terminates 0.16-0.56 mm. short of the level of m-cu; r-m distad of m-cu.

Capitulum of haltere (figure 9A) nearly spherical, white or yellowish to infuscated, bearing two to five irregularly placed setae on outer face and one to three in a vertical row on inner face.

Legs (figure 7) unicolorous, light yellowish-brown to dark grey-brown. Profemur 1.59-2.07 mm.; protibia 1.74-2.18 mm.; first protarsus .62-1.00 mm.; W.L./Pf.L. = 1.91-2.22. Claws dark brown to black; pulvilli pale yellowish-brown to dark brown.

Abdomen (figure 14A)

Ground color of abdomen light yellowish-brown to nearly black; anterior tergites darker than posterior two or three; first sternite not developed in southern forms, slightly developed in far northern forms; first tergite darker on anterior two-thirds; second, third, and fourth tergites dark except for irregular pale band on anterior one-fourth; tergites 2-6 with paired pale spots; some specimens with anterior corners of tergites 2-6 darker than remaining tergites. A longitudinal row of setae occurs between tergites and sternites.

Genitalia (figures 9B, 9D, 16G)

Tergite 8 with numerous scattered setae; sternite with single row essentially. Tergite 9 (located ventrally) produced apically into a triangular process, basally somewhat bilobed, each lobe bearing 9-11 long setae; sternite 9 much reduced. Gonocoxites uniform, pale yellowish-brown to nearly black; gonostyles approximately one-quarter shorter than gonocoxites, dark brown to black, strongly sclerotized; penis valve (figure 16G) pale, transparent, with circular head (free apex) bearing a minute preapical spine. Coxite length .48-.62 mm.; style length .35-.50 mm.; Co.L./St.L. = 1.22-1.45.

FEMALE

Total length 3.00-7.10 mm. The color pattern throughout as in males; general coloration somewhat paler than associated males.

Head (figure 1)

Chaetotaxy as in male, except frontal macula bears two to seven setae; pedicel with five to nine setae; membranous area around antennal bases white to somewhat fuscous. Head width .89-1.07 mm.; width between eyes .46-.57 mm.; prementum length .28-.37 mm.; clypeus length .26-.33 mm.; H.W./W.B.E. = 1.86-2.14; H.W./P.L. = 2.78-3.37; H.W./C.L. = 2.83-3.77. Last two antennal segments equal.

Thorax

Pleural apophyseal areas smaller and less pigmented than in male; chaetotaxy identical except there are 10-30 setae (fig-

ure 6B) on medial pronotal sclerite immediately cephalad of mesonotum.

Thoracic appendages

Wing length 3.14-4.44 mm.; width .92-1.37 mm.; W.L./W.W. = 3.18-3.46; W.L./H.W. = 3.40-4.11. Vein An somewhat longer than in male, attains level of m-cu to .24 mm. short of attaining this level; r-m and m-cu in line (equidistant from base).

Legs somewhat shorter than in male; W.L./Pf.L. = 2.10-2.37; prothoracic leg .85-.92 as long as metathoracic; mesothoracic .71-.75 as long as metathoracic. Appendages otherwise as in male.

Abdomen (figure 10)

Cerci light yellowish-brown to dark grey-brown, covered with short setae, one-fourth the length of cerci; spermathecae (figures 10A, 14H) heavily sclerotized and pigmented, dark brown to black; diameter of spermathecae .06-.08 mm.

LARVA (figures 11, 12)

Based only on U.S. specimens

Total length (last instar) 10.00-13.00 mm.; larvae clear, practically transparent with a slightly yellow-green cast (opaque white in alcohol); eyes dark purple; margin of head capsule around mandibular bases and foramen magnum dark brown; mandibles yellowish except tips of teeth dark brown; antennal blades yellow-brown to brown; tracheal air sacs covered with black pigment cells dorsally; anal fan setae yellowish to yellow-brown; anal teeth yellowish to brown; thoracic and abdominal setae colorless, transparent.

Head (figure 11)

Head length 1.00 to 1.30 mm.; antennae (figure 17K) .50-.52 mm. long, no setae on anterior face; long antennal blades .42-.47 mm.; short blade .33-.35 mm.; postantennal filaments .49-.55 mm. long; prelabral appendages (figure 12D) less than 2.5 times longer than broad, irregularly long-serrate anteriorly, terminating apically in a single long tooth, posterior surface smooth, length .20-.22 mm.

Head capsule with seven pairs of plumose setae—three dorsal, one subocellar, two subocular, and one postocular; labrum with three pairs of small setae on anterior face; anterior face of labral apex imbricated with short, stout, bifurcate setae plus two pairs of laterally located seta fans or brushes; labral brushes with approximately 20 setae each, the most distal pair with four pectinate setae. Mandibular fan with 22-29 setae, 3-5 of anterior setae apically pectinate; mandibles (figures 12E, 17I) with three major teeth, median tooth with large attached tooth which attains level of posteriormost tooth at apex; posterior tooth with three or four small teeth on posterior margin.

Thorax and abdomen

Setae of thorax and abdomen largely plumose, transparent. Abdominal segment 9 (figure 12F) without an obvious dorsal process; anal fan with 23-26 short-plumose setae.

PUPA (figures 18A, 18B, 18C)

Total length 10.00-11.00 mm. Cephalothorax one-fourth of total length. Colorless and transparent as larvae. Respiratory horn spindleshaped (figure 18C), finely reticulated on surface; length .85-.97 mm. Abdominal tergite 7 with four pairs of plumose setae posteriorly and one pair laterally. Anal paddles with inner rib closely serrate for apical three-fourths; lateral rib sparsely serrate on apical one-fourth. Median rib with a plumose seta near middle.

Specimens Examined

Type ♂, Cornell Exp. No. 1027, Sub. 718, Lake Forest, Illinois, 1900.

Cotype ♂, Cornell Lot No. 231, Sub. 11, Lake Forest, Illinois, May 1901, Needham.

Cotype ♀, Lake Forest, Illinois. No further data.

Cotypes, 25 larvae, Lake Forest, Illinois, May 1901, Needham.

(All types in the collection at Cornell University, Ithaca, New York.)

In addition to this type series, specimens have been examined from the following localities: *Alaska:* Tanana, Hurricane, 166 mi. north of Anchorage; May 27

to July 6. *Colorado:* Rabbits Ear Pass; July 18. *Illinois:* Cottage Grove, Kiethsburg; May 19-23. *Iowa:* Ledges State Park, Dubuque; April 11 to June 23. *Michigan:* Detroit. *Minnesota:* Ramsey Co., St. Louis Co., Pine Co., Wyoming, Cushing; May 3 to June 27. *Montana:* Glacier Park; May 14. *Manitoba:* Baldur, Bird, Churchill; June 21 to July 1. *Ontario:* Ottawa; April 27 to June 22. *Quebec:* Aylmer, Great Whale River, Harrington Harbor; May 11 to July 2. *Tennessee:* Reelfoot Lake; Aug. 14. *Utah:* Uintah Mts.; June 19.
Adult specimens examined, 435.

CHAOBORUS (CHAOBORUS) FLAVICANS (MEIGEN)

Corethra flavicans Meigen, 1830, Systematische Beschreibung der bekannten Europaischen zweiflügeligen Insekten VI, p. 243.
Corethra albipes Johannsen, 1903, N. Y. State Mus. Bul. 68, p. 398. Felt, 1904, N. Y. State Mus. Bul. 79, pp. 363-366 *(Sayomyia).* Dyar and Shannon, 1924, Insecutor Inscitiae Menstruus *12:*211 *(Chaoborus).* Johannsen, 1934, Cornell Agr. Expt. Sta. Mem. 164, p. 44.
Sayomyia rotundifolia Felt, 1904, *ibid.,* pp. 266-268. Johannsen, 1933, *ibid.,* p. 43.
Chaoborus crystallina, Dyar and Shannon (not DeGeer), in part, 1924, *ibid.,* p. 210. Matheson, 1925, Canad. Ent. *57:* 159. Johannsen, 1934, *ibid.,* p. 43. Matheson, 1944, A Handbook of the Mosquitoes of North America, Comstock Pub. Co., Ithaca, N. Y., p. 95.
Chaoborus eluthera Dyar and Shannon, 1924, *ibid.,* p. 211. Edwards, 1932, Genera Insectorum, Fasc. 194, p. 25.
Chaoborus flavicans (Meigen). Martini, 1929, *in* Lindner, Die Fliegen der Palaearktischen Region, Bd. 3, Fasc. 11, 12, p. 56. Edwards, 1930, Ent. Monthly Mag. *66:*163-164. Edwards, 1932, *ibid.,* p. 26. Matheson, 1944, *ibid.,* p. 94.

Comments

Chaoborus flavicans is more variable than *C. americanus* in color and chaetotaxy and especially in the genitalic structures of the males. The variation in the penis valves of the males is quite marked, so that if only the extremes were available it might seem that two distinct species are involved (figure 16H). However, with an adequate sample of specimens all intergrades can be found, and it becomes impossible to segregate individual specimens. Even this might not invalidate the possibility that two or more species are involved except that both extremes and some intergrades have been found in single homogeneous samples. Single specimens have been seen in which the penis valves differed widely from each other.

This species has been found across the whole North American continent. Its southern limits are Maryland, Missouri, central Colorado, and northern California. It extends north from Belleville, Ontario to the MacKenzie River delta and into Alaska.

Larvae in North America have been taken in water-filled road ruts, temporary ponds, and small pools.

Description

MALE

Total length 4.70-7.00 mm. All setae relatively uniform in color with exceptions noted below. Setae practically colorless or slightly silvery-grey through light yellowish-brown to brown on darker specimens; setae of legs and abdomen usually pale; thoracic and head setae dark; general body coloration pale grey or light straw-yellow to dark brown.

Head

In greyish or yellowish specimens vertex light brown; in dark specimens dark brown. Frontal macula, lateral margins of clypeal sclerite, prementum, stipes, and three basal segments of maxillary palpi darkened; pedicel and basal portion of each flagellar segment infuscated.

Head width .79-.89 mm.; width between eyes .37-.44 mm.; length of prementum .32-.35 mm.; length of clypeus .28-.32 mm.; length of penultimate antennal segment .25-.26 mm.; length of ultimate antennal segment .17-.26 mm. H.W./W.B.E. = 1.81-2.28; H.W./P.L. = 2.27-2.63; H.W./C.L. = 2.52-2.94; Pu.L./U.L. = 1.00-1.40.

Thorax

Thorax pale fumose grey or light yellowish with light brown darkened areas to very dark grey with more extensive dark brown areas. In lighter specimens only anterior pronotum, disc of scutum, scutellum, and postnotum darkened; laterally, median area of postpronotum and lower two-thirds of preepisternum darkened. In darker specimens ground color dark grey (unpigmented only around spiracles), lateral margins of scutum somewhat paler than disc and a slightly paler band extending from posterior spiracle to lower margin of anterior pronotum. Pronotal setae 30-40 (approx.); proepisternals 2-9; posterior pronotals 3-6; preepisternals 3-5; anepisternals 8-14; upper mesepimerals 3-11; parascutellars 1-3.

Thoracic appendages

Wings clear; length 2.70-3.59 mm.; width .68-.92 mm. W.L./W.W. = 3.65-4.24; W.L./H.W. = 3.72-4.40; longer posterior marginal scales .168 mm. long, the shorter .078 mm. long (measured at apex of An); termination of An .11-.19 mm. short of level of m-cu.

Legs as in *C. americanus* except last three tarsal segments sometimes slightly darkened. Profemur length 1.74-1.96 mm.; protibia 1.85-2.00 mm.; first protarsus .81-.88 mm.; W.L./Pf.L. = 1.79-2.06.

Abdomen (figure 14B)

Ground color of abdomen pale yellowish or grey to dark brown. In pale specimens first and second tergites light brown; third, fourth, and fifth tergites with white or yellowish anterior one-fourth, followed by dark band of equal width, followed by lighter brown; sixth and seventh tergites light yellowish-brown. First sternite undeveloped; sternites of remaining segments light yellowish-brown; seta bases surrounded by brown ring.

In dark specimens, pattern essentially the same except light area on tergites 3 through 5 is only one-eighth total tergite length, darker band still apparent. In all specimens intersegmental membranes light yellowish. Paired, pale spots on tergites inconspicuous but present. Setae between tergites and sternites fewer and smaller in size than in *C. americanus*.

Genitalia (figure 16H)

Tergite 8 with numerous scattered setae; sternite 8 with a single transverse row of setae. Tergite 9 produced apically, basal lobes with seven to nine long setae. Gonocoxites uniform pale yellowish-brown or greyish-brown to dark brown; gonostyles dark brown, strongly sclerotized with sparse minute setae on mesal face and surrounding apex; penis valves pale, transparent, each with small, ovoid, apically acute or obtuse head that bears a preapical, clawlike spine longer than head. Coxite length .50-.57 mm.; style length .41-.46 mm.; Co.L./St.L. = 1.04-1.32.

FEMALE

Total length 3.00-5.20 mm. Color pattern, general coloration, and seta color as in male.

Head

Setae of head more numerous than in male; setae of vertex extend anteriorly on either side of frontal stripe in four or five irregular rows; no setae on frontal macula; pedicel bearing 5-10 setae. Head width .73-.82 mm.; width between eyes .30-.37 mm.; length of prementum .28-.35 mm.; length of clypeus .28-.34 mm.; H.W./W.B.E. = 2.00-2.52; H.W./P.L. = 2.21-2.64; H.W./C.L. = 2.25-2.64.

Thorax

Somewhat paler than associated males, pleural apophyseal area smaller, and some females (one-fourth of those examined) with one to six medial pronotal setae.

Thoracic appendages

Wing length 2.70-3.88 mm.; wing width .81-1.18 mm.; W.L./W.W. = 3.07-3.39; W.L./H.W. = 4.00-4.80. Vein An attains level of m-cu or surpasses it by up to .21 mm. Halteres with up to 10 setae on inner face of capitulum. Legs somewhat shorter than in male.

Abdomen

Paired pale spots of abdomen not as conspicuous as in female *C. americanus* but present. Spermathecae as in figure 14I.

LARVA

Total length (last instar) 9.00-12.65 mm.; clear, practically transparent; eyes purple; posterior margin of head capsule, around foramen magnum and mandibular bases, brown; muscle origins showing through head capsule as grey spots; tips of antennae and tips of mandibular teeth brown; terminal setae or blades of antennae and postantennal filaments brown. Tracheal air sacs covered with black pigment cells dorsally; anal teeth brown; all other structures (including setae) colorless, transparent.

Head

Head length .90-1.29 mm.; antennae (figure 17L) .56-.62 mm. long, a small seta on anterior face of antenna one-fourth to one-half from distal end; longer antennal blades .56-.60 mm. long; shorter blade .23-.31 mm. long; postantennal filaments .58-.62 mm. long; prelabral appendages (figure 17A) 4.1 to 5.1 times longer than broad, somewhat serrate anteriorly, terminating in a long spine .25-.29 mm. long.

Labrum with two pairs of setae on anterior face; apical pair larger, conspicuous; proximal pair smaller, inconspicuous. Setal armature of labral apex with only 12-15 setae for each of the lateral brushes; anterior face of labral apex imbricated with stout bifurcate setae.

Mandibular fan with 9-12 setae; mandibles with three major teeth (figure 17H); median tooth with a small basal tooth, almost between 2 and 3; posterior tooth with small teeth on the posterior margin.

Thorax and abdomen

Abdominal segment 9 with a dorsal, posteriorly directed, conical process. Anal fan with 20-24 rays.

PUPA

Total length 8.20-9.50 mm.; respiratory horn spindleshaped, somewhat more constricted apically than in *C. americanus,* finely reticulated on surface, length .86-.99 mm. Abdominal tergite 7 (figure 18E) with four pairs of plumose setae posteriorly, no lateral setae. Anal paddle (figure 18D) with inner rib serrate for apical three-fourths; lateral rib without any trace of serrations. Median rib with a plumose seta just distad of middle and a single minute seta apically.

Specimens Examined

Type ♀ of *C. albipes* (Johannsen), Ithaca, New York, Aug. 1901.

Type ♂ of *C. rotundifolia* (Felt), Karner, New York, July 7, 1904.

Topotypes of *C. eluthera* Dyar and Shannon, 1♂, 1♀, Potlatch, Idaho, June 20, 1907, J. M. Aldrich; 1 ♂, Potlatch, June 24, 1903, Aldrich.

Five ♂♂ and four ♀♀ from England and the Channel Islands determined as *C. flavicans* by F. W. Edwards and Paul Freeman.

Specimens also examined: *Alaska:* Fairbanks; May 24. *Alberta:* Bilby; June-July. *British Columbia:* Kelowana, Aspen Creek; May 20-July 7. *California:* Alturas; August. *Colorado:* Ft. Collins, N. St. Vrain Ck., Boulder Co.; Aug. 8-Sept. 7. *Illinois:* Lake Forest, Zion, Dunes Park; June 14-July 20. *Maine:* Norcross; July 14. *Michigan:* Livingston Co.; May 28. *Minnesota:* Little Falls, Lake Vadnais, Hennepin Co., Itasca State Park; June 9-July 3 (larvae, Oct.). *Missouri:* St. Louis; May 12. *New Jersey:* Delair; Sept. 22. *New York:* Ithaca (adults and larvae), Ringwood Hollow, Clifton Springs; April 30-Aug. 3. *Northwest Territories:* Reindeer Depot, MacKenzie River delta; July. *Oregon:* Klamath Lake, Siltcoos Lake (larvae); July 24. *Ontario:* Belleville (larvae). *South Dakota:* Waubay; June 6. *Washington:* Pullman; April. *Wisconsin:* Madison; August 17 (larvae). *Wyoming:* Platt Co.; July 12. Specimens examined, 176.

CHAOBORUS (CHAOBORUS) BOREALIS NEW SPECIES

Comments

This species is very close to the European *C. crystallinus.* The male genitalia are quite similar. However, the Nearctic species has a relatively shorter prementum and clypeus in both sexes. In the Nearc-

tic species the penultimate antennal segment of the male varies from subequal to one and one-half times longer than the ultimate, while in *C. crystallinus* the penultimate is from one and one-half to two times longer than the ultimate.

Females of *C. borealis* have relatively shorter, narrower wings than *C. crystallinus*. *C. borealis* also has a distinct spur at the base of RS, while *C. crystallinus* does not. These differences plus the extreme difference in general habitat indicate that the European and Nearctic forms are distinct and separate species. *C. crystallinus* is known from England, Germany, and Denmark, while *C. borealis* is known only from Churchill, Manitoba; Norman Wells, Northwest Territories; and Whitehorse, Yukon Territory, Canada.

This species is separable from *C. flavicans* and *C. americanus* by the characteristics given in the key. It is, in addition, distinguished from both by the abdominal color pattern (figure 14C) and the thoracic color pattern (figure 13A) in the adults. In the males, tergite 9 is not produced. The larvae are very similar to *C. flavicans*. The most constant difference is the lack of a seta on the anterior face of the antenna.

Description

MALE

Total length 6.00 mm. Paratypes 4.50-6.00 mm.

General coloration grey with dark grey to black markings; setae black on head and on appendages and dorsal region of thorax; setae of abdomen grey; setae of pleural regions light grey; basal one-third of femora with light setae, apically darker; apical portions of legs with grey setae. Paratypes identical.

Head

Head capsule light grey, infuscated over vertex; frontal stripe and macula dark grey; pedicel dark grey; flagellar segments pale basally, dark grey apically; clypeus infuscated, lateral margins dark; stipes dark grey; maxillary palpi infuscated; sclerotized portions of labellae dark grey.

Seta pattern of head essentially as in *C. americanus*. Color pattern and seta pattern in paratypes identical, except specimens from Churchill darker grey in ground color and have more conspicuous pattern; specimens from Whitehorse identical with or somewhat paler than type.

Head width .89 mm.; width between eyes .44 mm.; length of prementum .24 mm.; length of clypeus .26 mm.; length of penultimate antennal segment .24 mm.; length of ultimate segment .15 mm.; H.W./W.B.E. = 2.00; H.W./P.L. = 3.64; H.W./C.L. = 3.44; Pu.L./U.L. = 1.54

In the paratypes these measurements are as follows: head width .87-.91 mm.; width between eyes .44-.45 mm.; length of prementum .25 mm.; length of clypeus .24-.27 mm.; length of penultimate antennal segment .22-.24 mm.; length of ultimate antennal segment .19-.20 mm.; H.W./W.B.E. = 1.96-2.00; H.W./P.L. = 3.38-3.55; H.W./C.L. = 3.36-3.58; Pu.L./U.L. = 1.06-1.21.

Thorax (figure 13A)

General ground color grey with prominent pattern of dark grey areas (figure 13A); paratypes similar except for the Churchill specimen, which is darker in ground color and has black markings rather than dark grey; dark areas less extensive than in preceding species. Pronotal setae approximately 30; proepisternals 8; postpronotals 7; preepisternals 11; anepisternals 13; upper mesepimerals 14; parascutellars 2. In the paratypes these counts are pronotals 35-40 (approximately); proepisternals 7-10; postpronotals 6; preepisternals 6-10; anepisternals 11-12; upper mesepimerals 10-14; parascutellars 1-2.

Thoracic appendages

Wings clear, slightly infuscated on anterior and posterior one-third. Paratypes all identical. Wing length 3.25 mm.; width .81 mm.; W.L./W.W. = 4.00; W.L./H.W. = 3.65.

In the paratypes: wing length 3.18-3.25 mm.; width .74-.81 mm.; W.L./W.W. = 4.19-4.30; W.L./H.W. = 3.44-3.66. Vestiture of wings as in preceding species except marginal scales somewhat longer than

in *C. americanus*. Length of longer scales .164 mm.; shorter scales .071 mm.; paratypes identical. Wing venation as in *C. americanus* except for a short but conspicuous spur arising at base of RS and directed basad. Vein An terminates .12 mm. short of m-cu; in paratypes this vein terminates .16-.21 mm. short of m-cu.

Capitulum of haltere somewhat ovoid in type and paratypes; light grey in ground color with two patches of darker grey pigmentation on inner face surrounding inner seta groups; one or two setae anteriorly; posterior with four setae in type, three to five in paratypes; three irregularly placed setae on outer face; pedicel dark grey, shorter and stouter than *C. americanus*.

Legs as in preceding species except setae of outer apical one-third of femora darker than basal setae. Profemur length 1.72 mm.; protibia length 1.85 mm.; first protarsus .92 mm. In the paratypes, profemur length 1.51-1.92 mm.; protibia 1.85-2.03 mm.; first protarsus .88-.92 mm.; W.L./Pf.L. = 1.91 in type, 1.65-2.14 in paratypes.

Abdomen (figure 14C)

Ground color grey; tergite 1 uniform dark grey; tergites 2-6 with antero-median dark patch and paired pale spots outlined with darker pigmentation; setae in areas of dark pigmentation surrounded by small clear spots; sternites of uniform color. Tergite 7 with a median patch of dark grey.

Genitalia

Tergite 8 with numerous scattered setae; sternite with fewer setae but arranged in at least two irregular rows with some scattered setae anteriorly. Tergite 9 not acutely produced, only a small obtuse projection present; lateral setaceous lobes of tergite with 10 long setae, paratypes with 9 to 11.

Gonocoxites uniform dark grey; gonostyle light grey on basal one-fourth, dark grey on apical three-fourths; gonostyle with sparse, minute setae on inner surface basally and on all surfaces on apical one-fourth. Penis valve (figure 16I) transparent, pale, with large spatulate head. Head with preapical clawlike spine not exceeding head in length. Coxite length .54 mm.; style length .41 mm.; Co.L./St.L. = 1.31. In the paratypes, coxite length .54-.57 mm.; style length .35-.40 mm.; Co.L./St.L. = 1.36-1.60.

FEMALE

Total length 4.50-5.50 mm. Females somewhat paler than associated males.

Head

No setae on frontal macula; pedicel bearing four setae; membranous area around antennal base pale grey. Head width .97 mm.; width between eyes .48 mm.; prementum length .27 mm.; clypeus length .30 mm.; H.W./W.B.E. = 2.02; H.W./P.L. = 3.57; H.W./C.L. = 3.23. In female paratypes these measurements are head width .92-.94 mm.; width between eyes .45-.47 mm.; prementum length .27-.30 mm.; clypeus length .27 mm.; H.W./W.B.E. = 2.00-2.06; H.W./P.L. = 3.09-3.57; H.W./C.L. = 3.42-3.47.

Thorax

Medial pronotal setae absent; pronotal setae 35 (approximately); proepisternals 7; postpronotals 9; preepisternals 19; anepisternals 13; upper mesepimerals 17; parascutellars 2. In the paratypes, pronotals 24-44; proepisternals 6-10; postpronotals 5-10; preepisternals 10-15; anepisternals 14-17; upper mesepimerals 13-19; parascutellars 2.

Thoracic appendages

Vein An somewhat longer than in male, attaining level of m-cu in allotype and falling .07 mm. short in paratypes. Wing length 3.85 mm.; width 1.14 mm.; W.L./W.W. = 3.35; W.L./H.W. = 3.92. In paratypes these are wing length 3.70-3.77 mm.; width 1.07 mm.; W.L./W.W. = 3.44-3.51; W.L./H.W. = 3.77-4.08. Vein m-cu slightly proximad of r-m, not in line in any specimens examined.

Profemur length 1.62 mm.; protibia 1.74 mm.; first protarsus .85 mm.; W.L./Pf.L. = 2.36. In paratypes, profemur 1.73-1.77 mm.; protibia 1.86-1.92 mm.; first protarsus .81-.85 mm.; W.L./Pf.L. = 2.12. Relative lengths of legs as in *C. americanus*.

Abdomen

Cerci pale grey. Spermathecae (figure 14M) heavily sclerotized and darkly pigmented; sclerotization on duct as in *C. americanus* but ducts more slender and shorter, less curved; diameter of spermathecae .08 mm., in paratypes .08-.10 mm.

LARVA

Total length 10.00-11.00 mm.; clear, nearly transparent, sometimes faintly infuscated dorsally. This larva differs from that of *C. flavicans* only in the following details.

Head

Head length 1.33-1.44 mm.; antenna length .55-.62 mm., no seta on anterior face of antenna; antennal blades .55-.59 mm. long, four in number plus one shorter blade .29 mm. long; postantennal filaments .55-.59 mm. long, five pairs present; prelabral appendages 7.00-7.33 times longer than broad, two in number, somewhat serrate anteriorly, terminating in one long spine .23-.24 mm. long.

Mandibular fan with 11-12 setae; mandibles with three major teeth, median tooth with a small basal tooth clearly on that tooth and not between 2 and 3.

Thorax and abdomen

Setae of thorax and abdomen as in *C. flavicans;* anal fan with 21 to 22 rays.

PUPA

Unknown.

Specimens Examined

Holotype ♂, Whitehorse, *Yukon Territory*, May 18, 1949, L. C. Curtis.

Allotype ♀, Whitehorse, *Yukon Territory*, May 18, 1949, L. C. Curtis.

Paratypes, 2 ♂♂, Whitehorse, *Yukon Territory*, May 18, 1949, L. C. Curtis; 1 ♂, Churchill, *Manitoba*, July 1, 1949; 1 ♂, Churchill, *Manitoba*, July, 1949; 2 ♀♀, Churchill, *Manitoba*, June 23, 1949 (reared from larvae collected June 17, 1949); 2 ♀♀, Churchill, *Manitoba*, July 1, 1949 (reared from larvae collected June 17); 4 ♂♂, 1 ♀, Norman Wells, *Northwest Territories*, June 11-12, 1949, W. R. M. Mason. Holotype, allotype, 6 ♂♂ and 4 ♀♀ paratypes in the Canadian National Collections; 1 ♂, 1 ♀ paratypes in the University of Minnesota Collections; 1 ♂ paratype in the U. S. National Museum.

Specimens also examined: 2 ♀♀, Whitehorse, May 18, 1949, L. C. Curtis; 1 ♀, Churchill, June 29, 1949; 1 ♀, Churchill, June 30, 1949; 3 larvae from Churchill. Total specimens examined, 22.

THE SUBGENUS SCHADONOPHASMA DYAR AND SHANNON

Schadonophasma[3] Dyar and Shannon, 1924, Insecutor Inscitiae Menstruus *12:* 212. Type: *Corethra trivittata* Loew, 1862 = *C. nyblaei* (Zetterstedt), 1838. This subgenus is monotypic.

The following differences separate this subgenus as represented by *C. nyblaei* from *Chaoborus s. str.* on the one hand and from the species constituting the subgenus *Sayomyia* on the other. Adults of *C. nyblaei* differ from *Chaoborus s. str.* in the following details: no parascutellar setae; a prominent spur directed basad at the base of RS; wings spotted; wing veins (aside from marginal scales) obviously scaled; spermathecae ovoid, with a short straight neck; no comblike setal row on third mesothoracic tarsus of females.

C. nyblaei differs from *Sayomyia* in the presence of well developed pulvilli, in the lack of a lobe or paired stout setae on the apical third of the gonocoxite, and in the greater number of thoracic setae.

CHAOBORUS (SCHADONOPHASMA) NYBLAEI (ZETTERSTEDT)

Erioptera nyblaei Zetterstedt, 1838, Insecta Lapponica, p. 830.

[3] J. Lane (1953) raises *Schadonophasma* and *Sayomyia* to full genera but this seems unjustified on any grounds and is not accepted here.

Corethra trivittata Loew, 1862, Berlin Ent. Ztschr., Bd. 6, p. 186, [*fide* Edwards, 1932]. Dyar, 1902, N. Y. Ent. Soc. Jour. *10*:201. Johannsen, 1903, N. Y. State Mus. Bul. 68, p. 398. Felt, 1904, N. Y. State Mus. Bul. 79, pp. 361-363 *(Sayomyia)*. Dyar and Shannon, 1924, Insecutor Inscitiae Menstruus *12*:212-213 *(Chaoborus)*. Edwards, 1930, Nat. Hist. Mag. and Ann., 10th series *6*:533 *(Chaoborus)*. Johannsen, 1934, Cornell Agr. Expt. Sta. Mem. 164, p. 44 *(Chaoborus)*.

Corethra punctipennis, Giles (not Say), 1902, Handbook of Gnats or Mosquitoes, 2nd ed., London, p. 502.

Sayomyia knabi Dyar, 1905, Ent. Soc. Wash. Proc. *7*:16, footnote 3.[4]

Chaoborus pallidus, Edwards (not Fabricius) in part, 1920, Ent. Monthly Mag. *56*:265. Martini, 1929, *in* Lindner, Die Fliegen der Palaearktischen Region, Bd. 3, Fasc. 11, 12, p. 58.

Chaoborus nyblaei (Zett.), Edwards, 1930, *ibid.*, p. 533. Edwards, 1932, Genera Insectorum, Fasc. 194, p. 26. Matheson, 1944, Handbook of the Mosquitoes of North America, Comstock Pub. Co., Ithaca, N. Y., p. 94.

Comments

The distribution of this species is rather interesting. According to Peus (1934) the species occurs in the Arctic regions of Europe. In the Nearctic it ranges from Massachusetts northwards, across northern Canada to Alaska, and then south to southern California along the coast. In the Sierra Nevada ranges it has been collected as far south as Lake Tahoe, California. It has been found in the Canadian Rockies at Banff, Alberta and at Kalso, British Columbia.

The one record for the North Central States (Wisconsin; Dickenson, 1944) is erroneous, as the specimen (examined by the author) is a culicine.

Description

MALE

Total length 7.50-8.50 mm. Setae pale yellowish, or light grey to black. Dark setae usually confined to anterior pronotum, scutum, scutellum, and legs. General body coloration varies from light yellowish-brown to dark brown and from light grey to dark grey.

Head

Head capsule pale in color, darkened over vertex; pedicel dark grey or brown to black; flagellar segments with dark basal ring that is pale basad of whorl, dark at whorl, then somewhat paler distad of whorl; lateral margins of clypeus, maxillary stipes, and palpi and sclerotized portion of labellae infuscated.

Head width .91-1.17 mm.; width between eyes .39-.53 mm.; length of prementum .37-.50 mm.; length of clypeus .33-.44 mm.; length of penultimate antennal segment .23-.33 mm.; length of ultimate segment .19-.26 mm.; H.W./W.B.E. = 2.10-2.64; H.W./P.L. = 2.21-2.72; H.W./C.L. = 2.25-2.76; Pu.L./U.L. = 1.00-1.58.

Thorax

In fresh specimens thorax light grey in ground color with dark grey or brown to black markings, as in *C. americanus*. In specimens that have been pinned for 20 years or more the color has changed to yellowish-brown with dark brown markings. Pronotal setae approximately 18-37; proepisternals 4-13; posterior pronotals 4-10; preepisternals 3-8; anepisternals 11-18; upper mesepimerals 8-18; parascutellars none. In two specimens from Reindeer Depot, MacKenzie Delta, N.W.T., these counts are: proepisternals 23; postpronotals 16; preepisternals 9; anepisternals 25; upper mesepimerals 27.

Thoracic appendages

Wings (figure 13G) regularly marked with dark grey cloudy spots in membrane; wing scales and setae light grey except

[4] Described from a single larva collected at Springfield, Mass. by F. Knab. It is based on the possession of smooth instead of anteriorly serrate prelabral appendages. The author has what is apparently this specimen (on loan from United States National Museum) bearing the number 96 with a sketch of the smooth appendage on the label and bearing the name *Sayomyia trivittata* with the "*trivittata*" scratched out. This is otherwise indistinguishable from the larva of *C. nyblaei*.

dark over wing spots and white on Costa and subcosta for a short distance near apex of subcosta and on Costa between apex of Sc and R_1. Wing length 3.70-5.00 mm.; wing width .92-1.22 mm.; W.L./W.W. = 3.81-4.25; W.L./H.W. = 3.92-4.37. Lanceolate scales of posterior margin from .21-.23 mm. in length for the longer and .07-.10 for the shorter (measured at apex of An). Vein An ends from .21 mm. short of level of m-cu to directly opposite m-cu.

Capitulum of haltere near spherical; color white to pale grey; two to three setae on outer face and two to four setae on inner face, both in vertical, somewhat irregular rows.

