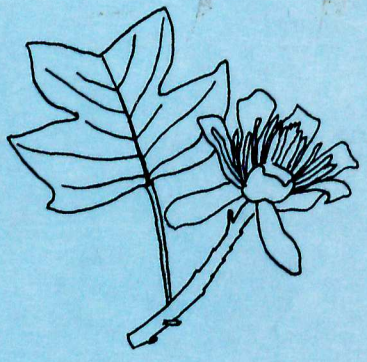
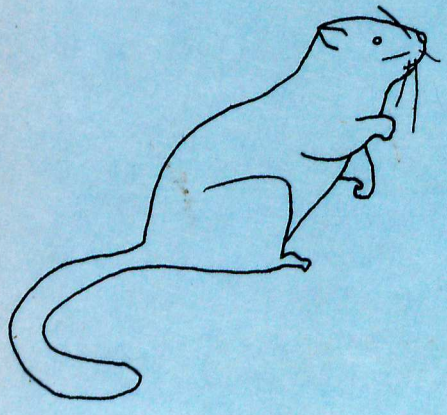
REVISION OF THE NEARCTIC DICROTENDIPES KIEFFER, 1913 (DIPTERA: CHIRONOMIDAE)

J. H. Epler





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9

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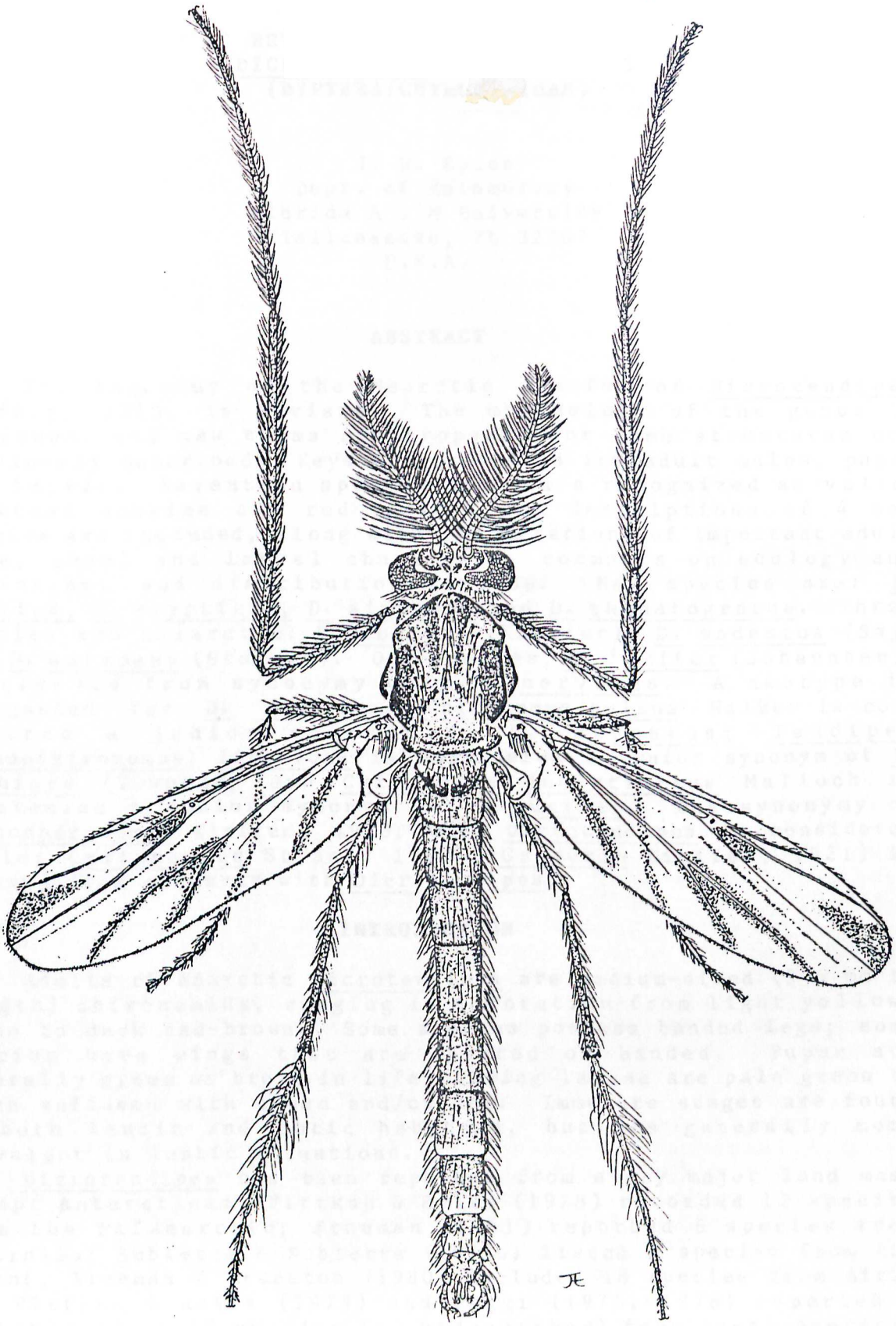

Dicrotendipes thanatogratus n. sp., adult male

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ABSTRACT

The taxonomy of the Nearctic species of Dicrotendipes Kieffer, 1913, is revised. The morphology of the genus is reviewed, and new terms are proposed for some structures not previously described. Keys are presented for adult males, pupae and larvae. Seventeen species names are recognized as valid. Thirteen species are redescribed and descriptions of 4 new species are included, along with illustrations of important adult male, pupal and larval characters, comments on ecology and variation, and distribution records. New species are: D. adnilus, D. crypticus, D. simpsoni and D. thanatogratus. Three species are Holarctic: D. lobiger (Kieffer), D. modestus (Say) and D. nervosus (Staeger). One species, D. lucifer (Johannsen), is removed from synonymy with D. nervosus. A neotype is designated for D. modestus. Chironomus pulsus Walker is considered a junior synonym of D. modestus; Tendipes (Limnochironomus) figueroai is considered a junior synonym of D. aethiops (Townes); and Chironomus indistinctus Malloch is considered a junior synonym of D. lucifer. The synonymy of Limnochironomus Kieffer, 1920, with Dicrotendipes is considered valid; Carteronica Strand, 1928 (=Carteria Kieffer, 1921) is removed from synonymy with Dicrotendipes.

INTRODUCTION

Adults of Nearctic Dicrotendipes are medium-sized (3-6 mm in length) chironomids, ranging in coloration from light yellow-green to dark red-brown. Some species possess banded legs; some species have wings that are spotted or banded. Pupae are generally green or brown in life; living larvae are pale green to green suffused with cream and/or red. Immature stages are found in both lentic and lotic habitats, but are generally more prevalent in lentic situations.

Dicrotendipes has been reported from every major land mass except Antarctica: Fittkau & Reiss (1978) recorded 12 species from the Palaearctic; Freeman (1961) reported 6 species from Australia; Sublette & Sublette (1973b) listed 9 species from the Orient; Freeman & Cranston (1980) included 18 species from Africa; Fittkau & Reiss (1979) and Paggi (1975, 1978) reported a probable 12 or 13 species (10 undescribed) from South America; and Sublette (1964) and Sublette & Sublette (1965) listed 12 species for the Nearctic, although Oliver (1980) included only 9.

Although the genus is widespread and common in North America, identification of Dicrotendipes has presented a problem. Townes (1945) presented a key for the adult males of 10 species, but keys to the immature stages have been incomplete. Hauber & Morrissey (1945) keyed 4 species; Roback (1957) 4; Webb (1972) 6; Beck (1976) 6; Simpson & Bode (1980) 3; and Webb & Brigham (1982) keyed 5 species. Unfortunately, because of misdetermined material, extralimital species, and the use of unreliable characters, none of these keys will reliably identify most Dicrotendipes, especially the immature stages, to species. Many keys for larvae (Beck 1976; Bryce & Hobart 1972; Hilsenhoff 1981; Mason 1973; Oliver et al. 1978; Oliver & Roussel 1983; Webb & Brigham 1982) fail to key many of the Nearctic species to genus correctly for the same reasons; the key in Pinder & Reiss (1983) will work for the majority of specimens encountered.

In this revision the adult males of 17 species and the immature stages of 14 species are described or redescribed from the Nearctic. The majority of these descriptions are based on reared material. Adult females are not treated.

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Anderson, Ramsey Canyon Preserve, AZ; J.A. Stevenson, Florida State Parks; and J.D. White and C.S. Gidden, St. Marks National Wildlife Refuge, FL. For field assistance in Colorado I wish to thank M. O'Conner, C. Ganse, T. Hayden, and especially R. Hutterer and D. Rush. I am grateful to my father and mother, John and Betty Epler, for years of support and for allowing me to use their home as a base of operations while working in SE Arizona. P. Ashe, B. Bilyj, P.S. Cranston, L.C. Ferrington, Jr., D.R. Oliver, F. Reiss, S.S. Roback and O.A. Saether are due special thanks for their assistance in bibliographical matters and for enlightening discussions. I extend grateful thanks to A.G. Aldrete for searching for the type of Tendipes (Limnochironomus) figueroai. Above all I wish to express my sincere and deep gratitude to my wife Linda, whose love, assistance and typing skills have helped bring my project to fruition. This research was partially supported by a USDA CSRS grant (FLAX 79009) and 2 grants from the Florida Entomological Society.

METHODS

Approximately 4000 specimens were examined. A large portion of the material was borrowed from museums in Canada, the United States, Great Britain, and West Germany. Material was also borrowed from the private collections of other chironomid workers, in addition to specimens collected by the author.

Adult body parts were mounted under 5 coverslips in a manner similar to that described by Saether (1969) and Soponis (1977). If the material mounted was reared, larval and pupal exuviae were usually each placed under a separate coverslip on the same slide with the dissected adult parts, making a total of 7 areas on a reared specimen slide. All type material which I mounted or remounted was prepared in Canada balsam-xylene. Other methods for the preparation of chironomids for microscopic study can be found in Schlee (1966), Hansen & Cook (1976), Simpson & Bode (1980), Webb & Brigham (1982) and Pinder (1983).

Specimens were prepared for examination with the scanning electron microscope (SEM) by placing them in a series of 15 minute dehydrating baths of 95% ethanol and toluene, beginning with a 75% ethanol/25% toluene bath, then a 50%/50% bath, a 25%/75% bath, and 2 final 15 minute baths in pure toluene. Specimens were air dried on filter paper, dissected if necessary, affixed to SEM tabs using double-sided tape, and sputter-coated with a 60%/40% gold/palladium mixture. They were then examined with a Cambridge Stereoscan S4-10 at an accelerating voltage of 20 KV. The value of using an SEM for morphological studies can not be overestimated and is exemplified by many recent papers, such as Webb et al. (1981) and Sublette (1979).

Terminology and abbreviations generally follow Saether (1980). Abbreviations and definitions for other terms and ratios used are:

Pupae:

DR - disc ratio; the total number of ventral anal lobe setae (Fig. 29b, V) divided by the number of ventral setae from dorsal seta position to anterior margin of anal lobe (Fig. 29b, D);

average both sides for DR for individual specimen. For example, the specimen illustrated in Fig 29b has 46 ventral setae (V), and 27 setae from the position of the dorsal seta to the anterior margin of the anal lobe (D): DR = V/D = 46/27 = 1.70.
Pex - pupal exuviae.

Larvae:

IPD - interplate distance; shortest distance between the 2 ventromental plates.
Lex - larval exuviae.
MR - mental ratio; width of mentum divided by the width of the 3 median teeth (Fig. 33).
PSR - plate separation ratio; average width of ventromental plates (Fig. 34, W) divided by IPD.
VPR - ventromental plate ratio; width of ventromental plate divided by its length (Fig. 34).

In general, methods for measuring body parts followed Schlee (1966) and Soponis (1977). Methods used for measuring various adult body parts are depicted in Figs. 1, 2, 4, 5, 11-13, 15 and 19. Adult thoracic setal counts include setae of both sides. Wing setal counts are for 1 wing. Counts of hypopygial structures and anal point setae were averaged from both sides. Pupal measurement methods are illustrated in Figs. 27, 29a and 29b. Anal lobe setal counts and DR values were averaged from both sides and are reported as a 1 side value. Larval measurement methods are presented in Figs. 31, 33, 34, 36 and 37. Larval head capsule structure counts and ratios (ventromental strial ridges, etc) were averaged from both sides and are reported as a 1 side value. Ventromental strial ridges were counted across the middle of the plate (Fig. 34). Larval labral and maxillary structures are illustrated in Figs. 44-46.

Postmentum length is used as a measure of head capsule size; it is measured from the median ventral postoccipital margin forward to the bottom of the incision between the median and first lateral teeth of the mentum (Fig. 31). This measurement is used because the flexibility of the larval labrum, distortion of the head capsule by coverslip pressure and breaking or distortion due to dissection do not allow accurate full length head capsule measurements. Head capsule width measurements are not accurate for the same reasons. The postmentum, on the other hand, usually remains intact after dissection or is not affected by pressure. Even if it splits lengthwise, which sometimes occurs, the postmentum remains measureable.

Unless otherwise stated ,all measurements are in micrometers, and consist of the range, the mean and, in parentheses, the number of specimens measured if different from the number (n) cited at the beginning of the description. Means are not given for samples of 3 or less.

The synonymies accompanying the descriptions are not meant to be exhaustive. I have included only those citations which contain pertinent taxonomic, distribution or biological information. Only type material examined is listed with full collection data. All other material examined is listed by location (state, etc.), number of specimens examined, and collection months in Roman numerals. Full collection data for all specimens examined is available from the author or can be

found in Epler (1983). Collections where type specimens are deposited are abbreviated as follows: BAC - B.A. Caldwell, Georgia Dept. of Natural Resources; BMNH - British Museum (Natural History); CAL - G. Grodhaus, California Dept. of Health; CNC - Canadian National Collection; COR - Cornell University; ENMU - Eastern New Mexico University; FAMU - Florida A & M University (Florida State Collection of Arthropods); INHS - Illinois Natural History Survey; JHE - J.H. Epler; KU - Snow Entomological Museum, University of Kansas; KWS - K.W. Simpson, New York State Dept. of Health; USNM - United States National Museum.

Except where noted, color descriptions for adult males were taken from pinned, living, or freshly killed specimens. Pupal and larval color descriptions are based mainly on slide mounted pupal and larval head capsule exuviae.

All drawings were made by the author. The hypopygial figures are drawn to show a ventral and internal view on the left, and a dorsal view to the right. The superior volsella in the hypopygial drawings is depicted as it appears when viewed through a light microscope; in actuality the volsellar sensilla chaetica are ventral. Larval menta are drawn with the "left" ventromental plate removed; premandibles are drawn without the premandibular brush.

GENERAL BIOLOGY

Adult Dicrotendipes are commonly encountered during the warmer months in most of North America, but can be found throughout the year in some southern states (Alabama, Florida, Texas). Several species form monospecific swarms. I have examined a swarm of approximately 500 males of D. neomodestus from Florida, one of approximately 60 male D. fumidus from South Carolina, and a swarm of 75 male D. fumidus, swarming from 0.3 - 2 m high, from Alabama. I have collected male and female D. lobiger from loose columnar swarms at a height of 2-4 m among lakeside conifers in Wyoming. Large emergences of adults can cause nuisance problems when in close proximity to residential areas (Frommer & Rauch 1971; Ali & Mulla 1980).

Immature stages are found in both lentic and lotic habitats, but are generally more prevalent in lentic situations. The larvae in general are not "burrowers" as listed in Coffman & Ferrington (1984), but would be better classified as "clingers" and/or "sprawlers". Although often reported in the literature as "bottom-dwelling" (Roback 1957) or "epibenthic, unattached" (Beck 1977), the majority of Dicrotendipes larvae are found on the surface of aquatic vegetation, and among or on vegetation or Aufwuchs on rocks, logs, or similar substrata. The larvae construct silken tubes which are attached to the substrate. The pupal stage is also spent in the tube. I have rarely collected Dicrotendipes larvae from bottom mud, although larvae do occur commonly in algal mats on the bottom. Darby (1962) reported finding D. californicus larvae on the surface of bottom mud in late May and early June in California, but found that as submerged vegetation increased, the vegetation became the favored habitat. Lenz (1954-1962) reported Dicrotendipes larvae (as Limnochironomus) as predominantly littoral and living on rocks,

plant stems, and among aquatic vegetation, but also noted their existence in benthic detritus in water 10 m or more in depth, as well as among mosses and other vegetation on rocks in flowing water. I have collected D. crypticus larvae from vegetation on rocks in the swiftly flowing portions of a New Mexican creek, and have scraped D. neomodestus from algae in sheets of water flowing over a dam in Pennsylvania. Disney (1975) found D. peringueyanus Kieffer living phoretically on the African river crabs Potomonautes africanus (A. Milne-Edwards) and P. pobeguini (Rathbun) in Cameroon.

Dicrotendipes larvae feed on algae, detritus, or the microorganisms associated with it. Lenz (1954-1962) reported that he observed larvae spinning small "catch-nets" within their tubes. By undulating their bodies, the larvae produced a current which forced water through the catch-net. After a period of time, the catch-net and its catch of detritus and microorganisms were consumed by the larvae. I have not observed feeding in Dicrotendipes, but many larval guts I've examined were packed with algae and detrital material. The larval undulations probably also serve a respiratory function, introducing fresh water in the larval tube. I have also observed pupae undulating in their tubes.

MORPHOLOGICAL NOTES

The majority of morphological terms used in this revision are defined and illustrated in Saether (1980). Gouin (1957, 1959), Fittkau (1962), Frommer (1967), Hirvenoja (1973), Hansen & Cook (1976) and Maschwitz (1976) provide excellent studies and/or reviews on adult and immature morphology and anatomy. Terms and structures which are new or of special interest in Dicrotendipes are discussed here.

Adult male. Saether (1971) described and discussed the cibarial pump and associated structures in several genera of chironomids. His emphasis was on the shape of the structure. Dicrotendipes, and many other genera, possess a number of small setae with prominent sockets, apparently on the inner wall of the cibarial pump (Fig. 3, CS). I refer to these as cibarial setae. I could find no reference describing these setae or their function, although they have been figured (Saether 1971, fig. 4d, i; Cranston 1982, fig. 3). They may function as taste receptors or flow indicators. Although not useful for species separation in Nearctic Dicrotendipes, cibarial setae may be of use in phylogenetic studies. Cibarial setae numbered from 4 to 19 in Nearctic Dicrotendipes I examined.

The dorsal setae of the head are treated as 5 groups in Saether (1980): postorbital, orbital, inner and outer verticals, and frontal setae. Frontal setae are not present in Nearctic Dicrotendipes. The remaining 4 groups of setae are basically multiserial and contiguous in Dicrotendipes; I refer to them by the collective term temporal setae.

The humeral and postpronotal areas of the thorax bear several structures of interest. In Dicrotendipes, 3 pits, scars, or tuberose areas are present (Fig. 5). The most ventral of these is the anterior spiracular pit (Fig. 5, Sp). Dorsal and

anterior to the spiracular pit lies the thoracic scar (Fig. 5, THS). Coe (1950, fig. 195a') and Sublette & Sublette (1973a:4, figs. 52, 53; 1974, fig. 15) referred to this structure as a prothoracic or thoracic sensory pit, or as a mesonotal sensory organ. Coffman (1979) believed that the thoracic scar in the adult was the vestige of the area of contact between the internal pupal respiratory system and the external pupal respiratory organ(s), the thoracic horns. In pharate Dicrotendipes pupae the base of the thoracic horn (Figs. 27, 28; THB) lies directly above the adult thoracic scar. I was able to observe tracheal connections between the adult thoracic scar and the pupal thoracic horn base in pharate Dicrotendipes pupae with a light microscope, as Coffman (1979) observed in Polypedilum. Sublette & Sublette (1974) noted pores on the "thoracic sensory pit", and considered them artifacts of SEM preparation. These pores are probably scars from the tracheoles which connected the pupal thoracic horn with the internal respiratory system (cf. Coffman 1979, fig. 5). I examined the interior of the thorax of several D. californicus with the SEM. Figure 7 is a view of the thoracic scar from the inside of the thorax. The tubelike processes are probably the remnants of the tracheoles. I do not believe the thoracic scar has any sensory function; however, a definite answer is not possible without examination of sections of this structure.

The thoracic scar is not illustrated in Saether (1980) and should not be confused with the postpronotal apophyseal pit of some Diamesa as described by Hansen & Cook (1976, fig. 64). The postpronotal apophyseal pit and its associated postpronotal apophysis are not present in Dicrotendipes. An internal examination of the thorax revealed a lateral extension of phragma I (Fig. 8; LE) lying above the thoracic scar (Fig. 8; THS). The phragma joins the prescutoscutal suture (Fig. 5; PSS) and a postpronotal suture (Fig. 5; PPS) at a point directly behind the thoracic scar, and anterior to the junction of the prescutoscutal suture and the parapsidal suture (Fig. 5; PS). The postpronotal apophysis may be lost or part of the lateral extension of phragma I; there is no discernable trace of an external apophyseal pit.

Located anterior to the parapsidal suture and dorsal to the thoracic scar lies the humeral pit (Fig. 5; HP). In Dicrotendipes, the humeral pit can be a series of small tubercles raised above the surface of the integument (Fig. 6), a shallow, elongate pit with minute tubercles, or a smooth, bare area, with a most several low mounds. The humeral pit lies directly beneath the pupal humeral callus (Figs. 28, 29; HC); its function is unknown. The structure is inter- and intraspecifically variable and is of little use in species separation in Nearctic Dicrotendipes, but may be of phylogenetic interest.

Tarsal sensilla chaetica have recently been investigated by Säwedal (1982) and Wülker et al. (1982). The short ventral sensilla chaetica have been of taxonomic value in some studies (Hirvenoja 1973; Saether 1977a, 1977b). These sensilla chaetica are present in male Nearctic Dicrotendipes only on the metatarsus of the middle leg, and are usually confined to the apical 2/5 of the tarsomere. Two types of short ventral sensilla chaetica are present, as also noted in Chironomus by Wülker et al. (1982).

The majority are palmate sensilla chaetica which appear under the light microscope as sensilla with hooked tips (see Hirvenoja 1973, figs. 1-2; Säwedal 1982, figs. 1-2). When observed with the SEM, the hook-like tips are found to be palmate (Figs. 9-10). In the majority of specimens examined, 1 or 2 of the distal sensilla (usually the penultimate and antepenultimate sensilla) are not palmate or hooked, but are straight. In all counts of tarsal sensilla chaetica in this paper, only the palmate sensilla chaetica are enumerated. Numbers of these sensilla are inter- and intraspecifically variable and are not useful for species separation in Nearctic species.

Wülker et al. (1982) determined that the palmate sensilla chaetica were contact chemoreceptors on the basis of several morphological characters. One of these characters was the presence of a terminal pore, through which a sensillum liquor is released. The palmate sensilla chaetica of Dicrotendipes also possess a terminal pore (Fig. 10; TP).

Many Dicrotendipes species possess a medial group of darker, flattened, bluntly tipped setae on abdominal sternite VI (and sometimes V) of the adult male and female. These setae are easily lost, especially if specimens have been roughly handled or excessively cleared. The sockets of the flattened setae are similar to those of the other abdominal setae; if the flattened setae fall or are knocked off, no trace remains of their unusual nature. These setae may be the "5-6 black spines ventrally" on segment VI noted by Freeman (1957,1961) for several Afrotropical, Australian and Oriental species of Dicrotendipes.

These flattened setae are not present on all Nearctic species. They are lacking on D. californicus, D. crypticus and D. fumidus, this based on many specimens examined with all setae on S VI intact. They are apparently absent on D. adnilus, D. lobus and D. thanatogratus, but sample sizes were small for these species. Flattened setae are present on D. aethiops, D. botaurus, D. incurvus, D. leucoscelis, D. lucifer, D. modestus, D. neomodestus, D. nervosus and D. simpsoni. Flattened setae are most easily found by examining pharate adults within their pupal exuviae.

Several characters of the hypopygium deserve special mention. At the base of the anal point are several to many setae, usually arranged in groups. The **lateral basal setae** (Figs. 16, 17; LBS) are arranged on the sides of the base of the anal point; the **dorsal basal setae** (Figs. 16, 17; DBS) lie at the dorsal base of the anal point. These 2 sets of setae are usually delimited, in properly prepared specimens, by a thin ridge which delimits a small, dorsal planar area at the base of the anal point. Several Nearctic species also bear another set of dorsal hypopygial setae, the **median setae** (Fig. 17; MS), anterior to the basal setae. The arrangement, presence, or absence of these groups of setae are of taxonomic value in some species.

The internal apodemes of the hypopygium (phallapodeme, coxapodeme, transverse sternapodeme, and anal tergal bands)(Fig. 18) are consistent throughout the Nearctic species, and are useless as specific characters. The phallapodemes control the aedeagal lobes (Wensler & Rempel 1962:202). In Nearctic Dicrotendipes, the aedeagal lobes are 2 usually triangular

membranous flap-like lobes or sacs, located ventral to the anal point base. The phallapodeme is usually positioned as in Fig. 18, but in some specimens can be seen positioned at right angles to the longitudinal axis of the body. This may be a result of excessive cover slip pressure, or the phallapodeme may not return to its original position after everting the aedeagal lobes. I have not been able to test this.

The superior volsella (Fig. 16-18; SVO) is generally the most useful structure for separation of many Nearctic Dicrotendipes species. The general shape, microtrichial coverage, and position of the sensilla chaetica (Fig. 19; SCh) are of importance. In the past, the sensilla chaetica of the superior volsella of Dicrotendipes have always been depicted as dorsal sensilla. However, close examination with the light microscope and the SEM revealed that the sensilla chaetica (and almost all other volsellar setae or microtrichia) are ventral (Figs. 20-24). The naked dorsal side and the setose ventral side are most clearly seen in Fig. 24. All hypopygial figures in this paper show the superior volsella as if viewed through a light microscope, i.e., in the right half of each figure, the sensilla chaetica of the superior volsella are depicted as dorsal.

The inferior volsella in Nearctic Dicrotendipes may be one of 2 basic types: one with a simple, expanded clubbed apex, with the dorsal sensilla chaetica not arranged in distinct rows (Figs. 62, 73, 80); or one with an expanded apex which may be weakly or strongly bi- or trifid, with the dorsal sensilla chaetica arranged in distinct rows (Figs. 47, 50, 54, 66, 83, 92, 98, 106, 110, 113). In this second type, the amount of bifurcation of the apex is quite variable, inter- and intraspecifically. The apex may vary from an almost smooth, unnotched tip to one which is deeply bifid. There are no known Nearctic Dicrotendipes with inferior volsellae with apices similar to those found on some African species, such as D. fusconotatus (Kieffer) or D. pilosimanus Kieffer (see Freeman 1957, figs. 7a,b). In these species, the apex is so deeply bifid that the volsella appears more like a simple club with a well-developed preapical digitiform extension.

The second type of inferior volsella bears 1 or 2 strong **ventral apical setae** (Fig. 17; VAS). These setae are not present, or are indistinguishable from other ventral setae, on the first (simple) type of inferior volsella.

Pupa. The pupa often possesses a **scutal tubercle** (Fig. 28; ScuT), usually visible only from a lateral aspect. This structure is practically impossible to find on pupal exuviae which have been spread out (Fig. 27). A somewhat circular **humeral callus** (Figs. 27, 28; HC), a group of small wartlike protuberances, is present dorsocaudally to the thoracic horn base. This structure lies directly above the humeral pit of the pharate adult.

Pupal abdominal 0-setae were discussed by Coffman (1979) for the Chironomidae. He classified Dicrotendipes as "pattern C5", i.e., having 1 dorsal and 1 ventral pair of 0-setae on segments II-VII(VIII), with the dorsal 0-setae mediad of the ventral 0-setae. My examination of Dicrotendipes pupal exuviae agreed with this configuration, except that the dorsal 0-setae on VIII are

laterad of the ventral 0-setae. The arrangement of these setae was consistent in all Nearctic species examined; they are not useful in species separation.

The lateral lamellar setae of tergites V-VIII (Fig. 29a; LLS) are actually inserted ventrally, but are still referred to as lateral. The lamellar setae making up the anal lobe fringe (Fig. 30, VS) are also ventral in origin. There are also usually 2 pairs of dorsal setae on the anal lobes: the **anterodorsal setae** (Fig. 29b; ADS) and the **dorsal setae** (Figs. 26, 29a, 29b; ADS).

The anterodorsal setae in Dicrotendipes are located mediad of the anterolateral corners of the anal lobes; they are long, thin, and extremely delicate. These setae are easily lost and are rarely observed in situ, but are sometimes found lying near their sockets on the dorsum of the anal lobes. More often the setae are broken off, and the setal sockets are the only remaining traces. Roback (1957:112, fig. 376) reared a female specimen (apparently a D. modestus) with the anterodorsal setae intact and considered it to be "an unusual species whose larva is not separable from T. modestus but whose pupa is extremely distinctive".

The dorsal setae of the anal lobe are located posterolaterad to the anterodorsal setae in Dicrotendipes, and are lamellar. These setae are used in calculating the disc ratio, **DR**. A cursory check of the pupae of some related genera revealed that both the anterodorsal and dorsal setae are present in some Chironomus, Einfeldia, Glyptotendipes, Goeldichironomus and Kiefferulus.

Larva. Although Lenz (1954-1962, figs. 189-193) illustrated the frontal apotome or portions of it for several species of Dicrotendipes and many other Chironomini, this structure has largely been ignored, especially by North American workers. Recently, the apotome and its related sclerites have been used again in larval descriptions (Oliver 1971, 1981b; Reiss 1974; Moller Pillot 1978-1979; Pinder & Reiss 1983). Three types of larval apotomes are represented in Nearctic Dicrotendipes. The most unusual of these is found in D. lobiger(Fig. 209), in which the clypeus is fused with the frontal apotome, forming a frontoclypeal apotome. A dorsal subquadrate to oval depression is also present.

A second type of apotome, a frontal apotome, is present in D. leucoscelis (Fig. 203). Labral sclerite 1 is present, and a ventral subquadrate to oval depression is present on the apotome. An apotomal depression similar to that of D. lobiger and D. leucoscelis is also present in some Einfeldia, Demeijerea, and Glyptotendipes (Oliver 1971; Pinder & Reiss 1983).

The third type of apotome is the most common in the Nearctic Dicrotendipes (Figs. 172, 180, 186, 218, 223, 245). Labral sclerite 1 is present, but there is no dorsal depression on the apotome, and the anterolateral corners of the apotome are produced. The degree to which the corners are angled may be dependent on the amount of coverslip pressure applied. A **frontal pit** is present on the ventral anteromesal margin of this type of apotome (Figs. 39-42, 187, 192, 193). This pit is not found in D. lobiger and D. leucoscelis. This structure has also been

illustrated by Lenz (1954-1962) and Moller Pillot (1978-1979). Lenz (1954-1962) referred to it as a "strukturiertem Feld" (structured field) or "eine helle ovale bzw. fast rundliche oder auch gelappte Platte" (a light oval or else almost circular or also lobed plate). Moller Pillot (1978-1979) described the frontal pit for Dutch Dicrotendipes larvae, calling it "een ronde of ellipsvormige venstervlek" (a circular or elliptical window mark). When viewed through a light microscope, the frontal pit displays a variety of forms. Most often a transverse, somewhat elliptical to suboval area with a median uvula-shaped process within it is present (Fig. 175). Often the elliptical or suboval area is not readily visible and only the uvular process is apparent (Fig. 181), or the pit area appears to be partially or completely filled with "bubbles" or "scales" (Figs. 187, 192, 193) obscuring the uvular process, or the uvular process is not apparent within the pit.

Structures of the frontal pit are more readily observed with the SEM. The frontal apotomes were removed from several D. incurvus larvae and mounted with the ventral (inner) side up. The transversely elliptical or suboval area is a pit (Fig. 39), with a central peg-like process (Figs. 39-42). The apex of the process has a rough, warty appearence (Fig. 40). In some specimens a lattice-like framework surrounds the central process (Fig. 40). The peg-like process corresponds to the uvular process and the lattice framework is the "bubbles" or "scales" observed with the light microscope. The function of the frontal pit is unknown; perhaps it serves some sort of sensory function. The frontal pit varies both inter- and intraspecifically. A similar structure is present in some Kiefferulus and Nilodorum larvae (Pinder & Reiss 1983).

The antennae are 5-segmented (Fig. 37). A ring organ is present on the basal 1/4 to 1/3 of segment 1; a striated blade and an accessory blade with a slightly clubbed, porous appearing apex are present at the apex of segment 1 (Fig. 38). At the apex of antennal segment 2 a well developed style and Lauterborn organs are present.

The mandible and its associated structures are generally similar throughout the majority of Nearctic Dicrotendipes species, and are generally not useful for species separation. In the D. nervosus group, however, the inner teeth of the mandible provide good characters. Two species in this group, D. lucifer and D. simpsoni, display a modification of the proximal tooth or possess a deep incision between the proximal inner tooth and the seta subdentalis (Figs. 224-226, 230, 231). What appears to be a trend towards this type of tooth can be seen in some D. nervosus specimens (Figs. 238, 239).

The internal apodemes of the mandibles are darkened in some individuals of several species. This character, along with dorsal and ventral darkening of the head capsule itself, is generally not useful for separation of most species.

The mentum in Dicrotendipes has 13 teeth (Fig. 33). In some Nearctic species, some teeth of the mentum may be rounded, fused, or closely appressed to their neighbors, resulting in a mentum which apparently has only 11 teeth (Figs. 199, 214, 220, 232, 241). In some specimens with such mental teeth, excessive cover

slip pressure may force some of these teeth apart. The sixth lateral tooth in D. nervosus may also have a small dorsal extension which might, if the mentum is subjected to too much pressure and the teeth are forced aside, give the tooth a pointed appearance and place it at an approximate right angle to the fifth lateral tooth (see Oliver et al. 1978, fig. 70).

The opposite effect may occur if the mentum, which is normally slightly arched, is not pressed sufficiently when mounted, or if the head capsule has been pinched laterally (e.g. with forceps). Excessive lateral pressure may force some teeth over each other.

The morphology of the ventromental plates of 2 species of Chironominae larvae has been studied by Webb et al. (1981). The ventromental plates of Dicrotendipes are similar in construction to those described in that paper: they are smooth ventrally, well striated dorsally, and possess a matching dorsal (inner) maxillary plate on the ventral surface of the maxilla. The ridges begin near the posterior margin of the plate and in most species run forward almost 4/5 of the length of the plate. The number of ventromental strial ridges (Fig. 34; SR) is important for species separation in some Dicrotendipes. The ridges (the clear spaces between the striae) are counted along a line which runs across the approximate middle of the plate.

HISTORICAL REVIEW

Kieffer (1913:23) established the genus Dicrotendipes from African material, stating (my translation) "this genus differs from all others in that the inferior appendages of the male forceps are bifurcated". Only one species, D. pictipennis, was included, which by monotypy (International Code of Zoological Nomenclature (ICZN), Art. 68(d)) is the type-species for the genus. When Freeman (1957) relegated Dicrotendipes to subgeneric status within Chironomus, the epithet pictipennis became a junior secondary homonym of C. pictipennis Philippi, 1865. The next available name for this species was quatuordecimpunctatum Goetghebuer, originally described in Polypedilum by Goetghebuer (1936). Freeman (1957) considered quatuordecimpunctatum a subspecies of D. pilosimanus Kieffer, 1914; thus, D. pilosimanus becomes the type-species of Dicrotendipes. Although Dicrotendipes is now again considered a genus, the name D. pictipennis is invalid under ICZN Art. 59(b), because it is a junior secondary homonym replaced before 1961.

The genus Limnochironomus was established from the Palaearctic by Kieffer (1920:166), who described the apex of the inferior volsella (appendage) as "sometimes simple, sometimes imperfectly bi- or trilobed". Several species were included. The type-species, by original designation, is L. falciformis Kieffer, 1912. This species is a junior synonym of Chironomus nervosus Staeger, 1839.

Kieffer (1922b) later described 3 more species in Dicrotendipes: trilabis, cordatus, and leucolabis. In his description of the inferior volsella of D. cordatus, Kieffer (1922b:65) stated "the apex strongly broadened like a heart, the 2 lobes not as long as wide, divided by a curved indentation".

By including cordatus in Dicrotendipes, Kieffer expanded the concept of the genus. In the other species of Dicrotendipes he described, the apex of the inferior volsella is deeply bifid. However, the cordiform apex of the inferior volsella of D. cordatus would also fit the description of the same structure in Limnochironomus, as can be seen from Kieffer's figure (Kieffer 1922b:fig. 66).

Calochironomus was first mentioned by Kieffer (1921b) in a key to genera. No species were mentioned. In a later paper on African chironomids (Kieffer 1922b:66), he included 6 species in the genus and designated the type-species as fusconotatum, which was described from a female.

Kieffer (1921c:590) established the genus Carteria based on material from the Philippines and Formosa, naming Chironomus longilobus (Kieffer, 1916) (originally described in Tendipes), as the type-species. However, Carteria was preoccupied by Carteria Diesing, 1866 (a protozoan), and was renamed Carteronica by Strand (1928).

Edwards' (1929) concept of Chironomus was much broader than that of the continental European workers (e.g. Thienemann) at that time. He did not consider Limnochironomus distinctive enough to rate subgeneric rank, but relegated it to his Group C of Chironomus.

Goetghebuer (1936, 1937) also defined Chironomus in a broad sense. He considered Carteria, Calochironomus, Dicrotendipes and Limnochironomus to be subgenera of Chironomus. He apparently was unaware of Strand's 1928 paper renaming Carteria as Carteronica.

Aristovskaya (1936:114) established the genus Sernowia in a footnote, stating (loosely translated): "name at present for form previously described by N.N. Lipina as Chironominae genuinae No. 6". However, no type-species was designated. Pankratova's subsequent listing (in Chernovskii 1949) of Chironominae genuinae No. 6 and Sernowia (as Sernovia) as synonyms of Limnochironomus ex gr. nervosus Staeger does not satisfy the requirements for designation of a type-species (ICZN Art. 69). The name Sernowia thus becomes a nomen nudum and is not available (ICZN Art, 13(b)). Sernowia is also misspelled as "Sernorwia" in a table (Aristovskaya 1936:118).

Lenz (1937:6) described the larva and pupa of Chironomus (Limnochironomus) flexus Johannsen, 1932, and established it as a new genus, Limnotendipes. By monotypy, the type-species was flexus.

Cladotendipes was established by Lenz (1937) for a single species, Chironomus inferior Johannsen, 1932. Sublette and Sublette (1973b) placed C. inferior in Dicrotendipes, but made no mention of Cladotendipes. See also Ashe (1983).

Townes (1945), in his comprehensive monograph of the Nearctic Chironomini (as Tendipedini), kept Limnochironomus as a subgenus of Tendipes (=Chironomus), and considered Limnotendipes a junior synonym. He described 4 new species from the Nearctic: aethiops, botaurus, leucoscelis and milleri, and combined several species previously described in Chironomus in Tendipes (Limnochironomus): modestus Say, 1823; californicus Johannsen, 1905; fumidus Johannsen, 1905; neomodestus Malloch, 1915; and nervosus Staeger, 1839. He also included Limnochironomus

lobiger, a species described by Kieffer (1921a). Both nervosus and lobiger were originally described from the Palaearctic.

Freeman (1955) synonymized Calochironomus and Limnochironomus with Dicrotendipes. The type-species of Calochironomus was described from a female. The male, apparently associated with the female by the pattern of wing spots and banded legs, has an inferior volsella with a deeply bifid apex, and is a Dicrotendipes in the sense of Kieffer's (1913) original description of the genus. Freeman also noted that the only species of Calochironomus in which the male was known to Kieffer, C. oxylabis Kieffer, 1922, was quite unlike the other species in the genus and was a Chironomus (Einfeldia). This species is now considered a junior synonym of Chironomus formosipennis Kieffer, 1908 (Freeman 1957; Freeman and Cranston 1980). Freeman (1955) considered Limnochironomus a synonym of Dicrotendipes mainly because when Kieffer (1922b) expanded the concept of Dicrotendipes by including D. cordatus, a species with a cordiform apex to its inferior volsella, there was no longer a difference between the 2 genera. By Kieffer's (1920:106) own definition the inferior volsella of Limnochironomus could be imperfectly bi- or trilobed; a cordiform apex (as in D. cordatus) is imperfectly bilobed.

Freeman (1957) redefined Chironomus in much broader terms and included Dicrotendipes as a subgenus. He also synonymized Carteria and Carteronica with Chironomus (Dicrotendipes). The gonostylus of Carteronica species was very short and wide. Goetghebuer (1936:465) had described a species from Africa with a similar gonostylus, Chironomus (Carteria) regalis, and Freeman (1957) included this species and 2 new species with similar gonostyli, penicillatus and multispinosus, in his Chironomus (Dicrotendipes). He did not use structural similarities in the males to synonymize these 2 genera, but relied on similar thoracic color patterns of the females.

Beck (1962) described a new Nearctic species as Chironomus (Dicrotendipes) lobus, from Florida.

Sublette & Sublette (1965) catalogued 11 Nearctic species as Chironomus (Dicrotendipes). Sublette (1964) described an additional species, incurvus, from Louisiana, bringing the total of recognized Nearctic species to 12.

Hamilton et al. (1969) used the genus Chironomus in a stricter sense. Instead of a large genus with many subgenera, they preferred to use several smaller genera, in accordance with current European workers. Dicrotendipes was elevated back to the genus level.

Freeman's synonymy of Limnochironomus with Dicrotendipes has not been accepted by some authors (e.g., Pinder 1978). Freeman's synonymies were based solely on adult characters. Through the kindness of Dr. F. Reiss, I have been able to examine rearings of an African species, D. sudanicus (Freeman), with deeply bifid inferior volsellae. I do not consider the immature stages to differ on a generic level from those of Limnochironomus, and conclude that Freeman's synonymy of Limnochironomus with Dicrotendipes is sound.

Calochironomus is definitely a synonym of Dicrotendipes. However, Carteronica is not. This is based on examination of

reared material of Chironomus (Carteria) regalis Goetghebuer and Chironomus longilobus (Kieffer) (type-species of Carteronica) made available to me by Dr. L. Hare. It should also be noted that the Afrotropical species which resemble Carteronica placed in Dicrotendipes by Freeman & Cranston (1980) (crispi Freeman, multispinosus Freeman, penicillatus Freeman and regalis Goetghebuer), are not Carteronica, but represent another, new, genus (manuscript in preparation).

Kimius, a monotypic genus established by Ree (1981) for the species hoonsooi, was included as a synonym of D. niveicaudus (Kieffer) by Sasa & Hasegawa (1983). I have seen specimens of this species and agree with the synonymy.

TAXONOMY

Genus Dicrotendipes Kieffer

Dicrotendipes Kieffer 1913:23. Type-species: Dicrotendipes pictipennis Kieffer, 1913 (junior homonym, preoccupied by pictipennis Philippi, 1865; = Polypedilum quatuordecimpunctatum Goetghebuer, 1936 = Dicrotendipes pilosimanus Kieffer, 1914), by monotypy.

Limnochironomus Kieffer 1920:166. Type-species: Tendipes falciformis Kieffer, 1912, (= nervosus Staeger), by original designation.

nec Carteria Kieffer 1921c:590. Type-species: Chironomus longilobus (Kieffer, 1916), by original designation (junior homonym preoccupied by Carteria Diesing 1866); Freeman & Cranston 1980:190; Ashe 1983:15,21.

Calochironomus Kieffer 1921b:274. Type-species: Calochironomus fusconotatum Kieffer, 1922, by designation of Kieffer (1922b:66).

nec Carteronica Strand 1928:48 (replacement name for Carteria Kieffer 1921); Freeman & Cranston 1980:190, Ashe 1983:15,21.

Chironomus (Limnochironomus), Goetghebuer 1928:50, Goetghebuer 1936:464, Goetghebuer 1937-1954:19.

Chironomus (Chironomus) Group C, Edwards 1929:386.

Sernowia Aristovskaya 1935:114. Nomen nudum. (No type-species designated).

nec Chironomus (Carteria), Goetghebuer 1936:465.

Chironomus (Dicrotendipes), Goetghebuer 1936:466; Goetghebuer 1937-1954:31.

Chironomus (Calochironomus), Goetghebuer 1936:467.

Chironomus (sensu stricto), Goetghebuer 1936:470 (partim).

Limnotendipes Lenz 1937:6. Type-species: Chironomus (Limnochironomus) flexus Johannsen, 1932, by monotypy.

Cladotendipes Lenz 1937:7, Type-species: Chironomus inferior Johannsen, 1932; by monotypy.

Tendipes (Limnochironomus), Townes 1945:102; Hauber & Morrissey 1945:287; Roback 1957:109.

Dicranotendipes Kruseman 1949:254 (misspelling).

Kimius Ree 1981:217. Type-species: Kimius hoonsooi Ree, 1981 (synonym of D. niveicaudus (Kieffer, 1921)) by original designation; Sasa & Hasegawa 1983:321.

DIAGNOSIS

Adult male. Medium sized chironomids, light yellow-green to dark green or light brown to dark red-brown. Legs sometimes banded, wings sometimes spotted.

Eyes bare. Temporal setae in 1-3 rows beginning mesad to dorsomesal extension of eye, ending behind eye. Frontal tubercles present, small (2 micrometers) to medium (28 micrometers), very rarely absent. Antennal flagellum with 11 flagellomeres. Maxillary palp 5-segmented, basal segment weakly sclerotized and bearing one large lateral seta. Clypeus subquadrate, setose. Cibarial setae present.

Antepronotum bare, narrowed and weakly notched dorsomesally. Thoracic scar well developed; humeral pit usually present dorsocaudally to thoracic scar. Scutal tubercle well to poorly developed, or absent. Acrostichal setae in double row, anteriorly beginning close to antepronotum and running posteriorly to anterior base of scutal tubercle (if present) or approximately mid-scutum. Dorsocentral setae in 1-3, usually 2, rows/side. Scutellar setae in 1-3 rows. Supraalar seta 1, rarely 2, /side. Prealar setae 2-7/side. Wing membrane without setae; squama with setal fringe. Brachiolum with 1-3 setae and 2 groups of campaniform sensilla; R, R_1 and R_{4+5} with setae; costa ends at R_{4+5}; FCu proximal, below, or distal to RM.

Metatarsal beard present or absent on foreleg, almost always present on hind leg. Foretibia with inner apical rounded scale which projects slightly beyond similar scale on outer tibial apex. Middle and hind tibiae with 2 combs each, barely separated, each comb bearing one spine which projects beyond others. Sensilla chaetica on metatarsus of middle leg, usually confined to apical 1/5, occasionally running almost entire length of tarsomere. Pulvilli 2 entire lobes; empodium thin, with sparse ventral fringe.

Abdominal sternite VI with or without a medial group of one to many darker, flattened, bluntly tipped setae, which are easily lost.

Gonostylus usually evenly curved on inner and outer margins, bearing one short, stout seta apically and several to many longer setae on inner preapical margin. Superior volsella well developed, digitiform, cylindrical, triangular, or pediform; bare dorsally, bare or with microtrichia ventrally; often membranous apically; bearing several to many large sensilla chaetica on mesal and/or ventral surface. Inferior volsella well developed, strongly bowed dorsoventrally with an expanded clubbed or slightly to deeply bifid or trifid apex bearing several to many long, strong sensilla chaetica. Anal point of hypopygium pyriform to elongate-spatulate, occasionally with shelf-like basal lateral extension, usually deflexed.

Pupa. Light green to green or brown in life; exuviae almost colorless to dark brown. Cephalic tubercles present, poorly to well developed, broadly to narrowly conical, each with a short preapical frontal seta. Dorsum of thorax weakly to strongly granulose or pebbled, usually with a circular humeral callus lateroventral to base of thoracic horn. A scutal tubercle sometimes present. Thoracic horn with more than 50 branches

emanating from 2 main trunks. Base of thoracic horn somewhat dumbell-shaped, tracheal bundles usually separate (joined in some D. fumidus). Precorneal setae 2-3, dorsocentral setae 4, rarely 5.

Abdominal segment I without lateral setae, segments II-IV with 3 lateral hairlike setae, V-VII with 4 lateral lamellar setae, VIII with 4 or 5 lateral lamellar setae. Anal lobe with an anterior pair of dorsal setae, easily lost; a pair of dorsal caudolateral lamellar setae; and 30+ ventral lateral lamellar setae on each lobe, usually uniserial, at times partially biserial. An uninterrupted row of caudal hooklets on T II. Sternites I-III with or without 1-2 transverse rows of spines. Caudolateral corners of VIII with one to many, weakly to strongly developed, straight to strongly sinuate spurs. Shagreen usually absent on T I, present as fine longitudinal band(s) or generally spread spinules on S I. Ventral shagreen on S II and III present as 2-4 longitudinal bands connected by a transverse anterior band; weak to absent on S IV-VI. Dorsal shagreen on T II-VI subquadrate, hourglass-shaped, or triangular in outline; often with small, separate elliptical to round anterolateral shagreen areas which may merge with median shagreen area. Segment VII with rounded anterolateral shagreen areas, better developed dorsally. Dorsal shagreen of VIII U-shaped, or 2 longitudinal bands, or a pair of anterior and caudal oval to round areas; ventral shagreen of VIII at most a weak copy of dorsal pattern, usually more reduced. Small caudolateral spine groups present on T V-VII. Pedes spurii A well developed on S IV. Pedes spurii B present on II. Segments II-VIII with one dorsal and one ventral pair O-setae. Segment I with 2-3 ventral, 2-4 dorsal pairs of setae; II with 3-4 ventral, 3-5 dorsal pairs; III with 3-4 ventral, 5 dorsal pairs; IV-VII with 4 ventral, 5 dorsal pairs; VIII with 1 ventral and 1 dorsal pair of setae. T VIII usually with small posterolateral dorsal lobes mediad of caudolateral spurs.

Larva. Body pale green to green suffused with cream and/or red. Head capsule pale yellow to red-brown, often with a dark middorsal stripe over frontal apotome; postmentum often darker than remainder of head capsule. Mentum and mandibular teeth dark red-brown to black. Three pairs of eyespots, the ventral 2 pairs often joined, giving the appearance of only 2 pairs of eyespots. Dorsal eyespot largest, roughly oval to triangular in outline.

Antenna with 5 segments, segment 1 2-4X longer than second, segment 4 greater or approximately equal to 3. Antennal blade arises from apex of segment 1, reaching to 4th or 5th segment. Lauterborn organs and well developed style present at apex of segment 2.

Frontal apotome usually concave and roughly tuberculate along frontal suture, sometimes fused with 1st labral sclerite; usually with a ventral median frontal pit or a dorsal depression. Labrum with setae I-IVA+B present; S I moderately plumose; S II large, unfringed; S III hairlike; S IVA small, two-segmented, S IVB subequal to S IVA, simple. Laterad to S II is a group of 3 fringed labral chaetae, subequal to S II, and 3-4 smaller chaetae. Labral lamella with fringe of 20-75 teeth. Pecten epipharyngis with 3-9, rarely 12, usually rounded, ventral lobes.

5-8 chaetulae laterales. Premandible distally bifid, the inner blade subequal to 2-3X wider than outer blade; 1-3 inner medial teeth usually present; a medial premandibular brush present.

Mandible with apical tooth, a dorsal preapical tooth, and 3 inner teeth, the proximal inner tooth sometimes modified. Pecten mandibularis composed of 6-18 strong setae. Seta subdentalis widest at middle, 4-7 times longer than wide; sometimes with accesory tooth. Seta interna with 4 main branches, united basally.

Mentum with 13 teeth, the median tooth and 1st laterals subequal, median tooth often notched mesolaterally, 2nd lateral tooth often fused or partially fused with 1st lateral; 5th and 6th lateral teeth sometimes rounded and fused. Ventromental plates 1.4X-2.2X wider than long, deeply striate, with smooth or crenulated anterior margin. Setae submenti usually simple, sometimes distally divided in many species.

Triangulum occipitale very narrow, scarcely visible in ventral view.

Ventral tubules usually absent, occasionally 1 pair present on 8th abdominal segment. Procercus wider than long or as wide as long, with 6-8 apical setae; 2 anterolateral preapical setae located on lightly sclerotized preapical plate. A pair of well developed supraanal setae present. Two pairs of anal tubules, usually somewhat conical, sometimes rounded and reduced; ventral pair usually larger than dorsal pair.

Remarks

Males of Dicrotendipes are usually easily separated from other genera by their distinctive, sharply bowed inferior volsellae. Some Einfeldia or Stenochironomus may superficially resemble Dicrotendipes, but closer examination of the inferior and superior volsellae will usually separate them.

