Manual for the Identification of Aquatic Crane Fly Larvae for Southeastern United States

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INTRODUCTION[1]

Tipulidae, or crane flies, are the largest family of Diptera, including more than 14,000 known species. Since by far most of the species were described by Charles P. Alexander, I follow his concept of the family here in this manual, its three subfamilies (Tipulinae, Cylindrotominae and Limoniinae) and the 107 groups (49 genera, 91 subgenera) recorded from southeast North America. This concept also agrees with that used in current North American manuals such as Alexander and Byers (1981) and Byers (1996). Some European authorities on crane flies recognize three or four families, which correspond in part to the subfamilies just mentioned (for example, see Savchenko, Oosterbroek and Stary, 1992; Stary, 1991).

Most species of Tipulidae are found in moist environments. The adult flies often occur in low plants beside streams and ponds. They are particularly abundant and diverse in forested places; however, a surprising number of species occur in grasslands, cultivated fields, urban and suburban environments and even in desert habitats.

Larvae of aquatic Tipulidae may be found in most shallow freshwater environments, such as ponds, streams, marshes and seasonally flooded forests. Many species feed on organic debris, such as dead leaves and the associated microorganisms in leaf packs, often in mud or sand, or beneath rocks in these habitats. Others inhabit and feed on algae and mosses that grow where water flows slowly over rock cliffs or where water splashes on rocks near waterfalls. A few kinds may be found in tree-holes or in the littoral (intertidal) zone of the ocean shore. In freshwater environments, larvae of some genera (*Pedicia, Hexatoma*, etc.) are predators feeding on small insects including larvae of some other kinds of crane flies.

Terrestrial larvae of some Tipulinae may, when numerous, cause economic damage to forage crops, including turf, or to seedling plants by feeding on the roots. Aquatic larvae of a few tipuline species occasionally are pests in rice fields. Most aquatic crane fly larvae are primarily of ecological importance, in the reduction of organic debris, including dead leaves and wood that fall in the water. Both adults and larvae are important in the diets of some other insects, as well as of fishes, birds, mammals, amphibians, reptiles and spiders.

The life cycle in Tipulidae consists of a short egg stage (from a few days to two weeks), four larval growth stages, a pupal stage of 5 to 12 days and a brief adult stage, usually of only 4 or 5 days. The duration of the life cycle is influenced by environmental conditions such as temperature, moisture and availability of suitable food. A species having two generations per year in southern North America may have only one in more northern latitudes. Many aquatic species have a single generation per year. In species with two generations per year (a common occurrence at temperate latitudes), on entire cycle may be completed in about three months, in summer, while the other lasts about nine months. Some small limoniine crane flies have more than two generations per

[1] Modified text from Gelhaus and Byers, 1995

year. In far northern North America and in high mountains, the life cycle for some species may require two years (that is, two summer seasons for larval growth).

The larvae of only a few genera are truly aquatic in the sense of being able to obtain dissolved oxygen from the water surrounding them. These include *Antocha* and *Hesperoconopa* species, which are apneustic (lack spiracles) and some species of Tipula (e.g., *Arctotipula, Nippotipula*) in which spiracles are present but non-functional. Some larvae in the subgenus *Erioptera (E.*) apparently obtain oxygen by tapping into aquatic plant roots or the soil surrounding them. Some other kinds of crane fly larvae can remain submerged for expended periods of time, apparently obtaining oxygen by means of elongate membranous anal gills as in *Pseudolimnophila* or in the subgenus *Yamatotipula* of *Tipula*. But the anal gills are not well developed in several other genera, and cutaneous respiration may be possible, although this as not been adequately investigated. Many larvae living in shallow water obtain oxygen from the air by extending the spiracular disc to the surface and holding back the water by means of hairs that surround the disc. With rare exceptions (for example, *Antocha*), the pupae of crane flies also require access to the air; therefore, most aquatic larvae leave the water and pupate in the mud, dead leaves, mosses or soil along the shore.

Little is known about the immature forms of Tipulidae in southeast North America, in fact, even species distribution based on adults is poorly sampled for this region (see species list). For this reason, the following key and illustrations have been based largely upon North American or European species that belong to genera occurring in this region. Several regional genera are unknown in the larval form. The biology and life-history of crane flies is a vast and only slightly explored field, greatly in need of interested students.

HOW TO USE THIS MANUAL

This manual is a first draft compilation and modification of a number of published works on larval taxonomy of Tipulidae. The scope of this work is regional and habitat delimited. This manual includes only those aquatic and semi-aquatic generic and subgeneric groups that occur, or are likely to occur, in the southeastern corner of North America (from Virginia and Kentucky south to Louisiana and Florida). When using it, please keep in mind that you may still need to reference other keys, particularly when a specimen does not match well to what is in this manual. Key references to consult are found in Alexander and Byers (1981) for a generic key for all larval North American crane flies (terrestrial to aquatic), Byers (1996) for a generic key for all larval North American aquatic tipulids, and Gelhaus (1986) for a larval key to the subgenera of *Tipula* for North America.

Along with the use of this key, I ask the user to please send comments to me where this key and information can be improved. This might include problem larval specimens. Please keep in mind that only a minute percentage of crane flies have been reared, and therefore our knowledge of the larval taxonomy of this vast group relies on just a few species. It should be expected that one will encounter new larval types other than represented here. I am also greatly interested in habitat associations and information relating presence/absence of groups with water quality parameters.

SPECIMEN COLLECTION, REARING AND PREPARATION[2]

The diversity of habitats occupied by larvae of *Tipula* requires a variety of collection methods. Details are given by Gelhaus (1983). A sturdy garden trowel is indispensable for collecting in aquatic and terrestrial situations. Uses include clearing aside soil in forest situations; digging up saturated soils bordering aquatic habitats for sieving; or dislodging gravel and rocks on the bottom of fast-flowing streams and rivers. Both a D-frame aquatic net and forceps have limited use when collecting larvae of *Tipula*. The D-frame net is desirable when larvae inhabit leaf packs (e.g., *Nippotipula*) or are under rocks in rivers and streams (e.g., *Sinotipula*). Heavy forceps are needed for hand collecting in aquatic habitats that are too small for D-nets or sieves, such as shallow seepages or springs. Detailed examination of mosses or soft, rotting logs requires forceps.

As briefly discussed by Brindle (1960c), the use of a sieve when collecting in saturated soils is highly recommended, as larvae are cryptically colored, slow moving and easy to overlook when only hand collecting with forceps. A 1 mm mesh screen is adequate for retaining all late-second instar and older larvae (Brindle suggests 1/16 of an inch). When sieved, a larva usually curls up for a short time, or if small and very active, it may move through the sieve mesh. A sieve works best in fine, sandy areas; it is not as efficient in heavily organic areas with large amounts of plant debris. In all cases, though, sieving reduces the amount of material to be sorted through and washes debris from the larvae, making them more visible.

Terrestrial and semiaquatic larvae almost always live within 50 mm of the substrate surface, regardless of climatic conditions. Larvae of the related genus *Dolichopeza* remain near the surface even during the winter when their habitat is frozen (Byers, 1961), and I have observed similar behaviors in larvae of the subgenera *Lunatipula*, *Pterelachisus* and *Vestiplex*. Hot, dry summer weather also does not appear to force larvae to move deeper into the substrate. *Tipula (Trichotipula) stonei*, in fact, develops and matures during the summer, and even during a prolonged drought, larvae were found in the top 30-50 mm of dry forest soil. *Tipula (Lunatipula) oxytona* moves downward to 200 mm during dry periods (Rogers, 1933), but this appears to be an exceptional instance and may be related to this species' occurrence in sandy soils which rapidly lose moisture near the surface.

For species whose larval habitat is unknown, certain predictions can be made by observing the behavior of the adults or by knowledge of larval habitats for related species. Adults may occur away from the specific larval habitat. Teneral adults or ovipositing females give a clearer idea of where larvae occur, as does the activity of males seeking newly emerged females. Pupal collections are useful, for pupae occur near the larval habitat or even among the larvae. In species with highly synchronous adult emergences, however, once pupae are found, few individuals will remain as larvae, and a return visit is required during the next generation to secure larvae.

Snap-cap glass vials (60 ml), one-third filled with soil or other habitat material and each with only one or two larvae, are excellent for field use and allow larvae to be easily recovered once in the laboratory. Self-sealing plastic bags are excellent for transporting larvae over a long time period, when many larvae are found in one specific site, or if associated soil or debris from the larval habitat is needed for rearing or sieving in the laboratory. The bags should be one-third to one-half filled with substrate from the larval habitat. The collections are then kept cool until brought into the laboratory, as even short periods of heat (as in a vehicle on a warm day) will kill the larvae. Larvae from aquatic habitats should be transported in damp debris, mosses or leaf litter; although from an aquatic habitat, they are susceptible to drowning.

A single microhabitat may yield more than one species of larvae; therefore, larvae should be carefully sorted before placement in rearing chambers. Larvae often expose the spiracular discs at the surface when placed in water, permitting identification in life with a microscope. Chilling the larvae for a few minutes helps if they are very active.

A proper rearing container must admit fresh air and maintain an even moisture level. Both Chiswell (1956) and Byers (1961) recommended Petri dishes, but I found such dishes of limited use. Petri dishes have a small volume, are easily

[2] Text from Gelhaus, 1986 on larval *Tipula*

kept too wet, but also quickly dry out. The small volume also allows overcrowding even when there are only a few larvae per dish. Petri dishes are advantageous for observations of larval behavior, but for rearing, I prefer glass containers 40-80 mm high and 100 mm diameter. Such jars hold enough food (i.e., leaf litter, rotting wood, etc.) from the habitat to allow late-third or fourth-instar larvae to develop to the pupal stage. Moreover, they do not require daily checking for food depletion and moisture control. Aquatic species need only wet litter or, at most, a small amount of free water; terrestrial species should be kept just damp. Ideally, one larva should be kept per container; practically, I have kept up to six larvae per jar.

All *Tipula* reared have been herbivorous or saprophagous. Wet, decaying leaves for aquatic species and damp leaves or debris for terrestrial larvae suffices for most; some species of *Yamatotipula, Platytipula* and *Triplicitipula* will accept and feed readily on young green shoots of common weeds (Young, 1981; Gelhaus, personal observation). When conditions are adequate, larvae remain buried within the debris or soil during the day.

Although in most cases it is best to try to duplicate the natural conditions of the larval habitat in the laboratory, in some situations this is not desirable. It is not necessary to maintain species from rapidly flowing streams or rivers, such as some *Sinotipula* or *Nippotipula*, in constantly aerated water. Gordon Pritchard *(in litt.)* reared larvae of *T. (Sinotipula) commiscibilis* in containers of wet leaves at 15 degrees C., although they were originally collected from a fast-flowing, cold, mountain stream. Many species are influenced by photoperiod, particularly when about to pupate; they should be exposed to a source of natural light or to artificial light of similar periodicity (e.g., *Platytipula*).

Since a female *Tipula* may lay 200-300 eggs, rearing larvae from eggs would appear to be ideal for obtaining many larvae of a single species. Unfortunately, the life histories of many species cause problems in rearing and in maintaining laboratory cultures. Some mated females are reluctant to lay. Although pinching the cervical region of the female will often induce egg laying, it is not reliable. Eggs of many species undergo an obligate diapause that is broken only when they are exposed to certain photoperiods, temperatures or moisture conditions. For example, Hartman and Hynes (1977) found that the eggs of *T. (Triplicitipula) simplex* would only hatch after exposure to a certain photoperiod and alternating wet and dry conditions. I found that eggs of an undescribed species of *T. (Platytipula)* only hatched after exposure to cold and typical winter photoperiods. Other groups have eggs which hatch soon after being laid (approximately one week). Subgenera with brief egg stages include *Nippotipula, Bellardina* and most species of *Yamatotipula*. Eggs of *T. (Nobilotipula) nobilis* had no apparent diapause but took approximately three weeks to hatch. Eggs of *Lunatipula, Pterelachisus* and *Savtshenkia* appeared to have a developmental diapause but the cues breaking the diapause are unknown.

First-instar larvae have a high initial mortality, and many eggs never hatch. After larvae start feeding, though, provided food depletion and overcrowding are prevented, mortality is minimal and they usually develop rapidly. For example, *T. (Yamatotipula) tricolor* completed a generation in 69 days in the laboratory.

As larvae reach maturity, it is important to watch for inactive larvae or teneral pupae. As noted by Byers (1961) for the tipuline genus *Dolichopeza*, larvae prior to pupation are contracted and inactive. As the pupal molt becomes imminent, the larval head is deflected ventrally and pupal structures become visible through the larval cuticle. Most aquatic larvae leave the water to pupate in drier soil; most pupae immersed in water quickly die. Some species have an obligate, fourth-instar, larval diapause in which they remain contracted and inactive during the summer. I have observed this prepupal diapause in certain species of *Yamatotipula* (e.g., *T. sayi*), all reared species of *Platytipula* and *T. (Nippotipula) abdominalis*.

The best association of immature and adult stages of a species is from the last larval skin, pupal skin and emerged adult of a single individual. All the morphological characters that are needed for identification can be located on the shed skins and there is little likelihood of an erroneous association. The last larval skin is usually found near the posterior end of the pupa and may be crumpled into a compact mass. If found within one or two days after pupation (pupa will still be white or light brown), the skin can be easily stretched and cleaned in water. If the skin does not tear easily when stretched or is known to have been recently shed, I place it in water in an ultrasonic cleaning appliance and vibrate it for 10-15 seconds. The cleaned skin is then quickly restretched and stored in 70-80 percent alcohol to which a small amount of glycerin has been added.

Soon after the first pupae are found, I preserve some of the remaining larvae. Chiswell (1956) and Brindle (1960c) recommend preserving larvae in Pampel's fluid, but I have found

that it is satisfactory to kill larvae by pouring water near the boiling point on them, then transferring them to storage in alcohol. This heat treatment is necessary for the expansion of the spiracular disc. Killing larvae in alcohol is unsatisfactory and results in shrunken, contracted specimens. I rarely preserve larvae in the field but, when necessary, Kahle's solution gives reasonably good specimens. Before storage in alcohol, killed larvae should be placed in the ultrasonic cleaning appliance for 10-15 seconds to remove fine dirt particles.

Pupae should usually be isolated from larvae, particularly if the rearing container is crowded. Pupae are delicate and should be handled as little as is possible. They can be transferred to a layer of fine damp sand or soil in a large vial with a loose fitting cap. The emerging adult needs a vertical space at least twice the length of the pupa to develop and expand properly. Once the adult has emerged, the pupal skin can be soaked for 5-10 minutes in water, then washed in a stream of water or placed in the ultrasonic vibrator. Unlike the debris on a larva or larval skin, dirt on a pupal skin is difficult to remove completely.

MORPHOLOGY[3]

Larvae of most kinds of crane flies are elongate and subcylindrical, tapering slightly toward the head and posterior ends. The head is strongly sclerotized anteriorly, with somewhat less sclerotized plates or rods extending backward with the prothoracic segment and separated by shallow or deep posterior incisions. The thoracic skin is attached to the head close behind the mouthparts and antennae, and the head can be completely withdrawn into the thoracic region. The mouthparts are well developed. There are three thoracic segments and eight distinct abdominal segments. The surface surrounding the posterior spiracles is considered to be the main part of the ninth abdominal segment. Membranous anal papillae (sometimes called anal lobes if short and blunt, or anal gills if they appear to have a respiratory function) belong to the tenth abdominal segment.

Most abdominal segments are divided into two rings or subsegments. A transverse, slightly raised band with stiff hairs or small blackened spines may occur on the ventral surface, or on both ventral and dorsal surfaces, of one of these rings, usually the anterior one. In the following key, these are called "creeping welts" since they function in movement of the larva. The skin may be somewhat tough and of grey or brown color in some species of *Tipula*, or it may be thin and nearly transparent in some other genera. Hairs on the skin may be sparse or abundant and of differing lengths , particularly in the subfamily Tipulinae. The position of setae is used in the classification below the level of the genus .

Most larval Tipulidae are metapneustic. That is, the dorsal tracheal trunks open posteriorly only, by way of two large spiracles on a smooth posterodorsal surface close behind the eighth abdominal segment. This surface is the spiracular disc. It is surrounded by lobes that vary in number, shape, extent of sclerotization and the length of their marginal hairs, depending on the genus and species . Because of this variation, the appearance of the spiracular disc is often used in the recognition of larvae. The larvae of Tipulinae usually have four lobes above the spiracular disc and two on the lower edge of the disc. Larvae of Limoniinae usually have three lobes above the disc (less often only two, or without distinct lobes) and two below .

Earlier authors often relied on structure of mouthparts to differentiate crane fly larvae; but in the following key this has been avoided where possible because it is difficult to dissect such small parts. Finer level of identifications often require examination of mouthparts (see Alexander and Lloyd, 1914; Wiedenska, 1987). Below the mandibles and maxillae is a median structure formed by sclerotized extensions of the post-occiput on each side. This is the hypostomal bridge (called the mentum, mental plates, or maxillary plates by some authors). It characteristically has teeth on its anterior edge (, but it may be reduced to a small extension from each side, with no medial sclerotization . In larvae of the tribes Pediciini and Hexatomini (subfamily Limoniinae), the maxillary palps are conspicuously prolonged forward and their tips may be seen even when the head is withdrawn in the thorax.

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[3] modified from Gelhaus and Byers, 1995

Morphology of larval *Tipula*[4]

Morphology

Larvae of *Tipula* are elongate and cylindrical, tapering slightly at the cephalic end (Fig. 3). Mature larvae range from 12 to 60 mm in length. The black head is only partially visible, as the larval skin is attached near the anterior end of the head. The posterior end of the larva has short to long lobes surrounding two conspicuous spiracles. Beneath this spiracular area are often whitish lobes, varying in number and length, surrounding the anus. The body varies from white to brown, occasionally having a pinkish tint. Tufts of hairs and dark setae may also be seen, or the larva may appear completely hairy. Sometimes there are patterns of longitudinal lines or spots on the abdomen.

The head varies slightly from group to group, and the characters that vary are not well-suited for identification purposes. It is not described for any of the taxa treated here. A treatment of the head and its parts is found in Chiswell (1955) for *Tipula* and in Byers (1961) for a related genus, *Dolichopeza*.

Three thoracic and eight abdominal segments are clearly visible, although there are actually ten abdominal segments, according to Byers (1961). The obvious segments can be recognized by the transverse row of setae found on each segment, dorsally and ventrally. The prothoracic segment has two rows of dorsal setae, but this does not indicate two segments (Byers,

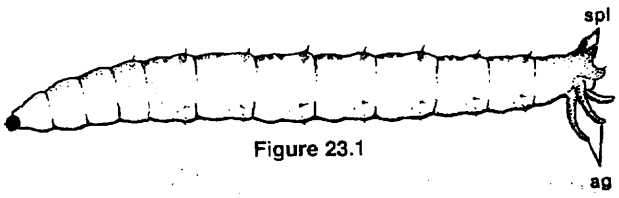


Figure 23.1. Lateral view of larva of *Tipula* (*Yamatotipula*) *furca* Walker, *ag*, anal gills; *spl*, spiracular lobes.

Byers 1996

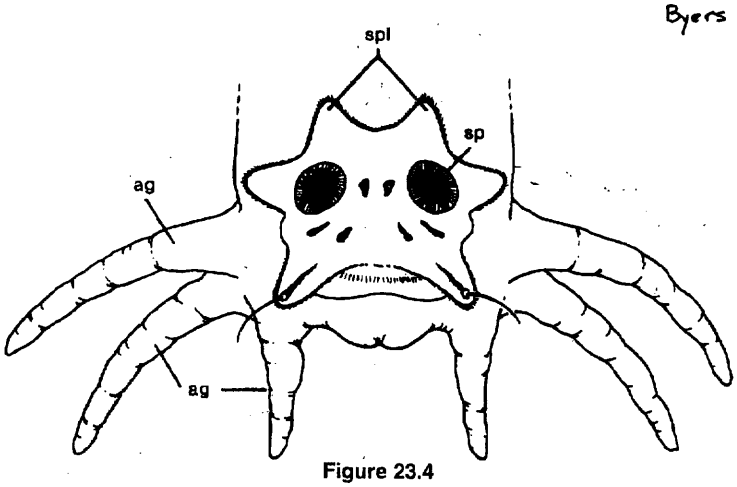
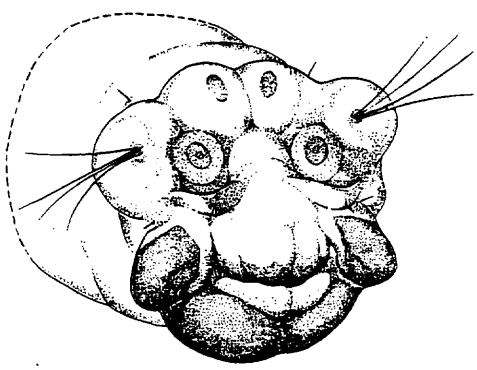


Figure 23.4. Posterior end of larva of *Tipula* (*Yamatotipula*) *furca* Walker, *ag*, anal gill, *sp*, spiracle; *spl*, spiracular lobes.

Byers 1996



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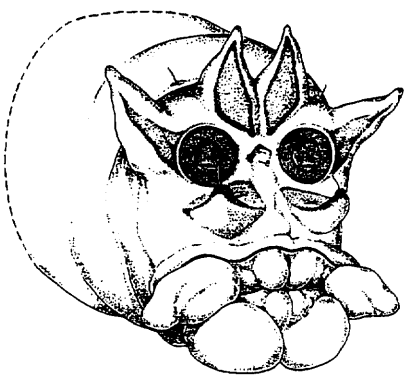
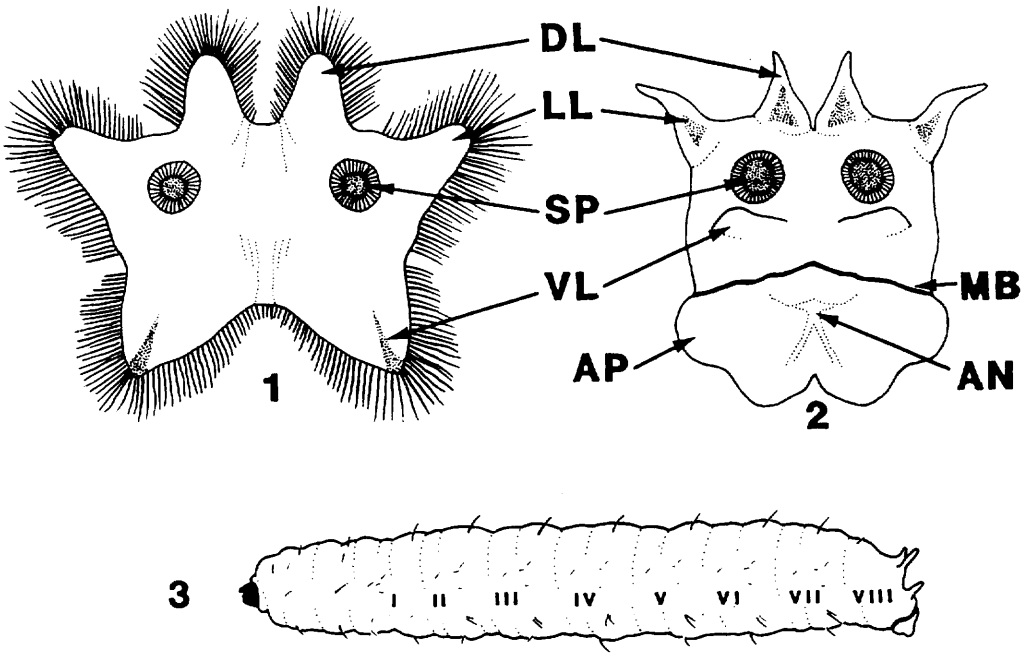


2

Hartman + Hynes 1982

Figs. 1–3. Figs. 1, 2. Caudal view of *Tipula simplex*. Fig. 1. First instar larva. Fig. 2. Fourth instar larva.

[4] from Gelhaus 1986



Figs. 1-3. General morphology of *Tipula* larvae. 1, spiracular area, aquatic larva. 2, spiracular area, terrestrial larva; AN-anus, AP-anal papilla, DL-dorsal lobe, LL-lateral lobe, MB-marginal band, SP-spiracle, VL-ventral lobe. 3, *T. stonei*, lateral aspect, abdominal segments I-VIII labelled; length 18 mm.

1961:734). Abdominal segment IX contains the spiracles and the immediately surrounding region. The anus and the perianal region constitute abdominal segment X, as in the adult. Abdominal segments I-VIII each appears subdivided, with a large, anterior portion (annulus) and a narrow, posterior section containing the dorsal and ventral macrosetae (Figs. 3, 16).

The cuticle is tough, hence the common name, "leather-jackets." Strong sclerotization is almost always restricted to the lobes surrounding the spiracles; the one exception is in the *T. (Lunatipula) disjuncta* group, in which dark sclerites extend from the lobes onto the dorsum of abdominal segment VIII (Fig. 56). The cuticle itself is light brown; any darker regions are caused by concentrations of hairs.

Chiswell (1956) was the first to treat the macrosetae in detail. He illustrated setal arrangements for various genera of Tipulinae and consistently applied a numbering system for the setae which I have adopted here; the homologues can be traced from genus to genus.

When specimens are roughly handled, the macrosetae can be broken off. Although the positions of broken setae can be determined from the basal sockets, information concerning setal length, thickness, and color is lost. Breakage is a primary reason for concentrating on abdominal setal arrangements; thoracic arrangements are found on only three segments, with the same arrangement repeated on the mesothorax and metathorax. In contrast, abdominal arrangements are repeated on the first seven abdominal segments, so that breakage is less of a problem.

Macrosetae of aquatic larvae are long, thin, light to dark brown (Fig. 9), and may be obscured by dense hairs. Certain aquatic groups possess setae that are branched (setae D6, L3, V1), with the distal halves of these setae divided into two to four branches (Figs. 9, 66). Branched setae have not been noted or illustrated by other authors, although groups in which the setae occur have been described.

Macrosetae of terrestrial larvae are almost always short, thick and dark brown to black (Fig. 81). Larvae of the *T. (Lunatipula) disjuncta* group and of subgenus *Odonatisca* are notable exceptions as the setae are elongate and yellow (Fig. 53). Because of the lack of long hairs on terrestrial larvae, the macrosetae are not usually obscured by hairs.

The arrangement of setae often differs be-

tween groups, but seems to be constant within a group (or, at least, within a particular species). Three sets of setae are present on each abdominal segment: dorsal, ventral and pleural. The dorsal and ventral setal arrangements are bilaterally symmetrical. Generally, there are six pairs of dorsal setae in two rows (Fig. 4a), five pairs of ventral setae in two rows (Fig. 4b), and four pleural setae (Fig. 4c). Seta L3 is below seta L2 and seta L1 is most often behind seta L2, but in *Nobilotipula* and the palearctic *T. (Platytipula) melanoceros* these three setae are in vertical alignment (Fig. 67).

Most aquatic or semiaquatic larvae possess the full complement of setae, but reduction in setal size, or complete absence of certain setae, is frequently seen in terrestrial larvae (e.g., Figs. 37, 54). Setae D4, D5, L1, L3, V1 and V5 are often considerably shortened and setae D5 and V1 are occasionally absent.

In addition to macrosetae, larvae of *Tipula* exhibit various kinds, sizes and patterns of finer hairs. Hairs are found on every segment except part of abdominal segment IX and most of segment X. The thoracic segments are usually covered by rather uniform, appressed silky hairs which provide no useful characters. On the other hand, hairs on abdominal segments I-VII exhibit much variation between groups and have been used in this study. On segment VIII and on the spiracular lobes they are usually long and uniform; hairs on the pleura are scattered and usually very short.

The hairs can be separated into three groups: macroscopic hairs, long microscopic hairs and short microscopic hairs. An idea of their sizes in relationship to each other and to macrosetae can be obtained from Figs. 105 and 147. In almost all larvae, the hairs are cylindrical and narrow, without longitudinal ridges, and usually dull brown (Fig. 8). In *Nobilotipula*, however, they are flattened, relatively broad, with longitudinal ridges and are reflective (Figs. 70, 71).

Macroscopic hairs are easily seen under low magnification and often equal or exceed the length of the macrosetae. They can be distinguished from setae because hairs lack the distinctive basal sockets. Although usually single, macroscopic hairs are sometimes organized into clusters or tufts. Hair clusters are made up of many hairs and surround setae D4, D5 and V2 (Fig. 147). They also may be found on abdominal dorsum VIII of *Yamatotipula* and other groups (Fig. 151) or on the apices of the spiracular and accessory lobes of *Nippotipula* (Fig. 60). They also form distinctive abdominal patterns in certain species of *Yamatotipula* (e.g., *pruinosa*, see Chiswell, 1956). Hair tufts are found only in the subgenus *Tipula* and are made up of a few, closely set dark hairs located near setae D5 and V2 but not surrounding them (Figs. 116, 117). The predominance of macroscopic hairs varies with the group but they are usually abundant only in aquatic larvae. For example, larvae of the subgenus *Angarotipula* and the *T. (Trichotipula) oropezoides* group are covered almost exclusively with these hairs (Figs. 8, 124). In *Schummelia*, they form a semicircular band on the dorsum of abdominal segment VIII (Fig. 98).

Short microscopic hairs are always organized into groups, usually short to long, transverse

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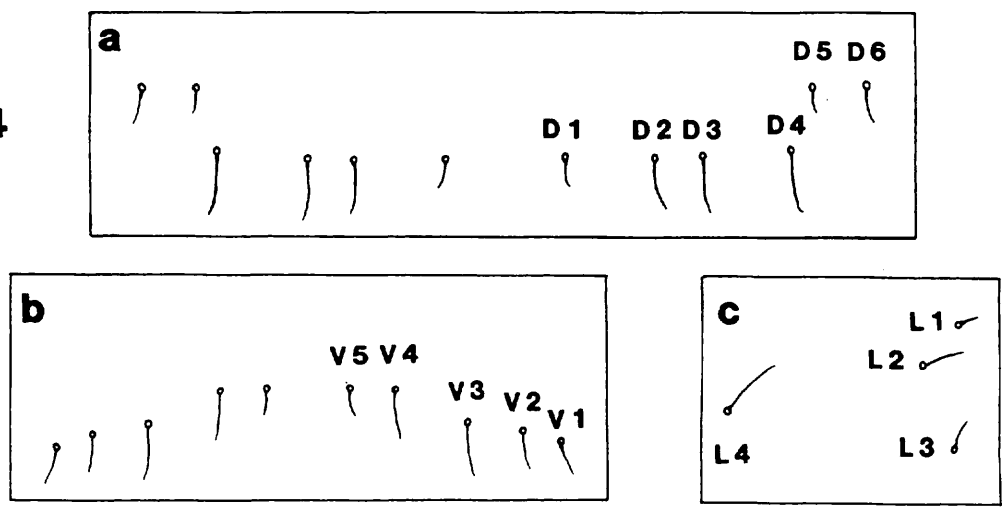


Fig. 4. Abdominal macrosetal arrangements. a, dorsal setae. b, ventral setae. c, pleural (=lateral) setae.

rows (Figs. 40, 47), and individual hairs may be difficult to discern at lower magnifications. In most terrestrial subgenera, such as *Lunatipula* or *Pterelachisus*, the body is almost exclusively covered with these hairs; a similar condition is found in the aquatic subgenera *Nippotipula*, *Sinotipula* and *Arctotipula*. Short microscopic hairs are entirely absent in *Tipula (Trichotipula) stonei* and the subgenus *Schummelia*. Light and dark short hairs sometimes form contrasting patterns, e.g., a spotted pattern in *T. (Yamatotipula) caloptera* (Fig. 150), dark longitudinal lines in *T. (Y.) strepens* (Fig. 151) and irregular designs in *Sinotipula* (Fig. 111) and certain species of *Savtshenkia*.

Long microscopic hairs vary in length; usually they are much shorter than macroscopic hairs but sometimes are intermediate between macroscopic and short microscopic hairs. These long hairs are always single, unlike the short hairs, and are not found in most subgenera. All three classes of hairs occur together in *T. (Yamatotipula) strepens* (Fig. 147), but long microscopic hairs predominate in *Schummelia* (Fig. 96) and *T. (Trichotipula) stonei* (Fig. 126).

The abdomen often has cuticular outgrowths that are useful for differentiating certain groups. In *Arctotipula*, abdominal segments II-VII each possess two pairs of lateral tubercles and one ventral tubercle, all of a similar conical shape (Figs. 15, 16). *Nippotipula* has one or two pairs of elongate tubercles on abdominal segment VIII and two pairs of prominent outgrowths, which I call accessory lobes, anterior to the normal six spiracular lobes (Figs. 60, 62). One species of *Savtshenkia* (unreared) has many small tubercles on the dorsum and pleura, each with a small group of hairs at its apex (Fig. 91); possibly these function to anchor the larva among aquatic mosses in the fast-flowing streams where it is found. There is a pair of small, lateral swellings in *Schummelia* on segment VIII under the band of hairs (Fig. 99).

In the subgenera *Nippotipula* and *Sinotipula* and *T. (Yamatotipula) caloptera*, transverse cuticular swellings are found on abdominal segments II-VII (Figs. 62, 108). These might be termed "creeping welts," although the swellings in *Tipula* lack recurved hooks or spinules such as those found on creeping welts of other genera (e.g., *Limonia*). They do appear to have some type of anchoring function in *Tipula*, as all three groups live in flowing water where a cuticular swelling acting as a wedge between rocks, leaf debris or mosses might maintain the larva's position against the current.

Taxonomically, the most important part is the spiracular region. This consists of the spiracular disc (segment IX, including the two prominent spiracles and the surrounding area) and the six spiracular lobes arising from the posterior border of segment VIII. Some controversy has arisen concerning which segment bears the spiracles. For example, Teskey (1981) claimed the spiracles are on segment VIII, as did Alexander (1920) and others. I agree with the view of Byers (1961) that the spiracles are on a small segment IX, part of which is later invaginated inside (forming the "spiracular yoke") during the pupal stage.

The spiracular lobes show great variation in size, structure and sclerotization but are constant in number and general position. The lobes are paired: two dorsal lobes, two lateral lobes (although they are often slightly dorsolateral) and two ventral lobes (Figs. 1, 2). In aquatic and some semiaquatic larvae, the spiracular lobes are all similar in shape and generally in size. They close against one another and around but not against the spiracles. In terrestrial larvae, the dorsal and lateral lobes are usually similar in shape, and sometimes size, but the ventral lobes are often smaller and different in shape than the other lobes. When closed, the ventral lobes, at most, are appressed against the spiracles, not against the other lobes. In aquatic species the ventral lobes are directed ventrally or posteriorly (i.e., sclerotized region facing posteriorly or dorsally, Fig. 1), whereas the ventral lobes in terrestrial species are directed dorsally (i.e., inner sclerotized region facing nearly anteriorly, Fig. 2).

Aquatic species have a glabrous region on the posterior surface of the spiracular disc that extends to the apices of the spiracular lobes. This area may be lightly to heavily sclerotized, with virtually no darkened pattern in *Sinotipula* (Fig. 110), to a distinct pattern in *Angarotipula* (Fig. 5). Many aquatic species have a dark median line on each ventral lobe and often dark, marginal bands on every lobe (Fig. 145). Terrestrial species always have the inner surface of the ventral lobes glabrous and often patterned but without dark, median lines. The dorsal and lateral lobes vary from nearly unsclerotized in the *T. (Trichotipula) stonei* group or *Pterelachisus* (Fig. 84), to having large sclerites present but some areas unsclerotized in *Serratipula* (Fig. 100), and to sclerotization of the entire posterior surfaces, forming acute points at the apices in *Lunatipula*, *Vestiplex* and *Odonatisca* (Figs. 41, 72, 140). Two taxa, *Nippotipula* and *Arctotipula*, appear anomalous in that they are aquatic but have the posterior surfaces of all the lobes and the spiracular disc generally unsclerotized and covered with short hairs (Fig. 14). The aquatic

and semiaquatic species nearly always possess a border of apparently hydrophobic setae around the outer margins of all spiracular lobes. In *Angarotipula*, these hairs are long and dense (Fig. 5); in *Yamatotipula*, they are shorter (Fig. 145), and in some palearctic species of *Savtshenkia* the hairs are very short. In *Beringotipula*, the short hairs encircle only the spiracular disc but do not border the lobes (Fig. 27). The border of setae is absent in fully terrestrial larvae.

A number of functions have been attributed to the spiracular lobes, although none has been investigated in detail. The similarly-shaped lobes of aquatic species, with the well-developed border of hydrophobic setae, appear suited for closing around the spiracles and trapping an air bubble. The air bubble may serve to prevent the entrance of water into the spiracles (Theowald, 1957), or may act as a physical gill (Teskey, 1981;Pritchard, 1983). Glabrous spiracular lobes with well-developed hydrophobic setae, when opened at the water surface, can keep a larva afloat, particularly if it is a small larva in the second or third instar. Brindle (1960c) disagrees with the view that the enclosed air bubble might prevent the entrance of water into the spiracles, but suggests that in semiaquatic habitats soil would be excluded.

In terrestrial larvae, only the ventral lobes are closed against the spiracles, apparently preventing the entrance of water or soil particles into the spiracles. The heavily sclerotized dorsal and lateral lobes of *Lunatipula*, *Odonatisca* and others probably function in locomotion; the sclerotized, pointed apices might be thrust against soil and debris (i.e., when the lobes are slightly contracted posteriorly) and serve as a brace, allowing the larva to extend its forward region.

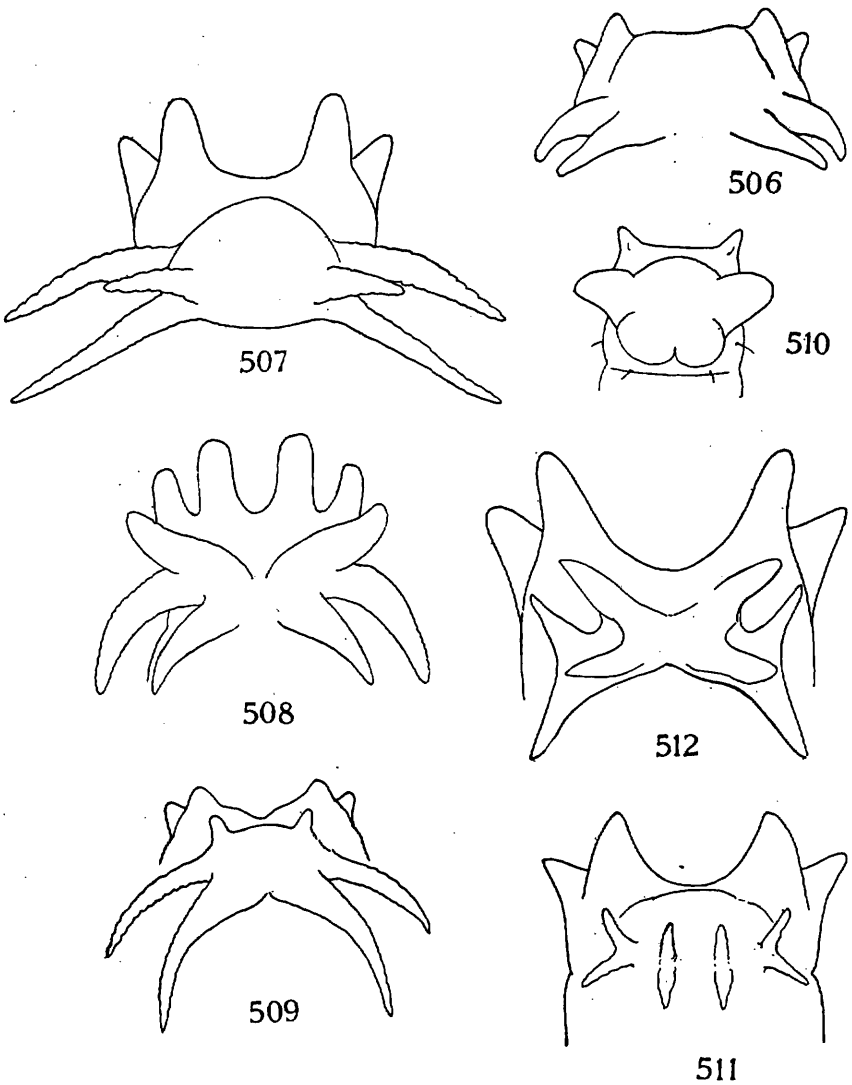
The unsclerotized lobes of *Arctotipula* and *Nippotipula* appear to have a quite different use according to Pritchard and Stewart (1982). They found the spiracles of these aquatic taxa to be non-functional with the spiracular lobes serving as a site for cutaneous respiration. This may also be a function for the various abdominal swellings and accessory lobes of both these taxa.

The spiracles vary in size, shape and color. Nearly all groups possess circular or slightly elliptical spiracles (Figs. 125, 136), but those in *Tipula (Trichotipula) oropezoides* are distinctly trilobed (Fig. 119). The spiracles are small and widely separated in *Arctotipula* and some others (Fig. 14), and quite large and close together in a number of groups, including *Platytipula* and *Bellardina* (Figs. 20, 76). The spiracles have a central circular area, usually dark brown or black, and an outer brown ring with many slit-like openings (aeropyles). The spiracles of *Arctotipula* and *Nippotipula* are thickened and raised slightly above the surrounding surface (Fig. 14); most other groups have spiracles which are nearly flush with the surface.

The anal segment, containing the anus, is a pale, membranous region below the spiracular lobes and disc. It is always bordered basally by a thin, brown or black line called the marginal band (Fig. 2). In one subgenus, *Vestiplex*, there is an additional band extending between the anus and the more ventral papillae (Fig. 140). The anal opening is transverse. The various lobes on this segment, called anal papillae, are taxonomically important. They vary in number, placement and size and are completely absent in a few taxa. The most usual arrangement is a pair of lateral papillae and one or two pairs of median papillae (Figs. 99, 149); sometimes the median papillae are somewhat anterior to the lateral one, not strictly medial in position (Fig. 75). The size, shape and number of the papillae are distinctly correlated with habitat. They are large, elongate and/or numerous in aquatic species (Figs. 6, 90) and reduced in size and number in semiaquatic and terrestrial species (Figs. 57, 113). Brindle (1957, 1960c) discussed the specialization of the papillae and postulated an osmoregulatory function; Pritchard (1983) cited the possibility of their use in gas exchange (hence the earlier use of the term "anal gills"). The stouter medial papillae in terrestrial species are of use in locomotion, according to Chiswell (1956); they act as a pushing structure in the forward extension of the body, similar to the function postulated for hook-like dorsal and lateral lobes.

The overall morphology of *Tipula* larvae does change considerably from the first through the fourth (final) instars, and this work is based only on the morphology of the fourth-instar larva. The first-instar larva usually lacks distinct spiracular lobes, and the sclerotization of the spiracular region is rudimentary (see Hennig 1950, Fig. 205). The first instar also has a simplified macrosetal arrangement and lacks most hairs. The anal papillae may also be reduced in number from that of later instars. Second-, third- and fourth-instar larvae have spiracular regions of similar shapes, but the sclerotized patterns may change among these instars; in addition, the abdominal hairs increase in number and complexity as the larva gets older. Therefore, second and third instars may possibly be identified successfully using characters found in this work, particularly if the distinctive taxonomic features are not hair or sclerite patterns. First-instar larvae cannot be identified using the characters employed in this work.

Types of anal papillae of *Tipula*[5]



TYPES OF ANAL GILLS IN GENUS TIPULA, VENTRAL ASPECT

506, *Tipula oropezoides*; 507, *T. nobilis*; 508, *T. caloptera*; 509, *T. dejecta*; 510, *T. usitata*; 511, *T. ignobilis*; 512, *T. iroquois* (supposition)

[5] from Alexander, 1920

Various larval spiracular discs of Limoniinae[6]

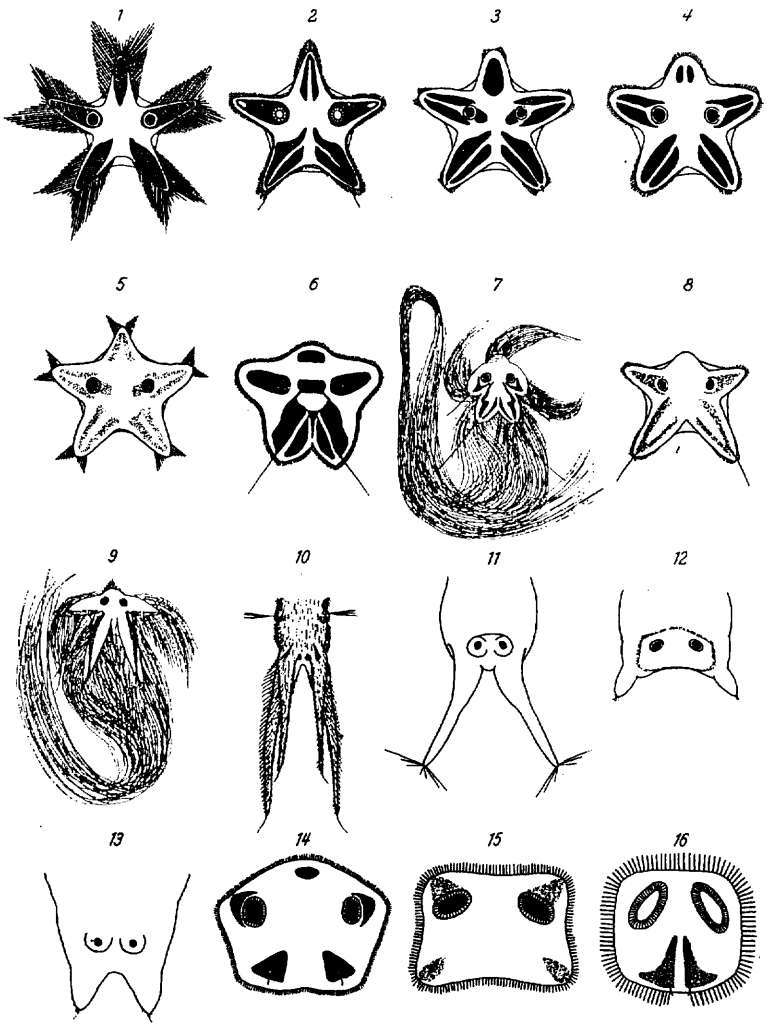


Abb. 8. Stigmenfeldformen von Limoniidenlarven. IV. Stadium, schematisch

1 Ormosia haemorrhoidalis (Eriopterinae); *2 Cheilotrichia cinerascens* (Eriopterinae); *3 Molophilus spec.* (Eriopterinae); *4 Ormosia lineata* (Eriopterinae); *5 Erioptera lutea* (Eriopterinae); *6 Gonomyia lucidula* (Eriopterinae); *7 Oxydiscus senilis* (Hexatominae); *8 Limnophila nemoralis* (Hexatominae); *9 Limnophila ferruginea* (Hexatominae); *10 Limnophila submarmorata* (Hexatominae); *11 Pedicia straminea* (Pediciinae); *12 Pedicia immaculata* (Pediciinae); *13 ? Limnophila spec.* (vgl. S. 229); *14 Austrolimnophila ochracea* (Hexatominae); *15 Limonia nubeculosa* (Limoniinae); *16 Limonia modesta* (Limoniinae)

[6] from Lindner 1959

Eggs of Limoniinae[7]

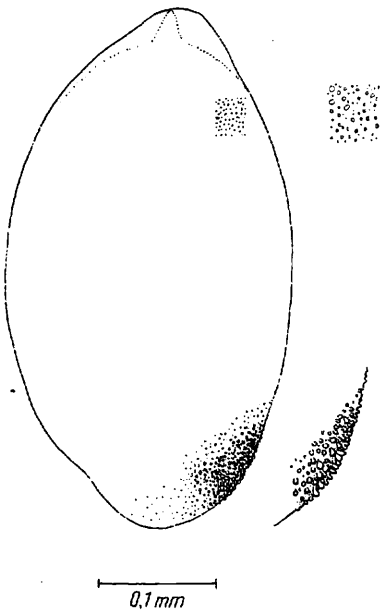


Abb. 5. *Limonia (Metalimnobia) bifasciata* SCHRK., Ei

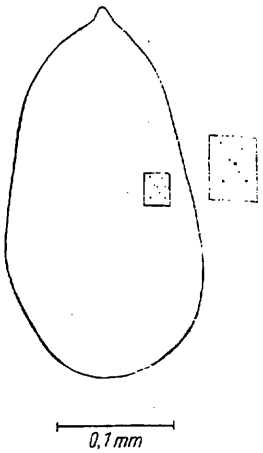


Abb. 6. *Limonia (Dicranomyia) stigmatica* MEIG., Ei

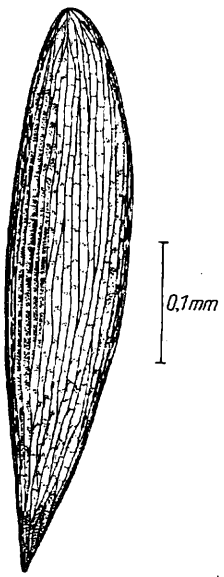


Abb. 12. *Limnophila (Eloeophila) maculata* MEIG., Ei

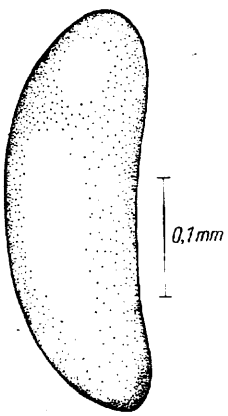


Abb. 7. *Helius (Helius) longirostris* MEIG., Ei

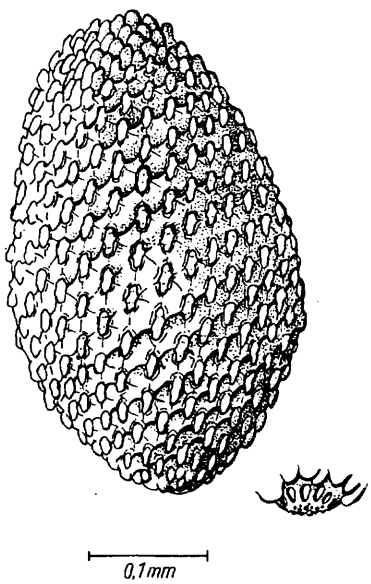


Abb. 8. *Dicranoptycha (Dicranoptycha) fuscescens* SCHUMM., Ei

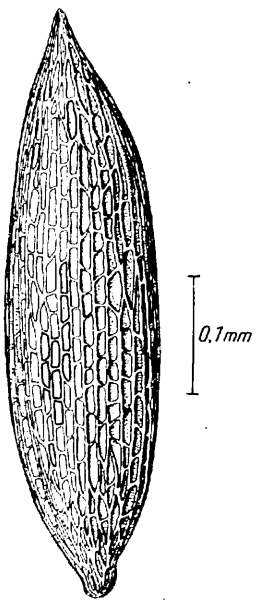


Abb. 11. *Limnophila (Phylidorea) fulvonervosa* SCHUMM., Ei

[7] from Cramer 1968

Pupae of various Tipulidae[8]

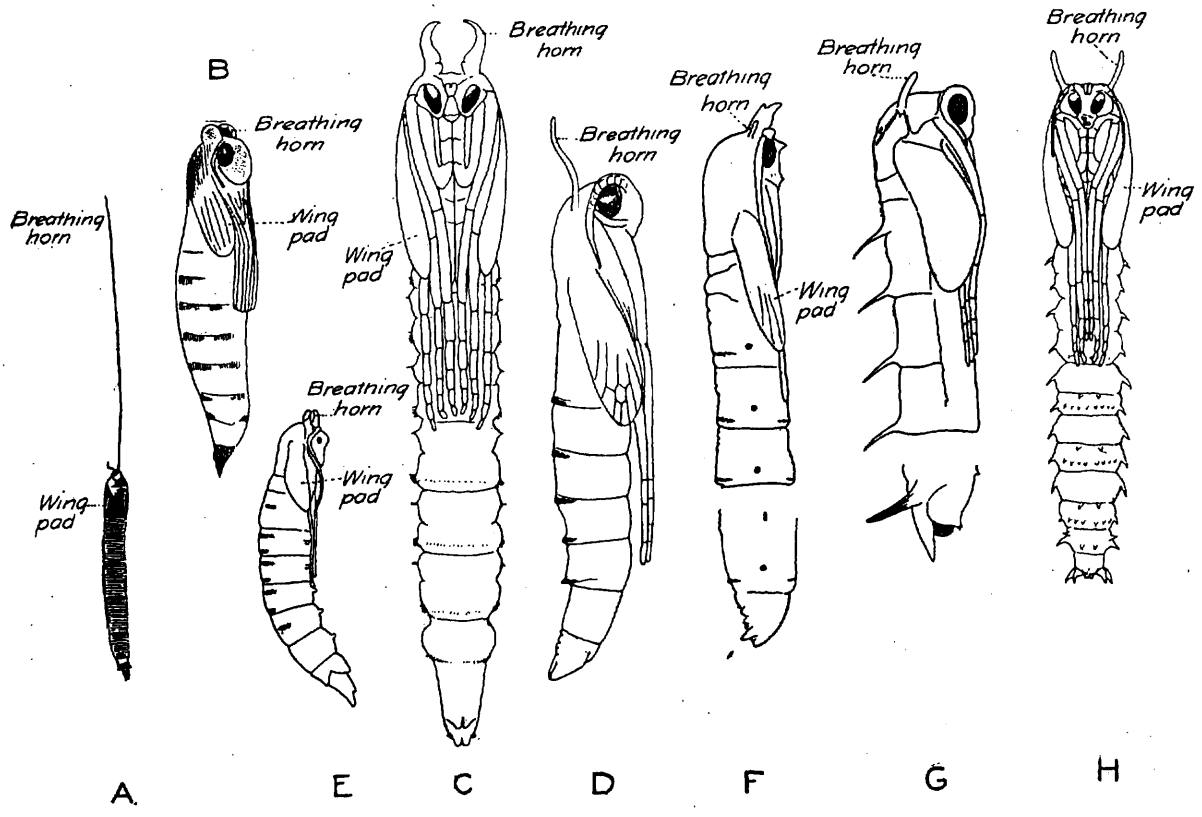


FIG. 123. PUPAE OF VARIOUS SPECIES OF CRANE-FLIES

A, *Bittacomorpha clavipes* (Ptychopteridae), dorsal aspect; after Hart. B, *Limnobia cinctipes* (Limnobiini), lateral aspect. C, *Epiphragma fascipennis* (Limnophilini), ventral aspect; after Needham. D, *Ula elegans* (Limnophilini), lateral aspect. E, *Dicranota bimaculata* (Pediciini), lateral aspect; after Miall. F, *Hexatoma megacera* (Hexatomini), lateral aspect. G, *Liogma nodicornis* (Cylindrotominae), lateral aspect. H, *Tipula ultima* (Tipulini), ventral aspect; after Needham

[8] from Alexander 1920

Phylogeny of Tipuloidea within Diptera

From Dosterbroek + Courtney, 1995

Two very different hypotheses of relationship

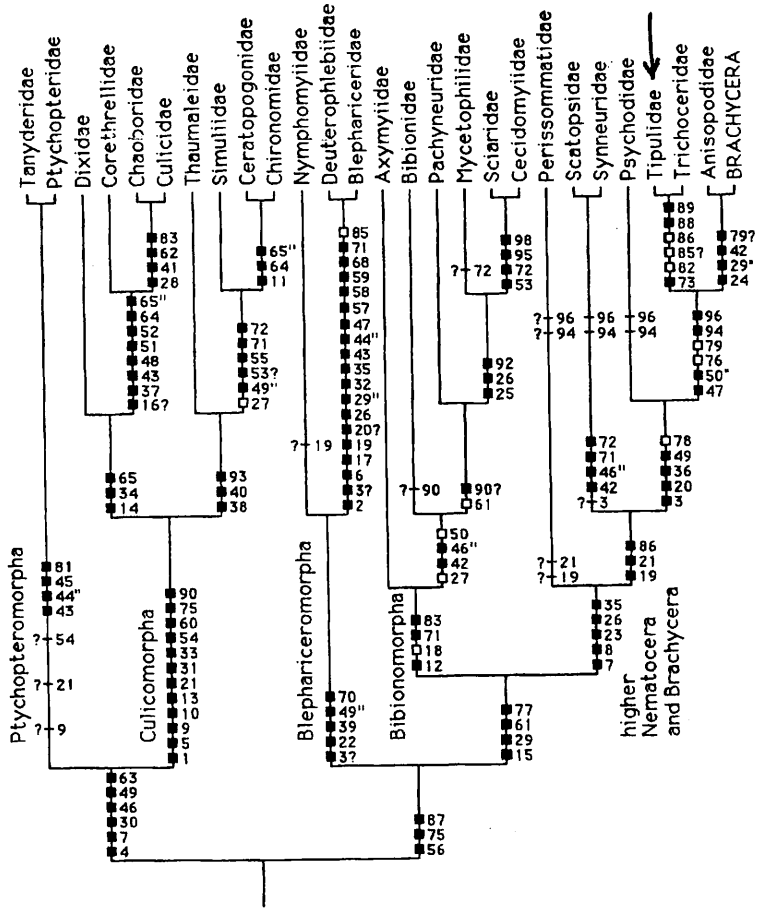


Figure 9. Cladogram of the families of nematocerous Diptera (see text for discussion). Names of families are *sensu* Wood & Borkent (1989), names of infraorders as defined in the present paper. Numbers 1–56 refer to characters of the larva, 57–62 of the pupa, 63–98 of the adult. Black rectangles refer to character state 1, double accents to character state 2, white rectangles to reversals.

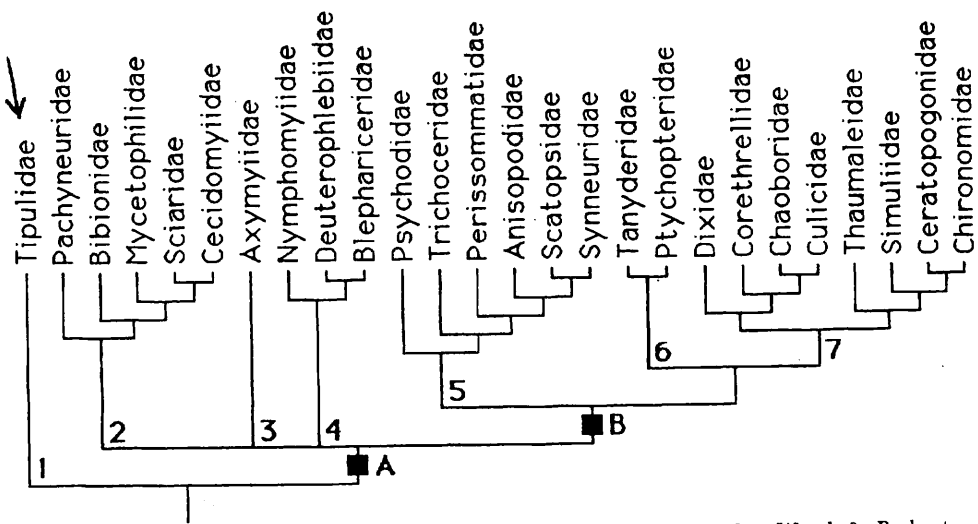


Figure 3. Phylogenetic relationships of the nematocerous families after Wood & Borkent (1989). Infraorders: 1, Tipulomorpha; 2, Bibionomorpha; 3, Axymyiomorpha; 4, Blephariceromorpha; 5, Psychodomorpha; 6, Ptychopteromorpha; 7, Culicomorpha. Synapomorphies: A, Prostheca not articulated (see char. 99); B, Mandible oblique or vertical (see char. 18).

Phylogeny within Tipuloidea

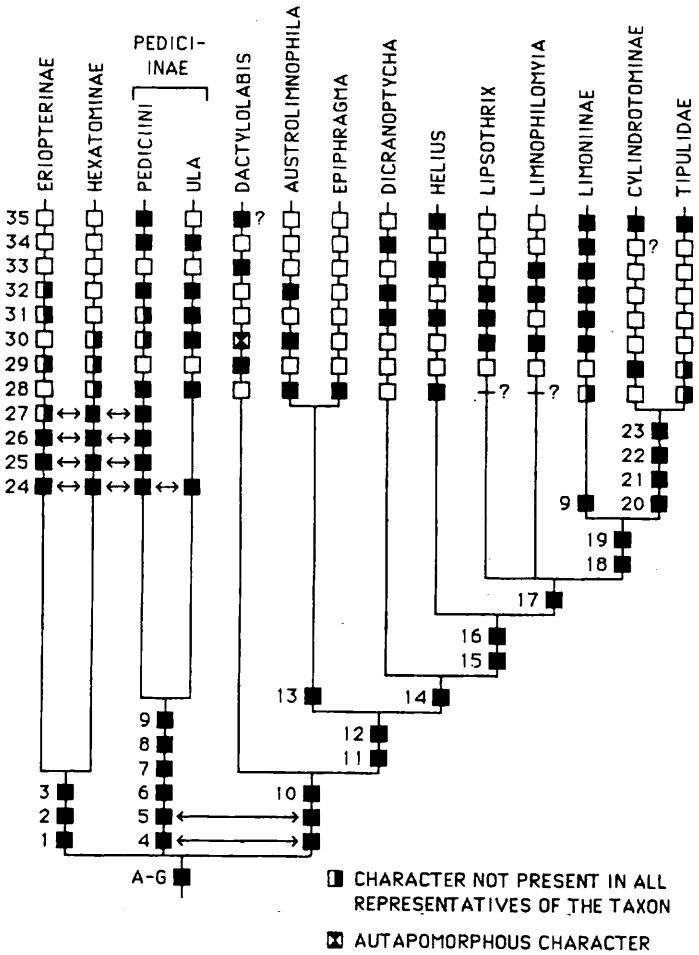


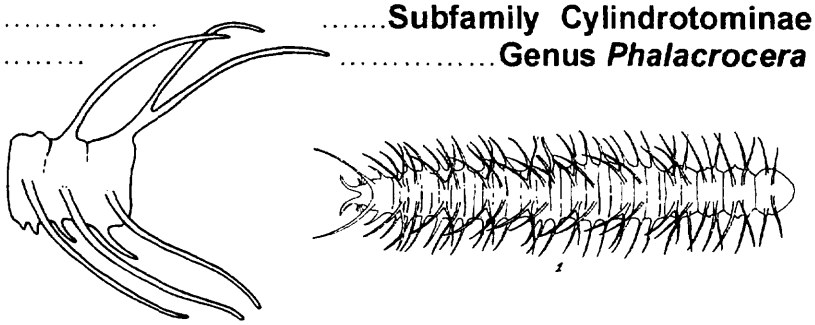
Fig. 4. Phylogeny of the major groups of Tipuloidea.

From Oosterbroek + Theowald, 1991

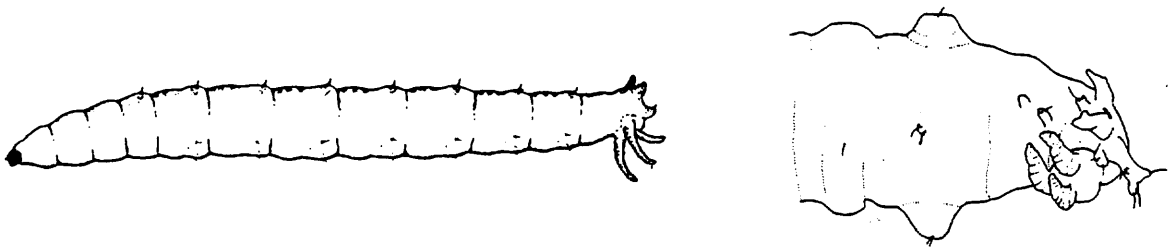
Based exclusively on characters of immature stages.

KEY TO SUBFAMILIES OF TIPULIDAE

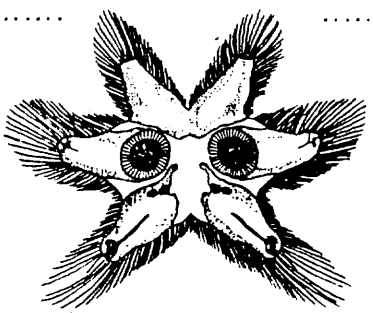
1. Thoracic and abdominal segments with both dorsal and lateral longitudinal rows of conspicuous, elongate (approximately 10 times as long as basal diameter) fleshy projections , posterior pair on most abdominal segments deeply divided ....**Subfamily Cylindrotominae:** ....**Genus *Phalacrocera***



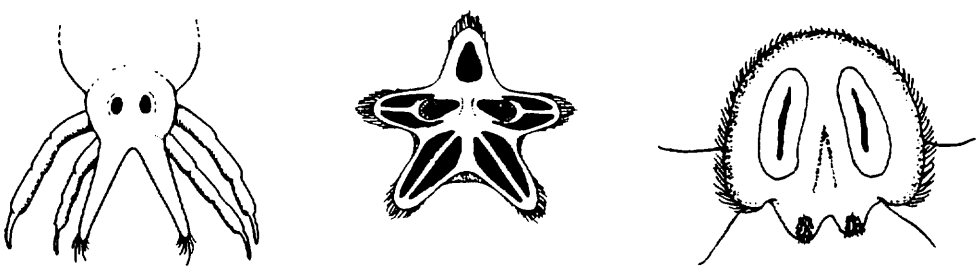
1'. Thoracic and abdominal segments without dorsal longitudinal rows of conspicuous projections ; lateral abdominal projections, if present, blunt and shorter than their basal diameter **2**



2 Spiracular disc bordered by 6 (or rarely 8) usually subconical lobes, ordinarily 2 dorsal, 2 dorsolateral or lateral and 2 below spiracles ; lobes short and blunt in some genera .....**Subfamily Tipulinae** ....**Go to couplet 3**

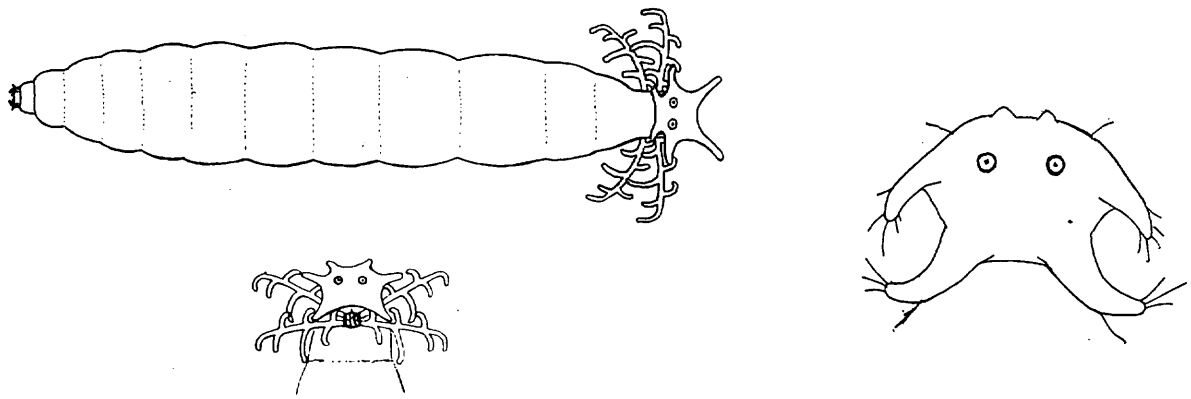


2' Spiracular disc bordered by 5 or fewer lobes of variable shape, often 1 dorsomedial, 2 lateral and 2 below spiracles , 7 lobes in *Gonomyodes*; spiracles rarely absent .....**Subfamily Limoniinae** .....**Go to couplet 24**

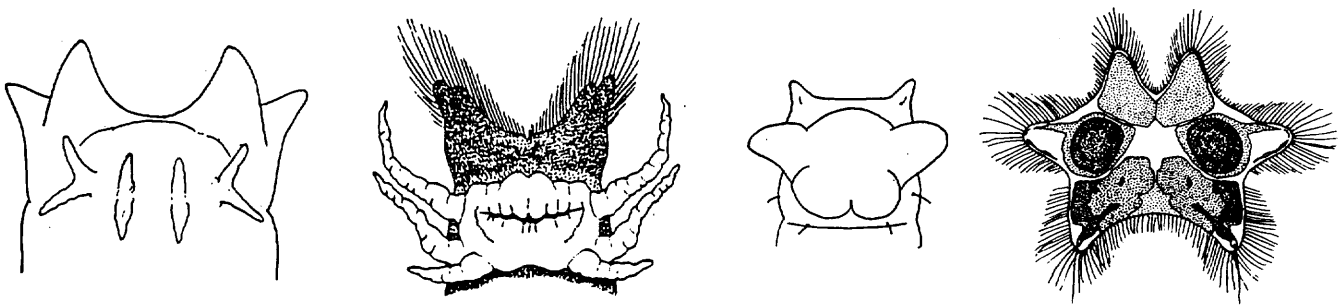


KEY TO THE GENERA AND SUBGENERA OF AQUATIC TIPULINAE FROM SOUTHEASTERN NORTH AMERICA

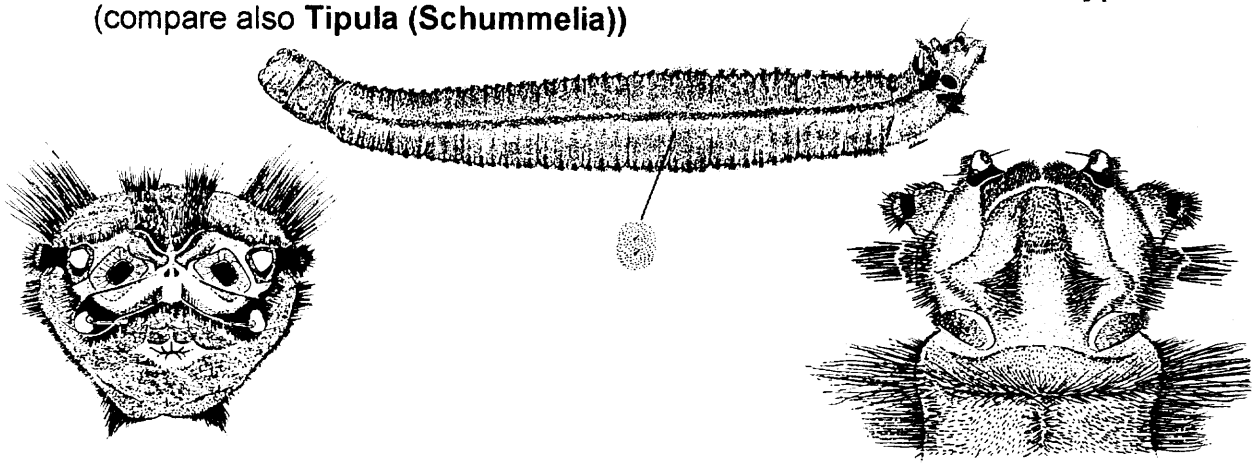
3. Anal papillae pinnately branched. Dorsal lobes of spiracular disc short, bluntly rounded; lower lobes more than twice as long as their basal diameter; all lobes without sclerotization (darker areas) Larva aquatic or semiaquatic..... ..... **Leptotarsus (Longurio)**



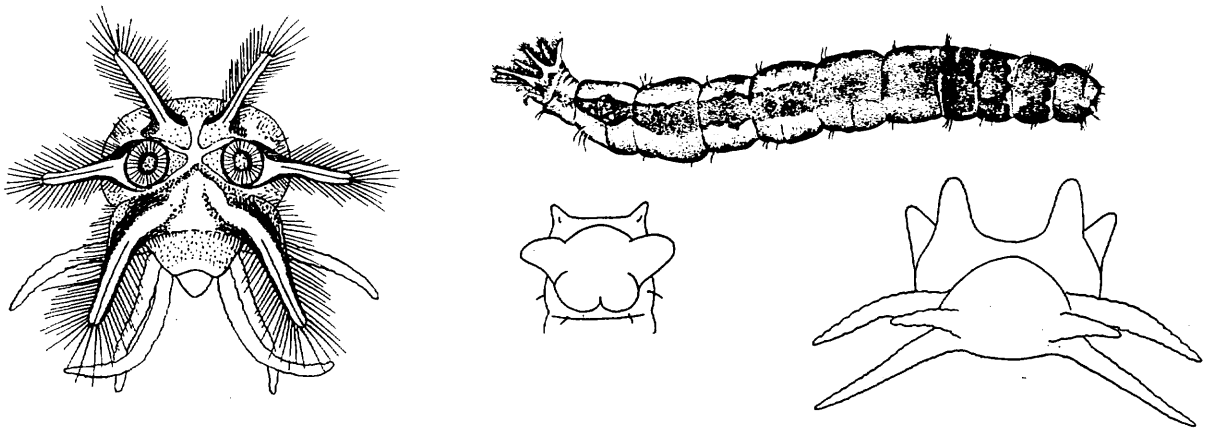
3'. Anal papillae, if evident, not pinnately branched. Lobes of spiracular disc variable in shape, usually sclerotized. **4**



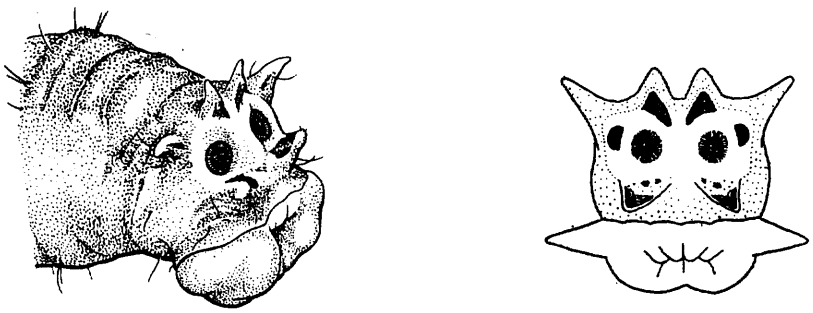
4. Anal papillae absent, even as low protuberances, although two oval swellings present at the anteroventral border of the segment IX; hair on abdominal segments and posterior ring of metathorax long and uniformly dense, giving larva a woolly appearance; remainder of thorax nearly bare with just short pubscence; fringe of long hairs on side, just before spiracular disc; minute spiracles laterally on segments I-VII in addition to large terminal pair. Semiaquatic. .... **Brachypremna**
(compare also **Tipula (Schummelia)**)



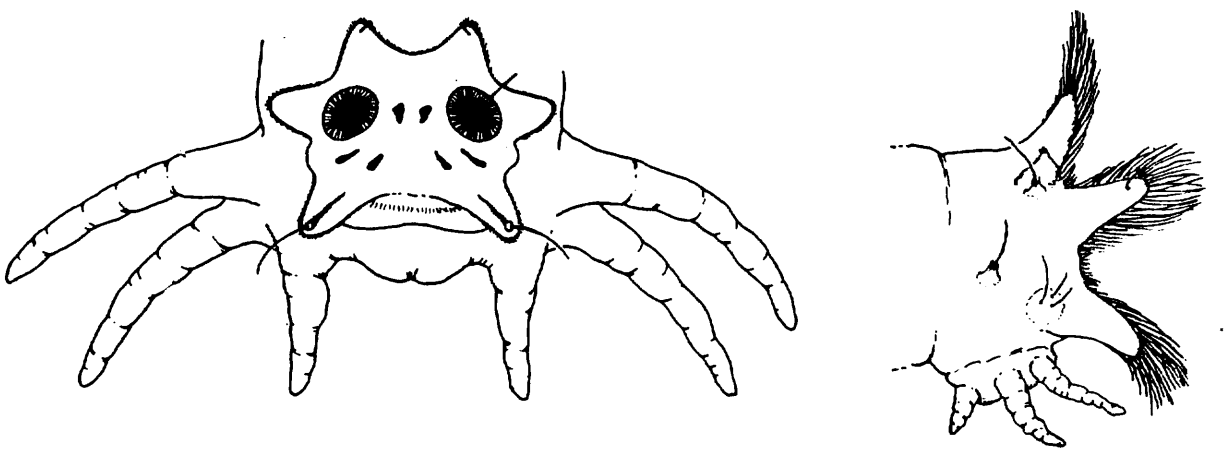
4'. Anal papillae present, at least as a low protuberance anterior to anus; oval swellings absent. Pilosity not strongly contrasting between thorax and abdomen; lateral spiracles absent; hair fringe or tuft, if present, located differently **5**



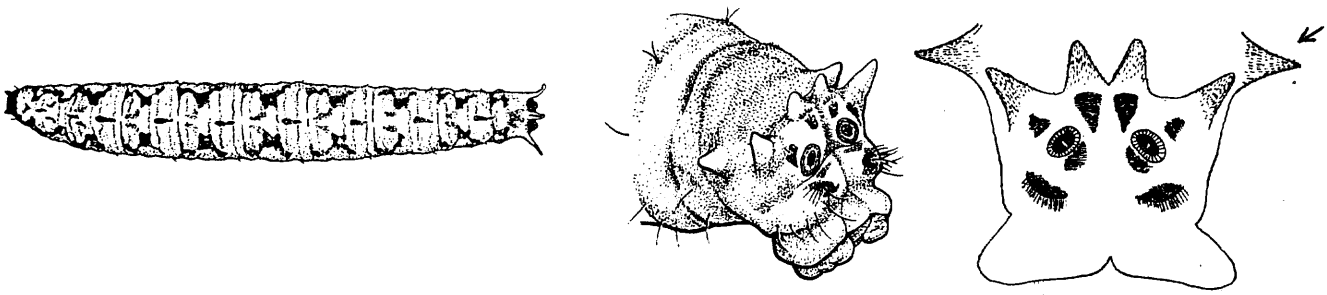
5 Four or fewer distinct papillae , median and often lateral papillae reduced to broad protuberances; spiracular lobes without border of setae (exceptions: *Tipula (Tipula)*, *Tipula (Savtshenkia)* in part,) dorsal and lateral lobes usually not similar in size and shape to ventral lobes; ventral lobes close against spiracles, but not against dorsal and lateral lobes; in semi-aquatic to terrestrial situations **6**



5' Usually six to eight anal papillae, occasionally four, all papillae with distinctly narrowing apices; spiracular lobes with developed border of setae (exceptions: *Arctotipula*); all spiracular lobes usually similar in size and shape; lateral lobes equal to or smaller than ventral lobes; when closed, all lobes are against one another; in aquatic or semi-aquatic situations **10**

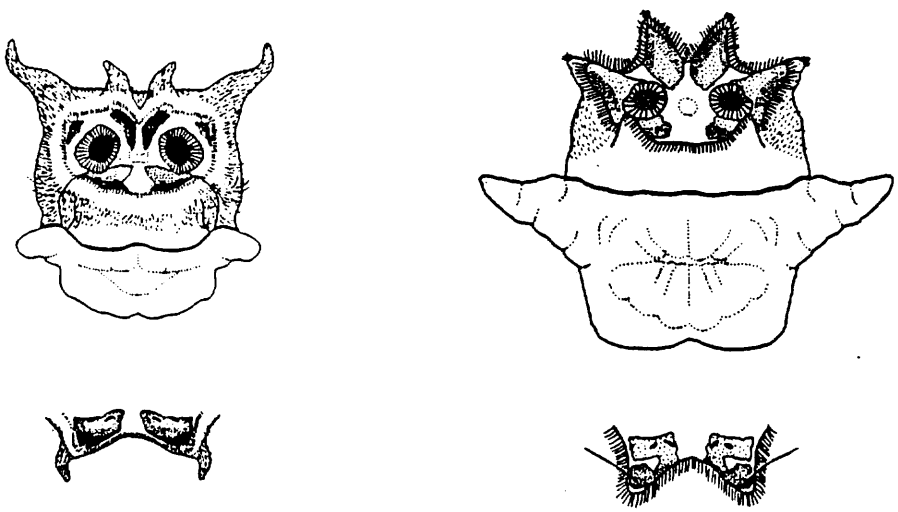


6. Dorsal lobes of spiracular disc closely appressed to one another (subgenus *Dolichopeza*) or abdominal segment 8 bearing a subconical lobe at each side below and before dorsolateral lobe of spiracular disc (subgenus *Oropeza*). Larva in mosses and liverworts, sometimes in wetlands and edge of aquatic habitats ..... **Dolichopeza**

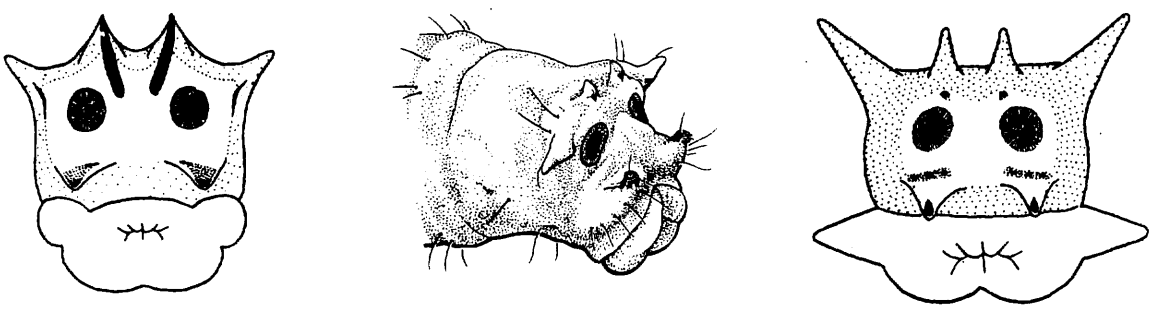


6'. Dorsal spiracular lobes not closely appressed; abdominal segment 8 without lateral subconical lobes. **7**

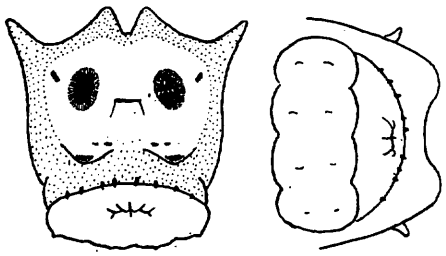
7 Border of short setae surrounding glabrous area of spiracular disc or lobes **8**



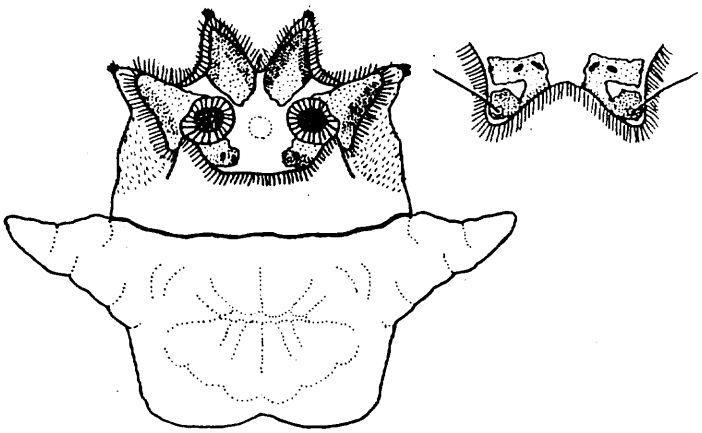
7'. Border of setae absent .....**various terrestrial subgenera of *Tipula*,** .....**genera *Nephrotoma, Ctenophora*** .....(see keys in Gelhaus, 1986, Alexander and Byers, 1981)



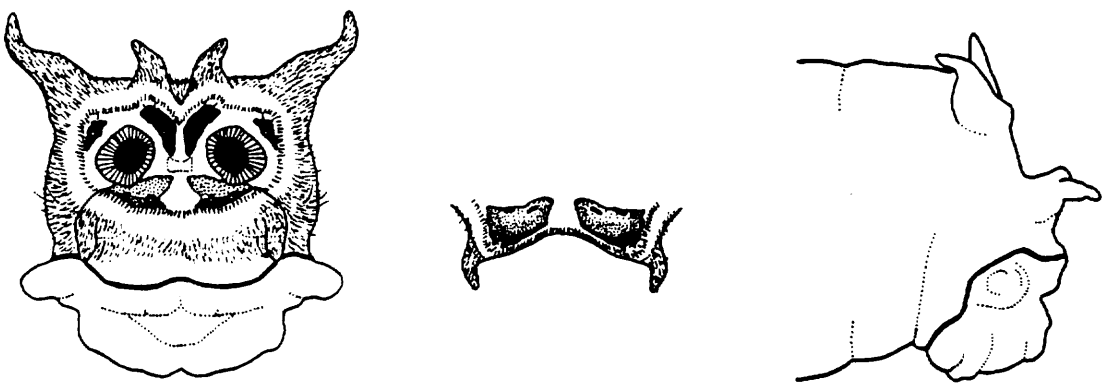
8. Eight equally short papillae, sometimes very reduced; macroscopic hairs not in isolated clusters or tufts near most lateral setae of dorsal and ventral abdominal segments, in mosses, semiaquatic ..... ***Tipula (Savtshenkia)*, in part**



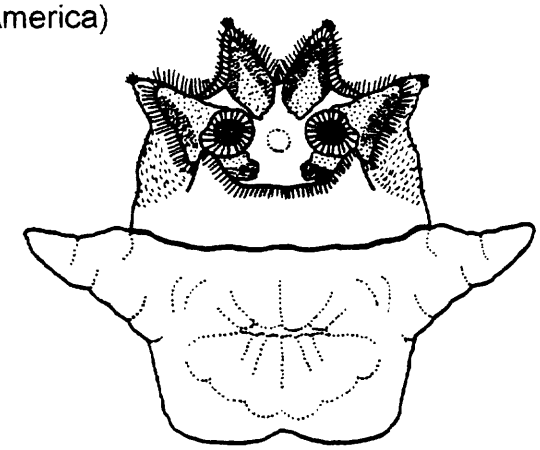
8' Four papillae, lateral pair as distinct lobes, ventral pair reduced to broad protuberances ; macroscopic hairs in clusters or tufts near most lateral setae of dorsal and abdominal segments **9**



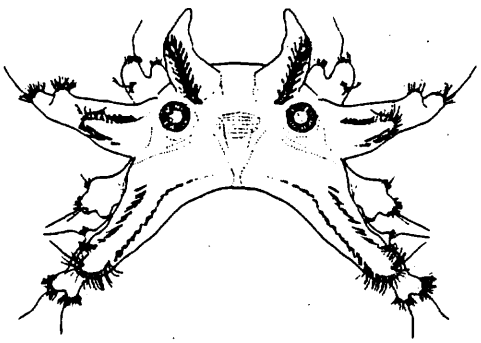
9 Border of short setae only around central area of spiracular disc and not on margins of lobes ; each ventral spiracular lobe with finger-like, subapical projection ; posterior surfaces of dorsal and lateral lobes without sclerotization; clusters of macroscopic hairs on dorsum and venter of abdomen ..... ***Tipula (Beringotipula)***

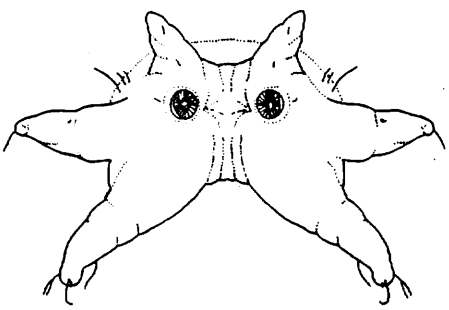


9' Border of all setae extending around margins of all spiracular lobes ventral lobes without subapical projection; posterior surface of each dorsal and lateral lobe mostly sclerotized; abdomen with distinct tufts of dark macroscopic hairs; terrestrial to semi-aquatic, in wetlands ..... ***Tipula (Tipula)*** (not known to occur in Southeast but includes several serious introduced pests in North America)

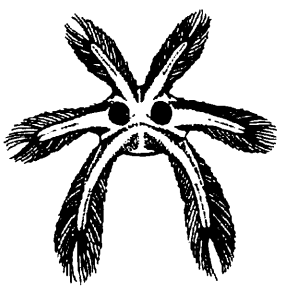


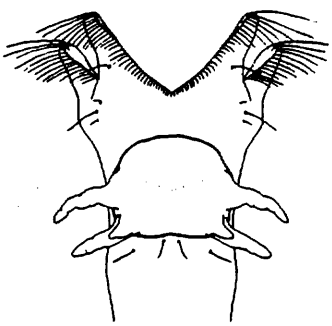
10 Border of setae around spiracular lobes reduced or absent ; posterior surfaces of spiracular lobes with little sclerotization and covered with short microscopic hairs; **11**



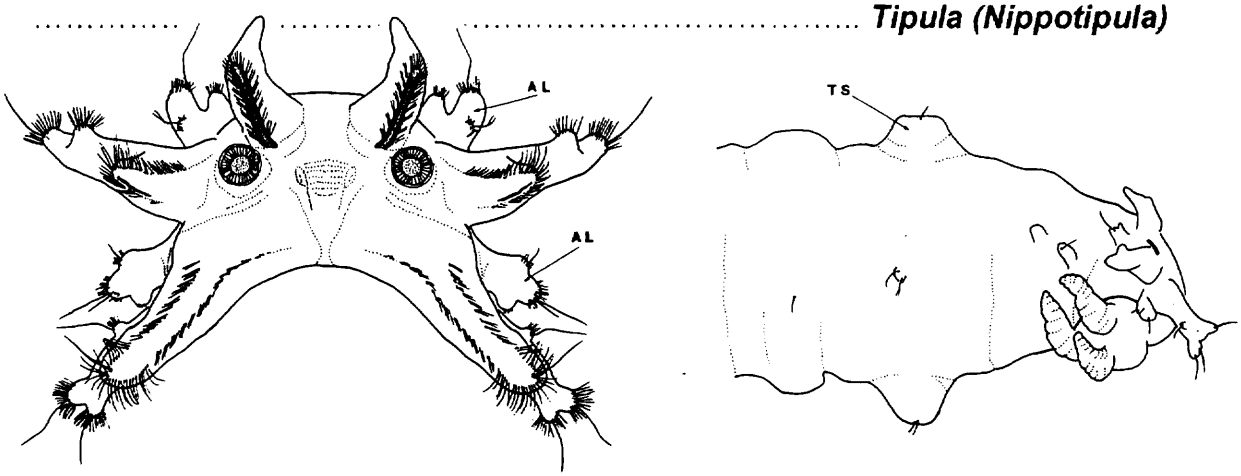


10' Border of setae around spiracular lobes strongly developed ; posterior surfaces of spiracular lobes sclerotized and glabrous **12**

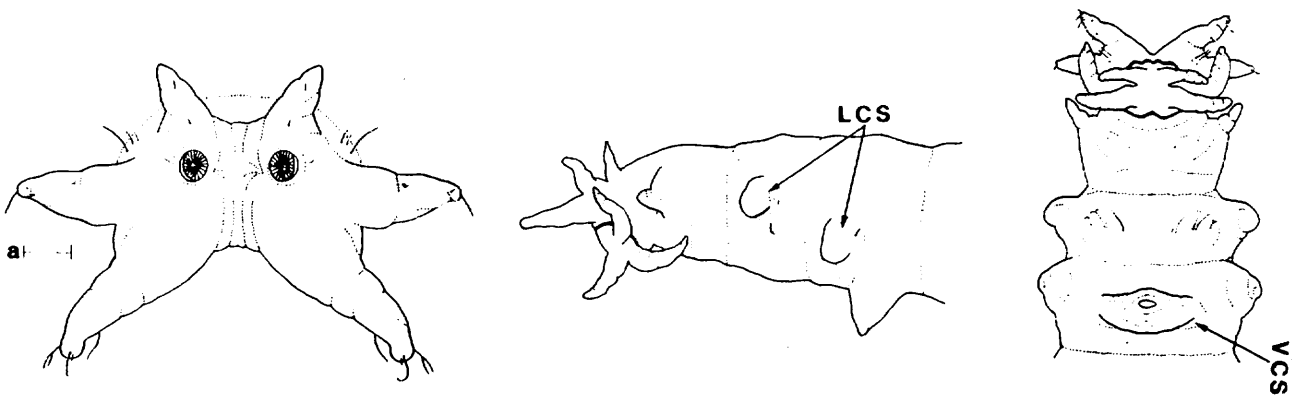




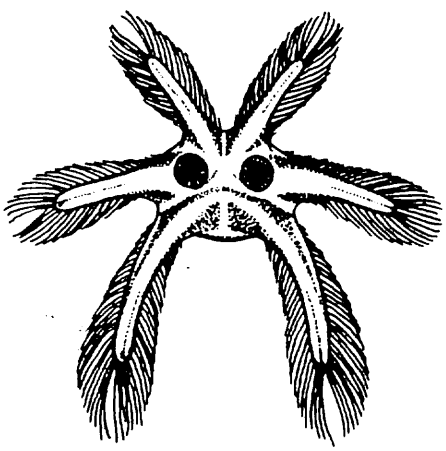
11. Transverse swellings on dorsum and venter of each abdominal segment 1-VII; two pairs of accessory lobes in addition to usual six spiracular lobes; all spiracular and accessory lobes (except dorsal) with at least bifurcate apices. Spiracular lobes with reduced border of setae; aquatic in wooded streams ..... ***Tipula (Nippotipula)***



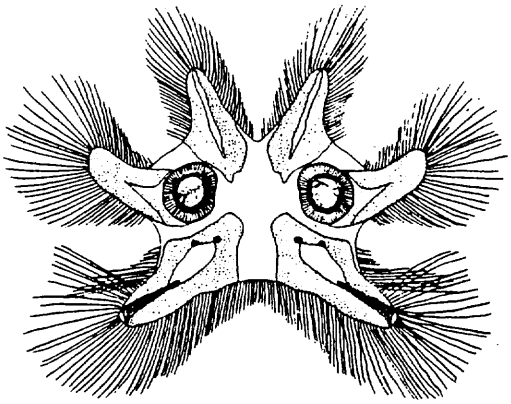
11'. Conical swellings, one ventral and two lateral on each abdominal segment 2-7 (reduced or absent in some species); larvae in well oxygenated bottom sediments of ponds, littoral zones of lakes, and in streams ..... ***Tipula (Arctotipula)***



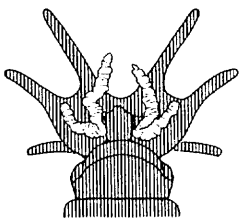
12. Spiracular lobes long and slender, each 2-3X as long as basal widths ; ventral lobes longer than dorsal and lateral lobes **13**

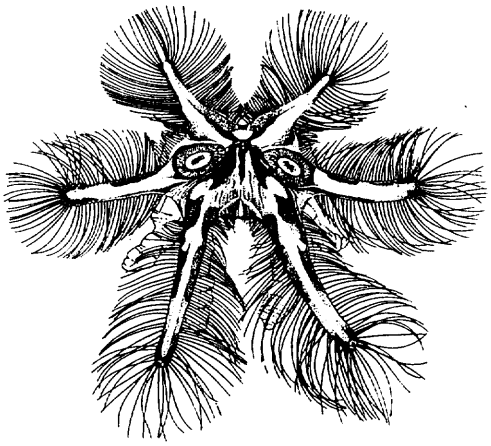


12' Spiracular lobes each less than twice as long as width at base , if close to 2X as long (*Tipula (Sinotipula) gothicana* group), then all spiracular lobes of nearly equal length **15**



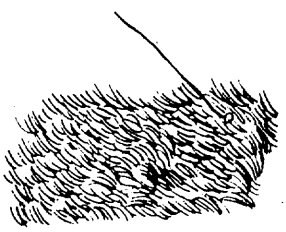
13. Two pairs of elongate retractile anal papillae present. Lobes of spiracular disc darkened along margins, pale medially. Larvae in open-ended tube of floating vegetation ..... ***Megistocera***

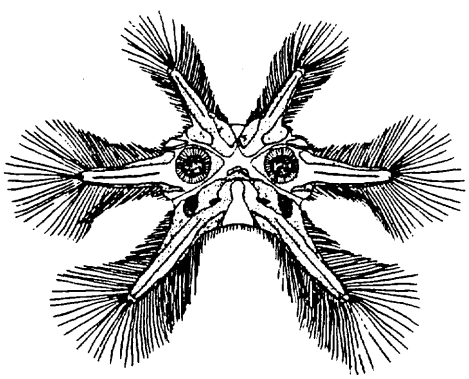




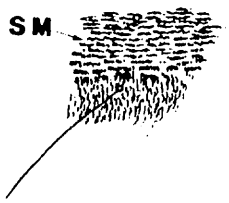
13'. Three pairs of elongate anal papillae present. Lobes of spiracular disc darkened along margins but each with a thin submedian dark line. Larvae not found in tubes of vegetation, but may be found among emergent vegetation **14**

14 Abdomen with abundant macroscopic hairs and few microscopic hairs; pigmentation of lateral lobes of spiracular disc extending around spiracles larvae among submerged decaying vegetation or in soil margins of marshes ..... ***Tipula (Angarotipula)*** (not known to be in Southeast)

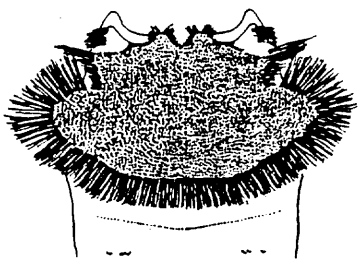




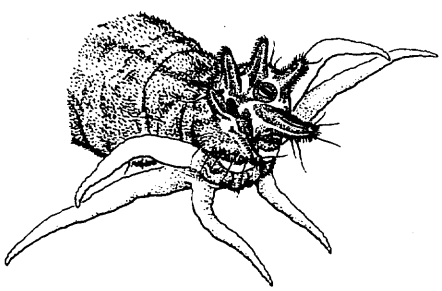
14' Abdomen with rows of short microscopic hairs , macroscopic hairs only around bases of macrosetae; spiracular disc only slightly pigmented between spiracles larvae in marshy area among decaying vegetation, mosses or soil margins ..... ***Prionocera***
(Not known to be in Southeast)



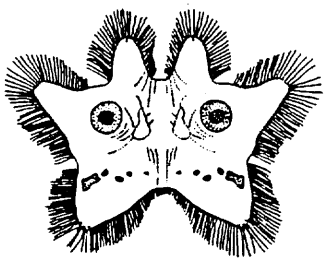
15. Abdominal segment 8 with dorsal row of macroscopic hairs surrounding semicircular pilose area and pair of broad lateral swellings ; posterior surface of each dorsal lobe with extensive dark sclerite four short anal papillae; larvae in wet soil in seepage area or along streams, usually in woodlands ..... ***Tipula (Schummelia)***

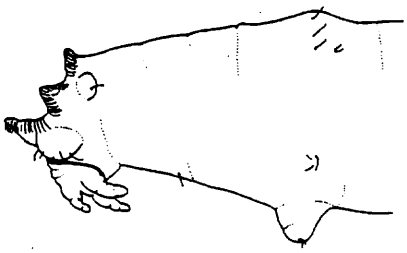


15'. Abdominal segment 8 without semicircular row of hairs, although hair tufts, swellings and small tubercles may be present; dorsal lobes with usually only light brown sclerites; usually six to eight anal papillae **16**

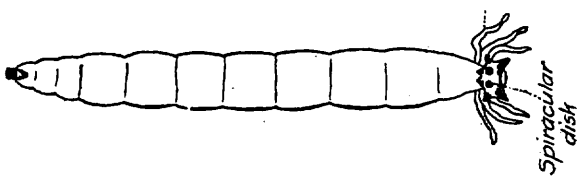


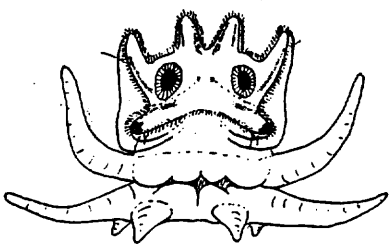
16. Abdominal segment 2-7 each with transverse ventral swelling, width often twice height ; abdominal dorsum with light and dark patches of short microscopic hairs, the lighter hairs forming a pair of pale, longitudinal, marginal lines or an "H"-shaped pattern ; macroscopic hairs absent, not surrounding macrosetae as hair tufts; spiracles small, separated by more than 1,5X diameter of a spiracle (usually 2X or more); spiracular lobes mostly unmarked ; larvae under rocks or in packs of dead leaves in fast flowing streams or rivers..... ..... ***Tipula (Sinotipula)* in part (*commiscibilis* group)** (western North America)





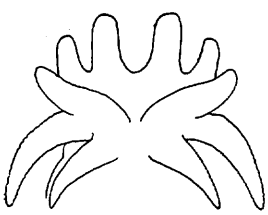
16'. No conspicuous transverse abdominal swellings (exception: some species in subgenus *Tipula (Yamatotipula)* with swellings 3X as long as high); abdominal dorsum usually unpatterned or, if pattern present, then not as above and macroscopic hairs present, usually around macrosetae ; spiracles separated by less than 1.5X diameter of a spiracle; spiracular lobes usually distinctly marked.. .....**17**