Legs pale grey in ground color; femur with dark ring apically; tibia with dark rings both apically and basally; tarsus 1 dark apically and basally; remaining tarsi uniformly slightly infuscated. Setae of femora long, rather sparse; setae of tibiae of equivalent length, more numerous; setae of tarsi short (one-half the length of those on femora), very dense. Profemur 1.85-2.74 mm.; protibia 1.88-2.88 mm.; first protarsus .81-1.37 mm.; W.L./Pf.L. = 1.72-2.15.

Abdomen (figure 14D)

Ground color light grey; segments 2-7 with medial, dark, broad ring; tergite 1 dark on anterior two-thirds; sternite 1 not developed. Segment 8 somewhat darkened, uniform; paired pale spots on tergites 2-6 present but inconspicuous.

Genitalia

Tergite 8 with numerous scattered setae; sternite with a double or triple transverse row of setae. Tergite 9 apically produced, rounded; basal lobes of 9 with 9-12 long setae. Gonocoxites dark grey to nearly black. Gonostyles three-fourths as long as coxites, dark grey to black, bearing sparse, minute setae. Penis valve (figure 16J) light to dark grey; head large with large, preapical clawlike spine extending well beyond apex of head.

FEMALE

Total length 5.00-7.00 mm. Color pattern as in males, except somewhat paler and abdomen less conspicuously ringed.

Head

Antennal pedicel bearing 5-15 setae. Width .91-1.25 mm.; width between eyes .27-.44 mm.; prementum length .31-.48 mm.; clypeus length .32-.45 mm.; penultimate antennal segment length .14-.19 mm.; ultimate segment length .15-.22 mm.; H.W./W.B.E. = 2.66-3.45; H.W./P.L. = 2.40-3.27; H.W./C.L. = 2.40-3.00; Pu.L./U.L. = .70-1.22.

Thorax

Chaetotaxy nearly identical with that of male except usually from three to seven median pronotal setae.

Thoracic appendages

Wing length 3.77-5.59 mm.; wing width 1.14-1.70 mm.; W.L./W.W. = 3.20-3.71; W.L./H.W. = 3.88-4.83. Vein An terminates from level of m-cu to .33 mm. beyond level of m-cu.

Length of profemur 1.77-2.59 mm.; protibia 1.88-2.85 mm.; first protarsus .92-1.33 mm.; W.L./Pf.L. = 1.91-2.93.

Abdomen

Ground color light grey; pattern of dark markings more variable than in males, ranging from mere dark spots around seta bases on tergites 1-8 to dark medial bands on tergites 2-7; sternites scarcely marked, some with medial dark band. Paired pale spots on tergites 2-6.

Genitalia (figure 15A)

Sternite 8 with postero-median dark patch cleft by a narrow longitudinal pale line. Cerci light grey. Spermathecae (figure 14J) heavily sclerotized and pigmented; pigmented part of ducts short and slightly curved. Diameter of spermathecae .07-.09 mm.

LARVA

Total length (last instar) 15.00-19.00 mm. Colorless, clear, nearly transparent. Canadian specimens infuscated dorsally. The pigmentation that is present is as in the larvae of *C. americanus*.

Head

Head length 1.50-2.78 mm.; antennae (figure 17J) .70-1.18 mm.; no setae on anterior face. Antennal blades .51-.70 mm., four in number, plus one shorter blade

.27-.48 mm. long. Postantennal filaments .57-.96 mm.; prelabral appendages (figure 17B) 4.5 times longer than wide, similar in outline to those in *C. flavicans,* irregularly long-serrate on apical one-half of anterior face, smooth posteriorly, terminating in one to three long apical spines .34-.35 mm. in length. In Canadian specimens these appendages are broader and more deeply serrate, three times longer than broad.

Labrum with two pairs of small setae on anterior face; anterior face of labral apex imbricated with stout, bifurcate, flattened setae plus two pairs of laterally located seta clusters or fans; each labral fan with 12-15 setae each, no pectinate setae. Mandibular fan with 13-20 setae, none pectinate; mandible (figure 17G) with three major teeth, median tooth largest with a small basally attached tooth not attaining level of posteriormost at apex; posterior tooth with five small teeth on posterior margin at base.

Thorax and abdomen

Abdominal segment 9 with a short, stout, conical process on dorsum; anal fan with 24-33 long, short-plumose rays. Anal apparatus much as in *C. americanus* except pectinate processes more prominent.

PUPA

Total length 8.00-10.00 mm. Cephalothorax one-fourth total length. Colorless except as adult pigmentation appears. Respiratory horns spindleshaped, finely reticulated on surface; length 1.02-1.13 mm. Abdominal tergite 7 (figure 18G) with three pairs of plumose setae posteriorly and one pair laterally. Anal paddle (figure 18F) not distinguishable from that of *C. flavicans.* Inner rib serrate for distal three-fourths; lateral rib smooth externally; median rib well developed with a plumose seta at middle and a minute seta at distal end.

Specimens Examined

Alberta: Banff; July 21. *Baffin Island:* Lake Harbor; Aug. 7. *British Columbia:* Kalso, Canim Lake, Trinity Valley, Victoria; June 13-Oct. 4. *California:* Stanford (larvae, Feb. 8, and adults), Oakland, Mendocino County, Humboldt County, Lake Tahoe, San Luis Obispo County, Green Valley (Solano County) (adults, larvae, pupae), Yosemite; May 4-Oct. 17. *Manitoba:* Gillam, Churchill; July 17-July 30. *Massachusetts:* Springfield (larvae and adults), Amherst; April 28-Oct. 7. *New York:* June 13. *Northwest Territories:* Reindeer Depot (MacKenzie Delta), Yellow Knife; Aug. 13-Aug. 17. *Nova Scotia:* February. *Ontario:* Belleville (larvae). *Oregon:* Portland, Philomath (larvae and adults); May 27. *Quebec:* Great Whale River; Aug. 13. *Yukon Territory:* Whitehorse; May 14-August 1. Specimens examined, 121.

THE SUBGENUS SAYOMYIA COQUILLETT

Sayomyia Coquillett, 1903, Canad. Ent. *35:*189-190. Type: *Corethra punctipennis* Say.

This name was originally proposed by Coquillett as a generic name. He believed *Mochlonyx* Loew to be a synonym of *Corethra* Meigen and that *Corethra* should be assigned to specimens previously called *Mochlonyx.* This left the species to which *Corethra* had previously been assigned without a name, and Coquillett proposed *Sayomyia.* The discovery of the earlier name *Chaoborus* Lichtenstein sank *Sayomyia* as a synonym until its resurrection by Dyar and Shannon (1924) as a subgeneric name.

Edwards (1932) characterizes this subgenus as follows, "Pulvilli absent (except in some neotropical species). Venation: Rs usually shorter than in *Chaoborus s. str.,* angled at base, with a shorter or longer spur extending from the angle toward the base of the wing. Extreme tip of Cu_2 faint or absent; a hairy spur extending forward from near the tip of Cu_2 parallel with wing margin, usually long and sometimes reaching the tip of Cu_1. An reaching only slightly beyond the base of cubital fork. Wing fringe usually long. Wings with or without markings. Pupal respiratory horns sometimes more swollen

than in typical *Chaoborus,* even almost globular."

To Edwards' diagnosis may be added a few more characteristics and a few restrictions for the Nearctic species. Known Nearctic species all with wing markings; pulvilli not absent but minute, setaceous; parascutellar setae absent, mesepimeral setae eight or fewer, preepisternals four or fewer; no paired, pale patches on abdominal tergites 2-6; gonocoxite of male with a lobe on inner face bearing two stout setae or at least with paired stout setae *(C. albatus);* third segment of mesothoracic tarsus of female with double row of short setae extending over apical two-thirds of posterior surface, forming an open comb similar to that in *C. americanus;* females without setae on frontal macula and without median pronotal setae; median mandibular tooth of larvae without a basally attached tooth; larval labrum with a pair of stout setae located medially on anterior face; abdominal segment 9 with a conical dorsal process appearing two-segmented.

CHAOBORUS (SAYOMYIA) PUNCTIPENNIS (SAY)

Corethra punctipennis Say, 1823, Acad. Nat. Sci. Phila. Jour. *3*:16. Johannsen, 1903, N. Y. State Mus. Bul. 68, p. 397. Felt, 1904, N. Y. State Mus. Bul. 79, p. 361 *(Sayomyia).* Knab, 1908, Ent. Soc. Wash. Proc. *10*:36-40, figs. 5-8. Dyar and Shannon, 1924, Insecutor Inscitiae Menstruus *12*:213 *(Chaoborus).* Matheson, 1925, Canad. Ent. *57*:159-160. Edwards, 1932, Genera Insectorum, Fasc. 194. Johannsen, 1934, Cornell Agr. Expt. Sta. Mem. 164, p. 43, pl. 18, fig. 165. Lane, 1942, Rev. de Ent. *13*:140-141. Matheson, 1944, A Handbook of the Mosquitoes of North America, Comstock Pub. Co., Ithaca, N. Y., p. 94, pl. 10, fig. 1. Lane, 1953, Neotropical Culicidae, Saõ Paulo, Brazil.

Corethra appendiculata Herrick, 1884, Geological and Natural History Survey of Minnesota, 12th Annual Report for 1883, pp. 10-11, pl. V (not 5), figs. 1-4. *New Synonomy.*

Comments

The description of this species that follows will indicate that there is a considerable amount of variation in color and in absolute and relative size. Examination of a few specimens from widely separated areas (northern Minnesota and southern Louisiana) would suggest that at least two distinct species are involved.

However, as additional specimens are examined, a continuous variation in size and proportions is revealed with no distinct discontinuities. In addition, while size is in general smaller in the southern specimens, there is no absolute correlation with geographical distribution. Very small specimens are found in Iowa while larger forms are found in southern Illinois some 400 miles further south.

Also, the smallest specimen that the author has seen was collected at Mound, Louisiana, while a few miles south at Natchez, Mississippi, several specimens were collected which are only slightly smaller than the average size of all of the Minnesota specimens examined. The color variation is nonsignificant, since all gradations of color available throughout the range are to be found in collections from single localities in Minnesota.

In regard to the larvae, there are considerable size differences between those collected from small bodies of water and those from larger lakes. Mature larvae from Iowa, which were collected in a small pool in September, are all approximately the same size and constitute the minimum sizes in the measurement ranges given. At the same time larvae collected in December in Lake Mendota, Wisconsin show little size variation and constitute the maximum sizes in the range given. Larvae from other areas and other times are intermediate. Muttkowski (1918) indicates that the summer broods of larvae are always smaller at maturity than the overwintering larvae in Lake Mendota.

This species is found throughout the eastern part of North America from Florida to southern Ontario and west to central Saskatchewan, Colorado, and central Texas. It has been recorded by J. Lane (1942) from Jalisco, Mexico.

The larvae are found in large lakes, in small ponds, and, according to Knab (1909), in rivers.

Description

MALE

Total length 3.30-5.50 mm. Antennal setae yellowish; thoracic and abdominal setae yellowish-brown; setae of legs yellowish-brown except dark brown at tarsal apices. General body coloration pale grey to yellowish with more or less numerous red-brown spots on abdomen and on femora and tibiae.

Head

Head capsule light yellowish or cream colored, slightly darkened over vertex; pedicel red-brown; flagellar segments pale with a red-brown ring at setal whorl; proboscis (including clypeus and prementum) light reddish-brown; palpi brown, except segment 2 pale on basal one-half. Only a single row of setae on either side of frontal stripe.

Head width .51-.75 mm.; width between eyes .18-.22 mm.; length of prementum .17-.24 mm.; length of clypeus .14-.21 mm.; length of penultimate antennal segment .15-.22 mm.; length of ultimate antennal segment .12-.21 mm.; H.W./W.B.E. =2.77-4.10; H.W./P.L. = 2.93-3.33; H.W./C.L. = 3.27-3.91; Pu.L./U.L. = 1.00-1.25.

Thorax

Thorax pale grey in ground color with red-brown darkened areas (figure 13B). Anterior pronotal lobes darkened medially; posterior pronotum darkened at upper margin; vittae of scutum reddish-brown; setae of scutum arise from small reddish-brown spots or pinnaculae; scutellum, postnotum, anterior margin of anterior anepisternum, lower two-thirds of precpisternum, pleural apophyseal area, and epimeron all reddish-brown. Pronotal setae approximately 18-35; proepisternals 6-9; posterior pronotals 2-3; preepisternals 0-2; anepisternals 9-14; upper mesepimerals 3-6.

Thoracic appendages

Wings (figure 13D) translucent, milky, marked with reddish-brown spots, as indicated in figure; setae at these points red-brown; length 1.70-2.80 mm.; width .48-.74 mm.; W.L./W.W. = 3.33-3.88; W.L./H.W. = 2.78-3.71. Longer lanceolate scales of posterior margin from .143-.171 mm.; the shorter from .057-.073 mm. M_2 sharply angled at base; An terminates proximad of level of m-cu; r-m slightly distad of m-cu.

Capitulum white to very pale grey, somewhat ovoid, bearing one or two setae on outer face and two or three setae on inner face.

Legs marked with reddish-brown spots. Femora and tibiae variously spotted except at ends with larger or smaller markings, some forming almost complete rings, most nearly ringlike on profemora. In addition, profemur and protibia with broad distal ring; mesofemur and mesotibia with but faintly marked distal ring; metafemur and metatibia with rather broad, conspicuous apical ring; each tarsal joint except last with conspicuous apical ring. Profemur 1.00-1.33 mm.; protibia .92-1.44 mm.; first protarsus .48-.70 mm.; W.L./Pf.L. = 1.71-1.94. Claws yellowish, darker at tip.

Abdomen (figure 14E)

Ground color of abdomen pale grey; tergites 1-6 with latero-median area reddish-brown, seta bases in dark red-brown spots. Sternites with antero-lateral areas reddish-brown and all seta bases in dark red-brown spots; sternite 1 not developed. Segment 7 with both tergite and sternite darker than preceding segments.

Genitalia (figures 16A, 16B)

Tergite and sternite 8 with numerous long setae on posterior half. Tergite 9 produced apically into a broadly rounded lobe with a pair of but slightly differentiated basal lobes; each basal lobe with 11-20 long setae. Gonocoxites (figure 16A) sordid white to very pale gray on basal two-thirds, reddish-brown on apical third.

Gonocoxites with lobe on dorsal surface. This lobe bears numerous small, rather fine setae and, in addition, two stout setae directed antero-mesally. Gonostyle approximately one-third shorter than gonocoxite,

pale basally, red-brown on apical third, bearing a few minute setae along its length. Penis valve (figure 16B) pale basally, red-brown to dark brown apically. Apex enlarged and circular with small preapical spine. Coxite length .28-.44 mm.; gonostyle length .20-.27 mm.; Co.L./St.L. = 1.43-1.76.

FEMALE

Total length 2.60-4.00 mm. Color and color pattern essentially as in male; darker areas somewhat more extensive; somewhat darker than associated males.

Head

Pedicel bearing three to six setae. Head width .48-.75 mm.; width between eyes .12-.24 mm.; prementum length .17-.28 mm.; clypeus length .14-.24 mm.; H.W./W.B.E. = 3.14-3.78; H.W./P.L. = 2.47-3.42; H.W./C.L. = 2.76-3.40.

Thorax

Pigmented areas of thorax more extensive than in male. Pronotal setae 12-30; proepisternals 4-7; postpronotals 2-6; prepisternals 1-4; anepisternals 9-22; upper mesepimerals 2-8.

Thoracic appendages

Wing length 1.51-2.96 mm.; width .55-.96 mm.; W.L./W.W. = 2.70-2.97; W.L./H.W. = 2.70-3.95. Scales of wings generally pale and slender; those arising from pigment spots, unlike those of males, both dark in color and broader. Vein Cu_2 sharply angled at distal end, attaining wing margin, with spur running parallel to margin toward Cu_1.

Legs slightly longer than in males; profemur length .88-1.40 mm.; protibia length .88-1.59 mm.; first protarsus length .40-.74 mm.; W.L./Pf.L. = 1.83-2.29.

Abdomen and genitalia (figure 15B)

Abdominal color pattern as in male except dark pigmentation more extensive. Cerci pale yellowish or very light grey; spermathecae (figure 14K) ovate, heavily sclerotized, dark brown; neck of duct sclerotized, pigmented, short, conical; diameter of spermathecae .050-.057 mm.

LARVA

Total length 7.50-9.50 mm. (Eggleton, 1932, states that they attain a length of 11.65 mm.); clear, practically transparent; eyes dark purple; mandibular teeth, antennal blades, and postantennal filaments yellowish; tracheal sacs with black pigment cells; thoracic and abdominal setae colorless, transparent.

Head length .85-1.11 mm.; antennae (figure 17M) .35-.50 mm., one small seta (.021-.026 mm. long) on anterior face at a point .4 antennal length from base; longer antennal blades .32-.50 mm. long; shorter blade .24-.32 mm. long; postantennal filaments .38-.48 mm. long; prelabral appendages (figure 17C) 16-20 times longer than wide, irregularly long-rayed for full length anteriorly and for apical three-fourths posteriorly; these appendages .22-.31 mm. long.

Head capsule with five pairs of plumose setae, three dorsal, one subocular, and one postocellar; labrum with two pairs of setae on anterior face, proximal pair quite minute, distal pair quite obvious (similar to *C. astictopus*, figure 17P), .065-.114 mm. long; anterior face of labral apex imbricated with small bifurcate setae and two lateral pairs of setal fans, the most distal pair of approximately 15 setae each, innermost four pectinate medially; most proximal pair of approximately seven setae each; small clusters of minute spines on head anterior to mandibles and on attenuated anterior portion behind antennae.

Mandibular fan with 12-27 setae. Mandibles (figure 17F) with three major teeth, posterior tooth with three small teeth on posterior margin; mandibular teeth preceded by two long setae, one short seta, and two small spines.

Setae of thorax and abdomen largely plumose, transparent. Anal fan with 16-22 rays.

PUPA (figures 18H, 18I)

Total length 7.00-9.00 mm. Cephalothorax one-quarter of length; colorless, transparent as in larva. Respiratory horn spindleshaped, coarsely reticulated; length

.60-.68 mm. Abdominal tergite 7 with three pairs of plumose setae. Anal paddle with mesal rib closely serrate for distal three-fourths; lateral rib with one to three small teeth at distal end; median rib weakly developed, incomplete, bearing a plumose seta and a minute, simple seta just proximad of middle.

Specimens Examined

Alabama: Flatwood; June 10. *Colorado:* Ft. Collins; Aug. 5-Sept. 16. *Connecticut-Rhode Island:* Killingly Pond; Aug. 19. *Florida:* Miami; Dec. 9. *Georgia:* Okefenokee Swamp, Spring Creek; June, July. *Illinois:* Springfield, Dubois, Urbana, Havana, East St. Louis, Olive Branch, Savanna (larvae and adults), Danville (larvae, November); April 24-Sept. 5. *Indiana:* Cedar Lake; July 17. *Iowa:* Ames, Lacy-Koesauqua State Park, Backbone State Park (larvae and adults); July 4-Sept. 10. *Louisiana:* Mound; July 21. *Maryland:* Plummers Island, Forest Glen; May 5-Aug. 20. *Massachusetts:* Melrose, Wilmington; June. *Michigan:* Washtenaw County, Douglas Lake, Grand Junction; July. *Minnesota:* McGregor, Lake Lida, Itasca State Park, Cass Lake, St. Paul, Whitefish Lake, St. Louis County, Olmsted County, Crookston, Chisago County, Little Falls, Fergus Falls; June 16-Sept. 25. *Mississippi:* Natchez, Bayou St. Louis; May 16-June 17. *Missouri:* Parkville, St. Louis; May 25-29. *New York:* McLean Reservoir, Long Lake, Old Forage, Ithaca (larvae); July 13-Aug. 13. *Ontario:* Brule Lake, Lake of Bays, Ottawa, Orillia; June 23-Aug. 22. *Quebec:* Kingsmere, Laniel, Aylmer, Knowlton, Norway Bay; June 28-Sept. 7. *Saskatchewan:* Waskesiu; Aug. 8. *Tennessee:* Sugartree; July. *Texas:* Brownsville, Richmond, Zavella County, San Antonio, Ft. Worth (larvae), Harlingen; Mar. 15-Aug. 26. *Virginia:* Grassymeade, Richmond; Feb. 3-Aug. 31. *Washington, D. C.:* Aug. 21. *Wisconsin:* Schullsberg, Madison (larvae and adults); May 26-Aug. 28 (larvae in December).
Specimens examined, 501.

CHAOBORUS (SAYOMYIA) ASTICTOPUS DYAR AND SHANNON

Chaoborus astictopus Dyar and Shannon, 1924, Insecutor Inscitiae Menstruus *12:* 214. Edwards, 1932, Genera Insectorum, Fasc. 194, p. 26. Deonier, 1943, Ent. Soc. Amer. Ann. *36:*383-388. Type locality: East Lake, Tulare County, Calif.[5]

Chaoborus lacustris Freeborn, 1926, Pan-Pacific Ent. *2:*161-163. Edwards, 1932, *ibid.*, p. 26. Herms, 1937, Calif. Agr. Expt. Sta. Bul. 607, pp. 1-22.

Comments

The author has examined a topotype ♂ of this species collected in the same series by the same collector as the type and a ♂ paratype of *C. lacustris*. These are conspecific.

The species is most closely related to *C. punctipennis*. Aside from the difference in range occupied (*C. astictopus* is confined to the Pacific Coast), definitive differences are difficult to find. *C. astictopus* is in general more pale. The femora and tibiae are marked with smaller brown spots, each of which surrounds a single seta, while in *C. punctipennis* these spots are larger and usually surround several setae. In addition, there are no spots around the setae on the mesonotum or the abdomen in *C. astictopus*, while spots are present in both areas in *C. punctipennis*.

The larvae are practically indistinguishable except on the basis of a single seta on the anterior face of the antenna. In *C. punctipennis* this seta is quite short, .021-.026 mm. in length, while in *C. astictopus* this seta is somewhat larger, .034 mm. long.

The species is found from Portland, Oregon to southern California, in mountainous areas as well as at lower elevations.

Description

MALE

Total length 3.00-5.00 mm. All setae pale yellowish to golden yellow. General

[5] This type locality has been determined by Dr. Alan Stone.

body coloration white to pale grey. Femora and tibiae with numerous small (sometimes obscure) reddish-brown spots. Thorax and abdomen with patterns of dark brown to reddish-brown markings.

Head

Head capsule pale grey or white, pale brown over vertex; pedicel brown; flagellar segments pale, a narrow brown ring at base of each setal whorl; proboscis pale brown; maxillary palpi grey-brown with grey setae, segment 2 white on basal one-half.

Head width .57-.64 mm.; width between eyes .20-.24 mm.; length of prementum .20-.22 mm.; length of clypeus .17-.18 mm.; length of penultimate antennal segment .15-.16 mm.; length of ultimate antennal segment .12 mm.; H.W./W.B.E. = 2.53-2.85; H.W./P.L. = 2.69-2.85; H.W./C.L. = 3.30-3.46; Pu.L./U.L. = 1.22-1.28.

Thorax

Thorax pale grey to white or cream-white in ground color with brown to reddish-brown markings; anterior pronotal lobes darkened antero-medially or antero-dorsally; posterior pronotum darkened at upper angle; vittae of scutum brown and may or may not be margined with darker brown; in addition, scutum may or may not have a brown mark on either side of median vittae anterior to lateral vittae; no spots around seta bases; scutellum darkened at sides; postnotum, anterior anepisternum, area of pleural suture and pleural apophyseal pit, epimeron, and lower two-thirds of preepisternum all red-brown. Pronotal setae 12-21; proepisternals 6-7; postpronotals 2-4; preepisternals 1-2; anepisternals 8-10; upper mesepimerals 3-4.

Thoracic appendages

Wings (figure 13E) translucent, milky, marked with brown spots as in illustration. Scales rising from these darkened spots brown; the remaining scales pale. Wing length 2.03-2.66 mm.; width .57-.70 mm.; W.L./W.W. = 3.57-3.79; W.L./H.W. = 3.57-4.35. Lanceolate scales of posterior margin of two alternating lengths, the longer .145-.158 mm., the shorter .057-.065 mm.

Haltere pale grey to white; capitulum somewhat ovoid, bearing one or two setae on outer face and two or three setae on anterior part of inner face.

Femora and tibiae pale grey to white, with numerous small brown spots, each surrounding the base of a single seta; these spots restricted to outer face of profemora, protibiae, mesofemora, mesotibiae, and anterior face of metafemora and metatibiae. All femora with brown distal rings; all tibiae with both proximal and distal rings; first and second tarsal segments darkened distally.

Metathoracic leg longest, approximately 5.00 mm. from coxa to claw; prothoracic leg .83 as long as metathoracic; mesothoracic leg .68 as long. Profemur 1.14-1.40 mm.; protibia 1.18-1.40 mm.; first protarsus .55-.70 mm.

Abdomen (figure 14F)

Ground color pale grey or white. Tergites 1-6 with paired brown areas extending almost full length of lateral margins and projecting mesally as dark brown triangles. Tergites 7 and 8 wholly darkened. Sternite 1 not developed; sternites 2-6 with smaller paired brown patches located laterally; sternites 7 and 8 almost entirely dark.

Genitalia (figures 16E, 16F)

Tergite and sternite of segment 8 with numerous long setae medially on tergite, confined to posterior margin on sternite. Tergite 9 produced into a slight median lobe; a pair of slightly differentiated lateral lobes on either side on posterior margin, each bearing 12-14 long setae. Gonocoxites white to pale grey on anterior two-thirds, brown on apical third; gonocoxites with small lobe on inner, dorsal surface. This lobe bears two stout setae and a few short fine setae. Gonostyle one-fourth to one-third shorter than gonocoxite, pale basally, dark brown on apical half, bearing few minute setae along its length. Penis valve (figure 16F) pale basally, dark brown apically, apex bifurcate with two short blunt processes. Coxite length .28-.40 mm.; style length .21-.27 mm.; Co.L./St.L. = 1.33-1.52.

FEMALE

Total length 2.50-4.00 mm. Coloration and color pattern essentially as in males.

Head

Pedicel bearing two to five setae. Head width .55-.65 mm.; width between eyes .17-.21 mm.; prementum length .20-.24 mm.; clypeus length .17-.20 mm.; H.W./W.B.E. = 2.86-3.33; H.W./P.L. = 2.35-2.70; H.W./C.L. = 2.88-3.33.

Thorax

Pronotal setae 10-25; proepisternals 5-7; postpronotals 1-3; preepisternals 1-2; anepisternals 10-17; upper mesepimerals 3-7.

Thoracic appendages

Wing length 2.07-2.77 mm.; wing width .66-.92 mm.; W.L./W.W. = 2.83-3.10; W.L./H.W. = 3.50-4.40. Scales of wings generally pale and slender except those arising from pigmented areas broader and dark brown. Vein Cu_2 sharply angled at distal end, attaining wing margin, sometimes with a spur running parallel to wing margin toward Cu_1.

Legs slightly longer than in males. Profemur length 1.07-1.33 mm.; protibia 1.18-1.40 mm.; first protarsus .55-.62 mm.; W.L./Pf.L. = 1.90-2.24.

Abdomen

Cerci pale grey or white, covered with short yellowish setae; spermathecae (figure 14L) ovate to spherical, heavily sclerotized and pigmented; neck of duct short, conical, more obvious than in *C. punctipennis;* diameter of spermathecae .078-.085 mm.

LARVA

Total length 8.00-10.50 mm.; clear, practically transparent; eyes black; mandibular teeth and setae, antennal blades and postantennal filaments, and margin of foramen magnum all pale yellow; anal fan and anal apparatus pale yellow; tracheal sacs with black pigment cells dorsally; plumose setae of head, thorax, and abdomen clear and transparent, colorless. Head length .80-1.11 mm.; antennae (figure 17N) .32-.54 mm.; a small seta (.034 mm.) on anterior face .3 antennal length from base; longer antennal blades .35-.45 mm., shorter blade .25-.31 mm.; postantennal filaments .37-.46 mm. long; prelabral appendages (figure 17D) .24-.30 mm. long, 17 to 21 times longer than wide, irregularly long-rayed on anterior face and on apical half of posterior face. Labrum (figure 17P) with two pairs of setae on anterior face, proximal pair quite minute, distal pair quite obvious, .11-.14 mm. long. A small cluster of spines on head capsule just anterior to base of mandibles. Mandibular fan with 13-22 blades (Deonier, 1943, cites one example in which a specimen had 15 blades on one mandible and 22 on the other).

Thorax and abdomen

Setae of thorax and abdomen largely plumose, colorless. Abdominal segment 9 with an elongate, tapering, dorsal process that appears to be two-segmented (figure 18J); anal fan with 15-19 rays.

PUPA

Southern California specimens only

Total length 4.8-6.2 mm. Cephalothorax two-sevenths of total length; colorless, transparent as in larvae (opaque white in alcoholic specimens). Respiratory horn spindleshaped, rather more rotund than in *C. punctipennis;* coarsely reticulated; .57-.82 mm. long. Abdominal tergite 7 with three pairs of plumose setae as in *C. punctipennis.* Anal paddle (figure 18K) with mesal rib very sparsely serrate medially, only one or two irregular serrations on apical third; lateral rib with one, two, or no teeth at apex; median rib weakly developed but complete, bearing a plumose and a minute, simple seta just proximad of midline.

Specimens Examined

Paratype ♂ of *C. lacustris* Freeborn.

California: East Lake (topotype), Lakeport, Woodlake, Clear Lake, Nice, Hopland, Upper Lake, Middletown, Potter Valley, Lassen County, Palo Alto, Morgan Hill, Stanford (larvae), Sanger, Loma Linda, Exeter, Lake Sherwood (Ventura County) (adults, larvae, pupae), Irvine Lake (Orange County), Agoura (Los Angeles County), Malibu Lake, Chatsworth (Los Angeles County); April 22-Oct. 11. *Oregon:* Portland, Harrisburg (larvae), Siltcoos Lake (larvae); May 17-July 15.

Specimens examined, 267.

CHAOBORUS (SAYOMYIA) ALBATUS JOHNSON

Chaoborus albatus Johnson, 1921, Boston Soc. Nat. Hist. Occas. Papers *5*:11. Dyar and Shannon, 1924, Insecutor Inscitiae Menstruus *12*:214. Edwards, 1932, Genera Insectorum, Fasc. 194, p. 26. Matheson, 1944, A Handbook of the Mosquitoes of North America, Comstock Pub. Co., Ithaca, N. Y., p. 94.

Description

MALE

Total length 4.00-5.50 mm. Antennal setae pale cream or white; thoracic and abdominal setae white; setae of legs white except at brown rings where setae are greyish or pale brown. General body coloration white or pale cream; a few brown markings on thorax and abdomen; no spots on legs.

Head

Head capsule white or pale cream, light brown over vertex; pedicel light brown; flagellar segments white, a thin brown ring at base of each setal whorl; proboscis very light brown; setae of head somewhat more numerous than in *C. punctipennis*. Palpal segments all pale brown except segment 2 white on basal two-thirds.

Head width .60-.65 mm.; width between eyes .15-.18 mm.; length of prementum .17-.24 mm.; length of clypeus .17-.18 mm.; length of penultimate antennal segment .26-.28 mm.; length of ultimate segment .16-.19 mm.; H.W./W.B.E. = 3.23-4.17; H.W./P.L. = 2.70-3.33; H.W./C.L. = 3.30-3.53; Pu.L./U.L. = 1.36-1.65.

Thorax

Thorax white to very pale cream, with brown markings (figure 13C). Anterior pronotal lobes wholly white or brown only on lower half of anterior portion; posterior pronotum with or without a small brown patch at upper angle; scutum with brown vittae and a pair of small brown patches on either side of medial pair of vittae and anterior to lateral pair; no marks around seta bases; scutellum white or pale cream; postnotum brown; dorsad of pleural cleft a brown band extends across lower part of proepimeron and anepisternum; preepisternum either with lower two-thirds brown or with a narrow band of brown extending horizontally across preepisternum in a line one-third of distance from top. Pronotal setae 17-23; proepisternals 8-10; posterior pronotals 2-3; preepisternals 1-2; anepisternals 13-14; upper mesepimerals 3-5.

Thoracic appendages

Wings (figure 13F) translucent, milky, marked with brown spots as illustrated; length 2.03-2.70 mm.; width .59-.72 mm.; W.L./W.W. = 3.43-3.72; W.L./H.W. = 3.43-4.10. The longer lanceolate scales of posterior margin .157-.171 mm.; the shorter .057-.073 mm.

Legs without spots; femur with brown ring just before distal end; tibia with brown ring just beyond proximal end and a brown ring at distal end; tarsal segments 1-4 with distal ends brown, tarsus 5 pale. Profemur 1.11-1.44 mm.; protibia 1.22-1.55 mm.; first protarsus .22-.27 mm. Claws brown.

Abdomen (figure 14G)

Ground color white to very pale cream; antero-lateral corner of tergites 2-8 brown (8 sometimes pale); sternites 3-6 similarly marked.

Genitalia (figures 16C, 16D)

Tergite and sternite of segment 8 with numerous long setae on posterior half. Tergite 9 not produced; a pair of slightly developed basal lobes on either side posteriorly, each bearing 13-15 long setae. Gonocoxite white on basal two-thirds, brown on distal one-third. Gonocoxite without lobe. Gonostyle from one-fourth to one-third shorter than gonocoxite, pale brown, sparsely beset with minute setae. Penis valve (figure 16D) with apex brown, otherwise pale; valve simple, clawlike, without bifurcation of apex or preapical spine. Coxite length .30-.40 mm.; style length .22-.27 mm.; Co.L./St.L. = 1.31-1.47.

FEMALE

Total length 3.50-4.00 mm.

Head

Pedicel bearing five to seven setae. Head width .62-.68 mm.; width between eyes .21-.24 mm.; prementum length .21-.27 mm.; clypeus length .20-.24 mm.; H.W./W.B.E. = 2.75-2.93; H.W./P.L. = 2.42-2.93; H.W./C.L. = 2.82-3.14.