There is no single character which will separate the pupae from pupae of other genera. The shape of the thoracic horn base may be distinctive. It is usually somewhat dumb-bell shaped, with one of the 2 main bundles of tracheoles leading to the thoracic horn located in each end (Figs. 27, 28; THB) . These bundles sometimes appear joined, and in some specimens examined the shape of the thoracic horn base appeared suboval. Those species with ventral spine rows on one or more of sternites I-III are often readily separable. The caudolateral spurs on tergite VIII are often distinctive for many species, but are reduced in others. The basic shagreen pattern of a median and 2 smaller anterolateral shagreen areas, best seen on tergites III-VI, will serve to distinguish many species. The DR may also serve to separate Dicrotendipes pupae from other genera.

Most larvae can be distinguished by the 13-toothed (apparently 11-toothed in some) mentum with the 3 median teeth subequal; the short, squat, well-striated ventromental plates; the narrow triangulum occipitale; apically bifid premandibles; the lobed pecten epipharyngis, and the frontal apotome. The larvae are most easily confused with: Glyptotendipes (ventromental plates of Dicrotendipes are shorter, squatter); Einfeldia (median teeth not subequal in Einfeldia), and Goeldichironomus

(triangulum occipitale much wider in Goeldichironomus and pecten epipharyngis of many small teeth); the shape of the frontal apotome alone will usually separate these genera. The presence of a pair of ventral tubules, a common character used in many larval keys to separate Dicrotendipes from some other larvae, will not exclude Dicrotendipes larvae, for at least one Nearctic species occasionally possesses a weak pair.

The following keys will work best with properly prepared material. Teneral specimens may not exhibit the true coloration of mature specimens. One is encouraged to use the figures in conjunction with the keys and to check the species descriptions, as well as reading the Remarks section for each species for comments on variation.

Finally, one must realize that not all specimens can be keyed. Structures wear or break off. Measurements and ratios used in the keys and descriptions are based on specimens measured; it is quite possible that populations I could not measure may differ, and anomalous specimens may be found. Rearing is almost essential; an association of any 2 life stages will greatly increase one's ability to identify Dicrotendipes to species.

KEY TO ADULT MALES OF NEARCTIC DICROTENDIPES

1. Superior volsella strongly pediform, apex directed outward (Figs. 59, 94, 99); or triangular (Figs. 84, 85) 2
– Superior volsella digitiform (Figs. 62, 73, 76), long and slender (Figs. 50, 54), or long with weakly expanded membranous apex (Figs. 50, 54, 104, 110); if somewhat pediform, then apex directed inward (Figs. 66, 86) 8
2. Superior volsella triangular (Fig. 85) or if weakly pediform, sensilla chaetica restricted to posterior margin of volsella (Fig. 84); coastal, brackish water species .....**D. lobus (Beck)**
– Superior volsella pediform; sensilla chaetica not restricted to posterior margin of volsella 3
3. Legs strongly banded 4
– Legs not banded, at most distal portions of some leg segments darker 5
4. AR 2.13–2.36, mean 2.29; SV_2 4.15–4.41, mean 4.29; SV_3 2.71–2.89, mean 2.80; known from central and E New Mexico and Imperial Dam vicinity, California (possibly Kansas) .....**D. cryptícus n. sp.**
– AR 2.29–2.69, mean 2.47, SV_2 3.81–4.42, mean 4.07; SV_3 2.61–2.84, mean 2.71; widespread in western U.S. and Mexico .....**D. californicus (Johannsen)**
5. Anal point with raised truncate base (Fig. 47); known only from Chiricahua Mountains of SE Arizona....**D. adnilus n. sp.**
– Anal point not as above; widespread 6
6. Dorsum of tergite IX with many long setae laterad of anal point (Fig. 113) .....**D. thanatogratus n. sp.**
– Dorsum of tergite IX not as above 7
7. Gonostylus inflated medially, narrowed proximally and preapically (Fig. 98); general coloration brown .....

.....D. neomodestus (Malloch)

- Gonostylus not as above (Fig. 92); general coloration green to red-brown .....D. modestus (Say)

8. Superior volsella short, digitiform (Figs. 62, 73, 76) 9

- Superior volsella long and slender or long with weakly expanded membranous apex (Figs. 50, 54, 104, 110) 12

9. Anal point with wide shelf-like base, tapering gradually to apex (Fig. 62); superior volsella cylindrical, with slightly out-turned apex (Fig. 63) .....D. fumidus (Johannsen)

- Anal point spatulate or narrowed at base 10

10. Superior volsella with thin membranous preapical extension (Figs. 73-75); metatarsi usually with wide basal white band (lacking in most Florida specimens)..D. leucoscelis (Townes)

- Superior volsella not as above; metatarsi without wide basal white band 11

11. Anal point long, narrowly spatulate (Fig. 76); superior volsella with sclerotized area at apex (Figs. 78-82) .....
.....D. lobiger (Kieffer)

- Anal point and superior volsella not as above 12

12. Superior volsella long, slender, recurved, with an acute apex (Figs. 54-55) .....D. botaurus (Townes)

- Superior volsella not as above 13

13. Apex of superior volsella turned in (Figs. 66, 69-72, 86, 88-90) 14

- Apex of superior volsella turned out (Figs. 57, 59, 84, 92, 94-97) or straight, semi-globose (Figs. 111, 112) 15

14. Gonostylus long, thin, and strongly curved (Figs. 86, 87); superior volsella usually without microtrichia; apex at most semi-membranous (Figs. 88-90) .....D. milleri (Townes)

- Gonostylus not as above (Figs. 66-68); at least basal half of superior volsella with microtrichia, apex membranous (Figs. 69-72) .....D. incurvus (Sublette)

15. Superior volsella cylindrical, curving outward; apex bare, not expanded (Figs. 50-53); thorax with well developed scutal tubercle; Arizona, New Mexico, Mexico .....
.....D. aethiops (Townes)

- Superior volsella not as above, apex expanded or inflated; thorax with or without scutal tubercle, widespread 16

16. Sensilla chaetica of superior volsella in a line often reaching middle of appendage tip, not directed exclusively inward (Figs. 105-109); length of superior volsella 2-3.25X maximum width; wing with more than 35 setae on R & R_1 .....D. nervosus (Staeger)

- Sensilla chaetica of superior volsella distributed on inner surface of appendage, the majority directed inward (Figs. 111, 112); length of superior volsella 4.25-5.25X maximum width; wing with 35 or fewer setae on R & R_1 17

17. SV_2 less than 4.00; LR_1 1.69-1.91, mean 1.80 .....
.....D. lucifer (Johannsen)

- SV_2 greater than 4.00; LR_1 1.88-2.10, mean 1.95 .....
.....D. simpsoni n. sp.

KEY TO PUPAE OF NEARCTIC DICROTENDIPES

(Pupae unknown for D. adnilus n. sp., D. aethiops (Townes) and D. botaurus (Townes)).

1. Ventral spine row(s) present on S II (Figs. 30, 116, 120b, 136) 5
- Ventral spine row(s) absent 2
2. Intersegmental spines present between T V and T VI (Figs. 194, 195); 5 lateral setae on T VIII .... D. leucoscelis (Townes)
- Not as above 3
3. Shagreen spinules on T II-V largest posteriorly, tips often rounded (Fig. 121); exuviae light yellow-brown to dark yellow-brown ..... D. fumidus (Johannsen)
- Shagreen spinules on T II-V more or less equal; exuviae clear or light to dark brown 4
4. Median shagreen spinules more or less equal on T VI; exuviae light to dark brown; strongly reticulate cuticular pattern on T VI-VIII, especially on T VI; coastal, brackish water species ..... D. lobus (Beck)
- Median shagreen area on T VI with longest spinules in middle of area (Fig. 141); exuviae clear with yellowish borders; reticulate cuticular pattern on T VI-VIII at most moderately developed; widespread ..... D. nervosus group (D. lucifer (Johannsen), D. nervosus (Staeger), D. simpsoni n. sp.)
5. 5, rarely 4, lateral setae on T VIII; caudolateral spurs on T VIII moderately to weakly produced, often barely exceeding lateral margin (Figs. 135, 137, 138); exuviae brown with posterior 1/4-1/5 of shagreen areas infused with darker brown ..... D. lobiger (Kieffer)
- 4, rarely 5, lateral setae on T VIII; caudolateral spurs on T VIII well developed (Figs. 142-145, 151-153); exuviae not colored as above 6
6. Caudolateral spur on T VIII double or triple, spurs well separated (Figs. 128, 129, 134) 7
- Caudolateral spur on T VIII single (Figs. 118, 127) or closely appressed double (Figs. 119. 145) 8
7. Cephalic tubercles long, thin, sharply acute (Fig. 133), 33-40, mean 37, anal fin setae; New York, Indiana, Michigan, Minnesota, Oregon, Ontario and Manitoba .... D. milleri (Townes)
- Cephalic tubercles shorter, wider (Figs. 130-132); 33-55, mean 45, anal fin setae; widespread . D. incurvus (Sublette)
8. Median shagreen area on T VI with larger anterior and/or posterior spinules (Figs. 148, 155); caudolateral spur on T VIII originates at posterior corner angle of segment (Figs. 151, 153); widespread 10
- Median shagreen spinules on T VI largest anteriorly only or those of posterior portion only slightly larger than middle (Fig. 115); caudolateral spur on T VIII originates anterior to posterior corner angle of segment (Fig. 118); Texas, Kansas, South Dakota and westward 9
9. T II with 59-74, mean 66 caudal hooklets; DR 2.00-3.19, mean 2.52; known from central and eastern New Mexico and Imperial Dam vicinity, California (possibly Kansas) .... D. crypticus n. sp.
- T II with 66-112, mean 88, caudal hooklets, DR 2.66-4.45,

mean 3.43; widespread in western U.S. .....
.....**D. californicus (Johannsen)**

10. Dorsum of anal disc with thinly spined anteromesal shagreen areas (Fig. 163); known only from Florida .....
.....**D. thanatogratus n. sp.**

– Dorsum of anal disc without shagreen 11

11. Anterior and posterior spinules of median shagreen area on T VI more strongly developed than those of center (Figs. 148, 155); caudolateral spur on T VIII usually strongly recurved or sinuate (Figs. 151-153, 157) 12

– Posterior spinules of median shagreen area on T VI larger, more rounded OR longer than those of anterior portion of shagreen area (Fig. 126); caudolateral spur on T VIII not strongly sinuate or recurved, almost straight (Fig. 127) ...
.....**D. incurvus (Sublette)**

12. Anal lobe with 31-50, mean 38, lateral setae .....
.....**D. neomodestus (Malloch)**

– Anal lobe with 40-64, mean 50, lateral setae (one specimen seen from Florida with only 30-33 anal lobe setae) .....
.....**D. modestus (Say)**

KEY TO 4TH INSTAR LARVAE OF NEARCTIC DICROTENDIPES

(Larvae unknown for D. aethiops (Townes), D. botaurus (Townes) and D. milleri (Townes))

1. Frontal apotome with a dorsal anteromesal oval or subquadrate area (Figs. 203, 209); frontal pit absent 2

– Frontal apotome without such an area; frontal pit usually present 3

2. Sixth lateral tooth of mentum well developed (Fig. 205); 30-41, mean 35, ventromental strial ridges; a frontoclypeal apotome present (Fig. 209) .....**D. lobiger (Kieffer)**

– Sixth lateral tooth of mentum reduced or closely appressed to 5th (Fig. 199); 37-60, mean 52, ventromental strial ridges; a frontal apotome present (Fig. 203) .....
.....**D. leucoscelis (Townes)**

3. Second lateral tooth of mentum almost completely fused with or closely appressed to 1st so that 1st lateral tooth appears notched (Figs. 214, 220) 4

– Second lateral tooth at most only partially fused to 1st lateral at base, 1st lateral tooth not appearing notched (Figs. 159, 168b, 173, 177, 189) 6

4. Head capsule integument appears coarsely granular at 400X ..
.....11

– Head capsule integument at most appears slightly granular at 400X 5

5. Mentum as in Fig. 214; anterior margin of ventromental plate mostly smooth (Fig. 214); anal tubules reduced; coastal, brackish water species .....**D. lobus (Beck)**

– Mentum as in Fig. 220; at least anterior outer margin of ventromental plate scalloped (Fig. 220); anal tubules normal; widespread .....**D. neomodestus (Malloch)**

6. Ventromental plate with 20 or fewer strial ridges, deeply scalloped (Fig. 164); VPR less than 1.50; head capsule pale yellow with strong reticulations ....**D. thanatogratus n. sp.**

- Ventromental plate with more than 20 strial ridges; VPR greater than 1.50; head capsule color variable, if pale yellow, than without strong reticulations 7

7. Proximal tooth of mandible saddle-shaped or with 2 points (Figs. 224-226); OR with inner surface of mandible adjacent to proximal tooth with deep semicircular incision (Figs. 230, 231) 8

- Proximal tooth of mandible mostly triangular in outline, not as above 9

8. Sixth lateral tooth of mentum rounded and closely appressed or fused to 5th lateral tooth (Fig. 232); inner surface of mandible adjacent to proximal tooth with deep semicircular incision (Figs. 230, 231) .....**D. simpsoni n. sp.**

- Sixth lateral tooth of mentum pointed (Fig. 227); inner surface of mandible adjacent to proximal tooth without deep semicircular incision (Figs. 224-226) .... **D. lucifer (Johannsen)**

9. Sixth lateral tooth of mentum rounded and closely appressed or fused to 5th lateral tooth (Fig. 241) ....**D. nervosus (Staeger)**

- Sixth lateral tooth pointed, separate 10

10. Head capsule integument appears coarsely granular at 400X; head capsule color yellow-brown to yellow-red-brown.....11

- Head capsule integument at most appears slightly granular at 400X; head capsule color light brown to brown OR pale yellow 13

11. Postmentum or posterior portion of head capsule not darkened; 1st laterals of mentum often turned outward (Fig. 177) .....**D. fumidus (Johannsen)**

- Postmentum or posterior portion of head capsule much darker than rest of head capsule; 1st laterals of mentum rarely turned outward 12

12. Ventromental plate with scalloped anterior margin (Fig. 173); 23-28, mean 25, ventromental strial ridges; known from central and eastern New Mexico and Imperial Dam vicinity, Califormia (possibly Kansas) .....**D. crypticus n. sp.**

- Ventromental plate with smooth anterior margin (Fig. 168b); 34-42, mean 37, ventromental strial ridges; widespread in western U.S. .....**D. californicus (Johannsen)**

13. Head capsule pale yellow 14

- Head capsule light brown to brown 15

14. Ventromental strial ridges 28-36, mean 32; postmentum usually darkened .....**D. modestus (Say)**

- Ventromental strial ridges 23-29, mean 25; postmentum rarely darkened .....**D. incurvus (Sublette)**

15. Anterior margin of ventromental plates mostly smooth (Fig. 159); known only from Chiricahua Mountains of SE Arizona ... .**D. adnilus n. sp.**

- Anterior margin of ventromental plates with shallow to deep scallops (Fig. 189); widespread .....**D. modestus (Say)**

Dicrotendipes adnilus n. sp.

Figs. 47-49, 158, 162.

Type locality: U.S.A., Arizona, Cochise Co., Chiricahua Mountains, Turkey Creek.

Type material: Holotype, male, Arizona: Cochise Co., Chiricahua Mountains, Turkey Creek at road, el. 1951 m, black light, 1-VIII-1980, leg. J.H. Epler (USNM). - Paratypes: 2 males, collected with holotype (CNC, JHE).

Diagnosis: Male imagines can be separated from *D. modestus* by the raised, truncate base of the anal point and the brown coloration. The "leg" portion of the superior volsella is also somewhat stouter. The pupa is unknown. The presumed larva is separated from *D. modestus* by the smooth anterior margin of the ventromental plates.

Etymology: Adnilus is an anagram for Linda; I take great pleasure in naming this species for my wife Linda: companion, field assistant, and typist extraordinaire.

Male imago (n=2; 1 holotype and 1 paratype)

Color. Head, thorax and abdomen dark brown. Legs dark brown, femoral bases and trochanters paler. Wings clear, veins pale brown.

Length. Total 4.23-4.45 mm. Thorax 1.20-1.25 mm. Abdomen 3.03-3.20 mm.

Head. Temporals 34-42. Clypeus with 14-17 setae. Cibarial setae 9-11. Palpal segment lengths (1): 53; 53; 153; 168; 243. Frontal tubercles 13 long, 10 wide. AR 1.88-2.11.

Thorax. Scutal tubercle reduced. Acrostichals 2; dorsocentrals 16-18; scutellars 14-16; prealars 7-8. Humeral pit present as bare spot or slight pit filled with minute tubercles.

Wing. Length 2.30-2.48 mm; width 650-680. FCu below RM. VR 0.95. Brachiolum with 2 setae; R & R_1 with 30-31 setae; R_{4+5} with 17-19 setae; squama with 14-17 setae.

Legs. Foretarsal beard absent. Metatarsus of middle leg with 8-11 palmate sensilla chaetica. Lengths and proportions of legs:

	P_1	P_2	P_3
fe	1050-1075	925-965	1040-1120
ti	815-900	920-980	1160-1280
ta_1	1320-1390	460-470	800-880
ta_2	645-690	290-300	405-440
ta_3	510-545	210-225	320-340
ta_4	390-410	140-150	140-200
ta_5	180-185	120	135-140
LR	1.54-1.62	0.48-0.50	0.69

BV	1.84-1.85	3.03-3.04	2.93-3.00
SV	1.41-1.42	4.01-4.14	2.73-2.75

Abdomen. Flattened setae on S VI not apparent.

Hypopygium (Fig. 47). Gonostylus narrow, curved medially, with 6 large setae on inner apex. Phallapodeme length 120-125. Superior volsella (Figs. 48, 49) length 75-80, width 55-63; pediform, ventrally covered with setae to toe and bottom of foot, with 9-11 sensilla chaetica arranged in 3 irregular rows; toe and bottom of foot bare. Inferior volsella with tip of club moderately expanded, barely indented at apex, with 2 dorsal rows of 3-4 sensilla chaetica each; with 1 large ventral apical seta. Anal point minutely setose dorsally, pyriform, deflexed, narrowed proximally to a raised, truncate base; with 8-11 dorsal basal setae, 7-10 lateral basal setae.

Pupa. Unknown

Larva (presumptive association; n=1).

Color. Head capsule light yellow-brown, postocciput dark red-black; postmentum, postgenae and mandibular apodemes brown. Frontal apotome with brown stripe.

Head. Postmentum length 223. Mandible (Fig. 158) length 165; with 3 triangular inner teeth. Pecten mandibularis composed of 10 setae. Mentum (Fig. 159) with 13 well defined teeth, median tooth equal to 1st laterals; 2nd lateral tooth partially fused basally or lying over 1st lateral. Mentum width 130; MR 2.71. Ventromental plate with mostly smooth anterior margin, width 108; length 52; VPR 2.08; IPD 59; PSR 1.83; 35 strial ridges. Lengths of antennal segments: 67, 18, 12, 13, 5. AR 1.40 (Fig. 160). Width of inner blade of premandible greater than outer blade. Pecten epipharyngis with 6 lobes. Anterior margin of frontal apotome concave, roughly tuberculate (Fig. 161); frontal pit (Fig. 162) transversely elliptical, with ventral uvula-shaped process. Posterior 1/3 of labral sclerite 1 with low tubercles.

Body. Ventral tubuli absent.

Additional material examined. U.S.A.: Arizona: 1 larva (presumptive association); VIII.

Remarks

Dicrotendipes adnilus is probably a Mexican species which reaches its northern limit in the Chiricahua Mountains of SE Arizona. The 3 males I collected were attracted, with 4 male D. californicus, to a UV light trap at Turkey Creek where it crosses under the road to Rustler Park in the Chiricahua Mountains. I collected 1 Dicrotendipes larva, from periphyton scraped from rocks in the center of the stream, from Turkey Creek. It died before it could be reared. As it resembles no other known Dicrotendipes larva, I assume it to belong to D. adnilus. More collecting of the Chiricahuas, as well as the Huachuca Mountains to the west, is needed.

Dicrotendipes aethiops (Townes)
Figs. 50-53.

Tendipes (Limnochironomus) aethiops Townes, 1945:107-108, Fig. 121 (adult description).
Tendipes (Limnochironomus) figueroai Vargas, 1952:48-50, Figs. 1-4 (adult description). NEW SYNONYMY.
nec Chironomus (Limnochironomus) aethiops (Townes): Beck & Beck 1959:94 [misdetermination of D. incurvus (Sublette)].
Chironomus (Dicrotendipes) aethiops (Townes): Sublette & Sublette 1965:169 (placement).
nec Chironomus (Dicrotendipes) aethiops (Townes): Webb 1972:74-76, Figs. 1-9 [larva, pupa description; misdetermination of D. fumidus (Johannsen)].
nec Dicrotendipes aethiops (Townes): Webb & Brigham 1982:11.77, Fig. 11.208 (in key, misdetermination of D. fumidus).

Type locality: U.S.A., New Mexico, Las Vegas Hot Springs.
Diagnosis: The brown coloration and distinctive out-curving superior volsella serve to separate males of this species from most other Dicrotendipes. Poorly mounted specimens could resemble species of the D. lucifer complex; however, D. lucifer complex specimens are greenish, not brown. The immature stages are not known.

Male imago (n=4)

Color. Head and thorax brown, thoracic vittae darker; abdomen dark brown with trace of green. Legs pale brown, femoral bases and trochanters paler. Wings mostly clear, a very diffuse cloudy spot at base of cell r_{2+3}, veins pale brown.

Length. Total 3.80-4.36, 4.08 mm. Thorax 1.04-1.30, 1.17 mm. Abdomen 2.73-3.09, 2.90 mm.

Head. Temporals 39-44, 41. Clypeus with 12-19, 17 setae. Cibarial setae 9-12, 11. Palpal segment lengths: 25-30, 26; 48-60, 53; 138-160, 149; 163-185, 170; 243-293, 259. Frontal tubercles 5-20, 9 long; 5-15, 8 wide. AR 1.88-2.45, 2.17.

Thorax. Scutal tubercle well developed. Acrostichals 2-9, 7; dorsocentrals 22-41, 31; scutellars 11-21, 15; prealars 9-10, 10. Humeral pit present as shallow pit.

Wing. Length 1.90-2.43, 2.17 mm; width 540-675, 590. FCu below or slightly proximal to RM. VR 0.94-0.96, 0.95. Brachiolum with 2 setae. R & R_1 with 33-36, 34 setae; R_{4+5} with 14-30, 22 setae; squama with 5-16, 10 setae.

Legs. Foretarsal beard absent. Metatarsus of middle leg with 7-13, 9 palmate sensilla chaetica. Lengths and proportions of legs:

	P_1	P_2	P_3
fe	890-1090, 968	810-1005, 899	910-1114, 991
ti	720-870, 780	730-980, 845	1000-1240, 1103

ta_1	1090-1190, 1143	400-550, 453	700-930, 798
ta_2	550-690, 610	260-310, 275	360-410, 386
ta_3	460-544, 496	180-230, 198	240-360, 305
ta_4	350-430, 383	120-160, 138	170-220, 188
ta_5	120-210, 171	100-130, 111	110-145, 128
LR	1.45-1.60, 1.48	0.50-0.56, 0.54	0.70-0.75, 0.72
BV	1.66-1.99, 1.81	2.04-3.15, 3.04	2.77-2.97, 2.88
SV	1.40-1.72, 1.53	3.61-4.11, 3.87	2.53-2.73, 2.63

Abdomen with 3-4 darker, flattened, bluntly tipped setae, which are easily lost, on S VI.

Hypopygium (Fig. 50). Gonostylus narrow, curved medially with 5-7 large setae on inner apex. Phallapodeme length 110-128, 121. Superior volsella (Figs. 51-53) length 83-88, 85; width 13-18, 16; slender, cylindrical, curving laterad; ventral apical 1/4 bare, membranous, with 3-4 sensilla chaetica before bare apex. Inferior volsella with tip of club slightly expanded, barely indented at apex, with 2 dorsal rows of 3-4 sensilla chaetica each, with one large ventral apical seta. Anal point bare dorsally, pyriform, deflexed; with 0-2 dorsal basal setae, 3-4 lateral basal setae.

Pupa and larva. Unknown.

Type material examined. Holotype: Male, New Mexico, Las Vegas HS, 13-8-[1901], H.S. Barber (USNM).-Paratypes: 4 males, 7 females, same locality, 8, 11, 12, 13, 14, 16, 19-8-[1901], H.S. Barber (USNM).
Additional material examined: U.S.A.: Arizona: 3 males; VIII. New Mexico: 7 males; VIII, IX. MEXICO: Baja California: 1 male; V.

Remarks

Dicrotendipes aethiops is an uncommon species of higher elevations (above 1600 m) of the desert Southwest and Mexico. Specimens recorded by Beck & Beck (1959) as Chironomus (Limnochironomus) aethiops from Florida were D. incurvus, at that time undescribed (personal communication, E.C. Beck). Specimens described by Webb (1972) as the immature stages of D. aethiops are D. fumidus, based upon my examination of Webb's material.

Although I was not able to see any specimens of Vargas'

Tendipes (Limnochironomus) figueroai, the figures in the publication (Vargas 1952, figs. 1-3) are obviously of D. aethiops. The differences between the 2 species stated by Vargas (1952:48) are probably due to individual variation and, more importantly, excessive cover slip pressure. Such pressure can flatten the anal point area and cause the superior and inferior volsellae to rotate or twist (Fig. 53).

I searched the area around Las Vegas Hot Springs, NM, (the type locality) for 3 days, attempting to collect and rear the immatures of D. aethiops. Because Vargas (1952:48) had stated that T. (L.) figueroai was found in the same small arroyos with simuliids, I searched habitats supporting or likely to support blackflies. I concentrated my collecting efforts on streams, checking stones and vegetation in and out of strong flow areas, as well as collecting in slackwater pools. I also collected in the various pools of hot (48° C) water in the area. The hot pools empty into Gallinas Creek; the creek temperature was 27° C in the area of the springs. I collected no immature D. aethiops, but did collect D. crypticus on algae covered rocks in the midstream of Gallinas Creek.

I also collected D. aethiops adults in Ramsey Canyon in the Huachuca Mountains of southeast Arizona. A search of the stream near the collection site of the adults produced no Dicrotendipes larvae.

The structure of the superior volsella places this species in the D. nervosus group. I would expect the immatures to generally resemble those of the other species of this group.

The holotype of T. (L.) aethiops is in the USNM. I examined its slide mounted hypopygium and 11 pinned male and female paratypes, all from Las Vegas Hot Springs. I have slide mounted 5 of these paratypes. One female paratype is not a D. aethiops, but is either a D. californicus or D. crypticus, based on the spotted wings and banded legs of the specimen.

The type of T. (L.) figueroai, genitalia mounted in balsam, is, according to Vargas (1952:50), "en la lamina 6252 de la coleccion del Instituto de Salubridad y Enfermedades Tropicales". Dr. Alfonso Garcia Aldrete, of the Biological Institute of the University of Mexico, Mexico City, kindly searched for the holotype for me. He reported that the species was recorded in the museum's catalog, but that the specimen was missing.

Dicrotendipes botaurus (Townes)

Figs. 54-56.

Tendipes (Limnochironomus) botaurus Townes, 1945:109-110, Fig. 123 (adult description); Townes 1952:74, Fig. 115 (adult description).

Chironomus (Dicrotendipes) botaurus (Townes): Sublette & Sublette 1965:169 (placement, distribution).

Dicrotendipes botaurus (Townes): Saether 1977:181, Fig. 79 (figure of female genitalia).

Type locality: U.S.A., Montana, Big Timber.

Diagnosis: The recurved, apically acute superior volsella is distinctive for this species. The immatures are unknown.

Male imago (n=6)

Color. Head and palps light brown; thorax light orange-brown, scutellum light green, abdomen green. Legs greenish stramineous; fore tibiae with darkened apices, ta_1 light proximally, darkening distally, remaining tarsomeres brown; mid and hind legs with ta_{2-5} brown. Wings clear, veins pale brown.

Length. Total 4.03-4.50 mm (3). Thorax 1.10-1.32, 120 mm (4). Abdomen 2.90-3.58, 3.19 mm (4).

Head. Temporals 34-48, 40 (5). Clypeus with 15-29, 20 setae. Cibarial setae 8-11, 10. Palpal segment lengths: 40-56, 48; 50-80, 62; 120-170, 135; 143-188, 158; 148-258, 216. Frontal tubercles 5-10, 7 long, 5-9, 5 wide. AR 2.31-2.56, 2.49.

Thorax. Scutal tubercle absent. Acrostichals 4-9, 7; dorsocentrals 13-32, 19; scutellars 4-10, 7 (5); prealars 9-12, 10 (5). Humeral pit scarcely discernable, at most 3 minute tubercles.

Wing. Length 1.95-2.58, 2.22 mm; width 575-720, 633. FCu below or slightly distal to RM. VR 0.87-0.93, 0.90. Brachiolum with 2 setae. R & R_1 with 13-21. 18 setae; R_{4+5} with 4-11, 8 setae; squama with 8-16, 10 setae.

Legs. Foretarsal beard absent. Metatarsus of middle leg with 7-13, 10 palmate sensilla chaetica. Lengths and proportions of legs:

	P_1	P_2	P_3
fe	830-1080, 970	800-1070, 929	880-1180, 1010
ti	670-865, 783	705-975, 831	970-1300, 1109
ta_1	1070-1310, 1189(4)	370-490, 437	675-880, 768
ta_2	515-650, 564(4)	230-300, 259	355-450, 392
ta_3	450-560, 493(4)	160-205, 182	280-360, 314
ta_4	340-400, 365(4)	100-130, 116	130-200, 172
ta_5	160-190, 174(4)	80-120, 104(5)	110-140, 124
LR	1.56-1.60, 1.59(4)	0.50-0.57, 0.53	0.68-0.72, 0.69
BV	1.75-1.86, 1.80(4)	3.17-3.79, 3.39(5)	2.72-3.09, 2.89
SV	1.39-1.44,	3.75-4.17,	2.66-2.83,

1.41(4) 4.04 2.76

Abdomen with 3-5 darker, flattened, bluntly tipped setae, which are easily lost, on S VI.

Hypopygium (Fig. 54). Gonostylus broad, widest in middle, curved medially, with 8-12 large setae on inner apex. Phallapodeme length 123-145, 137(4). Superior volsella (Fig. 55) length 73-109, 88(5); width 13-16, 14(5); long, slender, recurved, apically acute, somewhat spoon-shaped; apex and outer 1/3 bare; 2-3 sensilla chaetica near apex, a dense bush of smaller setae proximal to these. Inferior volsella with tip of club moderately expanded, indented, almost bifid, with 2 dorsal rows of 3-6 sensilla chaetica each; with one large ventral apical seta. Anal point (Fig. 56) bare dorsally, pyriform, deflexed, with a narrow peduncle; with 3-8 dorsal basal setae arranged in V, 6-10 lateral basal setae.

Pupa and larva. Unknown.

Type material examined. Holotype: Male, Big Timber, Montana, July 14, 1917, H.G. Dyar (USNM).
Additional material examined: U.S.A.: Kansas: 1 male; VI. Oklahoma: 1 male; V. Tennessee: 1 male; VI. CANADA: Manitoba: 7 males, 2 females; VII, VIII.

Remarks

An uncommon species of central North America. Adults have been collected in such diverse places as 2 miles offshore of Lake Winnipeg to 100 meters downstream from a spring in north Kansas.

I have examined the slide mounted hypopygium of the holotype, located in the USNM.

Dicrotendipes californicus (Johannsen)

Figs. 23-24, 57-61, 115-119, 168a-172.

Chironomus californicus Johannsen, 1905:217 (adult description).
Tendipes (Limnochironomus) californicus (Johannsen): Townes 1945:105, Fig. 118 (adult description); Vargas 1952:48 (distribution).
Tendipes (Dicrotendipes) californicus (Johannsen): Sublette 1960:218 (partial adult description, distribution); Darby 1962:157-158, Figs. 56, 93, 143, 144 (ecology, in key).
Chironomus (Dicrotendipes) californicus Johannsen: Sublette & Sublette 1965:169 (placement, distribution); Morrow et al. 1968:102, Fig. 15 (description of egg mass); Bath & Anderson 1969:171, Figs. 21, 32, 48, 61, 70 (larval description); Webb 1972:76 (in key).
Dicrotendipes californicus (Johannsen): Frommer & Rauch 1971:33-39 (biology); Frommer & Sublette 1971: Fig. 7 (phenology); Hudson 1971:163, 168 (distribution); Gillespie 1974:114-116, Fig. 27 (adult description, distribution); Beck 1977:93 (larval ecology); Sublette & Sublette 1979:94 (distribution); Martin et al. 1979:150, Fig. 15 (karyotype).

Type locality: U.S.A., California, Pasadena.

Diagnosis: The faint, cloudy spots on the wing, banded legs, broad, medially expanded gonostylus, and pediform superior volsella with bare tip (often reflexed) will separate most D. californicus adults from other Nearctic species except D. crypticus. Characters presented in the adult key should separate most D. californicus from D. crypticus. Pupae of D. californicus and D. crypticus possess ventral spines on S I-III; shagreen on T VI is heaviest on the anterior portion of the median shagreen area; and the caudolateral spur on T VIII often originates anterior to the posterolateral corner of that segment. Characters in the pupal key will separate most D. californicus from D. crypticus pupae. The coarse, granular appearance of the head capsule integument and the dark posterior portion of the head capsule will separate D. californicus and D. crypticus larvae from other species. Larval D. californicus possess ventromental plates with smooth anterior margins and higher strial ridge counts as opposed to the scalloped anterior margins and lower strial ridge counts of D. crypticus.

Male imago (n=11)

Color. Head and palps light brown; thorax brown; abdomen brown to olive-brown, with light brown to light green narrow bands at the intersegmental membranes. Legs stramineous, with brown apical and basal bands on the femora and tibiae, the basal band on the femur sometimes lacking; metatarsus pale basally, darkening apically, the remaining tarsomeres brown. Wings with pale gray spots at bases of cells r_{4+5} and m_{3+4}, and over anal vein; these spots sometimes difficult to discern, especially in slide mounted specimens; wing veins light brown.

Length. Total 3.73-5.05, 4.20 mm(9). Thorax 1.00-1.33, 1.16 mm(10). Abdomen 2.58-3.75, 3.04 mm(9).

Head. Temporals 36-53, 41(9). Clypeus with 16-30, 22(10) setae. Cibarial setae 11-17, 13(8). Palpal segment lengths: 35-50, 43(9); 43-59, 49(9); 138-178, 160(10); 141-178, 158; 183-265, 213(8). Frontal tubercles 10-28, 19 long, 6-10, 9 wide. AR 2.29-2.67, 2.47(9).

Thorax. Scutal tubercle weakly developed to absent. Acrostichals 4-14, 8; dorsocentrals 23-39, 33(12); scutellars 6-16, 12(12); prealars 6-10, 9. Humeral pit of 6-10 minute tubercles.

Wing. Length 1.83-2.43, 2.06 mm(10); width 430-650, 587(10). FCu below or slightly distal to RM. VR 0.91-0.99, 0.94(19). Brachiolum with 2 setae. R & R_1 with 16-36, 27(10) setae; R_{4+5} with 4-18, 10(10) setae; squama with 11-19, 15 setae.

Legs. Foretarsal beard absent. Metatarsus of middle leg with 7-17, 10(8) palmate sensilla chaetica. Lengths and proportions of legs:

	P_1	P_2	P_3
fe	800-1040, 905(10)	810-970, 860(10)	830-1120, 946
ti	640-870,	715-950,	925-1210,

	740(10)	810	1037(12)
ta_1	950-1320, 1158(7)	340-450, 407	640-785, 733
ta_2	440-580, 510(7)	210-290, 245	305-415, 365
ta_3	380-500, 440(7)	160-210, 180	270-380, 309
ta_4	255-385, 347(6)	100-140, 113	150-205, 177
ta_5	140-195, 167(7)	90-115, 100	105-130, 115
LR	1.48-1.65, 1.56(7)	0.47-0.53, 0.50	0.67-0.74, 0.70
BV	1.82-2.00, 1.93(6)	3.12-3.40, 3.25(10)	2.71-2.99, 2.86(10)
SV	1.36-1.52, 1.44(7)	3.81-4.42, 4.07(10)	2.61-2.84, 2.71(10)

Abdomen. Flattened setae on S VI not apparent. Hypopygium (Fig. 57). Gonostylus very broad, widest in middle, apex more attenuated than in D. botaurus or D. fumidus, curved medially, with 6-9,8(12) setae on inner apex. Phallapodeme length 100-128, 115(8). Superior volsella (Figs. 59-61) length 55-95, 73(9); width 40-53, 48(9); pediform, ventrally covered with microtrichia to near bottom of "foot", with 6-11, 8 sensilla chaetica arranged in 2-3 transverse rows; apex bare, reflexed (Fig. 60). Inferior volsella with tip of club slightly expanded, indented slightly, with 2, rarely 3, dorsal rows of 4-6 sensilla chaetica each; with 1-2 large, ventral apical setae. Anal point (Fig. 58) bare dorsally, pyriform, strongly deflexed; with 3-7, 4(9) dorsal basal setae and 6-9, 8 lateral basal setae.

Pupa: (n=12)

Color. Yellow-brown to light brown

Length. Total 4.58-5.71, 5.27 mm(5). Cephalothorax 1.28-1.49, 1.38 mm(5). Abdomen 3.08-4.26, 3.68 mm(8).

Cephalothorax. Cephalic tubercles (Fig. 117) moderately to well developed, broadly conical. Dorsum roughly pebbled; 2-3, 2(7) precorneal, 4(7) dorsocentral setae. Scutal tubercle present.

Abdomen (Fig. 115). Sternites I-III (Fig. 116) with transverse spine rows; S I with single row; S II with 2 rows; S III with a single row. S I-III also with 2 or 4 longitudinal lateral spinule bands, spinules larger anteriorly. Posterior margin of T II with transverse row of 66-112, 88 hooklets. Tergites II-III without anterolateral shagreen areas; with

subquadrate or trapezoidal to broadly triangular median shagreen area. T IV-VI with oval to elongate-elliptical anterolateral shagreen areas and subquadrate to broadly triangular median shagreen area, with shagreen spinules larger in anterior portion of median shagreen area. T VII with anterior transverse shagreen band or 2 oval anterolateral shagreen areas. T VIII with 2 anterolateral and 2 posterolateral oval or reniform, or U-shaped, or low, broad, posterior triangular, or 2 oval to reniform anterolateral and a low, broad, posterior triangular shagreen areas. T V-VIII often with reticulate cuticular pattern, best developed on VII-VIII. T VIII with 4 lateral lamellar setae. Caudolateral spurs on VIII (Figs. 118, 119) single or closely appressed double, usually strongly sinuate and originating anterior to posterolateral corner of segment. Anal lobes with 34-64, 50 setae. DR 2.66-4.45, 3.43.

Fourth instar larva: (n=15)

Color. Head capsule yellowish-brown, integument appearing coarsely granular; postmentum and postgenae red-brown or posterior portion of postmentum and mandibular apodemes red-brown to brown; postocciput dark red-brown to black. Frontal apotome (Fig. 172) with brown to red-brown stripe, integument reticulated anteriorly.

Head. Postmentum length 215-267, 237(12). Mandible (Fig. 168a) length 130-190, 161(9), with 3 triangular inner teeth. Pecten mandibularis composed of 8-12, 10(12) setae. Mentum (Fig. 168b) with 13 well defined teeth, median tooth equal or subequal to 1st laterals; 2nd lateral tooth basally fused or appressed to 1st lateral. Mentum width 115-155, 135(14); MR 2.45-2.94, 2.73(14). Ventromental plate with smooth anterior margin, width 101-125, 111; length 51-63, 56; VPR 1.68-2.13, 1.98; IPD 54-65, 60(12); PSR 1.51-2.11, 1.85(12); 34-42, 37 strial ridges. Length of antennal segments: 63-75, 68(12); 15-22, 20(12); 10-15, 13(12); 11-15, 13(12); 5-6, 6(12). AR 1.13-1.53, 1.32(12)(Fig. 169). Width of inner blade of premandible (Fig. 170) greater than outer blade, outer blade drawn to fine point. Pecten epipharyngis (Fig. 171) with 3-6, 5(11) lobes. Anterior margin of frontal apotome concave, roughly tuberculate; frontal pit transversely elliptical. Posterior third of labral sclerite 1 with low tubercles.

Body. Ventral tubuli absent.

Type material examined. Holotype: Male, Pasadena, Cal., V-31-1895 (COR). -Paratype: Male, same data as holotype (head and thorax only)(COR).

Additional material examined: U.S.A.: Arizona: 53 males, 3 pharate females pupae/Lex, 7 females; VI-X. California:1 pharate male pupa/Lex, 92 males, 1 female/Pex/Lex, 29 females, 1 pharate female pupa/Lex, 5 pupae, 41 larvae; II-X. Colorado: 1 male; VIII. Idaho: 1 male; VII. New Mexico: 7 larvae; VII, IX. South Dakota: 3 males; V, VIII. Texas: 1 male pupa/Lex, 22 males, 1 female/Pex/Lex, 1 pharate female pupa/Lex, 1 female, 2 pupae; V-IX, XII. Utah: 410 males, 23 females; VII. COSTA RICA: Cartago: 1 male; VII. MEXICO: Morelos: 1 male; VII. Oaxaca: 1 male; VII. Sinaloa, 1 male; VIII.

Remarks

Dicrotendipes californicus is the commonest *Dicrotendipes* encountered at lower elevations in the southwestern U.S. Collections range from below sea level in Death Valley, CA, to an elevation of 1951 m in the Chiricahua Mountains, AZ. This species ranges at least as far south as Costa Rica and perhaps Colombia; its northern limit appears to be southern Idaho and South Dakota, and I have collected it as far east as Dallas, TX. It is apparently absent from central and eastern New Mexico, where it is replaced by *D. crypticus*. Many of the specimens recorded by Sublette & Sublette (1979) from New Mexico as *D. californicus* are *D. crypticus*.

The male genitalia of this species and *D. crypticus* are inseparable and subject to much variation. Normally, the superior volsella is pediform (Fig. 59). The apex, or "toe", is apparently quite thin or membranous, for it is often pushed up or reflexed (Fig. 60), a condition apparently caused by cover slip or some other form of pressure. Some specimens possess one normal and one reflexed superior volsella. No differences could be found between those with 1 or 2 reflexed apices and those with 2 normal superior volsellae. A deformed superior volsella is illustrated in Figure 61.

On many teneral adult specimens, the characteristic bands on the legs are not evident.

The pupae of this species and *D. crypticus* are unusual in that most specimens possess caudolateral spurs on T VIII which originate anterior to the posterolateral corner of that segment. In other species with sinuate spurs (i.e., *D. modestus*), the spurs usually originate directly on the posterolateral corner. The presence of a closely appressed compound caudolateral spur (Fig. 119) is not a useful species character, as used in Darby's (1962:74) key.

Darby (1962) found *D. californicus* larvae living mainly on submerged vegetation and less often on the surface of bottom mud. Larvae I have collected and reared were found on submerged plants and emergent vegetation at the edge of a slowly moving stream, on submerged floating plants, and living among plant material scraped from rocks in pools of slowly moving water. Often abundant in reservoirs and other lentic habitats, populations can reach nuisance levels in residential areas (Frommer & Rauch 1971; Ali & Mulla 1980).

Martin et al. (1979) described the karyotype of this and 2 other species of *Dicrotendipes*. They found that *D. californicus* possesses only 3 polytene chromosomes, as compared to 4 found in other members of the genus. Their investigation was based upon reared specimens from Riverside, CA. I have examined reared material from this lab and found it all to be true *D. californicus*. Martin et al. (1979) state, however, that the material was not of good quality. Further cytological investigation of this species and *D. crypticus* is warranted.

I have examined the holotype male (No. 2458) and a paratype male, both housed in the collection of Cornell University. I have slide mounted the holotype in Canada balsam. Its thorax was damaged by the rather thick pin on which the specimen was

impaled. Both of the holotype's superior volsellae have reflexed apices.

Dicrotendipes crypticus n. sp.
Figs. 120a, 120b, 173-175

Dicrotendipes californicus (Johannsen)(partim): Sublette & Sublette 1979:94 (distibution; some records are for *D. crypticus*).

Type locality: U.S.A., New Mexico, Eddy Co., Pecos River, 13 mi S. Malaga near State Line.
Type material: *Holotype:* Reared male with Pex/Lex, New Mexico: Eddy Co., Pecos River, 13 mi S Malaga near State Line, Sta K, 14-II-76 (USNM). - *Paratypes*: (19): California: Imperial Co., Imperial Dam vicinity, 6 June 1973, G. Grodhaus, M.B. Madon, 1 reared female/Pex/Lex, 1 larva. New Mexico: Eddy Co., Pecos River, 13 mi S Malaga near State Line, Sta K, 14-II-76, 1 reared male/Pex/Lex. Eddy Co., Pecos River at bridge on Highway 82 between Artesia and Loco Hills, Sta L, 14-II-76, 1 reared male/Pex/Lex, 1 reared male/Lex, 1 pharate male pupa/Lex. Mora Co., 6 mi N Charette Lake, 4-IX-67, 1 reared male/Pex/Lex, 1 reared female/Pex/Lex. San Miguel Co., Gallinas Ck at Hot Springs, W of Las Vegas, el 2073 m, 5-6-VIII-1980, leg. J.H. Epler, 3 pharate male pupae/Lex, 2 pharate female pupae/Lex, 1 pharate male pupa, 5 pupal exuviae. (CAL, CNC, ENMU, FAMU, INHS, JHE, USNM).
Diagnosis. See diagnosis under *D. californicus*.
Etymology: From the Greek *kryptos*, meaning hidden or secret; referring to the cryptic nature of this species' identity.

Male imago (n=7; 1 holotype and 6 paratypes)

Color. Similar to *D. californicus*. The brown basal bands on the femora are lacking in all the specimens I have examined (these bands are often lacking in *D. californicus*, also).

Length. Total 3.38-3.83 mm(2). Thorax 0.93-1.13 mm(2). Abdomen 2.45-3.40 mm(2).

Head. Temporals 39-55, 48(4). Clypeus with 20-27, 24(5) setae. Cibarial setae 8-16, 12(5). Palpal segment lengths: 38-48, 43(4); 43-53, 47(4); 140-163, 158(4); 143-151(3); 165-218(3). Frontal tubercles 10-23, 18(5) long, 6-12, 10(5) wide. AR 2.13-2.36, 2.30(5).

Thorax (n=4). Scutal tubercle weakly developed. Acrostichals 9-13, 11; dorsocentrals 30-55, 37; scutellars 8-10, 9; prealars 8-11, 9. Humeral pit of approximately 10 minute tubercles.

Wing. Length 1.73-2.11, 1.92 mm (5); width 520-565, 541(4). FCu below or slightly distal to RM. VR 0.91-0.93, 0.92(5). Brachiolum with 2 setae. R & R_1 with 15-26, 23(4) setae; R_{4+5} with 4-8, 6(4) setae; squama with 12-27, 19(4) setae.

Legs. Foretarsal beard absent. Metatarsus of middle leg with 5-11, 8 palmate sensilla chaetica. Lengths and proportions of legs:

	P_1	P_2	P_3
fe	805-1000, 863	745-920, 816	810-1040, 908
ti	640-840, 717	700-910, 782	900-1155, 1003
ta_1	960-1235, 1048(6)	335-415, 369	610-800, 678
ta_2	430-540, 478(6)	210-260, 234	300-375, 341
ta_3	375-445, 416(6)	160-195, 174	240-300, 270
ta_4	280-345, 312(6)	95-125, 110	115-180, 147
ta_5	140-160, 152(6)	80-100, 93	95-120, 108
LR	1.38-1.59, 1.47(6)	0.45-0.49, 0.47	0.65-0.70, 0.68
BV	1.83-2.11, 1.93(6)	3.05-3.39, 3.22	2.89-3.11, 2.99
SV	1.42-1.58, 1.51(6)	4.15-4.57, 4.33	2.71-2.89, 2.82

Abdomen. Flattened setae on S VI not apparent.
Hypopygium. Indistinguishable from D. californicus (Fig. 57). Gonostylus very broad, widest in middle, curved medially, apex attenuated, with 6-10, 8(5) setae on inner apex. Phallapodeme length 90-118, 107(5). Superior volsella length 58-88, 76(4); width 40-48, 45(4); pediform, ventrally covered with microtrichia to near bottom of "foot", with 6-9, 8(5) sensilla chaetica arranged in 3 transverse rows; apex bare, often reflexed. Inferior volsella with tip of club slightly expanded, shallowly bifid or trifid, with 2 or 3 rows of 3-4 sensilla chaetica each; with 1-2 large, ventral apical setae. Anal point bare dorsally, pyriform, strongly deflexed; with 4-6, 5(4) dorsal basal setae and 6-9, 8(4) lateral basal setae.

Pupa: (n=8) similar to D. californicus.
Color. Pale yellow-brown.
Length. Total 4.96-5.63, 5.28 mm (4). Cephalothorax 1.25-1.43, 1.36 mm (4). Abdomen 3.38-4.20, 3.76mm (6).
Cephalothorax. Cephalic tubercles well developed, broadly conical. Dorsum roughly pebbled; 2(5) precorneal, 4(5) dorsocentral setae. Scutal tubercle present.
Abdomen (Figs. 120a, 120b). Sternites I-III with transverse spine rows; S I with a single row; S II with 2 rows; S III with

0, 1, or 2 rows. S I-III also with 2 or 4 longitudinal lateral spinule bands, spinules larger anteriorly. Posterior margin of T II with transverse row of 59-74, 66 hooklets. Tergites II-III without anterolateral shagreen areas; with subquadrate to low, broadly triangular median shagreen area. T IV-VI with oval to elongate-elliptical anterolateral shagreen areas and subquadrate to broadly triangular median shagreen areas, with shagreen spinules larger in anterior portion of median shagreen area. T VII with 2 oval anterolateral shagreen areas. T VIII with U-shaped shagreen area. T VIII with 4 lateral lamellar setae. Caudolateral spurs on VIII similar to D. californicus (Figs. 118, 119), single or closely appressed double, usually strongly sinuate, originating anterior to posterolateral corner of segment. Anal lobes with 35-57, 49 setae. DR 2.00-3.19, 2.52.

Fourth instar larva: (n=12)

Color. Head capsule yellow-brown, integument appearing coarsely granular; postmentum, or postmentum and postgenae, red-brown, integument with reticulate pattern. Postocciput dark red-brown to black. Frontal apotome with brown to red-brown stripe.

Head. Postmentum length 200-275, 221(11). Mandible length 130-193, 161(8), with 3 triangular inner teeth. Pecten mandibularis composed of 7-12, 10(9) setae. Mentum (Fig. 173) with 13 well defined teeth, median tooth even with 1st laterals; 2nd lateral tooth basally fused or appressed to 1st lateral. Mentum width 113-145, 132(10); MR 2.31-2.84, 2.57(10). Ventromental plate with crenulate anterior margin, width 87-115, 100; length 45-62, 52; VPR 1.63-2.18, 1.91; IPD 60-76, 65(10); PSR 1.42-1.63, 1.49(10); 23-28, 25 strial ridges. Length of antennal segments: 54-68, 60; 15-22, 19; 9-12, 10(11); 11-14, 13(11); 5-7, 6(11). AR 1.15-1.41, 1.26(11)(Fig. 174). Width of inner blade of premandible greater than outer blade; outer blade drawn to point. Pecten epipharyngis with 5-10, 6(9) lobes. Anterior margin of frontal apotome concave, roughly tuberculate; frontal pit (Fig. 175) transversely elliptical, with ventral uvula-shaped process, not exceeding posterior margin of pit. Posterior 1/4 of labral sclerite 1 with low tubercles.

Body. Ventral tubuli absent.

Additional material examined. U.S.A.: California: 1 male; VI. Kansas: 16 Pex(?; see Remarks). New Mexico: 172 males, 1 pupa/Lex; IV, VI, VIII.

Remarks

Dicrotendipes crypticus apparently replaces D. californicus on the eastern plains and foothills of New Mexico. I have examined reared specimens which fit my concept of this species from the Imperial Dam vicinity of California. I have also seen pupal exuviae which are probably D. crypticus from Kansas. These pupae had 70-93 hooklets on T II, and DR's from 2.10 to 2.31. Reared and larval specimens I've examined from Arizona and western New Mexico (the area between the 2 known ranges of this species) and specimens reared from Dallas, Texas (east of its range) are true D. californicus. D. crypticus is morphologically (at least in the immature stages) and geographically distinct

from D. californicus. All larval specimens of D. crypticus I collected and reared were washed from rocks in the swiftly flowing mid-stream current of Gallinas Creek at Las Vegas Hot Springs, NM. The precise habitat of other reared material examined is not known. If D. crypticus larvae occur only in lotic situations such as Gallinas Creek, it could be ecologically separated from D. californicus; most collections of D. californicus larvae are from still or slowly moving water. I have never collected larvae of both species together. A detailed study of the life histories of both species may bring more information to light. Because of the apparent difference in larval habitat, D. crypticus might be considered an ecotype of D. californicus.