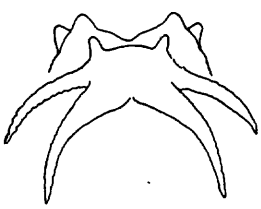


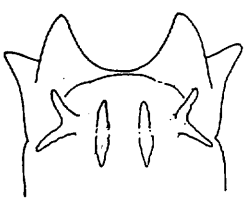


17. Four anal papillae **18**

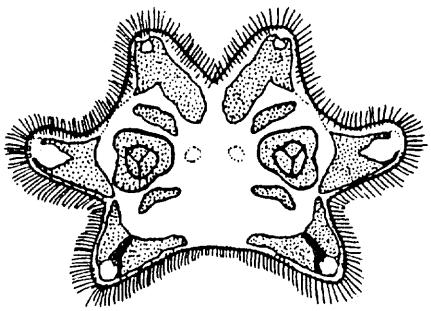
17.' Six or more anal papillae **19**

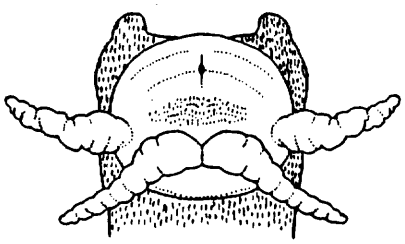






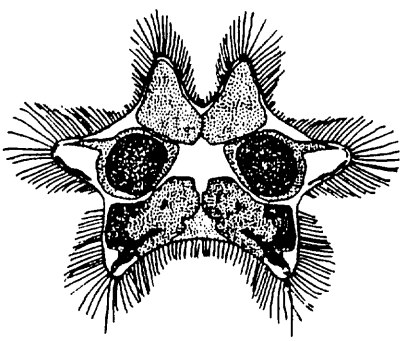
18. Abdomen with hairs singly placed and of uniform length , no distinctly longer macroscopic hairs present as clusters or tufts around macrosetae; spiracles trilobed, with small isolated sclerites above and below ..... ***Tipula (Trichotipula)***

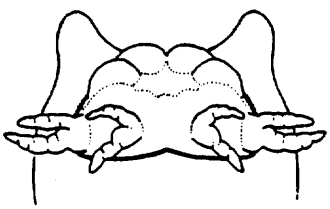




18'. Abdomen with hairs of greatly differing lengths, with distinct hair clusters or tufts near most lateral setae of dorsum and venter; spiracles oval or circular ..... ***Tipula (Yamatotipula)*** **in part** (*Tipula ludoviciana* keys here, with 4 short papillae)

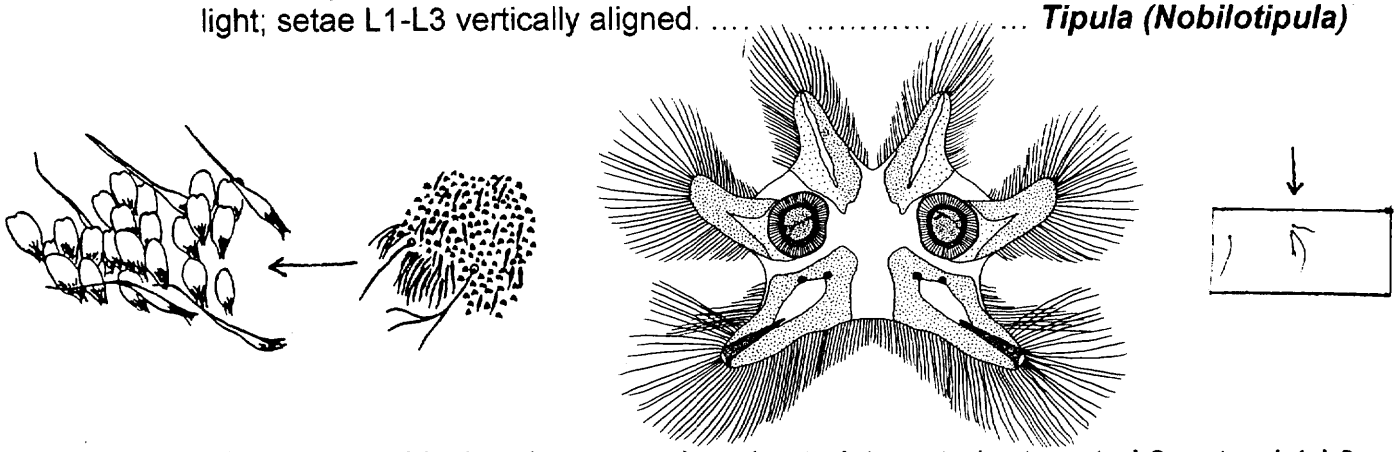
19. Eight anal papillae .... ***Tipula (Savtshenkia)*** **in part**
NOTE: The undescribed larva of the western N. A. *Tipula (Yamatotipula) meridiana* will key here as well – reared from wet mosses on exposed rocks in streams



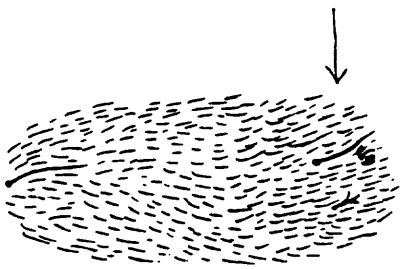


19' Six anal papillae **20**

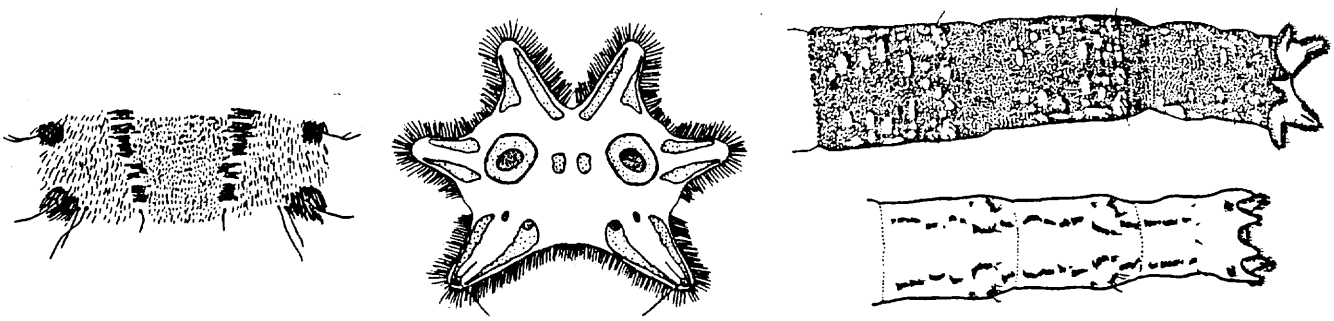
20. Microscopic and macroscopic hairs distinctly flattened, broad and reflective of light; setae L1-L3 vertically aligned. .... ***Tipula (Nobilotipula)***



20'. All hairs cylindrical and narrow; pleural seta L1 posterior to seta L2, setae L1-L3 not vertically aligned (exception: some species of *Platytipula*) **21**

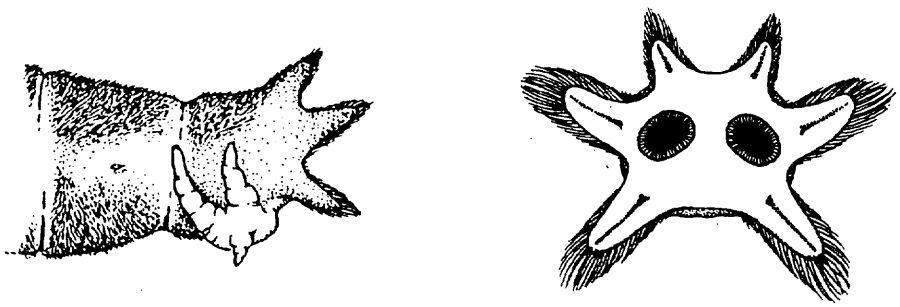


21. Dorsum of abdomen primarily with long and short microscopic hairs, short hairs in rows ; macroscopic hairs in distinct clusters around lateral macrosetae on abdominal dorsum and venter, and on dorsum of segment 8 (anterior to separation between dorsal and lateral spiracular lobes); often a conspicuous pattern on dorsum of abdomen (including longitudinal dark lines, spots or transverse rows of tufts) formed by microscopic and (rarely) macroscopic hairs ; posterior surface of each lateral lobe with at most a faint median line setae of spiracular lobe hair border short, setal length 1/2 or less of ventral lobe width..... ***Tipula (Yamatotipula)* in part**

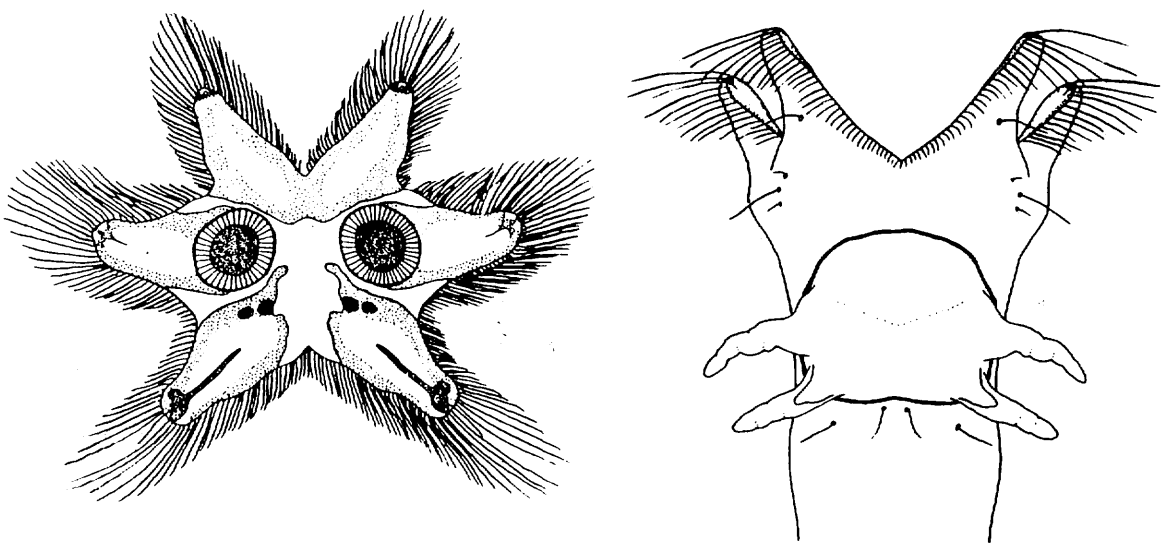


21' Dorsum of abdomen primarily with macroscopic hairs with at most indistinct clusters around single pair of lateral setae on dorsum and venter; microscopic hairs not in compact rows; no conspicuous hair patterns on abdomen; each lateral lobe usually with a dark median line, although line may be short ; setae bordering spiracular lobes long, setal length 3/4 or more of ventral lobe basal width; **22**
(**NOTE:** Undescribed larva of western *Tipula (Sinotipula) gothicana* will key here – found in leaf packs and under rocks in fast flowing streams – unlike habitats of remaining three groups)

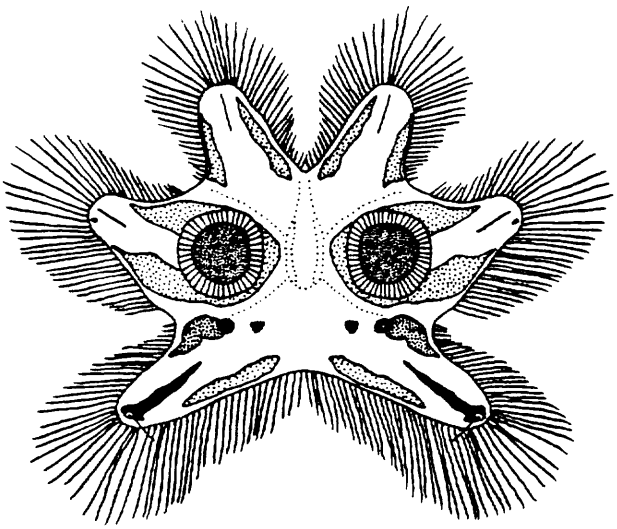
22 Lateral and one medial pair of anal papillae curled dorsally around abdominal segment 8; each dorsal spiracular lobe sometimes with a median dark line **23**

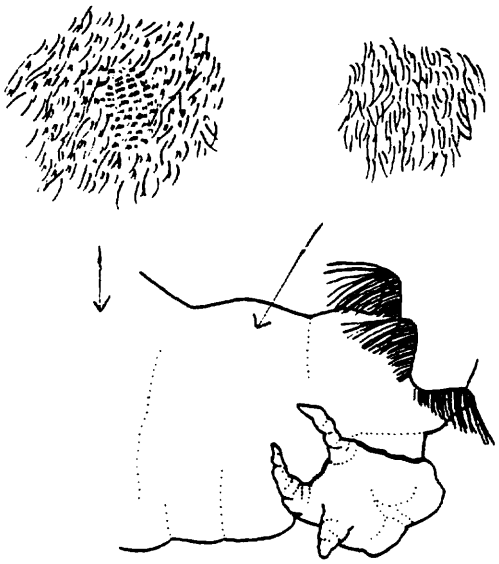


22' All anal papillae directed laterad or ventrad, not dorsad each dorsal spiracular lobe without dark median line; larvae in wet soil or decaying leaves along margins of small streams, in marshy area, ponds or seepage areas, often where aquatic habitat is temporary or seasonal .....***Tipula (Platytipula)***



23 Dorsum of abdominal segments 1-7 with microscopic hairs isolated in small patches, or scattered singly among macroscopic hairs ; dorsum of segment 8 without microscopic hairs ..... ***Tipula (Bellardina)***
(Only in western and central North America)





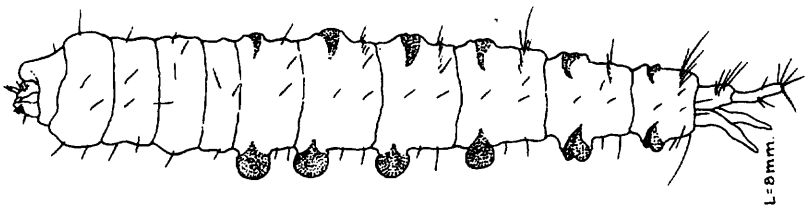
23' Dorsum of abdominal segments 1-7 with microscopic hairs in rows intermingled with macroscopic hairs ; dorsum of segment 8 with microscopic and macroscopic hairs ..... ***Holorusia hespera***
(western North America only)

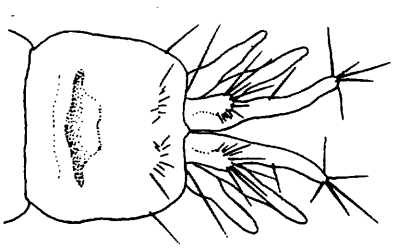
1 - 7

8

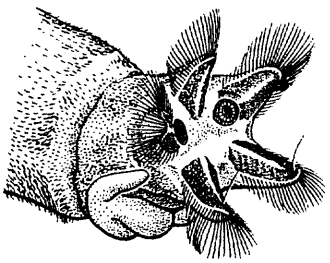
KEY TO THE GENERA AND SUBGENERA OF AQUATIC LIMONIINAE FROM SOUTHEASTERN NORTH AMERICA

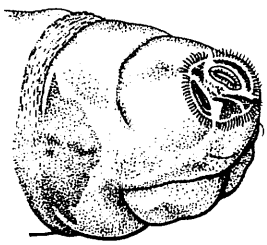
24 Posterior spiracles absent; tracheal system closed; dorsal and lateral lobes of abdominal segment 9 absent of extremely reduced **25**

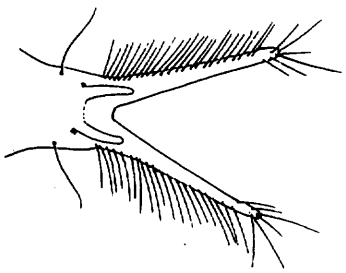




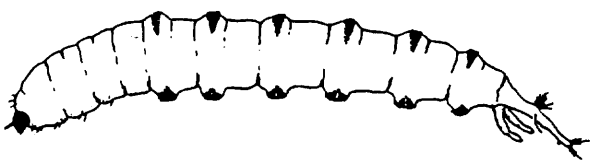
24' Posterior spiracles present, usually conspicuous, but sometimes concealed when lobes of spiracular disc are infolded (e.g., *Cryptolabis*); dorsal and lateral lobes of abdominal segment 9 usually present, but absent in some species **26**



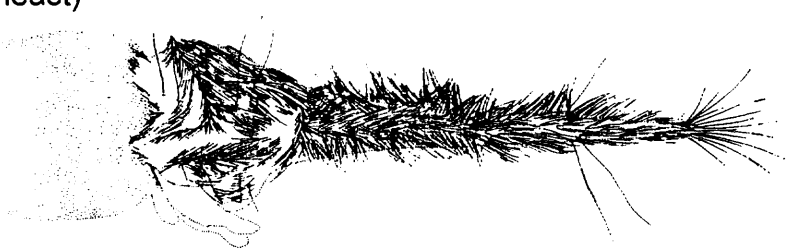




25. Ventral lobes of abdominal segment 9 elongate, deeply separated, slightly divergent, with a few tufts of hairs . Anal papillae elongate. Dorsal and ventral creeping welts conspicuous on abdominal segments 2-7. Larva in silken tube found on stones in swift well oxygenated water ..... ***Antocha***



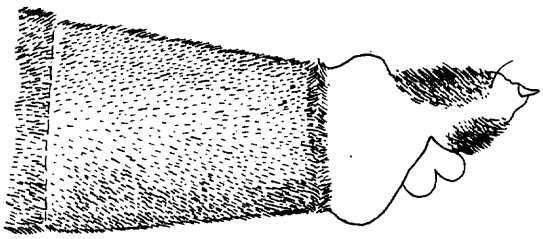
25'. Abdominal segments 8 and 9 covered with dense long pilosity; segment 9 elongate, tapering, shallowly bifurcate at apex. Anal papillae short, not extending beneath segment 9. No conspicuous creeping welts. Larva found in sandy bottoms of cold clear rapid streams of Pacific drainage..... ..... ***Hesperoconopa***
(Not known in the Southeast)



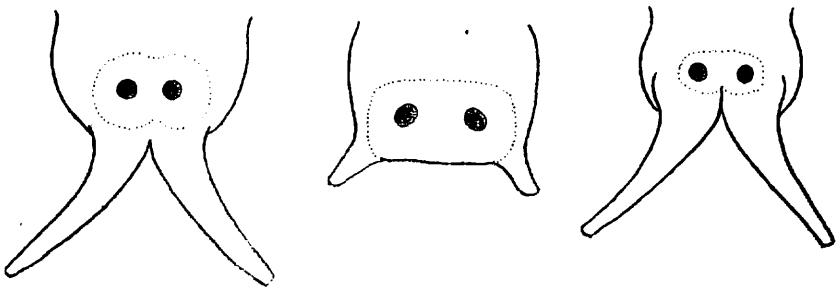
See Also Next Page:

ALSO:

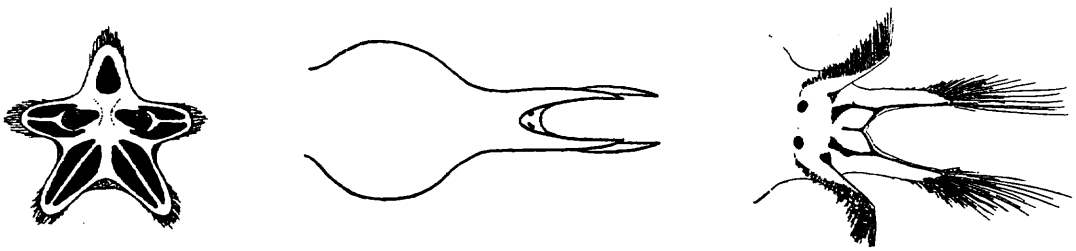
25" Ventral lobes of abdominal segment 9 short, conical; abdomen without creeping welts and with short hair. In marsh sediments. ..... ***Erioptera (Erioptera)* in part**



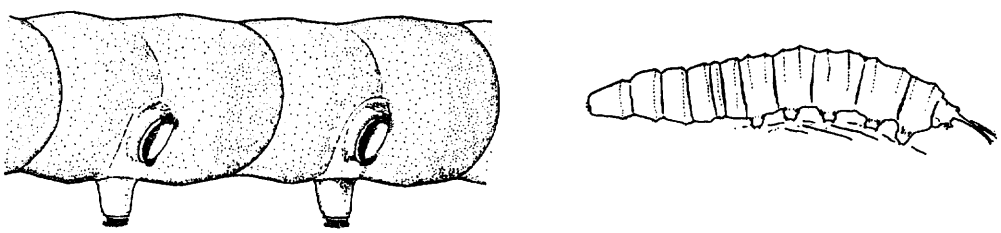
26. Ventral lobes of spiracular disc elongate, dorsal and lateral lobes absent or extremely reduced **27**



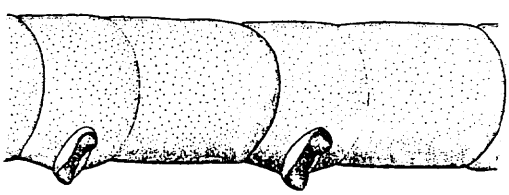
26' Ventral lobes of spiracular disc usually short, less often absent; dorsal and lateral lobes well developed if ventral lobes are elongate **29**



27 Paired prolegs (pseudopods) with sclerotized apical crochets (curved hooks) on venter of abdominal segments 3-7 ; larvae in streams or in saturated soil along streams ..... **most *Dicranota***

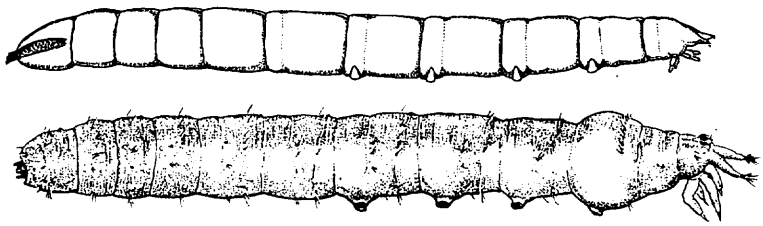


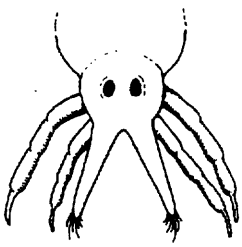
27' Abdomen without prolegs; roughened creeping welts on broad, low tubercles on basal annulus of abdominal segments 4-7 ..... **28**

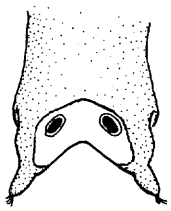


28 Creeping welts on both dorsum and venter of abdominal segments 4-7, with microscopic, sclerotized spicules on welts ..... ***Dicranota*, in part** .....**(subgenus Rhaphidolabina only?)**

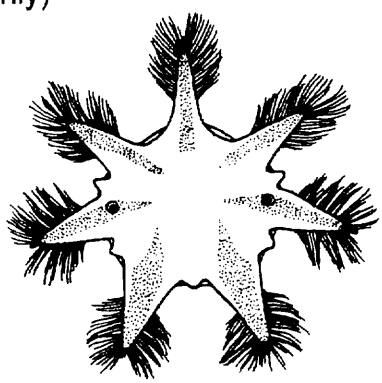
28' Creeping welts or broad tubercles on venter of abdominal segments 4-7, without microscopic, sclerotized spicules; larvae in wet soil or algae of swampy woods, spring margins and seepage areas on slopes or rock cliffs ..... ***Pedicia***



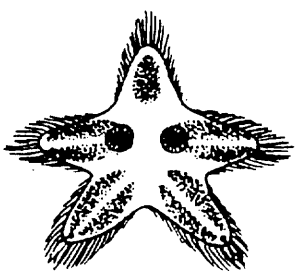


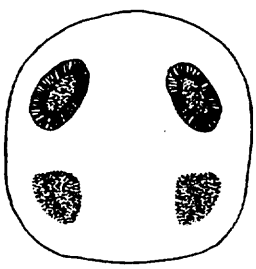


29 Spiracular disc surrounded by seven lobes, situated one dorsomedially and one each dorsolaterally, laterally and ventrally on each side; spiracles small, widely separated, at bases of lateral lobes of spiracular disc. Larva found in organic silt in small stream .... ***Gonomyodes***
(Western North America only)



29' Spiracular disc with five or fewer peripheral lobes, or without distinct lobes **30**

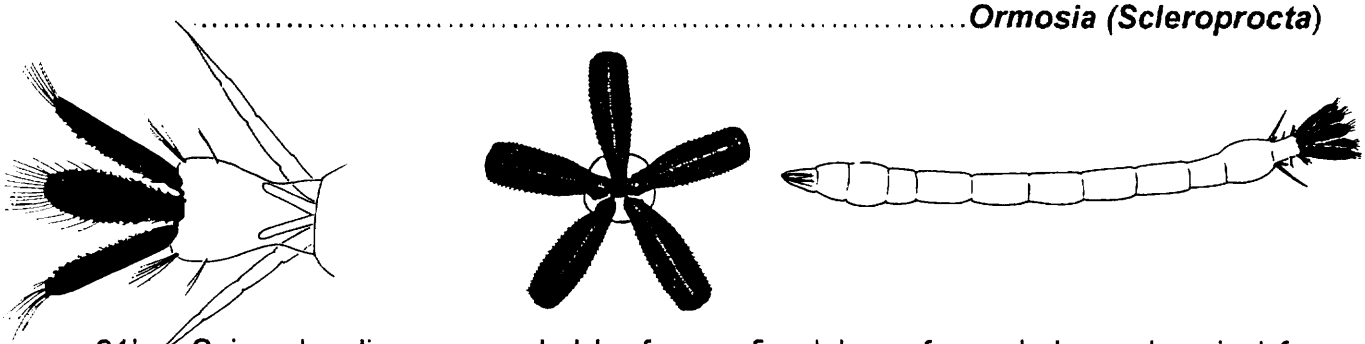




30. Spiracular disc with four or five peripheral lobes **31**

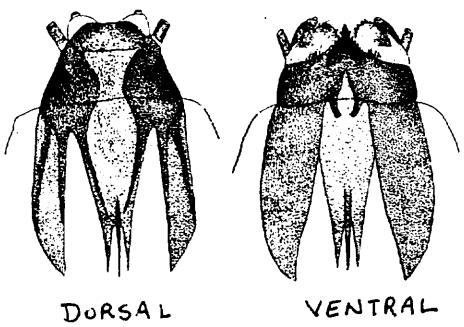
30' Spiracular disc with only three lobes, or without distinct lobes **72**

31 Spiracular disc surrounded by five lobes, each in form of a black spatulate plate with finely toothed margins. Larvae found in marshy soil ....***Ormosia (Scleroprocta)***

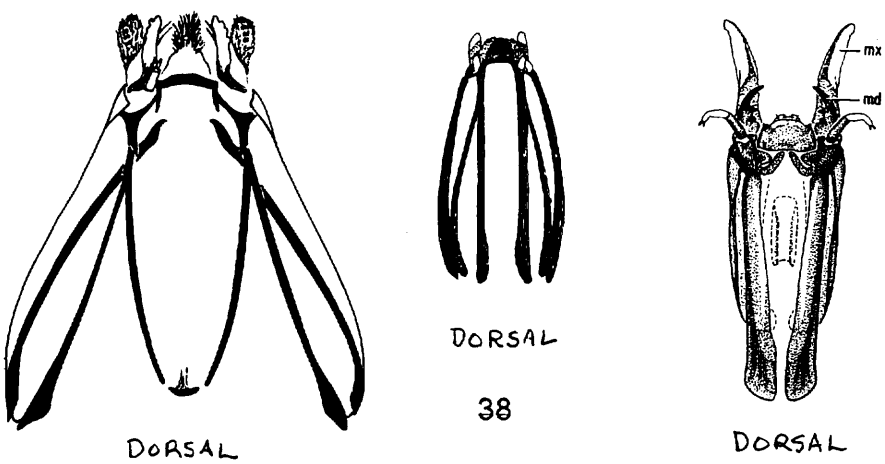


31' Spiracular disc surrounded by four or five lobes of rounded or subconical form **32**

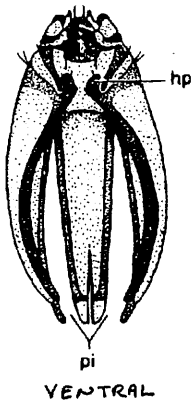
32 Internal portion of head capsule broadly sclerotized dorsally and laterally, with posterior incisions shallow or not extending to near line of attachment of skin . (This can be determined by cutting the prothoracic skin at one side, or often can be seen through the skin) **33**

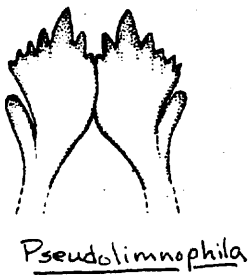


32' Internal portion of head capsule divided by deep posterior incisions into elongate, slender, rod-like to spatulate sclerites, or if sclerites broad and plate-like, they are darkly sclerotized only along their edges, giving appearance of separate rods **61**

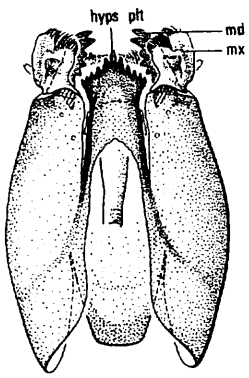


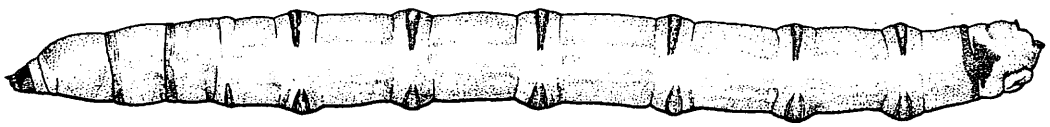
33. Hypostomal bridge (called mentum or maxillary plates by some authors) of two prolongations, one from lower edge of each lateral, sclerotized plate, separated medially by membranous area (hypostomal plates in contact but not fused in *Pseudolimnophila*); abdominal segments without creeping welts **34**





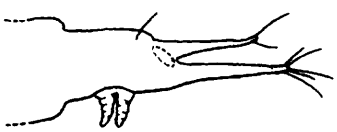
33' Hypostomal bridge complete, although it may be deeply incised posteriorly abdominal segments with creeping welts present on basal (anterior) annulus of segments, or abdominal segments have transverse bands or patches of dense pilosity on both basal and apical (posterior) annuli **51**



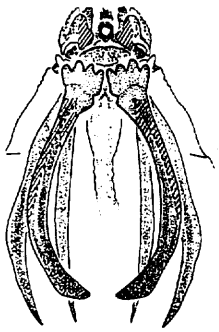


34 Plane of spiracular disc approximately perpendicular to long axis of body ; disc with 5 peripheral lobes **35**

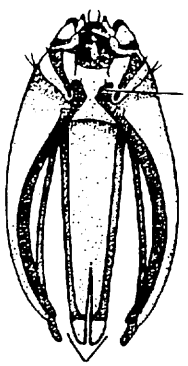
34' Plane of spiracular disc diagonal to long axis of body ; disc with 4 peripheral lobes **49**



35 Hypostomal prolongations expanded to form sclerotized plates with toothed anterior margins **36**



35' Hypostomal prolongations, if expanded, either not sclerotized or not toothed on anterior margins **37**



36 Hypostomal plates with 4 teeth each ; spiracular disc broadly blackened, the black spots on dorsolateral (lateral) and ventral lobes divided medially by pale line; spot on dorsal lobe nearly always undivided (i.e., entire); larva in wet humic soil ..... ***Molophilus***

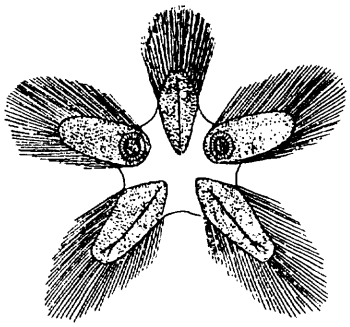
36' Hypostomal plates with 5 to 8 teeth each ; spiracular disc small, without extensive blackened area (somewhat darkened spots on all lobes divided by pale zone or line); larva in organic mud ..... ***Erioptera*, in part**

37 Posterior surfaces of all five lobes of spiracular disc with solidly darkened spot **38**

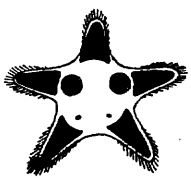
37' Spots on some or all lobes of spiracular disc divided medially by pale line or by wider pale zone **39**

38 Darkened areas on dorsolateral lobes of spiracular disc continued inward to surround spiracles; larvae in wet organic soil in woods and near water .... ***Ormosia (Rhypholophus)* in part**

(Not Southeastern)



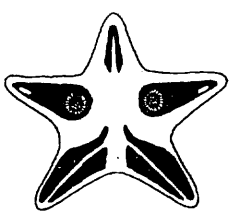
38' Black spots of dorsolateral lobes not continued inward around spiracles ; larvae in muddy stream banks ..... ***Erioptera (Trimicra)***



39 Spiracular disc with 5 lobes approximately equal in shape and size; darkly pigmented spots of dorsal and ventral lobes divided medially by pale line; spots of lateral lobes extended inward to surround spiracles , not divided by pale line **40**

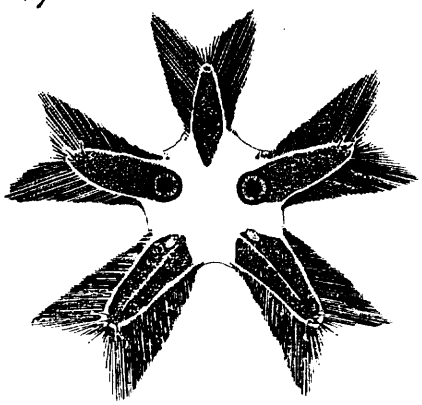
39' Spiracular disc with 4 or 5 lobes, if 5 lobes, dorsal lobes smaller than lateral or ventral lobes; pigmentation of lobes not as above **41**

40 Pigmented spots of lateral lobes black or very dark, each enclosing a small, pale subapical spot; marginal hairs of lobes short; larvae in wet marshy soil ..... ***Cheilotrichia***



40' Pigmented spots of lateral lobes dark brown, without enclosed pale spot; marginal hairs long, nearly as long as lobes; larvae in wet, organic soil in woods .....***Ormosia (Rhypholophus)* in part**

(not Southeastern)

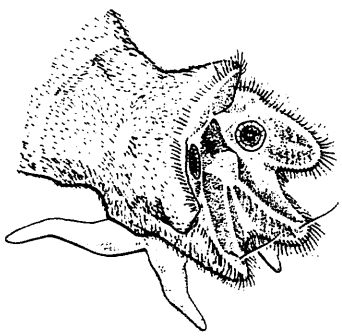


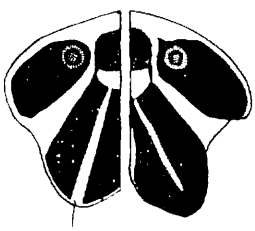
41 Median, dorsal lobe of spiracular disc bearing densely sclerotized, horn-like projection with apex bent downward over disc ; black, wedge-shaped spots at periphery of disc between ventral lobes, between ventral and lateral lobes, and between lateral lobes and median dorsal lobes; larvae in fine sand, silt and organic debris at margins of clear streams ..... ***Arctoconopa***

(not Southeastern)

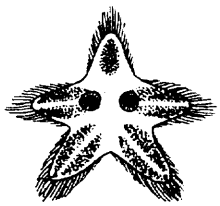
41' Median, dorsal lobe of spiracular disc without sclerotized, horn-like projection ; no wedges of black pigmentation between lobes of disc **42**

42 Center of spiracular disc with solid dark marking, continuous (or nearly so) with sclerotization of the dorsolateral lobes. **43**

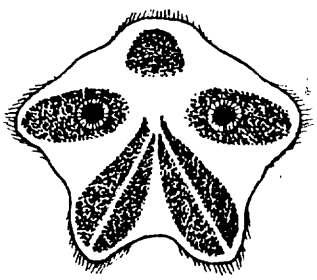




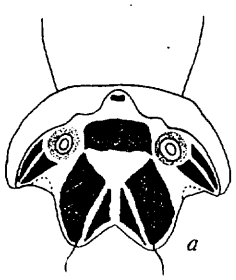
42' Center of spiracular disc without large dark marking, although 4-6 small, dark spots near center of spiracular disc may occur; Dorsolateral lobes and ventral lobes with blackened spots usually distinctly divided by pale median line, ... **44**



43 Peripheral lobes of spiracular disc short, blunt; Dorsolateral lobes with solidly blackened spots or with spots divided; larvae in moist soil, usually near water ..... ***Gonomyia* in part**



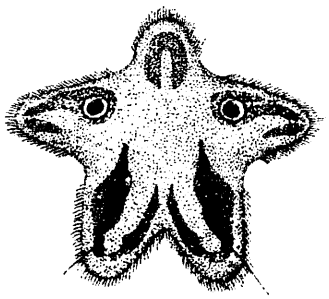
43' Peripheral lobes more conspicuous, not blunt; Dorsolateral lobe with blackened spot divided; larva in sandy loam at edge of stream or stream bank ..... ***Ellipteroides (Prognomyia)*** (based on African species)



44 Blackened spot of median dorsal lobe of spiracular disc not divided, larvae in organic mud ..... ***Ormosia*, in part**

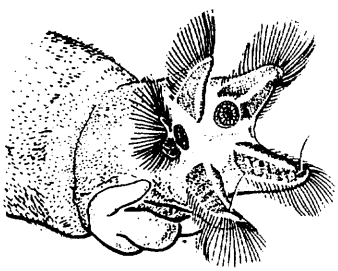
44' Spot on median dorsal lobe and spots on other lobes divided by pale median line **45**

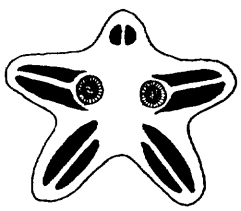
45. Sclerotization of all lobes divided by medial pale line, with sclerotization of dorsolateral lobe extending as narrow band encircling spiracles. .... ***Gonempeda***



45' No narrow band encircling spiracles..... **46**

46 Area between spiracles generally unpigmented, not blackened. Larva found in organic mud ..... ***Ormosia*, in part**





46' Area between spiracles with some darkly pigmented spots **47**

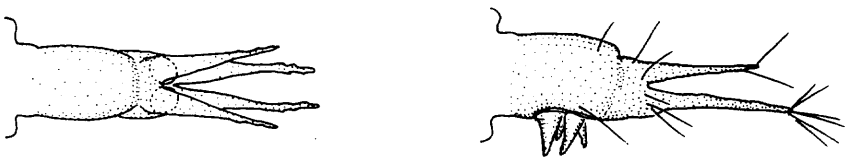
47 Four to six small spots (as two to three pairs) between and below spiracles; spiracular disc not small compared with body size. Larva in moist earth, sometimes along edge of streams..... ***Erioptera (Symplecta)***

47 Two round spots between spiracles; spiracular disc small compared with body size. **48**

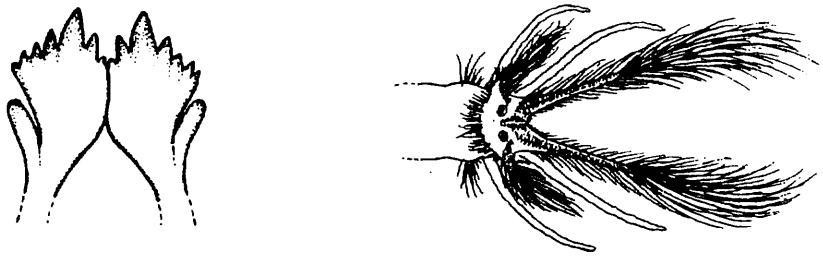
48 Pigmentation of spiracular disc brown to light brown; spiracular lobes with slender, not broadly rounded apices ..... ***Erioptera (Erioptera)*, in part**

48' Pigmentation of spiracular disc black; spiracular lobes shorter, more rounded apices ..... ***Erioptera (Ilisia)***
(Erioptera (Hoplolabis) and *E. (Mesocyphona)* may also key here)

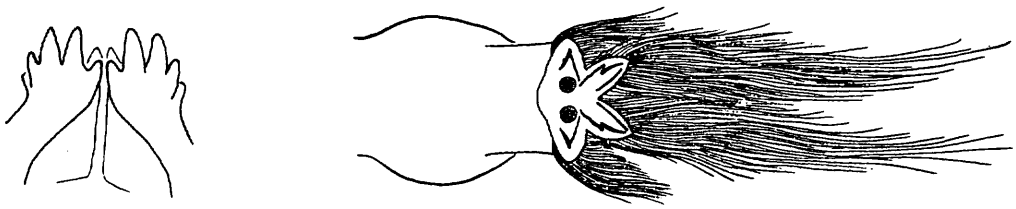
49 Ventral lobes of spiracular disc not darkly pigmented on upper surface (Fig. 33), not fringed with long hairs; spiracles pale and difficult to see. Hypostoma reduced to small longitudinal rod below maxilla on each side. Larva found in sandy bottoms of clear cold streams ..... ***Cryptolabis***



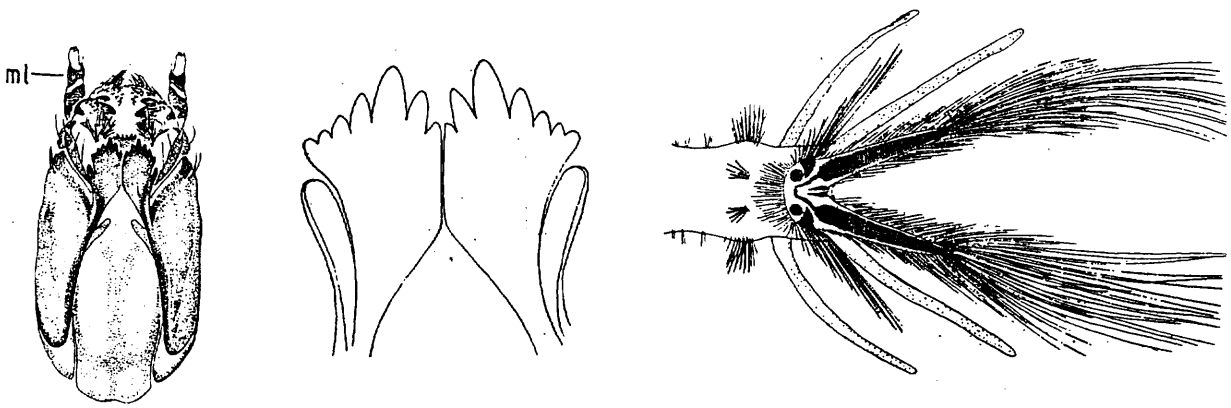
49' Ventral lobes of spiracular disc darkly pigmented on upper surface, fringed with long hairs that are longer than the lobes ; spiracles dark. Hypostoma in form of a toothed plate at each side. **50**



50 Hypostomal plates each bearing four anterior teeth. Larva found in organic mud in wet woodlands ..... ***Paradelphomyia***



50' Hypostomal plates each bearing seven or eight anterior teeth. Larva found in thin organic mud in swampy woods, pond margins and similar habitats .... ***Pseudolimnophila***
(Note: With rough handling, the ventral lobes may break off leaving the "ventral lobes" short, dorsolateral lobes longest)



51 Spiracular disc with 5 peripheral lobes **52**

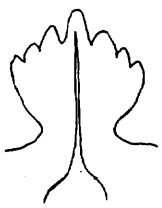
51' Spiracular disc with 4 peripheral lobes, but if vestigial median dorsal lobe is present, it is unpigmented. **56**

52. Creeping welts on abdominal segments only slightly raised, pale, without microscopic hairs or with hairs indistinct except at high magnifications; **53**

52' Creeping welts on abdominal segments distinct, conspicuous **54**

53. Hypostomal bridge with three teeth. Ventral lobes of disc short, broadly rounded, with triangular dark spot enclosing pale setal base; larva in damp, punky wood ..... ***Austrolimnophila*, in part**

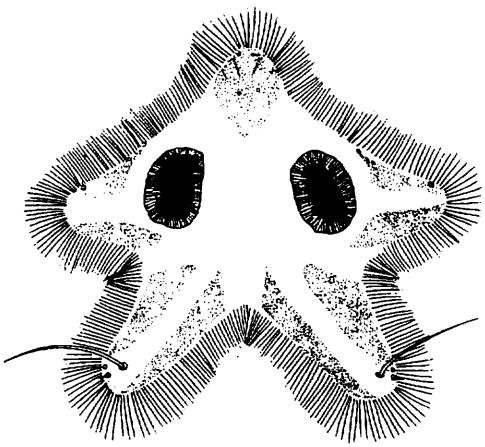
53'. Hypostomal bridge with seven teeth. Ventral lobes of spiracular disc with single linear dark brown spot. Larva found in pieces of damp to saturated much decayed hardwood ..... ***Atarba***

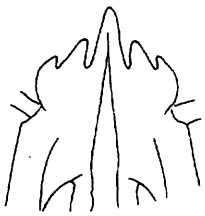


54 Abdominal segments 2-7 with both dorsal and ventral creeping welts on basal rings . Lobes of spiracular disc wider than long, broadly rounded, unpigmented or with only limited darkened spots ; larvae found in numerous aquatic and terrestrial situations ..... ***Limonia***

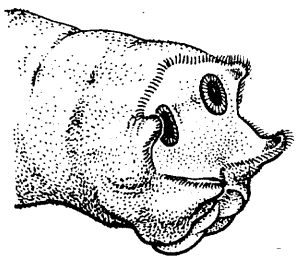
54' Abdominal segments 2-7 with ventral creeping welts only . Ventral lobes of spiracular disc as long as their width at base, or longer **55**

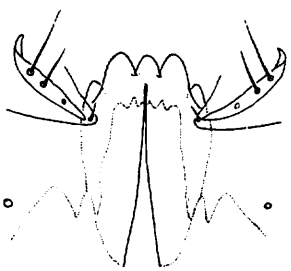
55 Ventral lobes of spiracular disc longer than their width at base, darkened at margins with a broad median pale zone on each. Hypostomal bridge with five teeth. Larva brownish with long appressed pubescence. Larva in marsh borders in decomposing aquatic vegetation or in marshy areas in woods .... ***Helius***



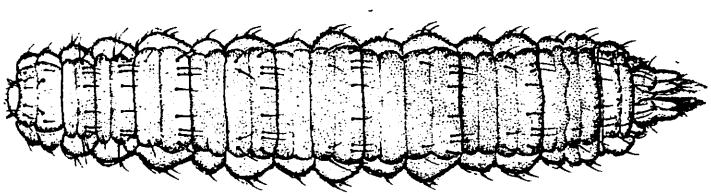


55' Ventral lobes of spiracular disc only about as long as basal width, almost uniformly brownish posteriorly . Hypostomal bridge with three teeth. Larva pale, with short appressed pubescence, found in wet decayed wood of deciduous trees ..... ***Epiphragma*, in part**



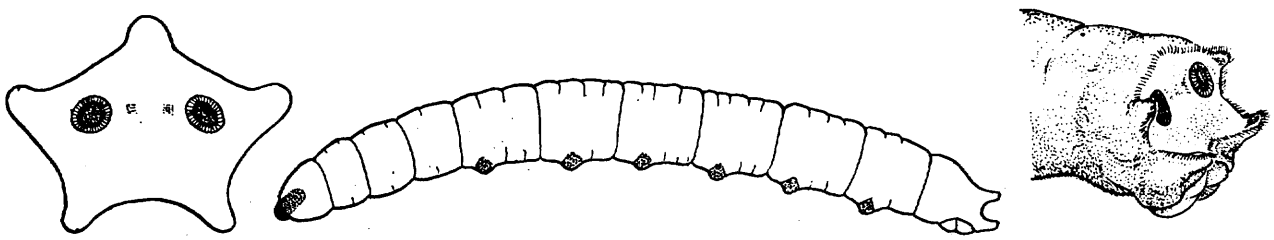


56. Abdominal segments 2-7 without distinct creeping welts; all segments with transverse bands or patches of dense pilosity. Lateral lobes of spiracular disc broadly pigmented from spiracles outward; broadly pigmented faces of ventral lobes narrowly connected across lower disc. Larva found in thin mosses and algal mats on wet rocky cliff, rarely in soil ..... ***Dactylolabis***



56' Abdominal segments 2-7 with distinct creeping welts; all segments without transverse bands or patches of dense pilosity **57**

57 Abdominal segments 2-7 with ventral creeping welts only. Hypostomal bridge with three teeth. Larva in wet decaying wood of deciduous trees ... . ***Epiphragma*, in part**

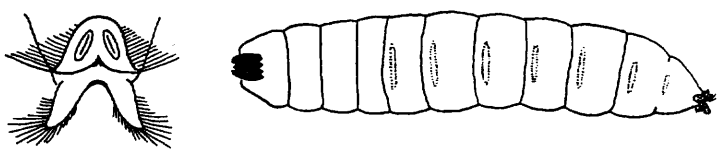


57' Abdominal segments 2-7 with both dorsal and ventral creeping welts. Hypostomal bridge with more than three teeth..... **58**

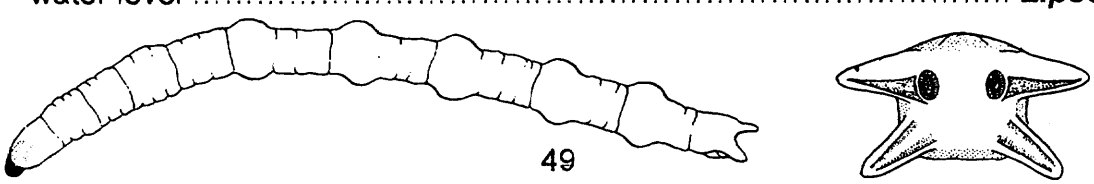
58 Ventral lobes of spiracular disc longer than their width at base, tapering to subacute apex, fringed with long hairs **59**

58' Ventral lobes of spiracular disc shorter than their width at base, broadly rounded, without long marginal hairs **60**

59 Body wide, flattened. Ventral creeping welts without minute spines. Spiracular disc small in proportion to body. Spiracles dorsoventrally elongate. Larva semi-aquatic, found in indistinct tunnels beneath algal mats on wet cliffs, beside waterfalls, and in other similar locations ..... ***Elliptera***

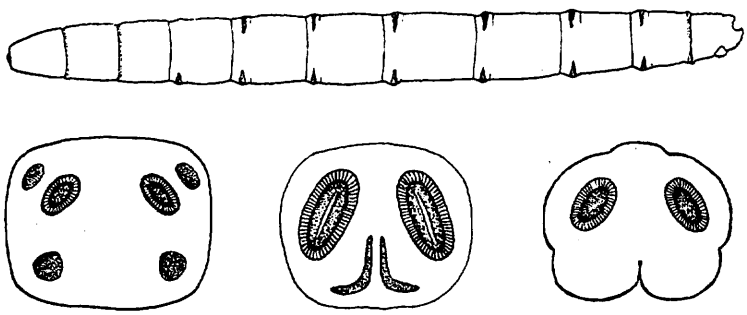


59' Body elongate, nearly cylindrical (round in cross section), or only slightly flattened; anterior annulus of most abdominal segments (annulus with creeping welt) greater in diameter than posterior annulus. Ventral creeping welts with numerous rows of minute spines. Spiracles round to transversely elongated; ventral lobes of spiracular disc narrowly darkened at margins; dorsal lobes more extensively darkened. Larva found in sodden decayed wood, at or just below water level ..... ***Lipsothrix***

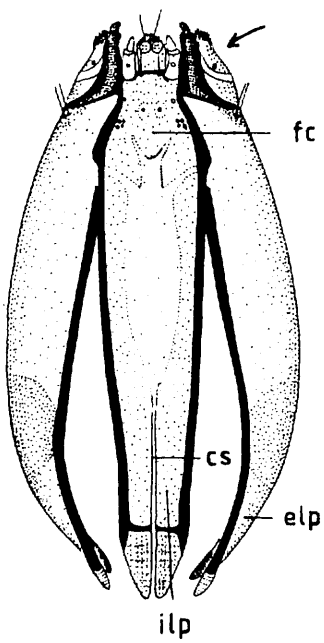


60 Spiracular disc with darkened area around each spiracle and in middle of each ventral lobe, margins of lobes paler and with moderately long fringe of hairs; spiracles transversely elongated; larva in thin growth of algae on wet, calcareous rocks ..... ***Orimarga***

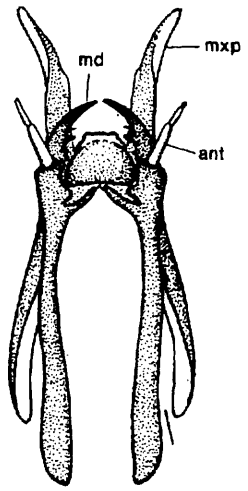
60' Spiracular disc generally pale, with only small isolated, darkly pigmented spots; spiracles oval, inclined together dorsally large genus with larvae in a variety of aquatic and terrestrial habitats ..... ***Limonia***



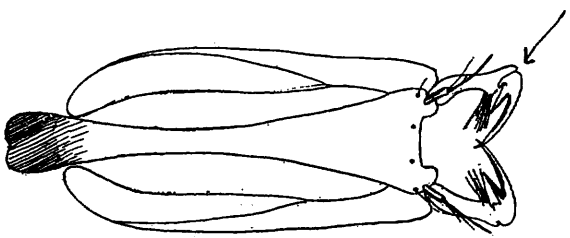
61 Maxillae not prolonged forward, inconspicuous in dorsal aspect; ..... **Tribe Eriopterini, in part**
.....**Return to couplet 35**



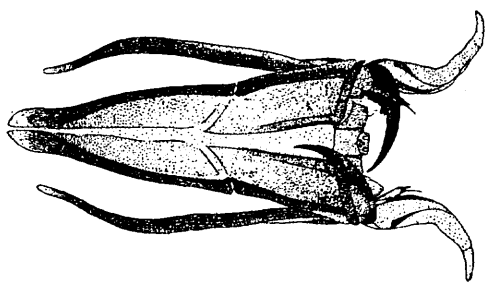
61' Maxillae prolonged forward, each as a dorsoventrally flattened, tapering (less often subconical) blade, together appearing as divergently curved tusks with tips visible even when head is withdrawn into thoracic segments (*Cryptolabis* also has prolonged maxillae – couplet 49).....**62**



62 Mandible complex, jointed near mid-length ; maxilla and labrum-epipharynx densely fringed with long yellowish to golden hairs. Dorsal plates of head fused into spatulate plate widest posteriorly. Spiracular disc small, with its upper lobes often infolded to conceal spiracles; marginal hairs protruding from cavity, formed by infolding **63**

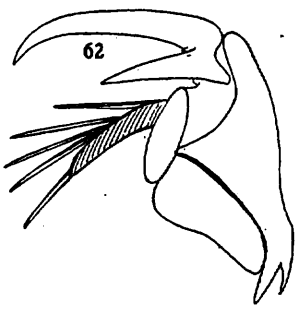


62' Mandible not jointed near mid-length ; maxilla and labrum-epipharynx with mostly short pilosity. Dorsal plates of head not fused, although each may be widest posteriorly **64**

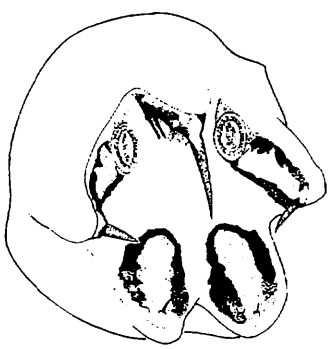


63 Pigmentation of ventral lobes of spiracular disc discontinuous, either as transverse striations near base of lobe, more continuous coloration toward apex, or reduced to short darkened median line; all four lobes (lateral pair sometimes reduced) fringed with long golden hairs. Basal tooth or teeth of apical portion of mandible much less than half as long as main outer tooth. Larva found in moist to wet humus soil or decomposing vegetation in swampy woodlands ..... ***Pilaria***

63 Pigmentation of ventral lobes of spiracular disc more evenly distributed, but more intense toward apex of lobe; all four lobes fringed with long hairs. Basal tooth of apical portion of mandible about half as long as main outer tooth. Larva found in organic mud in swampy woodlands ..... ***Ulomorpha***

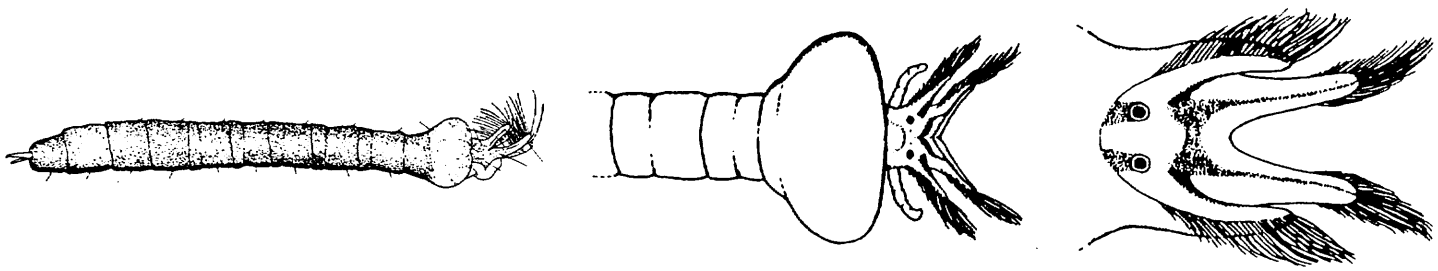


64 Spiracular disc surrounded by 5 short, bluntly rounded lobes; ventral lobes without long marginal hairs; in some species a densely sclerotized, horn-like projection from near apex of dorsal and dorsolateral lobes; larvae in sandy bottoms and margins of clear streams ..... ***Rhabdomastix*, in part**

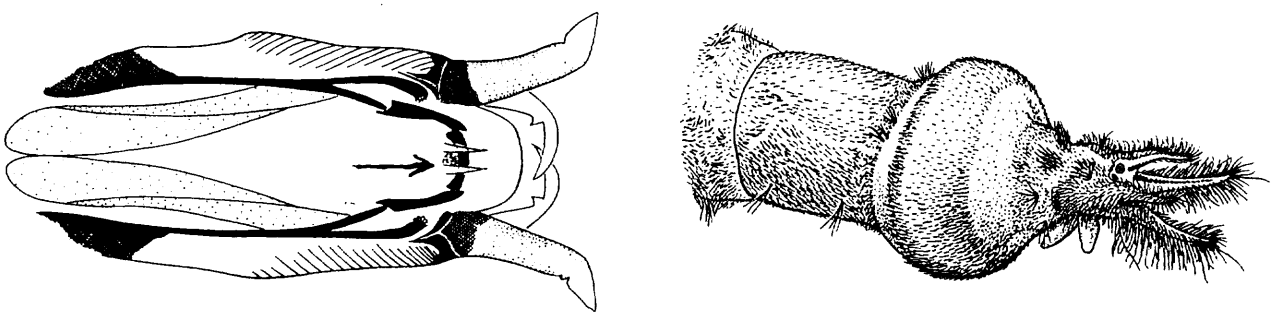


64' Lobes of spiracular disc (usually 4) not all short and bluntly rounded; ventral lobes usually elongate, with long marginal hairs; no sclerotized, horn-like projections from any lobes **65**

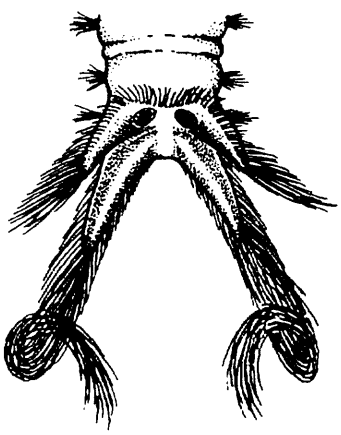
65 Mid-ventral region of head membranous before line of attachment of skin, without darkened transverse bar just beneath surface ; larvae in sand or gravel, near margins of clear, cool streams (Note: in this genus especially, but also in some others in similar habitats, larvae may be found with the 7th abdominal segment swollen, possibly as an aid in anchorage or locomotion. This swelling may persist in preserved specimens) ..... ***Hexatoma***
(See key to species)



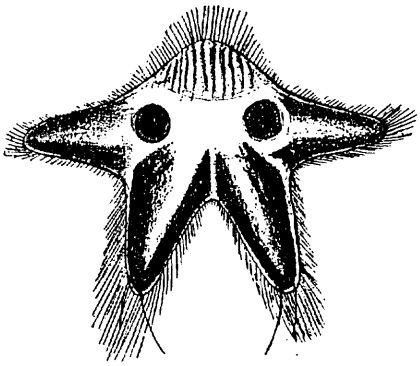
65' Mid-ventral region of head membranous before line of attachment of skin, with darkened transverse bar (part of hypopharynx) visible just beneath surface .....**genus *Limnophila* 66**
(Tenative key to subgenera follows)



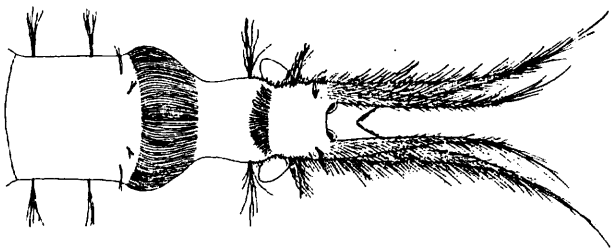
66. Spiracular disc with dorsolateral lobes shorter than ventral lobes; marginal hair fringe normally much longer on ventral than on dorsolateral lobes **70**



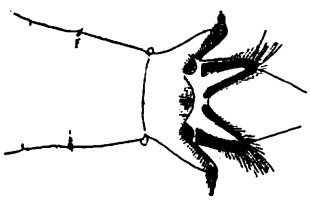
66'. Spiracular disc with dorsolateral and ventral lobes subequal in size; marginal hair fringe not conspicuously longer on ventral lobes **67**



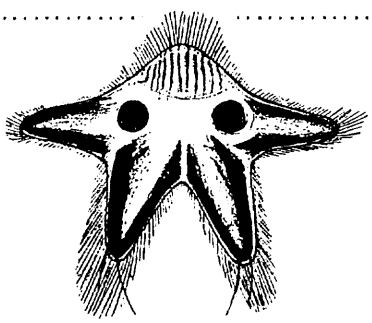
67. Spiracular disc with dorsolateral and ventral lobes forming long cylindrical processes. Body cuticle covered with sparse dark pubescence ***L. (Eloeophila)***



67'. Spiracular disc with dorsolateral and ventral lobes flattened, not cylindrical **68**

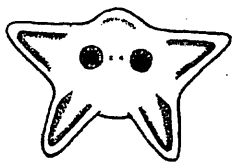


68. Dorsal spiracular lobe with a series of dark parallel lines .... ***L. (Dicranophragma)***

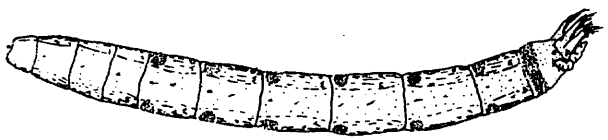


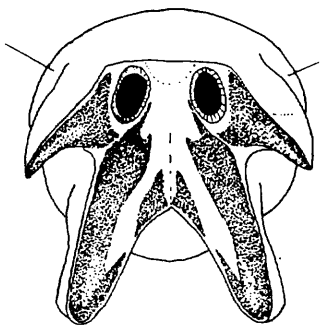
68'. Dorsal spiracular lobe unpigmented, or with different sclerotization pattern ... **69**

69. Spiracular disc with dorsolateral and ventral lobes with darker, ill-defined borders. ..... ***L. (Brachylimnophila)***
(based on European species only)

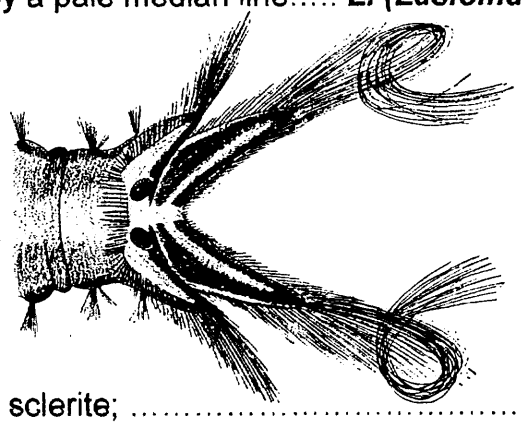


69'. Spiracular disc with dorsolateral lobes with triangular dark brown marking each; ventral lobes with V-shaped dark brown marking, the inner arm narrower in outer half; mature larvae large, to 38 mm length ..... ***L. (Eutonia)***





70. Ventral lobe with dark sclerite divided by a pale median line..... ***L. (Lasiomastix)***

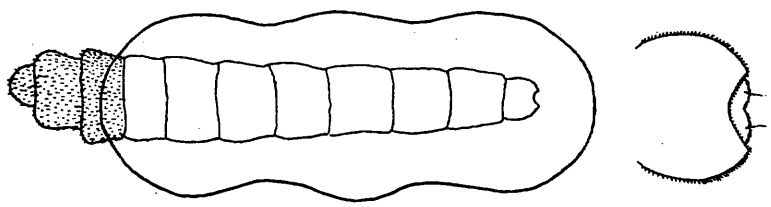


70'. Ventral lobe with solid (undivided) dark sclerite; **71**

71. Spiracular disc with ventral lobes longer than basal width of lobes ..... ***L. (Idioptera)***

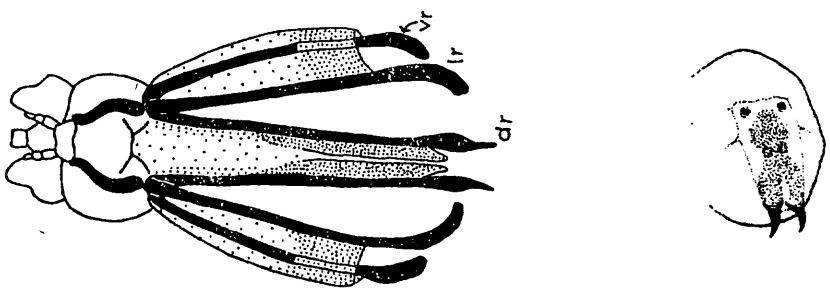
71'. Spiracular disc with ventral lobes not longer than basal width of lobes ..... ***L. (Ephylidorea)*** and ***L. (Phylidorea)***.

72 Spiracular disc broadly indented dorsally; larva in a flattened, oblong, hardened case in wet soil near small streams or springs; exposed (thoracic) segments bearing numerous hairs ..... ***Thaumastoptera***

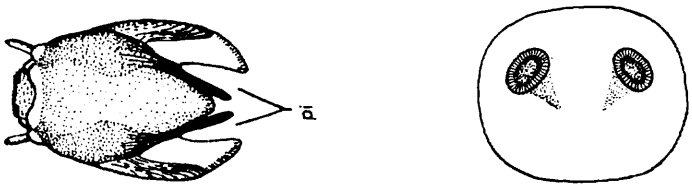


72' Spiracular disc not broadly indented dorsally; larva not in a flattened, oblong, hardened case; thoracic segments not hairy **73**

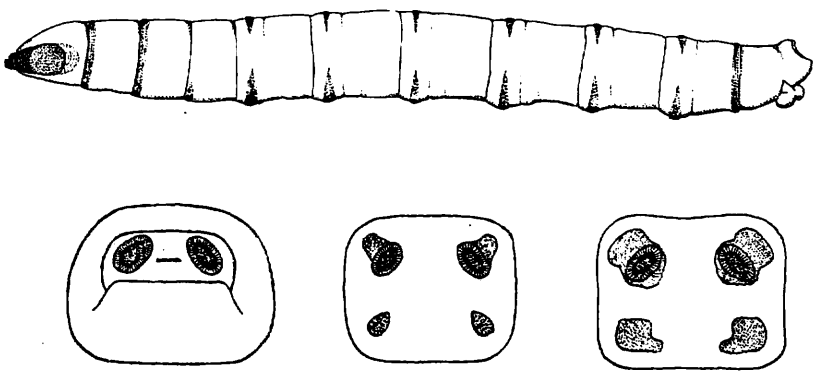
73. Internal portion of head divided by deep posterior incisions into elongate, slender, flattened sclerotized rods (can be determined by cutting prothoracic skin at one side, or often can be seen through skin); spiracles very small, pale, separated by about 3 times diameter of a spiracle; larva in sandy bottoms and margins of clear streams ..... ***Rhabdomastix*, in part**



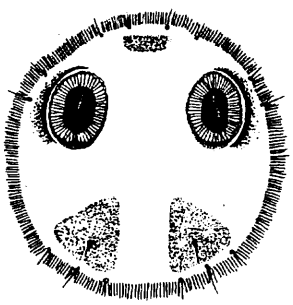
73' Internal portion of head broadly sclerotized dorsally and laterally; sclerites plate-like, with shallow posterior incisions ; spiracles usually large, oval, inclined together dorsally **74**



74 Abdominal segments 2-7 with both dorsal and ventral creeping welts (of differing structure in some species) on basal rings. Posterior spiracular disc roughly circular or broadly oval to transversely subrectangular; spiracles often large, oval, inclined together dorsally. Larvae found in various terrestrial and aquatic habitats ..... ***Limonia*, in part**



74' Abdominal segments 2-7 with ventral creeping welts only; welts pale, without microscopic setae. Spiracles subcircular. Larva in dampy, punky wood .... ***Austrolimnophila*, in part**



From Alexander + Byers, 1981

Biology and behavior. The Tipulidae are found from the northernmost lands of the Arctic to lowland equatorial forests, and from the marine intertidal zone to over 5600 m in certain high mountain ranges. Most species are associated with moist, temperate environments; adults are ordinarily found in low, leafy vegetation near streams and lakes in forested areas. However, many species inhabit open meadows, fairly dry rangelands, and even deserts. Because many species of Tipulidae are so abundant, they are extensively preyed upon by birds, mammals, fishes, and other vertebrates, as well as by spiders and predacious insects. The Tipulidae are therefore of tremendous ecological importance. Larvae of a few species that feed on roots of forage crops or on seedling field crops can become economic pests.

As might be expected in a group of insects as large and varied as the Tipulidae, the immature stages occupy a wide variety of habitats. Habitats ranging from strictly aquatic to completely terrestrial are briefly described here, and examples of the genera that are found in each are given:

- fresh water, especially rapidly flowing streams—*Antocha* Osten Sacken, *Hesperoconopa* Alexander, *Cryptolabis* Osten Sacken
- intertidal zones or brackish water—*Limonia* (*Idioglochina* Alexander) on the Pacific coast, *Limonia* (*Dicranomyia* Stephens) on the Atlantic
- aquatic environment during the larval stage and margins or dryer areas for pupation—*Tipula* Linnaeus, *Limonia* Meigen, *Thaumastoptera* Mik, and many Pediciini, Hexatomini, and Eriopterini
- steep or vertical cliff faces supporting a film or scum of algal growth that is constantly kept wet by slow-flowing or percolating waters or, occasionally, by more rapidly flowing water—some species of *Limonia* Meigen, *Orimarga* Osten Sacken (Vaillant 1950), *Elliptera* Schiner
- moist to wet cushions of mosses or liverworts growing on rocks or earth—Cylindrotominae, various Limoniinae, Tipulinae including *Dolichopeza* Curtis (Byers 1961*b*)
- dry to saturated decaying wood or, occasionally, sodden logs in streams, where larvae commonly feed on fungus mycelia—*Ctenophora* Meigen, *Gnophomyia* Osten Sacken, *Teucholabis* Osten Sacken, *Lipsothrix* Loew
- rich organic earth or mud, as found along margins of streams or lakes or in swamps and marshes; in masses of leaf drift at stream borders; in wet spots in woods where humus is kept saturated—numerous genera and species
- sandy, gravelly, or loamy soils with moderate humus, as found along stream borders—eriopterine groups such as *Gonomyia* Meigen, *Rhabdomastix* Skuse, *Arctoconopa* Alexander, and *Hesperoconopa* Alexander
- decaying plant materials such as masses of leaves, stems, or fruits in various stages of putrefaction—various subgenera and species of *Limonia*
- fungi, both woody and fleshy—*Ula* Haliday, *Limonia* (*Metalimnobia* Matsumura)
- organic matter accumulated in the nests of birds and mammals—chiefly Tipulinae
- leaves of various terrestrial higher plants and mosses—chiefly *Cylindrotoma* Macquart
- dry soil as found in lawns, pastures, or on the ranges of the west—*Nephrotoma* Meigen, *Tipula* Linnaeus, *Dicranoptycha* Osten Sacken.

The following papers provide detailed accounts of the immature stages and include bibliographies that may also be consulted for further information: Alexander 1920, 1922, 1931*b*; Bangerter 1928–1934; Brindle 1957–1967; Brodo 1967; Bryce 1956, 1957; Byers 1958–1961*b*; Chiswell 1956; Foote 1963; Hennig 1950; Hynes 1958–1969*c*; Pritchard and Hall 1971; Rogers 1926*a*–1949; Rogers and Byers 1956; Saunders 1928; Savtshenko 1955; Theowald 1957, 1967; Tokunaga 1930; Vaillant 1950.

The life cycle of a crane fly typically consists of a brief egg stage (6–14 days), four larval stages, and a fairly short pupal stage (5–12 days) before emergence of the short-lived adult. Depending on the species and the environmental conditions, especially temperature and humidity, the entire cycle may be as short as 6 wk or as long as 4 yr. Exceptionally long cycles occur in Arctic species. Most species at temperate latitudes or elevations produce one or two generations a year.

From Byers, 1996

Table 23A. Summary of ecological and distributional data for *Tipulidae (Diptera)*. (For definition of terms see Tables 6A-6C; table prepared by K. W. Cummins, R. W. Merritt, and G. W. Byers.)

Taxa (number of species in parentheses)	Habitat	Habit	Trophic Relationships	North American Distribution	Refs.
Tipulidae (573+) Crane flies)	Generally lentic—littoral, lotic—erosional and depositional (detritus)	Generally burrowers (and sprawlers)	Generally shredders—detritivores, collectors—gatherers	Widespread	18, 1957, 1984, 2990, 1371, 1584, 3076, 4511
Tipulinae(53+)	Generally lotic—depositional and lenticlittoral	Generally burrowers	Generally shedders?	Widespread	18, 1296, 1957, 1984 3076, 4511
Brachypremna(1)	Lotic—depositional margins (in fine sediments of springs and small streams)	Burrowers		Eastern United States	1372, 3563
Holorusia(1)	Lotic—depositional and lentic margins (in detritus, moss, and fine sediments)	Burrowers	Shredders—detritivores	West	806
Leptotarsus (*Longurio*)(4)	Lotic—depositional (springs and small streams)	Burrowers?		Eastern United States	
Megistocera(1)	Lentic—littoral (vascular hydrophytes—floating zone)	(Form part of the neuston living in surface film in open-ended tubes of floating vegetation)	Shredders—herbivores? Texas	Florida to eastern	3425
Prionocera(16)	Lentic—littoral	Burrowers (in detritus)		Widespread	
Tipula(30+)	Lotic—erosional and depositional (detritus), lentic—littoral (detritus)	Burrowers (in detritus)	Shredders—detritivores and herbivores, collectors—gatherers, possibly some scrapers, predators (engulfers) with animals taken in the process of shredding?	Widespread	185, 576, 669, 671, 722, 1044, 1470, 1530, 1663, 2113, 2272, 2273, 2712, 2990, 3199, 3203, 3206, 1482, 1584, 3563, 3919, 4234, 1371, 806, 4057, 4110, 2077, 3675, 3870, †, ‡, 3286, 3422, 4338, 4511, *, 2671, 2673
Cylindrotominae(5)	Generally lentic and lotic—margins (in moss)	Generally burrowers—sprawlers	Generally shredders—herbivores	North	18, 24, 1228, 1957, 1984, 3076, 4511
Phalacrocera(4)	Lentic—vascular hydrophytes (moss in marsh areas)	Burrowers—sprawlers	Shredders—herbivores (chewers)	Northern United States and southern Canada	2688
Triogma(1)	Lotic and lentic—margins (in moss)	Burrowers—sprawlers (semiaquatic)		Northern United States	
Limoniinae(515+)	Generally lotic—depositional, erosional, and margins, lentic—littoral and margins	Generally—burrowers	Shredders, collectors, and predators (engulfers)	Widespread	18, 24, 1957
Antocha(7)	Lotic—erosional (in fast water on rocks and logs)	Clingers (in silk tube)	Collectors—gatherers	Widespread	669, 671, 2316, 1326, 4234, ‡
Arctoconopa(9)	Lotic—erosional and depositional, margins (clear streams)	Burrowers		Widespread	
Cryptolabis(12)	Lotic—depositional (sand in clear, cold streams)	Burrowers		Widespread	2316

* Includes some important references on related terrestrial species.
† Unpublished data, K. W. Cummins and M. J. Klug, Kellogg Biological Station.
‡ Unpublished data, K. W. Cummins, Kellogg Biological Station.
§ Emphasis on trophic relationships.

Table 23A. Continued

[illegible]	Habitat	Habit	Trophic relationships[§]	North American Distribution	[illegible]
Dactylolabis(18)	Lotic—erosional and depositional (in moss and algal mats, especially rocky seeps)	Burrowers—clingers		Widespread	3668
Dicranota(55)	Lotic—erosional and depositional (detritus), lentic—littoral (detritus); lotic and lentic margins (in damp soil)	Sprawlers—burrowers	Predators (engulfers)	Widespread	669, 2686, 2687, 2193, 4234, ‡
Elliptera(5)	Lotic—burrowers erosional (in moss and algal mats on wet rock faces)	Burrowers—clingers		Widespread	
Erioptera(35+) (includes *Trimicra* as a subgenus)	Lotic—erosional and depositional (sand, detritus, and margins), lentic margins	Burrowers (semi-aquatic)	Collectors—gatherers	Widespread	3422
Gonomyia(15+)	Lotic and lentic—margins	Burrowers (semi-aquatic)		Widespread	3419, 4234
Gonomyodes(4)	Lotic—depositional	Burrowers		West	
Helius(2)	Lentic and lotic—margins (in detritus in wet woodlands or marshes)	Sprawlers—burrowers		Widespread	3422
Hesperoconopa(5)	Lotic—depositional (sand in cold, clear streams)	Burrowers		West	4234
Hexatoma(34) (includes *Eriocera* as a subgenus)	Lotic—erosional and depositional (detritus and moss) lentic—littoral (detritus)	Burrowers—sprawlers, clingers	Predators (engulfers, Oligochaeta, Diptera)	Widespread	669, 3422, 4511 3563, 4234
Limnophila(40+)	Lotic and lentic margins, lotic—depositional (in fine sediments and detritus)	Burrowers	Predators (engulfers, Oligochaeta, Diptera)	Widespread	3422, 3563, 3078
Limonia(95+) (includes *Geranomyia* as a subgenus)	Lotic and lentic—margins (on exposed objects—rocks and logs; in fine organic sediments and detritus)	Burrowers—sprawlers (semiaquatic)	Shredders—herbivores (chewers—macroalgae)	Widespread	3409, 3420, 3422, 3909
Lipsothrix(4)	Lotic—depositional (soft, saturated wood)	Burrowers	Shredders (decaying wood)	Widespread	96, 979, 3426, 981
Molophilus(15+)	Lotic and lentic margins	Burrowers (semi-aquatic)		Widespread	1521, 3422, 3563
Orimarga(5)	Lotic and lentic margins (wet, soft, decaying wood)	Burrowers	Shredders?	Southern United States	
Ormosia(40+)	Lotic and lentic margins (in detritus and fine organic sediments)	Burrowers (semi-aquatic)	Collectors—gatherers?	Widespread	4234
Paradelphomyia(8)	Lentic and lotic—margins (in organic sediments—wet woodlands)	Burrowers		Widespread	

‡ Unpublished data, K. W. Cummins, Kellogg Biological Station.
§ Emphasis on trophic relationships.

Table 23A. Continued

Genus (number of species in parentheses)	Habitat	Habit	Trophic Relationships	North American Distribution	Comments, Preferences
Pedicia(57)	Lotic and lentic—margins (detritus in springs, seeps, and swampy woods)	Burrowers (semi-aquatic)	Predators (engulfers)	Widespread	2430, 4234
Pilaria(12)	Lentic—littoral (wet detritus and fine sediments at margin)	Burrowers	Predators (engulfers)?	Widespread	
Polymera(2)	Lotic—depositional (wet detritus at margin)	Burrowers		Southeastern United States	
Pseudolimnophila (5)	Lentic and lotic—margins (in organic sediments—wet woodlands and marshes)	Burrowers		Widespread	
Rhabdomastix(26)	Lotic—depositional (sand in clear streams and at margin)	Burrowers		Widespread	4234
Thaumastoptera(1)	Lotic—depositional (fine sediments of small streams, springs, and seeps)	Burrowers		California	
Ulomorpha(8)	Lentic and lotic—margins (in organic sediments of wet woodlands)	Burrowers	Predators (engulfers)?	Widespread	

§ Emphasis on trophic relationships.

From Young + Gelhaus, 2000

TABLE 17. Habitat classification for aquatic crane flies of Pennsylvania

In the following table, we have attempted a preliminary classification of the aquatic species of Pennsylvania into their specific larval habitats. Classification of the larval habitats was based on the authors' field work along with published information in Alexander (1920), Rogers (1930, 1933, 1942), Gelhaus (1986), Young (1978) and others. Species we have classed as aquatic based on generic placement, but with no actual information available on specific larval habitat, are omitted from this table although they may be found on the aquatic species list. Species marked with a ? in the table are based on supposition of larval habitat. There is overlap between species we have classed as aquatic and semi-aquatic; additional fieldwork and rearing will help to refine these classifications.

The habitat categories are defined very broadly in this preliminary classification. ***Lotic*** refers to larval habitats in the main sections of current of streams or rivers, either on or in the bottom substrate. ***Hygropetric*** refers to vertical substrates where water flows or seeps, either on falls in streams, seepages on slopes over rocks or other situations. ***Stream edge*** refers to habitats immediately along streams or rivers which are distinctly wet. ***Marshes*** are classed as ***open*** (including lake or pond margins) or ***shaded*** (usually seepage areas in forest). ***Temporary aquatic*** habitat refers to streams, ponds, or marshes that predictably flow or fill in fall and winter, drying in summer.

AQUATIC SPECIES	AQUATIC HABITAT CLASSES					
	Lotic	Hygro-petric	Stream edge	Open marsh	Shaded marsh	Temp. aquatic
Antocha (Antocha) obtusa	X					
Antocha (Antocha) opalizans	X					
Antocha (Antocha) saxicola	X					
Cryptolabis (Cryptolabis) paradoxa	X					
Dicranota (Eudicranota) pallida	X					
Dicranota (Paradicranota) eucera	X					
Dicranota (Rhaphidolabina) flaveola	X					
Dicranota (Rhaphidolabis) cayuga	X					
Dicranota (Rhaphidolabis) persimilis	X					
Dicranota (Rhaphidolabis) tenuipes	X					
Erioptera (Erioptera) chlorophylla					X	
Erioptera (Erioptera) straminea			X	X		

TABLE 17 - HABITAT CLASSIFICATION FOR AQUATIC CRANE FLIES OF PENNSYLVANIA

AQUATIC SPECIES	AQUATIC HABITAT CLASSES					
	Lotic	Hygro-petric	Stream edge	Open marsh	Shaded marsh	Temp. aquatic
Helius (Helius) flavipes				X	X	
Hexatoma (Eriocera) austera	X					
Hexatoma (Eriocera) brachycera	X					
Hexatoma (Eriocera) brevioricornis					X	
Hexatoma (Eriocera) cinerea	X					
Hexatoma (Eriocera) fuliginosa	X					
Hexatoma (Eriocera) longicornis	X					
Hexatoma (Eriocera) spinosa	X					
Leptotarsus (Longurio) testaceus	X					
Limnophila (Dicranophragma) angustula					X	
Limnophila (Dicranophragma) fuscovaria					X	
Limnophila (Eloeophila) solstitialis			X			
Limnophila (Eutonia) alleni				X		
Limnophila (Lasiomastix) macrocera			X	X	X	
Limnophila (Lasiomastix) subtenuicornis					X	
Limnophila (Phylidorea) adusta					X	
Limnophila (Phylidorea) adustoides					X	
Limnophila (Phylidorea) auripennis					X	
Limnophila (Phylidorea) caudifera					X	
Limnophila (Phylidorea) consimilis					X	
Limnophila (Phylidorea) fratria					X	
Limnophila (Phylidorea) lutea					X	
Limnophila (Phylidorea) luteola					X	
Limnophila (Phylidorea) novaeangliae					X	
Limnophila (Phylidorea) platyphallus					X	
Limnophila (Phylidorea) similis					X	
Limnophila (Phylidorea) subcostata					X	

AQUATIC SPECIES	AQUATIC HABITAT CLASSES					
	Lotic	Hygro-petric	Stream edge	Open marsh	Shaded marsh	Temp. aquatic
Limnophila (Prionolabis) rufibasis		X				
Limonia (Dicranomyia) fusca					X	
Limonia (Dicranomyia) humidicola		X	X			
Limonia (Dicranomyia) longipennis				X		
Limonia (Dicranomyia) stulta					X	
Limonia (Geranomyia) canadensis		X	X			
Limonia (Geranomyia) communis		X	X			
Limonia (Geranomyia) distincta		X	X			
Limonia (Geranomyia) diversa		X	X			
Limonia (Geranomyia) rostrata		X	X			
Limonia defuncta		X	X			
Limonia simulans		X	X			
Pedicia (Pedicia) albivitta		X			X	
Pedicia (Pentacyphona) autumnalis					X	
Pedicia (Tricyphona) calcar					X?	
Pedicia (Tricyphona) inconstans		X	X	X	X	
Pedicia (Tricyphona) paludicola				X		
Pilaria imbecilla				X		
Pilaria quadrata						X
Pilaria recondita				X		
Pilaria tenuipes			X		X	
Prolimnophila areolata				X		
Pseudolimnophila (Pseudolimnophila) contempta			X			
Pseudolimnophila (Pseudolimnophila) inornata				X		
Pseudolimnophila (Pseudolimnophila) luteipennis				X	X	

TABLE 17 - HABITAT CLASSIFICATION FOR AQUATIC CRANE FLIES OF PENNSYLVANIA

AQUATIC SPECIES	AQUATIC HABITAT CLASSES					
	Lotic	Hygro-petric	Stream edge	Open marsh	Shaded marsh	Temp. aquatic
Pseudolimnophila (Pseudolimnophila) noveboracensis				X		
Tipula (Angarotipula) illustris				X		
Tipula (Arctotipula) williamsiana	X					
Tipula (Nippotipula) abdominalis	X					
Tipula (Nippotipula) metacomet	X					
Tipula (Nobilotipula) collaris					X	
Tipula (Nobilotipula) nobilis					X	
Tipula (Platytipula) hugginsi	X					X
Tipula (Platytipula) spenceriana				X		X
Tipula (Platytipula) ultima			X	X	X	X
Tipula (Yamatotipula) cayuga			X?			
Tipula (Yamatotipula) concava			X			
Tipula (Yamatotipula) aprilina					X?	
Tipula (Yamatotipula) caloptera	X					
Tipula (Yamatotipula) calopteroides			X?			
Tipula (Yamatotipula) dejecta					X	
Tipula (Yamatotipula) eluta			X?		X?	
Tipula (Yamatotipula) fraterna			X			
Tipula (Yamatotipula) furca			X		X	
Tipula (Yamatotipula) iroquois			X			
Tipula (Yamatotipula) jacobus			X		X	
Tipula (Yamatotipula) noveboracensis			X?			
Tipula (Yamatotipula) strepens			X			
Tipula (Yamatotipula) tephrocephala						X?
Tipula (Yamatotipula) tricolor			X	X	X	
Ulomorpha pilosella					X	
Ulomorpha rogersella					X?	

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* from
Gelhaus, J.K. 1986
Larvae of the Crane Fly Genus
Tipula in North America
(Diptera : Tipulidae)
Univ. Kansas Sci Bulletin
53(3): 121-182.

+ Type-species.
V! Preserved material available, Zoological Museum, Amsterdam.
L Larva.
P Pupa.
* Identification of pre-imaginal stages not certain.

Achyrolimonia
decemmaculata Loew: Brindle 1967 (LP), Savchenko 1985 (LP).
Afrolimonia: see under *Libnotes*.
Amalopis: see under *Pedicia*.
Antocha (Antocha)
bifida Alexander: Hinton 1966, 1968 (P).
monticola Alexander: Needham & Christensen 1927 (LP)
+ *saxicola* Osten Sacken: Alexander 1920 (LP), Johannsen 1934 (LP), Peterson 1960 (L), V! (L).
vitripennis Meigen: Hinton 1957 (P), Brindle 1967 (LP), Hinton 1968 (P), Rozkosny & Pokorny 1980 (L), Savchenko 1985 (LP), V! (LP).
spec.: Malloch 1917 (L) (as Genus incertus 2), Vimmer 1928 (LP, as *calceata*), Alexander 1931 (LP), Byers 1978 (L), Alexander & Byers 1981 (L), Savchenko 1986 (L).
Antocha (Orimargula)
+ *alpigena* Mik: Bangerter 1929 (LP), Rozkosny & Pokorny 1980 (L), Savchenko 1985 (LP).
australiensis Alexander: Hinton 1965, 1968 (P).
Aphrophila
neozelandica Edwards: Winterbourn & Gregson 1989 (L).
Arctoconopa
carbonipes Alexander: Hynes 1969a (LP), Byers 1978 (L), Savchenko 1982 (LP).
Atarba
+ *picticornis* Osten Sacken: Rogers 1927a (LP).
viridicolor Alexander: Rogers 1927a (P).
spec.: Byers 1981 (L).
Atypophthalmus
inustus Meigen: Beling 1878 (LP, as *obscuricornis*), V! (P).
+ *umbratus* de Meijere: de Meijere 1917 (L).
Austrolimnobia: see under *Sigmatomera*.
Austrolimnophila
medialis Alexander: Wood 1952 (LP).
ochracea Meigen: Beling 1873a (LP, as *pallida*), Lindner 1959 (L), Brindle & Bryce 1960 (L), Brindle 1967 (LP), Savchenko 1986 (LP), V! (P).
Baeoura
claripennis Alexander: Wood 1952 (LP).
witzenbergi Wood: Wood 1952 (P).
Brachylimnophila: see under *Neolimnomyia*.
Cheilotrichia (Empeda)
cinerascens Meigen: *Levy 1919 (LP), Crisp & Lloyd 1954 (L), Lindner 1959 (L), Brindle 1967 (L), Krivosheina 1969 (L), Savchenko 1982 (P), 1986 (L), Reusch 1988 (LP).
Chionea
alexandriana Garrett: Byers 1983 (P).
+ *araneoides* Dalman: Egger, Frauenfeld & Brauer 1854 (L), Alexander 1920 (L), Savchenko 1982 (L).
lutescens Lundström: Edwards 1936 (P), Savchenko 1982 (P), Byers 1983 (P).
scita Walker: Byers 1983 (L).
stoneana Alexander: Byers 1983 (L).
Cladura
+ *flavoferruginea* Osten Sacken: Alexander 1920, 1922 (LP).
Conosia
+ *irrorata* Wiedemann: Wood 1952 (LP).
Crunobia: see under *Pedicia*.
Cryptolabis
magnistyla Alexander: Hynes 1963 (LP).
spec.: Byers 1978 (L), Alexander & Byers 1981 (L).
Cylindrotoma
+ *distinctissima distinctissima* Meigen: Lenz 1920b (LP), Haake, 1922 (L), Peus 1952 (LP), Brindle 1967 (LP), Brodo 1967 (LP).
distinctissima americana Coquillett: Cameron 1918 (LP, as *splendens*), Alexander 1920 (LP, as *splendens*).
Dactylolabis
cubitalis Osten Sacken: Alexander 1920 (P), Johannsen 1934 (P).
denticulata Bergroth: Mik 1894 (LP), Alexander 1920 (LP), Vimmer 1925 (LP), Bangerter 1931 (LP), Johannsen 1934 (L), Wesenberg-Lund 1943 (L).
hudsonica Alexander: Sinclair 1988 (LP).
montana Osten Sacken: Sinclair 1988 (LP), V! (LP).
sexmaculata Macquart: Bangerter 1931 (LP), Brindle & Bryce 1960 (L), Brindle 1967 (LP), Savchenko 1986 (LP).
transversa Meigen: Bangerter 1931 (LP, as *gracilipes*), Brindle & Bryce 1960 (L), Brindle 1967 (L), Savchenko 1986 (LP).
wodzickii Nowicki: Nowicki 1867 (LP), Alexander 1920 (LP), Lindner 1959 (L).
spec.: Alexander & Byers 1981 (key).
Dicranomyia (Dicranomyia)
autumnalis Staeger: Cramer 1968 (LP), Savchenko 1985 (LP), 1986 (LP).
capicola Alexander: Wood 1952 (LP).
casei Alexander: Williams 1943 (LP).
chorea Meigen: Reusch 1988 (L), V! (P).
didyma Meigen: Engel 1916 (LP, as *trinotata*), Vimmer 1925 (LP, as *trinotata*), Ussing 1929 (LP), Bryce 1957a (L), Brindle 1967 (LP), Savchenko 1985 (LP), V! (P).
floridana Osten Sacken: Rogers 1932 (LP).
frontalis Staeger: Reusch 1988 (LP).
grimshawi Alexander: Williams 1943 (LP).
halobia Tokunaga: Tokunaga 1936 (P).
humidicola Osten Sacken: Alexander 1920 (LP, as *badia*), Johannsen 1934 (P, as *badia*), Byers 1978 (L).
jacobus Alexander: Williams 1943 (LP).
kauaiensis Grimshaw: Swezey 1915 (LP, as *foliocuniculator*).
mariana Seligo: Seligo 1931 (LP).
marmorata Osten Sacken: Saunders 1928 (LP, as *signipennis*).
mitis Meigen: Vaillant 1956 (L), Brindle 1967 (L), Savchenko 1985 (L).
+ *modesta* Meigen: Vimmer 1925 (LP), Lindner 1959 (L), Brindle 1967 (LP), Savchenko 1985, 1986 (L).
monostromia Tokunaga: Tokunaga 1930 (LP), Kawada 1960 (LP), Hinton 1968 (P).
nigrescens Hutton: Winterbourn & Gregson 1989 (L).
peringueyi Alexander: Wood 1952 (LP).
punctulata De Meijere: Alexander 1931 (LP).
sera Walker: Szadziewski 1979 (LP).
stulta Osten Sacken: Alexander 1920 (LP), Johannsen

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from Oosterbroek + Theowald 1991

NOTE: Nomenclature follows European tradition of more restrictedly defined groups, i.e. subgenera often treated as genera.

1934 (L).
tipulipes Karsch: Wood 1952 (LP).
trifilamentosa Alexander: Tokunaga 1933 (LP), Kawada 1960 (LP), Hinton 1968 (P).
ventralis Schummel: Brindle 1967 (LP), Savchenko 1985 (LP).
vicina Macquart: Hemmingsen et al. 1959 (L, as *canariensis*)

Dicranomyia (Idioglochina)
+ *marmorata* Osten Sacken: Hinton 1968 (P), Ring 1978 (P). Savchenko 1928 L, P
tokunaguna Alexander: Tokunaga 1939 (L, as *gloriosa*).

Dicranomyia (Idiopyga)
melleicauda complicata De Meijere: V! (P).
Dicranophragma: see under *Limnophila*.

Dicranoptycha
megaphallus Alexander: Young 1987 (LP)
minima Alexander: Alexander 1919b (L).
pallida Alexander: Alexander 1919b (LP, as *winnemana*).
spec.: Alexander 1920 (LP).

Dicranota (Dicranota)
bimaculata Schummel: Miall 1893 (LP), Malloch 1917 (LP), Levy 1919 (LP), Vimmer 1925 (LP), Johannsen 1934 (L), Wesenberg-Lund 1943 (L), Crisp & Lloyd 1954 (L), Brindle 1967 (LP), Reusch 1988 (LP), V! (L).
+ *guerini* Zetterstedt: *Fahy 1972 (L).
spec.: Vimmer 1906 (L), 1925 (P), Malloch 1917 (L), Vimmer 1924 (L, as *Amalopis*), Miall 1934 (LP), Cook 1949 (L), Savchenko 1986 (L), Reusch 1988 (L), V! (L).

Dicranota (Paradicranota)
robusta Lundström: Brindle 1962, 1967 (LP), Savchenko 1986 (LP).
subtilis Loew: Lindner 1959 (L), Brindle 1962, 1967 (L), Savchenko 1986 (L).

Dicranota (Rhaphidolabina)
claripennis Verrall: Brindle 1962, 1967 (L).
+ *flaveola* Osten Sacken: Alexander 1920 (LP).

Dicranota (Rhaphidolabis)
cayuga Alexander: Alexander 1920 (L).
exclusa Walker: Nielsen et al. 1954 (L), Brindle 1962 (L).
+ *tenuipes* Osten Sacken: Needham 1908 (L), Alexander 1920 (L).

Diogma
+ *glabrata* Meigen: Müggenberg 1901 (LP), Alexander 1920 (LP), Lenz 1920b (LP), Haake 1922 (LP), Peus 1952 (LP), Brindle 1967 (LP), Krivosheina 1969 (L).
spec.: Malloch 1917 (L), Byers 1978 (L).
Diotrepha: see under *Orimarga*.

Discobola
+ *annulata* Linnaeus: Krivosheina 1969 (L), Savchenko 1985, 1986 (L), Krivosheina et al. 1986 (L).
caesaria Osten Sacken: Mik 1884 (P), Alexander 1920 (P).

Elephantomyia
aurantiaca Alexander: Wood 1952 (LP).
edwardsi Lackschewitz: Bangerter 1934 (LP), Savchenko 1986 (LP).
montana Alexander: Wood 1952 (LP).
pseudosimilis Alexander: Wood 1952 (P).
+ *westwoodi* Osten Sacken: Alexander 1920 (LP).
spec.: Malloch 1917 (L) (as Genus incertus 1), Krivosheina 1969 (L), Savchenko 1986 (L).

Elliptera
+ *omissa* Schiner: Mik 1886 (LP), Malloch 1917 (LP), Alexander 1920 (LP), Vimmer 1925 (L), Bangerter 1934 (LP), Johannsen 1934 (LP), Brindle 1967 (LP), Savchenko 1985 (LP), V! (LP).

Ellipteroides (Ellipteroides)
lateralis Macquart: Bangerter 1928 (LP), Brindle 1967 (LP), Savchenko 1982 (LP).

Ellipteroides (Progonomyia)
nigrobimbo Alexander: Wood 1952 (LP).

Ellipteroides (Protogonomyia)
alboscutellatus von Roser: Bangerter 1930 (LP), Brindle 1967 (LP), Savchenko 1982 (LP).

Eloeophila (= *Ephelia*)
apicata Loew: Brindle & Bryce 1960 (L), Brindle 1967 (LP).
dubiosa Alexander: Wood 1952 (LP).
+ *maculata* Meigen (= *marmorata* Meigen): Wolff 1922 (L), Bangerter 1928 (LP), Brindle & Bryce 1960 (L), Brindle 1967 (LP), Pokorny 1978 (LP), Savchenko 1986 (LP), Reusch 1988 (P), V! (L).
mundata Loew: Brindle & Bryce 1960 (L), Pokorny 1978 (LP), Savchenko 1986 (LP).
submarmorata Verrall: Crisp & Lloyd 1954 (L), Lindner 1959 (L), Brindle & Bryce 1960 (L), Brindle 1967 (LP), Pokorny 1978 (LP), Savchenko 1986 (LP).
trimaculata Zetterstedt: Brindle & Bryce 1960 (L), Brindle 1967 (LP).
verralli Bergroth: Brindle 1958 (L), Brindle & Bryce 1960 (L), Brindle 1967 (LP), Reusch 1988 (P).
spec.: Walton 1944 (L, as undescribed, erroneously considered *Pedicia rivosa* by Hinton 1950), Alexander & Byers 1981 (L, as *Limnophila* spec.), V! (L).

Elporiomyia: see under *Limnophila*.
Empeda: see under *Cheilotrichia*.

Epiphragma
+ *fasciapenne* Say: Needham 1903, 1908 (LP), Malloch 1917 (LP), Alexander 1920 (LP), Teskey 1976 (L), Alexander & Byers 1981 (L).
imitans Alexander: Bruch 1939 (LP).
ocellare Linnaeus: Beling 1873b (LP, as *picta*), *Wolff 1922 (L, as *punctata*), Vimmer 1925 (LP, as *punctata*), Hennig 1950 (L), Brindle & Bryce 1960 (L), Brindle 1967 (LP), Krivosheina 1969 (L), Mamaev et al. 1977 (L), Savchenko 1986 (LP), V! (P).
solatrix Osten Sacken: Alexander 1920 (LP).
spec.: Crisp & Lloyd 1954 (L). *Eriocera*: see under *Hexatoma*.

Erioconopa
+ *trivialis* Meigen: Nielsen et al. 1954 (L), Okely 1979 (LP), Savchenko 1986 (L), V! (L).

Erioptera (Erioptera)
chlorophylla Osten Sacken: Alexander 1920 (LP), Johannsen 1934 (LP).
cladophoroides Alexander: Bruch 1939 (LP).
fusculenta Edwards: Brindle 1967 (LP), Savchenko 1982 (P).
flavata Westhoff: Beling 1878 (LP, as *flavescens*), Vimmer 1925 (LP, as *flavescens*), Brindle 1967 (LP, as *flavescens*), Savchenko 1986 (L, as *geminata*).
+ *lutea* Meigen: Beling 1886 (LP), Vimmer 1925 (LP), Bangerter 1930 (LP), Crisp & Lloyd 1954 (L), Lindner 1959 (L), Brindle 1967 (LP), Savchenko 1982 (L), Reusch 1988 (P).
megophthalma Alexander: Alexander 1920 (LP).

septemtrionis Osten Sacken: Alexander 1920 (P).
squalida Loew: Houlihan 1969 (P).
vespertina Osten Sacken: Alexander 1920 (P).
spec.: *Dette 1916 (L, as flavescens) *Keilin 1944 (L), Peterson 1960 (L), V! (L).