Thorax

Pronotal setae 20-31; proepisternals 7-10; posterior pronotals 2-3; preepisternals 1-4; anepisternals 13-21; upper mesepimerals 5-7.

Thoracic appendages

Wing identical with that of male, except at distal ends of veins R_{4+5}, Cu_1, and Cu_2 there may be brown pigment patches. Wing length 2.51-2.81 mm.; wing width .77-.96 mm.; W.L./W.W. = 2.80-3.24; W.L./H.W. = 3.89-4.11. Profemur length 1.18-1.33 mm.; protibia length 1.33-1.48 mm.; first protarsus .59-.66 mm.; W.L./Pf.L. = 2.00-2.37.

Abdomen

Color pattern as in male except sternites with no pigmentation. Cerci white to pale cream. Spermathecae (figure 14N) heavily sclerotized and pigmented, round to ovate; sclerotized and pigmented neck of duct larger than in two preceding species, conical, straight; diameter of spermathecae .066 mm.

LARVA[6]

Total length unknown; clear, practically transparent; eyes purple; tips of mandibular teeth brown; otherwise all colorless (slide preparation). Head length unknown; antennae (figure 17O) .41 mm., a small seta (.022 mm. long) located .35 of total antennal length from proximal end; longer antennal blades .38 mm. long, shorter blade .25 mm.; postantennal filaments .40 mm.; prelabral appendages (figure 17E) slightly less than seven times longer than wide, resembling those of *C. flavicans*, .20 mm. long, serrate anteriorly on distal three-fourths and posteriorly on distal half.

Labrum with two pairs of setae on anterior face, the proximal minute, the distal pair quite obvious (.066 mm. long). Apex of labrum armed as in *C. punctipennis*. Mandibular fan with nine setae. Mandibles with three major teeth, posterior tooth with four small teeth or spines on posterior margin. Anal fan with 17 setae.

Specimens Examined

Illinois: Peoria; June 15. *Indiana:* Cedar Lake; July 17. *Louisiana:* Kilbourne; May 10. *Massachusetts:* Brookline; June 28. *Michigan:* Roscommon County; July 14. *Minnesota:* Fergus Falls, Olmsted County, Bemidji, Cass Lake, Gull Lake; June 14-Aug. 17. *New York:* Millwood; June 26. *Ontario:* Riverhead, Toronto, Orillia; July 13-Aug. 8. *Quebec:* Aylmer, Norway Bay; Aug. 6-19. *Tennessee:* Reelfoot Lake; Aug. 14.

Specimens examined, 66.

CHAOBORUS (SAYOMYIA) ANNULATUS NEW SPECIES

Comments

One specimen of this species was recorded by Matheson (1925) as *Chaoborus brasiliensis* Theobald (= *C. festivus* Dyar and Shannon). In the key given by Lane (1942, 1943), the specimens here considered run to *C. brasiliensis*. However, comparison of the specimen examined by Matheson and other material that has come to hand with specimens of *C. brasiliensis* (loaned by the United States National Museum) reveals a number of trenchant differences.

[6] The larva of this species has not been previously described. However, the author has one slide from the Cornell collections of dissected parts of the head of a larva which is labeled, "*Chaoborus albatus* Johnson? Collected where *albatus* abundant, E. N.Y., Townes."

We know of only two species of the subgenus *Sayomyia* in New York, *C. punctipennis* and *C. albatus*. This larva belongs to the subgenus *Sayomyia* quite obviously. It has the proximal seta on the antennae; it has no attached tooth on the median mandibular tooth, and it has the apparently two-segmented, long, pointed process on the ninth segment. In addition it has a pair of very conspicuous setae on the anterior face of the labrum. It is not *C. punctipennis* since the prelabral appendages resemble those of *C. flavicans* or *C. nyblaei*. For this reason it seems safe to describe what there is of this larva as *C. albatus*. Unfortunately there are no data as to the locality nor the habitat of the larva nor even the date.

In *C. brasiliensis* there is considerable pigmentation in the pleural areas and the scutellum is dark brown, while in this species there is almost no pigmentation in the pleural areas and none in the scutellum. *C. brasiliensis* also has a smaller head, longer clypeus, and longer wings relative to head width. In addition, the triangular spine on the metathorax (subalar process, figure 6A) is obtuse and bare in this species, while in *C. brasiliensis* it is acute and covered at the tip with minute spines.

This species is readily separated from other species of the subgenus *Sayomyia* in North America by the presence on the wing membrane of two indistinct, brown bars rather than small discrete brown spots (figure 13H).

Description

FEMALE

Total length 2.50 mm.; paratypes 2.75-3.00 mm. Antennal and cranial setae pale yellowish; thoracic and abdominal setae white; setae of legs white except that those at distal end of tibia brown. General body color white, with faint brown pattern on thorax and abdomen; legs conspicuously ringed with brown.

Head

Head capsule white; pedicel white, with four long setae (paratypes with three to four setae); flagellar segments as in *C. punctipennis;* proboscis pale brown; maxillary palpi, including second segment, brown; setae of head capsule more sparse than in *C. punctipennis,* a single row of long setae and a single row of small setae extending anteriorly on each side of coronal stripe.

Head width .61 mm.; width between eyes .18 mm.; length of prementum .20 mm.; length of clypeus .17 mm.; H.W./W.B.E. = 3.30; H.W./P.L. = 3.07; H.W./C.L. = 3.58. In the paratypes these measurements are: head width .60-.62 mm.; width between eyes .17-.20 mm.; length of prementum .17-.20 mm.; length of clypeus .14-.18 mm.; H.W./W.B.E. = 3.10-3.50; H.W./P.L. = 3.23-3.66; H.W./C.L. = 3.66-4.40.

Thorax

White in ground color with very pale to pale brown darkened areas. Anterior pronotal lobes entirely white; posterior pronotum with pale brown cloud at upper angle; scutum with two pairs of pale brown vittae; postnotum pale brown; remainder of thorax white, without spots or pattern. Pronotal setae 11; proepisternals 5; postpronotals 1; preepisternals 2; anepisternals 9; upper mesepimerals 4. In the paratypes these counts are: pronotals 11-18; proepisternals 3-5; postpronotals 1-2; preepisternals 2-5; anepisternals 8-10; upper mesepimerals 3-4.

Thoracic appendages

Wings (figure 13H) translucent, milky, marked with two incomplete pale brown crossbands and a partial connecting bar forming a short, broad letter H, with costal margin slightly darkened. Wing length 2.00 mm.; wing width .62 mm.; W.L./W.W. = 3.17. In paratypes these measurements are: wing length 1.92-2.07 mm.; width .62-.70 mm.; W.L./W.W. = 2.88-3.29. Posterior marginal scales of alternating lengths, the longer .20 mm., the shorter .10 mm. long. In paratypes these are as follows: the longer .18-.20 mm., the shorter .086-.10 mm.

Halteres white; structure and vestiture as in *C. punctipennis.*

Leg structure and vestiture as *C. punctipennis,* white, conspicuously marked with brown rings, nine on profemur, seven on protibia; tarsi with brown apices, except for last segment. Legs relatively longer than in *C. punctipennis;* profemur 1.40 mm.; protibia 1.40 mm.; first protarsus .55 mm. Tarsal segments are missing in type so total leg length cannot be given for this specimen. In paratypes the measurements are as follows: profemur 1.29-1.40 mm.; protibia 1.29-1.40 mm.; first protarsus .51-.55 mm. Total length of prothoracic leg 3.96-4.11 mm.; mesothoracic leg 2.85-2.96 mm.; metathoracic leg 4.70-4.81 mm.; W.L./Pf.L. = 1.42. In paratypes this ratio is 1.44-1.60. Pulvilli slightly larger and with longer setae than *C. punctipennis,* setae of pulvilli attaining middle of claws. Claws as in *C. punctipennis.*

Abdomen

Ground color white; tergites 1 and 2 with conspicuous lateral brown triangular patches extending toward midline; segments 3-7 with tergites much less pigmented and pigmentation confined largely to lateral margins and anterior third; sternites 1-5 white; sternite 6 with brown pigmentation medially; sternites 7 and 8 largely pale brown. Genitalia as in *C. punctipennis;* cerci white with short setae. Spermathecae (figure 14O) spherical with a slender neck; diameter .060 mm. in both holotype and paratypes.

Specimens Examined

Holotype ♀, Crystal River, Citrus County, *Florida,* September 18, 1950, Light Trap, Hudson; 12 ♀♀ paratypes, data as above; 1 ♀ paratype, Miami, Dade County (36th Street Light Trap), December 9, 1947, W. Buren; 1 ♀ paratype, Miami Beach, Dade County, December 15, 1947; 1 ♀, Miami, Dade County, December 9, 1947, W. Buren; 2 ♀♀, Morrison Field, West Palm Beach, October 5, 1942, D. E. Hardy; 2 ♀♀, Lake Worth, Aug. 6, 1951, W. W. Wirth. *Georgia,* 1 ♀, Billy's Island, Okefenokee Swamp, June 1912.
Total specimens examined, 21.

Holotype and 12 paratypes in the collection of the United States National Museum; two paratypes in collection of the University of Minnesota.

THE GENUS MOCHLONYX LOEW

Mochlonyx Loew, 1844, Ent. Zeitung, Stettin, p. 121, footnote.
Type: *Corethra velutina* Ruthe.

Morphological Considerations

Adults of the genus *Mochlonyx* are very similar to the adults of *Chaoborus* in all general morphological features and differ from them only in some details. The members of this genus are more primitive in structure than *Chaoborus.*

The head (figure 19) is wider in both sexes than in *Chaoborus,* and the width between the eyes is relatively greater. A distinct coronal suture is present. The head capsule sclerotization has not expanded beneath the foramen magnum, and the articulations of the maxillae are in their primitive position immediately ventrad of the posterior tentorial pits (figures 19A, 19B).

The antennae differ from those of *Chaoborus* in that the first antennal segment is larger and bears a cluster of setae in the females but not in the males. The second antennal segment (pedicel) is thickly beset with long setae in the females but not the males.

The mouthparts (figures 19C, 19D, 19E) are fundamentally identical with those of *Chaoborus.* In *Mochlonyx* the lacinia is larger, is toothed along both the inner and outer edges, and is stoutly sclerotized although unpigmented. The maxillae articulate with the head capsule immediately ventrad of the posterior tentorial pits.

Mochlonyx lacks a sensory pit in the second segment of the maxillary palpus. The labium is as in *Chaoborus* except the prementum is relatively shorter. In the chaetotaxy of the head, the only essential difference is that already noted in the first two antennal segments of the females.

The thorax of *Mochlonyx* (figure 20A) is shorter and deeper than that of *Chaoborus.* In addition, the anterior prothoracic lobes of the females are not separated by the anterior expansion of the mesothoracic tergum but are continuous from one side to the other. The median portion of the prothorax bears numerous long setae.

In the males, the prothoracic lobes are much as in *Chaoborus* with only a narrow strip of sclerotization connecting them dorsally. There are no setae on the area between the pronotal lobes in the males. The pleural apophyseal pit is not as complex in structure as in *Chaoborus,* and the metanotal process and the subalar process are lacking.

In chaetotaxy *Mochlonyx* differs from *Chaoborus* in the presence (in the case of *M. cinctipes* and *M. velutinus* but not of *M. fuliginosus*) of one to seven setae on katepisternum 3. Similar vittae are pres-

ent on the mesonotum, and there are similar microsetae on the whole thoracic surface. The medial setae of the mesonotum are short, while the lateral and posterior setae are quite long. The scutellum bears two to four transverse rows of long setae, and the postnotum is bare.

The most apparent difference between these two genera in the adults is in the size of the first tarsal segment (figure 20B). In *Mochlonyx* the first tarsal segment in both sexes is only one-fourth the length of the second segment.

An additional appendage difference is apparent in the last tarsal segments of the males. On the last tarsal segments of the males of *M. velutinus* and *M. cinctipes* and the prothoracic and mesothoracic legs of the males of *M. fuliginosus*, there is a well developed, setaceous lobe located proximally and posteriorly.

The claws in *Mochlonyx* are large and complex. In the males of *M. velutinus* and *M. cinctipes* (figure 20D) each of the two claws bears a long medial tooth and a rather variable but usually long, serrate basal tooth. In the males of *M. fuliginosus* the claws of the prothoracic and mesothoracic legs are identical with those in the two preceding species, but those on the metathoracic leg are simple, with only a small setalike projection at the base.

In the females of all species the proximal lobe is absent, and there is on each claw a single long, basally serrate, proximal tooth. There are no pulvilli, although a branched, setalike empodium is present. The legs are all approximately equal in length, with the metathoracic leg slightly longer. There are no tibial spurs, and the legs are all densely covered with rather short setae.

There is little difference in wing structure from that in *Chaoborus* (figures 20E, 20F). The halteres of these two genera show striking differences in the setal armature. In *Mochlonyx* (figure 20C) the setae are numerous on the capitulum, and there are even a few on the pedicel.

The abdominal segments in the male are shorter than in *Chaoborus*, only slightly longer than in the female. The sclerites are covered with long setae but lack the regular marginal rows of *Chaoborus*. The sclerites also bear regular rows of microsetae, and the membranes are closely beset with patches of microsetae, four to five per patch.

The spiracles are more readily discernible than in *Chaoborus*. They are simple and circular. The spiracle of segment 7 is twice as large as the preceding spiracles in the male and 2.5 to 3 times larger in the female.

The female genitalia (figure 21C) are similar to those of *Chaoborus* with the addition of a small sclerite located ventrally immediately anterior to the gonopore. This sclerite (sigma of culicidologists) is a sinuate, undivided structure with a partially serrate posterior margin in *M. velutinus*, while in *M. cinctipes* and *M. fuliginosus* it is divided medially and quite smooth posteriorly. This sclerite should be a fragment of the posterior part of sternite 8, but it is laterally continuous with sternite 9 and may, therefore, be a secondary sclerotization of the intersegmental membrane between sternites 8 and 9. There are three spermathecae as in *Chaoborus*.

In the male genitalia (figures 21A, 21B, 21D, 21E, 21F, 21G, 23D) the most apparent differences are the presence of a short stout seta at the apex of the gonostyle and the fact that segment 8 is half as long as segment 7. In addition, the penis valves (figures 21A, 21F, 23D) are large and simple, with no enlargement of the free end or head. The male genitalia are rotated 180° as in *Chaoborus*.

The greatest difference between *Mochlonyx* and *Chaoborus* is evident in the larvae. The larvae of *Mochlonyx* are recognizably Culicidae. The head (figures 22A, 22B) is much broader than in *Chaoborus*, and the antennae, although prehensile, are widely separated.

A large conspicuous clypeus defined by clearly marked clypeofrontal sutures occupies the median portion of the head from the anteriormost margin to the foramen magnum.

From the membranous area between the clypeus and the labrum there arise one pair of lateral and two pairs of median setae. The lateral setae (figure 22A), lo-

cated at the outer anteriormost corners of the clypeus, are long and simple. The two median pairs of setae (figures 22A, 22C) bear small, simple spines and larger, branched spines medially. These setae are probably homologous to the postantennal filaments and/or the prelabral appendages of the larvae of *Chaoborus*.

The labrum (figures 22B, 22D) projects ventrally and posteriorly from the anterior edge of the clypeus. It is considerably larger than the labrum in *Chaoborus* and is somewhat triangular in outline. Just anterior to the middle there are three pairs of setae, with the middle pair considerably longer. The dorsal surface of the apex of the labrum is covered with an imbrication of short, stout, flattened setae (figure 22D). These setae are apically two- to five-forked.

There is a medial sclerotized band in which on the palatal surface of the labrum is a pair of lateral pockets opening anteriorly (figure 22D). Within each of these pockets is a fan of seven flattened, stout setae which are distally serrate on both sides. These fans are in all probability homologous to the messorial fans of the Culicinae and to those lateral fans which occur at the labral apex in *Chaoborus* larvae.

The tentorium consists of a pair of stout rods that pass through the head capsule from points apparently posterior to the antennal foramina near the anterior mandibular articulations (figure 23B) to the lateral margins of the foramen magnum posteriorly (figure 22A).

The mouthparts are somewhat less reduced than in *Chaoborus*. The mandibles (figure 22E) are large and well sclerotized. At their anterior margin they bear a fan of seven setae which is homologous to the mandibular fan of *Chaoborus*. Posteriorly there are seven to eight stout, well pigmented teeth. These teeth are preceded by four pectinate setae, the base of each being partially surrounded by a short, concave spine. Earlier instars show only two or three of these pectinate setae.

The anterior mandibular articulation (figure 23B) is on a process projecting from the ventral margin of the head capsule below the antennal foramen. The posterior articulation is to the ventral wall of the head capsule immediately anterior to and laterad of the maxilla.

The maxilla (figure 22G) consists of a single lobe, the stipes, and a short one-segmented palpus. The stipes bears a lateral and a medial tuft of bladelike setae with serrate tips. Between these setal tufts there is a long stout spine with a bifurcate tip. The palpus is armed with a single, stout seta and two small setae.

The labium (figure 22F) is much reduced. The submentum is vestigial, and the prementum is a single small median lobe which is fringed aborally with a short and a long row of doubly serrate setae. The anterior or oral margin of the ventral wall of the cranium (maxillary segment) is fringed with a dense cluster of short, bladelike setae with serrate tips.

The thorax and abdomen (figure 23A) offer little contrast to those of *Chaoborus*. A siphon is present on the posterior part of abdominal segment 8. This siphon is typically culicid and has a pair of branched setae on either side of its base. The tracheal system is fully developed in this genus, but paired enlargements occur in abdominal segment 7 and in the thorax.

The anal segment bears a ventral and a dorsal brush as in *Chaoborus*. Both of these brushes are composed of long-plumose setae (figure 23A). There are four anal papillae, and the anal apparatus is similar to that of *Chaoborus*, lacking only the large ventral hooks.

The pupae of *Mochlonyx* resemble those of *Chaoborus* in most features. They differ chiefly in the respiratory horns, the anal paddle, and the general shape of the abdominal segments.

The respiratory horn (figure 23C) is relatively more slender than that of *Chaoborus;* the aperture is located at the apex of the main body of the horn. The abdominal segments are shorter and broader than in *Chaoborus;* they are drawn out into narrowly rounded lobes, each bearing a pair of lanceolate setae at the latero-posterior angles (figure 23C). The anal paddles (figure 23C) are more rounded

posteriorly than in *Chaoborus*, and the membrane is gradually thicker and more sclerotized progressing from the central portion toward the edges. The median supporting rib is present.

Taxonomic Considerations

The genus *Mochlonyx* was established by Loew in 1844 with *Corethra velutina* Ruthe as the type. This is a synonym of *Tipula culiciformis* DeGeer. However, DeGeer's *T. culiciformis* is a primary homonym of *T. culiciformis* L. (1767). The next available name for the type species is apparently *Corethra velutina* Ruthe (1831) originally designated by Loew. Edwards' opinion (1920, 1930) that *Mochlonyx* is the valid name for this genus is here accepted.

MOCHLONYX VELUTINUS (RUTHE)

Tipula culiciformis DeGeer, 1776, Memoires pour Servir a l'Histoire des Insects, *6*:372.

[non] *Tipula culiciformis* Linnaeus, 1767, Systema Naturae, ed. 12, *1(2)*:978.

Corethra velutina Ruthe, 1831, Isis *8*:1205.

Corethra karnerensis Felt, 1904, N. Y. State Mus. Bul. 79, pp. 347-353, figs. 83-91. Johannsen, 1934, Cornell Agr. Expt. Sta. Mem. 164, p. 40 *(Mochlonyx)*.

Corethra lintneri Felt, 1904, *ibid.*, pp. 353-356, figs. 92-96. Johannsen, 1934, *ibid.*, p. 40 *(Mochlonyx)*.

Corethra culiciformis (DeGeer), Dyar and Shannon, 1924, Insecutor Inscitiae Menstruus *12*:206-207. Matheson, 1925, Canad. Ent. *57*:159.

Mochlonyx culiciformis (DeGeer), Martini, 1929, *in* Lindner, Die Fliegen der Palaearktischen Region, Bd. 3, Fasc. 11, 12, pp. 46-47. Edwards, 1932, Genera Insectorum, Fasc. 194, p. 22. Matheson, 1944, A Handbook of the Mosquitoes of North America, Comstock Pub. Co., Ithaca, N. Y., p. 93, pl. 11, fig. 3.

Comments

This species is readily distinguished from other species in the genus by its unicolorous wing scales and by its reddish-brown to black scutum. In the females the sclerite sigma is undivided, while in *M. cinctipes* and *M. fuliginosus* it is composed of two pieces.

The species is widely distributed in North America from New Jersey, northern Illinois, north central Colorado, and the Uintah Mountains in Utah and north into northern Quebec, Northwest Territories, the Yukon, and Alaska. It has not been collected on the Pacific Coast except in Alaska.

The larvae are found early in the spring, usually in semipermanent or temporary ponds and pools.

Description

MALE

Total length 4.50-6.00 mm. Setae of antennal whorls light brown; setae of vertex pale yellowish; setae of clypeus and maxillary palpi dark brown; remaining setae pale yellowish, except dark brown at distal ends of femora and proximal ends of tibiae. General coloration pale yellow-brown to light brown, with mesothoracic scutum pale reddish-brown to dark reddish-brown to nearly black.

Head

Head capsule pale brown, somewhat darkened over vertex; pedicel dark purplish-brown in northern and western forms and pale yellowish-brown in eastern forms, bare of setae. Flagellar segments with narrow, dark basal ring; black at setal whorl; somewhat darkened apically. Clypeus light brown, darker around margins; stipites, palpi, prementum, and sclerotized portions of labellae brown.

Head width .88-1.07 mm.; width between eyes .44-.57 mm.; length of prementum .18-.24 mm.; length of clypeus .21-.24 mm.; penultimate antennal segment length .28-.35 mm.; ultimate antennal segment length .20-.24 mm.; H.W./W.B.E. = 1.82-2.09; H.W./P.L. = 4.35-5.00; H.W./C.L. = 3.77-4.44; Pu.L./U.L. = 1.29-1.42.

Thorax

Thorax light to dark reddish-brown to nearly black and, owing to microsetae, pruinose. Pronotal setae 24-37; proepisternals 6-12; postpronotals 3-11; preepisternals 4-13; anepisternals 7-13; upper mesepimerals 13-22; parascutellars 3-6; katepisternals 0-8 (specimens from southern part of range with no more than one, northern specimens with five to eight).

Thoracic appendages

Wings (figure 20F) unmarked, translucent, pale to slightly infuscated; length 3.14-4.11 mm.; width .74-1.03 mm.; W.L./W.W. = 3.95-4.30. The longer posterior marginal scales .168-.178 mm. long, the shorter scales .068-.071 mm. long; vein Cu_2 as in *Sayomyia*.

Legs pale yellowish-brown, apices of femora darker brown, last tarsal segments dark brown; covered with short, pale setae, these setae dark at apices of femora and on last tarsal segments, setae long on mesothoracic and metathoracic tibiae. Profemur length 1.59-1.92 mm.; protibia length 1.70-1.96 mm.; first protarsus .18-.25 mm.; W.L./Pf.L. = 1.90-2.13. Claws yellowish-brown.

Halteres pale grey-brown, capitulum darker.

Abdomen

Ground color of abdomen grey, central portion of each segment brown; brown area of sternites, in general, smaller than that on tergites.

Genitalia (figures 21A, 21B, 21D)

Posterior half of tergite 8 and of sternite 8 with numerous long setae. Tergite 9 (figure 21D) produced into a slender spinelike process, basally somewhat bilobed, each lobe with from 11-22 long setae. Sternite 9 much reduced, sclerotization limited to a narrow band across anterior margin. Gonocoxites (figure 21A) brown; gonostyles brown, one-third to almost one-half shorter than gonocoxites, strongly sclerotized; penis valves (figures 21A, 21B) dark brown, strongly sclerotized, slender apically, bifurcate basally, much longer than in *Chaoborus*. Coxite length .45-.50 mm.; style length .25-.31 mm.; Co.L./St.L. = 1.59-1.94.

FEMALE

Total length 4.00-5.50 mm. General coloration often much paler than associated males. Setal coloration and chaetotaxy identical with that of male with exceptions noted below.

Head

First antennal segment with 10-12 setae; second antennal segment pale yellowish-brown, thickly beset with yellow setae. Head width .92-1.11 mm.; width between eyes .46-.58 mm.; prementum length .20-.25 mm.; clypeus length .20-.25 mm.; H.W./W.B.E. = 1.90-2.12; H.W./P.L. = 4.33-4.64; H.W./C.L. = 3.82-4.64; ultimate segment of antenna slightly longer than penultimate.

Thorax

Thorax often much paler than in males; pale yellowish to brown in pleural areas with light reddish-brown to dark reddish-brown mesonotum, scutellum, and postnotum. Median area of pronotum thickly covered with long, yellow setae. Pronotal setae (on lateral lobes) 44-56 (approx.); proepisternals 8-13; postpronotals 8-15; preepisternals 5-20; anepisternals 10-17; upper mesepimerals 19-29; parascutellars 3-5; katepisternals 1-5.

Thoracic appendages

Wing length 3.24-4.25 mm.; wing width 1.00-1.33 mm.; W.L./W.W. = 3.16-3.37; W.L./H.W. = 3.40-3.84; r-m distad of m-cu (figure 20F).

Halteres (figure 20C) identical with those of male. Legs essentially identical in structure except for ultimate tarsal segment. Color of legs as in male except distal one-half of each femur with brown setae. Profemur 1.55-1.88 mm.; protibia 1.62-2.07 mm.; first protarsus .22-.29 mm.; W.L./Pf.L. = 2.01-2.27.

Abdomen

Sclerites often paler than in male; tergites pale brown to brown; sternites lighter, yellowish-brown. Cerci (figure 21C) colored as abdominal sclerites, covered with short setae as in *Chaoborus;* spermathecae heavily pigmented, dark brown, somewhat ovoid in shape, with short, pigmented neck leading to duct, diameter .07-.10 mm.

LARVA (figures 22, 23A, 23B)

Total length (last instar) 7.00-9.00 mm.; pale grey to yellowish-brown, translucent; head brown, siphon pale brown, eyes dark brown, nearly black; setae pale yellow to brown; mandibular teeth dark brown to black, fringing setae of maxillary segment dark brown. Tracheal air sacs of thorax and abdominal segment 7 covered dorsally with grey pigment cells.

Head (figure 22)

Head length .70-.88 mm.; head width 1.07-1.37 mm.; antennae .26-.33 mm. long, with four long, bladelike setae and a minute, proximal seta; the three longer, apically blunt, antennal blades .40-.51 mm. long, the acute blade one-third shorter; clypeolabral setae equal to antennal blades in length. Medial two pairs of clypeolabral setae with short, simple and branched spines located variously from apex to tip, usually medially and on lateral face. Lateral pair of setae simple.

Head capsule with one pair of stout, simple setae on posterior margin of dorsal side, an additional pair anteriorly, mesad of eyes, and a pair of plumose setae anterior to the latter between clypeus and eyes. Clypeus with three pairs of plumose setae on anterior third. Labrum (figure 22D) with two pairs of small setae and one pair of long setae midway along length near lateral margin of aboral surface.

Thorax and abdomen (figure 23A)

Setae of thorax plumose, short. Thorax stout, segmentation obscure except for setal pattern; air sacs of thorax elongate. Abdominal setae plumose, abdomen otherwise without distinguishing characteristics. Segment 7 one-half longer than preceding segments; air sacs in segment 7 spindle-shaped, large. Segment 8 with dorsal siphon, .70-.81 mm. long, four times longer than wide. Siphon with two basal plumose setae. Segment 9 bare of setae and with no dorsal process. Last abdominal segment with an anal fan composed of 28-30 long-plumose setae; a cluster of four long-plumose setae on posterior dorsal margin.

PUPA (figure 23C)

Total length 6.00-7.00 mm.; cephalothorax almost half total length. Color pale yellowish-brown. Respiratory horns spindleshaped, length .69-.85 mm., four times longer than greatest diameter. Abdominal segment 7 almost twice as long as preceding segment; segment 8 one-quarter length of 7. Tergite 7 with four pairs of plumose setae posteriorly, one pair of simple setae medially, and a pair of stout lanceolate setae at each latero-posterior angle. Anal paddle with medial rib bearing a simple seta at distal end and plumose seta one-fourth of rib length from distal end.

Specimens Examined

Alaska: Anchorage, McKinley Park; June 19. *Alberta:* Banff; July 12-13. *British Columbia:* Kalso, Mile 255-Alaska-Richardson Highway; June 3-13. *Colorado:* Jackson County, Grand Lakes; June 25-July 16. *Connecticut:* Suffield; May 14. *Illinois:* Antioch; June 8. *Massachusetts:* Amherst, Northampton, Springfield, Cushmans Pond (larvae, April); May 16-20. *Manitoba:* Churchill, Gillam; July 15-Aug. 20. *Minnesota:* Itasca State Park, Cloquet, Carlton County, Finland, St. Louis County, Vineland, Virginia (larvae and adults); May 8-June 17. *Montana:* Glacier National Park, Whitefish, Two Medicine Lake; May 18-July 8. *New Hampshire:* Dublin, Jeffrys, Franconia: April-May. *New Jersey:* Lahaway. *New York:* Elizabethtown, Ithaca, Karner, Ringwood, Old Forge, Castile, Lake Champlain; May 17-Aug. 27. *Northwest Territories:* Norman Wells, Sawmill Bay, Yellowknife (larval and pupal skins and adults); June 11-July 19. *Ontario:* Ottawa, Arnprior; May 21-July 9. *Quebec:* Broadview, Aylmer, Ft. Chimo (larval and pupal skins and adults); May 21-July 29. *Saskatchewan:* Waskesiu; June 15. *Utah:* Uintah County (larvae and adults); June 17-July 15. *Wyoming:* Yellowstone Park; June 30. *Yukon Territory:* Whitehorse (larval and pupal skins and adults); June 13-July 18. Specimens examined, 478.

MOCHLONYX CINCTIPES (COQUILLETT)

Corethra cinctipes Coquillett, 1903, Canad. Ent. *35*:190. Felt, 1904, N. Y. State

Mus. Bul. 79, pp. 356-357, pl. 28, fig. 1, text fig. 97. Dyar and Shannon, 1924, Insecutor Inscitiae Menstruus *12*:208. Matheson, 1925, Canad. Ent. *57*:159.

Corethra cinctipes, var. *obscura* Dyar and Shannon, 1924, *ibid.*, p. 208.

Mochlonyx cinctipes (Coquillett), Edwards, 1932, Genera Insectorum, Fasc. 194, p. 22. Johannsen, 1934, Cornell Agr. Expt. Sta. Mem. 164, pp. 40-41, pl. 16, figs. 151-157. Matheson, 1944, A Handbook of the Mosquitoes of North America, Comstock Pub. Co., Ithaca, N. Y., p. 93, pl. 11, fig. 2.

Comments

Mochlonyx cinctipes is a strictly Nearctic species which is rather widely but sparsely distributed across the northern part of the continent. The adults are much less variable in both size and color than *M. velutinus* and are quickly distinguished from that species by their yellowish-brown color, by their lack of the conspicuous reddish-brown to black color on the mesonotum, and by their mottled-appearing wings.

The prementum and clypeus are relatively shorter and the wings wider in the males than in *M. velutinus*, and both the males and females have more numerous thoracic setae, particularly proepisternals and preepisternals. The females, furthermore, have a wider head relative to wing length.

Larvae have always been found very early in the spring and always in temporary pools.

Description

MALE

Total length 4.00-5.50 mm. Setae of antennal whorls pale yellow-brown; setae of vertex yellowish; setae of clypeus and maxillary palpi pale brown; remaining setae of head, thorax, and abdomen very pale yellowish-brown. Setae of legs pale brown except for ring of yellow setae near distal end of each femur, near proximal end of each tibia, and at proximal ends of tarsal segments 1 and 2. General coloration yellowish-brown; mesothoracic scutum no darker than pleural areas.

Head

Head capsule pale yellowish-brown; pedicel slightly darker, somewhat pruinose; flagellar segments darkened at setal whorl and for a short distance distad of whorl. All head structures pale yellow-brown.

Head width .90-1.14 mm.; width between eyes .42-.57 mm.; length of prementum .14-.22 mm.; length of clypeus .15-.22 mm.; penultimate antennal segment length .25-.34 mm.; ultimate antennal segment length .20-.22 mm.; H.W./W.B.E. = 1.85-2.10; H.W./P.L. = 4.81-6.30; H.W./C.L. = 4.33-5.72; Pu.L./U.L. = 1.22-1.50.

Thorax

Thorax yellow-brown, with a greyish pruinose appearance. Scutellum with numerous long and short setae in several irregular transverse bands. Pronotal setae 26-43; proepisternals 15-28; postpronotals 10-19; preepisternals 12-22; anepisternals 10-29; upper mesepimerals 8-18; parascutellars 1-4; katepisternals none.

Thoracic appendages

Wings mottled (figure 20E), color pattern formed by light and dark scales. Wing membrane without spots, translucent, pale to slightly infuscated; wing length 2.77-3.66 mm.; wing width .72-1.07 mm.; W.L./W.W. = 3.41-3.86. Longer posterior marginal scales .121-.142 mm.; shorter scales .067-.071 mm.

Legs pale yellowish-brown, distal ends of femora with a pale ring covered with pale setae, a dark ring bearing dark setae immediately proximad, followed by another pale ring proximad of latter; tibiae with a pale yellowish ring proximally, followed distally by a dark ring; tarsal segments 1, 2, and 3 with pale proximal rings bearing pale yellowish setae. Profemur length 1.40-1.96 mm.; protibia length 1.48-2.03 mm.; first protarsus .18-.25 mm.; W.L./Pf.L. = 1.81-1.98.

Halteres yellow-brown, uniform from scabellum to capitulum.

Abdomen

Ground color of abdomen yellow-brown, central portion of each sclerite somewhat darker, resulting in a ringed appearance.

Genitalia

Genitalia much like those of *M. velutinus*. Tergite 9 (figure 21E) produced into a short, stout process posteriorly, lobes at base of tergite 9 each bearing 20-24 long setae. Gonostyle (figure 21G) with one to several moderately long setae on inner face near base in addition to minute setae scattered along full length; penis valves (figure 21F) larger and stouter than in *M. velutinus*. Coxite length .44-.50 mm.; style length .22-.31 mm.; Co.L./St.L. = 1.52-1.93.