Although the immature stages are separable, adults are so similar that a series of ratios must be used to separate them. I consider species level identification of adult D. crypticus to be risky outside of its known range, unless the specimens are reared or in some other manner associated with the immatures.

The slide mounted reared holotype will be deposited in the USNM, and slide mounted paratypes will be placed in several other major collections.

Dicrotendipes fumidus (Johannsen)

Figs. 62-65, 121-125, 176-181.

Chironomus tennellus Zetterstedt: Johannsen 1905:214-216; Plate 21, Figs. 1-4 (misdetermination).

Chironomus fumidus Johannsen, 1905:221-222, Fig. 18 (adult description); Adams 1940:127 (distribution).

Chironomus incognitus Malloch, 1915:480-481, Plate XL, Fig. 1 (adult male description); Townes 1945:104 (synonymy); Townes 1952:73 (synonymy); Sublette & Sublette 1965:169 (synonymy).

Chironomus (Limnochironomus) fumidus Johannsen: Johannsen 1937:44 (larval description).

Tendipes (Limnochironomus) fumidus (Johannsen): Hauber & Morrissey 1945:289-290, Figs. 4, 5, 12, 14 (description of adult, pupa, larva); Townes 1945:104 Fig. 116 (adult description); Townes 1952:73 (adult description); Roback 1957:112, Fig. 359 (larval description).

Chironomus (Dicrotendipes) fumidus Johannsen: Sublette & Sublette 1965:169 (placement, distribution).

Dicrotendipes fumidus (Johannsen): Hudson 1971:168 (distribution); Gillespie 1974:109-111, Fig. 21 (adult description); Beck 1977:94 (ecology); Sublette & Sublette 1979:94 (distribution); Martin et al. 1979:149, Fig. 13 (karyotype).

Type locality: U.S.A., New York, Ithaca.

Diagnosis: The broad anal point, large heavy gonostylus, and distinctive superior volsella separate this species from other male Dicrotendipes. The pupa bears no ventral spine rows on S I-III, and the shagreen spinules are larger and often rounded in the posterior portion of the median shagreen areas on T II-VI.

The venter of the larval head capsule is usually unicolorous, with a granular appearance. The first lateral teeth of the mentum are often turned outward.

Male imago (n=13)

Color. Head and palps light brown to brown; thorax orange-brown mixed with green to dark fuscous, often with 3 darker vittae; scutellum green to light brown; abdomen dark green to fuscous or dark brown, hypopygium often lighter. Legs stramineous to light brown, foreleg often darker than others; apices of femora and tibiae darker, distal tarsomeres darker. Wings clear, veins brown.

Length. Total 4.26-6.25, 5.17 mm(10). Thorax 1.26-1.68, 1.45 mm(11). Abdomen 3.00-4.58, 3.75 mm(12).

Head. Temporals 34-63, 46. Clypeus with 15-33, 21 setae. Cibarial setae 8-14, 10(11). Palpal segment lengths: 30-60, 47; 48-73, 56; 93-188, 135; 113-185, 154; 120-288, 202. Frontal tubercles 6-18, 12 (12) long, 5-13, 8(12) wide. AR 2.40-3.07, 2.81(9).

Thorax. Scutal tubercle barely developed to absent. Acrostichals 0-12, 3; dorsocentrals 16-34, 25; scutellars 8-16, 12; prealars 8-14, 11. Humeral pit a series of 1-12 minute tubercles.

Wing. Length 2.04-3.38, 2.63 mm; width 610-980, 736. FCu below or slightly distal to RM. VR 0.87-0.97, 0.92. Brachiolum with 1-3, 2 setae. R & R_1 with 4-58, 14 setae; R_{4+5} with 2-37, 5 setae; squama with 10-25, 17 setae.

Legs. Foretarsal beard well developed. Metatarsus of middle leg with 11-28, 16(11) palmate sensilla chaetica. Lengths and proportions of legs:

	P_1	P_2	P_3
fe	815-1250, 1048	800-1200, 1011(12)	880-1370, 1117(12)
ti	720-1070, 894	770-1190, 968	1030-1640, 1304(12)
ta_1	980-1520, 1246(12)	390-660, 507	620-960, 795(11)
ta_2	420-690, 580	205-395, 305	360-490, 437(11)
ta_3	400-630, 531(12)	180-295, 251	300-450, 355(11)
ta_4	300-480, 394(12)	110-190, 145	160-250, 206(11)
ta_5	170-230, 198(12)	110-175, 132	120-170, 149(11)
LR	1.31-1.51, 1.41(12)	0.49-0.59, 0.52	0.60-0.65, 0.63(11)

BV	1.71-2.06, 1.86(12)	2.81-3.39, 3.08(12)	2.61-2.94, 2.76(11)
SV	1.46-1.64, 1.54(12)	3.08-4.12, 3.98(12)	2.89-3.08, 2.98(11)

Abdomen. Flattened setae on S VI not apparent.

Hypopygium (Fig. 62). Gonostylus heavy, very broad, curved medially, apex bluntly rounded, with 7-12, 9 setae on inner apex. Phallapodeme length 103-160, 126(12). Superior volsella (Figs. 63-65) length 63-95, 77; width 13-30, 21; digitiform, ventrally covered with microtrichia, dorsum and apex bare, apex reflexed slightly laterad, with 2-5, 4 sensilla chaetica, one much larger than others. Inferior volsella a simple, greatly expanded club, with 9-19, 14 dorsal sensilla chaetica, sometimes arranged in 3 very irregular rows, with 1-2 large, ventral apical setae. Anal point bare dorsally, strongly deflexed, with broad basal shelf tapering apically; with 0-13, 5 dorsal basal setae and 6-18, 12 lateral basal setae.

Pupa: (n=13)

Color. Pale yellow-brown to light brown.

Length. Total 5.45-7.60, 6.16 mm(10). Cephalothorax 1.45-1.93, 1.62 mm(9). Abdomen 3.94-5.68, 4.64 mm.

Cephalothorax. Cephalic tubercles (Fig. 125) well developed, broadly conical, often with small warts. Dorsum roughly pebbled; 2-3, 2(11) precorneal, 4-6, 5(9) dorsocentral setae. Scutal tubercle present.

Abdomen (Fig. 121). Sternites I-III without transverse spine rows. Posterior margin of tergite II with transverse row of 82-133, 105 hooklets. T II and III without anterolateral shagreen areas; with subquadrate median shagreen area, shagreen spinules larger in posterior portion. T IV-VI with oval to elongate-elliptical anterolateral shagreen areas or a transverse anterior band, anterior areas often joined laterally with subquadrate median shagreen area, shagreen spinules larger in posterior portion of median shagreen area. T VII with 2 oval anterolateral shagreen areas. T VIII with 2 oval anterolateral shagreen areas and 2 semi-oval or triangular posterolateral areas or transverse posterior band. T VI-VIII often with reticulate cuticular pattern. T VIII with 4 lateral lamellar setae. Caudolateral spurs on VIII (Figs. 122-124) single or closely appressed double; spurs mostly straight to slightly sinuate; occasionally short, peg-like; often with several smaller spurs at base. Anal lobes with 41-71, 56 setae. DR 1.91-4.19, 2.90.

Fourth instar larva: (n=18)

Color. Head capsule yellow-brown, venter unicolorous or only slightly darker posteriorly; integument appearing coarsely granular. Postocciput red-brown to black. Frontal apotome (Fig. 180) often with brown stripe.

Head. Postmentum length 250-323, 281. Mandible (Fig. 176) length 164-238, 194, with 3 triangular inner teeth. Pecten mendibularis composed of 13-18, 14(16) setae. Mentum (Fig. 177)

with 13 well defined teeth, median tooth subequal to 1st laterals; 1st laterals usually turned outward; 2nd laterals closely appressed or fused basally to about mid-length of 1st laterals. Mentum width 149-200, 175(17); MR 2.33-2.79, 2.60(17). Ventromental plate with smooth to crenulate anterior margin; width 125-147, 135(17); length 59-76, 68(17); VPR 1.86-2.15, 1.99(17); IPD 65-97, 79(17); PSR 1.42-2.15, 1.73(17); 26-36, 32 strial ridges. Length of antennal segments: 78-100, 88(17); 18-29, 24(17), 12-17, 14(17); 12-20, 15(17); 5-7, 6(16). AR 1.32-1.82, 1.53(16)(Fig. 178). Width of outer blade of premandible (Fig. 179) smaller than or subequal to inner blade, blunt or bluntly pointed. Pecten epipharyngis with 4-7, 5(17) lobes. Anterior margin of frontal apotome (Fig. 181) concave, roughly tuberculate; weak transverse elliptical frontal pit present or absent, with a long, well developed ventral uvula-shaped process, which exceeds posterior margin of frontal pit (if margin visible). Posterior margin of labral sclerite 1 with very low, rounded tubercles.

Body. Ventral tubuli absent.

Type material examined. Holotype: Male, Ithaca, New York, 12 July, 1901 (COR). -Allotype: Female, Ithaca, New York, 22 July, 1901 (COR).
Additional material examined: U.S.A.: Alabama: 76 males; I, XII. Arkansas: 5 males; V, VII, IX. California: 5 males, 1 female, 4 pupae/Lex, 1 pupa, 2 larvae; II, IV, V, XI. Colorado: 1 male, 1 larva; VII. Georgia: 1 male; IX. Idaho: 9 males; VI, VIII. Illinois: 1 male; V. Kansas: 7 males; III, X. Kentucky: 1 male, XII. Maryland: 2 males, 1 female; II, V. Michigan: 5 males, 1 female; VI-VIII. Minnesota: 2 males; I, II. Missouri: 1 male; VIII. Montana: 4 males; VII. New Hampshire: 1 male. New Mexico: 5 males/Pex/Lex, 3 pharate male pupae/Lex, 11 males, 1 female/Pex/Lex, 2 pharate female pupae/Lex, 3 Pex, 26 larvae; IV, VI, VIII, IX. New York: 1 male/Pex/Lex, 15 males; V-VIII. North Carolina: 1 female/Pex/Lex; IV. Oklahoma: 4 males, V. South Carolina: 1 pharate male pupa, 65 males; VI-X. South Dakota: 2 males/Pex/Lex, 14 males, 3 females/Pex/Lex; II, III, V-VII. Utah: 5 pharate male pupae/Lex, 1 pharate male pupa, 4 pharate female pupae/Lex, 1 female/Pex/Lex; XII. Washington: 1 male/Pex, IV. Washington, D.C.: 1 male; X. CANADA: Newfoundland: 9 males; VI. Ontario: 1 male/Pex/Lex, 16 males, 1 female pupa/Lex, 2 Pex; IV-VIII.

Remarks

A common and widespread species throughout the U.S. and southern Canada.

In many of the museum collections I've examined, adults of this species has been misdetermined as D. neomodestus or D. lobiger, apparently because of its dark coloration. Webb (1972) misdetermined this species as D. aethiops. Larval specimens of D. fumidus from the western U.S. are easily confused with D. californicus; rearings or associations may be necessary for accurate species determinations.

Johannsen (1937:44) stated that the larva and pupa he

described previously (Johannsen 1905:214) as Chironomus tennellus were in fact D. fumidus. The 1905 and 1937 larval and pupal descriptions of Johannsen do fit D. fumidus. Townes (1945:104,120) stated that Johannsen was in error, and assigned these specimens to D. neomodestus. I have not seen the Johannsen specimens, and I do not know if they were actually seen by Townes. The specimens could not be D. neomodestus, for Johannsen (1937:44) noted the absence of ventral spines on S I-III, a character state fitting D. fumidus. Dicrotendipes neomodestus has these spines. I believe Townes was in error.

The variation of the superior volsella exhibited by some specimens (Figs. 64-65) is a result of rotational twisting. In some specimens prepared from pinned material, the superior volsellae have apparently twisted as a result of drying on the pin, and did not return to their former positions after slide mounting. Excessive cover slip pressure could also be at fault, and I would not preclude the possibility of some specimens naturally possessing such deformed appendages.

The character used in Webb's (1972) key, "inner and outer blades of premandible equal in width", is not a reliable species character. Premandible width can be subject to the amount of pressure applied to the structure. As more pressure is applied, the premandibles rotate and flatten, often spreading out. If little pressure is applied, the premandibles remain "sideways" and, if viewed in this fashion, premandibular blades appear thin. The premandibles of other species can also appear wider if squashed excessively when mounted.

The character mentioned in Hauber & Morrissey's (1945:288) key, "proximal of the four mandibular teeth not darkened", is not a specific character for D. fumidus. All teeth were darkened in the majority of specimens I examined.

The anterior margin of the ventromental plates varies from smooth to crenulate. Strial ridge counts are relatively constant. I have observed this in specimens collected in the same area on the same date.

Townes (1945) believed this species to breed most abundantly in streams and rivers. If it does breed in such areas, this species probably inhabits the slower moving water near shore or in pools. I have reared larvae living in silken tubes on Myriophyllum and scraped from algae covered rocks in pools of barely moving water in New Mexico. Webb (1972) reported D. fumidus larvae (as D. aethiops) from Scirpus acutus Muhlenberg from the littoral zone of a Utah lake, and Johannsen (1937) collected this species from pools near Cayuga Lake in New York.

Martin et al. (1979) described the karyotype of this species based on material from Yankton, South Dakota.

The male holotype (No. 2457) and female allotype of Chironomus fumidus are in the collection of Cornell University. The holotype male is in very poor condition; only the thorax and one leg remain on a pin, and a single antennal flagellum is slide mounted. The slide appears to have been stored on its side and the mountant has run out from beneath the cover slip. If the hypopygium (and probably a wing; Johannsen (1905: plate 28, fig. 18) illustrated a C. fumidus wing) was mounted with the antennal flagellum, it may have left with the mountant, and may now be

lying in a puddle of dried balsam in a slide box somewhere in the Cornell collection. Since this species is well known in the literature and part of the type, as well as the female allotype, is extant, I see no need for a lectotype designation.

I removed the female allotype from its pin and slide mounted it in Canada balsam. An extra leg, not belonging to the allotype, was found attached to the pin. It has been separately slide mounted and labeled "leg found on same pin with Allotype Chironomus fumidus Joh.".

The lectotype of Chironomus incognitus (No. 2581), which I have examined, is in the INHS collection. The distal portion of the abdomen is slide mounted; the remainder of the body pinned.

Dicrotendipes incurvus (Sublette)

Figs. 39-42, 66-72, 126-132, 182-187.

Chironomus (Limnochironomus) aethiops (Townes): Beck & Beck 1959:94 (misdetermination).

Chironomus (Dicrotendipes) incurvus Sublette 1964:126-127, Figs. 49-55 (adult, pupa, larva description).

Dicrotendipes incurvus (Sublette): Beck 1977:95 (larval ecology).

Type locality: U.S.A., Louisiana, Natchitoches.

Diagnosis: The incurved apex of the superior volsella and moderately curved gonostylus will separate this species from other Nearctic members of the genus. The ventral spine rows on S I-III and double or triple caudolateral spurs on T VIII of the pupa will separate most specimens from all other Nearctic Dicrotendipes except D. milleri. Characters given in the pupal key should separate most D. incurvus from D. milleri. Pupae with single spurs can be separated from D. modestus by the larger and more rounded, or longer, spines of the posterior portion of the median shagreen area on T VI. Larvae closely resemble D. modestus, but can be separated by the lower strial ridge count and the usually undarkened postmentum.

Male imago (n=15)

Color. Head, palps, and thorax orange-stramineous; abdomen pea green; legs greenish stramineous, distal tarsomeres light brown. Wings clear, veins light yellow-brown.

Length. Total 3.48-4.80, 4.28 mm(10). Thorax 0.87-1.30, 1.12 mm(11). Abdomen 2.59-3.83, 3.13 mm(13).

Head. Temporals 35-52, 41(13). Clypeus with 13-26, 17(14) setae. Cibarial setae 5-12, 7(11). Palpal segment lengths: 28-50, 39(14); 40-60, 52(13); 100-175, 141(14); 113-178, 149(14); 168-262, 225(9). Frontal tubercles 3-13, 7(12) long, 3-8, 6(12) wide. AR 2.18-2.75, 2.40(13).

Thorax. Scutal tubercle poorly developed to absent. Acrostichals 7-13, 10(14); dorsocentrals 15-27, 21; scutellars 5-19, 12(13); prealars 7-12, 9(14). Humeral pit poorly to moderately developed, 4-10 small, low, rounded tubercles.

Wing. Length 1.59-2.43, 2.05 mm(14); width 485-760, 597(14). FCu below or slightly distal to RM. VR 1.06-1.16, 1.11(14). Brachiolum with 2-3, 2 setae. R & R_1 with 14-41,

28(14) setae; R_{4+5} with 8-26, 18(14) setae; squama with 5-17, 12(13) setae.

Legs. Foretarsal beard absent. Metatarsus of middle leg with 8-16, 11(14) palmate sensilla chaetica. Lengths and proportions of legs:

	P_1	P_2	P_3
fe	740-1080, 921(10)	675-980, 850(11)	730-1100, 947(11)
ti	545-850, 688(11)	585-910, 760(11)	835-1270, 1070(11)
ta_1	960-1345, 1189(7)	330-490, 417(11)	520-805, 693(11)
ta_2	435-605, 531(7)	180-265, 226(11)	255-400, 334(11)
ta_3	365-505, 449(7)	105-170, 145(11)	190-300, 246(11)
ta_4	305-400, 359(7)	60-110, 88(11)	110-170, 143(11)
ta_5	130-170, 154(7)	55-90, 74(11)	65-110, 94(11)
LR	1.57-1.85, 1.73(7)	0.52-0.57, 0.55(11)	0.62-0.67, 0.65(11)
BV	1.70-1.94, 1.84(6)	3.52-3.98, 3.81(11)	3.21-3.48, 3.32(11)
SV	1.28-1.35, 1.33(6)	3.71-4.11, 3.86(11)	2.84-3.01, 2.91(11)

Abdomen with 0-5, darker, flattened, bluntly tipped setae, which are easily lost, on S VI.

Hypopygium (Fig. 66). Gonostylus narrow to moderately broad, moderately to strongly curved medially, slightly attenuated near apex, with 7-14, 9(13) large setae on inner apex. Phallapodeme length 95-140, 115(14). Superior volsella (Figs. 69-72) length 73-100, 87; width 18-32, 24(13); long, slender, cylindrical, apex expanded and produced mesad; bare dorsally, ventrally with microtrichia at least on basal portion, sometimes extending to near apex; apex membranous, with 2-4, 3 sensilla chaetica on inner apex. Inferior volsella often slightly recurved, with tip of club slightly expanded, moderately to deeply indented at apex, with 2-3 dorsal rows of 2-5, 4 sensilla chaetica each, with 1-2, 1 large ventral apical setae. Anal point bare dorsally, elongate-elliptical, deflexed, with narrow peduncle; with 2-4, 3 dorsal basal setae and 4-8, 6 lateral basal setae.

Pupa: (n=5) similar to D. milleri.

Color. Clear with pale yellow borders to light brown.

Length. Total 4.01-5.38, 4.74 mm(9). Cephalothorax 1.05-1.48, 1.24 mm(9). Abdomen 2.95-4.28, 3.58 mm(13).

Cephalothorax. Cephalic tubercles (Figs. 130-132) poorly to well developed, moderately broad to elongate-conical. Dorsum pebbled, with low, smooth, well separated "pebbles"; 2-3, 2 precorneal, 4 dorsocentral setae. Scutal tubercle absent.

Abdomen (Fig. 126). Sternites I-III with transverse spine rows; S I with 0-1 row; S II with 2 rows; S III with a single row; S I-III also with 2-4 longitudinal lateral spinule bands, spinules larger anteriorly. Posterior margin of T II with transverse row of 43-75, 61 hooklets. T II-III often with faint, small, anterolateral shagreen areas, with subquadrate to narrowly triangular median shagreen area; T IV-VI with oval to elongate-elliptical anterolateral shagreen areas, often merging mesally with subquadrate to broadly triangular median shagreen area, with shagreen spinules slightly larger in posterior portion of median shagreen area; T VII with 2 oval to elongate-elliptical anterolateral shagreen areas; T VIII with 2 longitudinal shagreen bands or a pair of anterolateral and a pair of posterolateral suboval to elliptical shagreen areas. T VIII with 4 lateral lamellar setae. Caudolateral spurs on VIII (Figs. 127-129) usually compound double or triple, weak to moderately sinuate, inner spur(s) smaller; occasionally single, straight to weakly sinuate. Anal lobes with 34-55, 45 setae. DR 2.04-3.16, 2.51.

Fourth instar larva: (n=15)

Color. Head capsule pale yellow to pale yellow-brown; postocciput yellow to red-brown. Frontal apotome (Fig. 186) sometimes with brown stripe. Postmentum rarely with small darkened area near postocciput.

Head. Postmentum length 198-232, 215(14). Mandible (Fig. 182) length 155-178, 167(9) with 3 triangular inner teeth. Pecten mandibularis composed of 10-12, 10(13) setae. Mentum (Fig. 183) with 13 well developed teeth, median tooth subequal to 1st laterals; 2nd laterals partially fused basally or appressed to 1st laterals; 6th lateral sometimes appressed to 5th. Mentum width 109-150, 133(14); MR 2.52-3.11, 2.80(11). Ventromental plate with well crenulated anterior margin, rarely smooth; width 92-106, 98; length 48-62, 52. VPR 1.65-2.04, 1.88; IPD 41-66, 55(13); PSR 1.55-2.29, 1.81(13); 23-29, 25 strial ridges. Length of antennal segments: 60-76, 68; 17-23, 21(13); 11-13, 12(13); 12-16, 15(13); 6-8, 6(13). AR 1.08-1.40, 1.28(13)(Fig. 184). Width of inner blade of premandible (Fig. 185) greater than outer blade. Pecten epipharyngis with 5-7, 5(13) lobes. Anterior margin of frontal apotome concave, roughly tuberculate (Fig. 187); a weak transverse elliptical frontal pit, with ventral uvula-shaped process poorly to well developed. Posterior 1/3 of labral sclerite 1 with low, rounded tubercles.

Body. Ventral tubuli absent.

Type material examined. Holotype: Male, U.S. Fish Hatchery, Natchitoches, Louisiana, 27-IX-58, R.F. Tyler (USNM). - Allotype: Female, same data as holotype except 6-XI-58 (USNM).

- Paratypes: 4 males, same locality, 12-IX-58; 1 pharate male pupa/Lex, Chivary Dam Spillway, Natchitoches, La., 24-XI-59 (USNM).
Additional material examined: U.S.A.: Alaska: 1 male; VIII. California: 1 male; VIII. Florida: 25 males/Pex/Lex, 17 pharate male pupae/Lex, 5 pharate male pupae, 1 male pupa, 13 males, 5 females/Pex/Lex, 1 pharate female pupa/Lex, 1 pupa, 1 Pex; I-VI, IX. Illinois: 5 males; IV, V, VII, X. Indiana: 5 males; VI, VII. Kansas: 7 males; IV. Maine: 1 male, VIII. Michigan: 3 males; VII, VIII. Minnesota: 1 male; VIII. Montana: 1 male; VII. New Hampshire: Pex; VI. New York: 1 male/Pex, 2 males; VI-VIII. Oklahoma: 1 pharate male pupa; VIII. South Carolina: 7 males, 2 Pex; III-V, VIII, XI. Texas: 1 male; IV. Utah: 3 males, VI. Wisconsin: 1 male/Pex; V. Wyoming: 2 males; VII. CANADA: Manitoba: 2 males; VII, VIII. Ontario: 5 males/Pex/Lex, 1 male/Pex, 33 males, 2 pharate female pupae/Lex, 4 Pex, 1 intersex; V-VIII. Quebec: 2 males, 2 Pex; VI, VII. Saskatchewan: 1 male; V.

Remarks

A species of ponds and still waters of eastern North America, apparently becoming less common westward.

The superior volsella is quite variable. The apex is apparently membranous and is often distorted, probably by cover slip pressure (Fig. 71). Pinned specimens are often difficult to determine, due to twisting and other deformations which may occur during drying. Badly distorted specimens could be mistaken for members of the D. nervosus group. Because of the general similarity in the shape of the superior volsella and because some workers may not have been aware of Sublette's (1964) paper in which D. incurvus was described, I would not doubt that many collections of this species have been recorded as "D. nervosus". Beck & Beck (1958) mistook this species (then undescribed) for D. aethiops. The superior volsellae of D. incurvus and D. milleri are similar; that of D. incurvus appears to be more membranous apically and possesses microtrichia, at least basally.

The gonostylus of D. incurvus is also variable. Normally of moderate width, some specimens examined possessed a wide, somewhat inflated gonostylus (Fig. 68), similar to D. californicus. I have also seen specimens in which the gonostylus was strongly curved and thin (Fig. 67), resembling, but not as strongly curved or attenuated, the gonostylus of D. milleri.

It is evident from the structure of the superior volsella and pupal morphology that D. incurvus and D. milleri are closely related. The pupae of both species possess double or triple caudolateral spurs on T VIII. I have separated these species by the relative shape of the cephalic tubercles and anal setae count. These are variable structures, especially the cephalic tubercles, and rearing is necessary to delimit species. These 2 species may be 2 variants of a single species. Studies on the as yet unknown larva of D. milleri should help clarify the situation.

Larvae and single-spurred pupae of D. incurvus may be difficult to separate from D. modestus. The larval mentum of both species is similar; strial ridge counts are slightly lower

for D. incurvus. The postmentum is usually darkened in D. modestus. I have seen only 3 specimens (1 pupa/Lex and 2 unassociated larvae) which had a slightly darkened area on the postmentum near the postocciput. Sublette (1964:127) stated that the pupa of this species could be distinguished from D. modestus and D. neomodestus by the higher anal lobe setae count, which Sublette said was "about 65". I have not seen a specimen of D. incurvus with a count this high; the highest number recorded was 55, from a paratype specimen. Differences in shagreen pattern on T VI stated in the pupal key will separate most specimens. These species should be reared for correct identification.

I examined the frontal pit in several specimens of D. incurvus with the SEM. The frontal apotome was removed and turned over so that the inner surface could be examined (Fig. 39). Some specimens showed a pit with a single, simple central projection (Fig. 42), while other specimens displayed a lattice-work structure (Figs. 40-41).

On the basis of the immature stages, D. incurvus and D. milleri are closely related to the Palaearctic D. tritomus (Kieffer), a species erroneously synonymized with D. nervosus (Staeger) by Townes (1945). The male D. tritomus differs from D. incurvus in that the apex of the superior volsella is turned out, not in, as in D. incurvus. The genitalia are similar to D. nervosus (cf. Pinder 1978: Figs. 157D and 158B). In D. tritomus the sensilla chaetica of the superior volsella are apparently below the membranous division of the apex; in D. nervosus these setae are above the dividing line. Immatures are easily separable. Pupae of the D. nervosus group lack ventral spines on S I-III; D. tritomus, D. incurvus and D. milleri possess these spines. The mentum and mandibular teeth of D. incurvus and D. tritomus are "normal"; those of the D. nervosus group show modifications in one or both of these characters. Unfortunately, Palaearctic material available to me was in poor condition and did not allow more detailed examination of the adult male and larva of D. tritomus.

Fittkau & Reiss (1978) reported D. tritomus from East Siberia. I have seen single male specimens from the Kenai Peninsula, Alaska, Norman, Oklahoma, and Fort Providence, North West Territories, which may be D. tritomus. The specimens are less than perfect, and without good comparative Palaearctic material, I am unable to place these specimens with certainty. If these specimens are D. tritomus, this species would be the fourth Dicrotendipes with a Holarctic distribution.

I have examined the slide mounted male holotype, female allotype, and 5 paratypes, all located in the USNM. One paratype specimen, a pharate male pupa with larval exuviae, is unusual in that the larval ventromental plates exhibit a smooth anterior margin. All other larval specimens examined possessed crenulate anterior margins.

Dicrotendipes leucoscelis (Townes)
Figs. 7, 73-75, 194-203.

Tendipes (Limnochironomus) leucoscelis Townes 1945:104, Fig. 117 (adult description); Townes 1952:73, Fig. 111 (adult

description).
Chironomus (Limnochironomus) leucoscelis (Townes): Beck & Beck 1959: 93 (distribution).
Chironomus (Dicrotendipes) leucoscelis (Townes): Sublette & Sublette 1965:169 (placement, distribution).
Dicrotendipes leucoscelis (Townes): Beck 1976:55 (larval key); Beck 1977:96 (larval ecology).

Type locality: U.S.A., Idaho, Coeur d'Alene Lake.
Diagnosis: The distinctive superior volsella of the adult male will separate this species from all other Nearctic Dicrotendipes. The intersegmental hooklets between T V-VI, and the 5 lateral setae and unique caudolateral armature on T VIII will separate the pupa. The frontal apotome with its subquadrate depression, the partially fused fifth and sixth lateral teeth of the mentum, and high strial ridge count will distinguish the larva.

Male imago (n=18)
Color. Head light green to light brown, antennae orange-brown; thorax orange-brown with green to dark olive-green; scutellum pale green; abdomen yellow-green to green, apex light brown. Legs with femora pale green, tibiae brown, proximal 0.6-0.8 of metatarsi white, distal portion brown; distal tarsomeres of other legs brown; in Florida specimens, the basal portion of the metatarsi is not white, but light brown to brown. Wings dusky brown, veins brown.
Length (n=16). Total 3.93-5.33, 4.65 mm. Thorax 0.98-1.45, 1.19 mm. Abdomen 2.93-3.98, 3.46 mm.
Head. Temporals 33-52, 42. Clypeus with 9-23, 16 setae. Cibarial setae 5-14, 10(14). Palpal segment lengths: 28-55, 41; 35-78, 55; 100-208, 163; 120-211, 168; 135-325, 247(17). Frontal tubercles 3-25, 10(17) long, 2-12, 7(17) wide. AR 2.05-2.58, 2.29.
Thorax. Scutal tubercle absent to poorly developed. Acrostichals 5-15, 9; dorsocentrals 10-32, 20; scutellars 0-11, 6; prealars 4-10, 8. Humeral pit absent (?) to poorly developed, appearing as a low, ridge-like fold to a series of 1-4 low, rounded tubercles.
Wing. Length 1.84-2.68, 2.22 mm; width 530-760, 625. FCu distal to or below RM. VR 0.83-0.96, 0.90. Brachiolum with 1-3, 2 setae. R & R_1 with 34-59, 44 setae; R_{4+5} with 22-37, 28 setae; squama with 4-14, 8 setae.
Legs. Foretarsal beard absent. Metatarsus of middle leg with 3-6, 5 palmate sensilla chaetica. Lengths and proportions of legs:

	P_1	P_2	P_3
fe	860-1220, 1031	810-1170, 974(17)	870-1280, 1059(17)
ti	620-940, 764	710-1100, 891	910-1420, 1174
ta1	1120-1520,	360-530,	570-930,

	1327(16)	451	733(16)
ta_2	520-770, 643(16)	200-290, 242	290-480, 381(16)
ta_3	455-610, 539(16)	125-195, 163	240-360, 298(16)
ta_4	360-480, 418(15)	70-120, 88	130-200, 165(16)
ta_5	180-220, 210(15)	75-110, 92	100-150, 122(16)
LR	1.56-1.95, 1.72(16)	0.47-0.53, 0.51	0.54-0.67, 0.63(16)
BV	1.57-1.90, 1.74(15)	3.55-4.13, 3.95(17)	2.79-2.11, 3.07(15)
SV	1.22-1.46, 1.37(16)	3.94-4.37, 4.10(17)	2.85-3.54, 3.06(15)

Abdomen with 3-5 darker, flattened, bluntly tipped setae, which are easily lost, on S VI.

Hypopygium (Fig. 73) with 0-4, 2 medial setae. Gonostylus broad, curved medially, apex blunt, with 5-8, 7 large setae on inner apex. Phallapodeme length 108-153, 125(15). Superior volsella (Figs. 74-75) length 55-80, 70; width 18-33, 24; digitiform, gently curving mesad, slightly expanded preapically; dorsally bare, ventrally covered with microtrichia; with small preapical membranous extension; 6-10, 7 sensilla chaetica in 1-2 rows. Inferior volsella with long expanded simple club, often indented lateromesally; with 12-22, 16 dorsal sensilla chaetica, roughly arranged in 3-4 very irregular rows; with 13-20 large ventral setae. Anal point bare or setose dorsally, pyriform, deflexed; often with bare area at base of point; 0-4, 1 dorsal basal setae and 6-15, 10 lateral basal setae.

Pupa: (n=6)

Color. Light brown to brown.

Length. Total 5.03-5.58, 5.42 mm(5). Cephalothorax 1.18-1.40, 1.29 mm(5). Abdomen 3.18-4.38, 3.97 mm.

Cephalothorax. Cephalic tubercles (Fig. 197) long, attenuated, thinly conical. Dorsum mostly smooth with a few low "pebbles"; 2 precorneal, 4 dorsocentral setae. Scutal tubercle not observed.

Abdomen. Sternites I-III without transverse spine rows. Posterior margin of T II with transverse row of 45-73, 58 hooklets. Tergites II-V with subquadrate to hourglass shaped median shagreen area; T VI with hourglass shaped or anterior transverse band and posterior triangular to diamond shaped median shagreen areas, T VII with 2 thinly spined anterolateral shagreen areas; T VIII with 2 anterolateral and 1 posterior transverse band or triangular shagreen areas. An irregular row of 10-20, 14

spines on intersegmental membrane between V and VI (Figs. 194, 195). T VIII with 5 lateral lamellar setae. Caudolateral spurs on VIII (Fig. 196) 2-5, 4, moderately sinuate. Anal lobes with 21-45, 33 setae, sometimes partially biserial. DR 2.18-3.00, 2.60(4).

Fourth instar larva: (n=6)

Color. Head capsule light red-brown with yellowish cast; postocciput red-brown.

Head. Postmentum length 217-298, 265(5). Mandible (Fig. 198) length 155-207, 182 with 3 triangular inner teeth. Pecten mandibularis composed of 14-18, 17(4) setae. Mentum (Fig. 199) with 13, sometimes appearing as 11, teeth, median tooth slightly higher than 1st laterals; 5th and 6th laterals rounded, closely appressed, or fused. Mentum width 118-173, 152; MR 2.62-2.88(3). Ventromental plate with smooth anterior margin; width 99-144, 123; length 48-59, 57; VPR 1.98-2.53, 2.18; IPD 27-38(3); PSR 3.32-4.36(3); 37-60, 52 strial ridges. Length of antennal segments (n=5): 61-85, 73; 17-28, 23; 11-18, 15; 12-16, 14; 6-8, 7. AR 1.17-1.35, 1.28(5)(Fig. 200). Width of inner blade of premandible (Fig. 201) greater than outer blade, outer blade bluntly pointed. Pecten epipharyngis (Fig. 202) with 5-9, 7 lobes, lobes often trifid. Frontal apotome with anterior margin almost straight, slightly concave; with cuticular reticulations; an anteromesal subquadrate depression present (Fig. 203); frontal pit absent. 1st labral sclerite smooth.

Body. Ventral tubuli not apparent on exuviae examined.

Type material examined. -Paratypes: 2 males, Okomocto, 9-VII-12, 9-VII-13 (COR).

Additional material examined: U.S.A.: Florida: 3 males/Pex/Lex, 21 males, 1 female/Pex/Lex; I-V, IX, X. Idaho: 6 males, 2 females; VI. Michigan: 2 males; VI, VII. Minnesota: 2 males; VI, VII. South Carolina: 4 males; IV, V. CANADA: New Brunswick: 1 male; VII. Ontario: 10 males, 1 female/Pex/Lex, 1 female; V-VII.

Remarks

The white bases of the metatarsi, so distinctive in specimens from the northern portion of this species' range, are not present in most Florida and South Carolina specimens examined. The metatarsi in southern specimens are a light brown to brown color, slightly lighter than the remainder of the leg.

The preapical lateromesal margins of the inferior volsellae are indented, forming a groove in which the anal point apparently rests.

The pupa of D. leucoscelis is the only known Nearctic Dicrotendipes with intersegmental hooklets between T V-VI (Figs. 194, 195), a character shared with the Palaearctic D. notatus. Larval head capsule structures (mentum, frontal apotome) of the 2 species are also similar. Gouin (1936:162) originally described the larva and pupa of D. notatus, and noted a pair of ventral tubules ("une paire de filaments branchiaux") on the larva. Lenz (1954-1962:194) described the pupa, but believed Gouin had described the larva of a Glyptotendipes, because of the

presence of the ventral tubules. Moller Pillot (1978-1979) discussed this, and described the larva of D. notatus with ventral tubules on the eighth abdominal segment. I do not know if D. leucoscelis possesses ventral tubules; I have not examined any living or preserved whole larval specimens of this species. Only associated larval exuviae were available, and I could find no trace of ventral tubules on these specimens. Perhaps only certain specimens may possess them, as is apparently the case with D. simpsoni.

Dicrotendipes leucoscelis has been reared from small vegetation-choked ponds, a ditch, and one reared specimen was collected from a bromeliad in Florida.

The holotype is in the Townes collection at the American Entomological Institute, Gainesville, Florida. I have not examined it. I have seen 2 male paratypes from the Cornell University collection. I have slide mounted one of these in balsam; the other consists only of a point mounted head. I also examined a pinned male specimen from the USNM labeled "Chironomus (Limnochironomus) bicolor Tow. paratypes", apparently a name for this species which Townes decided not to use.

Dicrotendipes lobiger (Kieffer)

Figs. 6, 8-10, 20-22, 25, 76-82, 135-140, 204-209

Limnochironomus lobiger Kieffer, 1921a:71 (adult description); Lenz 1954-1962:192, Figs. 191, 204 (larval and pupal description); Pinder 1978:126, Figs. 61J-K, 158C (in key).

Chironomus brevitibialis sensu Goetghebuer nec Zetterstedt, Goetghebuer 1921:40, Fig. 193 (adult description).

Limnochironomus miriforceps Kieffer, 1922:51 (adult description).

Chironomus (Limnochironomus) lobiger (Kieffer): Goetghebuer 1928:51 (adult description).

Chironomus (Limnochironomus) miriforceps (Kieffer): Goetghebuer 1928:53 (adult description).

Chironomus lobiger (Kieffer): Edwards 1929:386, Fig. 12g (adult description).

Tendipes (Limnochironomus) lobiger (Kieffer): Kruseman 1933:175, Fig. 37 (adult description); Goetghebuer 1937-1954:19, Fig. 66 (adult description); Townes 1945:103, Fig. 115 (adult description); Townes 1952:72, Fig. 109 (adult description).

Tendipes (Limnochironomus) lobiger var. miriforceps (Kieffer): Goetghebuer 1937-1954:19 (adult description).

Limnochironomus lobiger var. miriforceps Kieffer: Lenz 1954-1962:192, Fig. 205 (pupal description).

Tendipes (Dicrotendipes) lobiger (Kieffer): Sublette & Sublette 1965:169 (position, distribution).

"Dicrotendipes gregarius", manuscript name, Gillespie 1974:111, Fig. 33 (adult description).

Dicrotendipes lobiger (Kieffer): Fittkau & Reiss 1978:431 (distribution).

Dicrotendipes gr. lobiger (Kieffer): Moller Pillot 1978-1979:IV.17.8 (larva description).

Type locality: West Germany, Schleswig-Holstein, Grosser Plöner

See.

Diagnosis: The large size, distinctive superior volsella, and elongate-spatulate anal point distinguish the adult male of this species. The 5 lateral setae T VIII and the unusual spine rows on S I-III separate the pupa. The frontoclypeal apotome, with its subquadrate depression and scaly appearance, will separate the larva.

Male imago (n=15)

Color. Head green, palps brown, pedicels red-brown; thorax dark green, postscutellum and vittae dark red-brown; abdomen dark green, hypopygium brown; legs light brown to brown. Wings clear, veins light brown.

Length. Total 5.03-6.34, 5.82 mm (13). Thorax 1.18-1.56, 1.42 mm (13). Abdomen 3.85-4.68, 4.40 mm (14).

Head. Temporals 42-61, 47(13). Clypeus with 14-28, 20 setae. Cibarial setae 8-19, 13(10). Palpal segment lengths: 43-55, 48; 48-80, 64; 185-250, 222; 175-215, 190; 210-290, 255(14). Frontal tubercles 2-10, 7 long, 2-8, 5 wide. AR 2.36-4.00, 3.03.

Thorax. Scutal tubercle absent. Acrostichals 0-12, 4(14); dorsocentrals 22-50, 32(13); scutellars 11-30, 19(13); prealars 8-15, 11(12). Humeral pit moderately to well developed, ranging from a small ridged pit to 4-12 well defined low, rounded tubercles.

Wing. Length 2.73-3.63, 3.23 mm (14); width 730-1025, 858(14). FCu distal to RM. VR 0.82-0.91, 0.88. Brachiolum with 2-4, 3 setae. R & R_1 with 18-54, 38 setae; R_{4+5} with 1-41, 17 setae; squama with 8-22, 15 setae.

Legs. Foretarsal beard well developed. Metatarsus of middle leg with 4-15, 8 palmate sensilla chaetica. Lengths and proportions of legs:

	p_1	p_2	p_3
fe	1165-1325, 1246	1150-1380, 1276	1215-1560, 1427(14)
ti	980-1220, 1129	1060-1340, 1226	1460-1790, 1624
ta_1	1265-1620, 1439	500-635, 591	830-1070, 964
ta_2	600-800, 747	325-430, 378	495-640, 563
ta_3	445-620, 552	245-345, 290	340-450, 396
ta_4	250-490, 375	155-210, 186	200-270, 233
ta_5	190-230, 208	140-175, 156	130-185, 162
LR	1.14-1.52,	0.39-0.55,	0.53-0.65,

	1.28	0.48	0.59
BV	1.90-2.20, 2.03	2.84-3.40, 3.07	2.01-3.23, 2.90(14)
SV	1.45-1.82, 1.66	3.81-4.88, 4.25	2.88-3.34, 3.14(14)

Abdomen. 0-3 flattened setae on S VI.

Hypopygium (Fig. 76) with 0-15, 5 median setae. Gonostylus heavy, very broad, curved medially, apex bluntly pointed, with 7-13, 9 large setae on inner apex. Phallapodeme length 110-158, 129. Superior volsella (Figs. 78-82) length 73-113, 93, width 19-38, 28; digitiform; dorsally bare, covered with microtrichia ventrally; with sclerotized apical ridge or tip; 4-8, 5 sensilla chaetica, usually directed mesad, often arcing laterad. Inferior volsella with large expanded, simple club bearing 16-40, 26 dorsal sensilla chaetica roughly arranged in 2-6 very irregular rows; with 6-30 ventral setae. Anal point (Fig. 77) bare dorsally, rarely minutely setose; elongate-spatulate, deflexed; with 0-4, 1 dorsal basal setae and 7-18, 12 lateral basal setae, with an enlarged pair of setae adjacent to the ventral base of the anal point.

Pupa: (n=4)

Color. Yellow-brown, T II-VI with darker brown posterior band.

Length. Total 6.36-7.12, 6.90 mm. Cephalothorax 1.22-1.95, 1.60 mm. Abdomen 5.10-5.50, 5.30 mm.

Cephalothorax. Cephalic tubercles (Figs. 139, 140) conical, with wide base; surface wrinkled and/or warty. Dorsum roughly pebbled; 2 precorneal, 4 dorsocentral setae. Scutal tubercle not observable.

Abdomen (Fig. 135). Sternites I-III (Fig. 136) with transverse spine rows; S I with a single, low, broadly triangular row; S II with 2 rows; S III with a single row; each row consisting of 2-8 irregular, smaller rows of spines. S I-III also with 4 longitudinal spinule bands; spinules are larger posteriorly and blend with transverse spine bands. Posterior margin of T II with transverse row of 69-107, 89 hooklets. Tergites II-III with hourglass shaped, subquadrate, or broadly X-shaped median shagreen areas; T IV-VI with subquadrate median shagreen areas; shagreen spinules on T II-VI becoming larger posteriorly; T VII with 2 subequal anterolateral shagreen areas; T VIII with 2 suboval anterolateral and 2 suboval posterolateral shagreen areas. T VIII with 5 lateral lamellar setae. Small anterolateral lobes mediad of caudolateral spurs of T VIII with small, rounded, sclerotized tip. Caudolateral spurs on VIII (Figs. 137, 138) 1-4, 2, short to moderately long, straight, often bluntly rounded, sometimes barely or not exceeding lateral margin of tergite. Anal lobes with 53-67, 60 setae. DR 2.16-2.94, 2.53.

Fourth instar larva: (n=3)

Color. Head capsule dark brown to red-brown, postocciput

dark red-brown. Frontoclypeal apotome with strong scale-like reticulate pattern.

Head. Postmentum length 285(1). Mandible (Fig. 204) length 178-208, with 3 triangular inner teeth. Pecten mandibularis composed of 12-15 setae. Mentum (Fig. 205) with 13 well defined teeth, median tooth subequal to 1st laterals. Mentum width 149-170; MR 2.48-2.74. Ventromental plate with smooth anterior margin; width 120-131, length 65-72. VPR 1.76-1.92; IPD 58-69; PSR 1.85-2.26; 30-41 strial ridges. Length of antennal segments: 80-84; 16-18; 10-11, 14-16, 6-7. AR 1.71(2) (Fig. 206). Width of inner blade of premandible (Fig. 207) subequal to outer blade. Pecten epipharyngis (Fig. 208) with 7 lobes. 1st labral sclerite fused with frontal apotome, forming a frontoclypeal apotome (Fig. 209); apotome with a large anteromesal subquadrate depressed area.

Body. Ventral tubuli absent.

Material examined: U.S.A.: Alaska 2 males/Pex/Lex, 1 male/Pex, 1 female/Pex/Lex, 1 Pex; VI, VII. Idaho: 5 males; VI. Indiana: 1 male; VI. Wyoming: 46 males, 4 females; VII. CANADA: Manitoba: 1 male; VI. Northwest Territories: 15 males, 13 larvae; V-VII, IX. ENGLAND: Cambridgeshire, 2 males/Pex/Lex, 2 females/Pex/Lex; VI-VIII. WEST GERMANY: Bodensee: 3 males; VI.

Remarks

A Holarctic species, D. lobiger is found at higher latitudes and at higher elevations in lower latitudes in the Nearctic. I have compared Nearctic material with Palaearctic material and some excellent larval illustrations kindly sent by Dr. F. Reiss.

In an unpublished Ph.D. dissertation, Gillespie (1974) described a new species from Idaho, "D. gregarius". I have examined the material and conclude that these specimens are D. lobiger. Since her dissertation was never published, Gillespie's new species' names are not available names (ICZN, Article 9).

A pinned specimen from Isabella Co., Michigan, in the USNM determined by Townes as Tendipes lobiger is an Einfeldia; this is probably one of the two specimens cited by Townes (1945:194) as distribution records for Michigan.

The superior volsella is subject to much variation (Figs. 78-82). Most differences are due to rotation or twisting, number of sensilla chaetica, and the extent of apical sclerotization of the volsella. Edwards (1929:Fig. 12g) also noted considerable variation in Palaearctic material.

The immatures of this species are quite unique for the genus. The pupa possesses ventral spine rows on S I-III (Fig. 136), but the spinules are subject to much variation. Alaskan specimens possess much smaller spinules and smaller caudolateral spurs on T VIII than specimens examined from England. In addition to the dorsal setae on T II-VII there are 2 pairs of minute circular scars on each tergite. One pair is located near the center of the tergite, the two scars relatively close to each other; the other pair, well separated, is located near the posterolateral margin of the median shagreen area. These scars appear to be setal scars. The small anterolateral lobes, mediad of the caudolateral spurs on T VIII, bear a small rounded

sclerotized tip. The caudolateral spurs on T VIII of the pupa are barely developed in many specimens (Fig. 137), but are well developed (similar to D. modestus) in others. The larval frontal apotome is fused with the first labral sclerite (Fig. 209), forming a frontoclypeal apotome. Because of these morphological differences, this species may deserve subgeneric rank. I prefer not to do this now, but will reserve judgement until this genus has been studied in all life stages on a world-wide basis, a project I hope to complete in the future.

The larva is apparently restricted to lentic environments.

The holotype is apparently located in L'Institut Royal des Sciences Naturelles de Belgique, Brussels. I have not examined any type material.

Dicrotendipes lobus (E.C. Beck)

Figs. 83-85, 210-218.

Chironomus (Dicrotendipes) lobus E.C. Beck, 1962:89, Fig. 1 (adult description); Sublette & Sublette 1965:169 (placement, distribution).

nec Dicrotendipes lobus (E.C. Beck): Beck 1976:55 (larval key); Beck 1977:97 (larval ecology)(probably refers to D. thanatogratus n. sp. in both references).

Type locality: U.S.A., Florida, Collier Co., Ozello.

Diagnosis: The weakly pediform or triangular superior volsella, with sensilla chaetica limited to its posterior margin, and brown coloration, is distinctive for the male of this species. The lack of spine rows on S I-III, dark coloration, shagreen on T VI, strong reticulate cuticular pattern on T V-VIII, and coastal brackish water habitat serve to distinguish the pupa. The almost completely fused first and second lateral teeth of the mentum, smooth anterior margin of the ventromental plates, reduced anal tubules, and coastal brackish water habitat will separate the larva.

Male imago (n=5)

Color. Head and palps light brown; thorax and abdomen dark brown; legs brown, slightly darker distally. Wings light dusky brown, veins light brown.

Length. Total 3.10-4.18, 3.59 mm. Thorax 0.90-1.25, 1.02 mm. Abdomen 2.20-2.93, 2.57 mm.

Head. Temporals 23-34, 31. Clypeus with 18-27, 22 setae. Cibarial setae 6-9, 8(4). Palpal segment lengths: 30-38, 35; 38-53, 46; 95-108, 103; 100-140, 137; 155-213, 184. Frontal tubercles 3-14, 9 long, 3-10, 7 wide. AR 1.79-1.82.

Thorax. Scutal tubercle absent. Acrostichals 8-13, 10; dorsocentrals 16-43, 28; scutellars 8-15, 11; prealars 6-12, 9. Humeral pit poorly to moderately developed, at most 5-6 minute tubercles.

Wing. Length 1.38-2.05, 1.66 mm; width 410-570, 471. FCu slightly distal to RM. VR 0.87-0.90, 0.88. Brachiolum with 2 setae. R & R_1 with 20-30, 27 setae; R_{4+5} with 13-22, 16 setae; squama with 7-11, 8 setae.

Legs. Foretarsal beard absent. Metatarsus of middle leg with 2-5, 4 palmate sensilla chaetica. Lengths and proportions of legs:

	P_1	P_2	P_3
fe	790-970, 851	720-890, 788	810-1000, 896(4)
ti	625-730, 668	630-780, 691	860-1050, 917
ta_1	820-980 (3)	305-415, 361	490-725, 619
ta_2	420-525 (3)	190-235, 211	285-425, 349
ta_3	330-460 (3)	140-170, 151	235-335, 282
ta_4	240-370 (3)	85-90, 89	130-175, 147
ta_5	160-180 (3)	95-120, 101	120-140, 127
LR	1.20-1.56 (3)	0.43-0.56, 0.52	0.56-0.72, 0.67
BV	1.57-2.04 (3)	3.18-3.53, 3.33	2.53-2.77, 2.65(4)
SV	1.46-1.88 (3)	3.85-4.87, 4.12	2.69-2.87, 2.80(4)

Abdomen. Flattened setae on S VI not apparent.

Hypopygium (Fig. 83) with 0-3, 1 median setae. Gonostylus moderately wide, curved medially, slightly attenuated apically, with 5-8, 7 large setae on inner apex. Phallapodeme length 98-118, 106. Superior volsella (Figs. 84-85) length 55-75, 66; width 60-78, 68; weakly pediform to triangular; covered with microtrichia ventrally; with 2-10, 5 sensilla chaetica located on distal margin. Inferior volsella with tip of club slightly expanded, moderately bifid to trifid at apex, with 2-4, 3 dorsal rows of 3-7, 4 sensilla chaetica each; with 1 large ventral apical seta. Anal point bare or minutely setose, pyriform, deflexed, with 0-2, 1 dorsal basal setae and 9-15, 12 lateral basal setae.

Pupa: (n=3)

Color. Brown.

Length. Total 4571(1). Cephalothorax 1175(1). Abdomen 3400-4225(2).