Erioptera (Mesocyphona)
spec.: Alexander 1920 (P).

Eugnophomyia
+ *luctuosa* Osten Sacken: Rogers 1928 (LP).

Euphylidorea
lineola Meigen: Beling 1886 (L), Levy 1919 (LP), Vimmer 1925 (LP), Brindle 1958 (L), Brindle & Bryce 1960 (L), Brindle 1967 (LP), Savchenko 1986 (L).
meigenii Verrall: Nielsen et al. 1954 (L), Brindle & Bryce 1960 (L), Brindle 1967 (LP), Savchenko 1986 (L), V! (L).

Eutonia
+ *barbipes* Meigen: Wolff 1922 (L).
marchandi Alexander: Hynes 1958 (LP).
spec.: *Hennig 1950 (L, as *Limnophila* spec.).

Geranomyia
argentifera De Meijere: Alexander 1931 (P).
bezzii Alexander & Leonard: Seurat 1924 (LP).
caloptera Mik: Bangerter 1929 (LP, as *maculipennis*).
canadensis Westwood: Alexander 1920 (LP), Alexander & Malloch 1920 (LP), Johannsen 1934 (LP).
fletcheri Edwards: Alexander 1931 (LP).
gelatifex Edwards: Hingston 1932 (P), Edwards 1934 (P).
rostrata Say: Rogers 1927d (LP), Johannsen 1934 (L), Peterson 1960 (L), Byers 1978 (L).
rubrithorax Alexander: Wood 1952 (LP).
sexocellata Alexander: Wood 1952 (LP).
+ *unicolor* Haliday: Pierre 1926 (LP), Saunders 1930 (LP), Poisson 1932 (LP), Brindle 1967 (LP), Toye 1967 (L), Hinton 1968 (P).

Gnophomyia
jacobsoni Alexander: Rogers 1927b (LP), 1928 (L).
lugubris Zetterstedt: Brindle 1967 (LP), Mamaev et al. 1977 (L, as *tristis*), Savchenko 1982 (LP).
toschiae Alexander: Teskey 1976 (L), Alexander & Byers 1981 (L).
+ *tristissima* Osten Sacken: Malloch 1917 (LP), Alexander 1920 (LP), Rogers 1928 (LP).
spec.: Savchenko 1986 (L).

Gonempeda
+ *flava* Schummel: Brindle 1967 (P), Savchenko 1982 (P).

Gonomyia (Gonomyia)
kansensis Alexander: Alexander 1920 (P).
lucidula De Meijere: Crisp & Lloyd, 1954 (L), Lindner 1959 (L), Brindle 1967 (LP), Savchenko, 1982 (LP).
spec.: Vimmer 1925 (L), Alexander 1931 (L), Alexander & Byers 1981 (L), Savchenko 1986 (L).

Gonomyia (Lipophleps)
hawaiiensis Alexander: *Williams 1943 (L).
pleuralis Williston: Rogers 1926 (LP).
sulphurella Osten Sacken: Alexander 1920 (P), Johannsen 1934 (P).
sulphurelloides Alexander: Wood 1952 (LP).
spec.: Alexander 1931 (L).

Gonomyia (Neolipophleps)
alexanderi Johnson: Alexander 1920 (LP).

Gonomyodes
tacoma Alexander: Hynes 1969b (LP), Byers 1978 (L).

Helius
flavipes Macquart: Alexander 1920 (LP), Johannsen 1934 (P).
flavus Walker: Brindle 1967 (L).
+ *longirostris* Meigen: Gercke 1884 (P), Bangerter 1929 (LP), Brindle 1967 (LP), Cramer 1968 (LP), Savchenko 1986 (LP), Reusch 1988 (L).
mainensis Alexander: Alexander 1920 (LP), Johannsen 1934 (L).
pallirostris Edwards: Brindle 1967 (L).
spec.: V! (L).

Hesperoconopa
dolichophallus Alexander: Hynes 1968 (LP).

Hexatoma (Eriocera)
albitarsis Osten Sacken: Alexander 1915b, 1920 (LP), Johannsen 1934 (LP).
cinerea Alexander: Alexander 1920 (LP), Johannsen 1934 (LP).
fultonensis Alexander: Alexander 1914a, 1920 (LP), Johannsen1934 (L), Peterson 1960 (L).
longicornis Walker: Alexander 1914a, 1920 (LP).
spinosa Osten Sacken: Alexander 1914a, 1920 (LP), Johannsen 1934 (L), Peterson 1960 (L), Byers 1978 (L).
spec.: Malloch 1917 (L), Alexander 1931 (L), Cook 1949 (L), V! (L).

Hexatoma (Hexatoma)
bicolor Curtis: Brindle & Bryce 1960 (L), Brindle 1967 (LP), Savchenko 1986 (LP), V! (L).
fuscipennis Curtis: Brindle & Bryce 1960 (L), Brindle 1967 (LP), V! (L).
megacera Osten Sacken: Alexander 1915b (LP), 1920 (LP), Johannsen 1934 (LP), Byers 1978 (L).
+ *nigra* Latreille: *Lindner 1959 (L).
spec.: *Wolff 1922 (L, as *Limnophila* spec.; L, as cf *tenuipes*), Rozkosny & Pokorny 1980 (L).

Hoplolabis (Hoplolabis)
+ *armata* Osten Sacken: Alexander 1920 (P).

Hoplolabis (Parilisia)
vicina Tonnoir: Brindle 1967 (LP), Savchenko 1982 (LP), Reusch 1988 (P).

Idioglochina: see under *Dicranomyia*.

Idiognophomyia
enneki Alexander: Byers 1974 (LP).

Idioptera
+ *pulchella* Meigen: Brindle & Bryce 1960 (L), Brindle 1967 (L), Savchenko 1986 (L).

Idiopyga: see under *Dicranomyia*.

Ilisia
+ *maculata* Meigen: Crisp & Lloyd 1954 (L), Brindle 1967 (LP), Savchenko 1982 (L).

Lasiomastix: see under *Limnophila*.

Libnotes (Afrolimonia)
ladogensis Lackschewitz: Savchenko 1985, 1986 (L).
stantoni Edwards: *Alexander 1931 (LP).
subapicalis Alexander: Wood 1952 (LP).
spec.: Savchenko 1986 (L).

Libnotes (Libnotes)
perkinsi Grimshaw: Williams 1943 (LP).
undulata Matsumura: Krivosheina 1969 (L), Mamaev et al. 1977 (L).

Limnophila (Dicranophragma)
+ *fuscovaria* Osten Sacken: Alexander 1920 (LP), Johannsen 1934 (L P).

Limnophila (Elporiomyia)
crepuscula Wood: Wood 1952 (LP).

+ *nox* Alexander: Wood 1952 (LP).
Limnophila (Lasiomastix)
+ *macrocera* Say: Alexander 1920 (LP), Johannsen 1934 (LP), Byers 1978 (L).
Limnophila (Limnophila) (= *Poecilostola*)
+ *pictipennis* Meigen: Beling 1878 (LP), Brauer 1883 (L), V! (LP).
punctata Schrank: Beling 1886 (LP), Gerbig 1913 (L), Wolff 1922 (L), Brindle 1958 (L), Brindle & Bryce 1960 (L), Brindle 1967 (LP), Rozkosny & Pokorny 1980 (L), Savchenko 1986 (LP).
spec.: Levy 1919 (LP), *Wolff 1922 (L, as spec. (= *Hexatoma* ?), as *rufibasis*), Hennig 1950 (L) (= *Eutonia*?), Lindner 1959 (L), Byers 1978 (L), Savchenko 1986 (L).
Limnophilomyia
+ *lacteitarsis* Alexander: Wood 1952 (LP).
Limonia
flavipes Fabricius: Beling 1886 (L), Brindle 1967 (LP), Reusch 1988 (LP).
hercegovinae Strobl: Reusch 1988 (L).
macrostigma Schummel: Lindner 1959 (L), Brindle 1967 (LP), Savchenko 1985, 1986 (LP), Reusch 1988 (LP).
nigropunctata Schummel: Beling 1878 (L).
nubeculosa Meigen: Bryce 1957a (L), Lindner 1959 (L), Brindle 1967 (LP), Savchenko 1985, 1986 (LP), Reusch 1988 (LP).
simulans Walker: Needham 1908 (LP), Malloch 1917 (L), Alexander 1920 (LP).
+ *tripunctata* Fabricius: Beling 1873b (LP), Lindner 1959 (L), Brindle 1967 (LP), Savchenko 1985, 1986 (LP), Reusch 1988 (LP).
trivittata Schummel: V! (L).
spec.: Teskey 1976 (L), Byers 1978 (L), Alexander & Byers 1981 (L).
Liogma
+ *nodicornis* Osten Sacken: Alexander 1914b, 1920 (LP), Peus 1952 (LP), Brodo 1967 (LP), Alexander & Byers 1981 (L).
Lipophleps: see under *Gonomyia*
Lipsothrix
errans Walker: Beling 1886 (LP, as *icterica*), Brindle 1967 (LP), Krivosheina 1969 (L), Savchenko 1982, 1986 (LP).
fenderi Alexander: Hynes 1965 (LP).
hynesiana Alexander: Hynes 1965 (LP).
nigrilinea Doane: Hynes 1965 (LP).
remota Walker: Hinton 1955 (P), Brindle 1967 (LP), Hinton 1967, 1968 (P).
shasta Alexander: Hynes 1965 (LP).
sylvia Alexander: Rogers & Byers 1956 (LP), Hynes 1965 (LP).
Mesocyphona: see under *Erioptera*.
Metalimnobia
annulus cinctipes Say: Alexander 1920 (LP).
bifasciata Schrank: Stannius 1829 (LP, as *xanthoptera*), Pastejrik 1908 (L, as *xanthophora*), Vimmer 1912, 1925 (L, as *xanthophora*), de Meijere 1917 (LP), Brauns 1954b (P), Brindle 1967 (LP), Cramer 1968 (L), Savchenko 1985 (LP), 1986 (LP), V! (LP).
fallax Johnson: Alexander 1920 (LP), Johannsen 1934 (LP).
immatura Osten Sacken: Malloch 1917 (P).
quadrimaculata Linnaeus: Beling 1873b (LP, as *annulus*), Brauns 1954b (P), Lindner 1959 (L), Brindle 1967 (LP), Krivosheina 1969 (L), Savchenko 1985, 1986 (L), V! (P).
quadrinotata Meigen: Lindner 1958 (LP), Brindle 1967 (LP), Savchenko 1985 (LP).
triocellata Osten Sacken: Johnson 1906 (LP), Malloch 1917 (LP).
Molophilus
griseus Meigen: Crisp & Lloyd 1954 (L), Gachet 1967 (LP, as *ripicolus*), Savchenko 1982 (L).
hirtipennis Osten Sacken: Alexander 1920 (LP), Byers 1978 (L).
obscurus Meigen: Brindle 1967 (LP), Savchenko 1982 (P).
occultus De Meijere: Okely 1979 (L), Savchenko 1986 (L).
ochraceus Meigen: Beling 1886 (LP), Vimmer 1925 (LP), Brauns 1954b (P), Reusch 1988 (LP).
spec.: Crisp & Lloyd 1954 (L), Lindner 1959 (L), Byers 1978 (L), Alexander & Byers 1981 (L), Savchenko 1986 (L), Winterbourn & Gregson 1989 (L).
Mongoma: see under *Trentepohlia*.
Neolimnomyia (Brachylimnophila)
nemoralis Meigen: Beling 1886 (LP), Vimmer 1925 (LP), Crisp & Lloyd 1954 (L), Brindle 1958 (L), Lindner 1959 (L), Brindle & Bryce 1960 (L), Brindle1967 (LP), Savchenko 1986 (LP).
Neolimnomyia (Neolimnomyia)
batava Edwards: Brindle & Bryce 1960 (L), Brindle 1967 (LP), Savchenko 1986 (LP), Reusch 1988 (P).
filata Walker: Brindle & Bryce 1960 (L), Brindle 1967 (LP), Savchenko 1986 (LP).
Neolimnophila
carteri Tonnoir: Beling 1886 (LP, as *hyalipennis*).
Neolimonia
dumetorum Meigen: Beling 1886 (L).
Neolipophleps: see under *Gonomyia*.
Orimarga (Diotrepha)
+ *mirabilis* Osten Sacken: Rogers 1927c (LP).
Orimarga (Orimarga)
attenuata Walker: Vaillant 1951 (LP, as *hygropetrica*), Savchenko 1985 (LP).
Orimargula: see under *Antocha*.Ormosia
hederae Curtis: V! (P).
lineata Meigen: Lindner 1959 (L), Brindle 1967 (L), Savchenko 1982, 1986 (L).
meigenii Osten Sacken: Alexander 1920 (LP), Byers 1978 (L).
nigripila Osten Sacken: Alexander 1920 (P).
romanovichiana Alexander: Alexander 1920 (LP, as *nubila*).
spec.: Johannsen 1934 (L), Byers 1978 (L), Alexander & Byers 1981 (L), Savchenko 1982 (LP), Reusch 1988 (P).
Oxyrhiza: see under *Paradelphomyia*.
Paradelphomyia (Oxyrhiza) (= *Oxydiscus*).
americana Alexander: *Alexander 1920 (L).
cayuga Alexander: *Alexander 1920 (L).
minuta Alexander: *Alexander 1920 (LP), Johannsen 1934 (L), Savchenko 1986 (P).
senilis Haliday: Crisp & Lloyd 1954 (L), Lindner 1959 (L), Brindle 1967 (L), Krivosheina 1969 (L), Savchenko 1986 (L), Reusch 1988 (P).
spec.: Brindle & Bryce 1960 (L).
Paradicranota: see under *Dicranota*.
Paralimnophila
skusei Hutton: Winterbourn & Gregson 1989 (L).

Paramongoma: see under *Trentepohlia*.
Paraphylidorera: see under *Phylidorea*.
Parilisia: see under *Ilisia*.
Pedicia (Amalopis)
+ *occulta* Meigen: Lindner 1959 (L), Brindle 1967 (L), Savchenko 1986 (L).
Pedicia (Crunobia)
littoralis Meigen: Brindle 1967 (L).
+ *straminea* Meigen: Beling 1878 (LP, as *schineri*), Vimmer 1925 (LP, as *schineri*), Lindner 1959 (L), Brindle 1967 (L), Savchenko 1986 (L).
spec.: Brindle 1962 (L).
Pedicia (Pedicia)
albivitta Walker: Needham 1903 (L, as unidentified), 1908 (L), Alexander 1920 (L), Johannsen 1934 (L), Byers 1978 (L).
+ *rivosa* Linnaeus: Beling 1878 (LP), Levy 1919 (LP), Vimmer 1925 (LP), Oldham 1926 (L), Wardle 1926 (L), Wardle & Taylor 1926 (L), Wesenberg-Lund 1943 (L), Hennig 1950 (L), Brauns 1954b (P), Crisp & Lloyd 1954 (L), Brindle 1962 (L), 1967 (LP), Savchenko 1986 (LP), V! (LP).
spec.: Alexander & Byers 1981 (L).
Phalacrocera
+ *replicata* Linnaeus: Bengtsson 1897 (L), Miall & Shelford 1897 (LP), Malloch 1917 (LP), Alexander 1920 (LP), Lenz 1920b (LP), Haake 1922 (LP), Johannsen 1934 (LP), Wesenberg-Lund 1943 (L), Peus 1952 (LP), Brindle 1967 (LP), Brodo 1967 (LP), Krivosheina 1969 (L), Byers 1978 (L), V! (L).
tipulina Osten Sacken: Brodo 1967 (P).
vancouverensis Alexander: Spencer 1930 (LP).
Phylidorea (Macrolabina)
+ *nigronotata* Siebke: Wiedenska 1987 (LP).
Phylidorea (Paraphylidorea)
+ *fulvonervosa* Schummel: Crisp & Lloyd 1954 (L), Brindle & Bryce 1960 (L), Brindle 1967 (LP), Savchenko 1986 (L), Wiedenska 1987 (LP), Reusch 1988 (P).
Phylidorea (Phylidorea)
abdominalis Staeger: Brindle 1967 (LP).
adusta Osten Sacken: *Alexander 1920 (LP), Johannsen 1934 (P).
+ *ferruginea* Meigen: Beling 1878 (P, as *lineola*), de Meijere 1917 (LP), *Levy 1919 (LP), Wolff 1922 (L), Hennig 1950 (P), Lindner 1959 (L), Brindle & Bryce 1960 (L), Brindle 1967 (LP), Savchenko 1986 (LP), V! (P).
longicornis Schummel: Brindle 1967 (P, as *glabricula*).
nervosa Schummel: Wiedenska 1987 (LP).(as nigricellus)
squalens Zetterstedt: Brindle & Bryce 1960 (L), Brindle 1967 (LP), Savchenko 1986 (LP), Wiedenska 1987 (LP).
Pilaria
discicollis Meigen: Gerbig 1913 (L), Levy 1919 (LP), Vimmer 1924, 1925 (P), Brindle 1958 (L), Lindner 1959 (L), Brindle & Bryce 1960 (L), Brindle 1967 (LP), Rozkosny & Pokorny 1980 (L), Savchenko 1986 (LP), Reusch 1988 (LP), V! (L).
fuscipennis Meigen: Brauer 1883 (L), Beling 1886 (LP), Vimmer 1906 (L), Gerbig 1913 (L), Levy 1919 (LP), Wolff 1922 (L), Vimmer 1925 (LP), Rozkosny & Pokorny 1980 (L), V!(L).
quadrata Osten Sacken: Alexander 1920 (P).
recondita Osten Sacken: Alexander 1920 (LP), Johannsen 1934 (L), Alexander & Byers 1981 (L).
ripicola Gérard: Gérard 1968 (LP).
scutellata Staeger: Brindle & Bryce 1960 (L), Brindle 1967 (LP).
tenuipes Say: Malloch 1917 (L), Alexander 1920 (LP), Johannsen 1934 (LP).
spec.: Anton 1943a (L, as ? *Ulomorpha*), Hennig 1950 (L, as ? *Ulomorpha*), Crisp & Lloyd 1954 (L), Byers 1978 (L).
Polymera
georgiae Alexander: Rogers 1933 (LP).
rogersiana Alexander: Rogers 1933 (LP).
Progonomyia: see under *Ellipteroides*.
Protogonomyia: see under *Ellipteroides*.
Pseudolimnophila
inornata Osten Sacken: Alexander 1920 (LP), Johannsen 1934 (P), Byers 1978 (L), Alexander & Byers 1981 (L).
lucorum Meigen: Crisp & Lloyd 1954 (L), Hinton 1954 (P), Brindle 1958 (L), Brindle & Bryce 1960 (L), Brindle 1967 (LP), Rozkosny & Pokorny 1980 (L), Savchenko 1986 (LP), Reusch 1988 (P).
+ *luteipennis* Osten Sacken: Hart 1895 (LP), Malloch 1917 (LP), Alexander 1920 (LP), Johannsen 1934 (L), V! (L).
Psiloconopa: see under *Symplecta*.
Rhabdomastix (Sacandaga)
afra Wood: Wood 1952 (LP).
californiensis Alexander: Hynes 1969c (LP).
fascigera Alexander: Hynes 1969c (LP).
flaviventris Alexander: Hynes 1969c (LP).
hynesi Alexander: Hynes 1969c (LP).
leonardi Alexander: Hynes 1969c (LP).
schistacea Schummel: Beling 1886 (LP), Vimmer 1925 (LP).
setigera Alexander: Hynes 1969c (LP), Byers 1978 (L).
subfascigera Alexander: Hynes 1969c (LP).
trichophora Alexander: Hynes 1969c (LP).
spec.: Savchenko 1982 (LP).
Rhamphophila
+ *obscuripennis* Hudson: Hudson 1920 (LP, sinistra).
Rhaphidolabina: see under *Dicranota*.
Rhaphidolabis: see under *Dicranota*.
Rhipidia
bryanti Johnson: Alexander 1920 (LP), Johannsen 1934 (LP).
+ *maculata* Meigen (= *duplicata* authors): Beling 1873b (P), 1878 (L), Brauns 1954b (P), Brindle 1967 (L), Savchenko 1985 (L), Reusch 1988 (LP).
uniseriata Schiner: Beling 1878 (L).
Rhypholophus
haemorrhoidalis Zetterstedt: Beling 1878 (P), 1886 (LP), Crisp & Lloyd 1954 (L), Lindner 1959 (L), Brindle 1967 (LP), Krivosheina 1969 (L), Savchenko 1982, 1986 (LP), V! (P).
varius Meigen: de Meijere 1917 (LP), Wolff 1922 (L), Brindle 1967 (L P).
spec.: V! (LP).
Sacandaga: see under *Rhabdomastix*.
Scleroprocta
innocens Osten Sacken: Alexander, 1920 (P), Johannsen 1934 (P), Brindle 1967 (P).
+ *sororcula* Zetterstedt: Brindle 1967 (LP, as *danica*).
spec.: Alexander 1920: Figs 405-406 (as unidentified), Bangerter 1930 (LP, as *fascipennis*), Savchenko 1982 (LP).

Sigmatomera (Austrolimnobia)
rufa Hudson: Hudson 1920 (LP).
Sigmatomera (Sigmatomera)
shannoniana Alexander: Alexander 1930 (L).
Styringomyia
ingrami Edwards: Edwards 1924 (P).
neocaledoniae Alexander: Hynes 1990 (LP).
Symplecta (Psiloconopa)
graphica Osten Sacken: Hart 1895 (L).
stictica Meigen: Brindle 1967 (LP), Houlihan 1969 (P), Reusch 1988 (LP).
Symplecta (Symplecta)
cana Walker: Hart 1895 (LP, as *punctipennis*), *Malloch 1917 (LP, as *punctipennis*), Vimmer 1925 (LP, as *punctipennis*).
+ *hybrida* Meigen: Beling 1878 (LP, as *punctipennis*), Alexander 1920 (LP), Johannsen 1934 (LP), Savchenko, 1982 (LP), Reusch 1988 (LP), V! (L).
macroptera Philippi: Bruch 1939 (LP).
Symplecta (Trimicra)
+ *pilipes* Fabricius: Beling 1878 (LP), Gerbig 1913 (L), Alexander 1920 (L), Pierre 1924 (P, as *marina*), Vimmer 1925 (LP), Johannsen 1934 (L), Bruch 1939 (LP), Séguy 1942 (LP, as *pauliana*), Wood 1952 (LP, as *inconspicua*), Vaillant 1953 (LP, as *hirsutipes*), Brindle 1967 (L), Byers 1978 (L), Savchenko 1982 (L).
Teucholabis
+ *complexa* Osten Sacken: Alexander 1920 (LP).
Thaumastoptera
+ *calceata* Mik: Lenz 1920a (LP), Liang 1925 (LP), Brauns 1954b (P), Vaillant 1956 (L), Brindle 1967 (LP), Savchenko 1985 (LP).
spec.: Vimmer 1929 (L).
Tonnoiraptera
+ *neozelandica* Tonnoir: Tonnoir 1926 (P).
Trentepohlia (Mongoma)
pennipes Osten Sacken: de Meijere 1911 (LP), Alexander 1920 (LP).
Trentepohlia (Paramongoma)
bromeliadicola Alexander: Picado 1913 (LP), Alexander 1920 (LP).
Tricyphona
+ *immaculata* Meigen: Beling 1878 (L), de Meijere 1917 (LP), Lindner 1959 (L), Brindle 1962 (L), 1967 (LP), Okely 1979 (L), Savchenko 1986 (LP).
inconstans Osten Sacken: Alexander 1920 (LP), Johannsen 1934 (L), Byers 1978 (L).
schummeli Edwards: Brindle 1967 (L).
unicolor Schummel: Brindle 1962 (L), 1967 (LP).
Trimicra: see under *Symplecta*.
Triogma
exsculpta Osten Sacken: Brodo 1967 (LP).
+ *trisulcata* Schummel: Alexander 1920 (LP), Lenz 1920b (LP), Haake 1922 (LP), Johannsen 1934 (L), Wesenberg-Lund 1943 (L), Peus 1952 (LP), Brindle 1967 (LP), V! (L).
Ula
bolitophila Loew: Krivosheina 1969 (L), Krivosheina et al. 1986 (L), Savchenko 1986 (L).
elegans Osten Sacken: Alexander 1915a (LP), Malloch 1917 (LP), Alexander 1920 (LP).
+ *mollissima* Haliday: Engel 1916 (L, as *macroptera*), Vimmer 1925 (LP, as *macroptera*), Lindner 1959 (L, as *crassicauda*), Savchenko 1986 (L).
sylvatica Meigen: Bangerter 1934 (LP), Bryce 1957b (L), Lindner 1959 (L), Brindle & Bryce 1960 (L), Brindle 1967 (LP), Savchenko 1986 (LP), V! (LP).
- Immature stages of Japanese *Ula* species are described by Tokunaga et al. 1954 (not consulted).
Ulomorpha
+ *pilosella* Osten Sacken: Alexander 1920 (LP), Johannsen 1934 (L).
spec.: Anthon 1943a (L), Hennig 1950 (L).

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Southeastern U.S. Crane flies (Virginia to Kentucky south to Louisiana and Florida)
(Derived from World Catalog of Tipuloidea database compiled from Pjotr Oosterbroek)
(Classification modified to traditional North American)

Genus	Subgenus	species	Subspecies	Describer	Distribution	Subfamily
Antocha	(Antocha)	biarmata		Alexander, 1940	USA (NY, Tenn, NC).	Limoniini
Antocha	(Antocha)	capitella		Alexander, 1941	USA (Tenn).	Limoniini
Antocha	(Antocha)	decurvata		Alexander, 1941	USA (Tenn).	Limoniini
Antocha	(Antocha)	opalizans		Osten Sacken, 1860	Canada, USA (Wis to Que and Maine, south to Ga and SC).	Limoniini
Antocha	(Antocha)	saxicola		Osten Sacken, 1860	Canada, USA (Ont to Nfld, south to Mo and Ga).	Limoniini
Atarba	(Atarba)	bellamyi		Alexander, 1950	USA (Ga, Fla).	Eriopterini
Atarba	(Atarba)	picticornis		Osten Sacken, 1869	Canada, USA (Mich to NH, south to Kans, Ark, La and Fla).	Eriopterini
Austrolimnophila	(Austrolimnophila)	toxoneura		(Osten Sacken, 1860)	Canada, USA (Minn and Ont to Nfld, south to Tenn and NC).	Hexatomini
Brachypremna		dispellens		(Walker, 1861)	USA (Ill and NJ, south to Texas and Fla); Brazil, Colombia, Costa Rica, Guatemala, N	Tipulinae
Cheilotrichia	(Empeda)	noctivagans		(Alexander, 1917)	USA (Va, south to Fla).	Eriopterini
Cheilotrichia	(Empeda)	stigmatica		(Osten Sacken, 1869)	Canada, USA (SD to Nfld, south to Tenn and NC).	Eriopterini
Chionea	(Chionea)	scita		Walker, 1848	Canada, USA (Ont to Vt, south to Ky and Ga).	Eriopterini
Chionea	(Chionea)	valga		Harris, 1841	Canada, USA (Alta to Labr, south to Minn, Wis and Va).	Eriopterini
Chionea	(Chionea)	wilsoni		Byers, 1983	USA (Ala).	Eriopterini
Cladura		flavoferruginea		Osten Sacken, 1860	Canada, USA (Wis to Que and Maine, south to Kans and Ga).	Eriopterini
Cryptolabis	(Cryptolabis)	paradoxa		Osten Sacken, 1860	Canada, USA (Ont to NSc, south to Ark, Tenn and Fla).	Eriopterini
Ctenophora	(Ctenophora)	nubecula		Osten Sacken, 1864	Canada, USA (Ont and Que to NJ, south to Mo and Tenn).	Tipulinae
Dactylolabis	(Dactylolabis)	cubitalis		(Osten Sacken, 1869)	USA (Wis to NY, south to Ind, Tenn and NC).	Hexatomini
Dactylolabis	(Dactylolabis)	hudsonica		Alexander, 1931	Canada, USA (Ont and Que to Nfld, south to Tenn and NC).	Hexatomini
Dactylolabis	(Dactylolabis)	montana		(Osten Sacken, 1860)	Canada, USA (Ont to Nfld, south to Kans, Ill, Tenn and SC).	Hexatomini
Dactylolabis	(Dactylolabis)	pemetica		Alexander, 1936	USA (NH and Maine, south to Ohio and NC).	Hexatomini
Dicranoptycha		acanthophallus		Alexander, 1940	USA (Tenn, NC and Ga).	Limoniini
Dicranoptycha		australis		Alexander, 1926	USA (Ind, south to Okla and Fla).	Limoniini
Dicranoptycha		byersi		Young, 1987	USA (Tenn, NC).	Limoniini
Dicranoptycha		elsa		Alexander, 1929	Canada, USA (Kans to Que and NY, south to Ga).	Limoniini
Dicranoptycha		germana		Osten Sacken, 1860	Canada, USA (Minn to Que and Maine, south to Ill and SC).	Limoniini
Dicranoptycha		megaphallus		Alexander, 1926	USA (Kans to Va, south to La and Fla).	Limoniini
Dicranoptycha		nigripes		Osten Sacken, 1860	USA (Ala, Ga).	Limoniini
Dicranoptycha		septemtrionis		Alexander, 1926	Canada, USA (Mich to Que and Mass, south to Kans and Ga).	Limoniini
Dicranoptycha		sobrina		Osten Sacken, 1860	USA (Kans to Md, south to Tenn and Fla).	Limoniini
Dicranoptycha		spinifera		Young, 1987	USA (Pa, south to Ga).	Limoniini
Dicranoptycha		tennessa		Alexander, 1941	USA (Pa, south to Ala).	Limoniini
Dicranoptycha		tigrina		Alexander, 1919	USA (Pa, south to Kans, Okla and NC).	Limoniini
Dicranoptycha		winnemana		Alexander, 1916	USA (Md, south to Okla, Texas and Fla).	Limoniini
Dicranota	(Dicranota)	divaricata		Alexander, 1925	USA (NC).	Pediciini
Dicranota	(Eudicranota)	catawbiensis		Alexander, 1940	USA (Tenn, NC).	Pediciini
Dicranota	(Eudicranota)	notabilis		Alexander, 1929	USA (Tenn).	Pediciini
Dicranota	(Eudicranota)	yonahlossee		Alexander, 1941	USA (NC).	Pediciini
Dicranota	(Paradicranota)	eucera		Osten Sacken, 1869	Canada, USA (Minn to Mass, south to Va).	Pediciini
Dicranota	(Paradicranota)	rivularis		Osten Sacken, 1860	USA (NH, south to Va).	Pediciini
Dicranota	(Plectromyia)	confusa		(Alexander, 1924)	Canada, USA (Que to NBr, south to Tenn and SC).	Pediciini
Dicranota	(Plectromyia)	townesi		Alexander, 1940	USA (SC).	Pediciini
Dicranota	(Rhaphidolabina)	flaveola		(Osten Sacken, 1869)	Canada, USA (Mich and Ont to Nfld, south to Tenn and NC).	Pediciini
Dicranota	(Rhaphidolabis)	avis		(Alexander, 1926)	USA (Maine, south to NC).	Pediciini
Dicranota	(Rhaphidolabis)	cayuga		(Alexander, 1916)	Canada, USA (Alaska to Nfld, south to Oreg, Colo and SC).	Pediciini
Dicranota	(Rhaphidolabis)	forceps		(Alexander, 1924)	Canada, USA (Mich to NSc, south to Tenn).	Pediciini
Dicranota	(Rhaphidolabis)	hickmanae		Alexander, 1940	USA (Tenn).	Pediciini
Dicranota	(Rhaphidolabis)	persimilis		(Alexander, 1920)	USA (Md, south to Tenn and SC).	Pediciini
Dolichopeza	(Dolichopeza)	americana		Needham, 1908	Canada, USA (Alaska, Alta to Labr and Nfld, south to SD, Ark and Ga).	Tipulinae
Dolichopeza	(Oropeza)	australis		Byers, 1961	USA (Ala, Ga and Fla).	Tipulinae
Dolichopeza	(Oropeza)	carolus		Alexander, 1943	Canada, USA (Ont to Que and Nfld, south to Wis, Tenn and Fla).	Tipulinae
Dolichopeza	(Oropeza)	dorsalis		(Johnson, 1909)	Canada, USA (Yukon and BC to Maine and NSc, south to SD, Ind, NC and Fla).	Tipulinae
Dolichopeza	(Oropeza)	johnsonella		(Alexander, 1931)	Canada, USA (Ill to Que and Mass, south to Ark and Fla).	Tipulinae
Dolichopeza	(Oropeza)	obscura		(Johnson, 1909)	Canada, USA (Alta to NSc, south to Kans, Ark and Fla).	Tipulinae
Dolichopeza	(Oropeza)	polita	comuta	Byers, 1961	Canada, USA (Ont, south to Ill, Tenn and Va).	Tipulinae
Dolichopeza	(Oropeza)	polita	polita	(Johnson, 1909)	Canada, USA (Ont to Que and Maine, south to Wis and Ga).	Tipulinae
Dolichopeza	(Oropeza)	sayi		(Johnson, 1909)	Canada, USA (Minn to Ont, Que, Maine and NBr, south to Va).	Tipulinae

Dolichopeza	(Oropeza)	subalbipes		(Johnson, 1909)	Canada, USA (Minn to Ont, Que, Maine and NBr, south to La and Fla).	Tipulinae
Dolichopeza	(Oropeza)	subvenosa		Alexander, 1940	USA (WVa and Md, south to Tenn and Ga).	Tipulinae
Dolichopeza	(Oropeza)	tridenticulata		Alexander, 1931	Canada, USA (Man to Que and Maine, south to Kans, Mo and Ga).	Tipulinae
Dolichopeza	(Oropeza)	walleyi		(Alexander, 1931)	Canada, USA (Alta to Que and NSc, south to SD, Mo, Kans and Fla).	Tipulinae
Elephantomyia	(Elephantomyia)	westwoodi	westwoodi	Osten Sacken, 1869	Canada, USA (Wis and Ont to Nfld, south to Kans and Fla).	Limoniini
Elliptera		illini		Alexander, 1920	USA (Ill, south to Tenn and Ga).	Limoniini
Elliptera		tennessa		Alexander, 1926	USA (Tenn).	Limoniini
Ellipteroides	(Progonomyia)	slossonae		(Alexander, 1914)	USA (Kans, south to Okla, SC and Fla); Jamaica, Mexico, Panama.	Eriopterini
Epiphragma	(Epiphragma)	fasciapenne		(Say, 1823)	Canada, USA (Alta to Nfld, south to La and Fla).	Hexatomini
Epiphragma	(Epiphragma)	solatrix		(Osten Sacken, 1860)	USA (Kans to NY, south to Texas, La and Fla); Mexico.	Hexatomini
Erioptera	(Erioptera)	chlorophylla		Osten Sacken, 1860	Canada, USA (Minn to NSc, south to Tenn and Fla).	Eriopterini
Erioptera	(Erioptera)	chlorophylloides	chlorophylloides	Alexander, 1919	Canada, USA (Ont and Que to Nfld, south to Colo, Kans and Tenn).	Eriopterini
Erioptera	(Erioptera)	furcifer		Alexander, 1919	Canada, USA (Ont to Mass, south to Kans, Tenn and SC).	Eriopterini
Erioptera	(Erioptera)	megophthalma		Alexander, 1918	Canada, USA (Mich and Ont to Nfld, south to Tenn and NC).	Eriopterini
Erioptera	(Erioptera)	osceola		Alexander, 1933	USA (Fla).	Eriopterini
Erioptera	(Erioptera)	seminole		Alexander, 1933	USA (Fla).	Eriopterini
Erioptera	(Erioptera)	septemtrionis		Osten Sacken, 1860	Canada, USA (Wash to Nfld, south to Calif, NMex, Kans and Fla).	Eriopterini
Erioptera	(Erioptera)	straminea		Osten Sacken, 1869	Canada, USA (Kans to Que and Maine, south to SC).	Eriopterini
Erioptera	(Erioptera)	subchlorophylla		Alexander, 1919	USA (Mass, south to Fla).	Eriopterini
Erioptera	(Erioptera)	vespertina		Osten Sacken, 1860	Canada, USA (Iowa to Ont, Que and NSc, south to Kans, Ala and Fla).	Eriopterini
Erioptera	(Mesocyphona)	caliptera	caliptera	Say, 1823	Canada, USA (Calif to Nfld, south to Fla); Cuba, Bolivia, Dominica, St Vincent, Puer	Eriopterini
Erioptera	(Mesocyphona)	evergladea		Alexander, 1933	USA (Fla).	Eriopterini
Erioptera	(Mesocyphona)	femoraatra		Alexander, 1950	USA (Ga).	Eriopterini
Erioptera	(Mesocyphona)	knabi		Alexander, 1913	USA (Mich, south to Calif, Ariz and Fla); Mexico.	Eriopterini
Erioptera	(Mesocyphona)	needhami		Alexander, 1918	Canada, USA (Kans to Ont and NSc, south to Fla).	Eriopterini
Erioptera	(Mesocyphona)	parva	parva	Osten Sacken, 1860	USA (Kans to Mich, NY and Conn, south to Fla); Costa Rica, Ecuador, Guyana, Mexi	Eriopterini
Erioptera	(Mesocyphona)	serpentina		Alexander, 1941	USA (Mass, NC).	Eriopterini
Erioptera	(Mesocyphona)	tantilla		Alexander, 1916	USA (Kans, Miss); Jamaica.	Eriopterini
Erioptera	(Psiloconopa)	laevis	restricta	(Alexander, 1941)	USA (NC).	Eriopterini
Erioptera	(Psiloconopa)	sweetmani		(Alexander, 1940)	USA (NC, Ga).	Eriopterini
Erioptera	(Symplecta)	cana		(Walker, 1848)	Canada, USA (Alaska, Yukon, Que to Nfld, south throughout the USA); Guatemala,	Eriopterini
Erioptera	(Teucherioptera)	chrysocoma		Osten Sacken, 1860	Canada, USA (Que to NBr, south to NC).	Eriopterini
Erioptera	(Teucherioptera)	chrysocomoides		Alexander, 1929	USA (Mass, south to Tenn).	Eriopterini
Erioptera	Illisia	armillaris		(Osten Sacken, 1869)	Canada, USA (Kans to Ont, Que, Maine and NSc, south to NC).	Eriopterini
Erioptera	Illisia	graphica		(Osten Sacken, 1860)	Canada, USA (Nebr to Ont and Mass, south to La and Fla).	Eriopterini
Erioptera	Illisia	indianensis		(Alexander, 1922)	USA (Iowa to Mich, south to Kans, Mo and Ky).	Eriopterini
Erioptera	Illisia	venusta	venusta	(Osten Sacken, 1860)	Canada, USA (Wis and Ont to Que and Maine, south to Kans and Fla).	Eriopterini
Erioptera	Trimicra	pilipes	pilipes	(Fabricius, 1787)	Canada, USA (Wash to NSc and RI, south to Calif, Channel Is, Texas and Fla); Berm	Eriopterini
Eugnophomyia		luctuosa		(Osten Sacken, 1860)	USA (Kans and Ill to DC, south to Okla, Miss and Fla); Colombia, Guatemala, Mexico	Eriopterini
Gonempeda		nyctops		(Alexander, 1916)	Canada, USA (Mich and Que to Maine, south to Tenn and NC).	Eriopterini
Gonomyia	(Gonomyia)	cognatella		Osten Sacken, 1860	USA (Wis to NY and Conn, south to Kans, Mo and SC).	Eriopterini
Gonomyia	(Gonomyia)	currani		Alexander, 1926	Canada, USA (Ont and Que to Mass, south to NC).	Eriopterini
Gonomyia	(Gonomyia)	florens		Alexander, 1916	Canada, USA (Ont to Maine, south to Kans, Tenn and NC).	Eriopterini
Gonomyia	(Gonomyia)	subcinerea		Osten Sacken, 1860	Canada, USA (BC and Wash to Nfld, south to Utah, Kans and Fla).	Eriopterini
Gonomyia	(Gonomyia)	taeniata		Alexander, 1927	USA (NC, Ga).	Eriopterini
Gonomyia	(Idiocera)	blanda		(Osten Sacken, 1860)	Canada, USA (Alta to NSc, south to Kans, Mo and Fla).	Eriopterini
Gonomyia	(Idiocera)	mathesoni		(Alexander, 1915)	Canada, USA (Mich to Nfld, south to Kans, Mo and NC).	Eriopterini
Gonomyia	(Lipophleps)	burgessi		Alexander, 1944	USA (La).	Eriopterini
Gonomyia	(Lipophleps)	manca		Osten Sacken, 1869	USA (Kans to Ind, NY and Mass, south to Fla).	Eriopterini
Gonomyia	(Lipophleps)	puer		Alexander, 1913	USA (DC, south to Fla); Brazil, Costa Rica (Isla del Coco), Dominica, Dominican Rep	Eriopterini
Gonomyia	(Lipophleps)	sacandaga		Alexander, 1914	Canada, USA (Mich to Vt, south to Mo and NC).	Eriopterini
Gonomyia	(Lipophleps)	sulphurella		Osten Sacken, 1860	Canada, USA (Kans to Ont and Nfld, south to Texas and Fla).	Eriopterini
Gonomyia	(Neolipophleps)	alexanderi		(Johnson, 1912)	Canada, USA (Kans and Ill to Nfld, south to Okla and SC).	Eriopterini
Gonomyia	(Paralipophleps)	pleuralis		(Williston, 1896)	USA (Ga, Fla); Bermuda; Bolivia, Brazil, Costa Rica (Isla del Coco), Cuba, Dominican	Eriopterini
Helius	(Helius)	flavipes		(Macquart, 1855)	Canada, USA (Alta to NSc, south to Texas and Fla).	Limoniini
Hexatoma	(Eriocera)	albitarsis		(Osten Sacken, 1869)	Canada, USA (Iowa to Pa, south to Ark and Fla).	Hexatomini
Hexatoma	(Eriocera)	aurata		(Doane, 1900)	USA (Tenn, NC, south to Fla).	Hexatomini
Hexatoma	(Eriocera)	brachycera		(Osten Sacken, 1877)	Canada, USA (Ont to Nfld, south to Tenn and NC).	Hexatomini
Hexatoma	(Eriocera)	brevioricornis		Alexander, 1941	Canada, USA (Que to Mass, south to Kans, Tenn and NC).	Hexatomini
Hexatoma	(Eriocera)	cinerea		(Alexander, 1912)	Canada, USA (Minn to Ont, Que and Maine, south to Ark, Tenn and SC).	Hexatomini
Hexatoma	(Eriocera)	fuliginosa		(Osten Sacken, 1860)	Canada, USA (Mich and Que to NH, south to Fla).	Hexatomini
Hexatoma	(Eriocera)	fultonensis		(Alexander, 1912)	USA (NY and Mass, south to Tenn).	Hexatomini
Hexatoma	(Eriocera)	gibbosa		(Doane, 1900)	Canada, USA (Mich to Mass, south to Ill, Tenn and Va).	Hexatomini

Hexatoma	(Eriocera)	longicornis		(Walker, 1848)	Canada, USA (Alaska to Maine, NBr and NSc, south to Kans and NC).	Hexatomini
Hexatoma	(Eriocera)	tristis		(Alexander, 1914)	USA (Ind to NY and Mass, south to NC).	Hexatomini
Hexatoma	(Eriocera)	wilsonii		(Osten Sacken, 1869)	USA (Ohio to Del, south to NC).	Hexatomini
Hexatoma	(Hexatoma)	megacera		(Osten Sacken, 1860)	Canada, USA (Ont and Que to NH, south to Ind and Va).	Hexatomini
Hoplolabis	(Hoplolabis)	armata		(Osten Sacken, 1860)	Canada, USA (Utah and Colo to Wis, Ont and Nfld, south to Okla and Ga).	Eriopterini
Leptotarsus	(Longurio)	minimus		(Alexander, 1914)	USA (Tenn, NC, SC and Ga).	Tipulinae
Leptotarsus	(Longurio)	pruinosus		(Johnson, 1913)	USA (Fla).	Tipulinae
Leptotarsus	(Longurio)	rivertonensis		(Johnson, 1909)	USA (NJ, south to NC).	Tipulinae
Leptotarsus	(Longurio)	testaceus		(Loew, 1869)	USA (Maine, south to Tenn and Fla).	Tipulinae
Limnophila	(Atopolimnophila)	laricicola		Alexander, 1912	Canada, USA (Mich to Nfld, south to Tenn and Va).	Hexatomini
Limnophila	(Brachylimnophila)	brevifurca		(Osten Sacken, 1860)	Canada, USA (Mich to Nfld, south to Tenn and SC).	Hexatomini
Limnophila	(Dicranophragma)	angustula		Alexander, 1929	Canada, USA (Mich to Nfld, south to Tenn and Fla).	Hexatomini
Limnophila	(Dicranophragma)	fuscovaria		Osten Sacken, 1860	Canada, USA (Wis to Ont and NSc, south to Kans and Fla).	Hexatomini
Limnophila	(Idiolimnophila)	emmelina		Alexander, 1914	Canada, USA (Ont to Mass, south to Va).	Hexatomini
Limnophila	(Lasiomastix)	macrocera	macrocera	(Say, 1823)	Canada, USA (Mich and Ont to NSc, south to Ill, Tenn and Fla).	Hexatomini
Limnophila	(Lasiomastix)	macrocera	suffusa	Alexander, 1927	USA (Ga, Fla).	Hexatomini
Limnophila	(Lasiomastix)	subtenuicornis		(Alexander, 1918)	Canada, USA (Mich and Ont to NY, south to Tenn).	Hexatomini
Limnophila	(Lasiomastix)	tenuicornis		Osten Sacken, 1869	Canada, USA (Ont to NSc, south to Tenn and SC).	Hexatomini
Limnophila	Afrolimnophila	irrorata		(Johnson, 1909)	USA (NJ, south to Fla).	Hexatomini
Limnophila	Eloeophila	aprilina		(Osten Sacken, 1860)	Canada, USA (Que to Nfld, south to Tenn and SC).	Hexatomini
Limnophila	Eloeophila	irene		(Alexander, 1927)	Canada, USA (Mich and Ont, south to SC).	Hexatomini
Limnophila	Eloeophila	johnsoni		(Alexander, 1914)	Canada, USA (Ont to Que and NBr, south to Tenn and SC).	Hexatomini
Limnophila	Eloeophila	serotinella		(Alexander, 1926)	USA (Tenn, SC and Fla).	Hexatomini
Limnophila	Eloeophila	seticellula		(Alexander, 1938)	USA (Tenn, NC, SC).	Hexatomini
Limnophila	Eloeophila	solstitialis		(Alexander, 1926)	Canada, USA (Mich and Ont to Que and Maine, south to Tenn and Fla).	Hexatomini
Limnophila	Eloeophila	vernata		(Alexander, 1927)	USA (NC).	Hexatomini
Limnophila	Euphylidorea	adusta		(Osten Sacken, 1860)	Canada, USA (Minn and Ont to Nfld, south to Ill and NC).	Hexatomini
Limnophila	Euphylidorea	adustoides		(Alexander, 1927)	USA (Ind to Mass, south to Tenn).	Hexatomini
Limnophila	Euphylidorea	albipes		(Leonard, 1913)	USA (Vt, south to Tenn and SC).	Hexatomini
Limnophila	Euphylidorea	cherokeensis		(Alexander, 1940)	USA (Tenn, NC).	Hexatomini
Limnophila	Euphylidorea	consimilis	consimilis	(Dietz, 1921)	Canada, USA (Mich and Que to Vt, south to Tenn and NC).	Hexatomini
Limnophila	Euphylidorea	consimilis	griseipleura	(Alexander, 1941)	USA (NC).	Hexatomini
Limnophila	Euphylidorea	epimicta		(Alexander, 1927)	USA (Fla).	Hexatomini
Limnophila	Euphylidorea	frosti		(Alexander, 1961)	USA (Fla).	Hexatomini
Limnophila	Euphylidorea	globulifera		(Alexander, 1941)	USA (NC).	Hexatomini
Limnophila	Euphylidorea	lutea		(Doane, 1900)	Canada, USA (Que to Nfld, south to Tenn and NC).	Hexatomini
Limnophila	Euphylidorea	nigrogeniculata		(Alexander, 1926)	USA (Tenn).	Hexatomini
Limnophila	Euphylidorea	niveitarsis		(Osten Sacken, 1869)	USA (NY and Mass, south to Ind, Tenn and NC).	Hexatomini
Limnophila	Euphylidorea	osceola		(Alexander, 1927)	USA (Fla).	Hexatomini
Limnophila	Euphylidorea	similis		(Alexander, 1911)	Canada, USA (Minn to Que and Maine, south to SC).	Hexatomini
Limnophila	Euphylidorea	stupkai		(Alexander, 1940)	USA (Tenn, NC).	Hexatomini
Limnophila	Euphylidorea	subsimilis		(Alexander, 1927)	USA (Tenn).	Hexatomini
Limnophila	Eutonia	marchandi		(Alexander, 1916)	Canada, USA (Mich to Mass, south to Fla).	Hexatomini
Limnophila	Eutonia	phorophragma		(Alexander, 1944)	USA (NC, Ga).	Hexatomini
Limnophila	Prionolabis	munda		(Osten Sacken, 1869)	Canada, USA (Wis and Ont to NSc, south to Tenn and NC).	Hexatomini
Limnophila	Prionolabis	mundoides		(Alexander, 1916)	USA (Pa, south to Fla).	Hexatomini
Limnophila	Prionolabis	politissima		(Alexander, 1941)	USA (Tenn, NC).	Hexatomini
Limnophila	Prionolabis	rudimentis		(Alexander, 1941)	USA (Tenn, NC).	Hexatomini
Limnophila	Prionolabis	rufibasis	rufibasis	(Osten Sacken, 1860)	Canada, USA (Ont to Nfld, south to Wis, Tenn and SC).	Hexatomini
Limnophila	Prionolabis	rufibasis	sedula	(Alexander, 1941)	USA (Tenn, NC).	Hexatomini
Limnophila	Prionolabis	simplex		(Alexander, 1911)	USA (NY to NH, south to Fla).	Hexatomini
Limnophila	Prionolabis	walleyi		(Alexander, 1929)	Canada, USA (Ill to Ont, south to Tenn and NC).	Hexatomini
Limonia	(Caenoglochina)	apicata	subapicata	(Alexander, 1931)	USA (Fla).	Limoniini
Limonia	(Caenoglochina)	rogersiana	rogersiana	Alexander, 1926	USA (Ga, Fla).	Limoniini
Limonia	(Caenoglochina)	rogersiana	longistylata	(Alexander, 1929)	USA (Fla).	Limoniini
Limonia	(Dicranomyia)	adirondacensis		Alexander, 1922	Canada, USA (Wis to Que and NY, south to NC).	Limoniini
Limonia	(Dicranomyia)	brevivena	brevivena	Osten Sacken, 1869	Canada, USA (Wash to Nfld, south to Calif, Ariz and Fla); Bermuda.	Limoniini
Limonia	(Dicranomyia)	defuncta		(Osten Sacken, 1860)	Canada, USA (Wis to Nfld, south to Ill, ?Tenn and SC).	Limoniini
Limonia	(Dicranomyia)	distans		Osten Sacken, 1860	USA (Md, south to Calif, Texas, Ala and Fla); Bermuda; Belize, Brazil, British Guyana	Limoniini
Limonia	(Dicranomyia)	distendens	distendens	Lundstrom, 1912	Canada, USA (Mich to Que and NH, south to Tenn and SC); Austria, Belgium, Czech	Limoniini
Limonia	(Dicranomyia)	distendens	distendens	Lundstrom, 1912	Canada, USA (Mich to Que and NH, south to Tenn and SC); Austria, Belgium, Czech	Limoniini
Limonia	(Dicranomyia)	divisa		(Alexander, 1929)	USA (Iowa to NY and Mass, south to Kans and Fla); Dominica, Haiti, Jamaica, Puert	Limoniini
Limonia	(Dicranomyia)	floridana		Osten Sacken, 1869	USA (Md, south to Fla).	Limoniini

Limonia	(Dicranomyia)	frontalis		(Staeger, 1840)	Canada, USA (Oreg to Nfld, south to Kans, Iowa, Ind, Ohio and Conn); Austria, Belg	Limoniini
Limonia	(Dicranomyia)	gladiator		Osten Sacken, 1860	Canada, USA (Alta to Que and Maine, south to Colo and Ga).	Limoniini
Limonia	(Dicranomyia)	halterata		Osten Sacken, 1869	Canada, USA (Alaska to Nfld, south to Calif, Colo, NMex, and Pa); Czech Rep., Finla	Limoniini
Limonia	(Dicranomyia)	humidicola		Osten Sacken, 1860	Canada, USA (BC to NSc, south to Calif, Ariz and Ga); Puerto Rico.	Limoniini
Limonia	(Dicranomyia)	immodesta		Osten Sacken, 1860	Canada, USA (Alta to NSc, south to Iowa and SC).	Limoniini
Limonia	(Dicranomyia)	pudica		Osten Sacken, 1860	Canada, USA (Mich to Que and Maine, south to Kans and NC).	Limoniini
Limonia	(Dicranomyia)	pudicoides		(Alexander, 1930)	Canada, USA (Ind to Que and Maine, south to Tenn and NC).	Limoniini
Limonia	(Dicranomyia)	reticulata		(Alexander, 1912)	USA (Fla); Cuba, Jamaica, Mexico, Puerto Rico.	Limoniini
Limonia	(Dicranomyia)	shelfordi		(Alexander, 1944)	USA (Mich, south to Ky and WVa).	Limoniini
Limonia	(Dicranomyia)	stulta		Osten Sacken, 1860	Canada, USA (Wis to Que and Maine, south to Kans and Ga).	Limoniini
Limonia	(Erostrata)	globithorax	globithorax	Osten Sacken, 1869	Canada, USA (Wis and Ont to Nfld, south to Kans and Fla).	Limoniini
Limonia	(Glochina)	liberta		Osten Sacken, 1860	Canada, USA (Man to Nfld, south to Okla and Fla); Bermuda; Russia: WS (near Tom	Limoniini
Limonia	(Melanolimonia)	morioides		Osten Sacken, 1860	Canada, USA (Alaska to Nfld, south to Oreg, Colo, Tenn and NC).	Limoniini
Limonia	(Melanolimonia)	spinifera		Alexander, 1927	Canada, USA (Mich to NBr, south to Tenn and NC).	Limoniini
Limonia	(Metalimnobia)	cinctipes		(Say, 1823)	Canada, USA (Alta to Nfld, south to Oreg, Utah, Wyo, Kans, Miss and Fla); Russia: I	Limoniini
Limonia	(Metalimnobia)	fallax		(Johnson, 1909)	Canada, USA (Minn to Que, NY and NJ, south to Okla and NC).	Limoniini
Limonia	(Metalimnobia)	immatura		(Osten Sacken, 1860)	Canada, USA (BC to Que and Maine, south to Kans and Fla).	Limoniini
Limonia	(Metalimnobia)	triocellata		(Osten Sacken, 1860)	Canada, USA (Alta to NSc, south to Kans, Ill, Tenn and Ga).	Limoniini
Limonia	(Numantia)	fusca		(Meigen, 1804)	Canada, USA (Mich and Ont to Nfld, south to Tenn and Ga); Austria, Belgium, Bulga	Limoniini
Limonia	(Rhipidia)	bryanti		Johnson, 1909	USA (Colo to Maine, south to Ariz and Fla).	Limoniini
Limonia	(Rhipidia)	domestica	domestica	Osten Sacken, 1860	USA (Iowa to NJ and Conn, south to Kans, Texas and Fla); Bermuda; Bolivia, Brazil,	Limoniini
Limonia	(Rhipidia)	fidelis		Osten Sacken, 1860	Canada, USA (Alta to NSc, south to Oreg, Ill, Tenn and Fla).	Limoniini
Limonia	(Rhipidia)	maculata		Meigen, 1818	Canada, USA (Alaska to Nfld, south to Calif, Tenn and NC); Austria, Belgium, Bulga	Limoniini
Limonia	(Rhipidia)	schwarzi		Alexander, 1912	USA (Fla); Cuba, Dominican Rep., Jamaica, Puerto Rico, Venezuela.	Limoniini
Limonia	(Rhipidia)	shannoni		Alexander, 1914	USA (Ind to Md, south to Tenn and Fla); Panama.	Limoniini
Limonia	Discobola	annulata		(Linnaeus, 1758)	Canada, USA (BC to Nfld, south to Oreg, Kans, Tenn and NC); Austria, Bulgaria, Cz	Limoniini
Limonia	Geranomyia	canadensis		(Westwood, 1836)	Canada, USA (Alaska to Nfld, south to Calif, Texas and Fla).	Limoniini
Limonia	Geranomyia	communis		Osten Sacken, 1860	Canada, USA (BC to Nfld, south to Calif, La and Fla).	Limoniini
Limonia	Geranomyia	distincta		Doane, 1900	Canada, USA (Mich to Nfld, south to Texas and Fla).	Limoniini
Limonia	Geranomyia	diversa		Osten Sacken, 1860	USA (Oreg to Maine, south to Calif, Kans, Ark and SC).	Limoniini
Limonia	Geranomyia	intermedia		(Walker, 1848)	USA (Kans, La); Cuba, Jamaica.	Limoniini
Limonia	Geranomyia	rostrata		(Say, 1823)	Canada, USA (Mich to Nfld, south to La and Fla).	Limoniini
Limonia	Geranomyia	vanduzeei		Alexander, 1916	USA (Fla).	Limoniini
Limonia	Geranomyia	virescens		(Loew, 1851)	USA (Fla); Guyana, Puerto Rico, Virgin Is.	Limoniini
Limonia	Gnophomyia	tristissima		Osten Sacken, 1860	Canada, USA (NWT to Que and Maine, south to Texas and Fla).	Eriopterini
Limonia	Limonia	indigena	indigena	(Osten Sacken, 1860)	Canada, USA (Iowa and Ont to Nfld, south to Tenn and SC).	Limoniini
Limonia	Limonia	macateei		(Alexander, 1916)	Canada, USA (Ont to Maine, south to Tenn and Fla).	Limoniini
Limonia	Limonia	maculicosta		(Coquillett, 1905)	Canada, USA (Alaska to Vt, south to Calif and Va); ?Belgium, Finland, Sweden; Rus	Limoniini
Limonia	Limonia	parietina		(Osten Sacken, 1861)	Canada, USA (Ont to Maine, south to Ill and NC).	Limoniini
Limonia	Limonia	tristigma		(Osten Sacken, 1860)	Canada, USA (Alta to NBr, south to Kans, Tenn and NC).	Limoniini
Limonia	Neolimonia	rara		(Osten Sacken, 1869)	USA (Iowa and Wis to NY, south to Kans and Fla).	Limoniini
Liogma		nodicornis		(Osten Sacken, 1865)	Canada, USA (Alta to Nfld, south to SD, Ga and SC).	Cylindrotomi
Lipsothrix		sylvia		(Alexander, 1916)	Canada, USA (Ont to NSc, south to Tenn and SC).	Limoniini
Megistocera		longipennis		(Macquart, 1838)	USA (Texas to Fla); Argentina, Bolivia, Brazil, Cuba, Dominican Rep., Guyana, Haiti,	Tipulinae
Molophilus	(Molophilus)	cramptoni		Alexander, 1924	Canada, USA (Mich and Que to Maine, south to Tenn and SC).	Eriopterini
Molophilus	(Molophilus)	floridensis		Alexander, 1925	USA (Fla).	Eriopterini
Molophilus	(Molophilus)	forcipulus	forcipulus	(Osten Sacken, 1869)	Canada, USA (Wis to NBr, south to Tenn and Fla).	Eriopterini
Molophilus	(Molophilus)	fultonensis		Alexander, 1916	Canada, USA (Wis to Que and Maine, south to Tenn and SC).	Eriopterini
Molophilus	(Molophilus)	hirtipennis		(Osten Sacken, 1860)	Canada, USA (Minn and Ont to Nfld, south to Kans, Tenn and NC).	Eriopterini
Molophilus	(Molophilus)	novacaesariensis		Alexander, 1916	USA (?Minn, Ind to NJ, south to Fla).	Eriopterini
Molophilus	(Molophilus)	perflaveolus		Alexander, 1918	Canada, USA (BC, south to Calif and Utah, also Tenn, NC, SC); Japan (Honshu).	Eriopterini
Molophilus	(Molophilus)	pubipennis		(Osten Sacken, 1860)	Canada, USA (Ont to Nfld, south to Kans and Fla).	Eriopterini
Molophilus	(Molophilus)	sparus		Alexander, 1940	USA (Fla).	Eriopterini
Neocladura		delicatula		(Alexander, 1914)	Canada, USA (Mich and Que to Maine, south to Tenn and SC).	Eriopterini
Neolimnophila		appalachicola		Alexander, 1941	USA (Tenn, NC).	Eriopterini
Neolimnophila		capnioptera		Alexander, 1947	USA (Ga).	Eriopterini
Neolimnophila		ultima	ultima	(Osten Sacken, 1860)	Canada, USA (Alta to Que and Maine, south to Miss and Ga); Russia: ?FE (?Sakhalin	Eriopterini
Nephrotoma		abbreviata		(Loew, 1863)	USA (Mo, Ill, Tenn, NC, south to Texas, La, Miss and Fla).	Tipulinae
Nephrotoma		alterna		(Walker, 1848)	Canada, USA (BC to Labr and Nfld, south to Colo and Fla).	Tipulinae
Nephrotoma		calinota		(Dietz, 1918)	Canada, USA (Mich to NH, south to NC).	Tipulinae
Nephrotoma		cingulata		(Dietz, 1918)	Canada, USA (Minn to NBr and NSc, south to Ark, Miss, Ala and Fla).	Tipulinae
Nephrotoma		cornifera		(Dietz, 1918)	USA (Ind to Va, south to Tenn and Fla).	Tipulinae
Nephrotoma		eucera		(Loew, 1863)	Canada, USA (Ont, SD and Kans to Vt, Conn and Ga).	Tipulinae

Nephrotoma		euceroides		Alexander, 1919	Canada, USA (Minn to NBr and NSc, south to Tenn and NC).	Tipulinae
Nephrotoma		ferruginea		(Fabricius, 1805)	Canada, USA (Alaska to Nfld and NSc (Sable Is), south to Oreg, Ariz, Texas, Ark, G	Tipulinae
Nephrotoma		gnata		(Dietz, 1918)	USA (Iowa to Mass, south to Ark, Ala, Fla).	Tipulinae
Nephrotoma		gracilicornis		(Loew, 1864)	Canada, USA (Man to Nfld, south to SD, Mo, Tenn and NC).	Tipulinae
Nephrotoma		lugens		(Loew, 1864)	Canada, USA (Alta to NSc, south to Colo, Tenn and NC).	Tipulinae
Nephrotoma		macrocera		(Say, 1823)	Canada, USA (Nebr to Que and NH, south to Okla, La, Miss, Ala and Fla).	Tipulinae
Nephrotoma		okefenoke		(Alexander, 1915)	USA (Va, Tenn, NC, Ga and Fla).	Tipulinae
Nephrotoma		pedunculata		(Loew, 1863)	Canada, USA (Alta to Nfld, south to Minn and Va).	Tipulinae
Nephrotoma		polymera		(Loew, 1863)	Canada, USA (ND to Nfld, south to Kans, Mo, Tenn and NC).	Tipulinae
Nephrotoma		punctum		(Loew, 1863)	Canada, USA (Man to NBr, south to Tenn).	Tipulinae
Nephrotoma		rogersi		Byers, 1968	USA (SC, south to Fla).	Tipulinae
Nephrotoma		sodalis		(Loew, 1864)	Canada, USA (Alaska to Nfld, south to BC, Wyo, NMex, Ala and Ga).	Tipulinae
Nephrotoma		subalterna		Oosterbroek, 1984	Canada, USA (Ont, Ind, Va, Tenn, NC and Ga).	Tipulinae
Nephrotoma		suturalis	suturalis	(Loew, 1863)	USA (Kans to NJ, south to Texas, La, Fla).	Tipulinae
Nephrotoma		tenuis		(Loew, 1863)	Canada, USA (Minn to NBr and NSc, south to Ala and SC).	Tipulinae
Nephrotoma		urocera		(Dietz, 1918)	USA (Tenn, NC, south to Ala and Fla).	Tipulinae
Nephrotoma		virescens		(Loew, 1864)	Canada, USA (Mich to NH, south to Kans, Miss, Ala and Fla).	Tipulinae
Orimarga	(Diotrepha)	mirabilis		(Osten Sacken, 1878)	USA (Ind to Ga, south to Texas and Fla); Cuba, ?St. Vincent.	Limoniini
Orimarga	(Orimarga)	wetmorei		Alexander, 1920	USA (Fla).	Limoniini
Ormosia	(Ormosia)	adirondacensis		Alexander, 1919	Canada, USA (Que to NSc, south to Tenn and NC).	Eriopterini
Ormosia	(Ormosia)	arcuata		(Doane, 1908)	Canada, USA (Alta to NBr, south to Kans and Tenn).	Eriopterini
Ormosia	(Ormosia)	bilineata		Dietz, 1916	Canada, USA (SD to Nfld, south to NC).	Eriopterini
Ormosia	(Ormosia)	brevicalcarata		Alexander, 1927	USA (NC).	Eriopterini
Ormosia	(Ormosia)	carolinensis		Alexander, 1925	USA (NC, SC).	Eriopterini
Ormosia	(Ormosia)	harrisoniana		Alexander, 1940	USA (Tenn).	Eriopterini
Ormosia	(Ormosia)	holotricha		(Osten Sacken, 1860)	USA (Vt and NH, south to Tenn and NC).	Eriopterini
Ormosia	(Ormosia)	lilliana		Alexander, 1940	USA (Tenn, NC).	Eriopterini
Ormosia	(Ormosia)	meigenii		(Osten Sacken, 1860)	Canada, USA (Ont to NSc, south to Ill and SC).	Eriopterini
Ormosia	(Ormosia)	mitchellensis		Alexander, 1941	USA (NC).	Eriopterini
Ormosia	(Ormosia)	monticola		(Osten Sacken, 1869)	Canada, USA (Minn to NBr, south to NC).	Eriopterini
Ormosia	(Ormosia)	romanovichiana		Alexander, 1953	USA (Kans to Que and Maine, south to Tenn and SC).	Eriopterini
Ormosia	(Ormosia)	rubella		(Osten Sacken, 1869)	Canada, USA (Wis to Nfld, south to Ga).	Eriopterini
Ormosia	(Ormosia)	serridens		Alexander, 1919	USA (Ohio, Md, Va, Tenn).	Eriopterini
Ormosia	(Ormosia)	subdentifera		Alexander, 1941	USA (NC).	Eriopterini
Ormosia	(Ormosia)	tennesseensis		Alexander, 1940	USA (Tenn).	Eriopterini
Ormosia	(Ormosia)	townesi		Alexander, 1933	USA (NC).	Eriopterini
Ormosia	(Parormosia)	nigripila		(Osten Sacken, 1869)	Canada, USA (Mich to Nfld, south to Fla).	Eriopterini
Ormosia	(Parormosia)	pygmaea		(Alexander, 1912)	Canada, USA (Mich to NBr, south to NC).	Eriopterini
Ormosia	Scleroprocta	apicalis		(Alexander, 1911)	USA (NY, south to Tenn and Ga).	Eriopterini
Ormosia	Scleroprocta	innocens		(Osten Sacken, 1869)	Canada, USA (Mich to NH, south to Tenn and SC).	Eriopterini
Paradelphomyia	(Oxyrhiza)	americana		(Alexander, 1912)	Canada, USA (Mich to NBr, south to Tenn and SC).	Hexatomini
Paradelphomyia	(Oxyrhiza)	minuta		(Alexander, 1911)	Canada, USA (Mich and Ont to Nfld, south to Tenn and NC).	Hexatomini
Paradelphomyia	(Oxyrhiza)	pleuralis		(Dietz, 1921)	Canada, USA (Mich and Ont to NSc, south to Fla).	Hexatomini
Pedicia	(Pedicia)	albivitta		Walker, 1848	Canada, USA (Man to Nfld, south to Kans, Mo and SC).	Pediciini
Pedicia	(Pedicia)	contermina		Walker, 1848	Canada, USA (Mich to Nfld, south to NC).	Pediciini
Pedicia	(Pedicia)	margarita		Alexander, 1930	Canada, USA (Nfld, south to Tenn).	Pediciini
Pedicia	(Pentacyphona)	huffae		(Alexander, 1940)	USA (Tenn).	Pediciini
Pedicia	(Tricyphona)	auripennis	attenuata	(Alexander, 1941)	USA (NC).	Pediciini
Pedicia	(Tricyphona)	auripennis	nephophila	(Alexander, 1941)	USA (Tenn, NC).	Pediciini
Pedicia	(Tricyphona)	calcar		(Osten Sacken, 1860)	Canada, USA (Ont to Nfld, south to Wis, Tenn and SC).	Pediciini
Pedicia	(Tricyphona)	gigantea		(Alexander, 1940)	USA (NC).	Pediciini
Pedicia	(Tricyphona)	inconstans	calcaroides	(Alexander, 1940)	USA (Tenn, NC).	Pediciini
Pedicia	(Tricyphona)	inconstans	inconstans	(Osten Sacken, 1860)	Canada, USA (Minn to Nfld, south to Kans, Mo, Ark, Ga and SC).	Pediciini
Pedicia	(Tricyphona)	johnsoni		Alexander, 1930	USA (Mass, south to Fla (coastal)).	Pediciini
Pedicia	(Tricyphona)	macateei		Alexander, 1919	Canada, USA (Que to Mass, south to NC).	Pediciini
Pedicia	(Tricyphona)	vernalis	catawba	(Alexander, 1940)	USA (Tenn, NC).	Pediciini
Pedicia	(Tricyphona)	vernalis	vernalis	(Osten Sacken, 1861)	Canada, USA (Ont to Nfld, south to Ga).	Pediciini
Phalacrocera		tipulina		Osten Sacken, 1865	Canada, USA (Wis to Nfld, south to Va).	Cylindrotomi
Pilaria		arguta		Alexander, 1929	USA (Fla).	Hexatomini
Pilaria		imbecilla	imbecilla	(Osten Sacken, 1860)	Canada, USA (Ont to Que, Mass and NBr, south to Kans, Ill and Ga).	Hexatomini
Pilaria		imbecilla	illinoiensis	(Alexander, 1920)	USA (Ill, Ind, south to Tenn).	Hexatomini
Pilaria		quadrata		(Osten Sacken, 1860)	Canada, USA (Iowa to Ont and NSc, south to Kans and Fla).	Hexatomini
Pilaria		recondita		(Osten Sacken, 1869)	Canada, USA (Minn to Ont and NSc, south to La and Fla).	Hexatomini

Pilaria		stanwoodae		(Alexander, 1914)	Canada, USA (Que to Maine, south to SC).	Hexatomini
Pilaria		tenuipes		(Say, 1823)	Canada, USA (Minn to Ont and NBr, south to Kans, Texas and Fla); Mexico.	Hexatomini
Polymera	(Polymera)	georgiae		Alexander, 1911	USA (Ga, NC, SC and Fla).	Hexatomini
Polymera	(Polymera)	rogersiana		Alexander, 1929	USA (Fla).	Hexatomini
Prolimnophila		areolata		(Osten Sacken, 1860)	Canada, USA (Wis and Ont to Nfld, south to Tenn and NC).	Hexatomini
Pseudolimnophila	(Pseudolimnophila)	australina		Alexander, 1927	USA (Ind to Md, south to Ala and Fla).	Hexatomini
Pseudolimnophila	(Pseudolimnophila)	contempta		(Osten Sacken, 1869)	Canada, USA (Ont to Nfld, south to Kans and Fla).	Hexatomini
Pseudolimnophila	(Pseudolimnophila)	luteipennis		(Osten Sacken, 1860)	Canada, USA (Ont to NBr, south to Calif, La and Fla); Mexico, "Central America".	Hexatomini
Pseudolimnophila	(Pseudolimnophila)	noveboracensis		(Alexander, 1911)	Canada, USA (BC to NSc, south to Utah and SC).	Hexatomini
Rhabdomastix	(Sacandaga)	brachyneura		Alexander, 1933	USA (NC, SC).	Eriopterini
Rhabdomastix	(Sacandaga)	flava		(Alexander, 1911)	Canada, USA (Que to Nfld, south to Tenn and NC).	Eriopterini
Rhabdomastix	(Sacandaga)	margarita		Alexander, 1940	USA (Tenn, NC).	Eriopterini
Rhabdomastix	(Sacandaga)	mediovena		Alexander, 1933	USA (SC).	Eriopterini
Shannonomyia	(Shannonomyia)	lenta	lenta	(Osten Sacken, 1860)	Canada, USA (Minn and Ont to Nfld, south to Tenn and Ga).	Hexatomini
Tanyptera	(Tanyptera)	dorsalis		(Walker, 1848)	Canada, USA (Minn to Ont, Que and Nfld, south to Ill, Tenn and NC).	Tipulinae
Tasiocera	(Dasymolophilus)	niphadias		(Alexander, 1925)	USA (Mich to Tenn and Fla).	Eriopterini
Tasiocera	(Dasymolophilus)	ursina		(Osten Sacken, 1860)	Canada, USA (Kans to Que and Nfld, south to Tenn and NC).	Eriopterini
Teucholabis	(Teucholabis)	carolinensis		Alexander, 1916	USA (SC, south to Fla).	Eriopterini
Teucholabis	(Teucholabis)	complexa		Osten Sacken, 1860	USA (Mich to NY and Conn, south to Okla and Fla); ?St. Vincent.	Eriopterini
Teucholabis	(Teucholabis)	immaculata		Alexander, 1922	USA (Ind, south to Kans and Ga).	Eriopterini
Teucholabis	(Teucholabis)	lucida		Alexander, 1916	USA (Kans to DC, south to Fla).	Eriopterini
Teucholabis	(Teucholabis)	myersi		Alexander, 1926	USA (Fla); Cuba.	Eriopterini
Tipula	(Arctotipula)	williamsiana		Alexander, 1940	USA (Tenn, SC).	Tipulinae
Tipula	(Beringotipula)	borealis		Walker, 1848	Canada, USA (Ont to Que, Maine, NBr and NSc, south to Kans, Tenn and SC).	Tipulinae
Tipula	(Lunatipula)	apicalis		Loew, 1863	Canada, USA (Ont to Que, Maine, NBr and NSc, south to Mich, Tenn and NC).	Tipulinae
Tipula	(Lunatipula)	australis		Doane, 1901	USA (Kans to Md, south to Texas and Ga).	Tipulinae
Tipula	(Lunatipula)	bicornis		Forbes, 1890	Canada, USA (Wis to Ont, Que, Maine and NBr, south to Kans, Ark, Tenn and Va).	Tipulinae
Tipula	(Lunatipula)	catawba		Alexander, 1915	USA (NC, SC).	Tipulinae
Tipula	(Lunatipula)	dietziana		Alexander, 1915	USA (NY, south to Kans and SC).	Tipulinae
Tipula	(Lunatipula)	duplex		Walker, 1848	Canada, USA (Minn and Ont to NBr and NSc, south to Kans, Ark, Tenn and Fla).	Tipulinae
Tipula	(Lunatipula)	fattigiana		Alexander, 1944	USA (Ga).	Tipulinae
Tipula	(Lunatipula)	fuliginosa		(Say, 1823)	Canada, USA (Ont to Que and NH, south to Kans, Ark and NC).	Tipulinae
Tipula	(Lunatipula)	georgiana		Alexander, 1915	USA (Mass, NY, Ga).	Tipulinae
Tipula	(Lunatipula)	mallochi		Alexander, 1920	USA (Kans to Ill and Md, south to Fla).	Tipulinae
Tipula	(Lunatipula)	mariannae		Alexander, 1940	USA (Fla).	Tipulinae
Tipula	(Lunatipula)	morrisoni		Alexander, 1915	USA (Kans to RI, south to Ark, Miss and SC).	Tipulinae
Tipula	(Lunatipula)	oxytona		Alexander, 1927	USA (Fla).	Tipulinae
Tipula	(Lunatipula)	seminole		Alexander, 1915	USA (NC, Ga).	Tipulinae
Tipula	(Lunatipula)	submaculata		Loew, 1863	Canada, USA (Wis to Ont, Que, Maine, NBr and NSc, south to Ark, Tenn and SC).	Tipulinae
Tipula	(Lunatipula)	translucida		Doane, 1901	USA (Kans to Ill and Pa, south to Okla and SC).	Tipulinae
Tipula	(Lunatipula)	triton		Alexander, 1915	USA (Ind and Ky to DC, south to SC and Ga).	Tipulinae
Tipula	(Lunatipula)	tuscarora		Alexander, 1915	USA (Kans to Ill and Md, south to Tenn and SC).	Tipulinae
Tipula	(Lunatipula)	valida	atricornis	Alexander, 1940	USA (Tenn, NC).	Tipulinae
Tipula	(Lunatipula)	valida	valida	Loew, 1863	Canada, USA (Minn to Ont, Que and Nfld, south to Ill and NC).	Tipulinae
Tipula	(Nippotipula)	abdominalis		(Say, 1823)	Canada, USA (Minn to Ont, Que and Nfld, south to Kans and Fla).	Tipulinae
Tipula	(Nobilotipula)	collaris		Say, 1823	Canada, USA (Mich and Ont to Que, NY and Pa, south to Tenn and SC).	Tipulinae
Tipula	(Nobilotipula)	nobilis		(Loew, 1864)	Canada, USA (Mich and Ont to Que, Maine and NBr, south to NC).	Tipulinae
Tipula	(Platytipula)	cunctans		Say, 1823	Canada, USA (Man to NBr, south to Colo, Ala and NC).	Tipulinae
Tipula	(Platytipula)	nebulinervis		Alexander, 1940	USA (Fla).	Tipulinae
Tipula	(Platytipula)	paterifera		Alexander, 1962	USA (Kans, Mo, Ohio and Tenn).	Tipulinae
Tipula	(Platytipula)	tennessa		Alexander, 1920	USA (Mass, Tenn).	Tipulinae
Tipula	(Platytipula)	ultima		Alexander, 1915	Canada, USA (Sask to NSc, south to Wyo, Kans, Miss and Fla).	Tipulinae
Tipula	(Pterelachisus)	angulata	cherokeana	Alexander, 1940	USA (Tenn, NC).	Tipulinae
Tipula	(Pterelachisus)	coleana		Alexander, 1940	Canada, USA (Que, Tenn).	Tipulinae
Tipula	(Pterelachisus)	entomophthorae		Alexander, 1918	Canada, USA (Alta to Labr and Nfld, south to Minn, Tenn and NC).	Tipulinae
Tipula	(Pterelachisus)	margarita		Alexander, 1918	USA (NY, Ohio, Tenn).	Tipulinae
Tipula	(Pterelachisus)	trivittata	trivittata	Say, 1823	Canada, USA (Alta to Ont, Que and Nfld, south to Kans, Tenn and SC).	Tipulinae
Tipula	(Savtshenkia)	fragilis		Loew, 1863	Canada, USA (Alta to Maine, NBr and NSc, south to Ind, Tenn and DC).	Tipulinae
Tipula	(Savtshenkia)	ignobilis		Loew, 1863	Canada, USA (Man to Ont, Que, Maine and NBr, south to Kans, Tenn and SC).	Tipulinae
Tipula	(Schummelia)	annulicornis		Say, 1829	Canada, USA (Mich to Mass, south to Ark, Tenn and SC).	Tipulinae
Tipula	(Schummelia)	friendi		Alexander, 1941	USA (Mass, Tenn and NC).	Tipulinae
Tipula	(Schummelia)	hermannia		Alexander, 1915	Canada, USA (Minn to Ont, Que and Nfld, south to Kans and Fla).	Tipulinae
Tipula	(Schummelia)	stenorhabda		Alexander, 1941	USA (NC).	Tipulinae

Tipula	(Schummelia)	synchroa		Alexander, 1927	USA (Fla).	Tipulinae
Tipula	(Trichotipula)	algonquin		Alexander, 1915	Canada, USA (Mich and Ont to Que and Maine, south to Tenn and NC).	Tipulinae
Tipula	(Trichotipula)	oropezoides		Johnson, 1909	Canada, USA (Mich and Ont to Que and Nfld, south to Tenn and Fla).	Tipulinae
Tipula	(Trichotipula)	stonei		Alexander, 1965	Canada, USA (Ont to NY and Mass, south to Kans and Fla).	Tipulinae
Tipula	(Trichotipula)	unimaculata		(Loew, 1864)	Canada, USA (Ont to Maine, south to Kans, Ill and NC).	Tipulinae
Tipula	(Triplicitipula)	flavoumbrosa		Alexander, 1918	USA (Mich, south to Kans, Ark, SC and Fla).	Tipulinae
Tipula	(Triplicitipula)	perlongipes		Johnson, 1909	USA (Kans, Ind, NC, SC and Fla).	Tipulinae
Tipula	(Triplicitipula)	triplex	triplex	Walker, 1848	Canada, USA (Alta to Nfld, south to Kans and NC).	Tipulinae
Tipula	(Triplicitipula)	triplex	colei	Alexander, 1942	USA (Tenn).	Tipulinae
Tipula	(Triplicitipula)	triplex	linearis	Alexander, 1940	USA (Tenn).	Tipulinae
Tipula	(Triplicitipula)	umbrosa		Loew, 1863	USA (La, Fla).	Tipulinae
Tipula	(Vestiplex)	caroliniana		Alexander, 1916	USA (NC).	Tipulinae
Tipula	(Vestiplex)	longiventris		Loew, 1863	Canada, USA (Wis and Ont to Que and Maine, south to Texas and SC).	Tipulinae
Tipula	(Yamatotipula)	aprilina		Alexander, 1918	USA (Maine, south to SC).	Tipulinae
Tipula	(Yamatotipula)	brevifurcata		Alexander, 1926	USA (Tenn, NC).	Tipulinae
Tipula	(Yamatotipula)	caloptera		Loew, 1863	Canada, USA (Minn to Ont, Que and Nfld, south to Kans, Mo, Ark and Fla).	Tipulinae
Tipula	(Yamatotipula)	calopteroides		Alexander, 1919	USA (Pa, Tenn, NC and SC).	Tipulinae
Tipula	(Yamatotipula)	catawbiana		Alexander, 1940	USA (WVa, Tenn, NC and Ga).	Tipulinae
Tipula	(Yamatotipula)	cayuga		Alexander, 1915	Canada, USA (Mich and Ont to Que and Nfld, south to Tenn and NC).	Tipulinae
Tipula	(Yamatotipula)	concava		Alexander, 1926	Canada, USA (Mich to Maine, south to Kans, Mo, Ark and Tenn).	Tipulinae
Tipula	(Yamatotipula)	conspicua		Dietz, 1917	USA (NC).	Tipulinae
Tipula	(Yamatotipula)	dejecta		Walker, 1856	Canada, USA (Mich and Ont to Que, NH and RI, south to Ill and NC).	Tipulinae
Tipula	(Yamatotipula)	eluta		Loew, 1863	Canada, USA (Ont to NBr, south to Ill, Ark and Fla).	Tipulinae
Tipula	(Yamatotipula)	floridensis		Alexander, 1926	USA (Fla).	Tipulinae
Tipula	(Yamatotipula)	fraterna		Loew, 1864	USA (NH, south to Fla).	Tipulinae
Tipula	(Yamatotipula)	furca		Walker, 1848	Canada, USA (Ont to Que and Maine, south to Kans, Texas and Fla).	Tipulinae
Tipula	(Yamatotipula)	iroquois		Alexander, 1915	Canada, USA (Que and Nfld, south to Tenn and NC).	Tipulinae
Tipula	(Yamatotipula)	jacobus		Alexander, 1931	Canada, USA (NSc, south to Ark, Tenn and Fla).	Tipulinae
Tipula	(Yamatotipula)	ludoviciana		Alexander, 1919	USA (La, Fla); Cuba.	Tipulinae
Tipula	(Yamatotipula)	maculipleura		Alexander, 1927	USA (Tenn).	Tipulinae
Tipula	(Yamatotipula)	manahatta		Alexander, 1919	USA (NY, south to Tenn and Fla).	Tipulinae
Tipula	(Yamatotipula)	nephophila		Alexander, 1940	USA (Tenn, NC).	Tipulinae
Tipula	(Yamatotipula)	osceola		Alexander, 1927	USA (Fla).	Tipulinae
Tipula	(Yamatotipula)	sackeniana		Alexander, 1918	USA (NY to Conn, south to Tenn and Ga).	Tipulinae
Tipula	(Yamatotipula)	sayi		Alexander, 1911	Canada, USA (Ont to Que and Nfld, south to Iowa, Kans, La and Fla); Bermuda.	Tipulinae
Tipula	(Yamatotipula)	subeluta		Johnson, 1913	USA (Mass, south to Fla).	Tipulinae
Tipula	(Yamatotipula)	tricolor		Fabriclus, 1775	Canada, USA (Minn to Ont, Que and Maine, south to Colo, Ark and Fla).	Tipulinae
Toxorhina	(Toxorhina)	magna		Osten Sacken, 1865	Canada, USA (Mich to Mass, south to Kans, La and Fla).	Limoniini
Toxorhina	(Toxorhina)	muliebris		Osten Sacken, 1865	Canada, USA (Wis to Que and Maine, south to Ill and Va).	Limoniini
Ula	(Ula)	elegans		Osten Sacken, 1869	Canada, USA (Alaska to NSc, south to Oreg, Alta, Wyo, Tenn and SC).	Pedicilni
Ulomorpha		pilosella		(Osten Sacken, 1860)	Canada, USA (Mich to NSc, south to Tenn and SC).	Hexatomini
Ulomorpha		rogersella		Alexander, 1929	USA (NC, south to Fla).	Hexatomini

INDIVIDUAL

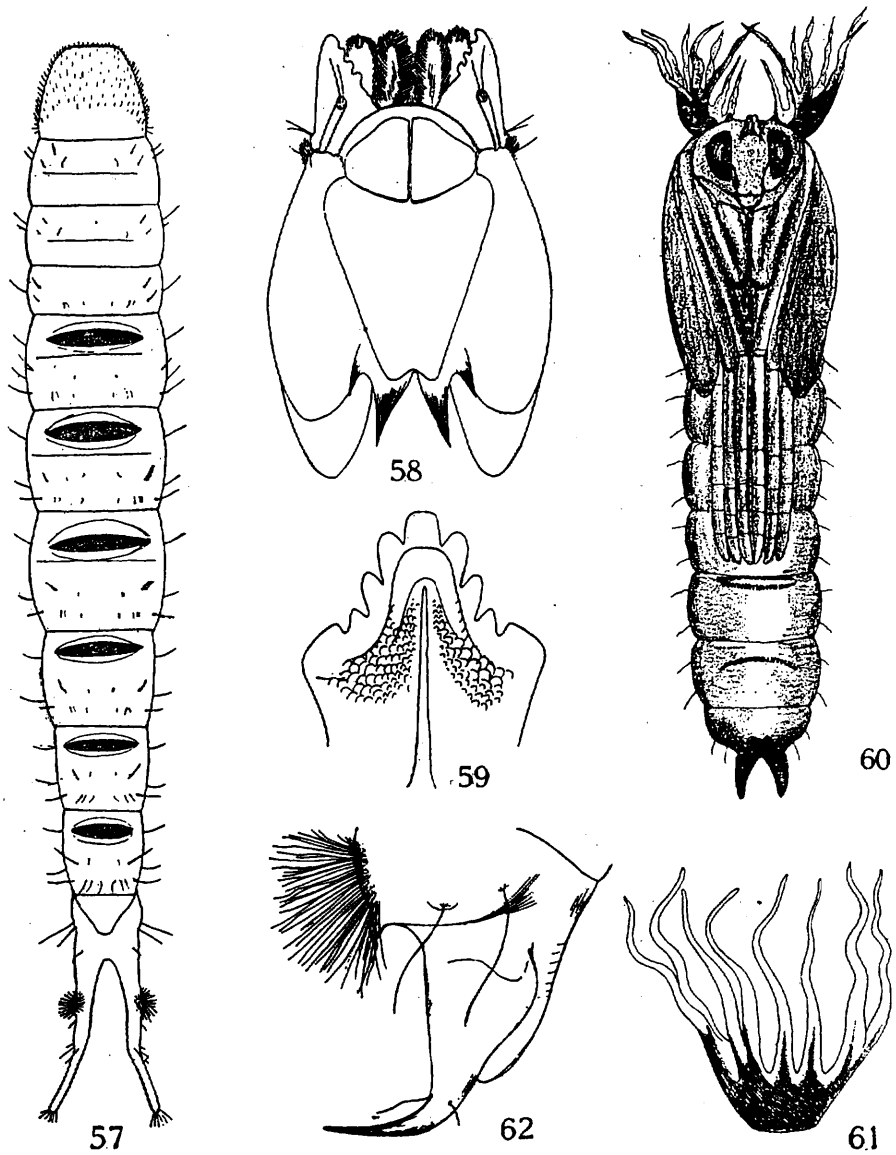
GENERA

Genera of Southeastern U.S. Crane flies (Virginia to Kentucky south to Louisiana and Florida)

Current US Classification		Subfamily	Tribe	Current European Classification		In This Key
Antocha	*(Antocha)*	Limoniinae	Limoniini	*Antocha*	*(Antocha)*	X
Atarba	*(Atarba)*	Limoniinae	Eriopterini	*Atarba*	*(Atarba)*	X
Austrolimnophila	*(Austrolimnophila)*	Limoniinae	Hexatomini	*Austrolimnophila*	*(Austrolimnophila)*	X
Brachypremna		Tipulinae		*Brachypremna*		X
Cheilotrichia	*(Empeda)*	Limoniinae	Eriopterini	*Cheilotrichia*	*(Empeda)*	X
Cheilotrichia	*(Gonempeda)*	Limoniinae	Eriopterini	*Gonempeda*		X
Chionea	*(Chionea)*	Limoniinae	Eriopterini	*Chionea*	*(Chionea)*	
Cladura		Limoniinae	Eriopterini	*Cladura*		
Cryptolabis	*(Cryptolabis)*	Limoniinae	Eriopterini	*Cryptolabis*	*(Cryptolabis)*	X
Ctenophora	*(Ctenophora)*	Tipulinae		*Ctenophora*	*(Ctenophora)*	
Ctenophora	*(Tanyptera)*	Tipulinae		*Tanyptera*	*(Tanyptera)*	
Dactylolabis	*(Dactylolabis)*	Limoniinae	Hexatomini	*Dactylolabis*	*(Dactylolabis)*	X
Dicranoptycha		Limoniinae	Limoniini	*Dicranoptycha*		
Dicranota	*(Dicranota)*	Limoniinae	Pediciini	*Dicranota*	*(Dicranota)*	AS GENUS
Dicranota	*(Eudicranota)*	Limoniinae	Pediciini	*Dicranota*	*(Eudicranota)*	AS GENUS
Dicranota	*(Paradicranota)*	Limoniinae	Pediciini	*Dicranota*	*(Paradicranota)*	AS GENUS
Dicranota	*(Plectromyia)*	Limoniinae	Pediciini	*Dicranota*	*(Plectromyia)*	AS GENUS
Dicranota	*(Rhaphidolabina)*	Limoniinae	Pediciini	*Dicranota*	*(Rhaphidolabina)*	X
Dicranota	*(Rhaphidolabis)*	Limoniinae	Pediciini	*Dicranota*	*(Rhaphidolabis)*	AS GENUS
Dolichopeza	*(Dolichopeza)*	Tipulinae		*Dolichopeza*	*(Dolichopeza)*	X
Dolichopeza	*(Oropeza)*	Tipulinae		*Dolichopeza*	*(Oropeza)*	X
Elephantomyia	*(Elephantomyia)*	Limoniinae	Limoniini	*Elephantomyia*	*(Elephantomyia)*	X
Elliptera		Limoniinae	Limoniini	*Elliptera*		X
Epiphragma	*(Epiphragma)*	Limoniinae	Hexatomini	*Epiphragma*	*(Epiphragma)*	X
Erioptera	*(Erioptera)*	Limoniinae	Eriopterini	*Erioptera*	*(Erioptera)*	X
Erioptera	*(Haplolabis)*	Limoniinae	Eriopterini	*Haplolabis*	*(Haplolabis)*	X
Erioptera	*(Ilisia)*	Limoniinae	Eriopterini	*Ilisia*		X
Erioptera	*(Mesocyphona)*	Limoniinae	Eriopterini	*Erioptera*	*(Mesocyphona)*	X
Erioptera	*(Psiloconopa)*	Limoniinae	Eriopterini	*Symplecta*	*(Psiloconopa)*	X
Erioptera	*(Symplecta)*	Limoniinae	Eriopterini	*Symplecta*	*(Symplecta)*	X
Erioptera	*(Teucherioptera)*	Limoniinae	Eriopterini	*Erioptera*	*(Teucherioptera)*	
Erioptera	*(Trimicra)*	Limoniinae	Eriopterini	*Trimicra*		X
Eugnophomyia		Limoniinae	Eriopterini	*Eugnophomyia*		
Gnophomyia		Limoniinae	Eriopterini	*Gnophomyia*		
Gonomyia	*(Gonomyia)*	Limoniinae	Eriopterini	*Gonomyia*	*(Gonomyia)*	AS GENUS
Gonomyia	*(Idiocera)*	Limoniinae	Eriopterini	*Idiocera*	*(Idiocera)*	AS GENUS
Gonomyia	*(Lipophleps)*	Limoniinae	Eriopterini	*Gonomyia*	*(Lipophleps)*	AS GENUS
Gonomyia	*(Neolipophleps)*	Limoniinae	Eriopterini	*Gonomyia*	*(Neolipophleps)*	AS GENUS
Gonomyia	*(Paralipophleps)*	Limoniinae	Eriopterini	*Gonomyia*	*(Paralipophleps)*	AS GENUS
Gonomyia	*(Progonomyia)*	Limoniinae	Eriopterini	*Ellipteroides*	*(Progonomyia)*	X
Helius	*(Helius)*	Limoniinae	Limoniini	*Helius*	*(Helius)*	X
Hexatoma	*(Eriocera)*	Limoniinae	Hexatomini	*Hexatoma*	*(Eriocera)*	AS GENUS
Hexatoma	*(Hexatoma)*	Limoniinae	Hexatomini	*Hexatoma*	*(Hexatoma)*	AS GENUS
Leptotarsus	*(Longurio)*	Tipulinae		*Leptotarsus*	*(Longurio)*	X
Limnophila	*(Afrolimnophila)*	Limoniinae	Hexatomini	*Afrolimnophila*		
Limnophila	*(Atopolimnophila)*	Limoniinae	Hexatomini	*Limnophila*	*(Atopolimnophila)*	
Limnophila	*(Brachylimnophila)*	Limoniinae	Hexatomini	*Neolimnomyia*	*(Brachylimnophila)*	X
Limnophila	*(Dicranophragma)*	Limoniinae	Hexatomini	*Limnophila*	*(Dicranophragma)*	X
Limnophila	*(Eloeophila)*	Limoniinae	Hexatomini	*Eloeophila*		X
Limnophila	*(Euphylidorea)*	Limoniinae	Hexatomini	*Euphylidorea*		X
Limnophila	*(Eutonia)*	Limoniinae	Hexatomini	*Eutonia*		X
Limnophila	*(Idiolimnophila)*	Limoniinae	Hexatomini	*Limnophila*	*(Idiolimnophila)*	
Limnophila	*(Lasiomastix)*	Limoniinae	Hexatomini	*Limnophila*	*(Lasiomastix)*	X
Limnophila	*(Prionolabis)*	Limoniinae	Hexatomini	*Prionolabis*		
Limonia	*(Caenoglochina)*	Limoniinae	Limoniini	*Dicranomyia*	*(Caenoglochina)*	AS GENUS
Limonia	*(Dicranomyia)*	Limoniinae	Limoniini	*Dicranomyia*	*(Dicranomyia)*	AS GENUS
Limonia	*(Discobola)*	Limoniinae	Limoniini	*Discobola*		AS GENUS
Limonia	*(Erostrata)*	Limoniinae	Limoniini	*Dicranomyia*	*(Erostrata)*	AS GENUS
Limonia	*(Geranomyia)*	Limoniinae	Limoniini	*Geranomyia*		AS GENUS
Limonia	*(Glochina)*	Limoniinae	Limoniini	*Dicranomyia*	*(Glochina)*	AS GENUS
Limonia	*(Limonia)*	Limoniinae	Limoniini	*Limonia*		AS GENUS
Limonia	*(Melanolimonia)*	Limoniinae	Limoniini	*Dicranomyia*	*(Melanolimonia)*	AS GENUS
Limonia	*(Metalimnobia)*	Limoniinae	Limoniini	*Metalimnobia*	*(Metalimnobia)*	AS GENUS
Limonia	*(Neolimonia)*	Limoniinae	Limoniini	*Neolimonia*		AS GENUS

Limonia	*(Numantia)*	Limoniinae	Limoniini	*Dicranomyia*	*(Numantia)*	AS GENUS
Limonia	*(Rhipidia)*	Limoniinae	Limoniini	*Rhipidia*	*(Rhipidia)*	AS GENUS
Liogma		Cylindrotominae	Cylindrotomini	*Liogma*		
Lipsothrix		Limoniinae	Limoniini	*Lipsothrix*		X
Megistocera		Tipulinae		*Megistocera*		X
Molophilus	*(Molophilus)*	Limoniinae	Eriopterini	*Molophilus*	*(Molophilus)*	X
Neocladura		Limoniinae	Eriopterini	*Neocladura*		
Neolimnophila		Limoniinae	Eriopterini	*Neolimnophila*		
Nephrotoma		Tipulinae		*Nephrotoma*		
Orimarga	*(Diotrepha)*	Limoniinae	Limoniini	*Orimarga*	*(Diotrepha)*	AS GENUS
Orimarga	*(Orimarga)*	Limoniinae	Limoniini	*Orimarga*	*(Orimarga)*	AS GENUS
Ormosia	*(Ormosia)*	Limoniinae	Eriopterini	*Ormosia*	*(Ormosia)*	AS GENUS
Ormosia	*(Parormosia)*	Limoniinae	Eriopterini	*Ormosia*	*(Parormosia)*	AS GENUS
Ormosia	*Scleroprocta*	Limoniinae	Eriopterini	*Scleroprocta*		X
Paradelphomyia	*(Oxyrhiza)*	Limoniinae	Hexatomini	*Paradelphomyia*	*(Oxyrhiza)*	X
Pedicia	*(Pedicia)*	Limoniinae	Pediciini	*Pedicia*	*(Pedicia)*	AS GENUS
Pedicia	*(Pentacyphona)*	Limoniinae	Pediciini	*Tricyphona*	*(Pentacyphona)*	AS GENUS
Pedicia	*(Tricyphona)*	Limoniinae	Pediciini	*Tricyphona*	*(Tricyphona)*	AS GENUS
Phalacrocera		Cylindrotominae	Cylindrotomini	*Phalacrocera*		X
Pilaria		Limoniinae	Hexatomini	*Pilaria*		X
Polymera	*(Polymera)*	Limoniinae	Hexatomini	*Polymera*	*(Polymera)*	X
Prolimnophila		Limoniinae	Hexatomini	*Prolimnophila*		
Pseudolimnophila	*(Pseudolimnophila)*	Limoniinae	Hexatomini	*Pseudolimnophila*	*(Pseudolimnophila)*	X
Rhabdomastix	*(Sacandaga)*	Limoniinae	Eriopterini	*Rhabdomastix*	*(Sacandaga)*	X
Shannonomyia	*(Shannonomyia)*	Limoniinae	Hexatomini	*Shannonomyia*	*(Shannonomyia)*	
Tasiocera	*(Dasymolophilus)*	Limoniinae	Eriopterini	*Tasiocera*	*(Dasymolophilus)*	
Teucholabis	*(Teucholabis)*	Limoniinae	Eriopterini	*Teucholabis*	*(Teucholabis)*	
Tipula	*(Arctotipula)*	Tipulinae		*Tipula*	*(Arctotipula)*	X
Tipula	*(Beringotipula)*	Tipulinae		*Tipula*	*(Beringotipula)*	X
Tipula	*(Lunatipula)*	Tipulinae		*Tipula*	*(Lunatipula)*	
Tipula	*(Nippotipula)*	Tipulinae		*Tipula*	*(Nippotipula)*	X
Tipula	*(Nobilotipula)*	Tipulinae		*Tipula*	*(Nobilotipula)*	X
Tipula	*(Platytipula)*	Tipulinae		*Tipula*	*(Platytipula)*	X
Tipula	*(Pterelachisus)*	Tipulinae		*Tipula*	*(Pterelachisus)*	
Tipula	*(Savtshenkia)*	Tipulinae		*Tipula*	*(Savtshenkia)*	X
Tipula	*(Schummelia)*	Tipulinae		*Tipula*	*(Schummelia)*	X
Tipula	*(Trichotipula)*	Tipulinae		*Tipula*	*(Trichotipula)*	X
Tipula	*(Triplicitipula)*	Tipulinae		*Tipula*	*(Triplicitipula)*	
Tipula	*(Vestiplex)*	Tipulinae		*Tipula*	*(Vestiplex)*	
Tipula	*(Yamatotipula)*	Tipulinae		*Tipula*	*(Yamatotipula)*	X
Toxorhina	*(Toxorhina)*	Limoniinae	Limoniini	*Toxorhina*	*(Toxorhina)*	
Ula	*(Ula)*	Limoniinae	Pediciini	*Ula*	*(Ula)*	
Ulomorpha		Limoniinae	Hexatomini	*Ulomorpha*		X

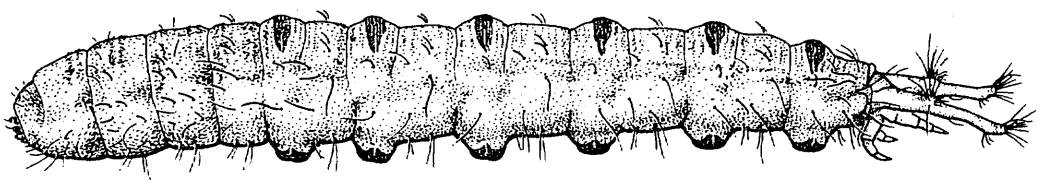
Antocha



from Alexander (1920) (Nearctic)

ANTOCHA SAXICOLA

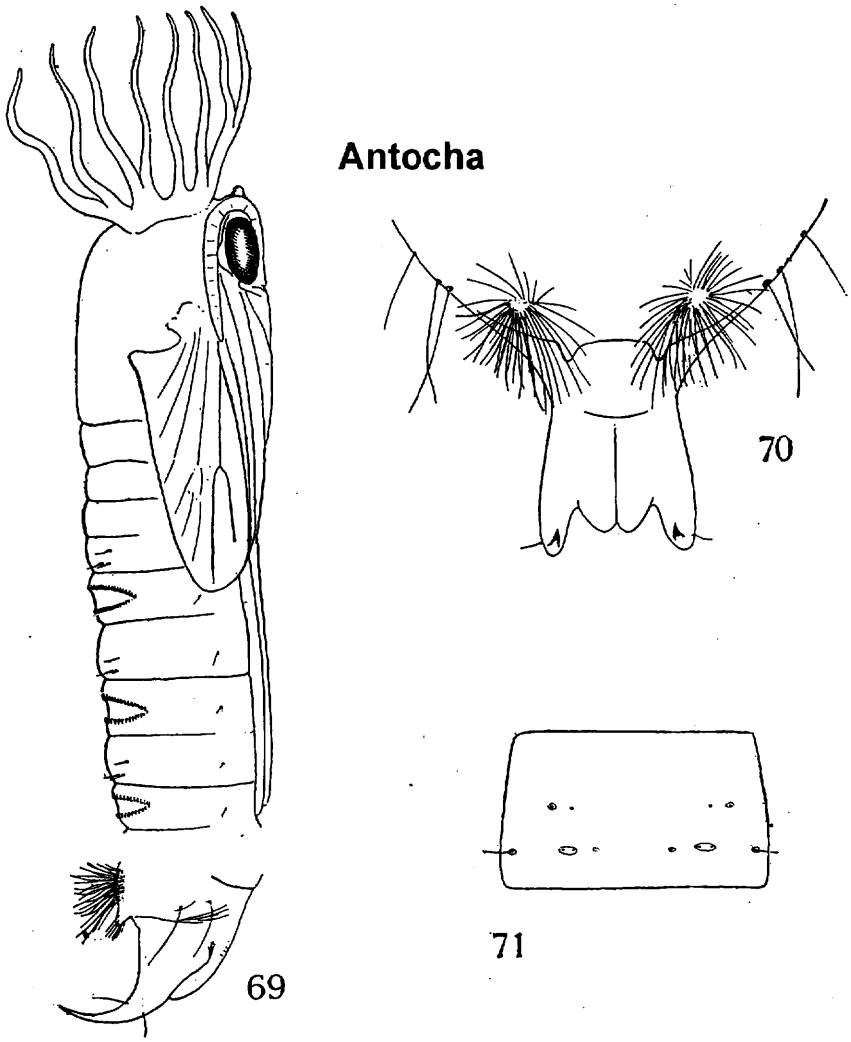
Larva: 57, dorsal aspect; 58, head capsule, dorsal aspect; 59, mentum
Pupa: 60, ventral aspect; 61, pronotal breathing horn, lateral aspect; 62, female cauda, lateral aspect



74 Antocha sp.

from Alexander + Byers, 1981 (Nearctic)

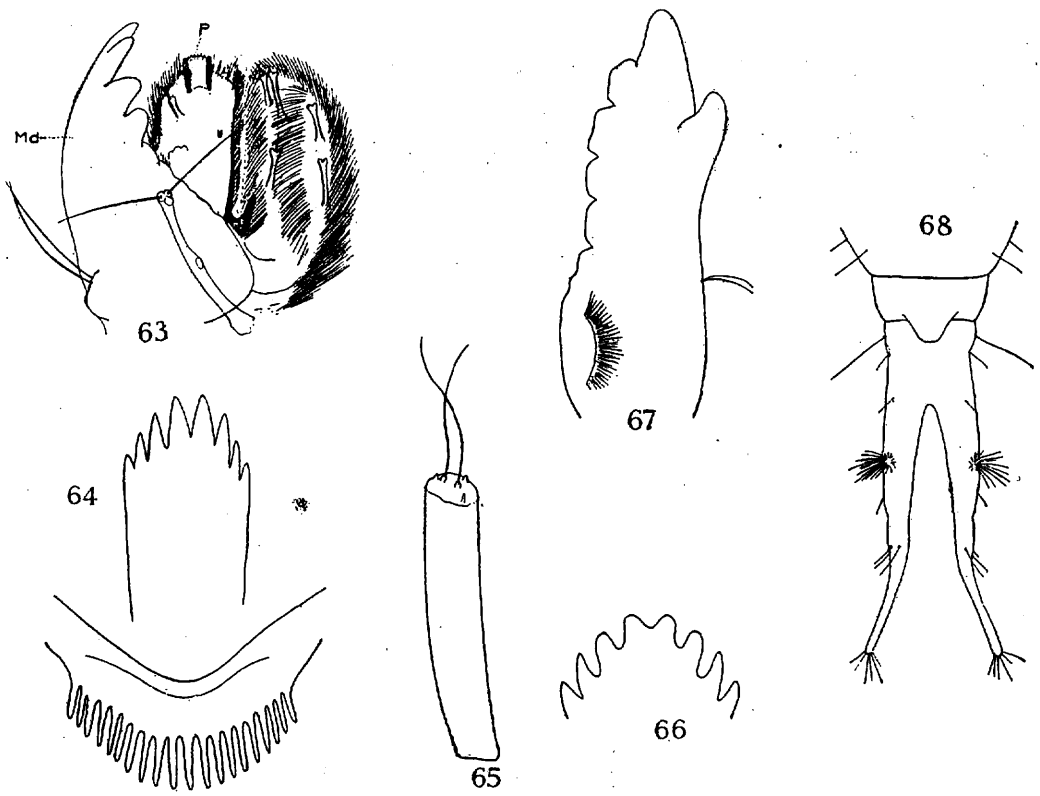
Antocha



ANTOCHA SAXICOLA, PUPA

69, Lateral aspect; 70, male cauda, dorsal aspect; 71, fifth abdominal segment, dorsal aspect (diagrammatic)

from Alexander, 1920 (Nearctic) sp.