FEMALE

Total length 4.00-4.50 mm. General coloration and structure as in male with exceptions noted below.

Head

First antennal segment with 8-12 long setae, second antennal segment thickly beset with long pale setae. Head width 1.07-1.17 mm.; width between eyes .47-.57 mm.; prementum length .22-.25 mm.; clypeus length .22-.25 mm.; H.W./W.B.E. = 2.05-2.35; H.W./P.L. = 4.55-4.82; H.W./C.L. = 4.55-4.93.

Thorax

Morphologically the thorax is as in *M. velutinus* females. Pronotal setae (lateral lobes) 62-71; proepisternals 26-33; postpronotals 17-20; preepisternals 20-28; anepisternals 16-36; upper mesepimerals 15-22; parascutellars 2-5; katepisternals 5-8.

Thoracic appendages

Female wing (figure 20E) often somewhat darker than in male. Wing length 3.14-4.14 mm.; wing width 1.00-1.40 mm.; W.L./W.W. = 2.94-3.22; W.L./H.W. = 2.65-3.44. Scales of wings broader than in male and also broader than in females of *M. velutinus;* r-m but slightly distad of m-cu.

Profemur length 1.66-1.96 mm.; protibia 1.85-2.07 mm.; first protarsus .29 mm.; W.L./Pf.L. = 1.88-2.11.

Abdomen

Cerci pigmented as abdominal segments, covered with short setae; spermathecae heavily pigmented, dark brown, ovoid in shape, with a short pigmented neck; diameter of spermathecae .085-.114 mm.

LARVA AND PUPA

The immature stages of this species cannot be distinguished from those of *M. velutinus*.

Specimens Examined

Alabama: Camp Rucker; Mar. 5. *Connecticut:* Suffield; May 14-16. *Massachusetts:* Amherst, Northampton, Springfield; May 4-28. *Minnesota:* St. Paul, Itasca State Park; May 20-31. *Montana:* Glacier National Park; April 28-May 17. *New Hampshire:* Dublin; May. *New York:* Ringwood Hollow, Ithaca (larvae), Delmar, Karner, Dryden; May 10-June 3. *Oregon:* Oakville, Corvallis; March 28-April 17. *Quebec:* Gatineau Point; May 19-June 7. *Virginia:* Mt. Vernon; April 20. *Washington:* Hoodsport, Port Madison; April 23-May 7. *Washington, D. C.:* May 19.

Specimens examined, 129.

MOCHLONYX FULIGINOSUS (FELT)

Corethra fuliginosus Felt, 1905, N. Y. State Mus. Bul. 97, p. 458. Dyar and Shannon, 1924, Insecutor Inscitiae Menstruus *12*:207. Matheson, 1925, Canad. Ent. *57*:159.

Mochlonyx fuliginosa (Felt), Edwards, 1932, Genera Insectorum, Fasc. 194, p. 22. Matheson, 1944, A Handbook of the Mosquitoes of North America, Comstock Pub. Co., Ithaca, N. Y., p. 93, pl. 11, fig. 1.

Comments

This is a very rare species in collections. It was originally described from a single female collected at Nassau, New York on June 12, 1905, and the author has presumably this specimen. In addition to this only four male specimens from New York and two from Massachusetts have been examined.

A comparison of the genitalia of the male of this species with the genitalia illustrated by Martini (1929, p. 47, text fig. 66) of *M. martinii* Edwards (= *M. velutina,* Martini [not Ruthe]) shows a very close resemblance. Thus it is possible that *M. martinii* is a synonym of *M. fu-*

liginosus (Felt) and that this species is also holarctic although sparsely distributed.

This species is readily separated from either of the preceding species by the small number of thoracic setae in both sexes, and in the males by the lack of a lobe on the last tarsal segment of the metathoracic leg.

Description

MALE

Total length 4.00-5.00 mm. Setae of antennal whorls pale grey; remaining setae pale yellowish or sordid white. General coloration pale greyish-yellow.

Head

Head capsule pale greyish-yellow, slightly darkened over vertex; pedicel with slight brown cast, bare of setae; flagellar segments slightly darker from whorl to distal end, transparent and pale from proximal end to whorl; head, clypeus, labium, and maxillary palpi pale greyish-yellow; setae appear in same regions and are of comparable size to those in preceding two species but are much more sparse.

Head width .70-.84 mm.; width between eyes .31-.35 mm.; length of prementum .10-.11 mm.; length of clypeus .14-.15 mm.; penultimate antennal segment length .20-.21 mm.; length of ultimate antennal segment .15-.20 mm.; H.W./W.B.E. = 2.22-2.36; H.W./P.L. = 7.00-7.30; H.W./C.L. = 4.45-5.90; Pu.L./U.L. = 1.05-1.27.

Thorax

Thorax pale greyish-yellow, somewhat pruinose. Scutellum with two irregular transverse rows of long setae. Pronotal setae 13-14; proepisternals 2-3; postpronotals 1; preepisternals 2-4; upper mesepimerals 3; parascutellars 1-2; anepisternals none.

Thoracic appendages

Wings unmarked, clear, pale; length 2.51-2.62 mm.; width .59-.62 mm.; W.L./W.W. = 4.00-4.44. Posterior margin of wing with lanceolate scales; the longer .142 mm. long, the shorter .071 mm.; scales of wing veins slender; venation as in *M. velutinus* except spur of Cu_2 extends farther toward Cu_1 at distal end.

Legs pale, unicolorous, greyish-yellow; sizes as in *M. velutinus* except metathoracic leg only two-thirds diameter of prothoracic and mesothoracic legs; densely covered with rather short, pale setae. Profemur length 1.66 mm.; protibia length 1.66-1.70 mm.; first protarsus length .18 mm.; W.L./Pf.L. = 1.51-1.57. Claws pale yellowish; last tarsal segment and claws of prothoracic and mesothoracic legs as in *M. velutinus* (with basal lobe on tarsal segment, and each claw with a median and basal tooth); last tarsal segment of metathoracic leg without a basal lobe and with simple claws.

Halteres pale greyish-yellow.

Abdomen

Ground color of abdomen pale greyish-yellow, central portion of each tergite slightly darker, giving a somewhat banded effect; sternites paler than tergites.

Genitalia (figure 23D)

Tergite 9 not at all produced posteriorly, with 15-17 long setae on either side; sternite 9 much reduced, with only a narrow band of sclerotization across anterior margin. Gonocoxites with six stout setae on inner face near apex; gonostyles pale, two-thirds as long as gonocoxites, strongly sclerotized, with a few fine, minute setae along entire length.

Penis valves pale, transparent, distal portion very short, basal portion much larger, rather blade-shaped. Coxite length .41-.43 mm.; style length .32-.33 mm.; Co.L./St.L. = 1.26-1.30.

FEMALE

Total length 3.50 mm. (approximately). Color as in associated males. Anatomically as in males with exceptions noted below.

Head

The only female specimen of this species available to the author has been decapitated. For this reason the original description is here cited, "Proboscis very short, pale yellowish. Palpi fuscous yellow . . . Antennae . . . pale yellowish; basal segment subglobular, fuscous internally, others brownish with sparse basal

whorls and a scanty clothing of pale yellowish hairs. Occiput rather thickly clothed with purplish-brown hairs."

Thorax

The thorax has also been damaged on the single available specimen, and the description of this must be incomplete.

Postpronotal setae 1; preepisternals 7; anepisternals none; upper mesepimerals 2; parascutellars 1; katepisternals none.

Thoracic appendages

Wing length 3.14 mm.; wing width .81 mm.; W.L./W.W. = 3.86; r-m distad of m-cu.

Legs alike in both sexes except for ultimate tarsal segment and claws. Last tarsal segment of prothoracic and mesothoracic legs with no proximal lobe, claws with but a single basal process; claws of metathoracic leg almost as in male, with only a slight basal tooth on each claw. Legs relatively shorter than in male. Profemur 1.85 mm.; protibia 1.97 mm.; first protarsus .22 mm.; W.L./Pf.L. = 1.70.

Abdomen

Chaetotaxy and coloration as in male. The female genitalia of this specimen have been removed and cannot be described.

LARVA and PUPA

Unknown.

Specimens Examined

New York: 1 ♀, Nassau, June 12, 1905; 1 ♂, Big Moose, June 14, 1905 (slide mounted); 2 ♂♂, Big Chief, June 15, 1905 (pinned); 1 ♂, Moody, iss. Aug. 4, H. G. Dyar. *Massachusetts:* 1 ♂, Mt. Tom, May 14, 1903, F. Knab; 1 ♂ (slide mounted), Springfield, July 18, 1903, F. Knab. The specimen from Big Moose, New York is here designated as the allotype. It is in the Cornell University collections.

THE GENUS EUCORETHRA UNDERWOOD

Eucorethra Underwood, 1903, Science *18:* 182-184.

Type: *Eucorethra underwoodi* Underwood.

Morphological Considerations

This is the largest of the Chaoborinae, the larvae attaining a length of 14.00-16.00 mm., the adults attaining a length of 9.00-10.00 mm. Morphologically the adults of *Eucorethra* are very similar to the two genera already considered. This genus is closer in most features (thoracic structures, claws, genitalia, and larval structures) to *Mochlonyx* than to *Chaoborus.*

The head (figures 24A, 24B) resembles *Mochlonyx* in the lack of the postgenal bridge, coronal stripe, and sensory pit on the second segment of the maxillary palpus. The females also resemble *Mochlonyx* in the presence of a few setae on the mesal surface of the first antennal segment.

The second antennal segment of the males has a few setae. The eyes are large and reniform, half surrounding the antennal foramina. The clypeus is much longer than in any of the other genera, almost as long as the head capsule height. The prementum is relatively short and is confined to the distal end of the rostrum, the proximal end of the rostrum being occupied by the greatly elongated stipites and the membranes between the latter. This particular feature serves to separate the adults of this genus from the other chaoborine genera at a glance.

The mandibles (figure 24C) are well developed, bladelike, and heavily sclerotized. The anterior mandibular articulation is to a small sclerotized plate which is very intimately fused to the antero-lateral angles of the clypeus. The posterior articulation is, as in the two preceding genera, to the sclerotized margin of the cibarium.

The maxillae are well developed (figure 24D). The cardo is small and triangular and articulates to the head capsule sclerotization mesad of the posterior tentorial pit. The stipes is slender proximally but expands distally to provide a broad base for the attachment of the lacinia and the maxillary palpus. The small detached portion of the stipes, which simulates a palpal segment, is present in this genus as in the two preceding genera. The lacinia is distally beset with small stout spines, and the whole lacinia is stoutly sclerotized.

The thorax (figure 25A) is more like that of *Mochlonyx* than *Chaoborus*. The anterior pronotal lobes are connected to each other dorsally by a rather large median sclerite, which is probably homologous to the median part of the anterior pronotum in females of *Mochlonyx*. This median sclerite is covered with numerous long setae. This is more or less intermediate between the unseparated median lobe of the anterior pronotum in females of *Mochlonyx* and the small detached, seta-bearing sclerite in *Chaoborus*.

The posterior pronotum shows a more primitive condition in this genus than in any other of the Chaoborinae. The two lateral sclerites of the posterior pronotum are connected by a small band of sclerotization extending across the dorsum between the anterior pronotum and the mesothoracic scutum. Aside from these few differences and some differences in proportions of parts, the thorax is similar to that of *Mochlonyx*.

The wings (figure 25C) are similar to those of the preceding genera except that the forks of RS, M, and Cu are relatively shorter, and An does not attain the fork of Cu. The membrane is covered with dark microtrichia, and all veins, with the usual exception of the crossveins and the distal end of An, have scales. The posterior wing margin bears lanceolate scales as in *Chaoborus*.

The legs are much as in *Mochlonyx* except the first tarsal segment is slightly more than twice as long as the second. At the distal end of the tibia of each leg is a short, stout, rather transparent spur (figure 25D). There are at the apex of the first, second, third, and fourth tibial joints of the prothoracic, mesothoracic, and metathoracic legs several short, stout, dark brown to black setae which might be termed spurs. Several of these spurs are also scattered along the length of the first tibial joint of each of the legs.

The last tarsal segment is like that in *Mochlonyx;* i.e., the males have a proximal lobe and the females do not. The claws are also as in *Mochlonyx* except somewhat stouter. The males have two processes on each claw, and the females have but a single, basally serrate, basal process. At the base of the claws there is a pair of small, transparent, setaceous pulvilli. Medially between these pulvilli and arising from the unguitractor is a branched, setaform empodium. The halteres (figure 25B) are much as in *Mochlonyx,* with a heavily setaceous capitulum and with setae on the anterior and posterior margins of the pedicel.

The abdomen of the adult differs but little from the preceding genera. The spiracles are conspicuous between the tergites and sternites, and the chaetotaxy resembles that of *Mochlonyx*. The abdominal segments of the male are not as elongate as in either of the preceding genera, only one-tenth longer than broad; segment 8 is larger, a little more than half as long as segment 7.

The female genitalia (figure 26A) resemble those of *Mochlonyx cinctipes* more nearly than any other member of this subfamily. The oviduct opens into a pocket, the atrium, between segments 8 and 9. This pocket is formed by the infolding of the posterior portion of sternite 8 so that the duct orifice lies dorsad of this sclerite as does the reduced ninth sternite which follows. There are three spermathecae which are spherical in form, each with a short, slender neck (figure 26C). On the apex of segments 10 plus 11 are the paired, setaceous cerci.

The male genitalia (figures 26B, 26D) resemble those of *Mochlonyx* more closely than those of *Chaoborus*. This genus differs from both of the preceding genera in that the genitalia are not rotated in any of the specimens seen. The tergite of segment 9 is produced posteriorly into two spinelike processes (figure 26D). At the base of each of these spines is a cluster of about 18 short setae. The sternite of segment 9 is reduced as in the preceding genera.

The gonocoxites (figure 26B) are similar to those of the other genera, covered with relatively long and short fine setae. There is on the inner face near the apex a cluster of short, stout setae as in *Mochlonyx*. The gonostyle is about one-third shorter than the gonocoxite and is beset with short fine setae for its full length.

The gonostyle has a short, stout seta at the distal end.

The penis valves are large and rounded at the tip. The inner face of each penis valve is unsclerotized and entirely but sparingly covered with comblike groups of very short spines. The actual genital opening cannot be discerned in any of the specimens available.

The larva of *Eucorethra* (figure 28A) has the appearance of a large anopheline. The head is broad, and the antennae are widely separated as in *Mochlonyx*, but the siphon (figures 28B, 28C) is very short and broad. The ocular-antennal segment (figures 27A, 27B) is large, and the clypeus is somewhat smaller, relatively, than in *Mochlonyx*. The antennae are long and slender and bear at the apex three blade-like setae about one-third as long as the antenna.

The labrum (figure 27C) is more obvious from a dorsal view than in the case of *Mochlonyx*, but it hangs down ventrally and posteriorly so the aboral surface of the labral apex can only be seen from a ventral view. At about the middle of the anteriormost half of the labrum is located a pair of converging linear clusters of flattened, spatulate, and apically toothed setae. Laterally, at the distal end of the labrum are clusters of short spines. Just mesad of these clusters on each side is a row of flattened overlapping plates. The homologies of these plates and setae are obscure.

The tentorium is fully developed but very delicate and occupies the same position as in *Mochlonyx*.

The mandibles (figure 27D) are stoutly sclerotized and have eight teeth, three of which are quite small. The mandibles in this genus lack the fans present in the preceding genera and have two setae at the anterior margin. The maxillae (figure 27E) and labium (figure 27F) are reduced as in the preceding genera and also have spatulate and apically serrate setae.

The thorax (figure 28A) is somewhat diamond-shaped when viewed from above. Laterally there are long, stout tufts of setae set in small heavily sclerotized plates. The distribution of these lateral setal tufts and the distribution of the small dorsal setae are the only criteria for distinguishing the segmentation of the thorax. Each abdominal segment bears long lateral and short medial setae.

Segment 8 (figure 28C) bears the short respiratory siphon. When viewed from above, this siphon resembles the spiracular plate of *Anopheles* except for the lack of a pecten (figure 28B). The spiracular openings are immediately anterior to the mesal portions of the lateral flaps. Segment 9 is a small, distinct annulation.

The anal segment, a composite of the remaining abdominal segments, bears a dense ventral brush composed of long plumose setae as in *Mochlonyx*. On the dorsal side of the distal end of this segment is a pair of small sclerotized plates, each bearing two densely plumose setae. The anal papillae are short and acutely tapered and lie immediately ventrad of the dorsal plumose setae. The anal apparatus is a series of stout double hooks located on either side below the papillae. The tracheal system is well developed and of the normal culicid form.

The pupa of *Eucorethra* is more like that of *Mochlonyx* than of *Chaoborus*. The abdominal segments have essentially the same shape as in *Mochlonyx*, and segment 8 is prominent. Segment 7 is no larger than the preceding segments. The tergite of segment 7 (figure 28E) bears two stout plumose hairs at each latero-posterior corner in addition to a cluster of four plumose setae and one simple seta posteriorly on each side of the midline.

The anal paddles (figure 28D) are slightly variable in shape but usually are ovoid and drawn into a broadly rounded projection mesally. There is a midrib as in *Mochlonyx* and no lateral ribs. The respiratory horns (figure 28F) are broadly open apically (trumpet-shaped) and thus differ from both of the preceding genera. The actual opening of the trachea seems to be through a narrow circular aperture located within the horn.

From the foregoing it seems evident that *Eucorethra* is, with *Mochlonyx*, near the base of the evolutionary line which has led to the highly specialized *Chaobo-*

rus. As far as the larvae are concerned, *Eucorethra* is the most primitive in that there is a well developed tracheal system. Also, there is no evidence of any enlargement of the tracheal trunks into air sacs such as those present in *Mochlonyx* and which attain their ultimate expression in *Chaoborus*.

The genus *Eucorethra* is apparently represented by but a single species, *E. underwoodi* Underwood.

EUCORETHRA UNDERWOODI UNDERWOOD

Eucorethra underwoodi Underwood, August 7, 1903, Science *18*:182-184. Coquillett, Oct. 1903, Canad. Ent. *35*:272. Felt, 1904, N. Y. State Mus. Bul. 79, pp. 357-360, pls. 12, 28, 39, 47. Dyar and Shannon, 1924, Insecutor Inscitiae Menstruus *12*:204-205. Matheson, 1925, Canad. Ent. *57*:159. Edwards, 1932, Genera Insectorum, Fasc. 194, pp. 19-20. Matheson, 1944, A Handbook of the Mosquitoes of North America, Comstock Pub. Co., Ithaca, N. Y., p. 92, pl. 11, fig. 6.

Pelorempis americana Johannsen, Aug. 11, [*fide* Aldrich] 1903, N. Y. State Mus. Bul. 68, pp. 403-405, pl. 41.

Comments

This is a strictly Nearctic species of rather wide northern distribution. Variation is less than in species of *Chaoborus* or *Mochlonyx*, and there is no apparent geographical variability. It is most readily separated from other Chaoborinae by the very long clypeus, the close approximation of the eyes, and the presence of spurs on the tibiae in the adults; and by the broadly separated antennae, the short respiratory siphon, and the lack of tracheal enlargements in the larvae. Larvae are found in small, permanent, shaded bodies of water such as springs, pools, and wells.

Description

MALE

Total length 9.50-10.00 mm. Setae of antennae, head, pleural areas of thorax, legs, and abdomen grey to black; setae of mesothoracic scutum dark golden brown; general body coloration dark grey with black and brown markings.

Head

Head capsule dark grey; pedicel golden brown with 12-14 setae; flagellar segments with a dense whorl of long, grey setae near base, shorter setae distally, with a narrow, dark-grey basal ring and broad dark band from whorl to near distal end; clypeus, prementum, and membranes between dark grey; prementum and clypeus covered with black setae; maxillary palpi dark grey, covered with short, black setae; setae of head rather short, dark grey.

Head width 1.18-1.21 mm.; width between eyes .14-.15 mm.; prementum length .50-.51 mm.; clypeus length .64-.67 mm.; penultimate antennal segment length .54-.57 mm.; ultimate antennal segment length .47 mm.; H.W./W.B.E. = 8.30-8.50; H.W./P.L. = 2.30-2.40; H.W./C.L. = 1.76-1.88; Pu.L./U.L. = 1.15-1.21.

Thorax (figure 25A)

Thorax dark grey with brownish cast, somewhat pruinose; vittae of scutum darker. Lateral setae of scutum long, golden brown; median setae of scutum short, golden brown; scutellum with long golden brown setae, a single row laterally, three or four rows medially. Pronotal setae (along lower margin only) 26-27; proepisternals 12-21; postpronotals 6-14; preepisternals 9-16; anepisternals none; upper mesepimerals 21-27; parascutellars 4-5; no setae on katepisternum 3.

Thoracic appendages

Wings (figure 25C) marked on membrane with grey-brown patches; Cu_1 and Cu_2 with grey-brown scales; lanceolate scales on posterior margin and curved scales on anterior margin. Longest of posterior wing margin scales .114 mm.; shorter scales .085 mm.; scales more sparsely distributed than in either *Chaoborus* or *Mochlonyx*, not present on crossveins nor on distal ends of An or Cu_2 and only sparsely on Cu_1 and M_2. Microtrichia larger than in preceding genera. An terminates before fork of Cu. Wing length 5.77-6.11 mm.; wing width 1.38-1.50 mm.;

W.L./W.W. = 4.07-4.16; W.L./H.W. = 5:20-5.23.

Capitulum of haltere (figure 25B) more setaceous than in *Mochlonyx* but otherwise similar. Pedicel and scabellum yellowish-grey; capitulum dark grey, covered with dark grey to black setae.

Legs grey-brown, dark grey at apex of each femur. Prothoracic legs with short, dark grey to black setae and scales on femora and tibiae; outer face of distal end of each tibia with a dense comb of yellow-brown setae; tarsi with longer setae; last tarsal segment with lobe on proximal end, covered with curved setae; claws yellow-brown. Mesothoracic and metathoracic legs as prothoracic except for a scattering of longer setae on anterior face of femur and no comb on tibia. Profemur length 3.22-3.33 mm.; protibia 3.44-3.55 mm.; first protarsus 2.11-2.22 mm.; W.L./Pf.L. = 1.79-1.83. Metathoracic leg longest, mesothoracic leg shortest.

Abdomen

Ground color of abdomen dark grey-brown, covered with dark grey setae. Tergites and sternites darker laterally and posteriorly, giving a ringed appearance.

Genitalia

The genitalia (figure 26B) have been described in the section on morphology. Gonocoxites dark, grey-brown, covered with grey-brown setae; gonostyles colored as coxites. Coxite length .62-.71 mm.; style length .50-.55 mm.; Co.L./St.L. = 1.12-1.42.

FEMALE

Total length 9.00-9.50. Color throughout as in males.

Head (figures 24A, 24B)

First antennal segment with a few setae on mesoventral face; second segment with numerous setae; flagellar segments shorter than in male with but a sparse basal whorl of setae and with fewer setae distally. Head width 1.21-1.32 mm.; width between eyes .20-.21 mm.; prementum length .50-.52 mm.; clypeus length .62-.70 mm.; H.W./W.B.E. = 5.66-6.64; H.W./P.L. = 2.32-2.65; H.W./C.L. = 1.73-2.11.

Thorax

Pronotal setae 18-30; procpisternals 9-22; posterior pronotals 7-11; preepisternals 10-14; anepisternals none; upper mesepimerals 27-38; parascutellars 2-9.

Thoracic appendages

Wing length 5.88-6.55 mm.; wing width 1.66-1.94 mm.; W.L./W.W. = 3.08-3.53; W.L./H.W. = 4.69-5.61. Profemur length 3.22-3.44 mm.; protibia length 3.44-3.66 mm.; first protarsus 1.88-2.22 mm.; W.L./Pf.L. = 1.76-1.96.

Abdomen

Cerci (figure 26A) dark grey-brown and covered with short, grey setae; spermathecae (figure 26C) heavily sclerotized and pigmented, with a short, slightly curved neck; diameter of spermathecae .10-.11 mm.

LARVA (figure 28A)

Total length 12.00-14.00 mm.; light to dark brown with dark brown to black setae.

Head (figure 27)

Head length 2.22-2.37 mm.; head width 1.63-1.92 mm.; antenna length .81-.85 mm.; antennal spine length .44-.48 mm. Ocular-antennal segment with a single pair of small, plumose setae immediately anterior to eyes on dorsal surface and with three pairs of small, plumose setae anterior to eyes on ventral surface. Two pairs of minute setae near foramen magnum on dorsal surface. The latter homologous to similar but larger setae in same position in *Mochlonyx velutinus*.

Clypeus small, triangular, with three pairs of small, plumose setae located laterally and a pair of large, simple setae widely separated on anterior margin. Posterior half of labrum (that part seen in dorsal aspect) with one pair of plumose and two pairs of simple setae at anterolateral corners. Maxillary segment with a pair of plumose and a pair of simple setae, and submentum with a pair of plumose setae.

Thorax and abdomen

Thoracic setae dark brown to black; lateral setae long and plumose, dorsal setae

short and plumose. Abdomen with long, plumose lateral setae on segments 1-7; short, plumose setae dorsally and ventrally. Segment 8 with short, plumose, simple setae. Siphon with three pairs of plumose setae and a single pair of simple setae. Anal segment (figure 28C) bearing a ventral fan of 32 long, plumose setae as in *Mochlonyx*, a dorsal cluster of four long, plumose setae at posterior end and a pair of small, plumose setae posteriorly just below midline.

PUPA

Total length 11.00-14.00 mm. Cephalothorax two-fifths total length; brown as in larva. Respiratory horn (figure 28F) trumpet-shaped, broadly open at apex, surface imbricated with minute spines; length .90-1.17 mm. Abdominal tergite 7 (figure 28E) with two pairs of plumose setae at each latero-posterior corner and four pairs of short, plumose setae and one pair of simple setae on either side of midline posteriorly. Anal paddle (figure 28D) with thickened midrib but without lateral thickenings; one plumose and one simple seta at apex of midrib.

Specimens Examined

Alaska: Anchorage, Juneau (larvae); July 2-Aug. 15. *Alberta:* Banff; July 21. *British Columbia:* Chilcut Pass (larvae, pupae, and adults), Douglas Lake, Cultus Lake, Kalso; July 11-Oct. 20. *California:* Eureka, Lake Tahoe, Agnew Meadows (Madera County), Canyon Dam (Plumas County), Emigrant Gap (Placer County); April 29-August 4. *Manitoba:* Gillam; Aug. 23. *Michigan:* Douglas Lake (larvae and pupae); July 29. *Minnesota:* Virginia (larvae). *Montana:* Florence, Two Medicine Lake, Glacier National Park; May 26-July 7. *New Brunswick:* Fredrichton; July 26. *New Hampshire:* Dublin; June. *New York:* Elizabethtown, Ithaca (larva, April 14), Plattsburg; June 8. *Ontario:* Ottawa, White River; June 20-Sept. 22. *Oregon:* Prospect, Hood River (larva); June 1. *Quebec:* Ft. Chimo (larvae, pupae, and adults); July 4-27. *Utah:* Uintah County (larvae, pupae, and adults), Summit County; June 17-July 15. *Washington:* Hoquiam, Olympia, Keysport, Longmire Springs, Lake Cushman; Mar. 31-June 29. *Wyoming:* N. W. Johnson County (larvae); July 29.

Specimens examined, 100.

THE GENUS CORETHRELLA COQUILLETT

Corethrella Coquillett, 1902, N. Y. Ent. Soc. Jour. *10:*191-192.

Type: *Corethra brakeleyi* Coquillett.

Comments

The genus *Corethrella* is largely tropical and is poorly represented in the Nearctic. For this reason any discussion of the morphology of the genus based only on Nearctic species is of necessity incomplete.

As far as the Nearctic species are concerned this is the smallest of the Chaoborinae, measuring only 1.29-2.50 mm. as adults and a maximum of 2.88 mm. as larvae.

The adult in this genus is the most divergent of the Chaoborinae, and the larva is as highly specialized, although along different lines, as the larva of *Chaoborus*. The adult head capsule is unlike that of any of the other genera in general form (figures 29A, 29B). The coronal suture extends nearly to the clypeus and there diverges, leaving a small triangular sclerite between its anterior arms and the clypeus.

The eyes are C-shaped and closely surround almost half of the antennal foramina. They are more closely approximated than in *Eucorethra*. On the ventral or caudal surface there is developed a postgenal bridge somewhat as in *Chaoborus*. The cardines of the maxillae are widely separated from the posterior tentorial pits. The clypeus is very short and sparsely setaceous. The maxillae (figure 29E) are like those in the other genera except in the matter of general shape. The same parts are present: the cardo which articulates to the infolded lower margin of the postgenal bridge; the stipes which is rather long and slender distally and expanded proximally; the lacinia which is

bladelike and not armed; and the four-segmented maxillary palpus.

Small, slender mandibles (figure 29D) are present. The articulation of the mandibles is identical with that in the previously described genera. The prementum is short, but the labellae are relatively longer and more slender than in any of the genera heretofore considered.

The antennae differ considerably in regard to the setae and to relative proportions, but the same essential form is preserved. In the male the first antennal segment bears a few setae, and the greatly enlarged second antennal segment or pedicel also bears setae as in *Eucorethra*.

The flagellum is composed of 13 elongate segments. These segments differ in the males from the other genera in two ways: (1) the basal whorl of long setae is sparse, and (2) the distal end of each segment from the whorl to the apex, except for the last three segments, is covered with closely set setae nearly as long as those of the basal whorl. In the females the pedicel is one-half the size of that in the male and has numerous short setae. The flagellar segments are shorter than in the males and with a more sparse but double whorl of shorter setae at the base of each and with fewer and shorter setae apically.

The thorax (figure 30A) resembles that of *Eucorethra* more than of any other genus. The anterior pronotal lobes are separated except for a narrow band, and the posterior pronotal lobes are connected by a narrow band of sclerotization between the anterior pronotum and the scutum of the mesothorax. The meron is somewhat better developed in this genus than in the other genera considered.

In chaetotaxy this genus differs considerably from the other genera. There are fewer setae generally; the proepisternal, preepisternal, and the anepisternal setae are entirely lacking; but the metanotum has a small cluster of setae at each side. The mesoscutum has rather sparse long setae, and the scutellum has a single row of long setae and a few shorter ones. The whole of the thorax is covered with numerous microsetae.

The wings (figure 30C) also differ in venation from the other Chaoborinae. Vein R_1 is quite short and does not terminate close to R_2 but turns sharply forward and terminates in the costa just beyond the distal end of Sc. RS is also quite short, as short as in *Sayomyia* but without a proximally projecting spur. Otherwise the venation is similar. The wing veins are beset with scales, the marginal scales being long and somewhat irregular in length; they are of three lengths rather than two as previously encountered. The microtrichia are very minute and can only be seen under 440X.

The halteres (figure 30B) are shorter and broader than in *Chaoborus*, with the pedicel not much narrower than the capitulum. The capitulum is setaceous but less so than in *Eucorethra*.

The legs are like the other Chaoborinae except that the femora and tibiae of all of the legs bear scales, and the tibiae of the metathoracic legs of the Nearctic species bear distal spurs (figures 29C, 29F). In addition, the mesothoracic legs are fully as large as or larger than the prothoracic and metathoracic legs. Setae on the metathoracic tibiae and tarsi are very long posteriorly; setae on other leg segments are shorter and about as dense as in *Chaoborus*.

There is a short comb of flattened setae at the distal ends of the prothoracic and metathoracic tibiae. The claws are simple and somewhat unequal in size (figures 30D, 30E). Those of the prothoracic leg of the male (figure 30E) are about twice as large as the others in the male and in the female. There are no pulvilli, nor is there any evidence of an empodium.

The abdomen of the males has a different form from that of the other Chaoborinae. Segment 1 is reduced as in the other genera. Segments 2 and 3 are the widest, following which each succeeding segment is narrower than the preceding one. Segment 7 is slightly less than half the size of segment 2. Segment 8 is equal in length to 7 and sharply constricted anteriorly so that the segment appears pedunculate. As a result, the abdomen of the males tapers rather sharply from anterior

to posterior. The abdomen of the female is similar to that of *Chaoborus* (figure 31B).

The male genitalia (figures 31A, 31C) are rotated through 180° as in the other genera. The gonocoxites are covered with long and short setae, and there is a single, very stout and sometimes quite long seta set in a spinelike cup located on the inner face near the base. The gonostyles are with or without apical armature.

The penis valves are fused distally into a single spinelike process but can be identified by their articulations to the gonocoxites and their musculature. The female genitalia (figure 31B) are practically identical with those of *Chaoborus* except in the matter of setal armature. An additional difference is the presence of but a single large spermatheca rather than the three of the other genera.

The larva of *Corethrella* still retains some Culicid characteristics but in other respects is as highly modified as *Chaoborus* (figure 33A). The tracheal system, although reduced, is intact and lacks any thoracic or abdominal sacs. The spiracles are located at the apex of a rather short siphon (figures 33A, 33B) somewhat intermediate in length between that in *Mochlonyx* and that in *Eucorethra*.

The greatest specializations occur in the head (figures 32A, 32B). The head is broad, but the antennae are closely approximated. The ocular-antennal segment is the largest segment in the head capsule. This bears laterally a long row of short, stout setae as well as several long, simple setae and short, plumose setae.

The clypeus is a conspicuous rectangular plate which is clearly demarked by the clypeofrontal suture. The approximation of the antennae has isolated the clypeus from the labrum; the course of the clypeofrontal suture clearly indicates this. The anterior margin of the clypeus bears two pairs of long, simple setae and one medial pair of small, plumose setae. The tentorium is stout and well sclerotized, having the same position as in the head of the larvae of *Mochlonyx*. The eyes are reduced to mere pigment spots on the outer anterior corners of the head capsule.

The antennae are borne on a pair of small projections anterior to the clypeus and posterior to the pendant labrum. When at rest the antennae fold back into grooves along the sides of the head. The antennae bear three apical bladelike setae, the longest (in *C. brakeleyi*) about one-third of the length of the antenna, the shortest about one-third shorter, and one intermediate. There is also a very short, curved basal seta.