Cephalothorax. Cephalic tubercles (Fig. 212) low, broadly conical. Dorsum pebbled; 2-3 precorneal, 4 dorsocentral setae. Scutal tubercle present.

Abdomen. Sternites I-III without transverse spine rows. Posterior margin of T II with transverse row of 80-95 hooklets. Tergites II and VI with triangular median shagreen area, T III-V with subquadrate median shagreen area. Anterolateral shagreen areas missing or merged with median shagreen area on T II-VI. T VII with 2 small suboval anterolateral shagreen areas. T VIII with 2 longitudinal lateral shagreen bands. A strong reticulate cuticular pattern on T V-VIII, best developed on T VII. T VIII with 4 lateral lamellar setae. Caudolateral spurs on VIII (Figs. 210, 211) short, with one large sharply pointed spur flanked at base by 1-4 smaller spurs. Anal lobes with 44-48(2) setae. DR 2.67-2.93(2).

Fourth instar larva: (n=4)

Color. Head capsule yellowish red-brown to light brown to brown, postmentum and mandibular apodemes often slightly darker; postmentum often with reticulate cuticular pattern, postocciput dark red-brown to black.

Head. Postmentum length 243-255, 251. Mandible (Fig. 213) length 184-210, 196, with 3 triangular inner teeth. Pecten mandibularis composed of 8-10, 9 setae. Mentum (Fig. 214) with 13 teeth, median tooth subequal to 1st laterals; 2nd lateral tooth almost completely fused or appressed to 1st lateral so that 1st lateral appears notched, and mentum appears to have only 11 teeth. Mentum width 135-154, 148; MR 2.37-2.59, 2.51. Ventromental plate with smooth anterior margin; width 101-109, 106; length 50-55, 52. VPR 1.98-2.16, 2.07; IPD 60-62, 61; PSR 1.74-1.98, 1.82; 32-38, 35 strial ridges. Length of antennal segments: 55-64, 61; 16-17, 17; 9-11(3); 12-14(3); 6(3). AR 1.20-1.45(3) (Fig. 215). Width of inner blade of premandible (Fig. 216) greater or subequal to outer blade. Pecten epipharyngis (Fig. 217) with 5 sharply pointed lobes. Anterior margin of frontal apotome (Fig. 218) concave, mostly smooth; frontal pit poorly developed, with at most a small, uvula-shaped process.

Body. Ventral tubuli absent. Anal tubules reduced, rounded.

Type material examined. Holotype: Male, Ozello, Fla., June 16, 1961 (USNM). - Paratype: Male, Collier Co., Fla., Everglades City, 1 Nov 1960 (FAMU).
Additional material examined: Florida: 15 males, 1 pharate female pupa/Lex, 1 pharate female pupa, 1 female, 2 Pex, 9 larvae; I, III-VIII, XI, XII. South Carolina: 3 larvae; I.

Remarks

A species found only in coastal brackish water habitats; known only from Florida and South Carolina.

When Beck (1962) described this species, she stated "similar to Chironomus modestus Say, but setae on inferior appendage not in two rows". Some specimens I examined did have 2 rows of sensilla chaetica on each inferior volsella, and some as many as

4; but most possessed 3 rows.

The species Beck referred to as D. lobus in his key (Beck 1976:55) and larval ecology synopsis (Beck 1977:97) is probably D. thanatogratus, for he stated the larva was found in streams and was oligohalobous. Dicrotendipes lobus larvae bear a strong resemblence to the freshwater D. neomodestus, but are restricted to tidal marshes and estuaries. I have collected D. lobus larvae from Najas in a brackish water pool, and from Juncus in salt marshes. I have also examined specimens taken from rotting Spartina alterniflora Loisel. Larvae were never abundant in the habitats sampled.

The reduction of the anal tubules is apparently an adaptation this species has made to brackish water life. McLachlan (1976) showed that, in Chironomus, as the concentration of inorganic ions in the water increased (e.g. increasing salinity), the size of the anal tubules was reduced.

The larva is often collected in the same areas as Goeldichironomus devineyae (E.C.Beck), another salt marsh chironomid which is much more commonly encountered (in Florida) than D. lobus, and could possibly be mistaken for a Dicrotendipes. However, G. devineyae larvae possess a pair of ventral tubuli (often reduced, especially in earlier instars; D. simpsoni, the only known Nearctic Dicrotendipes with ventral tubules, is not known to occur in brackish water habitats with G. devineyae), the triangulum occipitale is much larger than that of Nearctic Dicrotendipes, and the pecten epipharyngis is composed of numerous fine teeth, not lobes or thicker teeth as in most Nearctic Dicrotendipes larvae. Also, the distinctive mentum of D. lobus differs markedly from that of G. devineyae. I have also collected and reared D. modestus larvae from slightly brackish water near sites which yielded D. lobus, but not from the same exact area.

The holotype male, which I have examined, is slide mounted.

Dicrotendipes lucifer (Johannsen), n. comb.
Figs. 112, 224-229.

Chironomus lucifer Johannsen, 1907:110-111 (adult description); Townes 1945:108 [listed as new synonym of Tendipes (Limnochironomus) nervosus (Staeger)]; Townes 1952:74 (in synonymy).

Chironomus indistinctus Malloch, 1915:477-478, Figs. 6, 7, 13, 14 (adult description); Townes 1945:108 [listed as new synonym of T. (L.) nervosus (Staeger)] NEW SYNONYMY.

Chironomus (Limnochironomus) indistinctus Malloch: Johannsen 1937:44-45 (larva and pupa).

nec Tendipes (Limnochironomus) lucifer (Johannsen): Hauber & Morrissey 1945:290, Figs. 3, 6, 11, 15 (description of adult, pupa and larva; misdetermination of D. simpsoni

Tendipes (Limnochironomus) nervosus (Staeger) (partim): Townes 1945:108-109, Fig. 122B (adult description); Townes 1952:74, Fig. 114B (adult); Roback 1957:110, 111, Fig. 549 [in key, mentioned as synonymous with T. lucifer (Joh.)].

Dicrotendipes nervosus (Staeger): Mason 1973:21, 38 (larva).

Dicrotendipes nervosus (Staeger) (partim): Beck 1976:55 (in key); Beck 1977:100 (larval ecology).
Dicrotendipes nervosus (Staeger) Type I: Simpson & Bode 1980:67 (larva description).

Type locality: U.S.A., Kansas, Lawrence.
Diagnosis: The superior volsella and R & R_1 setal count of less than 35 place this species and D. simpsoni in the D. lucifer complex; D. lucifer adults can be separated from D. simpsoni by characters given in the adult key. Pupae are inseparable from the other members of the D. nervosus group; this group can be separated by a combination of characters: lack of ventral spines on S I-III, short caudolateral spurs on T VIII, and by the shagreen of T VI bearing its longest spines in the middle of the roughly triangular median shagreen area. The larva of D. lucifer can be separated by the mentum with its pointed sixth lateral teeth which are not fused or appressed to the fifth laterals, and by the bilobed or "saddle-shaped" proximal lateral tooth of the mandible, the proximal lobe usually smaller than the distal lobe; and by the absence of a deep semi-circular incision proximal to the proximal lateral tooth.

Male imago (n=4)

Color. Head light brown to light green; thorax light green with orange-brown vittae; postscutum and preepisternum light red-brown; abdomen green to dark green, darker apically; legs greenish-stramineous to stramineous, distal tarsomeres darker. Wings clear, veins yellow-brown.

Length. Total 4.38 mm (1). Thorax 0.95-1.18 mm (2). Abdomen 2.55-3.20 mm (2).

Head. Temporals 24-48(3). Clypeus with 11-20, 16 setae. Cibarial setae 6(1). Palpal segment lengths (n=2): 38-39; 48-55; 100-153; 125-195; 225-233. Frontal tubercles 8-15, 11 long, 3-7, 5 wide. AR 2.32-2.65, 2.47.

Thorax. Scutal tubercle absent. Acrostichals 7-13, 10; dorsocentrals 16-19, 18; scutellars 11-12, 11; prealars 6-9, 8. Humeral pit moderately well developed, with 6-10 tubercles.

Wing. Length 1.50-2.06, 1.75 mm; width 470-540, 513(3). FCu distal to RM. VR 0.84-0.90, 0.87. Brachiolum with 2 setae. R & R_1 with 23-33, 28 setae; R_{4+5} with 14-24, 19 setae; squama with 8-13, 10 setae.

Legs. Foretarsal beard absent. Metatarsus of middle leg with 6-10, 7 palmate sensilla chaetica. Lengths and proportions of legs (n=3):

	P_1	P_2	P_3
fe	760-960	645-840	690-930, 808(4)
ti	540-680	545-775	750-1050, 893(4)
ta_1	910-1300	305-410	500-725, 601(4)

ta_2	440-665	165-235	250-350, 294(4)
ta_3	365-550	110-140	195-255, 224(4)
ta_4	310-435	65-70	100-125, 115(4)
ta_5	140-180	55-60	75-90, 81(4)
LR	1.69-1.91	0.53-0.56	0.66-0.69, 0.67(4)
BV	1.61-1.77	3.74-4.15	3.09-3.34, 3.21(4)
SV	1.26-1.43	3.90-3.95	2.73-2.92, 2.84(4)

Abdomen with 0-1 darker, flattened, bluntly tipped setae, which are easily lost, on S VI.

Hypopygium. Similar to D. simpsoni (Fig. 110). With 0-2, 1 median setae. Gonostylus narrow, curving medially, with 9-10 (2) large setae on inner apex. Phallapodeme length 88-105, 97. Superior volsella (Fig. 111) length 75-78(3), width 15-18 (3); slender, cylindrical, usually with microtrichia ventrally, with expanded, inflated, usually round apex; with 3 sensilla chaetica on inner side, directed inward. Inferior volsella with apex of club moderately expanded, barely to deeply incised apically, with 2 rows of 3-5, 4 sensilla chaetica each; with 1 large ventral apical seta. Anal point bare dorsally, pyriform, deflexed, with 5-7, 6 dorsal basal setae and 6-8, 7 lateral basal setae.

Pupa: (n=9)

Color. Clear to pale yellow, with yellow to yellow-brown margins.

Length. Total 4.21-4.63 mm (2). Cephalothorax 1.04-1.30 mm (3). Abdomen 3.18-3.33 mm (2).

Cephalothorax. Cephalic tubercles small to large, conical. Dorsum lightly to well pebbled; 2 precorneal, 4 dorsocentral setae. Scutal tubercle absent.

Abdomen. Indistinguishable from D. nervosus (Fig. 141) and D. simpsoni. Sternites I-III without transverse spine rows. S I-III with 2-4 very light longitudinal spinule bands, spinules larger anteriorly. Posterior margin of T II with transverse row of 72-103, 81 hooklets. T II-III without well developed anterolateral shagreen areas, with a median subquadrate shagreen area; T IV-V with 2 anterolateral shagreen areas which usually merge with subquadrate median shagreen area; T VI with roughly triangular median shagreen area, shagreen spinules largest in middle; T VII with 2 suboval to circular anterolateral shagreen areas; T VIII with anterolateral and 2 posterolateral suboval to

circular shagreen areas or 2 lateral longitudinal shagreen bands; a reticulate cuticular pattern often present on posterior portions of T VI-VIII. T VIII with 4 lateral lamellar setae. Caudolateral spurs on VIII similar to D. nervosus (Figs. 142-145); usually single, short, stout, straight, bluntly pointed. Anal lobes with 41-67, 50 setae. DR 1.56-2.41, 2.13(8).

Fourth instar larva: (n=11)

Color. Head capsule yellow-brown, postmentum and mandibular apodemes sometimes darker; postocciput dark red-brown. Frontal apotome with or without brown stripe.

Head. Postmentum length 225-273, 252. Mandible length 193-220, 212(5); with 3 inner teeth, proximal tooth bilobed or "saddle-shaped", the proximal lobe usually smaller than distal lobe (Figs. 224-226). Pecten mandibularis composed of 11-15, 13(8) setae. Mentum (Fig. 227) with 13 well defined teeth, median tooth subequal to 1st laterals; 6th lateral tooth pointed and directed forward, not appressed or fused to 5th lateral. Mentum width 155-179, 165(8); MR 2.40-2.67, 2.55(8). Ventromental plate with shallow crenulations on anterior margin; width 90-107, 100(10): length 40-60, 49(10); VPR 1.70-2.38, 2.06(10); IPD 65-78, 73(8); PSR 1.28-1.41, 1.35(8); 24-31, 26 strial ridges. Length of antennal segments: 63-76, 69(7); 24-31, 28(9); 8-13, 11(9); 14-17, 16(9); 5-9, 7(9). AR 1.02-1.15, 1.09(7) (Fig. 228). Width of inner blade of premandible (Fig. 229) greater then outer blade. Pecten epipharyngis with 4-5, 5(5) lobes. Anterior margin of frontal apotome concave, roughly tuberculate; frontal pit similar to D. simpsoni (Fig. 234), with uvula-shaped process. Labral sclerite 1 smooth.

Body. Ventral tubuli not observed.

Type material examined: Holotype: Female, taken at electric light, Douglas Co., Kas, Aug. (COR). -Lectotype: Male, taken at electric light, Douglas Co., Kas., July (KU).
Additional material examined: U.S.A.: Georgia: 1 pharate male pupa/Lex, 2 pharate female pupae/Lex, 1 pupa/Lex, 1 larva; VIII, IX. Illinois: 5 males; V. New York: 5 males/Pex/Lex, 6 females/Pex/Lex; VII-X. In addition, I have seen unlabeled larval specimens from Florida. I have also examined nonassociated males of the D. lucifer complex from Alabama, Florida, Georgia, Illinois, Kansas, Maryland, Massachusetts, Michigan, New Jersey, New York, North Carolina, Oregon, Pennsylvania, South Carolina, South Dakota, Texas, Virginia, Washington, D.C., and Wyoming in the U.S.A.; and from Ontario and Saskatchewan in Canada.

Remarks

Townes (1945) synonymized this species and its junior synonym, C. indistinctus Malloch, with T. (L.) nervosus (Staeger). He did not have the benefit of reared material, but did illustrate the male genitalia of 3 "types" of T. (L.) nervosus. Fig. 122B (Townes 1945) is most certainly a species of the D. lucifer complex.

This species and at least D. simpsoni make up the D. lucifer complex of the D. nervosus group. Males of the D. lucifer complex usually have less than 35 setae on vein R_1 and a

distinctive superior volsella. The superior volsella (Fig. 111) is similar to that of D. nervosus (Figs. 105-109). However, the volsellae of D. lucifer and D. simpsoni are rotated 90<t8> counterclockwise, compared to the volsella of D. nervosus. It is not a rotation caused by mounting procedures, for live and fluid preserved specimens also display this rotation. Twisting of the superior volsella under pressure from the cover slip or from distortion when drying (in pinned material) is common and is often the reason for misdeterminations of several species. Dicrotendipes nervosus, D. incurvus, and the D. lucifer complex can all be mistaken for each other if specimens are not prepared carefully.

While the larvae of D. lucifer are easily separated from the other members of the D. nervosus group, the pupae of this group are inseparable, and adults of D. lucifer are separable from D. simpsoni only by leg ratios. The SV of the middle leg provides a reliable species character in all reared material I examined. This material came from New York, and while these ratios work on material from that area, my sample size was small. Specimens from other areas may differ enough that these ratios would be unusable. Diligent rearing in an area where both species are found may provide material for calculating ratios that would separate the adult males of the species in that area. Also, the hypopygium of D. lucifer is occasionally adorned with median setae. Median setae were not observed on any D. simpsoni males, but I do not consider such setae as good specific indicators.

Assignment of species names to the 2 known members (based on larvae) of the D. lucifer complex presented a problem. Townes (1945) synonymized C. lucifer and C. indistinctus with T. nervosus. The lectotypes of C. lucifer and C. indistinctus are both unreared males. The SV_2 of the C. lucifer lectotype is 3.92; that of the C. indistinctus lectotype is 3.69. Both are below 4.00, a dividing line which exists between the adults of the 2 species of the lucifer complex (based on reared material from New York). Since C. lucifer is the oldest available name, I have assigned it to the larval type which produced the adults with an SV_2 of less than 4.00. The name C. indistinctus is predated by C. lucifer and thus becomes a junior synonym of that species. The other larval species is considered a new species, D. simpsoni, and is described later.

Because of the lack of reared material from many areas, unreared adults are listed as "D. lucifer complex sp.", and only reared or good larval material is listed under Additional material examined for D. lucifer. Unassociated pupae were determined as "D. nervosus group".

This species corresponds to D. nervosus (Staeger) Type I in Simpson & Bode (1980). They found it in areas of slow current and high levels of organic matter, such as below sewage outfalls.

A pinned female with the labels "Holotype Chironomus lucifer Joh." and "Aug. Taken at electric light, Douglas Co., Kas." is in the Cornell University collection (No. 2460). The specimen is in poor condition: only the head (with antennae), one foreleg, one wing and the thorax remain. Townes (1945:108) designated a lectotype for this species. Johannsen (1907) did not designate a holotype specimen, but there is a holotype label on the female

specimen.

I have examined the lectotype male of C. lucifer (No. 3461) designated by Townes (1945); it is located at the Snow Entomological Museum at the University of Kansas, Lawrence, KA. The hypopygium was slide mounted; the remainder was pinned. I have mounted the rest of the body in Canada balsam on the same slide as the hypopygium. The lectotype was missing antennal flagella, one foreleg, one middle leg and one wing.

I have also examined the lectotype male of C. indistinctus (No. 2593), designated by Frison (1927:167), and 4 pinned paralectotypes, all in the INHS collection. Only the hypopygium of the lectotype was slide mounted; I have mounted the rest of the body in Canada balsam on the same slide. I also slide mounted one of the male paralectotypes.

Dicrotendipes milleri (Townes)

Figs. 86-91, 133-134.

Tendipes (Limnochironomus) milleri Townes, 1945:110, Fig. 124 (adult description); Townes 1952:74-75, Fig. 116 (adult description).

Chironomus (Dicrotendipes) milleri (Townes): Sublette & Sublette 1965:169 (placement, distribution).

Type locality: U.S.A., New York, Bemus Point.

Diagnosis: The strongly curved and long, thin gonostylus is distinctive for the male of this species. The pupa closely resembles the pupa of D. incurvus; characters given in the key should separate most D. milleri from D. incurvus The larva is unknown.

Male imago (n=7)

Color. Head pale green, palps light brown, pedicels light yellow-brown, scutellum green; abdomen light green, tergites VIII and IX light brown; legs pale stramineous-green, tarsi light brown. Wings clear, veins pale yellow-brown.

Length. Total 3.83-4.30, 4.07 mm(4). Thorax 0.90-1.08, 0.99 mm(5). Abdomen 2.88-3.23, 3.06 mm(4).

Head. Temporals 24-43, 36(5). Clypeus with 13-18, 15 setae. Cibarial setae 5-10, 7. Palpal segment lengths: 33-43, 37; 50-58, 54; 135-168, 153; 145-170, 156; 203-240, 220(5). Frontal tubercles 5-15, 9 long, 5-8, 7 wide. AR 2.26-2.43, 2.36(6).

Thorax. Scutal tubercle absent. Acrostichals 8-11, 10(6); dorsocentrals 18-23, 20(5); scutellars 7-10, 8(6): prealars 6-10, 8(5). Humeral pit moderately developed, 4-8 low rounded tubercles.

Wing. Length 1.80-2.13, 1.97 mm; width 495-600, 554. FCu distal to RM. VR 0.88-0.91, 0.90. Brachiolum with 2-3, 2 setae. R & R_1 with 31-40, 36 setae; R_4+5 with 17-31, 26 setae; squama with 6-11, 9 setae.

Legs. Foretarsal beard absent. Metatarsus of middle leg with 5-11, 9 palmate sensilla chaetica. Lengths and proportions of legs:

	P_1	P_2	P_3
fe	820-960, 896	780-890, 850(6)	870-975, 928(6)
ti	630-710, 672	690-800, 746	980-1110, 1035
ta_1	1120-1255, 1176(6)	365-410, 386	600-700, 648
ta_2	500-540, 523(6)	190-235, 210	295-340, 316
ta_3	420-460, 438(6)	120-145, 134	220-270, 239
ta_4	320-360, 342(6)	70-90, 78	120-150, 132
ta_5	150-180, 166(6)	70-90, 83	95-120, 104
LR	1.63-1.81, 1.75(6)	0.49-0.53, 0.52	0.59-0.65, 0.63
BV	1.84-1.90, 1.87(6)	3.61-4.24, 3.89(6)	3.06-3.44, 3.28(6)
SV	1.29-1.44, 1.33(6)	3.93-4.32, 4.10(6)	2.91-3.16, 3.01(6)

Abdomen with 0-5 darker, flattened, bluntly tipped setae, which are easily lost, on S VI.

Hypopygium (Fig. 86). Gonostylus long, thin, strongly curved; becoming very narrow preapically; with 6-7, 6 large setae on inner apex. Phallapodeme length 96-118, 109(4). Superior volsella (Figs. 88-90) length 83-110, 98(4); width 15-26, 22(4); similar to D. incurvus, long, slender, cylindrical, apex expanded and produced mesally; bare dorsally; ventrally bare, rarely with microtrichia near base; apex semi-membranous, not as membranous as D. incurvus, with 3-4, 3 sensilla chaetica on inner apex. Inferior volsella with apex of club expanded, barely indented apically, with 2 dorsal rows of 3-5, 4 sensilla chaetica each, with 1 large ventral apical seta. Anal point bare dorsally, pyriform to elongate-elliptical, deflexed, with narrow peduncle; with 2-4, 3 dorsal basal setae and 5-8, 6 lateral basal setae.

Pupa (n-6)

Color. Clear with pale yellow margins.

Length. Total 4.28-4.55, 4.43 mm. Cephalothorax 1.10-1.18, 1.12 mm. Abdomen 3.15-3.38, 3.31 mm.

Cephalothorax. Cephalic tubercles (Fig. 133) long, thinly conical. Dorsum pebbled with low, smooth, well separated "pebbles"; 2 precorneal, 4-5, 4 dorsocentral setae. Scutal

tubercle not observed.

Abdomen. Similar to D. incurvus (Fig. 126). Sternites I-III with transverse spine rows; S I with a single row; S II with 2 rows; S III with 0-1 rows. S I-III also with 2-4 longitudinal spinule bands, spinules larger anteriorly. Posterior margin of T II with transverse row of 53-60, 57 hooklets. Tergites II-III with faint suboval anterolateral shagreen areas and subquadrate to broadly triangular or hourglass shaped median shagreen area; T IV-VI with elliptical ovate anterolateral shagreen areas and subquadrate median shagreen area; T VII with 2 faint anterolateral shagreen areas; T VIII with 2 lateral shagreen bands. T VIII with 4 lateral lamellar setae. Caudolateral spurs on VIII (Fig. 134) compound double or triple, outer spur moderately sinuate; inner spur(s) smaller and straight. Anal lobes with 33-40, 37 setae. DR 2.24-3.50, 2.69.

Fourth instar larva: unknown.

Type material examined. -Paratype: Male, Ithaca, N.Y., Sept(COR). Additional material examined: U.S.A.: Indiana: 2 males; VII. Michigan: 2 males; VI, VIII. Minnesota: 3 males; VII, VIII. New York: 1 male; VII. CANADA: Manitoba: 1 male; VII. Ontario: 10 males, 10 females, 50 Pex; VII.

Remarks

This species is apparently limited to the northern U.S. and southern Canada. In addition to the records listed above under Additional material examined, Townes (1945) also recorded this species from Oregon.

There is some variation in the gonostylus. Some specimens possess a longer, thinner, and more drawn-out gonostylus (Fig. 87).

This species is closely related to D. incurvus and the Palaearctic D. tritomus. See Remarks under D. incurvus.

The male holotype, which I did not examine, is in the Townes collection at the American Entomological Institute, Gainesville, FL. I have examined a male paratype from the Cornell University collection; I have slide mounted the specimen in Canada balsam.

Dicrotendipes modestus (Say)

Figs. 26, 92-97, 148-154, 188-193.

Chironomus modestus Say, 1823:13-14 (adult description); Dyar 1902:57 (pupa and larva description); Johannsen 1905:227, Plate 22, Figs. 8-12, Plate 32, Fig. 8 (adult, pupa and larva description); Malloch 1915:476, Plate 31, Figs. 10, 17, Plate 34, Fig. 8 (adult, pupa and larva description).

Chironomus pulsus Walker, 1856:165 (adult description); Edwards 1929:386, Fig. 12d (adult description). NEW SYNONYMY.

Cladopelma modestus (Say): Lenz 1921:160 (placement).

Tendipes (Limnochironomus) pulsus (Walker): Kruseman 1933:176, Fig. 40 (adult description, distribution); Goetghebuer 1937-1954:20, Fig. 71 (adult description).

Chironomus (Limnochironomus) modestus Say: Johannsen 1937:43,

Figs. 116, 117 (pupa, larva description); Beck & Beck 1959:94 (distribution).

Tendipes (Limnochironomus) modestus (Say): Townes 1945:106, Fig. 119 (adult description); Hauber & Morrissey 1945:288, Figs. 1, 7-10, 13 (adult, pupa, larva description); Townes 1952:73, Fig. 112 (adult description); Roback 1957:111, Figs. 360-365 (pupa, larva description).

Limnochironomus pulsus (Walker): Lenz 1954-1962:194, Figs. 189, 194, 196, 198, 200, 203, 212, 213 (larva and pupa description); Pinder 1978:126, Figs. 61F-G, 158A (adult in key).

Tendipes (Dicrotendipes) modestus (Say): Darby 1962:51, 158, Fig. 57 (biology, adult in key).

Chironomus (Dicrotendipes) modestus Say: Sublette & Sublette 1965:169 (placement, distribution), Webb 1972:76 (in key).

Dicrotendipes modestus (Say): Hudson 1971:168 (distribution); Beck 1976:55 (in key); Beck 1977:98 (ecology); Sublette & Sublette 1979:95 (distribution).

Dicrotendipes pulsus (Walker): Fittkau & Reiss 1978:431 (distribution).

Type locality: U.S.A., Pennsylvania.

Diagnosis: The pediform superior volsella, moderate gonostylus, and anal point structure will usually separate the males of this species from other Nearctic Dicrotendipes. The ventral spine rows on S I-III, structure and placement of the caudolateral spurs on VIII, shagreen on T VI, and the anal lobe setal count will separate the pupa. The larva may be separated by a combination of characters of the mentum, ventromental plate structure and strial ridge count given in the key, and the usually darkened postmentum.

Male imago (n=36)

Color. Head stramineous, green or light brown; thorax stramineous, light green to red-brown, vittae and preepisternum usually darker; abdomen light green to dark olive, or brown, often with distal segments darker on green specimens; legs stramineous, light green, or light brown, distal tarsomeres darker.

Length. Total 2.75-5.68, 4.89 mm (27). Thorax 0.77-1.50, 1.24 mm (33). Abdomen 1.98-4.40, 3.64 mm (28).

Head. Temporals 21-57, 45(32). Clypeus with 9-29, 20(35) setae. Cibarial setae 4-13, 8(32). Palpal segment lengths: 23-63, 45(35); 31-78, 60(35); 58-215, 158(35); 84-208, 169(35); 100-285, 240(26). Frontal tubercles 3-18, 9(33) long, 3-12, 7(33) wide. AR 2.02-3.11, 2.58(34).

Thorax. Scutal tubercle absent. Acrostichals 4-20, 11(32); dorsocentrals 12-44, 26(35); scutellars 6-18, 12(35); prealars 6-13, 10(35). Humeral pit well developed.

Wing. Length 1.80-3.38, 2.41 mm (33); width 515-920, 689(31). FCu below or slightly distal to RM. VR 0.89-0.97, 0.92(32). Brachiolum with 2-3, 2(34) setae. R & R_1 with 15-47, 32(35) setae; R_{4+5} with 2-37, 20(34) setae; squama with 7-21, 13(34) setae.

Legs. Foretarsal beard absent. Metatarsus of middle leg with 4-17, 9(34) palmate sensilla chaetica. Lengths and propor-

tions of legs:

	P_1	P_2	P_3
fe	790-1220, 1021(29)	700-1180, 980(28)	780-1340, 1083(29)
ti	580-1005, 821(28)	640-1160, 906(27)	910-1600, 1230(30)
ta_1	1010-1540, 1323(29)	335-580, 471(30)	500-990, 789(29)
ta_2	465-720, 600(30)	200-345, 264(30)	310-540, 408(30)
ta_3	390-575, 495(29)	130-250, 180(30)	210-390, 295(30)
ta_4	300-460, 388(30)	80-170, 111(30)	130-225, 171(30)
ta_5	120-190, 170(30)	70-120, 91(30)	85-150, 112(30)
LR	1.35-1.94, 1.62(27)	0.48-0.59, 0.53(27)	0.51-0.69, 0.64(28)
BV	1.82-2.06, 1.92(26)	3.24-4.26, 3.65(27)	2.90-3.54, 3.19(27)
SV	1.22-1.57, 1.40(27)	3.65-4.25, 3.96(27)	2.70-4.03, 2.95(27)

Abdomen with 0-7 darker, flattened, bluntly tipped setae, which are easily lost, on S VI.

Hypopygium (Fig. 92). Gonostylus moderately to very broad, very weakly (almost straight) to moderately curved medially, with 6-16, 11(34) large setae on inner apex. Phallapodeme length 75-140, 120. Superior volsella (Figs. 94-97) length 41-118, 94(34), width 30-80, 59(34); pediform, with "foot" portion sometimes globose; usually completely covered with microtrichia ventrally, occasionally tip and bottom of "foot" bare; with 6-19, 12 sensilla chaetica in 2-4, 3 rows. Inferior volsella with tip of club expanded, moderately to deeply incised apically, with 2-4 rows of 3-6 sensilla chaetica each, with 1-3, 1 well developed ventral apical setae. Anal point bare, pyriform, deflexed, with 3-11, 5 dorsal basal setae and 5-12, 9 lateral basal setae.

Pupa: (n=25)

Color. Light yellow-brown to light brown.

Length. Total 3.55-6.28, 5.30 mm (21). Cephalothorax 0.88-1.48, 1.30 mm (21). Abdomen 2.68-5.00, 4.01 mm (22).

Cephalothorax. Cephalic tubercles (Fig. 154) usually well developed, conical to broadly conical. Dorsum usually moderately to roughly pebbled, sometimes smooth with small, well separated

"pebbles"; 2-3, 2 precorneal, 4-5, 4 dorsocentral setae. Scutal tubercle not apparent.

Abdomen. (Fig. 148). Sternites I-III with transverse spine rows; S I with single row; S II with 2 rows, S III with 0-1 row. S I-III also with 2-4 longitudinal spinule bands, spinules larger anteriorly. Posterior margin of T II with transverse row of 55-104, 72 hooklets. T II-III with a median subquadrate, broadly triangular, or 2 small triangular shagreen area(s), with or without suboval anterolateral shagreen areas which may merge medially to form an anterior transverse shagreen band; and a subquadrate or broadly triangular median shagreen area which may merge with anterolateral shagreen areas; shagreen spinules of anterolateral areas single or multiple-spined (Figs. 149, 150); shagreen spinules of median areas larger anteriorly than in middle; posterior spinules larger than in middle, but usually not as large as anterior spinules; T VII with or without 2 suboval anterolateral shagreen areas; T VIII with a pair of anterolateral and a pair of posterolateral shagreen areas, or 2 longitudinal lateral shagreen bands. T VIII with 4, rarely 5, lateral lamellar setae. Caudolateral spurs on VIII (Figs. 151-153) usually single, strongly sinuate; tip may be bifid; occasionally with short basal accessory spurs; spurs originate from posterior corner of segment. Anal lobes with 30-64, 50 setae. DR 1.75-3.25, 2.41.

Fourth instar larva: (n=19)

Color. Head capsule light yellow-brown to yellow-brown, occasionally colorless; postmentum usually dark brown, occasionally clear; postocciput yellow-brown to dark red-brown. Frontal apotome and 1st labral sclerite usually with brown stripe, occasionally without.

Head. Postmentum length 195-250, 219(17). Mandible (Fig. 188) length 135-178, 157(15), with 3 triangular inner teeth. Pecten mandibularis composed of 8-15, 11 setae. Mentum (Fig. 189) with 13 well defined teeth, median tooth subequal to slightly higher than 1st laterals; 1st and 2nd lateral teeth fused basally to almost 1/2 their length. Mentum width 120-153, 137(17); MR 2.46-3.17, 2.76(14). Ventromental plate with shallow to deep scalloping on anterior margin; width 95-118, 105(18); length 45-68, 53(17); VPR 1.46-2.23, 2.00(16); IPD 43-57, 53(13); PSR 1.77-2.28, 1.98(12); 27-37, 32 strial ridges. Length of antennal segments: 59-85, 69(17); 16-25, 21(16); 9-14, 12(16); 12-18, 15(16); 6-7, 6(16). AR 1.02-1.47, 1.28(16) (Fig. 190). Width of inner blade of premandible (Fig. 191) greater than outer blade. Pecten epipharyngis with 3-7, 5 lobes. Anterior margin of frontal apotome concave, roughly tuberculate; frontal pit variable: small, transversely elliptical with ventral uvula-shaped process, often filled with scale- or bubble-like structures (Fig. 192) to larger, rounded, subquadrate pit filled with scale- or bubble-like structures (Fig. 193), which may obscure ventral uvula-shaped process. Labral sclerite 1 almost smooth or posterior 1/4 with low tubercles.

Body. Ventral tubuli absent.

Type material examined: Neotype, reared male/Pex/Lex, Vineland,

Ont., 25-I-1977, coll. J.W. Jones, No. CH3315 (CNC).
Additional material examined: U.S.A.: Alabama: 14 males; II, III, VI-VIII, X. California: 3 pharate male pupae, 27 males; VI-VIII. Colorado: 1 male/Pex, 11 males, 1 female/Pex, 8 Pex; VII, VIII. Florida: 8 males/Pex/Lex, 10 pharate male pupae/Lex, 5 pharate male pupae, 592 males, 1 female/Pex/Lex; I-XII. Georgia: 5 males, 1 pupa; I, IV, V, X. Idaho: 18 males; VII, VIII. Illinois: 14 males; IV, V, VII, X. Indiana: 2 males/Pex, VII. Kansas: 14 males; IV. Maine: 3 males; VIII. Maryland: 11 males; IV-VII, IX, X. Massachusetts: 5 males; VI, VIII. Michigan: 9 males; V-VIII, X. Minnesota: 7 males; VI-VIII. Nebraska: 2 males; VI. New York: 2 males/Pex/Lex, 43 males, 1 female/Pex/Lex; V, VII-IX. North Carolina: 2 males; VI. Ohio: 1 male; I. Pennsylvania: 5 males; VIII. South Carolina: 1 male/Pex, 3 male pupae, 17 males; III-VIII, X. South Dakota: 3 males/Pex/Lex, 1 male pupa/Lex, 5 males; II, VI-X. Virginia: 9 males; VI, VIII, IX. Washington, D.C.: 16 males; V, VI, VIII. Wisconsin: 1 male/Pex/Lex; IV. Wyoming: 20 males; VII. CANADA: British Columbia: 6 males, 4 Pex; VII, VIII. Manitoba: 2 males/Pex/Lex, 13 males/Pex, 3 males, 2 females/Pex; VI-VIII. New Brunswick: 1 pharate male/Pex/Lex, 19 males; V-VIII. Newfoundland: 4 males; VI, VII. Northwest Territories: 26 males; VI, VII. Ontario: 10 males/Pex/Lex, 2 pharate male pupae/Lex, 5 males/Pex, 41 males, 1 female/Pex/Lex, 1 pupa; I, IV-IX, XI. Prince Edward Island: 1 male; VII. Quebec: 1 male/Pex/Lex, 5 males, 1 female/Pex/Lex, 2 Pex; V-VII. GREAT BRITAIN (?): 1 male (holotype C. pulsus). GREENLAND: 41 males; VI, VII. ITALY (?): 1 pharate male pupa/Lex, IV. WEST GERMANY: 2 pharate malespupae/Lex, 4 males, V, VII.

Remarks

A Holarctic species, probably the most widespread and variable Dicrotendipes in the Nearctic. It is apparently replaced by D. californicus and D. crypticus in the U.S. desert Southwest.

I have examined the type and reared Palaearctic D. pulsus (Walker) specimens from West Germany and Italy. I can find no differences between them and Nearctic D. modestus, and conclude they are the same species.

The amount of variability in coloration, superior volsella structure, and the gonostylus shape in D. modestus males is considerable. Generally, coloration of adult males varies from light green to green in the southern portion of the species' range to a dark olive or red-brown at higher latitudes and/or elevations. The majority of pinned specimens I examined were from the continental U.S., and were green.

The superior volsella is normally pediform and covered ventrally with microtrichia except for the bottom of the "foot" (Figs. 94, 97). Rarely, the "toe" is bare, but never reflexed as in some D. californicus or D. crypticus. The superior volsella sometimes is expanded and assumes a semi-globular shape (Figs. 95, 96). This was more often seen in specimens from higher latitudes or elevations. This appendage is quite variable, but is usually broader and higher than the superior volsella of D. neomodestus, a species easily confused with D. modestus,

especially if specimens are excessively cleared or crushed beneath a cover slip.

The shape of the gonostylus is also variable. There appear to be at least 3 forms: the moderately curved, moderately broad gonostylus which is most typical for this species (Fig. 92); a moderately curved, but much broader, gonostylus, almost as inflated as the gonostylus of D. californicus or D. crypticus (Fig. 57) but not as apically attenuated; and a form in which the inner side of the gonostylus is hardly curved, but almost straight (Fig. 93). I examined reared immatures of the first 2 forms and could find no differences. I have not seen associated immatures of the straight-styled form, which appears to be more common at higher latitudes and elevations.

I collected a series of adult specimens from higher elevations at Brooks Lake and at Grand Teton and Yellowstone National Parks in northwest Wyoming. Many specimens were dark in color (I first thought they were D. neomodestus), possessed gonostyli with only a slight medial curve and semi-globose superior volsellae. I also collected more typical forms at the same times and localities. I was not successful in collecting any larvae for rearing in those areas. Pupal exuviae I collected with a drift net in the Yellowstone River in Yellowstone National Park appeared to be typical D. modestus. Due to the variability shown throughout the range of D. modestus and the lack of associated immature stages, for the present I am assigning these specimens to D. modestus.

Variation in the pupa is most noticeable in the shape of the caudolateral spurs on T VIII and the shagreen spinules. The caudolateral spur can vary in the amount of sinuation and in the degree in which it is attenuated. Short basal spurs are sometimes present (Fig. 153). Two examples of typical spurs are illustrated in Figs. 151 and 152.

Variation in shagreen spinules is most noticeable in the anterolateral shagreen areas on T IV-VI. Some forms have smaller, finer spinules (Fig. 149, a Florida specimen), while other specimens possess larger, broader, and more intricate spinules (Fig. 150, from New York). No consistent differences could be found between other life stages of these forms, and intergradations in spinule size occur. Specimens with smaller spinules are more commonly found in the South, while those with the more intricate spinules are more common to the North; however, both types are found in both the northern and southern Nearctic.

The pupa of D. neomodestus is quite similar to D. modestus, and can only be separated by the anal lobe setal count. Dicrotendipes modestus usually has about 50 setae on each anal lobe, D. neomodestus about 38. However, overlaps occur. I have seen a reared specimen of D. modestus from Florida with only 30-33 anal lobe setae. Rearings or associations are needed to positively differentiate between these 2 species in the pupal stage.

Larval variations are mainly in the color of the head capsule. The postmentum is usually darkened in D. modestus, but is also darkened in many other species. The darkened postmentum, along with the ventromental strial ridge count, is most useful in

separating D. incurvus larvae from D. modestus larvae. The presence or absence of a dark stripe on the frontal apotome, used in Beck's (1976) key, is not a reliable character. Many specimens of D. modestus lack this stripe (and sometimes a darkened postmentum as well), and many other species (D. californicus, D. crypticus, D. fumidus, D. incurvus, D. lucifer, D. neomodestus, D. nervosus & D. simpsoni) may also have a dark stripe on the dorsum of the head.

The larval frontal pit is also subject to much variation. The pit in many specimens examined was small, with only the central uvula-shaped process apparent (Fig. 192), while that of some others was large and filled with an apparent lattice work (Fig. 193), similar to but often more developed than that of the D. incurvus specimen in Fig. 40. Many specimens displayed variations or intergradations. The lattice work was most noticeable in specimens from the northern portions of the species' range. Some unassociated larvae from northern Canada, which resembled D. modestus in all other characters, showed a great developement of this structure.

Because many of the larval determinations of this species in the past may have been incorrect, it is difficult to assess information from the literature concerning larval ecology. The larvae are most common in still waters or the slower moving portions of large rivers. I have collected larvae living in silken tubes from a variety of aquatic plants. In Florida, I have reared larvae collected from Typha in water which was mildly brackish.

This is a species of great variation, or perhaps a complex of sibling species is present. More rearing of specimens is needed, expecially from the far northern and western portions of its range.

I was not able to locate a type specimen for C. modestus. Stone (1980:35) stated "it appears that no type material of Say's Diptera exists in this country". Townes (1945:106), in his synonymy for T. (L.) modestus, stated "a fragment of a specimen determined by Say is in the Vienna Museum". This fragment is not type material, because Lichtenberg (1974:122) does not record a type for C. modestus, and Lichtenberg (personal communication) informed me that the type of C. modestus is not in the Vienna Museum. A specimen of modestus is in the museum; however, this specimen bears no determination label by Say and can not be considered to be type material. Say (1823) did not designate a holotype in his paper, and his description could fit any of a number of chironomid species. Although this species is often cited in the literature, it has often been misdetermined, and other species (D. incurvus, D. neomodestus and D. nervosus) have been incorrectly determined as D. modestus. I am designating as neotype a slide-mounted (in Canada balsam), reared male specimen with associated immature exuviae from Canada labeled: "Dicrotendipes modestus (Say), Vineland, Ont., 25-I-1977, coll. J.W. Jones, No. CH3315, NEOTYPE"; also with a circled number 18 (placed there by me for identification purposes during specimen examination) and my determination label. This specimen was chosen because it was reared, is typical for this variable species, and was collected relatively close to the original type

locality (Pennsylvania). The specimen will be returned to the CNC.

The type of C. pulsus, which I examined, is in the British Museum (Natural History). The hypopygium is mounted in a drop of balsam on a small plastic card; the rest of the body is pinned. I did not remount it.

Dicrotendipes neomodestus (Malloch)

Figs. 98-103, 155-157, 219-223.

Chironomus tenellus sensu Johannsen nec Zetterstedt: Johannsen 1905:214-216, Plate 21, Figs. 1-4 (misdetermination; adult, pupa, and larva description; see remarks under D. fumidus).
Chironomus neomodestus Malloch, 1915:475-476 (adult description).
Chironomus (Limnochironomus) fumidus Johannsen: Johannsen 1937:44 (Townes 1945:107, cites as a misdetermination; see remarks under D. fumidus).
Tendipes (Limnochironomus) neomodestus (Malloch): Townes 1945:107, Fig. 120 (adult description); Hauber & Morrissey 1945:289, Fig. 2 (adult description); Townes 1952:74, Fig. 113 (adult description); Roback 1957:112, Fig. 372-375 (larva and pupa description).
Chironomus (Dicrotendipes) neomodestus Malloch: Sublette & Sublette 1965:169 (placement, distribution).
Dicrotendipes neomodestus (Malloch): Hudson 1971:169 (distribution); Beck 1976:55 (larval key); Beck 1977:99 (larval ecology); Sublette & Sublette 1979:95 (distribution); Martin et al. 1979:150, Fig. 14 (karyotype); Simpson & Bode 1980:66 (larval description, ecology).

Type locality: U.S.A., Illinois, St. Joseph.
Diagnosis: The brown coloration, pediform superior volsella, and distinctive gonostylus will identify the majority of adult males of this species. The pupa is similar to D. modestus; most specimens can be separated by the lower anal lobe setal count. The larva is distinguished by its mentum with the second lateral tooth almost completely fused to the first lateral tooth, the first lateral thus appearing notched; and by the crenulate anterior margins of the ventromental plates.

Male imago (n=17)

Color. Head light brown; thorax light to dark brown or dark reddish brown; abdomen light brown to dark olive-brown, sometimes with a dark middorsal vitta which widens caudally; legs light brown to dark stramineous, distal tarsomeres darker. Wings clear, sometimes with pale infuscation over RM and FCu, veins light brown.

Length. Total 2.80-5.15, 4.18 mm (15). Thorax 0.73-1.41, 1.12 mm. Abdomen 2.08-3.85, 3.05 mm (15).

Head. Temporals 36-52, 45(14). Clypeus with 15-36, 21 setae. Cibarial setae 4-16, 9(14). Palpal segment lengths: 38-50, 41(16); 43-63, 54(16); 118-193, 165(16); 140-210, 164(15); 185-313, 230(12). Frontal tubercles 8-23, 15(15) long, 5-14, 8(15) wide. AR 1.90-2.86, 2.43(14).

Thorax. Scutal tubercle absent to weakly developed. Acrostichals 5-12, 10; dorsocentrals 21-38, 26(16); scutellars 8-15, 11(16); prealars 6-11, 9(16). Humeral pit well developed; 7-12 small tubercles.

Wing. Length 1275-2563, 1930(15); width 495-740, 578(14). FCu below RM. VR 0.88-0.95, 0.92(14). Brachiolum with 2-3, 2 setae. R & R_1 with 24-42, 34(15) setae; R_{4+5} with 9-27, 20(15) setae; squama with 6-21, 14(16) setae.

Legs. Foretarsal beard absent. Metatarsus of middle leg with 5-12, 7 palmate sensilla chaetica. Lengths and proportions of legs:

	P_1	P_2	P_3
fe	650-1165, 954(13)	575-1070, 848(13)	600-1200, 944(12)
ti	505-920 729(14)	520-1000, 777(14)	690-1300, 1036(14)
ta_1	785-1540, 1201(11)	260-485, 381(14)	460-940, 704(14)
ta_2	365-675, 534(11)	160-280, 222(14)	235-455, 344(14)
ta_3	310-565, 453(11)	115-200, 152(13)	190-350, 264(14)
ta_4	230-440, 363(11)	70-110, 89(13)	110-185, 151(14)
ta_5	130-225, 185(11)	75-125, 90(13)	90-150, 115(14)
LR	1.54-1.84, 1.67(11)	0.48-0.51, 0.49(15)	0.62-0.72, 0.68(13)
BV	1.80-1.91, 1.87(11)	3.23-3.80, 3.60(12)	2.80-3.23, 3.06(12)
SV	1.28-1.49, 1.39(11)	4.05-4.39, 4.23(13)	2.53-2.94, 2.78(12)

Abdomen with 0-6 darker, flattened, bluntly tipped setae, which are easily lost, on S VI.

Hypopygium (Fig. 98). Gonostylus strongly curved, somewhat inflated medially, narrowing preapically, with 6-9, 7 large setae on inner apex. Phallapodeme length 85-128, 107(16). Superior volsella (Fig. 99) length 52-98, 78, width 38-63, 47; pediform, covered with microtrichia ventrally, with 10-22, 13 sensilla chaetica loosely arranged in 2-5 rows. Inferior volsella with apex of club expanded, barely to moderately indented apically, with 2-3, 2 dorsal rows of 3-6, 4 sensilla chaetica each, with 1 weakly developed ventral apical seta. Anal point (Figs. 100-103) bare, pyriform, deflexed, with 1-12, 5 dorsal basal setae and 5-

14, 8 lateral basal setae. Posterior margin of tergite IX somewhat rounded.

Pupa: (n=11)

Color. Clear, or clear with pale yellow borders, to light yellow-brown.

Length. Total 3.51-4.74, 3.99 mm(8). Cephalothorax 0.90-1.18, 1.06 mm (18). Abdomen 2.29-3.98, 3.04 mm (9).

Cephalothorax. Cephalic tubercles well developed, conical. Dorsum moderately to roughly pebbled; 2-3, 2(9) precorneal, 4(9) dorsocentral setae. Scutal tubercle present.

Abdomen (Fig. 155). Sternites I-III with transverse spine rows; S I with a single row; S II with 2 rows; S III with 1 row. S I-III also with 4 longitudinal spinule bands, spinules larger anteriorly. Posterior margin of T II with transverse row of 52-86, 72 hooklets. Tergites II-III usually without anterolateral shagreen areas; if present, they are small and weakly developed; with subquadrate to broadly triangular median shagreen area. T IV-VI with oval anterolateral shagreen areas and subquadrate to broadly triangular median shagreen area, which sometimes merge mesally; shagreen spinules larger in anterior and posterior portions of median shagreen areas. T VII with 2 weak anterolateral shagreen areas; T VIII with 2 anterolateral and posterolateral shagreen areas, or these merge to form 2 longitudinal bands. T VIII with 4 lateral lamellar setae. Caudolateral spurs on VIII (Figs. 156, 157) single, occasionally with a smaller basal spur or closely appressed double; sinuate; arising from posterior corner of segment. Anal lobes with 31-50, 38 setae. DR 1.72-2.50, 2.17.

Fourth instar larva: (n=23)

Color. Head capsule light yellow-brown to brown; postmentum usually darker, occasionally not; genae sometimes darker, occasionally with a broad, diffuse, semi-circular red-brown stripe; mandibular apodemes sometimes darker; postocciput dark red-brown-black. Frontal apotome usually with brown stripe, occasionally absent, usually with reticulate cuticular pattern (Fig. 223).

Head. Postmentum length 188-225, 209(14). Mandible (Fig. 219) length 123-175, 149(18) with 3 triangular inner teeth. Pecten mandibularis composed of 6-12, 9(16) setae. Mentum (Fig. 220) with 13 teeth, median tooth subequal to 1st laterals; 2nd lateral tooth almost completely fused or appressed to 1st lateral so that 1st lateral appears notched. Mentum width 98-141, 127(16); MR 2.39-2.76, 2.56(15). Anterior margin of ventromental plate often smooth on inner 1/3, crenulate on outer 2/3, or entirely crenulate; width 74-113, 93; length 42-56, 48. VPR 1.68-2.28, 1.97; IPD 44-68, 59(21); PSR 1.30-2.23, 1.59(21); 19-35, 24 strial ridges. Length of antennal segments: 49-69, 58(16); 15-20, 18(16), 9-12, 10(10); 11-14, 13(16); 5-7, 6(15). AR 1.08-1.36, 1.23(15) (Fig. 221). Width of inner blade of premandible (Fig. 222) greater than outer blade. Pecten epipharyngis with 3-5, 5(14) lobes. Anterior margin of frontal apotome concave, roughly tuberculate, frontal pit elliptical-suboval, with ventral uvula-shaped process. Posterior 1/3 of labral sclerite 1 with

low, rounded tubercles.

Body. Ventral tubuli absent.

Type material examined. -Lectotype: Male, St. Joseph, Ill., May 3, 1914 (INHS). -Paralectotypes: 3 males, St. Joseph, Ill., Salt Fork, May 3, '14 (INHS, COR).
Additional material examined: U.S.A.: Alabama: 6 males; II, VIII. Arkansas: 3 males; VII, IX. Colorado: 1 male, 1 larva; VII, VIII. Florida: 1 male/Pex/Lex, 2 pharate male pupae/Lex, 73 males, 2 females/Pex/Lex, 1 pharate female pupa/Lex, 1 female pupa; IV, V, VII, IX-XI. Georgia: 1 male, 2 females pupae/Lex, 4 larvae; VIII-X. Illinois: 7 males, 1 Pex/Lex, 11 larvae; IV-VII, X. Kansas: 10 males; IV, VI, X, XI. Maine: 4 males; VIII. Maryland: 22 males; IV, VI-IX. Massachusetts: 4 males; VIII. Michigan: 3 males; VI, VIII. Minnesota: 1 pharate male pupa/Lex; VI. Mississippi: 2 males; IX. Missouri: 1 male; VI. New Mexico: 1 male/Pex/Lex; VII. New York: 11 males/Pex/Lex, 17 males, 19 females/Pex/Lex, 1 female; VI-IX. Ohio: 4 males; I, VI, VIII. Okalahoma: 2 males/Pex/Lex, 4 males; IX, X. Pennsyvlania: 1 male/Pex/Lex, 1 pharate male pupa, 26 males, 1 female/Pex/Lex, 2 females pupae/Lex; VI-IX. South Carolina: 2 males; XI. South Dakota: 7 males/Pex/Lex, 8 males; VI-IX. Texas: 26 males; IV-VI, VIII, X, XII. Virginia: 4 males; VIII, X. Washington, D.C.: 1 male; VI. CANADA: Manitoba: 2 males; VII. Northwest Territories: 1 larva; V. Ontario: 1 male/Pex/Lex, 1 pharate male pupa, 12 males, 1 female/Pex/Lex, 1 female pupa/Lex; V-IX. Quebec: 1 male, 1 larva; V, VIII.