ANTOCHA SAXICOLA, LARVA

63, Mandible and maxilla, ventral aspect; 64, hypopharynx; 65, antenna; 66, mentum, aberration; 67, mandible; 68, spiracular disk, dorsal aspect

Arctoconopa

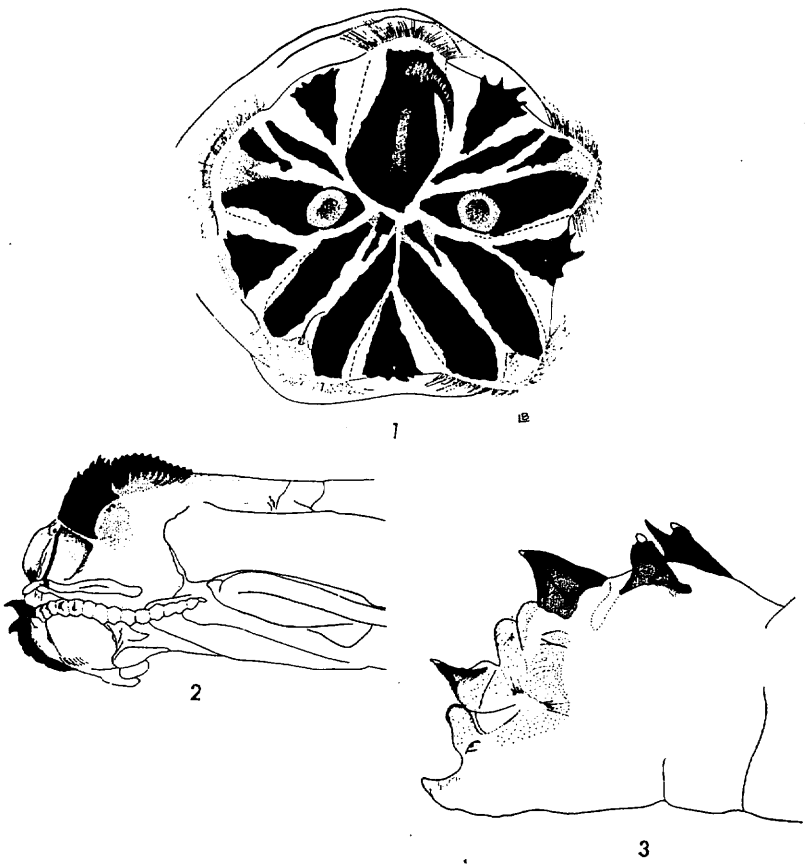


FIG. 1. Spiracular disk of *A. carbonipes* (three-quarter view). FIG. 2. Lateral view of pupal head region of *A. carbonipes*. FIG. 3. Lateral view of male cauda of *A. carbonipes*.

from Hynes, 1969
(Nearctic sp.)

Atarba

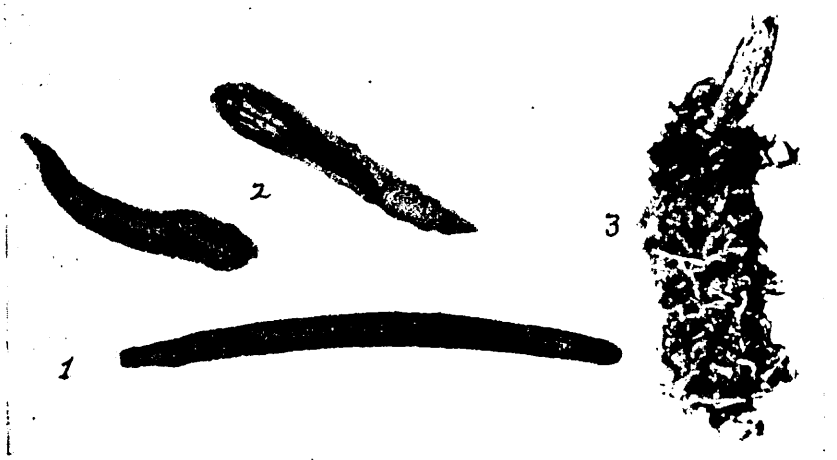


Fig. 1.—Larva, Pupae and Cocoon of *Atarba picticornis* O. S. (1) Larva, dorsal view; (2) Pupae, ventral and dorso-lateral views; (3) Cocoon with empty pupa skin projecting.

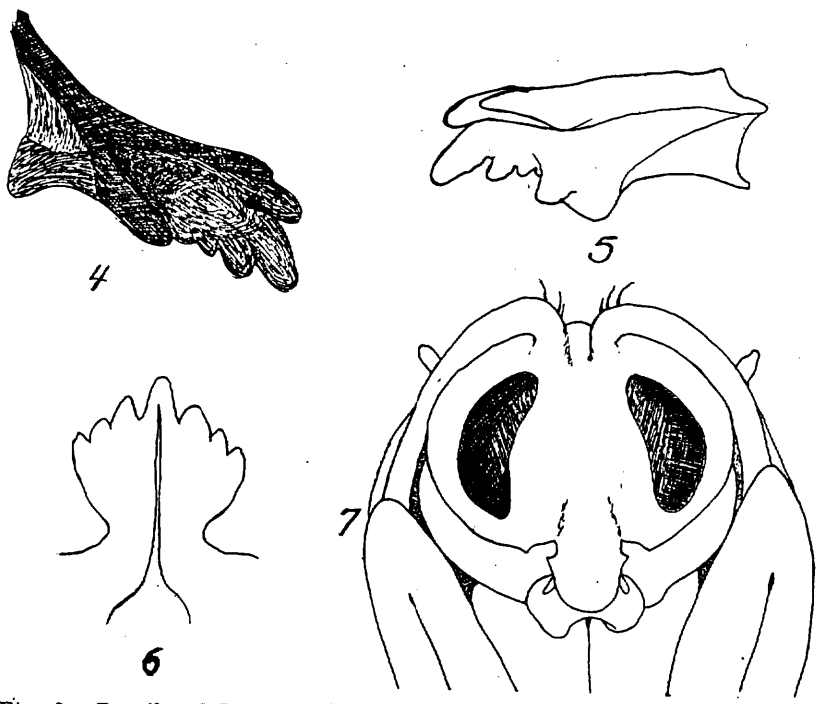


Fig. 2.—Details of Larva and Pupa. (4) Left mandible of larva, mesal view; (5) Right mandible of larva, dorsal view; (6) Mentum of larva; (7) Face of pupa.

From Rogers, 1927
Nearctic species

Austrolimnophila

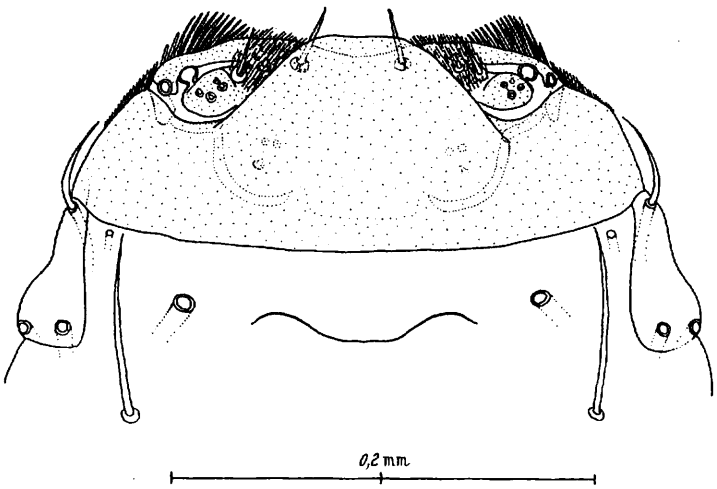


Abb. 62

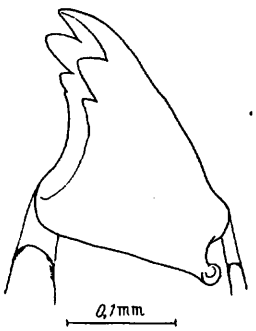


Abb. 63

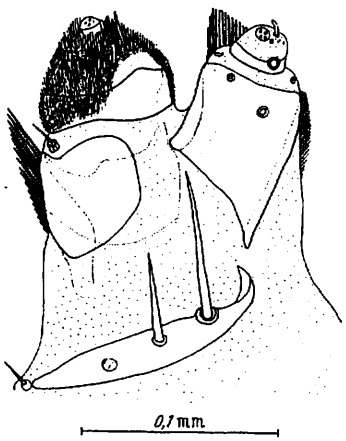


Abb. 64

Abb. 62—66. *Austrolimnophila ochracea*. IV. Stadium

Abb. 62. Vorderteil der Frons; Clypeus; Labrum

Abb. 63. Rechte Mandibel von dorsal

Abb. 64. Linke Maxille von ventral

Abb. 65. Hypopharynx von dorsal. Dorsalfläche vorn mit zahnartigen Dörnchen besetzt; auf der Ventralfläche dichtstehende kräftige Borsten sowie die Papillen der Labialpalpen (punktiert gezeichnet)

Abb. 66. Hypostomium, Hypostomalbrücke und Cardines der Maxillen, von ventral

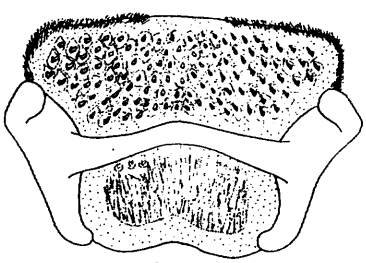


Abb. 65

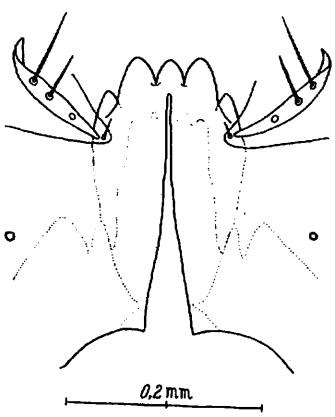


Abb. 66

from
Lindner, 1959
(Palearctic species)

Austrolimnophila

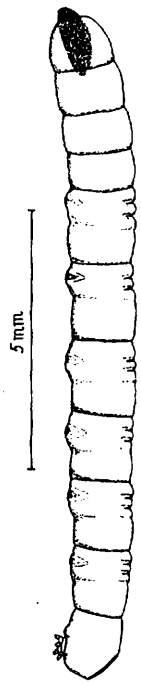


Abb. 58

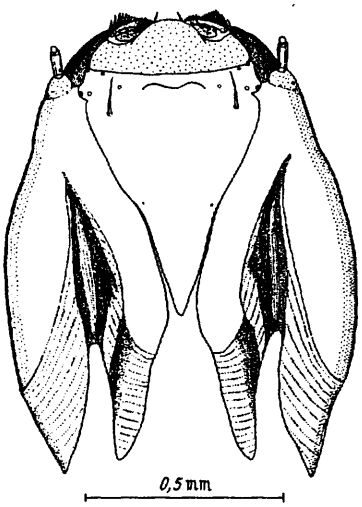


Abb. 60

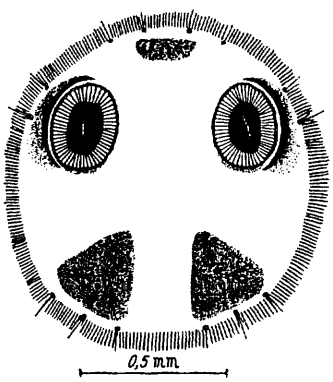


Abb. 59

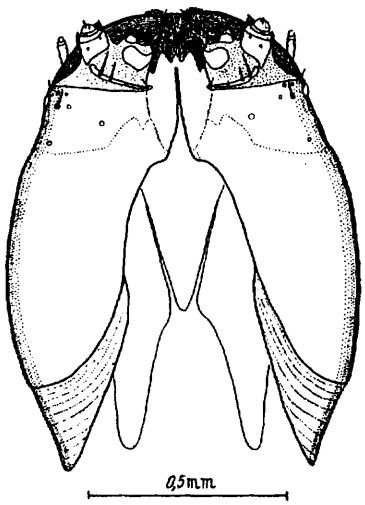


Abb. 61

Abb. 58—61. *Austrolimnophila ochracea*. IV. Stadium

Abb. 58. Larve von links

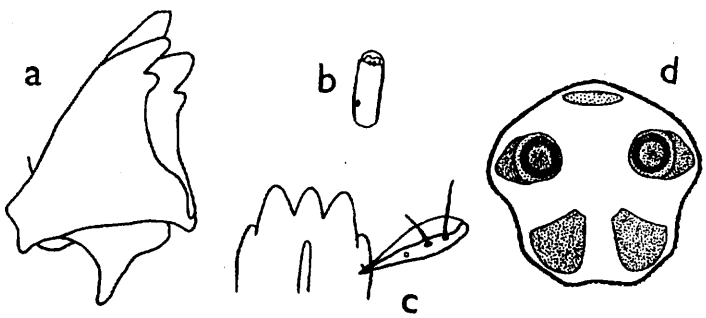
Abb. 59. Stigmenfeld

Abb. 60. Kopfkapsel von dorsal. Abgesehen vom Clypeolabrum und den Antennen sind die hell gelassenen Teile der Kopfkapsel vorwiegend schwarz gefärbt

Abb. 61. Kopfkapsel von ventral. Hell gelassene Teile unterhalb der punktierten Querlinie (vorn an den Kopfkapselseiten) schwarz, die Porenzone oberhalb dieser Querlinie und die Hypostomalbrücke samt dem Hypostomium sind rotbraun

from Lindner, 1959

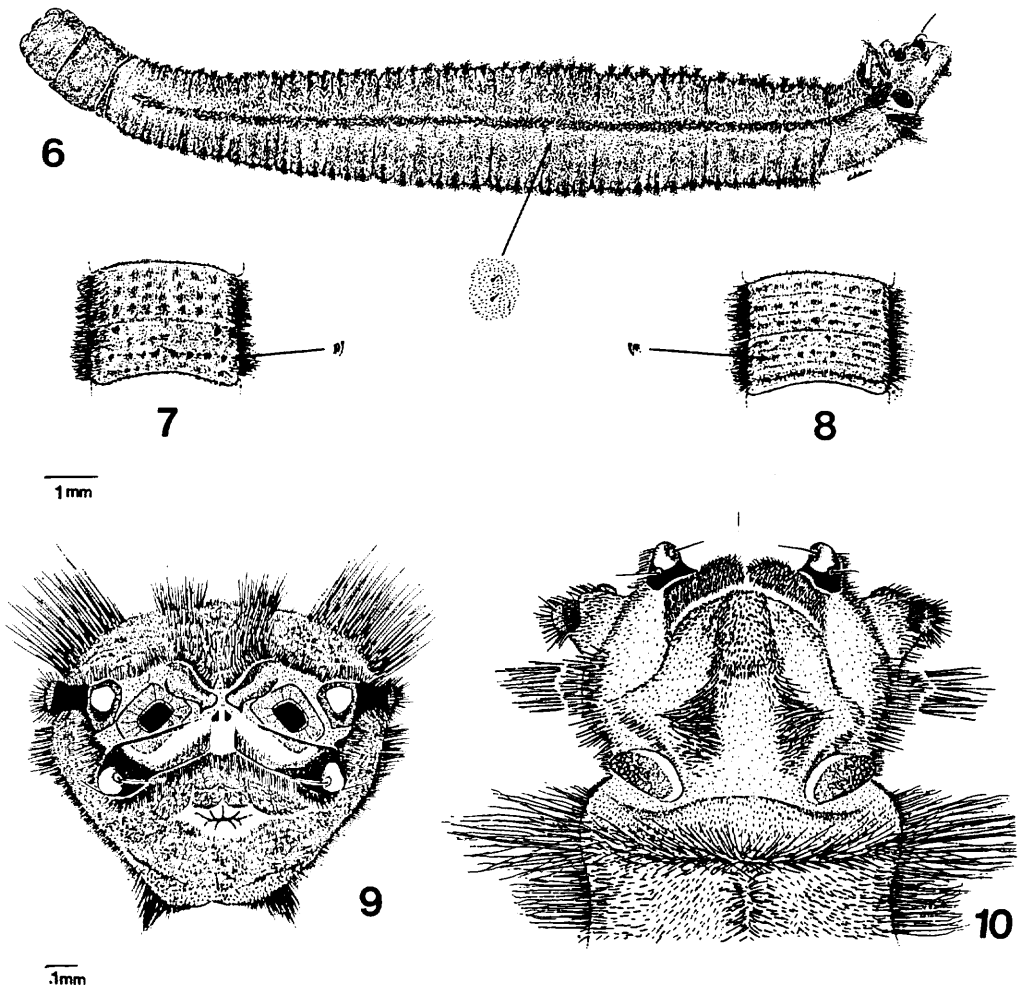
(Palearctic sp.)



from Brindle

AUSTROLIMNOPHILA OCHRACEA Mg.
Fig. 5: (a) mandible. (b) antenna. (c) hypostomium and subcardo of maxilla. (d) spiracular disc.

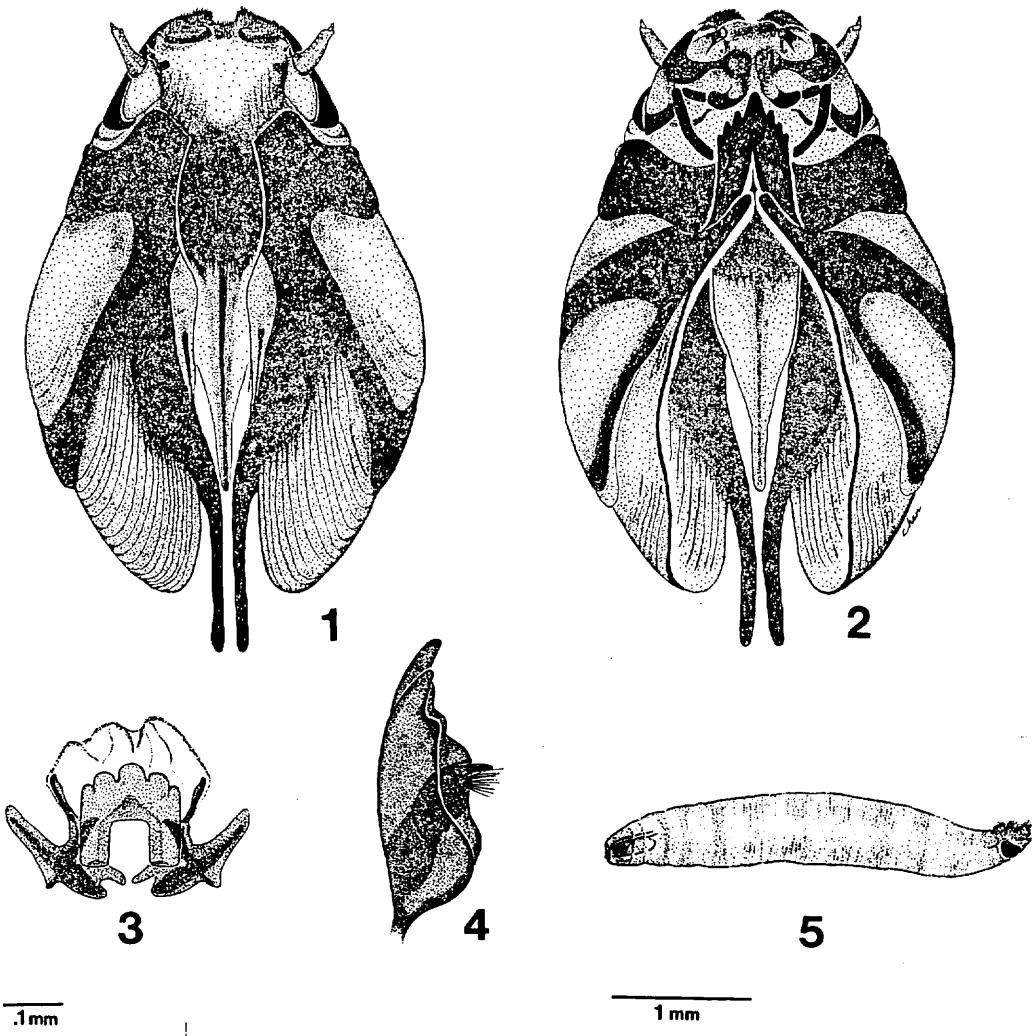
Brachypremna



Figs. 6–10. *Brachypremna dispellens* larva. 6, habitus, lateral, inset showing lateral macrosetae. 7–8, typical abdominal segment, dorsal and ventral, inset of macroseta. 9, spiracular area. 10, terminal abdominal segments, ventral aspect. Scale: 1 mm, Figs. 6–8; 0.1 mm, Figs. 9, 10.

From Gelhaus & Young, 1991

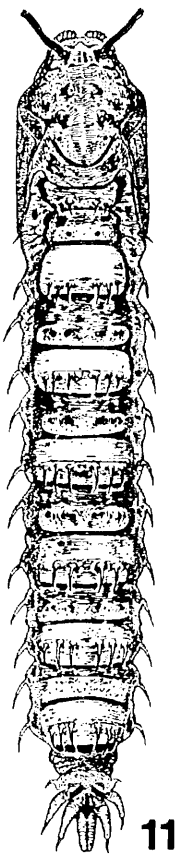
Brachypremna



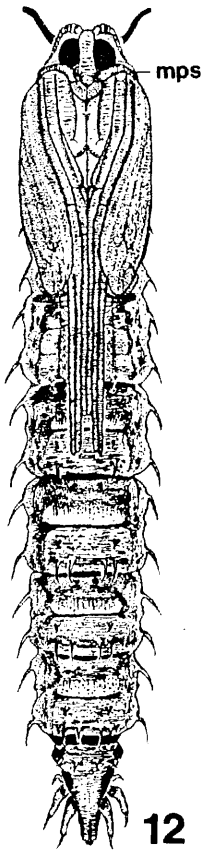
Figs. 1–5. *Brachypremna dispellens* larva. 1, head, dorsal. 2, head, ventral. 3, hypopharynx, ventral. 4, mandible, ventral. 5, first instar larva, lateral. Scale: 1 mm, Figs. 1, 2; 0.1 mm, Figs. 3–5.

From Gelhaus & Young, 1991

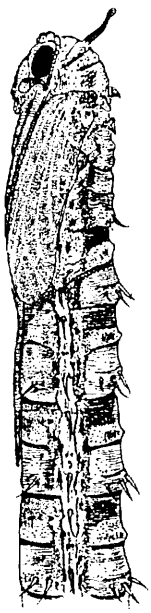
Brachypremna



11

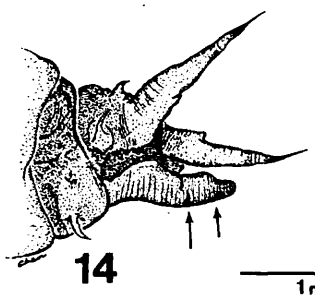


12

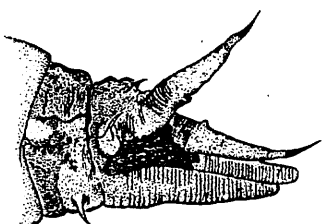


13

1mm



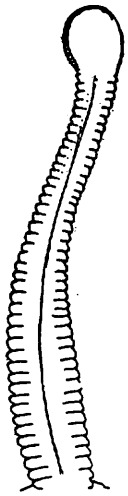
14



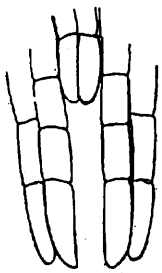
15

1 mm

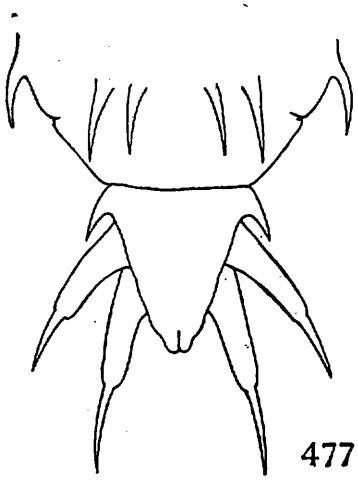
Figs. 11–15. *Brachypremna dispellens* pupa. 11–13, habitus, dorsal, ventral, lateral; mps—maxillary papal sheath. 14–15, terminal abdominal segments, lateral; 14, male; 15, female. Scale: upper, Figs. 11–13; lower, Figs. 14–15.



475

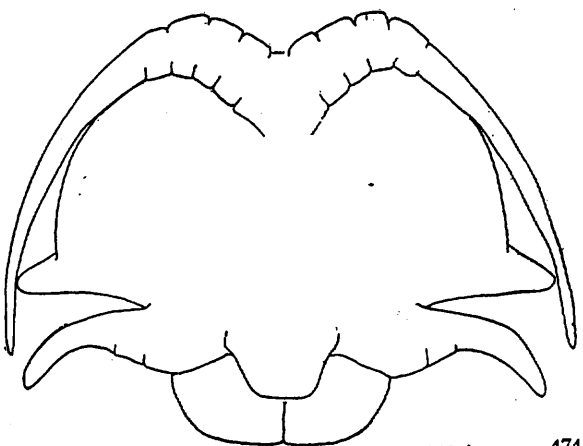


476



477

↑ Gelhaus + Young, 1991



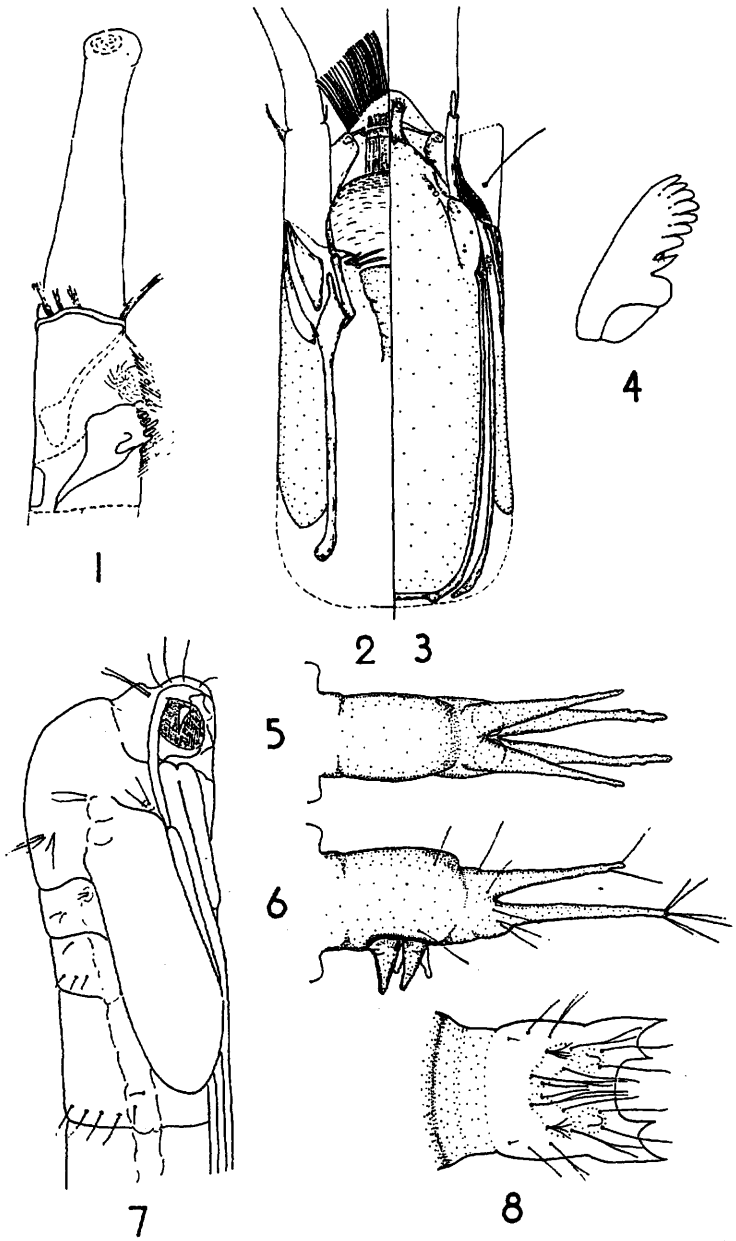
474

← Alexander 1920 ↗

BRACHYPREMNA DISPELLENS, *PUPA*

474, Head, ventral aspect; 475, pronotal breathing horn; 476, arrangement of leg sheaths; 477, male cauda, ventral aspect

Cryptolabis

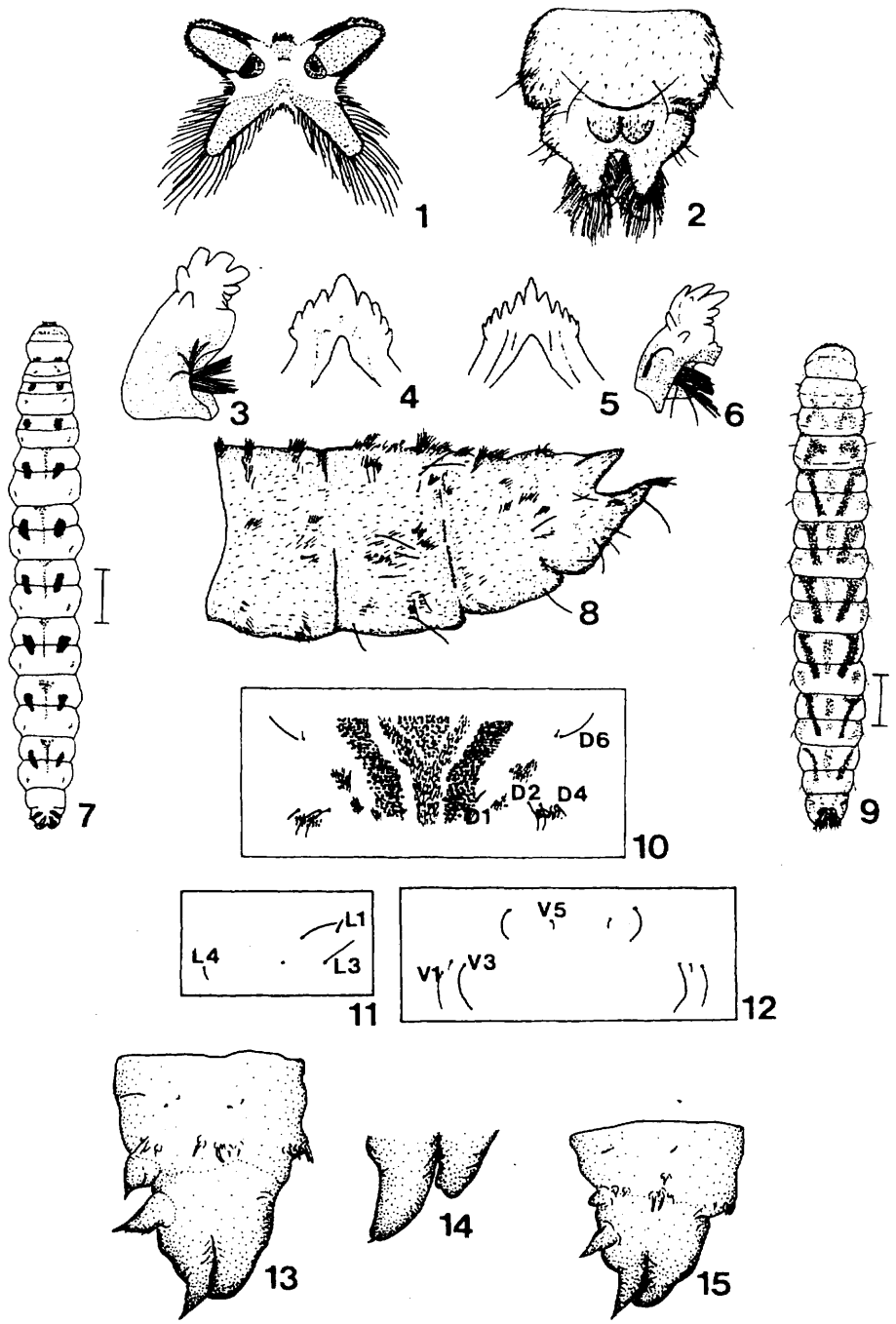


Cryptolabis magnistyla

view. Fig. 4, Larval mandible, lateral view. Fig. 5, Larval spiracular disk, dorsal view. Fig. 6, Larval spiracular disk and anal lobes, lateral view. Fig. 7, Pupa, lateral view. Fig. 8, Male pupal cauda, dorsal view.

from Hynes 1963
(Nearctic)

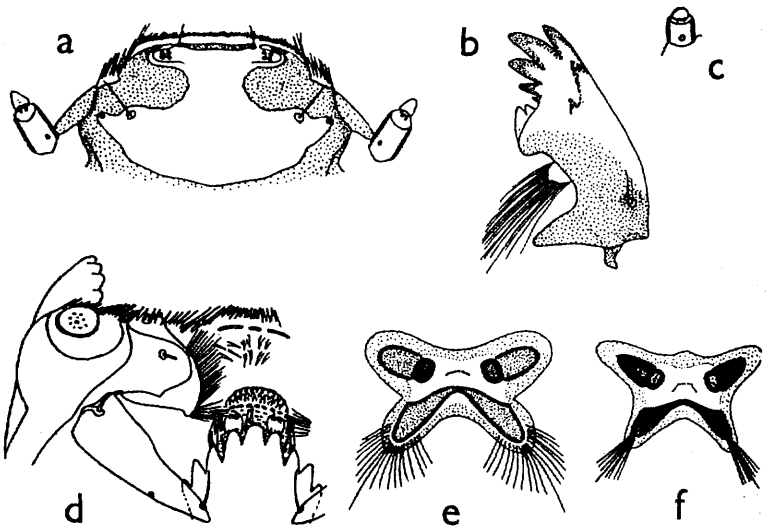
Dactylolabis



FIGS. 1–15. Structures of larvae and pupae of *Dactylolabis* spp. 1, 2, 5, 6, 8–14, *D. montana* (O.S.): 1, spiracular disc; 2, caudal segment (ventral); 5, hypostomal bridge; 6, mandible; 8, terminal segments (lateral); 9, larva [bar = 1 mm (dorsal)]; 10, dorsal abdominal macrosetae (second annulus); 11, lateral abdominal macrosetae; 12, ventral abdominal macrosetae (second annulus); 13, male caudal segment of pupa (lateral); 14, female caudal segment of pupa (lateral). 3, 4, 7, 15, *D. hudsonica* Alexander: 3, mandible; 4, hypostomal bridge; 7, larva [bar = 1 mm (dorsal)]; 15, male caudal segment of pupa (lateral).

from Sinclair, 1988 (Nearctic spp.)

Dactylolabis

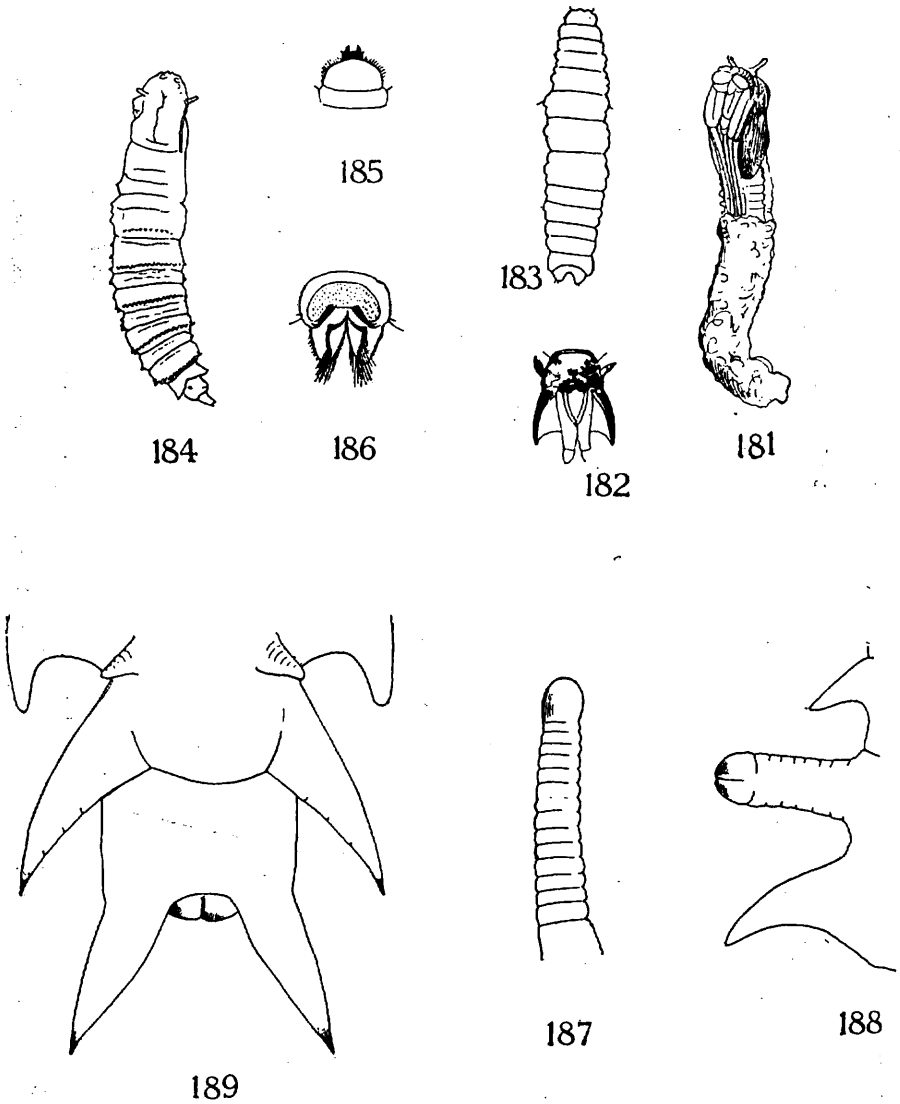


DACTYLOLABIS spp.

Fig. 1: (a) *D. transversa,* labrum and antennae. (b) *D. transversa,* mandible. (c) *D. sexmaculata,* antenna. (d) *D. sexmaculata,* anterior ventral view of part of head. (c) *D. sexmaculata,* spiracular disc. (f) *D. transversa,* spiracular *disc.*

Brindle + Bryce, 1960 (Palearctic)

Dactylolabis



DACTYLOLABIS DENTICULATA, D. WODZICKII, AND D. CUBITALIS

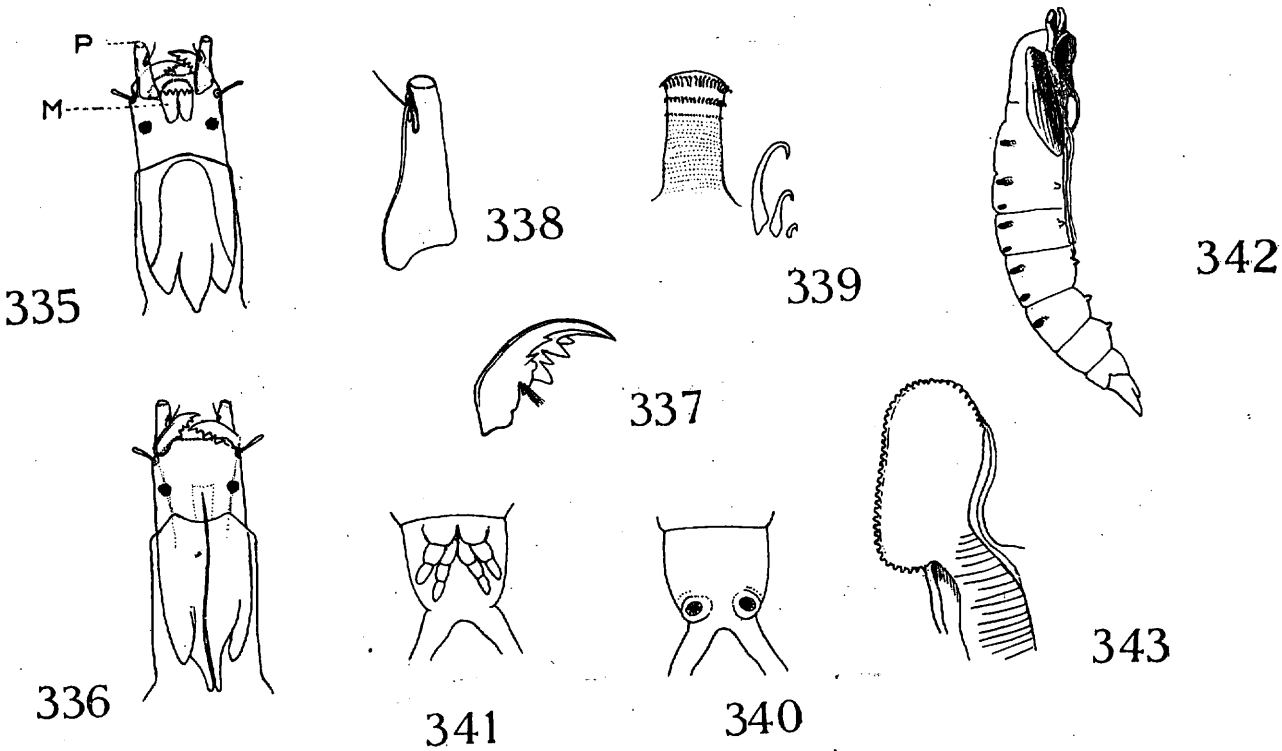
Dactylolabis denticulata (after Mik): 181, pupa; 182, larva, head capsule, ventral aspect; 183, larva, dorsal aspect — Palearctic

Dactylolabis wodzickii (after Nowicki): 184, pupa; 185, larva, head capsule; 186, larva, spiracular disk — Palearctic

Dactylolabis cubitalis, pupa: 187, pronotal breathing horn; 188, second abdominal segment, showing spiracle; 189, male cauda, dorsal aspect — Nearctic

from Alexander, 1920

Dicranota (Dicranota)

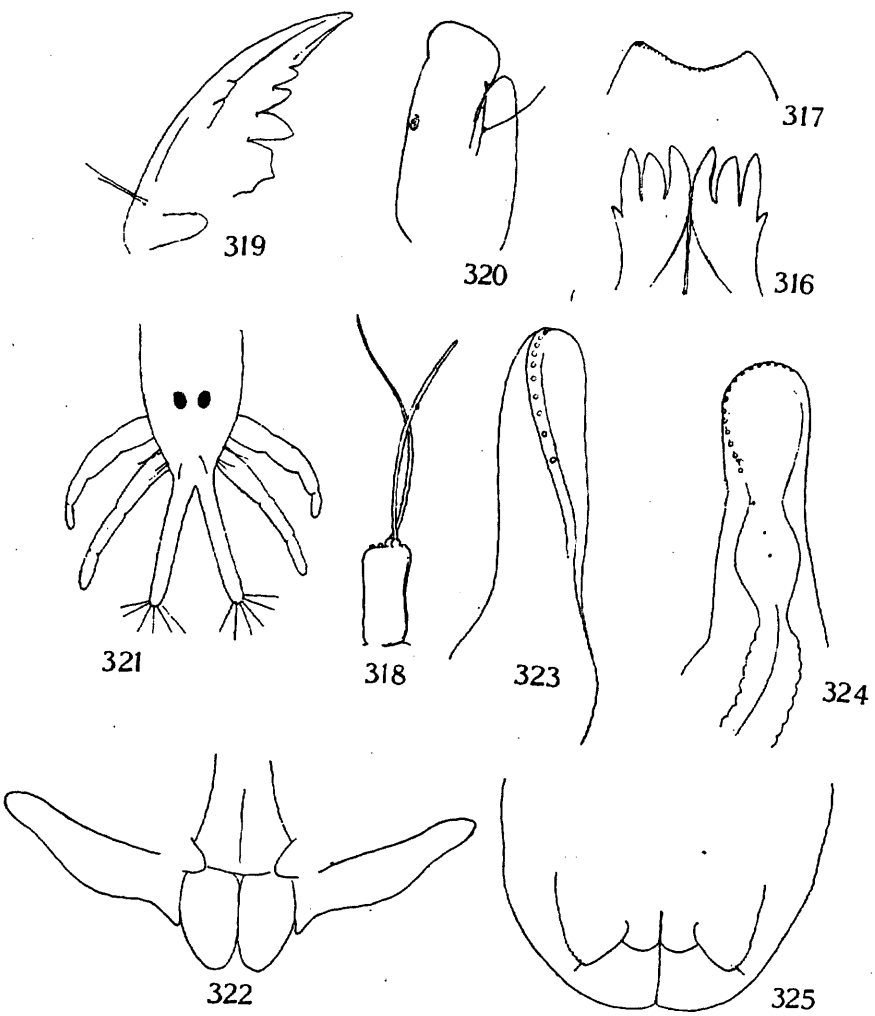


DICRANOTA BIMACULATA (AFTER MIALL)

Larva: 335, head capsule, ventral aspect; 336, head capsule, dorsal aspect; 337, mandible; 338, maxillary palpus; 339, abdominal pseudopods; 340, spiracular disk, dorsal aspect; 341, anal gills
Pupa: 342, female, lateral aspect; 343, pronotal breathing horn

from Alexander, 1920 (Palearctic sp.)

Dicranota (Rhaphidolabina)



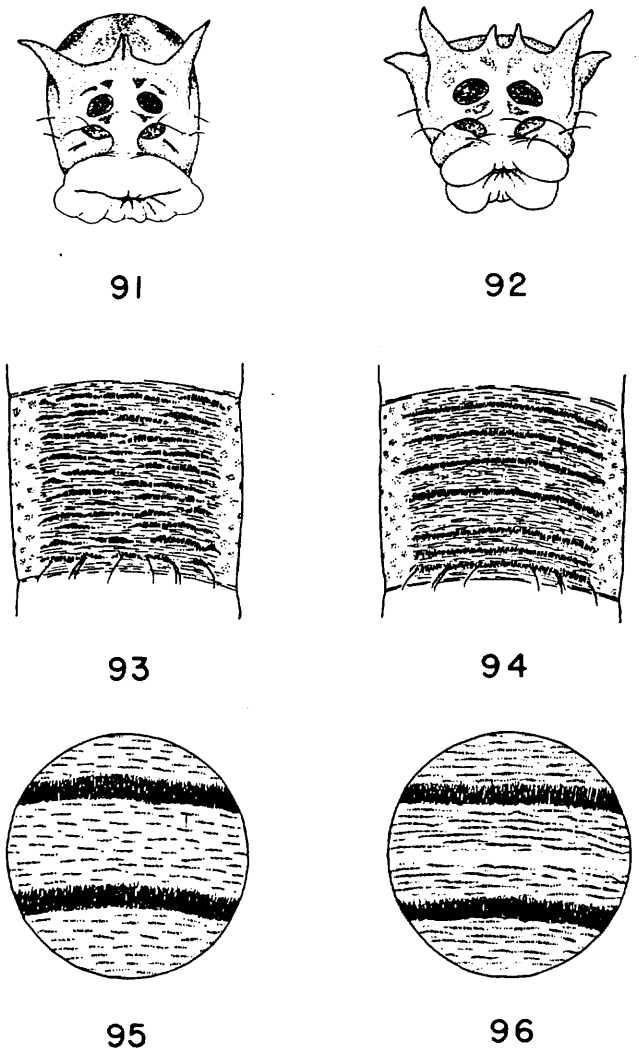
RHAPHIDOLABINA FLAVEOLA

Larva: 316, mentum; 317, hypopharynx; 318, antenna; 319, mandible; 320, maxilla; 321, spiracular disk

Pupa: 322, mouth parts; 323, pronotal breathing horn, dorsal aspect; 324, pronotal breathing horn, lateral aspect; 325, male cauda, dorsal aspect

from Alexander, 1920 (Nearctic sp.)

Dolichopeza



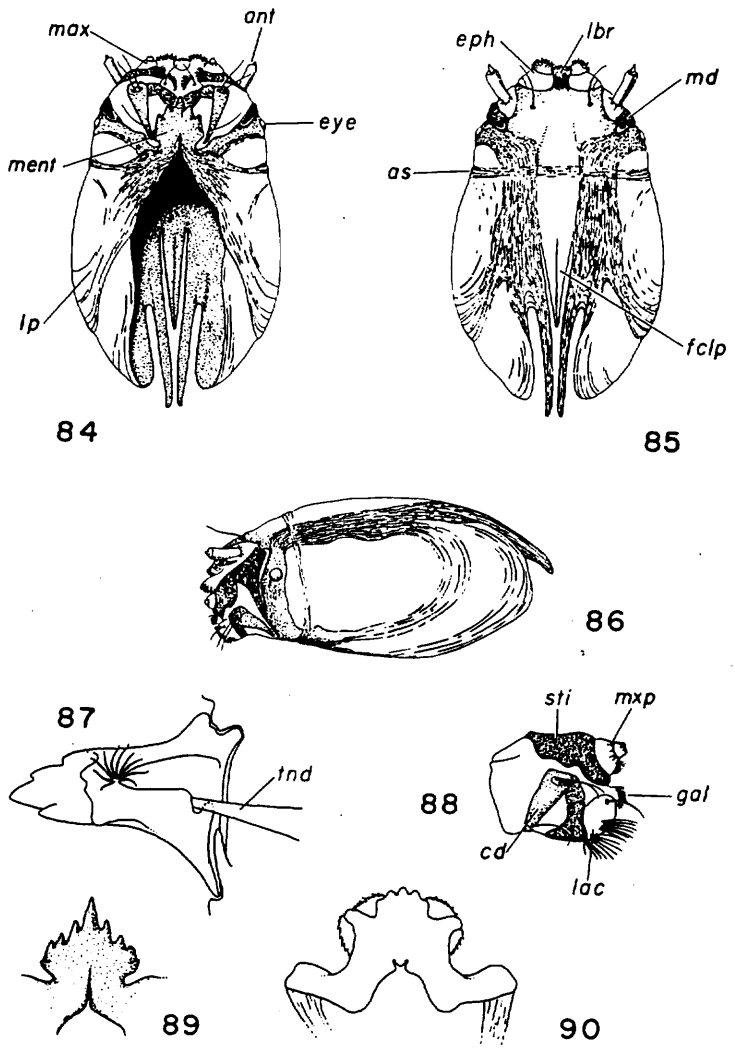
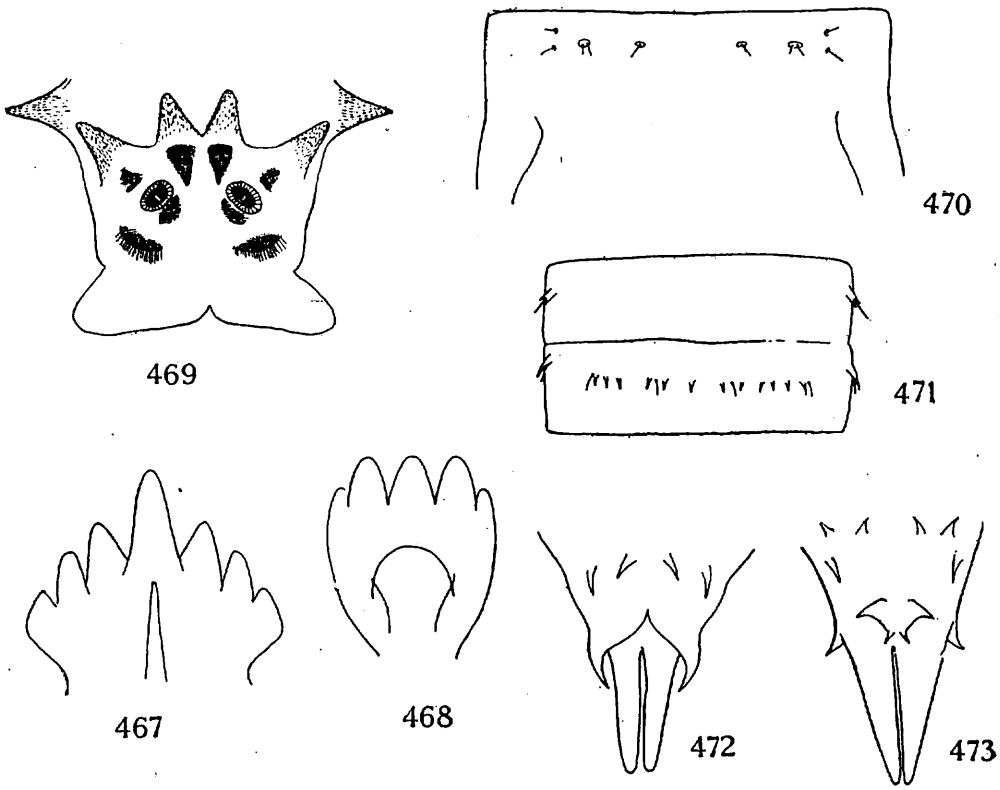


FIG. 91. Cauda of larva of *Dolichopeza (Dolichopeza) americana*. FIG. 92. Cauda of larva of *Dolichopeza (Oropeza) obscura*. FIG. 93. Typical abdominal segment of fourth instar larva of *Dolichopeza (Oropeza) subalbipes*, dorsal aspect. FIG. 94. Same as 93, *Dolichopeza (Oropeza) obscura*. FIG. 95. Detail of dorsum of fourth instar larva of *Dolichopeza (Oropeza) walleyi*. FIG. 96. Same as 95, *Dolichopeza (Oropeza) sayi*.

FIG. 84. Head capsule of fourth instar larva of *Dolichopeza (Oropeza) obscura*, ventral aspect; ant—antenna, lp—lateral plate, max—maxilla, ment—mentum. FIG. 85. Same as 84, dorsal aspect; as—line of attachment of skin, eph—epipharynx, fclp—fronto-clypeus, lbr—labrum, md—mandible. FIG. 86. Same as 84, left lateral aspect. FIG. 87. Right mandible of fourth instar larva of *Dolichopeza (Oropeza) similis*, mesial aspect; tnd—tendon of adductor muscles of mandible. FIG. 88. Right maxilla of fourth instar larva of *Dolichopeza (Oropeza) obscura*, ventrolateral aspect; cd—cardo, gal—galea, lac—lacinia, mxp—maxillary palp, sti—stipes. FIG. 89. Mentum of *Dolichopeza (Oropeza) similis*, ventral aspect. FIG. 90. Hypopharynx of *Dolichopeza (Oropeza) dorsalis*, ventral aspect.

From Byers, 1961
Nearctic sp.

Dolichopeza



OROPEZA OBSCURA

Larva: 467, mentum; 468, hypopharynx; 469, spiracular disk
Pupa: 470, metanotum (diagrammatic); 471, fifth abdominal tergite (diagrammatic); 472, female cauda, dorsal aspect; 473, female cauda, ventral aspect

From Alexander, 1920

FIG. 97. Fourth instar larva of *Dolichopeza (Dolichopeza) americana*, dorsal aspect.

97

From Byers, 1961

Dolichopeza
Key to North American larvae

TENTATIVE KEY TO FOURTH INSTAR LARVAE OF NORTH AMERICAN *DOLICHOPEZA*

1. Body coloration in life green with two series of irregular brown to black spots on dorsum (Fig. 97); median lobes above spiracular disc closely appressed; no conical projections from dorsolateral surfaces of eighth abdominal segment (Fig. 91) (subgenus *Dolichopeza*) ..... *americana*

   Body coloration in life greenish, brownish or some blending of these, lacking spots or other markings, except for transverse ridges of small hairs; median lobes above spiracular disc distinctly separated; a conical or subconical projection from each dorsolateral surface of eighth abdominal segment (Fig. 92) (subgenus *Oropeza*) 2

2. Minute microscopic hairs of pleura single, thickened and peg-like; those of dorsum sometimes in rows of various lengths but also often occurring singly; transverse ridges of larger microscopic hairs rarely indicated, never dense 3

   Minute microscopic hairs of pleura grouped in small, circular patches, the individual hairs not thickened and not seen as separate hairs except at high magnifications; those of dorsum arranged in transverse rows or very rarely single; transverse ridges of larger microscopic hairs evident on most body segments but may be weak on second through sixth abdominal segments 4

3. Minute microscopic hairs of pleura of eighth abdominal segment as numerous, dense or evenly distributed as those of seventh and other segments ..... *polita* sspp.

   Minute microscopic hairs of pleura of eighth abdominal segment sparse or irregularly distributed, leaving bare areas ..... *tridenticulata*

4. Larger microscopic hairs of dorsum arranged in dense transverse ridges that are variously interrupted, deflected or staggered (Fig. 93), so that it is difficult to count the number of ridges on a typical abdominal segment 5

   Larger microscopic hairs of dorsum arranged in subparallel transverse ridges, usually numbering six or seven per segment (Fig. 94); ridges may be weak on abdominal segments two through six 6

5. Minute microscopic hairs in short rows of varying lengths, the rows distinct, clearly separated ..... *venosa*

   Minute microscopic hairs in long, indefinite rows with poorly defined terminations, or not clearly arranged in rows (Fig. 93) .... *subalbipes*

6. Minute microscopic hairs in short, distinct rows with clearly defined terminations, the rows clearly separated (Fig. 95) 7

   Minute microscopic hairs in long, indefinite rows with poorly defined terminations, or not clearly arranged in rows (Fig. 96) 8

7. Dorsolateral lobes of eighth abdominal segment nearly conical, of about same shape as lateral lobes above spiracular disc and approximately two-thirds as long as the latter ..... *walleyi*

   Dorsolateral lobes of eighth abdominal segment short and blunt, only half or less than half as long as lateral lobes above spiracular disc ..... *similis*

8. Transverse ridges of larger microscopic hairs about equally well marked on all abdominal segments ..... *obscura*

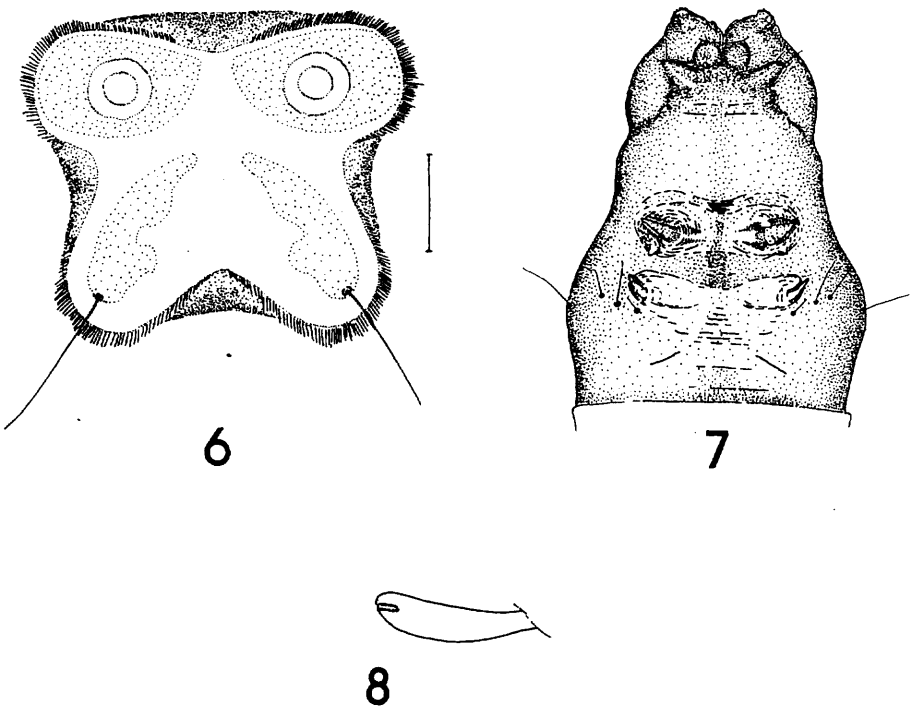
   Transverse ridges of larger microscopic hairs more weakly developed on second through fifth (or sixth) abdominal segments than on thoracic, first and seventh abdominal segments 9

9. Minute microscopic hairs clearly in rows, the rows crowded together near transverse ridges of larger microscopic hairs, leaving a narrow zone without hairs (Fig. 96) ..... *sayi*

   Minute microscopic hairs usually in poorly defined rows, the rows about evenly distributed between transverse ridges of larger microscopic hairs; hairs long and dense on eighth abdominal segment ..... *dorsalis*

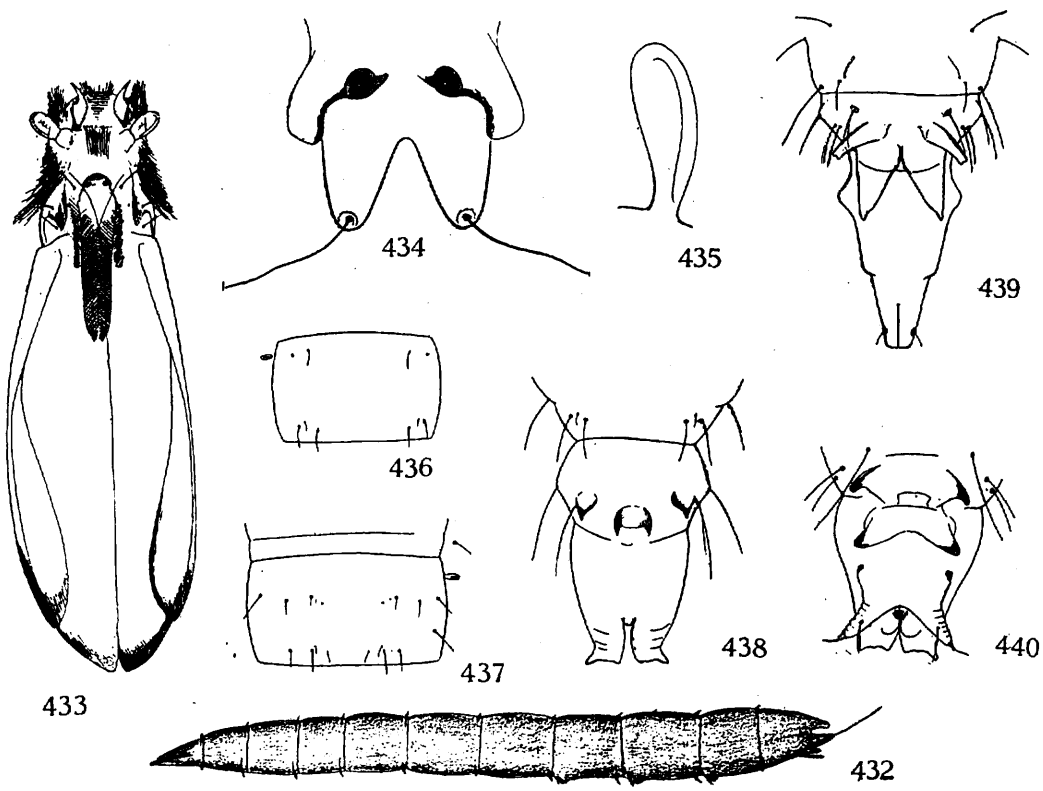
From Byers, 1961

Elephantomyia



Figures 6–8. *Elephantomyia* (*Elephantomyia*) *garrigouana* Alexander; scale indicator (when present) 0.1 mm. Figure 6. Spiracular disk. Figure 7. Male pupa, posterior end, dorsal view. Figure 8. Mesothoracic breathing horn.

from Hynes (1996) (Austropacific sp.)



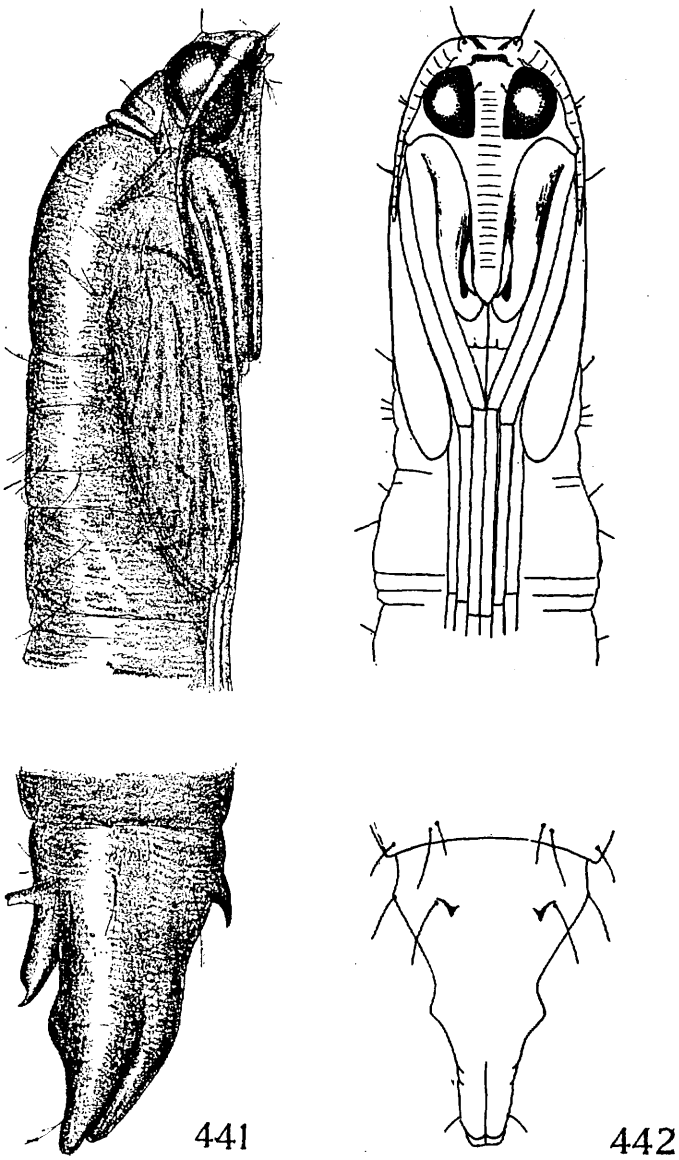
from Alexander (1920) (Nearctic sp.)

ELEPHANTOMYIA WESTWOODI

Larva: 432, lateral aspect; 433, head capsule, ventral aspect; 434, spiracular disk, dorsal aspect

Pupa: 435, pronotal breathing horn; 436, fifth abdominal segment, ventral aspect (diagrammatic); 437, fifth abdominal segment, dorsal aspect; 438, male cauda, ventral aspect; 439, female cauda, dorsal aspect; 440, male cauda, dorsal aspect

Elephantomyia

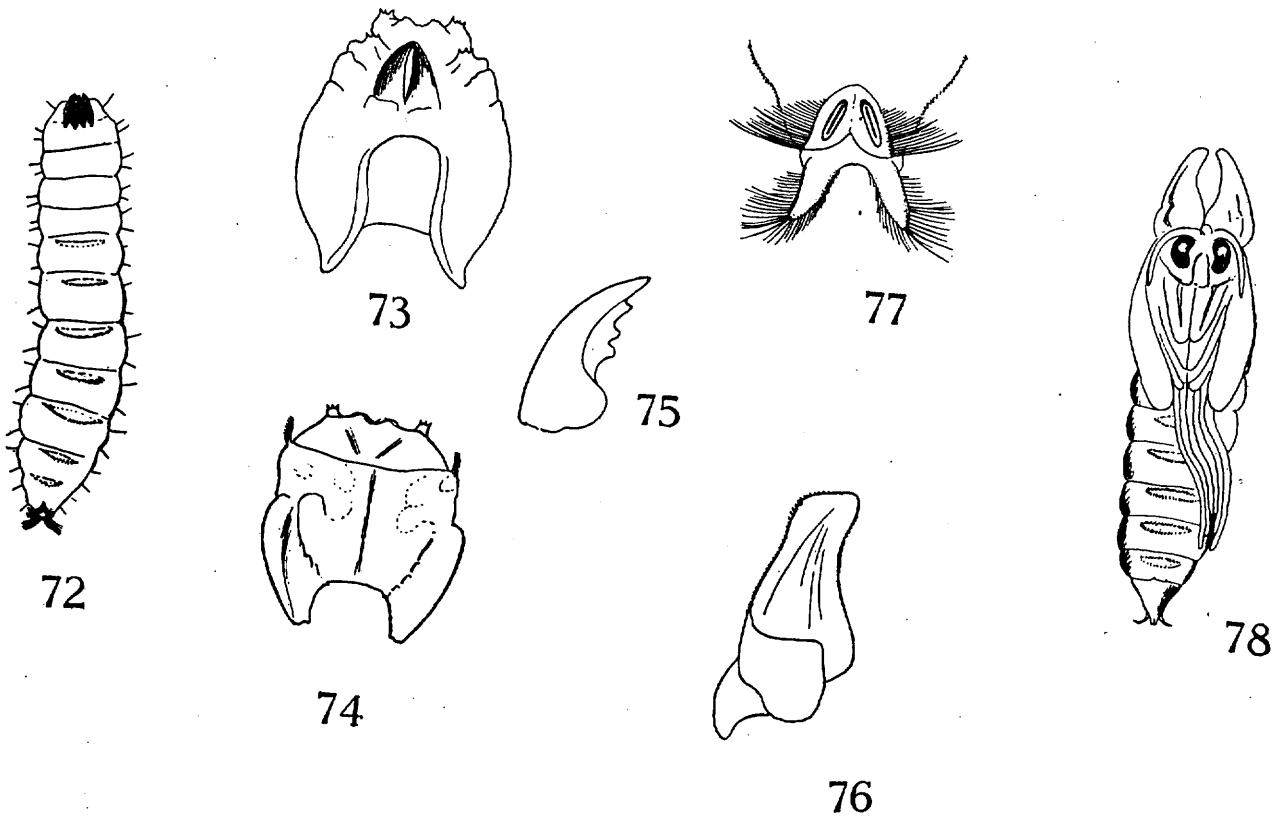


ELEPHANTOMYIA WESTWOODI, PUPA

441, Female, lateral aspect; 442, female, ventral aspect

Alexander (1920) Nearctic

Elliptera



ELLIPTERA OMISSA (AFTER MILK)

Larva: 72, dorsal aspect; 73, head capsule, ventral aspect; 74, head capsule, dorsal aspect; 75, mandible; 77, spiracular disk
Pupa: 76, pronotal breathing horn; 78, ventral aspect

Alexander, 1920 (Palearctic)

Ellipteroides (Progonomyia)

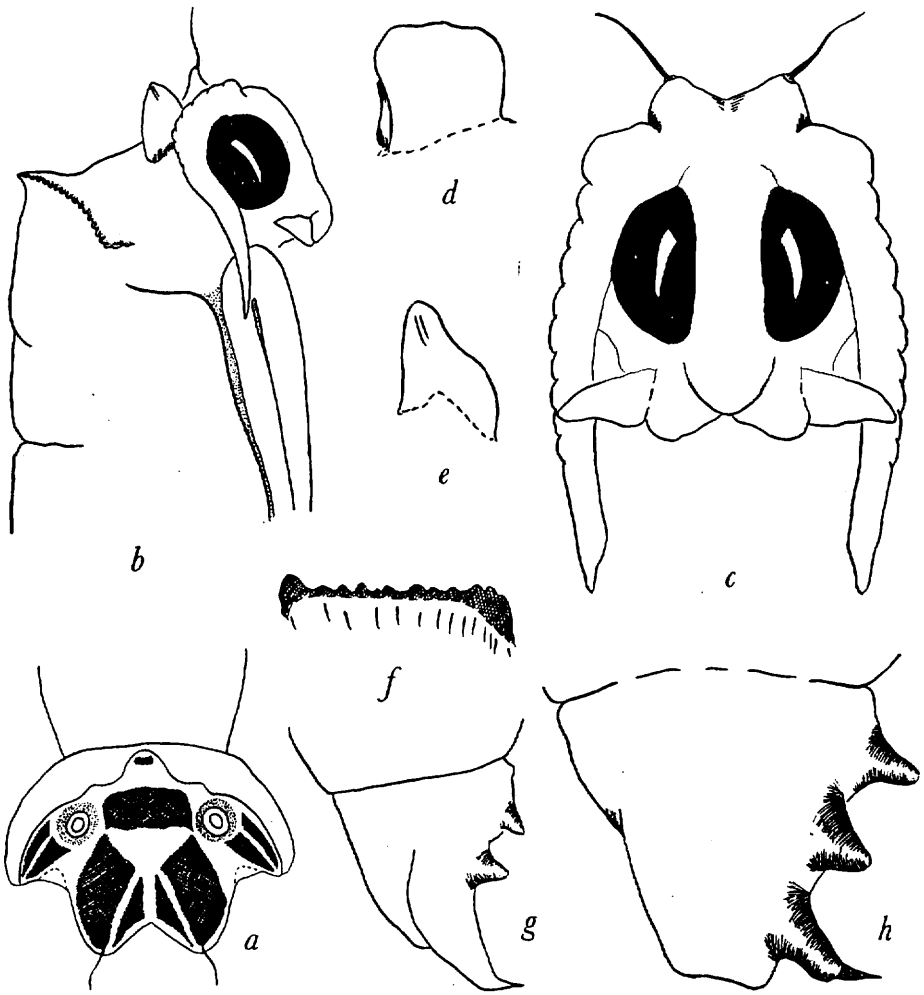
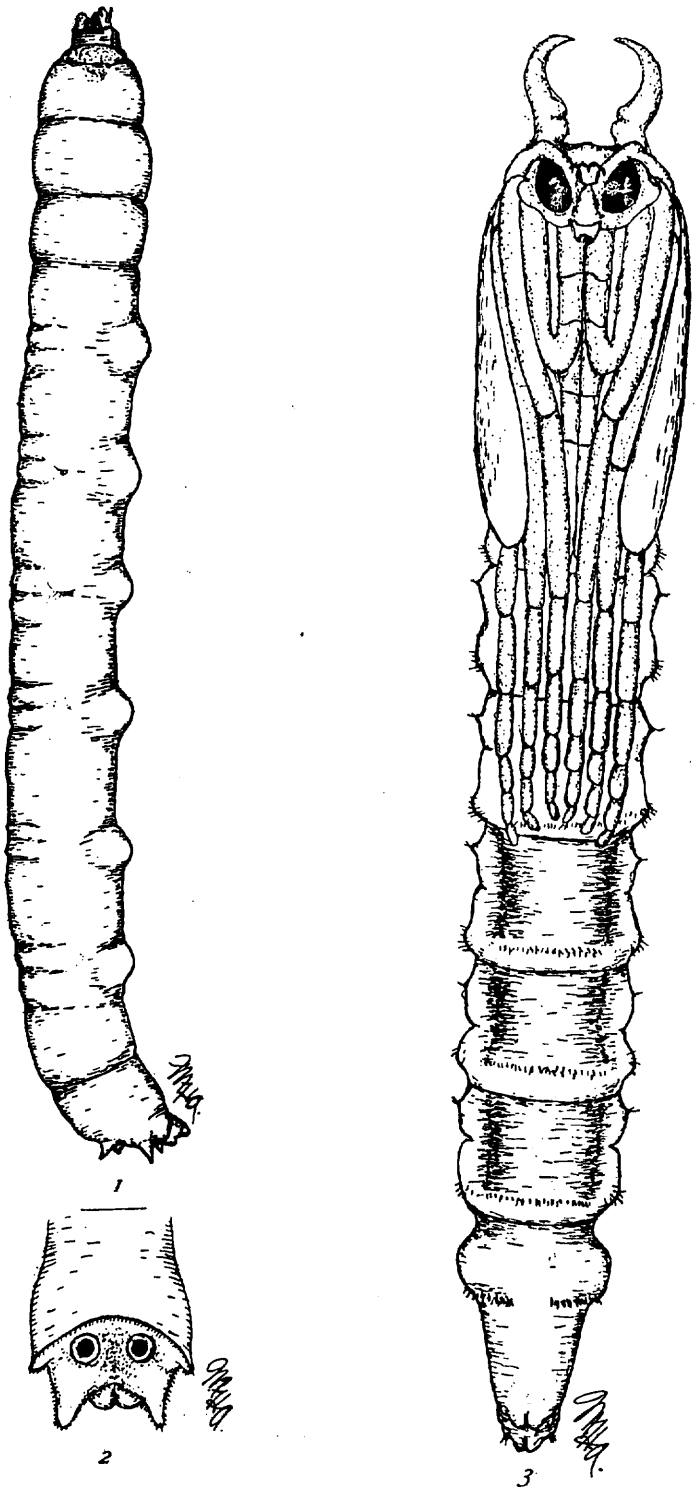


FIG. 90.—Pupa of *Gonomyia nigrobimbo* Alex. Larva: *a*, spiracular disc. Pupa: *b*, head and thorax (lateral view); *c*, head (ventral view); *d*, *e*, pronotal breathing horn (dorsal and lateral views); *f*, ridge of thorax; *g*, female cauda (lateral view); *h*, male cauda (lateral view).

From Wood (1952)
South African species

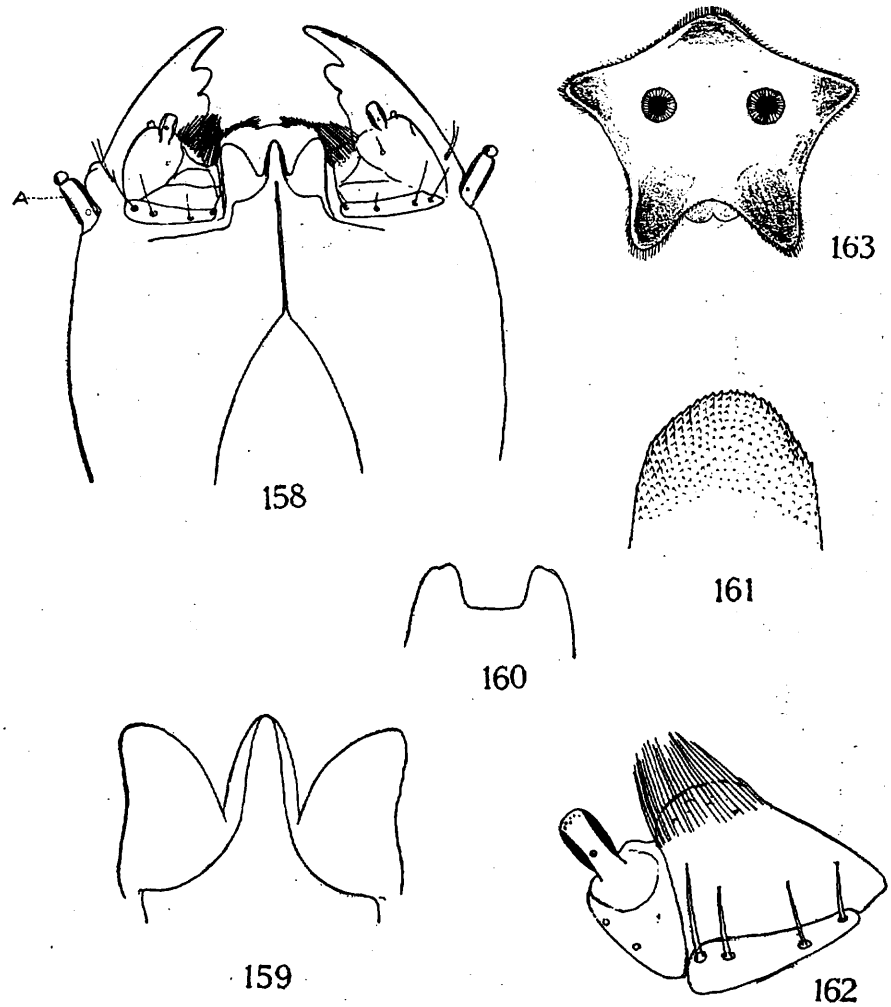
Epiphragma



Larva and pupa of crane fly (Epiphragma fascipennis)

from Needham (1908) Nearctic sp.

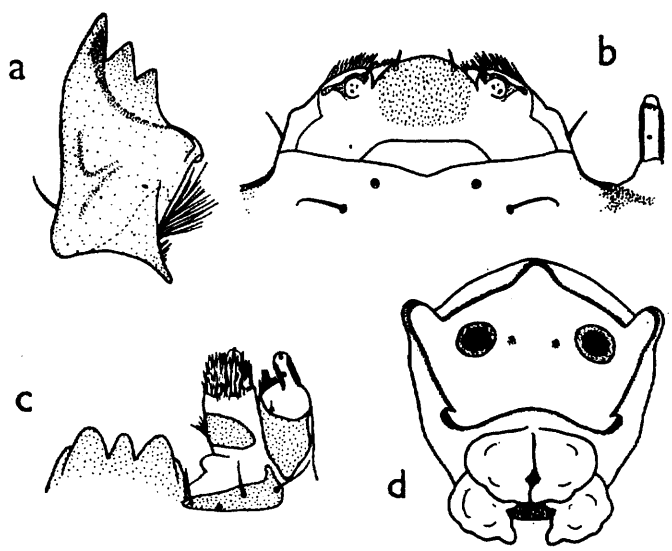
Epiphragma



from Alexander (1920) (Nearctic sp.)

EPIPHRAGMA SOLATRIX, LARVA

158, Head capsule, ventral aspect; 159, mentum; 160, prementum; 161, hypopharynx; 162, maxilla; 163, spiracular disk



from Brindle + Bryce (1960)

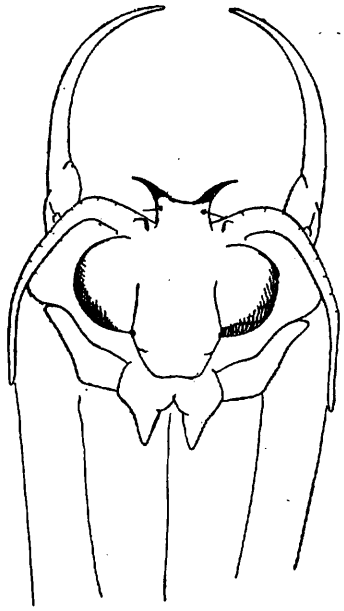
Palearctic - introduced in Nearctic (Pacific Northwest)

EPIPHRAGMA OCELLARIS L.

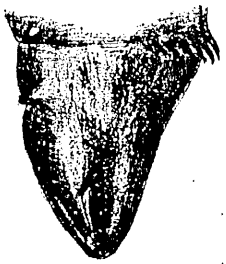
Fig. 2: (a) mandible. (b) labrum and antenna. (c) hypostomium and maxilla (d) spiracular disc.

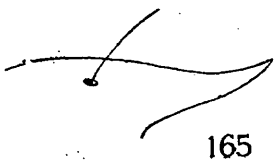
Epiphragma

164

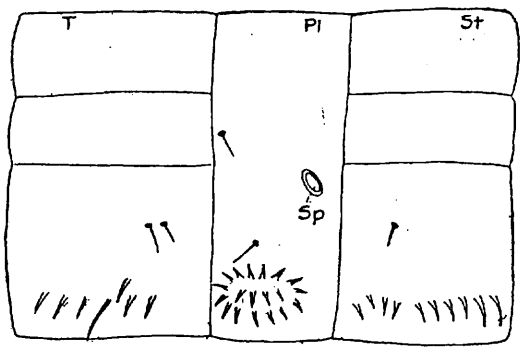


166





165

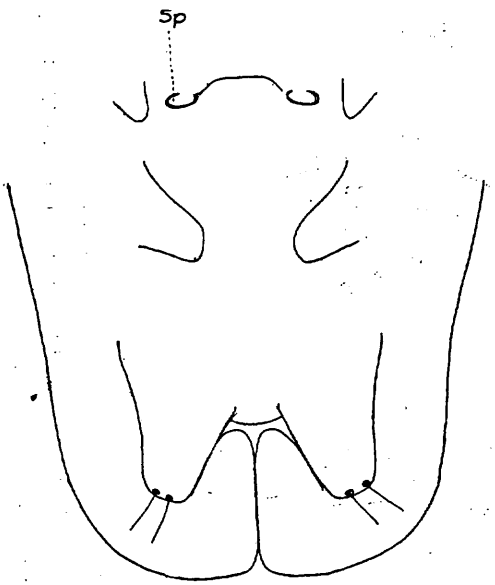


167

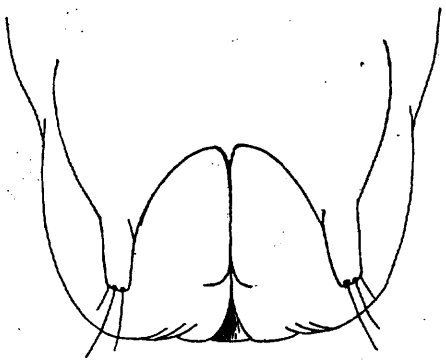
EPIPHRAGMA SOLATRIX AND E. FASCIPENNIS

Epiphragma solatrix, pupa: 164, lateral aspect; 166, head of male, ventral aspect; 167, fifth abdominal segment (diagrammatic)
Epiphragma fascipennis, pupa: 165, cephalic crest, lateral aspect

from Alexander (1920) - Nearctic

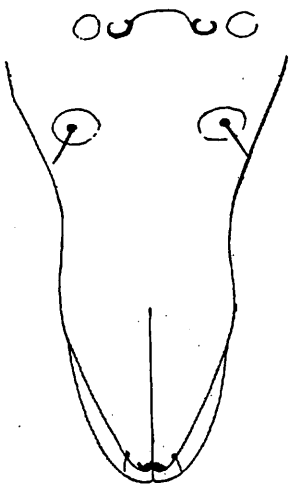


169



170

168

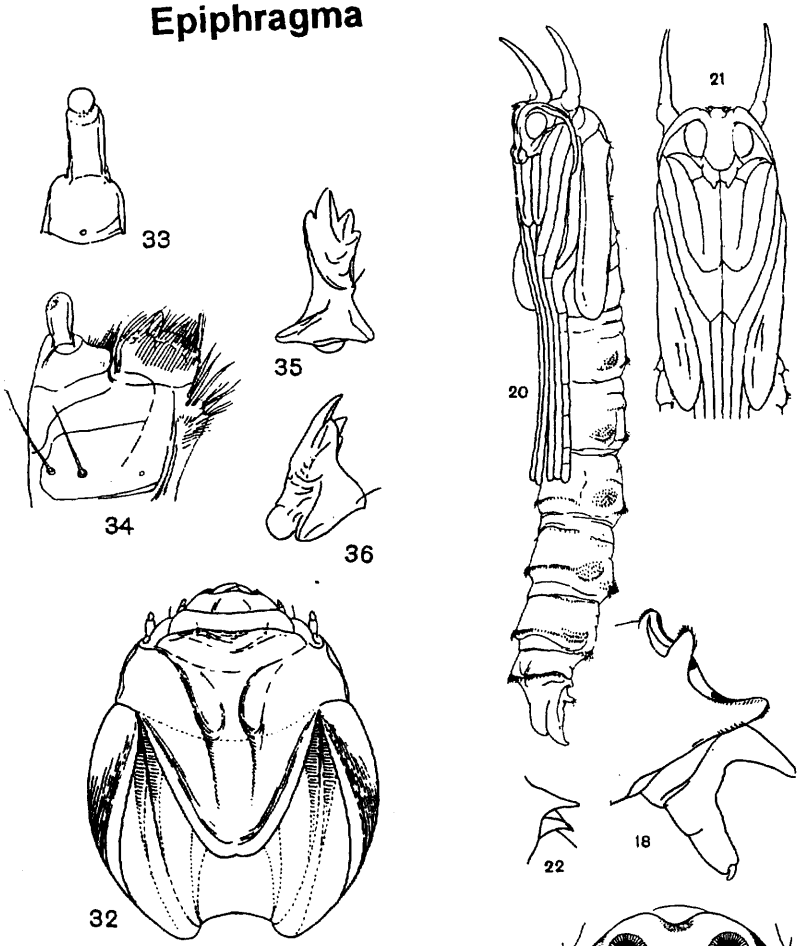


171

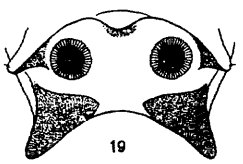
EPIPHRAGMA FASCIPENNIS AND E. SOLATRIX

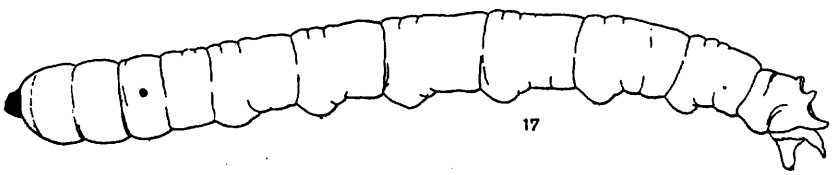
Epiphragma fascipennis: 168, larva, labrum; 169, pupa, male cauda, dorsal aspect
Epiphragma solatrix: 170, male cauda, dorsal aspect; 171, female cauda, dorsal aspect

Epiphragma



Epiphragma imitans Alex. Larva : 32, cápsula cefálica ; 33, antena ; 34, maxila ; 35-36, mandíbula.

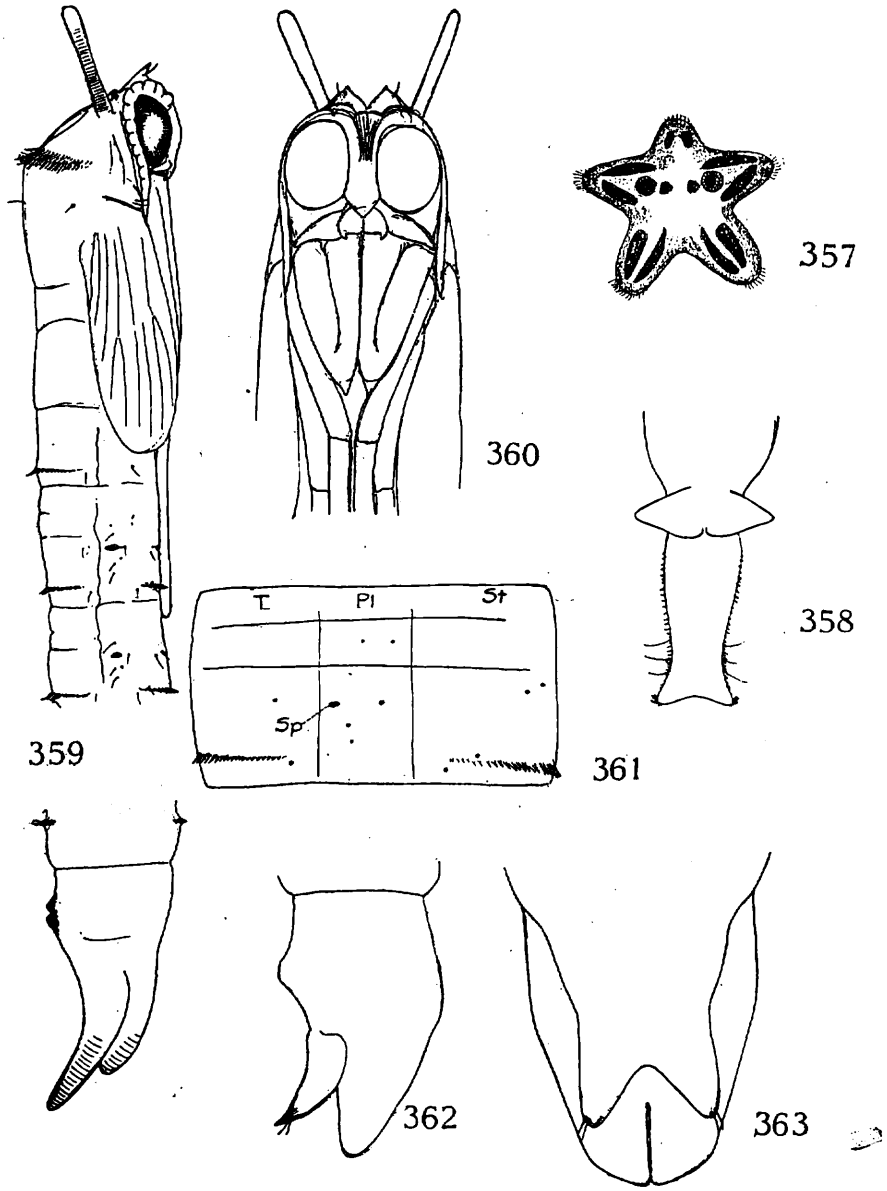




Epiphragma imitans Alex. : 17, larva, vista lateral ; 18, larva, cauda ; 19, disco espiracular ; 20, ninfa lateral ; 21, ninfa, antecuerpo ventral ; 22, cresta cefálica.

from Bruch (1939) (Neotropical sp.)

Erioptera (Erioptera)



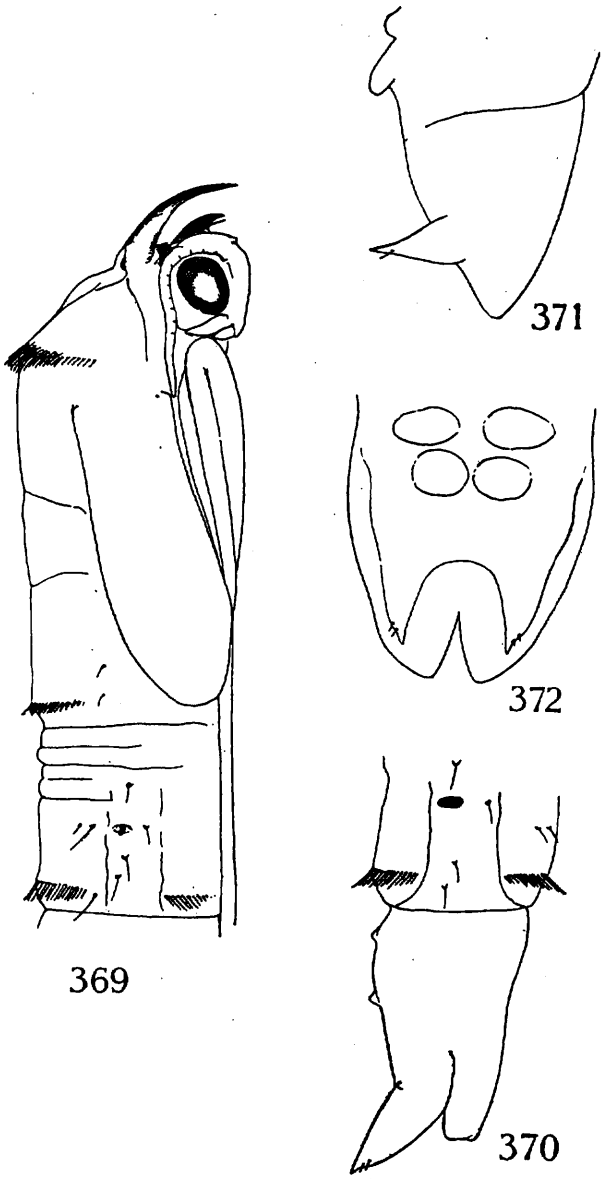
ERIOPTERA MEGOPHTHALMA

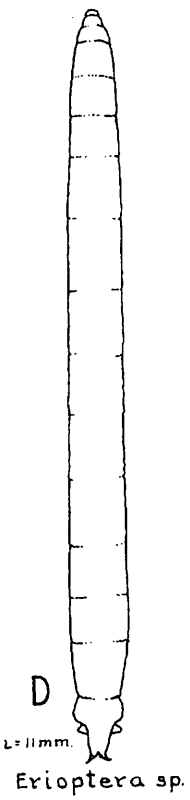
Larva: 357, spiracular disk; 358, anal gills, ventral aspect
Pupa: 359, female, lateral aspect; 360, female, ventral aspect; 361, fifth abdominal segment, lateral aspect (diagrammatic); 362, male cauda, lateral aspect; 363, male cauda, dorsal aspect

from Alexander (1920) - Nearctic sp.