The labrum (figure 32C) is ovoid in shape transversely and is armed with both long and short simple setae. On the dorsal side distally there are short spines grading into bladelike, trifurcate setae arranged in an imbricated fashion. On the oral surface there is a pair of brushes of short, simple or forked, bladelike setae, depending on the species. The mandibles (figure 32D) are stout, with six or seven teeth, a mandibular fan of seven to nine pectinate blades, and two pairs of stout, flattened setae. The maxillae (figure 32E) and the labium (figure 32F) are much reduced.

The thorax (figure 33A) is broadly oval transversely and bears at the margin long, plumose setae and dorsally small, simple and plumose setae. The arrangement of the setae is all that indicates the segmentation. Each abdominal segment bears long, plumose setae laterally and smaller, simple and plumose setae dorsally. The siphon on segment 8 is short (figure 33B). The anal segment bears no brush, but this is represented ventrally by several stout setae. The papillae are short and rounded apically. The anal apparatus consists of several anteriorly serrate, bladelike processes—all of which have the same form.

The pupa is entirely different from that of any other of the Culicidae. The cephalothorax is half the total length, and the abdomen is rather sharply tapered. The respiratory horn (figures 34C, 34D, 34E) is more or less trumpet-shaped and has a wide aperture. This is covered by a finely perforated spiracular end plate. The surface of the respiratory horn is imbricated with very short, broad spines, more or less scalelike.

The anal paddles (figures 34A, 34B) are triangular in shape and fused proximally.

They are thick, solid structures with no trace of any supporting ribs. The inner margin of the distal end of each paddle is serrate. Each paddle is armed with two apical setae, one short and one long, and with a long, simple seta medially on the outer margin. Abdominal segment 8 has serrate margins on the latero-posterior half and a single pair of setae ventrally. Segment 7 is also serrate on the latero-posterior margin and bears a few setae, the arrangement of which depends on the species.

CORETHRELLA BRAKELEYI (COQUILLETT)

Corethra brakeleyi Coquillett, 1902, Ent. News *13*:85. Smith, 1902, Canad. Ent. *34*:139-140. Dyar, 1902, N. Y. Ent. Soc. Jour. *10*:200-201, pl. 19, fig. 1. Coquillett, 1902, N. Y. Ent. Soc. Jour. *10*:191-192 *(Corethrella)*.

Corethrella brakeleyi (Coquillett), Johannsen, 1903, N. Y. State Mus. Bul. 68, pp. 399-402, pl. 40. Felt, 1904, N. Y. State Mus. Bul. 79, pp. 346-347. Dyar and Shannon, 1924, Insecutor Inscitiae Menstruus *12*:215-216. Matheson, 1925, Canad. Ent. *57*:160. Edwards, 1932, Genera Insectorum, Fasc. 194, p. 19. Matheson, 1944, A Handbook of the Mosquitoes of North America, Comstock Pub. Co., Ithaca, N. Y., pp. 91-92, pl. 11, fig. 5.

Comments

This species is the most common and widely distributed representative of the genus in the Nearctic, ranging from Massachusetts to Florida and west to Texas. Relative proportions and total size are not as variable as in species of the other genera, although the color ranges from a rather light brown in the more northern and western specimens to black in some of those collected in Louisiana.

Description

MALE

Total length 1.84-2.50 mm. Setae of antennae, distal one-third of femora, tarsi, and abdomen pale grey; medial setae of tibiae dark brown to black, remaining setae and scales brownish; general coloration dark brown to nearly black.

Head

Head capsule dark brown; pedicel light to dark brown with 20-25 setae; flagellar segments with long grey setae. Clypeus and prementum light brown, with very few light brown setae; maxillary palpi pale grey with sparse pale grey setae; labellae pale grey. Head with a single transverse row of short setae across vertex and a rather irregular single row of long setae around inner margin of eyes.

Head width .42-.48 mm.; width between eyes .04 mm.; prementum length .10-.12 mm.; clypeus length .07 mm.; penultimate antennal segment length .07 mm.; ultimate antennal segment length .08 mm.; H.W./W.B.E. = 10.00-11.33; H.W./P.L. = 3.66-4.85; H.W./C.L. = 6.00-6.80; Pu.L./U.L. = .83.

Thorax

Thorax brown to dark brown, pruinose; setae of mesoscutum and scutellum dark brown. Pronotal setae 5-7; postpronotals 2-4; upper mesepimerals 12-21; parascutellars 1.

Thoracic appendages

Wing membrane clear or with two slightly infuscated bars (figure 30C). Pattern of wings usually formed by brown scales on wing veins. When infuscated bars are present, these occupy the same position. Wing veins with silvery grey scales, except for brown ones noted above and patches of brown scales sometimes present at vein apices; posterior marginal scales present; the longer scales .114 mm.; the shorter .054 mm. Wing length 1.14-1.31 mm.; wing width .31-.37 mm.; W.L./W.W. = 3.32-3.68; W.L./H.W. = 2.35-2.93.

Haltere pale grey; apex of capitulum light brown, setae pale.

Femora and tibiae light brown, very pale at distal ends; tarsi pale grey; medial tibial setae dark brown to black; claws pale, simple, those of prothoracic leg (figure 30E) unequal and much larger than those of posterior legs. Length of profemur

.45-.64 mm.; protibia .55-.64 mm.; first protarsus .40-.48 mm.; W.L./Pf.L. = 2.04-3.63.

Abdomen

Ground color of abdomen light brown to dark brown; abdomen covered with long, pale setae. Tergites and sternites equally developed and pigmented. Spiracles small, inconspicuous.

Genitalia (figure 31A)

Segment 8 setaceous dorsally and ventrally. Tergite 9 bilobed, each lobe with 16-19 long setae; an apically acute, membranous portion produced posteriorly from tergite; sternite 9 much reduced. Gonocoxites pale brown; a row of five long setae on inner face of dorsal side; a very long and stout seta arising from a cuplike process near proximal end of setal row; the latter seta attains or almost attains distal end of gonocoxite. Gonostyle rather slender, pale grey, one-third shorter than gonocoxite, bare of setae. Penis valves fused apically into a spinelike process, basally distinct, each with a transparent basal plate extending into gonocoxite basally. Coxite length .17-.18 mm.; style length .11-.14 mm.; Co.L./St.L. = 1.18-1.50.

FEMALE

Total length 1.90-2.35 mm. Somewhat darker than associated males. Setae of antennae, of apex of femora, and of abdomen pale grey, remaining setae light to dark brown (darkest in specimens from Baton Rouge, Louisiana).

Head

Head capsule dark brown; first antennal segment with 13-15 setae; pedicel dark brown, with numerous short brown setae. Clypeus and prementum brown, setae brown; maxillary palpi pale to dark grey with like-colored setae. Head with a few short proclinate setae over vertex and with a single row of long setae from between eyes over vertex to ventral margin of head posteriorly.

Head width .41-.51 mm.; width between eyes .02-.04 mm.; prementum length .10-.12 mm.; clypeus length .07-.08 mm.; H.W./W.B.E. = 9.66-15.00; H.W./P.L. = 3.62-4.42; H.W./C.L. = 5.00-6.00.

Thorax

Thorax brown to dark brown, somewhat darker than associated males. Pronotal setae 2-9; posterior pronotals 2-4; upper mesepimerals 3-18 (3 and 16 in the two New Jersey specimens).

Thoracic appendages

Wing pattern more pronounced than in some southern males. Wing length 1.15-1.45 mm.; width .34-.50 mm.; W.L./W.W. = 2.82-3.37; W.L./H.W. = 2.61-2.96.

Femora and tibiae brown to dark brown, both very pale at distal ends; tarsi light grey; setae of femora and tibiae brown to black except at distal ends grey. Length of profemur .51-.67 mm.; protibia .50-.68 mm.; first protarsus .37-.54 mm.; W.L./Pf.L. = 2.17-2.38.

Abdomen

Abdomen not sharply reduced posteriorly but much like that of females of *Chaoborus*. Female genitalia much as in *Chaoborus*. Spermatheca .057 mm. in diameter.

LARVA

Maximum length of last instar larva 2.88 mm.; light brown in color with dark brown head, a dark brown spot on anterior margin of dorsal surface of abdominal segments 1 to 6; segments 7 and 8 with spot larger and covering most of dorsal surface and a small spot on each sternite; anal segment with a rectangular spot medially; siphon dark brown, all body setae dark brown.

Head (figures 32A, 32B)

Head length .48 mm.; head width .77-.81 mm.; antenna length .21-.24 mm.; length of longest antennal seta .14-.15 mm.; length of intermediate seta .11-.12 mm.; length of shortest seta .07-.10 mm. Ocular-antennal segment with transverse row of stout, spinelike setae laterally, pair of small plumose setae immediately behind each eye, and a long, simple seta just laterad of each eye; a long seta on ventral aspect at antero-lateral margin; clypeus with two pairs of long, simple setae and a single pair of medial, plumose setae anteriorly; labrum with two pairs of long

setae proximally and five additional pairs of simple setae more distally. Oral surface of labrum with messorial brushes of short, flattened, three-tined setae. Mandibular fan with seven blades, mandibles with seven teeth.

Thorax and abdomen (figures 33A, 33B)

Thorax transversely oval, with long setae on lateral margins. Lateral setae bifurcate or plumose, set in dark brown, well sclerotized pinnaculae; dorsal setae small, simple, and plumose. Abdominal segments 1 to 5 with few long lateral setae and with short, simple and plumose setae dorsally.

Segment 8 (figure 33B) with four pairs of lateral setae, the most ventral simple, the rest bifurcate; an additional small plumose setal pair on posterior margin of dorsal pigment spot. Siphon with a small, plumose seta basally and with two pairs of long, simple setae apically. Anal segment with anal fan represented by two pairs of long, simple setae; dorsal brush also represented by two pairs of simple setae. There are a dorso-lateral pair of rather stout setae, a ventro-lateral pair of smaller setae, and two pairs of very small setae proximally. Anal apparatus with seven or eight anteriorly serrate blades on each side (figure 33B).

PUPA

Total length (only one specimen) 2.33 mm.; cephalothorax slightly more than one-half total length. Color of slide specimen golden brown. Respiratory horn trumpet-shaped (figure 34C), somewhat constricted before middle, broadly open apically; covered sparingly with an imbrication of minute spines; length .27 mm.

Abdomen (figure 34A) sharply constricted between each heavily sclerotized segment; each segment somewhat drawn out at latero-posterior corners; lateral rows of spines present; intersegmental membrane with minute spines; median dorsal setae short. Tergite 7 without setae at latero-posterior corners. Anal paddles basally fused, somewhat irregularly serrate on inner margin. Cuticle of whole pupa somewhat reticulated.

Specimens Examined

Florida: Lake Worth, Avon Park, Crystal River (Citrus County), Miami, West Avocado, Marianna Air Base, West Palm Beach, Monticello (larvae, adults); June 7-Dec. 10. *Georgia:* Okefenokee Swamp; June. *Louisiana:* Baton Rouge, St. Bernard (larvae, adults), Ft. Jackson; Jan. 5-Nov. 21. *Maryland:* Plummers Island; Oct. 10. *Massachusetts:* Belchertown; April-May 1 (larvae). *Mississippi:* Harmon; May 22. *New Jersey:* Lahaway (pupa, adults), Hornerstown; April, May, November. *North Carolina:* Jacksonville. *South Carolina:* Martsville; June 30. *Tennessee:* Reelfoot Lake; Aug. 14. *Texas:* Conroe, San Antonio, Montgomery County; Aug. 12-Sept. 15.

Specimens examined, 122.

CORETHRELLA APPENDICULATA GRABHAM

Corethrella appendiculata Grabham, 1906. Ent. News *17*:343. Dyar and Shannon, 1924, Insecutor Inscitiae Menstruus *12*: 216. Lane, 1942, Rev. Ent. *13*:113-115. Lane, 1953, Neotropical Culicidae, Vol. 1, São Paulo, pp. 81-83.

Comments

In the material kindly loaned from the collection of Cornell University there is a slide-mounted male and associated larval and pupal skins. This specimen was identified as *Corethrella appendiculata* Grabham. This specimen fits exactly neither the extensive original description nor the subsequent one of Dyar and Shannon (1924). However, comparison with specimens from Panama, determined by J. Lane, and comparison with the ♂ genitalia of a cotype of *C. appendiculata* indicate that it is the same species. Discrepancies between the original description and the material examined are: the claws of all legs are not equal in the male, those of the prothoracic legs have one larger and one smaller than those of the mesothoracic and metathoracic legs; the basal antennal segments are darker; and there are more

setae on the head than indicated in any of the descriptions.

The immature stages of this species are found in tree holes.

Description

MALE

Total length 2.37-2.45 mm. Setae of antennae, maxillary palpi, eighth abdominal segment, gonocoxites, and mesothoracic tarsi pale yellowish; remaining setae pale greyish-brown. General coloration brown as in *C. brakeleyi.*

Head

Head capsule and pedicel dark grey-brown; pedicel with 35 or more setae; flagellar segments pale greyish-yellow. Maxillary palpi, labrum, and labellae pale yellowish-brown; clypeus and prementum pale brown; clypeus with one median seta and six or seven lateral setae; head with numerous short, curved, yellow setae on vertex, extending anteriorly between eyes, and a multiple row of long and short setae extending from between eyes over vertex and along inner margin of eyes posteriorly to cephalic margin (figure 31D).

Head width .50-.51 mm.; width between eyes .035-.040 mm.; prementum length .11 mm.; clypeus length .07 mm.; penultimate antennal segment length .05-.07 mm.; ultimate antennal segment length .07 mm.; H.W./W.B.E. = 11.66-14.40; H.W./P.L. = 4.37-4.50; H.W./C.L. = 7.00-7.20; Pu.L./U.L. = .72-1.00.

Thorax

Thorax brown, pruinose. Pronotal setae 9-12; posterior pronotals 8-10; upper mesepimerals 10-11; parascutellars 1.

Thoracic appendages

Wing membrane with two faint brown crossbands, one from distal end of Sc to distal end of Cu_2, the other one-third distance from wing base and lying between Costa and M; scales arising from veins in areas covered by these bars also grey-brown, remaining scales pale silvery-grey. Wing length 1.15-1.30 mm.; wing width .34-.37 mm.; W.L./W.W. = 3.37-3.50; W.L./H.W. = 2.31-2.39.

Halteres with capitulum all brown; pedicel pale, more slender than in *C. brakeleyi.*

Femora and tibiae light brown with light brown scales and setae, except at apex of each tibia where setae and scales dark brown, producing a ringed appearance. Tarsi pale greyish-brown with pale setae. Profemur length .60-.61 mm.; protibia .61-.65 mm.; first protarsus .48-.50 mm.; W.L./Pf.L. = 1.92-2.11.

Abdomen

Ground color of abdomen pale greyish-brown, covered with long, pale setae.

Genitalia (figure 31C)

Segment 8 with setae pale yellow; segment 9 similar to preceding species but each side of tergite with 25 or more yellowish setae. Gonocoxites pale yellowish-brown, covered with long and short yellowish setae. Row of five stout setae as in *C. brakeleyi,* but very stout seta is shorter, not attaining distal end of gonocoxite.

Gonostyle pale yellowish, slender, as long as coxite, bearing on inner face proximally a stout, yellowish seta. Penis valves more heavily pigmented than in *C. brakeleyi,* dark brown in color. Coxite length .17-.20 mm.; style length .17 mm.; Co.L./St.L. = 1.00-1.16.

FEMALE

Total length 1.29-1.66 mm. General coloration as in males; setal coloration identical.

Head

First antennal segment with 17-19 long setae; pedicel paler than in male, with numerous long setae. Clypeus and prementum short as in male, with a few more setae (four or five setae on clypeus medially).

Head width .55 mm.; width between eyes .028 mm.; prementum length .11 mm.; clypeus length .07 mm.; H.W./W.B.E. = 19.50; H.W./P.L. = 4.87; H.W./C.L. = 7.80.

Thorax

Thorax light to dark brown, pale grey around wing bases, pruinose as in *C. brakeleyi.*

Pronotal setae 6; postpronotals 10; upper mesepimerals 22; parascutellars 1.

Thoracic appendages

Wings marked and colored as in males. Wing length 1.24-1.48 mm.; wing width .38 mm.; W.L./W.W. = 3.22; W.L./H.W. = 2.23. Claws all of equal size, small as in mesothoracic and metathoracic legs of males. Profemur length .62 mm.; protibia .60 mm.; first protarsus .45 mm.; W.L./Pf.L. = 1.97.

Abdomen

Morphologically as in females of *C. brakeleyi*. Spermatheca somewhat ovoid in shape, .05-.06 mm. in diameter.

LARVA

Total length of larval skin (stretched) 2.60 mm. Nearly colorless, with pale yellowish-brown head; mandibular teeth black; spines at anterior edge of submentum dark brown; margin of foramen magnum dark brown; siphon and anal segment pale yellowish-brown; all body setae black.

Head

Head length .35 mm.; head width .61 mm.; antenna length .15 mm.; length of longest antennal seta .08 mm.; length of intermediate seta .05 mm.; length of shortest seta .04 mm. Head essentially as in *C. brakeleyi* except setae of clypeus all simple as are those of ocular-antennal segment; sutures bounding submentum parallel rather than divergent (figure 33C), apex of labrum with messores made up of simple rather than forked setae (figure 33D). Mandibles with six teeth; mandibular fan of nine bladelike, pectinate setae.

Thorax and abdomen

Actual groupings of thoracic and abdominal setae cannot be ascertained from this cast skin, although arrangement is similar to that in larva of *C. brakeleyi*. No conspicuous brown spots on abdominal segments. Siphon and anal segments similar except basal seta of siphon is simple.

PUPA (figures 34B, 34D)

Total length 2.88 mm.; cephalothorax one-half total length; pale yellow-brown (cast skin); respiratory horn (figure 34D) somewhat trumpet-shaped, spiracular opening large, located at external opening of trumpet. Surface of horn imbricated with short, wide spines like reptile scales; total length .21 mm. Abdomen (figure 34B) sharply constricted between each heavily sclerotized segment; each segment drawn out into spines at latero-posterior corners. Setae dorsally as in illustration; segment 7 with one seta at each latero-posterior corner. Whole surface of cuticle more or less reticulated.

Specimens Examined

Georgia: 1 ♂, 1 larval and 1 pupal skin, Macon (hole in gum log); October 1944 (slide mount). *Jamaica:* 1 ♂, Kingston; June 17, 1906; 1 ♂, genitalia of cotype, Kingston. *Panama:* 5 ♂♂, 3 ♀♀, Tabernilla, C. Z., A. Busck (Det. J. Lane, 1941); 4 ♂♂, 3 ♀♀, Gatun, C. Z., 1926, D. P. Curry; 2 ♂♂, 1 ♀, Gatun, C. Z., September 15, 1926, D. P. Curry. *St. Domingo:* 1 ♂, San Francisco Mountains, September 1905. Total specimens examined, 24.

CORETHRELLA LANEANA VARGAS

Corethrella laneana Vargas, 1946, Rev. Inst. de salubr. y Enferm. trop. Mexico 7:57-62. Belkin and McDonald, 1955, South. Calif. Acad. Sci. Bul. 54:82-96.

Comments

This species was originally described from a single male specimen collected in June 1944 in Monterrey, Nuevo Leon, Mexico. It was not recorded again until 1955 when Belkin and McDonald reported on their collection of adults and larvae at Saratoga Springs in Death Valley, California in 1954.

The holotype of Vargas' species has not been seen, but comparisons can be made with photographs in Vargas' paper. Belkin and McDonald believe that the Death Valley specimens may be distinct enough from the Vargas-described specimen to constitute a distinct subspecies. They do not, however, so name it. Dr. Belkin has very kindly permitted the author to examine adults, pupae, and larvae from his

collection. These specimens are here considered to be conspecific with Vargas' species.

In the males, *C. laneana* is readily distinguished from *C. brakeleyi* and *C. appendiculata* by the presence of a conspicuous apical seta on the gonostyle (figure 31E). In both males and females it can be distinguished from *C. brakeleyi* by the numerous setae on the clypeus (*C. brakeleyi* with only 5 or 6, *C. laneana* with 20-30).

The larvae are indistinguishable from those of *C. brakeleyi* except in *C. brakeleyi* the anal and dorsal brushes are each composed of four single setae. In *C. laneana* these setae are bifid. The reliability of this character is an open question.

The pupae of *C. laneana* differ from *C. brakeleyi* in that the respiratory horn of the former shows no trace of a medial constriction (figure 34E).

Description

MALE

Total length 1.70 mm. Setae colored as in *C. brakeleyi;* general coloration pale greyish-brown.

Head

Head capsule light grey-brown; pedicel darker grey-brown with approximately 20 setae; antennal segment 1 (scape) with three conspicuous setae laterally; flagellar segments with long grey setae, darker at whorl. Clypeus and prementum light grey-brown; clypeus with about 22 setae, prementum with about 30 setae; labellae pale grey. Head with a small number of short, proclinate setae across vertex and a single, rather irregular row of long setae around inner margin of eyes from above antennae to ventral margin of head posteriorly.

Head width .41 mm.; width between eyes .06 mm. (somewhat wider than in *C. brakeleyi*); prementum length .12 mm.; clypeus length .08 mm.; penultimate antennal segment length .07 mm.; ultimate antennal segment length .07 mm.; H.W./W.B.E. = 6.8; H.W./C.L. = 5.1; Pu.L./U.L. = 1.00; H.W./P.L. = 3.4.

Thorax

Thorax greyish-brown, pruinose; setae of mesoscutum and scutellum long and dark with an admixture of small, fine, pale setae. Pronotal setae, 2 large and 2 small; postpronotals, 2 large and 1 small; upper mesepimerals 0-2; parascutellars 1.

Thoracic appendages

Wing membrane clear except for slight darkening between R_1 and Sc; pattern of wings essentially as in *C. brakeleyi* (figure 30C), also formed by dark scales on wing veins. Wing scales otherwise silvery-grey except dark scales at apex of wing and on wing margin between Cu_1 and Cu_2. Posterior marginal scales present, identical with those of *C. brakeleyi*. Wing length 1.08 mm. (not including fringe); wing width .31 mm.; W.L./W.W. = 3.47; W.L./H.W. = 2.63.

Halteres pale grey; apex of capitulum pale brown.

Femora and tibiae pale brown, very light distally, somewhat darker basally; tarsi all pale grey. Legs covered with long and short setae; claws pale, simple, those of prothoracic legs unequal and larger than those of other legs. Length of profemur .51 mm.; protibia .51 mm.; first protarsus .46 mm.; W.L./Pf.L. = 2.34.

Abdomen

Ground color of abdomen pale grey-brown; abdomen covered with long and short pale setae. Tergites and sternites equally developed and pigmented. Spiracles small, inconspicuous.

Genitalia (figure 31E)

Segment 8 setaceous dorsally and ventrally. Tergite 9 bilobed, each lobe with 15 long setae; median membranous area not markedly acute; sternite 9 reduced. Gonocoxite pale brown; a row of five long setae on inner face of dorsal side; stout seta near proximal end of row is set in cuplike base. This seta is much shorter than in *C. brakeleyi* (about one-third the length of gonocoxite). Gonostyle (figure 31E) stouter than in *C. brakeleyi*, expanded distally and bearing a small apical seta in addition to one stout seta one-third

distance from base and an additional stout seta one-eighth distance from base. Gonostyle pale, transparent. Penis valves as in *C. brakeleyi*. Coxite length .17 mm.; gonostyle length .12 mm.; Co.L./St.L. = 1.41.

FEMALE

Total length 1.82-1.90 mm. Somewhat darker and with more marked wing pattern than male. Seta color largely as in male.

Head

Head capsule brown; first antennal segment with 13-15 setae; pedicel dark brown with numerous short, brown setae. Setae at flagellar whorls and those between shorter than in male. Clypeus and prementum brown, setae brown, numerous (30 or more); maxillary palpi and labellae pale grey with like-colored setae. Head with few short, proclinate setae and a few somewhat longer straight setae over vertex in addition to the single row of very long setae reaching from anterior aspect between eyes, over vertex, to ventral margin of head posteriorly.

Head width .45 mm.; width between eyes .05 mm.; prementum length .13 mm.; clypeus length .10 mm.; H.W./W.B.E. = 9.00; H.W./P.L. = 3.46; H.W./C.L. = 4.50.

Thorax

Thorax brown, somewhat darker than in male. Pronotal setae, 2 large, 8 small; posterior pronotals, 2 large, 1 or 2 small; upper mesepimerals 4.

Thoracic appendages

Wing pattern as in males. Wing length 1.30-1.38 mm. (less fringe); wing width .41 mm.; W.L./W.W. = 3.17-3.39; W.L./H.W. = 3.06.

Femora and tibiae brown; femora pale at distal ends; tibiae dark at distal and proximal ends; tarsi light grey. Legs covered with long and short setae, longest on profemora and metatibiae; setae less well developed than in male. Length of profemur .62 mm.; protibia .62 mm.; first protarsus .48-.52 mm.; W.L./Pf.L. = 2.65-2.70.

Abdomen

Abdomen and genitalia as in *C. brakeleyi*. Spermatheca .069 mm. in diameter.

LARVA

Total length (slide specimen) 3.50 mm.; apparently colored as *C. brakeleyi* with identical spots and pigment patches.

Head

Head length .51 mm.; head width .76 mm.; antenna length .24 mm.; length of longest antennal seta .13 mm.; length of intermediate seta .10 mm.; length of shortest seta .07 mm.

Chaetotaxy and appendages identical with *C. brakeleyi*. Mandibular fan with seven blades; mandibles with nine teeth.

Thorax and abdomen

Chaetotaxy and structure identical with *C. brakeleyi* except anal fan and dorsal brush are represented by two pairs of long bifid setae. Anal apparatus as in *C. brakeleyi*.

PUPA

Total length approximately 2.40 mm.; cephalothorax somewhat more than one-half total length; yellowish-brown. Respiratory horn .34 mm. long, trumpet-shaped, not particularly constricted medially (figure 34E); no spinelike imbrications apparent on available specimens.

Abdomen anatomically like *C. brakeleyi*. Tergite 7 with a small seta near each postero-lateral corner and two pairs of small setae between margin and stout, median pair; otherwise as in *C. brakeleyi*. In the two specimens available there appears to be a ribbed membrane along the margin of segments 2-7. This was apparently illustrated by Johannsen for *C. brakeleyi* but was not apparent on the specimen of that species available to the author.

Specimens Examined

California: Saratoga Springs, Death Valley; 1 ♂ genitalia, 2 ♀♀, July 28, 1954; 1 ♂, Sept. 10-11, 1954; 1 larva, Sept. 10, 1954; 1 pupa, July 28, 1954; 1 larval and 1 pupal skin, Sept. 10-11, 1954.

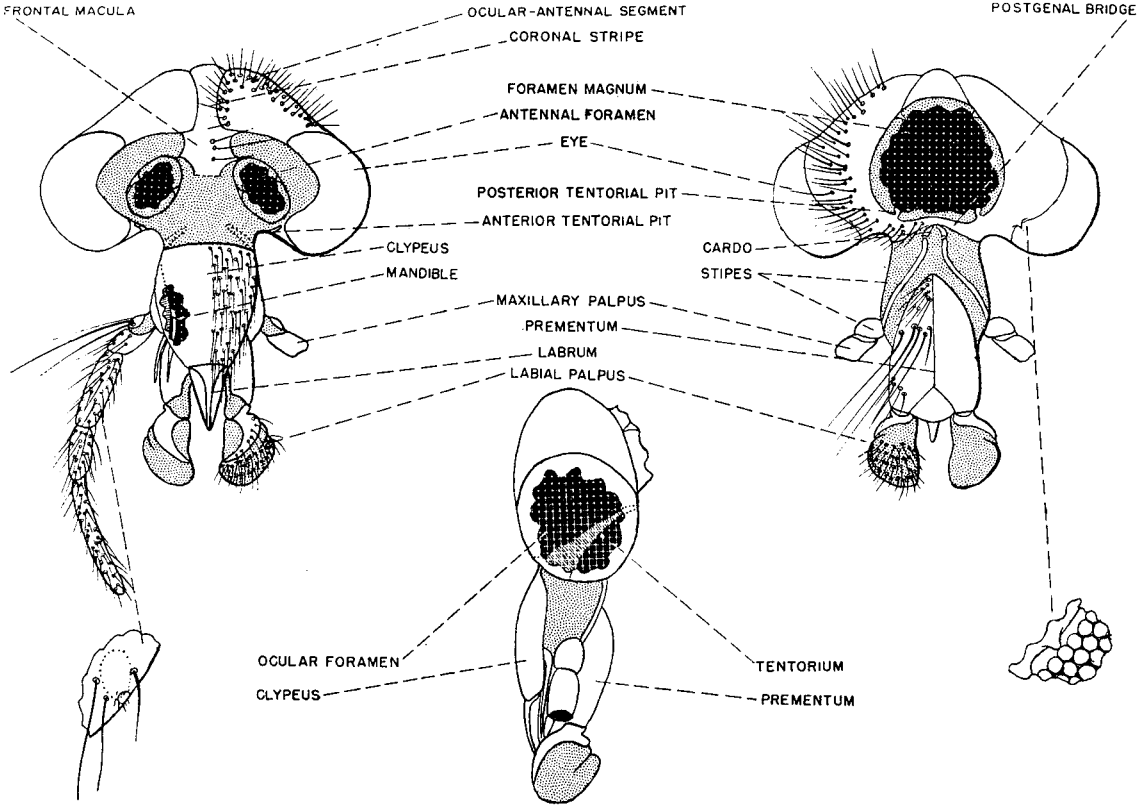


Fig. 1. *Chaoborus americanus*—head of adult female.

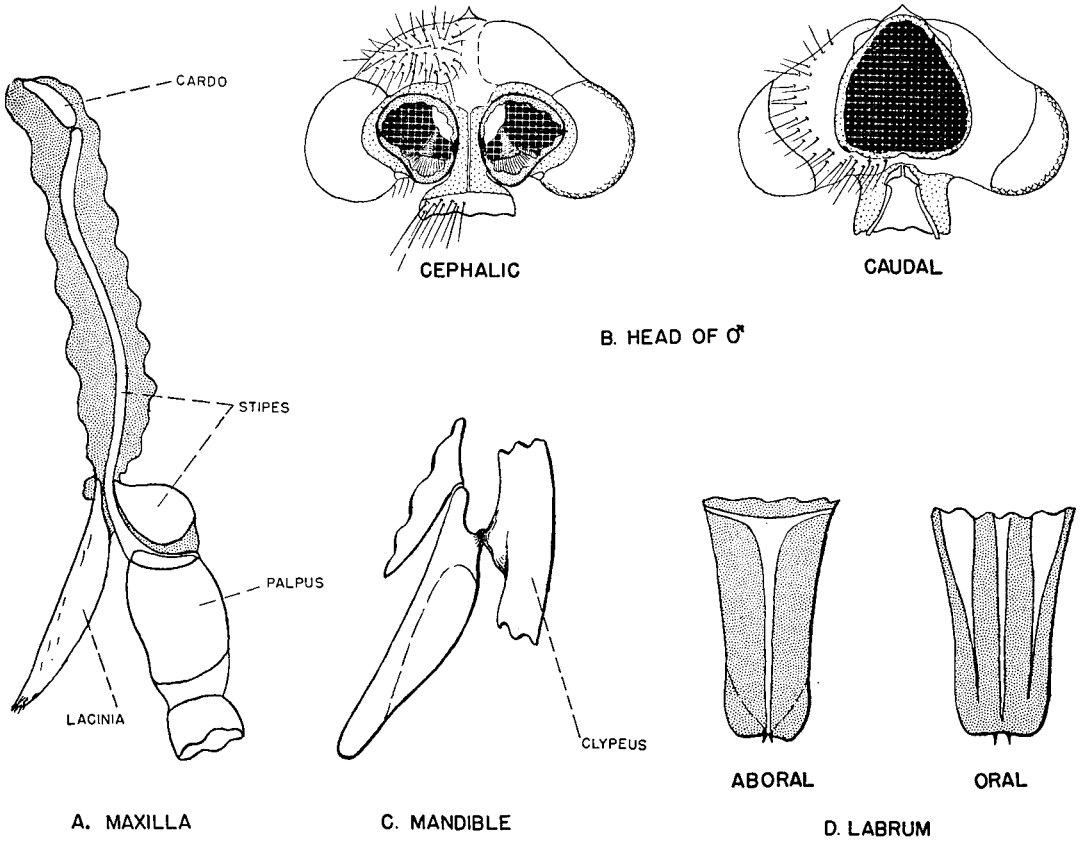


Fig. 2. C. *americanus*—details of head and mouthparts.