Remarks

A common species throughout the eastern U.S. and Canada. Adults can be mistaken for D. fumidus (similar in general coloration) or for dark forms of D. modestus, especially if slide mounted specimens have been excessively cleared or crushed. The gonostylus does show some gradation towards the shape of the gonostylus of D. modestus. I examined a specimen from Oklahoma in which the larva was easily determined to D. neomodestus, but the adult gonostylus was quite similar to D. modestus. The superior volsella of D. neomodestus tends to be smaller than that of D. modestus; the "foot" portion is more narrow and elongated, and the "leg" portion is wider. The shape of the anal point and posterior portion of tergum IX is easily distorted by cover slip pressure (Figs. 100-103), a condition which is not limited to this species.

The pupa is not always safely separable from D. modestus, because there are overlaps in anal lobe setal counts between these 2 species. A larval and/or adult association is desirable for reliable species separation.

Larval head capsule coloration is variable, ranging from individuals with dark red-brown postmental, genal, and frontal apotome areas, to those with only a brownish postmentum, and to those lacking any postmental darkening. The amount of scalloping on the anterior margin of the ventromental plates is variable. In general, larvae with coarse scalloping tend to have higher strial ridge counts; those with weaker scalloping tend to have lower counts, with many intermediates.

Simpson & Bode (1980) found this species to be pollution sensitive, although it thrived in areas of high levels of nutrients or organic matter. They also found it in a wide range of stream sizes and current speeds. I collected and reared larvae from algae lying under a quickly moving sheet of water flowing over a dam in Pennsylvania.

Martin et al. (1979) described the karyotype, based on specimens from Yankton, S.D.

I have examined the lectotype, designated by Frison (1927). The abdomen is slide mounted, the remainder of the body is point mounted; the specimen is in the collection of the INHS. I have also examined 3 male paralectotypes.

Dicrotendipes nervosus (Staeger)
Figs. 104-109, 141-147, 235-245.

Chironomus nervosus Staeger, 1839:567 (adult description); Walker 1929:386, Fig. 12e (adult).
Chironomus Goetgheburi Kieffer, 1915:81 (adult description); Goetghebuer 1921:149 (adult).
Tendipes falciformis Kieffer, 1912:51 (adult description).
Limnochironomus falciformis (Kieffer): Kieffer 1920:167 (established genus).
Limnochironomus falciformis var. (Kieffer): Kieffer 1920:167 (adult variant).
Limnochironomus Goetghebueri (Kieffer): Kieffer 1920:167 (adult).
Chironomus (Limnochironomus) nervosus (Staeger): Goetghebuer 1928:52, Figs. 74, 75 (adult and pupa).
Tendipes (Limnochironomus) nervosus (Staeger): Kruseman 1933:176, Figs. 38, 39 (adult description); Goetghebuer 1937-1954:20, Figs. 67, 68 (adult); Townes 1945:108, Fig. 112C (adult); Townes 1952:74, Fig. 114C (adult).
Limnochironomus nervosus (Staeger): Lenz 1954-1962:193, Figs. 188, 190, 195, 199, 201, 206, 207 (pupa and larva description); Pinder 1978:126, Figs. 61D-E, 157D (adult in key).
Chironomus (Dicrotendipes) nervosus (Staeger): Sublette & Sublette 1965:169 (placement and distribution).
nec Dicrotendipes nervosus (Staeger): Mason 1973:21, 38 (misdetermination of D. lucifer; Beck 1976:55 (in key).
"Dicrotendipes mooreae": manuscript name, Gillespie 1974:116, Fig. 18 (adult description).
Dicrotendipes nervosus (Staeger): Fittkau & Reiss 1978:431 (distribution); Sublette & Sublette 1979:96 (distribution); Reiss 1980:148 (distribution); Ree & Kim 1981:151, Fig. 12 (adult description and distribution).
Dicrotendipes gr. nervosus (Staeger): Moller Pillot 1978-1979:IV.17.9. (larva).

Type locality: Denmark?
Diagnosis: The superior volsella and R & R_1 setal count of more than 35 will separate the male from other members of the D. nervosus group. The pupa is identical to the other known members

of the D. nervosus group, D. lucifer and D. simpsoni. The larva can be separated by the fused or closely appressed fifth and sixth inner teeth of the mentum, and by the relatively unmodified proximal inner tooth of the mandible.

Male imago (n=7)

Color. Head pale brown to light green, thorax green with red-brown to golden vittae, abdomen light green to green, apical segments sometimes darker; genitalia light brown to light green; legs stramineous to green, apical tarsomeres darker. Wings clear, veins light yellow-brown.

Length. Total 3.71-5.78, 5.09 mm (4). Thorax 0.88-1.50, 1.13 mm (7). Abdomen 2.80-4.33, 3.79 mm (4).

Head. Temporals 46-72, 59(4). Clypeus with 15-27, 23 setae. Cibarial setae 7-13 (3). Palpal segment lengths: 43-65, 52(4); 50-85, 64(5); 135-210, 175(5); 173-230, 195(5); 190-290, 238(4). Frontal tubercles 7-25, 12(6) long, 5-10, 7(5) wide. AR 2.17-3.14, 2.59.

Thorax. Scutal tubercle poorly developed or absent. Acrostichals 8-16, 12(6); dorsocentrals 12-31, 25; scutellars 10-22, 16; prealars 8-14, 11(6). Humeral pit moderately to well developed, with 3-10 minute tubercles.

Wing. Length 1.60-2.79, 2.21 mm; width 445-770, 611. FCu below or slightly distal to RM. VR 0.88-0.97, 0.92(6). Brachiolum with 2-3, 3 setae. R & R_1 with 38-68, 48 setae; R_{4+5} with 22-38, 30 setae; squama with 8-21, 13 setae.

Legs. Foretarsal beard absent. Metatarsus of middle leg with 6-8, 7(6) palmate sensilla chaetica. Lengths and proportions of legs:

	P_1	P_2	P_3
fe	790-1150, 974	755-1155, 938(5)	820-1290, 1083(6)
ti	610-980, 801	700-1090, 899(6)	900-1480, 1225(6)
ta_1	980-1530, 1218	390-545, 467(6)	650-950, 811(6)
ta_2	495-765, 613(6)	200-320, 266(6)	310-520, 431(6)
ta_3	380-590, 484(6)	145-230, 196(6)	245-385, 321(6)
ta_4	305-470, 386(5)	90-150, 124(6)	140-230, 189(6)
ta_5	110-220, 163(6)	65-130, 96(6)	80-150, 119(6)
LR	1.43-1.99, 1.60	0.49-0.58, 0.53(6)	0.64-0.72, 0.67(6)

BV	1.79-1.94, 1.86(5)	3.36-3.51, 3.44(5)	2.85-3.06, 2.94(6)
SV	1.39-1.53, 1.46	3.71-4.29, 3.95(5)	2.65-2.96, 2.82(6)

Abdomen with 0-4 darker, flattened, bluntly tipped setae, which are easily lost, on S VI.

Hypopygium (Fig. 104). Gonostylus moderately wide, curved medially, with 6-14, 11 large setae on inner apex. Phallapodeme length 91-155, 124(5). Superior volsella (Figs. 105-109) length 71-118, 89, width 30-38, 34; slender, cylindrical with expanded, inflated apex, with 2-5, 3 sensilla chaetica running ventrally from inner side across to middle, above apical inflated portion. Inferior volsella with apex of club expanded, barely to deeply indented apically, with 2-3, 2 rows of 4-5, 4 sensilla chaetica each; with 1-2, 1 large ventral apical setae. Anal point bare dorsally, pyriform to elongate-elliptical, deflexed, with 4-8, 5 dorsal basal setae and 6-9, 8 lateral basal setae.

Pupa: (n=10)

Color. Clear to pale yellow, with yellow to yellow-brown margins.

Length. Total 4.51-6.50, 5.48 mm (8). Cephalothorax 1.18-1.63, 1.38 mm (8). Abdomen 3.34-5.00, 4.10 mm (8).

Cephalothorax. Cephalic tubercles (Figs. 146, 147) small to large, conical. Dorsum lightly to well pebbled; 2 precorneal, 4 dorsocentral setae. Scutal tubercle absent.

Abdomen (Fig. 141). Sternites I-III without transverse spine rows. S I-III with 2-4 very light longitudinal spinule bands, spinules larger anteriorly. Posterior margin of T II with transverse row of 65-121, 85 hooklets. T II-III without well developed anterolateral shagreen areas, with a median subquadrate shagreen area; T IV-V with 2 anterolateral shagreen areas which usually merge with subquadrate median shagreen area; T VI with roughly triangular median shagreen area, shagreen spinules largest in middle; T VII with 2 suboval to circular anterolateral shagreen areas; T VIII with 2 anterolateral and 2 posterolateral suboval to circular shagreen areas or 2 lateral longitudinal shagreen bands; a reticulate cuticular pattern often present on posterior portions of T VI-VIII. T VIII with 4 lateral lamellar setae. Caudolateral spurs on VIII (Figs. 142-145) usually single, occasionally double; short, stout, usually straight, bluntly pointed. Anal lobes with 37-64, 51 setae. DR 2.07-2.58, 2.39(9).

Fourth instar larva: (n=11)

Color. Head capsule yellow-brown to light brown, postmentum and mandibular apodemes sometimes darker; postocciput dark red-brown to black. Frontal apotome (Fig. 245) with or without brown stripe.

Head. Postmentum length 220-305, 269. Mandible (Fig. 235) length 149-219, 190(9); with 3 usually triangular inner teeth (Figs. 236, 237), occasionally the proximal tooth may bear a small lobe on its outer side (Figs. 238-240), but never developed

to the extent of the compound proximal inner tooth of D. lucifer or D. simpsoni. Pecten mandibularis composed of 9-14, 11(9) setae. Mentum (Fig. 241) with 13 teeth, median tooth subequal to 1st laterals; 6th, and sometimes 5th, lateral tooth rounded and fused or closely appressed to 5th (or 4th) lateral tooth. Mentum width 120-187, 156(10); MR 2.25-3.07, 2.58(10). Ventromental plate with almost smooth to crenulate anterior margin; width 91-117, 104(10); length 40-65, 50, VPR 1.77-2.41, 2.15(10); IPD 62-90, 72(8); PSR 1.30-1.71, 1.47(8); 22-36, 30(10) strial ridges. Length of antennal segments: 62-85, 71; 20-23, 21(10); 9-12, 11(8); 11-13, 13(8); 5-8, 6(8). AR 1.21-1.70, 1.42(8) (Fig. 242). Width of inner blade of premandible (Figs. 243, 244) greater than outer blade. Pecten epipharyngis with 3-6, 5 lobes. Anterior margin of frontal apotome concave, roughly tuberculate; frontal pit usually with long, uvula-shaped process. Labral sclerite 1 smooth.

Body. Ventral tubuli absent.

Material examined: U.S.A.: Alaska: 1 male; VII. California: 3 pharate male pupae, 133 males, 1 intersex, 3 females, 12 Pex, 31 larvae; II-XI. Colorado: 1 male; VI. Florida: 1 male, 1 larva; I. Idaho: 12 males, 2 females; VI, VII. Illinois: 1 male; IV. Kansas: 3 males; IV, VIII. Maryland: 1 male; V. Michigan: 6 males; IV-VI, IX. Minnesota: 2 males; V. Montana: 1 male; VII. Nevada: 7 males; VII, VIII. New York: 3 males; V, VI. South Carolina: 1 male, 3 larvae; I, V, VIII. Washington: 1 male; VI. Wyoming: 1 male; VII. CANADA: Alberta: 1 male/Pex/Lex; VII. British Columbia: 1 male; VIII. Manitoba: 6 males, 6 males/Pex; VI-VIII. New Brunswick: 1 male; VII. Northwest Territories: 19 males; VI, VII. Ontario: 4 males; VI, VII. Quebec: 1 male; VIII. Saskatchewan: 2 males/Pex/Lex, 22 males, 3 females/Pex-/Lex, V-VIII. WEST GERMANY: 4 males, 3 Pex, 2 larvae; VI, VIII.

Remarks

A Holarctic species, D. nervosus ranges at least as far south as southern California and Florida in North America.

The name D. nervosus (Staeger) is the most incorrectly used name in the genus for North America. I have seen specimens of D. incurvus, D. modestus, and the 2 species of the D. lucifer complex misdetermined as D. nervosus. Much of the confusion is due to lack of reared material and Townes' (1945) synonymy of C. lucifer Johannsen and C. indistinctus Malloch with D. nervosus (as T. (L.) nervosus). Due to this synonymy, larvae of the D. lucifer complex have been determined as D. nervosus because the associated adults keyed to T. (L.) nervosus in Townes (1945).

The D. nervosus group in North America is a group of at least 4 closely related species: D. aethiops (Townes), D. lucifer (Johannsen), D. nervosus (Staeger), and D. simpsoni n. sp. The immatures of D. aethiops remain unknown (Webb's (1972) specimens were D. fumidus); all life stages are known for the remaining 3 species. The group is characterized in the adult males by the superior volsella, which is long and thin, with a weakly expanded membranous apex. The pupae have no ventral spines on S I-III, possess short, stout caudolateral spurs on T VIII, and have a somewhat triangular median shagreen area on T

VI, with the longest spines found in the middle of the median shagreen area. The larvae usually display a modification of the proximal inner mandibular tooth, and/or the fifth and sixth inner teeth of the mentum are fused or closely appressed. Other species may have a single life stage which may possess one of these characters, but not the combination found in all 3 life stages for this group.

Adults of the true D. nervosus have superior volsellae as illustrated in Figs. 105-109. As this volsella is rotated 90 , it appears similar to that of D. lucifer (Fig. 111) or D. simpsoni (Fig. 112). Rotations like this can occur because of cover slip pressure, or, in pinned specimens, distortion while drying; so determinations based solely on male hypopygia can be incorrect.

Since pupae of the 3 species for which the pupae are known are inseparable, I prefer to call unassociated pupae "D. nervosus group sp."

The larvae of the 2 members of the lucifer complex, D. lucifer and D. simpsoni, have most often been misdetermined as D. nervosus. Both of these species possess mandibles with a modified proximal inner tooth. Such teeth are ordinarily not present in D. nervosus, although an apparent trend towards this character state can be seen in some specimens (Figs. 238, 239). See also Remarks under D. lucifer and D. simpsoni.

Reared specimens from California differ slightly from reared specimens examined from Saskatchewan. Minor, but inconsistent, differences were noted in adult AR. Larvae show the greatest differences. California larvae had a higher AR, higher number of strial ridges (low to mid 30's), and the anterior portion of the ventromental plates was smooth. Saskatchewan larvae had a lower AR, lower number of strial ridges (low to mid 20's), and the anterior portion of the ventromental plates was smooth or crenulate. A reared specimen from Alberta was intermediate in all these characters; I suspect that clinal variation may play a role in this instance. More rearing of this species is needed, especially in the western and southern Nearctic.

Because all larval and adult determinations of this species in North America are suspect, it is difficult to determine larval ecology. Brundin (1949) believed the larvae to be littoral mud dwellers; however, Humphries (1938) and Meuche (1939) found larvae living on reed stems and on algae covered rocks and boulders. Lehman (1971) reported larvae from stones in the Fulda River. These are typical Dicrotendipes habitats, and I would expect the Nearctic D. nervosus to be found in similar areas. I also examined 2 larvae from Steinhuder Meer in West Germany which were collected from a bryozoan colony.

The type specimen is apparently in the Copenhagen Museum in Denmark (Townes 1945:109). I have not seen it.

Dicrotendipes simpsoni n. sp.
Figs. 43, 110-111, 230-234.

Tendipes (Limnochironomus) lucifer (Johannsen): Hauber & Morrissey 1945:290, Figs. 3, 6, 11, 15 (description of

larva, pupa, adult); Roback 1957:110, 111, Fig. 549 (in key).

Tendipes (Limnochironomus) nervosus (Staeger) (partim): Townes 1945:108-109, Fig. 122B (adult description); Townes 1952:79, Fig. 114B (adult description).

Einfeldia sp.: Mason 1973:36 (misdetermination).

Dicrotendipes nervosus (Staeger) (partim): Beck 1976:55 (in key); Beck 1977:100 (larval ecology).

Dicrotendipes nervosus (Staeger) Type II: Simpson & Bode 1980:68 (larva description).

Type locality: U.S.A., New York, Erie Canal near Lyons.

Type material: -Holotype, male with Pex/Lex, Erie Canal Station 8, Lyons [New York], 2.1 mi W of Lock 27, coll: 27 Aug 1974, em: 2 Sept, 1974, sieve wash, K. W. Simpson (USNM). -Paratypes (15): Florida: Orange Co., L. Silver, 8 Nov 1961, W.M. Beck, Jr., 1 pharate male pupa/Lex. Georgia: Richmond Co., Savannah River 0.5 mi d.s. Spirit Creek, 10/19/76, leg. B.A. Caldwell, D. Williams, 1 pharate female pupa/Lex. New York: Genesee River Station 4, Rochester, 1.2 mi S of Barge Canal, multiplate sampler. coll: 25 July 1974, em: 2 Aug 1974, K.W. Simpson, 1 female/Pex/Lex. Erie Canal Station 5, Newark, 10 meters W of Stebbins Rd. br., float scrape, coll: 24 July 1974, em: 29 July 1974, K.W. Simpson, 1 female/Pex/Lex; same locality & collector, bottom sampler, coll: 28 Aug 1974, em: 30 Aug 1974, 1 female/Pex/Lex; same locality & collector, coll: 28 Aug 1974, em: 1, 3, 5 Sept 1974, 1 male/Pex/Lex, 3 females/Pex/Lex. L. Hudson River Station 5, 3.0 mi above Castleton, scraped from brick and line, coll: 11 Sept 1973, em: 18 Sept 1973, K.W. Simpson, 1 female/Pex/Lex. Mohawk River at Dyke Rd, downstream of Utica (Onieda Co.), aufwuchs (submerged stick), coll: 6 Sept 1978, em: 12 Sept, K.W. Simpson, 1 female/Pex/Lex. Genesee River Station 7, Rochester, 2.2 mi S of mouth, multiplate sampler, coll: 26 July 1974, em: 30 July 1974, K.W. Simpson, 1 male/Pex/Lex. Erie Canal Station 8, Lyons, 2.1 mi W of Lock 27, rock scrape, coll: 27 Aug 1974, em: 31 Aug 1974, K.W. Simpson, 1 female/Pex/Lex; same locality & collector, sieve wash, coll: 27 Aug 1974, em: 1, 6 Sept 1974, 2 females/Pex/Lex. (BAC, CNC, COR, FAMU, INHS, JHE, KWS, USNM)

Additional material examined: U.S.A.: Florida: 10 larvae; I, III, V, VIII, IX, XI.

Diagnosis: The superior volsella and R & R_1 setal count of less than 35 place the male of this species in the D. lucifer complex; it may be separated from D. lucifer by characters given in the key. The pupa is identical to the other known members of the D. nervosus group in North America. The unique larva of this species has the sixth lateral tooth of the mentum fused or closely appressed to the fifth lateral tooth, a proximal inner mandibular tooth which may or may not be compound, and a deep semicircular incision on the mandible proximal to the proximal inner tooth. The larva occasionally possesses a weak pair of ventral tubules on the eighth abdominal segment. See also diagnoses under D. lucifer and D. nervosus.

Etymology: I take great pleasure in naming this species for Dr. Karl W. Simpson, whose rearings of chironomid larvae, in

particular those of the D. lucifer complex, were instrumental in my work.

Male imago (n=3)

Color. Similar to D. lucifer.

Length. Total 3.60-3.64 mm (2). Thorax 1.03 mm (2). Abdomen 2.58-2.61 mm (2).

Head. Temporals 48(1). Clypeus with 20-23(2) setae. Cibarial setae 8-9(2). Palpal segment lengths (n=2): 30-35; 58-68; 126-133; 145-160; 185-216. Frontal tubercles 18-19 long, 6-8 wide (2). AR 2.55-2.68(2).

Thorax. Scutal tubercle absent or poorly developed. Acrostichals 14-18; dorsocentrals 20-24; scutellars 13-18(2); prealars 8-10(2). Humeral pit moderately well developed, with 6-10 tubercles.

Wing. Length 1.58-1.66 mm; width 470-495. FCu distal to RM. VR 0.89-0.90. Brachiolum with 2 setae. R & R_1 with 25-31 setae; R_{4+5} with 19-22 setae; squama with 8-12 setae.

Legs. Foretarsal beard absent. Metatarsus of middle leg with 5-8(2) palmate sensilla chaetica. Lengths and proportions of legs:

	p_1	p_2	p_3
fe	785-820	705-740	750-805
ti	500-565	620-660	805-860
ta_1	990-1060	315-340	520-570
ta_2	470-510	170-195	255-270
ta_3	395-430	110-125	205-220
ta_4	315-355	60-70	105-120
ta_5	145-160	55-60	75
LR	1.88-2.08	0.51-0.52	0.65-0.68
BV	1.68-1.78	3.87-4.15	3.19-3.26
SV	1.27-1.32	4.12-4.21	2.90-3.07

Abdomen with 0-1 flattened, bluntly tipped setae on S VI.

Hypopygium (Fig. 110). Gonostylus narrow, curving medially, with 9-11(2) large setae on inner apex. Phallapodeme length 103-105(2). Superior volsella (Fig. 112) length 73-78(2), width 16-18(2); slender, cylindrical, usually with microtrichia ventrally, with expanded, inflated, usually round apex; with 2-5 sensilla chaetica on inner side, directed inward. Inferior volsella with apex of club moderately expanded, barely to deeply incised, with 2 rows of 3-4 sensilla chaetica each; with 1 large ventral apical setae. Anal point bare dorsally, pyriform, deflexed, with 4-5 dorsal basal setae and 7-8 lateral basal setae.

Pupa: (n=7)

Color. Clear to pale yellow with yellow to yellow-brown margins.

Length (n=2). Total 3.86-4.49 mm. Cephalothorax 1.16-1.25 mm. Abdomen 2.70-3.24 mm.

Cephalothorax. Cephalic tubercles small to large, conical. Dorsum lightly to well pebbled; 2 precorneal, 4 dorsocentral setae. Scutal tubercle absent.

Abdomen. Similar to D. nervosus (Fig. 141). Sternites I-III without transverse spine rows. S I-III with 2-4 light longitudinal spinule bands, spinules larger anteriorly. Posterior margin of T II with transverse row of 69-99, 81 hooklets. Tergites II-III without well developed anterolateral shagreen areas, with a median subquadrate shagreen area; T IV-V with 2 anterolateral shagreen areas which usually merge with subquadrate median shagreen area; T VI with roughly triangular median shagreen area, shagreen spinules largest in middle; T VII with 2 suboval to circular anterolateral shagreen areas; T VIII with 2 anterolateral and 2 posterolateral suboval to circular shagreen areas or 2 lateral longitudinal shagreen bands; a reticulate cuticular pattern often present on posterior portions of T VI-VIII. T VIII with 4 lateral lamellar setae. Caudolateral spurs on VIII similar to D. nervosus (Figs. 142-145); usually single, short, stout, straight, bluntly pointed. Anal lobes with 45-63, 52 setae. DR 2.00-2.50, 2.26(6).

Fourth instar larva (n=7)

Color. Head capsule yellow-brown, postmentum and mandibular apodemes sometimes darker; postocciput dark red-brown. Frontal apotome with or without brown stripe.

Head. Postmentum length 228-260, 250. Mandible length 170-223, 192(4); with 3 inner teeth, proximal tooth bilobed or "saddle-shaped", sometimes single (Fig. 231); if bilobed, proximal lobe larger than distal lobe (Fig. 230); inner surface of mandible adjacent to proximal tooth with a deep semicircular incision. Pecten mandibularis composed of 12-13(2) setae. Mentum (Fig. 232) with 13 teeth. median tooth subequal to 1st laterals; 6th, and sometimes 5th, lateral tooth rounded and fused or closely appressed to 5th (or 4th) lateral tooth, so that mentum sometimes appears to have only 11 teeth. Mentum width 151-164(3); MR 2.48(2). Ventromental plate with mostly smooth, sometimes shallowly crenulate anterior margin; width 89-100, 96(6); length 45-52, 49(6); VPR 1.84-2.09, 1.96(6); IPD 68-73(3); PSR 1.24-1.35(2); 21-34, 25 strial ridges. Lengths of antennal segments: 56-77, 65(6); 19-28, 24(5); 9-12, 11(4); 14-16, 15(4); 6-8, 7(4). AR 1.07-1.29, 1.17(4). Width of inner blade of premandible greater than outer blade, similar to D. lucifer (Fig. 229). Pecten epipharyngis with 5 lobes. Anterior margin of frontal apotome concave, roughly tuberculate (Fig. 234), frontal pit with uvula-shaped process. Labral sclerite 1 smooth.

Body. A weak pair of ventral tubules sometimes present on venter of 11th segment.

Remarks

This species is referred to as Einfeldia sp. in Mason (1973)

and D. nervosus (Staeger) Type II in Simpson & Bode (1980).

This species is unique among the Nearctic Dicrotendipes because the larva sometimes possesses a weak pair of ventral tubules on the eighth abdominal segment (Fig. 43). The Palaearctic species D. notatus has also been reported as having ventral tubules (Gouin 1936; Moller Pillot 1978-1979; see also Remarks under D. leucoscelis above). Unfortunately, the larvae with ventral tubules that I examined had no accompanying ecological data. This may be a facultative condition which might allow the larva to survive under more adverse conditions. Mason (1973) may have seen specimens of D. simpsoni with ventral tubules and, because of their presence, considered the specimens to belong to Einfeldia.

See also Remarks under D. lucifer and D. nervosus.

The reared holotype male with associated exuviae will be placed in the USNM. Paratypes will be placed in the CNC, COR, FAMU, INHS, USNM and other collections. All type material is slide mounted.

Dicrotendipes thanatogratus n. sp.
Figs. 113-114, 163-167.

Type locality: U.S.A., Florida, Okaloosa Co., Bone Creek.
Type material: -Holotype: Reared male with Pex/Lex, Florida; Okaloosa Co., Bone Creek in Blackwater Nat'l Forest, coll: Feb 26, 1978, pres. Mr. 9, 1978, A.R. Soponis, B.T. Kidd, E. & D. Towns (USNM). -Paratypes (2): Florida: Clay Co., Peters Creek, 1-IV-66, Beck, 1 reared male/Pex/Lex (CNC). Flagler Co., drainage ditch, 26-V-64, Beck, 1 reared female/Pex/Lex (JHE).
Diagnosis: The brown coloration, clouded wings, and the well developed posterolateral setae of the adult male ninth tergite are distinctive. The pupa is separated by the spine rows on S I-III and the weak shagreen on the dorsum of the anal lobes. The deeply crenulate ventromental plates, with low strial ridge count, and the pale yellow, reticulated head capsule distinguish the larva.
Etymology: From the Greek thanatos, meaning death, dead; and the Latin gratus, meaning thankful, grateful. This species is named for the Grateful Dead, a group of musicians who for the past 20 years have provided the background music for my life.

Male imago (n=2: 1 holotype and 1 paratype)

Color. (Slide mounted material): Head and body brown, posterior 1/3 of T VII and VIII lighter; legs light brown. Wings very light brown, with darker clouds at base and apex of cell r_{4+5}, at base of cell m_{3+4}, along M_{3+4} and Cu_1, and along both sides of anal vein; wing veins brown.

Length. Total 4.40 mm (1). Thorax 1.15 mm (1). Abdomen 3.25 mm (1).

Head. Temporals 51(1). Clypeus with 21-25 setae. Cibarial setae 13(1). Palpal segment lengths: 31-40; 43-53; 133; 120-125; 185-208. Frontal tubercles 6-7 long, 5 wide. AR 2.23.

Thorax. Scutal tubercle moderately developed. Acrostichals 13-21; dorsocentrals 29-42; scutellars 12-16; prealars 8-12.

Humeral pit well developed, 3-5 low, rounded tubercles.

Wing. Length 1.65-1.85 mm; width 520-545. FCu below RM. VR 0.90-0.93. Brachiolum with 2-3 setae. R & R_1 with 33-37 setae; R_{4+5} with 31-34 setae; squama with 12-15 setae.

Legs. Foretarsal beard absent. Metatarsus of middle leg with 6-8, 7 palmate sensilla chaetica. Lengths and proportions of legs:

	P_1	P_2	P_3
fe	960(1)	765-825	830-900
ti	660(1)	725-800	980-1080
ta_1	1270(1)	390-430	660-690
ta_2	585(1)	230-240	350-360
ta_3	505(1)	160-170	280-290
ta_4	400(1)	100-110	150-160
ta_5	200(1)	90-95	105-115
LR	1.92(1)	0.54	0.64-0.67
BV	1.70(1)	3.24-3.34	2.79-2.89
SV	1.28(1)	3.78-3.82	2.74-2.87

Abdomen. Flattened setae on S VI not apparent.

Hypopygium (Fig. 113). Dorsum of T IX truncated posteriorly, with a group of 9-10 large setae laterad and anterior to anal point. Gonostylus moderately broad, curved medially, apex blunt, with 8-9 large setae on inner apex. Phallapodeme length 110-114. Superior volsella (Fig. 114) length 77-79, width 58-63; pediform, ventrally covered with microtrichia except bottom and tip of "foot", with 13 long sensilla chaetica arranged in 3 transverse rows. Inferior volsella with tip of club expanded, moderately indented apically, with 2 rows of 4-5 sensilla chaetica each; with 1-2 ventral apical setae. Anal point minutely punctate apically, pyriform, deflexed, with 0 dorsal basal setae and 6-9 lateral basal setae.

Pupa: (n=3)

Color. Light brown.

Length. Total 4.58-5.33 mm (2). Cephalothorax 1.18-1.23 mm (2). Abdomen 3.40-4.10 mm (2).

Cephalothorax. Cephalic tubercles moderately long, conical. Dorsum pebbled; 2 precorneal, 4 dorsocentral setae. Scutal tubercle not observable.

Abdomen. Sternites I-III with transverse spine rows; S I with single row; S II with 2 rows; S III with single row. S I-III also with 2-4 longitudinal spinule bands, spinules larger anteriorly. Posterior margin of T II with transverse row of 29-53 hooklets. Tergites II-III with subquadrate median shagreen

area; T IV-VI with anterolateral shagreen areas which merge with subquadrate median shagreen area, spines slightly larger anteriorly and posteriorly in median shagreen area; T VII with very weak anterior transverse shagreen band; T VIII with 2 suboval anterolateral shagreen areas and a posterior transverse shagreen band, or 2 subtriangular anterolateral and 2 suboval posterolateral shagreen areas. T VIII with 4 lateral lamellar setae. Caudolateral spurs on VIII (Fig. 163) single, straight to slightly sinuate, originating at posterior corner of segment. Anal lobes (Fig. 163) with 36-55 setae and 2 faint suboval anterolateral shagreen areas. DR 2.04-2.72.

Larva: (n=3)

Color. Head capsule pale yellow, with strong cuticular reticulations; postocciput clear-pale yellow.

Head. Postmentum length 235-275. Mandible length 200-218(2) with 3 triangular inner teeth. Pecten mandibularis composed of 10-13 setae. Mentum (Fig. 164) with 13 teeth, median tooth subequal to 1st laterals. Mentum width 163-169; MR 2.71-2.72(2). Ventromental plate with deeply crenulate anterior margin; width 89-107; length 57-70; VPR 1.43-1.65; IPD 78-80(2); PSR 1.25-1.37(2); 18-19 strial ridges. Length of antennal segments: 75-78; 20-23; 12-13; 15-20; 6-7. AR 1.26-1.39 (Fig. 165). Width of inner blade of premandible (Fig. 166) much wider than outer blade, outer blade drawn to fine point. Pecten epipharyngis with 5 lobes. Anterior margin of frontal apotome concave, roughly tuberculate (Fig. 161), frontal pit indistinct, with uvula-shaped process.

Body. Ventral tubuli absent.

Remarks

This species is known only from 3 reared specimens from Florida. It apparently is the larva Beck (1976:55; 1977:97) referred to as D. lobus. The 2 species do not resemble each other; D. lobus is found only in brackish coastal marshes, while D. thanatogratus is restricted to fresh water.

The presence of a weak shagreen pattern on the dorsum of the pupal anal lobes (Fig. 163) is unique for the Nearctic Dicrotendipes.

The reared holotype male and its exuviae will be placed in the USNM. One paratype will be placed in the CNC, the other will remain in my collection; all specimens are slide mounted.

LITERATURE CITED

Adams, C.F. 1940. A preliminary list of the Chironomidae (midges) of Missouri. Proceedings of the Missouri Academy of Sciences 5:124-127.

Ali, A. & Mulla, M.S. 1980. Activity of organophosphate and synthetic pyrethroid insecticides against pestiferous midges in some southern California flood control channels. Mosquito News 40:593-597.

Aristovskaya, G.V. 1935. Materialy k faune khironomid vodoemov Tatarespubliki. Trudy Tatarskogo Otdeleniya Vsesoyuznyi Nauchno-issledovatel'skii Institut Ozerno-rechnogo Rybnogo

Khozyaistva 2:109-158.
Ashe, P. 1983. A catalogue of the chironomid genera and subgenera of the world including synonyms (Diptera: Chironomidae). Entomologica Scandinavica Supplement 17:1-68.
Bath, J.L. & Anderson, L.D. 1969. Larvae of seventeen species of chironomid midges from southern California (Diptera). Journal of the Kansas Entomological Society 42:154-176.
Beck, E.C. 1962. Five new Chironomidae (Diptera) from Florida. Florida Entomologist 45:89-92.
- & Beck, W. M. 1959. A checklist of the Chironomidae (Insecta) of Florida (Diptera:Chironomidae). Bulletin of the Florida State Museum, Biological Sciences 4:85-96.
Beck, W.M., Jr. 1976. Biology of the larval chironomids. Florida Department of Environmental Regulation Technical Series 2:1-58. (revised May 1979).
- 1977. Environmental requirements and pollution tolerance of common freshwater Chironomidae. Environmental Monitoring Series, U.S.E.P.A., Cincinnati, 261 pp.
Brundin, L. 1949. Chironomiden und andere Bodentiere der südschwedischen Urgebirgsseen. Ein Beitrag zur Kenntnis der bodenfaunistischen Charakterzüge schwedischer oligotropher Seen. Institute of Freshwater Research, Drottningholm, Report 30:1-914.
Bryce, D. & Hobart, A. 1972. The biology and identification of the larvae of the Chironomidae (Diptera). Entomologist's Gazette 23:175-217.
Chernovskii, A.A. 1949. Opredelitel lichinok komarov semeistva Tendipedidae. Opredelitel Faune SSSR 31:1-186.
Coe, R.L. 1950. Family Chironomidae. Handbooks for the Identification of British Insects 9:121-206.
Coffman, W.P. 1978. Chironomidae, pp 345-376. In Merritt, R.W. & Cummins, K.W. (eds): Aquatic Insects of North America. Kendall/Hunt Publishing Co., Dubuque, Iowa. 441 pp.
- 1979. Neglected characters in pupal morphology as tools in taxonomy and phylogeny of Chironomidae (Diptera). Entomologica Scandinavica Supplement 10:37-46.
Cranston, P.S. 1982. The metamorphosis of Symposiocladius lignicola (Kieffer) n. gen., n. comb., a wood-mining Chironomidae (Diptera). Entomologica Scandinavica 13:419-429.
Darby, R.E. 1962. Midges associated with California rice fields, with special reference to their ecology (Dipt., Chir.). Hilgardia 32:1-206.
Disney, R.H.L. 1975. Notes of crab-phoretic Diptera (Chironomidae and Simuliidae) and their hosts in Cameroon. Entomologist's Monthly Magazine 111:131-136.
Dyar, H.G. 1902. Illustrations of the early stages of some Diptera. Proceedings of the Entomological Society of Washington 6:56-60.
Edwards, F.W. 1929. British non-biting midges (Diptera, Chironomidae). Transactions of the Royal Entomological Society of London 77:279-430.
Epler, J.H. 1983. Taxonomic revision of the Nearctic Dicrotendipes Kieffer, 1913 (Diptera:Chironomidae). M.S. thesis, Florida State University, Tallahassee, FL, 283 pp.
Fittkau, E.J. 1962. Die Tanypodinae (Diptera:Chironomidae)(Die

Tribus Anatopyniini, Macropelopiini und Pentaneurini). Abhandlungen zur Larvalsystematik der Insekten 6:1-453.
- & Reiss, F. 1978. Chironomidae, pp 404-440. In Illies, J. (ed): Limnofauna Europaea, 2 Aufl. G. Fischer, Stuttgart, 532 pp.
- & -. 1979. Die zoogeographische Sonderstellung der Neotropischen Chironomiden (Diptera). Spixiana 2:273-280.

Freeman, P. 1955. Chironomidae (Diptera Nematocera). Exploration du Parc National Albert Mission G.F. deWitte 83:3-41.
- 1957. A study of the Chironomidae (Diptera) of Africa south of the Sahara. III. Bulletin of the British Museum (Natural History), Entomology 5:323-426.
- 1961. The Chironomidae (Diptera) of Australia. Australian Journal of Zoology 9:611-737.
- & Cranston, P.S. 1980. Family Chironomidae, pp 175-202. In Crosskey, R.W. (ed): A Catalog of the Diptera of the Afrotropical Region. British Museum (Natural History), London, 1,437 pp.

Frison, T.H. 1927. A list of the insect types in the collection of the Illinois State Natural History Survey and the University of Illinois. Bulletin of the Illinois State Natural History Survey 16:135-309. (reference not seen).

Frommer, S.I. 1967. Review of the anatomy of adult Chironomidae. California Mosquito Control Association Technical Series Bulletin 1, 40 pp.
- & Rauch, P.A. 1971. Pupal duration, adult emergence and oviposition periods for the midge Dicrotendipes californicus (Johannsen)(Diptera:Chironomidae). California Vector Views 18:33-39.
- & Sublette, J.E. 1971. The Chironomidae of the Philip L. Boyd Deep Canyon Desert Center, Riverside Co., California. Canadian Entomologist 103:414-423.

Gillespie, J.M. 1974. A biosystematic study of Idaho Chironomini (Diptera:Chironomidae). Ph.D. dissertation, University of Idaho, 389 pp.

Goetghebuer, M. 1921. Chironomides de Belgique et spécialement de la zone des Flandres. Mémoires du Musee Royal d'Histoire Naturelle de Belgique 8:1-211.
- 1928. Diptères (Nématocères). Chironomidae. III. Chironominariae. Faune de France 5:1-174.
- 1936. Chironomides du Congo Belge. Revue de Zoologie et de Botanique africaines 28:453-492.
- 1937-1954. Tendipedidae (Chironomidae) b) Subfamilie Tendipedinae (Chironominae). A. Die Imagines, pp. 1-138. In Lindner, E. (ed): Die Fliegen der palaearktischen Region 13c.

Gouin, F. 1936. Métamorphoses de quelques Chironomides d'Alsace et de Lorraine avec la description de trois espèces nouvelles par M. Goetghebuer. Revue Francaise d'Entomologie 3:151-173.
- 1957. Études sur l'anatomie de la tête larvaire de quelques Chironomidae (Dipt. Nematoc.) I. Les structures Chironomines. Annales de la Societe entomologique de France 126:105-138.
- 1959. Morphology of the larval head of some Chironomidae

(Diptera, Nematocera). Smithsonian Miscellaneous Contributions 137:175-201.

Hamilton, A.L., Saether, O.A. & Oliver, D.R. 1969. A classification of the nearctic Chironomidae. Fisheries Research Board of Canada Technical Report 124:1-42.

Hansen, D.C. & Cook, E.F. 1976. The systematics and morphology of the Nearctic species of Diamesa Meigen, 1835 (Diptera:Chironomidae). Memoirs of the American Entomological Society 30:1-203.

Hauber, U.A. & Morrissey, T. 1945. Limnochironomids in Iowa including their life-histories. Proceedings of the Iowa Academy of Science 52:287-292.

Hilsenhoff, W.L. 1981. Aquatic insects of Wisconsin. Keys to Wisconsin genera and notes on biology, distribution and species. University of Wisconsin-Madison, Natural History Council 2:1-60.

Hirvenoja, M. 1973. Revision der Gattung Cricotopus van der Wulp und ihrer Verwandten (Diptera, Chironomidae). Annales Zoologici Fennici 10:1-363.

Hudson, P.L. 1971. The Chironomidae (Diptera) of South Dakota. Proceedings of the South Dakota Academy of Science 50:155-174.

Humphries, C.F. 1938. The chironomid fauna of the Grosser Ploner See, the relative density of its members and their emergence period. Archiv für Hydrobiologie 33:535-584.

International Code of Zoological Nomenclature. 3rd Edition adopted by the XX General Assembly of the International Union of Biological Sciences. 1985. Ride, W.D.L., Sabrosky, C.W., Bernardi, G. & Melville, R.V. (eds.). International Trust for Zoological Nomenclature, London. xx + 338 pp.

Johannsen, O.A. 1905. Aquatic nematocerous Diptera, pp. 76-327. In Needham, J.G., K.I. Morton & Johannsen, O.A. (eds): Mayflies and midges of New York. Bulletin of the New York State Museum 86.

- 1907. Some new species of Kansas Chironomidae. Kansas University Science Bulletin 4:109-112.
- 1932. Chironominae of the Malayan subregion of the Dutch East Indies. Archiv fur Hydrobiologie Supplement 11:503-552.
- 1937. Aquatic Diptera. IV. Chironomidae: Subfamily Chironominae. Memoirs of the Cornell University Agricultural Experiment Station 210:3-56.

Kieffer, J.J. 1911. Nouvelles descriptions des Chironomides obtenus d'eclosion. Bulletin de la Societe d'histoire naturelle de Metz 27:1-60.

- 1912. Description de quatre nouveaux Tendipes (Dipt.). Bulletin de la Societe entomologique de France 17:51-52.
- 1913. Chironomidae et Cecidomyidae. Voyage de Ch. Alluaud et R. Jeannel en Afrique Orientale (1911-1912). Resultats Scientifiques. Insectes Diptères :1-43.
- 1920. Tableau synoptique suivant des Chironomides paléarctiques appartenant aux genres Polypedilum et Limnochironomus. Annales de la Societe scientifique de Bruxelles 39:159-167.
- 1921a. Chironomides nouveaux ou peu connus de la région Paléarctique. Bulletin de la Societe d'histoire naturelle de

Metz 29:51-109.
- 1921b. Synopse de la tribu des Chironomariae (Dipteres). - Annales de la Societe scientifique de Bruxelles 40:269-276.
- 1921c. Chironomides des Philippines et de Formose. - Philippine Journal of Science 18:557-593.
- 1922a. Trois nouvelles espèces de Limnochironomus (Dipt.) de Sleswig-Holstein. Bulletin de la Societe entomologique de France 27:50-52.
- 1922b. Chironomides de l'Afrique Équatoriale. IIe partie. Annales de la Societe entomologique de France 91:1-72.

Kruseman, G. 1933. Tendipedidae Neerlandicae. I. Genus Tendipes cum generibus finitimis. Tijdschrift voor Entomologie 76:119-216.
- 1949. Note on Tendipedidae of the Suez Canal. Bijdragen tot de Dierkunde 28:249-254.

Lehman, J. 1971. Die Chironomiden der Fulda. Systematische, ökologische und faunistische Untersuchungen. Archiv für Hydrobiologie Supplement 37:466-555.

Lenz, F. 1921. Chironomidenpuppen und -larven. Bestimmungstabellen. Deutsche Entomologische Zeitschrift 3:148-162.
- 1937. Chironomariae aus Niederländisch-Indien. Larven und Puppen. Archiv für Hydrobiologie Supplement 15:1-29.
- 1954-1962. Tendipedidae (Chironomidae). b) Subfamilie Tendipedinae (Chironominae). B. Die Metamorphose der Tendipedinae, pp 139-260. In Lindner, E. (ed): Die Fliegen der palaearktischen Region, 13c.

Lichtenberg, R. 1974. Liste der Chironomiden-Typen am Naturhistorischen Museum in Wien. Chironomus 1:122-125.

Malloch, J.R. 1915. The Chironomidae or midges of Illinois, with particular reference to the species occurring in the Illinois River. Bulletin of the Illinois State Laboratory of Natural History 10:275-543.

Martin, J., Sublette, J.E. & Sublette, M.S. 1979. Karyosystematics of selected Chironominae of New Mexico, pp 129-156. In Sublette, J.E. (P.I.): Evaluation of longterm effects of thermal effluents on stream biota. Technical Report: "Utilization of Chironomidae (Diptera) as a water quality indicator group in New Mexico". New Mexico Energy Institute 32, 172 pp.

Maschwitz, D.E. 1976. Revision of the Nearctic species of the subgenus Polypedilum (Chironomidae:Diptera). Ph. D. thesis, University of Minnesota, 325 pp.

Mason, W.T. 1973. An introduction to the identification of chironomid larvae. Analytical Quality Control Laboratory, U.S.E.P.A., Cincinnati, Ohio, 90 pp.

McLachlan, A.J. 1976. Variation of "gill" size in larvae of the African midge Chironomus transvaalensis Kieffer. Journal of the Limnological Society of South Africa 2:55-56.

Meuche, A. 1939. Die Fauna im Algenbewuchs. Nach Untersuchungen im Litoral ostholsteinischer Seen. Archiv für Hydrobiologie 34:349-520.

Moller Pillot, H.K.M. 1978-1979. De larven der Nederlandse Chironomidae (Diptera). Nederlandse faunistische Mededelingen 1, 276 pp.

Morrow, J.A., Bath, J.L. & Anderson, L.D. 1968. Descriptions and

key to egg masses of some aquatic midges in southern California (Diptera:Chironomidae). California Vector Views 15:99-108.

Oliver, D.R. 1971. Description of Einfeldia synchrona n. sp. (Diptera:Chironomidae). Canadian Entomologist 103:1591-1595.

- 1981a. Chironomidae, pp 423-458. In McAlpine, J.F., Peterson, B.V., Shewell, G.E., Teskey, H.J., Vockeroth, J.R. & Wood, D.M. (coordinators): Manual of Nearctic Diptera, Vol. 1. Agriculture Canada Monograph 27, 674 pp.

- 1981b. Description of Euryhapsis new genus including three new species (Diptera:Chironomidae). Canadian Entomologist 113:711-722.

- McClymont, D. & Roussel, M.E. 1978. A key to some larvae of Chironomidae (Diptera) from the Mackenzie and Porcupine River watersheds. Fisheries & Marine Service Technical Report 791:iv + 73 pp.

- & Roussel, M.E. 1983. The genera of larval midges of Canada. Diptera:Chironomidae. The Insects and arachnids of Canada. Part II. Agriculture Canada Publication 1746, 263 pp.

Paggi, A. 1975. Formas imaginales y preimaginales de Chironomus (Dicrotendipes) alsinensis sp. nov. (Diptera:Chironomidae). Neotropica 21:149-156.

- 1978. Formas imaginales y preimaginales de Quironomidos (Diptera) IV. Dicrotendipes nestori sp. nov. Limnobios 1:235-241.

Pinder, L.C.V. 1978. A key to the adult males of the British Chironomidae (Diptera) the non-biting midges. Vol. I, The Key, 1-169; Vol. II, Illustrations of the Hypopygia, Figs. 77-189. Freshwater Biological Association Scientific Publication 37.

- 1983. The larvae of Chironomidae (Diptera) of the Holarctic region - Introduction. Entomologica Scandinavica Supplement 19:7-10.

- & Reiss, F. 1983. The larvae of Chironominae (Diptera:Chironomidae) of the Holarctic region.-Keys and diagnoses. Entomologica Scandinavica Supplement 19:293-435.

Ree, H.I. 1981. Studies on Korean Chironomidae (Diptera). 2. Description of a new genus and a new species of Chironominae. Korean Journal of Zoology 24:217-220.

- & Kim, H.S. 1981. Studies on Chironomidae (Diptera) in Korea 1. Taxonomical study on adults of Chironomidae. Proceedings of the College of Natural Sciences 6:123-226.

Reiss, F. 1974. Vier neue Chironomus-Arten (Chironomidae, Diptera) und ihre okologische Bedeutung für die Benthosfauna zentralamazonischer Seen und Überschwemmungswälder. Amazoniana 5:3-23.

- 1980. Zur zoogeographie der Chironomidenfauna (Diptera, Insecta) Nordkoreas, pp 145-149. In Murray, D.A. (ed): Chironomidae - ecology, systematics, cytology and physiology. Pergamon Press, New York, 354 pp.

Roback, S.S. 1957. The immature tendipedids of the Philadelphia area (Diptera:Tendipedidae). Monographs of the Academy of Natural Sciences of Philadelphia 9:1-152 + 28 plates.

Saether, O.A. 1969. Some Nearctic Podonominae, Diamesinae, and Orthocladiinae (Diptera:Chironomidae). Bulletin of the

Fisheries Research Board of Canada 170:1-154.
- 1971. Notes on the general morphology and terminology of the Chironomidae (Diptera). Canadian Entomologist 103:1237-1260.
- 1977a. Taxonomic studies on Chironomidae: Nanocladius, Pseudochironomus, and the Harnischia complex. Bulletin of the Fisheries Research Board of Canada 196:1-143
- 1977b. Female genitalia in Chironomidae and other Nematocera: morphology, phylogenies, keys. Bulletin of the Fisheries Research Board of Canada 197:1-209.
- 1980. Glossary of chironomid morphology terminology (Diptera:Chironomidae). Entomologica Scandinavica Supplement 14:1-51.

Sasa, M. & Hasegawa, H. 1983. Chironomid midges of the tribe Chironomini collected from sewage ditches, eutrophicated ponds, and some clean streams in the Ryukyu Islands, southern Japan. Japanese Journal of Sanitary Zoology 34:305-341.

Säwedal, L. 1982. Distribution of leg sensilla chaetica in male Chironomidae (Diptera) and its phylogenetic significance. Entomologica Scandinavica 13:1-22.

Say, T. 1823. Descriptions of dipterous insects of the United States. Journal of the Academy of Natural Sciences of Philadelphia 3:9-54, 73-104.

Schlee, D. 1966. Präperation und Ermittlung von Messwerten an Chironomiden (Diptera). Gewässer und Abwässer 41/42:169-193.

Simpson, K.W. & Bode, R.W. 1980. Common larvae of Chironomidae (Diptera) from New York State streams and rivers with particular reference to the fauna of artificial substrates. New York State Museum Bulletin 439:1-105.

Soponis, A.R. 1977. A revision of the Nearctic species of Orthocladius (Orthocladius) van der Wulp (Diptera: Chironomidae). Memoirs of the Entomological Society of Canada 102:1-187.

Staeger, C. 1839. Systematisk fortegnelser over de i Danmark hidtil fundne Diptera. Kröjer; Naturhistorisk Tidsskrift 2: 549-600.

Stone, A. 1980. History of Nearctic Dipterology, pp 1-62. In Griffiths, G.C.D. (ed): Flies of the Nearctic Region, Vol. I, Part I. E. Schweizerbart'sche Verlagsbuchhandlung, Stuttgart.

Strand, E. 1928. Miscellanea Nomenclatoria zoologica et palaeontogica, I-II. Archiv für Naturgeschichte 92A:30-75.

Sublette, J.E. 1960. Chironomid midges of California. I. Chironominae, exclusive of Tanytarsini (=Calopsectrini). - Proceedings of the United States National Museum 112:197-226.
- 1964. Chironomidae (Diptera) of Louisiana I. Systematics and immature stages of some lentic chironomids of west-central Louisiana. Tulane Studies in Zoology 11:109-150.
- 1979. Scanning electron microscopy as a tool in taxonomy and phylogeny of Chironomidae (Diptera). Entomologica Scandinavica Supplement 10:47-65.
- & Sublette, M.S. 1965. Family Chironomidae (Tendipedidae), pp 142-181. In Stone, A. et al. (eds): A catalog of the Diptera of America north of Mexico. United States Department

of Agriculture Handbook 276, 1696 pp.
- & - 1973a. The morphology of Glyptotendipes barbipes (Staeger)(Diptera:Chironomidae). Studies in Natural Sciences (Portales, N.M.) 1(6):1-81.
- & - 1973b. Family Chironomidae, pp 289-422. In Delfinado, M.D. & Hardy, D.E. (eds): Catalogue of the Diptera of the Oriental region. Vol. I. Suborder Nematocera. University of Hawaii Press, Honolulu, 618 pp.
- & - 1974. A review of the genus Chironomus (Diptera, Chironomidae) V. The maturus-complex. Studies in Natural Sciences (Portales, N.M.) 1(8):1-41.
- & - 1979. A synopsis of the Chironomidae of New Mexico, pp 53-128. In Sublette, J.E. (P.I.): Evaluation of long term effects of thermal effluents on stream biota. Technical Report: "Utilization of Chironomidae (Diptera) as a water quality indicator group in New Mexico". New Mexico Energy Institute 32, 172 pp.