Erioptera (Erioptera)

TIPULIDAE



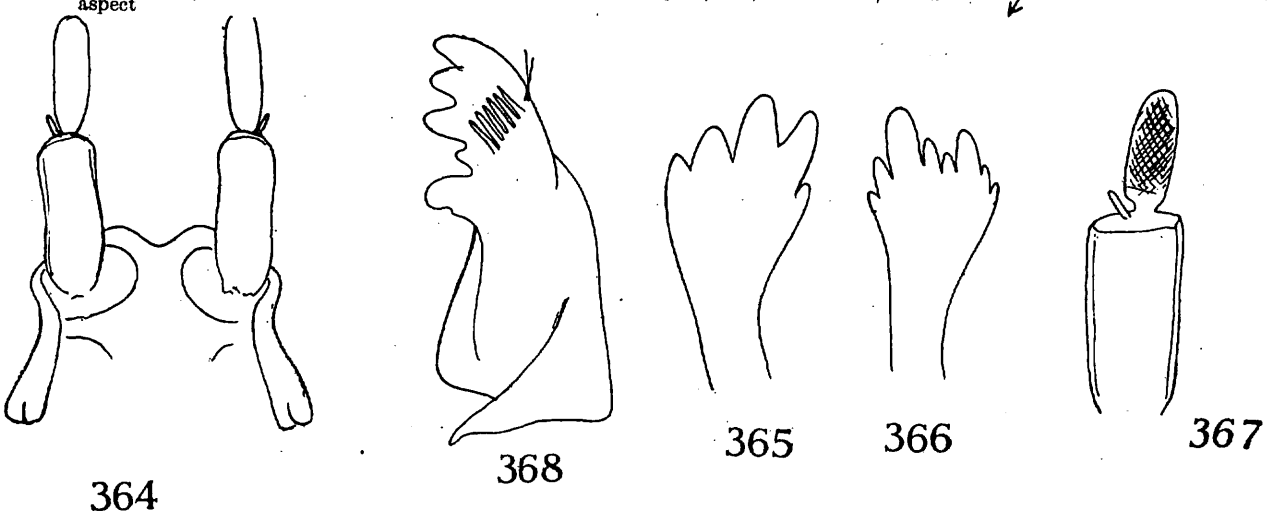


from Peterson (1960)
(Nearctic)
Erioptera (E.)
chlorophylla group

ERIOPTERA CHLOROPHYLLA, E. SEPTEMTRIONIS,

Erioptera chlorophylla, pupa: 369, female, lateral aspect; 370, female cauda, lateral aspect
Erioptera septemtrionis, pupa: 371, male cauda, lateral aspect; 372, male cauda, dorsal aspect

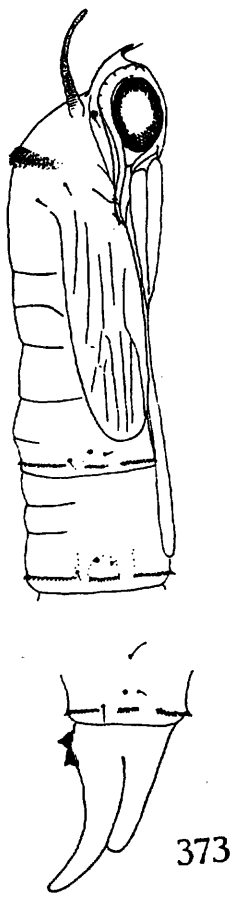
← Alexander (1920)
(Nearctic sp.)



ERIOPTERA CHLOROPHYLLA, LARVA

364, Head capsule, showing bases of antennae; 365, mental bar; 366, aberration of mental bar; 367, antenna; 368, mandible

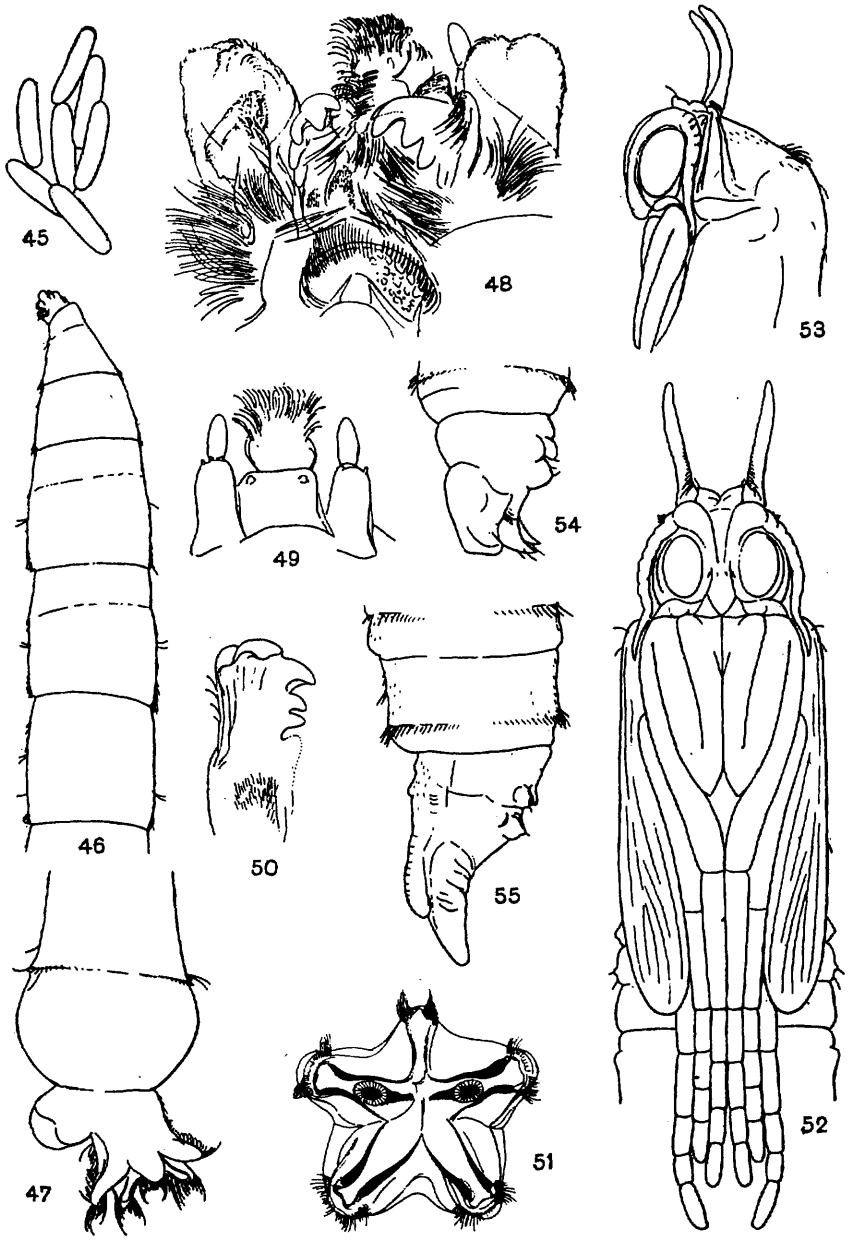
Erioptera (Hoplolabis)



Erioptera armata, pupa: 373, female, lateral aspect

from Alexander (1920) Nearctic

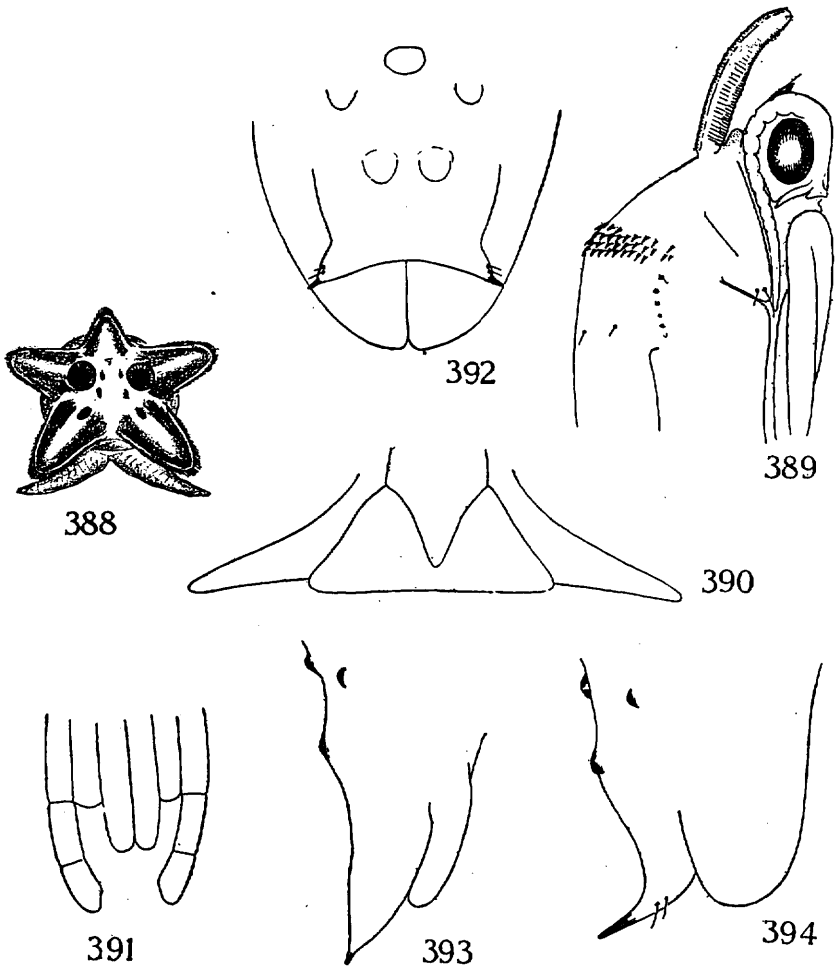
Erioptera (Mesocyphona)



Erioptera (E.) cladophoroides Alex. : 45, huevos ; 46, larva, porción anterior, vista lateral ; 47, larva, cauda ; 48, piezas bucales ; 49, labro y antenas ; 50, mandíbula ; 51, disco espiracular ; 52, ninfa, antecuerpo, ventral ; 53, cabeza y pro-mesonoto lateral ; 54 y 55, cauda de ninfa ♂ y ♀. (C. Bruch) delin.)

from Bruch (1939) - Neotropical

Erioptera (Symplecta)



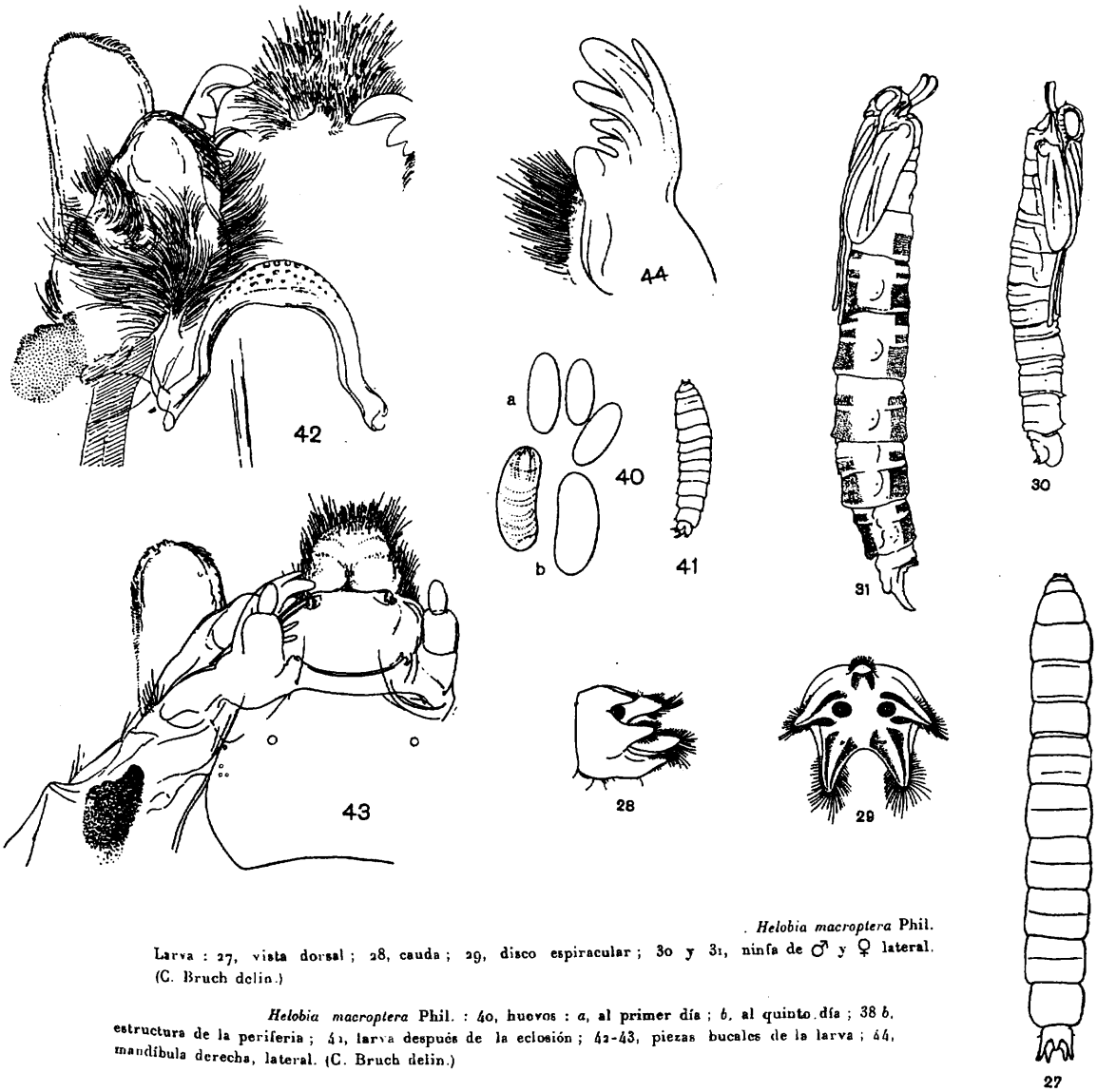
HELOBIA HYBRIDA

Helobia hybrida, larva: 388, spiracular disk
Helobia hybrida, pupa: 389, female, lateral aspect; 390, mouth parts; 391, arrangement of leg sheaths; 392, male cauda, dorsal aspect; 393, female cauda, lateral aspect; 394, male cauda, lateral aspect

from Alexander (1920) (Nearctic)

= Erioptera (Symplecta) cana

Erioptera (Symplecta)



. *Helobia macroptera* Phil.

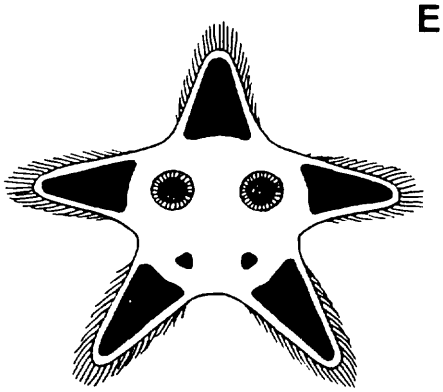
Larva : 27, vista dorsal ; 28, cauda ; 29, disco espiracular ; 30 y 31, ninfa de ♂ y ♀ lateral. (C. Bruch delin.)

Helobia macroptera Phil. : 40, huevos : *a*, al primer día ; *b*, al quinto día ; 38 *b*, estructura de la periferia ; 41, larva después de la eclosión ; 42-43, piezas bucales de la larva ; 44, mandíbula derecha, lateral. (C. Bruch delin.)

from Bruch, 1939 (Neotropical)

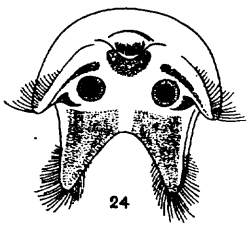
= Erioptera (Symplecta) macroptera

Erioptera (Trimicra)

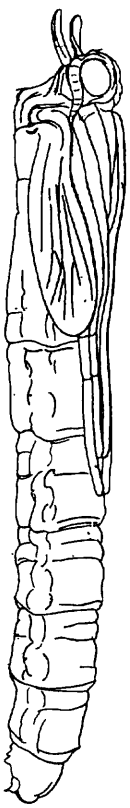


Trimicra pilipes, larva: 395, spiracular disk (after Gerbig)

from Alexander, 1920



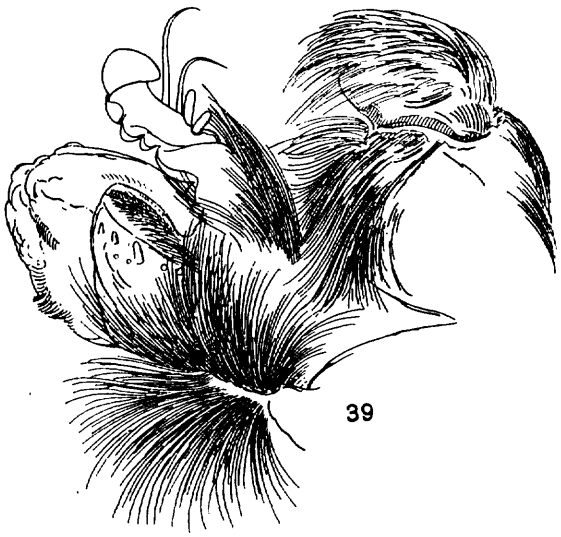
24



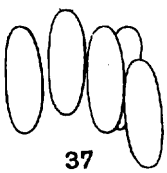
25

26

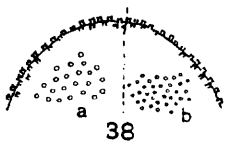
23



39



37



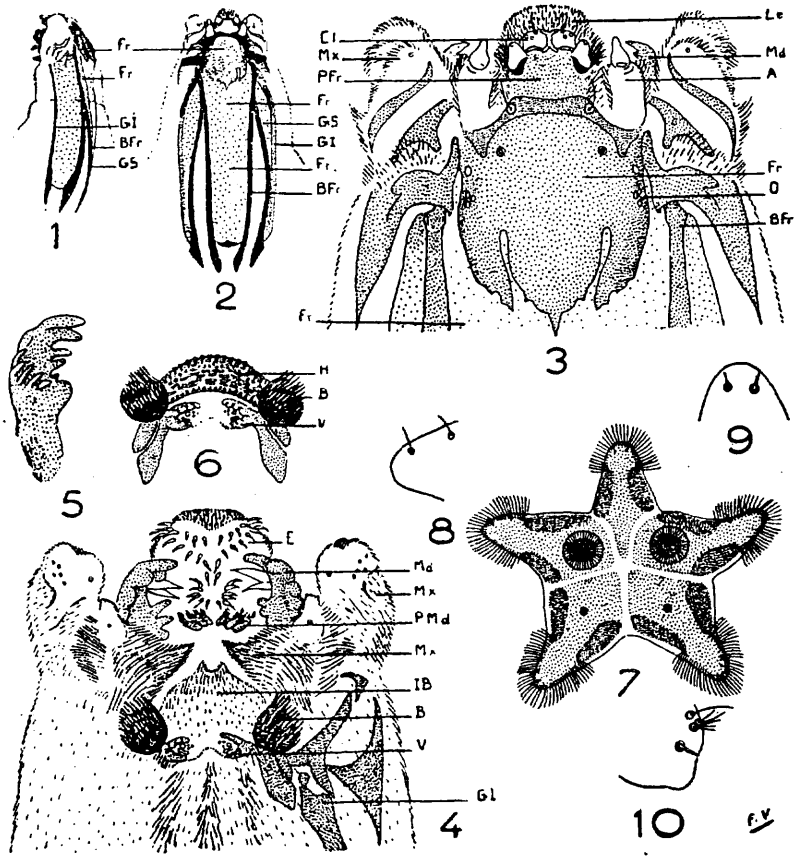
38

24, disco espiracular ; 25, ninfa del ♂ lateral ; 26, ninfa, cabeza, ventral. *Trimicra pilipes* F. Larva ; 23, vista dorsal ; *Trimicra pilipes* F. : 37, huevos ; 38 *a*, detalle de estructura de la periferia ; 39, labro, maxila, *y* mandíbula de la larva.

from Bruch 1939

Erioptera (Trimicra) pilipes - Cosmopolitan sp.

Erioptera (Trimicra)



from Valliant 1953 = Erioptera (Trimicra) pilipes

FIG. 1 à 10. — Larve de *Trimicra hirsutipes*. — Fig. 1 : tête, profil. Fig. 2 : tête, face dorsale. Fig. 3 : tête, face dorsale, extrémité antérieure. Fig. 4 : tête, face ventrale (les pièces internes de la capsule n'ont été représentées que d'un côté). Fig. 5 : mandibule. Fig. 6 : hypostome, face ventrale (le lobe infra-buccal a été enlevé). Fig. 7 : cupule respiratoire. Fig. 8 : lobe latéral. Fig. 9 : lobe dorsal. Fig. 10 : lobe ventral. A : antenne. B : brosse. BFr : baguette du frons. Cl : clypeus. E : épipharynx. Fr : frons. GI : baguette génale inférieure. GS : baguette génale supérieure. H : hypostome. IB : lobe infra-buccal. Le : labre. Md : mandibule. Mx : maxille. O : taches oculaires. PFr : préfons. PMd : prémandibule. V : pièces dentées.

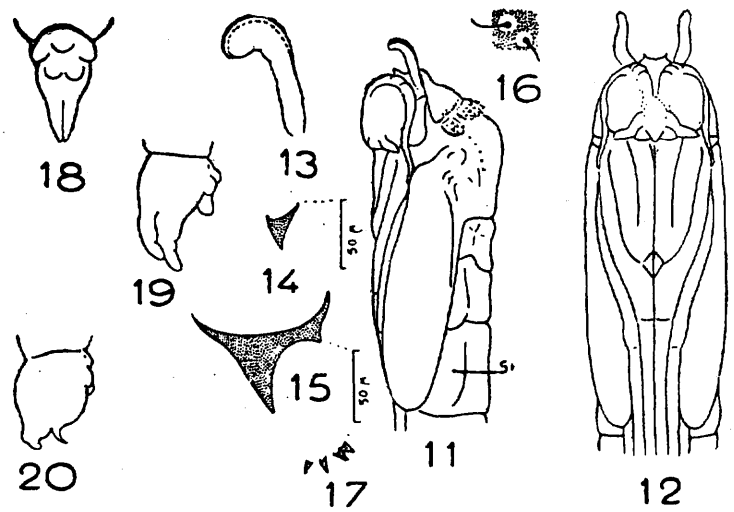
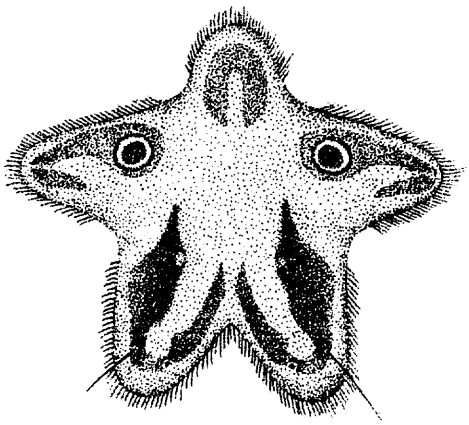
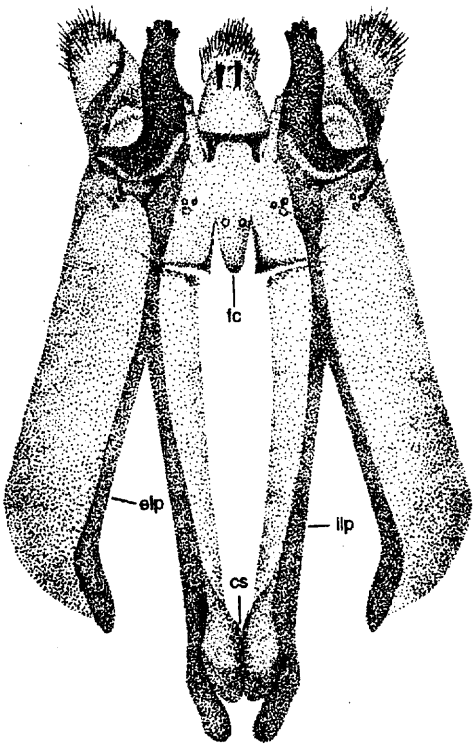
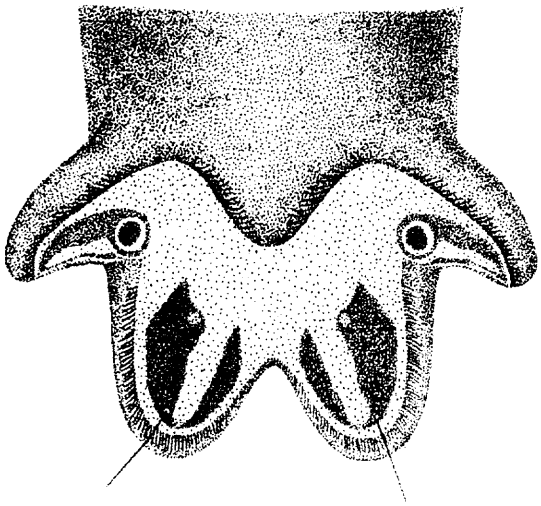


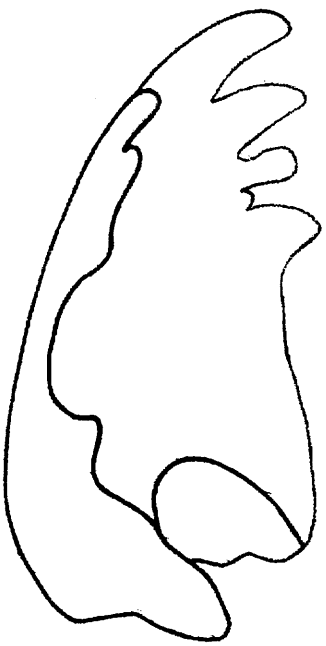
Fig. 11 à 20 : nymphe. Fig. 11 : profil, extrémité antérieure. Fig. 12 : face ventrale, extrémité antérieure. Fig. 13 : corne prothoracique, profil. Fig. 14 et 15 : épines du pronotum. Fig. 16 : soies sensorielles du pronotum. Fig. 17 : épines sternales de l'abdomen. Fig. 18 : extrémité de l'abdomen, femelle, face dorsale. Fig. 19 : extrémité de l'abdomen, femelle, profil. Fig. 20 : extrémité de l'abdomen, mâle, profil.

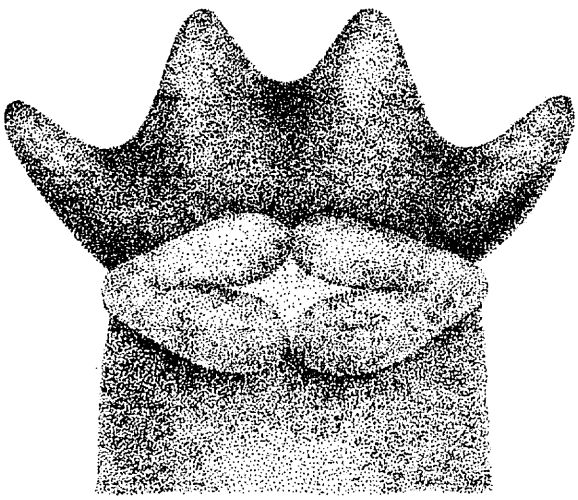
Gonempeda





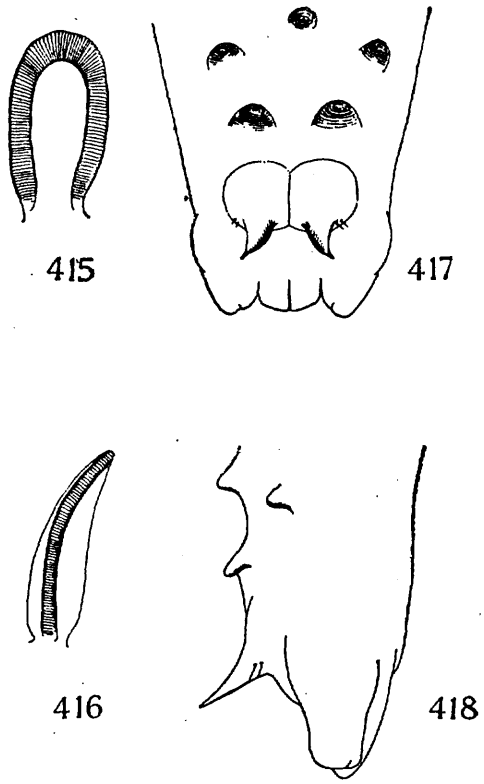






Gonempeda burra (western species) – spiracular disc; *G. flava* (Palearctic species) - head
From Podeniene and Gelhaus, in press

Gonomyia (Gonomyia)



AND G. KANSENSIS

Gonomyia kansensis, pupa: 415, pronotal breathing horn, lateral aspect; 416, pronotal breathing horn, ventral aspect; 417, male cauda, dorsal aspect; 418, male cauda, lateral aspect

from Alexander (1920) Nearctic sp.

Gonomyia (Lipophleps)

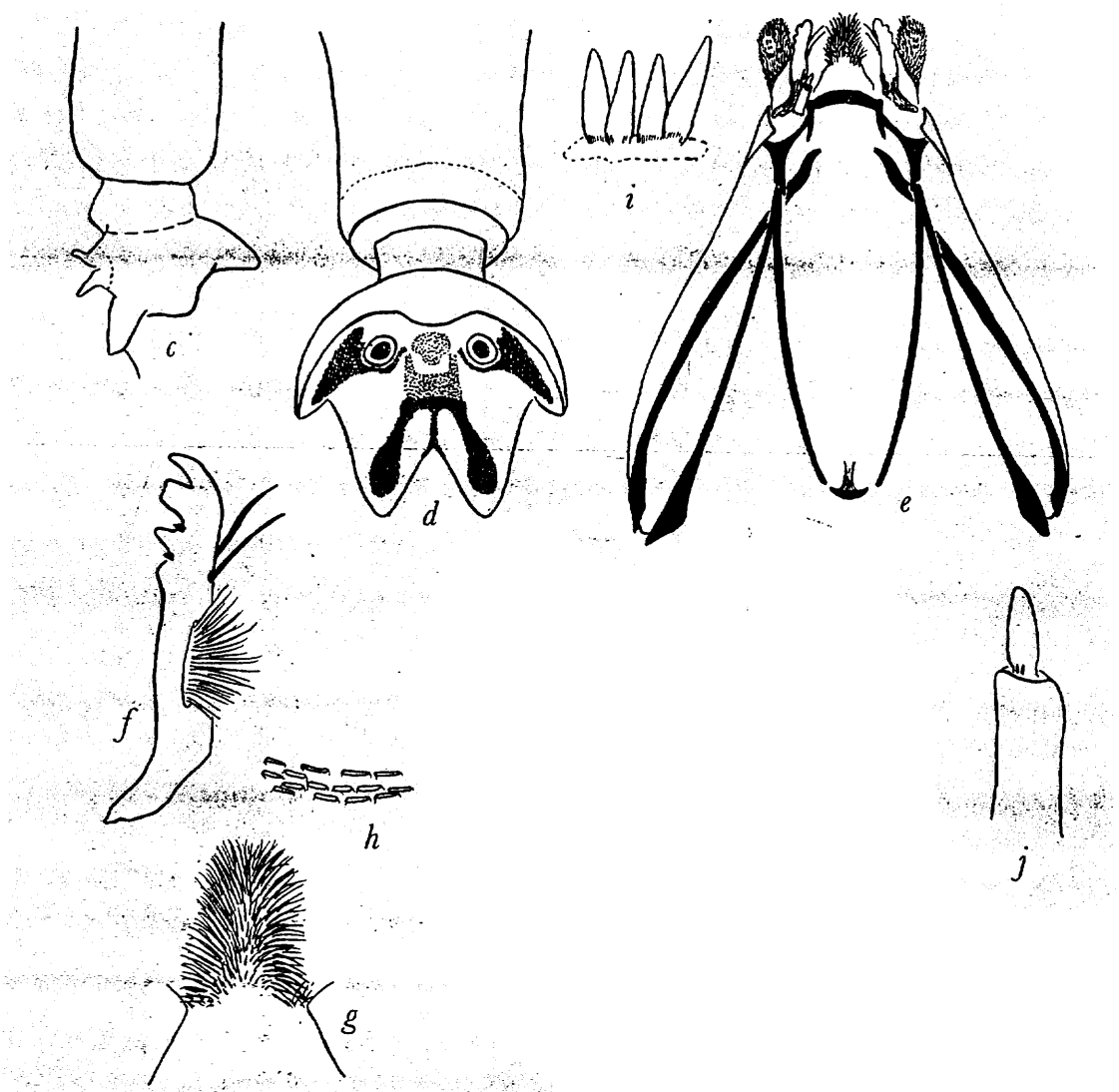
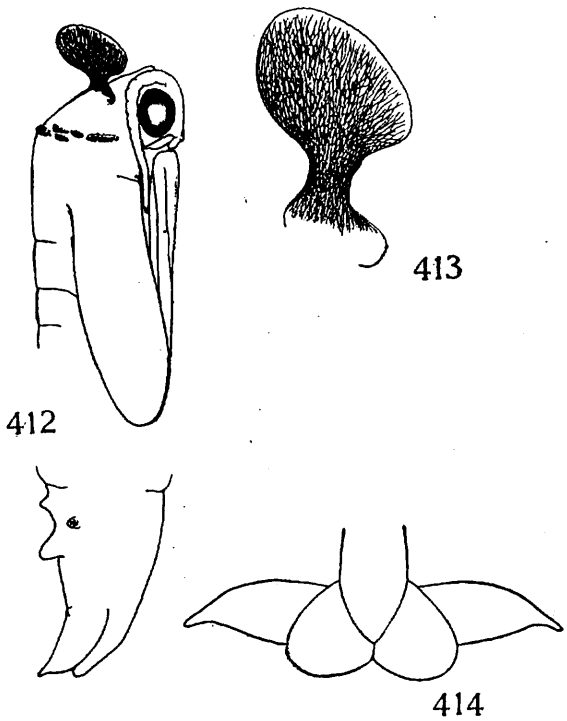


FIG. 87.—*Gonomyia sulphurelloides* Alex.
Larva: *c*, end of abdomen (lateral view); *d*, spiracular disc (dorsal view); *e*, head capsule (dorsal view); *f*, mandible; *g*, labrum-epipharynx; *h*, protuberance of hypopharynx; *i*, mental papillae; *j*, antenna.

From Wood, 1952
African species

Gonomyia (Lipophleps)

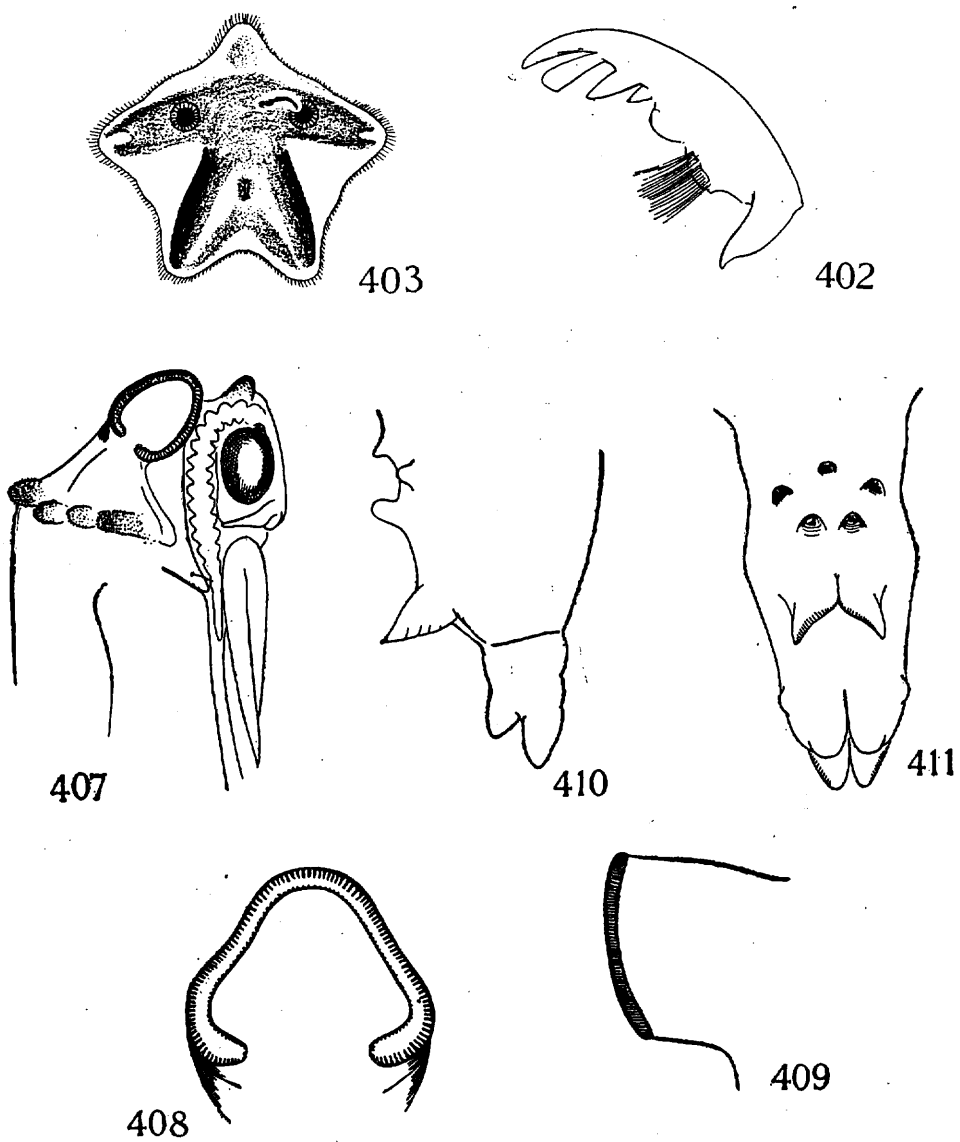


GONOMYIA SULPHURELLA

Gonomyia sulphurella, pupa: 412, female, lateral aspect; 413, pronotal breathing horn, lateral aspect; 414, mouth parts

from Alexander (1920) Nearctic sp.

Gonomyia (Neolipophleps)



GONOMYIA ALEXANDERI, PUPA

407, Male, lateral aspect; 408, pronotal breathing horn; 409, pronotal breathing horn, lateral aspect; 410, male cauda, lateral aspect; 411, male cauda, dorsal aspect

Gonomyia alexanderi, larva: 402, mandible; 403, spiracular disk

from Alexander, 1920 (Nearctic sp.)

Gonomyia (Paralipophleps)

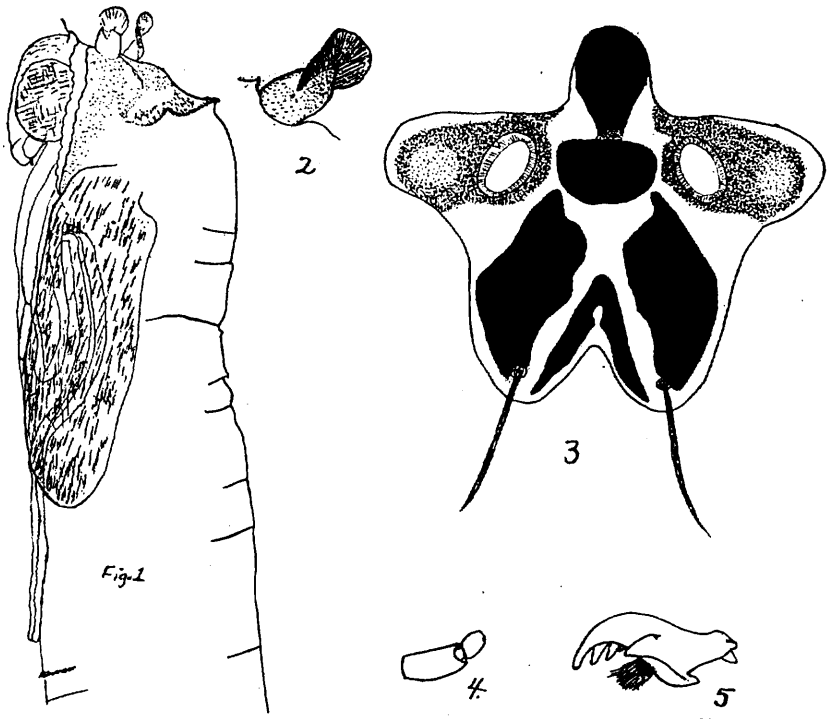


Fig. 1.—Immature stages of Gonomyia (L.) pleuralis

from Rogers (1926) Nearctic/Neotropical

Gonomyodes

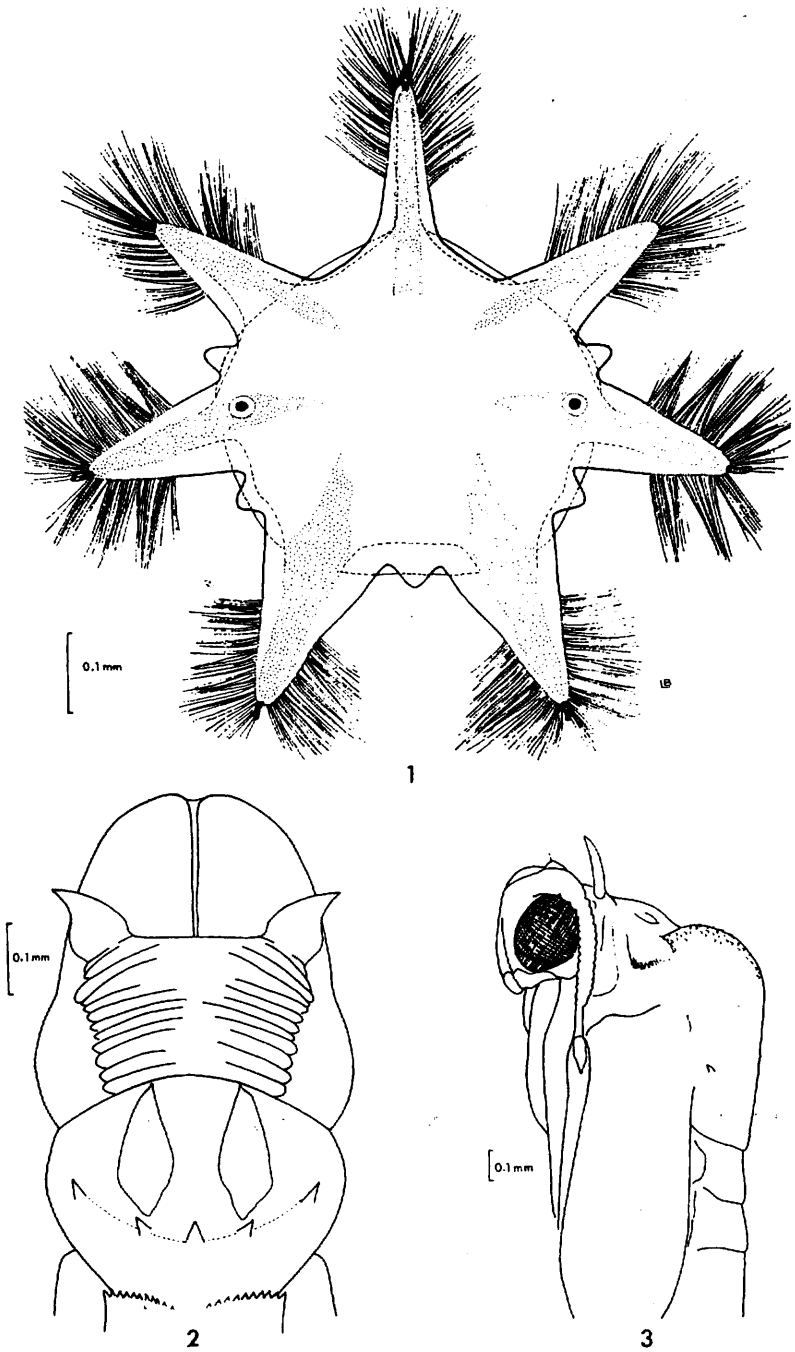
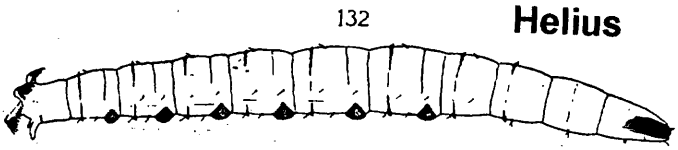
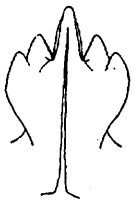


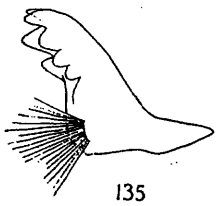
FIG. 1. Spiracular disk of *Gonomyodes tacoma*. FIG. 2. Dorsal view of cauda of male pupa of *Gonomyodes tacoma*. FIG. 3. Lateral view of pupa of *Gonomyodes tacoma*.

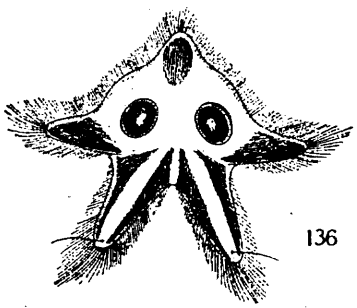
from Hynes (1969) Nearctic

Helius





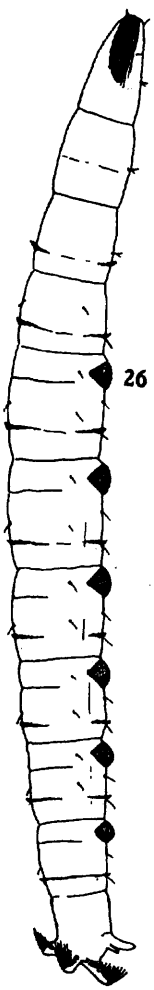


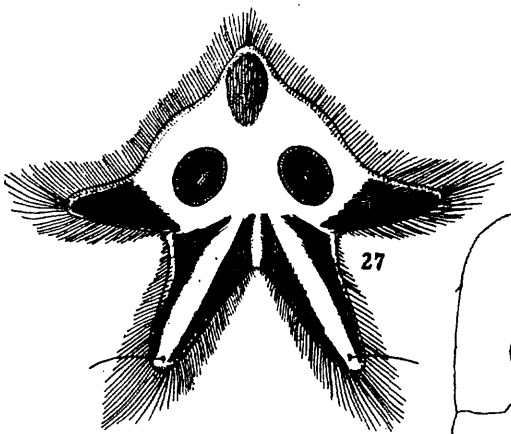


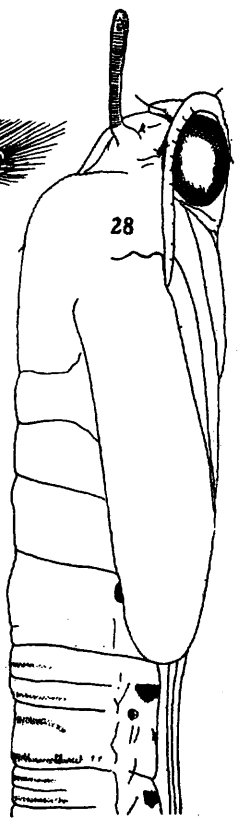
Rhamphidia mainensis, larva: 132, lateral aspect; 133, mentum; 135, mandible; 136, spiracular disk
Rhamphidia flavipes, larva: 134, antenna

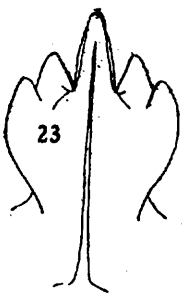
RHAMPHIDIA MAINENSIS, AND RHAMPHIDIA FLAVIPES

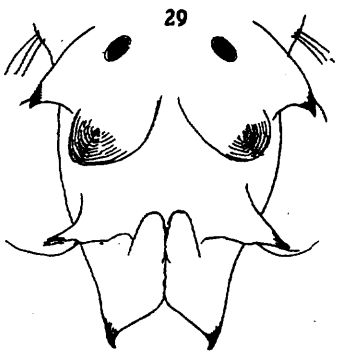
= Helius





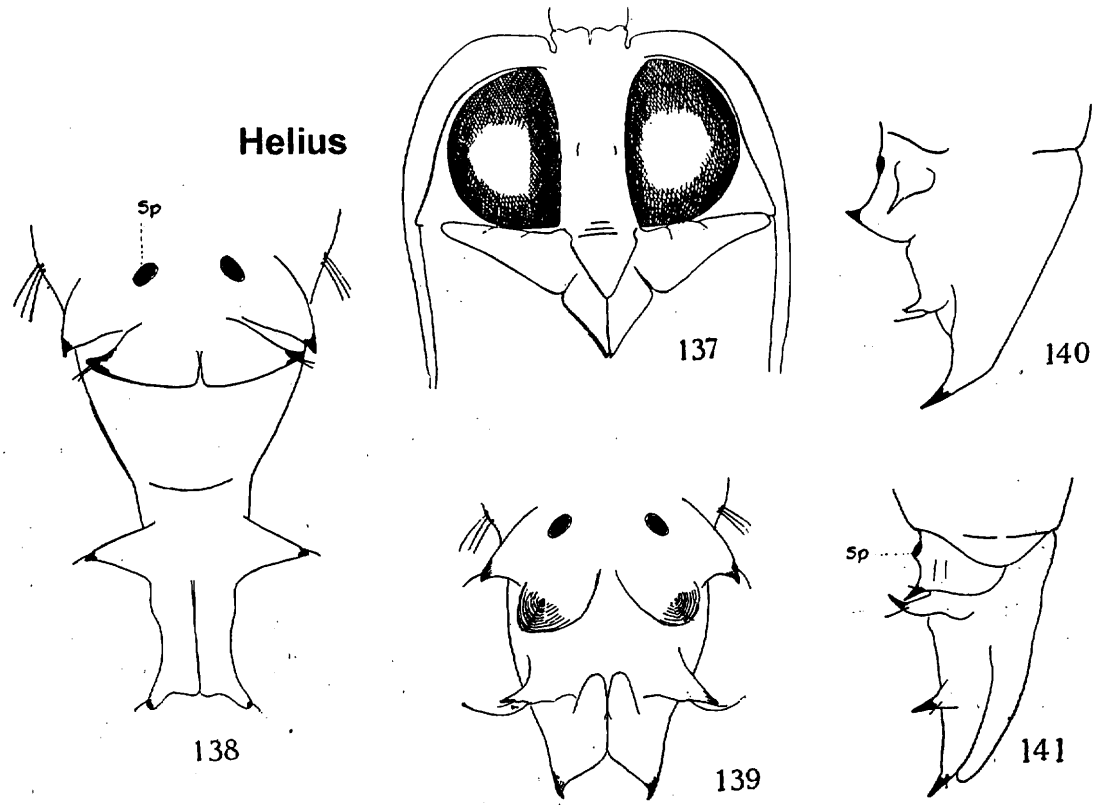






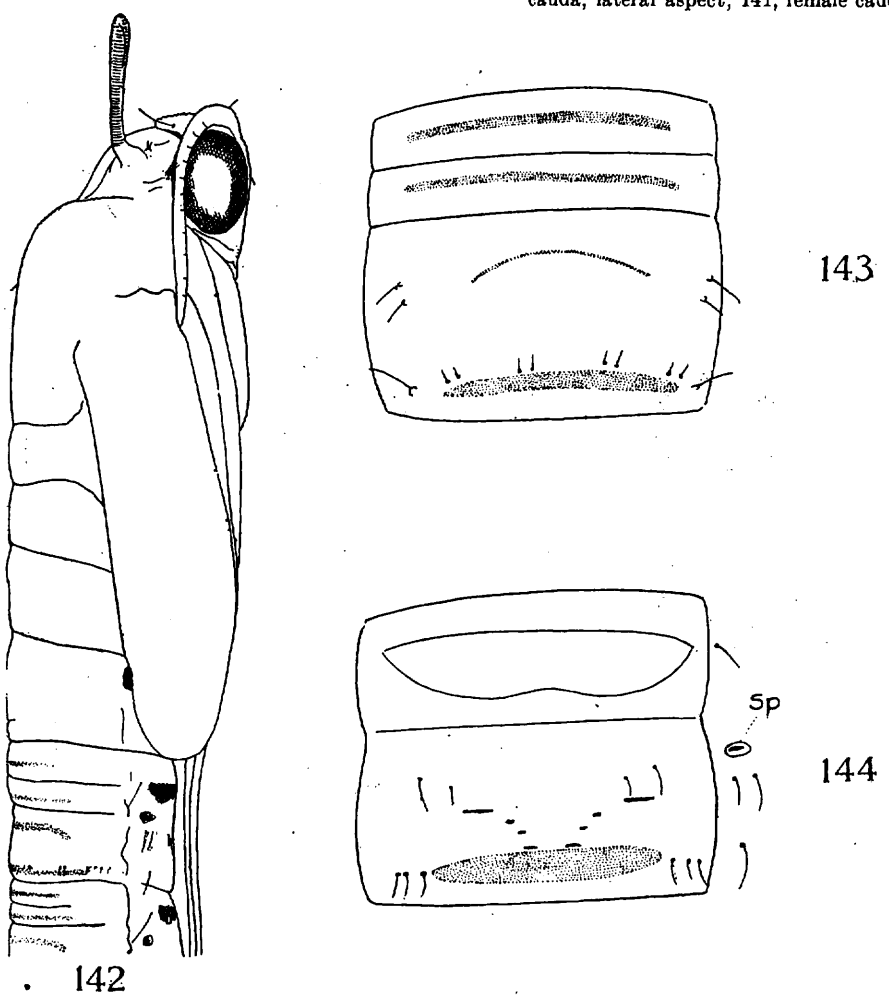
from Alexander, 1920
Nearctic spp.

Helius (Rhamphidia) mainensis: 23, mentum of larva; 26, larva, × 12; 27, spiracular disc
Helius flavipes: 28, pupa; 29, genital sac of male pupa



RHAMPHIDIA FLAVIPES, PUPA

137, Head of male, ventral aspect; 138, female cauda, dorsal aspect; 139, male cauda, dorsal aspect; 140, male cauda, lateral aspect; 141, female cauda, lateral aspect

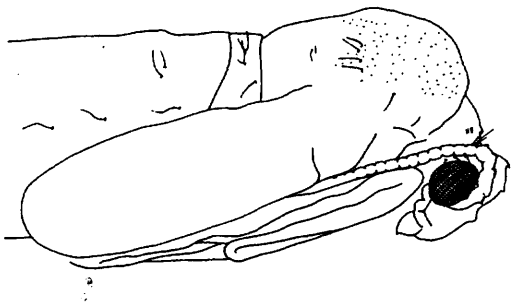


from Alexander, 1920

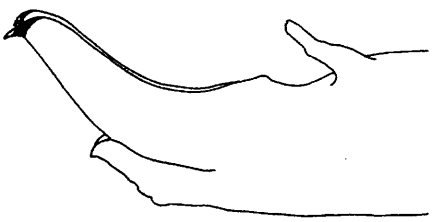
RHAMPHIDIA FLAVIPES, PUPA

142, Lateral aspect; 143, fifth abdominal segment, dorsal aspect (diagrammatic); 144, fifth abdominal segment, ventral aspect (diagrammatic)

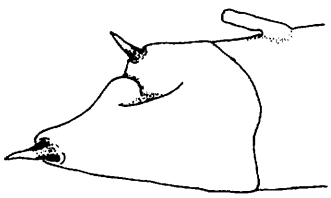
Hesperoconopa



2



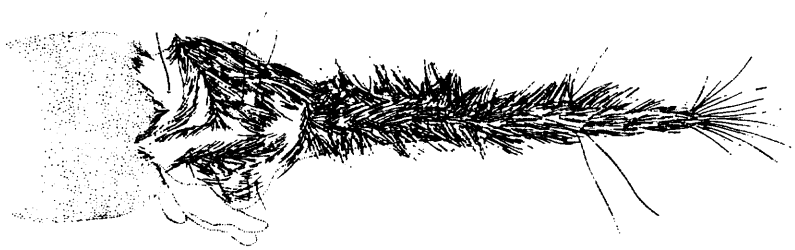
3



4

FIG. 1. Lateral view of terminal segments of *H. dolichophallus*. FIG. 2. Lateral view of anterior end of *H. dolichophallus*. FIG. 3. Lateral view of female cauda of *H. dolichophallus*. FIG. 4. Lateral view of male cauda of *H. dolichophallus*.

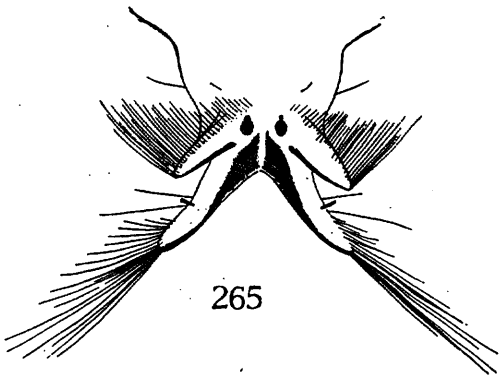
from Hynes, 1968

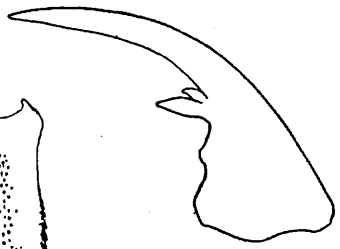


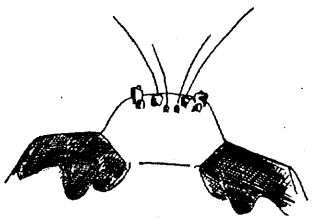
1

There are five species of *Hesperoconopa* now recorded from the continental United States. The immature stages and their habitats are not described although Alexander (1948, 1949) has indicated that they must be either aquatic or subaquatic. Several larvae and pupae of *Hesperoconopa dolichophallus* (Alex.) were taken in the backwaters and small tributaries of the White River in Mount Rainier National Park, Washington. Second, third, and fourth instar larvae, and pupae were found in patches of fine to coarse sand which were submerged beneath depths of one to twelve inches of swiftly flowing, cold water. Pupae were also taken from habitats where the water had recently receded. The larvae are difficult to separate from those of the genus *Dicranota*, with which they are associated, because of similarity of body coloration, but closer examination reveals the typical eriopterine head capsule of *Hesperoconopa*.

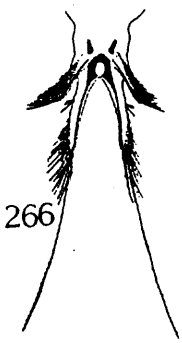
Hexatoma

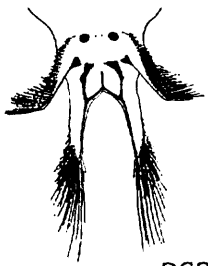


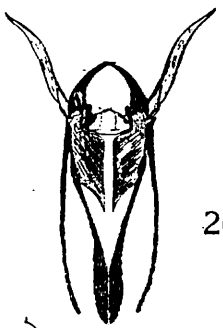


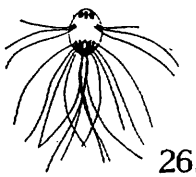


Eriocera cinerea, larva: 253, labrum; 254, pharyngeal plate; 255, mandible









ERIOCERA SPINOSA, E. CINEREA, E. LONGICORNIS, AND E. FULTONENSIS

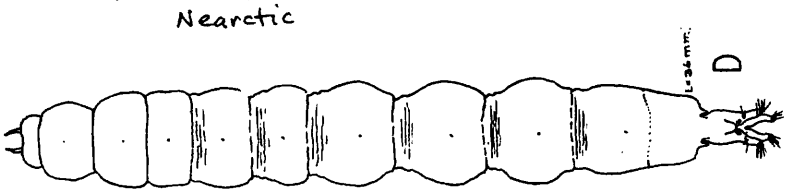
Eriocera spinosa, larva: 262, spiracular disk; 267, head capsule, dorsal aspect; 271, mandible

Eriocera cinerea, larva: 263 and 264, spiracular disk; 270, mandible

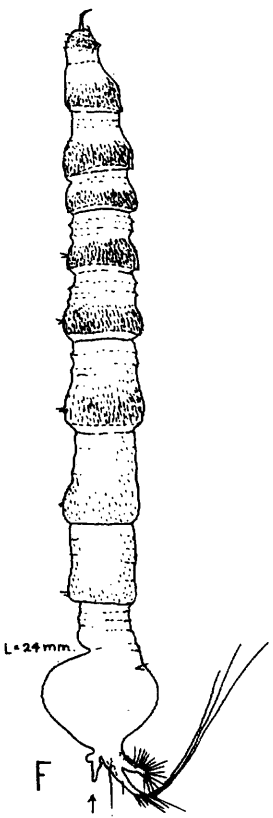
Eriocera longicornis, larva: 265, spiracular disk

Eriocera fultonensis, larva: 236, spiracular disk; 268, labrum; 269, mandible

from Alexander (1920)
Nearctic

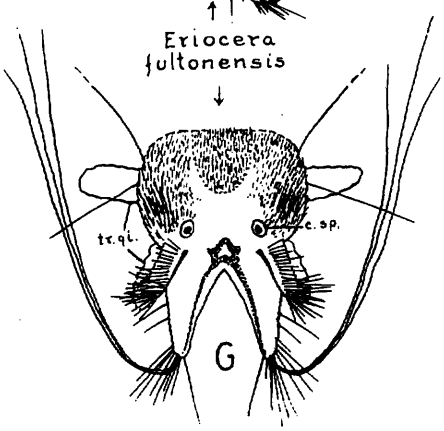


Eriocera spinosa
from Peterson, 1960



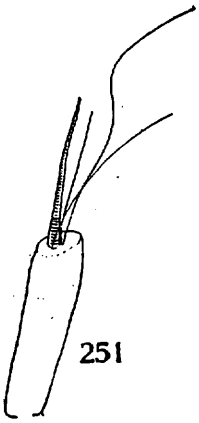
Peterson, 1960

Eriocera fultonensis

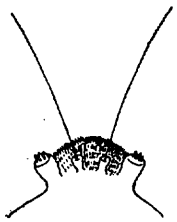


All Hexatoma (Eriocera) spp.

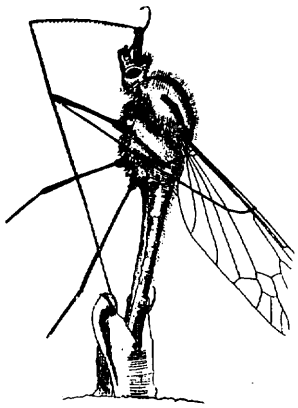
Hexatoma



251

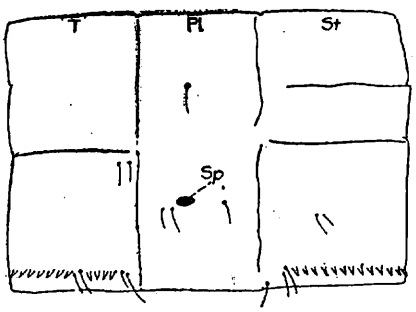


250

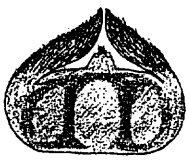


Adult male of *Eriocera spinosa* O. S. emerging from the pupal skin. The coloring and hair-characters are from a fully colored adult.

Alexander, 1914



252



243

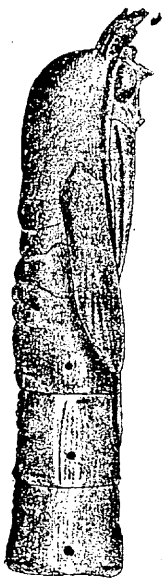
HEXATOMA MEGACERA

Hexatoma megacera: 250, larva, apex of labrum; 251, larva, antenna; 252, pupa, fifth abdominal segment, lateral aspect

245

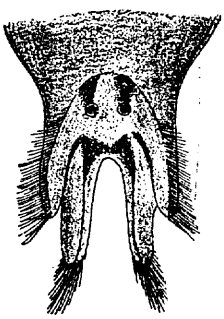
244

248

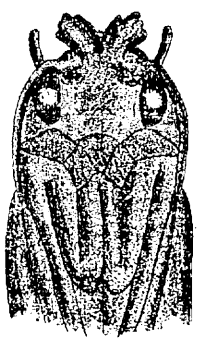


From Alexander, 1920

Hexatoma (Hexatoma) megacera



246

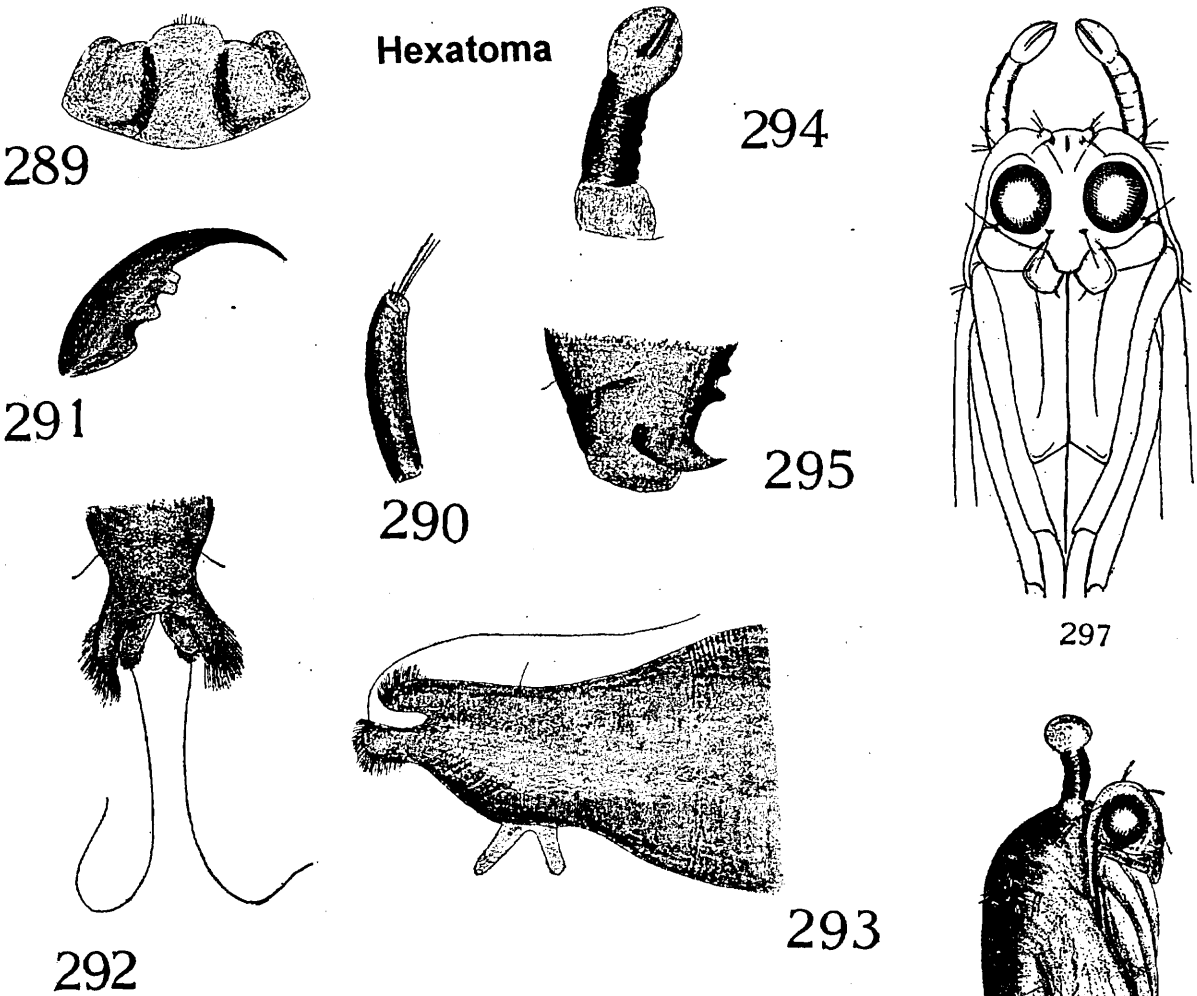


249

247

HEXATOMA MEGACERA

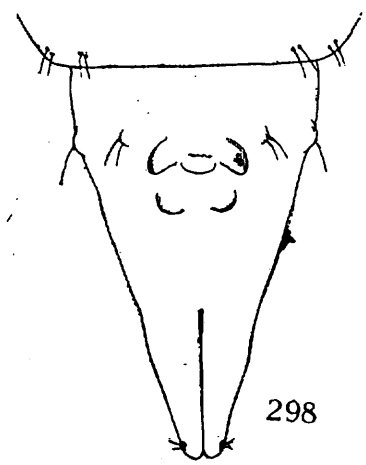
Larva: 243, labrum; 244, antenna; 245, mandible; 246, spiracular disk
Pupa: 247, lateral aspect; 248, male, ventral aspect; 249, female, ventral aspect

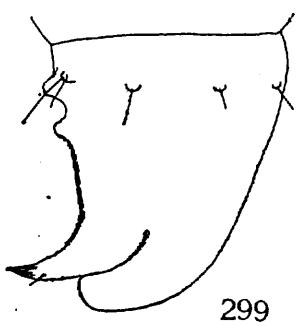


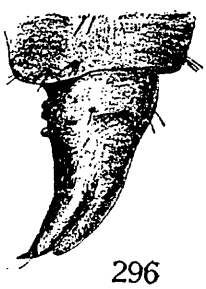
PENTHOPTERA ALBITARSIS

Larva: 289, labrum; 290, antenna; 291, mandible; 292, spiracular disk, dorsal aspect; 293, spiracular disk, lateral aspect

Pupa: 294, pronotal breathing horn; 295, male cauda, lateral aspect







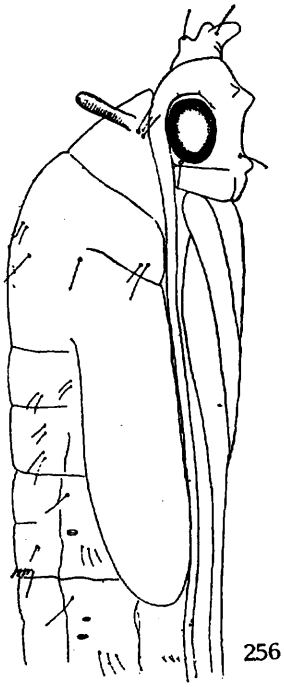
from Alexander, 1920

= Hexatoma (Eriocera) albitarsis

PENTHOPTERA ALBITARSIS, PUPA

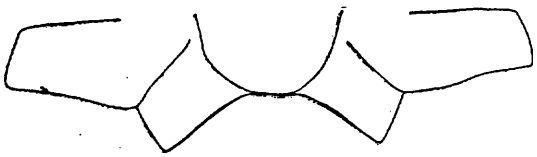
296, Female, lateral aspect; 297, female, ventral aspect; 298, female cauda, dorsal aspect; 299, male cauda, lateral aspect

Hexatoma



256

257



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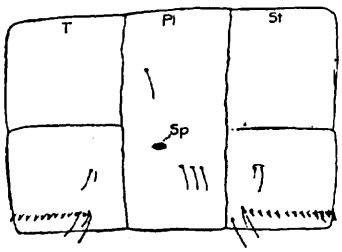

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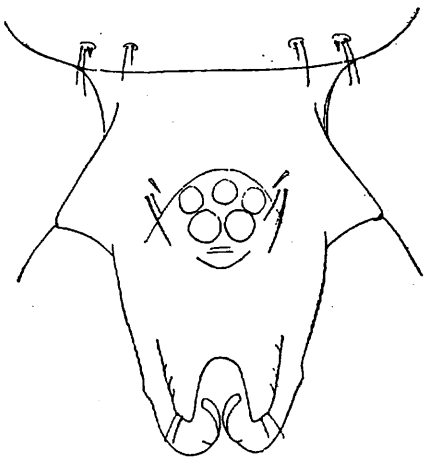

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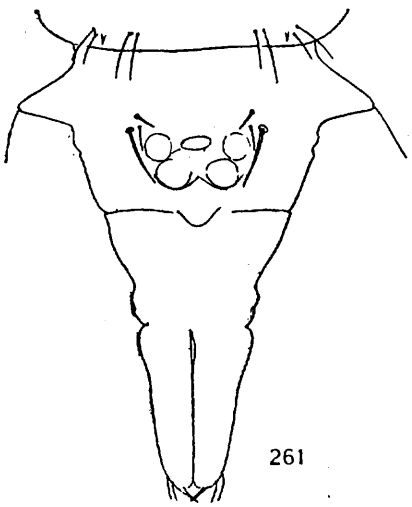


261

from Alexander, 1920
Nearctic spp.

ERIOCERA CINEREA, PUPA

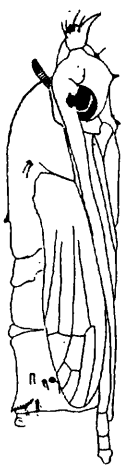
256, Male, lateral aspect; 257, cephalic crest of male, ventral aspect; 258, mouth parts; 259, fifth abdominal segment, lateral aspect; 260, male cauda, dorsal aspect; 261, female cauda, dorsal aspect

277

278

279

281



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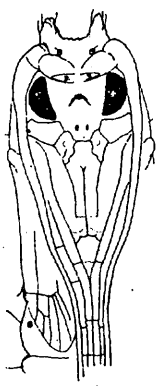

273

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282

280

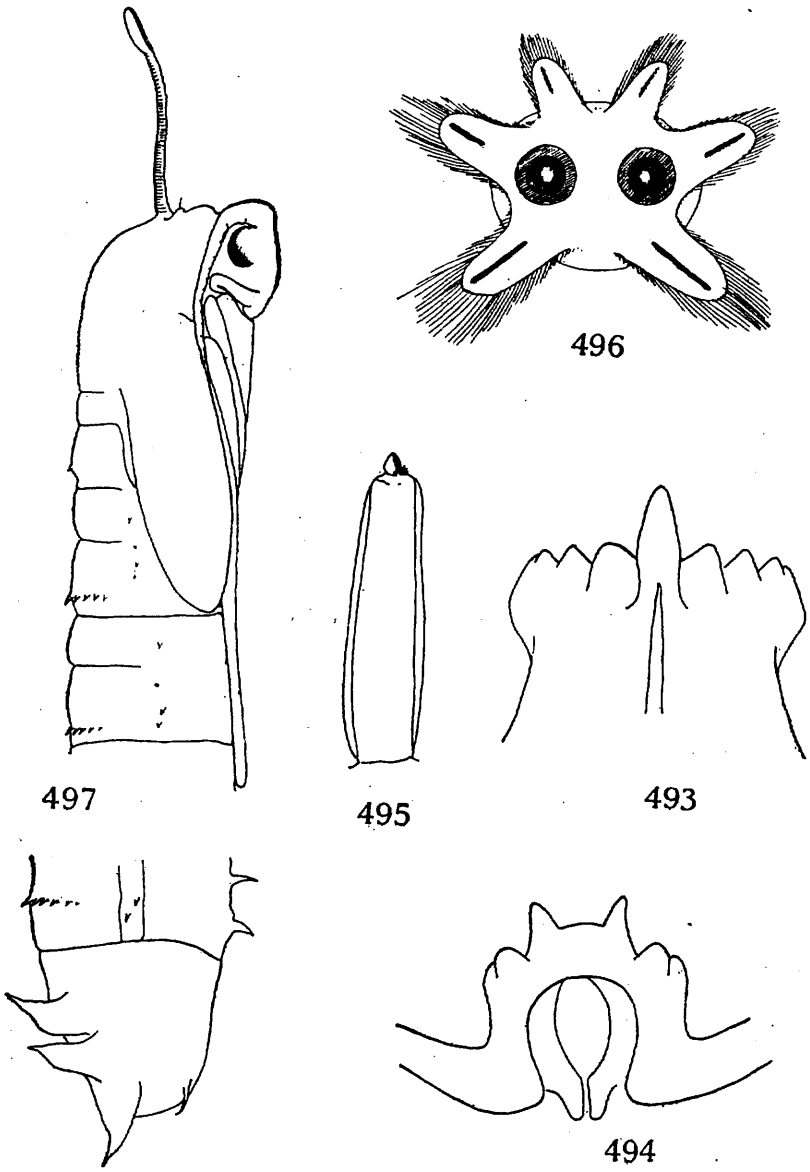
ERIOCERA LONGICORNIS, E. FULTONENSIS, AND E. SPINOSA

Eriocera longicornis, pupa: 272, male, lateral aspect; 273, male, ventral aspect; 274, female cauda, lateral aspect; 275, head of male, ventral aspect; 277, thorax of male, dorsal aspect; 278, female, lateral aspect

Eriocera fultonensis, pupa: 276, female cauda, lateral aspect; 279, female, lateral aspect

Eriocera spinosa, pupa: 280, female, lateral aspect; 281, male cauda, dorsal aspect; 282, male cauda, ventral aspect

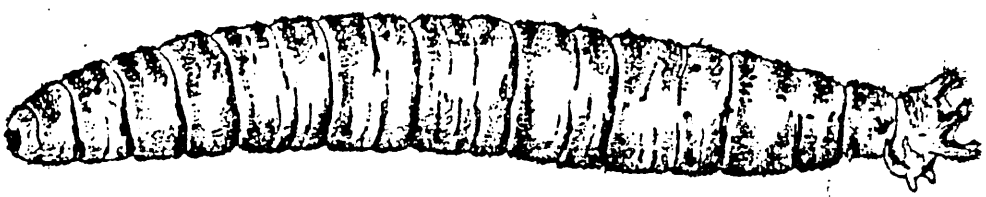
Holorusia



HOLORUSIA RUBIGINOSA

Larva: 493, mentum; 494, hypopharynx; 495, antenna; 496, spiracular disk
Pupa: 497, male, lateral aspect

from Alexander 1920

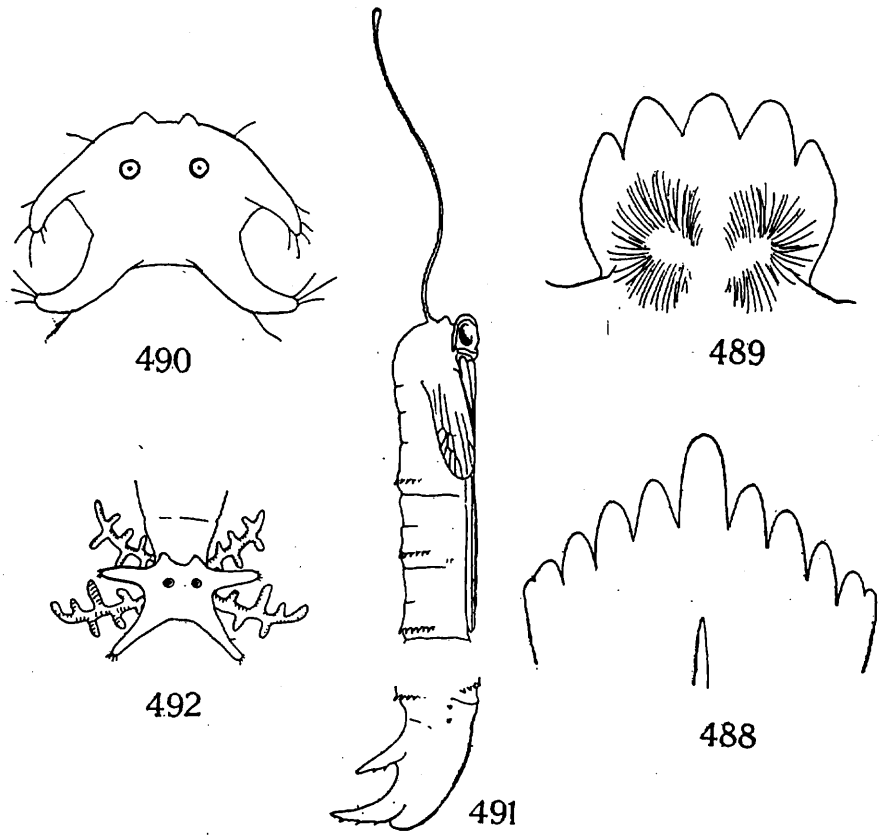


from Kellogg 1901

= Holorusia hespera Arnaud and Byers

Only Nearctic species

Leptotarsus (Longurio)



LONGURIO TESTACEUS AND AESHNASOMA RIVERTONENSIS

Longurio testaceus, larva: 488, mentum; 489, hypopharynx; 490, spiracular disk
Longurio testaceus, pupa: 491, male, lateral aspect
Aeshnasoma rivertonensis, larva: 492, spiracular disk, showing branched anal gills (after Johnson)

From Alexander 1920

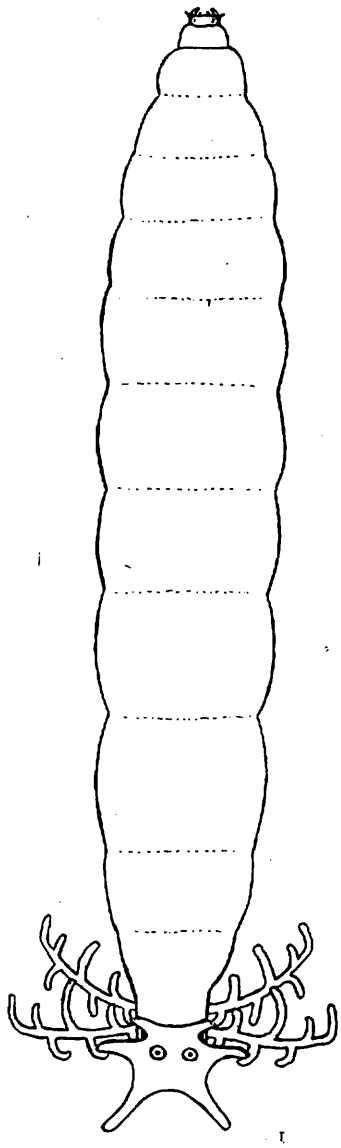
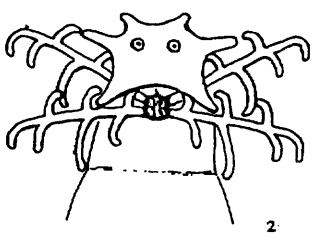


Figure 23.6

Figure 23.6. Anal gill of larva of *Leptotarsus* (*Longurio*) *testaceus* (Loew).

From Gelhaus & Byers, 1994



Both nearctic species.

from Johnson, 1906
Le. (Lo.) rivertonensis

Leptotarsus (Longurio)

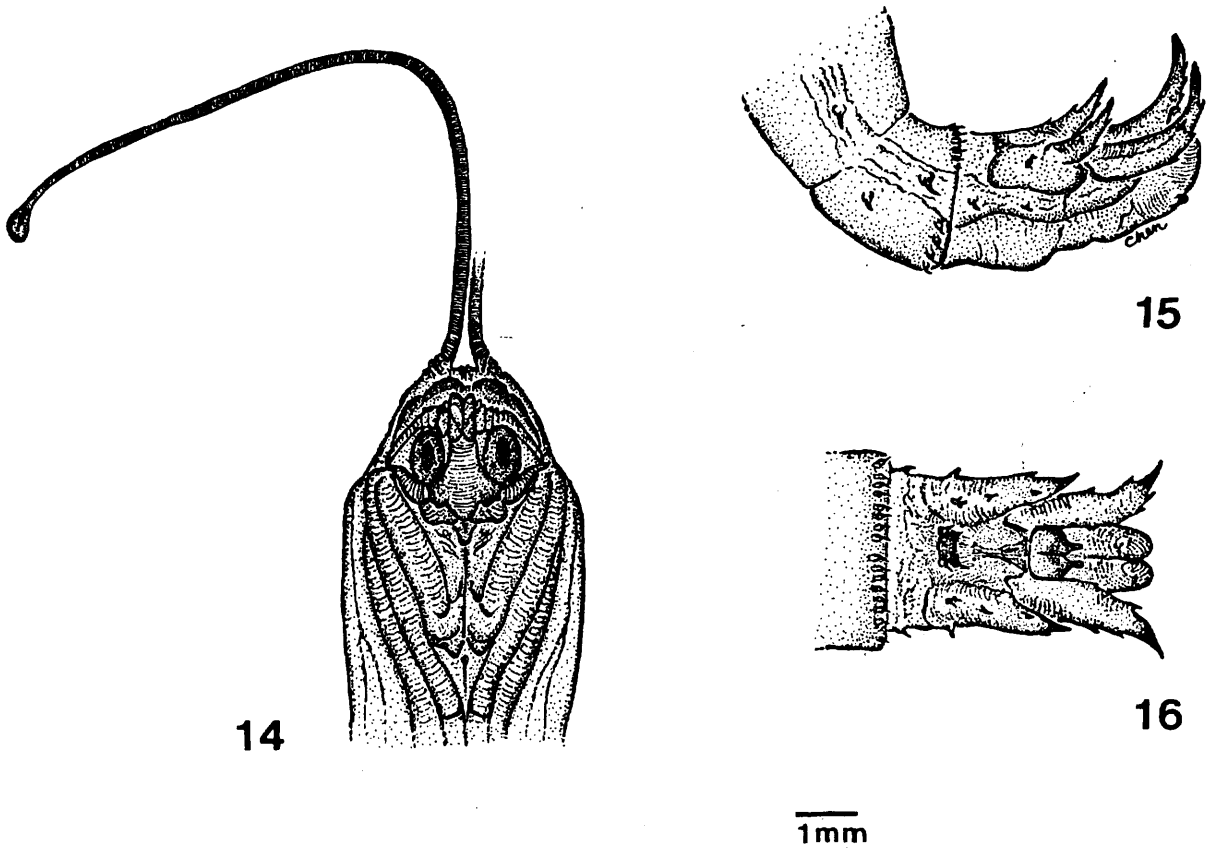
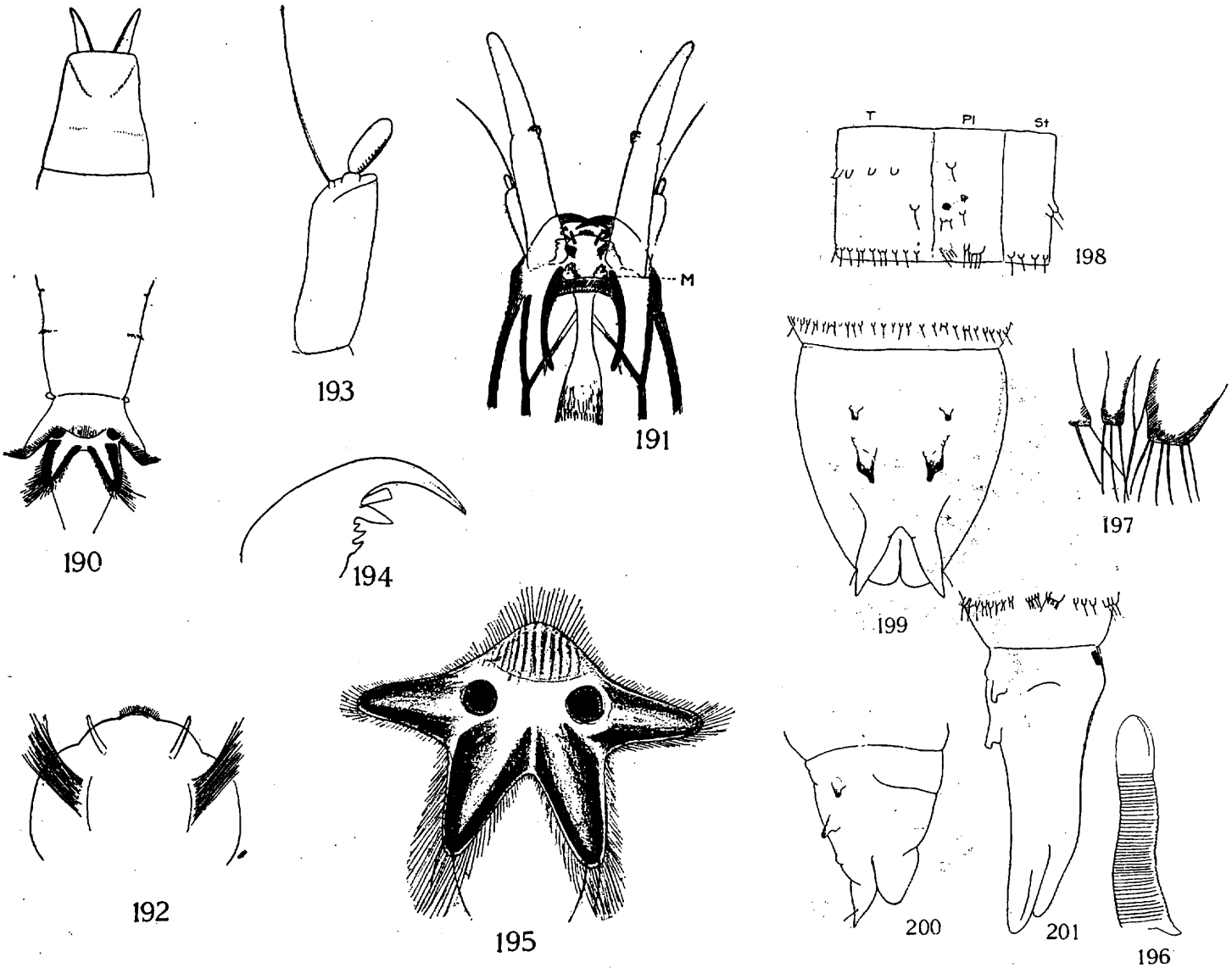


Fig. 14–16.—Pupa of *Leptotarsus* (*Longurio*) *testaceus*. 14, pupa, anterior ventral aspect showing respiratory horn. 15, lateral aspect; 16, dorsal aspect. 15–16, male terminal abdominal segments:

from Gelhaus & Young, 1995

Limnophila (Dicranophragma)



LIMNOPHILA (DICRANOPHRAGMA) FUSCOVARIA, LARVA

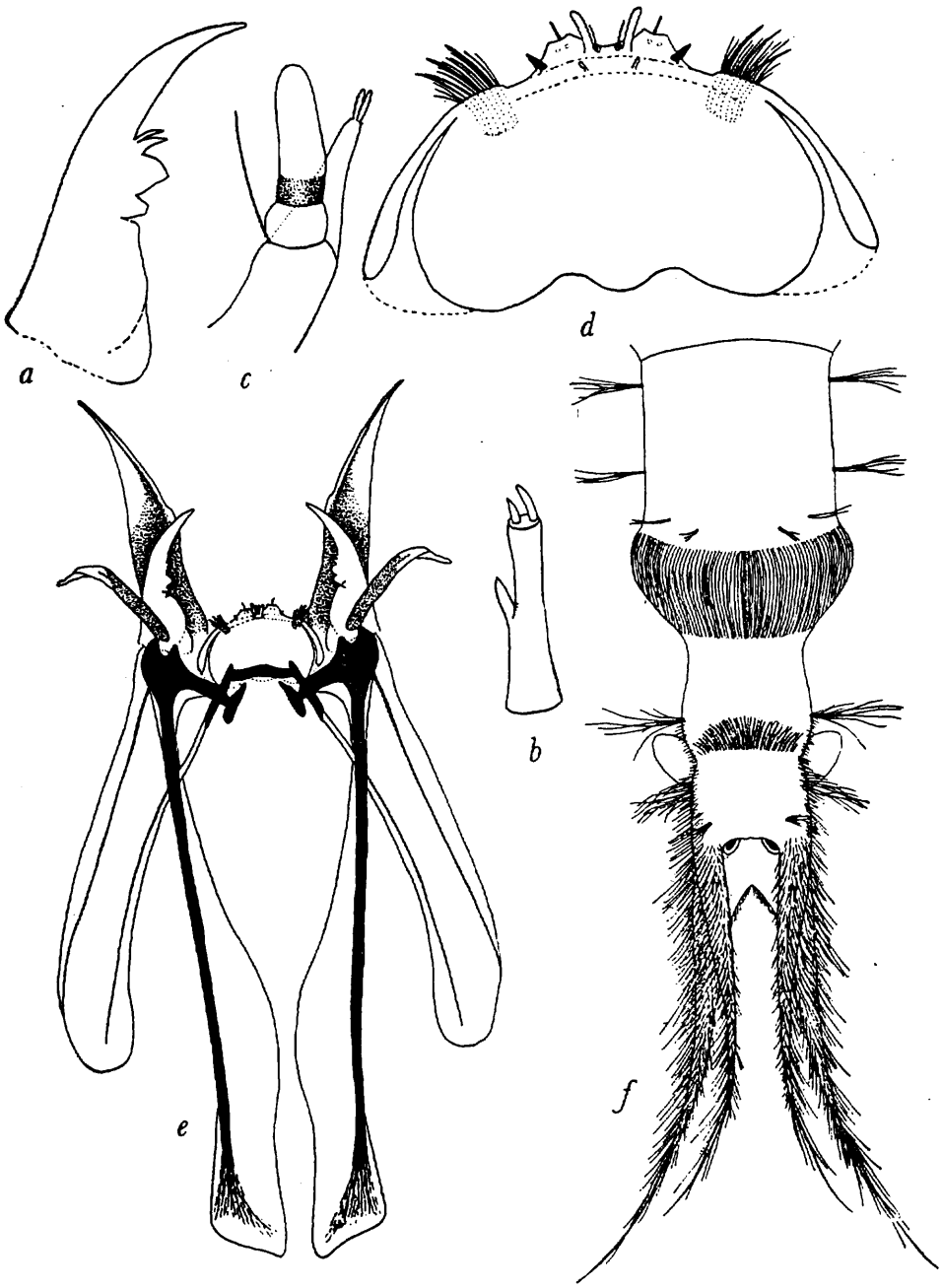
LIMNOPHILA (DICRANOPHRAGMA) FUSCOVARIA

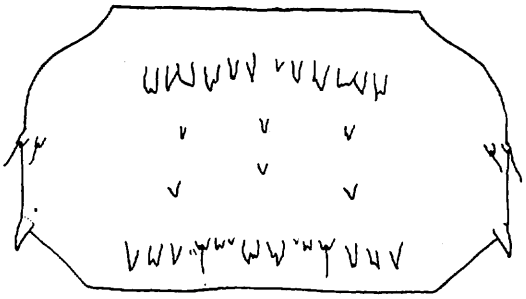
190, Cephalic and caudal ends, dorsal aspect; 191, head capsule, ventral aspect; 192, labrum epipharynx; 193, antenna; 194, mandible; 195, spiracular disk

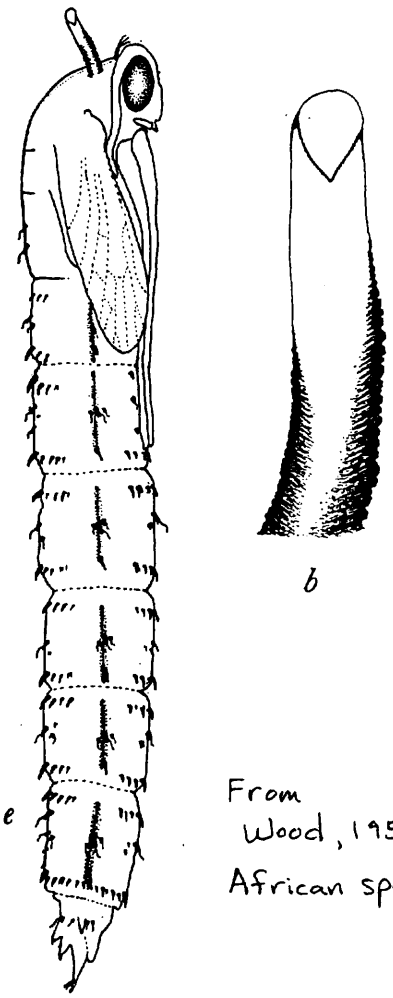
Limnophila (*Dicranophragma*) *fuscovaria*, pupa: 196, pronotal breathing horn; 197, pleural abdominal spines; 198, fifth abdominal segment (diagrammatic); 199, male cauda, dorsal aspect; 200, male cauda, lateral aspect; 201, female cauda, lateral aspect

From Alexander 1920
Nearctic sp.

Limnophila (Eloeophila)



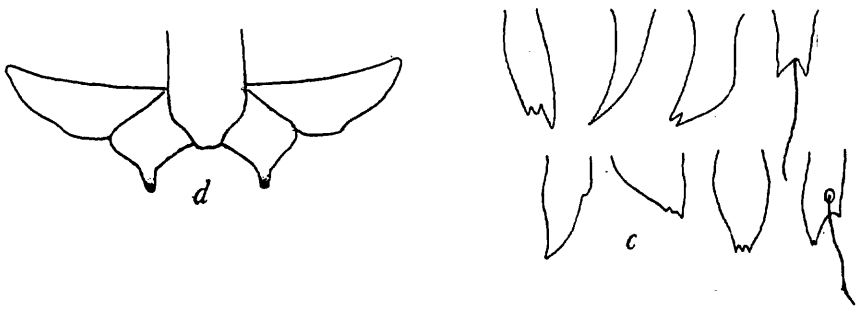


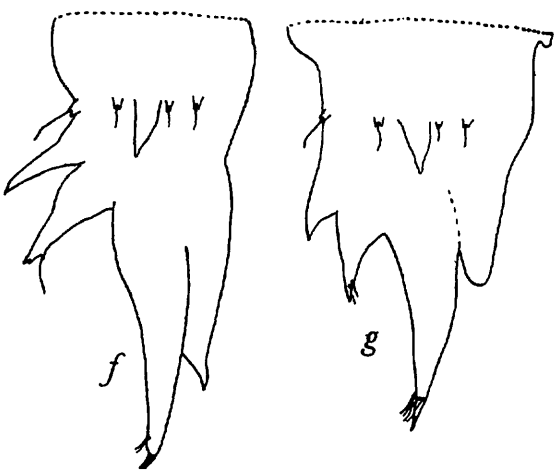


From Wood, 1952 African species

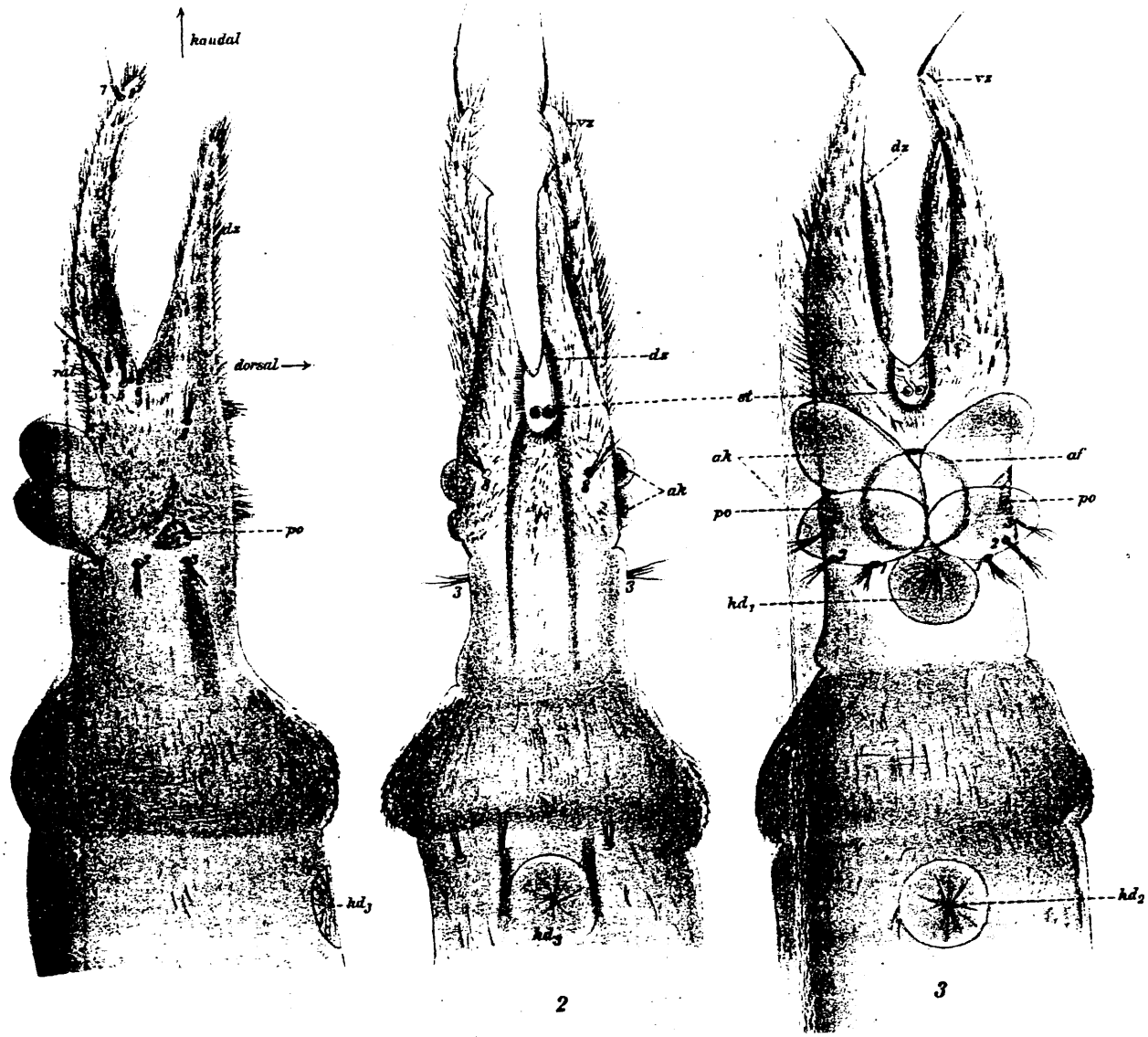
FIG. 70.—Larva of *Limnophila dubiosa* Alex. *a*, mandible; *b*, antenna; *c*, tip of maxilla; *d*, labrum (dorsal view); *e*, head capsule (ventral view); *f*, end of abdomen (dorsal view).