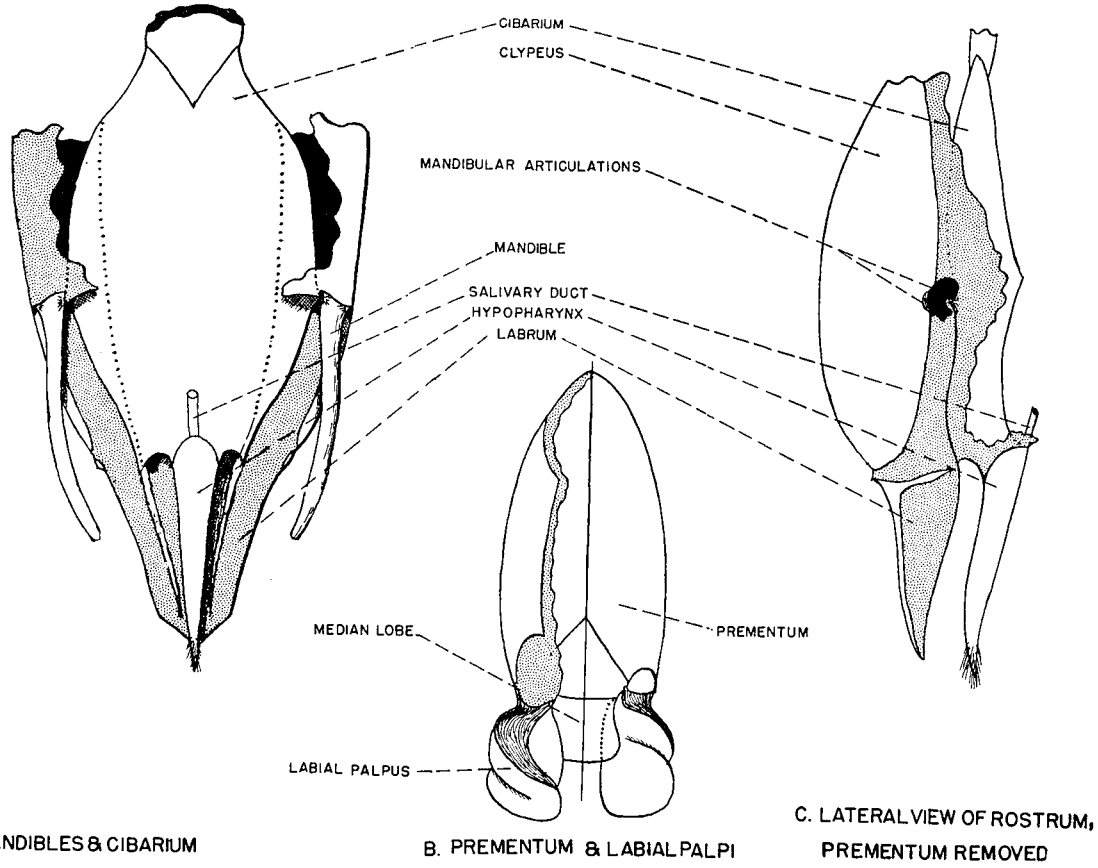


Fig. 3. C. *americanus*—details of mouthparts.

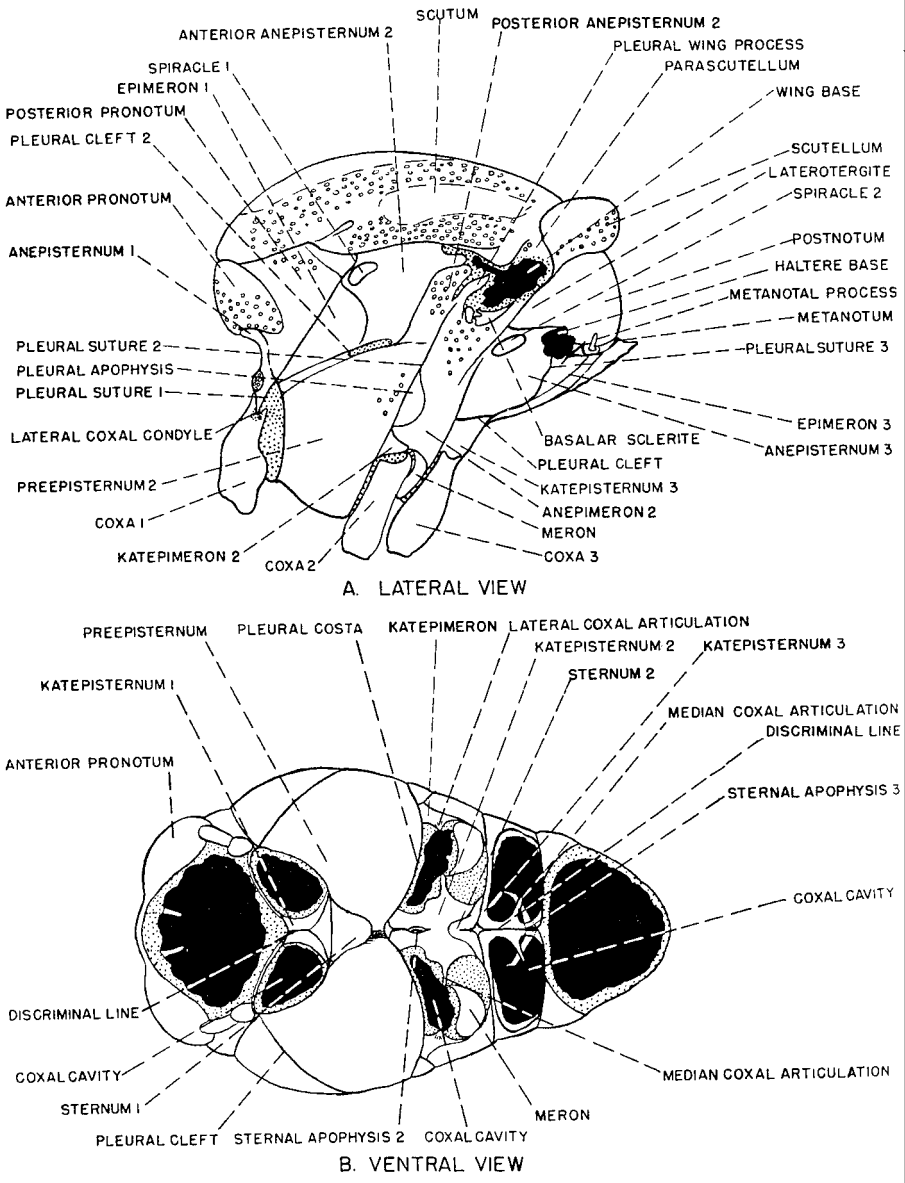


Fig. 4. C. *americanus*—thorax.

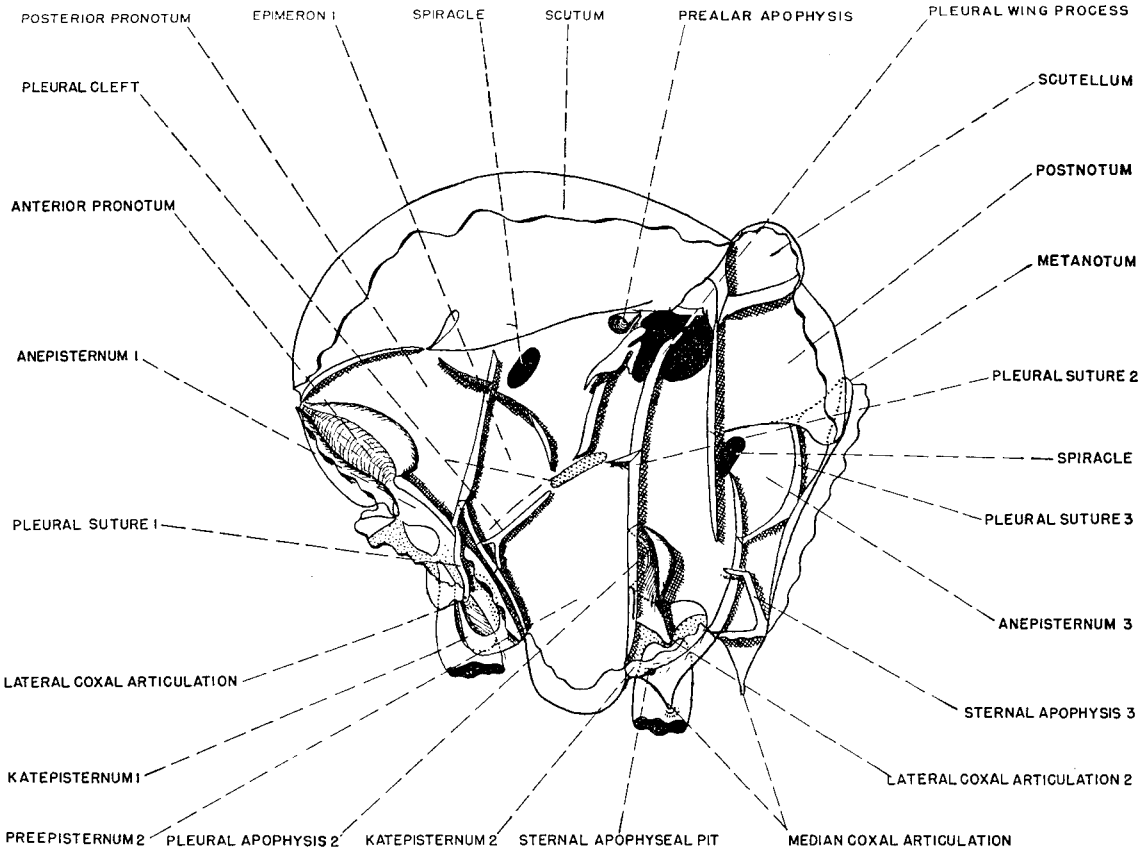


Fig. 5. C. *americanus*—internal aspect of thorax.

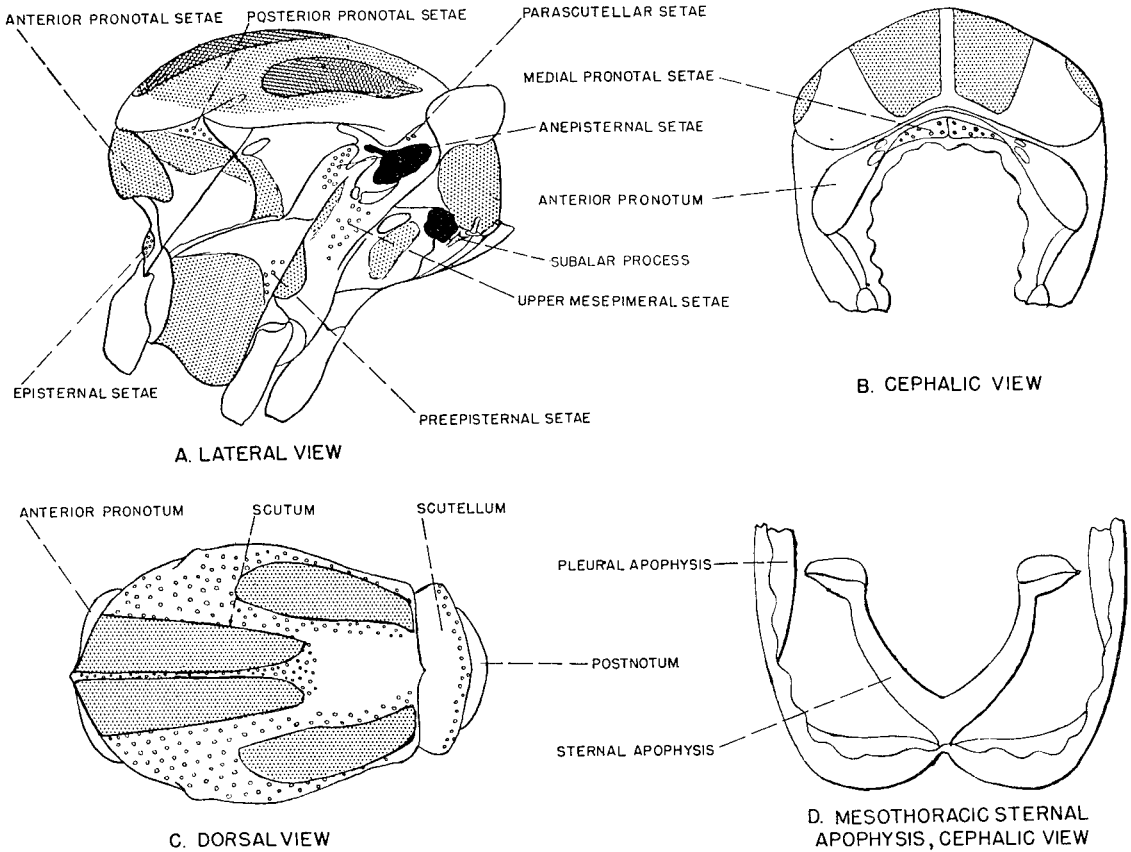


Fig. 6. C. *americanus*—details of thorax.

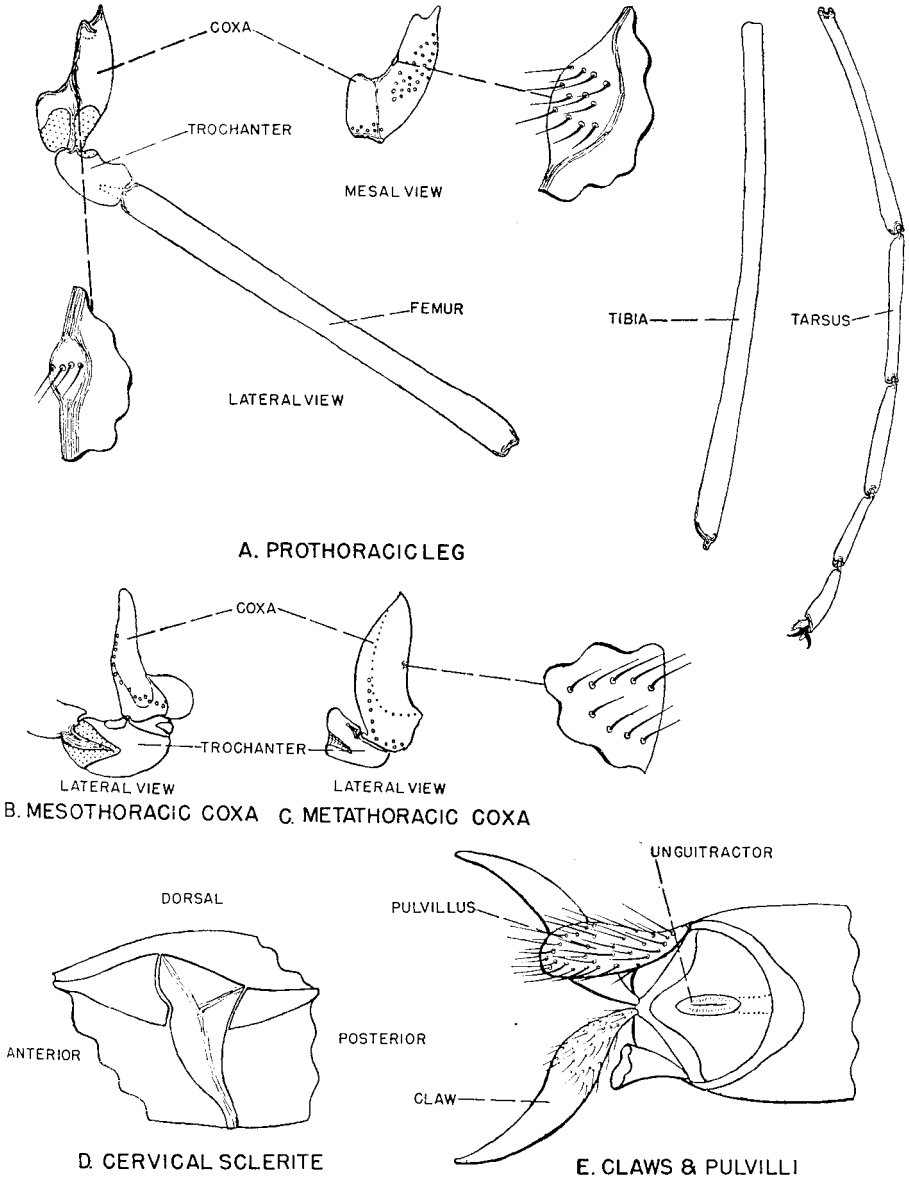
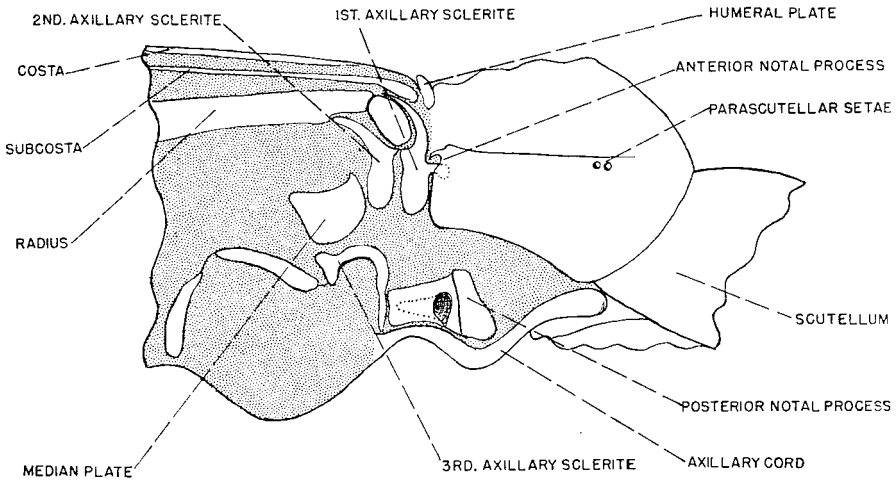


Fig. 7. C. *americanus*—details of legs.



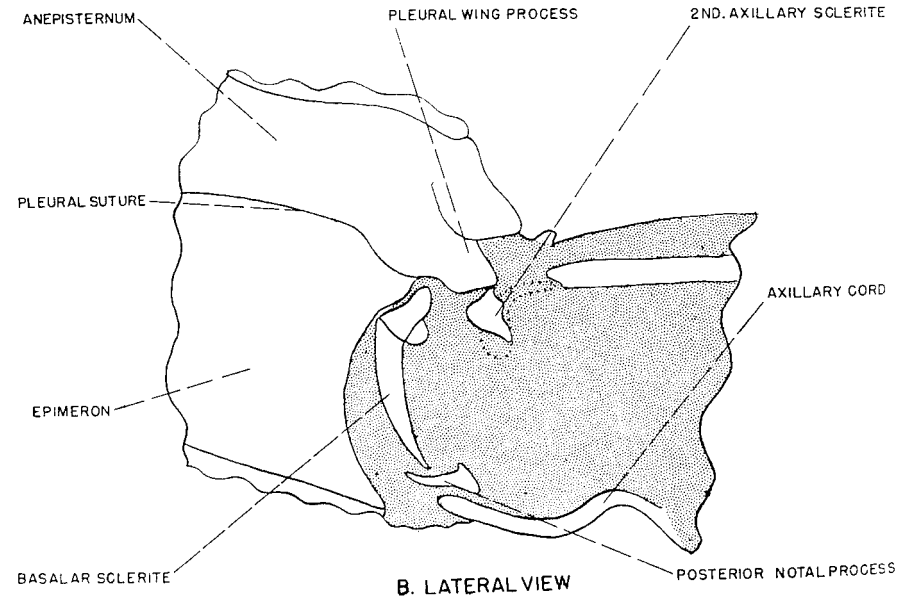


Fig. 8. C. *americanus*—wing bases.

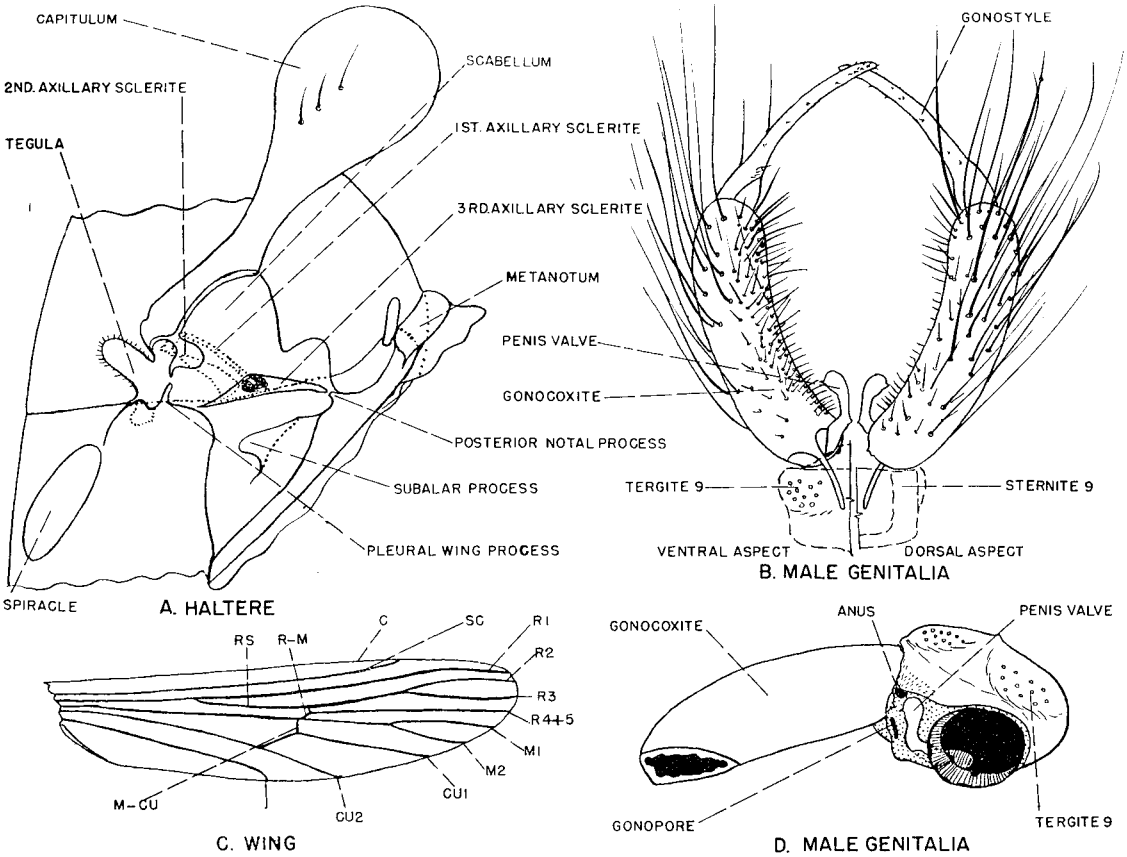


Fig. 9. C. *americanus*—haltere, wing, and male genitalia.

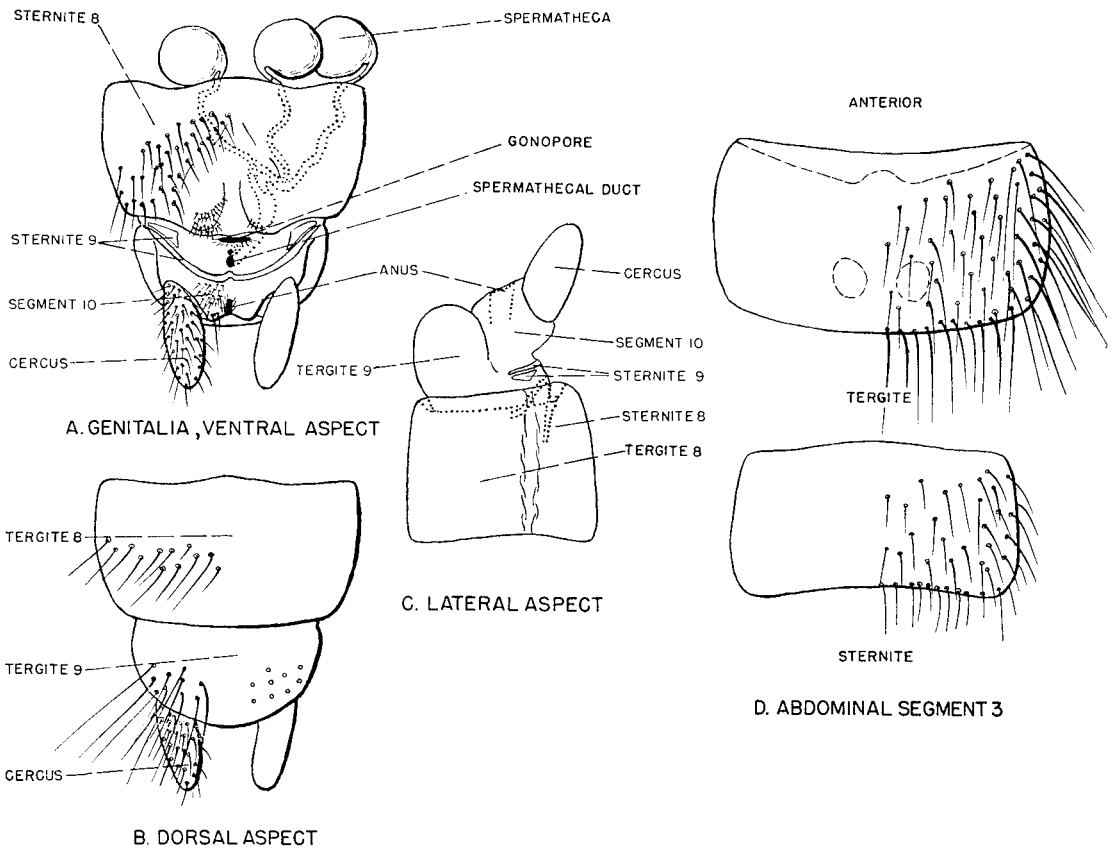


Fig. 10. C. *americanus*—female genitalia and abdominal segment 3.

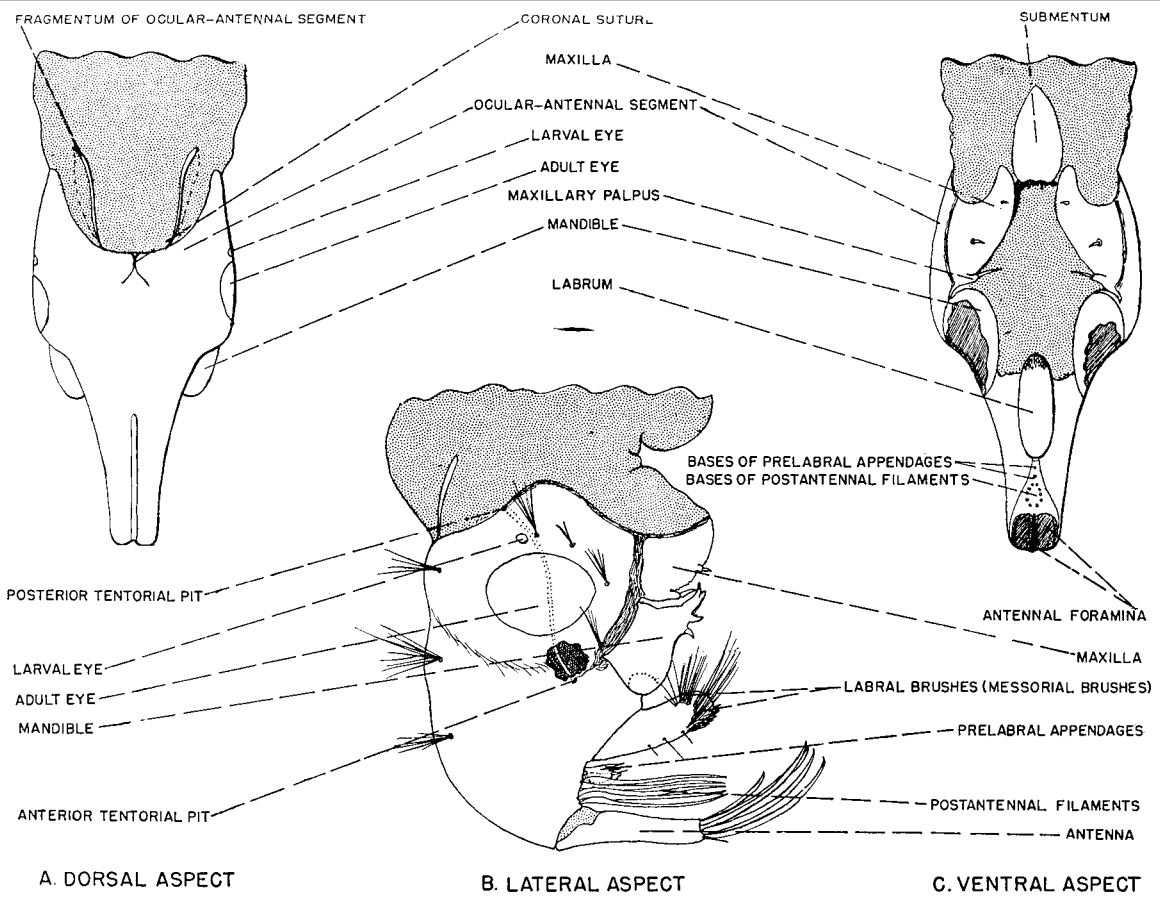


Fig. 11. C. *americanus*—head of larva.

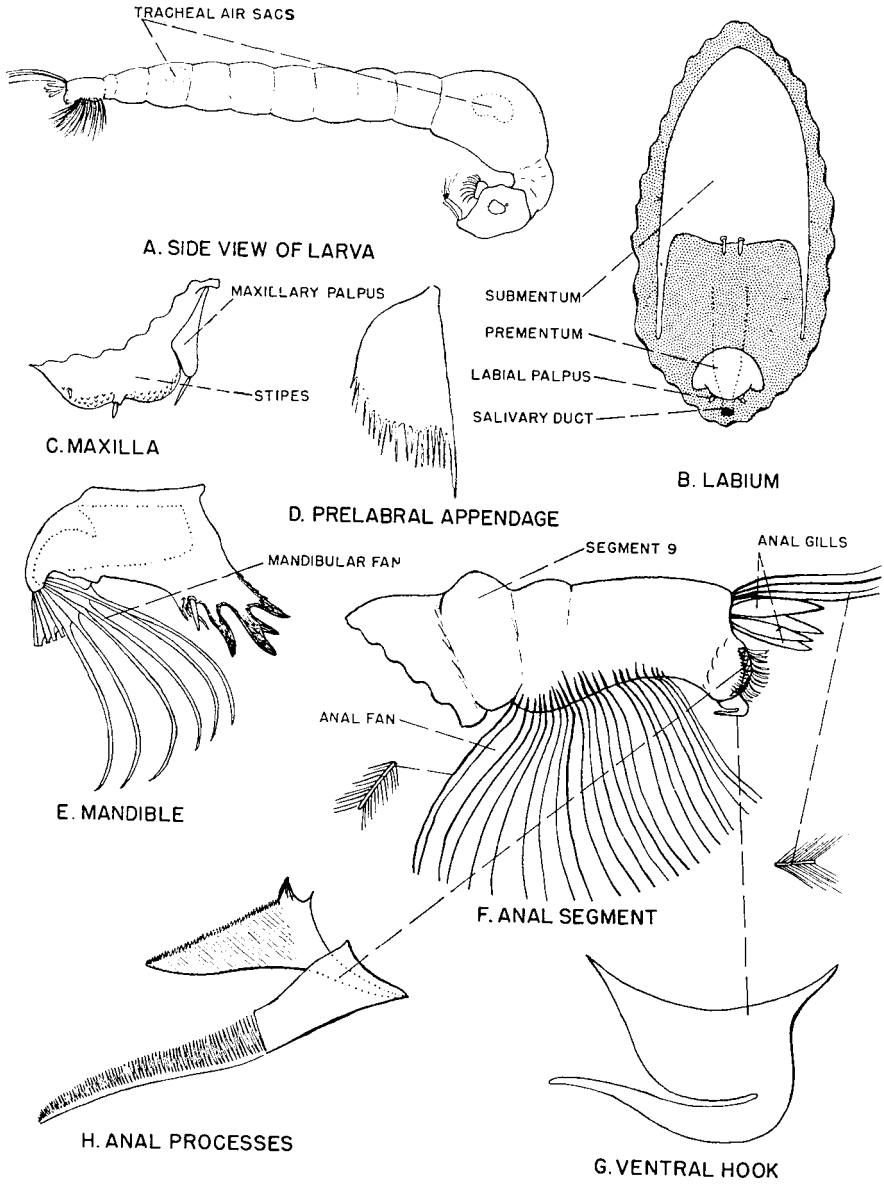


Fig. 12. C. *americanus*—details of larva.

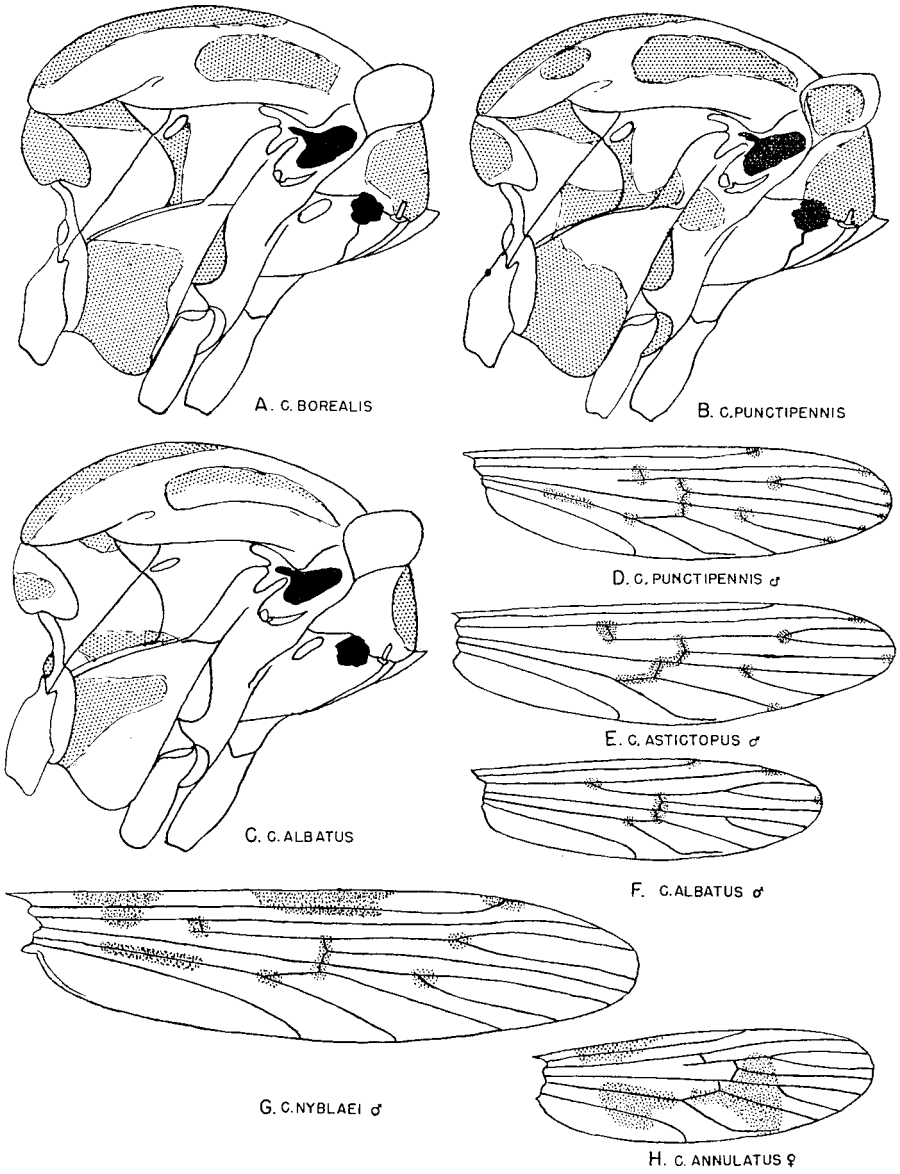


Fig. 13. *Chaoborus spp.*—thoraces and wings.