Townes, H.K. 1945. The nearctic species of Tendipedini (Diptera:Tendipedidae (=Chironomidae)). American Midland Naturalist 34:1-206.
- 1952. Tribe Tendipedini (=Chironomini), pp 27-147. In Johannsen, O.A. & Townes, H.K. Guide to the insects of Connecticut. Fifth fascicle. Midges and gnats. Tendipedidae (Chironomidae). Connecticut Geological and Natural History Survey Bulletin 80.

Vargas, L. 1952. Tendipes (Limnochironomus) californicus y Tendipes (Limnochironomus) figueroai n. sp. (Diptera, Tendipedidae). Revista de la Sociedad Mexicana de Historia Natural 13:47-51.

Walker, F. 1856. Insecta britannica: Diptera. 3:1-352.

Webb, C.J., Wilson, R.S. & McGill, J.D. 1981. Ultrastructure of the striated ventromental plates and associated structures of larval Chironominae (Diptera:Chironomidae) and their rôle in silk-spinning. Journal of Zoology 194:67-84.

Webb, D.W. 1972. The immature stages of Chironomus aethiops (Townes) with keys to the species of the known immature stages of the subgenus Dicrotendipes (Chironomidae:Diptera). Transactions of the Illinois State Academy of Science 65:74-76.
- & Brigham, W.U. 1982. Aquatic Diptera, pp 11.1-11.111. In Brigham, A.R., Brigham, W.U. & Gnilka, A. (eds): Aquatic insects and oligochaetes of North and South Carolina. Midwest Aquatic Enterprises, Mahomet, Illinois, 837 pp.

Wensler, R.J.D. & Rempel, J.G. 1962. The morphology of the male and female reproductive systems of the midge, Chironomus plumosus L. Canadian Journal of Zoology 40:199-229.

Wülker, W., Eisele, H. & Rössler, R. 1982. Tarsal sensilla of Chironomus (Diptera:Chironomidae): number, parasitogenic changes, ultrastructure, and function. International Journal of Insect Morphology and Embryology 11:137-146.

Figure Legends

Frontispiece: Dicrotendipes thanatogratus n. sp., adult male.

Figs. 1-5: Adult morphology.-1. Structures of head, frontal view. -2. Antennal flagellum and pedicel; AR measurement method. -3. Cibarial pump and associated structures. -4. Method of abdominal length measurement. -5. Thoracic structures. (A, abdominal length; Ac, acrostichal setae; Cls, clypeal setae; CP, cibarial pump; CS, cibarial setae; Dc, dorsocentral setae; HP, humeral pit; LL, labial lonchus; Pa, prealar setae; Ped, pedicel; Pm_{1-5}, maxillary palpomeres 1-5; PPS, postpronotal suture; PS, parapsidal suture; PSS, prescutoscutal suture; Scp, scape; Sct, scutellar setae; Scut, scutellar tubercle; Sp, spiracle; Su, supraalar seta; T, thorax length; Te, tentorium; Tem, temporal setae; THS, thoracic scar; To, torma.)

Figs. 6-10: Adult morphology (SEM). -6. D. lobiger, humeral pit. -7. D. californicus, inner view of thoracic scar. -8. D. californicus, interior view of spread thorax, looking forward. -9. D. lobiger, metatarsal palmate sensilla chaetica of middle leg. -10. D. lobiger, palmate sensillum chaeticum of middle leg. (LE, lateral extension of phragma I; THS, thoracic scar; TP, terminal pore.)

Figs. 11-15: Adult morphology. -11. Method of measuring all femora & the fore tibia. -12. Method of measuring fore metatarsus. -13. Method of measuring tibiae & tarsomeres of mid & hind legs. -14. Wing (see Saether 1980 for abbreviations). -15. Methods of wing measurement. (WL, wing length; WW, wing width.)

Figs. 16-19: Adult morphology. -16. Lateral view of hypopygium (nearest gonostylus, inferior & superior volsellae removed). -17. Dorsal view of right side of hypopygium. -18. Ventral view of right side of hypopygium, showing internal apodemes. -19. Ventral view, superior volsella. (AnP, anal point; ATB, anal tergal band; Ca, coxapodeme; DBS, dorsal basal setae; Gc, gonocoxite; Gs, gonostylus; IVo, inferior volsella; L, length of superior volsella; LBS, lateral basal setae; MS, median setae; Pha, phallapodeme; SCh, sensilla chaetica; SVo, superior volsella; TSa, transverse sternapodeme; VAS, ventral apical seta; W, width of superior volsella.)

Figs. 20-25: Adult morphology (SEM). -20. D. lobiger, dorsal view of hypopygium. -21. Same, dorsal view of superior volsella. -22. Same, ventral view of same superior volsella. -23. D. californicus. posterior view of hypopygium. -24. Same, posterior view of anal point and superior volsellae. -25. D. lobiger, lateral view of hypopygium, right (nearest) gonostylus removed. -Fig. 26: Pupal morphology (light photograph, phase contrast), D. modestus, dorsal seta of anal lobe.

Figs. 27-30: Pupal morphology. -27. Ventral view of spread cephalothorax. -28. Lateral view of cephalothorax. -29a. Dorsal view of abdomen. -29b. Dorsal view of anal lobe. -30. Ventral view of abdomen. (A, abdomen length; ADS,

anterodorsal seta; AS, anterolateral shagreen area; C, cephalothoracic length; CS, caudolateral spur; CT, cephalic tubercle; D, number of ventral setae from dorsal seta position to anterior margin of anal lobe; Dc, dorsocentral setae; DS, dorsal seta; HC, humeral callus; Hl, hooklets; LLS, lateral lamellar setae; MS, median shagreen area; Pc, precorneal setae; PSA, pedes spurii A; PSB, pedes spurii B; ScuT, scutal tubercle; THB, thoracic horn base; V, total number of ventral anal lobe setae; VS, ventral setae of anal lobe; VSR, ventral spine rows.)

Figs. 31-37: Larval morphology. -31. Ventral view of head capsule. -32. Dorsal view of head capsule. -33. Mentum. -34. Ventromental plate. -35. Premandible. -36. Mandible. -37. Antenna. (ABl, accessory blade; Bl, antennal blade; FA, frontal apotome; L, length; LO. lauterborn organ; M, mentum mentum width; Man, mandible; Max, maxilla; MT, width of median teeth; PM, postmentum length; PMa, pecten mandibularis; Pm, premandible; PmB, premandibular brush; Po, postocciput; RO, ring organ; S, style; Si, seta interna; Sl 1,2, labral sclerites 1,2; SR, strial ridges; SSd, seta subdentalis; TO, triangulum occipitale; Vm, ventromental plate; W, width.)

Figs. 38-42: Larval morphology (SEM). -38. Lauterborn organ with style at apex of antennal segment 2. -39. D. incurvus, ventral (inner) view of anterior portion of frontal apotome and labral sclerite 1; frontal pit in center. -40. Same, ventral view of frontal pit. -41. Same, ventral view of frontal pit, same specimen as Fig. 39. -42. Same, oblique view of frontal pit. -Fig. 43: Larval morphology (light photograph, phase contrast), D. simpsoni, ventral tubule on 8th abdominal segment.

Figs. 44-46: Larval morphology. -44. Palatal surface of labrum. -45. Ventral view of maxilla. -46. Dorsal view of maxilla. (Ch, chaetae; ChL, chaetulae laterales; ChP, chaetulae of palpiger; G, galea; La, lacinia; LL, labral lamella; MP, maxillary palp; P, palpiger; PE, pecten epipharyngis; $SM_{1,2}$, setae maxillaris; SI-SIVA, SIVB, labral setae.)

Figs. 47-49: D. adnilus, adult male. -47. Hypopygium. -48. Superior volsella, dorsal view. -49. Superior volsella, ventral view.

Figs. 50-53: D. aethiops, adult male. -50. Hypopygium. -51-53. Variations of superior volsella.

Figs. 54-56: D. botaurus, adult male. -54. Hypopygium. -55. Superior volsella. -56. Anal point, lateral view.

Figs. 57-61: D. californicus, adult male. -57. Hypopygium. -58. Variation of anal point. -59. Superior volsella, normal. -60. Superior volsella with reflexed apex. -61. Superior volsella, deformed.

Figs. 62-65: D. fumidus, adult male. -62. Hypopygium. -63. Superior volsella, normal. -64,65. Variations of superior volsella.

Figs. 66-72: D. incurvus, adult male. -66. Hypopygium. -67, 68. Variations of gonostylus. - 69-72. Variations of superior volsella.

Figs. 73-75: D. leucoscelis, adult male. -73. Hypopygium. -74, 75. Variations of superior volsella.

Figs. 76-82: D. lobiger, adult male. -76. Hypopygium. -77. Lateral view of anal point. - 78-82. Variations of superior volsella.

Figs. 83-85: D. lobus. -83. Hypopygium. -84, 85. Variations of superior volsella.

Figs. 86-91: D. milleri, adult male. -86. Hypopygium. -87. Variation of gonostylus. -88-90. Variations of superior volsella. -91. Lateral view of anal point.

Figs. 92-97: D. modestus, adult male. -92. Hypopygium. -93. Variation of gonostylus. -94-97. Variations of superior volsella.

Figs. 98-103: D. neomodestus, adult male. -98. Hypopygium. -99. Superior volsella. -100-103. Pressure-induced variations of anal point.

Figs. 104-109: D. nervosus, adult male. -104. Hypopygium. -105-109. Variations of superior volsella.

Figs. 110-111: D. simpsoni, adult male. -110. Hypopygium. -111. Superior volsella. -Fig. 112: D. lucifer, superior volsella.

Figs. 113-114: D. thanatogratus, adult male. -113. Hypopygium. -114. Superior volsella.

Figs. 115-119: D. californicus, pupa. -115. Abdomen, dorsal. -116. Ventral view, S I-IV. -117. Cephalic tubercle. -118, 119. Variations of caudolateral spurs. -Figs. 120a-120b: D. crypticus, pupa. -120a. Dorsal view of T II-III. -120b. Ventral view of S II-III.

Figs. 121-125: D. fumidus, pupa. -121. Abdomen, dorsal. -122-124. Variations of caudolateral spurs. -125. Cephalic tubercle. - Figs. 126-132: D. incurvus, pupa. -126. Abdomen, dorsal. - 127-129. Variations of caudolateral spurs. -130-132. Variations of cephalic tubercle. -Figs. 133-134: D. milleri, pupa. -133. Cephalic tubercle. -134. Caudolateral spurs.

Figs. 135-140: D. lobiger, pupa. -135. Abdomen, dorsal. -136. Ventral view of S I-III. -137,138. Variations of

caudolateral spurs. -139, 140. Variations of cephalic tubercle. -Figs. 141-147: D. nervosus, pupa. -141. Abdomen, dorsal. - 142-144. Variations of caudolateral spurs. -146, 147. Variations of cephalic tubercle.

Figs. 148-154: D. modestus, pupa. -148. Abdomen, dorsal. -149. Spinules of anterolateral shagreen area, Florida specimen. - 150. Spinules of anterolateral shagreen area, New York specimen. - 151-153. Variations of caudolateral spur. -154. Cephalic tubercle. -Figs. 155-157: D. neomodestus, pupa. - 155. Abdomen, dorsal. - 156-157. Variations of caudolateral spur.

Figs. 158-162: D. adnilus, larva (presumptive association). -158. Mandible. -159. Mentum and ventromental plate. -160. Antenna. -161. Dorsal view, anterior portion of frontal apotome, labral sclerite 1. -162. Ventral view, frontal pit. -Figs. 163-167: D. thanatogratus, pupa & larva. -163. Dorsal view, T VIII and anal lobes. -164. Mentum and ventromental plate. -165. Antenna. -166. Premandible. -167. Anterior portion of frontal apotome, labral sclerite 1.

Figs. 168a-172: D. californicus, larva. -168a. Mandible. -168b. Mentum and ventromental plate. -169. Antenna. -170. Premandible. -171. Pecten epipharyngis. -172. Frontal apotome and associated structures. -Figs. 173-175: D. crypticus, larva. -173. Mentum and ventromental plate. -174. Antenna. -175. Anterior portion of frontal apotome and posterior portion of labral sclerite 1.

Figs. 176-181: D. fumidus, larva. -176. Mandible. -177. Mentum and ventromental plate. -178. Antenna. -179. Premandible. -180. Frontal apotome and associated sclerites. -181. Anterior portion of frontal apotome.

Figs. 182-187: D. incurvus, larva. -182. Mandible. -183. Mentum and ventromental plate. -184. Antenna. -185. Premandible. -186. Frontal apotome. -187. Anterior portion of frontal apotome. -Figs. 188-193: D. modestus, larva. - 188. Mandible. -189. Mentum and ventromental plate. -190. Antenna. -191. Premandible. -192, 193. Variations of anterior portion of frontal apotome.

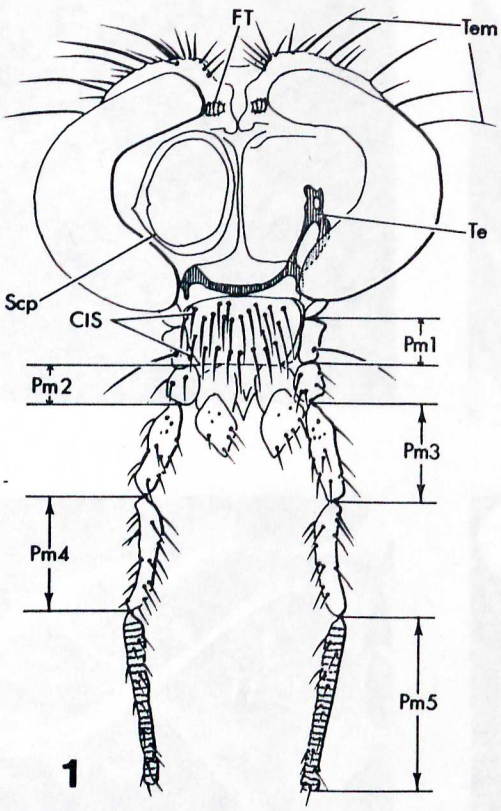
Figs. 194-203: D. leucoscelis, pupa and larva. -194. Dorsal view, T V-VI. -195. Intersegmental spines between T V-VI. - 196. Caudolateral spurs. -197. Cephalic tubercle. -198. Mandible. -199. Mentum and ventromental plate. -200. Antenna. -201. Premandible. -202. Pecten epipharyngis. -203. Frontal apotome.

Figs. 204-209: D. lobiger, larva. -204. Mandible. -205. Mentum and ventromental plate. -206. Antenna. -207. Premandible. - 208. Pecten epipharyngis. -209. Frontal apotome and associated sclerites.

Figs. 210-218: D. lobus, pupa and larva. -210, 211. Variations of caudolateral spurs. -212. Cephalic tubercle. -213. Mandible. -214. Mentum and ventromental plate. -215. Antenna. -216. Premandible. -217. Pecten epipharyngis. -218. Frontal apotome. -Figs. 219-223: D. neomodestus, larva. -219. Mandible. -220. Mentum and ventromental plate. -221. Antenna. -222. Premandible. -223. Frontal apotome and associated sclerites.

Figs. 224-229: D. lucifer, larva. -224-226. Variations of inner mandibular teeth. -227. Mentum and ventromental plate. -228. Antenna. -229. Premandible. -Figs. 230-234: D. simpsoni, larva. -230, 231. Variations of inner mandibular teeth. -232. Mentum and ventromental plate. -233. Antenna. -234. Anterior portion of frontal apotome.

Figs. 235-245: D. nervosus, larva. -235. Mandible. -236-240. Variations of inner mandibular teeth. -241. Mentum and ventromental plate. -242. Antenna. -243, 244. Variation of premandibles. -245. Frontal apotome.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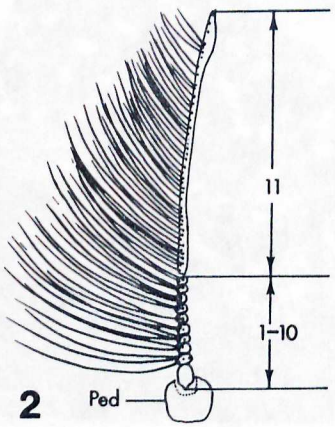
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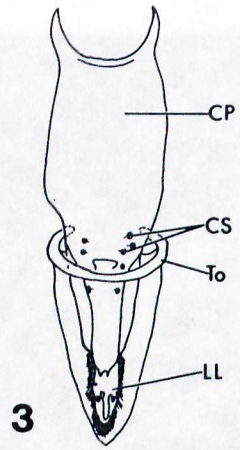
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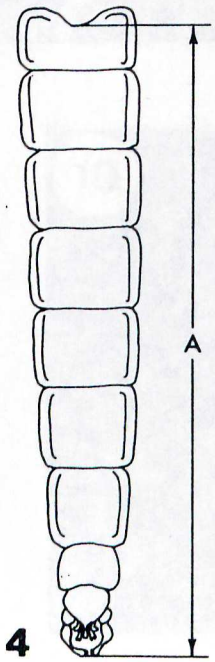
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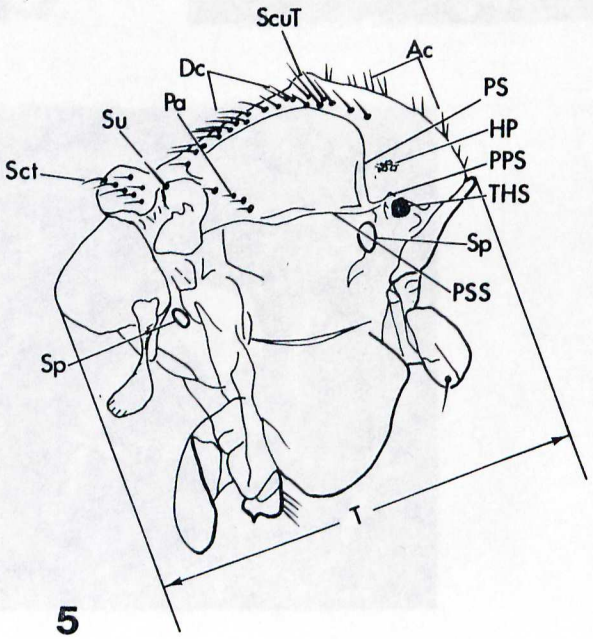
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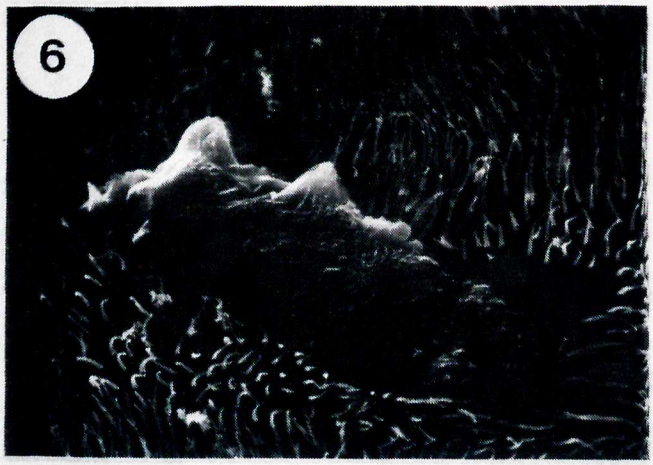
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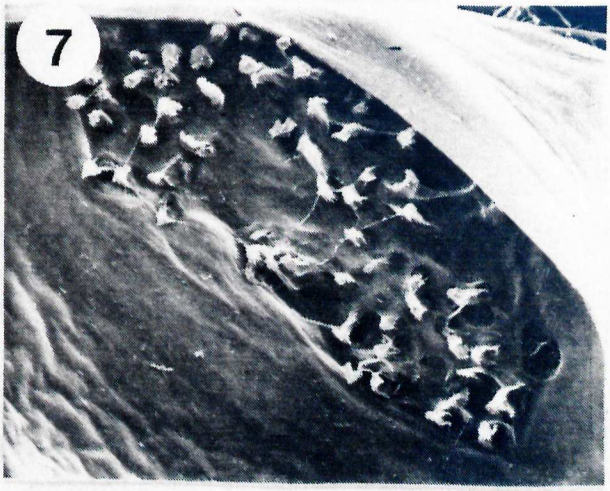
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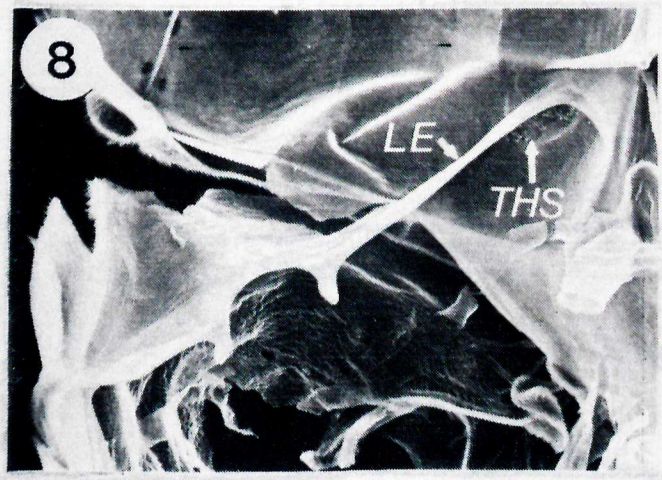
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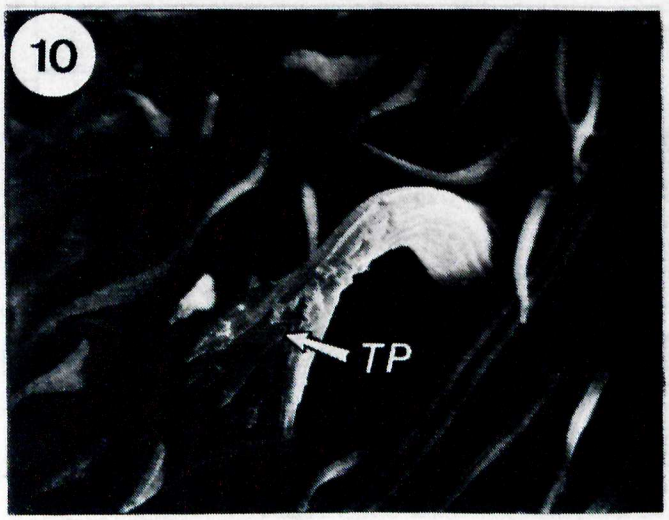
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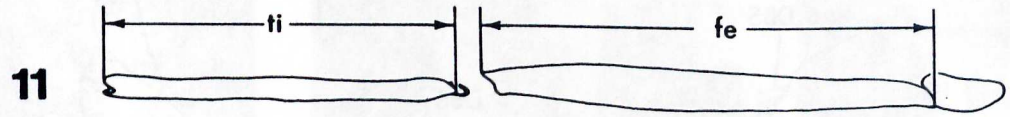
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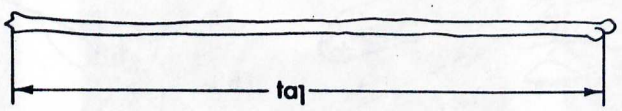
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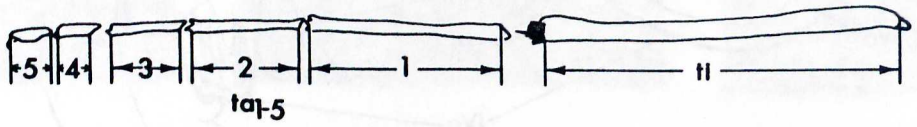
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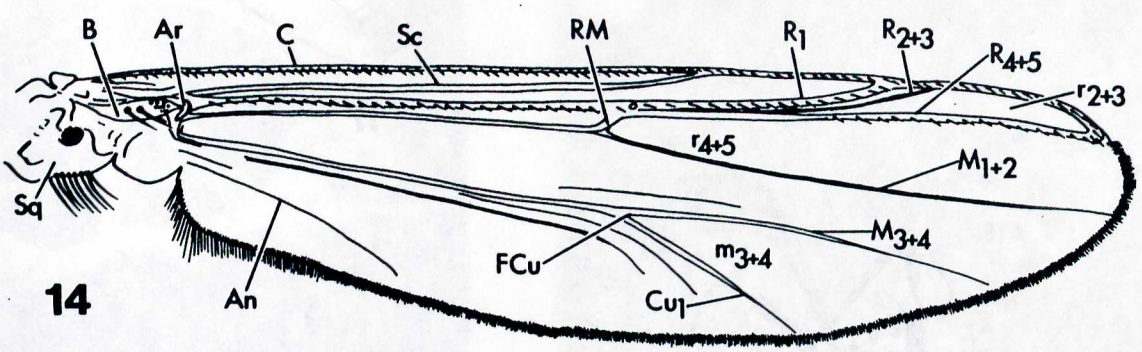
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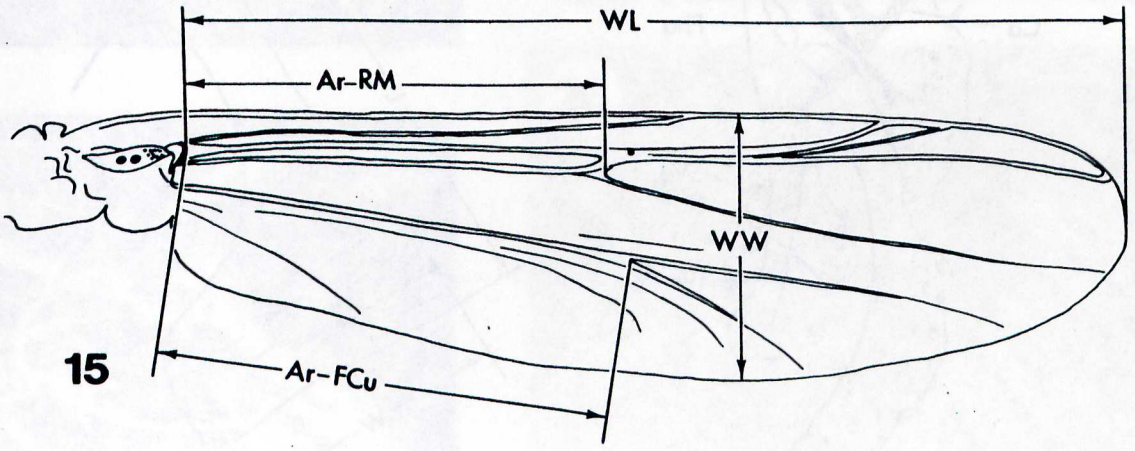
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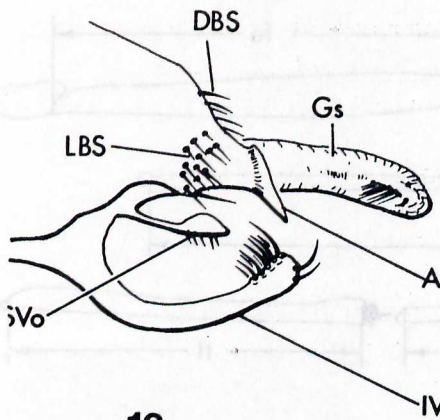
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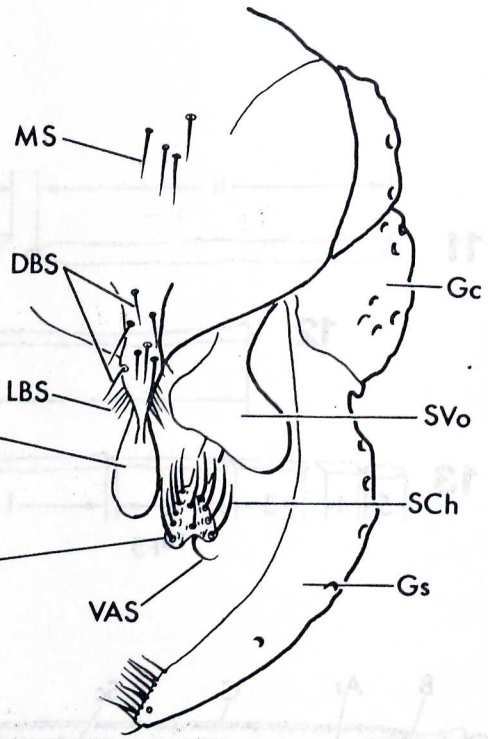
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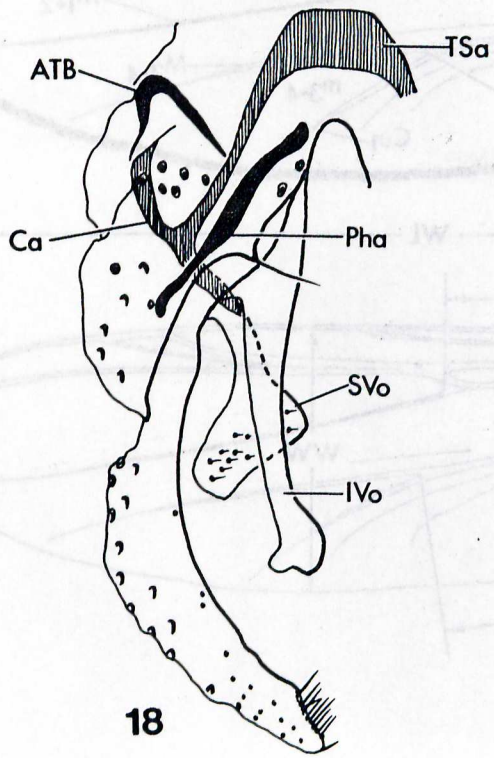
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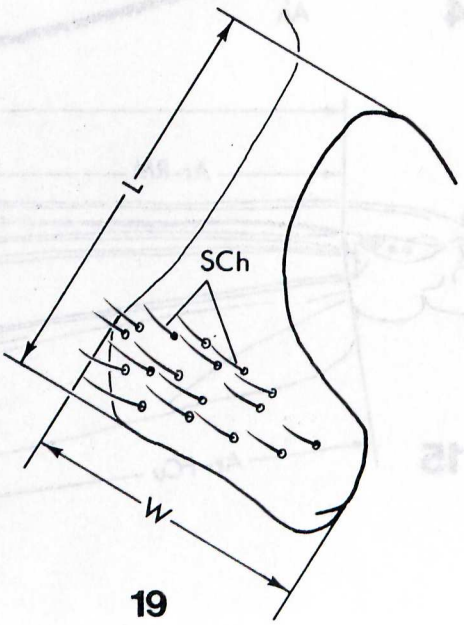
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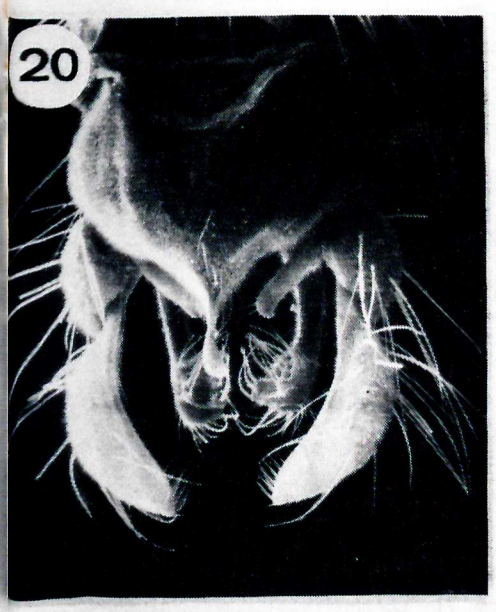
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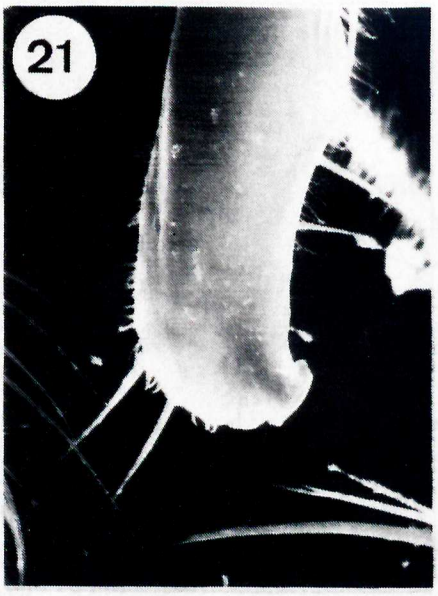
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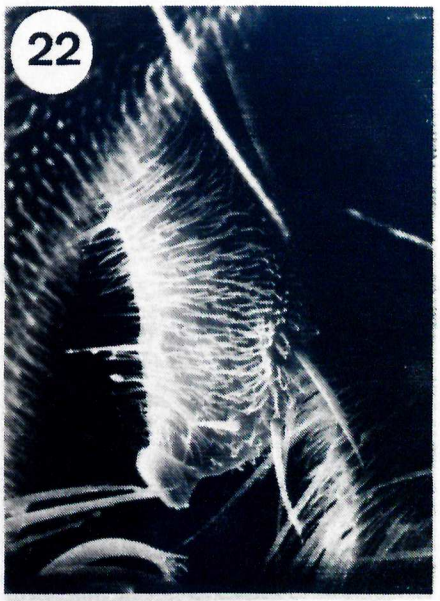
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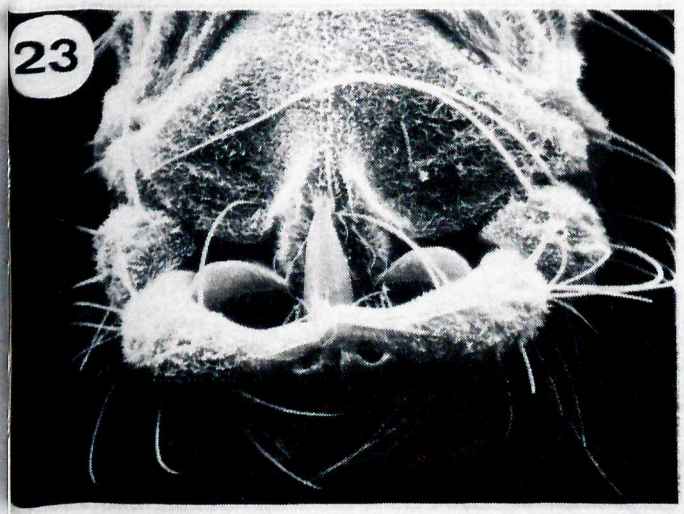
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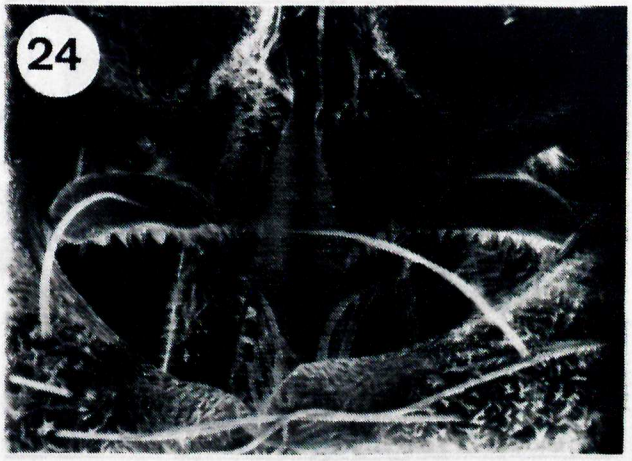
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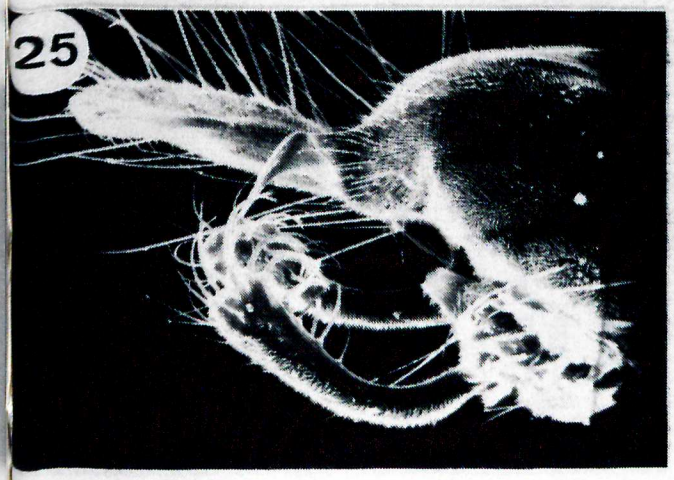
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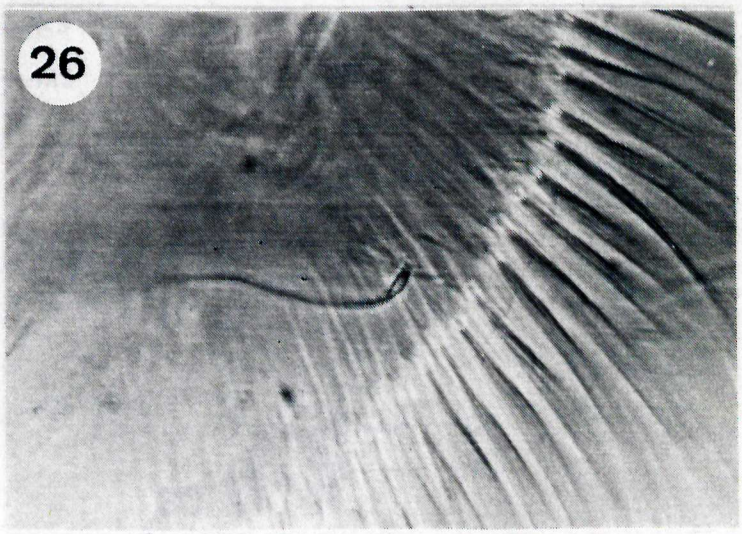
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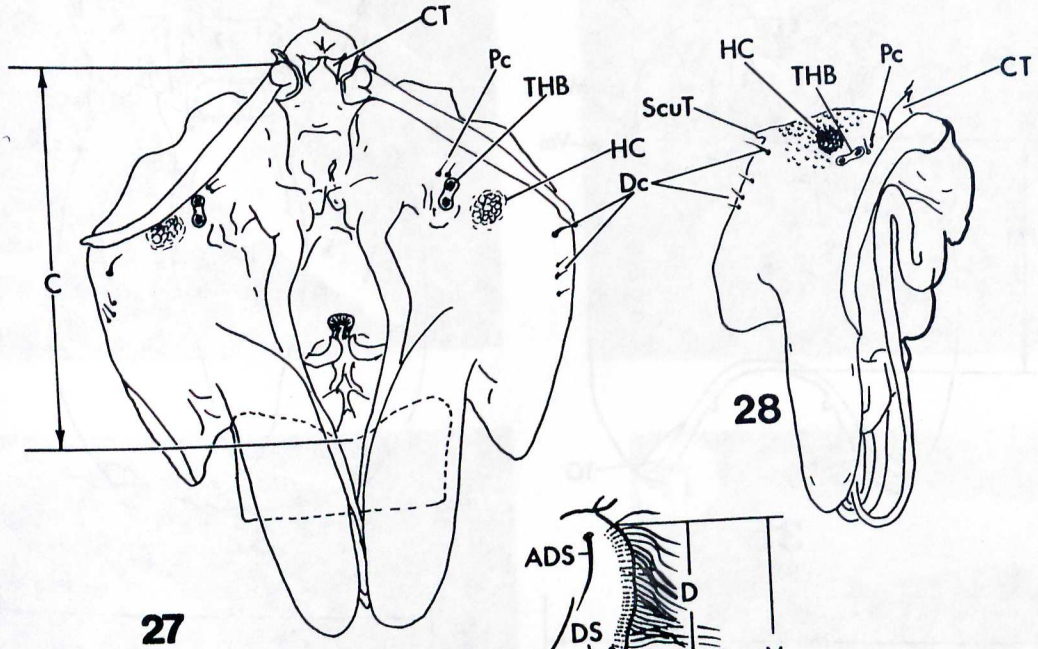

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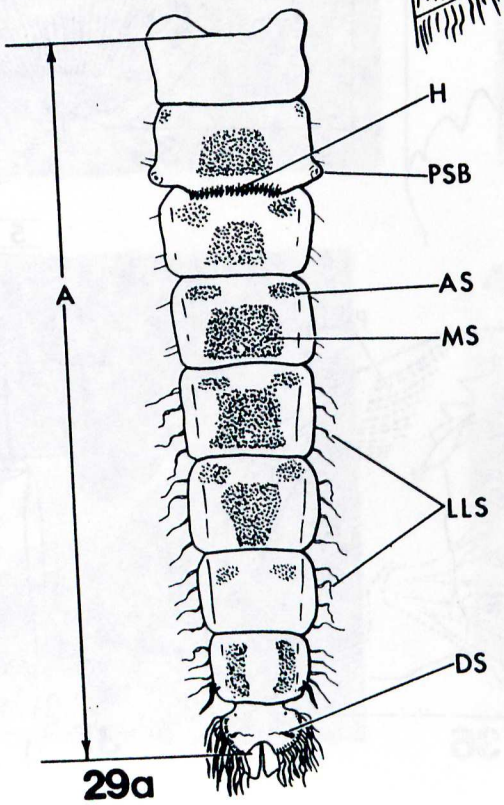

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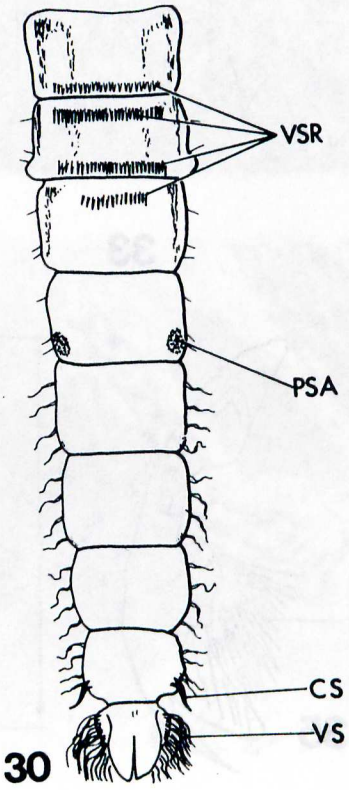

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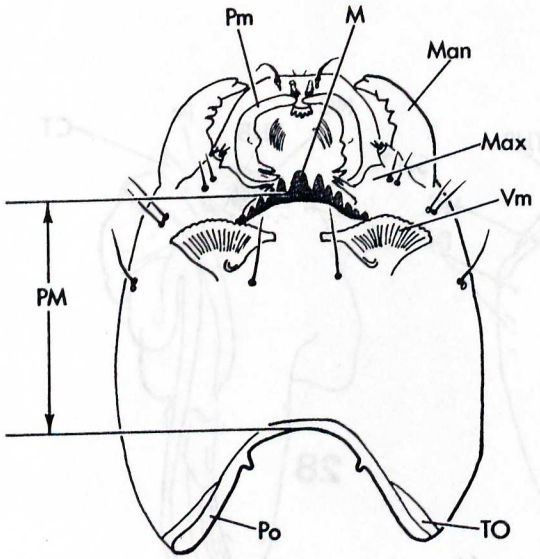

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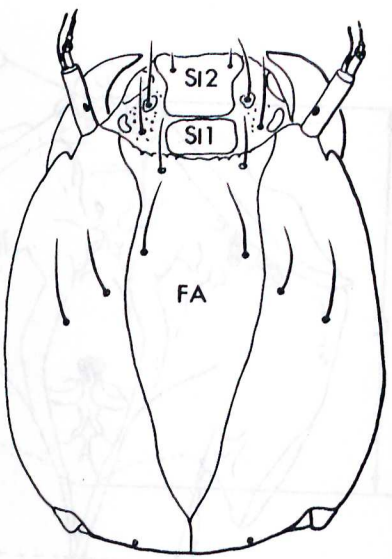

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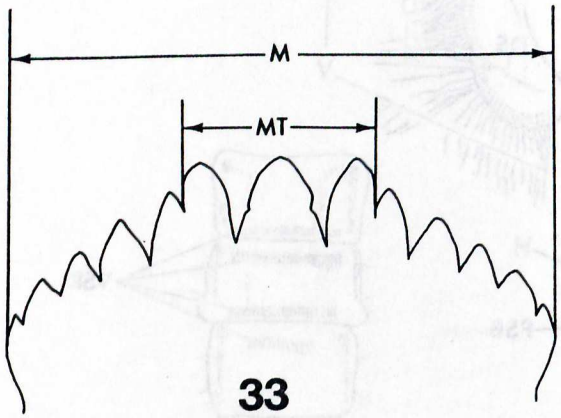

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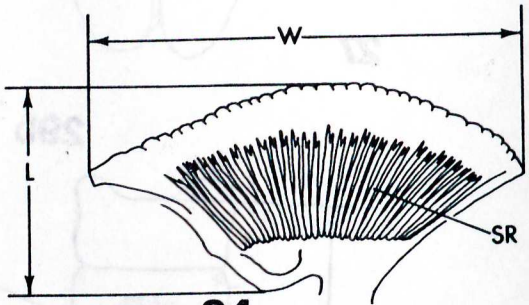

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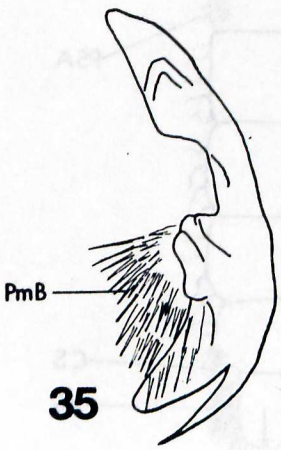

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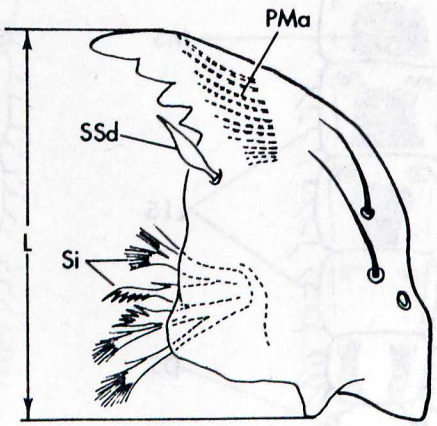

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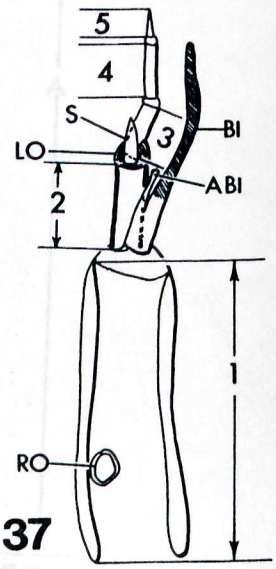

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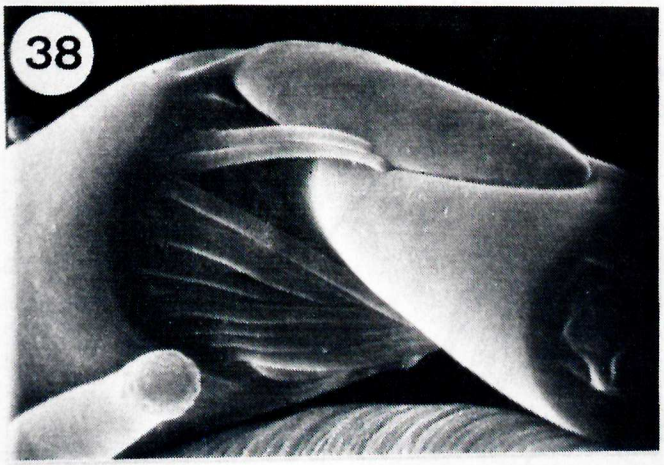
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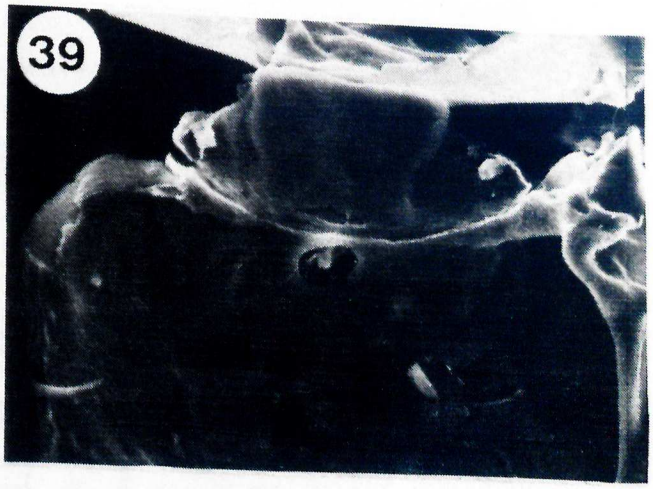
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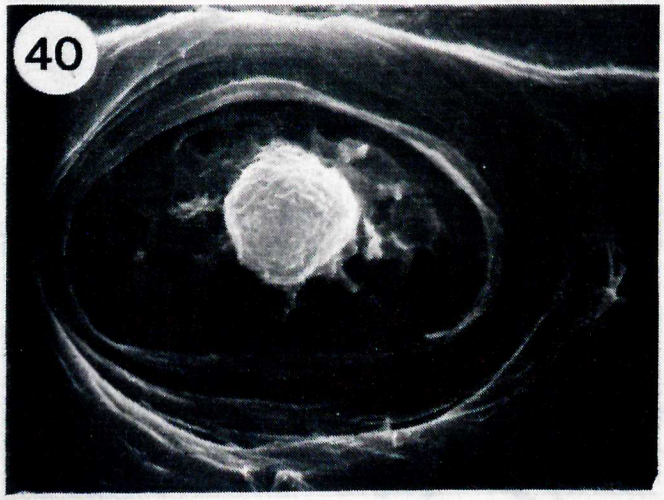
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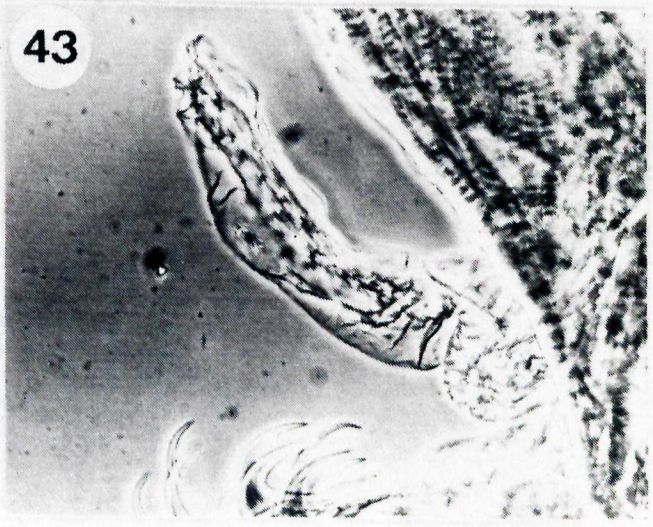
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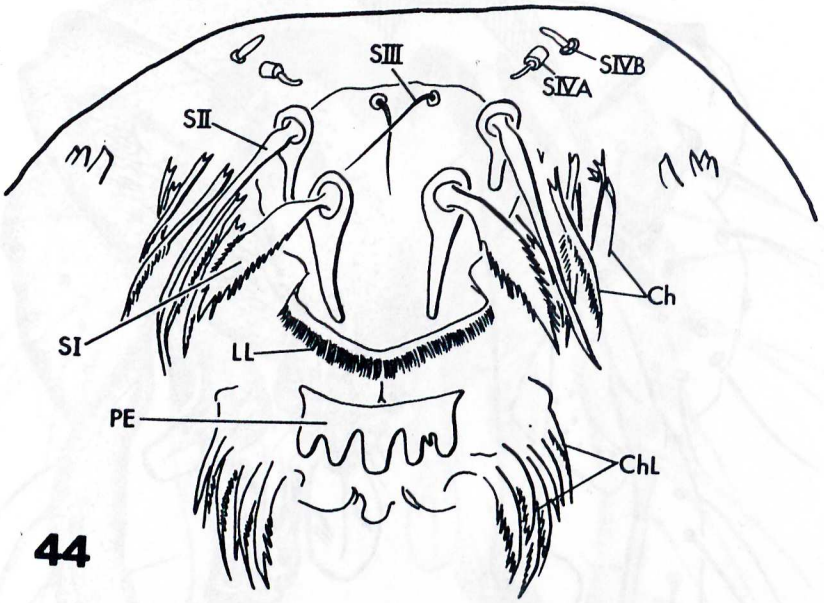