FIG. 71.—Pupa of *Limnophila dubiosa* Alex. *a*, fifth abdominal segment; *b*, pronotal breathing horn; *c*, spines on abdominal segments; *d*, mouth parts; *e*, pupa (lateral view); *f*, female cauda (lateral view); *g*, male cauda (lateral view).



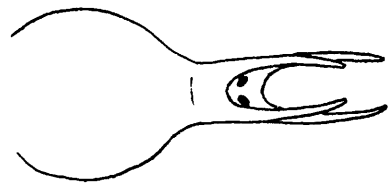


Limnophila (Eloeophila)

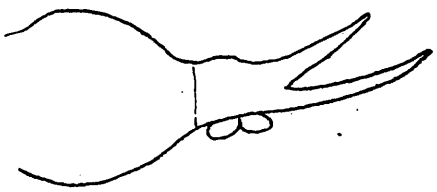


From Wolff 1922
L. (E.) maculata (Palearctic)

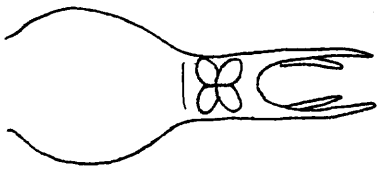
Limnophila (Eloeophila)



13. dorsal.



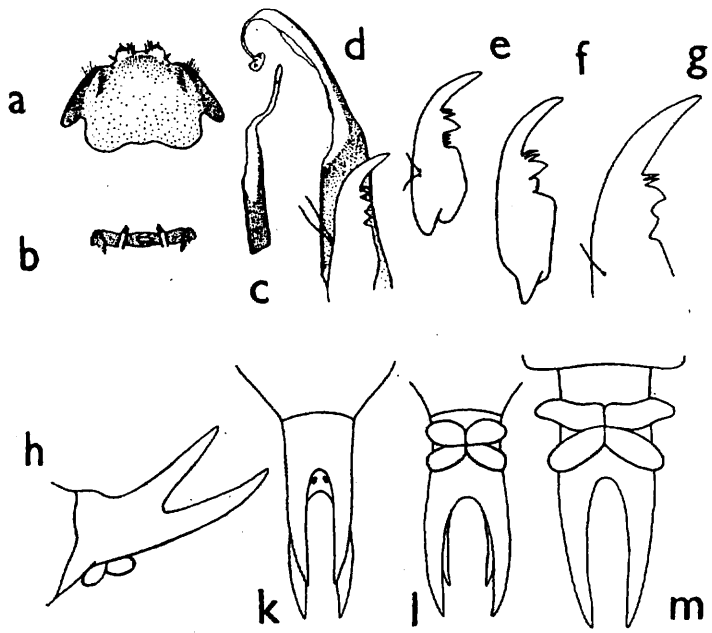
14. lateral



15. ventral

L. verralli (Bergr.)

from Brindle (1958) Palearctic sp

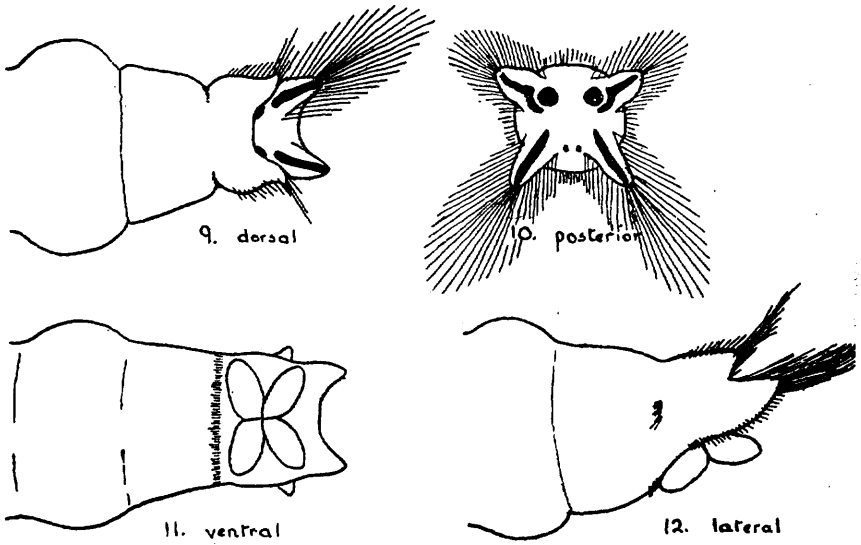


SUBGENUS *ELAEOPHILA*

Fig. 11: (a) *E. verralli,* labrum. (b) *E. verralli,* hypostomium. (c) *E. verr* antenna. (d) *E. verralli,* maxilla and mandible. (e) *E. submarmor* mandible. (f) *E. trimaculata,* mandible. (g) *E. maculata,* mandible. (h) *E. ralli,* anal segment, lateral view. (k) *E. verralli,* anal segment, dorsal v (l) *E. verralli,* anal segment, ventral view. (m) *E. maculata,* anal segm ventral view.

from Brindle and Bryce (1960) Palearctic spp.

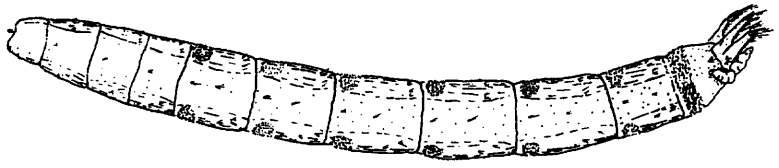
Limnophila (Euphylidorea)



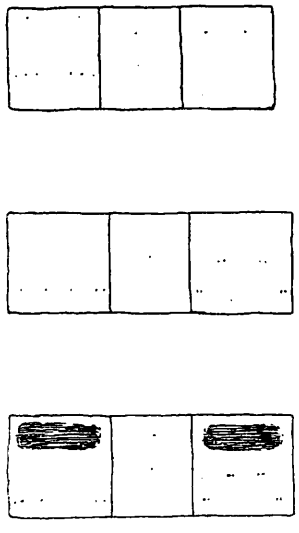
L lineola. (Mg.)

from Brindle, 1958 Palearctic sp.

Limnophila (Eutonia)



1



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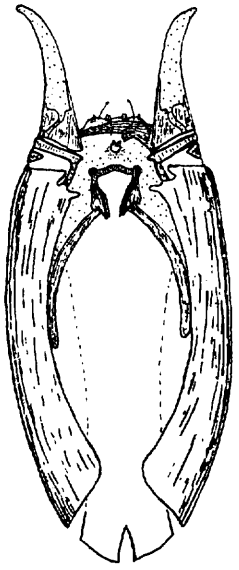

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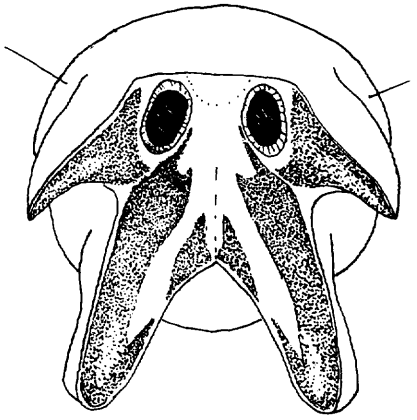

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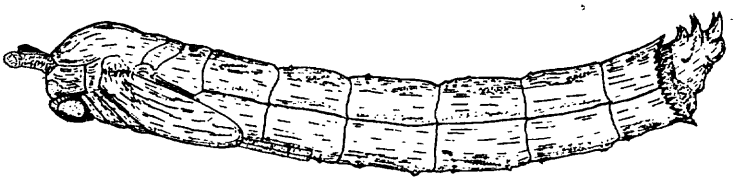
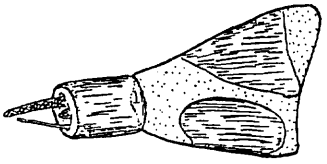


7

4



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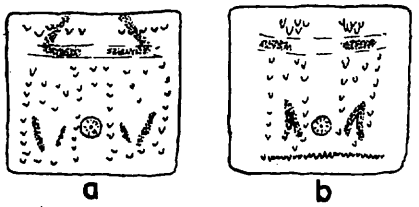

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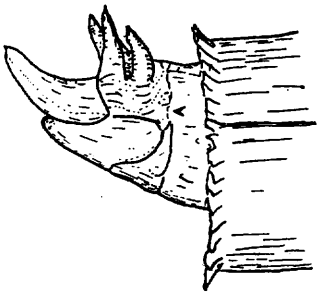


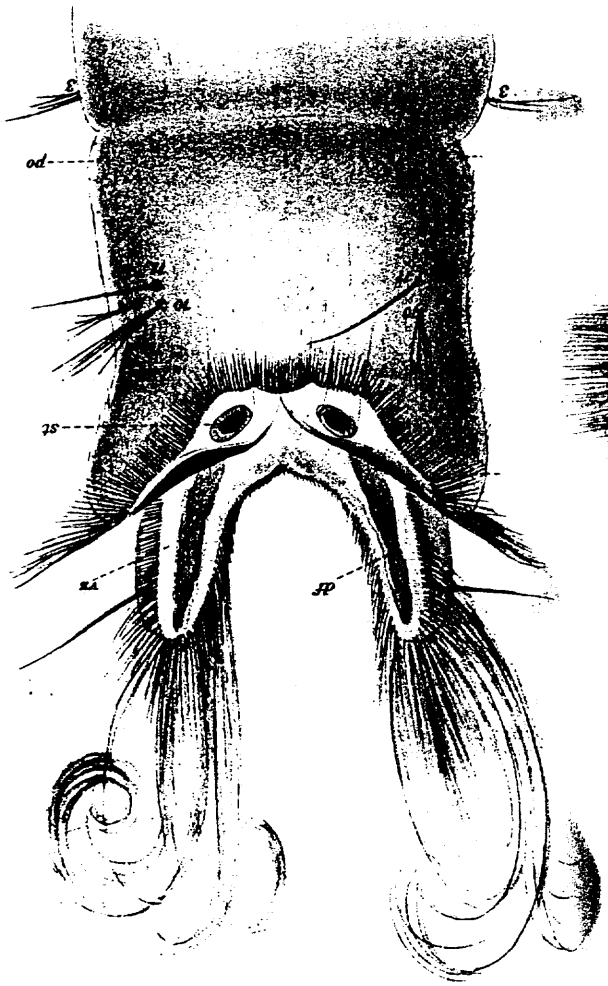
9

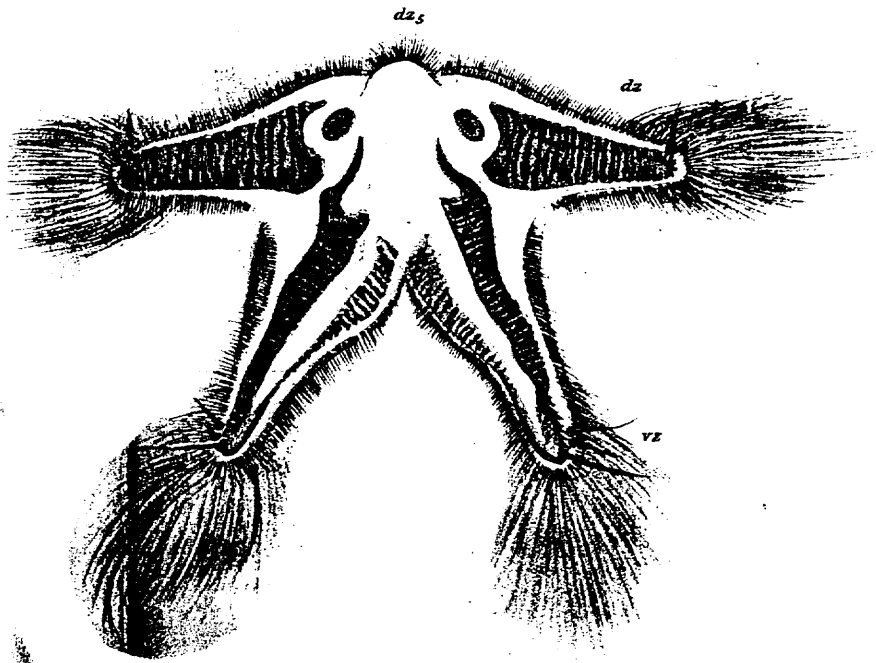
Fig. 1. Lateral view of larval body of *Limnophila marchandi;* fig. 2, *chaetotaxy* of segments—tergal, pleural, and sternal areas shown from left to right—(a) first thoracic segment, (b) second and third thoracic, first abdominal segments, (c) second through seventh abdominal segments; fig. 3, ventral view of head capsule; fig. 4, ventral view of mandible; fig. 5, antenna.

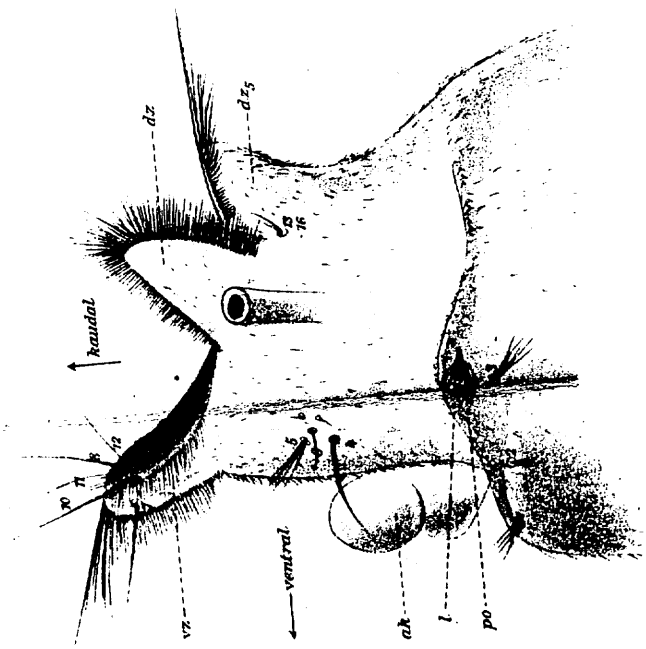
Fig. 6, spiracular disk of *Limnophila marchandi* (fringe of setae not shown); fig. 7, lateral view of pupal body; fig. 8, diagrammatic sketch showing arrangement of tubercles and markings on (a) tergal area, (b) sternal area of abdominal segments; fig. 9, female cauda.

From Hynes, 1958
Nearctic sp.

Limnophila (Eutonia)

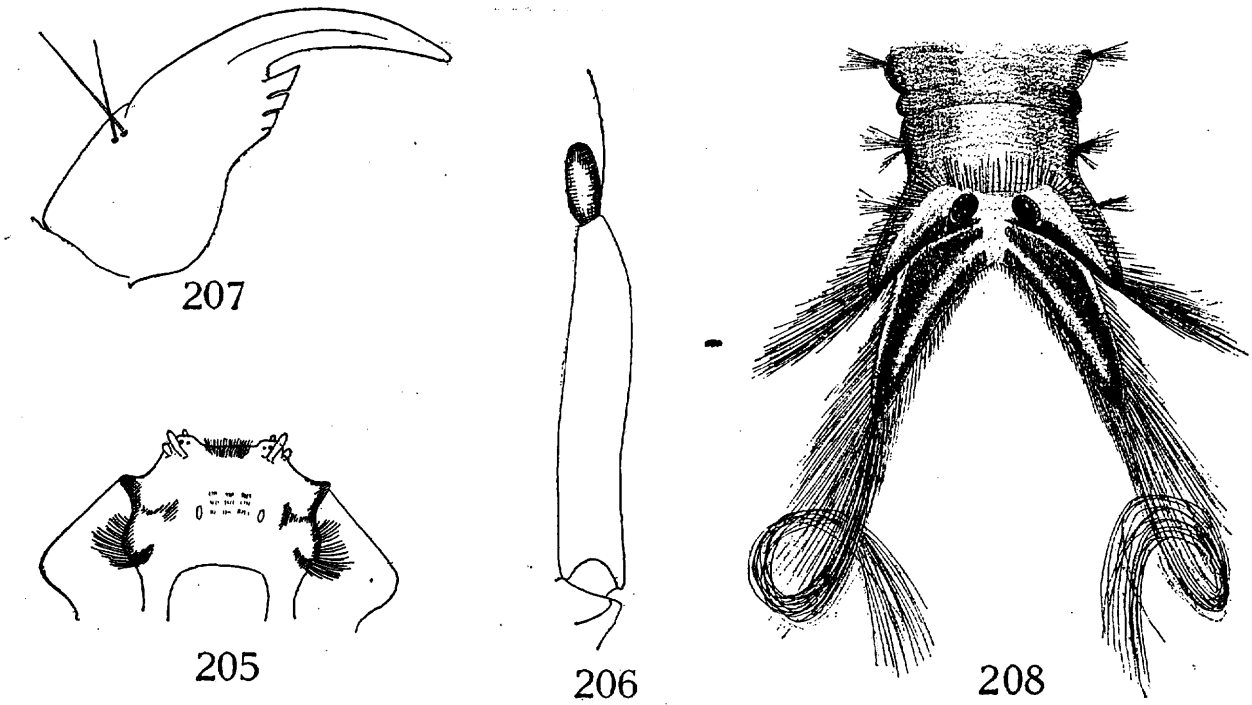






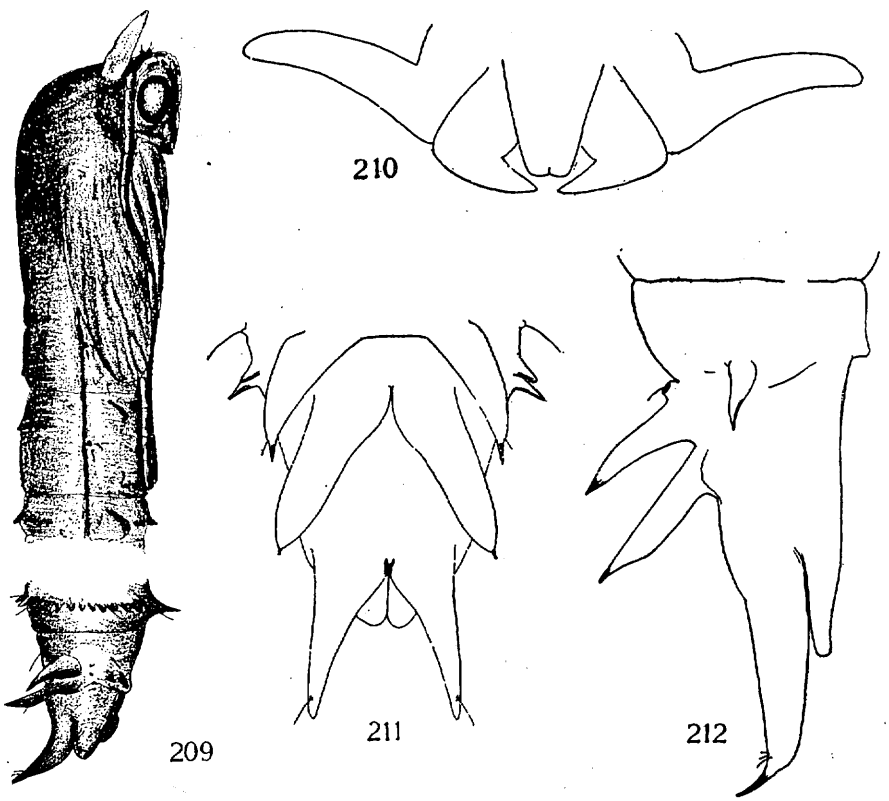
from Wolff 1922
L. (E.) barbipes Meigen
(Palearctic)

Limnophila (Lasiomastix)



LIMNOPHILA (LASIOMASTIX) MACROCERA, LARVA

205, Labrum; 206, antenna; 207, mandible; 208, spiracular disk, dorsal aspect



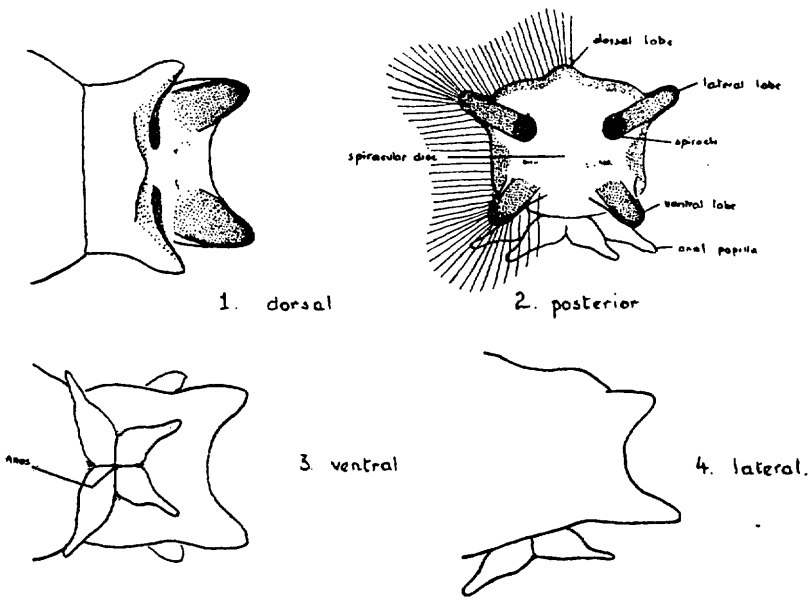
LIMNOPHILA (LASIOMASTIX) MACROCERA, PUPA

209, Male, lateral aspect; 210, mouth parts; 211, male cauda, dorsal aspect; 212, female cauda, lateral aspect

From Alexander, 1920
Nearctic sp.

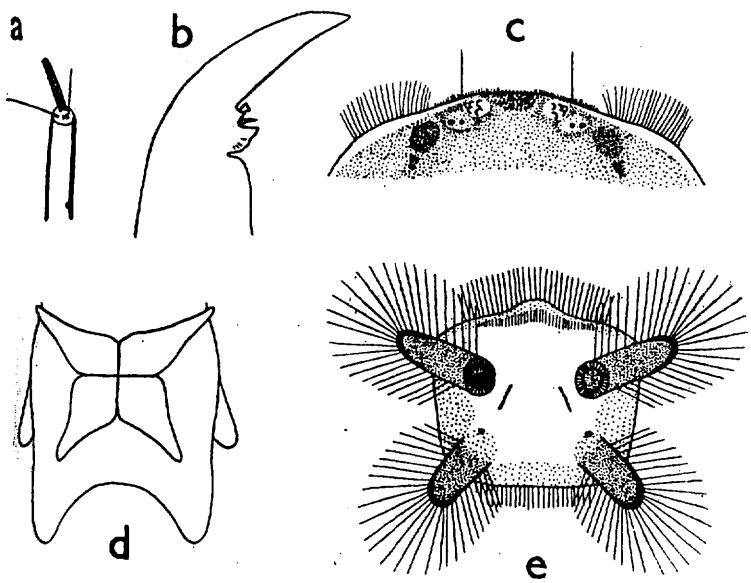
Limnophila (Limnophila)

Anal segments of Limnophila larvae



L. punctata (Schr.)

from Brindle, 1958



LIMNOPHILA (*LIMNOPHILA*) *PUNCTATA* Schr.
Fig. 12: (a) antenna. (b) mandible. (c) labrum. (d) anal papillae. (e) spiracular disc.

from Brindle + Bryce, 1960 Palearctic sp.

Limnophila (Phylidorea)

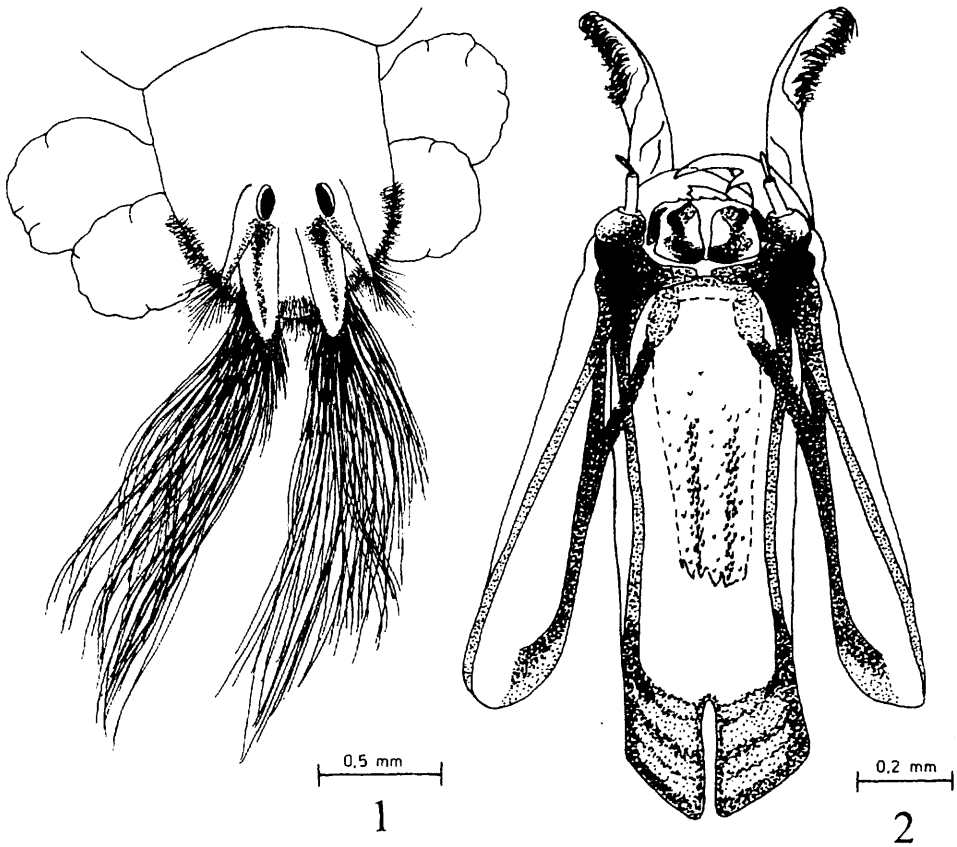
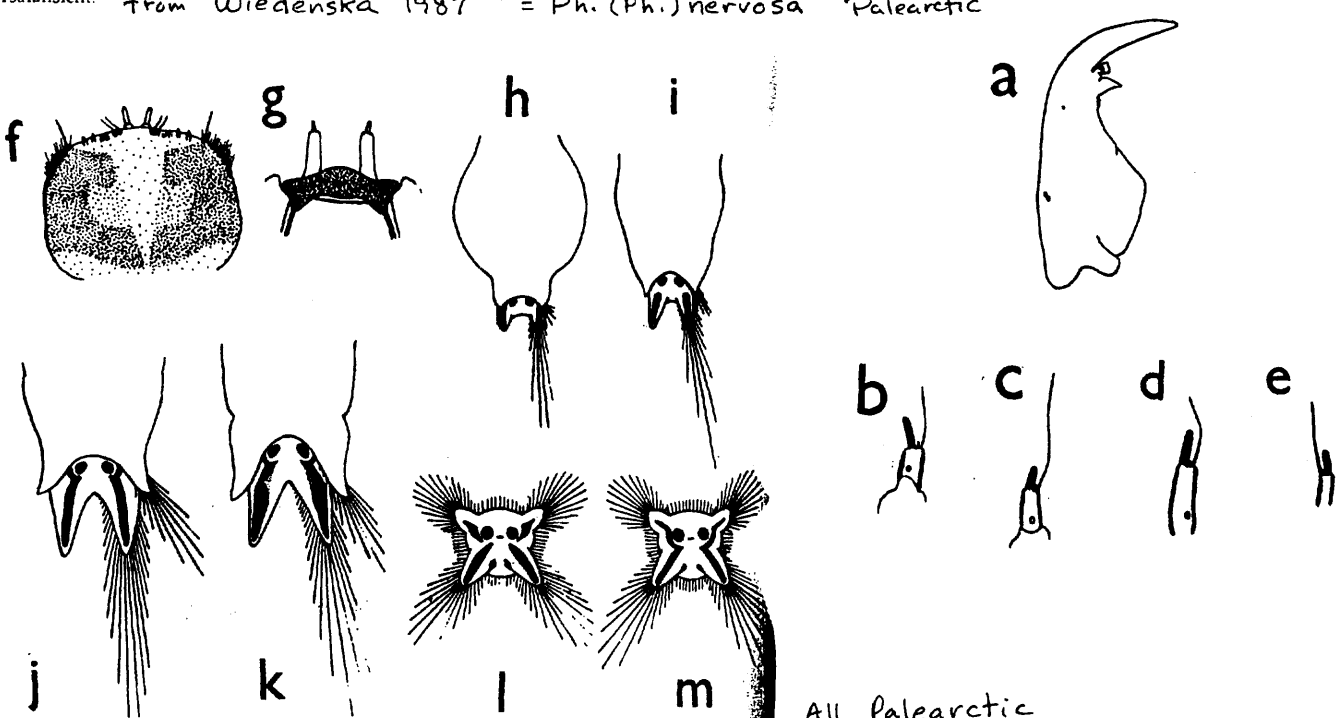


Fig. 1. Analsegment von *Phylidorea* (*Ph.*) *nigricollis*. Dorsalansicht. Fig. 2. Kopfkapsel *Phylidorea* (*Ph.*) *nigricollis*. Dorsalansicht. from Wiedenska 1987 = Ph. (Ph.) nervosa Palearctic



SUBGENERA *PHYLIDOREA* AND *IDIOPTERA*

Fig. 13: (a) *lineola*, mandible. (b) *lineola*, antenna. (c) *fulvonervosa*, antenn (d) *meigeni*, antenna. (e) *pulchella*, antenna. (f) *lineola*, labrum. (g) *lineo* hypostomium. ((h) *squalens*, anal segment, dorsal view. (i) *pulchella*, an segment, dorsal view. (j) *ferruginea*, anal segment, dorsal view. (k) *fulvon vosa*, anal segment, dorsal view. (l) *lineola*, spiracular disc. (m) *ferrugin* spiracular disc.

All Palearctic

from Brindle and Bryce, 1960
= Limnophila (Idioptera) pulchella.
= L. (Paraphylidorea) fulvonervosa
others = L. (Phylidorea)

Limonia s.l. review of larval habitats

As might be expected in a group so vast and diversified as is the present one, the immature stages ou the various species of *Limonia*, as known, frequent a wide range of ecological habitats, including virtually all those to be found in the entire family Tipulidae. At this time I am providing a broad distribution of such habitats, arranged from the aquatic to the terrestrial types. More specific details will be given under the discussions of the individual local subgenera.

1. Marine species. Living in the intertidal zone among growths or deposits of algae on the earth or rocks. Included subgenera: *Limonia, Dicranomyia, Geranomyia, Idioglochina*. The last-named group, very characteristic of the Pacific islands, will probably be found to be restricted to this type of habitat. A small number of species of *Dicranomyia* live in comparable situations inland where the saline content of the water is even higher, as the Great Salt Lake, Utah, U.S.A.

2. Fresh-water species. Living in water but coming to the surface for oxygen and moving to dryer areas for the purpose of pupation. Other species live in or beneath a layer or film of algal growth, with the water percolating through or flowing over them (hygropetric); still other species inhabit algal or mossy growths in streams. Included subgenera: *Limonia, Dicranomyia, Geranomyia, Alexandriaria*. No species of *Limonia* is yet known that is as strictly aquatic as is *Antocha* (Notes, VIII) or *Aphrophila* (Notes, II).

3. Bryophilous species. Living in or beneath moist to saturated mats or cushions of mosses or liverworts growing on earth or rocks. Included subgenera: *Libnotes, Dicranomyia, Geranomyia*.

4. Living in rich organic earth or mud, as at the margins of rills, streams, lakes or other water bodies, or in the comparable organic soil of swamps and marshes; in leaf drift gathered at stream margins or in wet pockets in woods. Included subgenera: *Limonia, Dicranomyia*.

5. In sandy, gravelly or loamy soil, with but slight humus, at margins of streams or ponds. Included subgenus: *Rhipidia*.

6. Beneath leaf mold in rich moist to saturated humus soil in woods. Included subgenera: *Limonia, Rhipidia, Dicranomyia*.

7. Living in wet or saturated decaying wood that is permeated with fungous mycelia; in fermenting sap beneath bark of trees. Included subgenera: *Limonia, Metalimnobia, Discobola, Rhipidia*.

8. In fungi, either woody or fleshy, sometimes in advanced stages of decay; in the mycelia of such fungi penetrating decaying wood. Included subgenus: *Limonia, Metalimnobia*.

9. In decaying animal or plant materials, as in piles of rotting stems, fruits or inflorescence, in various stages of putrefaction, including banana, taro and other plant species. Included subgenera: *Limonia, Libnotes, Rhipidia*.

10. Living in small gelatinous globules attached to the tips of leaves of tropical plants, as palms. Included subgenus: *Geranomyia*.

11. Mining leaves. Included subgenus: *Dicranomyia*. To date only two leaf-mining craneflies have been recorded, one in the Hawaiian Islands, the other in Samoa.

From Alexander, 1950

All stages are found together on the piers. The eggs are laid in the soft spots in the old wood, where the surface of the pier is kept wet, but not continually covered by water, in the zone of the "skin algae." The larvae live exposed or thinly algae covered, and crawl about slowly over the wet surface. They are greenish in color and very inconspicuous. In a cavity among the stems of the dwarf mosses[1] in a crevice at the upper limit of the wet area the larva spins about itself a sheet of tissue and fastens bits of moss stems and leaves to its outside, [fig. 9] and transforms inside the tube thus formed into a pupa. The tube is longer than its body, and the pupa moves in or out at will, doubtless by the aid of the hooks at the ends of its body.

The larva measures in total length 10 to 15 mm, according to the state of extension of its body, and its diameter is, correspondingly 1.5 to 2 mm. It is cylindric, abruptly tapering posteriorly on the last abdominal segment. The head is wholly retracted within the swollen prothorax: extracted therefrom, the head shows a broad middle pale yellow band, and its sides are black from the base of the antennae backward. The labrum is transversely oval, with a margin of close set scurfy hairs. The clypeus is one fourth broader than the labrum, yellow with parallel sides, but emarginate on the front for the reception of the labrum, there are three recurved stout setae on the lateral margins of the clypeus each side, and one on each angle and two upon its disk.

Fig. 9

There are no legs, but there is a scurfy pubescent creeping fold on the under surface of the meso- and metathorax and a similar one on the first abdominal segment: and there are much larger, transversely placed, muscular, scurfy-skinned creeping ridges on the under surface of abdominal segments 2-7 toward the front of each segment; and on these same abdominal segments on the dorsum, but not extending down on the sides, there are transverse bands of scurfiness differentiated from the general pubescence, in corresponding positions. The dorsum is covered with close set pubescence, greenish brown in color with an interrupted middorsal row of alternating paler dots and cross marks.

The respiratory disk of the larva [fig. 10] is channelled on the median line, with sloping sides that fold together when under water. Its border is fringed with short hairs, and is destitute of fleshy tubercles. The spiracles are oval. Four retractile fleshy anal gills are protruded for respiration under water, when the disk is closed.

The pupa, withdrawn from its tube [fig. 9] is smooth and shining, pale brownish on ends, and measures 8 mm in length and 1.5 mm in diameter. The front of the thorax is upcurved dorsally. The respiratory processes of the prothorax are broad, laterally flattened, obtuse at apex and each bears a basal recurved sharp hook on its dorsal side. The numerous minute divisions of the spiracular orifice are arranged in a semicircular row along the obtuse tip of the process. The dorsum of the thorax shows a faint fretwork of raised lines on its surface. The abdomen is smooth, but bears transverse lines of scurfy pubescence in positions corresponding to those already described for the larvae. The abdomen terminates in a pair of stout, sharp recurved hooks.

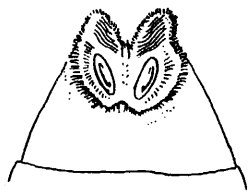


Fig. 10

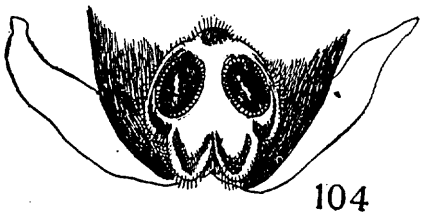
In all the pupae found except a few of the oldest, that were nearly ready for transformation, there were chitin tubes protruding from the spiracles of the middle abdominal segments. These were the linings of the larval tracheae, not wholly withdrawn from the spiracles. It is possible that these may serve a respiratory function for a pupa provided otherwise with only aerial respiratory apparatus yet living within the reach of the higher waves: that is to say, they may possibly act as do the tube gills of the Simulium pupa, obtaining oxygen from the water flowing over them. In that case both larva and pupa would be amphibious in respiratory habits.

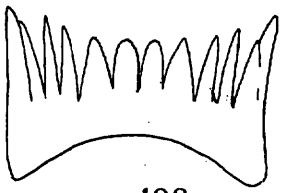
from Needham 1908 Nearctic sp.

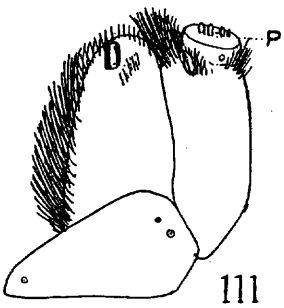
[1] These mosses were kindly named for me by Professor Barnes of Chicago University, as Bryum binum Schoeb. var. varium Lindb. and Amblystegium orthocladon Lesq. and James.

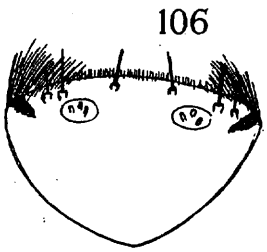
Limonia (Subgenus?)simulans

Limonia (Dicranomyia)







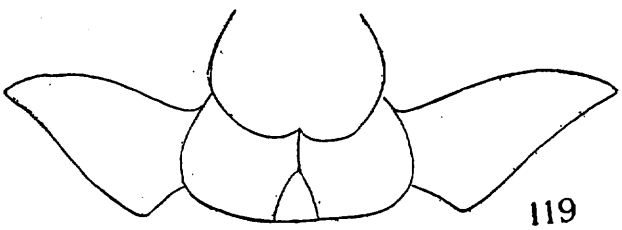


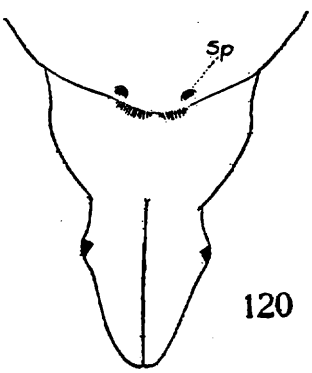
DICRANOMYIA BADIA AND D. STULTA

Dicranomyia badia: 104, spiracular disk
Dicranomyia stulta, larva: 105, spiracular disk; 106, labrum; 107, mentum; 108, hypopharynx; 109, antenna; 110, mandible; 111, maxilla

from Alexander 1920
Nearctic spp.

badia = Limonia
(Dicranomyia)
humidicola

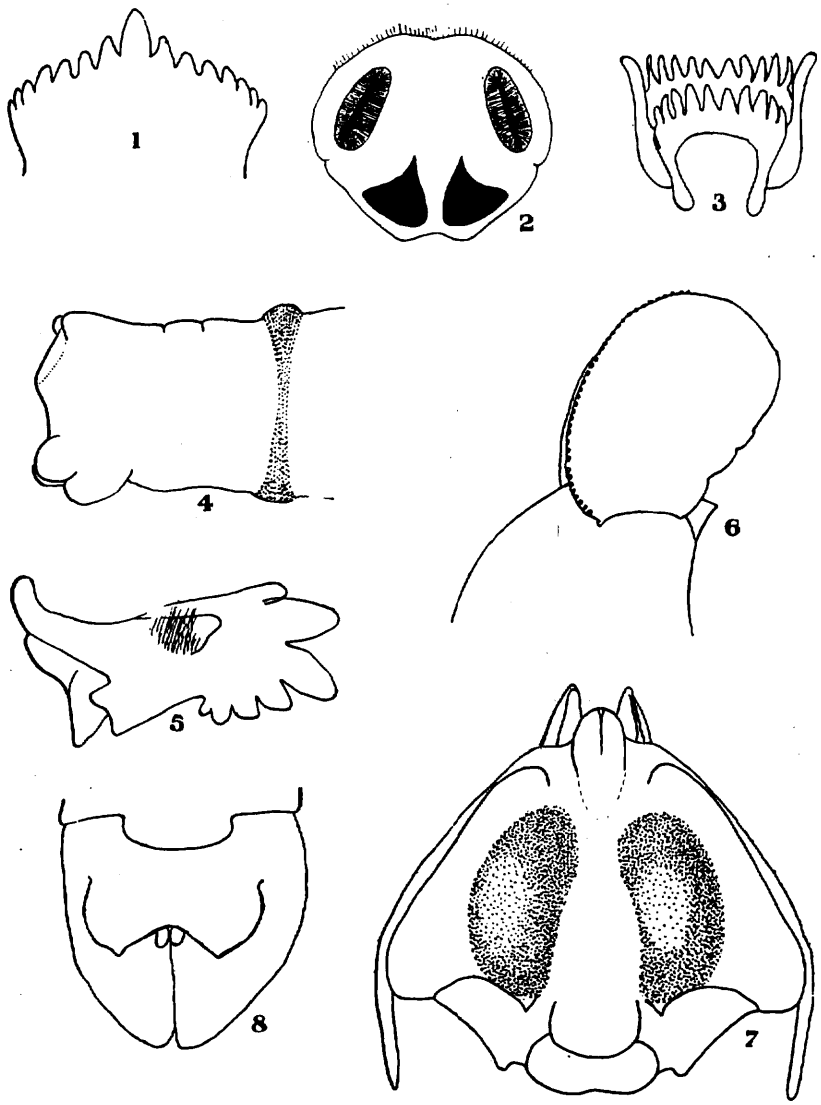




DICRANOMYIA BADIA, PUPA

118, Lateral aspect; 119, mouth parts; 120, female cauda, dorsal aspect

Limonia (Dicranomyia)



EXPLANATION OF FIGURES

1. Mentum of larval head capsule, ventral view.
2. Spiracular disk of larvae, caudal view
3. Hypopharynx of larval head capsule, dorsal view.
4. Caudal end of larva, side view, showing anal gills.
5. Left mandible of larval head capsule, mesal surface.
6. Pronotal breathing-horns of pupa, side view.
7. Head of pupa, ventral view. The apices of the pronotal breathing-horns are shown on either side of the median cephalic crest.
8. Cauda of male pupa, dorsal view.

From Rogers 1932
Nearctic species - L. (D.) floridana - intertidal

Limonia (Dicranomyia)

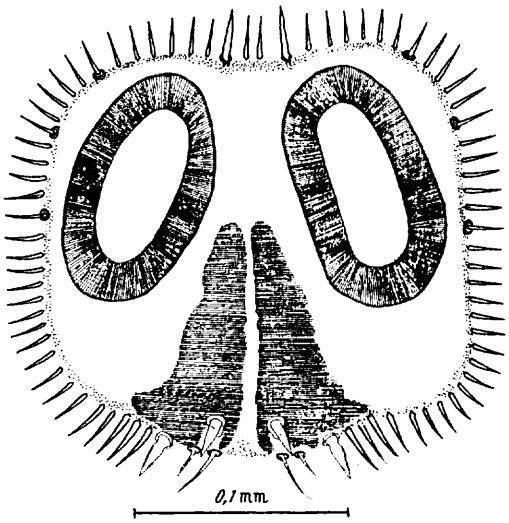


Abb. 30

Abb. 31

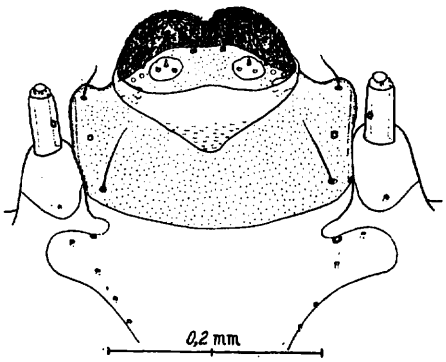


Abb. 33

Abb. 34

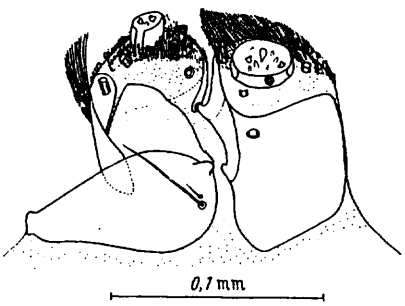


Abb. 35

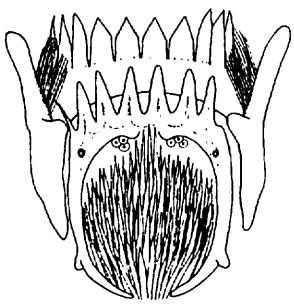


Abb. 36

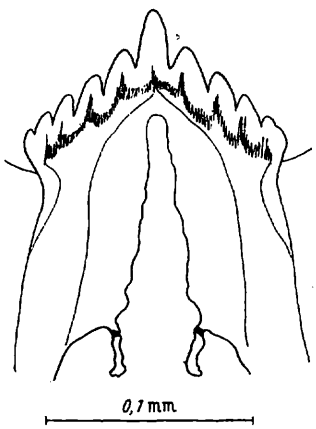


Abb. 37

Abb. 29—31. *Limonia (Dicranomyia) modesta*

Abb. 29. Larve im IV. Stadium, von links. Dörnchenzone am Vorderrand des 2. Segmentes nur ventral ausgebildet (vgl. Abb. 20)

Abb. 30. Stigmenfeld, IV. Stadium

Abb. 31. Stigmenfeld, I. Stadium

Abb. 33—37. *Limonia (Dicranomyia) modesta*. IV. Stadium

Abb. 33. Vorderteil der Frons; Antennen; Clypeus; Labrum; Vorderteil des Epipharynx

Abb. 34. Rechte Mandibel von dorsal

Abb. 35. Linke Maxille von ventral

Abb. 36. Hypopharynx von ventral

Abb. 37. Hypostomium und Hypostomalbrücke von ventral. An der Zahnleiste ist rechts (im Bilde links) ein 5. Seitenzahn angedeutet

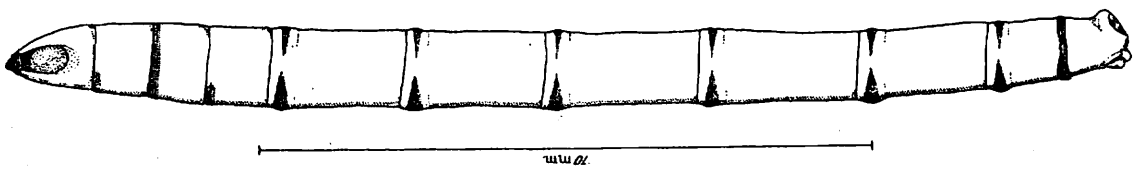


Abb. 29

From Lindner, 1959
Palearctic species

Limonia (Dicranomyia)

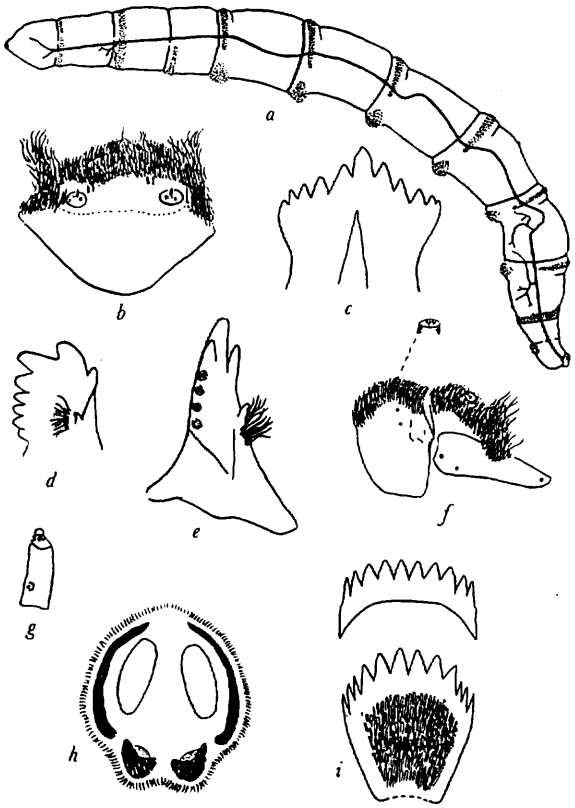


FIG. 51.—Larva of *Limonia tipulipes* (Karsch). *a*, lateral view of larva; *b*, dorsal view of labrum; *c*, mentum; *d*, mandible apex (lateral view); *e*, mandible (dorsal view); *f*, maxilla; *g*, antenna; *h*, spiracular disc; *i*, hypopharynx.

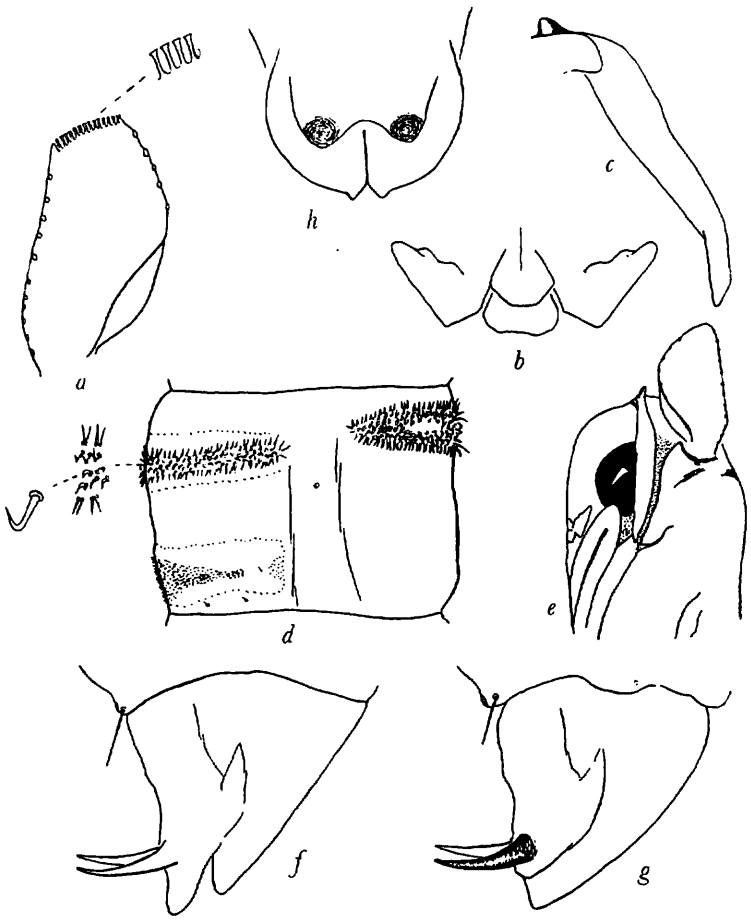
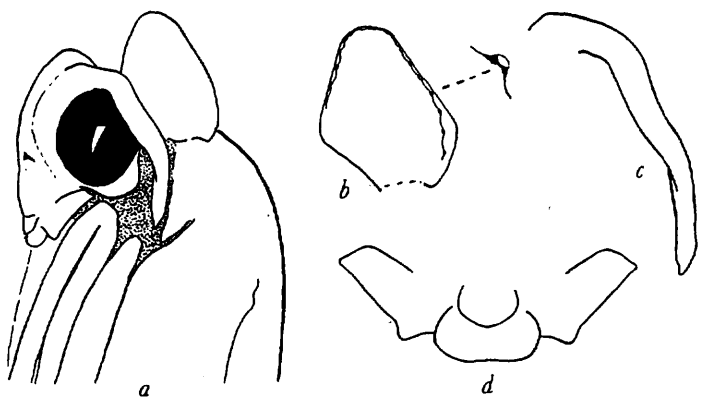


FIG. 52.—Pupa of *Limonia tipulipes* (Karsch). *a*, pronotal breathing horn, with apex enlarged; *b*, mouth parts; *c*, antennal sheath; *d*, abdominal segment five (lateral view), with further enlargement of hooks and spines; *e*, anterior portion of pupa (lateral view); *f*, female cauda (lateral view); *g*, male cauda (lateral view); *h*, male cauda (dorsal view).



From Wood, 1952
African species

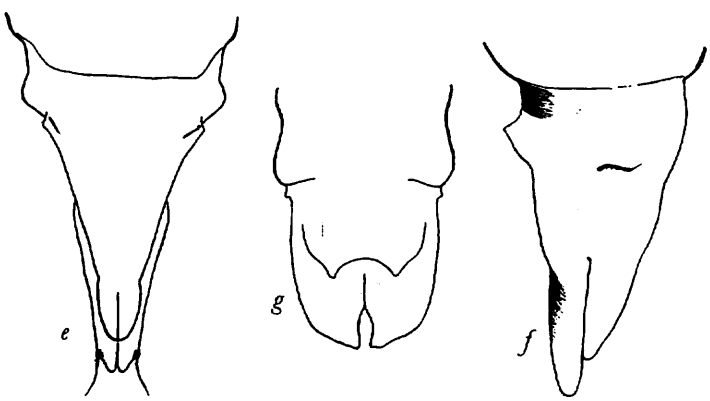


FIG. 58.—Pupa of *Limonia capicola* (Alex.). *a*, head portion of pupa; *b*, breathing horn; *c*, antennal sheath; *d*, mouth parts; *e*, female cauda (ventral aspect); *f*, female cauda (lateral aspect); *g*, male cauda (dorsal aspect).

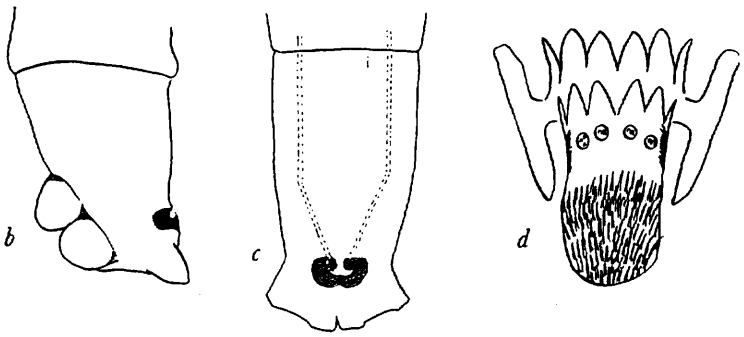
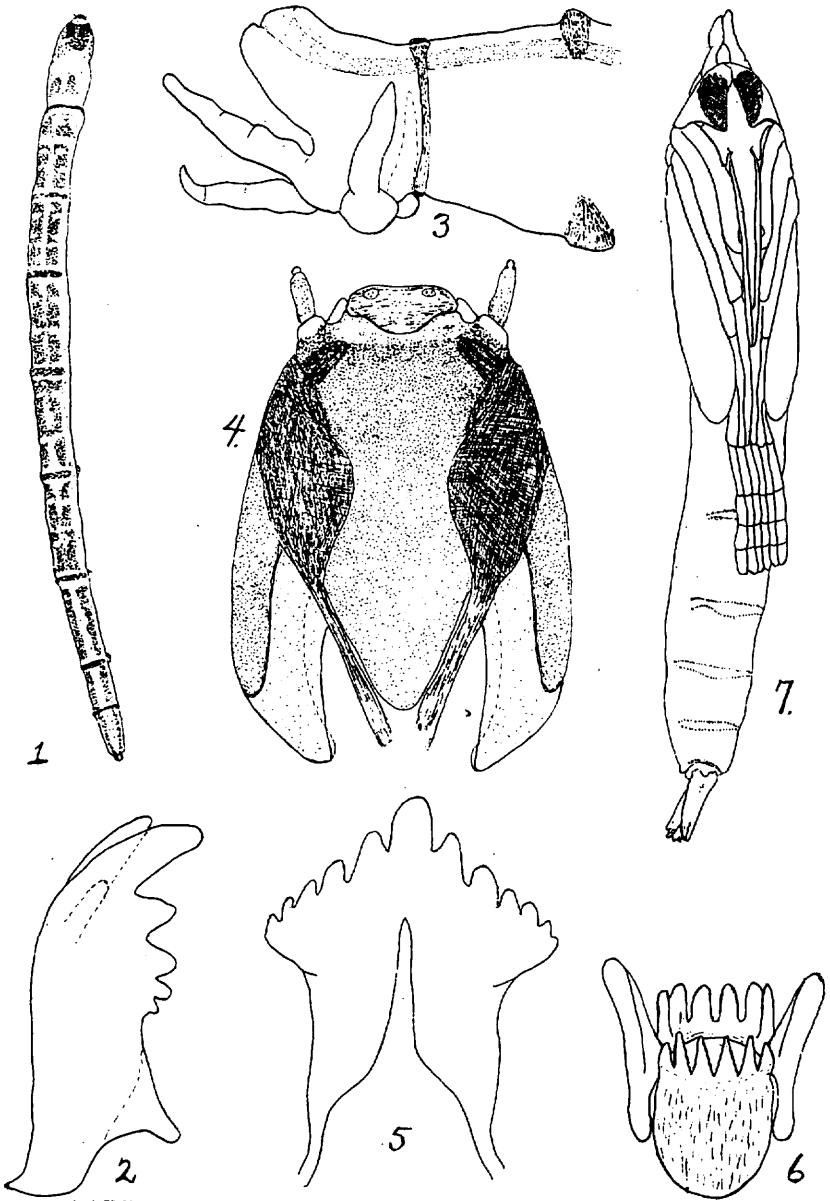


FIG. 57.—*Limonia capicola* (Alex.). *a*, wing of imago; *b*, end of abdomen of larva (lateral view); *c*, ditto (dorsal view); *d*, hypopharynx.

Limonia (Geranomyia)

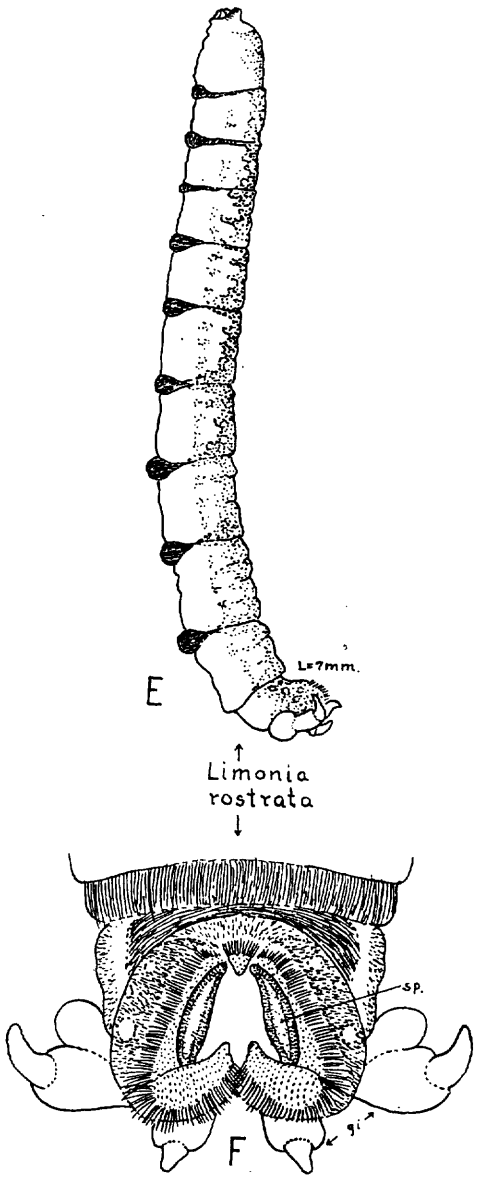


LARVA AND PUPA OF GERANOMYIA ROSTRATA (SAY)

EXPLANATION OF FIGURES

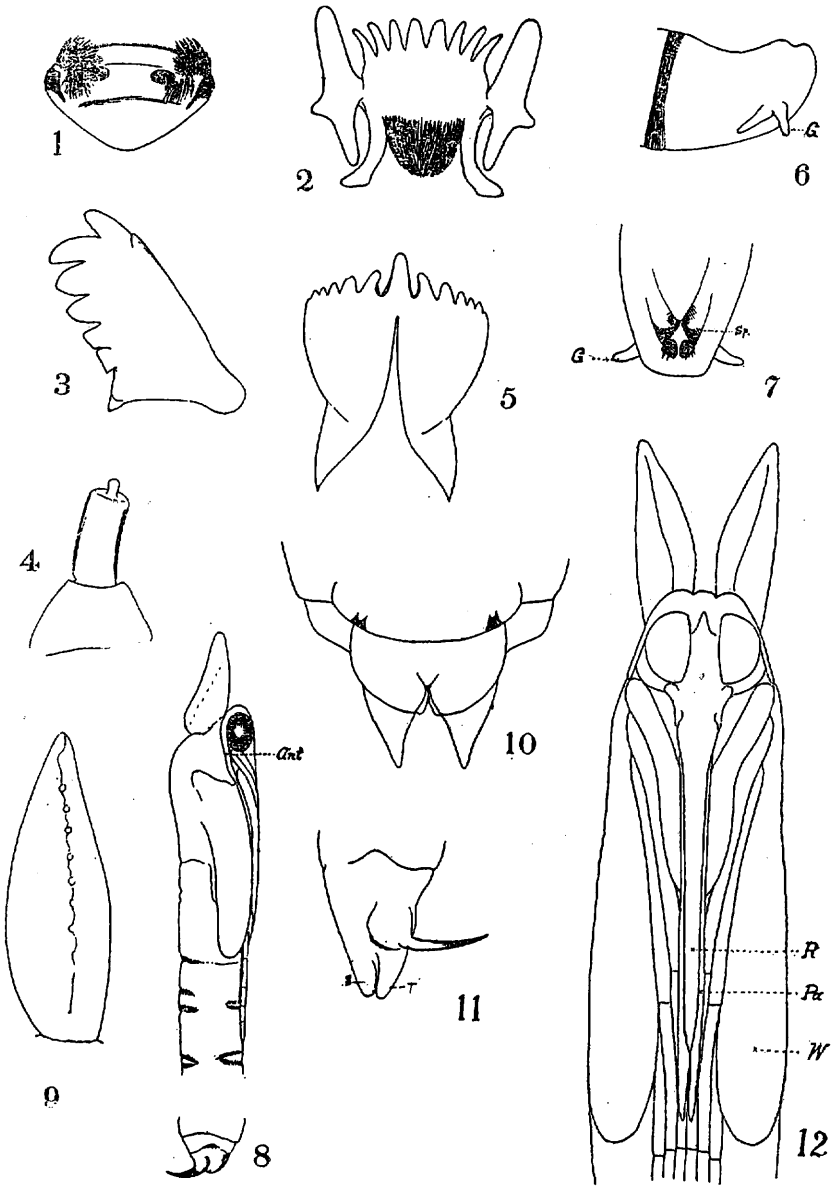
1. Larva, dorsal view, x. Drawn from alcoholic specimen.
2. Mandible of larva.
3. Anal gills and posterior segments of larva, drawn from the side.
4. Head capsule of larva, dorsal view, x.
5. Mentum of larva.
6. Hypopharynx of larva, from beneath.
7. Female pupa, ventral view, x.

from Rogers, 1927 Nearctic sp.



from Peterson 1960

Limonia (Geranomyia)



Ant—antennal sheath; G—gills; Pa—sheaths of the paraglossa; R—sheath of the rostrum; S—sternal valves of ovipositor; Sp—larval spiracles; T—tergal valves of ovipositor; W—wing sheath.

Fig. 1. Larva of *Geranomyia canadensis;* labrum.

Fig. 2. Larva of *Geranomyia canadensis*; hypopharynx.

Fig. 3. Larva of *Geranomyia canadensis;* mandible.

Fig. 4. Larva of *Geranomyia canadensis*; antenna.

Fig. 5. Larva of *Geranomyia canadensis;* mentum.

Fig. 6. Larva of *Geranomyia canadensis;* lateral aspect of caudal end.

Fig. 7. Larva of *Geranomyia canadensis;* dorsal aspect of caudal end.

Fig. 8. Pupa of *Geranomyia canadensis;* lateral aspect of male.

Fig. 9. Pupa of *Geranomyia canadensis;* dorsal aspect of pronotal breathing-horn.

Fig. 10. Pupa of *Geranomyia canadensis;* ventral aspect of male cauda.

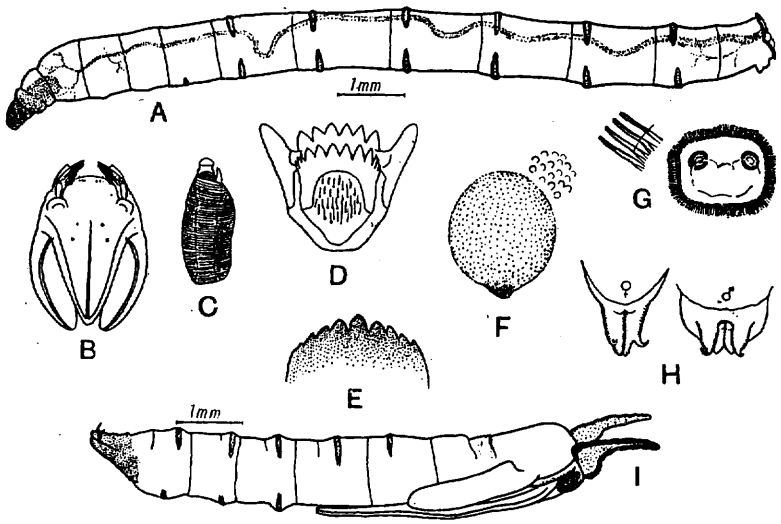
Fig. 11. Pupa of *Geranomyia canadensis;* lateral aspect of female cauda.

Fig. 12. Pupa of *Geranomyia canadensis;* ventral aspect of male.

from Alexander and Malloch 1920

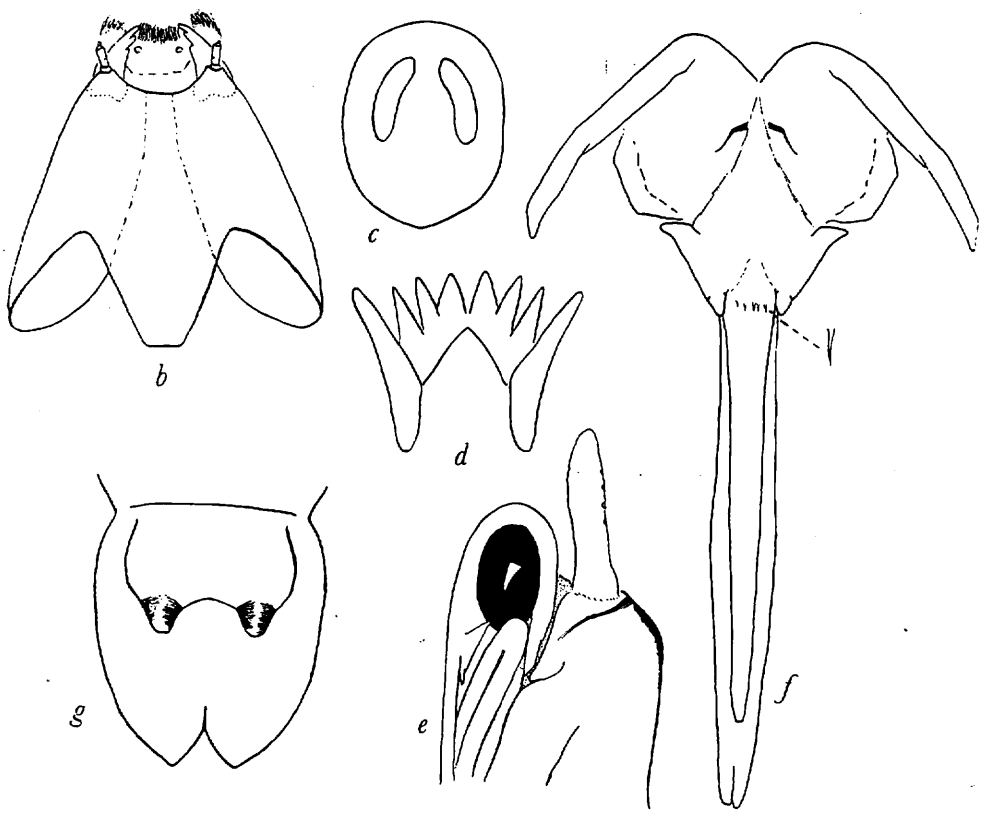
Nearctic Sp.

Limonia (Geranomyia)



From Saunders, 1930
Palearctic

Geranomyia unicolor. (A) larva, entire, lateral view; (B) head-capsule; (C) antenna (D); hypopharynx; (E) labial plate; (F) egg, with details of surface; (G) spiracular disc, with details of fringe; (H) pupal extremities, ♀, ♂; (I) pupa entire, lateral view.



from Wood, 1952
African sp.

FIG. 59.—*Limonia sexocellata* (Alex.). Imago: *a*, wing. Larva: *b*, head capsule (dorsal view); *c*, spiracular disc; *d*, hypopharynx (dorsal plate and hinge plates). Pupa: *e*, anterior portion; *f*, head region (ventral view); *g*, male cauda (dorsal aspect).

Limonia (Idioglochina)

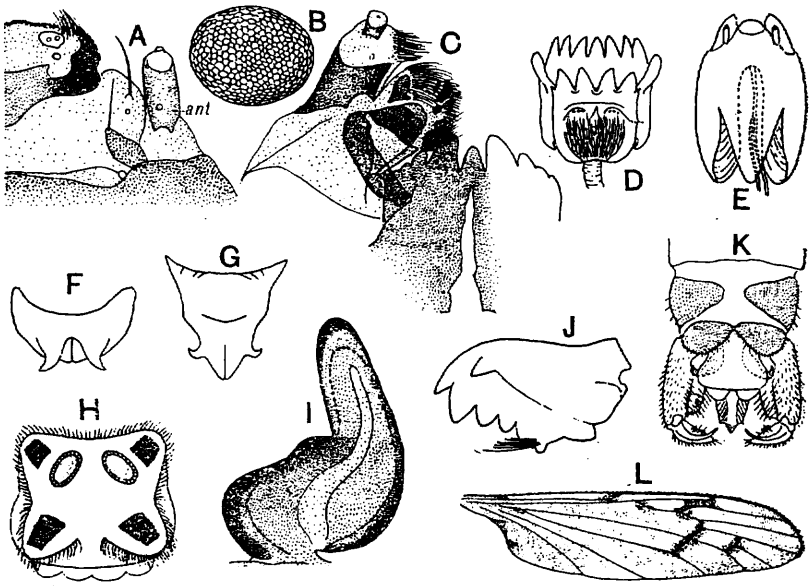
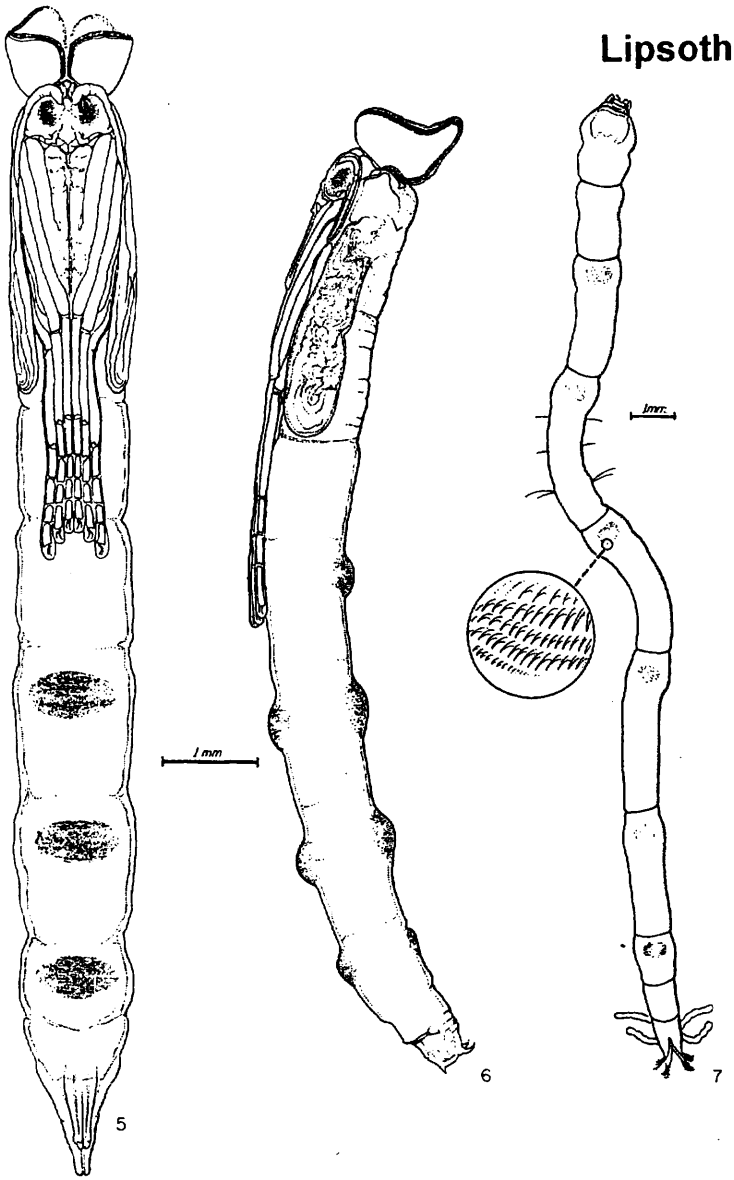


Fig. 7. *Dicranomyia signipennis*. A, right half of labrum, dorsal view, and antenna; B, egg; C, right maxilla and labium, ventral view; D, hypopharynx; E, larval head-capsule, dorsal view; F, last pupal segment, ♂; G, last pupal segment, ♀; H, spiracular disc of larva; I, pupal prothoracic respiratory horn, lateral view; J, mandible; K, ♂ hypopygium, ventral view; L, ♂ wing.

from Saunders, 1928 = Limonia (Idioglochina) marmorata

Nearctic sp. (intertidal)

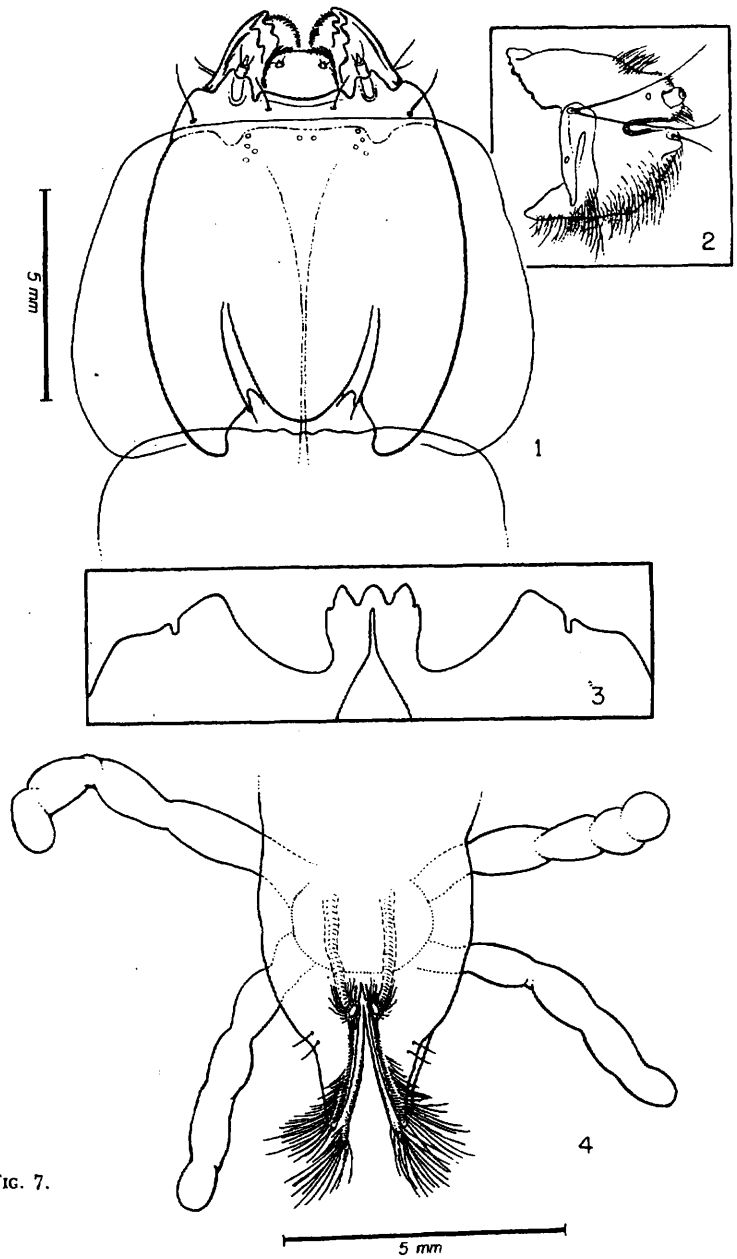
Lipsothrix



Immature stages of *Lipsothrix sylvia* (Alexander)

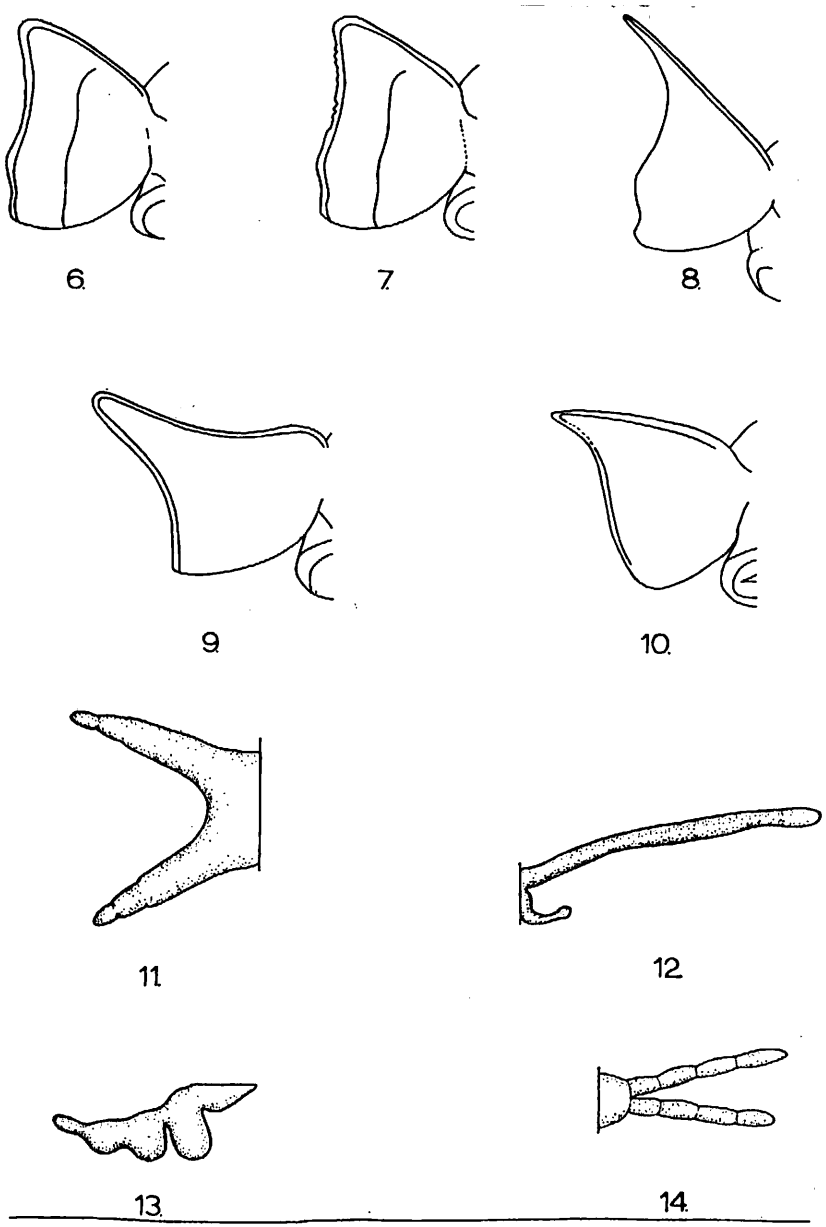
FIG. 5. Pupa, female, ventral aspect. FIG. 6. Pupa, male, left lateral aspect. FIG. 7. Larva, fourth instar, dorsal aspect. Inset: Microscopic hooks of creeping welt.

from Rogers and Byers, 1956
Nearctic sp.



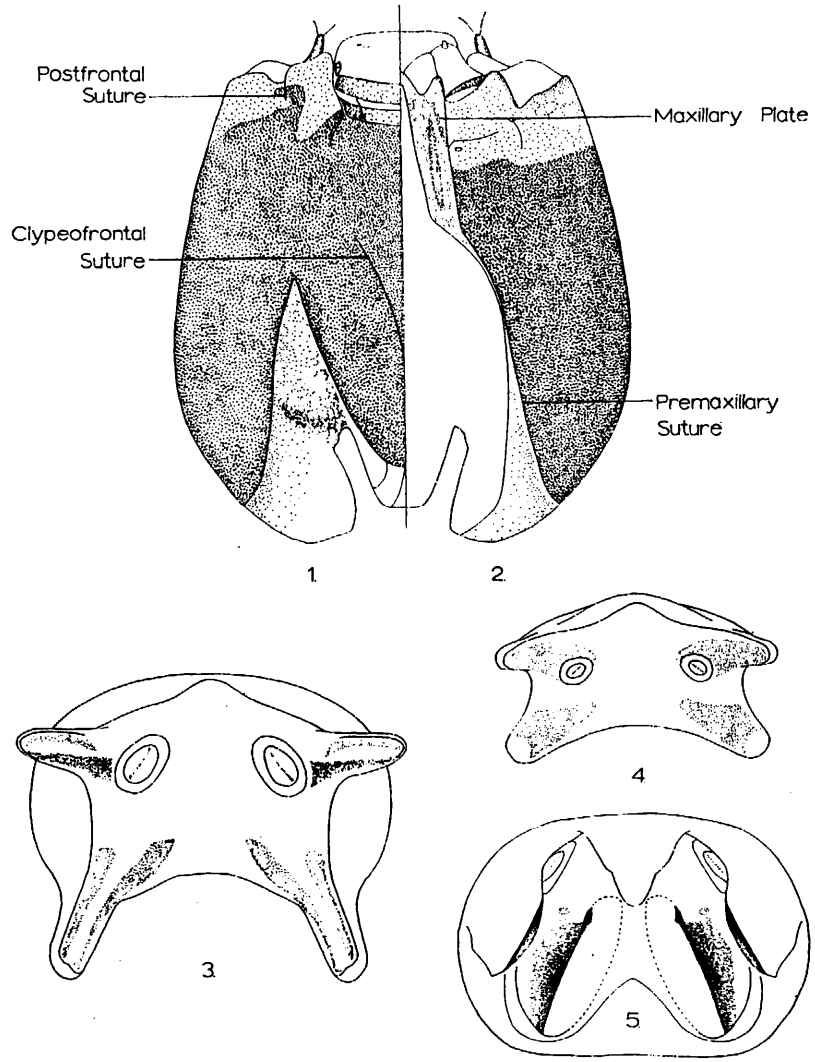
Details of larva of *Lipsothrix sylvia* (Alexander)

FIG. 1. Head capsule and prothoracic segment of fourth instar larva, dorsal aspect. FIG. 2. Right maxilla, ventrolateral aspect. FIG. 3. Mentum and anteroventral margin of head capsule, ventral aspect. FIG. 4. Terminal abdominal structures, showing spiracles, anal gills, and caudal lobes.



EXPLANATION OF FIGURES

Figs. 6–10. Breathing horns of *L. shasta*, *L. nigrilinea*, *L. fenderi*, *L. hynesiana*, and *L. sylvia*, respectively. Figs. 11–14. Anal lobe structure of *L. hynesiana*, *L. fenderi*, *L. shasta*, *L. sylvia*, respectively.



EXPLANATION OF FIGURES

Figs. 1–2. *Lipsothrix shasta*, dorsal and ventral view of head capsule, respectively. Figs. 3–5. Spiracular disks of *L. hynesiana*, *L. nigrilinea*, and *L. fenderi*, respectively.

from Hynes, 1965

Lipsothrix

Lipsothrix

The characters used in the following keys to the immature stages can be applied to either living or preserved specimens. Although the fourth instars were used for the larval keys, the characters used for description will apply for all instars except the first, which appears to be different in structure from those of the later instars.

Key to the Larval Forms of the Genus Lipsothrix in North America

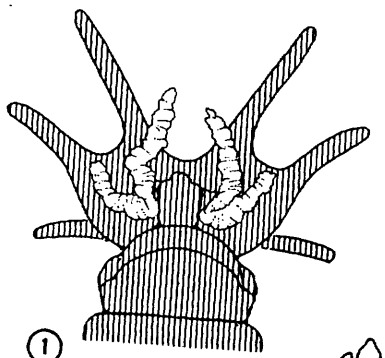
1. Spiracular disk with lobes expanded; inner surfaces and markings clearly seen 2
   Spiracular disk with lobes forming a terminal cone; inner surfaces and markings not clearly seen 4
2. Anal lobes with elliptical, bulbous expansions 3
   Anal lobes with no bulbous expansions ..... *L. hynesiana*
3. Spiracle with a darkened, central area ..... *L. nigrilinea*
   Spiracle without a darkened central area ..... *L. shasta*
4. Anal lobes subequal in size and shape (Fig. 14) ..... *L. sylvia*
   Anal lobes with anterior pair five to six times longer than posterior set ..... *L. fenderi*

from Hynes 1965 Nearctic spp.

Key to the Pupal Forms of the Genus Lipsothrix in North America

1. Breathing horns cuplike, with dorsocephalic edge of each horn extending forward 3
   Breathing horns with no such extension as described above 2
2. Anterior edge of breathing horns crenulate; apices of the leg sheaths mid-length of abdominal segment four ..... *L. nigrilinea*
   Anterior edge of breathing horns not crenulate; apices of leg sheaths at posterior margin of abdominal segment four ..... *L. shasta*
3. Dark seam extending from dorsal base to forward extension of breathing horn ..... *L. fenderi*
   Dark seam extending from dorsal base past forward extension to the ventrocephalic margin of the breathing horn 4
4. Dorsocephalic extension pointed or acute (Fig. 10) ..... *L. sylvia*
   Dorsocephalic extension rounded ..... *L. hynesiana*

Megistocera



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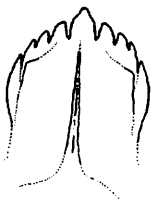

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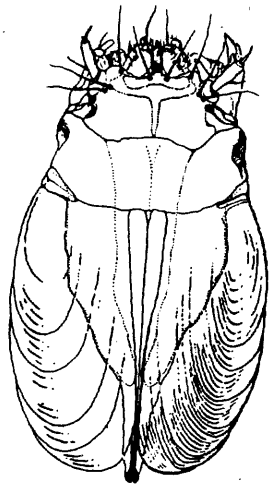

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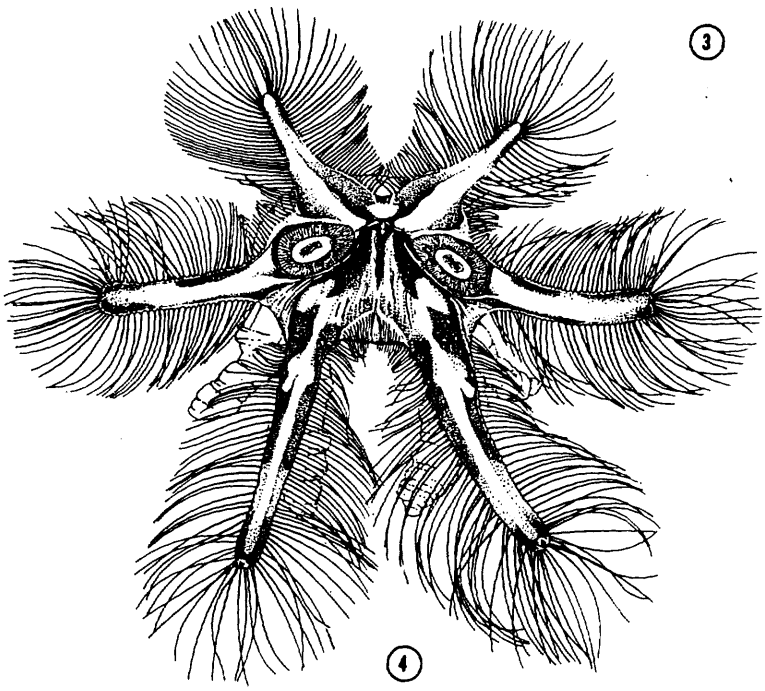

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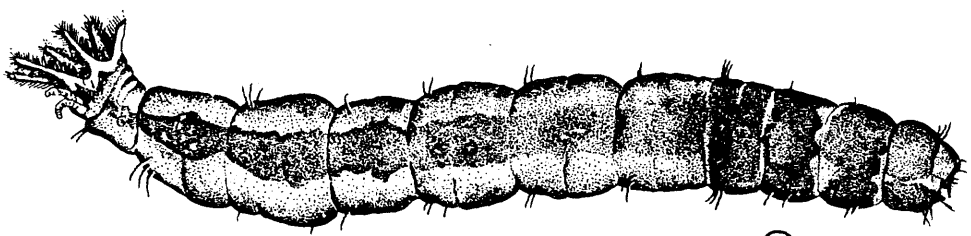

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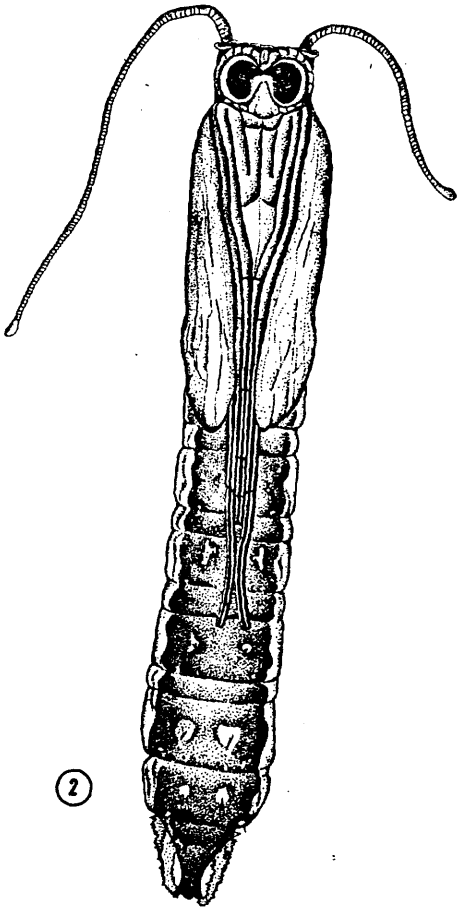

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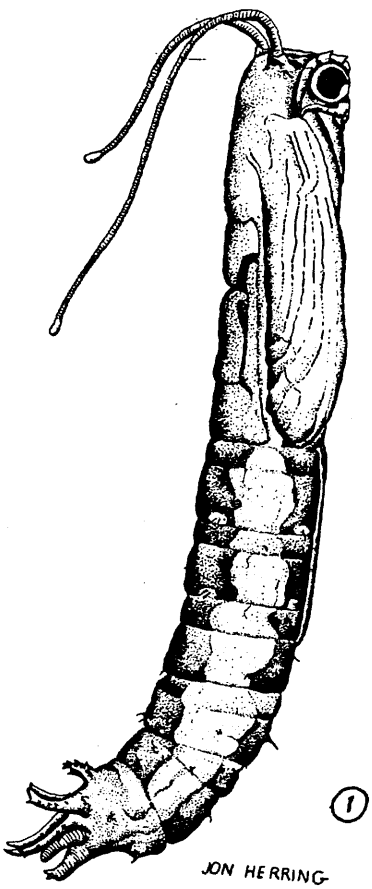
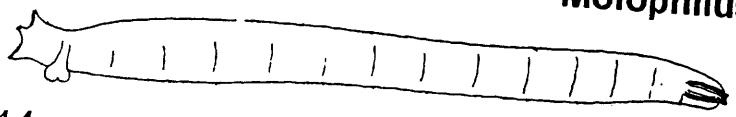


1

JON HERRING

From Rogers, 1949

Molophilus



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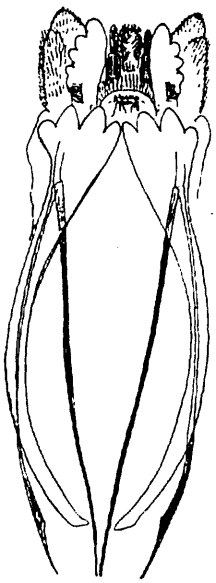

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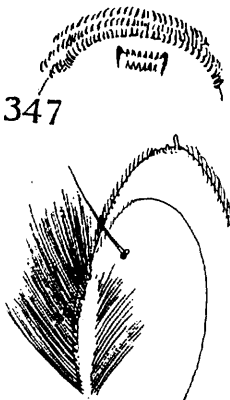
348



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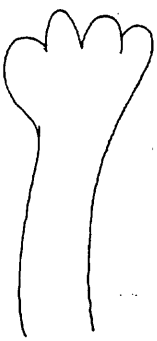
350

349



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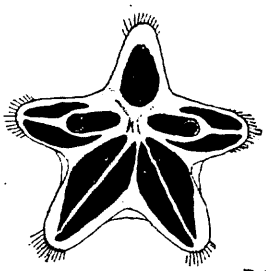
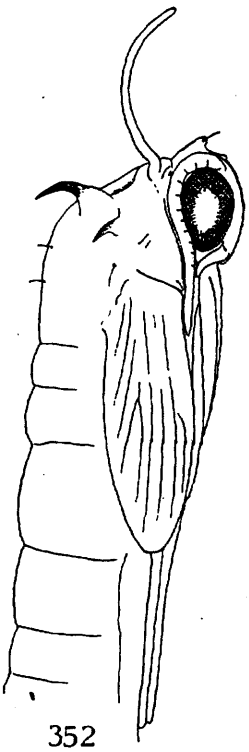


351

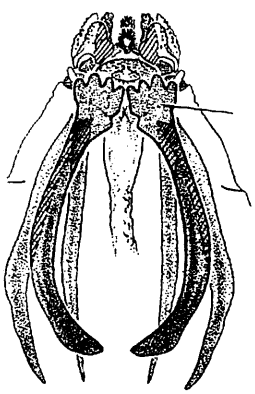


352

MOLOPHILUS HIRTIPENNIS, LARVA

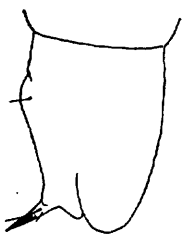
344, Lateral aspect; 345, head capsule, ventral aspect; 346, mental plate; 347, hypopharynx; 348, antenna; 349, mandible; 350, maxilla; 351, spiracular disk

from Alexander 1920
Nearctic sp.



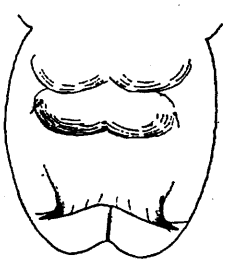
76 Molophilus sp.

from Alexander and Byers, 1981



353

355



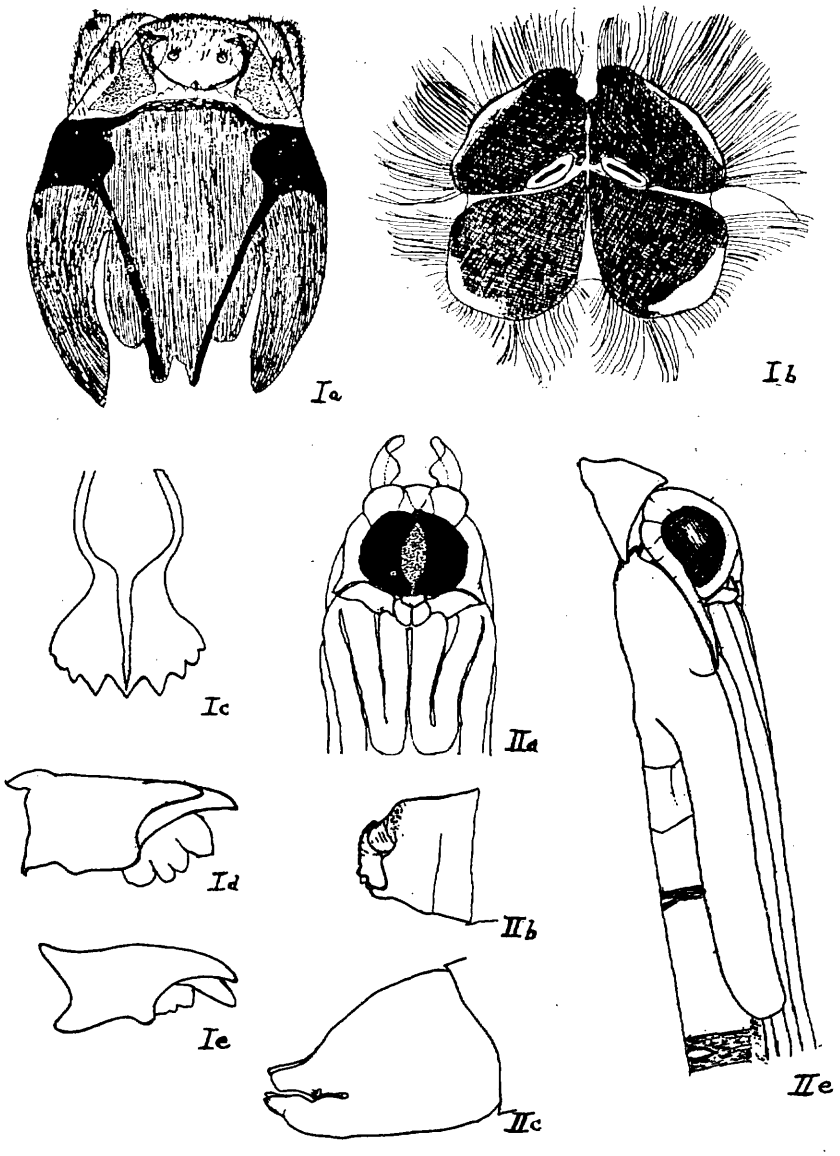
354

356

MOLOPHILUS HIRTIPENNIS, PUPA

352, Female, lateral aspect; 353, male cauda, lateral aspect; 354, male cauda, dorsal aspect; 355, female cauda, lateral aspect; 356, female cauda, dorsal aspect

Orimarga (Diotrepha)

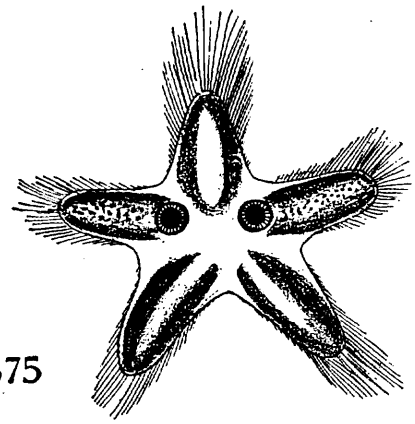


Larva and Pupa of Diotrepha mirabilis Osten Sacken.

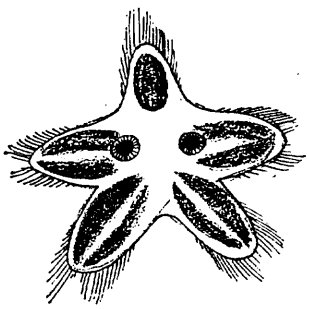
I a—Head capsule of larva, dorsal view.
I b—Spiracular disk of larva, caudal view.
I c—Mentum of larva.
I d—Mandible of larva, mesal view.
I e—Mandible of larva, dorsal view.
II a—Head of pupa, ventral view.
II b—Cauda of male pupa, scale larger than IIa and IIe.
II c—Cauda of female pupa, scale much larger than IIa and IIe.
II e—Head and thorax of pupa, lateral view.

from Rogers, 1927 Nearctic sp.

Ormosia (Ormosia)



375



379

374

ORMOSIA NUBILA,

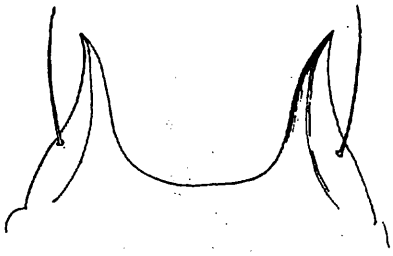
Ormosia nubila, larva: 374, mandible; 375, spiracular disk

Ormosia meigenii, larva: 379, spiracular disk

from Alexander 1920

nubila = Ormosia (O.) romanovichiana

Both nearctic spp.