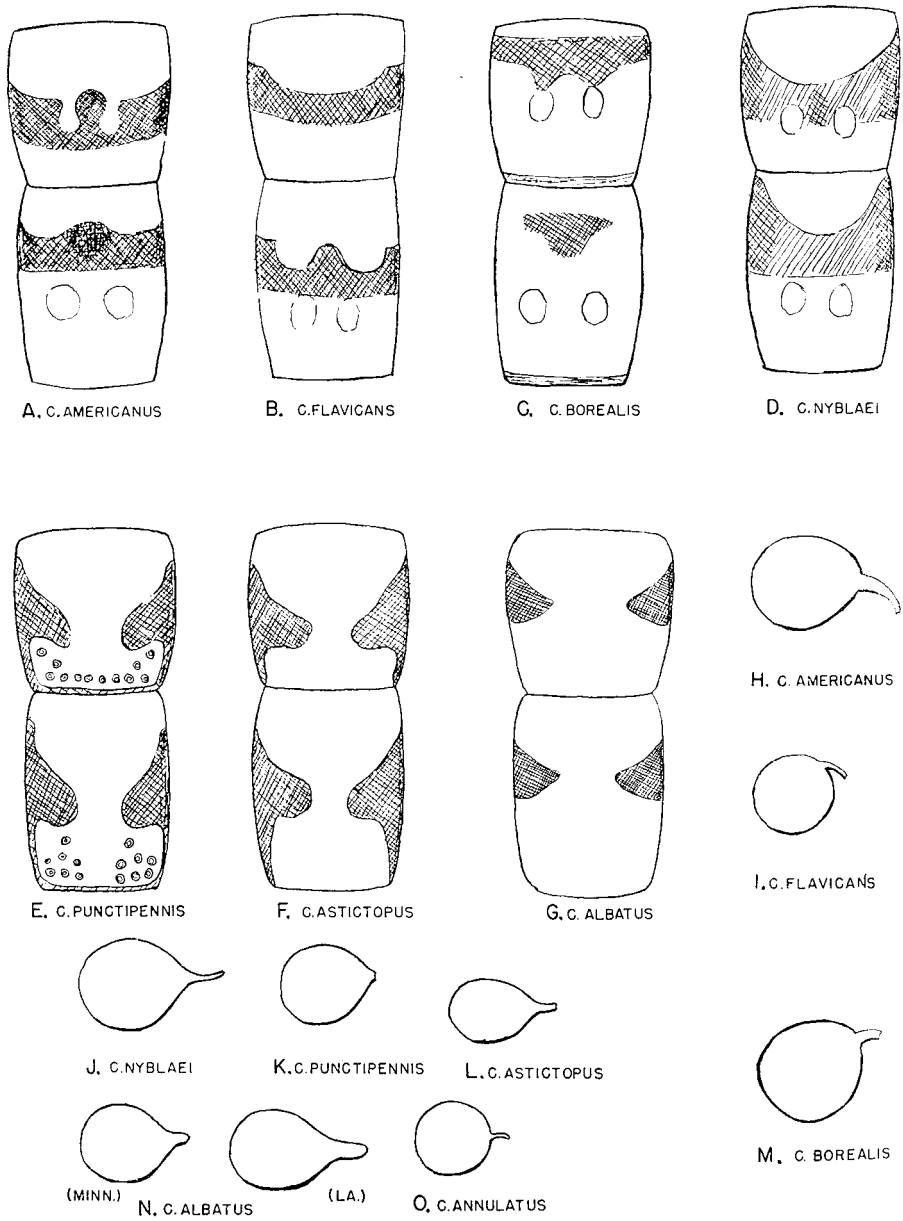
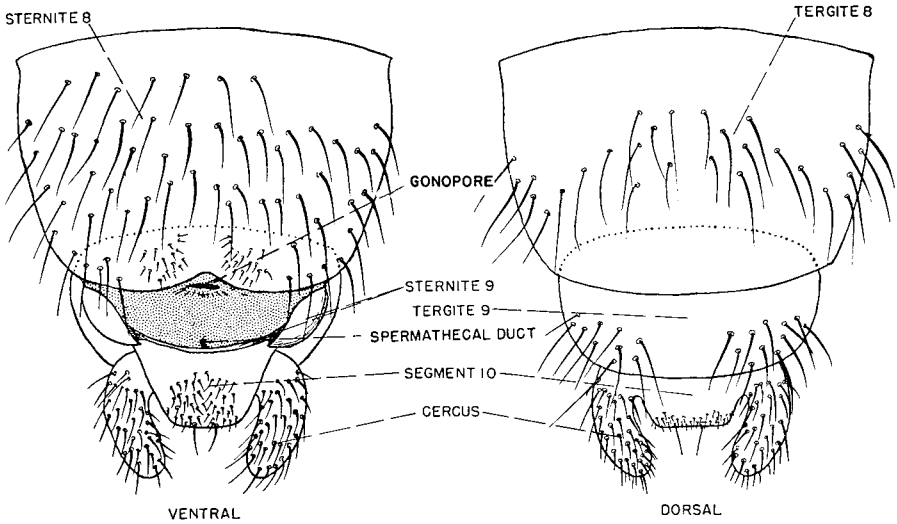
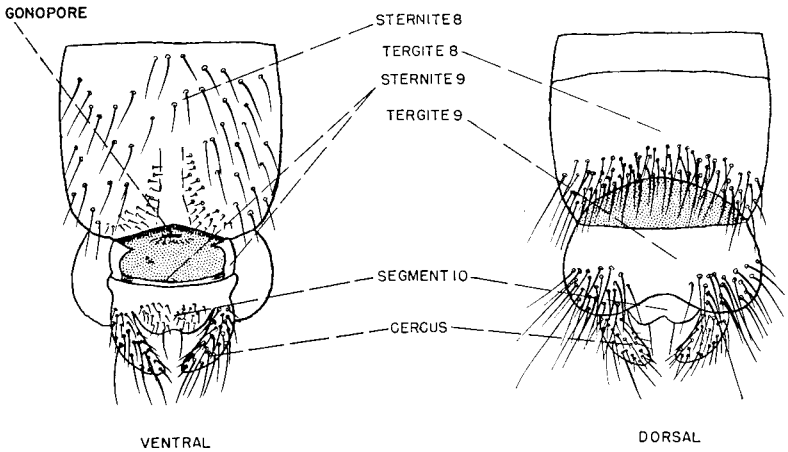


Fig. 14. *Chaoborus spp.*—pattern of abdominal terga 3 and 4 of males and spermathecae of females.



A. CHAOBORUS NYBLAEI



B. CHAOBORUS PUNCTIPENNIS

Fig. 15. Female genitalia of subgenera *Schadonophasma* and *Sayomyia*.

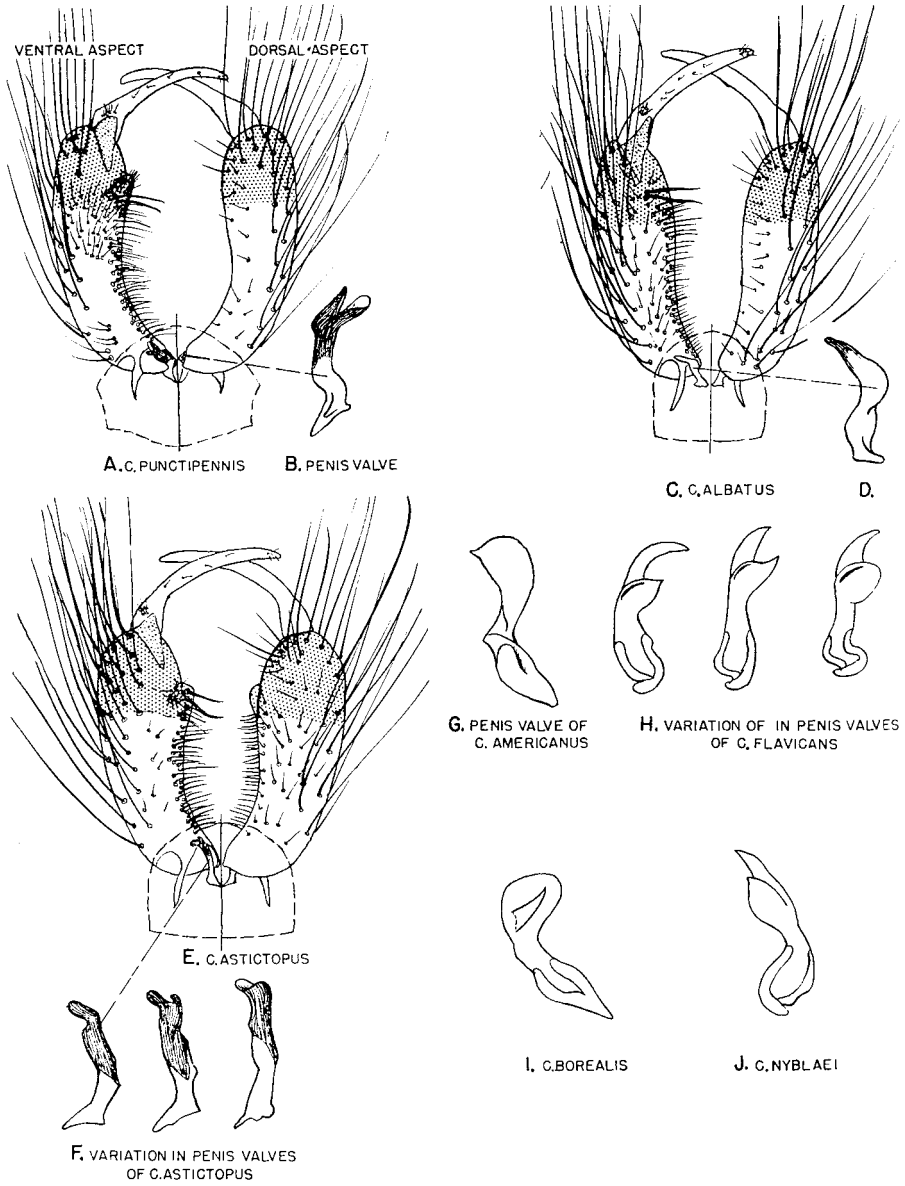


Fig. 16. *Chaoborus spp.*—male genitalia.

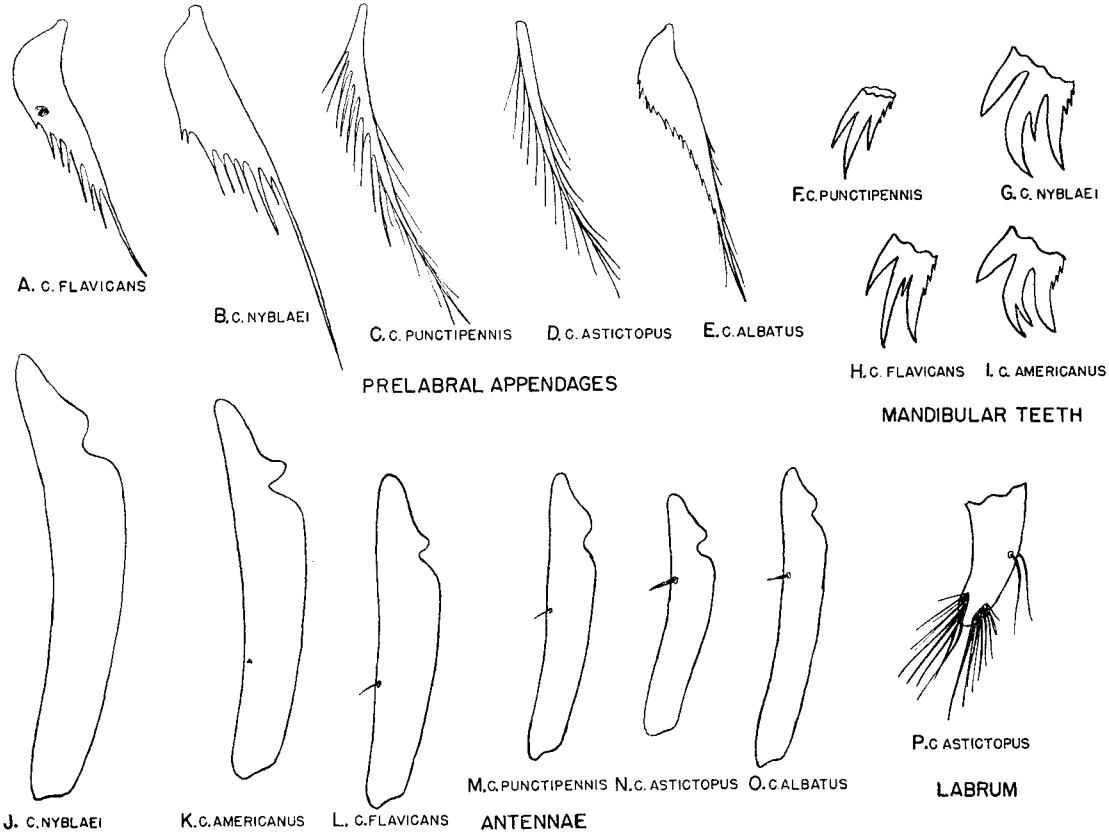


Fig. 17. *Chaoborus spp.*—larval structures.

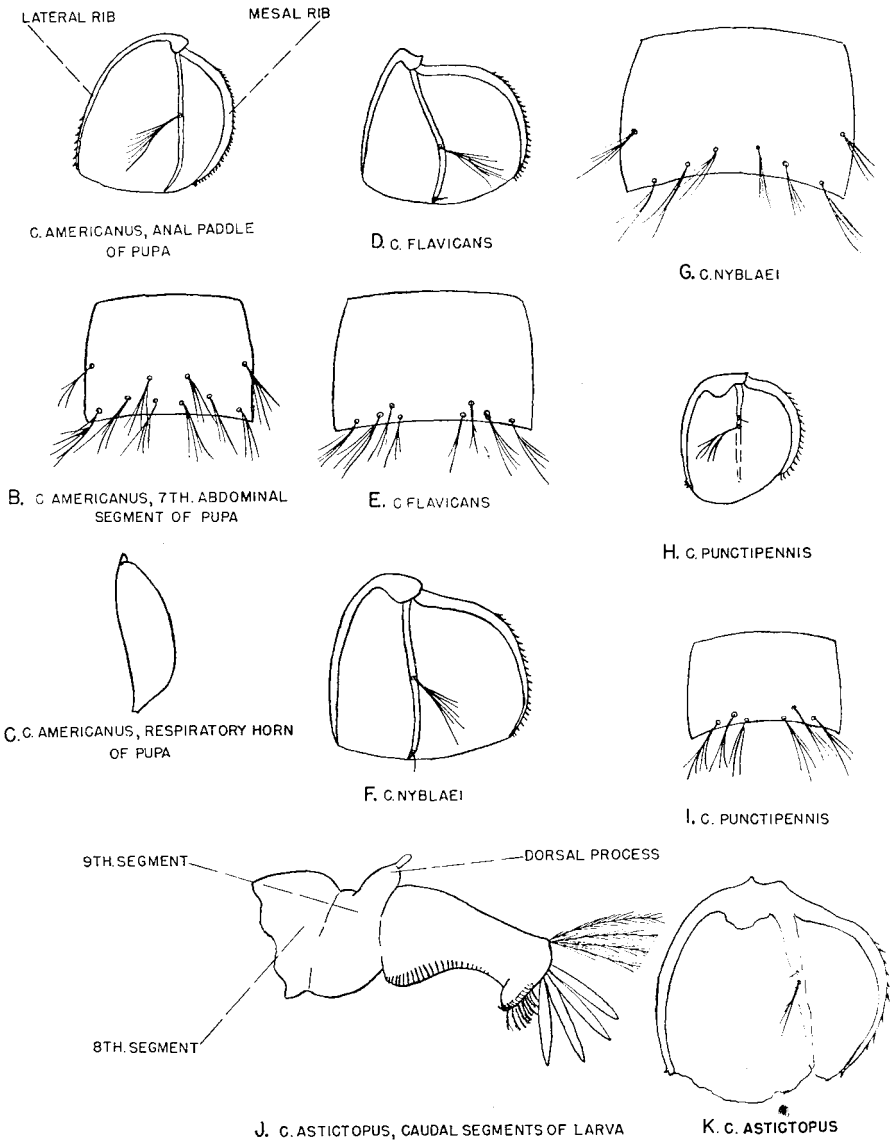


Fig. 18. *Chaoborus spp.*—larval and pupal structures.

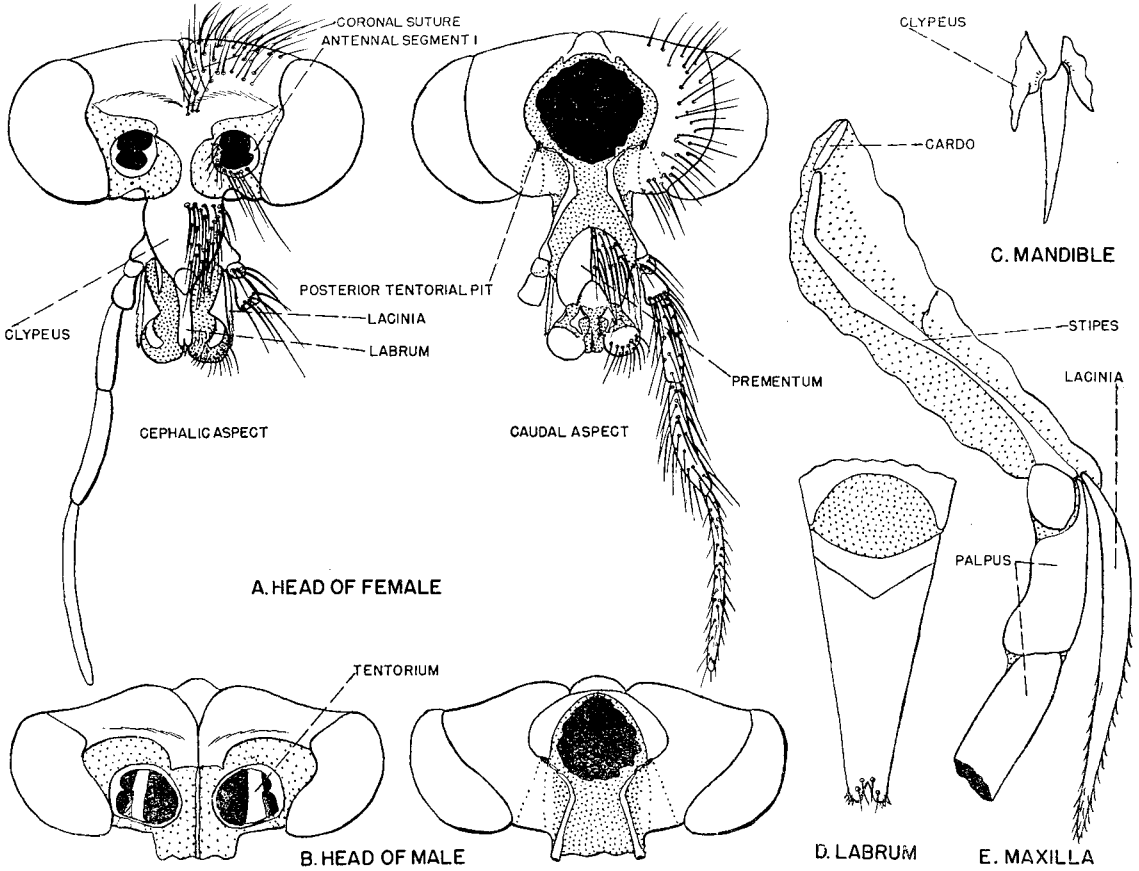


Fig. 19. *Mochlonyx velutinus*—head and mouthparts of adult.

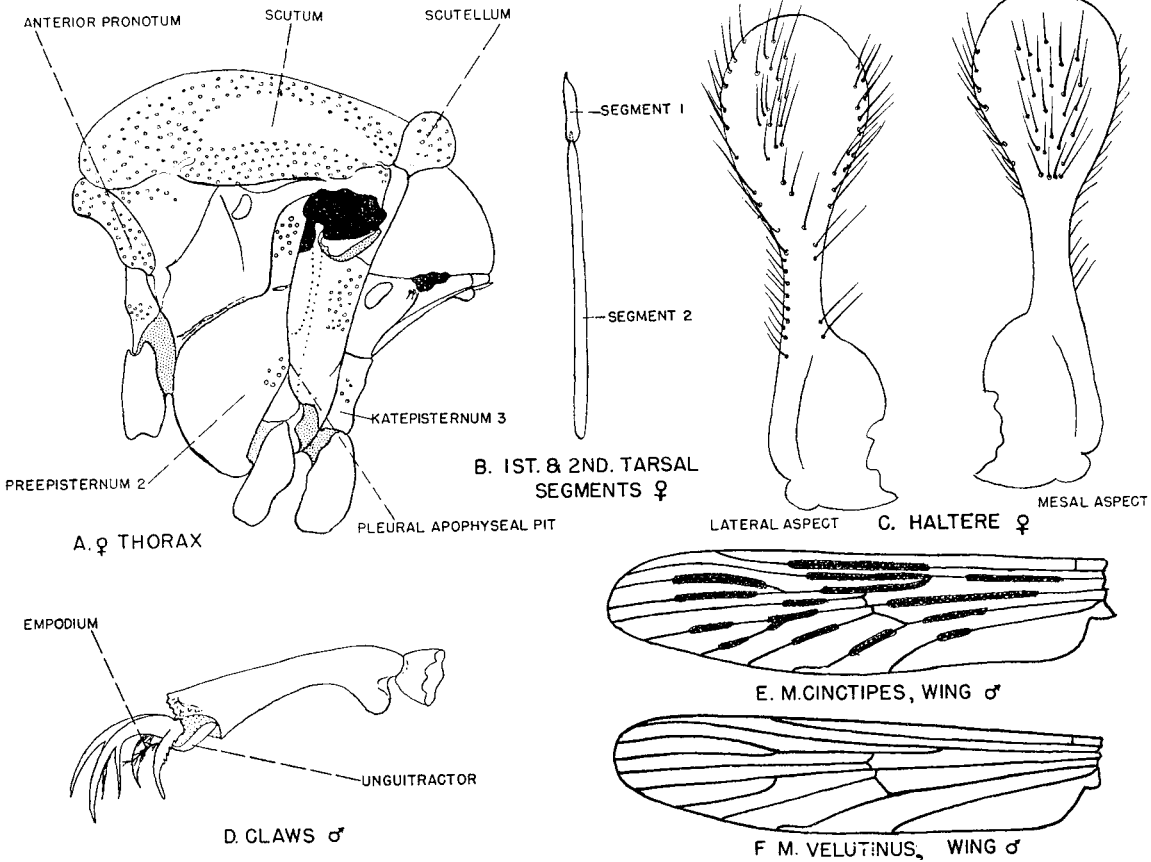


Fig. 20. *Mochlonyx velutinus*—thorax and appendages.

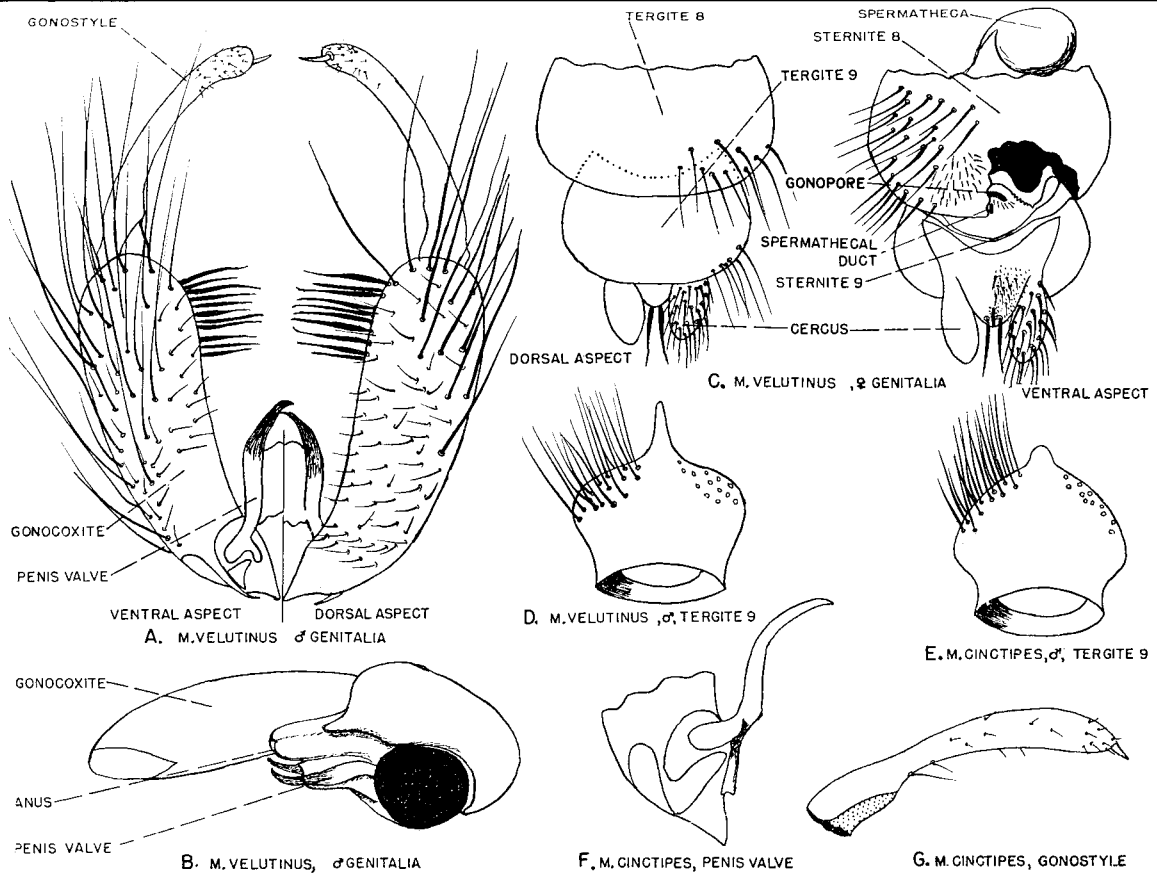


Fig. 21. *Mochlonyx velutinus* and *M. cinctipes*—genitalia.

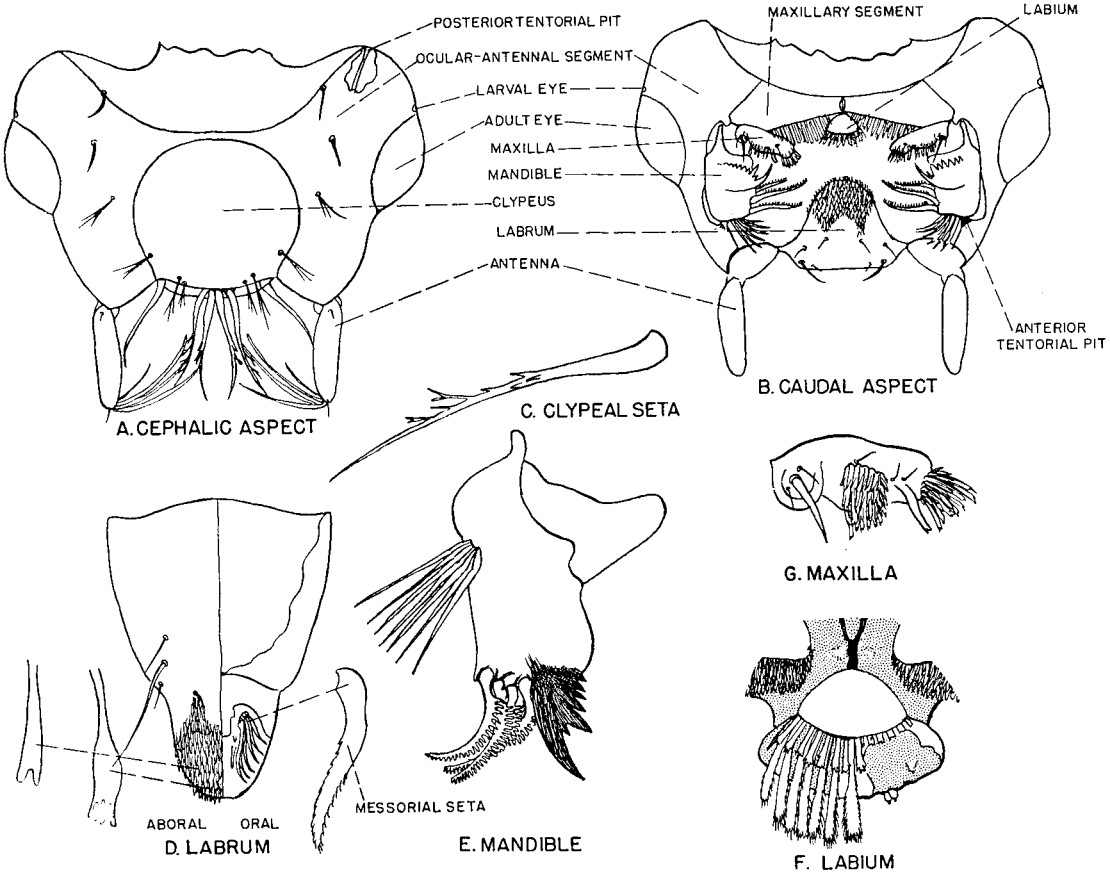


Fig. 22. *M. velutinus*—larval head and mouthparts.

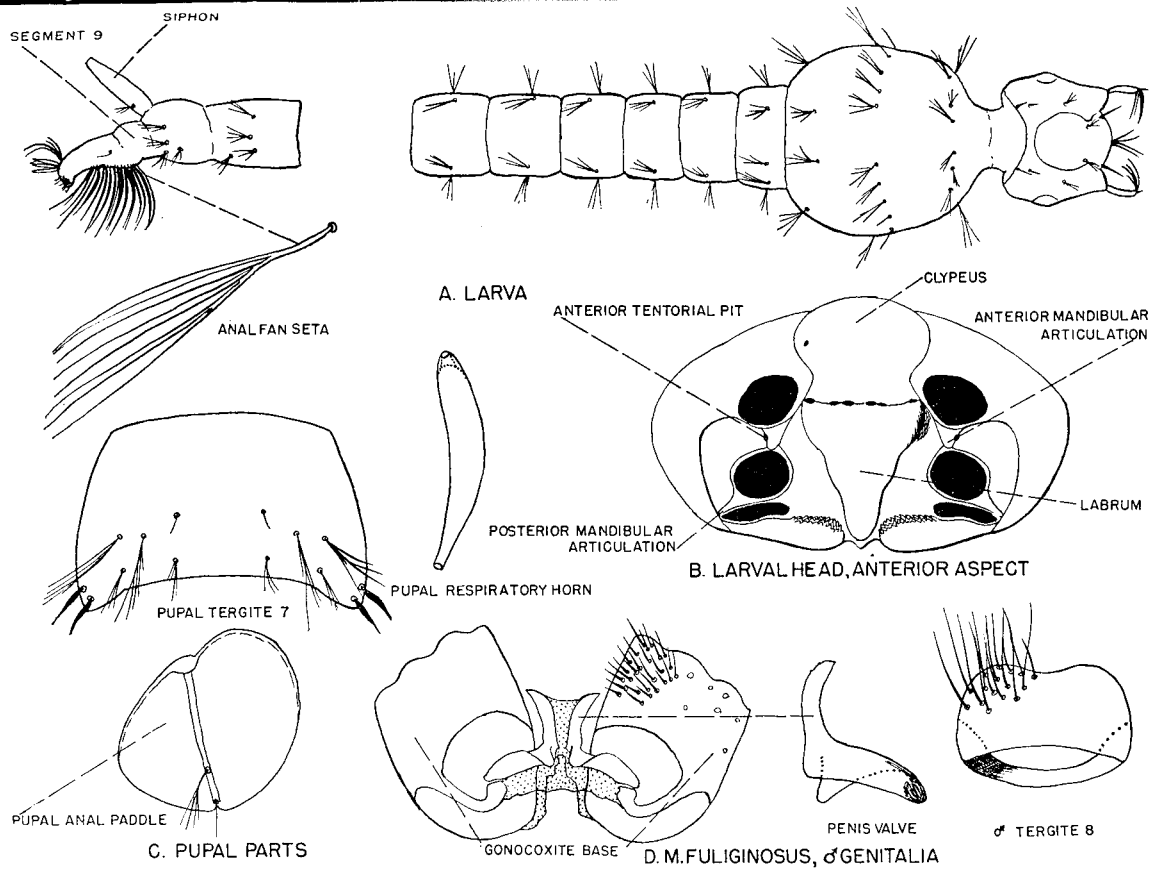


Fig. 23. *M. velutinus*—pupal and larval parts; *M. fuliginosus*—male genitalia.