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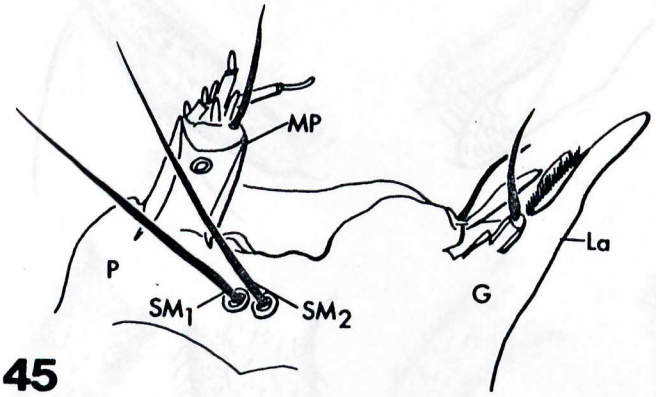

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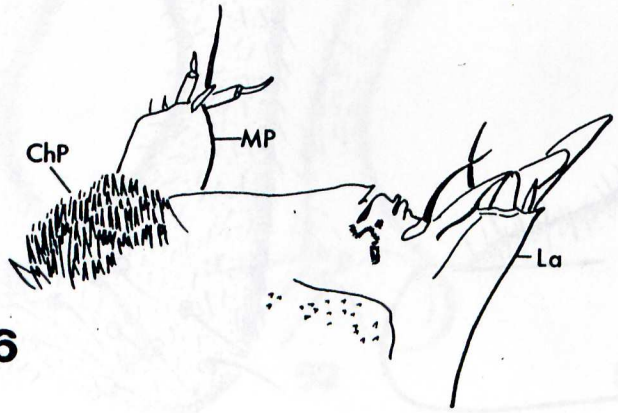

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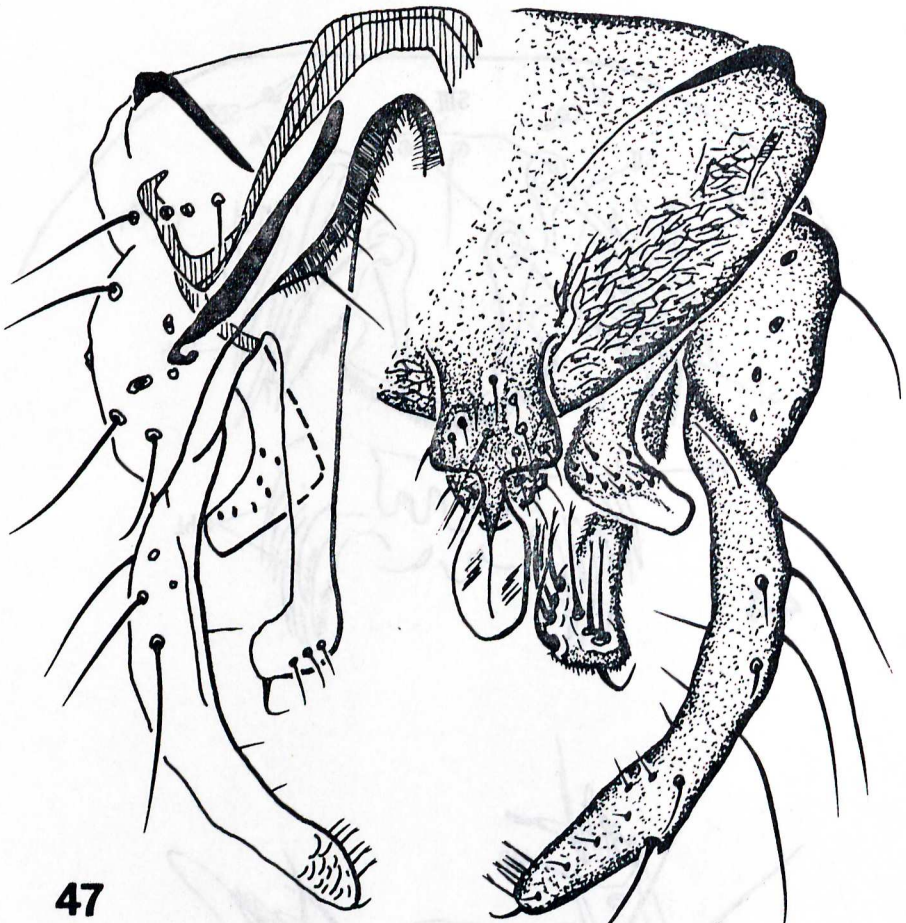

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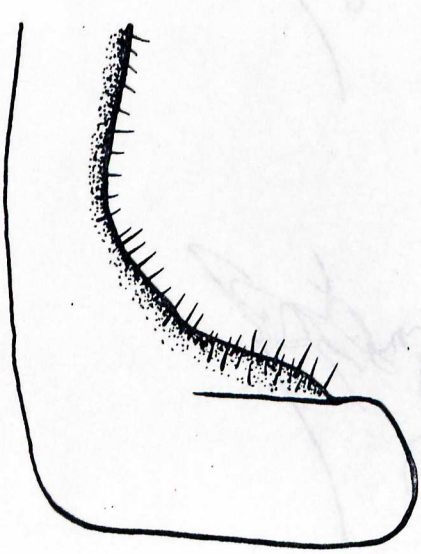

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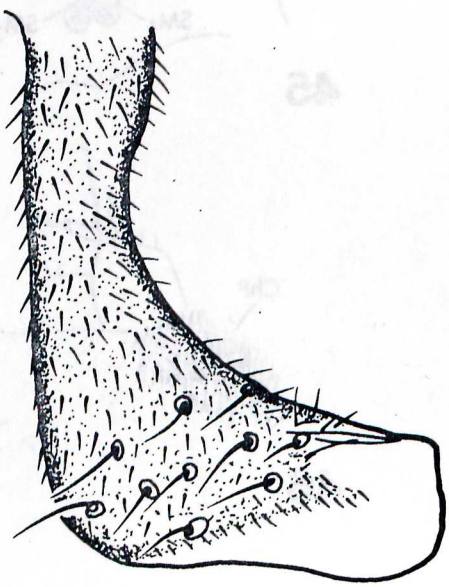

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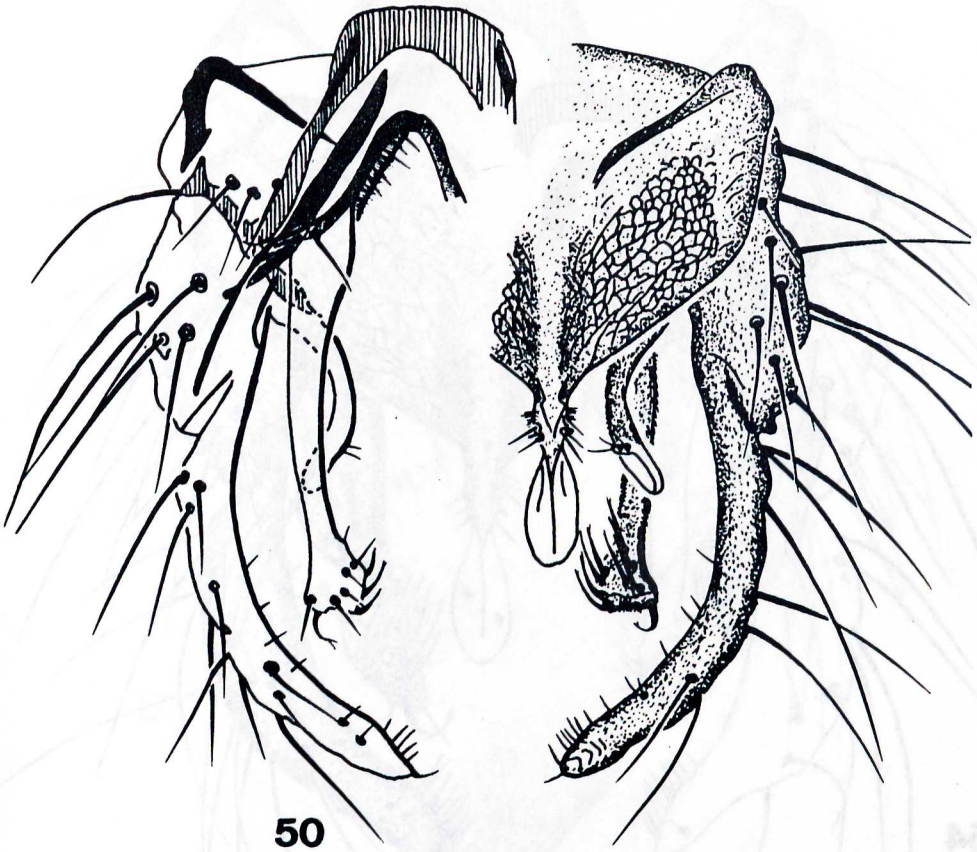

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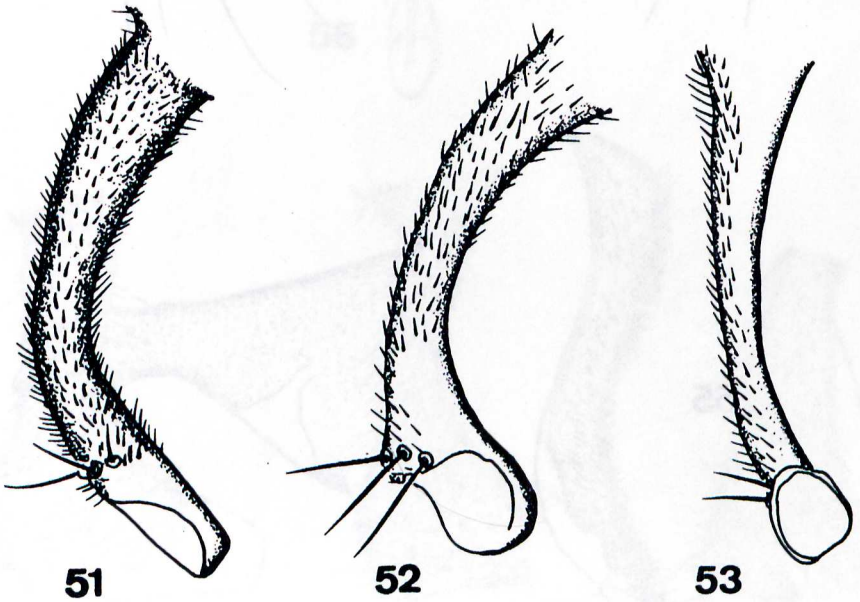

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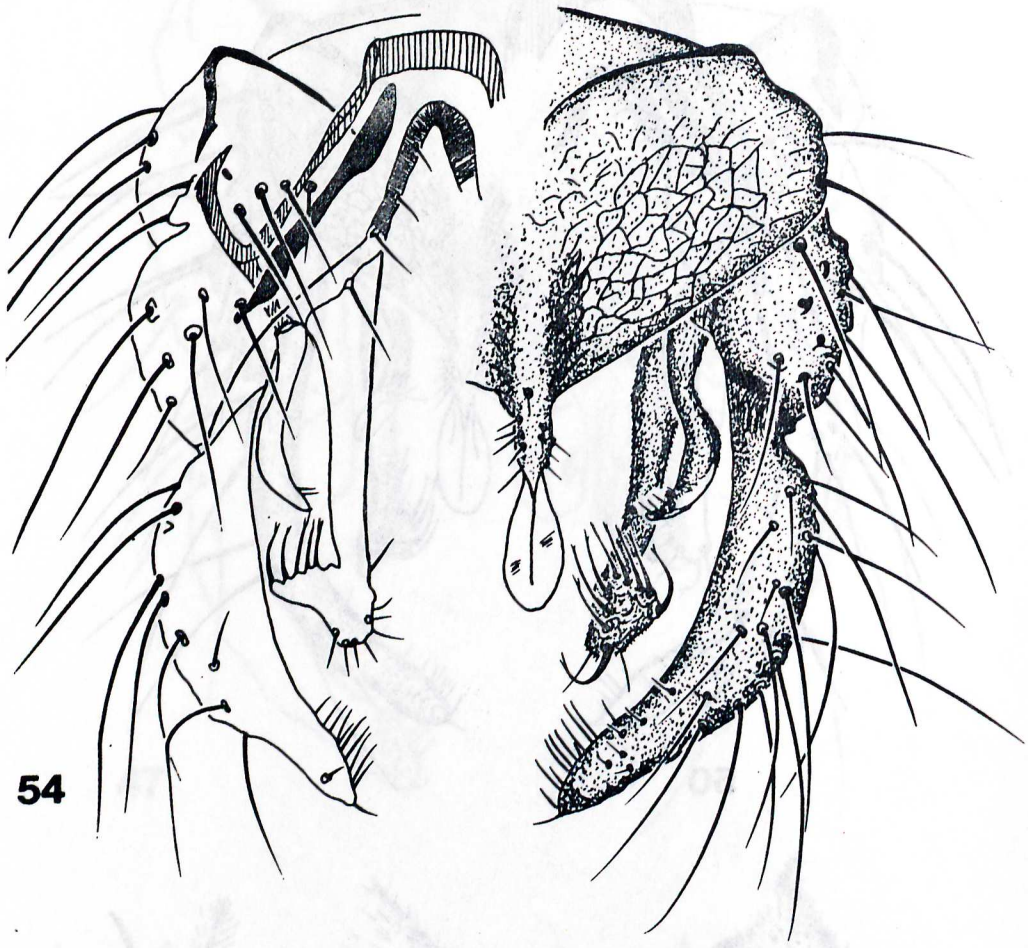

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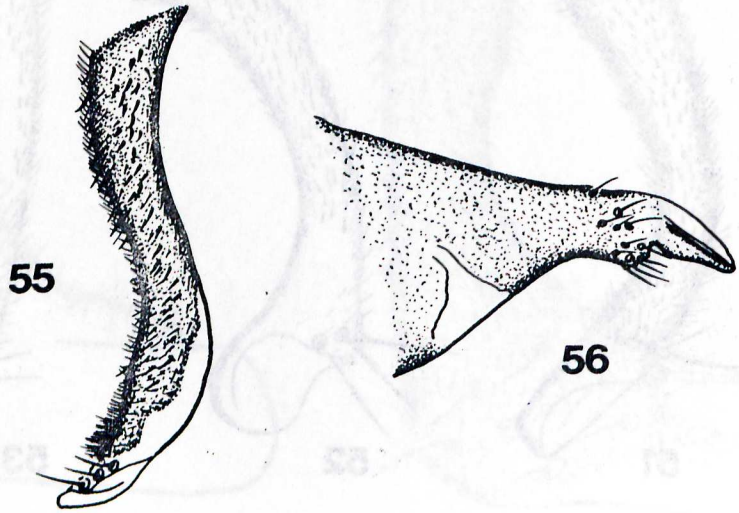

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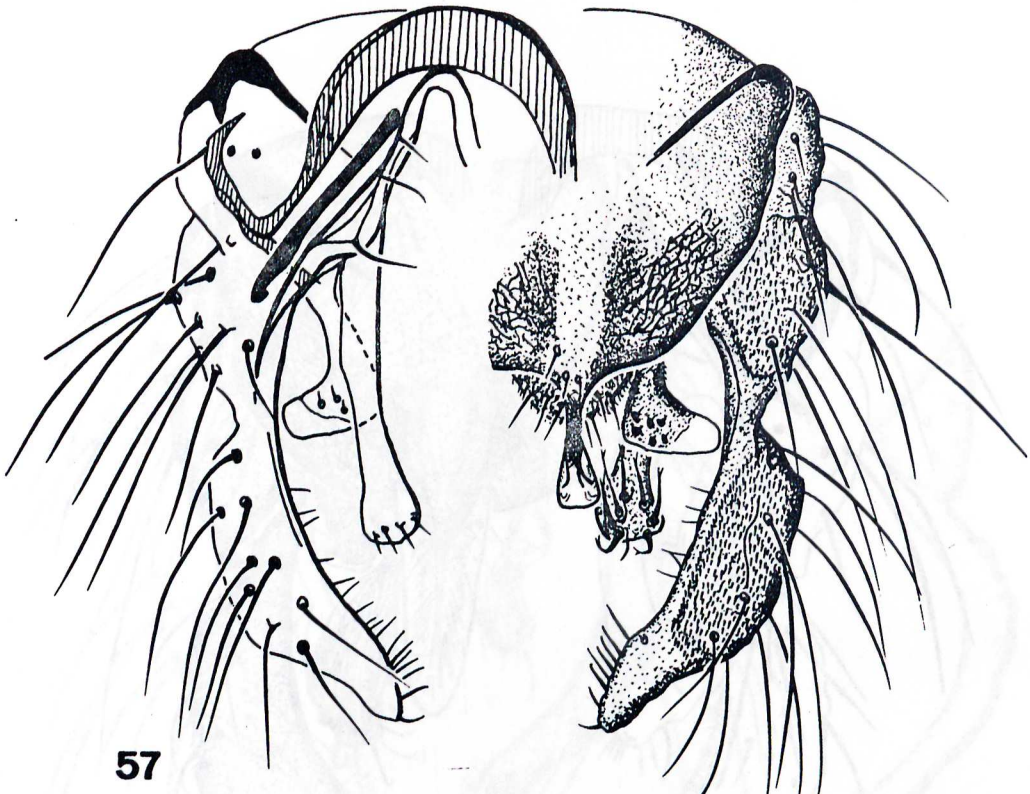

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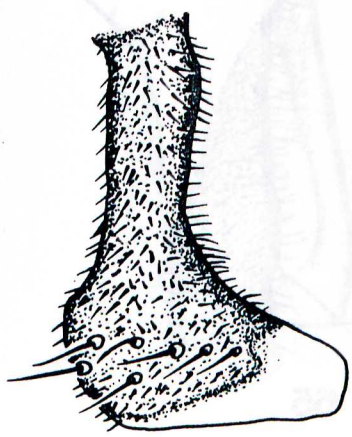

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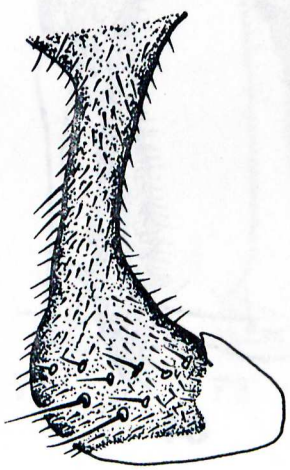

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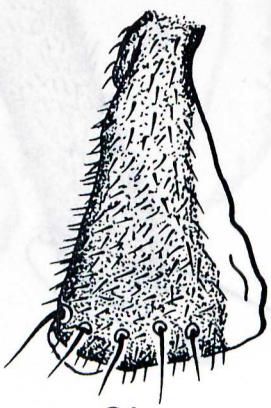

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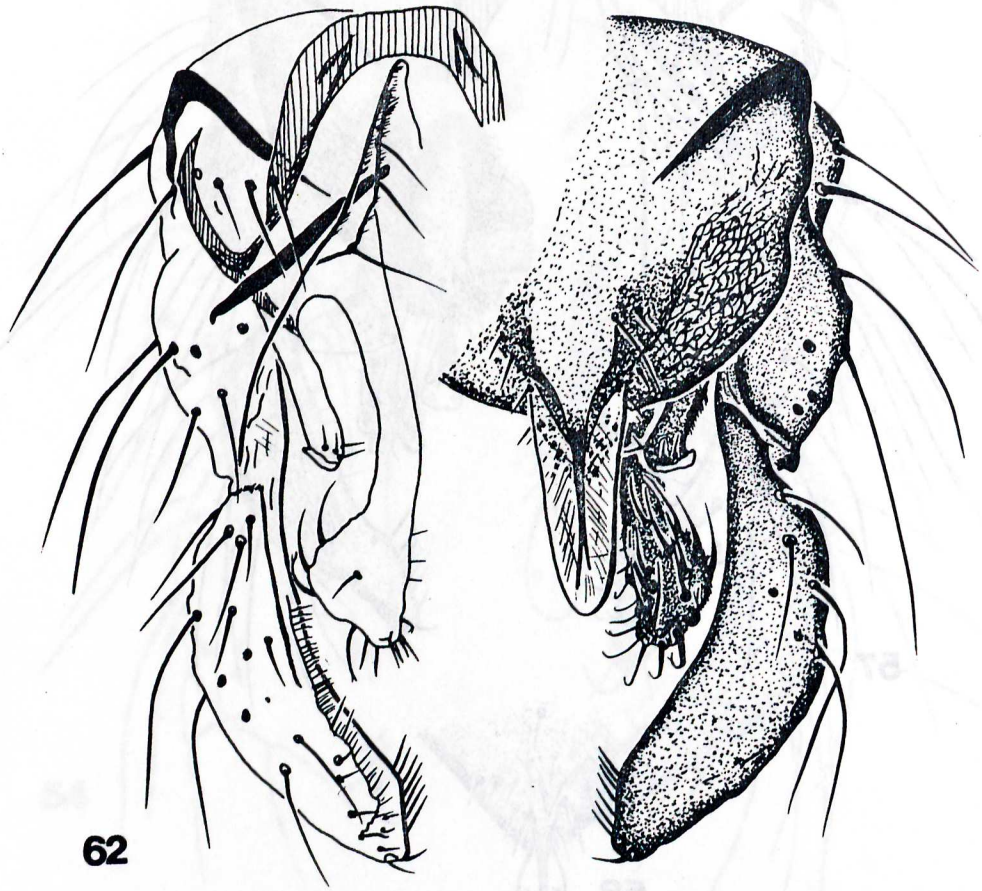

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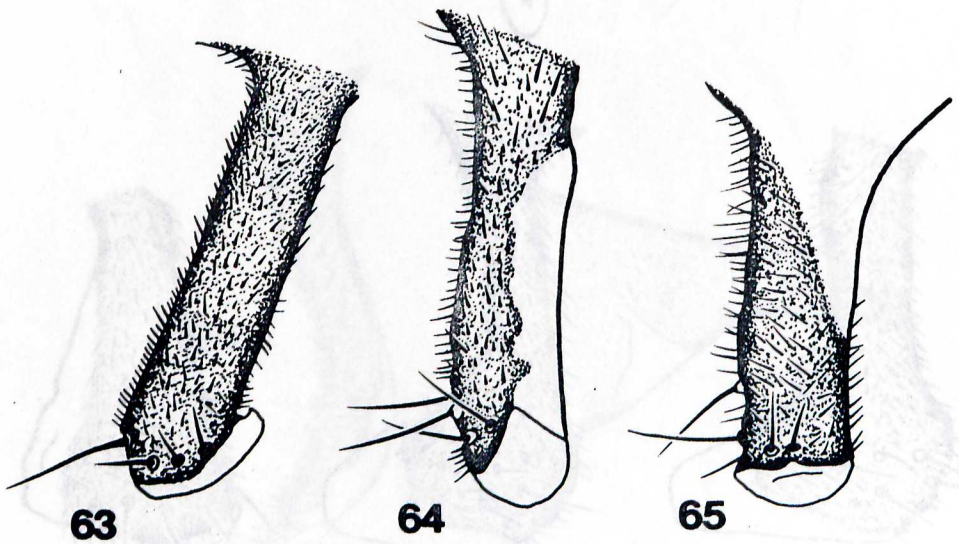

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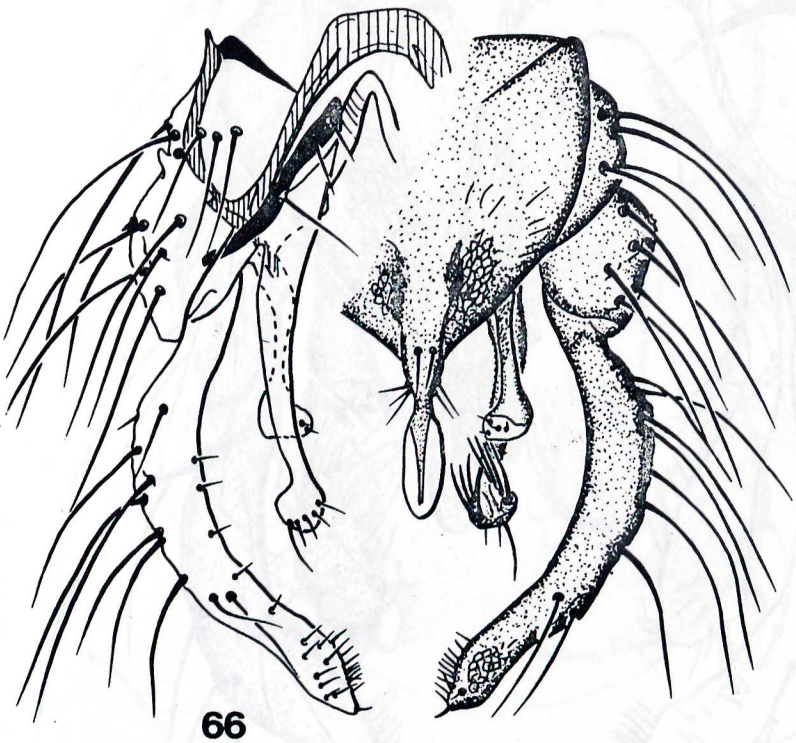

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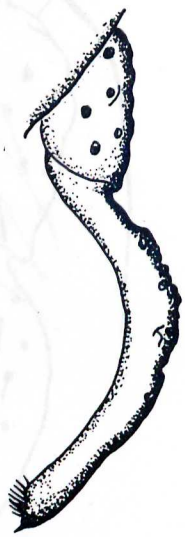

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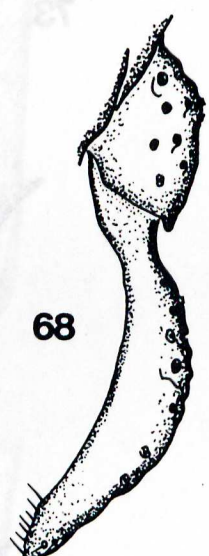

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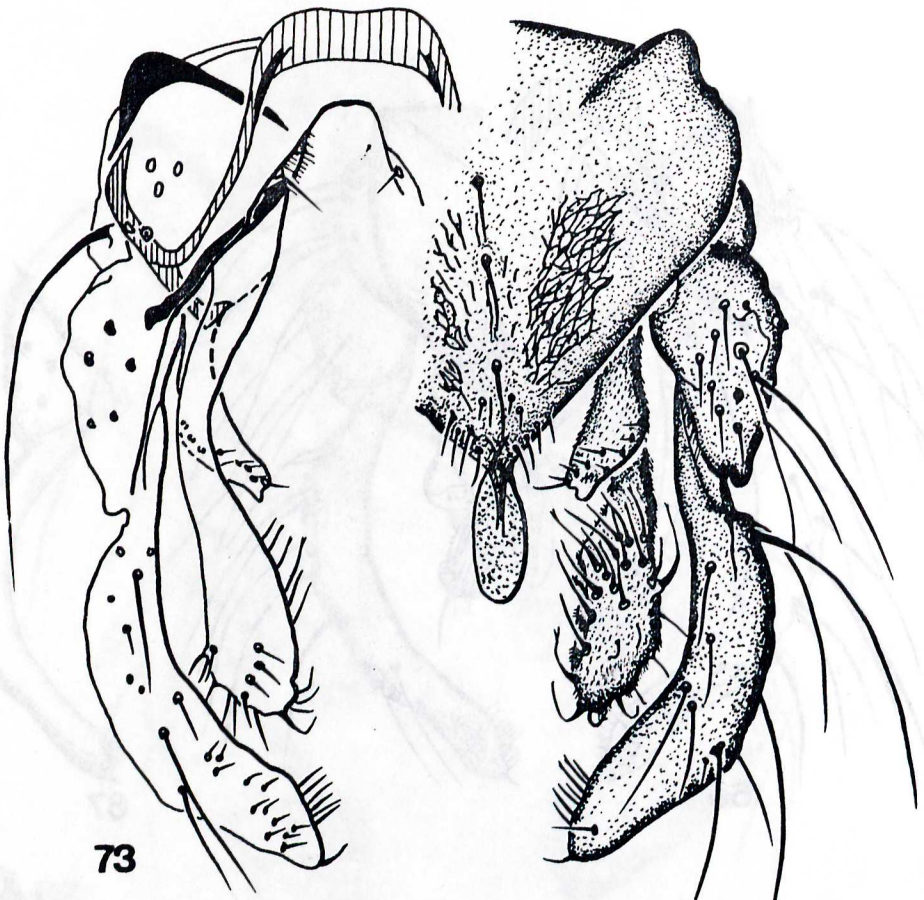

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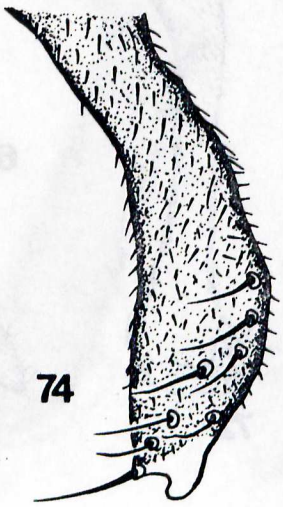

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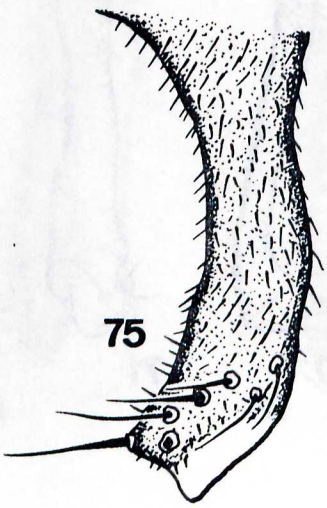

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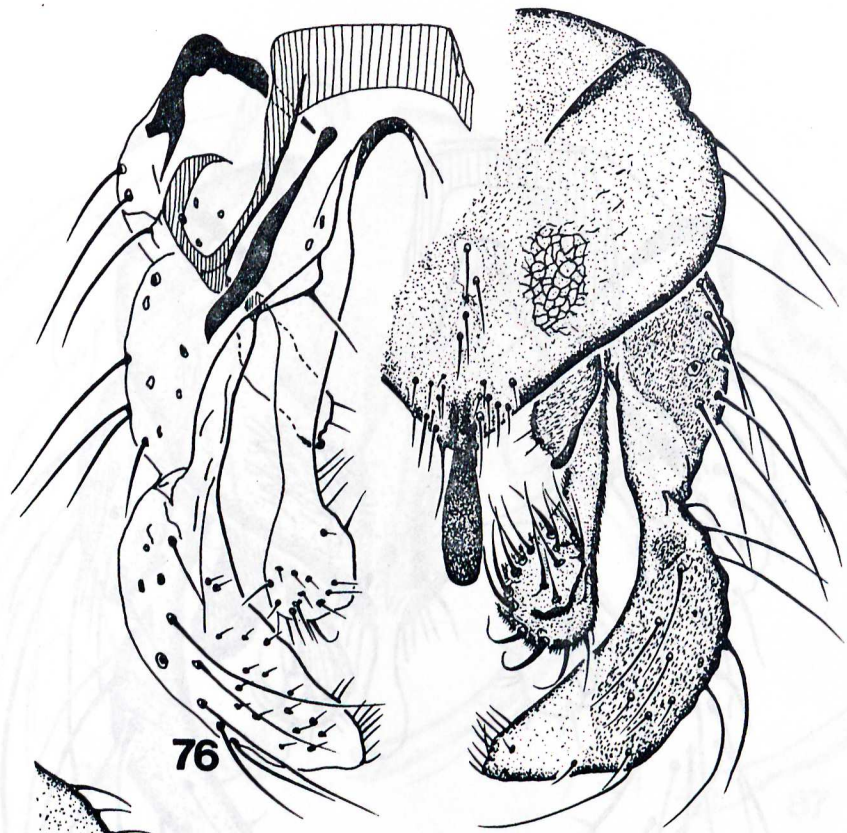

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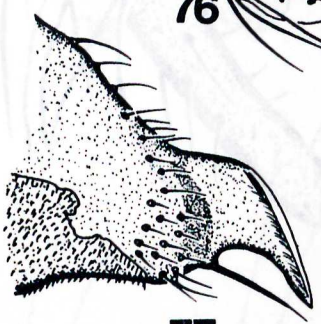

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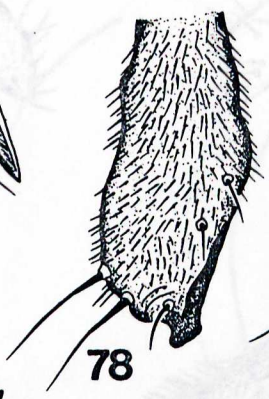

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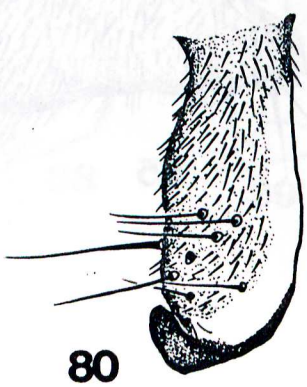

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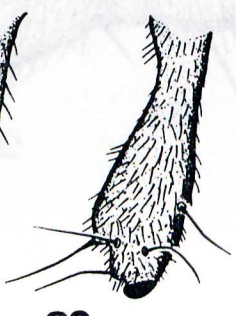

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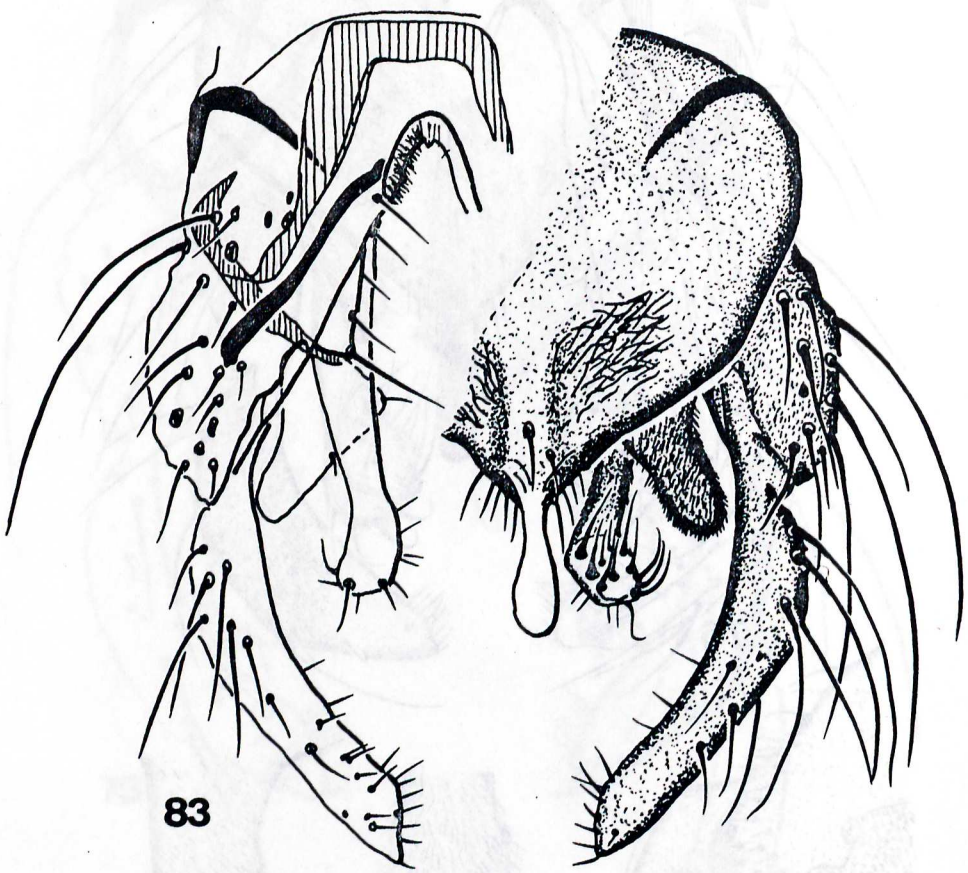

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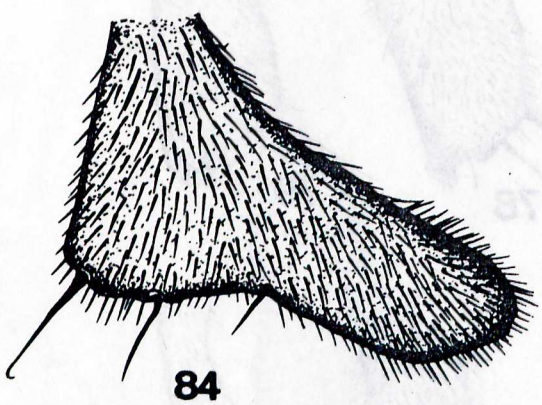

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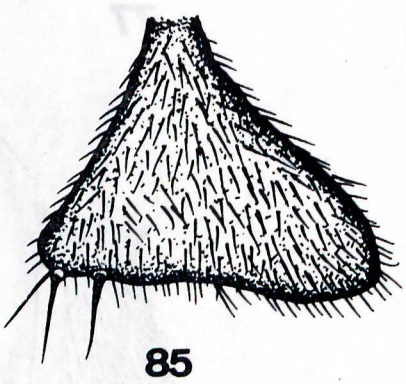

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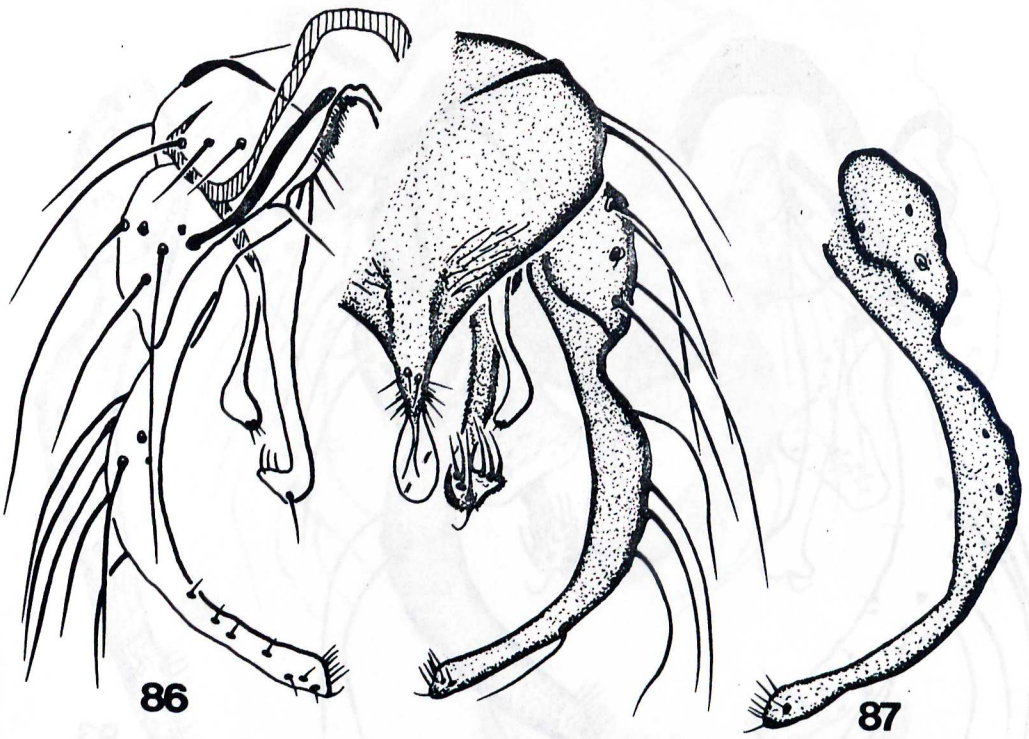
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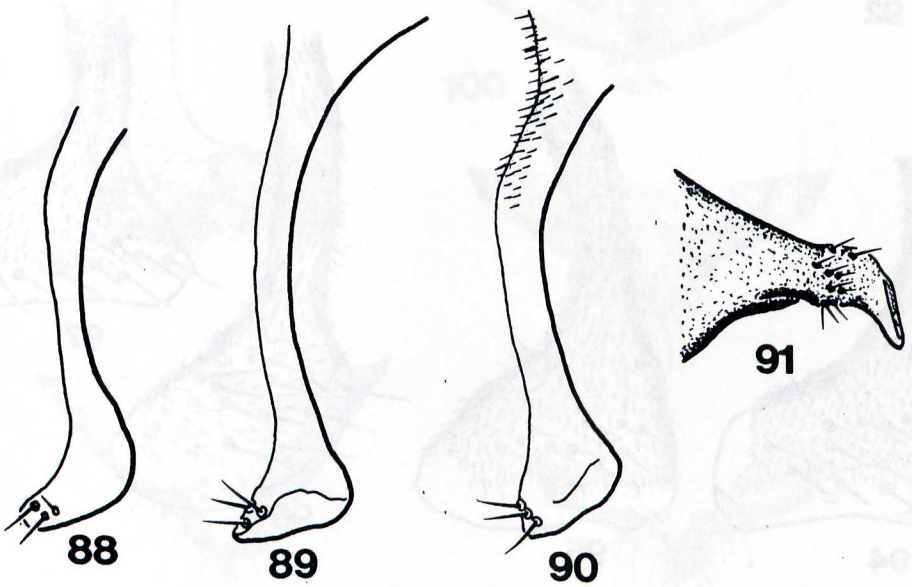
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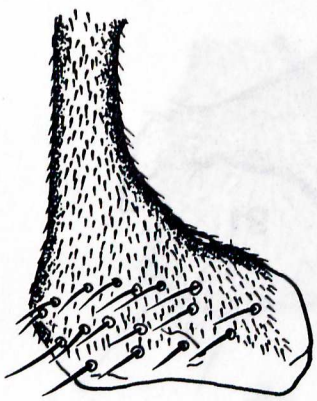

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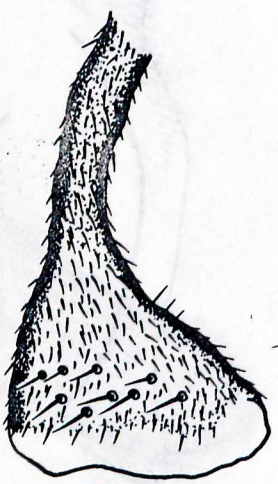

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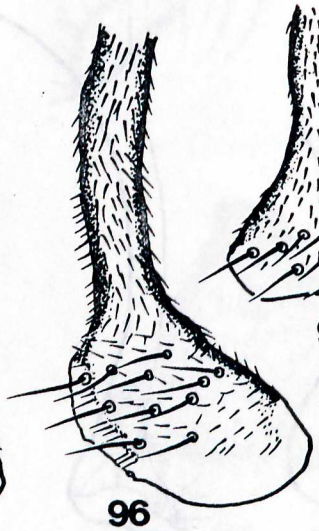

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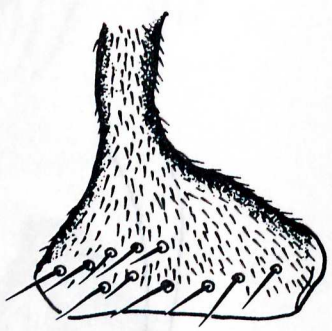

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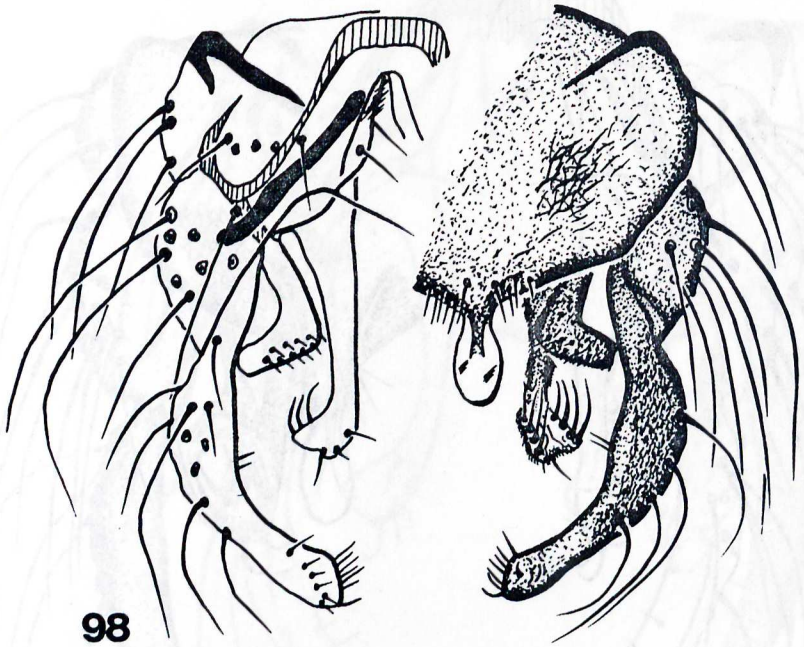

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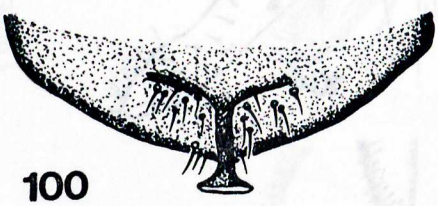

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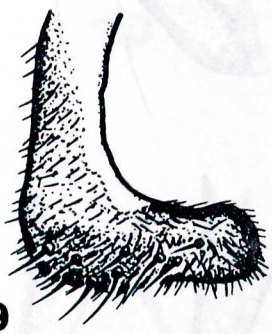

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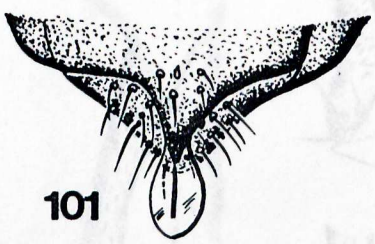

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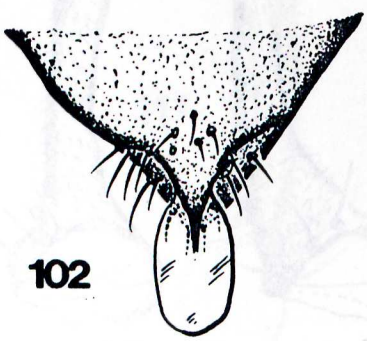

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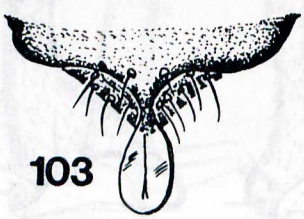

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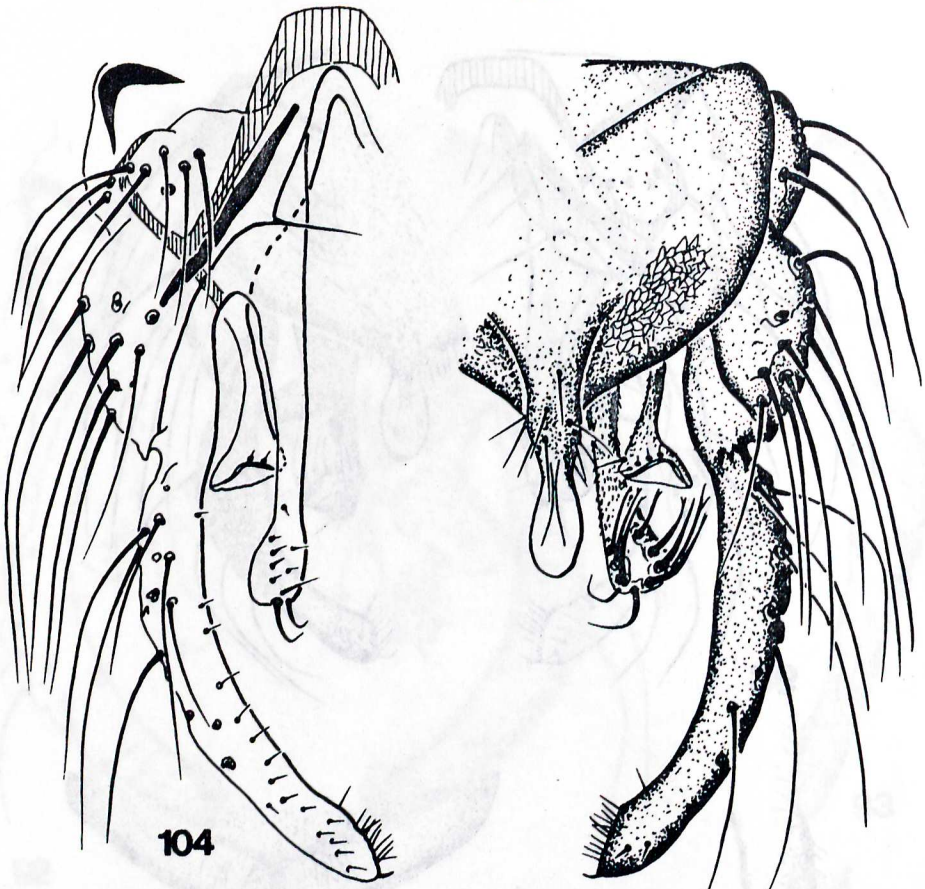

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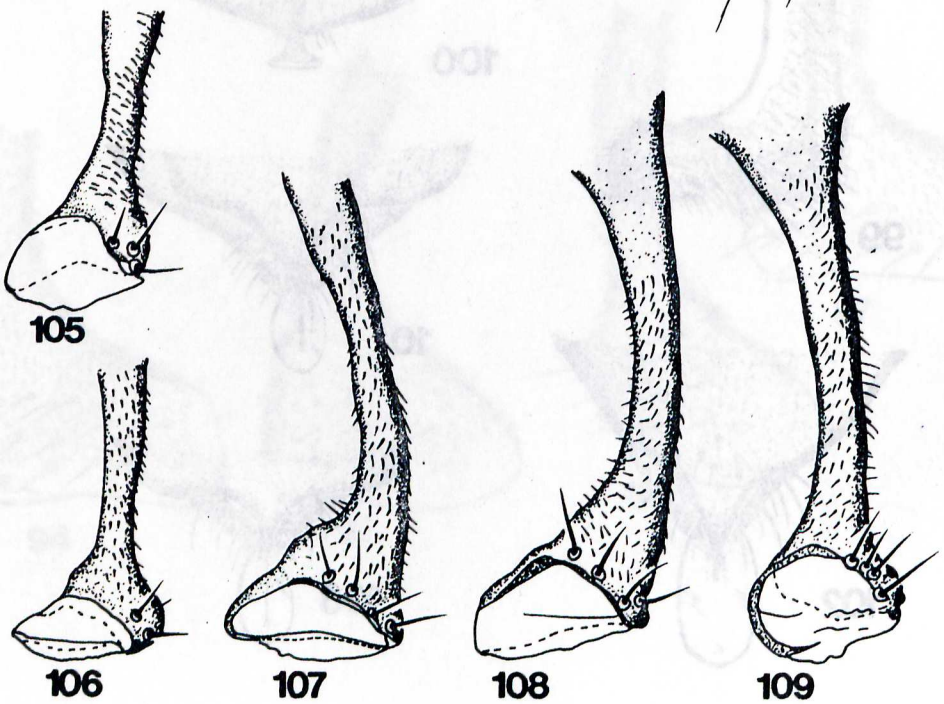

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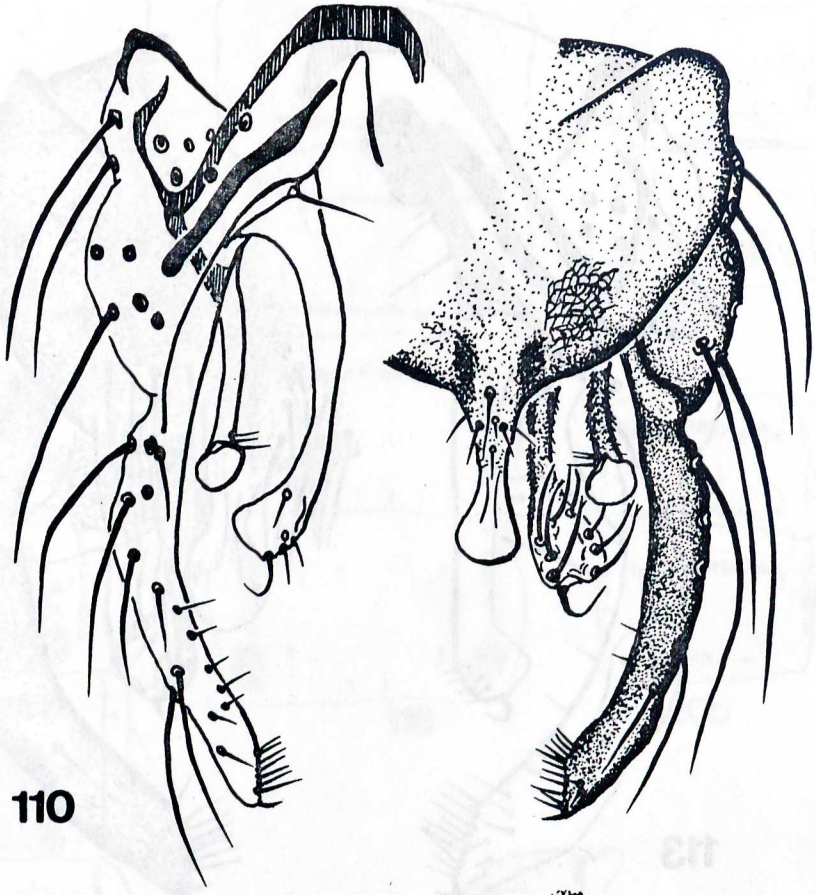