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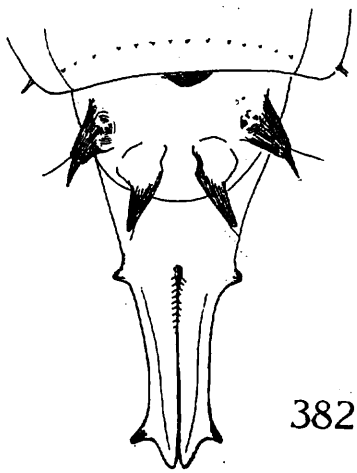


382

380

ORMOSIA NUBILA, PUPA

380, Female, lateral aspect; 381, cephalic crest of female, ventral aspect; 382, female cauda, dorsal aspect

Ormosia (Rhypholophus)

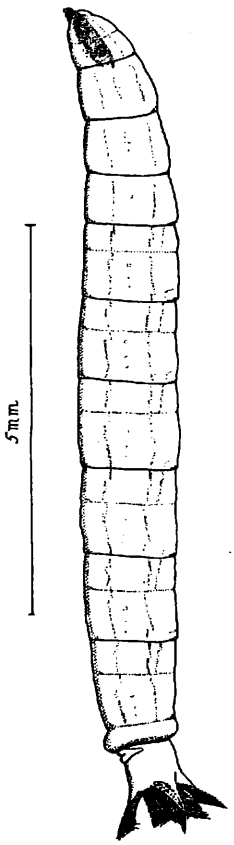


Abb. 67

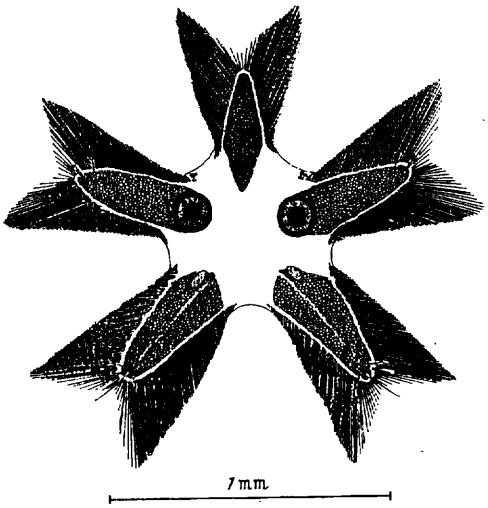


Abb. 68

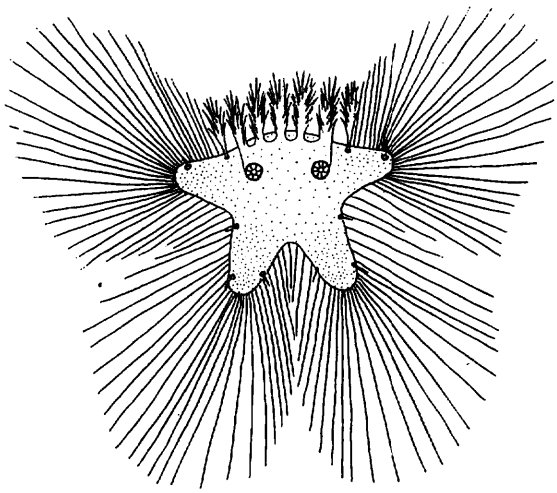


Abb. 69

Abb. 67—69. *Ormosia (Rhypholophus) haemorrhoidalis*

Abb. 67. Larve im IV. Stadium, von links. Punktiert eingezeichnet: die unbehaarten, daher heller erscheinenden Muskelansatzstellen

Abb. 68. Stigmenfeld, IV. Stadium

Abb. 69. Stigmenfeld, I. Stadium

from Lindner, 1959

Palearctic sp.

Ormosia (Rhypholophus)

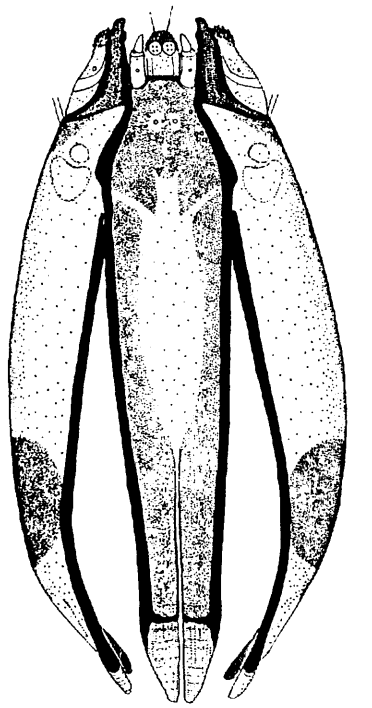


Abb. 70

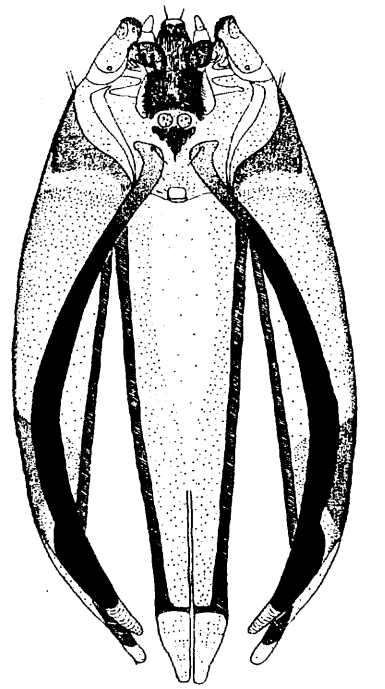


Abb. 71

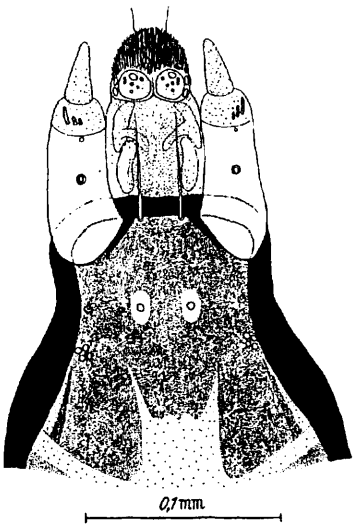


Abb. 72

Abb. 73

Abb. 70—73. *Ormosia (Rhypholophus) haemorrhoidalis.* IV. Stadium

Abb. 70. Kopfkapsel von dorsal. Vorn an den Lateralia sind die Umrisse der doppelten Stemmata punktiert eingezeichnet

Abb. 71. Kopfkapsel von ventral

Abb. 72. Frons; Antennen; Clypeus; Labrum

Abb. 73. Linke Mandibel, von der Labralseite aus gesehen. Basis (namentlich der lange hintere Gelenkzapfen, vgl. Abb. 70) perspektivisch verkürzt. Neben der oberen Borste am dorsalen Außenrand beginnt die Nahtlinie zwischen Distal- und Basalregion

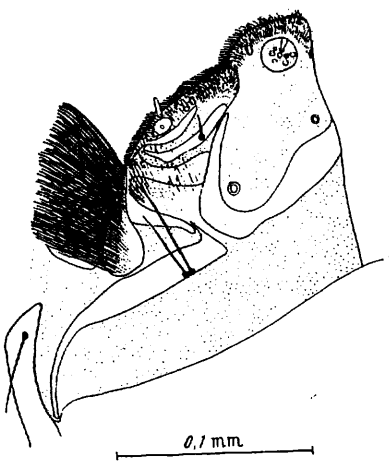


Abb. 74

Abb. 75

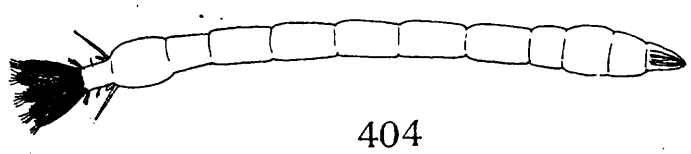
Abb. 74 und 75. *Ormosia (Rhypholophus) haemorrhoidalis.* IV. Stadium

Abb. 74. Linke Maxille von ventral

Abb. 75. Labialregion von ventral. Über den beiden runden Sinnesfeldern der Labialpalpenrudimente die Dörnchenreihen am Vorderrand des Hypopharynx, darüber die mit dichtstehenden Borsten bedeckten Laciniae

from Lindner, 1959
Palearctic sp.

Ormosia (Scleroprocta)



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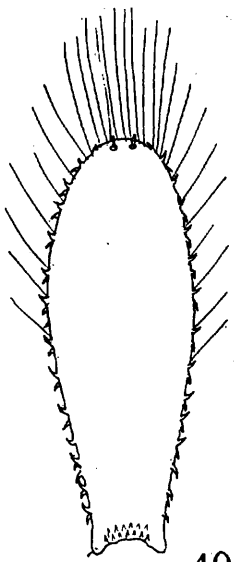

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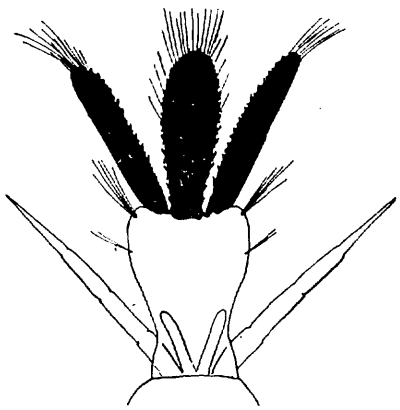
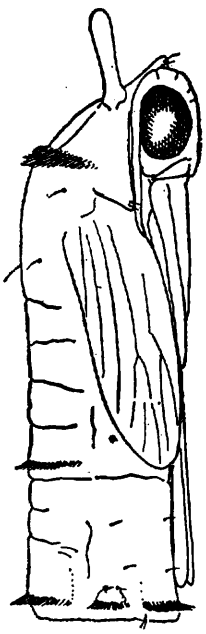


405

ERIOPTERINE NO. 1

Eriopterine No. 1, larva: 404, lateral aspect; 405, spiracular disk and anal gills; 406, lobe of spiracular disk, enlarged

= Ormosia (Scleroprocta) sp.
Prob. innocens



376

377

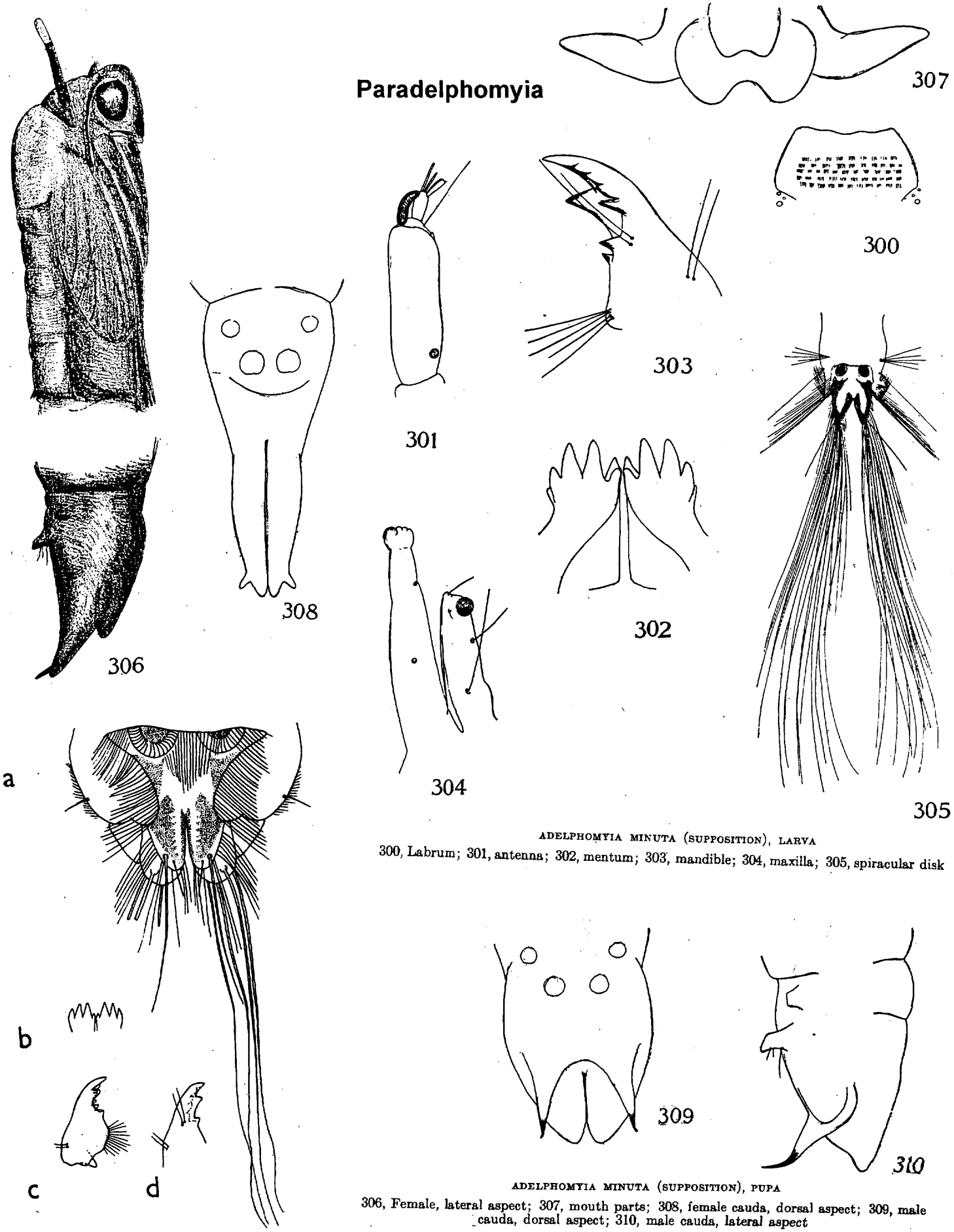
378

O. INNOCENS.

Ormosia innocens, pupa: 376, female, lateral aspect; 377, male cauda, dorsal aspect; 378, male cauda, lateral aspect

from Alexander, 1920
Nearctic sp.

Paradelphomyia



ADELPHOMYIA MINUTA (SUPPOSITION), LARVA

300, Labrum; 301, antenna; 302, mentum; 303, mandible; 304, maxilla; 305, spiracular disk

ADELPHOMYIA MINUTA (SUPPOSITION), PUPA

306, Female, lateral aspect; 307, mouth parts; 308, female cauda, dorsal aspect; 309, male cauda, dorsal aspect; 310, male cauda, lateral aspect

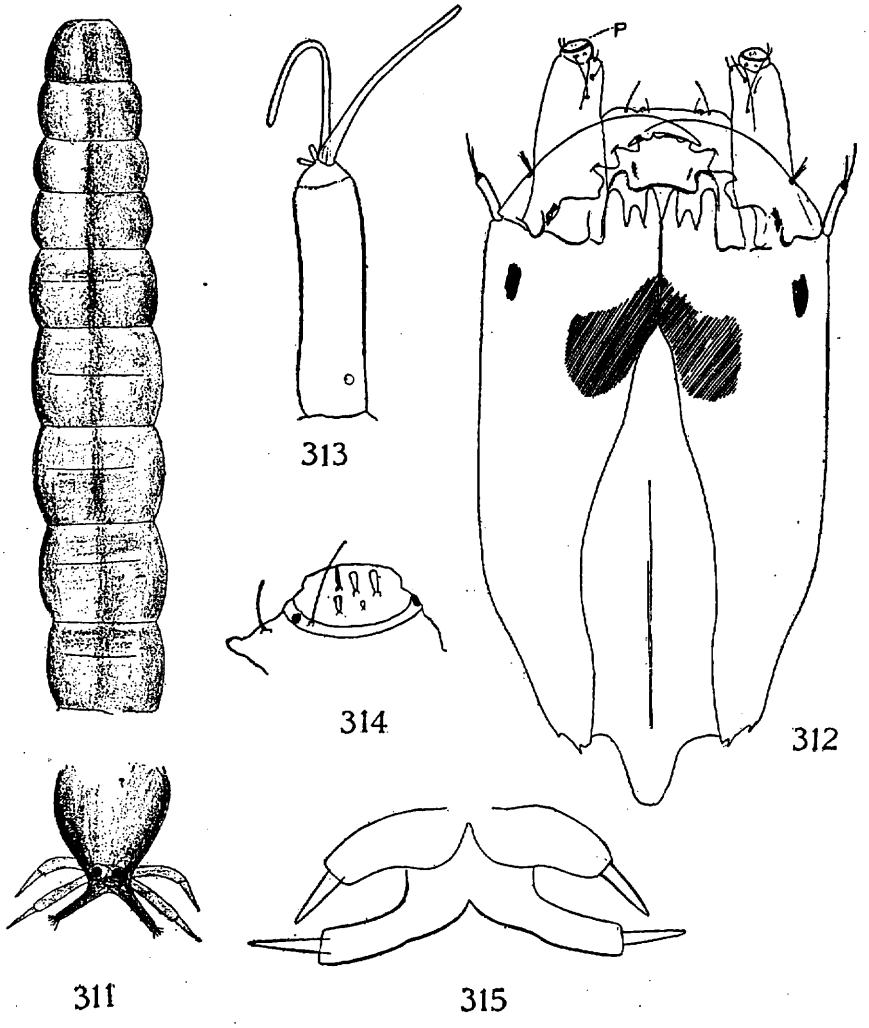
OXYDISCUS spp.

Fig. 3: (a) spiracular disc. (b) hypostomium. (c) mandible, dorsal. (d) mandible, ventral.

All above, Alexander 1920 Nearctic sp.

← Brindle and Bryce 1960 (Palearctic)

Pedicia (Pedicia)



from
Alexander 1920
Nearctic sp.

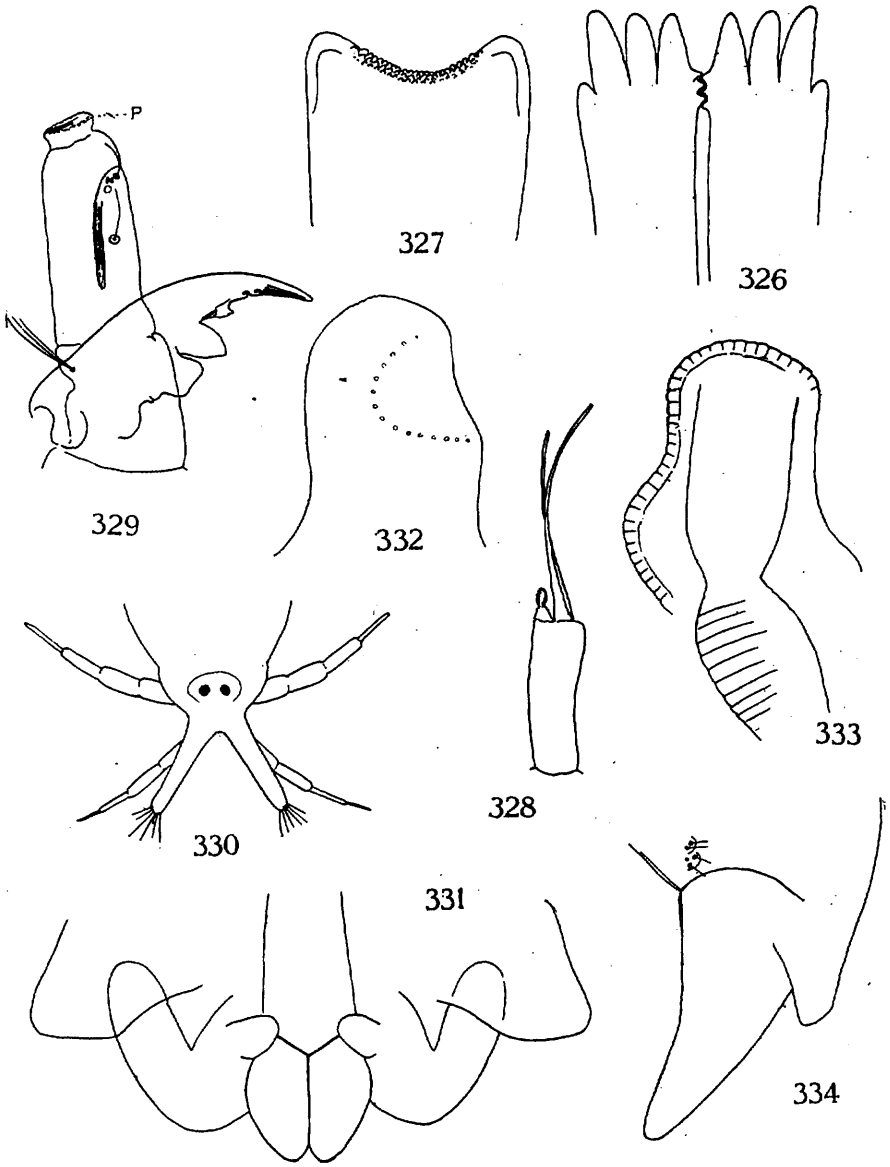
PEDICIA ALBIVITTA, LARVA

311, Dorsal aspect; 312, head capsule, ventral aspect; 313, antenna; 314, maxillary palpus; 315, anal gills, ventral aspect

75 Pedicia sp.

from Alexander and Byers, 1981

Pedicia (Tricyphona)



TRICYPHONA INCONSTANS

Larva: 326, mentum; 327, hypopharynx; 328, antenna; 329, mandible and maxilla; 330, spiracular disk

Pupa: 331, mouth parts; 332, pronotal breathing horn, dorsal aspect; 333, pronotal breathing horn, lateral aspect; 334, female cauda, lateral aspect

from Alexander, 1920 Nearctic sp.

Pedicia (Tricyphona)

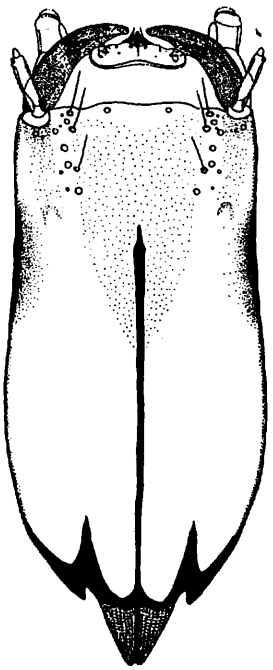


Abb. 41

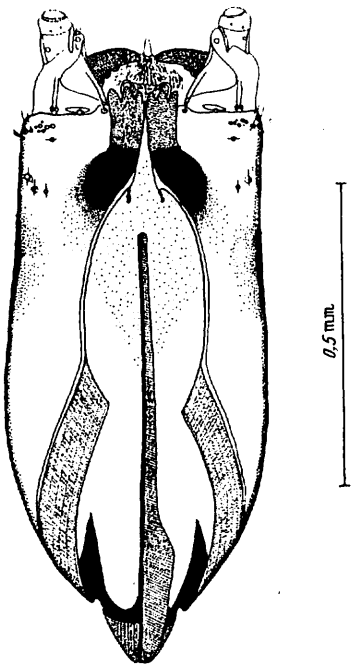


Abb. 42

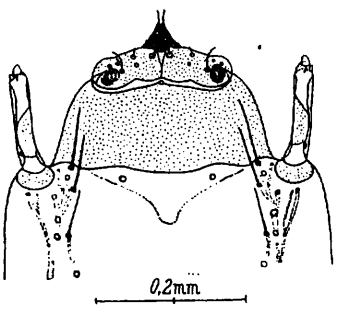


Abb. 43

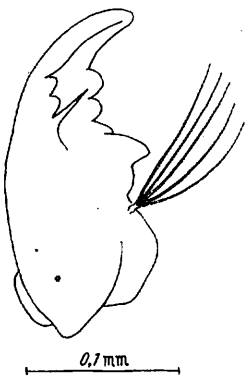


Abb. 44

Abb. 41—47. *Pedicia (Tricyphona) immaculata*. IV. Stadium

Abb. 41. Kopfkapsel, Dorsalansicht

Abb. 42. Kopfkapsel, Ventralansicht. Medianleiste etwas zur linken Kopfkapselseite (im Bilde nach rechts) gebogen, um den verbreiterten Endteil zu zeigen

Abb. 43. Vorderteil der Frons; Antennen; Clypeus; Labrum. Das Haarbüschel am Vorderrand des Labrums gehört bereits zum Epipharynx

Abb. 44. Linke Mandibel von dorsal

Abb. 45. Rechte Maxille von ventral. Rechts unten 2 Zähne des Hypostomiums

Abb. 46. Hypopharynx von ventral

Abb. 47. Hypostomium und Hypostomalbrücke von ventral

from Lindner, 1959.
Palearctic sp.

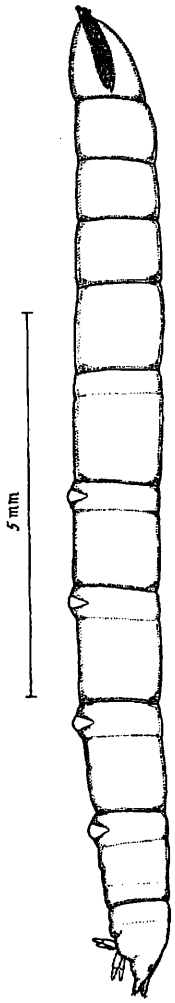


Abb. 38

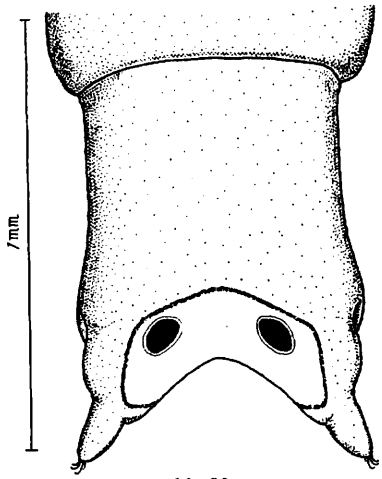


Abb. 39

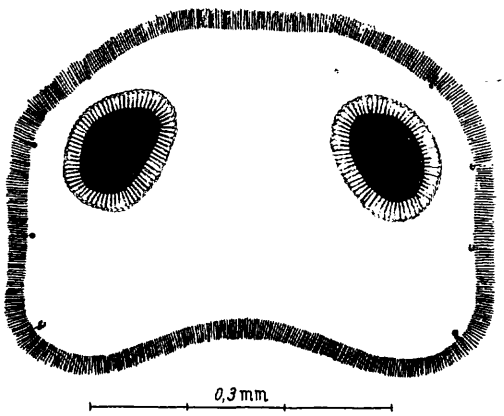


Abb. 40

Abb. 38—40. *Pedicia (Tricyphona) immaculata*. IV. Stadium

Abb. 38. Larve von links

Abb. 39. Endsegment von dorsal

Abb. 40. Stigmenfeld

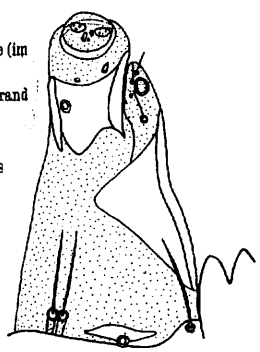


Abb. 45

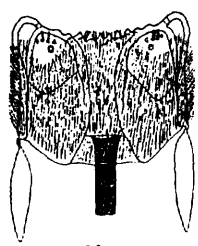


Abb. 46

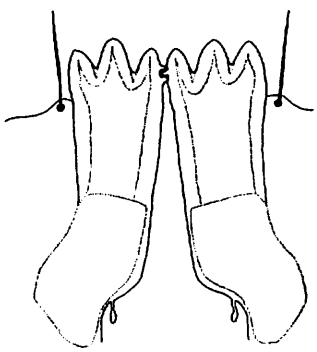
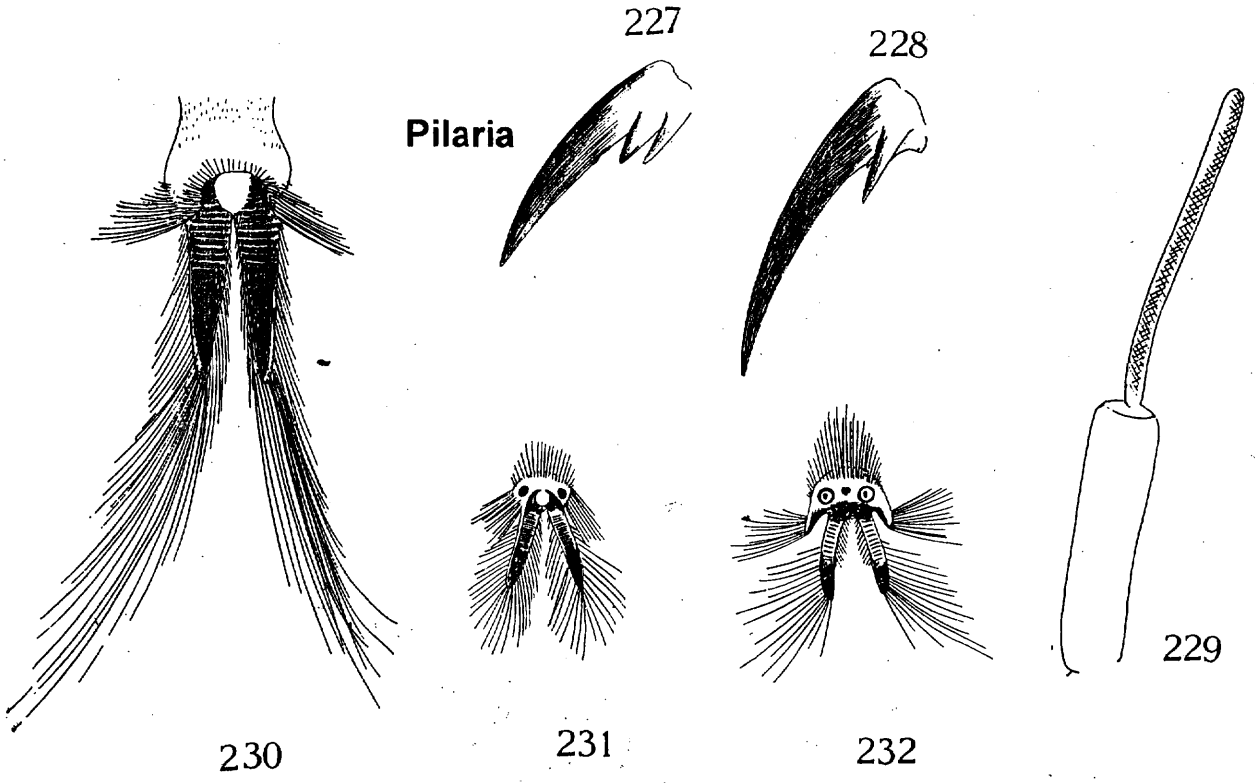


Abb. 47

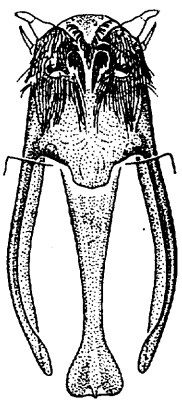
Pilaria



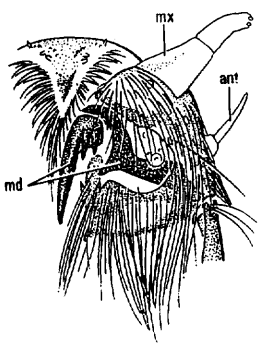
PILARIA RECONDITA, P. TENUIPES, P. FUSCIPENNIS, AND P. DISCICOLLIS

Pilaria recondita, larva: 227, tip of mandible
Pilaria tenuipes, larva: 228, tip of mandible; 229, antenna; 230, spiracular disk, dorsal aspect
Pilaria fuscipennis: 231, spiracular disk (after Gerbig) - Palearctic sp.
Pilaria discicollis: 232, spiracular disk (after Gerbig) - Palearctic sp.

from Alexander, 1920
Nearctic spp.

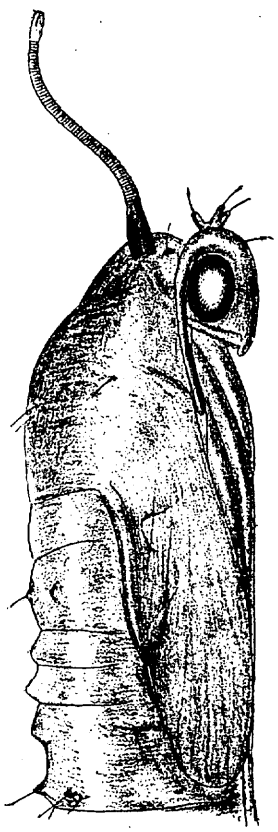


88 Pilaria recondita



89 Pilaria recondita

from Alexander + Byers, 1981
Nearctic spp.



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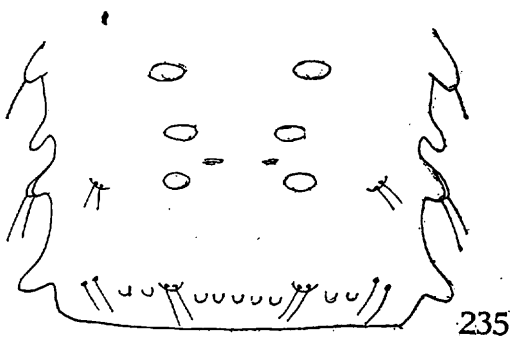

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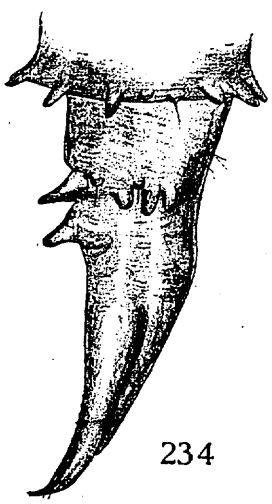

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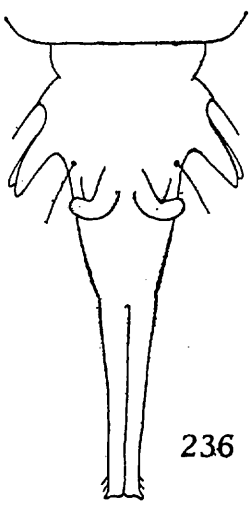


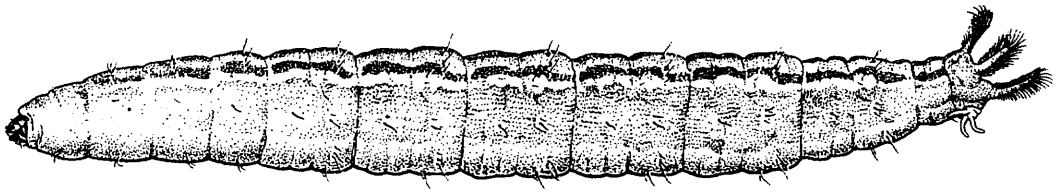
236

PILARIA TENUIPES, PUPA

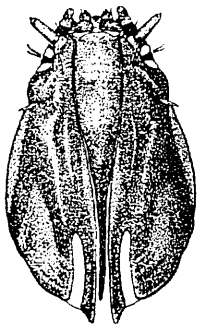
233, Female, lateral aspect; 234, female cauda, lateral aspect; 235, fifth abdominal segment, dorsal aspect; 236, female cauda, dorsal aspect

from Alexander 1920

Prionocera



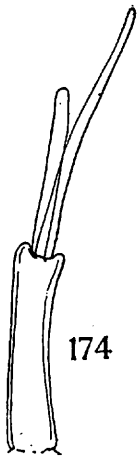
66 Prionocera sp.

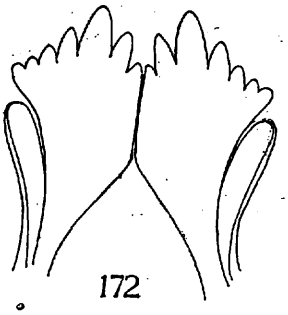


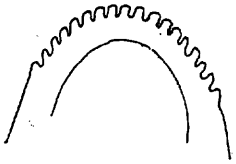
67 Prionocera dimidiata

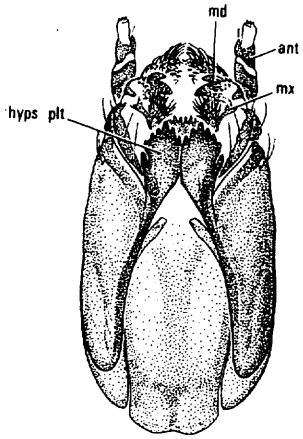
from Alexander and Byers, 1981
Nearctic sp.

Pseudolimnophila

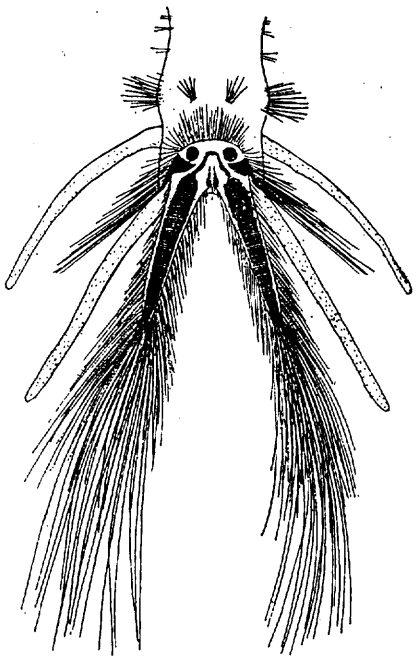


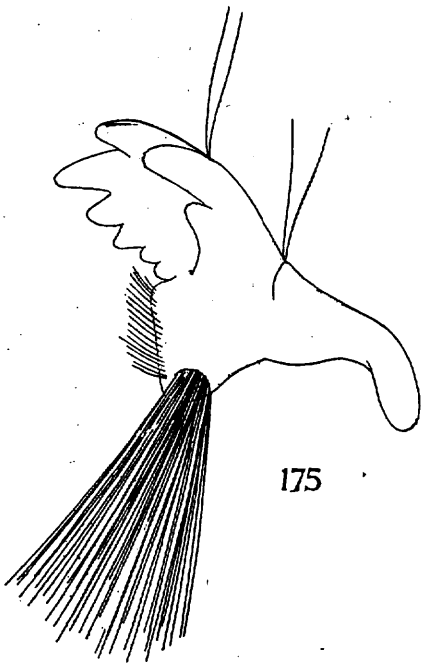


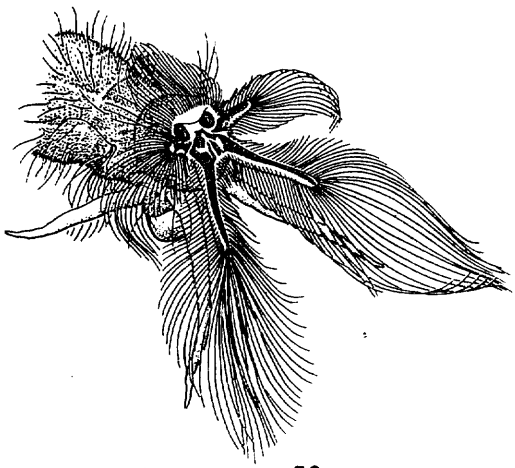




77

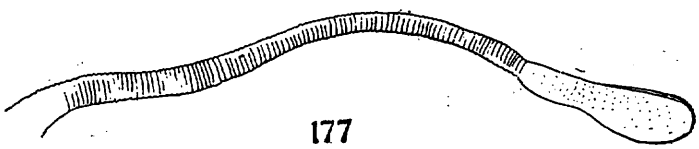






Pseudolimnophila inornata 78

from Alexander and Byers, 1981

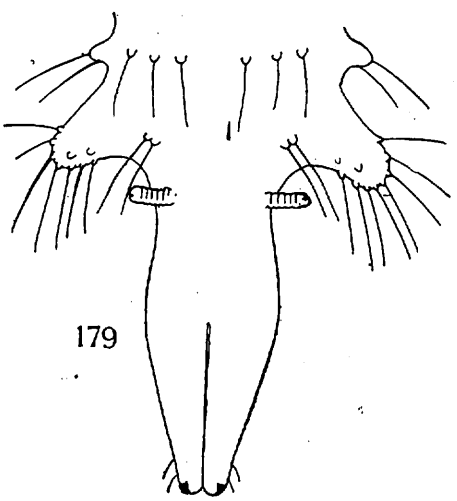


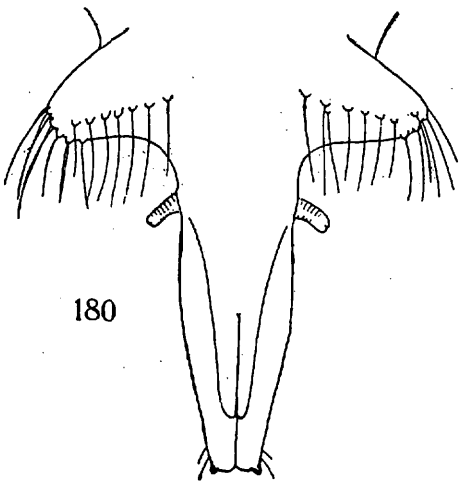
PSEUDOLIMNOPHILA LUTEIPENNIS AND P. INORNATA

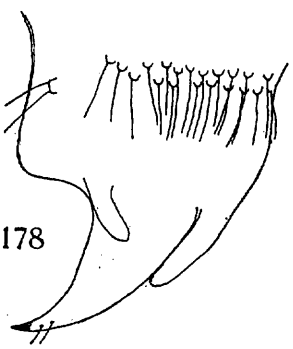
Pseudolimnophila luteipennis, larva: 172, mentum; 173, hypopharynx; 175, mandible; 176, spiracular disk

Pseudolimnophila inornata, larva: 174, antenna

from Alexander, 1920 Nearctic spp.





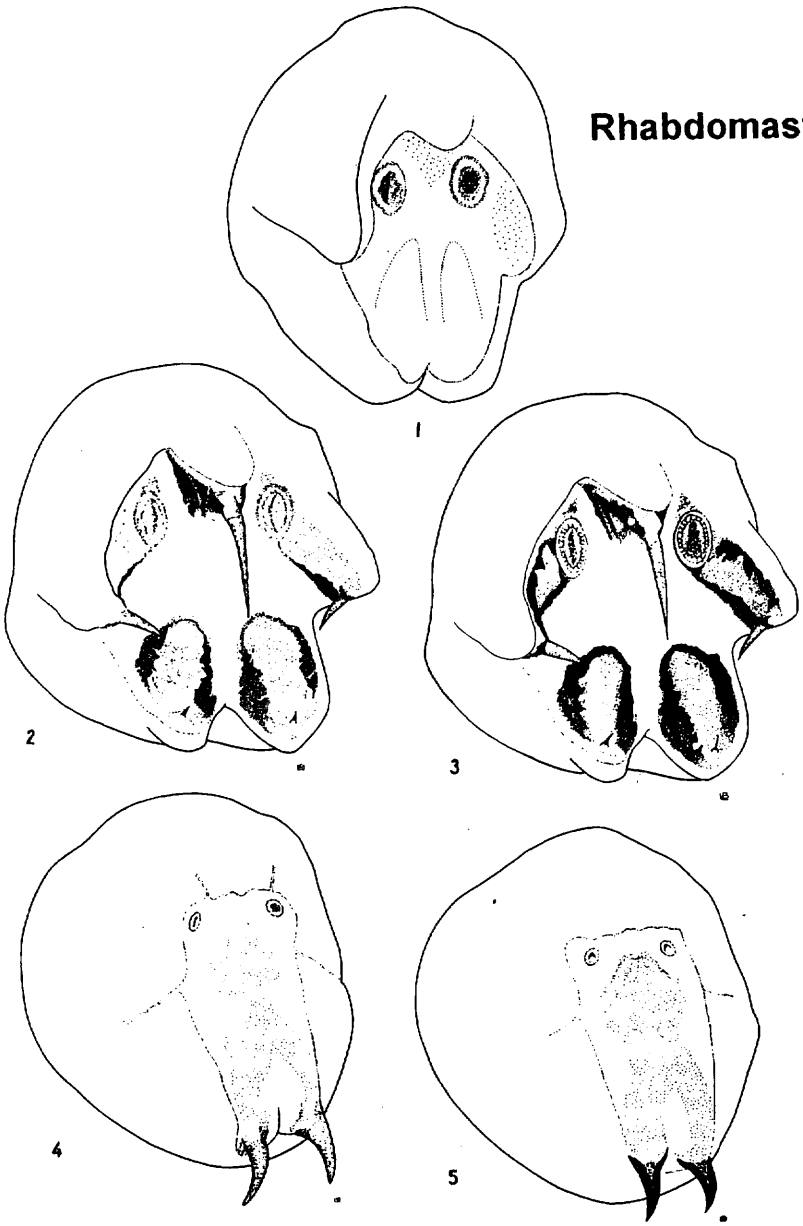


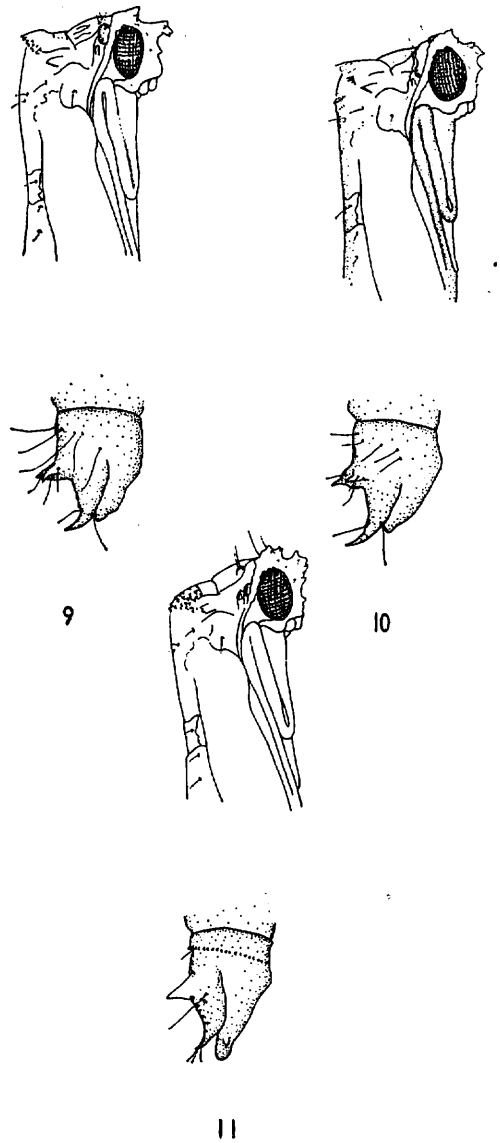
PSEUDOLIMNOPHILA INORNATA AND P. LUTEIPENNIS

Pseudolimnophila inornata, pupa: 177, pronotal breathing horn

Pseudolimnophila luteipennis, pupa: 178, male cauda, lateral aspect; 179, female cauda, dorsal aspect; 180, female cauda, ventral aspect

Rhabdomastix





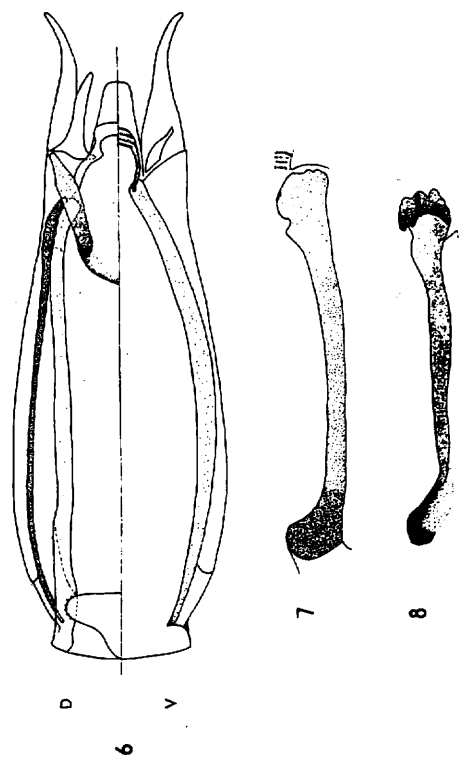


FIG. 1. Three-quarter view of spiracular disk of *R. fascigera*. FIG. 2. Three-quarter view of spiracular disk of *R. trichophora*. FIG. 3. Three-quarter view of spiracular disk of *R. californiensis*. FIG. 4. Three-quarter view of spiracular disk of *R. flaviventris*. FIG. 5. Three-quarter view of spiracular disk of *R. setigera*.

FIG. 6. Head capsule of *R. fascigera*; D = dorsal view, V = ventral view. FIG. 7. Ventral (maxillary) bar and maxillary plate of *R. setigera*. FIG. 8. Ventral (maxillary) bar and maxillary plate of *R. flaviventris*. FIG. 9. Lateral views of anterior and caudal ends of pupa of *R. fascigera*. FIG. 10. Lateral views of anterior and caudal ends of pupa of *R. trichophora*. FIG. 11. Lateral views of anterior and caudal ends of pupa of *R. setigera*.

from Hynes, 1969

all Nearctic spp.

Thaumastoptera

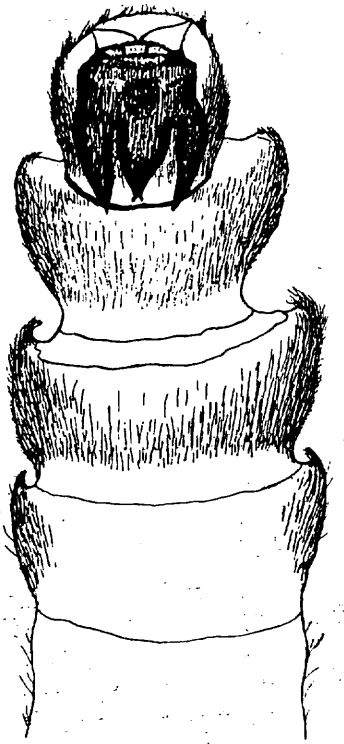


Abb. 6.
Die 4 vorderen Segmente und Kieferkapsel der Larve
40 × vergrößert.

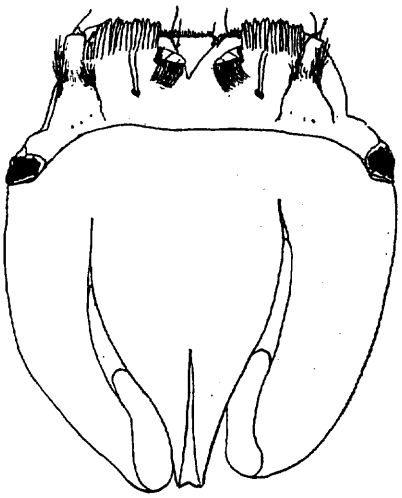


Abb. 15.
Kieferkapsel der Larve, Dorsalansicht.
130 × vergrößert.

Abb. 18.
Larvenlabium
260 × vergr.

Abb. 16.
Mandibel der Larven.
260 × vergrößert.

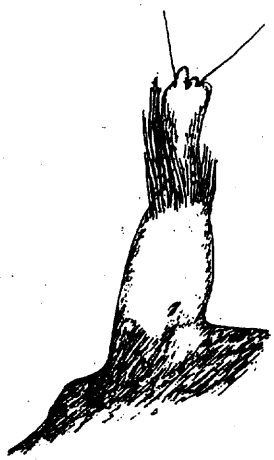


Abb. 14.
Antenne der Larve.
260 × vergrößert.

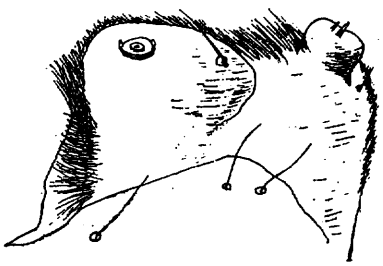


Abb. 17.
Larvenmaxille.
300 × vergrößert.

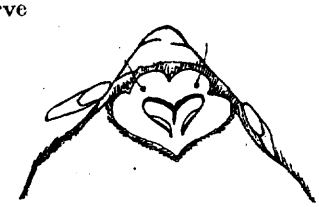


Abb. 10.
Larvenende analeorsaler Richtung gesehen. (Stigmenspalt, kurzes letztes Segment, Analschläuche.
50 × vergrößert.

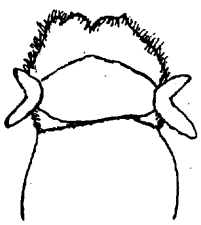


Abb. 11.
Larvenende von unten gesehen.
(Letztes Segment und Analschläuche).
40 × vergrößert.

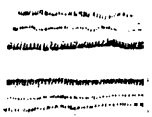


Abb. 12.
Stück aus den Hakenquerbändern des 8. Segmentes
260 × vergr.

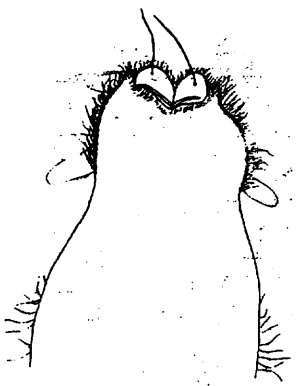


Abb. 7.
Hinterende der Larve von oben gesehen (Stigmenspalte).
40 × vergrößert.

Abb. 4.
Larve von oben gesehen.
10 × vergrößert.

Abb. 5.
Larve von der Seite gesehen.
10 × vergrößert.

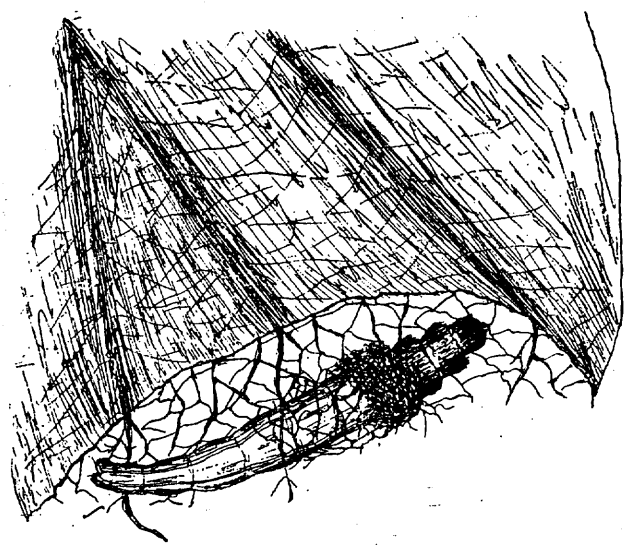


Abb. 28.
Thaumastoptera-Larve beim Gehäusebau. 10 × vergrößert.

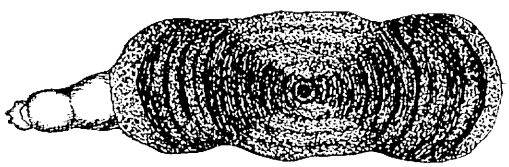


Abb. 2.
Gehäuse von der Unterseite gesehen.
(Hinterende der Larven sichtbar). 10 × vergrößert.

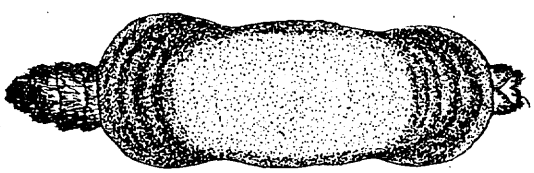


Abb. 3.
Gehäuse mit Larve von oben gesehen. 10 × vergrößert.

from Henz 1920
Palearctic sp.

Tipula

Introduction

At the time of Alexander's comprehensive 1920 paper, "The Crane-flies of New York. Part II. Biology and Phylogeny," the larvae of only four percent (16 species) of the nearctic species of *Tipula* had been described. From 1920 to 1983, the larvae of only five additional nearctic species were described and illustrated, and the life history of only one species was studied in any detail. My work represents a step toward correcting this lack of knowledge about this diverse genus, including descriptions of larvae and information about their biology.

The cosmopolitan genus *Tipula* contains approximately 450 nearctic species placed in 27 subgenera (Alexander, 1965). *Tipula* larvae are by nature of their habitat inconspicuous, although the larval stages may last from six months to five years. Larvae can be sufficiently abundant locally to have an appreciable ecological impact. The larval habitats vary tremendously within the genus. Larvae of some species are fully aquatic and are found in leaf packs or on the bottoms of streams (e.g., *Nippotipula*), while others occur in the wet soil of stream and lake margins, seepages, algal mats or wet mosses (e.g., *Yamatotipula*). Many species such as those in *Lunatipula* are found in soil under layers of leaf mold or other decaying vegetation in forested areas. Some species (e.g., *Serratipula*) are in the soil of pastures or meadows, where they feed on roots and leaves of young grasses. A few of these may become pests in favorable years by denuding hundreds of acres of rangeland, thus earning the common name "range crane fly." Some larvae are found in dead wood at various stages of decay (e.g., *Pterelachisus*). Still others, such as *Eremotipula* (inferring from pupal collections), occur in semiarid areas in the soil under rabbitbrush *(Chrysothamnus)* and other shrubs. All species appear to be herbivorous or to feed on decaying plant matter.

Existing keys, most recently by Alexander and Byers (1981), will at best identify larvae of nearctic *Tipula* to the generic level, and certain species of *Tipula* cannot even be distinguished from other genera of Tipulinae by these keys. All 42 subgenera are based exclusively on adult characters, and in the present study, inconsistencies are seen between adult and larval groupings in certain subgenera (e.g., the two larval types of the subgenus *Trichotipula*).

I have examined reared material for as many species as possible (approximately 70 species, 16 percent of the genus in the Nearctic) to ascertain the characters for each subgenus. Larvae were obtained for 20 of the 27 nearctic subgenera, and for four of these subgenera *(Bellardina, Hesperotipula, Serratipula* and *Sinotipula)* the larvae are here described for the first time. A key to the subgenera is included, as well as information on larval biology.

from Gelhaus, 1986

Tipula

HISTORICAL REVIEW

Much of the early taxonomic work on larvae of *Tipula* concerned only one or two species, with inadequate descriptions or illustrations. Alexander's 1920 paper remains the most relevant of these early works, for he comparatively treated the larvae of twelve species of nearctic *Tipula* and recognized the value of using a variety of characters.

J. R. Chiswell (1956) published the first major study of larval *Tipula*. Dealing with a small, local fauna (Great Britain), he was able to rear over forty percent of the species. He published complete descriptions with clear drawings and presented a key to the specific level for the fourth (final), larval instars. This study was quickly followed by a similar paper by Theowald (1957), which overlapped with Chiswell's work in some of the species treated, but additionally considered the larvae within a subgeneric classification. Theowald was the first to place the larvae of European Tipulinae in subgenera and species groupings and to discuss relationships among subgenera, based on larval characters.

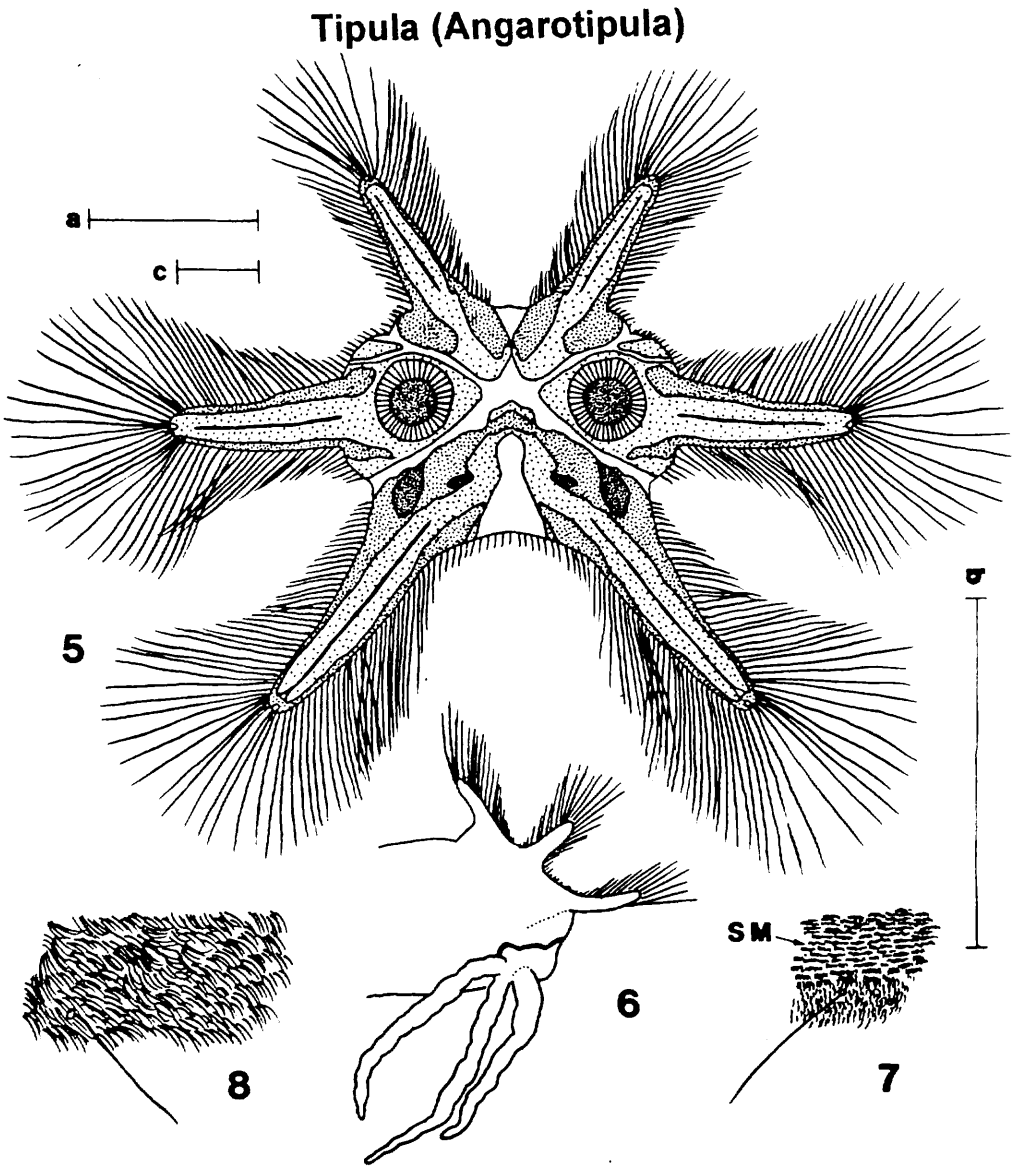
In the same time period, A. Brindle published a series of smaller papers (1957-1960) describing the larvae of British *Tipula* not described previously. Brindle (1960c) gave a key to the larvae of almost 50 British species and discussed the transition of larvae from terrestrial to aquatic habitats. Savchenko (1954, 1961, 1964) also illustrated various palearctic *Tipula* larvae; in 1966 (translated into German by Theowald and Theischinger, 1979) he constructed a phylogeny for the European tipuline groups, based in part on characters of the larvae.

THE GENUS *TIPULA* LINNAEUS

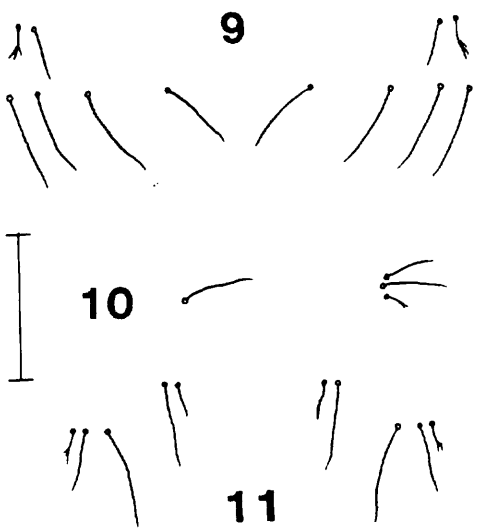
A useful diagnosis for larvae of the entire genus *Tipula* cannot be constructed, as every character varies enormously within the genus, and may be found in a similar state in other tipuline genera. Only a few genera of this subfamily can be separated from all *Tipula* on the basis of characters which do not occur somewhere within *Tipula*: *Nephrotoma* has distinct, thickened prothoracic welts; *Leptotarsus (Longurio)* has pinnately branched anal papillae; and *Brachypremna* shows a distinct contrast between short, thoracic hairs and long, dense abdominal hairs. Yet these genera are very similar in other characters to certain larvae of *Tipula*. For example, the mostly unsclerotized spiracular area of *Nephrotoma* is similar to that of *T. (Trichotipula) stonei;* the same area of *Leptotarsus* is similar to that of *T. (Arctotipula)* and the spiracular area of *Brachypremna* suggests that of *T. (Schummelia)* and *T. (Trichotipula) oropezoides*. The remaining tipuline genera are not easily separable from *Tipula*. The similarities between larvae of the genus *Prionocera* and those of *T. (Angarotipula)* are remarkable, and the two groups can only be separated on the basis of a minor difference in hairs. A similar case exists with the genus *Holorusia* and the subgenera *Platytipula* and *Bellardina*.

Larvae remain unknown for approximately one-fourth of the nearctic subgenera of *Tipula;* these subgenera are *Eremotipula, Eumicrotipula, Labiotipula, Lindnerina, Nesotipula, Setitipula* and *Tipulodinodes*. Nearly half of the nearctic subgenera have had the larvae of only one or two of their included species reared and associated. Therefore, it seems premature to offer subgeneric descriptions now, and instead I describe one or more species within each group, and discuss the characters of the subgenus based on all known larvae.

from Gelhous, 1986



Figs. 5, 6, 8. *Tipula (Angarotipula) illustris*. 5, spiracular area. 6, terminal abdominal segments, lateral aspect. 8, example of abdominal macroscopic hairs. Fig. 7. *Prionocera dimidiata*, example of abdominal microscopic hairs; SM-short microscopic hairs. All scale lines 1 mm. Scale a: Fig. 5, scale b: Figs. 7, 8, scale c: Fig. 6.



Figs. 9-11. *Tipula (Angarotipula) illustris*, abdominal macrosetae. 9, dorsal setae. 10, pleural setae. 11, ventral setae. Scale line 1 mm.

Tipula (Angarotipula)

Subgenus *Angarotipula* Savchenko

Of the two nearctic species of *Angarotipula*, only the larva of *Tipula illustris* has been reared and associated with adults.

Tipula (Angarotipula) illustris Doane

Malloch 1917:199-200, figures (as *Tipula* sp. 1).
Alexander 1920:996-997, Figs. 498-502 (as *Prionocera fuscipennis*).

Description: Length 20.0-24.7 mm, width 2.6-3.1 mm, body yellowish brown. *Abdomen:* Macrosetae brown, setae D1-D4 long, D5 and D6 slightly shorter, D6 branched (Fig. 9). Setae L1, L2 and L4 long, L3 shorter and branched (Fig. 10). Setae V2-V4 long, V1 and V5 slightly shorter, V1 branched (Fig. 11). Macroscopic hairs abundant, densest on dorsum (Fig. 8), short microscopic hairs only along cuticular folds on venter. *Spiracular Disc:* All spiracular lobes long and narrow, each at least 3 × as long as width at base, ventral lobes often 4 × as long as wide, lateral lobes equidistant from dorsal and ventral lobes (Fig. 5). Lateral lobes 1.25 × as long as dorsal lobes, ventral lobes approximately twice as long as dorsal lobes. Lobes with well-developed border of setae, longest setae twice basal width of lobe. Posterior surface of each lobe with median dark line extending from near base to near apex of lobe; each lobe with dark, lateral sclerites from base to apex, outer sclerites of ventral lobes extending as thin band across middle of spiracular surface. Two black spots near base of each ventral lobe. Remainder of spiracular disc yellowish. Spiracles circular, black. Marginal band light brown. *Anal Segment:* Six, subequal, elongate anal papillae (Fig. 6), lateral papillae single, medial papillae paired, length/basal width approximately 6-11.

Specimens examined: Nine larvae from the following localities in ONTARIO: South March; Dunrobin; 9.7 km W of Richmond; Galt; all collected by H. Teskey (CNC).

Subgeneric Discussion: The most distinctive feature of *Angarotipula* is the long, narrow spiracular lobes, each approximately three times its basal width. Each lobe has a complete border of long setae and a dark, median line extending the length of the lobe. The sclerotized pattern on the spiracular disc is quite recognizable, particularly the dark band extending across the middle of the disc from the outer lateral areas of each ventral lobe. The body is covered by macroscopic hairs; short microscopic hairs are only along the cuticular folds.

Larvae of *Angarotipula* are more similar to those of the genus *Prionocera* than to any other larvae of *Tipula*. In fact, the two groups have proven difficult to separate as larvae, for only minor structural differences exist and they may occur in similar habitats. The most important similarities between *Angarotipula* and *Prionocera* are the long, narrow spiracular lobes, virtually identical pattern of sclerotization on the spiracular disc including a dark, median line on each lobe, a well-developed border of setae, six elongate anal papillae, and a similar arrangement of abdominal macrosetae. One feature separates the two groups: in *Angarotipula*, there is a predominance of macroscopic hairs on the abdomen, with short microscopic hairs virtually absent (Fig. 8); by contrast, the abdomen of *Prionocera* is covered with rows of short microscopic hairs with macroscopic hairs only around the bases of the dorsal and ventral macrosetae (Fig. 7).

Habitats of *Angarotipula:* The larval habitat of *Tipula illustris* was first described by Malloch (1917, as *Tipula* sp. no. 1) as "in an inlet among weeds at the surface." Alexander (1920, as *Prionocera fuscipennis*) collected *T. illustris* larvae in New York from a cattail swamp and also found pupal skins among *Sparganium* stems. Rogers (1942, as *Prionocera fuscipennis*) collected larvae in Michigan from "sodden, partially or wholly submerged plant detritus of the marshes and seepage areas." He found them particularly characteristic of leaf-filled or vegetation-choked channels or pools. Teskey (collection labels, CNC) found *T. illustris* larvae in Ontario in the saturated grassy soil margin of a small pool and also in a rotten log in a swamp.

G. W. Byers (collection label, KU) collected pupae of *T. parrioides* in Alaska from the margin of a pond.

from Gelhaus, 1986

Tipula (Arctotipula)

Subgenus *Arctotipula* Alexander

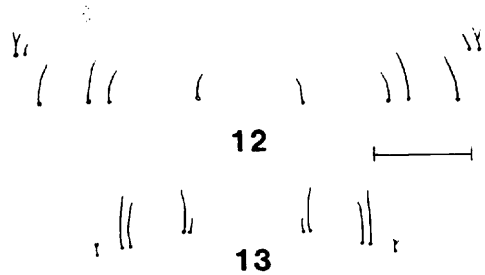
Of the 21 nearctic species of *Arctotipula*, only *Tipula sacra* is known from reared larvae associated with adults.

Tipula (Arctotipula) sacra Alexander

Pritchard and Hall 1971:474-477, Figs. 8-12, 22.

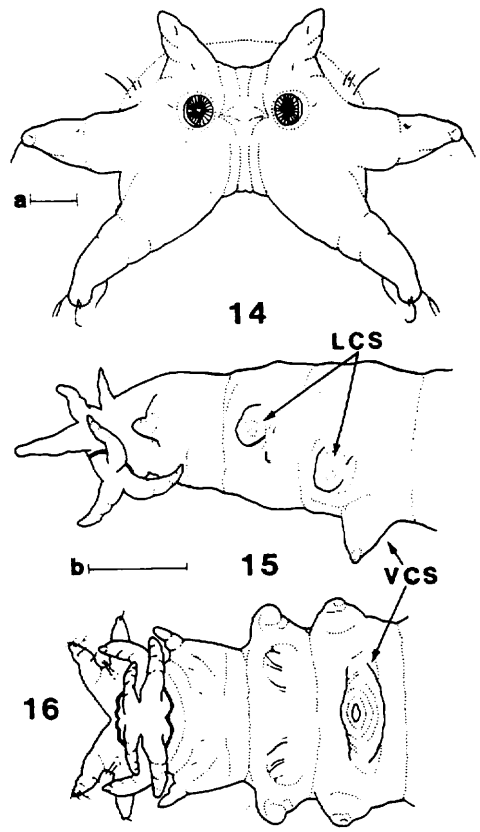
Description: Length 28.6-42.9 mm, width 3.9-5.1 mm, body light brown, slightly dorsoventrally depressed. *Abdomen:* Three pairs of conspicuous conical tubercles on segments II-VII, increasing in size posteriorly, largest tubercle twice as wide as long. Two pairs of tubercles on each pleural segment, one pair medioanteriorly, one pair dorsoposteriorly; third pair medioanteriorly on venter (Fig. 15). An additional pair of lateral tubercles on segment VIII, anterior to lateral spiracular lobes (Fig. 16). Macrosetae light brown. Setae D1, D5 and D6 short, D2-D4 longer, D6 usually branched (Fig. 12). Seta L1 short, L2-L4 longer, L3 usually branched. Setae V5 and V1 short, V2-V4 longer, V1 branched (Fig. 13). Short microscopic hairs covering abdomen, in transverse rows on dorsum and venter, single on pleura. An irregular pattern of lighter, circular areas sometimes visible on dorsum, pattern due to sparse microscopic hairs within the circular areas. Long microscopic and macroscopic hairs absent. *Spiracular Disc:* All spiracular lobes conical, dorsal lobe shortest, slightly longer than width at base, length of lateral lobe 1.5 × length of dorsal lobe, length of ventral lobe 2.5 × length of dorsal lobe (Fig. 14). Lateral lobes approximately equidistant from dorsal and ventral lobes. Lobes without darker sclerites. Spiracular disc and lobes completely covered with single short microscopic hairs except area surrounding spiracles. Macrosetae on posterior surface of all lobes; two macrosetae on dorsal lobe, near base and ⅔ lobe length; on lateral lobe, one to three at midlength, two at tip; two setae at tip of ventral lobe. Spiracles small, circular and widely separated by at least twice diameter of spiracle; inner circle dark, outer ring brown, spiracles noticeably raised from cuticular surface. Marginal band brown. *Anal Segment:* Six elongate anal papillae (Fig. 16), medial papillae paired, lateral papillae single, length/basal width 3-5.

Specimens Examined: Thirty-three larvae from the following localities in ALBERTA: Kananaskis Valley, Lusk Creek, H. Teskey, coll. (CNC); same locality as preceding, G. Pritchard, coll. (GPJKG); Maycroft, H. Teskey, coll. (CNC).



Figs. 12, 13. *Tipula (Arctotipula) sacra*, abdominal macrosetae. 12, dorsal setae. 13, ventral setae. Scale line 1 mm.

Subgeneric Discussion: Larvae of *Arctotipula*, based on *Tipula sacra* and the palearctic *T. salicetorum*, share a number of unique features. Both species possess con-



Figs. 14-16. *Tipula (Arctotipula) sacra*. 14, spiracular area. 15, terminal abdominal segments, lateral aspect, segments VII-X. 16, same segments as 15, ventral aspect; LCS-lateral conical swelling, VCS-ventral conical swelling. All scale lines 1 mm. Scale a: Figs. 15, 16, scale b: Fig. 14.

from Gelhaus, 1986

ical, unsclerotized spiracular lobes which are almost completely covered with short microscopic hairs, and the dorsal lobes are noticeably shorter than the lateral and ventral lobes. Very striking is the absence of a developed border of setae around the spiracular lobes. Both species have small, widely separated spiracles, six long anal papillae, and the spiracular lobes may be tipped with clusters of macroscopic hairs (in *T. salicetorum*). Also notable are the presence of three pairs of cuticular swellings on abdominal segments 2-7, and an additional pair of swellings on segment 8. The body is slightly depressed, macrosetal patterns are similar in both species, short microscopic hairs predominate and there are almost no macroscopic hairs.

Certain unreared larvae, undoubtedly *Arctotipula,* have been figured previously and deserve comment here. Although possessing the basic *Arctotipula* form, these show additional variation in certain characters. Alexander (1919) described and illustrated a probable *Arctotipula* as Tipuline no. 2. This larva has the abdominal dorsum strikingly patterned with three dark longitudinal stripes. *Tipula sacra* often has a light pattern of pale circular spots on the dorsum of the abdomen. Savchenko (1961) illustrated two types of larvae as *Tipula (?Arctotipula)* sp. no. 1 and 2. Each dorsal spiracular lobe of species no. 2 has a dark, narrow median sclerite with additional dark sclerites just below the spiracles. I have seen this pattern of sclerotization on unassociated larvae collected in Alaska. In addition, these Alaskan specimens have the abdominal tubercles only as low bumps and the anal papillae are short.

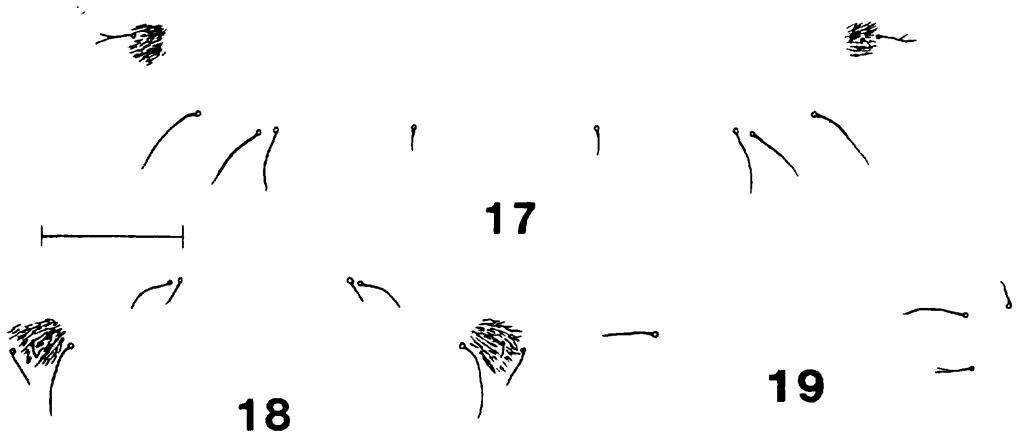
Arctotipula shows many morphological similarities to *Nippotipula* and few to other subgeneric groups. The shape of the spiracular lobes, the general lack of sclerotization on the lobes, the short microscopic hairs covering the spiracular disc and the inability to close the spiracular lobes are all characters seen only in these two subgenera. The larvae of both, although aquatic, lack the well-developed border of setae around the spiracular lobes as found in other aquatic subgenera. The presence of distinct abdominal cuticular swellings is found in *Arctotipula, Sinotipula* and *Nippotipula,* but the conical swellings in *Arctotipula* differ in position and shape from the transverse swellings of the others. The reduction of the spiracles and the almost complete lack of macroscopic hairs are also shared by these three subgenera.

HABITATS OF *ARCTOTIPULA*: The life history of *Tipula sacra* has been detailed in an excellent series of papers by Pritchard and Hall, including a general life history (Pritchard and Hall, 1971), larval food and development (Hall and Pritchard, 1975, Pritchard, 1976) and population dynamics (Pritchard 1978,1980). Pritchard and Hall found the larvae inhabiting the bottom sediments of well-oxygenated, abandoned beaver ponds. Unreared larvae of *Arctotipula* have been found in similar situations. The specimens of "Tipuline no. 2" of Alexander (1919) were collected in Alaska from "melted ponds in the tundra." I have seen other unreared larvae collected by W. L. Jellison from a pond drain in Montana and by D. G. Huggins in Alaska from the rocky bottom of a lake, near shore.

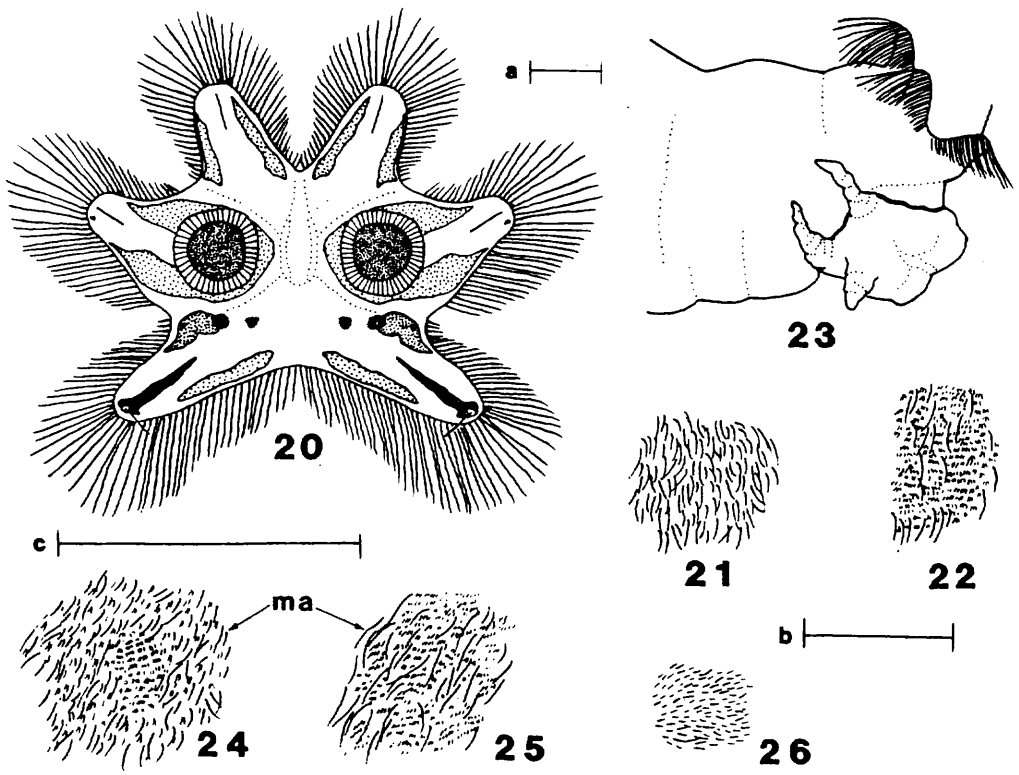
Tipula salicetorum, although not reared from the larva to the adult, has had larvae assigned to it with certainty. Hofsvang (1979) reports the larvae as inhabiting the littoral zone of a subalpine lake in southern Norway.

from Gelhaus 1986

Tipula (Bellardina)



Figs. 17-19. *Tipula (Bellardina) pura,* abdominal macrosetae and macroscopic hair clusters. 17, dorsal setae. 18, ventral setae. 19, pleural setae. Scale line 1 mm.



Figs. 20, 21, 23, 24, 26. *Tipula (Bellardina) pura.* 20, spiracular area. 21, example of hairs on dorsum of abdominal segment VIII. 23, terminal abdominal segments, lateral aspect. 24, example of hairs on dorsum of abdominal segments I-VII; ma-macroscopic hairs. 26, example of hairs on abdominal pleura. Figs. 22, 25. *Holorusia rubiginosa.* 22, same area as Fig. 21. 25, same area as Fig. 24. All scale lines 1 mm. Scale a: Fig. 23, scale b: Fig. 20, scale c: Figs. 21, 22, 24-26.

from Gelhaus 1986

Tipula (Bellardina)

Subgenus *Bellardina* Edwards

The larvae of two species in this subgenus, *Tipula pura* and *T. albimacula*, have been reared during this study.

Tipula (Bellardina) pura Alexander

Description: Length 33.6-39.3 mm, width 4.3-5.0 mm, body light brown. *Abdomen:* Macrosetae dark brown, setae D2-D4 long, D1 and D6 shorter, D5 pale and very short, D6 branched (Fig. 17). Setae L2 and L4 long, L1 and L3 shorter. L3 branched (Fig. 19). Setae V3 long, V1, V4 and V5 shorter, V2 pale and very short, V1 often branched (Fig. 18). Scattered, single macroscopic hairs longest and more dense on dorsum of segment VIII, and around bases of setae D5 and V2 (Fig. 21); short microscopic hairs in short rows, along body folds, in paired subcircular areas on dorsum and scattered singly among macroscopic hairs (Fig. 24). Hair on pleura single (Fig. 26). *Spiracular Disc:* All lobes subequal, approximately as long as width at base, lateral lobes equidistant from dorsal and ventral lobes (Fig. 20). Lobes with a well-developed border of setae, longest setae slightly less than basal width of lobe. Posterior surface of each lobe with two light brown marginal sclerites, sclerites of lateral lobes extending around spiracles. Each ventral lobe with a dark median line, extending almost length of lobe; three dark spots at base of lobe; a long seta near apex. Dorsal and lateral lobes often with faint median line, approximately ½ length of lobe; a dark spot at apex of lateral lobe. Spiracles large, circular, inner circle dark brown, outer ring brown; distance between spiracles equal approximately to diameter of a spiracle. Remainder of spiracular disc pale. Marginal band brown. *Anal Segment:* Six anal papillae, four elongate and curled dorsad around abdomen, two short and extending ventrad (Fig. 23); length/basal width of posterior papillae 2-3, smallest papillae length/basal width 1-1.5.

Specimens Examined: Seventeen larvae from Gravel Pit Lakes State Recreation Area, 24.1 km W of Cimarron, on U.S. Highway 64, Colfax Co., New Mexico, J. K. Gelhaus, coll. (JKG).

Subgeneric Discussion: *Bellardina*, to judge by *Tipula albimacula* and *T. pura*, forms a homogeneous group defined by rather generalized characters. The spiracular lobes are subequal, of medium length, and have a well-developed border of long setae. The pattern of sclerotization on the lobes is similar in both species: each ventral lobe always has a dark median line and three dark spots at the base; the dorsal and lateral lobes may also have short, faint median lines; all lobes have light brown, marginal sclerites. There are six anal papillae, four of which are elongate and curled dorsad around the abdomen. The spiracles are large, circular and not widely separated. Setae D5 and V2 are pale and difficult to see among macroscopic hairs, unlike the other, easily visible macrosetae. In fact, macroscopic hairs predominate on the body; short microscopic hairs are only restrictedly present in certain areas and are single or in short rows. Setae D6, V1 and L3 are usually branched. The larvae of both species attain a large size at maturity (30-40 mm).

Many of the characters listed above are shared by other aquatic groups. For example, subequal lobes with a border of long setae, elongate anal papillae, dark median lines on the ventral lobes, abundant macroscopic hairs and branched setae are also found in other groups such as *Yamatotipula*, *Platytipula*, the non-nearctic *Acutipula*, and the genus *Holorusia*. Consequently, separation of *Bellardina* from *Yamatotipula*, *Platytipula* and particularly *Holorusia* is rather difficult. *Yamatotipula* is distinguished by conspicuous, well-defined clusters of macroscopic hairs around setae D4, D5 and V2 and may also have conspicuous patterns of microscopic hairs; although setae D5 and V2 are obscured by macroscopic hairs in *Bellardina*, these hairs do not form distinct clusters but are simply part of the overall abundance of hairs. Additionally, short microscopic hairs are sparse and never form conspicuous patterns as seen in *Yamatotipula*.

Platytipula and *Holorusia* both have the abdomen generally covered with short microscopic hairs organized in long rows; macroscopic hairs are abundantly scattered between these rows (Figs. 22, 25). *Bellardina* has small areas of only short microscopic hairs which are not in long rows nor predominantly intermingled with macroscopic hairs (Figs. 21, 24). Other microscopic hairs are found singly among the macroscopic hairs, never in rows. The anal papillae of *Platytipula* extend laterally or ventrally and never curl upward; setae D5 and V2 are also not obscured by long hairs as in *Bellardina*. Also, the dorsal lobes may have median lines in *Bellardina* but never in *Platytipula*.

As more larvae have been associated, particularly those of *Platytipula* and *Bellardina*, the characters used in the key by Alexander and Byers (1981) for the separation of the genera *Tipula* and *Holorusia* have not proven to be useful and, consequently, have not been used in the present key.

Habitats of *Bellardina*: *Bellardina* occurs exclusively in the New World, with five species in North America. Four of the five are found only in the West; one other (*T. albimacula*) extends into the Central Plains.

Larvae of *T. pura* were found along the margins of a spring-fed, seepage-stream which ran for 15 m before its confluence with the Cimarron River, in New Mexico. Twenty mature larvae were found in a 30 cm square area in an exposed mud bank; additional larvae were collected in a nearby bank among roots of grasses and nettles.

Similar spring-fed aquatic habitats yielded larvae of *T. albimacula* at three localities in Kansas, all within the Flint Hills prairie region (Gelhaus, field notes). Larvae occurred in springs emanating from limestone outcroppings, specifically, among mats of watercress or aquatic mosses and apparently only from the upper areas of these springs; none were collected along the spring-fed streams.

from Gelhaus 1986

Tipula (Beringotipula)

Subgenus *Beringotipula* Savchenko

I have seen larvae associated with adults for three species in this subgenus.

Tipula (Beringotipula) rohweri Doane

Description: Length 19.7-23.6 mm, width 2.1-2.7 mm, body light brown. *Abdomen:* Macrosetae brown, setae D2 and D3 long, D1 and D6 slightly shorter, D4 short and pale apically, D5 absent (Fig. 31). Seta L2 long, L1, L3 and L4 shorter (Fig. 30). Seta V1 long, V3-V5 slightly shorter, V2 absent (Fig. 32). Dorsum and venter with short microscopic hairs in short transverse rows, with single long microscopic hairs scattered between rows (Figs. 31, 32). Macroscopic hairs on dorsum of segments VII and VIII and in clusters near seta D6, and around D3 and D4, and V1 and V3, ventral clusters most conspicuous. Pleura with single short microscopic hairs (Fig. 30). *Spiracular Disc:* Dorsal and lateral lobes conical, lateral lobes dorsolateral, close to dorsal lobes, lateral lobes 2.0-2.5 × length of dorsal lobe (Fig. 27). Lobes unsclerotized, with scattered single macroscopic hairs. A dark irregular sclerite near base of each dorsal and lateral lobe. Ventral lobes roughly triangular, as wide as long, with finger-like projection on lateral surface of lobe near apex (Fig. 28), projection approximately ½ to one length of ventral lobe (Fig. 29). Inner surface of each ventral lobe with sclerite extending to spiracle, outer edge darkest; two dark spots near inner edge. Remainder of ventral lobe with single long microscopic hairs. Border of very short setae around circumference of glabrous area of spiracular disc. Spiracles roughly oval, inner circle black, outer ring dark brown. Marginal band brown. *Anal Segment:* Four, short anal papillae (Fig. 27); each lateral papilla approximately as long as wide; each ventral papilla a broad, low swelling. Anal opening transverse.

Specimens Examined: Seven larvae from Gravel Pit Lakes State Recreation Area, 24.1 km W of Cimarron, on U.S. Highway 64, Colfax Co., New Mexico, J. K. Gelhaus, coll. (JKG).

Subgeneric Discussion: The larvae of *Beringotipula* form a very homogeneous group judging from the nearctic species examined, *Tipula rohweri, fallax* and *resurgens*, and the description of a palearctic species, *T. unca*. A unique feature is the digitiform projection located just below the apex of each ventral lobe. This protuberance is small (wider than long) in *T. unca* but is much longer than wide in the other known species. Wedge shaped, sclerotized spots occur near the base of each dorsal and lateral lobe but the lobes are unsclerotized and covered with single macroscopic hairs. The inner surface of each ventral lobe is sclerotized nearly to the apex and the lobes close against the spiracles. A border of short setae surrounds the glabrous area of the spiracular disc. The pattern of the darkened sclerites on the spiracular disc is similar in all the species examined. The anal papillae are short, with the lateral pair bluntly conical and the ventral papillae present only as broad protuberances. The abdomen has conspicuous, although slightly diffuse, clusters of macroscopic hairs around macrosetae V1 and V3, D3 and D4, and medial to D6. Additionally, the dorsum and venter of the abdomen has short microscopic hairs arranged in rows, with long microscopic hairs placed singly between these rows. Macroseta D4 is short and setae D5 and V2 are absent.

In the shape, size and placement of the spiracular lobes, *Beringotipula* is similar to *Pterelachisus, Savtshenkia* (cf. palearctic species *T. obsoleta* and *signata*), and the palearctic groups *Nigrotipula* and *Oreomyza*. A border of very short spiracular setae is found in the genus *Ctenophora* (cf. *C. elegans*) and the subgenera *Tipula* s. str. and *Savtshenkia* (cf. *T. signata* group sensu Theowald, 1957) as well as in *Beringotipula*. No other subgenus of *Tipula* shows a digitiform projection on each ventral lobe, but a similarity in form is found on the dorsal and lateral lobes of *Tipula* s. str. whereby each lobe is constricted distal to the sclerotized region. *Yamatotipula*, the palearctic *Acutipula* and *Beringotipula* all possess distinct macroscopic hair clusters in similar positions on the abdomen.

Beringotipula cannot be confused easily with other subgenera. The digitiform projection on each ventral lobe is unique among known tipulines, and few other taxa have both unsclerotized dorsal and lateral lobes and a short setal border. Although *Pterelachisus* and the palearctic *Oreomyza* and *Nigrotipula* have the spiracular disc similar to that of *Beringotipula*, they do not have the border of spiracular setae. (Correction added in proof: Theowald van Leeuwen, University of Amsterdam, informs me that a small digitiform projection on each ventral spiracular lobe is found also in larvae of the palearctic subgenus *Tipula (Mediotipula)*.)

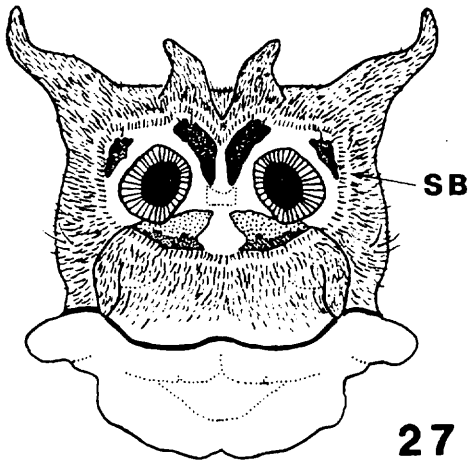
Habitats of *Beringotipula:* *Beringotipula* includes nearly 25 nearctic species whose known larvae occur in very wet habitats. Larvae of *Tipula rohweri* were collected from sodden, well-rotted logs at the edge of or lying across a small spring-fed stream in an oak-pine forest. Larvae were under the surface mosses or in the very decayed outer layers of the logs. At the same locality, other larvae of this species were found along the grassy margin of a small cold seep in the top layer of saturated soil enriched by pine needles and leaf fragments of deciduous trees.

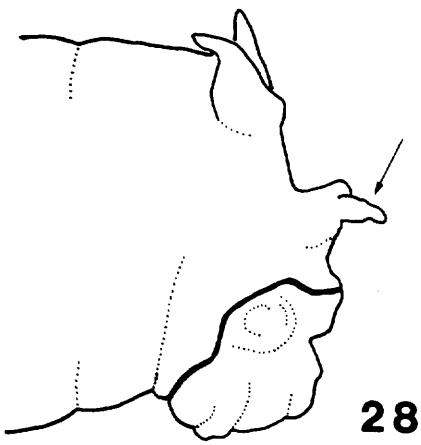
Other species occur in similar semi-aquatic habitats. In California, I found larvae of *T. fallax* in the sandy margins of a small mountain creek, and also in mosses on a vertical limestone cliff over which water slowly trickled. In New Mexico, one larva, possibly of *T. appendiculata*, was in a leaf pack in a rapidly flowing stream.

The larva of the palearctic *T. unca* has been collected from wet forest soil, often at the edges of streams and in wet moss cushions (Theowald, 1967).

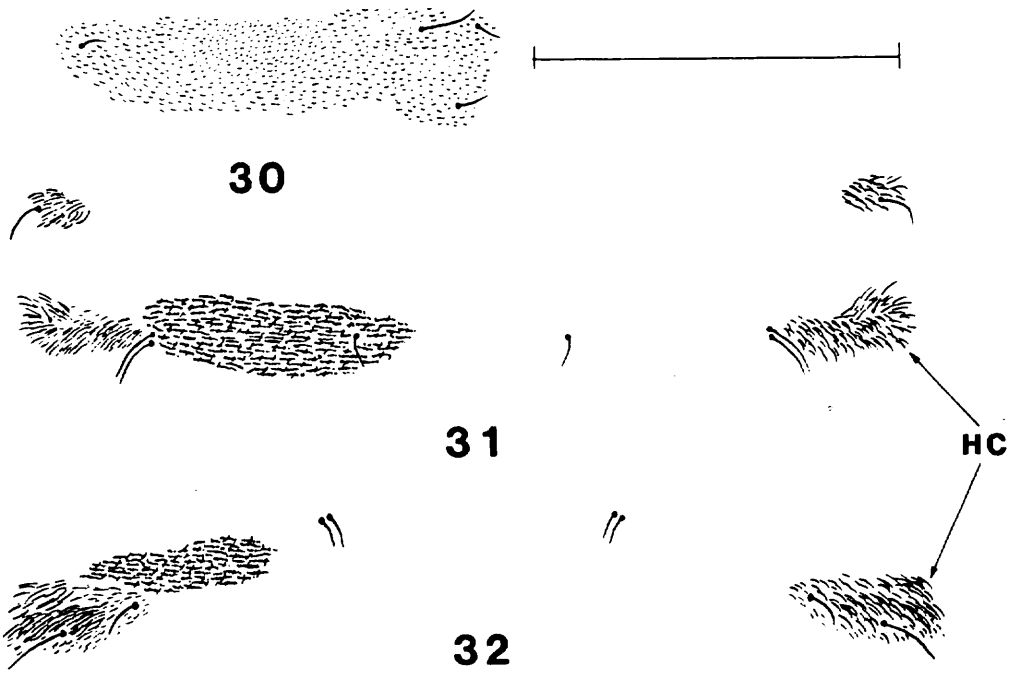
from Gelhaus 1986

Tipula (Beringotipula)





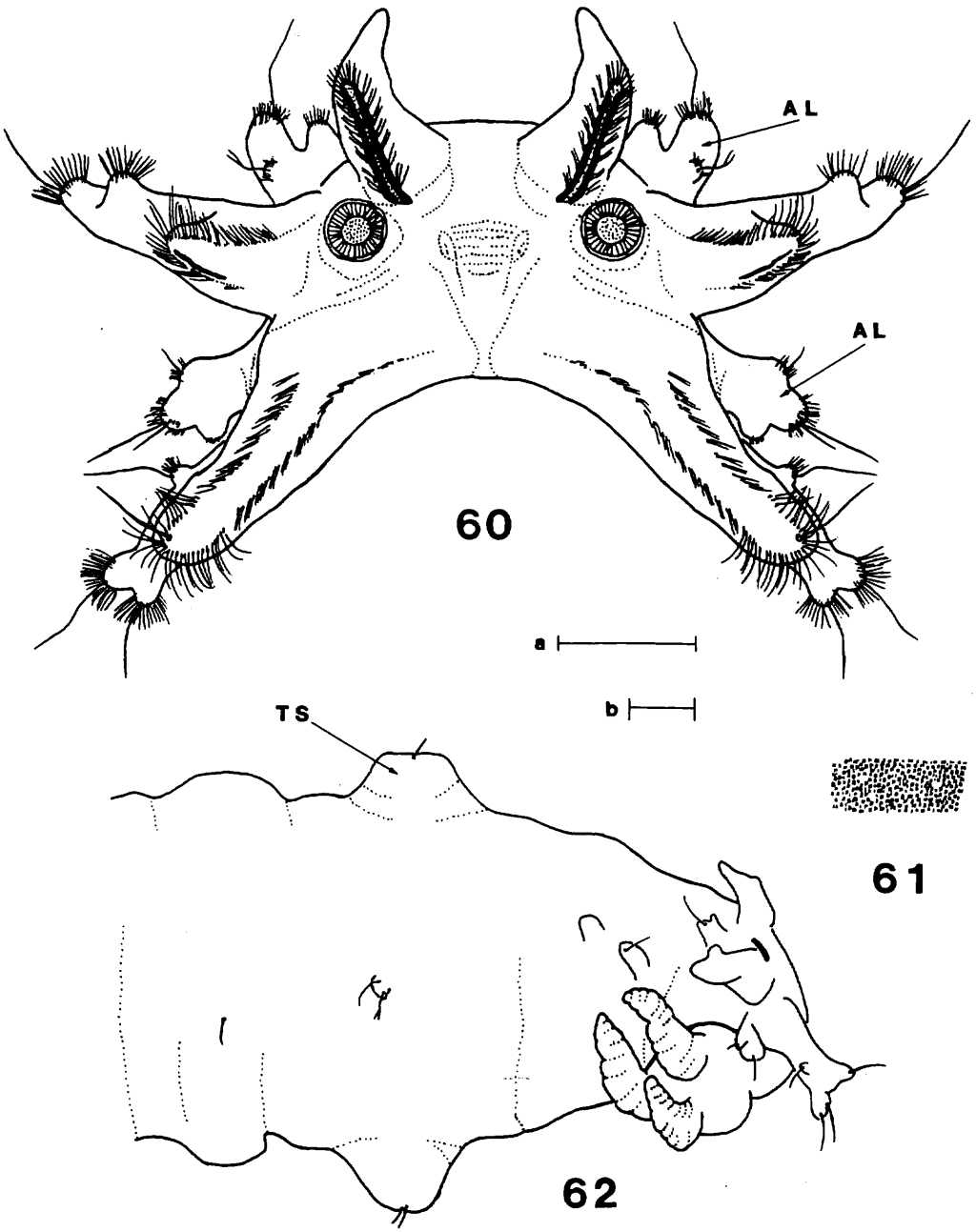
Figs. 27-29. *Tipula (Beringotipula) rohweri*. 27, spiracular area; SB-setal border. 28, terminal abdominal segments, lateral aspect. 29, ventral spiracular lobes, dorsal aspect. Scale line 1 mm.