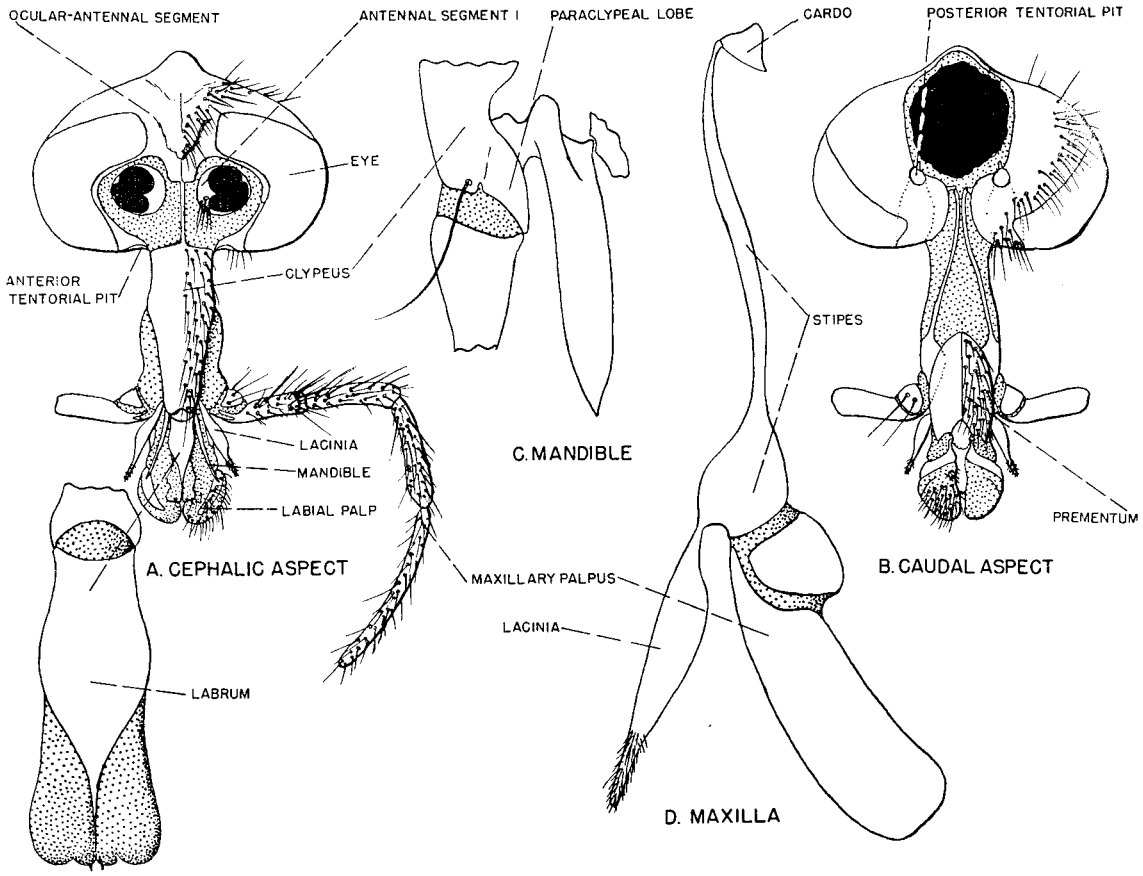


Fig. 24. *Eucorethra underwoodi*—head and mouthparts of female.

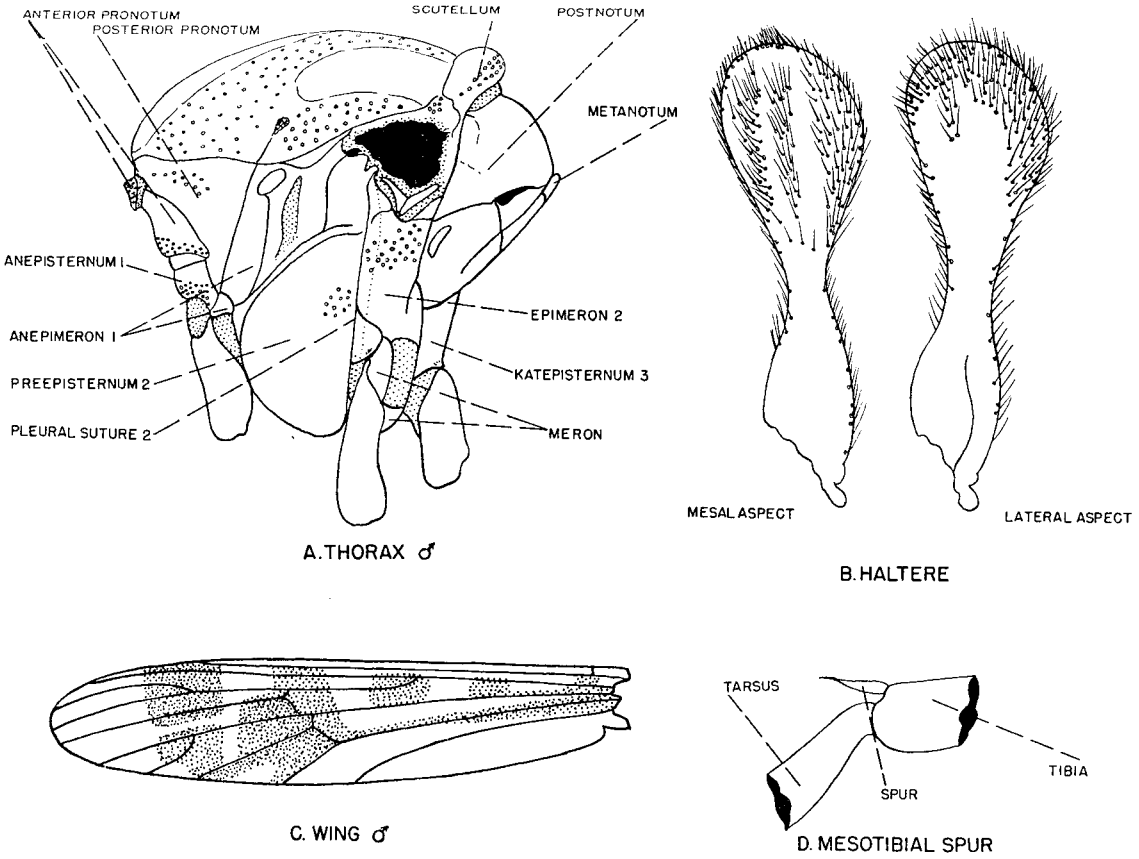


Fig. 25. *E. underwoodi*—thorax and appendages.

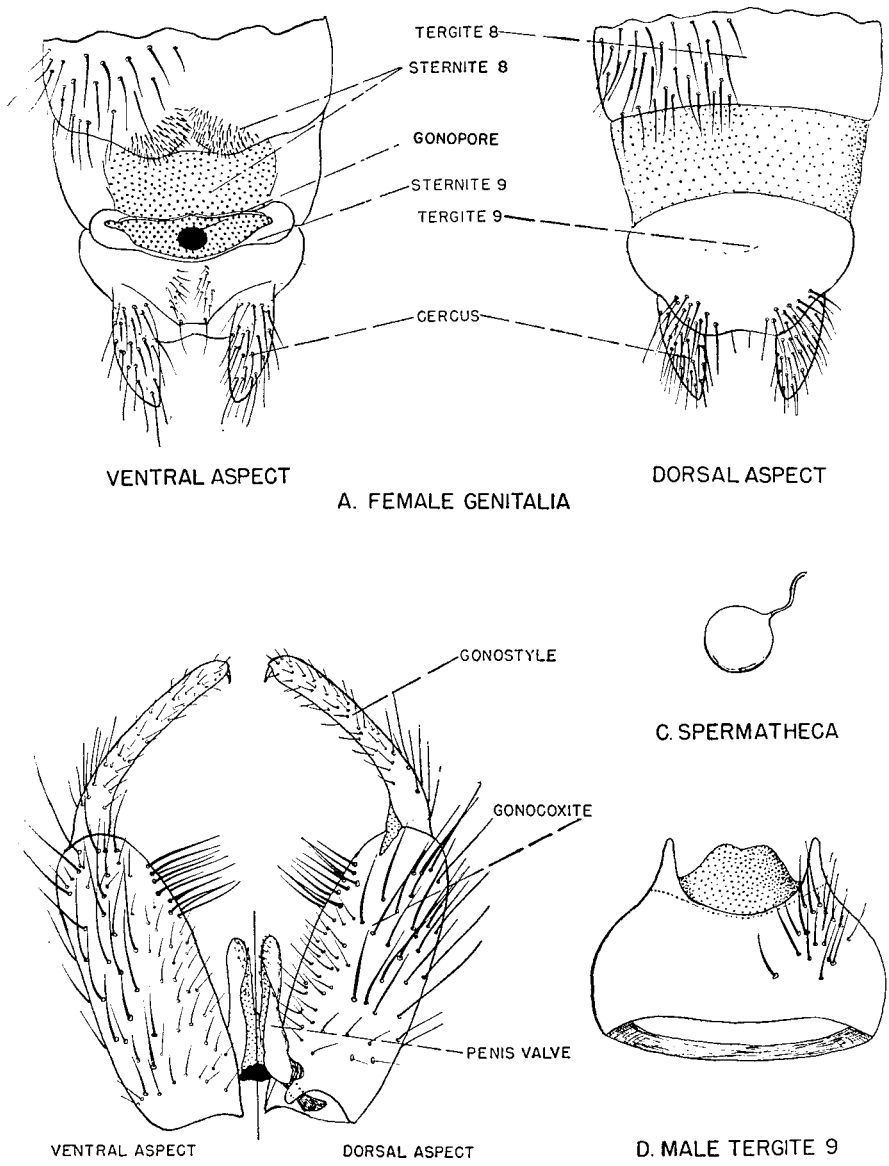


Fig. 26. *E. underwoodi*—male and female genitalia.

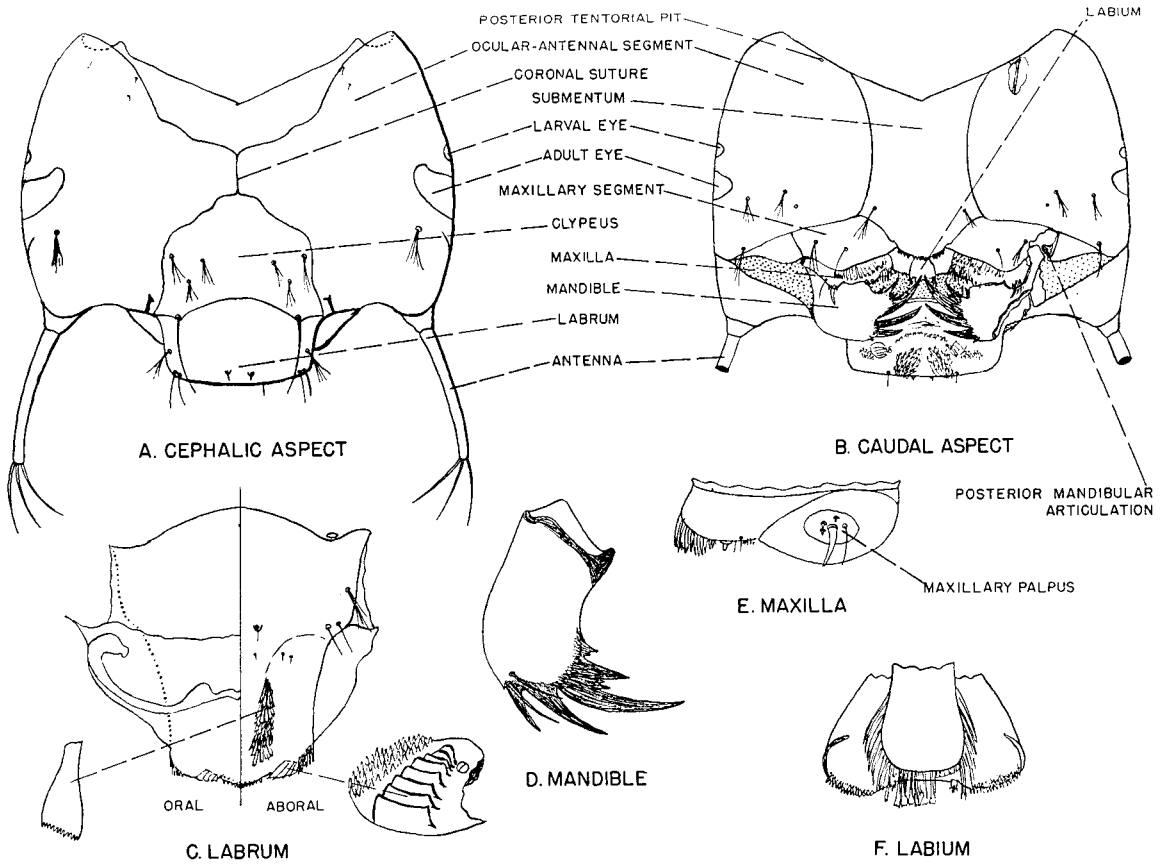


Fig. 27. *E. underwoodi*—larval head and mouthparts.

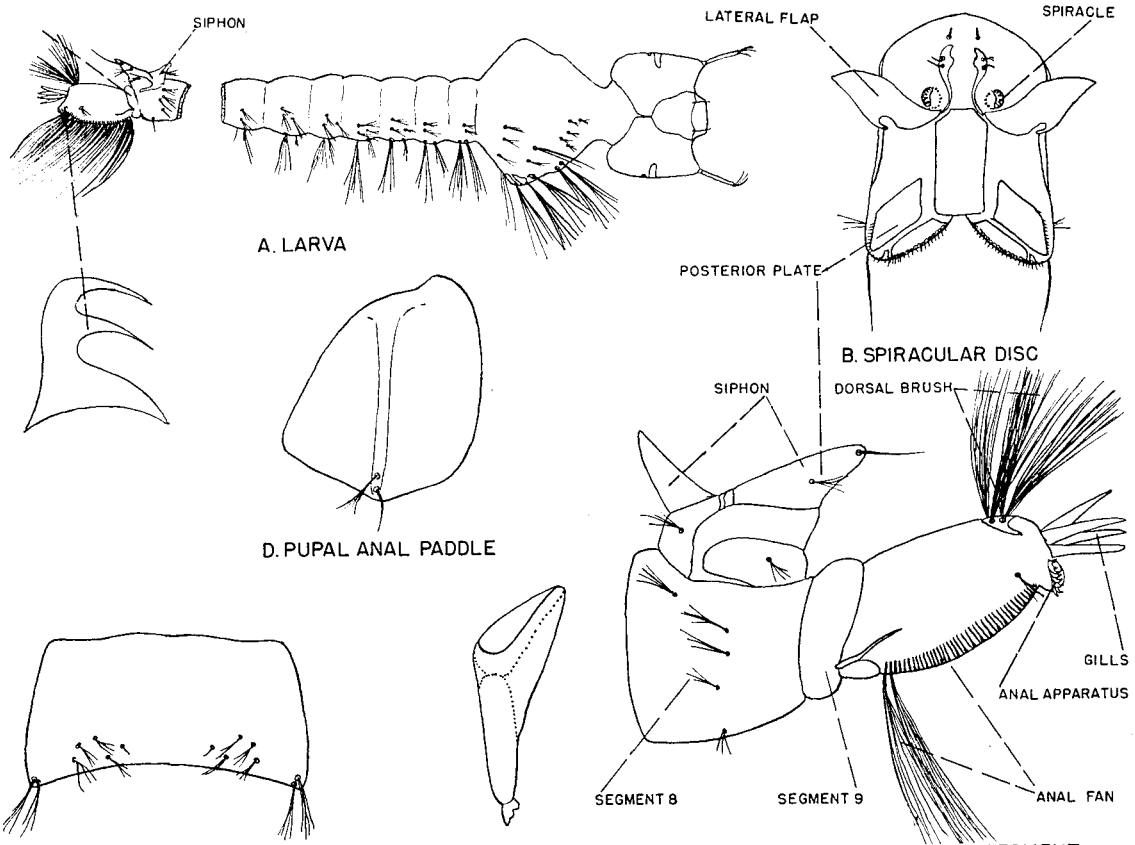


Fig. 28. *E. underwoodi*—larval and pupal parts.

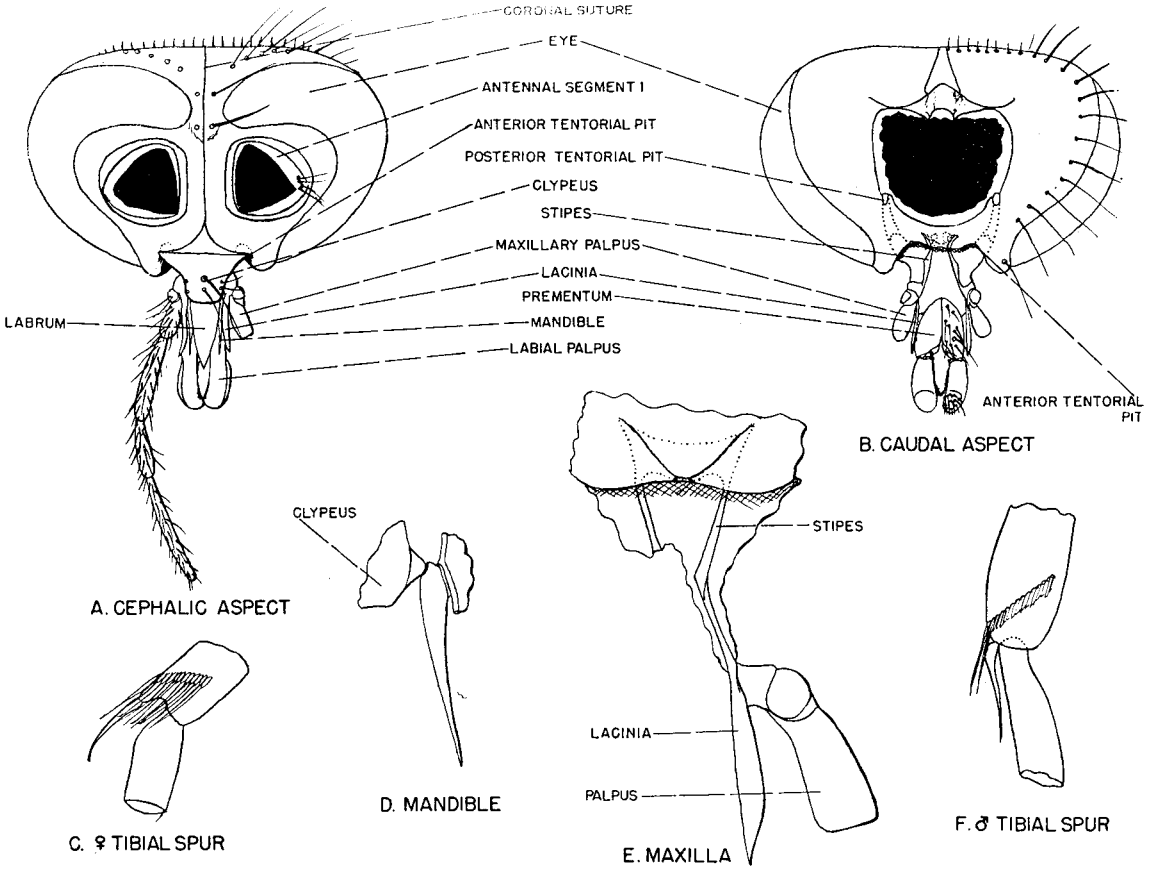
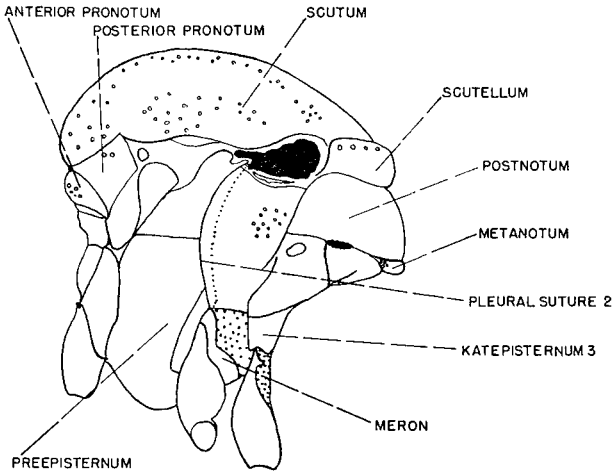
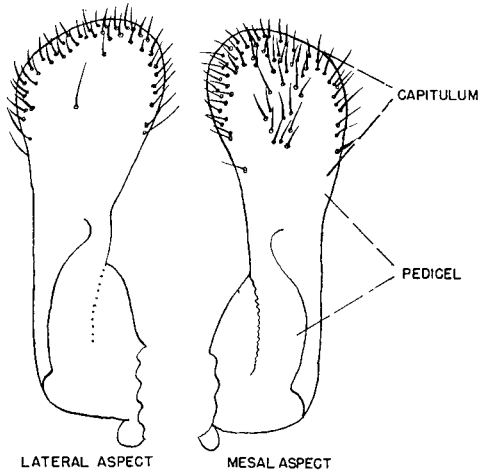


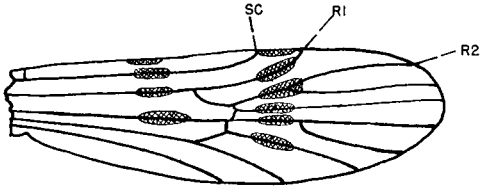
Fig. 29. *Corethrella brakeleyi*—head and mouthparts of male, tibial spurs.



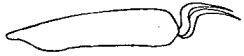
A. MALE THORAX



B. MALE HALTERE



C. MALE WING



D. MALE MESOTHORACIC CLAWS

E. MALE PROTHORACIC CLAWS

Fig. 30. C. *brakeleyi*—thorax and appendages.

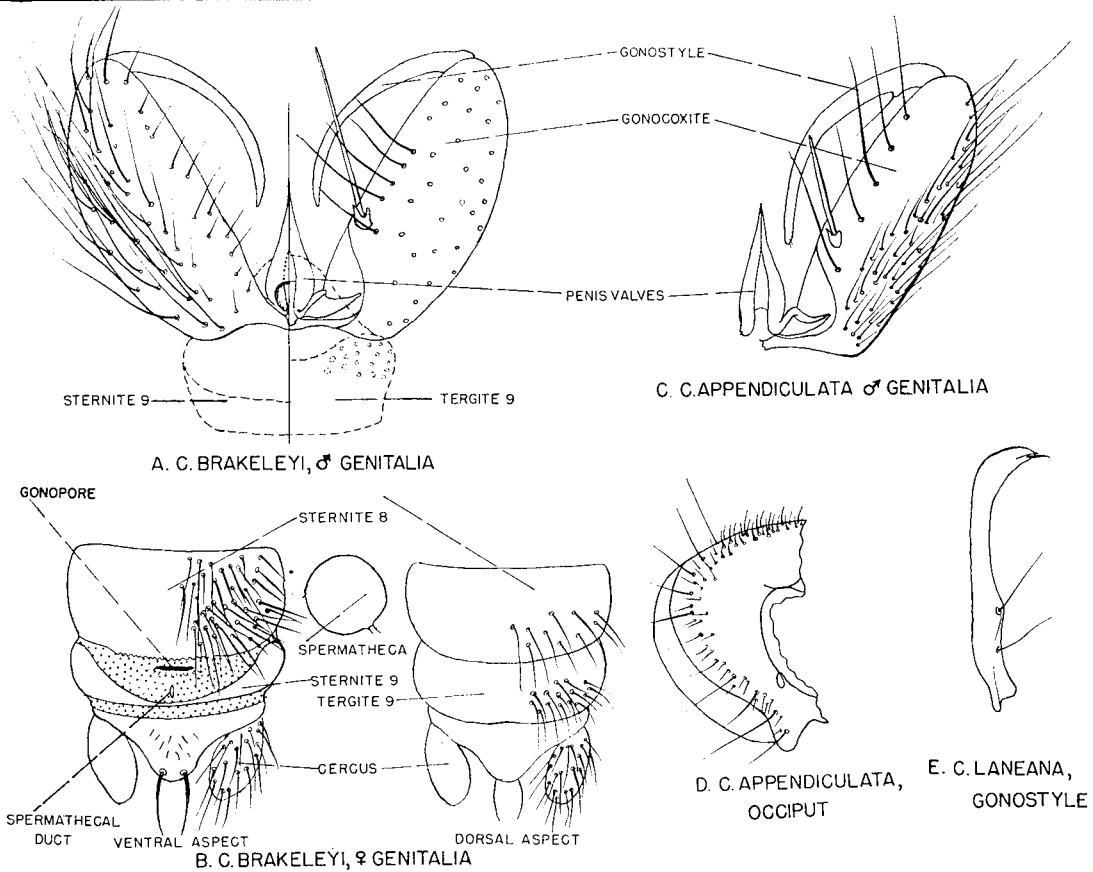


Fig. 31. C. *brakeleyi*—genitalia; C. *laneana*—gonostyle; C. *appendiculata*—male genitalia, occiput.

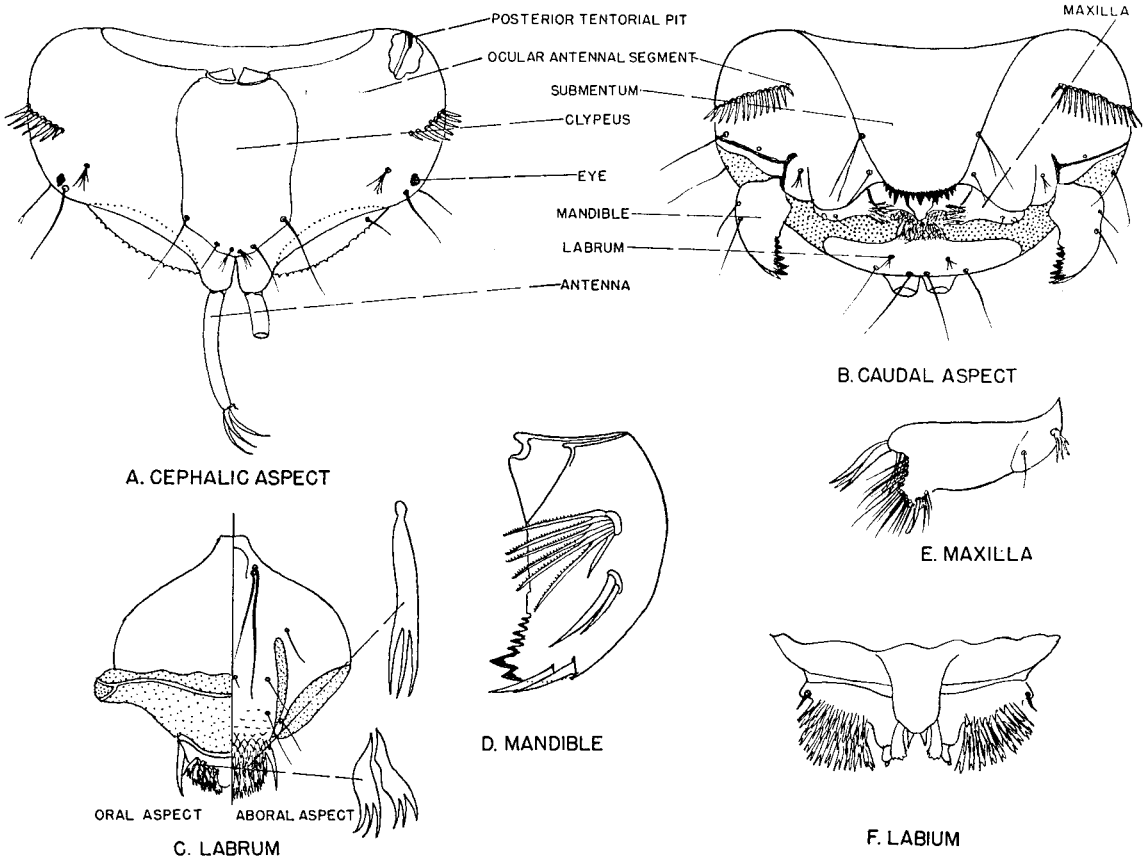


Fig. 32. C. *brakeleyi*—larval head and mouthparts.

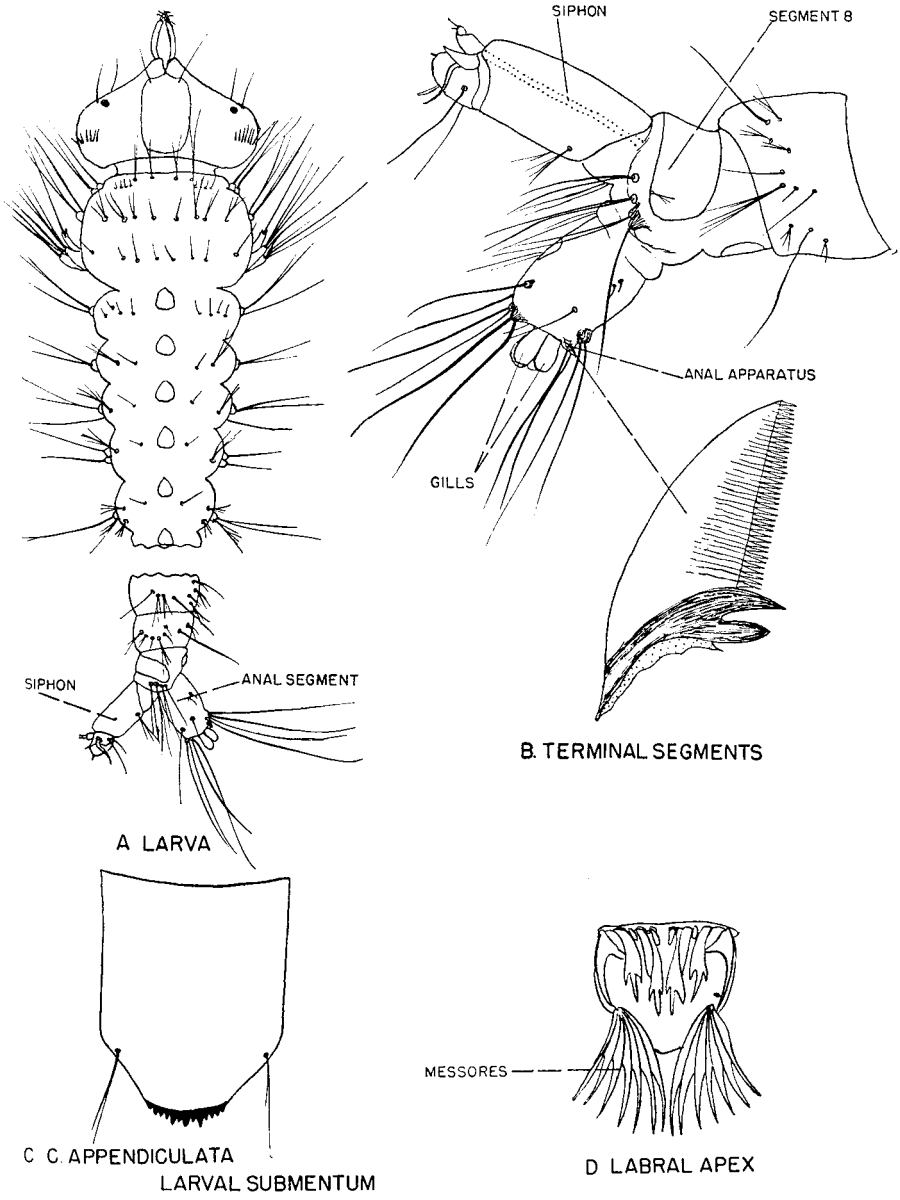


Fig. 33. C. *brakeleyi*—larva and details; C. *appendiculata*—details of larva.

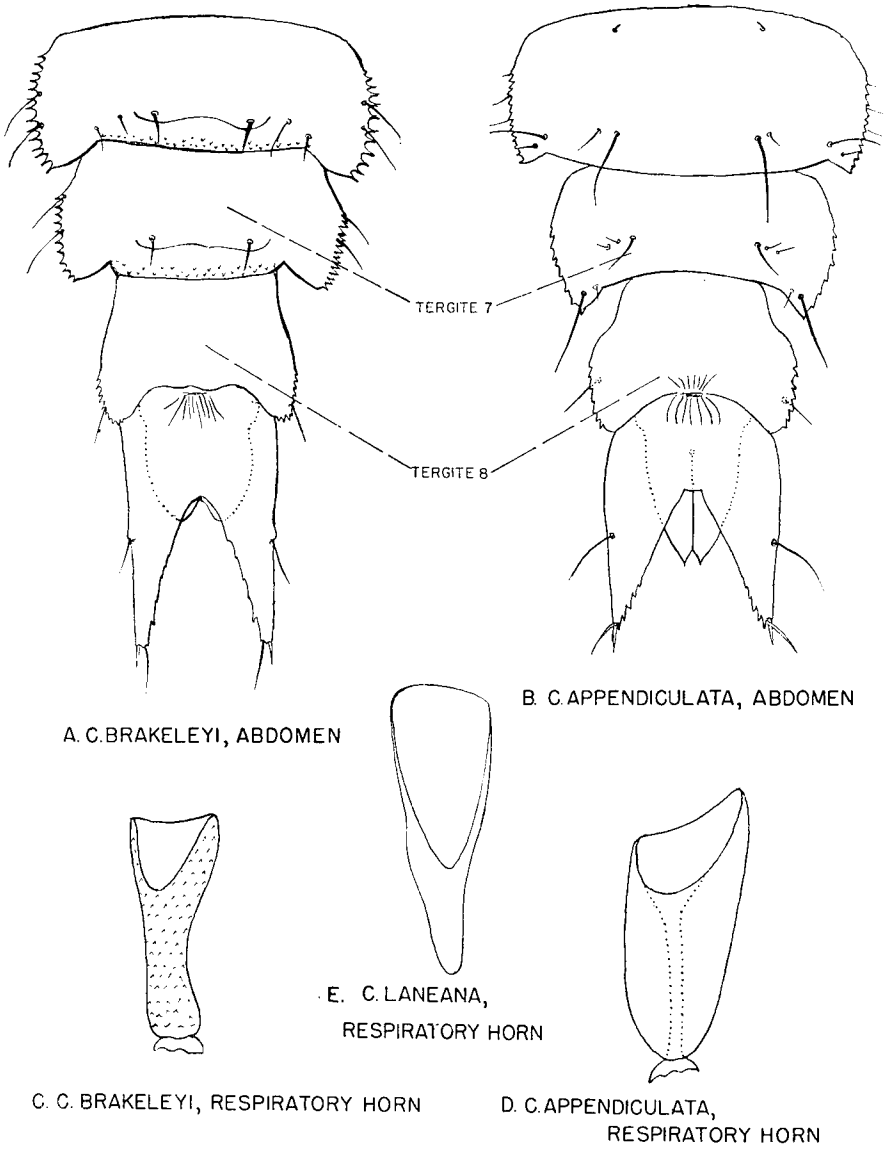


Fig. 34. C. *brakeleyi*, C. *laneana*, and C. *appendiculata*—pupal parts.

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