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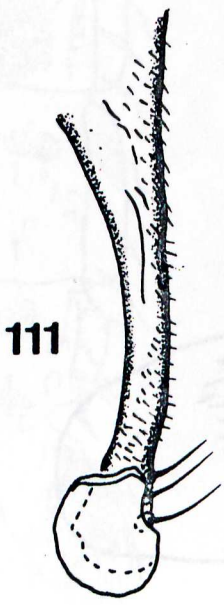

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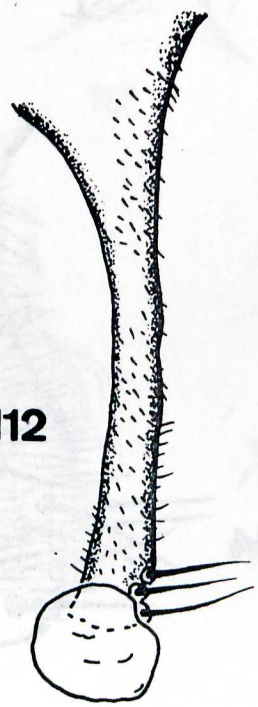

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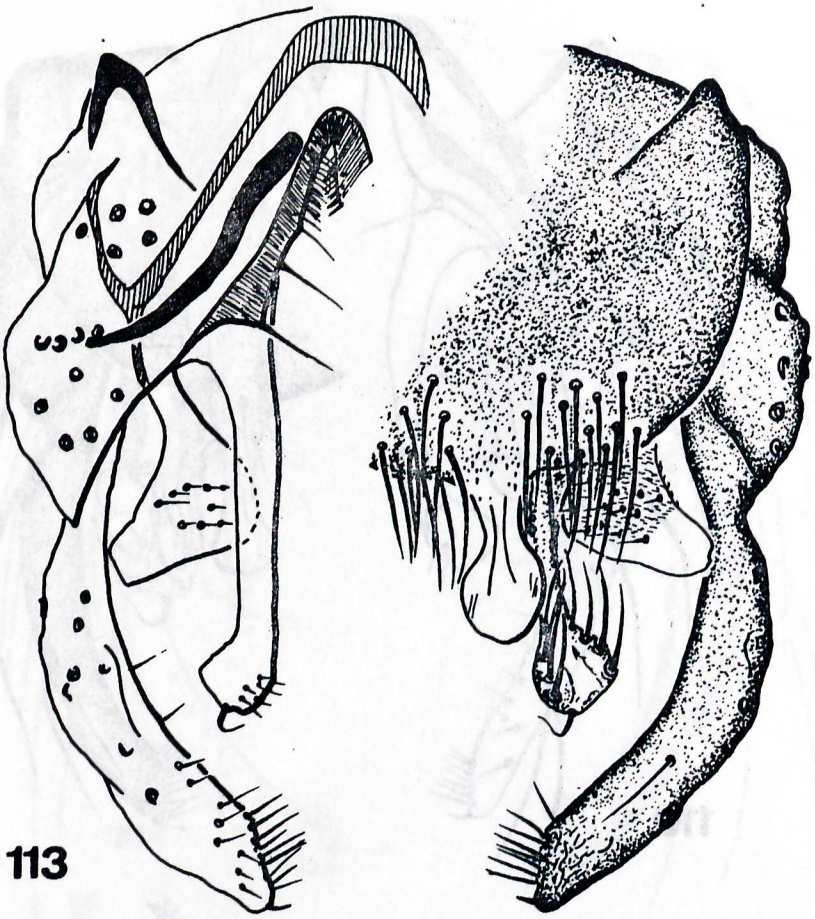

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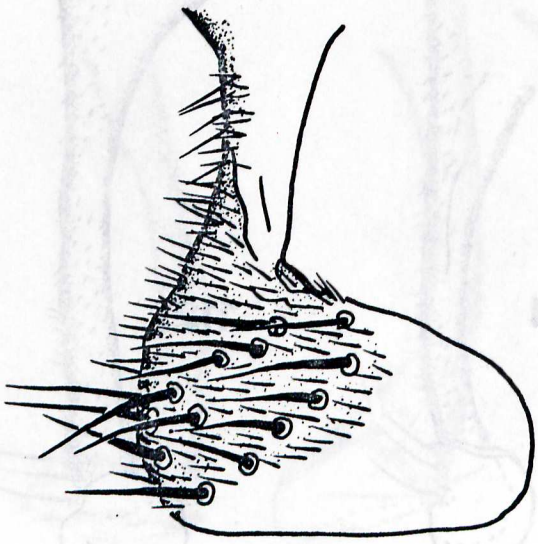

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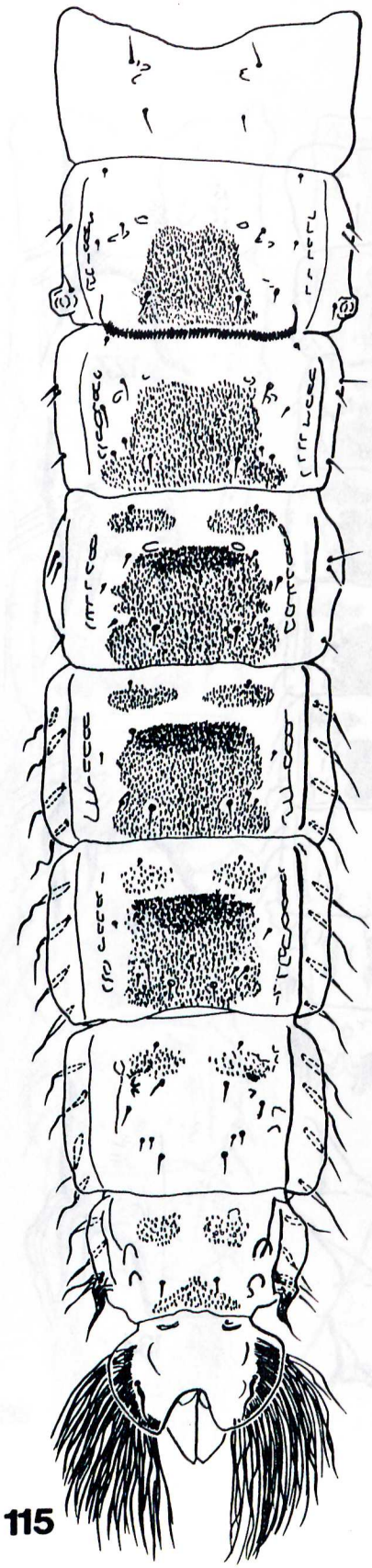

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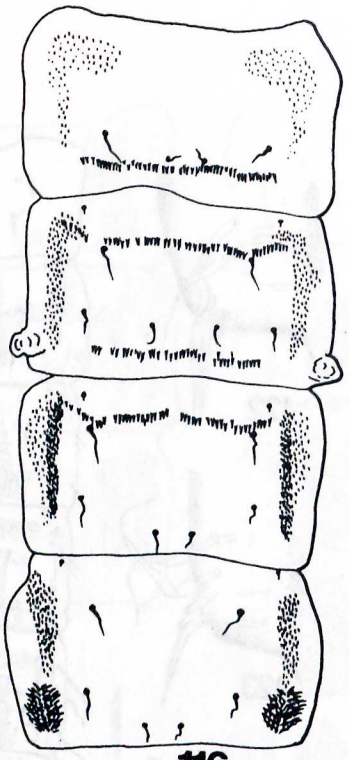

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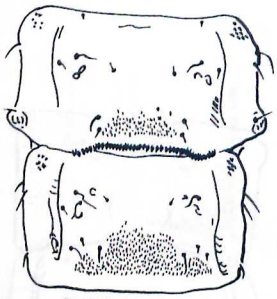

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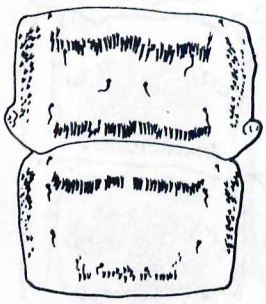

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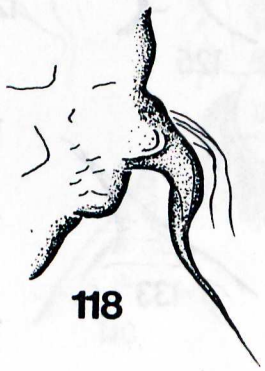

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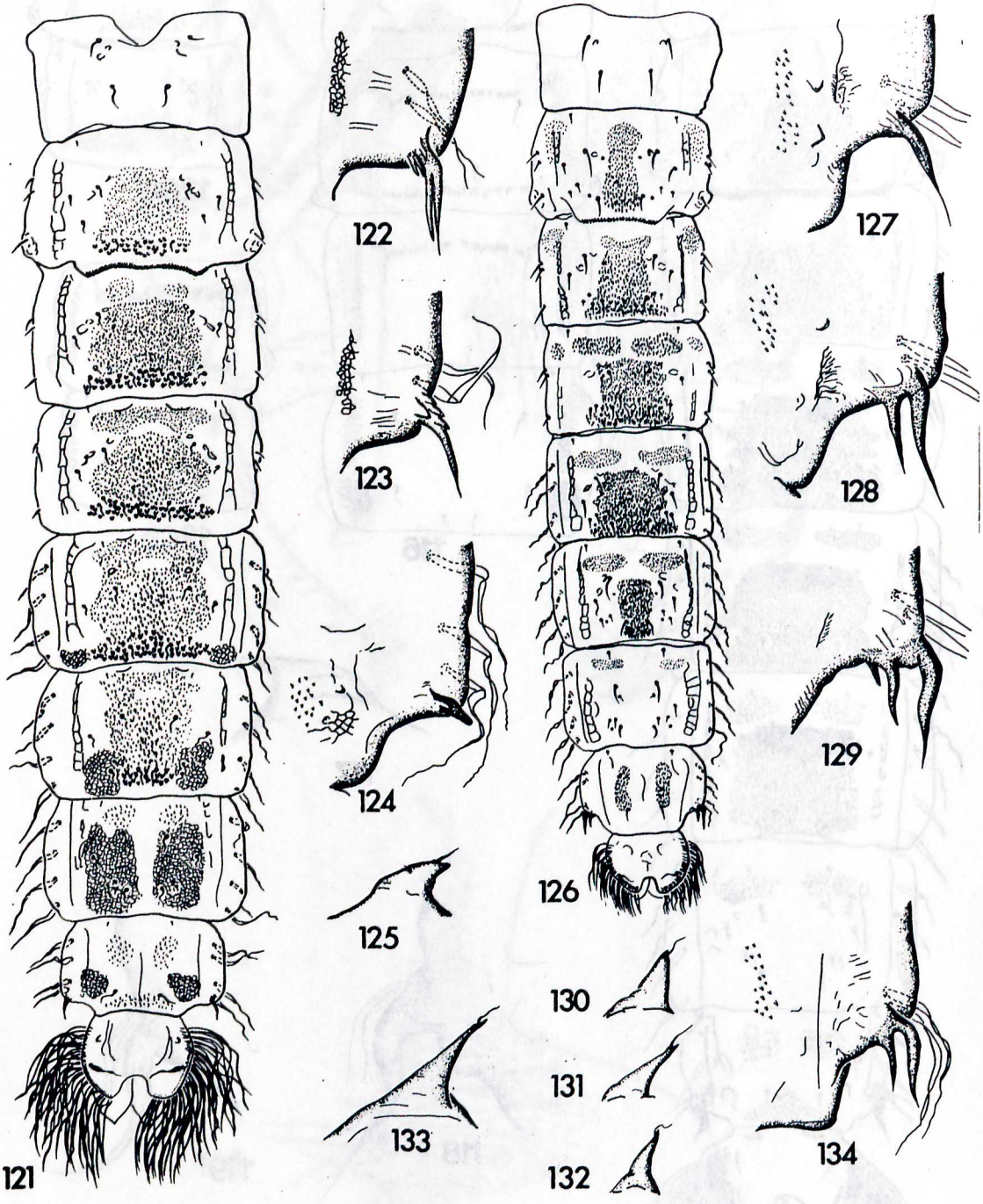
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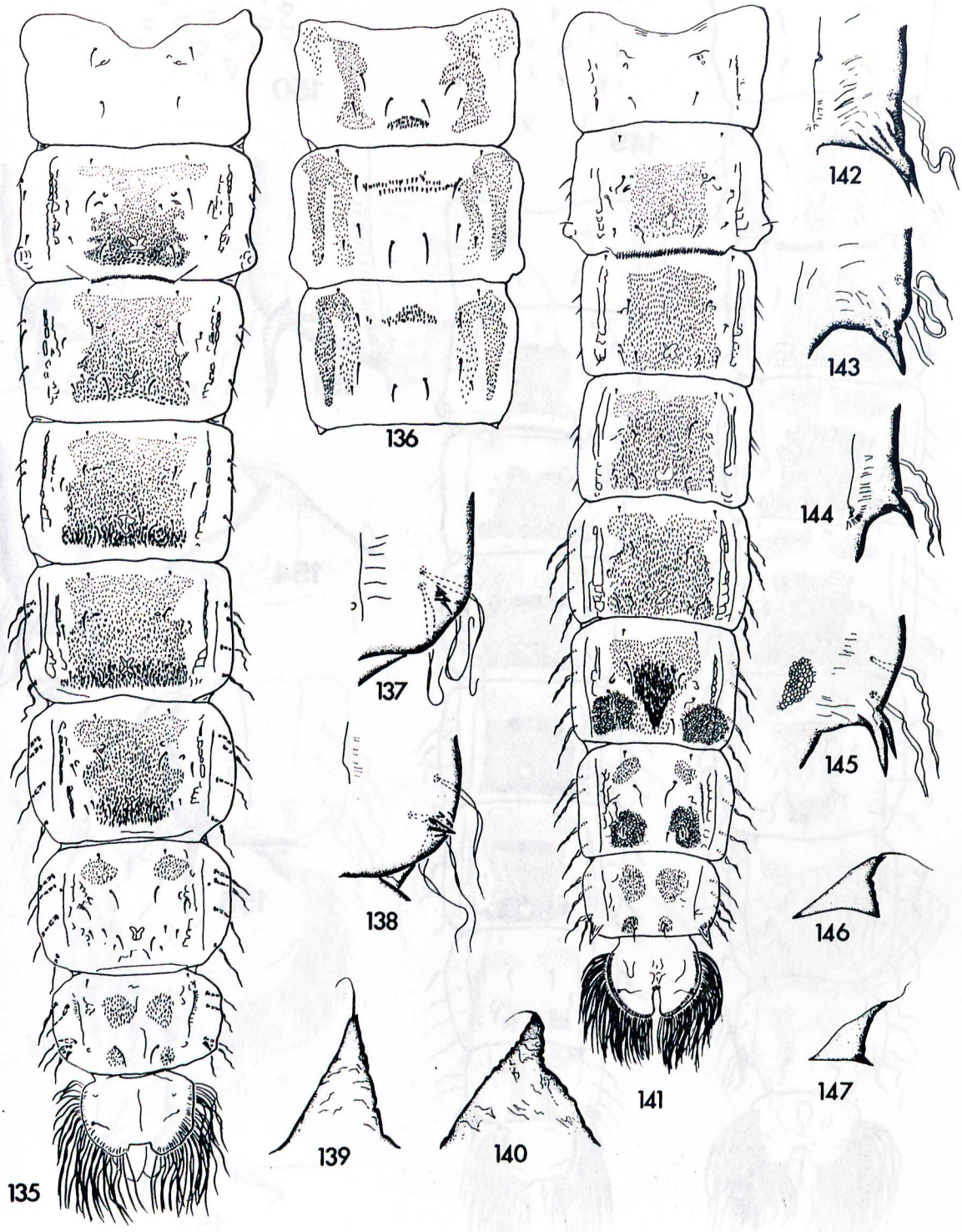
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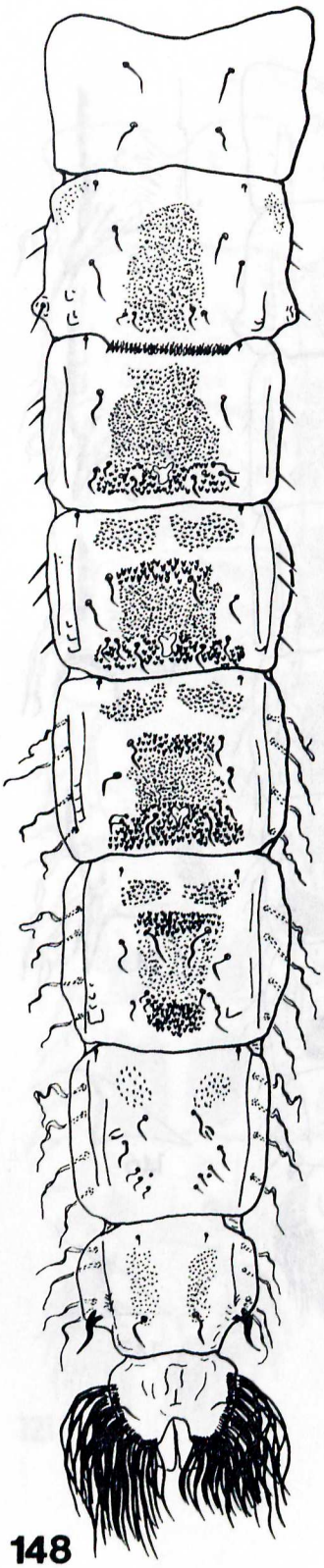

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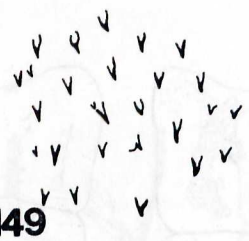

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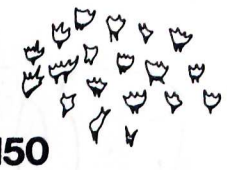

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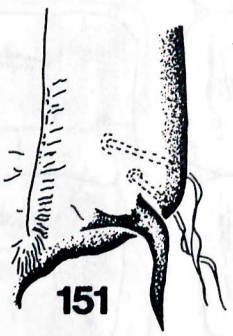

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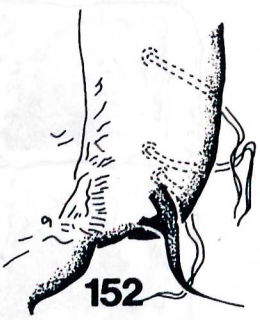

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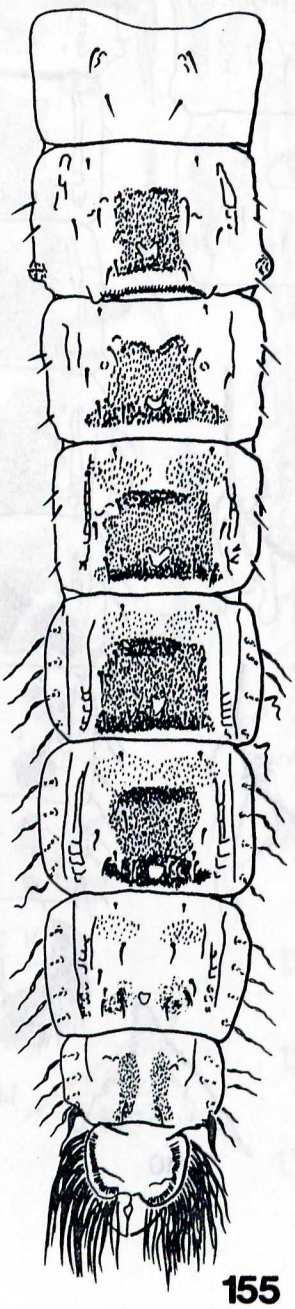

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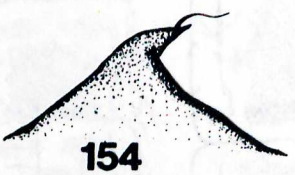

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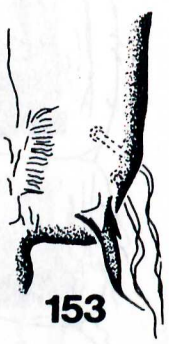

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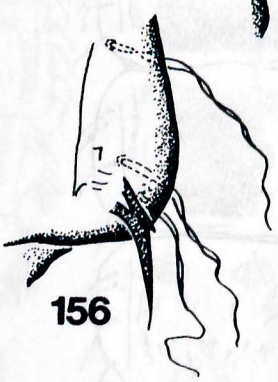

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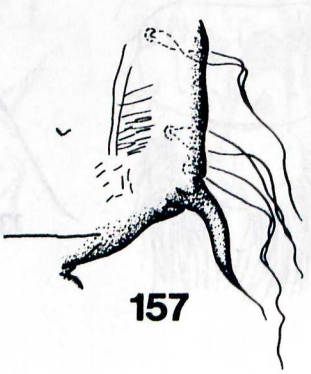

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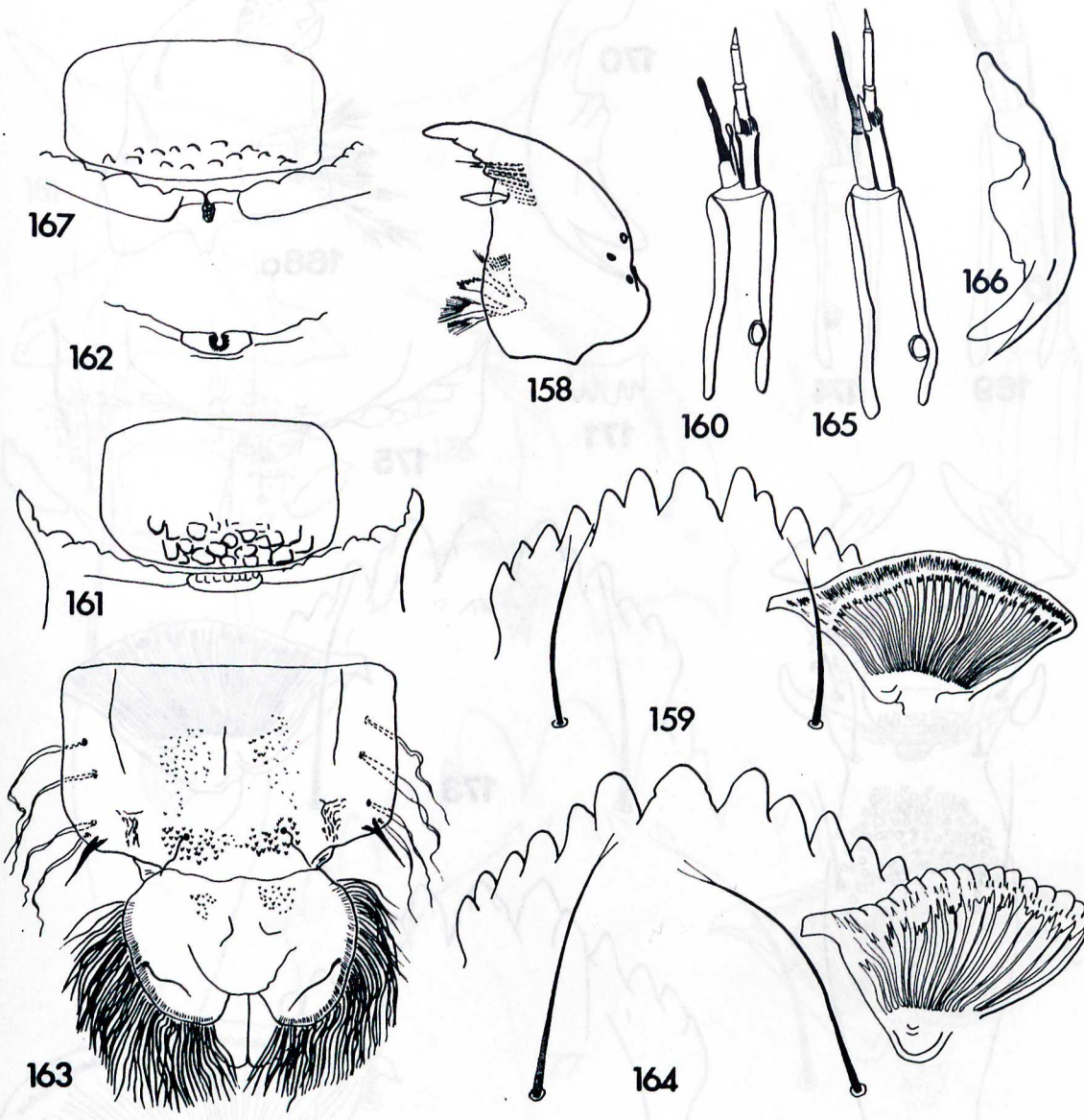
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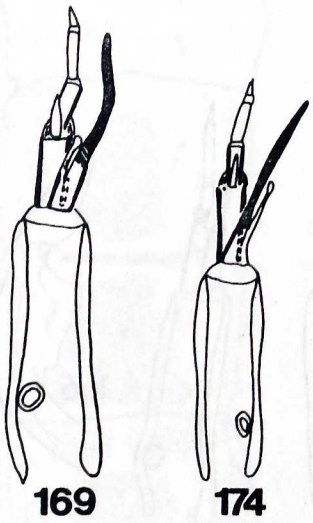

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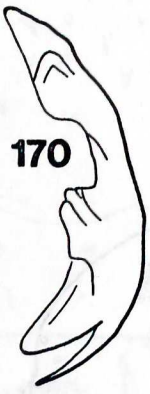

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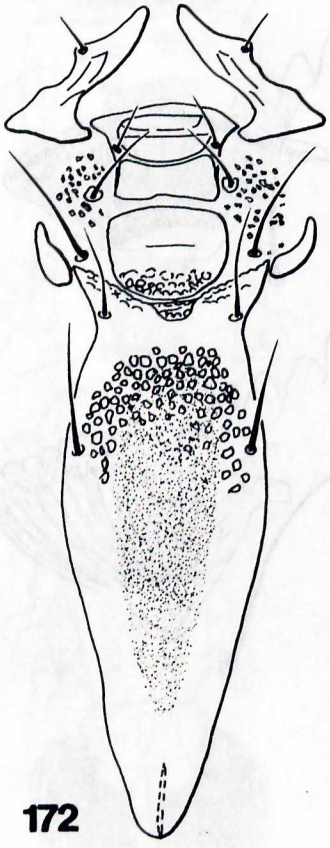

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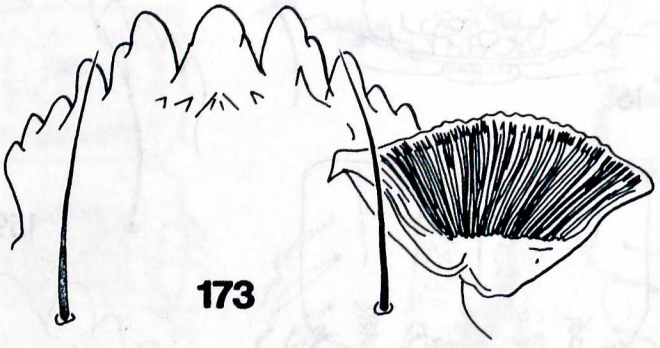
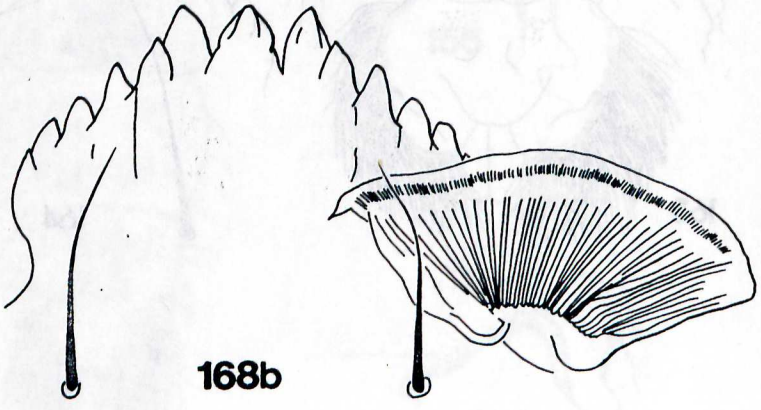


173



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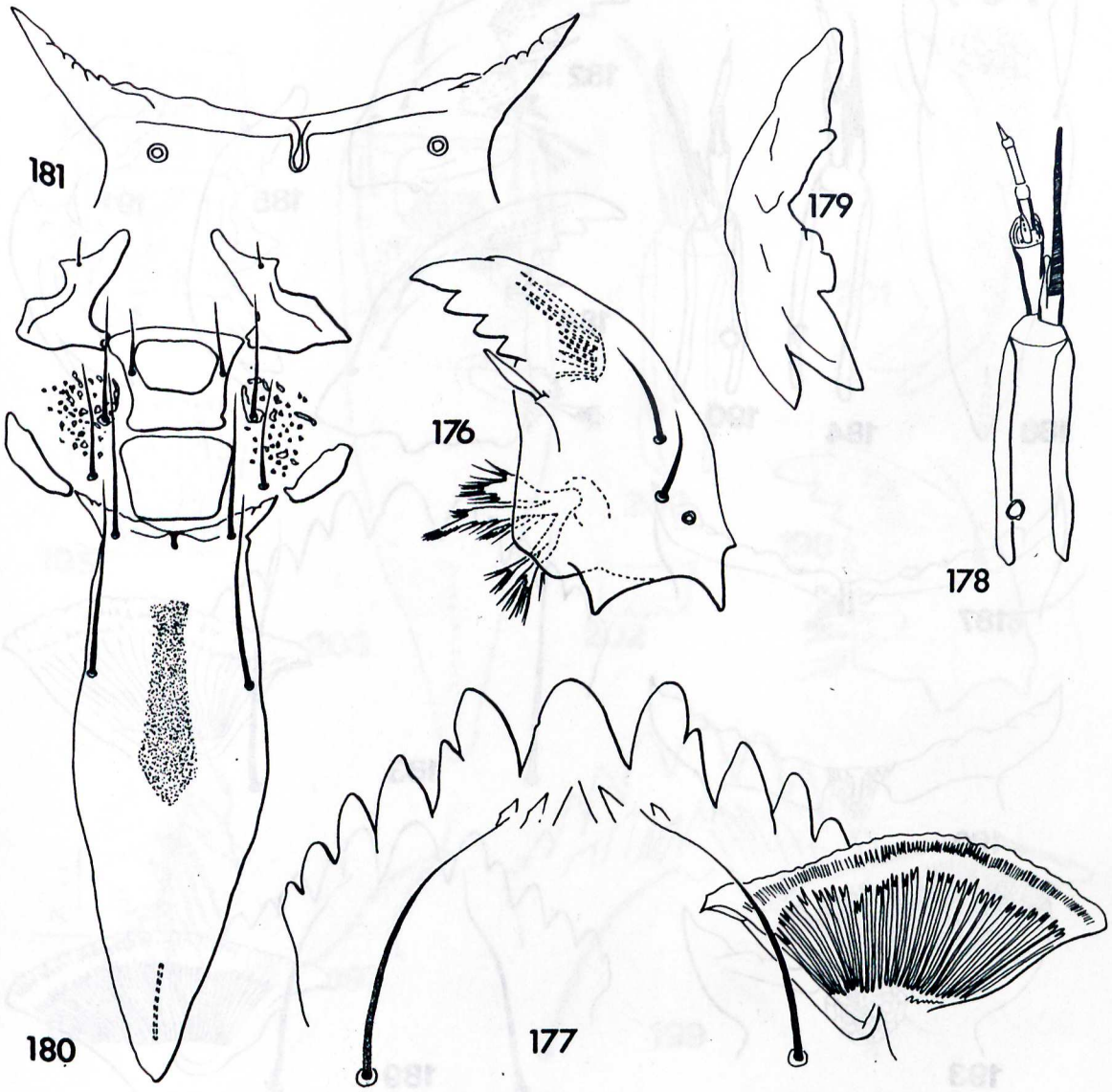
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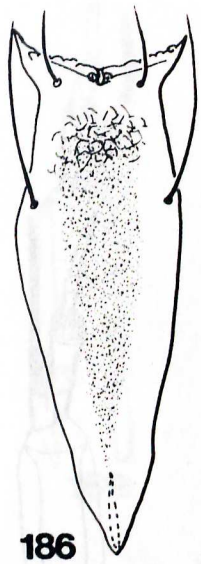
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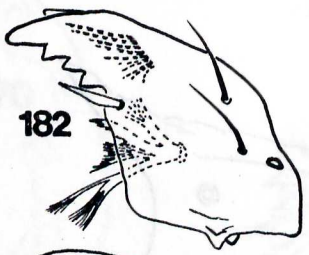
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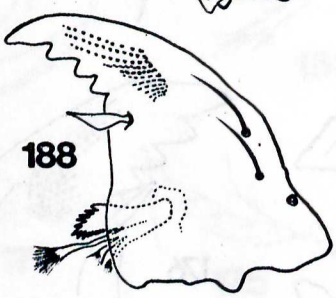
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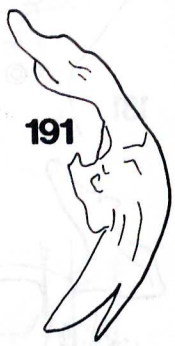
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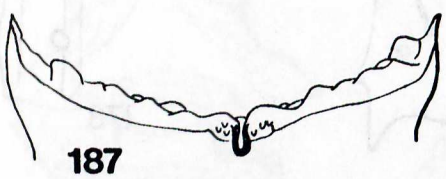
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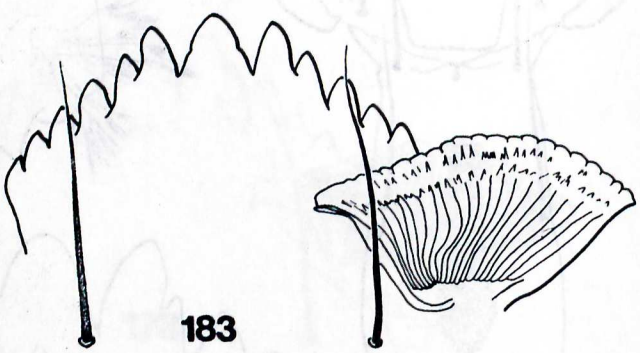
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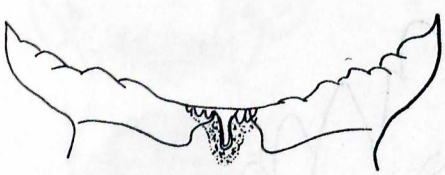
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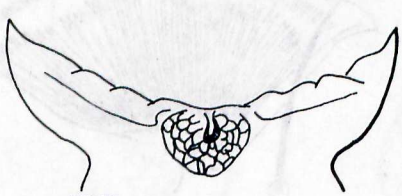
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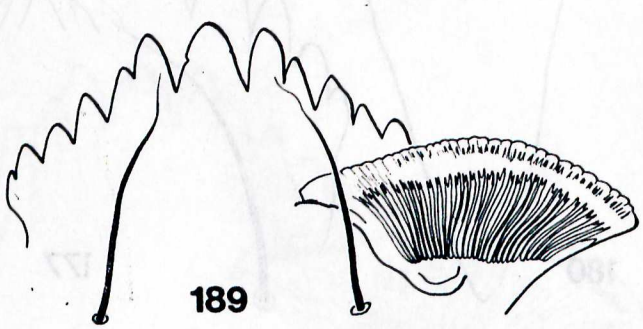
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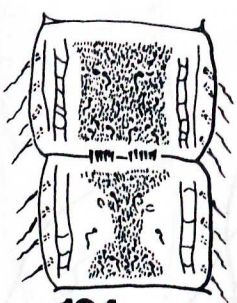

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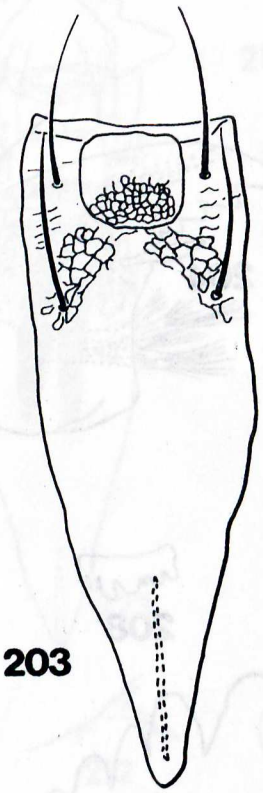

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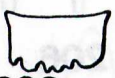

202

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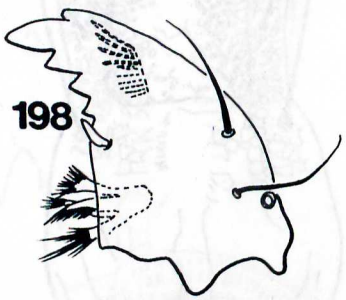

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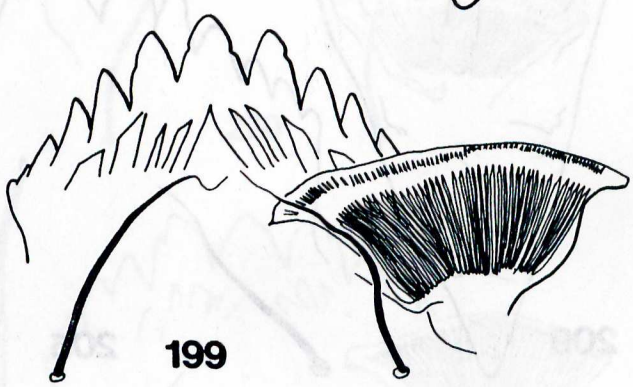

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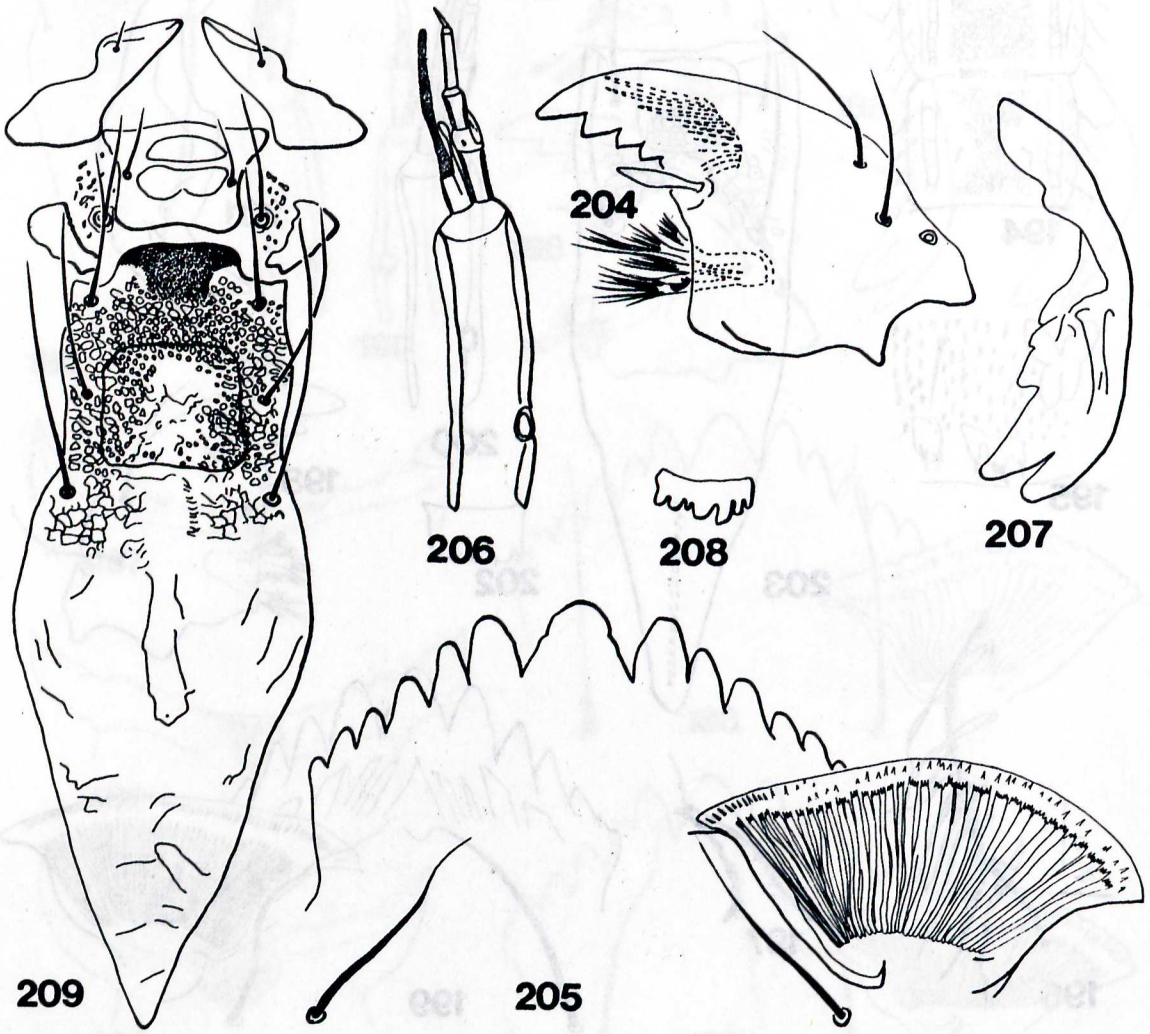
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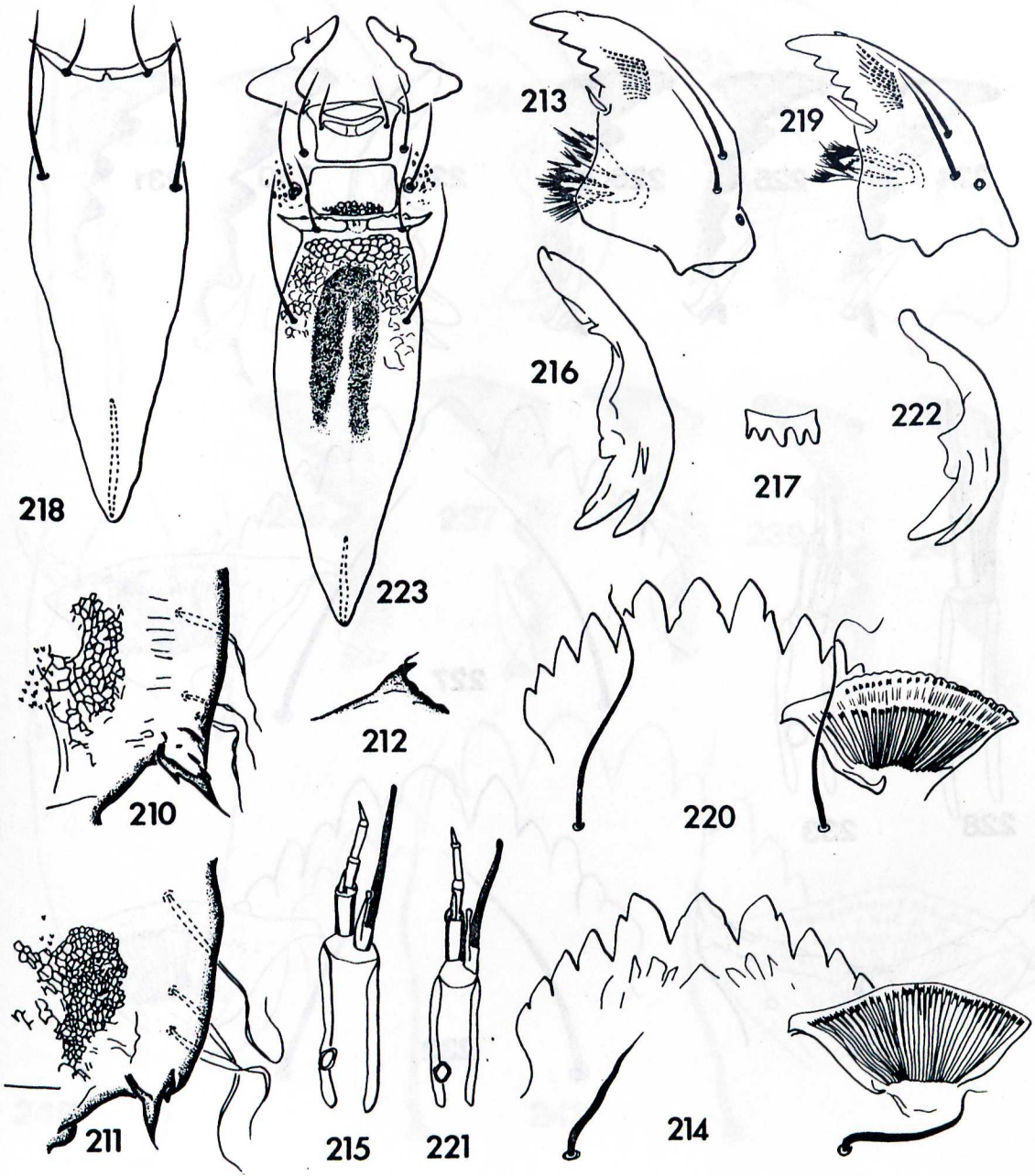
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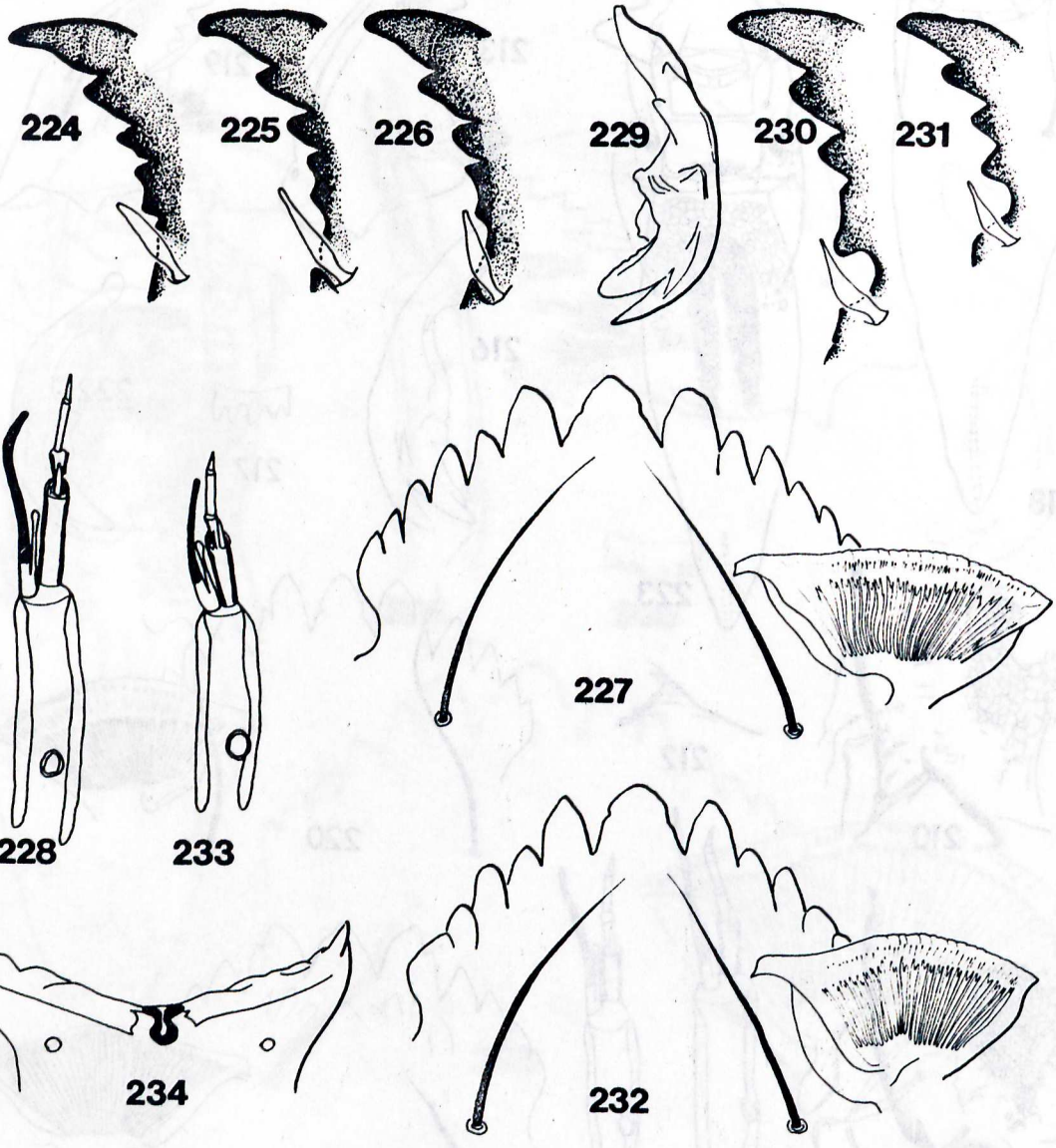
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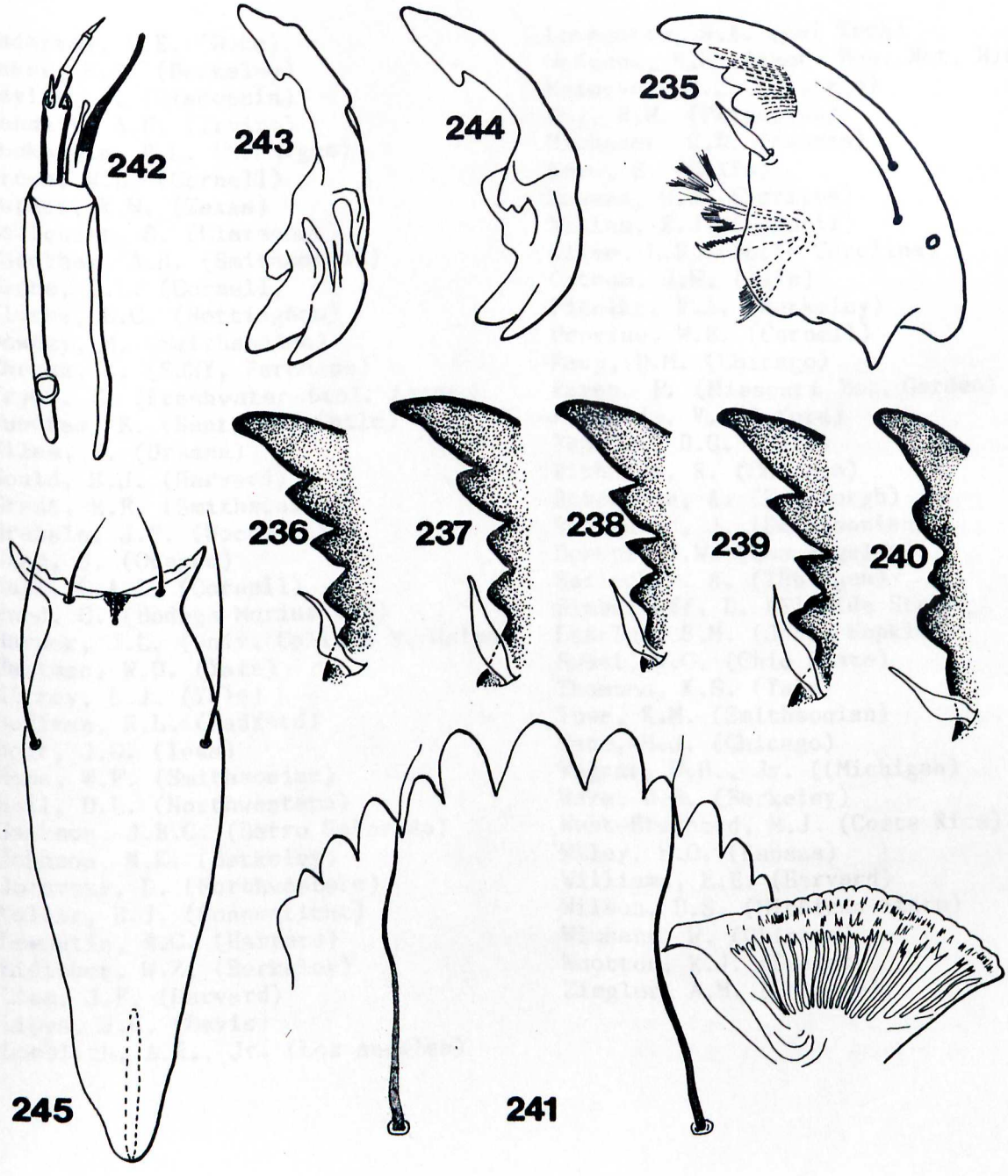
242
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241

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