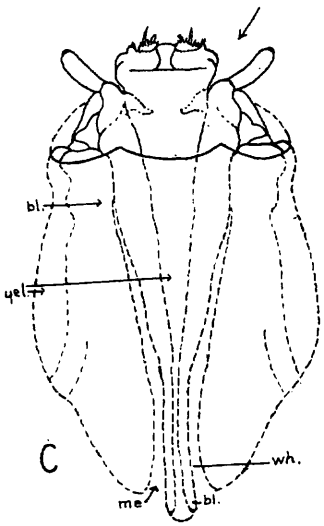


Figs. 30-32. *Tipula (Beringotipula) rohweri*. 30, macrosetae and example of hairs on abdominal pleura. 31, macrosetae, hair clusters and some of the microscopic hairs, representative of abdominal dorsum I-VII; HC-hair clusters. 32, same structures as 31, ventral abdominal segments I-VII. Scale line 1 mm.

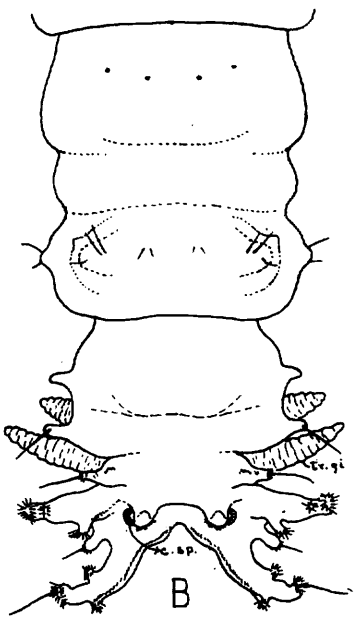
from Gelhaus 1986

Tipula (Nippotipula)

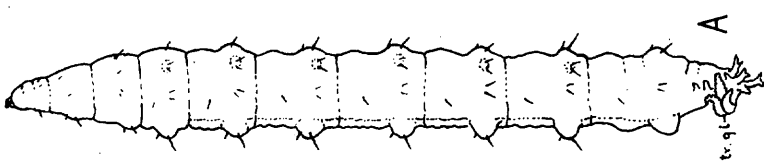




Figs. 60-62. *Tipula (Nippotipula) abdominalis.* 60, spiracular area; AL-accessory lobe. 61, example of abdominal microscopic hairs. 62, terminal abdominal segments, lateral aspect; TS-transverse swelling. All scale lines 1 mm. Scale a: Figs. 60, 61, scale b: Fig. 62.



Tipula abdominalis

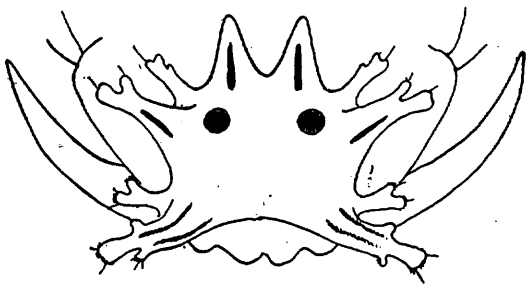


L=55mm

Tipula abdominalis

From Gelhaus 1986: 60-62
From Peterson 1960: A-C

Tipula (Nippotipula)



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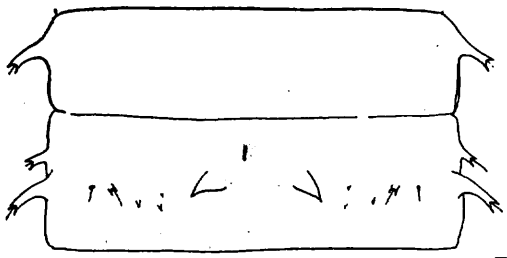
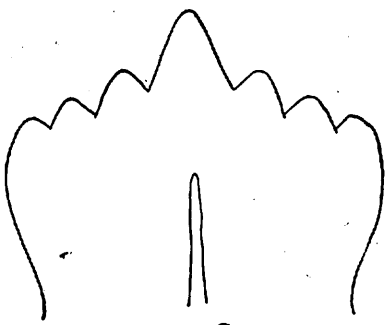
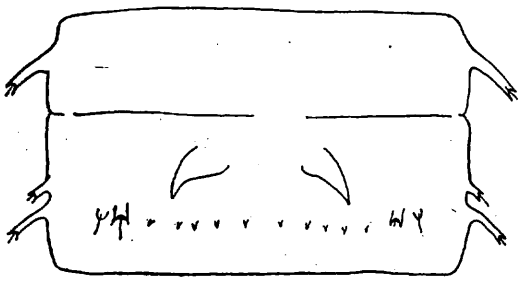


538



536

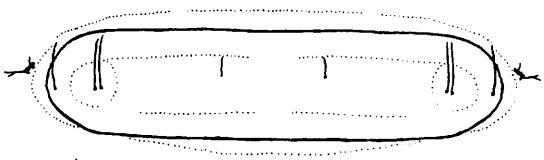


539

TIPULA ABDOMINALIS

Larva: 536, mentum; 537, spiracular disk
Pupa: 538, fifth abdominal tergite; 539, fifth abdominal sternite

From Alexander 1920



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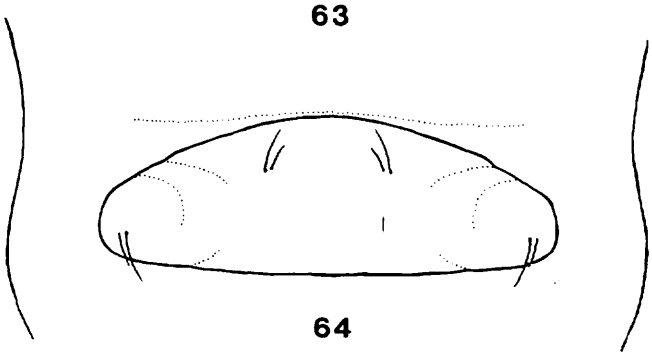


64

Figs. 63, 64. *Tipula (Nippotipula) abdominalis*, abdominal macrosetae. 64, ventral setae on transverse swelling. Scale line 1 mm.

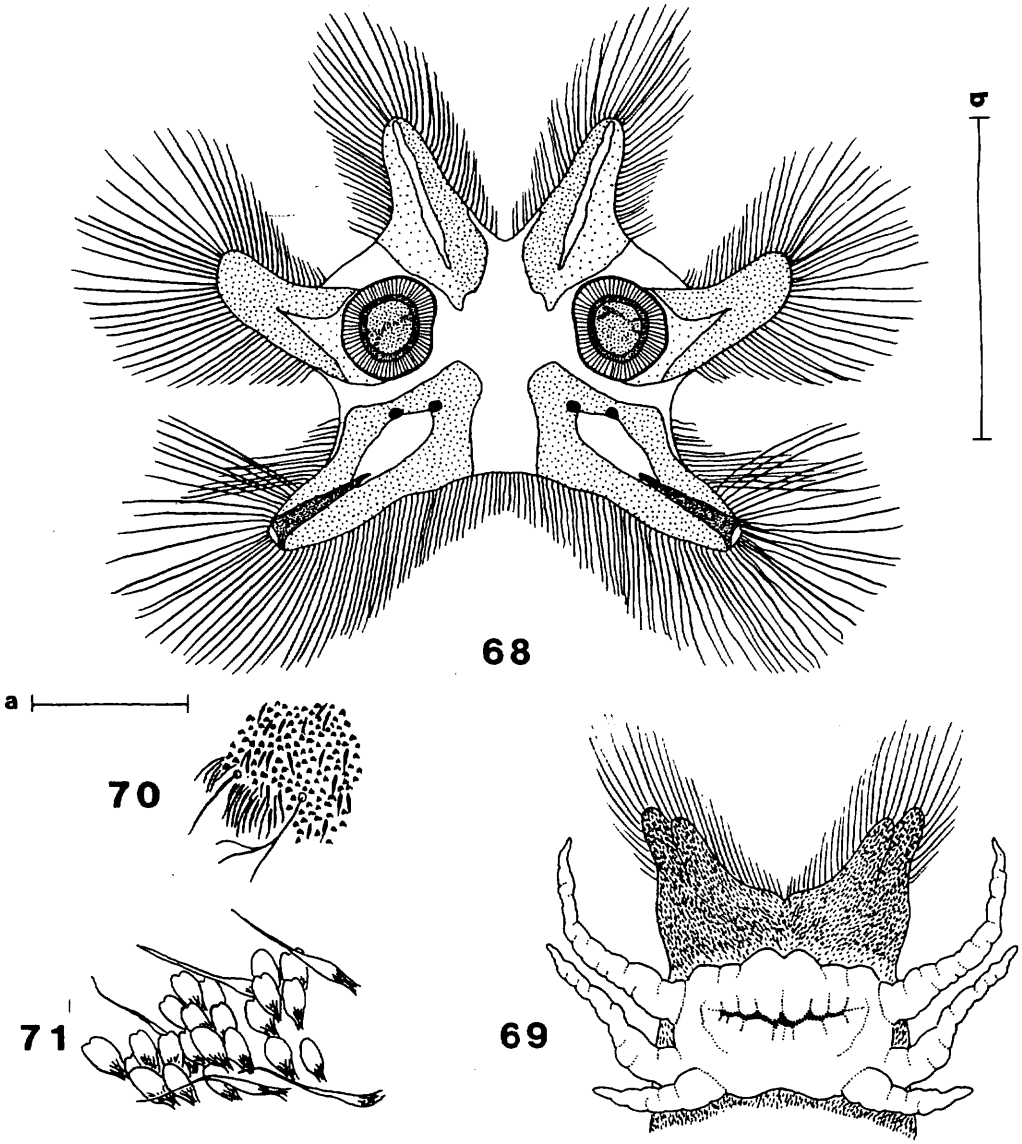
63, dorsal setae on transverse swelling.

From Gelhaus, 1986 ↑→

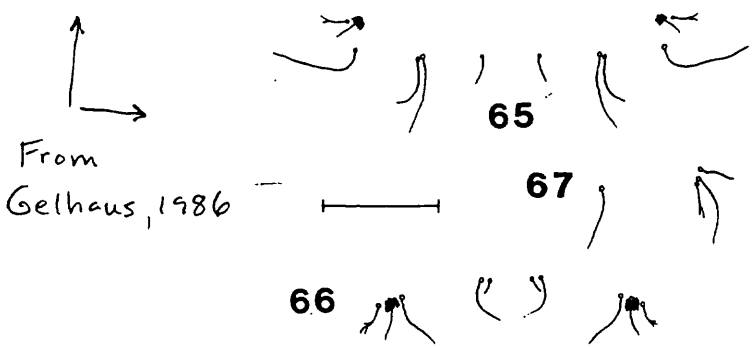
HABITATS OF *NIPPOTIPULA:* Only two nearctic species are included in *Nippotipula*, the well known *T. abdominalis* and the relatively recently described *T. metacomet*. Only the larva of *T. abdominalis* has been reared and associated with the adult, and the possibility exists that the larva of the sympatric *T. metacomet* has been confused with that of *T. abdominalis*.

The larvae of *T. abdominalis* are stream dwellers. Rogers (1942) collected the species in Michigan from the "leaf drift of two small sandy brooks" and in Florida (Rogers, 1933), from "among leaf drift and matted rootlets of sand bottom streams or in sand of stream bottom." Alexander (1920) found larvae "abundant under saturated decaying leaves or under tussocks of grass at the edge of the water." In Kansas, I have found the larvae most abundant in rocky or gravel-bottomed streams in heavily wooded areas; they are usually in leaf packs, under rocks, or even among mats of watercress. These streams may be permanent or intermittent.

Tipula (Nobilotipula)

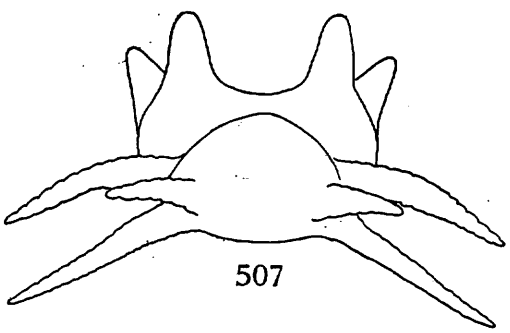


Figs. 68-71. *Tipula (Nobilotipula) nobilis*. 68, spiracular area. 69, anal papillae, ventral aspect. 70, example of microscopic hairs and setae on abdomen. 71, microscopic hairs, 250×. Scale lines 1 mm. Scale a: Fig. 69, scale b: Figs. 68, 70.



From Gelhaus, 1986

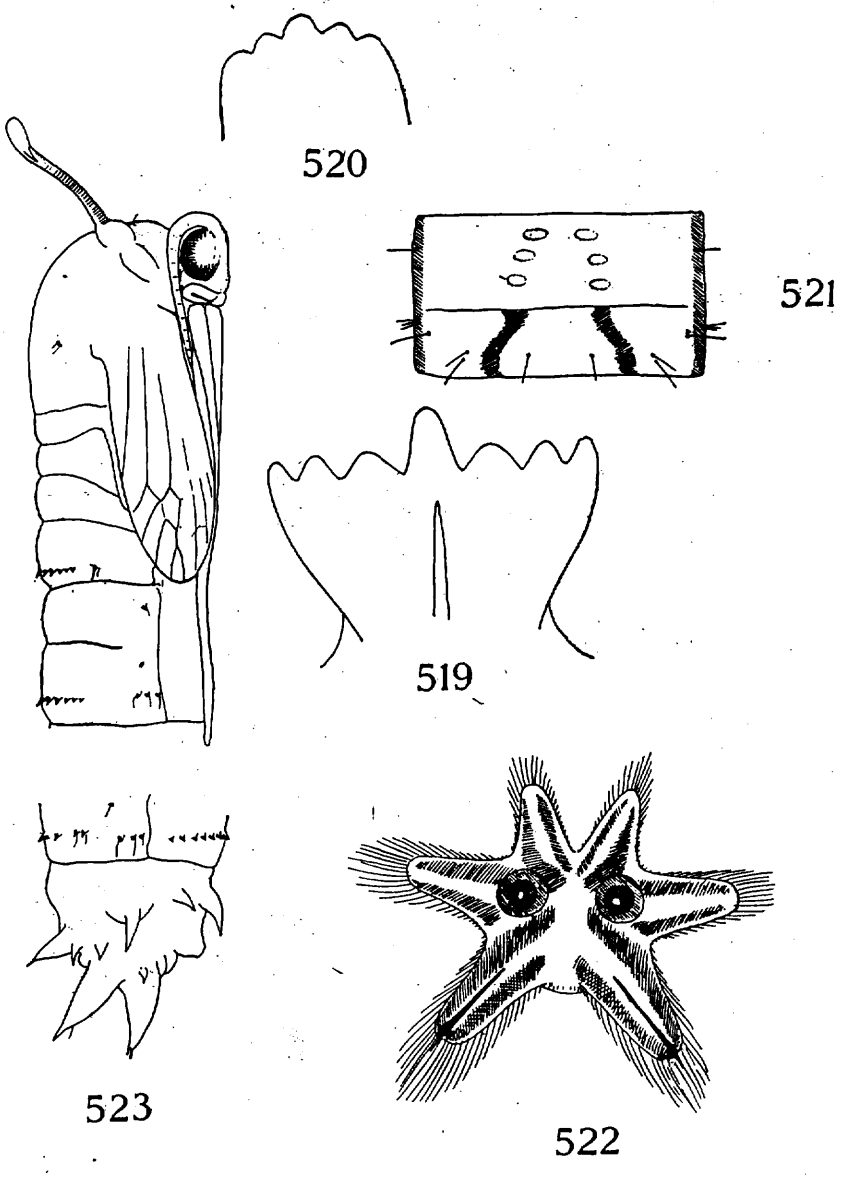
Figs. 65-67. *Tipula (Nobilotipula) nobilis*, abdominal macrosetae. 65, dorsal setae. 66, ventral setae. 67, pleural setae. Scale line 1 mm.



507, *T. nobilis*;

From Alexander, 1920

Tipula (Nobilotipula)



TIPULA COLLARIS

Larva: 519, mentum; 520, hypopharynx; 521, fifth abdominal segment, dorsal aspect; 522, spiracular disk

Pupa: 523, male, lateral aspect

Tipula (Nobilotipula)

Subgenus *Nobilotipula* Alexander

Larvae of both nearctic species in this subgenus, *Tipula nobilis* and *T. collaris*, have been described. Since *T. collaris* has been previously illustrated, I will redescribe and illustrate *T. nobilis* here.

Tipula (Nobilotipula) nobilis (Loew)

Alexander 1920:1004, Fig. 507.

Description: Length 19.7-20.6 mm, width 2.7-3.3 mm, body yellowish brown. *Abdomen:* Most macrosetae brown, setae D2 and D4 long, D3 of medium length, D1, D5 and D6 short, D6 pale and branched (Fig. 65). Setae L2 and L4 long, L1 and L3 shorter and pale, L3 branched; L1-L3 in approximately vertical alignment (Fig. 67). Setae V3 and V4 long, V1, V2 and V5 shorter, V1 branched (Fig. 66). Microscopic hairs single, flattened, broad, scale-like and reflective (Fig. 70,71), shortest hairs appressed to body, longer hairs often perpendicular to body, hair clusters around setae D5 and V2. *Spiracular Disc:* All spiracular lobes subequal, slightly longer than width at base, lateral lobes equidistant from dorsal and ventral lobes (Fig. 68). Lobes with well-developed border of setae, longest setae approximately equal to basal width of lobe. Posterior surface of each lobe with extensive light brown sclerite. Each ventral lobe with narrowly triangular, dark, median line; two dark spots near base. Spiracles brown, inner circle with dark irregular transverse pattern. Remainder of spiracular disc pale. Marginal band light brown. *Anal Segment:* Segment large, anal opening transverse; six elongate anal papillae, anterior papillae paired, posterior papillae single (Fig. 69); lateral papillae length/basal width 5.0-5.5.

Specimens Examined: Five larvae from the following two localities: MAINE: Penobscot Co., Orono, C. P. Alexander, coll. (UM); QUEBEC: Gatineau Park, 16.1 km NW of Ottawa (Ontario), H. Teskey, coll. (CNC).

From Gelhaus, 1986

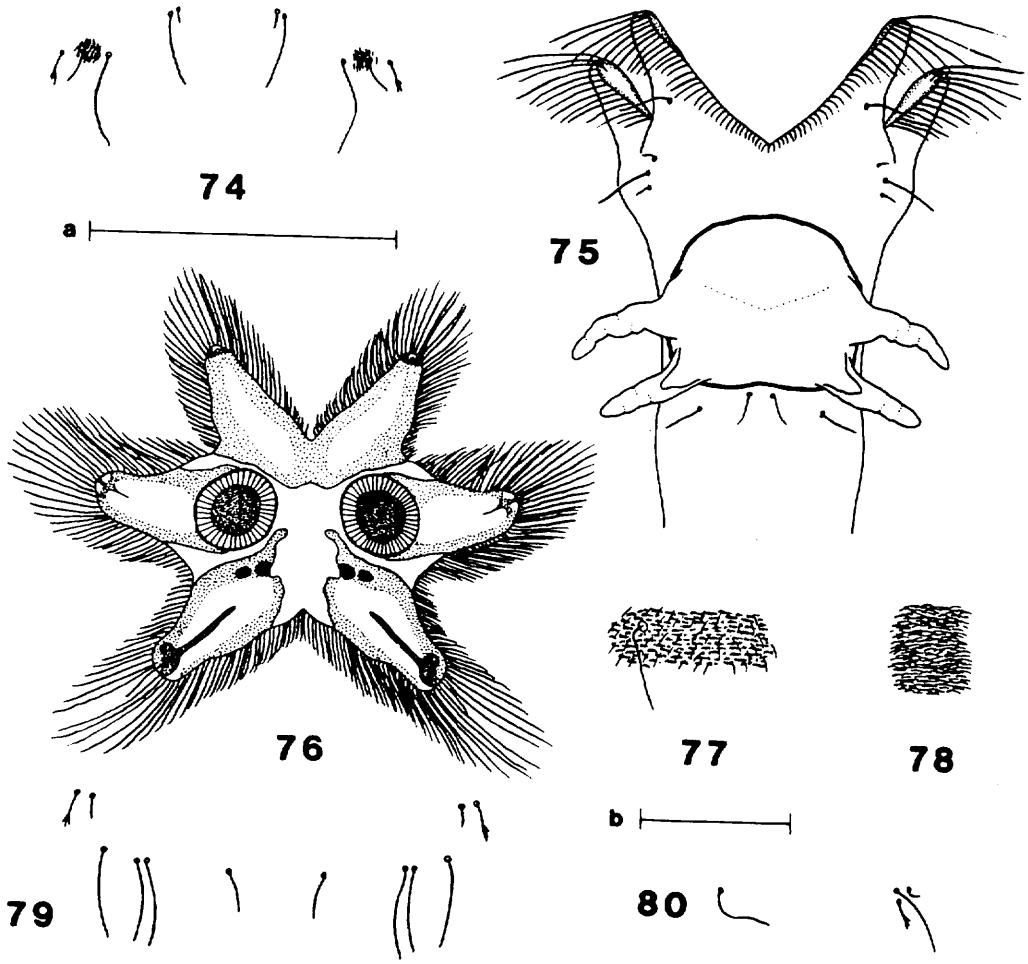
Subgeneric Discussion: The larvae of *Nobilotipula* possess two distinctive characters: the arrangement of the pleural abdominal macrosetae and the modified, lamelliform microscopic hairs. Most easily observable is the arrangement of setae L1-L3 in an approximately vertical alignment. This arrangement is also found in the palearctic *T. (Platytipula) melanoceros*. In all other known groups, and even in other species of *Platytipula* (e.g., *T. spenceriana*), seta L1 is caudad to seta L2, not above it. Although setae L1-L3 in *Angarotipula* are very close together, seta L1 is not directly dorsal to L2, but is slightly caudad to it.

The microscopic hairs in *Nobilotipula* are unique, being flattened and broad, with longitudinal ridges, and distinctly reflecting light (Fig. 71); those in other subgenera are cylindrical and narrow, without ridges, and not reflective. Two distinct lengths of microscopic hairs are seen in *Nobilotipula:* short microscopic hairs, which possess blunt, indented apices and are closely appressed to the body; and long microscopic hairs, with pointed apices that are often nearly perpendicular to the body. The hairs are usually singly placed, although in *T. collaris* the abdominal dorsum displays short rows of short microscopic hairs. These rows combine to form an overall arrangement of three pairs of circular areas anteriorly on each segment, followed by a pair of "comma"-shaped marks. In addition, the pleural microscopic hairs of this species are densely placed, giving the effect of a reddish-brown band on the abdominal pleuron.

Habitats of *Nobilotipula:* Alexander (1920) found larvae and pupae of *T. collaris* beneath saturated moss (*Amblystegium irriguum* [Wils.] B. & S.) in New York. A larva and two pupae were collected by S. Hamilton and G. Schuster in North Carolina, from a small, fast-flowing, heavily shaded stream in a deciduous woodland.

Larvae of *T. nobilis* were collected by Alexander (1920) in Maine, from wet moss and also from decaying witch-hazel leaves. Additionally, H. Teskey collected larvae of *Tipula nobilis* from a woodland swamp in Quebec, and S. Teale found larvae in New York in shallow (2.5-5.0 cm deep), leaf-filled pools with a thick, organic silty bottom.

Tipula (Platytipula)



Figs. 74-80. *Tipula (Platytipula) spenceriana*. 74, ventral abdominal macrosetae. 75, anal papillae, ventral aspect. 76, spiracular area. 77, example of microscopic hairs on dorsum of abdomen. 78, example of microscopic hairs on pleura of abdomen. 79, dorsal abdominal macrosetae. 80, pleural abdominal macrosetae. All scale lines 1 mm. Scale a: Figs. 77, 78, scale b: Figs. 74-76, 79, 80.

from Gelhaus 1986

Subgenus *Platytipula* Matsumura

Four nearctic species of *Platytipula* have been reared and associated with adults.

Tipula (Platytipula) spenceriana Alexander

Description: Length 20.0-30.5 mm, width 2.3-2.6 mm, body yellow-brown. *Abdomen:* Most macrosetae dark brown, setae D2-D4 long, D1 and D6 shorter, D5 very short, D6 pale and branched (Fig. 79). Setae L2 and L4 long, L3 shorter, pale and branched, L1 very short (Fig. 80). Setae V3 and V4 long, V1 and V2 shorter, V5 very short, V1 pale and branched (Fig. 74). Very short microscopic hairs in long rows on dorsum and venter (Fig. 77), sometimes on pleura; single macroscopic hairs scattered between rows of microscopic hairs, long and most dense around bases of V2 and D2-D5. Pleura with dense, single macroscopic hairs (Fig. 78). *Spiracular Disc:* All lobes subequal, slightly longer than width at base, lateral lobes equidistant from dorsal and ventral lobes (Fig. 76). Lobes with well-developed border of setae, longest setae as long as basal width of lobes. Posterior surface of each lobe with brown sclerite, darkest at margins. Each ventral lobe with a dark, median line, approximately as long as lobe; two dark spots at base; a short, pale seta at apex. Each lateral lobe with a dark, median line, approximately 1/3 as long as lobe. Spiracles large, approximately circular, inner circle black, outer ring brown: distance between spiracles equal to diameter of a spiracle. Remainder of spiracular disc pale. Marginal band light brown. *Anal Segment:* Six anal papillae, four elongate, extending laterally or ventrally; two short; anteriormost papillae paired, posteriormost papillae single (Fig. 75); length/basal width of lateral papillae 2.5-3.5.

Specimens Examined: Ten larvae from Gravel Pit Lakes State Recreation Area, 24.1 km W of Cimarron, on U. S. Highway 64, Colfax Co., New Mexico, J. K. Gelhaus, coll. (JKG).

Subgeneric Discussion: I have examined larvae of three nearctic species of *Platytipula*, *T. paterifera*, *spenceriana* and *ultima*, as well as the descriptions of *T. ultima* (Young, 1981) and *cunctans* (Hyslop, 1910, as *infuscata*). The descriptions of three palearctic species of *Platytipula* are also available (for *T. autumnalis*, *luteipennis* and *melanoceros*).

Larvae of *Platytipula* are all similar in structure. The spiracular lobes are all subequal and of a medium length, with a well-developed border of long setae. All species possess a long, dark median line on each ventral lobe, and usually there is a short, median line on each lateral lobe. All six lobes usually have pale brown sclerites, darkest at margin. Also, there may be two dark spots at the base of each ventral lobe (these are fused into a dark line in the palearctic *T. luteipennis*). All the species have six anal papillae of which four are long and extended laterad or ventrad. The spiracles are large and often separated by less than the diameter of a spiracle.

Tipula (Platytipula)

The size and arrangement of the macrosetae varies among the species. Setae D2 and D3 may both be short (e.g., *T. melanoceros*) or long (e.g., *T. spenceriana*) or only D2 may be long (e.g., *T. luteipennis*). Setae D5 and D6 are short in *T. melanoceros* but are longer in all other species. Seta L1 is posterodorsal to L2 in most species, but is completely dorsal to L2 in *T. melanoceros*. Setae D6, V1 and L3 are branched in at least the nearctic species examined (not shown in Theowald, 1957, 1967, or Young, 1981). The body is covered with a combination of both short microscopic hairs and macroscopic hairs; the microscopic hairs are in long rows with single macroscopic hairs scattered between the rows. The macroscopic hairs are most dense around the bases of the macrosetae and form a weakly developed cluster of hairs around setae V2; all the setae are clearly visible, though.

Larvae of *Platytipula* are similar morphologically to those of some aquatic subgenera, and present problems in separation from certain of these. The subequal, moderately long spiracular lobes with a well-developed border of long setae, the dark median line on each ventral lobe, elongate anal papillae, branched setae and the predominance of macroscopic hairs all can be found in other aquatic subgenera, including *Yamatotipula*, *Bellardina*, *Nobilotipula*, the palearctic *Acutipula* and *Emodotipula*, and the genus *Holorusia*. In particular, larvae of *Bellardina* and the genus *Holorusia* are most difficult to distinguish from those of *Platytipula*. The geographical range, specific habitat and overall body size may help in separating the three subgenera when used in conjunction with morphological characters found in the key.

Habitats of *Platytipula*: *Platytipula* contains 11 species in the Nearctic and many more species in the Palearctic. There is some life history information available for five nearctic species.

Larvae of *Tipula spenceriana* were found along a small, moderately flowing, seepage-stream, which ran for only 30 m before emptying into the Cimarron River, New Mexico. When first collected in mid-May, larvae in the second and third instars were found in wet mosses and algae in the stream. Less than one month later, the stream was greatly reduced in volume and rate of flow, and the larvae were mature.

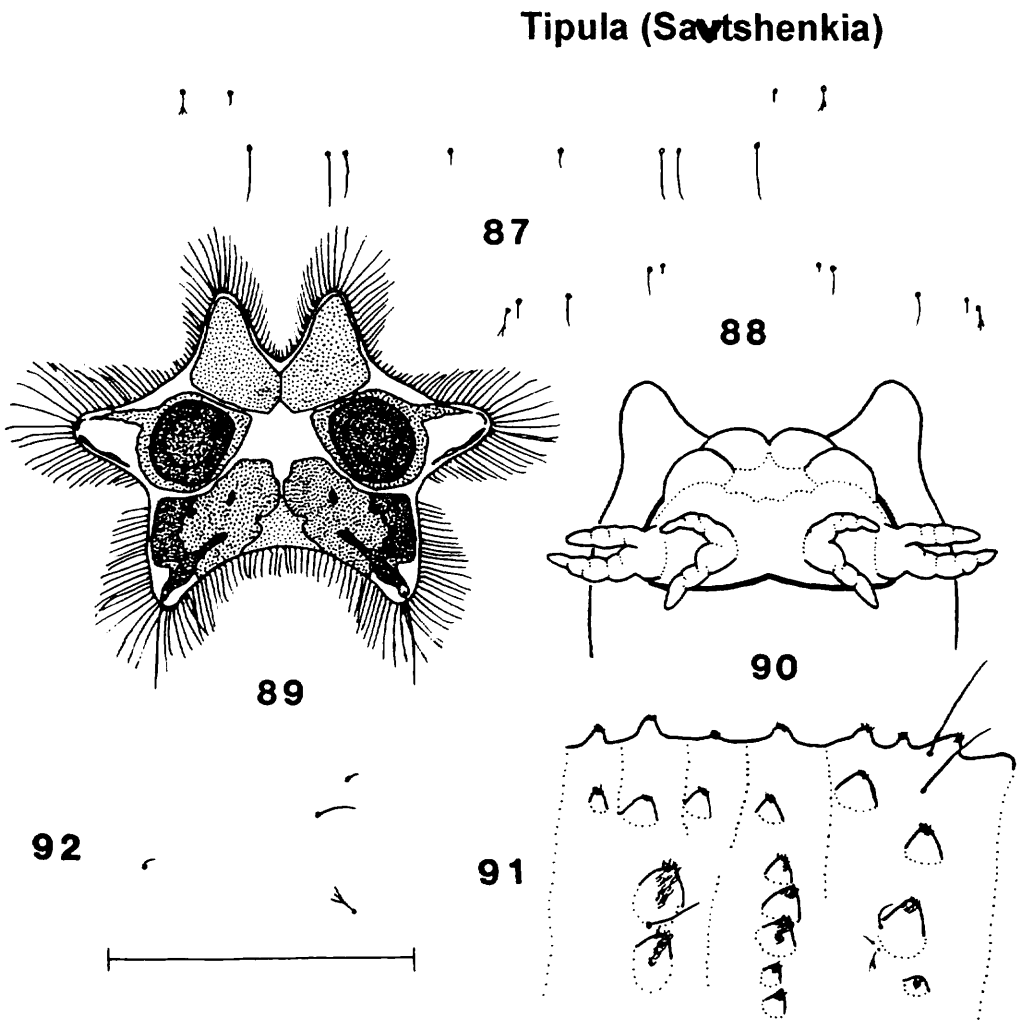
Tipula ultima may also inhabit the margins of streams. I have made a number of collections of larvae in Kansas from dense leaf debris at the edges of small, slowly flowing streams, marshy areas and seepages. The species was collected from the mud of a well-shaded seep in Kansas (Young, 1981), and in the mud surrounding crayfish burrows of a glacial pothole in Illinois (Needham, 1903, as *T. flavicans*). Caudell (1913, as *T. flaviçans*) collected pupae and adults in Virginia from a wet clayey area that had been previously inundated.

Larvae of *T. cunctans* have been reported twice from water-logged meadows (Hyslop, 1910; Rogers, 1933). At both times this species occurred in huge numbers, 200 larvae per square foot (2153 per square meter) as estimated by Hyslop, and caused damage by eating the roots and shoots of pasture grasses and clover. *Tipula maritima* also was collected from a similar meadow habitat in Indiana (J. S. Rogers, field notes). I have also found larvae of *T. cunctans* in Kansas from the clay margins of a shaded, small pond and marsh. Pupae of *T. pendulifera* were found in spongy, damp soil of an open slope surrounding a montane pond in Colorado. Pupae were usually found in burrows 51-63 mm deep, under mats of mosses (G. W. Byers, field notes).

The larvae of the palearctic species inhabit similar aquatic situations, most commonly in marshy soil or Sphagnum moss (Brindle, 1959; Theowald, 1967).

Certain generalizations can be made about life histories of known *Platytipula*. In the four species I have reared, larvae are often indicative of aquatic habitats that exist primarily in winter or early spring and dry considerably or entirely during the summer. As noted by Hyslop (1910), Young (1981) and myself, larvae develop rapidly during early spring and diapause throughout the summer in an inactive state out of water, pupating in the fall.

from Gelhaus 1986



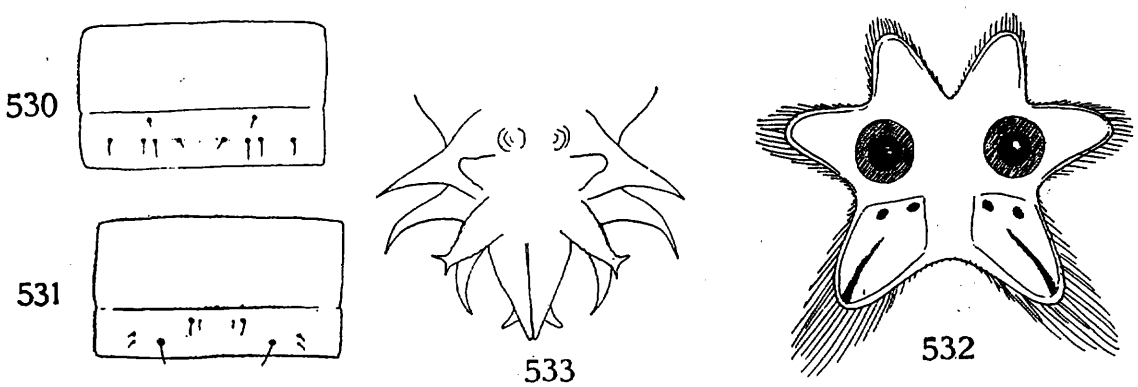
Figs. 87-90, 92. *Tipula (Savtshenkia) ignobilis*. 87, dorsal abdominal macrosetae; width 2 mm. 88, ventral abdominal macrosetae; width 2 mm. 89, spiracular area. 90, anal papillae, ventral aspect. 92, pleural abdominal macrosetae; width 1 mm. Fig. 91. *T. (Savtshenkia)* sp., unreared; abdominal segment, lateral aspect. Scale line 1 mm.

HABITATS OF *SAVTSHENKIA*: The only habitat information available about the eleven nearctic species of *Savtshenkia* pertains to *T. ignobilis*, where larvae were collected by Alexander (1920) from wet cushions of moss *(Amblystegium)* in New York and also from wet mosses in Maine. In Kansas, Young (1978) collected larvae from "a mat of wet moss on a cliff" and J. A. Slater, Jr. collected pupae from mosses at the base of a limestone cliff where water slowly trickled. G. W. Byers reared larvae in Michigan from "mixed mosses and *Conocephalum* near a small brook. . . . Mosses shaded and on a sandy-marl bank of the brook, where much organic silt also present" (field notes).

Nearly all the palearctic species appear to be associated with mosses, although the specific conditions vary. *Tipula cheethami* has been found "among mosses and liverworts that grow at the edges of streams and on exposed stones and logs in the streams themselves" (Chiswell, 1956). *Tipula macrocera* and *T. subnodicornis* were collected in wet moorland mosses *(Hypnum, Sphagnum* and *Polytrichium)* (Brindle, 1960b), and in cold bogs of tundra and high mountains (Theowald, 1967). Cold bogs and mountain streams are the habitats of *T. goriziensis* (Theowald, 1967). Other species of *Savtshenkia* are found in drier mosses. *Tipula alpium, staegeri,* and *marmorata* are all found in mosses on walls, stones and trees (Brindle, 1960b). *Tipula pagana* is found on and under mosses on soil (Theowald, 1967).

The unreared larva discussed previously (as Tipuline no. 1, Alexander, 1920), was collected in New York from aquatic mosses *(Hypnum)* in a rapidly flowing stream.

from Gelhaus 1986



TIPULA IGNOBILIS

Tipula ignobilis, larva: 530, fifth abdominal segment, dorsal aspect; 531, fifth abdominal segment, ventral aspect; 532, spiracular disk
Tipula ignobilis, pupa: 533, female cauda, dorsal aspect

from Alexander 1920

Tipula (Savtshenkia)

Subgenus *Savtshenkia* Mannheims

Tipula (Savtshenkia) ignobilis is the only nearctic species of this subgenus for which I have examined reared larvae.

Tipula (Savtshenkia) ignobilis Loew

Alexander 1920:1010-1011, Figs. 511, 530-532.

Description: Length 11.9-17.9 mm, width 1.2-2.6 mm, body brown. *Abdomen:* Most macrosetae dark brown, setae D2-D4 long, D1 and D6 short, D6 pale and branched, D5 very short and inconspicuous (Fig. 87). Seta L2 long, L1, L3 and L4 shorter, L3 pale and branched (Fig. 92). Setae V3 and V4 long, V1 and V2 shorter, V5 very short and inconspicuous, V1 branched (Fig. 88). Abundant macroscopic hairs, densest on dorsum and venter, sparse on pleura. *Spiracular Disc:* All lobes subequal, length slightly greater than basal width, lateral lobes equidistant from dorsal and ventral lobes (Fig. 89). Lobes with well-developed border of setae, longest setae ½ basal width of lobe or less. Posterior surface of each dorsal and ventral lobe with extensive light brown sclerites, often darkest laterally, each ventral lobe also with dark, median line, and two black spots at base. Posterior surface of each lateral lobe with two narrow, lateral light brown sclerites, often extending around margin of spiracles. Spiracles brown, approximately circular; remainder of spiracular disc pale. Marginal band light brown. *Anal Segment:* Eight, subequal anal papillae of medium length, in four pairs (Fig. 90); length/basal width 2.5-4.0.

Specimens Examined: Fifteen larvae from the following localities: MICHIGAN: Washtenaw Co., Cascade Glen, 1.6 km NW of Ann Arbor, G. W. Byers, coll. (KU); NEW YORK: Tompkins Co., Ithaca, C. P. Alexander, coll. (UM); Westchester Co., Armonk, H. Knizeski, coll. (HK).

Subgeneric Discussion: Larvae are known for the nearctic species *Tipula ignobilis* and for fifteen European species. All larval *Savtshenkia* possess four pairs of subequal anal papillae. These papillae show a progression from moderately long and conical as in *T. ignobilis* and *cheethami,* to low protuberances in *T. pagana* and *obsoleta.* The shape and placement of the spiracular lobes also varies. In *T. ignobilis,* and the *T. rufina* group (sensu Theowald, 1957), the lobes are subequal and moderately long (usually longer than wide), and radially arranged around the spiracular disc. These lobes rest against each other when closed. In other species, such as *T. obsoleta* and *marmorata,* the lobes are generally shorter with the ventral lobes closing against the spiracles, not against the dorsal and lateral lobes. All *Savtshenkia* have a border of setae around the spiracular lobes. At greatest length, in *T. ignobilis* and the *T. rufina* group, the longest setae are at least as long as half the basal width of the lobes. The border of setae is very short in species such as *T. obsoleta, odontostyla* and *marmorata,* with the longest setae less than one-fourth the basal width of the lobes. The amount of sclerotization of the spiracular lobes is also variable. In *T. ignobilis* and other species with moderately long, subequal lobes, the sclerotization is usually extensive, encompassing most of the posterior surface of each lobe. In those species with shorter lobes, the sclerotization extends onto the dorsal and lateral lobes, but only as far as their bases, with the distal areas of the lobes remaining unsclerotized. These short lobes may be conical or low and rounded; if low, then the ventral lobes are extensively sclerotized.

The two macrosetal arrangements illustrated for the palearctic species (Theowald, 1967) differ in minor details from that of *T. ignobilis.* The *T. rufina* group apparently lacks seta D5, although this seta is found in *T. ignobilis.* In the *T. signata* group, seta D1 is ventrolateral to seta D2, while in *T. ignobilis* it is in the dorsolateral position. *Tipula ignobilis* has a moderate amount of macroscopic hairs, and this apparently is found also in at least *T. alpium* and *marmorata.* Other species, such as *Tipula cheethami,* have predominantly short microscopic hairs.

The number and form of the anal papillae provide a distinctive, synapomorphic character for a subgenus otherwise showing much diversity in larval morphology. The presence of eight, subequal anal papillae is a unique feature in the genus *Tipula,* although *Acutipula* has eight, unequal anal papillae with the two ventral pairs very short. The moderately long, well-developed, subequal spiracular lobes with a border of long setae and with all the lobes closing against one another, as found in *T. ignobilis* and the *T. rufina* group, are similar to their equivalents in the *T. (Trichotipula) oropezoides* group, *Nobilotipula,* and *Schummelia.* The *Tipula signata* group, particularly *T. marmorata* or *obsoleta,* with short spiracular lobes, a border of short setae, and the ventral lobes closing against the spiracles shows resemblance to *Beringotipula* and the palearctic *Nigrotipula* and *Mediotipula* (setal border absent). A general predominance of macroscopic hairs is also found in *T. oropezoides,* but in this species the hairs are denser.

An unreared larva which might be considered within *Savtshenkia* possesses a number of interesting features. Alexander (1920) described this larva from New York as Tipuline no. 1, and I have seen a similar larva from North Carolina. The presence of eight, subequal anal papillae would place it with *Savtshenkia.* It also has moderately long, subequal spiracular lobes with a border of long setae, but possesses many short tubercles on the abdomen, encompassing all the macrosetal bases and numerous in other areas as well (Fig. 91). In addition, most of the apices of the tubercles have clusters of macroscopic hairs. These tubercles are somewhat similar to those of the palearctic *Oreomyza* (sensu Theowald, 1967). The dorsal and lateral spiracular lobes also have a tubercle just before the apex on the anterior, unsclerotized surface. The larvae are conspicuously mottled on the dorsum with patches of dark or light short microscopic hairs, a condition found similarly in some palearctic species of *Savtshenkia,* notably *T. cheethami, simulans* and *goriziensis.*

from Gelhaus 1986

Tipula (Schummelia)

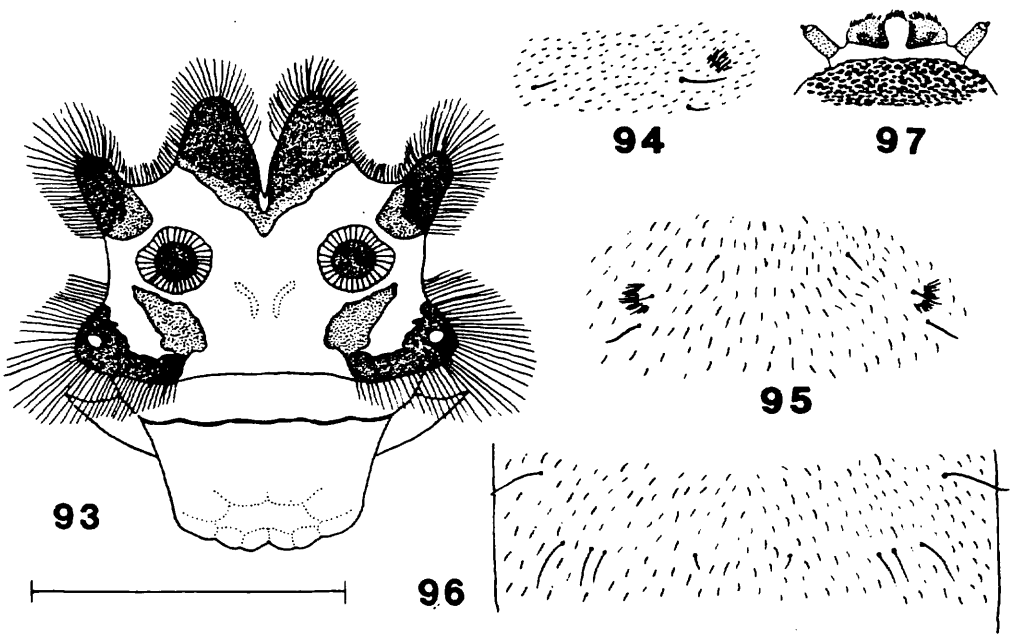
Subgenus *Schummelia* Edwards

Tipula synchroa is the only nearctic species of *Schummelia* for which the larvae have been associated with adults.

Tipula (Schummelia) synchroa Alexander

Description: Length 14.3-16.2 mm, width 1.4-1.6 mm, body yellowish brown. Anterior edge of prothorax with thickened cuticle (Fig. 97). *Abdomen:* Most macrosetae brown, setae D2-D4 and D6 long, D1 short, D5 absent, D6 pale (Fig. 96). Seta L2 long, L3 and L4 short, L1 very short and inconspicuous (Fig. 94). Setae V1 and V3 long, V4 short, V2 and V5 absent, V1 pale (Fig. 95). Dorsum of abdominal segment VIII with a semicircular row of long, dark brown macroscopic hairs (Fig. 98); underlying segment with pair of lateral swellings (Fig. 99), microscopic hairs between the hair row and spiracular lobes very short, stout and dark. Other microscopic hairs longer, pale and single. Small tufts of long microscopic hairs around setae L1 and V3, most conspicuous posteriorly. *Spiracular Disc:* All spiracular lobes short, dorsal and lateral lobes as long as width at base, ventral lobes slightly wider than long, lateral lobes equidistant from dorsal and ventral lobes (Fig. 93). Lobes with a well-developed border of setae, longest setae ⅔ basal width of ventral lobe. Border of setae around edges of lobes and between dorsal and lateral lobes, absent between other lobes. Posterior surface of all lobes almost completely covered with dark sclerites; dorsal lobes darkest. Ventral lobe with subapical clear spot, complete sclerite C-shaped. Anterior surface of dorsal and lateral lobes with well-developed subapical clusters of macroscopic hairs. Spiracles subcircular, inner circle dark brown, outer ring brown, distance between spiracles slightly greater than diameter of spiracle. Remainder of spiracular disc pale. Marginal band brown. *Anal Segment:* Segment protuberant; four subequal, single, conical anal papillae (Fig. 99), each as long as wide, anterior and anteriolateral to anus.

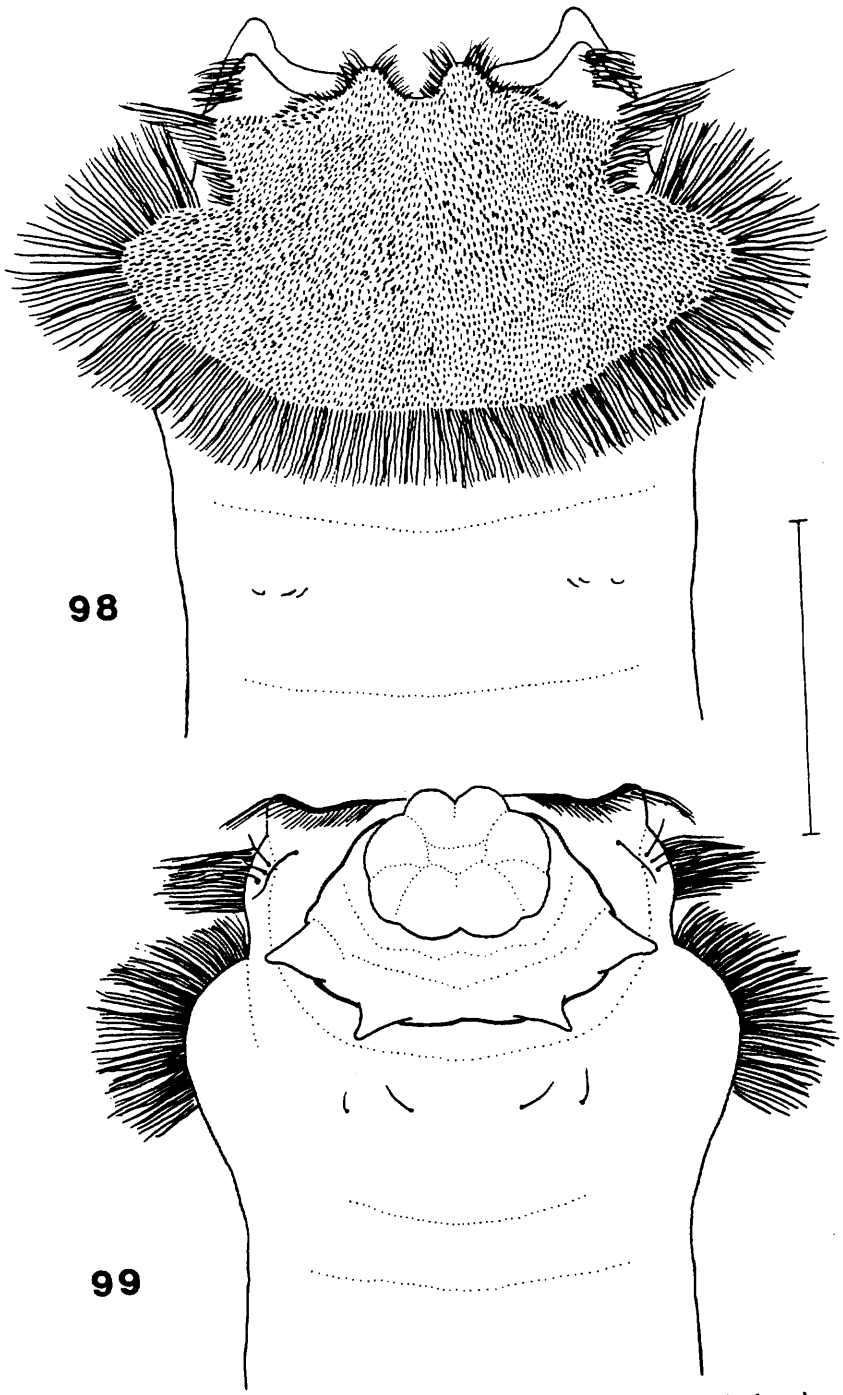
Specimens Examined: Nine larvae from Devil's Mill Hopper, 11.3 km NW of Gainesville, Alachua Co., Florida, J. S. Rogers, coll. (UM).



Figs. 93-97. *Tipula (Schummelia) synchroa*. 93, spiracular area. 94, pleural abdominal macrosetae and microscopic hairs. 95, ventral abdominal macrosetae and microscopic hairs. 96, dorsal abdominal macrosetae and microscopic hairs. 97, anteriormost area of prothorax and head capsule, dorsal aspect. Scale line 1 mm.

from Gelhaus 1986

Tipula (Schummelia)



Figs. 98, 99. *Tipula (Schummelia) synchroa*, terminal abdominal segments. 98, dorsal aspect. 99, ventral aspect. Scale line 1 mm.

HABITATS OF *SCHUMMELIA*: Very little information is available concerning the larval habitats of the seven nearctic species of *Schummelia*. Rogers (1933) recorded the larvae of *T. synchroa* from "wet, black, organic silt of seepage areas" apparently in shaded or heavily wooded situations. Unreared larvae of *Schummelia*, possibly *T. hermannia*, were collected from moist, humous soil in a floodplain woods in Michigan by R. W. Merritt (G. W. Byers, personal communication). *Tipula variicornis* has been collected from "wet leaf mould or wet soil in marshy places or at the edges of ponds and streams, usually in woods" (Chiswell, 1956).

from Gelhaus 1986

Tipula (Sinotipula)

Subgenus *Sinotipula* Alexander

Tipula (Sinotipula) commiscibilis is the only species in this group for which the larvae have been associated with adults.

Tipula (Sinotipula) commiscibilis Doane

Description: Length 35.8-51.5 mm, width 5.0-6.4 mm, dorsum with a dark brown background; on each segment with two light brown, lateral longitudinal bands connected by median, transverse, irregular band; 2 pairs of light brown spots anterior to median band, four pairs of light brown spots posterior to band (Fig. 111). Pleura and venter brown. *Abdomen:* Posterior portions of abdominal segments I-VII with conspicuous, ventral transverse swellings (Fig. 108), increasing in height posteriorly, the most developed swellings with basal width twice height. Abdominal segment VIII with circular swellings anterior to but between dorsal and lateral spiracular lobes and anterolateral to each ventral lobe (Fig. 108). Macrosetae dark brown, setae D2-D4 and D6 long, D1 and D5 shorter (Fig. 109). Setae L2-L4 long, L1 shorter (Fig. 107). Setae on transverse swellings, V1, V3 and V4 long, V2 and V5 shorter (Fig. 106). Body with short microscopic hairs, in rows on dorsum and venter, single on pleuron (Fig. 112). Dorsal microscopic hairs forming overall light and dark "H"-pattern as described above; scattered small circular areas without microscopic hairs, surrounded by dark microscopic hairs. Macroscopic hairs absent. *Spiracular Disc:* Lateral and ventral spiracular lobes short, basal width slightly greater than length; dorsal spiracular lobes narrower, as long as wide. Lateral lobes equidistant from dorsal and ventral lobes (Fig. 110). Spiracular lobes with well-developed border of setae, longest setae less than ½ basal width of lobe. Posterior surface of each lobe pale; two to four dark spots at base of each ventral lobe; often a light brown sclerite lateral to spots. Spiracles small, circular, inner circle dark, outer ring brown; distance between spiracles twice or more diameter of spiracle. Marginal band brown. *Anal Segment:* Six, short anal papillae (Fig. 108), medial papillae paired, lateral papillae single; length/basal width of lateral papilla 2.0-3.0.

Specimens Examined: Four larvae were collected from Big Hill Creek, Big Hill Springs Provincial Park, approx. 33 km NW of Calgary, Alberta, G. Pritchard, coll. (KU).

Subgeneric Discussion: *Sinotipula,* as judged by *Tipula commiscibilis,* shows a distinctive combination of features. An obvious character is the presence of ventral transverse swellings on the abdomen, found also in *Nippotipula* and, to a lesser extent, in *Yamatotipula* (specifically, *T. caloptera*). Both *T. caloptera* and *Sinotipula* also possess lateral swellings on abdominal segment VIII and a similar abdominal pattern formed by the dark and light, short microscopic hairs. Longer microscopic hairs are rare in *Sinotipula* and macroscopic hairs are absent. The spiracular lobes are short and broad with a well-developed border of setae as in other aquatic groups but the posterior surface of each lobe almost completely lacks darkened sclerites. The spiracles are small and widely separated, and the anal papillae are relatively short. None of the macrosetae is branched, although branched setae are found in most aquatic subgenera.

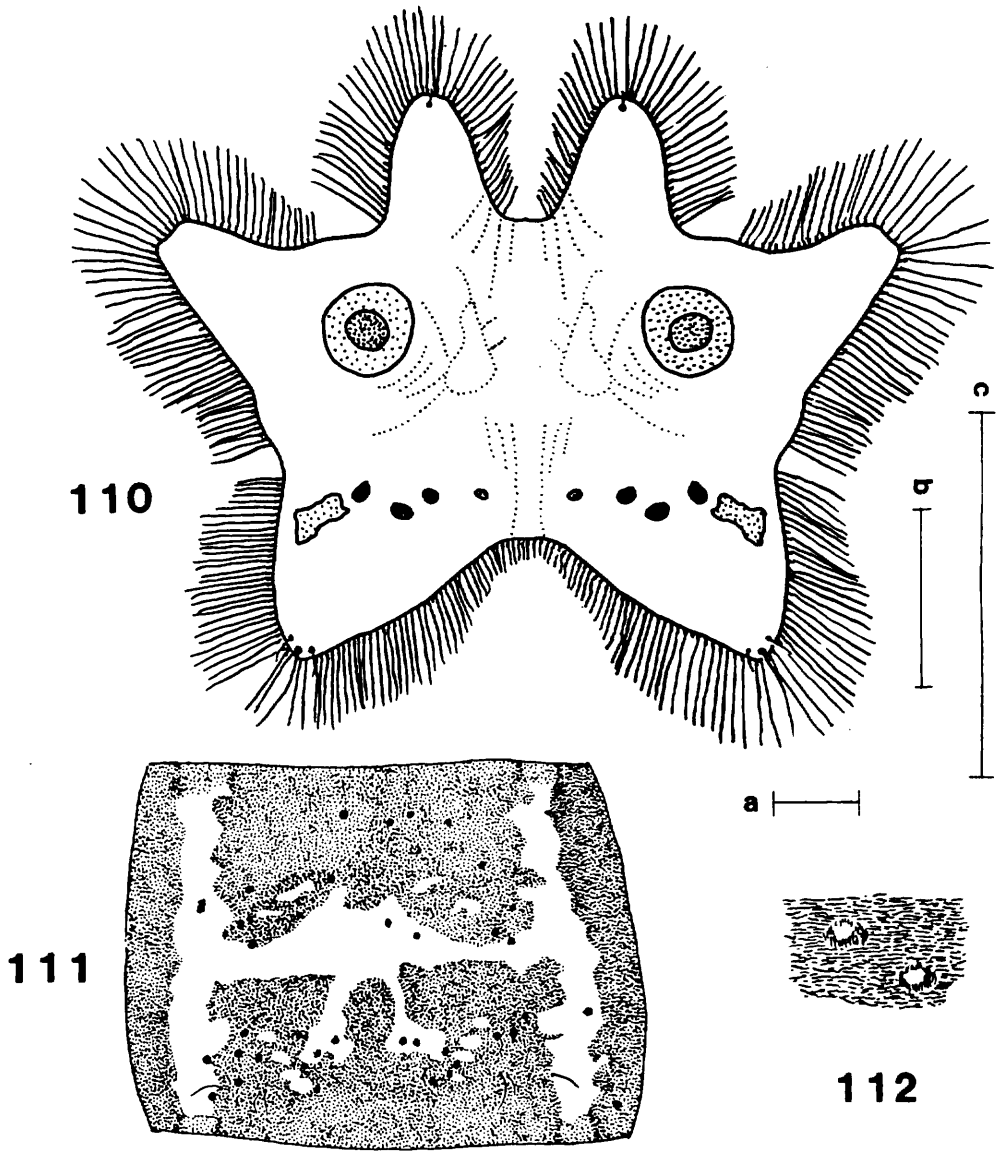
Few larvae of other subgenera could be confused with those of *Sinotipula.* The ventral abdominal swellings, microscopic hair pattern, small spiracles, total lack of macroscopic hairs, broad spiracular lobes and large mature size will serve to separate *Sinotipula* from other aquatic groups. *Yamatotipula* (specifically *T. caloptera*) is most similar in appearance to *Sinotipula,* although a few distinctions can be made between them. Of these, most important is the presence of clusters of macroscopic hairs on *T. caloptera* and the absence of macroscopic hairs in *Sinotipula.* Also lacking in *Sinotipula* is a dark median line on the ventral spiracular lobes, a character which all known larvae of *Yamatotipula* possess.

from Gelhaus, 1986

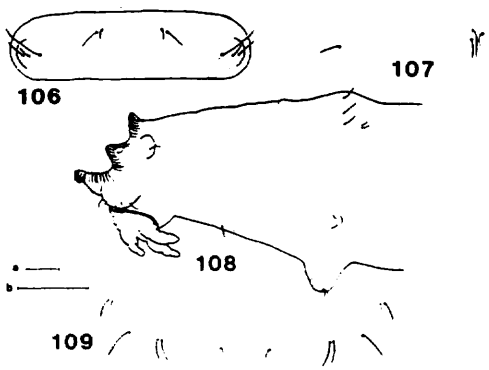
Habitats of *Sinotipula:* *Sinotipula* contains 19 nearctic species, all occurring in western North America. Larvae of *T. commiscibilis* described above were collected from a fairly fast-flowing creek, where they were under completely submerged rocks in the stream bed.

On a number of occasions, I have collected larvae which are very similar to those of *T. commiscibilis,* but I was unsuccessful in the two attempts to rear them. In an extremely fast run between two riffles, of the Cimarron River in Colfax Co., New Mexico, larvae were found under large rocks on the river bed, in water approximately 61 cm deep. They appeared to be the most abundant insect in terms of biomass, and were certainly the most common large insect. I have found larvae at other localities inhabiting similar situations, although not in the abundance seen in the Cimarron River.

Tipula (Sinotipula)



Figs. 110-112. *Tipula (Sinotipula) commiscibilis*. 110, spiracular area. 111, abdominal segment, dorsal aspect. 112, example of microscopic hairs on abdomen. All scale lines 1 mm. Scale a: Fig. 111, scale b: Fig. 110, scale c: Fig. 112.



from Gelhaus, 1986

Figs. 106-109. *Tipula (Sinotipula) commiscibilis*. 106, ventral abdominal macrosetae on transverse swelling. 107, pleural abdominal macrosetae. 108, terminal abdominal segments, lateral view. 109, dorsal abdominal macrosetae. All scale lines 1 mm. Scale a: Fig. 108, scale b: Figs. 106, 107, 109.

Tipula (Tipula)

Subgenus *Tipula* Linnaeus S. Str.

Only one species of this subgenus, *Tipula paludosa*, occurs in North America. It is an introduced species from Europe.

Tipula (Tipula) paludosa Meigen

Selected references: Hennig 1950:410, Figs. 216,222; Chiswell 1956:468-472, Figs. 91-93; Brindle 1960a:176-177, Fig. 1; Theowald 1967:27-28, Figs. 59-61.

Description: Length 23.3-38.0 mm, width 3.7-4.9 mm, body light brown, pleura often darker. Dark tufts of macroscopic hairs at base of each thoracic dorsal macroseta. *Abdomen:* Macrosetae black, all medium length; setae D5 and V2 absent (Figs. 114, 116, 117). Short microscopic hairs in short rows on dorsum and venter (Fig. 118), in groups of one to few hairs on pleura. Dark macroscopic hairs in tufts mediolateral to setae D6 and V1, and anterior to area between dorsal and lateral spiracular lobes, a few isolated hairs near seta D4. *Spiracular Disc:* All lobes subequal, as long as width at base, lateral lobes equidistant from dorsal and ventral lobes (Fig. 113). Lobes with complete border of short setae, longest setae approximately 1/5 basal width of ventral lobe. Most of posterior surface of each dorsal and lateral lobe sclerotized, sclerites darkest laterally. Inner surface of each ventral lobe with dark, C-shaped sclerite, apex darkest, three dark spots at base (Fig. 115). Spiracles roughly circular, inner circle black, outer ring brown; distance between spiracles less than or equal to diameter of a spiracle. Anterior surface of dorsal and lateral lobes with single microscopic hairs; macroscopic hair tufts at apex of each lobe. Marginal band brown. *Anal Segment:* Segment large, anal opening transverse. Four anal papillae (Fig. 113), lateral pair conical, length slightly longer than width at base, ventral pair as broadly rounded protuberances.

Specimens Examined: Over 50 larvae from the following localities in WASHINGTON: Skagit Co.: Mt. Vernon, R. Rosander, coll.; Burlington, J. Crawford and J. Ponnell, coll.; Whatcom Co.: Bellingham, L. Benedict, coll.; Birch Bay State Park, R. Rosander, coll.; Blaine, F. Nonini, coll.; Peace Arch, Knoblauch and Leckie, colls. (all WSU).

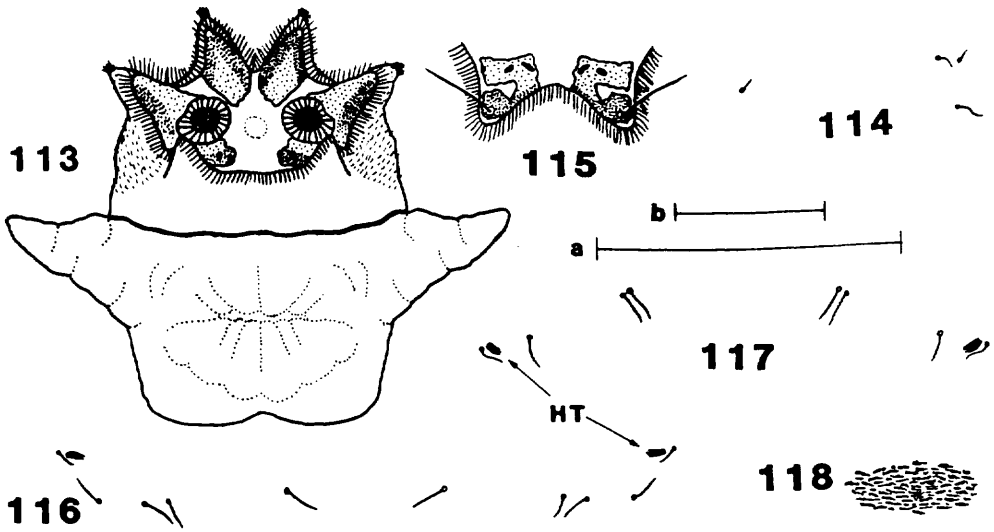
Subgeneric Discussion: *Tipula paludosa* is an easily recognized larva. The dorsal and lateral spiracular lobes are only sclerotized on the basal three-fourths of each lobe, with the apical fourth remaining unsclerotized. A small apical tuft of macroscopic hairs is present on each of these lobes. Each ventral lobe is heavily sclerotized on the inner surface and closes against the spiracles, not against the dorsal and ventral lobes. The setae around the spiracular lobes are only of moderate length, but completely border each lobe. A particularly distinctive feature is the dark tufts of macroscopic hairs near abdominal setae V1 and D6, and near the thoracic setae as well. Abdominal setae V2 and D5 are absent (or possibly obscured by the macroscopic hair tufts).

The shape and placement of the spiracular lobes and the border of short setae show a similarity of *Tipula* s. str. to *Yamatotipula* and the non-nearctic *Acutipula*. Both *Acutipula* (*T. vittata* group sensu Theowald, 1957) and *Tipula* s. str. have tufts of macroscopic hairs on the apices of the dorsal and lateral lobes. The subgenera *Yamatotipula, Acutipula, Beringotipula* and *Tipula* s. str. all have patches of macroscopic hairs on the abdomen, although in *Tipula* s. str., these tufts are made up of a few closely set, dark hairs located near the setae, and originating from one small constricted area, differing from the larger clusters of hairs surrounding the setae in the other subgenera. The anal papillae are not elongate as in *Yamatotipula, Platytipula* and most of the other aquatic and semiaquatic groups but are most similar to those found in terrestrial and some semiaquatic groups such as *Beringotipula* and *Lunatipula*. At least one species of *Yamatotipula (T. ludoviciana)* however, has similarly short papillae. The unsclerotized apices and sclerotized bases of the dorsal and lateral lobes in *Tipula* s. str. resemble corresponding parts of the ventral lobes in *Beringotipula*, in which the unsclerotized apex is produced past the sclerotized base.

Tipula s. str. cannot be confused easily with any other subgenus. The general form of the spiracular disc, the complete border of short setae around the spiracular lobes, the small, distinct hair tufts and the small anal papillae make *T. paludosa* distinctive.

from Gelhaus, 1986

Tipula (Tipula)



Figs. 113-118. *Tipula (Tipula) paludosa*. 113, spiracular area. 114, pleural abdominal macrosetae. 115, ventral spiracular lobes, dorsal aspect. 116, dorsal abdominal macrosetae, with hair tufts. 117, ventral abdominal macrosetae, with hair tufts; HT-hair tuft. 118, example of microscopic hairs on abdomen. All scale lines 1 mm. Scale a: Fig. 118, scale b: Figs. 113-117.

HABITATS OF SUBGENUS *TIPULA*: Although *T. paludosa* was accidentally introduced into North America, possibly in ballast from fishing vessels two or three centuries ago, *Tipula* is otherwise an Old World subgenus. The species has become established in Newfoundland and Nova Scotia (Alexander, 1967); recently it has also been found in British Columbia and Washington (Jackson and Campbell, 1975).

In Europe, *T. paludosa* has been collected from a variety of habitats. Brindle (1960a) found the larvae most common in various pasture soils (peat, clay, sand, marl), but he also collected them in marshy peat soil, in *Hypnum* moss in wet places, and in aquatic mosses through which water slowly trickled. The larvae are well known as pests of many field crops (e.g., barley, rye, wheat) and pastures in Europe, attacking both the roots and shoots (Chiswell, 1956). In North America, based on collection data with the specimens I examined and published reports (Jackson and Campbell, 1975), *T. paludosa* appears to be a pest primarily of turf and pastures.

from Gelhaus, 1986

Tipula (Trichotipula)

Subgenus *Trichotipula* Alexander

Of the 34 nearctic species of *Trichotipula*, only two, *Tipula oropezoides* and *T. stonei*, have been reared. The larvae of these species are quite distinct from one another and are discussed separately; in fact, the larvae of both species are at opposite extremes for the entire genus *Tipula* in terms of morpological characters and life histories.

Tipula (Trichotipula) oropezoides Johnson

Alexander 1920:1001-1002, Figs. 506, 513-518.

Description: Length 16.7-17.9 mm, width 1.9-2.1 mm, body brown. *Abdomen:* Most macrosetae brown, setae D1-D4 long, D6 shorter pale and branched, D5 absent (Fig. 121). Setae L1, L2 and L4 long, L1 dorsolateral to L2, L3 shorter, pale and branched (Fig. 120). Seta V3 long, V4 of medium length, V1 and V5 short, V1 pale and branched, V2 absent (Fig. 122). Abundant macroscopic hairs, single or in groups of two or three, densest on dorsum (Fig. 124). Microscopic hairs absent. *Spiracular Disc:* All lobes subequal, lobes approximately as long as width at base, lateral lobes equidistant from dorsal and ventral lobes (Fig. 119). Lobes with well-developed border of setae, longest setae 1/3 basal width of lobe. Posterior surface of all lobes with extensive brown sclerites; subcircular pale area at apex of each lobe. Ventral lobe with dark median line. An irregular, transverse brown sclerite above and below each spiracle. Spiracles brown, margins roughly trilobed, inner circle with dark, irregular "Y"-shaped pattern. Remainder of spiracular disc pale. Marginal band light brown. *Anal Segment:* Segment large and circular in ventral aspect; four, elongate anal papillae, with many constrictions along their length (Fig. 123), all papillae single and subequal, length/basal width 2.0-3.5.

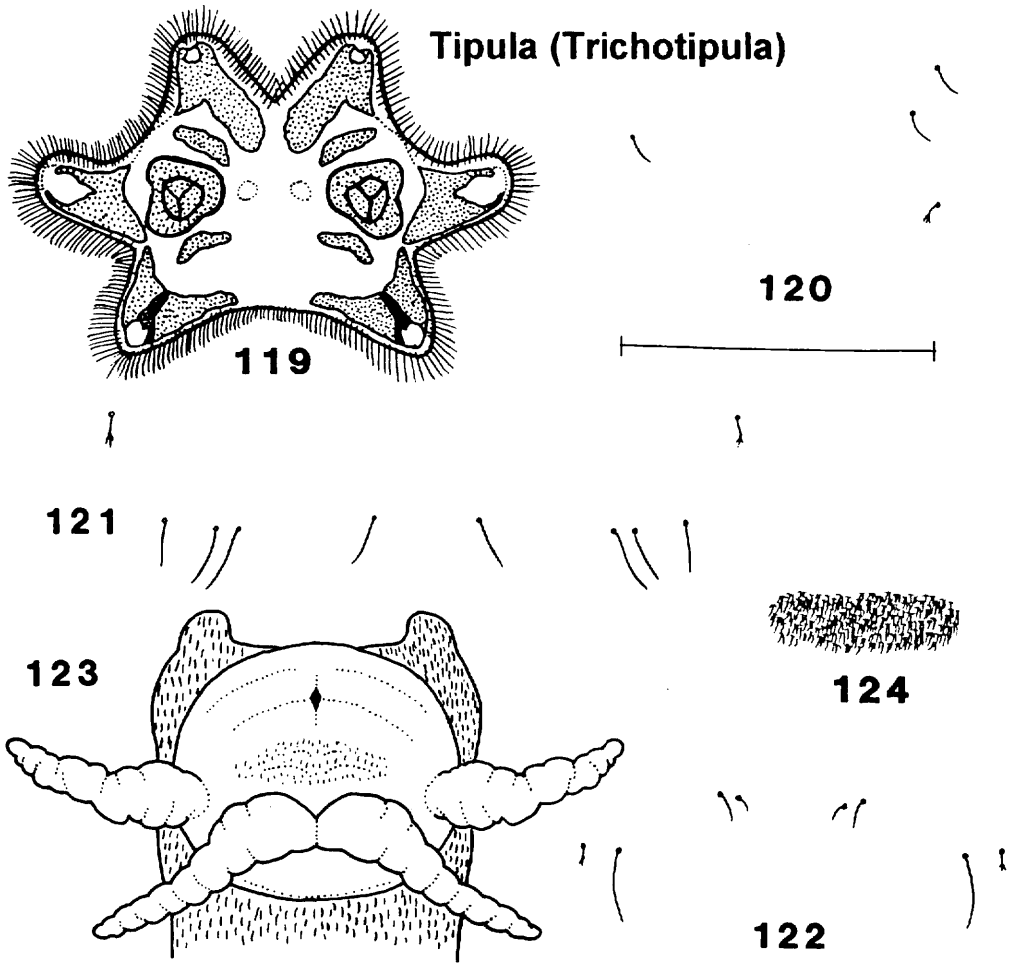
Specimens Examined: Six larvae from Needham's Glen, Ithaca, Tompkins Co., New York, C.P.Alexander, coll. (UM, AMNH).

Discussion: Two unique features of *T. oropezoides* are the trilobed spiracles and the small, transverse sclerites located above and below each spiracle. No other *Tipula* is known to possess spiracles which are not circular or at least oval in shape, nor are there such prominent sclerites on the spiracular disc, as the sclerites are usually confined only to the lobes. Also distinctive for *T. oropezoides* are the four elongate anal papillae. In the other species of *Tipula* which have four papillae, these are equally short and conical, as in *Schummelia*, or the median pair is low and rounded, as in *Lunatipula* and some other terrestrial groups. The short spiracular lobes and setal border are similar to these structures in *Schummelia* and some species of *Savtshenkia*. A predominance of macroscopic hairs with an absence of microscopic hairs is seen in *Savtshenkia* (e.g., *T. ignobilis*) as well as *T. oropezoides*. Other taxa, such as *Platytipula*, *Angarotipula* and the genus *Holorusia*, have an overall "hairy" appearance due to an abundance of macroscopic hairs but microscopic hairs are also present.

Habitats of *Trichotipula* (*oropezoides* group): Alexander (1920) collected larvae of *T. oropezoides* from beneath saturated moss, apparently near the edge of a stream. Rogers (1933) reared the larvae in Florida from "moist to wet clumps of moss, on wet rocks, stream banks and roots." G. W. Byers collected pupae from mixed mosses and liverworts in a floodplain woods in Indiana (field notes).

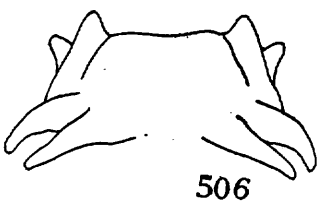
It is not known how many of the 33 nearctic species of *Trichotipula* will eventually prove to have larvae and larval habitats similar to those of *T. oropezoides* but two species require mention here. Adults of *T. algonquin* were found in wet mossy habitats (Rogers, 1930), and the larvae possibly occur there. Adults of *T. unimaculata* have also been found near wet areas (Rogers, 1942).

from Gelhaus 1986

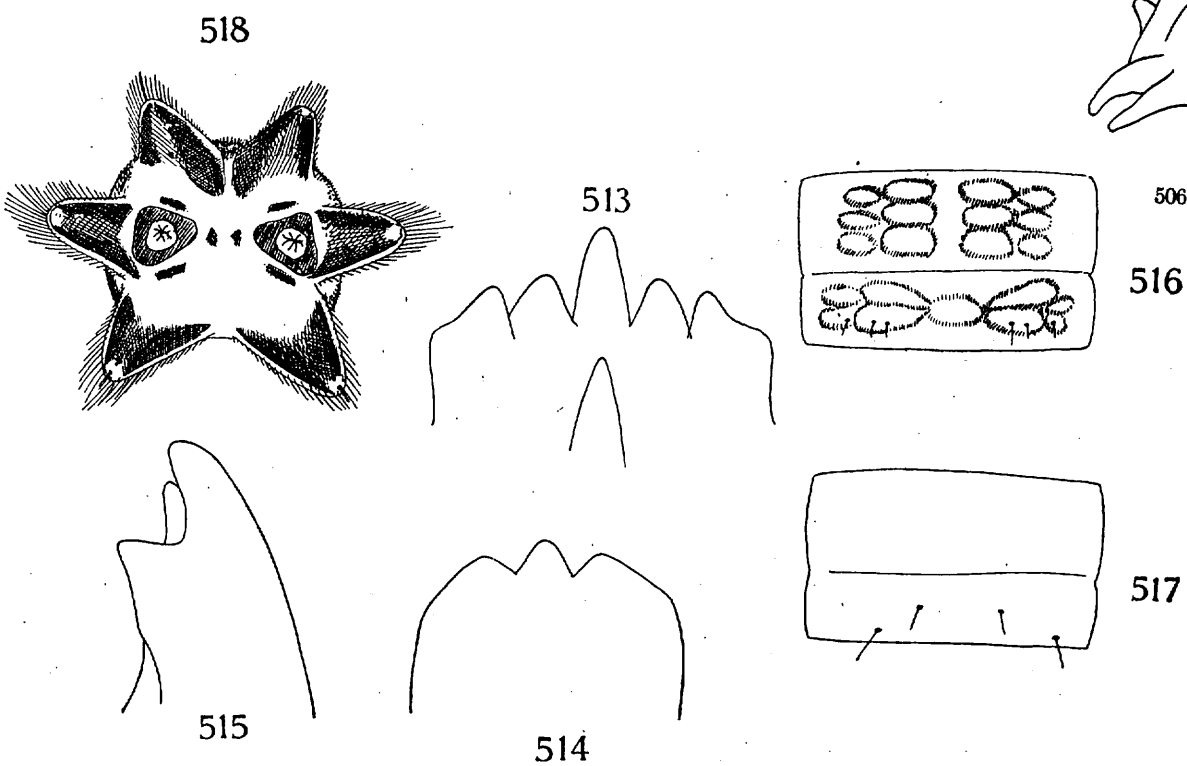


Figs. 119-124. *Tipula (Trichotipula) oropezoides*. 119, spiracular area. 120, pleural abdominal macrosetae. 121, dorsal abdominal macrosetae. 122, ventral abdominal macrosetae. 123, anal papillae, ventral aspect. 124, example of macroscopic hairs on abdomen. Scale line 1 mm.

from Gelhaus 1986



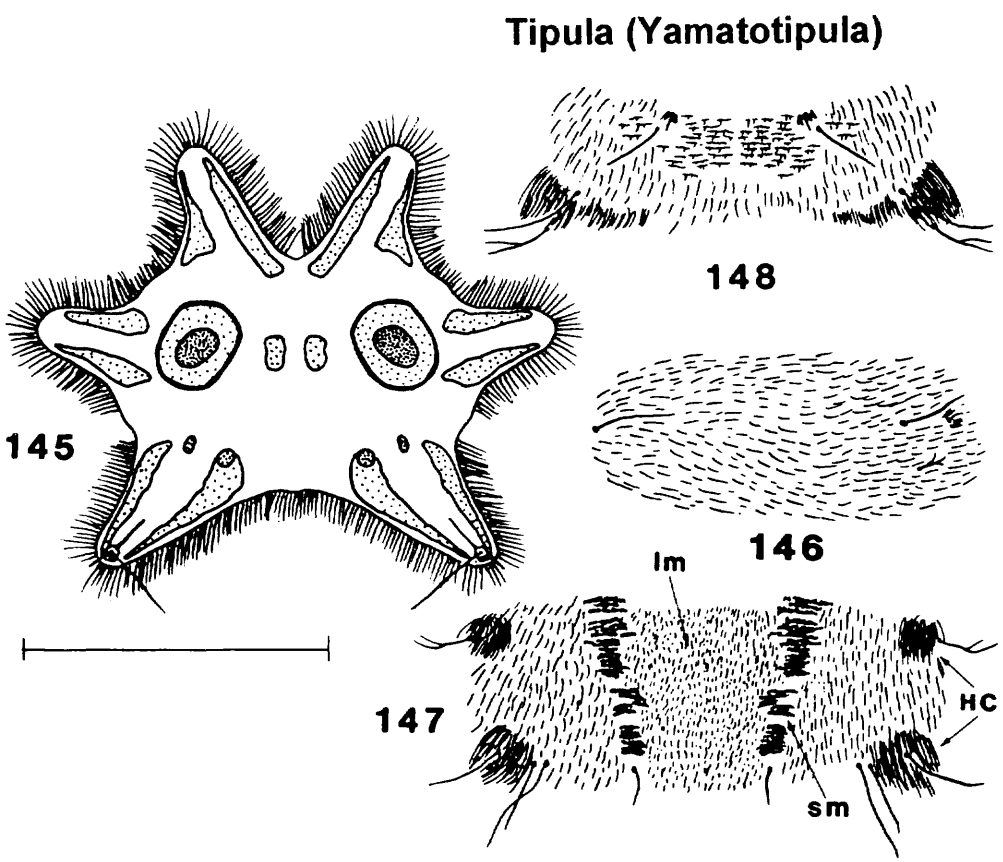
506, *Tipula oropezoides*;



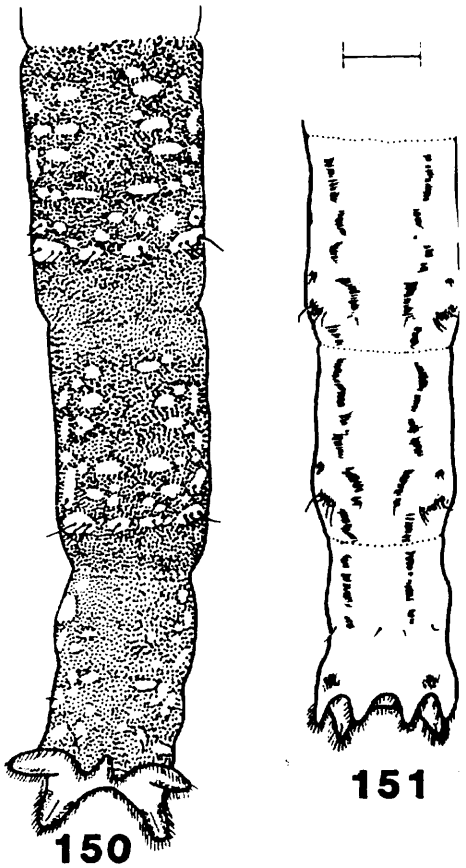
from Alexander 1920

TIPULA OROPEZOIDES, LARVA

513, Mentum; 514, hypopharynx; 515, mandible; 516, fifth abdominal segment, dorsal aspect; 517, fifth abdominal segment,



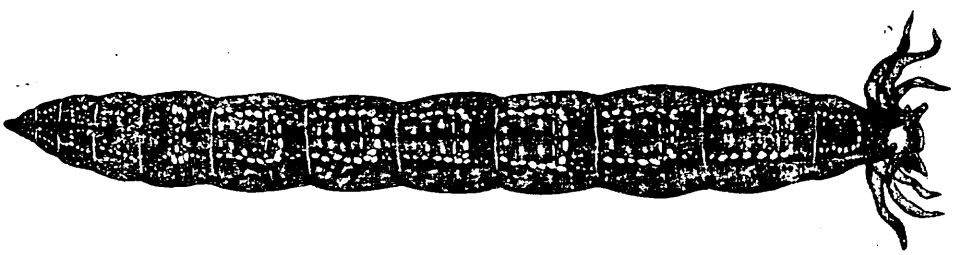
Figs. 145-148. *Tipula (Yamatotipula) strepens*. 145, spiracular area. 146, pleural abdominal macrosetae and hairs. 147, dorsal abdominal macrosetae and hairs; HC-hair cluster, lm-long microscopic hairs, sm-short microscopic hairs. 148, ventral abdominal macrosetae and hairs. Scale line 1 mm.



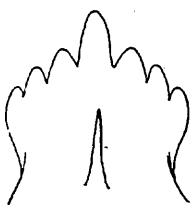
Figs. 150-151. *Tipula (Yamatotipula)* spp. 150, *T (Y.) caloptera*, terminal abdominal segments dorsal aspect. 151, *T. (Y.) strepens*, termina abdominal segments, dorsal aspect. Scale line mm.

from Gelhaus 1986 ↑

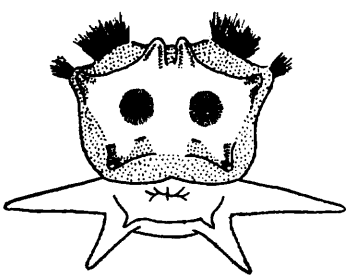
← Needham and Betten, 1901



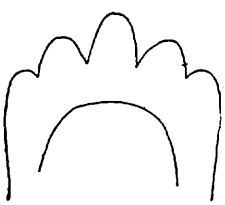
Probably Tipula (Y.) caloptera
(erroneously listed as T. abdominalis)



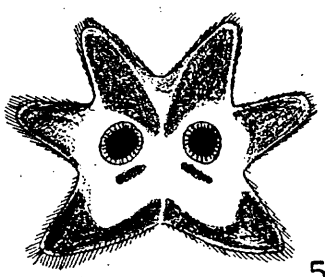
524



from Brindle 1960
T. (Y.) pruinosa
(Polearctic)



525



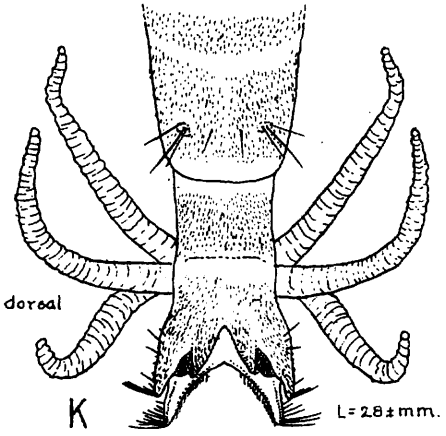
526

from Alexander, 1920 - Nearctic

TIPULA DEJECTA,

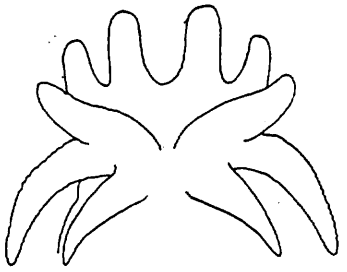
Tipula dejecta, larva: 524, mentum; 525, hypopharynx; 526, spiracular disk

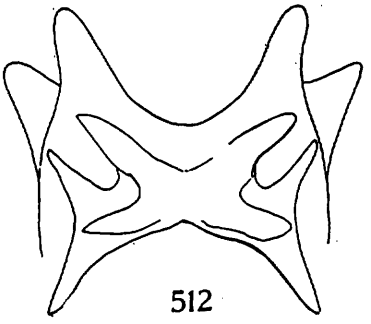
Tipula (Yamatotipula)

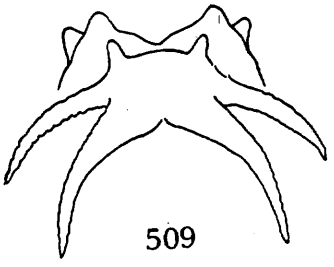


Tipula tephrocephala

From Peterson, 1960



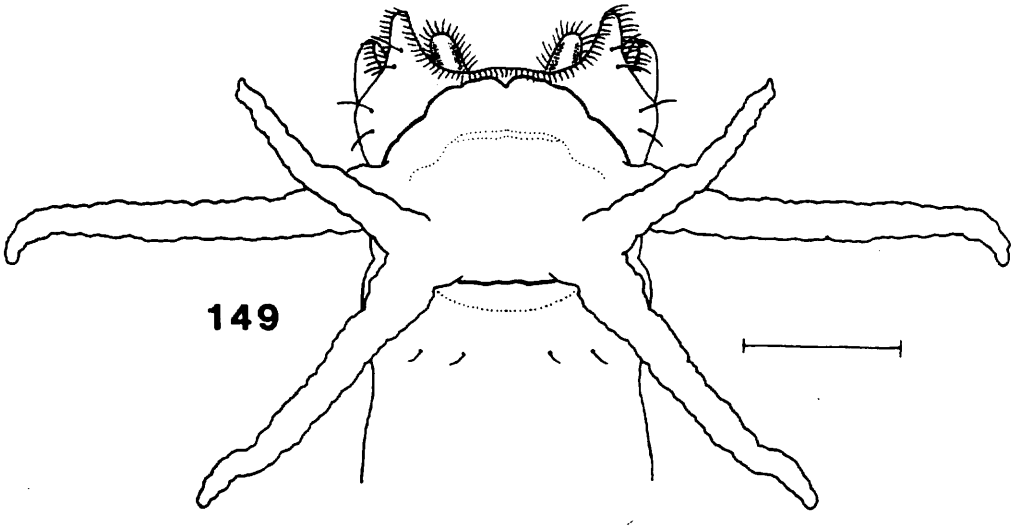


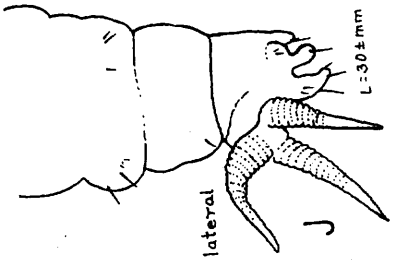


TYPES OF ANAL GILLS IN GENUS TIPULA, VENTRAL ASPECT

508, *T. caloptera*; 509, *T. dejecta*;
512, *T. iroquois* (supposition)

From Alexander, 1920





Tipula furca

From Peterson, 1960

Figs. 149. *Tipula (Yamatotipula) strepens*. Anal papillae, ventral aspect. Scale line 1mm.

From Gelhaus, 1986

All Nearctic species

Tipula (Yamatotipula)

SUBGENERIC DISCUSSION: I have studied associated larvae for 15 of the 50 nearctic species of *Yamatotipula* and know one additional species only from the published description. Larvae have also been described for seven palearctic species. All known *Yamatotipula* have distinct clusters of macroscopic hairs surrounding setae D5 and V2, and on the dorsum of the eighth abdominal segment, anterior to the area between the dorsal and lateral lobes. Often, a distinct cluster is present between setae D2 and D4, surrounding D3. The body also possesses a combination of short and long microscopic hairs. For example, in *T. caloptera* and certain other species, the body is covered almost exclusively with short microscopic hairs, organized in rows, with macroscopic hairs only in isolated clusters. In *T. strepens* and others, the long microscopic hairs are more predominant, with macroscopic hairs in clusters. In these latter larval types, the short microscopic hairs are less visible and often distributed in small groups.

The short microscopic hairs may additionally form distinctive patterns. The hairs may be dark and organized into distinct, dorsal stripes (Fig. 151) as found, for example, in *T. strepens*. In *T. caloptera* the combination of light and dark short microscopic hairs forms a distinct pattern of spotting on the dorsum (Fig. 150). The palearctic *T. pruinosa* group and nearctic *T. sulphurea* have a distinct pattern formed by paired, transverse rows of macroscopic hair tufts on the anterior portions of the abdominal segments, in addition to the tufts around the macrosetae. Many species of *Yamatotipula*, however, have no distinct hair patterns.

The spiracular lobes are all approximately equal in length, usually as long as wide, with a well-developed border of setae. The spiracles are large and oval to circular in shape. Although the patterning on the posterior surfaces of the lobes varies among the species examined, often the lobes have darker, lateral sclerites. All *Yamatotipula* known have a dark median line on each ventral lobe.

Six anal papillae are present in most species. Two pairs of papillae are usually long, with the anteriomedial pair often shortened. In some species this shortened medial pair is absent and only four papillae are present. For example, the palearctic *T. solstitialis* has only four long papillae. The nearctic *T. ludoviciana* has only four short papillae.

In *T. caloptera* there are very reduced, transverse abdominal swellings.

Yamatotipula shows similarities to other aquatic and semiaquatic subgenera. The radially arranged, subequal, spiracular lobes with a well-developed border of setae, branched setae D6, L3 and V1, and long anal papillae are characters shared by many aquatic and semiaquatic groups such as *Platytipula, Bellardina,* and *Nobilotipula*. The clusters of macroscopic hairs near macrosetae D5 and V2 are found also in *Beringotipula* and the non-nearctic *Acutipula*. *Tipula* s. str. has similarly placed patches of macroscopic hairs but they are very dark, few in number, and do not surround the setae, thus forming discrete tufts rather than the more diffuse clusters of *Yamatotipula*. The predominance of short microscopic hairs in a pattern of light and dark areas and transverse abdominal swellings seen in *T. caloptera* are found also in *Sinotipula*.

The distinct, longitudinal microscopic hair patterns as in *T. strepens* and other species and the transverse macroscopic hair patterns found in *T. sulphurea* are unique for *Yamatotipula*, and the larvae cannot be confused with those in any other known group. *Tipula caloptera* also has a distinct abdominal pattern which can only be confused with that of *Sinotipula*. *Tipula caloptera*, though, possesses macroscopic hair clusters and long anal papillae, while these clusters of hairs are absent and the papillae are short in *Sinotipula*. Species of *Yamatotipula* that lack these distinct patterns can be separated from the similar subgenera *Platytipula* and *Bellardina* and the genus *Holorusia* by the distinct clusters of hairs. *Tipula ludoviciana* has four, short, anal papillae and might be confused with *T. (Tipula) paludosa*. The ventral papillae in *T. ludoviciana*, however, have pointed apices while in *T. paludosa*, they are reduced to low, rounded protuberances; the patches of hairs are different in *Yamatotipula* and *Tipula* s. str. as discussed previously.

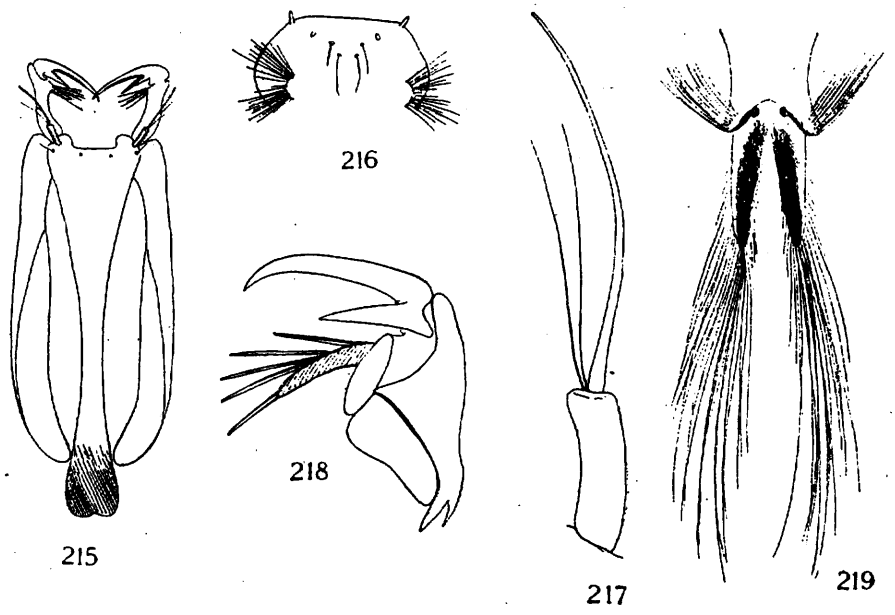
HABITATS OF *YAMATOTIPULA*: Larvae of *Yamatotipula* are found in a wide variety of aquatic and semiaquatic situations. Larvae of *T. strepens* are "semiaquatic in the moss and algal mats of the rills and trickles" (Rogers, 1942), and H. Teskey collected this species from wet mosses on stream banks (collection label, CNC). *Tipula caloptera* is recorded from Florida in "wet or submerged mats of mosses and algae" (Rogers, 1933), and I have collected the larvae from mosses in a cold spring-fed stream in Kansas. Rogers (1933) also notes that in *T. caloptera* the "larvae can live for months wholly submerged in well-aerated streams." A pupal skin of *T. brevifurcata* "projected from the wet mosses and algae at the brink of a small shaded falls" (Rogers, 1930). *Tipula concava* has been collected in Tennessee from the coarse sand about the roots of *Dianthera (=Justicia) americana* at the water's margin (Rogers, 1930), although I have collected it in Kansas from exposed tree root clumps and in leaf debris at stream edges. These stream margins are where I have commonly collected larvae of *T. furca*, either in wet, decaying leaf debris or in the sand and muck at the stream edge. Hynes (1957) notes that the larvae of *T. fraterna* are found in damp, steep, stream banks, which are usually covered with mosses and liverworts. In Kansas, I have found *T. tricolor* in leaf debris or mosses from springs and spring-fed streams.

Many larvae of *Yamatotipula* have been recorded from marshy areas with much silt and organic debris. *Tipula furca, sulphurea* and *subeluta* have been reared from the muddy margins of pools (Rogers 1933, 1942). *Tipula dejecta* was collected in thick organic matter in an alder swamp (Alexander, 1920). Rogers (1933) records a number of species, for example, *T. manahatta*, from "wet plastic soils of grass and sedge marshes." The larva of *T. footeana* was found among grass roots on an unshaded mudflat surrounding a lake in Idaho (Foote, 1963).

The known habitats of seven palearctic species are similar to those discussed here.

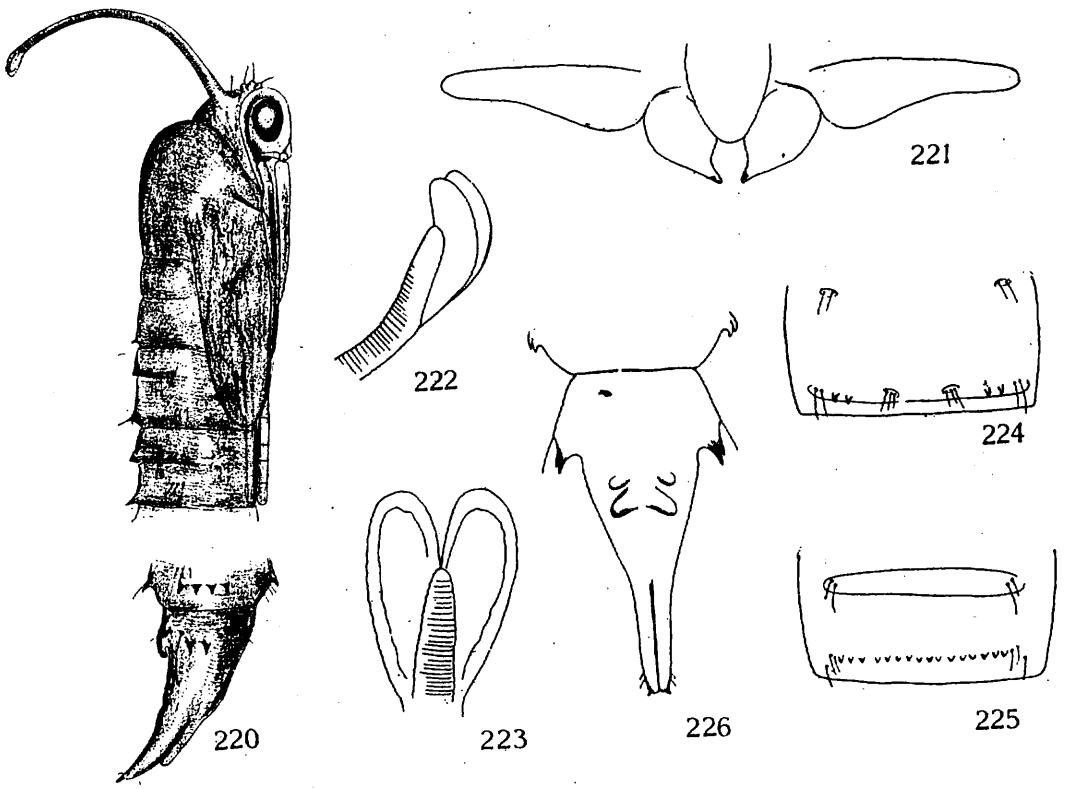
from Gelhaus, 1986

Ulomorpha



ULOMORPHA PILOSELLA

Ulomorpha pilosella, larva: 215, head capsule, dorsal aspect; 216, labrum; 217, antenna; 218, mandible; 219, spiracular disk, dorsal aspect



ULOMORPHA PILOSELLA, PUPA

220, Female, lateral aspect; 221, mouth parts; 222, apex of breathing horn; 223, apex of breathing horn viewed from beneath; 224, fifth abdominal segment, dorsal aspect; 225, fifth abdominal segment, ventral aspect; 226, female cauda, dorsal aspect

from Alexander, 1920

Nearctic sp.